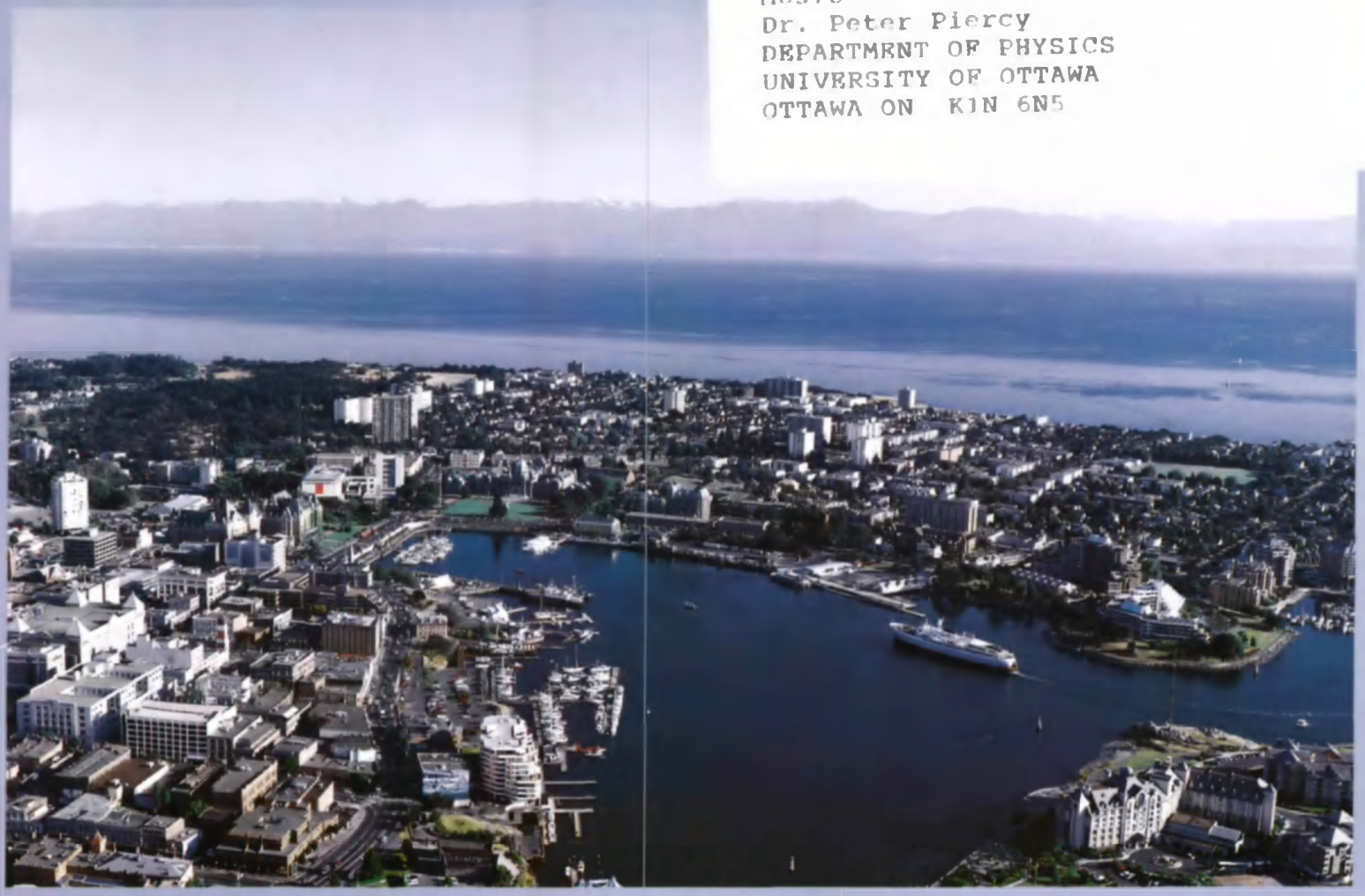
Vol. 57, No. 3

PHYSICS IN CANADA
LA PHYSIQUE AU CANADA

MAY / JUNE 2001
MAI / JUIN 2001

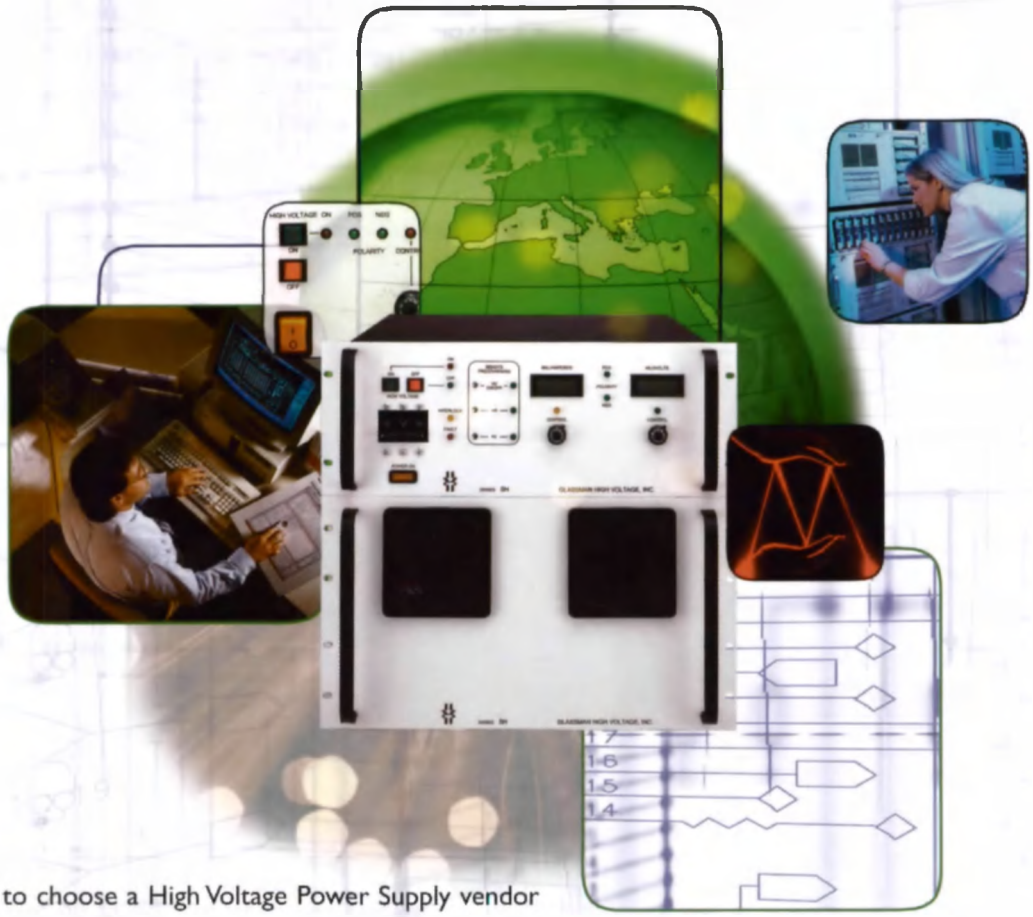


CAP CONGRESS
CONGRÈS DE L'ACP

JUNE 17-20 JUIN 2001

Université de Victoria / University of Victoria

When it comes to high voltage power supplies, the right design makes all the difference.



The time to choose a High Voltage Power Supply vendor is before your products have been developed, not after. That's where Glassman's Solutions Designers can make the difference for you.

Our power supply specialists bring the latest high voltage technology to your design team. Working side by side, we help create the power supply that will best meet their needs for performance and efficiency.

For over 20 years, Glassman has been an industry leader in innovative High Voltage Power Supply designs. No one has more High Voltage Power Solutions. And as for our warranty, we offer one of the most comprehensive in the industry.

Before your team begins their next project, talk to Glassman about your High Voltage Power Supply requirements. We have the solutions.

For more information on Glassman High Voltage Power Supply Solutions call us at **908-638-3800**, or visit our website at: www.glassmanhv.com.

GLASSMAN
HIGH VOLTAGE INC.

Designing Solutions for Power Supply Applications

Glassman High Voltage Inc., 124 West Main St., High Bridge, NJ 08829
Telephone (908) 638-3800, FAX (908) 638-3700
In Europe, Glassman Europe Limited (1256) 883007, FAX (1256) 883017
In Asia, Glassman Japan Limited (045) 902-9988, FAX (045) 902-2268
www.glassmanhv.com

BY SEA - Victoria is well-connected to mainland British Columbia and Washington State by vehicle and passenger ferries and high-speed catamarans. Victoria's arrival points include the Inner Harbour, the Town of Sidney, and Swartz Bay Ferry Terminal (thirty minutes from downtown Victoria, near Sidney).

BY AIR - Located thirty driving minutes from downtown Victoria and five minutes from Sidney, Victoria International Airport serves daily flights from Vancouver International Airport and Seattle-Tacoma Airport, as well as flights from points throughout Canada and the U.S. Regular float plane and helicopter service to downtown Victoria is available from Vancouver and Seattle.

GROUND TRANSPORTATION - Scheduled motorcoach service is available for travel from Vancouver and Seattle to Victoria. Rail service is offered between Victoria and Courtenay. Travel options around Greater Victoria and surrounding areas include taxi and limousine service, airporter bus, and public bus transportation. Car, RV, bicycle, motorcycle, and scooter rentals are also offered at various locations in the Victoria area.

DURING PEAK SEASON, ALLOW EXTRA TIME FOR TRAVEL

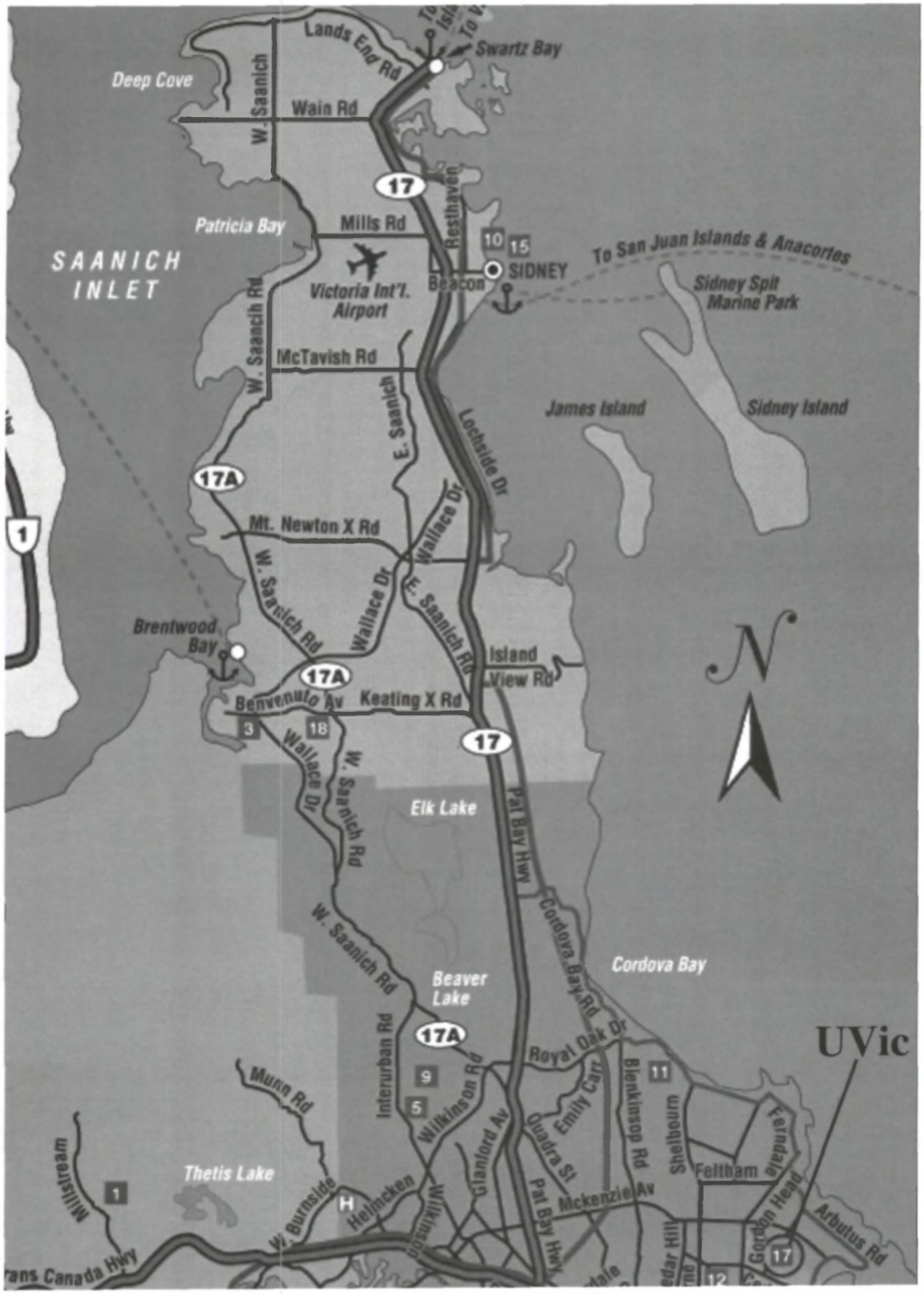
****

PAR MER - Victoria est très bien reliée à la terre ferme de la Colombie-Britannique et de l'État de Washington par des traversiers de véhicules et de passagers, et par des catamarans très rapides. Parmi les points d'arrivée de Victoria, notons l'arrière-port, la ville de Sidney et le terminus du traversier à Swartz Bay (trente minutes du centre-ville de Victoria, à proximité de Sidney).

PAR AIR - Situé à trente minutes d'auto du centre-ville de Victoria et à 5 minutes de Sidney, l'aéroport international de Victoria dessert des vols quotidiens de l'aéroport international de Vancouver, et de l'aéroport de Seattle-Tacoma, ainsi que des vols d'un peu partout au Canada et aux États-Unis. Un service régulier de transport en hydravion et d'héliportage pour se rendre au centre-ville de Victoria est disponible à Vancouver et à Seattle.

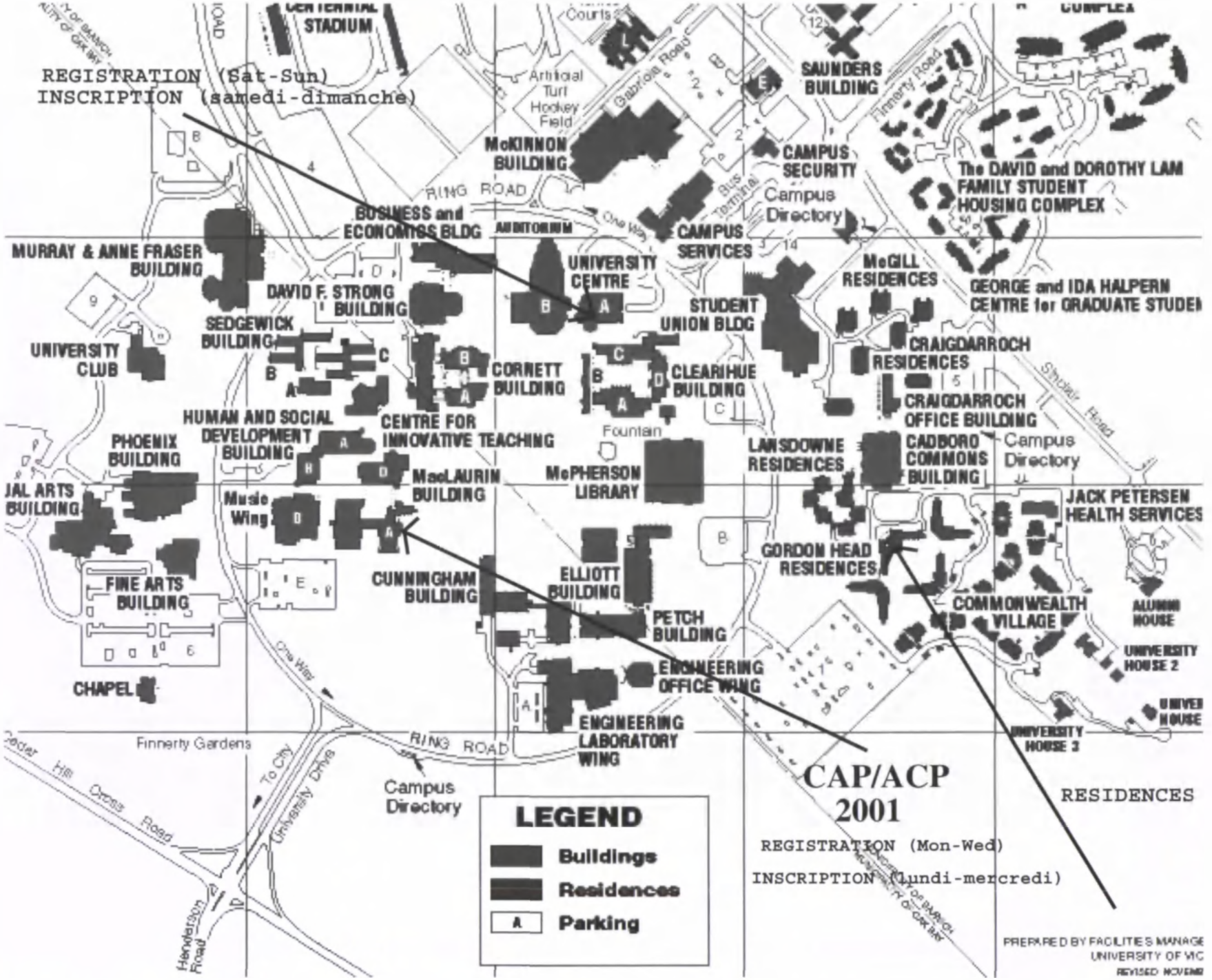
TRANSPORTS TERRESTRES - Un service d'autocar, ayant un horaire établi, est disponible pour voyager de Vancouver et Seattle à Victoria. Le transport ferroviaire est offert entre Victoria et Courtenay. Les autres options de transport dans l'agglomération de Victoria incluent les taxis, les limousines, les autobus d'aéroport, et le transport en commun. La location d'autos, d'autocaravanes, de bicyclettes, de motocyclettes et de mobylettes est aussi offerte à différents endroits de la région de Victoria.

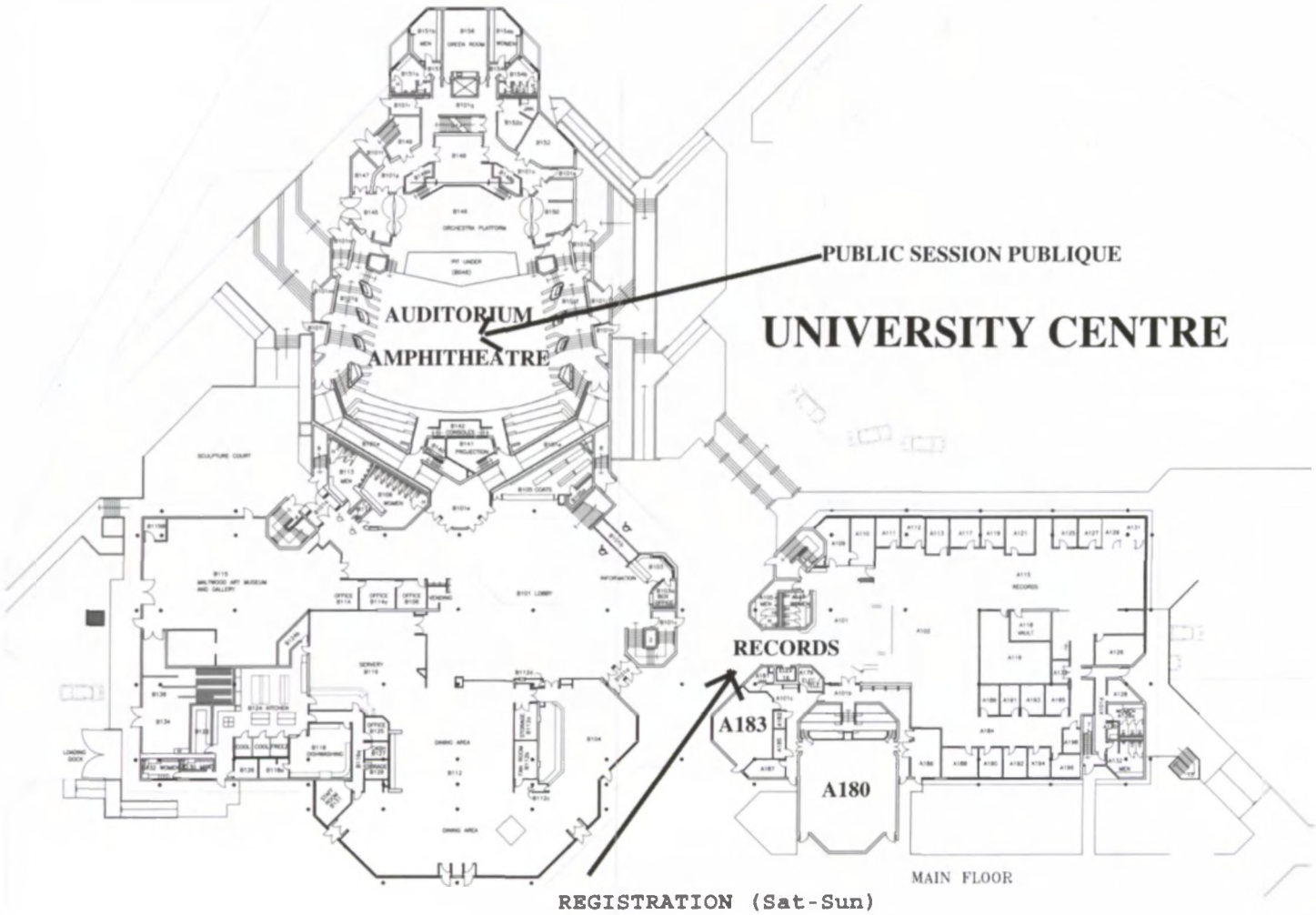
ALLOUEZ UN PEU PLUS DE TEMPS POUR LES DÉPLACEMENTS LORS DE LA HAUTE SAISON.



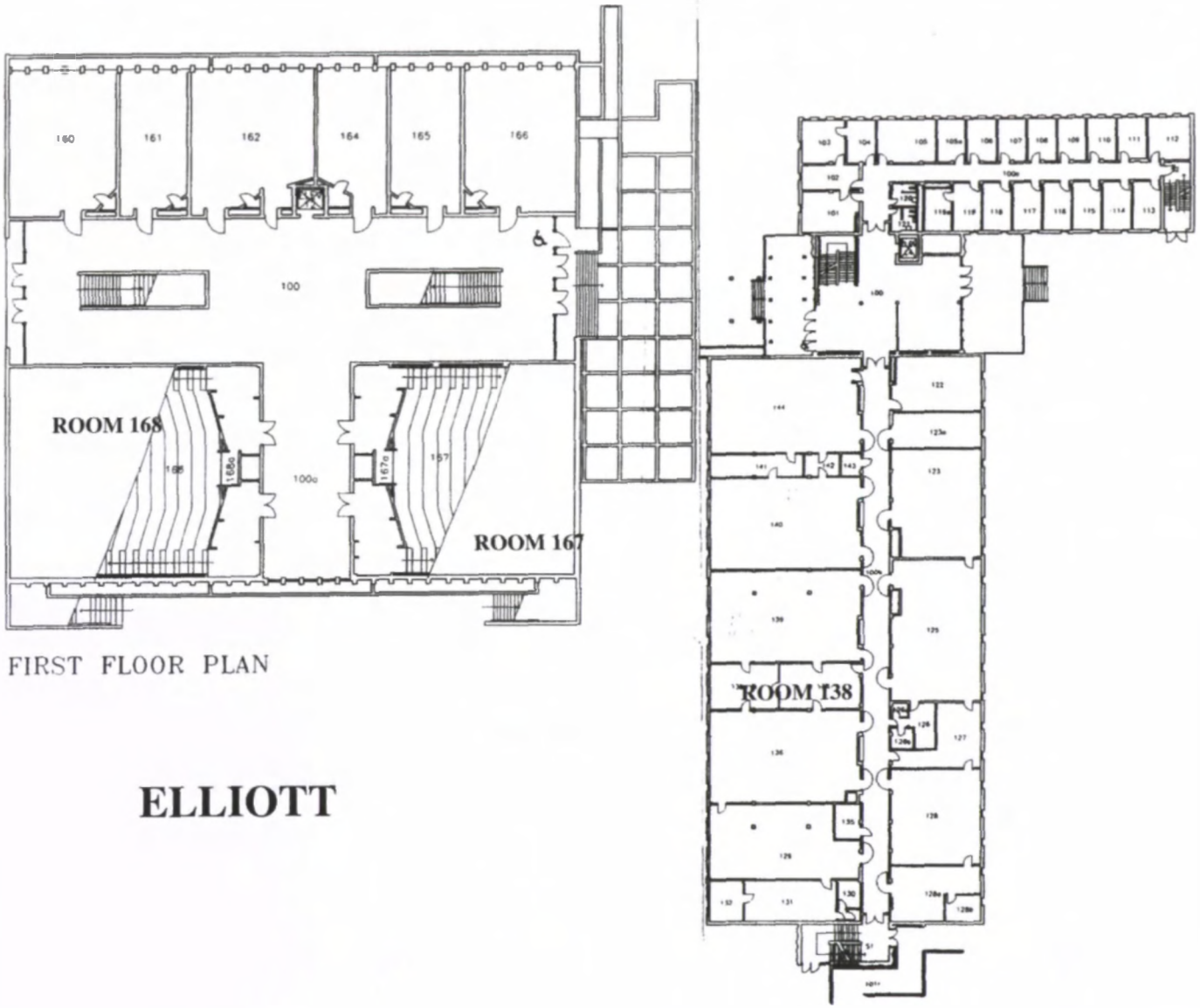
See page 12 for directions on how to get to your accommodations / the University once you arrive in Victoria.

Consultez la page 12 afin de connaître les directives à suivre pour vous rendre à vos hébergements / l'université une fois rendu à Victoria.


REGISTRATION (Sat-Sun)
INSCRIPTION (samedi-dimanche)
CENTENNIAL STADIUM
Artificial Turf Hockey Field
McKINNON BUILDING
SAUNDERS BUILDING
CAMPUS SECURITY
Campus Directory
The DAVID and DOROTHY LAM FAMILY STUDENT HOUSING COMPLEX
RING ROAD
Gabrioia Road
Finnerty Road
Bus Terminal
BUSINESS and ECONOMICS BLDG
AUDITORIUM
CAMPUS SERVICES
MURRAY & ANNE FRASER BUILDING
UNIVERSITY CENTRE
McGILL RESIDENCES
GEORGE and IDA HALPERN CENTRE for GRADUATE STUDEN
DAVID F. STRONG BUILDING
STUDENT UNION BLDG
SEDGEWICK BUILDING
CRAIGDARROCH RESIDENCES
UNIVERSITY CLUB
CORNETT BUILDING
CLEARIHUE BUILDING
Sinclair Road
CRAIGDARROCH OFFICE BUILDING
HUMAN AND SOCIAL DEVELOPMENT BUILDING
CENTRE FOR INNOVATIVE TEACHING
Fountain
PHOENIX BUILDING
LANSDOWNE RESIDENCES
CADBORO COMMONS BUILDING
Campus Directory
JAL ARTS BUILDING
Music Wing
MacLAURIN BUILDING
McPHERSON LIBRARY
JACK PETERSEN HEALTH SERVICES
GORDON HEAD RESIDENCES
FINE ARTS BUILDING
CUNNINGHAM BUILDING
ELLIOTT BUILDING
COMMONWEALTH VILLAGE
ALUMNI HOUSE
PETCH BUILDING
UNIVERSITY HOUSE 2
CHAPEL
ENGINEERING OFFICE WING
UNIVERSITY HOUSE 3
ENGINEERING LABORATORY WING
Finnerty Gardens
RING ROAD
Campus Directory
To City
University Drive
Henderson Road
RESIDENCES
CAP/ACP
2001
REGISTRATION (Mon-Wed)
INSCRIPTION (lundi-mercredi)
LEGEND
Buildings
Residences
A
Parking
PREPARED BY FACILITIES MANAGE
UNIVERSITY OF VIC

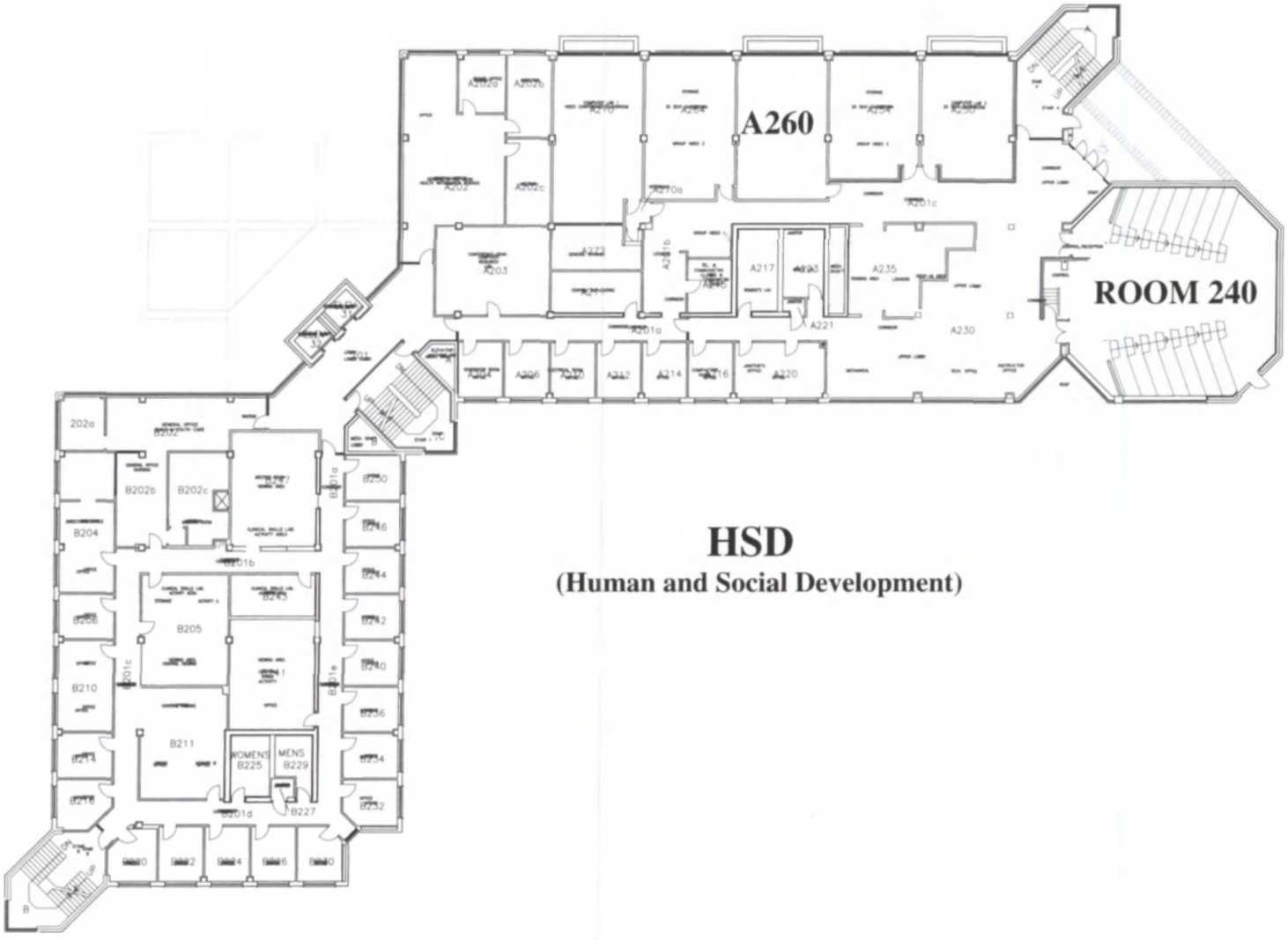


REGISTRATION (Sat-Sun)
INSCRIPTION (samedi-dimanche)



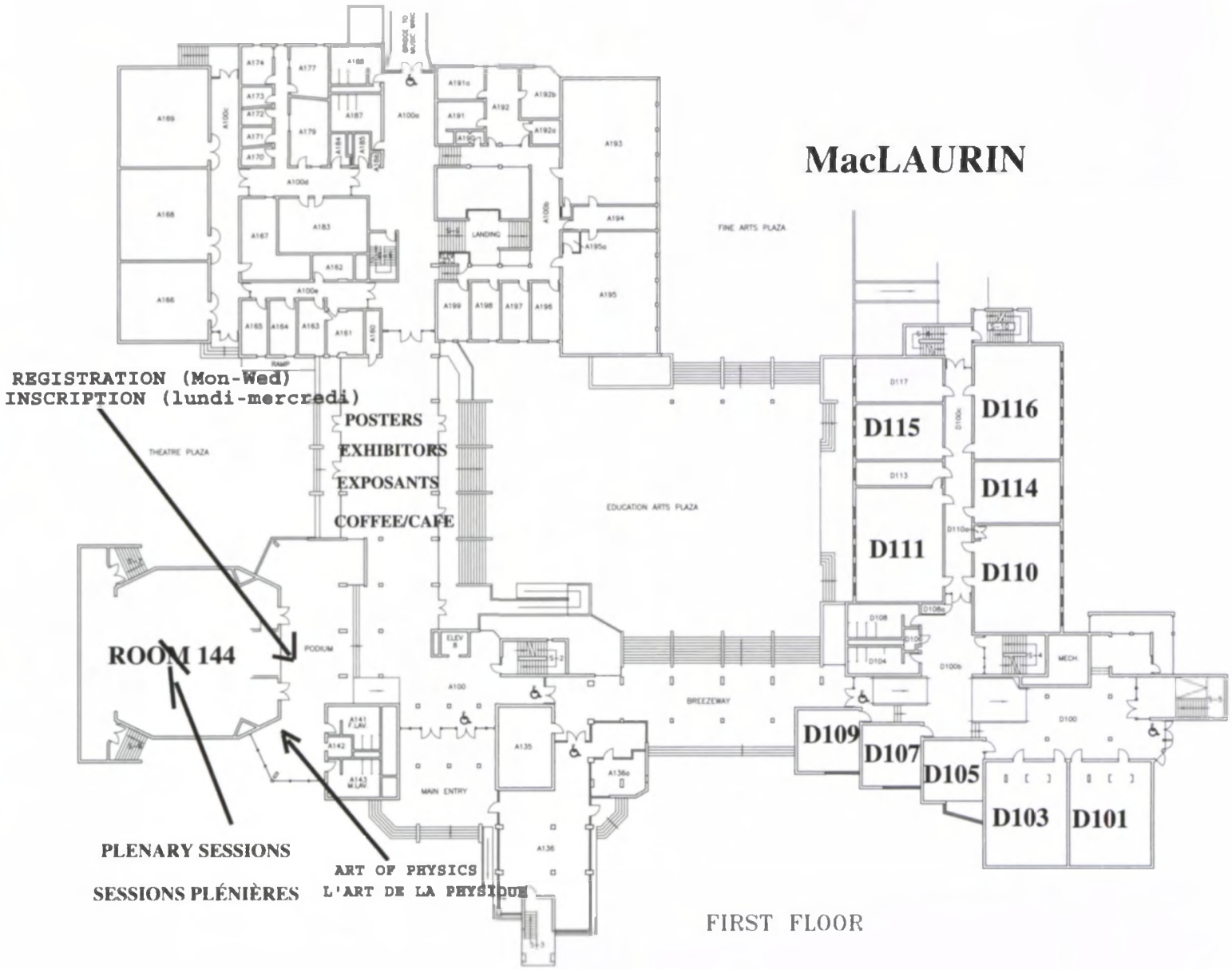
FIRST FLOOR PLAN

ELLIOTT



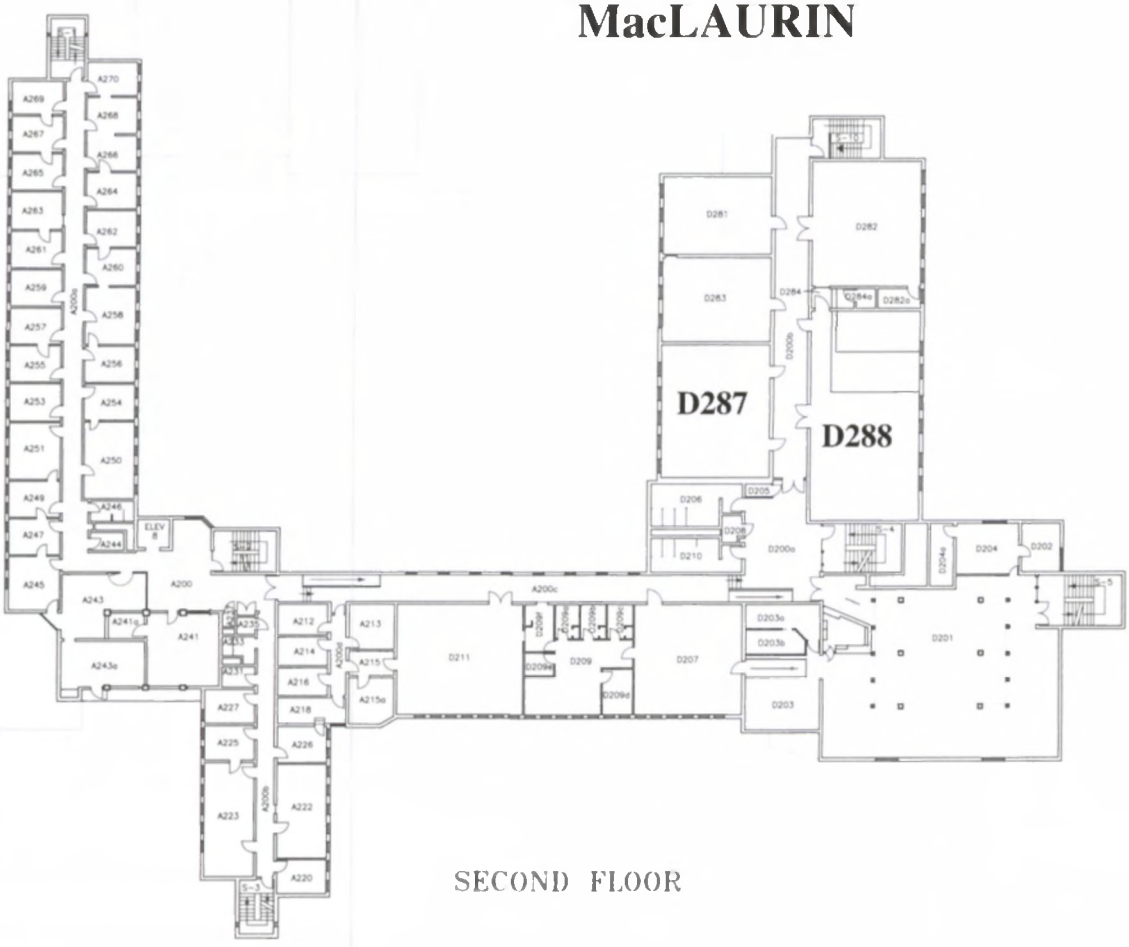
HSD

(Human and Social Development)


MacLAURIN
REGISTRATION (Mon-Wed)
INSCRIPTION (lundi-mercredi)
POSTERS
EXHIBITORS
EXPOSANTS
COFFEE/CAFE
ROOM 144
PLENARY SESSIONS
SESSIONS PLÉNIÈRES
ART OF PHYSICS
L'ART DE LA PHYSIQUE
FINE ARTS PLAZA
THEATRE PLAZA
EDUCATION ARTS PLAZA
BREEZEWAY
MAIN ENTRY
PODIUM
LANDING
MECH.
D115
D116
D114
D111
D110
D109
D107
D105
D103
D101

FIRST FLOOR

MacLAURIN



SECOND FLOOR

INSTITUTIONAL MEMBERS / *MEMBRES INSTITUTIONELS*

– Physics Departments / *Départements de physique* --

(as at 2001 May14 / *au 14 mai 2001*) :

Acadia University
Bishop's University
Brandon University
Carleton University
Cégep Beauce-Appalaches
Collège Montmorency
Concordia University
Dalhousie University
École Polytechnique
Laurentian University
McGill University
McMaster University
Memorial University of Newfoundland
Okanagan University College
Queen's University
Royal Military College
Simon Fraser University
St. Francis Xavier University
Trent University
Université du Québec à Trois-Rivières
Université de Moncton
Université de Montréal
Université de Sherbrooke
Université Laval
University of Alberta
University of British Columbia
University of Calgary
University of Guelph
University of Lethbridge
University of Manitoba
University of New Brunswick
University of Northern B.C.
University of Ottawa
University of Prince Edward Island
University of Regina
University of Saskatchewan (and Eng. Phys.)
University of Toronto
University of Victoria
University of Waterloo
University of Western Ontario
University of Windsor
University of Winnipeg
Wilfrid Laurier University
York University

SUSTAINING MEMBERS / *MEMBRES DE SOUTIEN*

(as at 2001 May 14 / *au 14 mai 2001*) :

A. John Alcock
David Atherton
J. Brian Atkinson
C. Bruce Bigham
Bertram N. Brockhouse
Allan I. Carswell
Robert L. Clarke
R. Fraser Code
Marie D'Iorio
Walter Davies
Christian Demers
Gerald Dolling
Gordon W.F. Drake
David J.I. Fry
William M. Gray
Akira Hirose
Thomas Jackman
Allan E. Jacobs
Martin W. Johns
J. Larkin Kerwin
James D. King
Peter Richard Kry
Ron M. Lees
Roger Lessard
J.S.C. (Jasper) McKee
Jean-Louis Meunier
J.C. Douglas Milton
Nader Mobed
Allan Offenberger
A. Okazaki
Roger Phillips
Satti Paddi Reddy
Robert G.H. Robertson
George Sofko
Michael O. Steinitz
Alec T. Stewart
G.M. Stinson
Boris P. Stoicheff
Eric C. Svensson
Louis Taillefer
John G.V. Taylor
Michael Thewalt
Jacques Trudel
Sreeram Valluri
Henry M. Van Driel
Paul S. Vincett
Erich Vogt

CORPORATE MEMBERS / *MEMBRES CORPORATIFS*

(as at 2001 May 14 / *au 14 mai 2001*)

The Corporate Members of the Canadian Association of Physicists are a group of corporations, laboratories, and institutions who, through their membership, support the educational activities of the Association. The entire proceeds of corporate membership contributions are paid into the CAP Educational Trust Fund and are tax deductible.

Les membres corporatifs de l'Association canadienne des physiciens et physiciennes sont un groupe de corporations, de laboratoires ou d'institutions qui supportent financièrement les activités éducatives de l'Association. Les revenus de leurs contributions déductibles aux fins d'impôt sont entièrement versés au Fonds Educatif de l'ACP.

Atlantic Nuclear Services Ltd.
Atomic Energy of Canada Limited
Datacomp Electronics Inc.
Elcan Optical Technologies
EXFO Electro-Optical Engineering
Glassman High Voltage Inc.
GSI/Lumonics
Institut national d'optique
JDS Uniphase Inc.
Kurt J. Lesker Canada
Leybold Canada Inc.
Meteorological Service of Canada
MPB Technologies Inc.
National Research Council of Canada
Newport Instruments Canada Corp.
Optech Incorporated
Perimeter Institute for Theoretical Physics
Spectra Research Corporation
TRIUMF
Varian Canada Inc.

The Canadian Association of Physicists cordially invites interested corporations and institutions to make application for Corporate membership and will welcome the inquiries addressed to the Executive Director, Canadian Association of Physicists, Suite 112, McDonald Building, 150 L.ouis Pasteur Avenue, Ottawa, ON, K1N 6N5. Tel: (613) 562-5614; Fax: (613) 562-5615; E-mail: CAP@physics.uottawa.ca ; Website: http://www.cap.ca.

L'Association canadienne des physiciens et physiciennes invite cordialement corporations et institutions à faire partie des membres corporatifs. Renseignements auprès de la directrice exécutive, Association canadienne des physiciens et physiciennes, Bureau 112, Immeuble McDonald, 150 rue Louis Pasteur, Ottawa, ON, K1N 6N5. Tél. (613) 562-5614; Téléc. (613) 562-5615; Courriel : CAP@physics.uottawa.ca; Internet : http://www.cap.ca.

Vol. 57 No. 3

Physics in Canada

May/June 2001

La Physique au Canada

mai / juin 2001

TABLE OF CONTENTS / TABLE DES MATIÈRES

NOTICE TO CAP MEMBERS

Bring this free copy of the Congress Issue to the Annual Congress at the University of Victoria. Replacement or additional copies will be available at $10 each.

AVIS AUX MEMBRES DE L'ACP

Veuillez apporter cet exemplaire gratuit du programme au congrès, à l'Université de Victoria. Des exemplaires de remplacement ou supplémentaires se vendront 10 $ chacun..

PRINTED BY / IMPRIMÉ CHEZ *M.O.M. PRINTING*

2001 CAP CONGRESS
CONGRÈS DE L'ACP 2001

FRONT COVER / COUVERTURE :

Photo: Victoria's Inner Harbour showing the Fairmont Empress Hotel and the Legislative Buildings. Provided courtesy of Infocus Photography, 917 Mason Street, Victoria, B.C. / L'arrière-port de Victoria, montrant l'hôtel Fairmont Express et les édifices du Parlement. Hommage de Infocus Photography, 917 Mason Street, Victoria, B.C.

PHYSICS IN CANADA
LA PHYSIQUE AU CANADA

The Journal of the Canadian Association of Physicists

La revue de l'Association canadienne des physiciens et physiciennes

ISSN 0031-9147

ANNUAL SUBSCRIPTION / ABONNEMENT ANNUEL

$40.00 Cdn + GST or HST (Cdn addresses)
$40.00 US (US addresses)
$45.00 US (other/foreign addresses)

Advertising, Subscriptions, Change of Address/
Publicité, abonnement, changement d'adresse:

Canadian Association of Physicists /
Association canadienne des physiciens et physiciennes
Suite Bur. 112, Imm. McDonald Bldg., Univ. of/d' Ottawa,
150 Louis Pasteur, Ottawa, Ontario K1N 6N5
Phone/ Tél: (613) 562-5614; Fax/Téléc.: (613) 562-5615
e-mail/courriel: CAP@physics.uottawa.ca
Website/Internet: http://www.cap.ca

Canadian Publication Product Sales Agreement
No. 0484202/Numéro de convention pour les envois de publications canadiennes: 0484202

WWW.CAP.CA
(select PIC online / Option: PiC Électronique)

— EDITORIAL / ÉDITORIAL —

THE RESPONSIBILITY OF THE SCIENTIST IN COMMUNICATING NEW DISCOVERIES!

LES SCIENTIFIQUES ONT LA RESPONSABILITÉ DE COMMUNIQUER LEURS NOUVELLES DÉCOUVERTES!

"Some experience of popular lecturing had convinced me that the necessity of making things plain to uninstructed people was one of the very best means of clearing up the obscure corners in one's mind.
T. H. Huxley (1825-1895)

Science, from the Latin word "scientia", means knowledge, as distinguished from ignorance or misunderstanding. The acquisition of scientific knowledge ensures that there can be applied science and technology, both of which are vitally important to the economy of any province or country. Knowledge, indeed, empowers us all, and I would remind readers of the words of Thomas Huxley, in 1877, when he said, "If a little knowledge is dangerous, where is the man who has so much as to be out of danger?". Therefore, in a very real sense, the role of the scientist is not only to inform and educate society but to make life a little less dangerous than might otherwise be the case. The scientist, therefore, has an increasing responsibility to contribute to the public good by interpreting accurately and effectively new knowledge and discoveries as they come along.

The responsibility of the scientist to the society that he or she serves is seldom discussed and poorly understood. It is, however, probably of greater significance in the year 2001 than it has probably ever been in the past. In order to appreciate this point, it is necessary to recall some of the events of the past century, including the rebellion against authority of the 1960s, the weakening, if not loss, of religion-based morality, and the weakening or absence of a code of ethics in scientific decision making. It appears, indeed, that at the present time, all issues are arguable in a court of law, and that economic and political authoritarianism has swept away the fundamental basis of scientific judgement for the public good, leaving the research scientist uncertain as to his role and function in society. The scientist, after all, through his or her discipline and creativity, has generated the new knowledge and is therefore in a unique position, not only to speak to its value, but to address such moral and ethical dilemmas as may arise from the application of a new discovery to the workplace, the educational system, or political action.

Physics, of course, is an exact science and not subject to many of the ambiguities inherent in other scientific walks of life. Nonetheless, questions can be asked about to how scientists pursue their occupation and about the ethical framework within which their research has evolved. The social benefits or liabilities of proposed research should be clear to the scientist, who is then ideally placed to communicate such information to a wider lay public. The developing and "centre- stage" discipline of human genetics is currently one in which ethical and moral issues are intimately entwined with research methods, with the use of human and animal subjects in the search for new knowledge as a particular example. The issue of personal responsibility, however, arises in a similar way in all scientific fields and the responsibility for informing and guiding the public lies firmly in the lap of those that generate new knowledge.

But there are other responsibilities of the scientific community with respect to fundamental and applied research.

Firstly, the scientific community has a responsibility, on completion of a research program, to ensure its publication and its availability to other scientists worldwide, particularly in the field in which the research has been carried out. There is also a basic understanding that, when taxpayers' money is used to fund research in any area of

scientific endeavour, the scientist owes it to the public to make his/her results available through the scientific literature, so that duplication of effort and concurrent waste of public funds will not occur.

So, in general, the physicist, molecular biologist, biochemist, or geneticist has an overriding responsibility to first publish the results of his or her research in properly refereed scientific journals. Not to do so or instead to communicate through the pages of a local or national newspaper, can have detrimental results for the future funding of research and for the status of scientists operating in the field. In the particular area of expertise relevant to our readers, physics, two instances have occurred within recent memory in which revelations were made in national newspapers prior to publication in scientific journals - one relating to the imagined discovery of a new super-heavy element and the other to a phenomenon now referred to as 'cold fusion'. Both announcements were in the end insupportable.

Similarly, molecular biology, dealing as it does with the elements of human life, is a field where rumour, mythology and carelessness must not acquire even the most minute degree of credibility. The scientific method must be applied rigorously to research in all fields in an unequivocal way. Secondly, the genetic scientist in particular, must have an inherent sensitivity to the publication of the results of his/her research program, as such research may involve the identification of a problem with no solution, as in the case of an inherited abnormality for which no gene or other therapy is likely to be available in the foreseeable future. The manner in which research is interpreted to the individual as opposed to the scientific community can be of vital importance to the ensuing quality of life.

What then are the responsibilities of the media in reporting new advances once the work is published? Communicating science through the media is almost the antithesis of a normal academic presentation. In a lecture, scientific paper, or even a short presentation, it is normal first to present the problem, then to describe how measurements were made, and then, finally, develop an exciting coda to the work which can be the demonstration of a new result, new data, or some inconsistency in other peoples' work.

Using radio or television to communicate new results is quite different. The only thing that is important is news and, if that news cannot be expressed in a small number of words and in a very short time, then the chances are that you have lost your audience or that someone will switch their radio or television set to another channel. Time is of the essence and short, crisp facts of a newsy nature are what is required. There may be an opportunity after the punch line to give some more in-depth discussion of the result, how it was made, the implications of the result for future clinical work, and the impact on society in the short and long term; but there is no guarantee that this will be the case. This being so, whether a scientist is presenting the result in simple lay terms or whether an interpreter from the media is doing the job, the recipe must remain the same.

Whenever new material is presented to the public, scientific accuracy is of the utmost importance. To exaggerate the immediate importance of a discovery, or to be overly optimistic concerning the opportunities to adapt this result to industry, clinical practice or some future therapy, is inappropriate and counterproductive. Any tendency for either the media or the practicing scientist to overstate the relevance of a new discovery is detrimental to the message that it is hoped to convey.

Because of their familiarity with the media, trained journalists are often more effective at communicating science to the layperson than the practicing researcher would be. It is a matter of being concise, clear and jargon-free. The absence of a scientific culture in Canada makes it of the greatest importance to communicate crisply, clearly and effectively, when you have something exciting and new to say. Often research scientists are not the best people to do that. On the other hand, the specialist radio or television journalist who can interface readily with the research scientist will usually do a much better job at informing the public of the nature and implication of the new research than the scientist himself.

In the field of molecular biology, of course, many new ethical, legal and social issues arise as our knowledge of genetic risks increases.

Many ethical dilemmas have already raised their heads in various situations and environments. The ability to predetermine the sex of a child many months prior to birth, the ability to identify the Down's Syndrome child in an ante-natal environment, and similar instances of genetic abnormality raise the possibility of the individual and the population making decisions detrimental to the evolution of human society as a whole. When options are available, the decision that society reaches in a particular case may fly in the face of past practice or even what is desirable to a modern humane society.

There has been much discussion recently of DNA fingerprinting and the determination of guilt or innocence on the basis of genetic tests of this kind. Few people in the community, despite the prevalence of Lotto 649 information, seem aware of the significance of statistics, what they indicate and what they do not. I was impressed by a commentator on CBC Radio recently who drew attention to the lack of certainty in much DNA testing, and the statistical extent to which identification was possible. An illustration was made which seemed to have some value in communicating this problem to the public. In the anecdote a member of the public is playing poker with the Archbishop of Canterbury. In the first hand, the Archbishop lays down a Royal Flush, the likelihood of which is rather small and the winning nature of the hand fairly strongly determined. There are, however, social factors in relation to this game which deserve attention. The first one is that the Archbishop is generally regarded as someone of high integrity who certainly would not cheat to win a game of poker and, despite the unlikely nature of the hand that he was dealt, the manner in which he attained it would be regarded by most people as above suspicion. On the other hand, if the individual concerned had been playing with a well-known card-shark, there might have been other factors relating to the character of the player, his record in crime or out of it, and his trustworthiness, that would be taken into consideration in conjunction with the evidence of the Royal Flush. So, in every instance of possibility that is less than certain, other factors, ethical, sociological and legal, must be taken into account. It is not always going to be easy either for a scientist or a member of the public to correctly incorporate all these competing parameters into an overall judgement.

As stated before, both the media and scientists have a responsibility to interpret realistically and correctly what a given research or clinical test result actually means. As to who should take responsibility for ensuring that ethical, legal and social issues are addressed, it is difficult for me as a physicist to answer this question, but it seems that the practising scientist must have a dominant role in all such deliberations, and at an early stage. Physicists have made many mistakes in the past.

Jasper McKee, P.Phys.
Editor, Physics in Canada

Dear Jasper,

Very topical and interesting. I agree that scientists should be fully engaged in the public discourse concerning the implications of their work. But I would like to make a small comment. I am not convinced, to paraphrase your words, that the social benefits or liabilities of the proposed research are clear to the scientist. After all, he is not a social scientist. He is a natural scientist immersed in his work with his own conflicts of interest. He seeks knowledge and wants the freedom to experiment. He will take calculated risks for the benefit of increased understanding. Sometimes in his eagerness he is ready to accept negative consequences. But more simply he does not have the training to fully appreciate how a particular technical change will affect society.

Cheers, Béla Joós, University of Ottawa

* *

LES SCIENTIFIQUES ONT LA RESPONSABILITÉ DE COMMUNIQUER LEUR NOUVELLES DÉCOUVERTES!

> *"L'expérience acquise lors des conférences de vulgarisation que j'ai données m'a convaincu que le besoin de faire comprendre des choses à des profanes était un des meilleurs moyens de s'assurer que tous les recoins de notre esprit soient bien ordonnés.*
>
> *– T.H. Huxley (1825-1895)*

Le mot science, du latin scientia, signifie connaissance, ainsi distinguée de l'ignorance et de l'erreur. L'acquisition de connaissances scientifiques permet l'arrivée des sciences appliquées et de la technologie, toutes deux essentielles à l'économie d'une province ou d'un pays. La connaissance, effectivement, nous rend plus forts, et je voudrais rappeler aux lecteurs ces mots de Thomas Huxley qu'il a prononcés en 1877, "Si un peu de connaissance représente un danger, où est l'homme qui en possède de façon à être hors de danger?". Donc, de fait, le rôle du scientifique est non seulement d'informer et d'éduquer la collectivité mais également de rendre la vie un peu moins dangereuse qu'elle pourrait l'être autrement. Le scientifique a, par conséquent, une responsabilité accrue de contribuer au bien-être collectif en interprétant correctement les nouvelles connaissances et découvertes à mesure qu'elles surviennent.

La responsabilité du scientifique envers la communauté, qu'il sert, est rarement discutée en plus d'être mal comprise. Elle a, pourtant, une plus grande portée en l'an 2001 qu'elle n'a probablement jamais eu dans le passé. Pour bien saisir cette question, il est nécessaire de se souvenir de certains évènements du siècle dernier, y compris la rébellion contre l'autorité des années 60, l'affaiblissement, sinon la perte, des valeurs morales basées sur la religion, et l'affaiblissement ou l'absence d'un code de déontologie lors des prises de décisions scientifiques. Il semble, en effet, qu'actuellement toutes les questions peuvent être contestées en cour de justice, que l'autoritarisme économique et politique ait balayé la base fondamentale du jugement scientifique pour le bien-être collectif, laissant le chercheur hésitant quant à son rôle et ses tâches dans la communauté. Le scientifique, tout compte fait, a engendré de nouvelles connaissances grâce à sa discipline et à sa créativité et est donc particulièrement bien placé, non seulement pour expliquer leur utilité, mais également pour aborder les dilemmes éthiques et moraux qui peuvent survenir lors de l'application d'une nouvelle découverte dans le milieu de travail, le système de l'éducation ou l'activité politique.

La physique, bien entendu, est une science exacte et n'est pas sujette aux nombreuses ambiguïtés inhérentes à d'autres champs de pensée scientifiques. Malgré tout, on peut questionner les méthodes de travail des scientifiques et la structure éthique dans laquelle leur recherche s'est développée. Les bénéfices ou les responsabilités sociaux reliés à un projet de recherche doivent être compréhensibles au scientifique, afin de lui permettre de communiquer cette information aux profanes. La génétique humaine, une discipline en pleine croissance et de premier plan, est présentement une discipline dont les questions éthiques et morales sont étroitement liées aux méthodes de recherche, comme, par exemple, l'utilisation d'humains ou d'animaux dans la recherche de nouvelles connaissances. La question de la responsabilité personnelle, toutefois, se pose de la même façon dans tous les domaines scientifiques et la responsabilité d'informer et de guider la collectivité réside fermement avec ceux qui engendrent de nouvelles connaissances.

Cependant, il existe d'autres responsabilités de la collectivité scientifique relativement à la recherche fondamentale et appliquée.

En premier lieu, la collectivité scientifique a la responsabilité, lors de l'achèvement d'un projet de recherches, de s'assurer de sa publication et de sa disponibilité aux autres scientifiques partout dans le monde, spécialement dans le domaine dans lequel les recherches ont été menées. Il existe également une entente de base que lorsqu'un projet de recherches, de n'importe quel secteur d'activité scientifique, est financé par l'argent des contribuables, le scientifique doit faire connaître ses résultats à la communauté par le truchement de la littérature scientifique, afin d'éviter une répétition d'efforts inutile et, parallèlement, un gaspillage de fonds publics.

Donc, en règle générale, le physicien, le biologiste, le biochimiste ou le généticien détient une responsabilité primordiale de publier les résultats de ses recherches en premier lieu dans des revues scientifiques convenablement appuyées. Ne pas le faire ou communiquer plutôt par l'intermédiaire d'un journal local ou national peut avoir des résultats néfastes pour le financement futur de la recherche et pour la position des scientifiques pratiquant dans ce domaine. En ce qui concerne le domaine de compétence pertinent à nos lecteurs, la physique, deux cas se sont produits assez récemment où des révélations ont été faites aux journaux nationaux avant leur publication dans une revue scientifique - un cas relatif à une découverte imaginaire d'un facteur superlourd et l'autre à un phénomène que l'on appelle aujourd'hui "fusion froide". Finalement, les deux annonces ne reposaient sur aucun fondement.

De la même façon, la biologie moléculaire, traitant des composantes de la vie humaine, est un domaine dans lequel les rumeurs, la mythologie et la négligence ne doivent pas obtenir la moindre crédibilité. La méthode scientifique doit être rigoureusement appliquée à la recherche, dans tous les domaines et sans aucune équivoque.

Deuxièmement, le scientifique de la génétique, en particulier, doit détenir une sensibilisation inhérente à la publication des résultats de son projet de recherches parce que ces recherches peuvent impliquer l'identification d'un problème sans sa solution, comme c'est le cas pour une malformation héréditaire pour laquelle aucune thérapie, génétique ou autre, ne deviendra probablement disponible dans un futur prévisible. La façon dont les recherches sont expliquées à l'individu, plutôt qu'à la collectivité scientifique, peut être essentielle quand à la qualité de vie qui s'ensuit.

Quelles sont les responsabilités des médias à rapporter de nouveaux progrès une fois le travail publié? Transmettre les sciences par l'intermédiaire des médias est presque l'antithèse d'une présentation théorique habituelle. Lors d'une conférence, d'un exposé scientifique, ou même d'une courte présentation, il est habituel de présenter le problème en premier, puis d'exposer la façon dont les mesures ont été déterminées, et, finalement, de développer un coda de travail qui peut être la démonstration d'un nouveau résultat, de nouvelles données ou de l'incohérence dans les travaux d'autres personnes.

Employer la radio ou la télévision pour transmettre de nouveaux résultats s'avère tout à fait différent. Les seules choses qui comptent sont les nouvelles et, si ces nouvelles ne peuvent être formulées en peu de mots et en peu de temps, les chances sont que vous avez perdu votre auditoire ou que quelqu'un a changé sa radio ou télé de chaîne. Le temps est essentiel et de l'information courte et concise de nature à nouvelles est requise. Une occasion de débattre les résultats de façon plus exhaustive, de la manière qu'ils ont été trouvés, des conséquences que ces résultats auront sur les futurs travaux cliniques et leur impact dans la société à court et à long terme, se présentera peut-être après la formule-choc, mais il n'est pas certain que cela se produira. Ceci étant le cas, qu'un scientifique présente les résultats en termes simples pour les profanes ou qu'un interprète des médias fasse le travail, la recette doit demeurer la même.

La précision scientifique est de la plus haute importance lorsque de nouvelles informations sont présentées à la collectivité. Exagérer l'importance dans l'immédiat d'une découverte ou être d'un optimisme excessif relativement aux occasions d'adapter ces résultats à l'industrie, au travail clinique ou à une thérapie future, est déplacé et contre-productif. Toute tendance de la part des médias, du praticien scientifique à exagérer la pertinence d'une nouvelle découverte nuit au message que l'on espère communiquer.

Les journalistes ont plus de succès à transmettre la science aux profanes que le chercheur à cause de leur familiarité avec les médias. Il s'agit d'être concis, précis et d'éviter le jargon. L'absence de culture scientifique au Canada accroît l'importance de communiquer de façon précise, concise et efficace lorsque vous avez quelque chose de passionnant et de nouveau à déclarer. Souvent, les chercheurs ne sont pas les meilleures personnes pour cette tâche. D'un autre côté, l'expert de la radio ou le journaliste de la télévision, qui peut être en liaison avec le chercheur, sera habituellement meilleur que le scientifique à informer la collectivité de la nature et des conséquences de nouvelles recherches.

Dans le domaine de la biologie moléculaire, bien entendu, plusieurs questions éthiques, légales et sociales surgissent à mesure que notre connaissance des risques génétiques s'accroît.

Plusieurs dilemmes se sont déjà pointés dans diverses situations et environnements. La capacité à prédéterminer le sexe d'un enfant plusieurs mois avant la naissance, l'aptitude à identifier l'enfant souffrant de trisomie dans un environnement prénatal, et d'autres cas de malformation héréditaire, soulèvent la possibilité qu'un individu et la population prennent des décisions nuisibles à l'évolution de toute la société humaine.

L'analyse d'empreinte génétique ainsi que la détermination de culpabilité ou d'innocence basée sur ce genre de tests génétiques ont été beaucoup discutées récemment. Peu de gens dans la collectivité, malgré l'information très répandue de Loto 649, ne semblent avertis de la portée des statistiques, de ce qu'ils indiquent et de ce qu'ils n'indiquent pas. J'ai été impressionné récemment par un commentateur de Radio CBC qui a attiré l'attention au manque de certitude des tests d'ADN et dans quelles mesures statistiques l'identification était possible. Une illustration a été produite et a semblé être utile à informer les gens de ce problème. Dans une anecdote, un membre du public joue au poker avec l'Archevêque de Canterbury. Au premier jeu, l'Archevêque obtient une quinte royale, ce qui représente une très petite probabilité et de fortes chances de déterminer le gagnant de la partie. Il y a, toutefois, des facteurs sociaux reliés à ce jeu qui valent la peine d'être notés. Le premier est que l'Archevêque est perçu comme une personne très intègre, qui ne tricherait pas pour gagner une partie de poker et, en dépit du peu de probabilité d'obtenir ce genre de jeu, il serait à l'abri de tout soupçon quant à la façon dont il y est arrivé. D'un autre côté, si ce même individu aurait joué avec un escroc bien connu aux cartes, d'autres facteurs relatifs au caractère du joueur : un casier judiciaire ou non, s'il est digne de confiance, auraient pu être pris en considération en plus de l'évidence de la quinte royale. Donc, dans tous les cas où les probabilités sont moins évidentes, d'autres facteurs : éthiques, sociologiques et légaux, doivent être pris en considération. Il ne sera pas toujours facile pour le scientifique ou un membre de la collectivité d'intégrer correctement tous ces critères concurrentiels en un jugement global.

Comme je l'ai déjà déclaré, les médias et les scientifiques ont la responsabilité d'interpréter avec réalisme et correctement ce que les résultats d'une recherche donnée ou d'un test clinique signifient vraiment. Quant à qui incombe la responsabilité que les questions éthiques, légales et sociales soient abordées, il m'est difficile, en tant que physicien, de répondre à cette question, mais il semble que le praticien scientifique doit avoir un rôle prédominant lors de ces délibérations et au tout début. Les physiciens ont fait beaucoup d'erreurs dans le passé.

J.S.C. McKee, phys.
Rédacteur en chef, La Physique au Canada

Le genre masculin n'a été utilisé que pour alléger le texte.

Cher Jasper,

Très pertinent et interessant. Je suis d'accord que les scientifiques devraient ,être pleinement impliqués dans la discussion publique sur les implications de leur recherche. Mais je voudrais faire un petit commentaire.Je ne suis pas convaincu, en paraphrasant vos paroles, que les avantages et les désavantages sociaux de ses plans de recherche soient clairs au chercheur scientifique. Après tout, il ne se spécialise pas en sciences sociales. Il est un chercheur en sciences naturelles, plongé dans son travail, avec ses propres conflits d'intérêts. Il est à la recherche de la connaissance et veut la liberté d'expérimenter. Il prendra des risques calculés pour le bénéfice d'une compréhension accrue. Parfois dans son enthousiasme il sera prêt à accepter des conséquences négatives. Mais plus simplement, il n'a pas la formation nécessaire pour pleinement juger l'impact de changements techniques spécifiques sur la société.

Cordialement, Béla Joós, Université d'Ottawa

IN MEMORIAM

JOHN ALLEN, 1908 - 2001

Professor John Allen (alias Jack), one of our most distinguished graduates, died recently at age 92. He was born in 1908 in Winnipeg, and studied Physics at the University of Manitoba, where his father, Frank Allen, was Professor of Physics. Frank Allen, in whose honour our building is named, founded the Department of Physics in 1904.

After graduating from University of Manitoba in 1929, Jack Allen went to the University of Toronto, where he studied under Sir John McLennan, taking a PhD in superconductivity. He designed and built the first cryostat, which is now on display in the museum of the Royal Institution in London. After two years at Caltech, in 1935 he left for Britain, where he had hoped to join the Russian physicist Peter Kapitsa at Cambridge. Kapitsa, however, had been detained in Russia by Stalin, and was unable to return to Cambridge, so the two men had to continue their researches independently.

Kapitsa was the first to discover superfluidity in liquid helium in 1937. Six months later, Allen and his graduate student Donald Misener discovered the same effect independently. The January 1938, issue of Nature carried letters by Kapitsa and by Allen and Misener announcing the discovery.

Allen remained at Cambridge until 1947, when he was appointed to the chair of Natural Philosophy at St. Andrews University, where he remained until his retirement in 1978. After retirement, Allen was commissioned by the Royal Society to design a memorial commemorating the measurement of Newton's constant "G" by the Astronomer Royal Nevil Maskelyne in 1774. The cairn and plaque designed by Allen were unveiled by Sir Andrew Huxley in 1983.

Allen was elected a Fellow of the Physical Society in 1945, of the Royal Society of Edinburgh and of the American Physical Society in 1948, and of the Royal Society in 1949. He also served as chairman of the Very Low Temperature Commission of the IUPAP from 1966 to 1969. In 1979 he received an honorary Doctorate of Science degree from the University of Manitoba.

Peter Blunden, Acting Head,
Department of Physics and Astronomy,
University of Manitoba

CALENDAR / CALENDRIER

2001 JUNE/JUIN

4-6 **Formation en: Optical System Design and Engineering**, Université Laval, Québec. Pour plus ample information: www.fsg.ulaval.ca.

17-20 **CAP Annual Congress / Congrès annuel de l'ACP, Victoria, B.C. For more information, see http://www.cap.ca. - Annual Congress section - option Congrès annuel.**

11-16 **16th Waterloo NMR Summer School**, University of Waterloo, Ontario. For more information: Hartwig Peemoeller, University of Waterloo, peemoell@uwaterloo.ca or Debbie Guenther, Arrangements Coordinator, University of Waterloo, dguenthe@uwaterloo.ca.

25-3 July **Pan-American Advanced Studies Institute on Physics and Technology at the Nanometer Scale**, San Jose, Costa Rica. For more information, see http://www.phy.ohiou.edu/~pasi/

2001 JULY/JUILLET

8-10 **Optoelectronic Semiconductor Conference 2001 for Graduate Students**, McMaster University, Hamilton, Ontario. For details see http://engphys.mcmaster.ca/oese2001.

8-12 **21st International Laser Radar Conférence (ILRC 21)**, Québec. For more information, please contact: Gilles Roy, Centre de Recherches pour la defense, Valcartier, gilles.roy@drev.dnd.ca.

30- **4TH International Conference on Biological Physics** Kyoto International Conference Hall, Kyoto, Japan, July 30 to August 3, 2001. For more details: http://kokusai.phys.nagoya-u.ac.jp.

2001 AUGUST/AOÛT

8-10 **OESC 2001 for Graduate Students**. McMaster University. For details see: http://engphpys.mcmaster.ca/oesc2001.

13-17 **Canadian Semiconductor Technology Conference**. The Château Laurier Hotel, Ottawa. For more information, send a note by e-mail to: semi2001@nrc.ca ; or visit the conference Website : www.sao.nrc.ca/ims/semi2001.

2001 SEPTEMBER/SEPTEMBRE

XXVI International Symposium on Acoustical Imaging, University of Windsor. For mor information contact Dr. Roman Maev by e-mail at maev@uwindsor.ca or by telephone at (519) 253-4232, ext. 2661.

2001 NOVEMBER/NOVEMBRE

4-10 **IEEE 2001 Nuclear Science Symposium and Medical Imaging Conference**, San Diego, California, U.S.A. For more information see http://www.nss-mic.org.

2002 JULY/JUILLET

14-19 **10th International Conference on the Physics and Chemistry of Ice**, Memorial University of Newfoundland, St. John's, NF. Sponsored jointly by MUN and NRC. For more information, contact: Stephen.Jones@nrc.ca or the website: http://www.housing.mun.ca/conf/pci/.

FUTURE CAP CONFERENCES / PROCHAINS CONGRÈS DE L'ACP

Congrès annuel 2002 Annual Congress, June 1-5 juin, 2002
Université Laval University, Québec, QC

Congrès annuel 2003 Annual Congress, June 8-11 juin, 2003
University of PEI / Université du l'IPE, Charlottetown, PEI.

CANADIAN ASSOCIATION OF PHYSICISTS
ASSOCIATION CANADIENNE DES PHYSICIENS ET PHYSICIENNES

ANNUAL GENERAL MEETING
ASSEMBLÉE GÉNÉRALE ANNUELLE

DATE: Tuesday, June 19, 2001
Mardi, le 19 juin 2001
TIME/HEURE: 17h00
PLACE: **Room/Salle A144**, Imm. MacLaurin Bldg., University/é of/de Victoria

DRAFT AGENDA / ORDRE DU JOUR PROVISOIRE

1. Call to Order and Approval of the Agenda

2. Approval of the Minutes of the June 6, 2000 Annual General Meeting
   .1 Matters arising from the Minutes

3. Annual Report
   .1 Audited Financial Statements to December 31, 2000
   .2 Membership Report

4. Appointment of Auditors

5. Report on the Activities of the Association
   .1 Update on Engineering Acts
   .2 Science Policy/Lobbying
   .3 Meetings with the APS
   .4 Professional Designation Update (Mick Lord, P.Phys.)
   .5 Other Matters

6. Report by the Chair of the 2001 Local Organizing Committee

7. Host Universities - Future Congresses

8. New Business
   .1 2002 Membership Fees (R. Hodgson)
   .2 Report of the Canadian National IUPAP Liaison Cttee
   .3 Report by Chair of Physics in Canada (J.S.C. McKee)
   .4 Report by Chair of Canadian Journal of Physics (G.W.F. Drake)
   .5 CUPC 2001 at the University of Winnipeg

9. Report of the Nominating Committee

10. Votes of Thanks and Change of the Chair

11. Date and Place of Next Meeting

12. Adjournment

Canadian Association of Physicists
l'Association canadienne des physiciens et physiciennes

MEDALLISTS 2001 *LAURÉATS*

CAP Medal for Achievement in Physics
Médaille de l'ACP pour contributions exceptionnelles en physique

William J.L. (Bill) Buyers
National Research Council, Chalk River / Conseil national de recherches à Chalk River

Herzberg Medal / *Médaille Herzberg*

Michel Gingras
University of Waterloo / Université de Waterloo

CAP Medal for Outstanding Achievement in Industrial and Applied Physics
La médaille de l'ACP pour contributions exceptionnelles en physique industrielle et appliquée

H. Roy Krouse
University of Calgary / Université de Calgary

CAP Medal for Excellence in Teaching Undergraduate Physics /
Médaille de l'ACP pour l'excellence en enseignement de la physique au premier cycle

Napoléon Gauthier
Royal Military College of Canada / Collège royal militaire du Canada

CAP/CRM Prize in Theoretical and Mathematical Physics /
Prix ACP-CRM en physique théorique et mathématique

André-Marie Tremblay
University of Sherbrooke / Université de Sherbrooke

CAP/DCMMP Brockhouse Medal / Médaille Brockhouse de l'ACP/DPMCM

Mark Sutton
McGill University / Université McGill

****

PRIZE EXAM RESULTS 2001 RÉSULTATS DE L'EXAMEN

120 students from 24 post-secondary institutions competed this year. The exam was administered by members of the Physics Department of the Université Laval. The names of the first, second, and third prize winners are shown, followed by the fourth to tenth ranking marks.

Patrick Gill	**FIRST PRIZE / PREMIER PRIX**	**University of Toronto / Université de Toronto**
Karol Gregor	**SECOND PRIZE / DEUXIÈME PRIX**	**University of Toronto / Université de Toronto**
Matthew McEvoy	**THIRD PRIZE / TROISIÈME PRIX**	**Université McGill / McGill University**

4.	Igor Khavkine	Concordia University
4.	Jeff Mottershead	University of Alberta
6.	Pierre Thibault	Université de Montréal
7.	Jordon Hovdedo	University Regina
8.	Brian Lee	University of Victoria
9.	Jackson Chan	University of Saskatchewan
10.	Simon Lambert	University of Alberta

THE 56th CAP ANNUAL CONGRESS

LE 56e CONGRÈS ANNUEL DE L'ACP

INFORMATION / PROGRAMME

2001 CAP CONGRESS / CONGRÈS DE L'ACP 2001

TECHNICAL PROGRAM COMMITTEE / COMITÉ DU PROGRAMME TECHNIQUE

Chair / *président*	Dr. M. Thewalt	thewalt@sfu.ca
Atomic & Molecular Physics / *physique atomique et moléculaire*	Dr. P. Zetner	p_zetner@umanitoba.ca
Condensed Matter and Materials Physics / *physique de la matière condensée*	Dr. P. Grutter	grutter@physics.mcgill.ca
Industrial and Applied Physics / *physique industrielle et appliquée*	Dr.T. Vo-Van	vovant@umoncton.ca
Medical and Biological Physics / *physique médicale et biologique*	Dr. J. Katsaras	john.katsaras@nrc.ca
Nuclear Physics / *physique nucléaire*	Dr. N. Kolb	norm.kolb@usask.ca
Optics and Photonics / *optique et photonique*	Dr. M. Duguay	mduguay@gel.ulaval.ca
Particle Physics / *physique des particules*	Dr. F. Corriveau	corriveau@physics.mcgill.ca
Physics Education / *enseignement de la physique*	Dr. D. Lawther	dlawther@upei.ca
Plasma Physics / *physique des plasmas*	Dr. R. Rankin	rankin@space.ualberta.ca
Theoretical Physics / *physique théorique*	Dr. D.W. Hobill	hobill@phas.ucalgary.ca

LOCAL ORGANIZING COMMITTEE / COMITÉ ORGANISATEUR LOCAL

Chair / *président*	Dr. C. Picciotto	pic@uvic.ca
Secretary / *secrétaire*	Ms. L. Charron	lcharron@uvic.ca
Budget, Signage, Registration / *budget, signalisations, inscription*	Ms. S. Green	sgreen@uvic.ca
Posters, Exhibits and Sponsors / *affiches, exposants et commanditaires*	Dr. G. Beer	gbeer@uvic.ca
Volunteers / *les bénévoles*	Dr. Arib Babul	ababul@uvic.ca
Accommodation, Meals, and Banquet *hébergement, repas et banquet*	Dr. M. Roney	mroney@uvic.ca
Meeting Rooms, Audio Visual Equipment / *salles de réunion, équip. audiovisuel*	Dr. L. Robertson	lyle@uvic.ca
Webpages, Tourist Information, Advertising / *pages web, information touristique, et publicité*	Dr. B. Kowalewski	kowalews@uvic.ca

CAP OFFICE STAFF / PERSONNEL DE L'ACP

Executive Director / *Directrice exécutive*	F.M. Ford	CAP@physics.uottawa.ca
Administrative Assistant / *Assistante administrative*	C. Harvey	carmen@physics.uottawa.ca

GENERAL INFORMATION / RENSEIGNEMENTS GÉNÉRAUX

2001CAP Congress / Congrès de l'ACP 2001
Canadian Association of Physicists / *Association canadienne des physiciens et physiciennes*
Suite/Bur. 112, Imm. McDonald Bldg. , Univ. of/d'Ottawa
150, avenue Louis Pasteur Avenue
OTTAWA, ON K1N 6N5
Tel/tél.: (613) 562-614; Fax/téléc.: (613) 562-5615; e-mail: cap@physics.uottawa.ca
http://www.cap.ca

REGISTRATION

The registration desks will be staffed according to the following schedule:

Saturday, June 17 - 14h00 - 21h00 (Records Lobby, Univ. Centre)
Sunday, June 18 - 08h00 - 19h00 (Records Lobby, Univ. Centre)
Monday, June 19 - 08h00 - 17h00 (Lobby A, MacLaurin Bldg.)
Tuesday, June 20 - 08h00 - 17h00 (Lobby A, MacLaurin Bldg.)
Wednesday June 21 - 08h00 - 12h00 (Lobby A, MacLaurin Bldg.)

PARKING

Parking is available Saturday, Sunday and weekdays (after 6 pm) free of charge in any of the lots on campus (both inside and outside of Ring Road) with the exceptions of the underground parkade in the University Centre, the Ian Stewart Recreation Complex and 24 hrs. Reserved spaces. If you have a Handicapped sticker, please bring this with you to use the designated parking spaces on campus.

Monday to Wednesday (7 am to 6 pm), parking is available in the lots located OUTSIDE of Ring Road (see campus map) in spaces designated as GENERAL (blue signs), with a ticket from the dispensers which can be found at any of the main entrances. Cost per day (full-day) is $5.00 or a 3-day pass is available for $15.00. Dispensers accept cash (coins, $5 or $10 bills - exact change needed) and major credit cards.

E-MAIL ACCESS

Congress participants will have access to e-mail accounts in the Computer Lab, Elliott Building, Room 138. Details will be provided at registration.

EXHIBITORS

Datacomp Electronics Inc.
Gamble Technologies Limited
Harcourt Canada
John Wiley & Sons Canada Ltd.
Melles Griot Canada
Pearson Education Canada
Quantum Technology Corp.
Systems for Research Corp.
Varian Canada Inc.

SPONSORS

Department of Physics & Astronomy, University of Victoria
Melles Griot Canada

INSCRIPTION

Le bureau d'inscription sera ouvert aux heures suivantes :

Samedi 17 juin - 14 h à 21 h (foyer Records, centre univ.)
Dimanche 18 juin - 8 h à 19 h (foyer Records, centre univ.)
Lundi 19 juin - 8 h à 17 h (foyer A, édifice. MacLaurin)
Mardi 20 juin - 8 h à 17 h (foyer A, édifice MacLaurin)
Mercredi 21 juin - 8 h à 12 h (foyer A, édifice MacLaurin)

STATIONNEMENT

Après 18 h et les fins de semaine, le stationnement est gratuit, à l'intérieur et à l'extérieur du chemin Ring, à l'exclusion du stationnement souterrain du centre universitaire, du complexe Ian Stewart et aux endroits indiqués *Réservation de 24 heures*. Ceux qui possèdent une étiquette-collant *Handicapés* pour la voiture doivent l'apporter s'ils veulent utiliser les endroits désignés à cet effet.

Les jours de semaine (7 h à 18 h), le stationnement est restreint aux terrains situés À L'EXTÉRIEUR du chemin Ring (consultez le plan du campus) et dans les espaces désignés GÉNERAL (enseignes bleues). Le permis de stationnement quotidien de 5 $, ou de 15 $ pour 3 jours, peut être obtenu aux parcomètres situés à quelques mètres des points d'accès à l'université. Selon le parcomètre, vous devrez avoir en main la monnaie exacte (petite monnaie, billets de 5 $ et de 10 $) ou une des principales cartes de crédit.

ACCÈS AU COURRIER ÉLECTRONIQUE

Les participants auront accès au courrier électronique du laboratoire d'informatique, édifice Elliott, pièce 138. Des renseignements supplémentaires seront disponibles lors de l'inscription.

EXPOSANTS

Datacomp Electronics Inc.
Gamble Technologies Limited
Harcourt Canada
John Wiley & Sons Canada Ltd.
Melles Griot Canada
Pearson Education Canada
Quantum Technology Corp.
Systems for Research Corp.
Varian Canada Inc.

COMMANDITAIRES

Département de physique et d'astronomie, Université de Victoria
Melles Griot Canada

2001 CAP CONGRESS

Welcome to the 56th Annual Congress of the Canadian Association of Physicists, hosted by the University of Victoria. A general outline of the program includes:

Sunday, June 18
The public plenary session will feature Dr. Kip Thorne, of Caltech, speaking on "Gravitational Waves: A New Window on the Universe." This session will be held in the Auditorium in the University Centre at 7:00 pm followed by a welcome reception in the Cafeteria in the University Centre for all attendees. One complimentary beverage will be provided in your registration package.

A B.B.Q. for graduate students (physics) or CAP members who graduated within the past four years will be held at Caddy's in the Commons Building starting at 4:00 p.m. This B.B.Q.. will be hosted by Mick Lord, P.Phys., of Science Applications International, who will also be giving a brief presentation on the CAP's professional certification program. Individuals interested in participating can either pre-register with the CAP by e-mail (cap@physics.uottawa.ca) BEFORE June 8th or can, if space permits, register by visiting the CAP desk at the Congress registration area before noon on Sunday, June 17th.

Monday, June 19, Beer and poster session
The Beer and Poster session will start at 7:00 pm in the Lobby of the MacLaurin Building. One complimentary beverage ticket will be provided in your registration package.

Tuesday, June 20
The congress banquet will take place at 7:30 pm in the Main Dining Room of the University Club located on the west side of the University of Victoria campus. The cost is $35 per person including taxes. Seating is limited, so register early if you wish to attend. If the banquet is sold out prior to Congress, you can put your name on a waiting list at the registration desk. There will be a reception with a cash bar in the Fireside Lounge adjacent to the Main Dining Room prior to the banquet.

REGISTRATION INFORMATION
After May 31, 2001, delegates should register on site.

Student discounts apply only to those who include a letter from the head of their department certifying their status. Conference fees are quoted in Canadian dollars.

Method of Payment
Payment can be made by credit card (VISA, MasterCard or American Express) or cheque payable to 'The University of Victoria CAP 2001'.

Cancellation Policy
In the unfortunate event that your conference registration must be cancelled, a full refund (less $50 administration fee) will be issued, provided that written notification is received by Prof. Charles Picciotto, Department of Physics & Astronomy, University of Victoria on or before May 18, 2001. No refunds will be issued after May 18, 2001..

TRANSPORTATION TO ACCOMMODATION
Taxis are available from the Victoria International Airport to downtown or the University of Victoria campus for about $40. Although there is no public transportation available from the airport into town, there is a private bus company airport shuttle service which will drop off at downtown hotels or at the University of

CONGRÈS DE L'ACP 2001

Bienvenue au 56e congrès annuel de l'Association canadienne des physiciens et physiciennes, à l'Université de Victoria. Voici un aperçu du programme.

Dimanche 18 juin
La session plénière mettra en vedette le Dr Kip Thorne, de Caltech, qui nous entretiendra du sujet suivant : "Les ondes gravitationnelles : une nouvelle fenêtre sur l'univers". Cette session aura lieu à l'auditorium du centre universitaire à 19 h et sera suivie d'une réception d'ouverture, pour tous les participants, dans la cafétéria du centre universitaire. Un breuvage gratuit sera compris dans le forfait d'inscription.

Un barbecue pour les étudiants de deuxième et troisième cycle (en physique) ou les membres de l'ACP ayant obtenu leur diplôme au cours des 4 dernières années, aura lieu chez Caddy's à l'édifice Commons à partir de 16 h. Mick Lord, phys., de "Science Applications International", sera l'hôte de ce barbecue et présentera brièvement le programme de certification professionnelle de l'ACP. Toute personne intéressée à s'y joindre peut se préinscrire avec le bureau de l'ACP par courriel (cap@physics.uottawa.ca) AVANT le 8 juin ou encore, s'il reste assez de places, s'inscrire à la table de l'ACP, installée au lieu d'inscription du Congrès, avant midi le dimanche 7 juin.

Lundi 19 juin - Session affiches et bière
Cette session débutera à 19 h dans le hall de l'édifice MacLaurin. Vous trouverez dans votre trousse d'inscription un billet pour un breuvage gratuit.

Mardi 20 juin
Le banquet du congrès aura lieu à 19 h 30 à la grande salle à manger du club universitaire qui est situé du côté ouest du campus de l'Université de Victoria. Le coût est de 35 $ par personne et comprend les taxes. Il faut s'inscrire tôt car le nombre de places est limité. Si les places sont toutes réservées, vous pouvez inscrire votre nom sur une liste d'attente au bureau d'inscription. Une réception avec bar payant aura lieu avant le banquet au Salon Fireside, voisin de la grande salle à manger.

INFORMATION RELATIVE À L'INSCRIPTION
Les inscriptions se feront sur les lieux après le 31 mai 2001.

Les étudiants qui veulent bénéficier d'un tarif réduit doivent joindre une lettre de leur chef de département pour attester leur statut d'étudiant. Les frais d'inscription sont en dollars canadiens.

Modalités de paiement
Le paiement peut être effectué par carte de crédit (Visa, MasterCard ou American Express) ou par chèque libellé à l'ordre de: *University of Victoria CAP 2001*.

Politique d'annulation
Si vous devez malheureusement annuler votre inscription, un chèque de remboursement (moins 50 $ de frais d'administration) sera émis si une demande de remboursement écrite est envoyée au Prof. Charles Picciotto, Département de physique et d'astronomie, Université de Victoria au plus tard le 18 mai 2001. Il n'y aura aucun remboursement après le 18 mai 2001.

TRANSPORT VERS L'HÉBERGEMENT
Des taxis sont disponibles de l'aéroport international de Victoria au centre-ville ou au campus de l'Université de Victoria à un coût d'environ 40 $. Bien qu'il n'y ait pas de transport en commun se déplaçant de l'aéroport au centre-ville, un service de navette, propriété d'une entreprise d'autobus privée, peut vous amener aux

Victoria Housing Office (Craigdarroch Office Building -Parking Lot #5) for about $13 (be sure to inform the driver if you want to go to the University). This bus can be picked up in front of the arrival gate at the airport.

If you take the ferry as a foot passenger, there is public transportation (#70) from the ferry to downtown Victoria. To go to the University of Victoria, take the #70 and inform the driver that you need to transfer at either the Royal Oak Exchange to #39 or at McKenzie Avenue to #26, both of which will take you to the University of Victoria. The bus terminal on campus is a short walk from the Housing Office (Craigdarroch Office Building).

If you are driving, the ferry will unload onto Highway 17 which leads directly into downtown Victoria. To go to the University of Victoria, you can exit off this highway onto McKenzie Avenue (east). Staying on this road for several kilometers, you will see the campus on the right hand side. Do NOT exit into the campus at this point - stay on McKenzie Avenue (which will turn into Sinclair Road) until you see Parking Lot #5 on the right hand side. This is the parking lot for the Housing Office (Craigdarroch Office Building).

ACCOMMODATION

CAP delegates staying on-campus at the University of Victoria will be housed in the Student Residences. The check-in desk (which is open 24 hours/day, 7 days/week) is located in Housing, Food and Conference Services in the Craigdarroch Office Building which can be accessed from Parking Lot #5. Participants who would like to stay on campus must complete the accommodation form which can be found in the congress registration information pages located on the CAP website at www.cap.ca.

Off-campus accommodations are also available. A block or rooms has been reserved for congress delegates at the following downtown hotel:

Chateau Victoria, 740 Burdett Avenue, Victoria, B.C. V8W 1B2
Phone: (250) 382-4221
E-mail: reservations@chateauvictoria.com

One bedroom suites are $142/night and standard rooms are $110/night. Please add 10% provincial tax and 7% GST.

(Rates are based on single or double occupancy; add $15.00 for each additional adult in the room to a maximum of 4 in one room) You must book before May 16th and identify yourself as attending the CAP Congress at the University of Victoria to get these rates.

For a complete listing of accommodation (hotels, motels, bed & breakfast inns etc.) in Victoria, check www.tourismvictoria.com.

RECREATIONAL FACILITIES

The University of Victoria has two recreational facilities. The McKinnon Building includes a gymnasium, dance studio, weight training room, 25m L-shaped pool, squash courts, fitness testing area, running track, playing fields and change and shower facilities. Racquets are available for rent. The Ian Stewart Complex includes

hôtels du centre-ville ou au bureau d'hébergement de l'Université de Victoria (édifice administratif Craigdarroch - terrain de stationnement n° 5) à un coût approximatif de 13 $ (assurez-vous de mentionner au chauffeur si vous désirez vous rendre à l'université). Vous pouvez prendre cet autobus à la barrière d'arrivée de l'aéroport.

Si vous prenez le traversier en tant que passager sans véhicule, le transport en commun (le 70) est disponible du traversier au centre-ville de Victoria. Pour vous rendre à l'Université de Victoria, prenez le 70 et informez le chauffeur que vous devez prendre une correspondance au Royal Oak Exchange à l'autobus n° 39 ou à l'avenue McKenzie à l'autobus n° 26, les deux vous amenant à l'Université de Victoria. Il n'y a pas loin à marcher du bureau d'hébergement (édifice administratif Craigdarroch) pour aller au terminus d'autobus situé sur le campus.

Si vous arrivez en voiture, le traversier va déposer son chargement sur l'autoroute 17 qui conduit directement au centre-ville de Victoria. Pour vous rendre à l'Université de Victoria, prenez la sortie avenue McKenzie (est). Demeurez sur cette route pour plusieurs kilomètres et vous verrez le campus à votre droite. **NE PAS** sortir immédiatement, demeurez sur l'avenue McKenzie (qui deviendra le chemin Sinclair) jusqu'à ce que vous aperceviez le terrain de stationnement n° 5 à votre droite. C'est le terrain de stationnement du bureau d'hébergement (édifice administratif Craigdarroch).

HÉBERGEMENT

Les délégués de l'ACP demeurant sur le campus de l'Université de Victoria seront logés dans les résidences des étudiants. Le bureau des inscriptions (ouvert 24 heures par jour, 7 jours par semaine) est situé au Département d'hébergement, d'alimentation et de conférences dans l'édifice administratif Craigdarroch qui est accessible du terrain n° 5. Les participants désirant demeurer sur le campus doivent remplir le formulaire d'hébergement que l'on peut obtenir sur le site Web de l'ACP (www.cap.ca) sous les pages de l'information relative à l'inscription, de la rubrique "Congrès annuel".

L'hébergement hors-campus est également disponible. Des chambres ont été réservées pour les délégués du congrès à l'hôtel du centre-ville suivant :

Château Victoria, 740, avenue Burdett, Victoria, C.-B. V8W 1B2,
Téléphone : (250) 382-4221
Courriel : reservations@chateauvictoria.com

Les suites à une chambre coûtent 142 $ par nuit et les chambres standard 110 $. Veuillez ajouter 10% de taxe provinciale et 7% de TPS.

(Les tarifs sont basés sur une occupation simple ou double; veuillez ajouter 15 $ par adulte additionnel, avec un maximum de 4 adultes par chambre). Vous devez réserver avant le 16 mai 2001 en tant que participant au congrès de l'ACP à l'Université de Victoria pour obtenir ces tarifs préférentiels.

Un guide complet d'hébergement disponible à Victoria (hôtels, motels, gîtes d'amis, auberges, etc.) est disponible à cette adresse : www.tourismvictoria.com.

INSTALLATIONS RÉCRÉATIVES

L'Université de Victoria détient deux installations récréatives. L'édifice McKinnon a entre autres un gymnase, un studio de dance, une salle de musculation, une piscine de 25 mètres, des courts de squash, une aire d'évaluation de condition physique, une piste de course, des terrains de sport, des douches et des

a fieldhouse, gymnasium, fitness/weight centre, hydra-gym, 25m outdoor pool, courts (squash, racquetball & badminton), an ice rink as well as change and shower facilities.

Day passes can be obtained (with proof of Congress participation, i.e. registration receipt) at a cost of $5.00 to $8.00 per day depending on the activities chosen. Detailed schedules will be available at the congress. There are also 8 jogging/walking trails on campus that can be accessed at several points off Ring Road.

MEALS AND PARKING
Meals are available at a variety of food outlets across campus. Directions to these places and parking information will be included in the registration package that you will receive at the information desk.

GENERAL INFORMATION ABOUT THE CITY AND THE UNIVERSITY
The University of Victoria sits on 160 wooded acres on the east side of the city of Victoria and serves approximately 17,000 students. UVic is easily accessible by car, bus, or bicycle, and is only a short stroll from the ocean. The Department of Physics & Astronomy is part of the Faculty of Science. It offers both undergraduate and graduate programs in Physics & Astronomy. Visit our web site at www.phys.uvic.ca for more information.

Victoria, located on Vancouver Island in Beautiful British Columbia, enjoys a mild climate year-round and offers many unique sights and attractions, from whale watching to beautiful gardens to street corner buskers. Its quaint shops, exceptional theatres, galleries & museums, and fine dining offer something for everyone! Visit www.tourismvictoria.com for further tourism information.

LOCAL CONTACT
Fax: (250) 721-7715
e-mail: office@phys.uvic.ca
Websites: www.cap.ca or www.phys.uvic.ca

LOCAL ORGANIZING COMMITTEE
Charles Picciotto (Chair)
Arif Babul
George Beer
Lorraine Charron
Susan Green
Bob Kowalewski
Lyle Robertson
Mike Roney

MAPS: see Congress information inside cover.

Floor Plans
- MacLaurin Building, main and second floors
- Elliott Building, including Elliott Lecture Wing
- University Centre
- Human & Social Development Building, main and second floors

vestiaires. Les raquettes peuvent être louées. Le complexe Ian Stewart inclut un complexe sportif, un gymnase, un centre de conditionnement physique et de musculation, un hydrogym, une piscine extérieure de 25 mètres, des courts (squash, racket-ball et badminton), une patinoire, ainsi que des douches et des vestiaires.

Le coût des laissez-passer quotidiens (avec une preuve de participation au congrès, e.g. reçu d'inscription) varient de 5 $ à 8 $, selon les activités choisies. Des horaires détaillés seront disponibles au congrès. En outre, il y a 8 pistes, entourant le campus, qui sont excellentes pour la marche ou le jogging.

REPAS ET STATIONNEMENT
Il est possible de trouver des repas à différents endroits au travers du campus. Vous trouverez les directives pour se rendre à ces endroits, ainsi que l'information relative au stationnement, dans votre trousse d'inscription que vous recevrez au bureau d'information.

RENSEIGNEMENTS GÉNÉRAUX SUR LA VILLE ET L'UNIVERSITÉ
L'Université de Victoria couvre 160 acres de terrain boisé dans l'est de la ville de Victoria et dessert environ 17 000 étudiants. Elle est facilement accessible par auto, par autobus, et par bicyclette en plus de n'être qu'à une petite marche de l'océan. Le Département de physique et d'astronomie fait partie de la Faculté des sciences. On y offre des programmes de premier cycle ainsi que de deuxième et troisième cycle en physique et en astronomie. Consultez notre site Web (www.tourismvictoria.com) pour des renseignements supplémentaires sur le tourisme.

Victoria, située sur l'île de Vancouver dans la belle province de la Colombie-Britannique, a un climat doux à l'année longue et offre des attractions touristiques uniques, allant de l'observation des baleines à des jardins magnifiques aux musiciens ambulants. Ses boutiques pittoresques, ses théâtres exceptionnels, ses galeries d'art et ses musées, et sa fine cuisine offrent un peu de tout à tout le monde! Consultez notre site Web (www.tourismvictoria.com) pour des renseignements supplémentaires sur le tourisme.

AGENT DE LIAISON LOCAL
Téléc.: (250) 721-7715
Cour. élec.: office@phys.uvic.ca
Sites web: www.cap.ca ou www.phys.uvic.ca

COMITÉ ORGANISATEUR LOCAL
Charles Picciotto (président)
Arif Babul
George Beer
Lorraine Charron
Susan Green
Bob Kowalewski
Lyle Robertson
Mike Roney

CARTES: - Elles se trouvent à l' intérieur de la page couverture du programme du Congrès.

Plans d'étages
- Édifice MacLaurin, rez-de-chaussée et deuxième étage
- Édifice Elliott, y compris l'aile de lecture Elliott
- Centre universitaire
- Édifice du Développement humain et social, rez-de-chaussée et deuxième étage

CAP2001 INVITED SPEAKERS / CONFÉRENCIERS INVITÉS CAP2001

(See program outline for list of sessions/speakers – *Voir programme des sessions pour la liste des sessions/conférenciers)*

BEHR, John, *TRIUMF*
Beta-Neutrino Correlations with Optical Traps (TU-A6-2)

BERNARD, John, *National Research Council*
Precision Optical Frequency Measurements with a Single, Trapped Ion (TU-A9-1)

BEVERIDGE, Terry, *University of Guelph*
The Mother of All Corsets: The Bacterial Cell Wall (TU-A4-1)

BHARDWAJ, Ravi, *National Research Council*
Ionization of Atoms and Molecules with Intense Femtosecond Pulses (WE-P4-2)

BOULAY, Mark G., *Queen's University*
Solar Neutrino Measurements with the Sudbury Neutrino Observatory (TU-A5-1)

BRETT, Michael, *University of Alberta*
Applications of Porous Thin Films with Engineered Nanostructures (TU-P2-1)

BROOKS, Robert L., *Guelph-Waterloo Physics Institute*
Cavity Ring-down Spectroscopy of Atmospheric Molecules (MO-A6-3)

BUCHMANN, Lothar R., *TRIUMF*
Two More Years of Nuclear Astrophysics (WE-P3-3)

BUYERS, William J.L., *National Research Council, Chalk River*
Surprises in Quantum Magnetism (TU-P1-1)

CARNEGIE, Robert K., *Carleton University*
Searching for the Higgs Boson at LEP (MO-A7-3)

CHETTLE, David R, *McMaster University*
Atomic and Molecular Physics Techniques for *in vivo* Trace Element Analysis (MO-A5-1)

CHIN, See L., *Université Laval*
Clean Fluorescence from Molecules Induced by Intense Femtosecond Ti-sapphire Laser Pulses (TU-A9-2)

CHOI, Byoung-Chul, *University of Alberta*
Magnetization Reversal Dynamics Studied by Time Resolved Kerr Microscopy (TU-A3-3)

COCHRANE, Robert, *Université de Montréal*
Metallic Multilayers (TU-A3-2)

CORRIVEAU, Francois, *McGill University*
QCD Physics with ZEUS at HERA (TU-P4-1)

DAVIDSON, Sean R.H., *University of Toronto*
Treatment Planning for Laser Thermal Therapy (TU-P3-2)

DAVIS, J.C. Seamus, *University of California at Berkeley*
The Electronic "Nanoscape" of High Temperature Superconductivity (MO-P2-3)

DESJARDINS, Patrick, *École Polytechnique*
Semiconductor Thin Film Growth Under Highly Kinetically Constrained Conditions (WE-A6-1)

DIXIT, Madhu, *Carleton University/TRIUMF*
Advances in Gas Avalanche Micro-Detectors (WE-A3-1)

DUBÉ, Martin, *McGillUniversity*
Quantum Computation and Decoherence (MO-A3-1)

DUZENLI, Cheryl R., *B.C. Cancer Agency*
3D Radiation Dosimetry Using Polymer Gels (WE-A1-1)

EGAMI, Takeshi, *University of Pennsylvania*
Neutron Scattering and Charge State in Cuprate Superconductors (MO-P2-5)

ETHIER, C.R., *University of Toronto*
Measurement Challenges in the Screening and Management of Glaucoma (MO-A5-2)

EVANS, W.F.J., *Trent University*
Measuring the Forcing Function of Global Warming (MO-A6-1)

FULTON, Brian, *University of York, England*
Novae and X-Ray Bursters: Measuring Breakout from the Hot-CNO Cycle at TRIUMF (WE-P3-2)

GALSTIAN, Tigran, *Université Laval*
New Infrared Sensitive Photopolymer Liquid Crystal Materials Open New Avenues for Information Routing (TU-P2-5)

GAUTHIER, N., *Royal Military College of Canada*
Privileges and Responsibilities of a University Career (SU-P3-1)

GINGRAS, M., *University of Waterloo*
Geometric and Random Frustration in Condensed Matter Physics: From Glasses to Ices (MO-P1-1)

GINGRICH, Doug, *University of Alberta*
The Status of the STACEE Project (TU-A5-4)

GOH, Cynthia, *University of Toronto*
Self-Assembly in Proteins and Nucleic Acids: What the AFM Can Tell Us (MO-P5-1)

GRIFFIN, Allan, *University of Toronto*
Landau-Khalatnikov Two-Fluid Hydrodynamics with Damping for a Trapped Bose-Condensed Gas (MO-A11-1)

GUO, Hong, *McGill University*
Ab Initio Modelling of Molecular Electronics (SU-A2-2)

HACHE, Alain, *Université de Moncton*
Nonlinear Photonic Crystals and Their Applications (TU-P2-4)

HALLETT, Michael, *McGill University*
Bioinformatics, Genomics and Proteomics (WE-A2-1)

HASS, Michael, *Weizmann Institute*
A New Measurements of the $^{7}Be(p,\gamma)^{8}B$ Cross-Section with an Implanted ^{7}Be Target (WE-P3-4)

HEARTY, Chris, *IPP / University of British Columbia*
First Physics From BaBar (TU-P4-3)

HEMINGWAY, Richard, *Carleton University*
OPAL Celebrates the Standard Model (MO-P3-1)

HERMAN, Peter R., *University of Toronto*
Advanced Lasers for Shaping Optical Components and Photonic Circuits (TU-A9-4)

HERON, Paula, *University of Washington*
Research as a Guide for Improving Student Learning in the Sciences (SU-A1-4)

HESSELS, Eric A., *York University*
High-Precision Measurement of the 2 Triplet P Intervals in Atomic Helium (WE-A7-1)

HILKE, Michael, *McGill University*
The Edge of a Two-Dimensional Electron Gas as Experimental Toy for a Perfect One-Dimensional System (SU-P2-2)

HILL, Robert, *University of Toronto*
Violation of the Wiedemann-Franz Law in the Normal State of a Cuprate Superconductor (MO-P2-1)

HOLT, Richard A., *University of Western Ontario*
Atomic Lifetime and HFS Measurements for Astrophysics (WE-A7-3)

HUTCHEON, Dave, *TRIUMF*
The DRAGON Mass Separator at TRIUMF/ISAC (WE-A3-3)

JERICHO, Manfred, *Dalhousie University*
Study of Bacteria with the Atomic Force Microscope (MO-P5-4)

JOSE, Jordi, *University of Barcelona*
Astrophysical Reactions and Explosive Nucleosynthesis (WE-P3-1)
JUNG, Jan, *University of Alberta*
Experimental Evidence for Intrinsic Ferroelastic Nanodomains and Their Effect on the Physical Properties of HTSC Cuprates (MO-P2-4)
KABIN, Konstantin, *University of British Columbia*
Exotic MHD Shocks: Possible Application to Mercury's Magnetosphere (TU-A8-1)
KARI, Lila, *University of Western Ontario*
From DNA to Computation and Back (MO-A3-4)
KARLEN, Dean, *Carleton University*
Prospects for a Future Linear e+e- Collider (MO-A7-2)
KIRCZENOW, George, *Simon Fraser University*
Ideal Spin Filters: Can We Make Spintronic Devices Out of Semiconductors and Ferromagnets? (SU-P2-1)
KLUGE, H. Jurgen, *GSI, Darmstadt, Germany*
High-Accuracy Experiments with Ions Confined in Storage Rings or Ion Traps (TU-A6-3)
KNUDSEN, David J., *University of Calgary*
Canadian Research in Auroral Plasma Physics (MO-P4-3)
KROUSE, H. Roy, *University of Calgary*
Stable Isotopes: A Universal Research Tool (TU-A1-1)
LEE, Lawrence, *University of Manitoba/TRIUMF*
The Physics of GO at Jefferson Lab (MO-A4-1)
LEFEBVRE, Michel, *University of Victoria*
Physics at the TeV Scale: Discovery Potential of the ATLAS Detector at the LHC (M0-A7-4)
LENNOX, R. Bruce, *McGill University*
Self-Assembled Monolayers As Models of Bilayer Lipid Membranes (TU-A4-3)
LESSARD, Louis, *Université de Montreal*
The PICASSO Project: Towards the Detection of Cold Dark Matter (TU-A5-2)
LOLOS, George J., *University of Regina*
The Role of Gluons and the Problem of Confinement in Hadrons: The JLab Program (MO-A4-2)
MADSEN, Steen J., *University of Nevada*
Optimizing Light Delivery for Photodynamic Therapy of Brain Tumors (TU-P3-1)
MANDELIS, Andreas, *University of Toronto*
Experimental and Computational Aspects of Optical Property Determination of Turbid Media Using Frequency-Domain Laser Infrared Photothermal Radiometry (MO-A5-5)
MANDELIS, Andreas, *University of Toronto*
Lock-in Common Mode Rejection Demodulation: A Novel Background-Suppression Signal Generation Methodology (WE-A8-1)
MARCHAND, Richard, *University of Alberta*
Anisotropic Plasmas Transport Modelling: From Laboratory to Space (MO-P4-2)
MARMET, Louis, *National Research Council of Canada*
The Ultimate Accuracy of Cooled-Cesium Atomic Clocks: Only Time Will Tell (TU-P5-1)
MARRIAN, Christie R.K., *Defense Advanced Research Projects Agency (DARPA)*
From Microelectronics to Nanoelectronics (SU-A2-1)
MARSIGLIO, Frank, *University of Alberta*
Even/Odd and Surface Effects in Superconducting Nanoparticles (MO-P2-2)
MARTEL, Richard, *IBM T.J. Watson Research Centre*
Electrical Properties of Carbon Nanotubes and Nanotube Devices (SU-A2-3)
MARTIN, James D.D., *University of Waterloo*
Stabilization of Predissociating Rydberg Molecules Using Microwave and Radiofrequency Fields (WE-P4-1)
MARZIALI, André, *University of British Columbia*
Nanopores and Capillaries: Advances in DNA Analysis (TU-A4-4)
MAY, A. David, *University of Toronto*
A Unified Approach to Spectral Lineshapes, Transport Phenomena, Laser Theory and Nonlinear Optics (MO-P4-1)
McDERMOTT, Lillian, *University of Washington*
Physics Education Research - The Key to Student Learning (SU-A1-1)
McDERMOTT, Mark, *University of Alberta*
Probing Adsorbed Protein Conformation with Tapping-Mode Scanning Force Microscopy (MO-P5-3)
McDONALD, W. John, *University of Alberta*
NALTA and the Mystery of Cosmic Rays (SU-P5-1)
McEWEN, Don J., *University of Saskatchewan*
The Polar Cap (MO-A6-2)
MENARY, Scott, *York University*
Future of CP Violation (MO-A7-1)
MICHAELIAN, Kirk H., *Natural Resources Canada*
Photoacoustic Infrared Spectroscopy and Thermophysical Properties of Hydrocarbons (WE-A8-3)
MILDENBERGER, Joe, *TRIUMF*
Rare Kaon Decays at BNL (MO-P3-5)
MILLER, D., *University of Toronto*
Femtosecond Laser Source Development/Extreme Optics - A New Initiative for the CLS (WE-P4-3)
MOAZZEN-AHMADI, Nasser, *University of Calgary*
Internal Rotation and Intramolecular Energy Transfer (WE-A7-2)
MONCHALIN, Jean-Pierre, *National Research Council of Canada*
Optics-Based Diagnostics for Industry (WE-A8-2)
MONTEMAGNO, Carl, *Cornell University*
Nanomachines: A Roadmap for Realizing the Vision (TU-A2-1)
NOBLE, Tony, *Carleton University*
SNO in Summer (MO-A2-1)
NORUM, Blaine, *University of Virginia*
Experimental Tests of the Gerasimov-Drell-Hearn Sum Rules (MO-A4-3)
O'MEARA, Joanne M., *Massachusetts Institute of Technology*
X-Ray Fluorescence Measurements of Uranium *in vivo* (MO-A5-4)
PINFOLD, James L., *University of Alberta*
The ATLAS Detector - A Discovery Device (WE-P2-3)
POWER, Joan F., *McGill University*
Longitudinal Light Profile Microscopy (LLPM): A New Method for Seeing Below the Surfaces of Thin Film Materials (TU-A9-3)
ROCHON, Paul, *Royal Military College of Canada*
Holographic Imaging Using Azopolymer Films (TU-P2-3)
RODNING, Nathan, *University of Alberta*
TWIST - Precision Muon Decay at TRIUMF (MO-P3-2)
RUDA, Harry E., *University of Toronto*
Formation and Characterization of InAs Self-Assembled Quantum Dots on GaAs and InP (WE-A6-2)
RUSACK, Roger W., *University of Minnesota*
The Last Fermion (MO-P3-3)

RYAN, Dominic H., *McGill University*
Neutrons, Muons and Gammas: Nuclear Probes of Frustrated Magnetic Order (TU-A3-4)
SACHRAJDA, Andrew, *National Research Council*
Quantuam Information Processing with Semiconductor Quantum Dots (MO-A3-2)
SAULL, Patrick R.B., *Pennsylvania State University*
High-Q2 and Exotic Physics with ZEUS at HERA (WE-A5-4)
SINERVO, Pekka, *University of Toronto.*
The High-Energy Frontier: The CDF II Experiment at Fermilab (WE-A5-5)
SPROUSE, Gene, *Sunnybrook University*
Atomic Probes of Electromagnetic and Weak Interactions with Trapped Radioactive Atoms (TU-A6-1)
SUTTON, Mark, *McGill University*
Intensity Fluctuation Spectroscopy Using Coherent X-Rays (WE-P1-1)
SYDORA, Richard D., *University of Alberta*
Kinetic Simulation and Theory of Current Filament Twisting and Merging (TU-A8-4)
THEWALT, Michael L.W., *Simon Fraser University*
Photoluminescence of Isotopically-Pure Silicon (WE-A6-3)
THORNE, Kip, *Caltech*
Gravitational Waves: A New Window Onto the Universe (SU-KEY)
THORNTON, Ronald K., *Tufts University*
Interactive Lecture Demonstrations: Active Learning in Large Lectures (SU-A1-5)
TREMBLAY, André-Marie, *Université de Sherbrooke*
Mathematics, Physics, and Computers: Strongly Correlated Electrons in Two Dimensions as a Case Study (MO-A1-1)
TSUI, Ying Yin, *University of Alberta*
Laser-Plasma Applications (TU-A8-3)
UNRUH, William G., *University of British Columbia*
Quantum Computing - Promise and Problems (MO-A3-3)
VACHON, Brigitte, *University of Victoria*
New Particle Searches at LEP2 (WE-A5-1
VAN DRIEL, Henry, *University of Toronto*
Ultrafast All-Optical Band Edge Control in Two-Dimensional Silicon Photonic Crystals (WE-A10-1)
VAN WIJNGAARDEN, William A., *York University*
Laser Cooling and Trapping of Cesium Atoms (TU-P5-3)
VENUS, David, *McMaster University*
Surface-Driven Magnetic Phenomena in Ultrathin Films Studied Using AC-Susceptibility (TU-A3-1)
VINCTER, Manuella G., *University of Alberta*
New Results from HERMES (TU-P4-2)
VITKIN, Alex, *University of Toronto, Ontario Cancer Institute/Univ. Health Network*
High Resolution Imaging with Optical Coherence Tomography: Basic Principles, Biomedical Applications, and Enabling Intrumentation (MO-A5-3)
VITKIN, Alex, *University of Toronto, Ontario Cancer Institute/Univ. Health Network*
Optical Polarization Studies in Random Media: Applications to Biological Tissue Analysis (TU-P3-3)
VRBA, Jiri, *CTF Systems Inc.*
Brain Magnetometry: From Fetus to Adult (TU-A4-2)
WADDINGTON, Jim, *McMaster University*
TIGRESS at ISAC: A Versatile Gamma-Ray Detector Array (WE-A3-2)
WALKER, Thad G., *University of Wisconsin-Madison*
Collisions and Cold Atoms (TU-P5-2)
WESTERVELT, Robert M., *Harvard University*
Imaging Coherent Electron Flow (SU-P2-3)
WHELAN, William M., *Ryerson Polytechnic University*
Utility of Optical Monitoring During Laser Thermal Therapy (TU-P3-4)
XIAO, Chijin, *University of Saskatchewan*
Plasma Confinement Studies on the STOR-M Tokomak (TU-A8-2)
YIP, Christopher, *University of Toronto*
Probing Biomolecular Assembly: Investigations of Protein - Protein Interactions by Scanning Probe Microscopy (MO-P5-2)
YOUNG, Jeff F., *University of British Columbia*
Engineering Photonic Bandstructure in Semiconductor-Based Photonic Crystal Waveguides (TU-P2-2)

SUNDAY, JUNE 17, 2001 - DIMANCHE LE 17 JUIN, 2001

A B.B.Q. for graduate students (physics) or CAP members who graduated within the past four years will be held at Caddy's in the Commons Building starting at 4:00 p.m. This B.B.Q.. will be hosted by Mick Lord, P.Phys., of Science Applications International, who will also be giving a brief presentation on the CAP's professional certification program. Individuals interested in participating can either pre-register with the CAP by e-mail (cap@physics.uottawa.ca) BEFORE June 8th or can, if space permits, register by visiting the CAP desk at the Congress registration area before noon on Sunday, June 17th.

Un barbecue pour les étudiants de deuxième et troisième cycle (en physique) ou les membres de l'ACP ayant obtenu leur diplôme au cours des 4 dernières années, aura lieu chez Caddy's à l'édifice Commons à partir de 16 h. Mick Lord, phys., de "Science Applications International", sera l'hôte de ce barbecue et présentera brièvement le programme de certification professionnelle de l'ACP. Toute personne intéressée à s'y joindre peut se préinscrire avec le bureau de l'ACP par courriel (cap@physics.uottawa.ca) AVANT le 8 juin ou encore, s'il reste assez de places, s'inscrire à la table de l'ACP, installée au lieu d'inscription du Congrès, avant midi le dimanche 7 juin.

The Canadian Association of Physicists'

INAUGURAL HERZBERG MEMORIAL PUBLIC LECTURE

Sunday, June 17, 2001, starting at 7:30 p.m.

UNICENTRE AUDITORIUM, UNIVERSITY OF VICTORIA

KIP THORNE*, CALTECH UNIVERSITY

"Gravitational Waves : A New Window Onto the Universe"

Gravitational waves are ripples of warpage in the fabric of spacetime, generated by the birth of the universe, by collisions of black holes, and by other cataclysmic events in the distant universe. Next year an international network of ground-based detectors (LIGO, VIRGO, GEO and TAMA) will begin a search for gravitational waves with wavelengths about the size of the Earth. In 2010, the joint US/European LISA mission (three spacecraft 5 million kilometers apart that track each other with laser beams) will begin a search for gravitational waves with wavelengths the size of the solar system. In this lecture Thorne will describe these gravitational-wave detectors, the remarkable technology that they rely on (such as controlling the quantum mechanical behavior of 40 kilogram objects), and the revolution that they may bring in our understanding of the universe.

* Kip Thorne received his B.S. degree from Caltech in 1962 and his Ph.D. from Princeton University in 1965. He returned to Caltech as an Associate Professor in 1967 and become Professor of Theoretical Physics in 1970, The William R. Kenan, Jr. Professor in 1981, and The Feynman Professor of Theoretical Physics in 1991. He was cofounder (with R. Weiss and R.W.P. Drever) of the LIGO (laser Interferometer Gravitational Wave Observatory) Project and is a member of the LISA (Laser Interferometer Space Antenna) International Science Team. Along with other numerous awards and recognition, Dr. Thorne has been a Woodrow Wilson Fellow, a Danforth Foundation Fellow, a Fulbright Fellow, and a Guggenheim Fellow, and has served on the International Committee on General Relativity and Gravitation, the Committee on US-USSR Cooperation in Physics, and the National Academy of Science's Space Science Board.

LA PREMIÈRE CONFÉRENCE COMMÉMORATIVE HERZBERG

de l'Association canadienne des physiciens et physiciennes

Le dimanche 17 juin 2001, à 19 h 30

AUDITORIUM UNICENTRE, UNIVERSITÉ DE VICTORIA

KIP THORNE*, UNIVERSITÉ CALTECH

« Les ondes gravitationnelles, nouvelle fenêtre sur l'univers »

Dans le tissu espace-temps, les ondes gravitationnelles sont des ondulations de gauchissement provoquées par la naissance de l'univers, par des collisions de trous noirs et par d'autres cataclysmes dans l'univers lointain. L'an prochain, un réseau international de détecteurs terrestres (LIGO, VIRGO, GEO et TAMA) entreprendra une recherche d'ondes gravitationnelles de longueur avoisinant la taille de la Terre. En 2010, la mission américano-européenne LISA (trois engins spatiaux distants de 5 millions de kilomètres se repérant l'un l'autre par rayon laser) amorcera une recherche d'ondes gravitationnelles de longueur égale à la taille du système solaire. Dans cette conférence, M. Thorne décrira ces détecteurs d'ondes gravitationnelles, la technologie sur laquelle ils misent (tel le contrôle du comportement mécanique quantique d'objets de 40 kilogrammes) et la révolution qu'ils peuvent apporter dans notre compréhension de l'univers.

* Kip Thorne se voit décerner un B.Sc. de Caltech en 1962 et un Ph.D. de l'Université Princeton en 1965. Il revient à Caltech à titre de professeur agrégé en 1967 et devient professeur de physique théorique en 1970, professeur de William R. Kenan, fils en 1981 et professeur Feynman de physique théorique en 1991. Il est (avec R. Weiss et R.W.P. Drever) cofondateur du projet LIGO (observatoire d'ondes gravitationnelles par interféromètre à laser) et membre de l'équipe scientifique internationale de la LISA (antenne spatiale d'interféromètre à laser). Outre divers autres prix et récompenses, le Dr Thorne a été boursier Woodrow Wilson, boursier de la Fondation Danforth, boursier Fulbright et boursier Guggenheim et il a siégé au Comité international sur la relativité générale et la gravitation, au Comité pour la coopération des É.-U.— URSS en physique et à la Commission scientifique spatiale de l'Académie nationale des sciences.

Listeners, Speakers, and Session Chairmen/Participants, Orateurs et Présidents de Session

SPECIAL INSTRUCTIONS FOR TIMED PAPER

INSTRUCTIONS SPÉCIALES POUR LE RESPECT DES TEMPS DE PRÉSENTATION

In order to ensure that listeners can transfer from one session to another, the oral presentations will be timed. As a courtesy to all conference participants, we would ask that the following simple guidelines be observed. Your cooperation is appreciated.

LISTENERS

1) Please arrive at a lecture room promptly before the next paper is to begin.

2) Please leave a session unobtrusively, preferably during or at the end of the question and answer period.

SPEAKERS

1) Make your slide projection arrangements before the start of your session.

2) Be ready to start your talk on time.

3) Pace your talk to end well before the next talk begins: about 3 minutes for a contributed paper and about 10 minutes for an invited paper.

4) Answer questions and perhaps comments as completely and briefly as made necessary by the response of the audience.

5) Obey your session chairman's instructions.

6) Most important, practice giving your talk before the meeting. Remember, you are the ambassador of your department and institution, and you will be judged by your audience.

SESSION CHAIRS

1) Get to the session room about half an hour before your session begins. Check that all needed projection and auxiliary equipment are present and operational. Check that your speakers are present.

2) Start each paper right on time.

3) Make sure each speaker stops talking well before the next paper begins.

4) Keep the question periods interesting, lively, and productive. Read over the papers in your session beforehand. If necessary, prepare comments and questions.

5) Do not let any discussion period get out of hand, either on the speaker's or the questioner's side.

6) If someone fails to appear to give a paper, then either close the session until the time of the next scheduled speaker or else use the time imaginatively, perhaps begin a discussion of earlier papers.

7) Under no circumstances may the order of giving the papers differ from that given in the program, as all Congress participants rely on the timing indicated in the program to plan their participation/attendance at sessions or individual presentations.

Pour permettre le passage des participants d'une session à une autre, les présentations orales seront chronométrées. Par politesse pour tous les participants à la conférence, il serait souhaitable que les règles suivantes soient observées. Votre coopération est grandement appréciée.

PARTICIPANTS

1) Veuillez s'il vous plait rentrer dans la salle avant le début d'une présentation.

2) Veuillez s'il vous plait quitter une session de façon discrète, de préférence pendant, ou à la fin, de la période de questions

ORATEURS

1) Préparer votre système de projection avant le début de votre session.

2) Soyez prêt à débuter votre présentation à l'heure.

3) Finissez votre présentation bien avant le temps prévu pour la présentation suivante: environ 3 minutes pour une communication régulière et environ 10 minutes pour une présentation invitée.

4) Répondez aux questions et commentaires aussi brièvement que possible tout en tenant compte des exigences de votre audience.

5) Respectez les consignes de votre président de session.

6) Le plus important est de répéter votre présentation avant la conférence. Souvenez vous que vous êtes l'ambassadeur de votre département et de votre institution et que vous êtes jugé par l'audience.

PRÉSIDENTS DE SESSION

1) Soyez dans la salle de votre session une demi-heure avant le début de la session. Vérifiez que tous les équippements de projections requis et les équippements annexes sont présents et en bon état de marche. Assurez vous de la présence des orateurs.

2) Débutez chaque présentation à l'heure

3) Assurez vous que chaque orateur termine sa communication bien avant le début prévu de la communication suivante.

4) Gardez la période de question captivante, vivante et féconde. Relisez au préalable les communications présentées dans votre session et au besoin préparez des commentaires et des questions.

5) Evitez de perdre le contrôle d'une discussion entre un orateur et son questionneur

6) Si un orateur ne se présente pas au moment prévu pour donner sa communication, vous pouvez soit suspendre la session jusqu'au temps de la présentation suivante, ou bien utiliser le temps de façon imaginative en débutant par exemple une discussion sur les présentations précédentes.

7) L'ordre des communications ne doit en aucunes circonstances être différent de celui apparaissant dans le programme, car les participants au congrès font confiance au déroulement indiqué dans le programme pour organiser leur participation aux sessions ou leurs présentations individuelles.

SESSION CODES / INDICATIFS DES SESSIONS

DAMP	Division of Atomic and Molecular Physics
DPAM	Division de physique atomique et moléculaire
DASP	Division of Atmospheric and Space Physics
DPAE	Division de physique atmosphérique et de l'espace
DCMMP	Division of Condensed Matter and Materials Physics
DPMCM	Division de physique de la matière condensée et matériaux
DMBP	Medical and Biological Physics
DPMB	Physique médicale et biologique
DIAP	Division of Industrial and Applied Physics
DPIA	Division de physique industrielle et appliquée
DNP	Division of Nuclear Physics
DPN	Division de physique nucléaire
DOP	Division of Optics and Photonics
	Division d'optique et photonique
DPE	Division of Physics Education
DEP	Division de l'enseignement de la physique
DPP	Division of Plasma Physics
	Division de physique des plasmas
DTP	Division of Theoretical Physics
DPT	Division de physique théorique
IMP	(Working Group on) Instrumentation and Measurement Physics
PIM	(Groupe sur la) physique des instruments et mesures
PPD	Particle Physics Division
	Division de physique des particules
CEWIP	Committee to Encourage Women in Physics
CEFEP	Comité pour encourager les femmes en physique

SU-KEY	Sunday Keynote Speaker / Session plénière publique le dimanche soir
SU-A#	Sunday A.M. / Dimanche matin
SU-P#	Sunday P.M. / Dimanche après-midi
MO-A#	Monday A.M. / Lundi matin
MO-P#	Monday P.M. / Lundi après-midi
MO-LUM	Monday Lumonics Competition / Compétition Lumonics, le lundi après-midi
MO-POS	Monday evening Poster Session / Session d'affiche le lundi soir
TU-A#	Tuesday A.M. / Mardi matin
TU-P#	Tuesday P.M. / Mardi après-midi
WE-A#	Wednesday A.M. / Mercredi matin
WE-P#	Wednesday P.M. / Mercredi après-midi

DETAILED CONGRESS PROGRAM / PROGRAMME DÉTAILLÉ DU CONGRÈS

Unless otherwise noted, all sessions will be held in MacLaurin Bldg. / *À moins d'avis contraire, toutes les sessions auront lieu dans l'immeuble MacLaurin*

SATURDAY, JUNE 16, 2001/ SAMEDI 16 JUIN 2001

09h00-16h00	ED FEST for Physics Teachers	Imm. Elliott Bldg , Room/Salle 168
09h30	Executive Meeting / Réunion de l'Exécutif,	UniCentre, Room A180
17h00	Council Meeting (Old and New) / Réunion du Conseil (ancien et nouveau)	UniCentre, Room A180

SUNDAY, JUNE 17, 2001 / DIMANCHE 17 JUIN 2001

TIME / HEURE	OTHER LOCATIONS	IMM. HSD BLDG. ROOM/SALLE A240	IMM. ELLIOTT BLDG. ROOM / SALLE 168
09h00	**Room/Salle 105, Immeuble Elliott Building** IPP Board of Trustees Meeting / Réunion du conseil d'administration de l'IPP **Room/Salle A180, UniCentre** Physics Department Heads/Chairs Workshop / Réunion pour les chefs des départements de physique		SU-A1 (DPE/DEP) **Physics Curriculum Developments / Nouveautés dans les programmes d'enseignement de la physique** Chair: J. Van Aalst, SFU L. McDERMOTT Physics Education Research - The Key to Student Learning (see abstract SU-A1-1)
09h30		SU-A2 (DCMMP/DPMCM) **Nanoscale and Mesoscopic Electronics / Échelle nanométrique et électronique mésoscopique** Chair: P. Grutter, McGill Univ. C.R.K. MARRIAN From Microelectronics to Nanoelectronics (see abstract SU-A2-1)	
09h45			A.J. Slavin (c) Just-in-time-Teaching Applied with Peer Instruction Using WebCT (see abstract SU-A1-2)
10h00			M. Nantel (c) Photonics Training and Education - A National Emergency (see abstract SU-A1-3)
10h15		Coffee Break / *Pause café*	
10h30			P.R.L. HERON Research as a Guide for Improving Student Learning in the Sciences (see abstract SU-A1-4)
10h45		H. GUO *Ab Initio* Modelling of Molecular Electronics (see abstract SU-A2-2)	
11h00			R.K. THORNTON Interactive Lecture Demonstrations: Active Learning in Large Lectures (see abstract SU-A1-5)
11h30		R. MARTEL Electrical Properties of Carbon Nanotubes and Nanotube Devices (see abstract SU-A2-3)	
12h00			LUNCH / *DÉJEUNER*
12h15		Morning session ends / *Fin de la session du matin* Lunch / *Déjeuner*	
13h00			SU-P1 (DPE/DEP) **Panel Session** 'Implementing the Results of Physics Education Research' / Table ronde sur la "mise en pratique des résultats de la recherche sur l'enseignement de la physique" Chair: J. Carolan, UBC (see abstract SU-P1-1)
13h30		SU-P2 (DCMMP/DPMCM) **Nanoscale and...**p.m. / **Échelle nanométrique...***après-midi- cont'd* Chair: P. Grutter, McGill Univ. G. KIRCZENOW Ideal Spin Filters: Can We Make Spintronic Devices out of Semiconductors and Ferromagnets? (see abstract SU-P2-1)	
14h15		Coffee Break / *Pause café*	

SUNDAY, JUNE 17, 2001 / DIMANCHE 17 JUIN 2001

TIME *HEURE*	OTHER LOCATIONS	ROOM/SALLE A240	IMM. ELLIOTT BLDG. ROOM / SALLE 168
14h30	**Room/Salle 167, Imm. Elliott Bldg.** IPP General Meeting / Assemblée générale (IPP)		SU-P3 (CAP/ACP) **Plenary Session / Session plénière** Chair: R. Hodgson, Univ. of Ottawa N. GAUTHIER *(CAP Teaching Medal winner / récipiendaire de la médaille d'enseignement de l'ACP)* Privileges and Responsibilities of a University Career (See abstract SU-P3-1)
14h45		M. HILKE The Edge of a Two-Dimensional Electron Gas as Experimental Toy for a Perfect One-Dimensional System (see abstract SU-P2-2)	
15h00			SU-P4 (DPE/DEP) **Physics Education Contributed Session / Session de communications sur l'enseignement de la physique** Chair: R. Hodgson, Univ. of Ottawa S. Greenspoon (c) A Consistent Vector Approach to Teaching Introductory Mechanics (see abstract SU-P4-1)
15h15			R.J.W. Hodgson (c) Vpython: Software for Three-Dimensional Physics Displays (see abstract SU-P4-2)
15h30		R.M. WESTERVELT Imaging Coherent Electron Flow (see abstract SU-P2-3)	Coffee break / *pause café*
16h00	**Caddy's, Édifice Commons Building** **Barbeque** for Graduate Students (physics) or CAP members who graduated within the last four years. **Barbecue** pour les étudiants de deuxième ou troisième cycle (en physique) ou les membres de l'ACP ayant obtenu leur diplôme au cours des 4 dernières années.		SU-P5 (DPE/DEP) **The NALTA Project / Le projet NALTA** Chair: R. Hodgson, Univ. of Ottawa W.J. McDONALD NALTA and the Mystery of Cosmic Rays (see abstract SU-P5-1)
16h15		Session ends / *Fin de la session*	
16h30			V. Pasek (c) The Collaboration of High School Students in the ALTA Project (see abstract SU-P5-2)
16h45			C.E. Waltham (c) Long-Baseline Test for NALTA Cosmic Air-Shower Array (see abstract SU-P5-3)
17h00			Session ends / *Fin de la session*
19h00	(SU-KEY) **Auditorium UniCentre Auditorium** **INAUGURAL HERZBERG MEMORIAL LECTURE / LA PREMIÈRE CONFÉRENCE COMMÉMORATIVE HERZBERG** **PUBLIC SESSION PUBLIQUE** Chair: G. Drake, Univ. Windsor K. THORNE *Caltech* Gravitational Waves: A New Window Onto the Universe		
20h00	Cafeteria UniCentre *Cafeteria* **Opening Reception / Réception d'accueil**		

MONDAY, JUNE 18, 2001

TIME / HEURE	OTHER LOCATIONS	ROOM / SALLE A144	IMM. HSD BLDG. ROOM / SALLE A240	ROOM / SALLE D288	ROOM / SALLE D287
07h00	**Commons Block, Salle Haro Room** 'Friends of CAP' Breakfast / Déjeuner des 'Ami(e)s de l'ACP' (07h00-08h20)				
08h30		MO-A1 **Plenary Session / Session plénière** Chair: G. Drake, Univ. of Windsor A.-M. TREMBLAY *(CAP/CRM Medal winner / récipiendaire de la médaille ACP/CRM)* Mathematics, Physics, and Computers: Strongly correlated electrons in two dimensions as a case study (see abstract MO-A1-1)			
09h15		MO-A2 (DNP-PPD/ DPN-PPD) **Plenary Session / Session plénière** Chair: F. Corriveau, McGill Univ. T. NOBLE SNO in Summer (see abstract MO-A2-1)			
10h00			MO-A3 (DCMMP-DTP/ DPMCM-DPT) **Quantum and DNA Computing / Calculs numériques des structures quantiques et du DNA** Chair: to be announced / à venir M. DUBÉ Quantum Computation and Decoherence (see abstract MO-A3-1)	MO-A6 (DAMP-DASP-DPP/ DPAM-DPAE-DPP) **Physics of Gaseous and Ionized Media I / Physique des milieux gaseux et ionisés I** Chair: to be announced / à venir W.F.J. EVANS Measuring the Forcing Function of Global Warming (see abstract MO-A6-1)	MO-A7 (PPD) **The Future of Particle Physics / L'avenir de la physique des particules** Chair: M. Vincter, Univ. Alberta S. MENARY Future of CP Violation (see abstract MO-A7-1)
10h15					
10h30			A. SACHRAJDA Quantum Information Processing with Semiconductor Quantum Dots (see abstract MO-A3-2)	D.J. McEWEN The Polar Cap (see abstract MO-A6-2)	D. KARLEN Prospects for a Future Linear e+e- Collider (see abstract MO-A7-2)
10h45					
11h00			Coffee Break / Pause café	Coffee Break / Pause café	Coffee Break / Pause café
11h15					
11h30			W.G. UNRUH Quantum Computing - Promise and Problems (see abstract MO-A3-3)	R.L. BROOKS Cavity Ring-down Spectroscopy of Atmospheric Molecules (see abstract MO-A6-3)	R.K. CARNEGIE Searching for the Higgs Boson at LEP (see abstract MO-A7-3)
11h45					
12h00			L. KARI From DNA to Computation and Back (see abstract MO-A3-4)	N. Whaley (c) Designing a Rocket-Borne Laser Spectrometer to Measure Atomic and Molecular Oxygen Densities (see abstract MO-A6-4)	M. LEFEBVRE Physics at the TeV Scale: Discovery Potential of the ATLAS Detector at the LHC (see abstract MO-A7-4)

ROOM / SALLE D111	ROOM / SALLE D110	ROOM / SALLE D101	ROOM / SALLE D103	ROOM / SALLE D114	TIME / HEURE
					07h00
					08h30
					09h15
MO-A8 (DOP) **Ultrafast Photonics / Photonique ultrarapide** Chair: M. Duguay, Univ. Laval A.J. Alcock (c) Generation of Sub-picosecond Cr4+ YAG Laser Pulses by Means of a Hybrid Semiconductor Saturable Absorber Mirror (see abstract MO-A8-1)	MO-A9 (DCMMP/ DPMCM) **Polymers and Soft Matter / Polymères et matériaux ductiles** Chair: A. Marziali, UBC R.B. Thompson (c) Self-Consistent Field Theory for a Particle/Diblock Composite System (see abstract MO-A9-1)	MO-A5 (DMBP-IMP / DPMB-PIM) **Instrumentation and Measurements in Biology and Medicine Biophotonics / Instrumentation et mesures en biologie et médicine biophotonique** Chair: A. Mandelis, Univ. Toronto D.R. CHETTLE Atomic and Nuclear Physics Techniques for *in vivo* Trace Element Analysis (see abstract MO-A5-1)	MO-A4 (DNP/DPN) **Electromagnetic Interactions / Interactions électromagnétiques** Chair: W. van Oers, Univ. Manitoba L. LEE The Physics of GO at Jefferson Lab (see abstract MO-A4-1)	MO-A10 (DCMMP/DPMCM) **Superconductivity (contributed) / Supraconductivité (communications)** Chair: F. Marsiglio, Univ. of Alberta R. MacKenzie (c) Type I Behaviour of Type II Superconductors in the SO(5) Model (see abstract MO-A10-1)	10h00
B.J. Siwick (c) Ultrafast Electron Diffraction: Probing Structural Dynamics on the Femtosecond Time-Scale (see abstract MO-A8-2)	L.C. McCormick (c) Free Solution Conjugate Electrophoresis for the Determination of Polymer Solution Polydispersity (see abstract MO-A9-2)			J.E. Sonier (c) Anomalous Weak Magnetism in Superconducting $YBa_2Cu_3O_{6+x}$ (see abstract MO-A10-2)	10h15
M. Duguay (c) Time-Oriented Approach to the Einstein-Podolsky-Rosen Paradox (see abstract MO-A8-3)	B. Joós (c) A Lattice Model for the Kinetics of Membrane Rupture (see abstract MO-A9-3)	C.R. ETHIER Measurement Challenges in the Screening and Management of Glaucoma (see abstract MO-A5-2)	G.J. LOLOS The Role of Gluons and the Problem of Confinement in Hadrons: The JLab Program (see abstract MO-A4-2)	R. Miller (c) Non-Local Effects and Vortex Lattice Geometries in 2D and 3D Conventional and Unconventional Superconductors (see abstract MO-A10-3)	10h30
A. Cowan (c) The Effects of Texturing on the Properties of a Nonlinear Conversion Process (see abstract MO-A8-4)	Coffee Break / Pause café			J. Nam (c) Local Characterization of YBCO Thin Film (see abstract MO-A10-4)	10h45
Coffee Break / Pause café		I.A. VITKIN High-Resolution Imaging with Optical Coherence Tomography: Basic Principles, Biomedical Applications, and Enabling Instrumentation (see abstract MO-A5-3)	Coffee Break / Pause café	Coffee Break / Pause café	11h00
	C. Barrett (c) Optical Properties of Polyelectrolyte Multilayer Thin Films (see abstract MO-A9-4)				11h15
A. Gajadharsingh (c) Optical Fiber Communication Using Dispersion Management Scheme (see abstract MO-A8-5)	O. Mermut (c) Structural Properties of Azobenzene Polyelectrolyte Multilayer Thin Films (see abstract MO-A9-5)	Coffee Break / Pause café	B. NORUM Experimental Tests of the Gerasimov-Drell-Hearn Sum Rules (see abstract MO-A4-3)	MO-A11 (DCMMP/DPMCM) **Best DCMMP Paper in the Canadian Journal of Physics / Meilleur papier publié dans la Revue de la physique canadienne** Chair: P. Grutter, McGill Univ. A. GRIFFIN Landau-Khalatnikov Two-Fluid Hydrodynamics with Damping for a Trapped Bose-Condensed Gas (see abstract MO-A11-1)	11h30
R.A. Lessard (c) Fabrication of Thin Film Photonic Band Gaps (see abstract MO-A8-6)	K. Asatryan (c) Creation of Two-Dimensional Orientational Structures in Pattern Photopolymerized Anisotropic Gels by Means of Homogeneous Quasistatic Electric Field (see abstract MO-A9-6)	J.M. O'MEARA X-Ray Fluorescence Measurements of Uranium *in vivo* (see abstract MO-A5-4)			11h45
Session Ends / Fin de la session	M. Côté (c) Structural Relaxation of the Excited State in Poly (P-Phenylene) (see abstract MO-A9-7)		Z. Papandreou (c) Branching Ratio of the Rare eta $\rightarrow \pi^0 + 2\gamma$ Decay (see abstract MO-A4-4)		12h00

MONDAY, JUNE 18, 2001 (cont.)

TIME / HEURE	OTHER LOCATIONS	ROOM / SALLE A144	IMM. HSD BLDG. ROOM / SALLE A240	ROOM / SALLE D288	ROOM / SALLE D287
12h15				A-L. Norman (c) Atmospheric Sulphur and Isotopic Indicators: A Source Apportionment Study in the Vancouver Region (see abstract MO-A6-5)	
12h30			Session ends / Fin de la session DCMMP Business Mtg (with lunch) Ends at 13h30 Réunion d'affaires DPMCM Se termine à 13h30	Session Ends / Fin de la session DPP Business Mtg (with lunch) Ends at 13h30 Réunion d'affaires DPP Se termine à 13h30	Session Ends / Fin de la session
12h45					
13h30		MO-P1 (CAP / ACP) **Plenary Session / Session plénière** Chair: G. Drake, Univ. Windsor M. GINGRAS *(CAP Herzberg Medal winner - récipiendaire de la médaille Herzberg)* Geometric and Random Frustration in Condensed Matter Physics: From Glasses to Ices (See abstract MO-P1-1)			
14h15			MO-P2 (DCMMP/DPMCM) **Superconductivity / Supraconductivité** Chair: J. Jung/R. Hill, Univ.Toronto R. HILL Violation of the Widemann-Franz Law in the Normal State of a Cuprate Superconductor (see abstract MO-P2-1)	MO-P4 (DAMP-DASP-DPP/ DPAM-DPAE-DPP) **Physics of Gaseous and Ionized Media II / Physique des milieux gaseux et ionisés II** Chair: to be announced / à venir D. MAY A Unified Approach to Spectral Lineshapes, Transport Phenomena, Laser Theory and Non-Linear Optics (see abstract MO-P4-1)	MO-P5 (DMBP/DPMB) **Atomic Force Microscopy and Biology / La microscopie à force atomique en biologie** Chair: J. Katsaras, NRC C. GOH Self-Assembly in Proteins and Nucleic Acids: What the AFM Can Tell Us (see abstract MO-P5-1)
14h30					
14h45			F. MARSIGLIO Even/Odd and Surface Effects in Superconducting Nanoparticles (see abstract MO-P2-2)	R. MARCHAND Anisotropic Plasmas Transport Modeling: From Laboratory to Space (see abstract MO-P4-2)	C. YIP Probing Biomolecular Assembly: Investigations of Protein-Protein Interactions by Scanning Probe Microscopy (see abstract MO-P5-2)
15h00					
15h15			Coffee Break / Pause café	Coffee Break / Pause café	Coffee Break / Pause café
15h30					M. McDERMOTT Probing Adsorbed Protein Conformation with Tapping-Mode Scanning Force Microscopy (see abstract MO-P5-3)
15h45			J.C.S. DAVIS The Electronic "Nanoscape" of High Temperature Superconductivity (see abstract MO-P2-3)	D.J. KNUDSEN Canadian Research in Auroral Plasma Physics (see abstract MO-P4-3)	
16h00	**Room/Salle D107** Meeting of the Committee to Encourage Women in Physics / Réunion du Comité pour encourager les femmes en physique				M. JERICHO Study of Bacteria with the Atomic Force Microscope (see abstract MO-P5-4)
16h15			J.A. JUNG Experimental Evidence for Intrinsic Ferroelastic Nanodomains and Their Effect on the Physical Properties of HTSC Cuprates (see abstract MO-P2-4)	J. Wanliss (c) Optical Signatures of Substorm Triggered Pulsations in Optical Signatures (see abstract MO-P4-4)	

ROOM / SALLE D111	ROOM / SALLE D110	ROOM / SALLE D101	ROOM / SALLE D103	ROOM / SALLE D114	TIME / HEURE
	S.S. Narine (c) The Physics of Chocolate (see abstract MO-A9-8)	A. MANDELIS Experimental and Computational Aspects of Optical Property Determination of Turbid Media Using Frequency-Domain Laser Infrared Photothermal Radiometry (see abstract MO-A5-5)	Session ends / Fin de la session	Session ends / Fin de la session	12h15
	Session ends / Fin de la session		DNP Business Meeting (with lunch) Ends at 13h30 Réunion d'affaires DPN (avec dîner) Se termine à 13h30		12h30
		Session ends / Fin de la session Meeting to discuss the possible establishment of a Division of Instrumentation and Measurement Physics / réunion pour discuter l'établissement d'une Division de la physique des instruments et mesures Ends at 13h30 / se termine à 13h30			12h45
					13h30
MO-P6 (DOP) **Photonic Materials and EDFAS I / Materiaux photoniques et EDFAS I** Chair: M. Duguay, Univ. Laval M.L. Florescu (c) Resonance Fluorescence in Photonic Crystals (see abstract MO-P6-1)	MO-P3 (PPD-DNP/PPD-DPN) **Completing the Standard Model / Compléter le modèle standard** Chair: N. Kolb, Univ. Saskatchewan R. HEMINGWAY OPAL Celebrates the Standard Model (see abstract MO-P3-1)	MO-P8 (DCMMP/DPMCM) **New Methods - Mesoscopic Physics / Nouvelles méthodes - Physique mésoscopique** Chair: M. Hilke, McGill Univ. A. Chahboun (c) Modification of Electron Transmittance Through Au/Si Interfaces During Ballistic Electron Emission Microscopy (see abstract MO-P8-1)	MO-P7 (DTP / DPT) **Classical and Semi-Classical Systems / Systèmes classiques et semi-classiques** Chair: G. Kunstatter, U. Winnipeg A. Peles (c) Control Analysis of a Double Pendulum System (see abstract MO-P7-1)		14h15
K. Asatryan (c) Study of Photoinduced Anisotropy and Non-Centrosymmetry in Thin Chalcogenide Glass Films (see abstract MO-P6-2)		M. Whitwick (c) Tomographic Reconstruction of Multiple In-line Holograms for Multiple Scattering in Low Electron Holography (see abstract MO-P8-2)	R.J.W. Hodgson (c) Particle Swarm Optimization and the Lennard-Jones Problem (see abstract MO-P7-2)		14h30
D. Dumont (c) High Resolution Optical Recording in Azo-Polymer-Stabilized Nematic Liquid Crystals (see abstract MO-P6-3)	N. RODNING TWIST- Precision Muon Decay at TRIUMF (see abstract MO-P3-2)	J.H. Brewer (c) Large Electron Transport and Muonium Formation (see abstract MO-P8-3)	S.R. Vallun (c) A Study of the Fourier Transform of the Gravitational Wave Signal from a Pulsar (see abstract MO-P7-3)		14h45
T. Galstian (c) New Holographic Polymer Dispersed Liquid Crystal Materials (see abstract MO-P6-4)		Coffee Break / Pause café	Coffee Break / Pause café		15h00
Coffee Break / Pause café	Coffee Break / Pause café				15h15
		P. Simon (c) Persistent Currents Through a Quantum Dot (see abstract MO-P8-4)	J. Sakhr (c) Extending the Gutzwiller Trace Formula to Systems of Two Identical Particles (see abstract MO-P7-4)		15h30
R.M. Beaulieu (c) Optical Characterization of Thin Dichromated Poly (Acrylic Acid) Films (see abstract MO-P6-5)	R.W. RUSACK The Last Fermion (see abstract MO-P3-3)	W. Andreas (c) Theory of the Spin Singlet Electronic Droplet in a Lateral Quantum Dot (see abstract MO-P8-5)	G.V. Morozov (c) Explicit Convergence of Born Series for Simple Perturbations: Comparison with Multiple Reflection Approach (see abstract MO-P7-5)		15h45
F. Bouguin (c) Étude des aberrations de lentilles holographiques *in-situ* dans le proche infra rouge (see abstract MO-P6-6)		J. Kynakidis (c) Excitation Spectra of Few-Electron Quantum Dots (see abstract MO-P8-6)	M.R.A. Shegelski (c) Exact vs Quasi-Classical Tunneling Times for Idealized Potentials (see abstract MO-P7-6)		16h00
Q. Mao (c) L-Band Multi-Wavelength Oscillating in Erbium-Doped Fiber Ring Lasers (see abstract MO-P6-7)	G. Trayling (c) A Geometric Basis for the Standard-Model Gauge Group (see abstract MO-P3-4)	S. Yang (c) Phononic Crystals (see abstract MO-P8-7)	Session Ends / Fin de la session		16h15

MONDAY, JUNE 18, 2001 (cont.)

TIME / HEURE	OTHER LOCATIONS	ROOM / SALLE A144	IMM. HSD BLDG. ROOM / SALLE A240	ROOM / SALLE D288	ROOM / SALLE D287
16h30				D.J. Knudsen (c) Sounding Rocket Observations of Auroral Ion Heating Cavities (see abstract MO-P4-5)	Session ends / Fin de la session
16h45			T. EGAMI Neutron Scattering and Charge State in Cuprate Superconductors (see abstract MO-P2-5)	E.F. Donovan (c) The Proton Aurora (see abstract MO-P4-6)	
17h00				Session ends / Fin de la session	(MO-LUM) **LUMONICS BEST STUDENT PAPER COMPETITION** **COMPÉTITION LUMONICS** Chair: B. Kowalewski, Univ. Victoria (eight 15 minute talks) (huit présentations de 15 minutes) G. Ballentine Correspondence of Micromagnetic Simulation to Time Resolved Experiment (see abstract TU-P6-2)
17h15			Session ends / Fin de la session		S. Yang Phononic Crystals (see abstract MO-P8-7)
17h30	**Room/Salle D109** PiC Editorial Board Meeting / Réunion du Conseil de rédaction de La Physique au Canada				R.A. Budiman Equilibrium Theory of Coherent Quantum Dot Formation (see abstract TU-P7-1)
17h45					B. KC Optical Use of Photon Counting Photomultipliers for Biophoton Measurements of Cartilage Tissue and Cultured Fibroblast Cells (see abstract WE-A4-4)
18h00					L.C. McCormick CE Separation of Uncharged Polymers using Polyelectrolyte Engines: A Theoretical Model (see abstract MO-A9-2)
18h15					G.V. Morozov Explicit Convergence of Born Series for Simple Perturbations: Comparison with Multiple Reflection Approach (see abstract MO-P7-5)
18h30	**University Club, Room/Salle A** CJP Editorial Board Meeting / Réunion du conseil de rédaction de La revue canadienne de physique				A. Sallabi Structures and Stability of CO and N2 Physisorbed on MgO: Descending the Devil's Staircase (see abstract TU-P7-5)
19h00	**Imm. MacLaurin Bldg., Lobby/Foyer** MO-POS **Poster Session**, with beer **Session affiches**, bière servie DAMP (11) DASP (5) DCMMP (23) DMBP (4) DIAP (2) DNP (4) DOP (12) DPP (1) DTP (2) PPD (1)				Session Ends / Fin de la session

ROOM / SALLE D111	ROOM / SALLE D110	ROOM / SALLE D101	ROOM / SALLE D103	ROOM / SALLE D114	TIME / HEURE
Session ends / Fin de la session	J. MILDENBERGER Rare Kaon Decays at BNL (see abstract MO-P3-5)	M.L. Cowan (c) Particle Velocity Fluctuations in Fluidized Suspensions: System-Size Dependence (see abstract MO-P8-8)			16h30
		J.H. Page (c) Using Phase Fluctuations of Multiply Scattered Ultrasonic Waves to Measure Particle Dynamics in Fluidized Suspensions (see abstract MO-P8-9)			16h45
	Session Ends / Fin de la session	Session Ends / Fin de la session	Session Ends / Fin de la session		17h00
					17h15
					17h30
					17h45
					18h00
					18h15
					18h30
					19h00

TUESDAY, JUNE 19, 2001

TIME / HEURE	OTHER LOCATIONS	ROOM / SALLE A144	IMM. HSD BLDG. ROOM / SALLE A240	ROOM / SALLE D288	ROOM / SALLE D287
07h00	**Commons Block, Salle Haro Room** Meeting of the Canadian National IUPAP Liaison Committee / Réunion du comité de liaison national Canadien (IUPAP)				
08h30		TU-A1 (CAP) **Plenary Session / *Session plénière*** Chair: W.J. McDonald, Univ.Alberta **H.R. KROUSE** *(CAP Medal for Outstanding Achievement in Industrial and Applied Physics winner - récipiendaire de la médaille de l'ACP pour contributions exceptionnelles en physique industrielle et appliquée)* Stable Isotopes: A Universal Research Tool (see abstract TU-A1-1)			
09h15		TU-A2 (DCMMP/DPMCM) **Plenary Session / *Session plénière*** Chair: P. Grütter, McGill Univ. **C. MONTEMAGNO** Nanomachines: A Roadmap for Realizing the Vision (see abstract TU-A2-1)			
10h00			TU-A4 (DCMMP-DMBP / DPMCM-DPMB) **The Frontiers of Biophysics / Les frontières de la biophysique** Chair: A. Rutenberg, Dalhousie U. T. BEVERIDGE The Mother of All Corsets: The Bacterial Cell Wall (see abstract TU-A4-1)	TU-A8 (DAMP-DASP-DPP / DPAM-DPAE-DPP) **Physics of Gaseous and Ionized Media III / Physique des milieux gaseux et ionisés III** Chair: to be announced / à venir K. KABIN Exotic MHD Shocks: Possible Application to Mercury's Magnetosphere (see abstract TU-A8-1)	TU-A9 (DOP-IMP / DOP-PIM) **Instrumentation and Measurements in Optics and Photonics / Instrumentation et mesures en optique et photonique** Chair: to be announced / à venir J. BERNARD Precision Optical Frequency Measurements with a Single, Trapped Ion (see abstract TU-A9-1)
10h15					
10h30			J. VRBA Brain Magnetometry: From Fetus to Adult (see abstract TU-A4-2)	C. XIAO Plasma Confinement Studies on the STOR-M Tokamak (see abstract TU-A8-2)	S.L. CHIN Clean Fluorescence from Molecules Induced by Intense Femtosecond Ti-sapphire Laser Pulses (see abstract TU-A9-2)
10h45					
11h00			Coffee Break / Pause café	Coffee Break / Pause café	Coffee Break / Pause café
11h30			R.B. LENNOX Self-Assembled Monolayers as Models of Bilayer Lipid Membranes (see abstract TU-A4-3)	Y.Y. TSUI Laser-Plasma Applications (see abstract TU-A8-3)	J.F. POWER Longitudinal Light Profile Microscopy (LLPM): A New Method for Seeing Below the Surfaces of Thin Film Materials (see abstract TU-A9-3)
11h45					
12h00			A. MARZIALI Nanopores and Capillanes: Advances in DNA Analysis (see abstract TU-A4-4)	R.D. SYDORA Kinetic Simulation and Theory of Current Filament Twisting and Merging (see abstract TU-A8-4)	P.R. HERMAN Advanced Lasers for Shaping Optical Components and Photonic Circuits (see abstract TU-A9-4)
12h15					
12h30	**Room/Salle D107** Canadian Institute for Neutron Scattering Meeting / Réunion de l'Institut Canadien sur la diffusion neutronique **University Club, Room/Salle A** Past President's Lunch / Déjeuner des anciens présidents		Session Ends / Fin de la session DMBP Business Meeting (with lunch) Ends at 13h30 Réunion d'affaires DPMB (avec repas) Se termine à 13h30	J.-C. Kieffer (c) From High Field Physics at 10^{21} W/cm^2 to Real World Applications with the 10TW Femtosecond INRS Laser (see abstract TU-A8-5)	Session Ends / Fin de la session DOP Business Meeting (with lunch) Ends at 13h30 Réunion d'affaires DOP (avec repas) Se termine à 13h30

ROOM / SALLE D111	ROOM / SALLE D110	ROOM / SALLE D101	ROOM / SALLE D103	ROOM / SALLE D114	TIME / HEURE
					07h00
					08h30
					09h15
TU-A6 (DAMP-DNP / DPAM-DPN) **Progress in Physics with Cooled and Trapped Atoms I / Progrès en physique des atomes froids et piégés I** Chair: K. Sharma, Univ. Manitoba G. SPROUSE Atomic Probes of Electromagnetic and Weak Interactions with Trapped Radioactive Atoms (see abstract TU-A6-1)	TU-A3 (DCMMP /DPMCM) **Magnetism / Magnétisme** Chair: M. Freeman, Univ. Alberta D. VENUS Surface-Driven Magnetic Phenomena in Ultrathin Films Studied Using AC-Susceptibility (see abstract TU-A3-1)		TU-A5 (PPD) **Neutrinos and Astroparticle Physics / Neutrinos et astroparticules** Chair: F. Corriveau, McGill Univ. M.G. BOULAY Solar Neutrino Measurements with the Sudbury Neutrino Observatory (see abstract TU-A5-1)	TU-A7 (DCMMP/DPMCM) **Semiconductors (contributed) / Semiconducteurs (communications)** Chair: H. Ruda, Univ. of Toronto C.V. Kaiser (c) Alpha Particle Spectroscopy as Applied to Textured Etch Processes (see abstract TU-A7-1)	10h00
				M. Adamcyk (c) In-Situ Stress Measurement During GaNAs Growth by Molecular Beam Epitaxy (see abstract TU-A7-2)	10h15
J. BEHR Beta-Neutrino Correlations with Optical Traps (see abstract TU-A6-2)	R. COCHRANE Metallic Multilayers (see abstract TU-A3-2)		L. LESSARD The PICASSO Project: Towards the Detection of Cold Dark Matter (see abstract TU-A5-2)	R.D. Wiersma (c) P-Type Carbon Doping of GaSb (see abstract TU-A7-3)	10h30
				E. Strohm (c) Photoconductivity of Dilute InGaNAs and GaNAs Alloys Grown by Molecular Beam Epitaxy (see abstract TU-A7-4)	10h45
Coffee Break / Pause café	Coffee Break / Pause café		Coffee Break / Pause café	Coffee Break / Pause café	11h00
H.J. KLUGE High-Accuracy Experiments with Ions Confined in Storage Rings or Ion Traps (see abstract TU-A6-3)	B-C. CHOI Magnetization Reversal Dynamics Studied by Time Resolved Kerr Microscopy (see abstract TU-A3-3)		C.E. Waltham (c) Through-Going Muons in the Sudbury Neutrino Observatory (see abstract TU-A5-3)		11h30
			D. GINGRICH The Status of the STACEE Project (see abstract TU-A5-4)	Session Ends / Fin de la session	11h45
J. Vaz (c) Atomic Mass Measurements with the Canadian Penning Trap Mass Spectrometer (see abstract TU-A6-4)	D.H. RYAN Neutrons, Muons and Gammas: Nuclear Probes of Frustrated Magnetic Order (see abstract TU-A3-4)				12h00
Session Ends / Fin de la session			Session Ends / Fin de la session PPD Business Meeting (with lunch) Ends at 13h30 Réunion d'affaires PPD (avec repas) Se termine à 13h30		12h15
	Session Ends / Fin de la session				12h30

TUESDAY, JUNE 19, 2001 (cont.)

TIME / HEURE	OTHER LOCATIONS	ROOM / SALLE A144	IMM. HSD BLDG. ROOM / SALLE A240	ROOM / SALLE D288	ROOM / SALLE D287
12h45				Session Ends / Fin de la session DAMP Business Meeting (with lunch) Ends at 13h30 Réunion d'affaires DPAM (avec repas) Se termine à 13h30	
13h30		TU-P1 (CAP/ACP) **Plenary Session / *Session plénière*** Chair: G. Drake, Univ. Windsor W.J.L. BUYERS *(CAP Medal of Achievement winner / récipiendaire de la médaille de l'ACP pour contributions exceptionnelles à la physique)* Surprises in Quantum Magnetism (See abstract TU-P1-1)			
14h15			TU-P2 (DIAP-DCMMP / DPIA-DPMCM) **Photonic Materials / Matériaux photoniques** Chair: T. Vo-Van, Univ. Moncton M. BRETT Applications of Porous Thin Films with Engineered Nanostructures (see abstract TU-P2-1)	TU-P3 (DMBP/DPMB) **Biophotonics / Biophotonique** Chair: B. Whelan, Ryerson Univ. S.J. MADSEN Optimizing Light Delivery for Photodynamic Therapy of Brain Tumors (see abstract TU-P3-1)	TU-P5 (DAMP-DNP / DPAM-DPN) **Progress in Physics with Cooled and Trapped Atoms II / Progrès en physique des atomes froids et piégés II** Chair: to be announced / à venir L. MARMET The Ultimate Accuracy of Cooled-Cesium Atomic Clocks: Only Time Will Tell (see abstract TU-P5-1)
14h30					
14h45			J.F. YOUNG Engineering Photonic Bandstructure in Semiconductor-Based Photonic Crystal Waveguides (see abstract TU-P2-2)	S.R.H. DAVIDSON Treatment Planning for Laser Thermal Therapy (see abstract TU-P3-2)	T.G. WALKER Collisions and Cold Atoms (see abstract TU-P5-2)
15h00					
15h15			Coffee Break / Pause café	Coffee Break / Pause café	Coffee Break / Pause café
15h30			P. ROCHON Holographic Imaging Using Azopolymer Films (see abstract TU-P2-3)		
15h45				A. VITKIN Optical Polarization Studies in Random Media: Applications to Biological Tissue Analysis (see abstract TU-P3-3)	W.A. VAN WIJNGAARDEN Laser Cooling and Trapping of Cesium Atoms (see abstract TU-P5-3)
16h00			A. HACHÉ Nonlinear Photonic Crystals and Their Applications (see abstract TU-P2-4)		
16h15				W.M. WHELAN Utility of Optical Monitoring During Laser Thermal Therapy (see abstract TU-P3-4)	E. Pinnington (c) Spectroscopic Studies of Highly-Ionized Atoms Using an EBIT (see abstract TU-P5-4)
16h30			T. GALSTIAN New Infrared Sensitive Photopolymer Liquid Crystal Materials Open New Avenues for Information Routing (see abstract TU-P2-5)		A.C. Szott (c) Theoretical Modelling of Charge Transfer Collisions (see abstract TU-P5-5)
16h45				Session Ends / Fin de la session	Session Ends / Fin de la session
17h00		**CAP Annual General Meeting / Assemblé générale de l'ACP** (see page 8 / se référer à la page 8)	Session Ends / Fin de la session		
19h00	**University Club, Fireside Lounge** Banquet Reception / réception de banquet				
19h30	**University Club, Main Dining Room** Banquet				

ROOM / SALLE D111	ROOM / SALLE D110	ROOM / SALLE D101	ROOM / SALLE D103	ROOM / SALLE D114	TIME / HEURE
					12h45
					13h30
TU-P4 (PPD) **The Matter at Stake / La matière en question** Chair: R. Hemingway, Carleton U. F. CORRIVEAU QCD Physics with ZEUS at HERA (see abstract TU-P4-1)	TU-P7 (DCMMP/DPMCM) **Thin Films and Surfaces / Couches minces et surfaces** Chair: P. Desjardins, École Polytech R.A. Budiman (c) Equilibrium Theory of Coherent Quantum Dot Formation (see abstract TU-P7-1)		TU-P6 (DCMMP/DPMCM) **Magnetism and Phase Transitions / Magnétisme et transitions de phase** Chair: D.H. Ryan, McGill Univ. A. Rahmim (c) Reconstruction of Magnetic Domains from Coherent X-Ray Scattering (see abstract TU-P6-1)		14h15
	Z.-F. Huang (c) Morphological Instability and Surface Decomposition of Strained Alloy Films Growth (see abstract TU-P7-2)		G. Ballentine (c) Correspondence of Micromagnetic Simulation to Time-Resolved Experiment (see abstract TU-P6-2)		14h30
M.G. VINCTER New Results from HERMES (see abstract TU-P4-2)	A. Ballestad (c) Time-Dependent Surface Morphology Associated with Growth Interrupts in GaAs Molecular Beam Epitaxy (see abstract TU-P7-3)		B.W. Southern (c) Spin Stiffness of Stacked Triangular Antiferromagnets (see abstract TU-P6-3)		14h45
	Coffee Break / Pause café		Coffee Break / Pause café		15h00
Coffee Break / Pause café					15h15
	D. Kim (c) Passivation of GaAs(110) by Ga_2O_3 Thin Films Deposited by ECR Plasma-Assisted Molecular Beam Epitaxy (see abstract TU-P7-4)		J. Pond (c) Studies of Impurities in Magnetic Insulators Using Low Temperature Nuclear Orientation (see abstract TU-P6-4)		15h30
C. HEARTY First Physics from BaBar (see abstract TU-P4-3)	A.K. Sallabi (c) Structures and Stability of CO and N_2 Physisorbed MgO: Descending the Devil's Staircase (see abstract TU-P7-5)		B.D. Gaulin (c) Random Field State in the Dilute Stacked Triangular Lattice Antiferromagnet $CsCo_{0.8}Mg_{0.2}Br_3$ (see abstract TU-P6-5)		15h45
	I. L'Heureux (c) Modelling the Oscillatory Zoning Observed in Synthetic (Ba,Sr) SO_4 Crystals (see abstract TU-P7-6)		D.R. Taylor (c) Random-Field Critical Behaviour of As-doped KDP (see abstract TU-P6-6)		16h00
M. Vetterli (c) Measurement of Pion Multiplicities at HERMES (see abstract TU-P4-4)	M. From (c) Dependence of Brillouin Light Scattering Spectra on the Number of Bilayers in Fe/Ag Multilayer Specimens (see abstract TU-P7-7)		D.B. Jack (c) Nonuniversal Critical Exponents in Monolayer Nitrogen (see abstract TU-P6-7)		16h15
K. Chu (c) Study of Multiparameter Fit for B-Meson Mixing Rate, Lifetime and Lepton Spectra at an Asymmetric e+e- B-Factory (see abstract TU-P4-5)	Session Ends / Fin de la session		Session Ends / Fin de la session		16h30
Session Ends / Fin de la session					16h45
					17h00
					19h00
					19h30

WEDNESDAY, JUNE 20, 2001

TIME / HEURE	OTHER LOCATIONS	ROOM / SALLE A144	IMM. HSD BLDG. ROOM / SALLE A240	ROOM / SALLE D288	ROOM / SALLE D287
07h00	**Commons Block, Salle Haro Room** CAP/NSERC Liaison Committee Pre-Meeting / Comité de liaison ACP/CRSNG : pré-réunion				
08h30		WE-A1 (CAP-COMP/ACP-OCPM) **Plenary Session / Session plénière** Chair: J. Katsaras, NRC C.R. DUZENLI 3D Radiation Dosimetry Using Polymer Gels (see abstract WE-A1-1)			
09h15		WE-A2 (DMBP-DCMMP / (DPMB-DPMCM) **Plenary Session / Session plénière** Chair: J. Katsaras, NRC M. HALLETT Bioinformatics, Genomics and Proteomics (see abstract WE-A2-1)			
10h00			WE-A4 (DMBP/DPMB) **Young Investigators in Biophysics and Medicine / Jeunes chercheurs en biophysique et médicine** Chair: M. Morrow, MUN A.J. Clark (c) Novel Sensor to Detect the Kinetics of Protein Adsorption (see abstract WE-A4-1)	WE-A7 (DAMP/DPAM) **Spectroscopic and Dynamical Studies of Atoms/Molecules I / Spectroscopie et dynamique des atomes et molécules I** Chair: to be announced / à venir E.A. HESSELS High-Precision Measurement of the 2 Triplet P Intervals in Atomic Helium (see abstract WE-A7-1)	WE-A10 (DOP) **Photonic Materials and EDFAS II / Matériaux photoniques et EDFAS II** Chair: M. Duguay, Univ. Laval H. VAN DRIEL Ultrafast All-Optical Band Edge Control in Two-Dimensional Silicon Photonic Crystals (see abstract WE-A10-1)
10h15			E. Lessard (c) Inverse Planning Anatomy-Based Dose Optimization for High Dose Rate Brachytherapy Using Fast Simulated Annealing Algorithm and Adaptable Objective Function (see abstract WE-A4-2)		
10h30			Y.-W. Hsueh (c) The Effect of Ceramides on Phospholipid Bilayers: A Deuterium NMR Study (see abstract WE-A4-3)	N. MOAZZEN-AHMADI Internal Rotation and Intramolecular Energy Transfer (see abstract WE-A7-2)	H.K. Zowal (c) Nonlinear Bragg Grating (see abstract WE-A10-2)
10h45			B. KC (c) Optical Use of Photon Counting Photomultipliers for Biphoton Measurements of Cartilage Tissue and Cultured Fibroblast Cells (see abstract WE-A4-4)		G. Das (c) Multiwavelength Operation of an Elliptical Erbium-Doped Fiber Laser (see abstract WE-A10-3)
11h00			J.P. Ogilvie (c) Proteinquakes: Observations of the Dynamics of Heme Proteins Using Diffractive Optics-Based Heterdyne Detected 4-Wave Mixing (see abstract WE-A4-5)	Coffee Break / Pause café	Coffee Break / Pause café
11h15			C. Laule (c) A Proton NMR Study of the Molecular Motion of Human Normal and Psoriatic Stratum Corneum (see abstract WE-A4-6)		
11h30			Coffee break / Pause café	R.A. HOLT Atomic Lifetime and HFS Measurements for Astrophysics (see abstract WE-A7-3)	Q. Mao (c) L-Band Multi-Wavelength Laser with Erbium-Doped Fiber Ring Cavity (see abstract WE-A10-4)
11h45			W. Price (c) Site-Directed Biomineralization Using Scanning Probe Lithography (see abstract WE-A4-7)		D. Qi (c) Ultrafast Light Emission from Poly(1-methoxy-4-(2-ethylhexyloxy-2,5-phenylenevinylene)) (MEH-PPV) (see abstract WE-A10-5)
12h00			V. Choy (c) Fuzzy Logic PID Controller for Laser Thermal Therapy in Prostate: A Numerical Study (see abstract WE-A4-8)	C. Linton (c) Laser Spectroscopy of Holmium Containing Molecules (see abstract WE-A7-4)	J. Schmid (c) MBE-Regrowth on *In-Situ* Etched $Al_xGa_{1-x}As$ for Buried High Index Contrast Gratings (see abstract WE-A10-6)
12h15			P.T. Eles (c) Orientation of Glycine and Glutamine Residues in Spider Dragline Silk Using Solid State NMR (see abstract WE-A4-9)	S. Letarte (c) Gas Dynamics of a Metastable Atomic Beam Source Initiated by Direct Discharge and Interfaced to a Mass Spectrometer Ion Source (see abstract WE-A7-5)	M. Taschuk (c) Lateral and Depth Resolution of Laser-Induced Breakdown Spectroscopy at Low Energies (see abstract WE-A10-7)

ROOM / SALLE D111	ROOM / SALLE D110	ROOM / SALLE D101	ROOM / SALLE D103	ROOM / SALLE D114	TIME / HEURE
					07h00
					08h30
					09h15
WE-A6 (DCMMP/DPMCM) **Semiconductors / Semiconducteurs** Chair: K. Kavanagh, SFU P. DESJARDINS Semiconductor Thin Film Growth Under Highly Kinetically Constrained Conditions (see abstract WE-A6-1)	WE-A9 (DTP/DPT) **Thermal and Quantum Systems / Systèmes thermiques et quantiques** Chair: S. Vallun, UWO G.W. Semenoff (c) Properties of D-Brane Black Holes (see abstract WE-A9-1)	WE-A5 (PPD) **Looking Forward / Un regard vers l'avenir** Chair: T. Mattison, UBC B. VACHON New Particle Searches at LEP2 (see abstract WE-A5-1)	WE-A3 (DNP/DPN) **Instrumentation and Methods / Instrumentation et méthodes** Chair: R. Pywell, Univ. Sask. M. DIXIT Advances in Gas Avalanche Micro-Detectors (see abstract WE-A3-1)	WE-A8 (DIAP-IMP / DPIA-PIM) **Instrumentation and Measurements in Industrial and Applied Physics / Instrumentation et mesures en physique appliquée et industrielle** Chair: A. Mandelis, Univ. Toronto A. MANDELIS Lock-in Common Mode Rejection Demodulation: A Novel Background-Suppression Signal Generation Methodology (see abstract WE-A8-1)	10h00
	G. Kunstatter (c) Approach to Equilibrium in an Interaction Field Theory (see abstract WE-A9-2)				10h15
H.E. RUDA Formation and Characterization of InAs Self-Assembled Quantum Dots on GaAs and InP (see abstract WE-A6-2)	D.D. Betts (c) A Study of the Spin ½ XXZ Model on the Square Lattice (see abstract WE-A9-3)	D.M. MacQueen (c) Supersymmetry at CDF-II (see abstract WE-A5-2)	J. WADDINGTON TIGRESS at ISAC: A Versatile Gamma-Ray Detector Array (see abstract WE-A3-2)	J.-P. MONCHALIN Optics-Based Diagnostics for Industry (see abstract WE-A8-2)	10h30
	Coffee Break / Pause café	C.J. Virtue (c) The Next Galactic Supernova and SNO (see abstract WE-A5-3)			10h45
Coffee Break / Pause café		Coffee Break / Pause café	Coffee Break / Pause café	Coffee Break / Pause café	11h00
	P. Kelly (c) Division Algebras and Supersymmetry (see abstract WE-A9-4)			K.H. MICHAELIAN Photoacoustic Infrared Spectroscopy and Thermophysical Properties of Hydrocarbons (see abstract WE-A8-3)	11h15
M.L.W. THEWALT Photoluminescence of Isotopically-Pure Silicon (see abstract WE-A6-3)	P. Desrosiers (c) Supersymmetric Calogero-Moser-Sutherland Models and Jack Superpolynomials (see abstract WE-A9-5)	P.R.B. SAULL High-Q2 and Exotic Physics with ZEUS at HERA (see abstract WE-A5-4)	D. HUTCHEON The DRAGON Mass Spectrometer at TRIUMF/ISAC (see abstract WE-A3-3)		11h30
	S. Luoma (c) From Energy Levels to Spectral Distributions (see abstract WE-A9-6)			R. Maev (c) Nonlinear Acoustic Imaging and Quantitative Acoustic Microscopy Review (see abstract WE-A8-4)	11h45
M.J. Korkusinski (c) Electronic and Optical Properties of Vertically Coupled InAs Self-Assembled Quantum Dots (see abstract WE-A6-4)	F.P. Temme (c) Completeness of Dual Tensorial Sets and Their Liouvillian Quasiparticle Algebras (see abstract WE- A9-7)	P. SINERVO The High-Energy Frontier: The CDF II Experiment at Fermilab (see abstract WE-A5-5)	W.D. Ramsay (c) E^{781}, A Second Generation 221 MeV pp Parity Violation Experiment at TRIUMF (see abstract WE-A3-4)	M. Nantel (c) Chlorine-Assisted Laser Micromachining of Silicon (see abstract WE-A8-5)	12h00
O.J. Pitts (c) Interfacial Quality and Optical Properties of GaSb/GaAs Quantum Wells Grown by MOVPE (see abstract WE-A6-5)	Session Ends / Fin de la session		S.A. Page (c) A New Measurement of the Weak Pion-Nucleon Coupling Constant via $\eta+p \rightarrow d+\gamma$ (see abstract WE-A3-5)	A.C. McMillan (c) The Meteorological Service of Canada Celebrates its 130^{e} Birthday (see abstract WE-A8-6)	12h15

WEDNESDAY, JUNE 7, 2000 (cont.)

TIME / HEURE	OTHER LOCATIONS	ROOM / SALLE A144	IMM. HSD BLDG. ROOM / SALLE A240	ROOM / SALLE D288	ROOM / SALLE D287
12h30			M. Chacron (c) Correlation-Enhanced Information Transfer and Signal Detection in P-type Electroreceptors (see abstract WE-A4-10)	Session Ends / Fin de la session	Session Ends / Fin de la session
12h45			I. Vavasour (c) Can Cross Relaxation Between Solid and Water Protons Account for T2 Relaxation Times in the Brain? (See abstract WE-A4-11)		
13h00			Session Ends / Fin de la session		
13h30		WE-P1 **Plenary Session / Session plénière** Chair: M. Thewalt, SFU M. SUTTON *(Brockhouse Medal winner / récipiendaire de la médaille Brockhouse)* Intensity Fluctuation Spectroscopy Using Coherent X-Rays (see abstract WE-P1-1)			
14h15					WE-P2 (PPD) **Particle Physics Techniques / Techniques en physique des particules** Chair: P. Saull, Penn State U. A. Olin (c) TWISTING with FORTRAN90 (see abstract WE-P2-1)
14h30					D. Thiessen (c) Muon Identification in the BaBar Experiment (see abstract WE-P2-2)
14h45					J.L. PINFOLD The ATLAS Dectector - A Discovery Device (see abstract WE-P2-3)
15h15					Coffee Break / Pause café
15h45					T. Mattison (c) Nonometer Vibration Control by Interferometer-Based Active Feedback (see abstract WE-P2-4)
16h00					M. Dobbs (c) Monte Carlo Simulation of QCD Corrections to Electroweak Processes at High Energy Hadron Colliders (see abstract WE-P2-5)
16h15					R. Mazini (c) Electroweak Vector Bosons Fusion will be a Copious Source of Information at the LHC (see abstract WE-P2-6)
16h30					C. Waltham (c) A 3-D Calculation of Atmospheric Neutrino Fluxes (see abstract WE-P2-7)
16h45					Session Ends / Fin de la session
17h00					
17h15					
17h30	**UniCentre, Room / Salle A180** Council Meeting (New and Old) / Réunion du conseil (nouveau et ancien)				

ROOM / SALLE D111	ROOM / SALLE D110	ROOM / SALLE D101	ROOM / SALLE D103	ROOM / SALLE D114	TIME / HEURE
Session Ends / Fin de la session	DTP Business Meeting (lunch provided) Ends at 13h00 Réunion d'affaires DPT (repas compris) Se termine à 13h00)	Session Ends / Fin de la session	Session Ends / Fin de la session	Session Ends / Fin de la session	12h30
					12h45
					13h00
					13h30
WE-P3 (DNP/DPN) **Radioactive Beams and Heavy Ions / Faisceaux radioactifs et ions lourds** Chair: J. D'Auria, SFU J. JOSE Astrophysical Reactions and Explosive Nucleosynthesis (see abstract WE-P3-1)	WE-P4 (DAMP/DPAM) **Spectroscopic and Dynamical Studies of Atoms/Molecules II / Spectroscopie et dynamique des atomes et molécules II** Chair: to be announced / à venir J.D.D. MARTIN Stabilization of Predissociating Rydberg Molecules Using Microwave and Radiofrequency Fields (see abstract WE-P4-1)				14h15
					14h30
B. FULTON Novae and X-Ray Bursters: Measuring Breakout from the Hot-CNO Cycle at TRIUMF (see abstract WE-P3-2)	R. BHARDWAJ Ionization of Atoms and Molecules with Intense Femtosecond Pulses (see abstract WE-P4-2)				14h45
Coffee Break / Pause café	Coffee Break / Pause café				15h15
L.R. BUCHMANN Two More Years of Nuclear Astrophysics (see abstract WE-P3-3)	D. MILLER Femtosecond Laser Source Development/Extreme Optics - a New Initiative for the CLS (see abstract WE-P4-3)				15h45
					16h00
M. HASS A New Measurements of the ^{7}Be(p,γ)^{8}B Cross-Section with an Implanted ^{7}Be Target (see abstract WE-P3-4)	R.C. Bilodeau (c) Laser Photodetachment Spectroscopy of Atomic Negative Ions (see abstract WE-P4-4)				16h15
	P. Forget (c) Development of a Broadband Laser Plasma X-Ray Source for Application to Femtosecond Time-Resolved EXAFS (see abstract WE-P4-5)				16h30
F. Grenier (c) Improvement in Source Selection of Small System with Discriminant Analysis (see abstract WE-P3-5)	Session Ends / Fin de la session				16h45
D. Thénault (c) Correlation Functions in Nuclear Reactions at Intermediate Energy (see abstract WE-P3-6)					17h00
T.A. Porcelli (c) Measurement of the Resonant dμt Molecular Formation Rate in Solid HD (see abstract WE-P3-7)					17h15
Session Ends / Fin de la session					17h30

2001 CONGRESS ORAL SESSION ABSTRACTS
RÉSUMÉS DES SESSIONS ORALES - CONGRÈS 2001

The oral session abstracts presented here are organized by session identifiers (SU-A1 to WE-P4). Each presentation is cross-referenced in the Author Index. *Les résumés des sessions orales ci-après sont par code (SU-A1 à WE-P4). Chaque présentation renvoie à l'Index des auteurs.*

Please see the Congress Program Outline for details on the times and locations of each of the sessions as well as all other (non-session) meetings organized in conjunction with the CAP's 2001 Congress. *Veuillez vous référer au résumé du programme du congrès pour les heures et endroits de chaque session ainsi que pour toutes les autres rencontres organisées en conjonction avec le congrès 2001 de l'ACP.*

[SU-A1] PHYSICS CURRICULUM DEVELOPMENTS / NOUVEAUTES DANS LES PROGRAMMES D'ENSEIGNEMENTS DE LA PHYSIQUE

IMMEUBLE ELLIOTT BUILDING, ROOM / SALLE 168

SUNDAY, JUNE 17 / DIMANCHE LE 17 JUIN

SU-A1-1 **09 h 00**

LILLIAN C. MCDERMOTT, University of Washington

Physics Education Research, The Key to Student Learning

Research on the learning and teaching of physics is essential for cumulative improvement in physics instruction. Pursuing this goal through systematic research is efficient and greatly increases the likelihood that innovations will be effective beyond a particular instructor or institutional setting. The perspective taken is that teaching is a science as well as an art. Research conducted by physicists who are actively engaged in teaching can be the key to setting realistic standards, to helping students meet expectations, and to assessing the extent to which real learning takes place.

SU-A1-2 **09 h 45**

Just-in-time-Teaching Applied with Peer Instruction Using WebCT, **A.J. Slavin**, *Trent University* — The occurrence of a paramagnetic to ferromagnetic transition in doped perovskites and its relationship to the semiconductor to metal transition that often (but not always) accompanies it still has many unresolved features, despite having been first observed and reported in the 1950's. Apart from the nature of the conduction process above and below this transition, the character of the magnetic phase change (first order, continuous, universality class) is currently unclear. The results of recent measurements using somewhat unconventional probes - the field dependent AC susceptibility and the spontaneous anisotropy - will be presented, along with a possible indication of the origin of some of the differences referred to above.

SU-A1-3 **10 h 00**

Photonics Training and Education - A National Emergency, **M. Nantel**, *Photonic Research Ontario* — Canada owes much of its recent economic success to the large photonics and telecommunications companies (Nortel Networks, JDS Uniphase, BCE, Alcatel) and multiple start-ups in the field. In fact, more than 40% of the value of the TSE 400 is from telecom stocks in the photonics field. These companies are in dire need of highly-qualified personnel (HQP) trained in photonics - at all levels: technicians, engineers, M.Sc. and Ph.D. scientists - and our educational institutions are not producing enough. This lack of available HQP has arguably become the main obstacle for growth in the photonics industry, and decisive corrective action needs to be taken. Over the past eighteen months, Photonics Research Ontario, an Ontario Centre of Excellence, has been agressively addressing this problem. An integrated approach touching every level, from high school to graduate school, is being pursued in Ontario, with several programs planned or in place in high schools ("Operation Science Pipeline"), in community colleges ("Photonics Education and Training for Critical Skills Shortages"), and in continuing education (a new Optics Summer School at the University of Toronto). Others are taking shape at the undergraduate and graduate levels.

SU-A1-4 **10 h 30**

PAULA R.L. HERON, University of Washington

Research as a Guide for Improving Student Learning in the Sciences

Systematic investigations reveal that many students emerge from introductory (and often more advanced) science courses without having developed a coherent conceptual understanding of some important basic topics. Research on learning and teaching can provide an effective guide for improving student understanding. Examples will be taken from introductory physics courses and from special science courses for precollege (K-12) teachers.

SU-A1-5 **11 h 00**

RONALD K. THORNTON, Tufts University

*Interactive Lecture Demonstrations: Active Learning in Large Lectures**

Physics education research has shown that learning environments that engage students and allow them to take an active part in their learning can lead to large conceptual gains compared to traditional instruction. An active learning environment is often difficult to achieve in large lecture sessions. This presentation will demonstrate the use of sequences of microcomputer-based interactive lecture demonstrations (ILDs) using real experiments and student interaction to create an active learning environment in large lecture classes. Interactive lecture demonstrations will be done in the area of energy, dynamics, and vectors using MBL motion and force probes and the Visualizer. A video tape of students involved in interactive lecture demonstrations will be shown. The results of a number of research studies at various institutions to measure the effectiveness of ILDs and guided inquiry conceptual laboratories will be presented.

*This work was partially funded by the NSF and by The Fund for the Improvement of Postsecondary Education (FIPSE, US Department of Education).

[SU-A2] NANOSCALE AND MESOSCOPIC ELECTRONICS - A.M. / ÉCHELLE NANOMÉTRIQUE ET ÉLECTRONIQUE MÉSOSCOPIQUE - MATINÉE

IMMEUBLE HSD BUILDING, ROOM / SALLE A240

SUNDAY, JUNE 17 / DIMANCHE, LE 17 JUIN

SU-A2-1 **09 h 30**

CHRISTIE R.K. MARRIAN, Defense Advance Research Projects Agency (DARPA/MTO)

From Microelectronics to Nanoelectronics

Downscaling of Silicon based CMOS now seems possible to dimensions around 20 nm. At the same time, alternatives based on molecular devices and single electronics do not seem as daunting as they did only a few years ago. Indeed molecular devices have recently been demonstrated which are already almost good enough for memory applications. In fact, a greater challenge appears to lie in the fabrication of circuits based on molecular electronics components. DARPA has a number of programs addressing the challenges facing the continued

downscaling of Microelectronics devices and circuits. I shall discuss the transition into the Nanoelectronics regime in the context of my experiences as a program manager within the Microsystems Technology Office here at DARPA

SU-A2-2 **10 h 45**

HONG GUO, McGill University

Ab Initio Modelling of Molecular Electronics

We have developed a novel self-consistent *ab initio* technique for modeling quantum transport properties of atomic and molecular scale nanoelectronic devices under external bias potential. The technique is based on density functional theory (DFT) using norm conserving nonlocal pseudopotentials to define the atomic core, with s,p,d Fireball atomic orbital as basis set for the Kohn-Sham wavefunction, and nonequilibrium Green's functions (NEGF) to construct the charge distribution under external bias and gate potentials for systems with open boundaries. This new NEGF-DFT *ab initio* formalism is implemented in our molecular electronics modeling package McDCAL (McGill Device CALulator software). We report our investigation on a number of fundamental questions concerning electric conduction mechanism, including charge transfer doping, Fermi-level alignment, molecule-electrode interaction, negative differential resistance, current switching, nonlinear current-voltage characteristics, nonlinear and nonequilibrium charge distribution, etc., in molecular scale devices consist of fullerenes, carbon nanotubes, semi-conducting and metallic atomic wires, as well as organic molecules.

SU-A2-3 **11 h 30**

RICHARD MARTEL, IBM T.J. Watson Research Center

Electrical Properties of Carbon Nanotubes and Nanotube Devices

Carbon nanotubes (CNTs) present unique electrical properties for molecular scale electronic applications. They can be considered as the result of folding graphite layers into carbon cylinders. They come in two forms: large diameter multi-wall nanotubes (MWNTs) and smaller diameter (1-2nm) single-wall nanotubes (SWNTs). They can be metallic or semiconducting depending on the folding angle and the diameter. The metallic nanotubes present exceptionally high current carrying capabilities before breakdown and very low resistance, resulting from a very weak electron-phonon coupling in this system. The semiconducting nanotubes can be used as active channels of field-effect transistors (FETs). In this talk, the electrical properties of both kinds of nanotubes will be reviewed with the emphasis on the properties of semiconducting SWNTs.

In the first part, I will present results on the electrical transport properties of metallic nanotubes. We fabricated rings of metallic SWNT and used these rings to study coherence transport phenomena at low temperature. We also explored the different scattering mechanisms in metallic SWNTs arranged in a bundle. In the second part, I will cover recent results on the nanotube transistors. The transconductance of the early generation of devices [1] was small (10^{-9} A/V), limited by the resistance of the contacts. I will present new results on nanotube FETs with optimized performances. We found that the "on" and "off" currents as well as the transconductance of the devices depend strongly on the properties of the junction between the source-drain metal and the nanotubes. By optimizing this geometry using carbide contacts, we have achieved several order of magnitude higher transconductances and the carrier mobilities now exceed 100 cm^2/Vs. These devices show bipolar transport (p- and n-type) resulting from the weak Fermi-level pinning of the contacts. The detail of the transport mechanism in these devices will be presented. Their characteristics will also be benchmarked with the silicon MOSFET and shown to be comparable. Finally, we demonstrated the fabrication of various logic circuits based on nanotubes using complementary p- and n-type nanotube FETs.

[1] S.J. Tans *et al.*, *Nature* **393**, 49 (1998). R. Martel *et al.*, *Appl. Phys. Lett.*, **73**, 2447 (1998).

[SU-P1] PANEL SESSION: IMPLEMENTING THE RESULTS OF PHYSICS EDUCATION RESEARCH / *TABLE RONDE : LA MISE EN PRATIQUE DES RÉSULTATS DE LA RECHERCHE SUR L'ENSEIGNEMENT DE LA PHYSIQUE*

SUNDAY, JUNE 17 / *DIMANCHE LE 17 JUIN*

IMMEUBLE ELLIOTT BUILDING, ROOM / SALLE 168

SU-P1-1 ***13 h 00 - 14 h 30***

Physics education research has provided many new avenues for improving physics education at all levels. Very little of this research has been done in Canada, but there are many individual efforts to employ these results at both the secondary and post-secondary levels. In this panel discussion we would like to address questions such as: what are the barriers to implementing research-based teaching techniques at both the secondary and post-secondary level? To what extent is implementation of improved pedagogy inhibited by such factors as provincial-wide curricula and exams and college/university entrance and/or program requirements? How can the physics teaching community improve coordination of efforts in this direction between the secondary and post-secondary community? How important are factors such as: funding, incentives, resistance to change, information, bureaucracy, and collegial interaction?

Panel Members : Don Mathewson, Richmond High School, Vancouver, B.C.
Lillian C. McDermott, Dept. of Physics, University of Washington
Ernie McFarland, Department of Physics, University of Guelph
Lionel L. Sandner, Department of Curriculum and Instruction, University of Victoria
Ronald K. Thornton, Center for Science and Mathematics Teaching, Tufts University

[SU-P2] NANOSCALE AND MESOSCOPIC ELECTRONICS - P.M. / *ÉCHELLE NANOMÉTRIQUE ET ÉLECTRONIQUE MÉSOSCOPIQUE - APRÈS-MIDI*

SUNDAY, JUNE 17 / *DIMANCHE LE 17 JUIN*

IMMEUBLE HSD BUILDING, ROOM / SALLE A240

SU-P2-1 **13 h 30**

GEORGE KIRCZENOW, Simon Fraser University

*Ideal Spin Filters: Can We Make Spintronic Devices out of Semiconductors and Ferromagnets?**

Spintronics is a new branch of electronics that utilizes the electron's spin degree of freedom as well as its charge to store, process and transmit information. During the last few years all-metal spintronic devices have been developed and have found commercial application. At the present time there is a great deal of interest in developing nanoscale semiconductor spintronic devices such as spin transistors. Using ferromagnetic metal contacts as room temperature sources of spin-polarized electrons for injection into such semiconductor devices is potentially attractive, but experiments directed at achieving this have been disappointing. In this talk I will review the main concepts of semiconductor spintronics and discuss the physical reasons for the difficulties that the spin injection experiments have encountered. I will then demonstrate theoretically that certain atomically ordered interfaces should act as ideal spin filters. These should make it possible in principle to achieve injection of up to 100% spin polarized electrons from ferromagnetic metals into semiconductors through both macroscopic interfaces and junctions between nanoscale quantum wires.

*This work has been supported by NSERC and by the Canadian Institute for Advanced Research. A patent application has been commenced by Simon Fraser University.

SU-P2-2 **14 h 45**

MICHAEL HILKE, McGill University

The Edge of a Two-Dimensional Electron Gas as an Experimental Toy for a Perfect One-Dimensional System

By using a novel technique of *in situ* cleaved edge overgrowth it is possible to obtain an atomically precise edge of a two-dimensional electron gas confined in a GaAs/AlGaAs quantum well. By defining a tunneling barrier, for example, the tunneling density of states can be measured directly. This is of considerable interest when probing the edge modes of fractional

quantum Hall systems because, for elementary fractions these edge modes are chiral Luttinger liquids, i.e., one-dimensional metals of interacting Fermions. We show that the experimental tunneling density of states exhibits characteristic power-laws of Luttinger liquids. Further, by tuning the magnetic field we observe a transition from a Luttinger-liquid to a Fermi-liquid Finally, it is possible to extract the edge density distribution.

SU-P2-3 **15 h 30**

ROBERT M. WESTERVELT*, Harvard University

Imaging Coherent Electron Flow

Semiconductor nanostructures based on two dimensional electron gases (2DEGs) have remarkable properties. The electron mean free path and the phase coherence length can exceed the size of the device. Coherent nanostructures provide new approaches to sensing and information processing. Although much is known about electron transport in 2DEG nanostructures, the actual pattern of electron flow is unclear, and is not specified by statistical measures such as the mean free path. Scanning a charged tip above the 2DEG inside a GaAs/AlGaAs heterostructure images electron flow by backscattering electron waves. As the width of the quantum point contact is increased, its electrical conductance increases in quantized steps of $2e^2/h$. Scanned probe images of the angular dependence of the electron flow on each step agree with theory, and fringes separated by half the electron wavelength are observed demonstrating the coherent nature of electron flow [1]. At longer distances unexpected dynamical channeling is observed. The electron flow forms persistent, narrow, branching channels rather than smoothly spreading fans seen closer to the QPC [2]. Theoretical study of this flow, including electron scattering by impurities and donor atoms, shows that the channels are not due to deep valleys in the potential, but rather are caused by the cumulative effect of small angle scattering

[1] M.A. Topinka, B. LeRoy, S. Shaw, E. Heller, R.M. Westervelt, K.D. Maranowski and A.C. Gossard, *Science* **289**, 2323 (2000).
[2] M.A. Topinka, B.J. LeRoy, R.M. Westervelt, S.E.J. Shaw, R. Fleischmann, E.J. Heller, K.D. Maranowski and A.C. Gossard, *Nature* **410**, 183 (2001).

*In collaboration with M.A.Topinka, B.J.LeRoy, S.E.J.Shaw, R.Fleischmann, E.J.Heller, K.D.Maranowski and A.C.Gossard.

[SU-P3] **CAP'S EXCELLENCE IN TEACHING MEDAL WINNER** — **SUNDAY, JUNE 17**
RECIPIENDAIRE DE LA MEDAILLE DE L'ACP POUR L'EXCELLENCE EN ENSEIGNEMENT DE LA PHYSIQUE — ***DIMANCHE LE 17 JUIN***
IMMEUBLE ELLIOTT BUILDING, ROOM / SALLE 168

SU-P3-1 **14 h 30**

NAPOLÉON GAUTHIER, Royal Military College of Canada

Privileges and Responsibilities of a University Career

The unfolding of a university career is almost as unique as the genetic encoding of the individual who defines it. This is possible because of the very nature of a university, this creation of the human mind which emerged from the ashes of the Dark Ages in a nearly final form, over a thousand years ago. Universities provide an environment which encourages independent and innovative thinking, be it in research, teaching or other socio-professional work, activities which would often not be possible in other professions. This presentation will attempt to examine the role of university teaching, given the high degree of latitude that is allowed, in an effort to highlight how such teaching can benefit the society that supports it.

[SU-P4] **PHYSICS EDUCATION CONTRIBUTED SESSION** — **SUNDAY, JUNE 17**
SESSION DE COMMUNICATIONS SUR L'ENSEIGNEMENTS DE LA PHYSIQUE — ***DIMANCHE, LE 17 JUIN***
IMMEUBLE ELLIOT BUILDING, ROOM / SALLE 168

SU-P4-1 **15 h 00**

A Consistent Vector Approach to Teaching Introductory Mechanics, **S. Greenspoon**, *Capilano College* — The standard textbook presentation of introductory mechanics contains ambiguities, which are a source of student confusion and problem-solving errors. These difficulties can be reduced by adopting a consistent vector approach, beginning with one-dimensional kinematics and including fixed-axis rotational kinematics and dynamics.

SU-P4-2 ***15 h 15***

Vpython: Software for Three-Dimensional Physics Displays, **R.J.W. Hodgson**, University of Ottawa — The software package Vpython provides users with a mechanism for easily generating real-time three-dimensional images in order to demonstrate various physics principles. Students often have difficulty visualizing three-dimensional problems in mechanics and electromagnetic theory. This tool provides both instructors and students with a simple mechanism to create and use dynamic and interactive images which will aid in the understanding of some complex problems. Programs can create and manipulate objects representing planets, springs, or other parts of a physical system being modeled. Changes to these objects are immediately reflected in a 3-D display that allows for interactive navigation. The Vpython graphics library, developed at Carnegie Mellon University for the Python language, is freely available for both instructors and students. This demonstration will show some examples of its use as well as the ease with which the graphics can be generated

[SU-P5] **THE NALTA PROJECT** — **SUNDAY, JUNE 17**
LE PROJET NALTA — ***DIMANCHE LE 17 JUIN***
IMMEUBLE ELLIOTT BUILDING, ROOM / SALLE 168

SU-P5-1 **16 h 00**

JOHN McDONALD, University of Alberta

NALTA and the Mystery of Cosmic Rays

This talk is about cosmic rays, an old subject that has recently become a hot topic, and the emergence of several North American collaborations that team up high school students and teachers with University-based researchers to study correlations in very large cosmic ray showers. The occurrence of cosmic rays with energies greater than 1020 eV has been confirmed in a number of experiments. The primary particles appear to be protons with energies much higher than expected from known sources. No completely satisfactory explanation for the observations has been found, but there are many novel suggestions, some of which involve new physics and/or changes in well-established laws of physics. The evidence for ultra high-energy cosmic rays will be reviewed and one of the new collaborations for studying them will be described. It is called ALTA (for Alberta Large-area Time coincidence Array). ALTA is part of NALTA, the North American Large Detector Anay consortium.

SU-P5-2 **16 h 30**

The Collaboration of High School Students in the ALTA (Alberta Large area Time coincidence Array) Project, **V. Pasek**, *Archbishop O'Leary High School* — Three years ago the high school physics teachers of Edmonton and its surrounding area were invited by the Centre for Subatomic Research of the Physics Department at the University of Alberta to participate in the Alberta Large area Time coincidence Array (ALTA) Project. This is an account of the events that have taken place since that time. The following questions will be addressed during the presentation: 1) What does the project entail; 2) How to convince the High School administration to donate funds towards the project; 3) Where does the project fit in Alberta's Physics High School program; 4) How to recruit students to participate in the project; 5) What are the student's responsibilities during his/her participation; 6) What are the benefits to the students, the teachers, the schools and the university.

5SU-P5-3 **16 h 45**

Long-Baseline Test for NALTA Cosmic Air-Shower Array*. B.Warrington, A.Kotlicki, P.Walden, **C.E.Waltham**, *University of British Columbia* — The North American Large-Area Time-Coincidence Array (NALTA) project is a unique attempt to include the high school physics community in cosmic ray research. Using semi-autonomous detector modules placed in high schools, linked by the internet and GPS timing, NALTA could eventually be an extremely large, if somewhat sparse, air shower array. As such, NALTA would provide an opportunity to search for time-correlated cosmic ray events over 100s or 1000s of km. Putative causes of such coincidences include the "GZ-effect" resulting from the break-up of cosmic ray nuclei in the solar photon field. Here we present the results of a long-baseline test using detector modules in Edmonton and Vancouver.

* Work supported by the Information, Science and Technology Agency of the Government of British Columbia.

PLENARY SESSION / *SESSION PLÉNIÈRE*

[SU-KEY] INAUGURAL HERZBERG MEMORIAL PUBLIC LECTURE
LA PREMIERE CONFERENCE PUBLIQUE COMMEMORATIVE HERZBERG
AUDITORIUM UNICENTRE AUDITORIUM

SUNDAY, JUNE 17
DIMANCHE LE 17 JUIN

SU-KEY **19 h 00**

KIP THORNE, Caltech

Gravitational Waves: A New Window Onto the Universe

Gravitational waves are ripples of warpage in the fabric of spacetime, generated by the birth of the universe, by collisions of black holes, and by other cataclysmic events in the distant universe. Next year an international network of ground-based detectors (LIGO, VIRGO, GEO and TAMA) will begin a search for gravitational waves with wavelengths about the size of the Earth. In 2010, the joint US/European LISA mission (three spacecraft 5 million kilometers apart that track each other with laser beams) will begin a search for gravitational waves with wavelengths the size of the solar system. In this lecture I will describe these gravitational-wave detectors, the remarkable technology that they rely on (such as controlling the quantum mechanical behavior of 40 kilogram objects), and the revolution that they may bring in our understanding of the universe

PLENARY SESSION / *SESSION PLÉNIÈRE*

[MO-A1] CAP/CRM MEDAL WINNER
RECIPIENDAIRE DE LA MÉDAILLE ACP/CRM
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE A144

MONDAY, JUNE 18
LUNDI LE 18 JUIN

MO-A1-1 **08 h 30**

ANDRÉ-MARIE TREMBLAY, Université de Sherbrooke

Mathematics, Physics, and Computers : Strongly Correlated Electrons in Two Dimensions as a Case Study

Formal approaches are useful but do not suffice when exact solutions are unknown and small parameters are unavailable. The Many-body theory of strongly correlated electrons falls into that class of problems. It will be shown how physical intuition and computer simulations can be combined with formalism to understand the general problem of destruction of quasiparticles in two dimensions by critical fluctuations. This problem arises in the context of high-temperature superconductors. Computers, mathematical formalism and physical intuition taken separately did not crack the problem.

PLENARY SESSION / *SESSION PLÉNIÈRE*

[MO-A2] (DNP-PPD)
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE A144

MONDAY, JUNE 18
LUNDI LE 18 JUIN

MO-A2-1 **09 h 15**

TONY NOBLE, Carleton University

SNO in Summer

The Sudbury Neutrino Observatory, SNO, is a deep underground observatory designed to detect neutrinos. The detector is comprised of 1000 tonnes of D_2O in an ultra-clean laboratory, located 2 km underground in a mine near Sudbury, Ontario. Previous experiments have observed too few electron neutrinos from the sun. SNO has the unique ability to determine whether neutrinos from the sun change flavour by measuring both the flux of electron-neutrinos, and the flux for all neutrino types. SNO has been in continuous stable operation since November 1999. It has met all design criteria. SNO will collect data for many years in several different operational phases to optimize the sensitivity for neutrino detection with different reactions. In addition to solar neutrinos, SNO will study atmospheric neutrinos, supernova neutrinos and cosmic ray muons. Observations to date and the future program for this unique Observatory will be described.

[MO-A3] QUANTUM AND DNA COMPUTING

CALCULS NUMÉRIQUE DES STRUCTURES QUANTIQUES ET DU DNA
IMMEUBLE HSD BUILDING, ROOM / SALLE A240

MONDAY, JUNE 18
LUNDI LE 18 JUIN

MO-A3-1 **10 h 00**

MARTIN DUBÉ, McGill University

Quantum Computation and Decoherence

The superposition of quantum states, essential to quantum computation, can easily be destroyed by the interaction between the fundamental qubits and external environments. The oscillator and spin bath models of quantum environments will first be reviewed and then used to discuss the mechanisms of decoherence at low temperature in solid state devices such as quantum nanomagnets and superconducting SQUIDs. This is done first for a central 2-level system (qubit), with particular emphasis on the suppression of the off-diagonal elements of the density matrix, and then for a pair of interacting qubits, crucial to any quantum algorithm and measurement operation. Decoherence in these systems is caused principally by coupling to electrons and nuclear spins, the spin bath couplings being particularly dangerous at low temperature.

MO-A3-2 **10 h 30**

ANDREW SACHRAJDA, National Research Council

Quantum Information Processing with Semiconductor Quantum Dots

One of the most intriguing challenges for physicists, engineers, and chemists is to discover ways of implementing the theoretically well developed concepts and applications related to quantum information, such as quantum computing and cryptography. There are many proposals for achieving this. Some schemes such as those utilizing NMR have already led to encouraging proof of concept demonstrations, although the number of qubits appears limited in this case. In this talk I will review some of the solid state schemes based on semiconductor technology that are being investigated at the Institute for Microstructural Sciences of the NRC. In one approach our qubit is based upon the two states of the spin of an electron. In order to make use of this we need to isolate and control single spins, find techniques to readout their spin state, entangle pairs of spins etc... In a second approach the qubit is based on a concept of isospin. The isospin denotes the two possible locations of an electron in a pair of vertically coupled quantum dots.

MO-A3-3 **11 h 30**

WILLIAM G. UNRUH, University of British Columbia

Quantum Computing-- Promise and Problems

Quantum Computing presents the possibility of avoiding some of the limitations of the classical theory of computation developed from Turing to the present day. In particular, for solving certain problems, quantum mechanics has been shown to be far faster than classical mechanics. Despite the promise, the technological challenges are immense, primarily surrounding the fragility of quantum coherence to disruption from the environment. This talk will review the promise, the difficulties and some proposed solutions to those difficulties.

MO-A3-4 **12 h 00**

LILA KARI, University of Western Ontario

From DNA to Computation and Back

How do cells and nature "compute"? They read and "rewrite" DNA all the time, by processes that modify sequences at the DNA or RNA level. We study the computational power of cellular organisms with the aim of understanding their information processing capabilities. Together with Laura Landweber we developed a formal model for the homologous recombinations that take place during gene rearrangement in ciliates (unicellular protozoans named for their wisp-like cover of cilia). We prove that our model has universal computational power which indicates that, in principle, some unicellular organisms may have the capacity to perform any computation carried out by an electronic computer. We show also preliminary results on the information-theoretical structure and coding theoretical properties of DNA.

[MO-A4] ELECTROMAGNETIC INTERACTIONS / *INTERACTIONS ÉLECTROMAGNÉTIQUES*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D103 — **MONDAY, JUNE 18 / *LUNDI LE 18 JUIN***

MO-A4-1 **10 h 00**

LAWRENCE LEE, University of Manitoba/TRIUMF

The Physics of GO at Jefferson Lab

The electron-proton parity-violation "GO" experiment at the Thomas Jefferson National Accelerator Facility (Jefferson Lab) aims to make a determination of the 'strange' quark currents in the proton. Two new proton ground state matrix elements will be measured which are sensitive to point-like 'strange' quarks and hence to the quark-antiquark sea in the proton. The matrix elements of interest are the elastic scattering vector weak neutral current 'charge' and 'magnetic' form factors, GZE and GZM, respectively. By measuring the very small parity-violating asymmetries in elastic electron-proton scattering at momentum transfers between 0.1 and 1.0 GeV^2 and combining these asymmetries with previously measured electromagnetic form factors, new information about the weak form factors of the proton can be obtained. This new high precision experiment is presently in the construction phase and is scheduled for installation and commissioning in 2002.

MO-A4-2 **10 h 30**

GEORGE J. LOLOS, University of Regina

The Role of Gluons and the Problem of Confinement in Hadrons: The JLab Program

While inclusive or semi-exclusive (e,e') reactions even at Q^2=1 (GeV/c)^2 clearly exhibit QCD signatures as expected from perturbative QCD (PQCD), exclusive (e,e') reactions at higher momentum transfer values show no such signatures. This is a severe limitation in our understanding of QCD in the region of confinement where hard gluon exhange dominates. Yet, recent advances in the theoretical treatment of non-PQCD provide a new hope toward understanding this critical region. New experiments are also in the planning stages at JLab to probe the role of glue in the confinement region.

MO-A4-3 **11 h 30**

BLAINE E. NORUM, University of Virginia

Experimental Tests of the Gerasimov-Drell-Hearn Sum Rules

The Gerasimov-Drell-Hearn Sum Rules relate the spin dependence of inelastic processes involving energetic photons and a target to a static property of that target, its anomalous magnetic moment. The application of this sum rule to the nucleons is being or is about to be tested at several laboratories around the world. Early indications suggest that a discrepancy may exist. One way to investigate the roots of any such discrepancies will be to test the application of the sum rule to a simple composite system, the deuteron wherein a large part of the spin dependence occurs for low gamma energies near the breakup threshold. The recently commissioned gamma source at the Duke Free Electron Laser Laboratory is uniquely to these measurements. The program of measurements as well as the capabilities of this new facility will be presented.

MO-A4-4 **12 h 00**

Branching Ratio of the Rare $\eta \to \pi^0 + 2\gamma$ Decay. **Z. Papandreou**, *University of Regina*, on behalf of the Crystal Ball Collaboration at BNL — Chiral Perturbation Theory (ChPT) has emerged as the leading theory for calculating interactions of quarks at low energies, and in particular in providing an accurate account of strong and electroweak interactions of pseudoscaler mesons. In the case of the η meson, the third order ChPT evaluation of the rare $\eta \to \pi^0 + 2\gamma$ Decay is the first unsuppressed term in this channel and thus is a sensitive test of ChPT. The Crystal Ball spectrometer, a nearly 4π solid angle device, is especially suited to study the above reaction. In the Fall of 1998 this detector was used to collected 20 million η mesons at BNL. The analysis of these events and a preliminary branching ratio will be reported.

[MO-A5] INSTRUMENTATION AND MEASUREMENTS IN BIOLOGY AND MEDICINE BIOPHOTONICS
INSTRUMENTATION ET MESURES EN BIOLOGIE ET MÉDICINE BIOPHOTONIQUE
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D101
MONDAY, JUNE 18 / *LUNDI, LE 18 JUIN*

MO-A5-1 **10 h 00**

DAVID R. CHETTLE, McMaster University

Atomic and Nuclear Physics Techniques for in vivo Trace Element Analysis

A number of trace elements are toxic. Acute exposure and short-term health effects are often well represented by the elemental concentration in blood. However, for chronic exposure and long term health effects it is valuable to determine stored quantities of the element in the body. For some elements it is possible to do this non-invasively. Since the human body is an extended medium, it is necessary to use a probe that can reach the storage site and produce a signal, in both cases with sufficient mean free path to result in a quantifiable measurement. Prime candidates are, therefore, photons and neutrons; the principal techniques used are x-ray fluorescence and neutron activation. As humans are radiosensitive, the radiation dose must be kept as low as possible and a careful appraisal of cost - benefit undertaken. The dual constraints of extended medium and dose minimisation make these *in vivo* analyses specialised applications of what have otherwise become relatively standard techniques.

Studies involving *in vivo* measurements of cadmium in livers and kidneys have contributed to the revised regulation of cadmium in the workplace. Measurements of lead in bone have demonstrated the importance of bone reservoirs for long term lead metabolism and are being used in active management of the exposure of lead workers. Systems are under development for manganese in bone and also for aluminum in bone.

MO-A5-2 **10 h 30**

C.R. ETHIER, University of Toronto

Measurement Challenges in the Screening and Management of Glaucoma

Glaucoma is an ocular disorder, usually associated with elevated intraocular pressure (IOP), that leads to progressive, irreversible loss of vision. Vision loss is due to the death of optic nerve fibres responsible for transmission of information from the retina to the brain, and is typically accompanied by changes in the topography in the optic nerve head region of the eye. Screening for glaucoma usually involves measurement of IOP, while management involves (among other techniques) assessing changes in the appearance and topography of the optic nerve head.

Here I describe two measurement technologies used in glaucoma, one old and one new. The old technology is tonometry, used to measure IOP without access to the interior of the eye. In its most common form it involves measuring the force required to cause a known deformation to the outer elastic shell of the eye. Clever solutions to the problem of knowing the induced deformation, as well as accounting for the confounding effects of tear film surface tension and corneal rigidity, will be described. The new technology is scanning laser tomography, used to measure optic nerve head topography. It is a 3D imaging modality that uses a confocal scanned laser system with an adjustable focal plane to detect the high-reflectivity interface between the retina and vitreous body. The operating principles of such systems will be described, followed by an overview of clinical challenges and practical problems with the use of this equipment. The talk will conclude with a brief description of how image processing techniques are being developed to extract clinically useful information from optic nerve head topographic scans.

MO-A5-3 **11 h 00**

I. ALEX VITKIN, University of Toronto, Ontario Cancer Institute / University Health Network

High-Resolution Imaging with Optical Coherence Tomography: Basic Principles, Biomedical Applications, and Enabling Instrumentation

Optical Coherence Tomography (OCT) is an imaging modality that uses the short coherence length of a broadband light source to generate micrometer-scale subsurface images of biological tissues. This ability to delineate microstructural detail in intact turbid biological media is currently being explored for a variety of research and clinical uses. Following a discussion of the basic theory of OCT, representative examples of its emerging biomedical applications will be provided. The presentation will conclude with an overview of the issues involved in the design of the main components of an OCT imager.

MO-A5-4 **11 h 45**

JOANNE M. O'MEARA, Massachusetts Institute of Technology

X-Ray Fluorescence Measurements of Uranium in vivo

Small quantities of heavy metals, such as mercury, lead, and uranium, can have severe health effects if absorbed by the human body. It is therefore essential to be able to measure trace amounts of these toxic elements in a number of tissues and organs within the body, in order to monitor individuals exposed occupationally, or otherwise, to heavy metals. *In vivo* x-ray fluorescence (XRF) is a powerful and convenient method for performing such measurements. Following irradiation with gamma- or x-rays, characteristic x-rays from the element of interest are emitted and detected. With specially designed calibration standards, the intensity of characteristic x-rays can then be related to the concentration of the element present in the target organ or tissue. *In vivo* XRF has been successfully applied to the measurement of lead in bone, as well as cadmium, gold, and platinum in the kidneys. Based on the success of *in vivo* XRF for such elements, the feasibility of an XRF monitoring system for assessing depleted uranium exposure among military personnel was investigated. The immediate motivation for this research was concern for the health of a group of Gulf War veterans with metallic shrapnel imbedded in soft tissue, as seen on conventional planar x-rays. There was reason to suspect that some of these fragments contain depleted uranium, due to its use in armor-piercing artillery shells. Additional diagnostic information was therefore sought, in part through *in vivo* XRF measurements.

This presentation will begin with an overview of the XRF elemental analysis technique, with emphasis on the challenges associated with *in vivo* applications. System design considerations will be highlighted with respect to these inherent difficulties. The development and performance of an *in vivo* XRF system for the measurement of uranium in bone mineral will be presented. The relevant information regarding biological kinetics and health effects of this toxin will also be discussed. As an example of the capabilities of this system, *in vivo* XRF results from the measurement of a survivor of "Friendly Fire" involving depleted uranium ammunition, Operation Desert Storm, will be presented.

MO-A5-5 **12 h 15**

ANDREAS A. MANDELIS*, University of Toronto

Experimental and Computational Aspects of Optical Property Determination of Turbid Media using Frequency-Domain Laser Infrared Photothermal Radiometry

In this work, the optical and thermal properties of tissue-like materials are measured using frequency-domain infrared photothermal radiometry. This technique is better suited for quantitative multi-parameter optical measurements than the widely-used pulsed photothermal radiometry (PPTR) due to the availability of two independent signal channels, amplitude and phase, and the superior signal-to-noise ratio provided by synchronous lock-in detection. A rigorous three-dimensional thermal-wave formulation with a three-dimensional diffuse and coherent photon density-wave source is applied to data from model phantoms. The combined theoretical, experimental and computational methodology shows good promise with regard to its analytical ability to measure optical properties of turbid media uniquely, as compared to PPTR, which exhibits uniqueness problems. From data sets obtained using calibrated test phantoms, the reduced optical scattering and absorption coefficients were found to be within 20% and 10%, respectively, from the independently-derived values using Mie theory and spectrophotometric measurements.

* In collaboration with Y. Chen, L. Nicolaides, University of Toronto, and I.A. Vitkin, University of Toronto and Ontario Cancer Institute.

[MO-A6] PHYSICS OF GASEOUS AND IONIZED MEDIA I / *PHYSIQUE DES MILIEUX GASEUX ET IONISÉS I*

MONDAY, JUNE 18 / *LUNDI, LE 18 JUIN*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D288

MO-A6-1 **10 h 00**

WAYNE F.J. EVANS, Trent University

Measuring the Forcing Function of Global Warming

The earth's climate system is warmed by 35° C due to the emission of infrared radiation by greenhouse gases in the atmosphere (surface radiative forcing) or by the absorption of infrared radiation (radiative trapping). Increases in this emission/absorption are the driving force behind global warming. Climate models predict that the release of greenhouse gases into the atmosphere has altered the radiative energy balance at the earth's surface by several percent by increasing the greenhouse radiation from the atmosphere. With measurements at high spectral resolution, this increase can be quantitatively attributed to each of several anthropogenic gases. An energy flux imbalance of about 3 W/m^2 has been created by anthropogenic emissions of greenhouse gases of which we have measured over 1.0 W/m^2.

Calibrated radiance spectra of the greenhouse radiation from the atmosphere have been measured at ground level from Peterborough using FTIR spectroscopy at high resolution. This long wave radiation consists of thermal emission from naturally occurring gases such as CO_2, H_2O and O_3 as well as from many trace gases such as CH_4, CFC11, CFC12, CFC22 and HNO_3. The forcing radiative fluxes from CFC11, CFC12, CCl_4, HNO_3, O_3, N_2O, CH_4 and CO_2 have been quantitatively measured. The experimental fluxes are simulated well by the FASCOD3 radiation code. The greenhouse radiation fluxes from the various gases have been computed with the radiation code from the NCAR community model. Overall the agreement in most fluxes is good, providing increased confidence in the NCAR CCM. Similar comparisons of our experimental measurements with simulations using the column model from the Canadian GCM are also reported. A comparison between our measurements of surface forcing emission and measurements of radiative trapping from the IMG satellite instrument is conducted. The relative roles of several causes of radiative forcing are summarised.

MO-A6-2 **10 h 30**

DON J. McEWEN, University of Saskatchewan

The Polar Cap

Optical emissions from the night sky in the central polar region over Eureka, Ellsemere Island, Nanavut have been monitored for the past decade from ASTROLab located near the north magnetic pole. The OI 630 nm emission in particular has been useful for studies of F-region plasma flow across the pole from the dayside of the earth to the nightside, and sun-aligned polar auroral arcs. With horizon-to-horizon meridian scans it has been possible to routinely view the whole polar cap to the poleward boundaries of the auroral oval. Results are reviewed. Solar activity and the solar wind are seen to exert direct control of these dynamic polar processes. The response of the earth to solar particle influences is often first and most clearly seen in polar regions.

MO-A6-3 **11 h 30**

ROBERT L. BROOKS, Guelph-Waterloo Physics Institute

Cavity Ring-Down Spectroscopy of Atmospheric Molecules

Cavity Ring-Down Spectroscopy (CRDS) has proven to be an extremely sensitive technique for acquiring absorption spectra of molecules with no intrinsic dipole moment (such as O_2). In addition, it holds the potential for optical measurements of pollutants at trace concentrations. Absolute concentrations can be measured for any transition whose f-value is known. An overview of the technique will be presented with results from our lab and others that have studied atmospheric molecules. In particular, results for the collision-induced absorption of transient oxygen dimers will be presented. A comparison of the CRDS technique and photo-acoustic spectroscopy of a weak molecular overtone transition will also be presented.

MO-A6-4 **12 h 00**

Designing a Rocket-Borne Laser Spectrometer to Measure Atomic and Molecular Oxygen Densities, **N. Whaley**, D. Knudsen, N. Moazzen-Ahmadi, and R.I. Thompson, *University of Calgary* — During the summer months of 2000, a literature and computational preliminary investigation was undertaken jointly between members of the Institute for Space Research and the Atomic, Molecular, and Optical Physics Group at the University of Calgary. Its goal was to explore the feasibility of initiating a project to design and construct a rocket-borne laser spectrometer instrument package for the simultaneous measurement of atomic and molecular oxygen densities during sub-orbital flight. Although the collaboration is still in its infancy, this paper will discuss the work carried out to date, and the work planned for the near future, as an illustrative example of the possible benefits of increased collaboration and communication between the members of DAMP and DASP.

MO-A6-5 **12 h 15**

Atmospheric Sulphur and Isotopic Indicators: A Source Apportionment Study in the Vancouver Region, **A.L. Norman**, *University of Calgary* — Aerosols and their formation mechanisms are of interest in the greater Vancouver region because visibility has decreased despite increased emissions controls on vehicles in the province. Sulphur dioxide and its oxidation to sulphate enhances fine aerosol formation. Information about the sources of atmospheric sulphur and the oxidation of reduced sulphur compounds to sulphate can be derived from the oxygen and sulphur isotope composition of aerosols and gases in the region. Results from a multi-year project to characterize and quantify sulphur in aerosol from ocean biogenic and anthropogenic sources will be presented.

[MO-A7] THE FUTURE OF PARTICLE PHYSICS / *L'AVENIR DE LA PHYSIQUE DES PARTICULES*

MONDAY, JUNE 18 / *LUNDI LE 18 JUIN*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D287

MO-A7-1 **10 h 00**

SCOTT MENARY, York University

Future of CP Violation

BTeV is an approved post-*B*-Factory era experiment which is to run at the Tevatron at Fermilab. The BTeV detector is designed to exploit the copious production of $b\bar{b}$ quark pairs in $p\bar{p}$ collisions so as to probe all aspects of *CP* Violation in the *b* (and *c*) sector. The goal of the experiment is to achieve the precision necessary to be able to find new physics beyond the standard CKM picture of *CP* Violation. In this talk I will describe the status of the detector design and construction.

MO-A7-2 **10 h 30**

DEAN KARLEN, Carleton University

Prospects for a Future Linear e+e- Collider

Work is well underway in Europe, North America, and Asia on the design of a next generation electron positron collider and on the physics justification of such a facility. Test facilities

have demonstrated that the technology for constructing the collider is in hand. A strong physics case has been made that the results are an important complement to the data to be recorded at the Large Hadron Collider (LHC) at CERN later this decade.

In this presentation I will review the proposed designs of the linear collider and associated detectors, the physics opportunities that the facility brings, and the linear collider activities taking place in Canada.

MO-A7-3 **11 h 30**

ROBERT K. CARNEGIE, Carleton University

Searching for the Higgs Boson at LEP

The main focus of the CERN LEP accelerator operation in 2000 was the direct search for the Higgs Boson up to a mass of about 115 Gev. Present particle physics data from LEP, the SLC and the Fermilab Tevatron are consistent with and indirectly indicate a Higgs particle in the general 100 GeV mass region. The current results on the Higgs Boson searches from the OPAL experiment and the other LEP experiments will be presented.

MO-A7-4 **12 h 00**

MICHEL LEFEBVRE, University of Victoria

Physics at the TeV Scale: Discovery Potential of the ATLAS Detector at the LHC

The Standard Model (SM) of particle interactions spectacularly accounts for all experimental results to date. Only the Higgs sector of the theory, responsible for electroweak symmetry breaking and particle masses, remains to be confirmed. Despite this success, there are compelling theoretical reasons to believe that new physics beyond the SM must exist below or near 1 TeV. Supersymmetry (SUSY) is a particularly popular extension of the SM, as well as a critical ingredient in Grand Unified Theories, but its existence in nature awaits experimental confirmation. The LHC, currently under construction at CERN, Geneva, will produce proton-proton collisions at a centre of mass energy of 14 TeV, allowing the exploration of physics at the TeV scale. The ATLAS detector, also currently under construction, is designed to take full advantage of the LHC. This talk will review the physics discovery potential of the ATLAS detector, with emphasis on the SM and SUSY Higgs sectors.

[MO-A8] ULTRAFAST PHOTONICS / *PHOTONIQUE ULTRARAPIDE*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D111 — **MONDAY, JUNE 18 / *LUNDI LE 18 JUIN***

MO-A8-1 **10 h 00**

Generation of Sub-Picosecond Cr4+:YAG Laser Pulses by Means of a Hybrid Semiconductor Saturable Absorber Mirror, A.J. **Alcock**[a], P. Poole[a] and B.T. Sullivan[b], (a) *Institute for Microstructural Sciences, National Research Council of Canada*, (b) Iridian Spectral Technologies, Ottawa — A Cr4+:YAG laser operating at wavelengths near 1460 nm has been mode-locked by means of a semiconductor saturable absorber mirror (SESAM) that is used as the high reflector in the optical resonator. The SESAM that we have developed is a hybrid device consisting of a single InGaAs quantum well, sandwiched between two thin InP layers, and sputtered layers of Nb_2O_5/SiO_2 deposited on one side of this epitaxially grown semiconductor structure to act as a high reflectivity mirror. An anti-reflection coating of the same materials is deposited on the other InP surface. The small saturable loss (~ 1%) introduced by the quantum well results in reliable mode-locking, and when infrasil prisms are inserted into the laser resonator, to compensate for group velocity dispersion, pulses as short as 500 femtoseconds are generated.

MO-A8-2 **10 h 15**

Ultrafast Electron Diffraction: Probing Structural Dynamics on the Femtosecond Time-Scale, **B.J. Siwick**[a], J.R. Dwyer[b], R.E. Jordan[b], R.J.D. Miller[a], (a) Departments of Physics and (b) Department of Chemistry, *University of Toronto* — With femtosecond time-resolved spectroscopy it is possible to probe the evolution of excited electronic states in many systems. Accompanying atomic rearrangements on this time-scale, however, have proven to be difficult (in most cases impossible) to determine with these experiments. The relationship between the experimental observable and the positions of atoms in an optical probe experiment is an extremely complicated one and additional (often unknown) information is needed to "invert" optical data to obtain structural information. Diffractive probes on the other hand have the potential to give a complete, global picture of structural changes, without ambiguity in the interpretation. We will present work in our laboratory that is geared towards the development of a electron diffractometer with sub-picosecond temporal resolution. The peculiarities of using electrons for these studies, compared with **x-rays**, will also be discussed.

MO-A8-3 **10 h 30**

Time-Oriented approach to the Einstein-Podolsky-Rosen Paradox, **Michel A. Duguay**, *Université Laval* — The time-oriented approach to the Lorentz transformation[1] and the language of quantum cryptography are applied to the Einstein-Podolsky-Rosen (EPR) paradox. In a thought experiment we, the observers, place at Earth a calcium-40 source of polarization-entangled photon pairs. Alice is 2 light-hours away from us and Bob is 2 light-hours: 1light-minute in the opposite direction. As calcium-40 emission events occur, they generate from our now-and-here point of view incomplete "memory elements" which move down the Minkowskian time axis centered on the past light cone. After 4 hours (4 h − 1 m) we see the memory elements come under Alice's (Bob's) detectors' scrutiny: reductions of the state vector by Alice's and Bob's detection events complete the memory elements on the Minkowskian time axis. Alice wishes to send Bob a message via the EPR polarization correlation function which she modulates by changing her polarizer's angle. When Bob is at 2 h + 1 m, the time-oriented approach shows in a clear and visual way that, from our point of view at Earth, an EPR-encrypted message "promptly" reaches Bob 2 minutes after Alice starts modulating her polarizer angle. Alice's photon count sequence is the EPR-decryption key and it is transmitted to Bob via classical electromagnetic means. This key will reach Bob 4 hours and 2 minutes later, enabling him then to decipher Alice's message. The time-oriented approach contradicts EPR as Scarani *et al.* had previously done[1,2], but unlike these authors, it does not require a preferred Lorentz frame.

1. M.A. Duguay, poster paper MO-POS-51, CAP annual meeting, Toronto (June 2000)
2. V. Scarani, W. Tittel, H. Zbinden, and N. Gisin, Los Alamos web archive at site xxx.lanl.gov/abs/quant-ph/0007008 (4 July 2000).

MO-A8-4 **10 h 45**

Second Harmonic Generation in 2D Planar Photonic Crystal Waveguides, **A. Cowan**, *University of British Columbia* — It is now well established that by etching a two dimensional texture into the guiding region of a planar dielectric waveguide, one can significantly modify the dispersion characteristics of the guided electromagnetic modes attached to the waveguide. Here we investigate how this texturing effects the properties of a nonlinear conversion process, second harmonic generation, in these photonic nanostructures. We use a Green's function approach to solve Maxwell's equations for the second harmonic field radiated above the surface of a planar photonic crystal, in a way that clearly describes the underlying physics. Through the combination of a generalized phase-matching condition, and strongly localized fields associated with the localized photonic modes, it is possible to achieve a mode-matched conversion process that is enhanced by a factor of $>10^6$ over that of untextured waveguides.

MO-A8-5 **11 h 30**

Optical Comminications Using Dispersion Management Scheme, **Ashvin Gajadharsingh** and P.A. Bélanger, *COPL Université Laval* — We present qualitatively how the idea of using solitons for optical communications has evolved towards the field of dispersion management. This scheme has revealed the existence of a new type of solitary wave, namely the dispersion managed soliton, which is superior to conventional solitons. Hence analytical tools are required to predict and understand the global dynamics of the dispersion managed soliton. Perturbative and variational approaches have been successful in doing so, and we shall show how the method of moments can be used to study non linear propagation of pulses in optical fibres and how this technique can be applied to dispersion management. The equivalence between the method of moments and the variational approach will be pointed out, and all the predictions will be supported by full numerical simulations.

MO-A8-6 **11 h 45**

Fabrication of Thin Film Photonic Band Gaps*, M. Diop, G. Maurin, A. Tork, I. Aboudihab and R. A. **Lessard**, *Centre d'Optique, Photonique et Laser (COPL) Université Laval* — Photonic crystals have been studied in the last few years in the optical range. They open many exciting opportunities in optoelectronic devices and integrated optics (e.g. novel waveguides, optical switches, etc.). Growth methods of self-organized microspheres were used to obtain two or three-dimensional structures by generating organized structures with features sizes comparable to optical wavelengths. In this work, we present experiments on large area thin film photonic crystals consisting of self-assembled polystyrene microspheres alone and also by replacing the air between the spheres with metallic silver or nanocrystalline titania. We also present optical characterization of these materials; the results show a tendency towards a photonic band gap structure.

[1] G.Subramania, K. Constant, R. Biswas, M.M. Sigalas and K.-M. Ho, *J. Lightwave Technology*, **Vol. 27**, No 11, 1970 (1999).

* We are grateful to the Natural Sciences and Engineering Research Council of Canada (NSERC-A0360), Canadian Institute for Photonic Innovation under NSERC (216182-1998), Quebec Funds for Research (FCAR-00-ER-0344) and FCAR center (CE-0043) for the financial support of this work.

[MO-A9] POLYMERS AND SOFT MATTER / *POLYMÈRES ET MATÉRIAUX DUCTILES*

MONDAY, JUNE 18 / *LUNDI, LE 18 JUIN*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D110

MO-A9-1 **10 h 00**

Self-Consistent Field Theory for a Particle/Diblock Composite System, **R.B. Thompson**[a], V.V. Ginzburg[a], A.C. Balazs[a], M.W. Matsen[b], (a) *University of Pittsburgh*, (b) University of Reading — Self-consistent field theory is very effective in explaining and predicting block copolymer equilibrium morphologies, as well as blends of copolymer with homopolymers or solvents. In practice, many modern materials are composite systems of polymers and non-polymeric filler particles. We present in this talk a self-consistent field theory for the simplest possible copolymer-particle composite system; a diblock/spherical particle mixture. We will show a selection of morphologies that demonstrate the richness of even this simplest system, and outline possible applications for such morphologies. The frame work of the theory can also be extended in a straightforward way to consider more complicated systems.

MO-A9-2 **10 h 15**

Free-Solution Conjugate Electrophoresis for the Determination of Polymer Solution Polydispersity,* **L.C. McCormick**[a], G.W. Slater[a], A.E. Karger[a], W.N. Vreeland[b], A.E. Barron[b], C. Desruisseaux[a], and G. Drouin[a], (a) *University of Ottawa*, (b) Northwestern University — The degree of polymerization is an important characteristic of a polymer solution strongly affecting mechanical properties such as tensile strength. Unfortunately, conventional methods including Mass Spectrometry and Gel Permeation Chromatography cannot easily determine polymer solution polydispersity. A recently developed Capillary Electrophoresis method utilizes a set of uniform charged "engines" to successfully characterize the molecular mass distribution of a water-soluble, uncharged polymer species. On their own, the set of charged "engines" would have uniform electrophoretic velocity, however when conjugated to the polydisperse uncharged polymers, their motion is retarded due to frictional drag forces. These forces are directly proportional to the polymer contour length, such that the polydispersity can be elucidated. We will present a theoretical treatment of this new method, identifying the experimental factors to be optimized for best performance, including a prediction of the optimal engine size. The effective friction coefficient of the conjugate is also predicted and demonstrated to be related to the stiffness of the two polymers of the conjugate, thereby providing a means of estimating the persistence length of the uncharged polymer through mobility measurements. Comparisons of our theoretical predictions will be made to available experimental results.

* Work supported (in part) by NSERC.

MO-A9-3 **10 h 30**

Lattice Model for the Kinetics of Membrane Rupture,* Luc Fournier and **Béla Joós**, *University of Ottawa* — We have constructed a model for the kinetics of rupture of membranes under tension. It is a lattice model which incorporates strain relaxation, and considers the nucleation of pores at constant area, constant temperature, and constant particle number. The particle number is conserved by allowing multiple occupancy of the sites. An equilibrium "phase diagram" is constructed as a function of temperature and strain with pore density as the order parameter. With parameters relevant to DMPC lipid membranes, well defined regions of "no pores", "low density of protopores (non-critical pores)", "single hole rupture", and "multi-hole rupture" are found. The effect of edge healing (transformation from a hydrophobic to a hydrophilic edge) has been included. The boundaries between the different regions are very sharp. At room temperature, rupture is predicted at 2.3 % strain, well within the reported range for lipid bilayers. Free energy curves as a function of pore density for various values of the tension and temperature will be presented. We will also discuss planned extensions of the model.

* Work supported by NSERC.

MO-A9-4 **11 h 15**

Optical Properties of Polyelectrolyte Multilayer Thin Films, **C. Barrett**, *McGill University* — This talk will describe our recent studies of aqueous dye-containing polymers adsorbed to surfaces, in both single and multi-layers, to investigate the mechanism of the layer-by-layer self-assembly process, the degree of interpenetration between successive layers, and the *in situ* (underwater) chain conformations. Our *in situ* methods to probe the layers will be described, including solution ellipsometry, zeta potential measurements, solid state NMR spectroscopy, and dye probe spectrophotometry. These methods allow one to investigate the conformation of the adsorbed polymer chains in solution as they exist in the adsorption baths, which can differ markedly from that in the dried state. This *in situ* information reveals swelling properties of assembled thin films that were found to depend strongly on the bath conditions, such as ion concentration and pH. For example, the thickness of the layers can be controlled over nearly an order of magnitude in some systems with bath pH, and the refractive index can be significantly modulated too. Once assembled onto substrates, the thin films can be addressed with laser light to induce localized changes to the film surface morphology, and applications to structure fabrication on the nanometre scale will be discussed.

MO-A9-5 **11 h 30**

Structural Properties of Azobenzene Polyelectrolyte Multilayer Thin Films, **O. Mermut**, *McGill University* — Layer-by-layer self-assembly from dilute polyelectrolyte solutions is a new and promising method for fabrication of hydrophilic organic thin films, using sequential electrostatic adsorption of alternating polycations/polyanions on a silicon surface. The resulting multilayers can be of particular interest for electro-optic applications upon incorporation of photo-addressable chromophores (such as azobenzene units), which allow one to address these films with laser light to induce reversible and localized changes to optical, surface, and structural properties of the films. Presented here are the results of our efforts to use azo-containing polyanions (P-Azo, poly[1-4-(3 carboxy-4-hydroxyphylazo)benzene sulfanamido 1,2-ethanediyl, sodium salt) to study the effect of polymer dipping solution parameters (such as pH) on film architectural properties (such as layer thickness, chromophore loading, and interlayer penetration) in weak polyionic multilayer systems. By varying the chemical properties of the polymer (for example molecular weight and charge fraction) we demonstrate good control over resultant physical properties of the films, such as kinetics of polymer adsorption, elastic modulus, and film thickness (where control of more than an order of magnitude has been achieved). Film mechanical properties were investigated through force-distance measurements using AFM, while optical methods of UV-Vis spectrometry and ellipsometry were used to study structural and dye-loading characteristics.

MO-A9-6 **11 h 45**

Creation of Two-Dimensional Orientational Structures In Pattern Photopolymerized Anisotropic Gels By Means of a Homogeneous Quasistatic Electric Field, **K. Asatryan**, A. Tork, V. Presnyakov, T. Galstian, *Laval University* — Electro-optical properties of anisotropic gels, produced by photopolymerization of liquid crystal mixtures composed of diacrylate monomer and conventional non-reactive liquid crystal, have been investigated. The possibility of controlling of the orientational (non-uniform) structures of anisotropic gels by means of an external uniform quasistatic electric field was demonstrated. After the photopolymerization of the preliminary oriented samples of pre-gel mixtures with a Kripton laser beam, operating in the ultraviolet, a homogeneous planar orientation was obtained. The testing of the polymerization region by the narrow beam of a He-Ne laser was carried out. It was shown that the switching characteristics of the gels vary from point to point. The degree of polymerization, hence the threshold voltage of the Freedericksz transition in the quasistatic electric field, approximately reproduces the transverse intensity Gaussian distribution of the polymerization beam. Possible applications of above-mentioned results were considered.

MO-A9-7 **12 h 00**

Structural relaxation of the excited state in poly(p-phenylene). **Michel Côté**[a], Peter D. Haynes[b], Richard J. Needs[b] and Michael Rohlfing[c], (a) *Université de Montréal*, (b) Cambridge University, U.K., (c) Institut fuer Festkoerpertheorie, Germany — The difference in energy between the absorption and luminescence spectra, which is refereed as the Stoke shift, is a manifestation of the different atomic structures between the ground state and the excited state. From experimental data, the effect of structural relaxation in the excited state of conjugated polymers is clearly visible. In this presentation, I will present our results on the excited state of poly(p-phenylene)(PPP) where we study the effect of structural relaxation on the exciton energy. We use density-functional theory calculations and tight-binding total energies to address this question.

MO-A9-8 **12 h 15**

The Physics of Chocolate. **S.S. Narine**, *University of Alberta* — What does making chocolate have to do with Physics? When most of us think of Physics, the last thing on our minds is chocolate, unless as a late-night snack to get us through that all-nighter for Quantum Mechanics. Yet understanding the structure of foods such as chocolate requires very sophisticated material physics, the rules of which are only now being unfolded. The organoleptic properties (texture, appearance, flavour, spreadability, melting, etc) of chocolate and many other fat-containing food products such as butter, margarine, peanut butter, ice cream, etc. are a function of the network formed by fat crystals within such products. Other materials that provide underlying structure to foods include protein and carbohydrate gels. The reason the physics of networks formed by fats, proteins, and carbohydrates is so interesting is because the structure of these networks often cannot be related in a linear manner to the nature of their constituent molecules. Rather, the properties of these networks are governed by the nature of aggregation of super-molecular assemblies, the formation of which are dictated by complicated thermodynamic requirements, and affected kinetically by the nature of the environment of formation. In this talk, the many levels of structure (molecular, crystalline, microstructural) of networks formed by fat crystals will be examined, and the macroscopic physical properties resulting from each level of structure will be discussed. The use of fractal geometrical analysis to quantify the microstructure of fat crystal networks will be discussed, as well as a model constructed to explain the mechanical properties of the network. The implications for sensory impressions on products such as chocolate and butter will be examined.

[MO-A10] SUPERCONDUCTIVITY (CONTRIBUTED) / *SUPRACONDUCTIVITÉ (COMMUNICATIONS)*

MONDAY, JUNE 18 / *LUNDI LE 18 JUIN*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D114

MO-A10-1 **10 h 00**

Type I Behaviour of Type II Superconductors in the SO(5) Model. J. Cline[b], M. Juneau[a], **R. MacKenzie**[a], M.-A. Vachon[a], (a) *Université de Montréal*, (b) McGill University — We study the energetics of superconducting vortices in the SO(5) model proposed by Zhang. We show that, for a wide range of parameters of the model corresponding to type II superconductivity (defined in terms of the ratio of penetration depth to coherence length), the free energy of a vortex whose magnetic flux is m times the flux quantum (an m-vortex) is less than m times that of a vortex of one flux quantum. Thus, the Abrikosov vortex lattice structure which normally forms when a type II superconductor is placed in an external magnetic field would be unstable (or, at best, metastable).

MO-A10-2 **10 h 15**

Anomalous Weak Magnetism in Superconducting $YBa_2Cu_3O_{6+x}$. **Jeff Sonier**, J.H. Brewer, R.F. Kiefl, R.I. Miller, G.D. Morris, C.E. Stronach, J.S. Gardner, S.R. Dunsiger, D.A. Bonn, W.N. Hardy, R. Liang, R.H. Heffner, *Simon Fraser University* — We report muon spin relaxation (mSR) measurements in high-quality underdoped and optimally-doped $YBa_2Cu_3O_{6+x}$ single crystals. In zero externally applied magnetic field we observe the onset of small spontaneous static magnetic fields. For the case of optimal doping ($x = 0.95$), these weak magnetic fields appear well below the superconducting transition temperature T_c. On the other hand, in underdoped crystals ($x = 6.67$) the onset of the spontaneous magnetic fields is observed well above T_c. The occurrence of weak static internal fields suggests that time-reversal symmetry is broken. The results are consistent with some recent theories that predict the onset of static internal magnetic fields at the pseudogap crossover. We will also report on some of our most recent findings.

MO-A10-3 **10 h 30**

Non-Local Effects and Vortex Lattice Geometries in 2D and 3D Conventional and Unconventional Superconductors. **Roger Miller**[a], Astria Price[a], Rob Kiefl[a], Jess Brewer[a], Doug Bonn[a], Ruixing Liang[a], Walter Hardy[a], Jeff Sonier[b], J.W. Brill[c], P.C. Canfield[d], (a) *University of British Columbia*, (b) Simon Fraser University, (c) University of Kentucky, (d) Iowa State Univeristy — Muon Spin Rotation has been used to investigate the magnetic field distribution n(B) in the vortex state of Type-II superconductors $NbSe_2$, $LuNi_2B_2C$, V_3Si and $YBa_2Cu_3O_{7-x}$. Theoretical models of n(B) are used to fit the time-domain data in order to extract the two fundamental length scales: the magnetic penetration depth and the vortex core radius. Surprisingly, a strong field dependence of the vortex core radius is observed in most materials which is attributed to strong vortex-vortex interactions. Also, many superconductors exhibit a field dependent effective penetration depth, which we attribute to non-local effects that are not yet fully taken into account within the present class of theoretical models. Finally, a shrinking vortex core radius in $NbSe_2$ and $LuNi_2B_2C$ at low temperature is attributed to bound quasiparticle states in the vortex cores.

MO-A10-4 **10 h 45**

Local Characterization of YBCO Thin Film. **J. Nam**, *McMaster University* — Characterization of thin film YBCO superconductors was carried out using two local probes: (1) optical difference microscopy and (2) laser scanning microscopy. In optical difference microscopy, the image is formed by subtracting two conventional images taken with mutually perpendicular polarized light. In laser scanning microscopy, a laser beam is focused onto the surface of a thin film microbridge giving rise to a local heating effect. Bolometric and thermoelectric effects in the heated region result in a voltage change across the sample that can be measured as a function of beam position. This results in a spatially resolved image of the electrical inhomogeneties in thin film. The inhomogeneties associated with the twin boundaries that form at either forty-five or minus forty-five degrees with respect to the a-axis of YBCO were studied. The correlation between the three images suggest that interfaces between grains with different twin boundary orientations are more resistive than interfaces between grains with the same twin boundary orientation.

[MO-A11] BEST DCMMP PAPER PUBLISHED IN THE CANADIAN JOURNAL OF PHYSICS / *MEILLEURE PAPIER PUBLIE DANS LA REVUE CANADIENNE DE PHYSIQUE*

MONDAY, JUNE 18 / *LUNDI LE 18 JUIN*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D114

MO-A11-1 **11 h 30**

ALLAN GRIFFIN*, University of Toronto

Landau-Khalatnikov Two-Fluid Hydrodynamics with Damping for a Trapped Bose-Condensed Gas

The dynamics of a trapped Bose-condensed gas at finite temperatures involves a two-component system: a condensate coupled to the thermally-excited atoms. While collective modes in the collisionless regime have been mainly studied so far, the collision-dominated hydrodynamic region is also of great interest. Starting from a Boltzmann transport equation for the non-condensate atoms and a generalized Gross-Pitaevskii equation for the condensate, we have recently given a microscopic derivation of the equations describing the hydrodynamic region. We use the standard Chapman-Enskog procedure to include deviations from local equilibrium. The equations we obtain can be written in a form identical to the well-known phenomenological Landau-Khalatnikov two-fluid equations used to describe superfluid He (first and second sound). Our equations include the transport coefficients of the thermal cloud (shear viscosity, thermal conductivity) as well as frequency-dependent second viscosities. The latter are associated with the slow equilibration rate between the condensate and non-condensate components, which can give rise to a new zero-frequency relaxational mode unique to superfluid gases. These transport coefficients naturally introduce several characteristic relaxation times which describe how fast one reaches local equilibrium. These in turn determine the frequency region which separates the collisionless and hydrodynamic regions. This review talk will be addressed to a general audience.

*This work was done in close collaboration with T. Nikuni (Toronto) and E. Zaremba (Queen's).

PLENARY SESSION / SESSION PLÉNIÈRE
[MO-P1] CAP HERZBERG MEDAL WINNER
RÉCIPIENDAIRE DE LA MÉDAILLE HERZBERG
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE A144
MONDAY, JUNE 18 / LUNDI LE 18 JUIN

MO-P1-1 **13 h 30**

MICHEL GINGRAS, University of Waterloo

Geometric and Random Frustration in Condensed Matter Physics: From Glasses to Ices

Frustration is ubiquitous in condensed matter physics. It occurs in magnetic and superconducting systems, in liquid crystals and in molecular solids. Frustration arises whenever some interacting degrees of freedom experience local (N-body, N>2) spatial arrangements that increase the energy of the system compared to what it would be were the interactions to be only considered between independent pairs of degrees of freedom, pair by pair. The simplest example of frustration consists of three antiferromagnetically coupled magnetic moment (spin) vectors on the corners of an equilateral triangle. Each spin would like to have its neighbor pointing antiparallel to it, but the triangular arrangement makes this energetically too costly. As a compromise, to "relieve the frustration", the three magnetic moments adopt a configuration where they point at 120 degrees relative to each other. Frustration can be geometric and regular, as in the example above, or random, varying from site to site, as occurs in all real samples, due to vacancies, off-stoichiometry, etc. In this talk, I will review the problem of geometric and random frustration in a wide variety of condensed matter systems, taking examples from molecular glasses, vortex glasses in high temperature superconductors, spin glasses in random magnetic systems, and vortex lattices in superconducting Josephson junction arrays. Most of the talk will, however, focus on the recent progress we have made in understanding the "dipolar spin ice" problem in some frustrated ferromagnetic systems, and its relationship with the long-standing problem of frozen hydrogen disorder in ice water.

[MO-P2] SUPERCONDUCTIVITY
SUPRACONDUCTIVITÉ
IMMEUBLE HSD BUILDING, ROOM / SALLE A240
MONDAY, JUNE 18 / LUNDI LE 18 JUIN

MO-P2-1 **14 h 15**

ROBERT W. HILL, University of Toronto

Violation of the Wiedemann-Franz Law in the Normal State of a Cuprate Superconductor

The question as to whether the high temperature cuprate superconductors have an underlying normal groundstate described by Fermi liquid physics remains a pertinent one. In an attempt to shed light on this issue, the thermal and charge transport in the high-T_c superconductor $Pr_{1.85}Ce_{0.15}CuO_4$ were investigated in the normal state down to very low temperature, accessed by applying a magnetic field normal to the CuO_2 planes up to 14 T. The charge transport exhibits good metallic behaviour down to 0.05K, whilst the corresponding thermal conductivity shows no component compatible with fermionic heat transport (linear in temperature). This complete violation of the Wiedemann-Franz law is strongly suggestive of a breakdown of Fermi liquid theory.

MO-P2-2 **14 h 45**

FRANK MARSIGLIO, University of Alberta

Even/Odd and Surface Effects in Superconducting Nanoparticles

Large numbers and crystal periodicity have traditionally been the hallmark of condensed matter physics. The ability to fabricate small superconducting grains, along with the sensitivity of various probes to surfaces, is making it necessary to take into account both finite size and surface effects. We describe recent work to account (separately) for a finite and fixed number of electrons in the superconducting state, as well as the presence of surfaces and impurities.

MO-P2-3 **15 h 45**

J. C. SEAMUS DAVIS*, University of California, Berkeley

The Electronic "Nanoscape" of High Temperature Superconductivity

Different microscopic perturbations to the cuprate-oxide high-Tc superconductors produce a variety of responses in the electronic structure at the nanometer length scale. Scanning tunneling microscopy (STM) is an excellent tool with which to explore this electronic "nanoscape". Among the phenomena observed are the effects of individual impurity atoms. Scattering by impurity atoms should create local electronic states characteristic of d-wave superconductivity[1,2]. I will discuss experiments on the high-Tc superconductor $Bi_2Sr_2CaCu_2O_{8-\delta}$ (Bi-2212) in which these states were discovered[3], measurements of their properties at deliberately introduced Ni and Zn impurity atoms[4,5], and the physical implications of these observations. Finally, I hope to introduce emerging nanoscale electronic phenomena that occur with reduced O-doping in Bi-2212. These phenomena are not yet well understood but are indicative of granular superconductivity and possible nanoscale electronic phase separation.

[1] Balatsky, A.V., Salkola, M.I., Rosengren, *A. Phys. Rev.* **B51**, 15547-15551 (1995).
[2] Flatté, M.E. & Byers, J.M., *Solid State Physics* **52**, 137-228 (1999).
[3] E. W. Hudson *et al*, *Science* **285**, 88 (1999).
[4] S. H. Pan *et al*, *Nature* **403**, 746 (2000)
[5] E. W. Hudson *et al*., to appear in *Nature* - April 2001.

* This project was carried out in collaboration with K.M. Lang, V. Madhavan and J. Hoffman (Berkeley), E.W. Hudson (NIST Gaithersburg) S.H. Pan (Boston University), H. Eisaki (Stanford University) and S. Uchida (Tokyo University).

MO-P2-4 **16 h 15**

JAN A. JUNG, University of Alberta

Experimental Evidence for Intrinsic Ferroelastic Nanodomains and Their Effect on the Physical Properties of HTSC Cuprates

This talk concentrates on the ferroelastic properties and the resulting nanodomain network in HTSC cuprates. HTSC cuprates belong to the class of ferroelastic perovskites. The evidence for ferroelastic transitions in cuprates has been provided by stress-strain measurements, helium ion-channeling, EXAFS and Raman measurements. Diffuse electron diffraction contrast measured in YBCO crystals with a high resolution TEM has shown that, due to an elastic misfit between CuO and BaO planes,the CuO planes are subjected to a ferroelastic transition which partitions them into ferroelastic nanodomains. The nanodomains govern the electrical transport properties of HTSC cuprates, such as the temperature dependence of the superfluid density and the critical current density,and their magnetic properties,such as the magnetic relaxation rates and the pinning of magnetic flux lines. Nanodomains contribute to nanoscopic inhomogeneous charge distribution in YBCO as revealed by inelastic neutron scattering measurements, and to nanoscopic variations of the energy gap in BSCCO crystals as revealed by STM.

MO-P2-5 **16 h 45**

TAKESHI EGAMI, University of Pennsylvania

Neutron Scattering and Charge State in Cuprate Superconductors

The phonon dispersions of superconducting cuprates determined by inelastic neutron scattering carried out at the HFIR (Oak Ridge) and ISIS (Rutherford) suggest that the charge state is inhomogeneous at two length scales, atomic and nano-scale. At the atomic scale the system appears to have Peierls instability to double the unit cell along the direction of the Cu-O bond. Underdoped samples show nano-scale inhomogeneity due to segregation into undoped and fully doped states. These results reveal the unusual nature of electron-phonon coupling in the strongly correlated electron system, and challenge conventional theories on the origin of the high-temperature superconductivity.

[MO-P3] COMPLETING THE STANDARD MODEL / *COMPLÉTER LE MODÈLE STANDARD*

MONDAY, JUNE 18 / ***LUNDI LE 18 JUIN***

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D110

MO-P3-1 **14 h 15**

RICHARD HEMINGWAY, Carleton University

OPAL Celebrates the Standard Model

After 12 years of successful operation, the LEP accelerator at CERN has been officially closed in preparation for the LHC. During the period 1995-2000 the LEP centre-of-mass energy was increased in steps from 130 to 209 GeV and more than 700 pb-1 of high energy data were recorded by OPAL. In this talk I will concentrate on Standard Model cross-sections and couplings and indirect limits on new physics. Needless to say, the Standard Model has been more firmly established than ever before.

MO-P3-2 **14 h 45**

NATHAN RODNING, University of Alberta

TWIST - Precision Muon Decay at TRIUMF

Muon decay is an excellent system for the study of the weak interaction. This interaction clearly violates parity, and is thought to have an exact (V-A) structure. TWIST - the TRIUMF Weak Interaction Symmetry Test - is a study of the probability distribution for positrons from muon decay at a level of precision of one part in 10,000 involving physicists from Canada, the United States, and Russia. Data with this precision will allow an unprecedented test of the (V-A) nature of the weak interaction as formulated in the Standard Model. TWIST will employ a set of precision planar drift chambers in a 2 Tesla solenoidal magnetic field to track positrons from 10^9 muon decays. The experiment is under preparation at TRIUMF in Vancouver, and is expected to be ready for engineering runs during the summer of 2001. The experiment and its potential for interesting physics will be described.

MO-P3-3 **15 h 45**

ROGER W. RUSACK, University of Minnesota

The Last Fermion

Our understanding of the fundamental constituents of nature requires that a tau neutrino exist as a partner to the tau lepton discovered 25 years ago at SLAC. The definitive proof of the existence of a neutrino has always been to observe its interaction with matter and determine the identity of the lepton produced. The DONUT (Direct Observations of NU Tau) experiment used a Fermilab high-energy proton beam to produce neutrinos and then detected the interaction of those neutrinos producing tau leptons. This talk will describe the experiment, its difficulties, and the results obtained.

MO-P3-4 **16 h 15**

A Geometric Basis for the Standard-Model Gauge Group*, **G. Trayling** and W.E. Baylis, *University of Windsor* — A geometric approach to the standard model in terms of the Clifford algebra $C\ell_7$ is advanced. A key feature of the model is its use of an algebraic spinor for one generation of leptons and quarks. Spinor transformations separate into left-sided ("exterior") and right-sided ("interior") types. By definition, Poincaré transformations are exterior ones. We consider all rotations in the seven-dimensional space that (1) conserve the spacetime components of the particle and antiparticle currents and (2) do not couple the right-chiral neutrino. These rotations comprise additional exterior transformations that commute with the Poincaré group and form the group $SU(2)_L$, interior ones that constitute $SU(3)_C$, and a unique group of coupled double-sided rotations with $U(1)_Y$ symmetry. The spinor mediates a physical coupling of the Poincaré and isotopic symmetries within the restrictions of the Coleman-Mandula theorem. The four extra space-like dimensions in the model form a basis for the Higgs isodoublet field, whose symmetry requires the chirality of $SU(2)$. The charge assignments of both the fundamental fermions and the Higgs boson are produced exactly. (Talk based on a paper accepted for publication in *J Phys A: Math Gen* on March 9, 2001).

*Work supported by NSERC

MO–P3-5 **16 h 30**

JOE MILDENBERGER, TRIUMF

Rare Kaon Decays at BNL

BNL Experiment 787 completed data taking at the end of 1998. Analysis of the final data set to improve the branching ratio measurement for the decay $K^+ \to \pi^+\nu\bar{\nu}$ is now nearing completion. This and other recent rare K^+ decay results from E787 will be presented, along with brief status reports on E949, the successor to E787, and KOPIO, the experiment to measure the branching ratio $K^0 \to \pi^0\nu\bar{\nu}$.

[MO-P4] PHYSICS OF GASEOUS AND IONIZED MEDIA II / *PHYSIQUE DES MILIEUX GASEUX ET IONISÉS II*

MONDAY, JUNE 18 / ***LUNDI LE 18 JUIN***

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D110

MO-P4-1 **14 h 15**

DAVID MAY, University of Toronto

A Unified Approach to Spectral Lineshapes, Transport Phenomena, Laser Theory and Nonlinear Optics

The goal of all physicists is to understand a subject so well that it becomes trivial and to develop a picture of the material such that it appears trivial to others. One way of achieving this is to combine it with other areas of physics using a common formalism and a common language. In the talk I will trivialize the subject of spectral lineshapes and I will sketch out, using a common language,how it is related to transport phenomena, laser theory and nonlinear optics. The talk will be tutorial in style, at the senior undergraduate or beginning graduate student level.

MO-P4-2 **14 h 45**

RICHARD MARCHAND, University of Alberta

*Anisotropic Plasmas Transport Modelling: From Laboratory to Space**

Plasma dynamics is in many ways similar to ordinary fluid dynamics, with the important difference that plasmas are electrically conducting and that, when magnetized, they can be very strongly anisotropic. As an example, the parallel electron thermal conductivity in a typical laboratory plasma of temperature 100 eV immersed in a magnetic flux density of 1T can be from 6 to 8 orders of magnitudes larger than the thermal conductivity in the direction perpendicular to the magnetic induction. A comparable anisotropy may also be found, on a very different scale, in the magnetosphere. Thus, when modelling transport in such media, special precautions are needed in order to faithfully reproduce the system anisotropy. These techniques are reviewed for two dimensional models, for structured as well as for unstructured meshes, and simulation examples are given for both laboratory and space plasmas. The extension of these techniques to 3D models is discussed and preliminary results are presented.

* This work is supported, in part, by the Natural Sciences and Engineering Council of Canada.

MO-P4-3 **15 h 45**

DAVID J. KNUDSEN, University of Calgary

Canadian Research in Auroral Plasma Physics

By virtue of its access to regions surrounding and including the geomagnetic pole, Canada provides a superior vantage for studying auroral phenomena. Canadian space physics research involves a large network of ground-based observations and numerous spacecraft instruments. Theoretical and modeling studies complement the observational program. The aurora is a visible projection onto two dimensions of physical processes occurring throughout the earth's magnetosphere. Ground and space-based optical and UV observations of the aurora are used to gain information on large-scale magnetospheric phenomena, including charged particle trapping and convection, acceleration and precipitation into the atmosphere, and large-scale magnetohydrodynamic eigenmodes and instabilities such as those related to auroral substorms. Apart from its role of magnetospheric projection screen, the aurora also serves as a laboratory to study the generation and propagation of plasma waves, and the interaction of those waves with charged particles. Naturally-occurring auroral plasma waves from ULF to HF (<1 Hz to 30 MHz) are studied from the ground and with spacecraft. Some types of wave interact strongly with ionospheric ions, leading to their upward acceleration and loss into interplanetary space. This process is observed using space-based charged-particle detectors. Wave propagation is also studied using artificial waves injected by space-based transmitters and ground-based radars.

This talk will overview the scientific thrusts of auroral plasma research in Canada, with an eye toward uncovering links and possibilities for collaboration with the larger community of Canadian physicists.

MO-P4-4 **16 h 15**

Substorm Triggered Pulsations in Optical Signatures, **J. Wanliss**, *University of Alberta* — An observational campaign was conducted to study the correlation of substorm triggered pulsations in optical signatures and auroral breakups. This campaign took advantage of the CANOPUS array of meridian scanning photometers and magnetometers. Data from four photometer stations yielded high time resolution data which allowed proper analysis of the pulsations and comparisons with the magnetometer data. An analysis of the data showed that, prior to geomagnetic substorm onset, pulsations in the photometer data occur at discrete and reproducible frequencies, and that these frequencies are narrow in latitudinal extent.

MO-P4-5 **16 h 30**

Sounding Rocket Observations of Auroral Ion Heating Cavities, **D.J. Knudsen**, *University of Calgary* — The aurora deposits as much as 100 mW per square meter into the upper atmosphere. Most of this power ends up as heat in the neutral atmosphere. A small portion produces the visible aurora; yet another small portion heats ionospheric ions which, because of their small heat capacity, can reach temperatures as high as one million K. This latter process is mediated through collisionless interaction with plasma waves, and is observed to concentrate within density-depleted cavities only tens of meters in diameter. The cause of these density cavities is presently unknown, as are other links in the chain of events which lead to heating and expulsion of ionospheric ions within them. This talk summarizes recent advances in the understanding of localized heating cavities, based primarily on observations conducted from Canadian-led auroral sounding rockets.

MO–P4-6 **16 h 45**

The Proton Aurora, **E.F. Donovan**, *University of Calgary* — The aurora is a direct result of the precipitation of electrons and protons into the Earth's upper atmosphere. Quantitative observations of auroral intensities at specific wavelengths corresponding to specific atomic and molecular transitions provide us with information about the energies and number fluxes of the precipitating particles. As well, spatial structures and temporal variations provide insights into the mechanisms that cause the precipitation and the dynamics of the terrestrial magnetosphere. In this talk, I will focus on the proton aurora. More specifically, I will discuss three candidate mechanisms that could be responsible for the precipitation of magnetospheric protons into the ionosphere. These are: 1) nonadiabatic motions in the vicinity of a current sheet; 2) pitch angle scattering due to wave-particle interactions; 3) adiabatic modification of the mirror height. The first two mechanisms are capable of causing ``strong-diffusion" in velocity space (and hence loss-cone filling).

[MO-P5] ATOMIC FORCE MICROSCOPY AND BIOLOGY
LA MICROSCOPIE A FORCE ATOMIQUE EN BIOLOGIE
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D287

MONDAY, JUNE 18 / *LUNDI LE 18 JUIN*

MO-P5-1 **14 h 15**

CYNTHIA GOH, University of Toronto

Self-Assembly in Proteins and Nucleic Acids: What the AFM Can Tell Us

The AFM is a great tool not just for visualization, but for addressing important issues at mesoscopic length scales. We are particularly interested in the question of structure formation by self-assembly in biological systems, and in this talk I will present examples of our work on proteins and nucleic acids, and discuss how we use atomic force microscopy for such studies, and what kind of information we are able to derive from them. In particular, I will show results regarding fibril formation in collagen and recA, and about interactions between recA and DNA. I will also discuss forces between short strands of DNA, and how we can study single nucleotide mismatches using the AFM.

MO-P5-2 **14 h 45**

CHRISTOPHER M. YIP, University of Toronto

Probing Biomolecular Assembly: Investigations of Protein - Protein Interactions by Scanning Probe Microscopy

Scanning probe microscopy has provided researchers with an exceptionally powerful approach for examining processes and structures on the nanometer length scale. Its application to the biological sciences and evolution as a novel biophysical characterization technique has provided tantalizing new insights into the critical structural, conformational, and chemical interactions involved in biomolecular assembly. Focusing on the assembly of biomolecules at two-dimensional interfaces, our recent investigations include *in situ* studies of the supramolecular architecture of the membrane-bound insulin receptor, and the role of epitaxy and electrostatic forces on controlling protein assembly at crystalline surfaces. We will further describe the use of correlative imaging and spectroscopy techniques for studying protein-lipid interactions and membrane assembly dynamics by scanning probe microscopy

MO-P5-3 **15 h 30**

MARK T. MCDERMOTT, University of Alberta

Probing Adsorbed Protein Conformation with Tapping-Mode Scanning Force Microscopy

The initial stages of biological response towards a biomaterial involve the spontaneous passivating of the foreign surface by protein films. The conformations adopted by proteins in a spontaneously adsorbed film on a biomaterial are important in governing further biological responses (e.g. cell binding and growth). The phase lag of an oscillating cantilever observed in tapping mode scanning force microscopy can be used to generate images based upon spatial variations in surface chemical and physical properties. In the present work, phase contrast imaging is shown to be sensitive to variations in the conformations of proteins adsorbed at the solid/liquid interface. Hence, the technique provides a means of directly observing substrate-induced differences in adsorbed proteins without the need for radioisotope or fluorophore labelling. Differences in the surface chemistries of self-assembled monolayers (SAMs) are used to effect adsorption of proteins with varying degrees of conformational change from the native state. Efforts to understand the energy-dissipating mechanisms responsible for generation of phase contrast are presented. We use force curve (distance vs. displacement) experiments to show the contributions of adhesion hysteresis and variations in mechanical properties of conformationally disparate protein films to the phase contrast. Further evidence of the ability of different surface chemistries to induce varying degrees of conformational change is elucidated by surface plasmon resonance and infrared spectroscopic studies of antibody binding to adsorbed films.

MO-P5-4 **16 h 00**

MANFRED H. JERICHO, Dalhousie University

*Study of Bacteria with the Atomic Force Microscope**

Atomic Force Microscopy (AFM) has opened a new door for the investigation of biological material. Not only is it possible to obtain images with molecular resolution, but the AFM cantilevers and tips can be used as tools to investigate such diverse properties as surface charges, surface adhesion as well as the elasticity of biological material. We have applied the AFM to investigate the properties of bacteria. A particularly challenging area is the investigation of live bacteria in growth medium. The bacterial cell wall is a semi-permeable structure and, together with the high solute concentration of the cytoplasm, the osmotic pressure inside bacteria - the turgor pressure - can be substantial. Many aspects of bacterial function are controlled by turgor pressure, such as the molecule transport through the periplasm and the synthesis of membrane porins. The talk will review a number of the problems one encounters in live bacteria imaging and will present results on tugor pressure measurements with the AFM in Gram-negative and Gram-positive bacteria.

*Work supported by the Natural Sciences and Engineering Research Council of Canada and by a Collaborative Health Research Program grant.

[MO-P6] PHOTONIC MATERIALS AND EDFAS I / *MATÉRIAUX PHOTONIQUES ET EDFAS I*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D111 — **MONDAY, JUNE 18 / *LUNDI LE 18 JUIN***

MO-P6-1 **14 h 15**

Resonance Fluorescence in Photonic Crystals, **Marian Florescu***, Sajeev John*, and Valery Rupasov[b], (a) *University of Toronto*, (b) Zenestra Photonics — We investigate the resonance fluorescence, the absorption and the dispersion of a probe field by a two-level atomic system driven by a strong external field and coupled to the radiation reservoir of a photonic crystal. We first develop a multi-photon scattering approach to the theory of resonance fluorescence in arbitrary laser field. For strong variations in the density of states of photonic crystal, we show that the active medium switches from an absorptive medium to a gain medium (negative absorption) as a function of intensity of the laser field. Consequently, for a wide range of driving field intensities, the probe field can be amplified. We investigate the robustness of these effects against non-radiative relaxation and dissipative dephasing effects of the atomic dipole. The two-level atom dispersion also displays new features, such as a large index of refraction at frequencies at which the absorption vanishes. The relevance of the new phenomena to possible technological applications is also discussed.

MO-P6-2 **14 h 30**

Study of Photoinduced Anisotropy and Non-Centrosymmetry In Thin Chalcogenide Glass Films, B. Paquet, **K. Asatryan**, T. Galstian, R. Valée, *Laval University* — Chalcogenide glasses attract more and more attention from both fundamental and practical points of view due to their promising electro-optical properties. Despite a number of research works done in this field, the complete understanding of physical mechanisms of photo-induced effects in chalcogenide glasses is not achieved. We investigate, in particular, the phenomena of photo-induced anisotropy and photo-assisted poling and second order nonlinearity in chalcogenide glass waveguides. Studies are carried out for the better understanding of mechanisms of photo-induced and electrical field induced anisotropic changes of electro-optical properties of these glasses and spatially their dependence of exciting light beam polarization.

MO-P6-3 **14 h 45**

High Resolution Optical Recording in Azo-Polymer-Stabilized Nematic Liquid Crystals, **D. Dumont***, T.V. Galstian*, Y. Chéard[b] and Y. Zhao*, (a) *Laval University*, (b) Sherbrooke University, Chemistry Department — A random oriented azo-polymer stabilized nematic liquid crystal is used to record anisotropic holograms. In this system, an azo-dye is attached to the polymer's main chain so the network can be optically reoriented with a linearly polarized quasi-resonant light. The axis of the gest-host system tends to repulse from the electric field of the excitation light and induce residual birefringence. The rotation of the dye, accompanied by the rotation of the polymer network, leads to the reorientation of the liquid-crystal molecules, which constitutes the main contribution to the photoinduced birefringence. In this work, we demonstrated the possibility of recording scalar and vectorial phase holograms in such a system, and keeping them recorded for long-term applications, by exposing the sample with an interference pattern. Due to the high intrinsic birefringence of liquid crystals, the properties of the output light (diffraction efficiency, polarization) are strongly dependent of the input polarization. The azo-polymer network enables one to record complex structures (with high resolution) in a material mainly composed of liquid crystals. It is also promising for reconfigurable data storage and multiplexing applications.

MO-P6-4 **15 h 00**

New Holographic Polymer Dispersed Liquid Crystal Materials, T. **Galstian**, *Université Laval* — New holographic polymer dispersed liquid crystal materials have been recently developed and studied. Materials presented are based on a mixture of an acrylate monomer, liquid crystal (LC) and are sensitized to 800-850 nm region. This allows highly efficient *in-situ* recording of reconfigurable photonic components for information routing. Some aspects of the infrared photo polymerization mechanisms in polymer liquid crystals are investigated and high diffraction efficiency is demonstrated. The optical and electrical control of their optical properties are tested and compared.

MO-P6-5 **15 h 45**

Optical Characterization of Thin Dichromated Poly (Acrylic Acid) Films, **R. Beaulieu***, R.A. Lessard*, M. Bolte[b], (a) *Centre d'optique, photonique et laser, Université Laval*, (b) CNRS, Clermont-Ferrand, France — Thin dichromated poly (acrylic acid) films with dimethylformamide have been used to photofabricate surface relief gratings. The formation of these gratings is subsequent to the illumination at a wavelength of 442 nm and is obtained without any chemical treatment or wet processing. Experiments have been conducted to verify if the formation of these gratings comes with a variation of the index of refraction of the self-developing photopolymer system. Experimental results that will be presented show that the coefficient of reflection of the illuminated regions is much higher than the one of the nonilluminated regions. This high contrast of reflectivity could lead to the photofabrication of passive optical components.

MO-P6-6 **16 h 00**

Étude des aberrations de lentilles holographiques *in-situ* dans le proche infra rouge, **F. Bouguin**, *Université Laval* — Nous avons enregistrer des lentilles holographiques sur un matériaux à base de cristaux liquides dispersés dans une matrice polymère et photosensible dans le proche infrarouge (830nm). Le principal avantage de ce travail est l'enregistrement *in-situ*, qui consiste à écrire et à lire l'hologramme à la même place, sans aucun déplacement, ni ajustement après exposition, ni aucune procédure chimique, de plus cette méthode de couplage de la lumière dans une fibre optique est beaucoup moins coûteuse que ces concurrentes. Nous allons dans un premier temps étudier les deux approches qui ont été générées pour créer cette lentille holographique; l'utilisation d'un laser TitaneSaphir afin de démontrer l'efficacité de la méthode et l'utilisation d'une diode laser bon marché à 830nm pour coupler la lumière

dans une fibre optique. Les différentes caractéristiques de ces deux hologrammes comme la tolérance angulaire, la tolérance sur la position, la focale et le profil d'intensité sont étudiées Dans un deuxième temps nous avons étudié les aberrations des deux types de lentille holographique suivant les lois de Seidel. Une comparaison des aberrations chromatiques, sphériques, l'astigmatisme et la distorsion est réalisée entre les deux lentilles holographiques et une lentille en BK7.

MO-P6-7 **16 h 15**

L-Band Multi-Wavelength Oscillating in Erbium-Doped Fiber Ring Lasers*, **Q. H. Mao** and J. Lit, *Wilfrid Laurier University* — Multi-wavelength fiber lasers could be very cost-effective sources for wavelength division multiplexing (WDM) systems and networks. Such lasers have been built with erbium-doped fiber (EDF) for the C-band (1529 to 1565nm) with various intra-cavity comb filters inserted into linear and ring cavities [1-3]. We have studied an L-band (1568 to 1610nm) multi-wavelength erbium-doped fiber laser (EDFL) by using a tunable Fabry-Perot etalon as the intra-cavity comb filter. We have succeeded in making such a laser by suppressing the backward ASE and reusing it to improve L-band gain, and by optimizing the cavity Q factor to keep the gain spectra of the EDF flattened. The number of lasing wavelengths increases as the FSR of the etalon decreases, but the stability becomes more critical because of multi-mode competition. At room temperatures, we have successfully obtained 5 stable lines separated by 2nm. This separation is limited by the inhomogeneous boarding effect of the gain medium.

[1] A.J. Poustie, N. Finlayson, and P. Harper, *Opt. Lett*, **19** (10), 716 (1994).
[2] J. Chow, G. Town, B. Eggleton, M. Ibsen, K. Sugden, and I. Bennion, *IEEE Photon. Technol. Lett.*, **8** (1), 60 (1996).
[3] N. Park and P. F. Wysocki, *IEEE Photon. Technol. Lett.*, **8** (11), 1459 (1996)

*Research work supported in part by CIPI and NSERC.

[MO-P7] CLASSICAL AND SEMI-CLASSICAL SYSTEMS
SYSTÈMES CLASSIQUES ET SEMI-CLASSIQUES
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D103

MONDAY, JUNE 18
LUNDI LE 18 JUIN

MO-P7-1 **14 h 15**

Control Analysis of a Double Pendulum System, **S. Peles,** *University of Manitoba* — Lyapunov's direct method has, for a long time, been the main tool used in control design for nonlinear systems in engineering, as it provides a mathematically rigorous proof of stability. A key aspect of this technique is that it does not require solving the equations of motion. However, the method can only provide a sufficient condition for stability, and does not address questions related to, for example, control optimization or transient behaviour of the system. We demonstrate how one can utilize some of the methods developed in recent years for the study of nonlinear equations of motion to improve some aspects of traditional control design. We demonstrate these ideas for the case of an inverted double pendulum, which is a commonly used model in robotics, and compare the results to those found with traditional methods

MO-P7-2 **14 h 30**

Particle Swarm Optimization and the Lennard-Jones Problem, **R.J.W. Hodgson**, *University of Ottawa* — Particle Swarm Optimization (PSO) is a recently-developed optimization tool for use in locating optimal function values in multi-variate problems. It is motivated by the behaviour of organisms such as fish schooling and bird flocking. PSO is an evolutionary computation technique which utilizes a population-based search procedure, significantly different from the natural selection component of Genetic Algorithms. In a PSO system a search is conducted using a population of particles, corresponding to individuals. Each individual represents a potential solution to the problem at hand. In our study we present an application of PSO to the familiar Lennard-Jones optimization problem and compare results with those obtained using basic and hybrid Genetic Algorithms.

MO-P7-3 **14 h 45**

A Study of the Fourier Transform of the Gravitational Wave Signal from a Pulsar, **S. Vallurl**[a], F.A. Chishtie[a], M. Davison[a], R. Biggs[a], B.S. Satyaprakash[b], S.V. Dhurandhar[c], (a) *University of Western Ontario*, (b) University of Cardiff, UK, (c) Inter-University Centre of Astronomy and Astrophysics, Pune, India — We present a Fourier transform of the gravitational wave (GW) signal from pulsars. Due to the rotation and orbital motion of the Earth, a monochromatic GW signal becomes frequency and amplitude modulated. The bandwidth about the signal frequency of the wave becomes an important aspect due to the Doppler modulation. We have obtained an analytic closed form of the Fourier transform, considering both the rotational and orbital motion of the Earth. We make a detailed numerical analysis of the Fourier transform and study its dependence on the bandwidth and the angular momentum l. This study will be a precursor to Principal Component Analysis which could facilitate the choice of search templates in a multidimensional parameter space dependence of a pulsar source

MO-P7-4 **15 h 30**

Extending the Gutzwiller Trace Formula to Systems of Two Identical Particles, **J. Sakhr**, *McMaster University* — We consider the extension of the Gutzwiller trace formula to systems of two identical particles. We first present the case of two noninteracting particles where the presence of a continuous symmetry causes the periodic orbits to appear in continuous families. Identical particles also introduce a discrete permutational symmetry into the problem. The semiclassical symmetry decomposition of the full density of states into bosonic and fermionic densities will then be discussed. Interparticle interactions break up the periodic orbit families into a discrete set of isolated orbits. We explore the effect of weak interactions which can be analysed using classical perturbation theory. Numerical results are presented for the two-particle cardioid billiard.

MO-P7-5 **15 h 45**

Explicit Convergence of Born Series for Simple Perturbations: Comparison with Multiple Reflection Approach, **Gregory V. Morozov**, Roman Gr. Maev, and G.W.F. Drake, *University of Windsor* — The Green's function method provides a powerful tool for finding solutions to problems involving the propagation of electromagnetic or acoustic waves through non-ideal layered structures. A general method of construction of the Green's function for finite one-dimensional inhomogeneous layers is developed. Then, we show how to make practical use of this function for the calculation of the reflection coefficient. After that, we make a comparison for some simple cases between Neumann (Born) series and the sequence of multiple reflection approach for the same coefficient.

MO-P7-6 **16 h 00**

Exact vs. Quasi-Classical Tunneling Times For Idealized Potentials, **Mark R.A. Shegelski**[a], Matthew Reid[b], and Roman Holenstein[a], (a) *University of Northern British Columbia*, (b) University of Alberta — We compare the exact tunneling time with the quasi-classical tunneling time for idealized potentials. We examine three one-dimensional cases where the potential is chosen to have a simple form. In each case, the exact tunneling time and the quasi-classical time differ significantly. In one case, the two differ in magnitude by a factor of up to about ten. In another case, the two differ not only quantitatively, but qualitatively as well. A discussion will be given as to why the two times are significantly different

[MO-P8] NEW METHODS - MESOSCOPIC PHYSICS
NOUVELLES MÉTHODES - PHYSIQUE MÉSOSCOPIQUE
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D101

MONDAY, JUNE 18
LUNDI LE 18 JUIN

MO-P8-1 **14 h 15**

Modification of Electron Transmittance Through Au/Si Interfaces During Ballistic Electron Emission Microscopy, **A.Chahboun**[a,b], R. Coratger[b], R.P. Lu[a], and K.L. Kavanagh[a], (a) *Simon Fraser University*, (b) CEMES-CNRS, France — We present Ballistic Electron Emission Microscopy (BEEM) results showing *in situ* modifications in Au/Si and Au/SiO_2/Si contacts. These modifications are attributed to STM tip effects on the gold surface. We have been able to enhance or reduce in a controlled manner the BEEM current yield through the interface. X-ray reflectivity measurements of the average surface roughness shows less surface evolution for thicker Au layers, correlated with greater evolution of deformation observed in BEEM images

MO-P8-2 **14 h 30**

Tomographic Reconstruction of Multiple In-line Holograms for Multiple Scattering in Low Electron Holography, **Michael B. Whitwick**, Mark R.A. Shegelski, Roma Holenstein, and Timothy A. Rothwell, *University of British Columbia* — Using the theory of the low energy electron point source (LEEPS) microscope with multiple scattering accounted for, we simulated LEEPS holograms for various objects (atomic cluster). Different holograms for this object were create by varying the relative position of the object to the screen. Combining the holograms for an object vastly improved the reconstructions even when multiple scattering is important.

MO-P8-3 **14 h 45**

Large Electron Transport & Muonium Formation, **J.H. Brewer***, G.D. Morris[b], (a) *University of Bntish Columbia*, (b) TRIUMF — Muonium -(μ^+e^- or Mu) is known to form when energetic positive muons (μ^+) are stopped in virtually all insulators and semiconductors. Suppression of characteristic Mu precession signals by applied electric fields shows that muonium formation often proceeds *via* transport of excess electrons from the μ^+ ionization track to the muon. This phenomenon allows study of electronic transport and polaron formation on a 10-100 nm distance scale using standard μSR techniques. The method will be described and several examples discussed, including Si, GaAs, SiO_2, Al_2O_3, CdS and rare gas solids

MO-P8-4 **15 h 30**

Persistent Currents Through a Quantum Dot, I. Affleck and **P. Simon**, *University of British Columbia* — We have studied the persistent currents induced by the Aharonov-Bohm effect in a closed ring which either embeds or is directly coupled to a quantum dot at Kondo resonance. We predict that, in both cases, the persistent current is very sensitive to the ratio between the length of the ring and the size of the Kondo screening cloud which appears as a fundamental prediction of scaling theories of the Kondo effect. Persistent current measurements, therefore, provide an opportunity to detect this cloud which has so far never been observed experimentally.

MO-P8-5 **15 h 45**

Theory of the Spin Singlet Electronic Droplet in a Lateral Quantum Dot, **Wensauer Andreas** , Marek Korkusinski and Pawel Hawrylak, *National Research Council Canada* — We present results of calculations of the electronic properties of the spin singlet electronic droplet at filling factor $\nu = 2$ in a lateral quantum dot as a function of the magnetic field B and the number of electrons N. The parabolic quantum dot with two lowest Landau levels is studied using restricted Hartree Fock and exact diagonalization methods. The stability of the spin singlet droplet at high magnetic fields is determined by the spin flip excitation localized at the edge of the droplet. The stability at low magnetic fields is determined by a spin flip excitation involving one electron at the edge and one electron in the second (HF) Landau level localized in the center of the droplet. We show that the spin singlet droplet vanishes at a critical number of electrons N_c. Above this critical number the even electron droplet evolves directly from a spin triplet state with one electron in the center and one in the edge to a state with spin polarized edge. We discuss how these spin transitions for even electron numbers combined with spin transitions for odd electron numbers manifest themselves in the addition and amplitude spectrum of a quantum dot in transport experiments. The results of HF calculations are compared with exact diagonalization studies and a connection between these effects and the Kondo effect is made.

MO-P8-6 **16 h 00**

Excitation Spectra of Few-Electron Quantum Dots, **Jordan Kyriakidis**, Andreas Wensauer, Marek Korkusinski, and Pawel Hawrylak, *National Research Council of Canada* — We present results of excitation spectra of laterally-confined few-electron droplets in a magnetic field. The quantum dots studied include parabolic quantum dots and a deformed quantum dot recently developed at NRC [1]. The ground and excited states are calculated using both direct and modified exact diagonalisation techniques. The modified technique combines Hartree calculations with total-spin resolved exact diagonalisation utilising damped gradient iteration and spectrum folding. The study focuses primarily on the combined effects of kinetic energy quantisation, electron-electron interaction, and quantum dot deformation on the ground and excited states as a function of electron number and magnetic field. We account for deviations from the axially-symmetric parabolic potential [1] by diagonalising the Hamiltonian of the deformed system using the ground and excited states obtained from the unperturbed interacting system.

[1] M. Ciorga, A.S. Sachrajda, P. Hawrylak, C. Gould, P. Zawadzki, S. Jullian, Y. Feng, and Z. Wasilewski, *Phys. Rev.* **B61**, R16315 (2000).

MO-P8-7 **16 h 15**

Phononic Crystals*, **S. Yang***, J.H. Page*, M.L. Cowan*, Z. Liu[b], C.T. Chan[c] and P. Sheng[c], (a) *University of Manitoba*, (b) South China University of Technology, (c) Hong Kong University of Science and Technology — The propagation of ultrasonic waves through 3-dimensional phononic crystals has been investigated using pulsed techniques. The crystals used in these experiments are fcc close-packed arrays of 0.800-mm-diameter tungsten carbide beads immersed in water. This system has a complete phononic bandgap at ultrasonic frequencies around 1 MHz. The transmission coefficients, dispersion curves, phase velocities and group velocities were measured along the [111] direction for frequencies in and around the gap. We also "imaged" the wave field at the surface of the crystal. At frequencies in the gap, we have directly observed the tunneling of ultrasound through the band gap. Our experimental results are interpreted using Multiple Scattering Theory (MST)[1], which provides a good explanation of our experimental data.

[1] Z. Liu, C.T. Chan, Ping Sheng, A.L. Goertzen and J.H. Page, *Phys. Rev.* **B62**, **2446** (2000).

* Work supported by NSERC and RGC (Hong Kong).

MO-P8-8 **16 h 30**

Particle Velocity Fluctuations in Fluidized Suspensions: System-Size Dependence*, **M.L. Cowan***, J.H. Page*, D.A. Weitz[b], (a) *University of Manitoba*, (b) Harvard University — We have used two new ultrasound scattering techniques, Diffusing Acoustic Wave Spectroscopy and Dynamic Single Scattering [1], to investigate the system-size dependence of particle velocity fluctuations in fluidized suspensions. In these experiments, the suspensions consisted of glass beads in a water/glycerol mixture at a particle Reynolds number of 1. Using these techniques, we have measured all three components of the rms particle velocity fluctuations, as well as the average velocity correlation length, at volume fractions ranging from 0.04 to 0.50. As the smallest cell dimension is increased, there is a marked increase in at least one component of the velocity fluctuations at all volume fractions; however the variation is not the same for all three velocity components. Our results suggest that the system-size dependence of the velocity fluctuations may be more complex than suggested by recent scaling arguments for sedimenting suspensions [2].

[1] M.L. Cowan, J.H. Page, and D.A. Weitz, *Phys. Rev. Lett.* **85**, 453 (2000).
[2] M.P. Brenner, *Phys. Fluids* **11**, **754** (1999)

* Research supported by NSERC

MO-P8-9 **16 h 45**

Using Phase Fluctuations of Multiply Scattered Ultrasonic Waves to Measure Particle Dynamics in Fluidized Suspensions, **J.H. Page***, M.L. Cowan*, B.A. van Tiggelen*, (a) *University of Manitoba*, (b) Université Joseph Fourier, Grenoble — We have measured the fluctuations in the phase of ultrasound transmitted through a very strongly scattering, fluidized suspension of glass beads in a glycerol/water solution. Through the use of the diffusion approximation for wave propagation, and by assuming circular Gaussian statistics for the field fluctuations, we are able to model the statistics of the phase, and relate the phase difference probability distribution to the relative motion of the scattering particles. The phase distributions are in excellent agreement with our model, giving us a new way of investigating the particle dynamics. These measurements of the particle motions are in good agreement with our results obtained from the temporal field autocorrelation function in Diffusing Acoustic Wave Spectroscopy [1].

[1] M.L. Cowan, J.H. Page and D.A. Weitz, *Phys. Rev. Lett.* **85**, 453 (2000).

PLENARY SESSION / *SESSION PLÉNIÈRE*
[MO-LUM] LUMONICS BEST STUDENT PAPER COMPETITION — MONDAY, JUNE 18
COMPÉTITION LUMONICS — *LUNDI LE 18 JUIN*
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D287

15h00 - Greg Ballentine, *University of Alberta*, Correspondence of Micromagnetic Simulation to Time-Resolved Experiment (see abstract TU-P6-2)
15h15 - Suxia Yang, *University of Manitoba*, Phononic Crystals (see abstract MO-P8-7)
15h30 - Roes Arief Budiman, *University of Toronto*, Equilibrium Theory of Coherent Quantum Dot Formation (see abstract TU-P7-1)
15h45 - Binod KC, *University of Calgary*, Optimal Use of Photon Counting Photomultipliers for Biophoton Measurements of Cartilage Tissue and Cultured Fibroblast Cells (see abstract WE-A4-1)
16h00 - Laurette McCormick, *University of Ottawa*, Free-Solution Conjugate Electrophoresis for the Determination of Polymer Solution Polydispersity (see abstract MO-A9-2)
16h15 - Gregory Morozov, *University of Windsor*, Explicit Convergence of Born Series for Simple Perturbations: Comparison with Multiple Reflection Approach (see abstract MO-P7-5)
16h30 - Abdulwahab Khalil Sallabi, *Concordia University*, Structures and Stability of CO and N_2 Physisorbed on MgO: Descending The Devil's Staircase (see abstract TU-P7-5)

[MO-POS] POSTER SESSION — MONDAY, JUNE 18
SESSION AFFICHE — *LUNDI LE 18 JUIN*
IMMEUBLE MACLAURIN BUILDING, LOBBY / FOYER

Poster abstracts start on page 77. / Les résumés de la session d'affiche débutent à la page 77.

PLENARY SESSION / *SESSION PLÉNIÈRE*
[TU-A1] OUTSTANDING ACHIEVEMENT IN INDUSTRIAL AND APPLIED PHYSICS MEDAL WINNER — TUESDAY, JUNE 19
RECIPIENDAIRE DE LA MEDAILLE DE L'ACP POUR CONTRIBUTIONS EXCEPTIONNELLES EN PHYSIQUE INDUSTRIELLE ET APPLIQUÉE — *MARDI LE 19 JUIN*
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE A144

TU-A1-1 **08 h 30**

H. **ROY KROUSE**, University of Calgary

Stable Isotopes: A Universal Research Tool

Measurements of stable isotope abundances are applied in three basically different ways; (1) Isotope dilution analyses; (2) stable isotope labelling/tracing, and (3) determining isotope fractionation in radioactive and mass dependent conversions. Isotope dilution analyses embrace such diverse applications as measuring the total body water content of humans and trace concentrations of elements in manufactured materials. Isotopic labels contain elements with markedly different isotope compositions than those of the media to which they are introduced. During an experiment, the label may become mixed with isotopes of the particular element in the medium (isotope dilution) and/or undergo isotope fractionation. If the latter is extensive, isotope dilution analyses and tracing can be compromised. Industrial pollutants may have isotopic compositions distinctly different from those of environmental receptors. Hence, some operations such as sour gas processing have unintentionally set up regional scale experiments to trace the fate of their emissions into ecosystems.

Radiogenic stable isotopes have been used extensively for geochronology and monitoring nuclear reactor operations. Mass dependent isotope fractionation embraces exchange reactions with temperature dependent equilibrium constants as well as uni-directional conversions. The former are the basis for geothermometers. The latter embrace physical processes (diffusion, evaporation/condensation) and kinetic isotope effects during bond rupture in chemical/biochemical conversions. Stable isotope abundance data have been applied to many diverse topics including paleodiets, migration of whales, food adulteration, medicine, forensic science, sewage reactors, paleoclimate, stratified lakes, ice sheet dynamics, fossil fuel exploration/utilization, establishing sources of natural (food, ivory, etc.) and manufactured products, ore deposits, and meteorites. Subjects have ranged from bacteria to mammoths. With recently developed techniques, such as sampling by laser probing, processes have been studied over distances of microns. At the opposite extreme, the history of our universe has been elucidated with stable isotopes. In the early 1950's, there were perhaps a dozen stable isotope ratio mass spectrometry laboratories world-wide, in contrast to the hundreds functioning today.

PLENARY SESSION / *SESSION PLÉNIÈRE*
[TU-A2] (DCMMP) — TUESDAY, JUNE 19
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE A144 — *MARDI LE 19 JUIN*

TU-A2-1 **09 h 15**

CARLO MONTEMAGNO, Cornell University

Nanomachines: A Roadmap for Realizing the Vision

Scientists and engineers have anticipated the potential benefits of integrating engineered devices to living systems at the molecular level for many years. Such devices offer the potential of taking advantage of the best attributes associated with both worlds. Hybrid living/non-living systems can potentially possess many of the essential properties of life such as the abilities to "intelligently" self-assemble, repair, and evolve. We will present the results of our efforts to incorporate biological energy transduction processes and cell signaling pathways into engineered nanofabricated devices. In particular, we will illustrate our strategy for fueling, controlling and integrating a recombinant, thermostable F1-ATPase biomolecular motor with a NEMS to create an engineered hybrid device.

Included in the presentation will be the initial results of our efforts to develop and demonstrate an integrated F1-ATPase powered NEMS device that is fueled by light-driven ATP production. ATP is synthesized from light using artificial liposomes (ca. ~150 nm in diameter) comprised of reconstituted FoF1-ATP synthase and bacteriorhodopsin. Subsequently, the ATP is used to provide energy to power a recombinant, thermostable F1-ATPase biomolecular motor (ca. ~12 nm) that is coupled to a NEMS device. Our current analysis indicates that a light collection area as small as 500 nm^2 will provide enough energy to power each F1-ATPase biomolecular motor. A single F1-ATPase biomolecular motor can generate a torque consistent with the force required to move engineered nanomechanical structures. We will also present our technique for integrating nanomechanical structures to biomolecular motors with a precision of 40 nm. Scientists and engineers have envied the elegance of molecular level energy transduction in living systems for many years. This work capitalizes on a core feature of living systems, the capability of transforming diverse sources of energy into a generic energy currency that can be universally used. The integration of a synthetic photosynthetic system with NEMS establishes a new mechanism for fueling the next generation of nanoelectromechanical devices. Light is used to produce ATP from ADP and P, the ATP is used by the F1-ATPase biomolecular motor to produce work with ADP and P as waste products. Ultimately, we anticipate that this chemically closed system will be used to pump fluids, open and close valves in microfluidic devices, provide locomotion, and possibly generate electricity. The potential applications for sub-micron size, light powered, autonomous devices or "Smart Dust" are many including long-lived microscopic intelligence and environmental sensors.

[TU-A3] MAGNETISM / *MAGNÉTISME*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D110

TUESDAY, JUNE 19 / *MARDI LE 19 JUIN*

TU-A3-1 **10 h 00**

DAVID VENUS, McMaster University

Surface-Driven Magnetic Phenomena in Ultrathin Films Studied Using AC-Susceptibility

In ultrathin films (1-10 monolayers in thickness) the presence of surfaces and interfaces produces changes in symmetry, geometry and co-ordination which cause many aspects of ferromagnetism to be expressed differently than in bulk samples. Well-known examples are a reduction in the Curie temperature and dimensionality of phase transitions, alteration of the magnetic anisotropy, and the appearance of magnetic coupling between separated ferromagnetic layers as used in spin valves. Many practical magnetic properties of ultrathin film are also altered by the different character and behaviour of magnetic domains and domain walls in these systems. This talk illustrates these effects, using measurements of the AC-susceptibility made *in situ* with the magneto-optic Kerr effect (MOKE). Particular emphasis is given to magnetic domain formation and domain wall motion in a class of uitrathin films where the magnetization vector is perpendicular to the surface. In these systems, the domain density changes exponentially with temperature, and alters, for example, the expression of the magnetic phase transitions. The properties of the domains are in turn strongly influenced by the film structure. The influence of chemical mixing at interfaces and of monolayer steps in thickness at the surface can be understood using simple models.

TU-A3-2 **10 h 30**

ROBERT COCHRANE, Université de Montréal

Metallic Multilayers

Metallic multilayer structures provide useful artificial configurations for studying a wide range of physical phenomena ranging from the formation of alloys to unusual magnetic and transport behaviour. In all these phenomena, the interface region between adjoining layers plays a crucial role in their properties. A well-known example is provided by ferromagnetic layers separated by non-magnetic inserts where interlayer magnetic coupling and giant magnetoresistance are observed. Disorder in the interface region can quickly suppress both effects as we have shown recently for Co/Cu multilayers. In these experiments, energetic MeV ion bombardment can be used to promote local atomic diffusion over a very short range, providing a controllable mechanism for generating interfacial mixing on a nanometer scale. In this presentation, structural modifications of several multilayer systems by energetic ions will be discussed as well as the associated effects on their magnetic properties

TU-A3-3 **11 h 30**

BYOUNG-CHUL CHOI, , University of Alberta

Magnetization Reversal Dynamics Studied by Time Resolved Kerr Microscopy

Picosecond time scale magnetization reversal dynamics in a 15nm thick Permalloy microstructure is studied using time-resolved scanning Kerr microscopy. The time domain images reveal a striking change in the magnetization reversal mode, associated with the dramatic reduction in switching time when the magnetization vector is pulsed by a longitudinal switching field while a steady transverse biasing field is applied to the sample. According to the time domain imaging results, the abrupt change of the switching time is due to the change in the magnetization reversal mode; i.e., the nucleation dominant reversal process is replaced by domain wall motion if transverse biasing field is applied. Furthermore, magnetization oscillations subsequent to reversal are observed at two distinct resonance frequencies, which sensitively depend on the biasing field strength. The high frequency resonance at f=2 GHz is caused by damped precession of the magnetization vector, whereas another mode at f=0.8 GHz is observed to arise from domain wall oscillation

TU-A3-4 **12 h 00**

DOMINIC H. RYAN, , McGill University

Neutrons, Muons and Gammas: Nuclear Probes of Frustrated Magnetic Order

To characterise the behaviour of a magnetic system, one generally starts by establishing the temperature at which the ordering sets in and then proceeds to bulk characterisation by susceptibility and magnetisation. However, when faced with the complex ordering induced by competing interactions, more detailed information is often needed: the magnitude of the ordered moment rather than its projection onto an externally applied field, the nature of the spin correlations, the length-scale over which they persist, and the fluctuation rate or characteristic relaxation time of those correlations.

[TU-A4] THE FRONTIERS OF BIOPHYSICS / *LES FRONTIÈRES DE LA BIOPHYSIQUE*

IMMEUBLE HSD BUILDING, ROOM / SALLE A240

TUESDAY, JUNE 19 / *MARDI LE 19 JUIN*

TU-A4-1 **10 h 00**

TERRY BEVERIDGE, University of Guelph

The Mother of All Corsets: The Bacterial Cell Wall

Microorganisms are the most abundant form of life on Earth and are capable of growing in almost any imaginable environment, from temperatures exceeding 100°C to below freezing, or under anaerobic or saturated salt conditions, to the more nourishing confines of the human gut. Prokaryotes (archaea and bacteria) share the common characteristics of having a relatively simple cellular design, minute size, and limited variation in shape. These traits ensure an extremely high surface area-to-volume ratio so that bacteria can better collect nutrients and expel wastes through diffusion. Since they live under the confines of diffusion, their surfaces possess a multitude of reactive chemical groups which interact strongly with solutes so that these can be transferred to the cytoplasm to be used in metabolism. Consequently, as a result of this and a semi-permeable membrane, a relatively large internal turgor pressure builds up (in the Gram-negative bacterium, Escherichia coli, this is ~ 300-500 kPa and in Gram-positive cells ~ 10-25x this pressure) that would explode the bacterium if a cell wall was not present.

Peptidoglycan is one of the major constituents of the walls of both varieties of bacteria and is a meshwork of linear polymers consisting of N-acetylglucosamine (GlcNac) - N-acetylmuramic acid (MurNac)dimers. The MurNac has a short peptide stem emanating from it that is capable of cross-bridging with adjacent peptidoglycan strands. This ultmately forms a huge macromolecular network that completely encases each bacterium (Gram-positive cells have more peptidoglycan than Gram-negatives), which is strong and elastic, and resists turgor pressure. Interfering with peptidoglycan metabolism (e.g., with penicillin) explodes the cell because the wall (with the aid of cellular autolysins) becomes defective and cannot resist the pressure. Gram-negatives have a complex wall with an asymmetric lipid-protein bilayer on top which overlies a thin peptidoglycan layer. This outer membrane contains lipopolysaccharide (LPS) as its sole surface lipid and its charge is 2-6x greater than a typical phospholipid per exposed surface area. LPS consists of three separate molecular regions, lipid A (the hydrophobic domain), core oligosaccharide and O-sidechain. Most charge resides between the upper lipid A and core portions and are due to ionizable phosphate and carboxylate groups which are important for salt-bridging adjacent molecules together via Mg2+ and Ca2+. The O-sidechain appears to be quite flexible but can also be highly charged.

Because of their highly reactive surfaces, all bacteria must live with a serious problem; they interact strongly with multivalent inorganic ions in the environment, collecting and precipitating them from solution. Eventually, their surfaces can form fine-grained mineral phases that can completely encase the cell but which are indirectly important for secondary mineral development in soils, sediments and aqueous environments. Microbes are constantly reworking the very ground on which we walk. Indeed, much of our evidence that the dawn of life on Earth occurred ~3.6 billion years ago stems from such mineralized remains of prokaryotes (e.g., the microfossils of the Gunflint chert of Northern Superior) which are still in evidence My talk will overview recent advances in the structure, biophysics and biogeochemistry of bacterial surfaces.

TU-A4-2 **10 h 30**

JIRI VRBA, CTF Systems Inc., Subsidiary of VSM MedTech Ltd.

Brain Magnetometry: From Fetus to Adult

Whenever we think, minute currents flow within our brains and produce tiny magnetic fields outside the head. These fields can be measured and used to draw inferences about the state of the brain itself. The only practical way to detect such small fields is to use superconducting sensors, known as SQUID magnetometers. The branch of science concerned with the magnetic field of the brain is called MagnetoEncephaloGraphy (or MEG) and is used to diagnose brain illnesses or to study functioning of a normal brain. MEG systems are complex instruments incorporating cryogenic detectors, sophisticated electronics, magnetic shielding and a large number of peripherals. They allow measurement of brain signals with the subject in a seated or supine position and utilize a range of advanced noise cancellation methods, and software for data collection and interpretation. The brain fields are not only small, but are also overshadowed by magnetic noise from the environment. To distinguish between the near field brain signals and the mostly far field magnetic noise, the SQUID detectors are configured as higher-order spatial gradiometers. Since modern MEG systems have hundreds of SQUID sensors, the higher-order gradiometers are formed synthetically. The brain fields in themselves, however, are not too interesting to a brain surgeon or a scientist. They need to know the current distribution within the brain. Unfortunately, the inversion of the magnetic field into a 3D current distribution is nonunique. To avoid this problem, various mathematical simplification and/or assumptions have been developed, leading to a wide range of methods for estimation of the brain activity. One class of successful methods takes advantage of the large number of SQUID sensors and utilizes array techniques originally developed in radar and underwater sonar work. These methods can produce striking volumetric images of the brain's electrical activity. Another interesting MEG application is the instrument for the measurement of fetal brain signals (fMEG). The sensitive end of these instruments is configured to cover the pregnant mother's abdominal surface extending from the perineum to the top of the uterus. The mother sits upon and leans against the sensor array, the fetus is stimulated (auditory or visual) and the magnetic responses are measured. The fetal MEG recordings are performed in the presence of strong fetal and maternal heart interference and extraction of the fetal brain signal represents a challenging signal processing problem. fMEG and MEG instruments are now being produced commercially and are operated in many laboratories around the world.

TU-A4-3 **11 h 30**

R. BRUCE LENNOX, McGill University

Self-Assembled Monolayers As Models of Bilayer Lipid Membranes

Self-assembled monolayers based on the chemisorption of alkylthiols to gold are the subject of continued interest in the surface science and surface engineering communities. They are particularly attractive because of their ease of preparation and manipulation. Despite the many characterization studies, relatively little is known (or asked) about the relationships between the monolayer film structure, chain dynamics, and function of the monolayer as a barrier to electron and ion transport. Because they have a resemblance to lipid membranes in terms of chain organization, we have studied the detailed phase/structure/permeability relationships in a variety of self-assembled films. Results will be discussed as to how these monolayers in fact respond to temperature, electric field, and chemical stimuli in a manner very analogous to lipid membranes. Calorimetry, ^{2}H NMR, FT-IR, and AC-electrochemical impedance spectroscopy provide a convergent picture of how these perturbants affect the monolayers. The analogy to lipid membranes has allowed us to use a protein-doped monolayer as a cell membrane mimic in biosensor applications.

TU-A4-4 **12 h 00**

ANDRÉ MARZIALI, University of British Columbia

Nanopores and Capillaries: Advances in DNA Analysis

Though genomic information holds promise for revolutionary changes in medicine, drug discovery, and our understanding of biology, we are still limited by the rate at which we can sequence genomic DNA and find differences and similarities between different organisms. Presently DNA sequencing is performed using capillary electrophoresis at a cost of a few dollars per sample (~ 500 nucleotides of information) and at a throughput of 96 samples/instrument / 3 hrs. This remains an exorbitant cost for the sequencing of mammalian genomes (~3 x 10^{9} nucleotides). Possible new technologies for higher throughput and less expensive sequencing include silicon chip based devices and nanopore sensors capable of single molecule detection of DNA. The promise and challenges involved with developing such devices for DNA analysis will be discussed.

[TU-A5] NEUTRINOS AND ASTROPARTICLE PHYSICS / *NEUTRINOS ET ASTROPARTICULES*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D103

TUESDAY, JUNE 19 / *MARDI LE 19 JUIN*

TU-A5-1 **10 h 00**

MARK G. BOULAY, Queen's University, for the SNO collaboration

Solar Neutrino Measurements with the Sudbury Neutrino Observatory

The Sudbury Neutrino Observatory is a large water Cerenkov neutrino detector with D_2O as the sensitive target material. SNO has been designed to provide sensitive tests for neutrino oscillations by measuring the flux and energy spectra of the solar ^{8}B neutrinos. The experiment has several phases, each with a different sensitivity to neutral currents. The first operational phase uses pure D_2O as the neutrino target. We have been collecting data in this phase, in which we are most sensitive to charged current (CC) and elastic scattering (ES) interactions, since May 1999. We present here, as results from the D_2O data, a pure charged-current and an elastic-scattering ^{8}B neutrino flux measurement. Emphasis of the talk will be on the analysis techniques used for the solar neutrino signal extraction.

TU-A5-2 **10 h 30**

LOUIS LESSARD, Université de Montréal

The PICASSO Project: Towards the Detection of Cold Dark Matter

Cold dark matter has been shown more and more convincingly to consist mainly of non-baryonic particles of which a candidate of choice could be the neutralino of super-symmetry. Present mass limits obtained at LEP and theoretical cross section estimates indicate that the sensitivity of all detection systems being developed must be substantially increased in order to detect such particles in the galactic environment. We will show, using the detection limit obtained by PICASSO, with a system of 20 10-ml detectors, what sensitivity could be obtained with the superheated droplet technique. A new fabrication process is being used which allows the construction of much larger detectors; presently, detectors of more than one liter volume, which represent a factor of 100 gain in sensitivity, are being produced and 6-liter detection units are feasible. This detector size would allow PICASSO to be at the forefront of the spin-dependent neutralino-proton cross section detection capability. We will discuss the gain in sensitivity now within reach, measurements in progress, and what future developments are being envisaged. The emphasis of the presentation will be on the instrumentation and experimental aspects of the project, and a realistic timescale for a large and competitive cold dark matter detector will be discussed.

TU-A5-3 **11 h 30**

Through-Going Muons in the Sudbury Neutrino Observatory. **C.E.Waltham**, *University of British Columbia*, for the Sudbury Neutrino Observatory collaboration — We present initial physics results from observing through-going cosmic ray muons in the Sudbury Neutrino Observatory (SNO). Most of these events are very high energy downward muons produced by meson decay in the atmosphere. These yield information on the rate, energy spectrum and atmospheric interactions of cosmic rays. The remainder are horizontal and upward muons produced by the interaction of atmospheric neutrinos in the rock surrounding SNO. We are uniquely able to see neutrino-induced muons coming from above the horizontal. The angular distribution of these muons is sensitive to neutrino oscillations.

TU-A5-4 **11 h 45**

DOUGLAS GINGRICH, University of Alberta

The Status of the STACEE Project

The Solar Tower Atmospheric Cherenkov Effect Experiment (STACEE) is a new ground-based atmospheric Cherenkov telescope for gamma-ray astronomy. A prototype telescope was used to observe high energy gamma-ray emission from the Crab Nebula and set a limit on the pulsed emission from the Crab Pulsar. The full STACEE has recently been commissioned and a three year observing period has begun. This talk will present the first observations made with the complete telescope

[TU-A6] PROGRESS IN PHYSICS WITH COOLED AND TRAPPED ATOMS I / *PROGRÈS EN PHYSIQUE DES ATOMES FROIDS ET PIÉGÉS I*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D111 — TUESDAY, JUNE 19 / *MARDI LE 19 JUIN*

TU-A6-1 **10 h 00**

GENE SPROUSE, Sunnybrook

*Atomic Probes of Electromagnetic and Weak Interactions with Trapped Radioactive Atoms**

The alkali element francium has a simple electronic structure, and copious amounts of a wide range of isotopes can be produced in present and future rare isotope facilities. Atomic trapping methods now offer new ways to study these atoms with precision, and we will discuss some of our recent measurements with trapped Fr atoms. Future measurements of the spin independent weak interaction can be used to test the Standard Model, but advances in atomic theory and improved understanding of the neutron distribution in nuclei are needed to make progress. We have made precise hyperfine anomaly measurements in Fr and have shown that they have some sensitivity to the radial distribution of the neutron magnetization. Measurements of this type can help to constrain the neutron distributions.

The anapole moment of a nucleus is a parity non-conserving (PNC), time reversal conserving moment that arises from weak interactions between the nucleons. It can only be detected in a PNC electron-nucleus interaction. We are studying the earlier suggestion[1] of directly measuring the probability of E1 transitions between the ground hyperfine states of an atom, allowed only through the anapole moment, with the present possibilities of atom manipulation. The light Fr isotopes, five of them available at the Stony Brook superconducting LINAC, form a suitable system in which to study nuclear anapole moments since the shell model provides a good description of the nuclear structure. Future measurements of the nuclear anapole moments for a sequence of isotopes should allow separation of the neutron and proton weak interaction between hadrons.

[1] C.E. Loving, and P.G.H. Sandars, *J. Phys.* **B10**, 2755 (1977); V.G. Gorshkov, V.F. Ezhov, M.G. Kozlov, and A.I. Mikhailov, *Sov. J. Nucl. Phys* **48**, 867 (1988)

*This work was supported by the NSF.

TU-A6-2 **10 h 30**

J.A. BEHR, TRIUMF

Beta-Neutrino Correlations with Optical Traps

Lasers can be used to cool and trap neutral atoms. Such techniques won the 1997 Nobel Prize for Chu, Phillips, and Cohen-Tannoudji, and are revolutionizing a number of subfields of atomic physics. At TRIUMF, we are applying these techniques to a rather different problem, the study of nuclear beta decay. We use a Magneto-Optical Trap to capture beta-decaying nuclei and hold them suspended in space, free of any backing materials. By detecting the low-energy nuclear recoils in coincidence with the beta, we can reconstruct the neutrino momentum. The angular distribution of the neutrinos with respect to the β direction is predicted by the Standard Model, and deviations from that prediction are sensitive to new interactions

TU-A6-3 **11 h 30**

H. JUERGEN KLUGE, GSI, Darmstadt and University of Heidelberg, Germany

High–Accuracy Experiments with Ions Confined in Storage Rings or Ion Traps

Particles stored in ion traps or storage rings open up the possibility to study the properties of rare species with high accuracy and sensitivity. The talk will concentrate on recent high-accuracy mass measurements performed by use of the storage ring ESR at the heavy-ion accelerator GSI/Darmstadt and of the ISOLTRAP Penning trap mass spectrometer installed at the on-line isotope separator ISOLDE, CERN/Geneva. Furthermore, the g-factor measurement of the electron bound in hydrogen-like $^{12}C^{5+}$ and $^{16}O^{7+}$ will be presented as a precision test of QED. An outlook will be given on the HITRAP project aiming at g-factor and atomic binding energy measurements in extreme fields (e.g. U^{91+}) and the SHIPTRAP facility presently being built up for studies of the chemical, atomic, and nuclear properties in the region beyond uranium

TU-A6-4 **12 h 00**

Atomic Mass Measurements with the Canadian Penning Trap Mass Spectrometer. **J.Vaz**[a], R.C. Barber[a], C.Boudreau[b], F. Buchinger[b], J.A. Caggiano[c], J.A. Clark[a], J.E. Crawford[b], H. Fukutani[a], S. Gulick[b], J.C. Hardy[d], A. Heinz[c], J.K.P. Lee[b], M. Maier[c], R.B. Moore[b], G.Savard[c], J. Schwartz[c], D.Seweryniak[c], K.S. Sharma[a], G. Sprouse[c] and J.C. Wang[c], (a) *University of Manitoba*, (b) McGill University, (c) Argonne National Laboratory, (d) Cyclotron Institute, Texas A&M University — The Canadian Penning Trap (CPT) mass spectrometer, currently situated at the ATLAS facility of the Argonne National Laboratory, was designed to be able to measure the masses of a wide variety of nuclides, having half–lives as low as 50ms, to an accuracy approaching 1ppb of the mass. Mass measurements on nuclei far from the line of stability will provide crucial information on nuclear structure. Short lived radioactive isotopes produced online in fusion-evaporation reactions are mass separated, thermalized in a fast gas catcher, and transported to the precision measurement Penning trap via a configuration of radio-frequency quadrupole (RFQ) ion guides. Ion accumulation/cooling is done in a RFQ trap prior to Penning trap injection. A status of the experimental program at the CPT will be presented, highlighting the results obtained to this point, current performance and limitations of the system, as well as the current efforts to further improve the system.

[TU-A7] SEMICONDUCTORS (CONTRIBUTED) / *SEMICONDUCTEURS (COMMUNICATIONS)*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D114 — TUESDAY, JUNE 19 / *MARDI LE 19 JUIN*

TU-A7-1 **10 h 00**

Alpha Particle Spectroscopy as Applied to Textured Etch Processes*. **C. Kaiser**[a], J.F. Young[a], T. Tiedje[a], Y. Levy[a], K. Chen[a],I. Kelson[b], (a) *University of British Columbia*, (b) Tel Aviv University — We explore the practical utility of alpha particle energy loss spectroscopy as a monitor of etch depth and side-wall profiles in a Silicon-On-Insulator membrane structure

A 1D grating with a pitch of 5 microns was formed in a 1 micron thick Si film sandwiched between SiO_2 support layers (total membrane thickness of less than 2 microns). The energies of two peaks in the transmitted alpha particle spectrum directly reveal the etch depth. The background signal between the two peaks can be used to deduce the sidewall profile

*Work supported, in part, by the Israeli Ministry of Science,Culture and Sport

TU-A7-2 **10 h 15**

In-situ Stress Measurement During GaNAs Growth by Molecular Beam Epitaxy. **M. Adamcyk**[a], M. Warren[a], T. Tiedje[b], V. Fink[b], M. Jeffries[b], K. Kavanagh[b], (a) *University of British Columbia*, (b) Simon Fraser University — In this paper, we study the growth of dilute (nitrogen content <3%) GaNAs/GaAs and by molecular beam epitaxy. Cross section transmission electron microscopy measurements show that 300 nm thick films having nitrogen concentrations in the 2% range tend to relax their tensile strain by crack formation rather than by dislocation formation. During growth, we use an optical strain measurement technique that determines the substrate curvature by tracking the spacing between initially parallel laser beams reflected from the sample surface. The substrate curvature is related to the stress in the film via Stoney's equation. The apparatus can detect the change in curvature of a wafer on which 10 nm of 0.2% tensile strained material is deposited. 1% GaNAs thin films are found to build up stress linearly in time throughout the growth of 400 nm thick films, thereby indicating that the layer remains coherently strained during growth. The evolution of the stress in the film as the sample cools down is interpreted by considering the state of strain relaxation in the film and the difference in thermal expansion between the epilayer and the substrate. Results on the effect of In incorporation on the stress in GaNAs will also be presented

TU-A7-3 **10 h 30**

P-Type Carbon Doping of GaSb. **R. Wiersma**, J.A.H. Stotz, O.J. Pitts, M.L.W. Thewalt, S.P. Watkins, *Simon Fraser University* — The growth of carbon-doped GaSb by MOVPE has never been reported, to our knowledge, despite increasing interest in carbon-doped GaAsSb alloys for HBT applications[1]. An important issue is the question of how carbon affects the lattice constant of GaSb alloys at high doping levels. In this work, we report the use of carbon tetrachloride in conjunction with triethylgallium and trimethylantimony to achieve doping levels in GaSb from 1e17 cm^{-3} to greater than 1e19 cm^{-3}. High resolution X-ray diffraction measurements confirm that the effect of carbon on the lattice parameter is significant for doping levels above 1e19 cm^{-3} as in the case of GaAs. By introducing controlled low doping levels of carbon into thick homoepitaxial samples we have succeeded for the first time in identifying carbon-related low temperature photoluminescence bands, which we suggest are due to donor-acceptor pair and free-to-bound transitions of carbon acceptors. Temperature dependent Hall measurements show significant differences in bulk concentration and mobility in comparing undoped GaSb to carbon doped GaSb. By fitting the hole concentration vs. temperature curve activation energies of acceptors can be calculated and used for comparison to PL results.

[1] C.R. Bolognesi, S.P. Watkins, *Compound Semiconductor* **6**, 94 (2000).

TU-A7-4 **10 h 45**

Photoconductivity of Dilute GaNAs Alloys grown by Molecular Beam Epitaxy. **E. Strohm**[a], M. Adamcyk[a], B.J. Ruck[a], T. Tiedje[a], S. Watkins[b], (a) *University of British Columbia*, (b) Simon Fraser University — The photoconductivity of dilute and GaNAs alloy thin films has been measured as a function of wavelength and light intensity. GaNAs thin films with N-content between 0.5 and 2% were grown by MBE at 500°C on semi-insulating GaAs substrates with a RF plasma source for the nitrogen. From the spectral dependence of the photoconductivity, we are able to determine the optical bandgap and Urbach tail width. The Urbach tail width is found to increase with N-content, while the bandgap decreases. For GaNAs films with 0.75% nitrogen incorporation, the Urbach parameter which quantifies the width of the Urbach tail was found to be 10.2 meV with respect to 7.6 meV for GaAs. This suggests a larger disorder in the nitride films. From the magnitude of the photoconductivity we are able to estimate the density of deep levels. The effect of nitrogen content and thermal annealing on the Urbach tail, carrier mobility and density of deep levels will be presented.

[TU-A8] PHYSICS OF GASEOUS AND IONIZED MEDIA III / *PHYSIQUE DES MILIEUX GASEUX ET IONISÉS III*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D288

TUESDAY, JUNE 19 / *MARDI LE 19 JUIN*

TU-A8-1 ***10 h 00***

KONSTANTIN KABIN*, *University of British Columbia*

Exotic MHD Shocks: Possible Application to Mercury's Magnetosphere

Space plasmas are often described by the equations of ideal Magnetohydrodynamics (MHD). These equations allow for shocks associated with several different types of waves present in the system (fast, slow and Alfvenic) which is a significant complication compared with the ordinary gas-dynamics. Some of these shocks are expected to be unstable (nonevolutionary), but have been observed in numerous numerical models. We present some new theoretical results concerning the nonuniqueness of shock solutions involving nonevolutionary shocks in cases of strong magnetic fields, and discuss the possible appearance of these exotic discontinuities in the magnetosphere of planet Mercury.

* In collaboration with R. Shefer[b], S. Shortkroff[c], D. Gierga[a], X. Zhu[a], H. Jiang[a], (a) Department of Nuclear Engineering and Whitaker College of Health Sciences and Technology, MIT, (b) Newton Scientific Incorporated, Cambridge, MA, (c) Department of Orthopedic Surgery, Brigham and Women's Hospital, Boston, MA

TU-A8-2 **10 h 30**

CHIJIN XIAO, University of Saskatchewan

Plasma Confinement Studies on the STOR-M Tokamak

In the Plasma Physics Laboratory at the University of Saskatchewan, experimental investigation of plasmas for fusion purpose has been centred on the STOR-M tokamak, a gas discharge device which confines high temperature and high density plasmas using strong magnetic fields. Anomalous transport of plasmas in a controlled thermonuclear fusion device has been a major obstacle for good plasma confinement. Various techniques have been developed world-wide to achieve and to study high-confinement modes (H-modes) in tokamak devices. H-modes have also been induced by several techniques, including fast plasma current pulse, electrode biasing, and a novel method by compact torus injection. The H-modes in STOR-M are usually accompanied by significant density increase, prompt reduction in hydrogen emission lines, and an increase in the global energy confinement time. Extensive studies of the plasma parameters and their fluctuations in the plasma edge region have been conducted in order to reveal the fundamental mechanism leading to H-modes. Our experimental observations seem to support a widely-accepted model based on fluctuation suppression and decorrelation due to poloidal velocity shear. In some other cases, H-modes have also been induced without clear evidence of formation of a poloidal velocity shear. In these cases, the observed changes in the toroidal velocity profile may have played an important role for inducing the H-modes.

TU-A8-3 **11 h 30**

Y.Y. TSUI, University of Alberta

Laser-Plasma Applications

Research carried out on a number of applications involving laser produced plasmas will be discussed. In the first application, a solenoidal magnetic field is used to guide a laser-plasma to a desired deposition spot on an object to be coated. By using a curved magnetic field together with baffles, the number of micron and sub-micron size debris particles which are also produced during the laser ablation process can be reduced from the coating surface. Contamination of a coating surface by such debris is one of the reasons preventing the development

of Pulsed Laser Deposition as a common industrial process for high quality coatings. In the second application, femtosecond laser pulses are used to machine micron and sub-micron structures. Laser micromachining is a flexible technique for precision patterning of surfaces in microelectronics, microelectromechanical devices, and integrated optical devices. In the third application, a sub-millijoule laser pulse is used to create a micron size spark at the surface of a material. Elemental composition of materials can be determined by measuring the line emission from ions and neutral atoms in such a transient laser produced plasma. This technique can also be used to generate a two-dimension map of the elemental composition of a sample surface by scanning a focused laser beam across its surface.

TU-A8-4 **12 h 00**

RICHARD D. SYDORA, University of Alberta

*Kinetic Simulation and Theory of Current Filament Twisting and Merging**

Current systems in laboratory and astrophysical magneto-plasmas are often found to be filamentary in nature. The dynamics of these current filaments may be very complex, particularly when they interact. The merging or coalescence of current filaments generates helicity and induces magnetic reconnection which produce rapid topological changes as the magnetic energy is converted into plasma kinetic energy. In this talk, recent nonlinear kinetic simulation results will be presented using electromagnetic particle-in-cell models in 2 and 3-dimensions. A simplified current sheet model consisting of multiple attracting current filaments is considered as a first step. An analytical and simulation analysis of the coalesence instability in this model is presented along with the dynamical processes which occur during the magnetic reconnection and merging phases. In certain regimes plasma heating and charged particle acceleration is observed. The physical processes leading to non-thermal electron distributions and possible implications for X-ray sources will be discussed.

*This work is supported by the Natural Sciences and Engineering Research Council of Canada

TU-A8-5 **12 h 30**

From High Field Physics at 10^{21} W/cm^2 to Real World Applications With the 10TW Femtosecond INRS Laser*, **J.C. Kieffer**, H. Pepin, H. Mercure*, F. Martin, M. Chaker, J.P. Matte, T.W. Johnston, F. Vidal, C. Belzile, F. Blanchard, D. Comtois, A. Desparois, P. Forget, Z. Ichalalene, B. Ledrogof, S. Magnan, V. Pitre, C. Potvin*, *INRS, Quebec Canada*, (a) IREQ, Hydro-Quebec — We will discuss potentials of the new high peak (10TW) and high average power (6W) INRS laser system in some areas of the Femtoscience. This laser system (600mJ, 60fs, 10Hz) is a unique tool to explore i) matter under extreme conditions (relativistic intensities (10^{21}W/cm^2 on solids), isochoric heating, ultrafast high average power x-ray and particle sources); ii) imaging with applications to structure determinations of transient or metastable systems and to high resolution radiology; and iii) metrology and control of elemental systems (femtosecond ultrasonics, LIPS, phase change control). Impacts of these new directions on breast cancer research, biochemistry, nanotechnology and photonics will be outlined.

* Work supported in part by CIPI, NSERC, FCAR, NIH, Hydro-Quebec, and the Ministère de l'éducation.

[TU-A9] INSTRUMENTATION AND MEASUREMENTS IN OPTICS AND PHOTONICS
INSTRUMENTATION ET MESURES EN OPTIQUE ET PHOTONIQUE

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D287

TUESDAY, JUNE 19 / *MARDI LE 19 JUIN*

TU-A9-1 **10 h 00**

JOHN BERNARD, National Research Council Canada

Precision Optical Frequency Measurements with a Single, Trapped Ion

A single trapped ion, which is laser cooled and probed on an ultra-narrow dipole-forbidden transition, is an almost ideal frequency standard. Such an ion can be held indefinitely in an electromagnetic trap and isolated from collisions and external perturbations. Our group at the National Research Council has been studying the 445-THz (674 nm) $5s\,^2S_{1/2}$-$4d\,^2D_{5/2}$ transition in $^{88}Sr^+$ for a number of years for its application as an optical frequency standard. A laser, locked to an evacuated, environmentally isolated, high-finesse cavity, has been used to probe the S-D transition and linewidths as narrow as 250 Hz have been recorded. In 1997-98, we used a frequency synthesis chain to measure the frequency of the S-D transition to an accuracy of 200 Hz making it one of the most accurately known optical frequencies. Systematic offsets in this standard frequency due to perturbations are less than 1 Hz or 1 part in 10^{15}. More recently, we have used our Sr^+ ion standard to measure two other important optical frequencies. In the first measurement, performed in collaboration with a group from Université Laval, we measured the frequency of a laser at 193 THz (1556 nm) which was frequency doubled and locked to a two-photon transition in ^{87}Rb. This laser is to be used for calibrating wavelength division multiplexed (WDM) frequencies in the region of 1500 nm. In a second measurement, the Sr^+ ion standard was used to measure the frequency of the metrologically important iodine-stabilized helium-neon laser at 474 THz (633 nm). We are currently developing an optical frequency comb, based on a mode-locked femtosecond-pulse laser and we hope soon to demonstrate a clock based on the Sr^+ ion.

TU-A9-2 **10 h 30**

SEE L. CHIN*, Université Laval

Clean Fluorescence from Molecules Induced by Intense Femtosecond Ti-Sapphire Laser Pulses

Intense femtosecond Ti-sapphire laser pulses will tunnel ionize and fragment molecules. The subsequent fluorescence from the ionized and fragmented molecules is completely free of the interference from the plasma continuum even at one atmospheric pressure (hence, clean fluorescence). Inner valence electron tunnel ionization is believed to be responsible for the molecular spectrum in N_2. The observation is applicable to a new technique of LIDAR as well as pollutant measurements and chemical trace analysis.

* In collaboration with A. Talebpour, and A. Becker, Université Laval.

TU-A9-3 **11 h 30**

J.F. POWER, McGill University

Longitudinal Light Profile Microscopy (LLPM): A New Method for Seeing Below the Surfaces of Thin Film Materials

As modern materials processing advances, thin film structures of increasing complexity are being fabricated. Depth-sensitive information in materials, on the scale of 0.5 µm to 1 mm may provide key insight in mechanisms of corrosion, photodegradation, photo-stabilization and additive migration into thin film materials. Longitudinal light profile microscopy (LLPM)[1] is a new technique for the observation of depth structure on the above scale. While previously reported techniques derive such information indirectly, LLPM is capable of detecting direct, depth-dependent images of a material cross section, based on contrast mechanisms derived from photo-luminescence, scatter and optical absorption. The method is based on a right angle illumination and viewing geometry in which the material to be imaged is cleaved to expose a cross section of interest. The cleaved material is then set between microscope slides and the cross sectional edge is optically polished to provide a viewing surface for optical inspection. A collimated laser beam is propagated through the material, parallel to the view surface, but offset from it by a few tens of microns. A microscope aligned orthogonal to the viewing surface is focused onto the axis of the beam propagating through the material, and returns an image (based on light scatter or photoluminescence) of the beam's light intensity attenuating along the depth axis. When light scattering is weak, the depth attenuation of the beam in the sample may be written in the following general form:

$$I(x) = I^{\circ}\, C(x)\, \exp\left(-\int \beta(x^{\circ})\,dx^{\circ}\right)$$

where I(x) is the depth profile of light intensity arising from scattering or photoluminescence, b is the (depth varying) absorption coefficient, and I_0 is the light intensity incident on the sample's entry surface. The expression in parentheses is termed the *attenuation contrast* while C(x) is a depth dependent factor related to sample morphology termed the *matrix contrast* C(x) accounts for environmental and morphology related factors affecting the photoluminescence quantum efficiency, and/or scattering efficiency with depth. A single beam light profile image may have contrast in both modes. Images based solely on the matrix contrast (seen when b ~ 0) show unusual enhancements of subtle differences in scattering in depth, related to morphology, and to density of scatterers. The LLPM method shows exceptional contrast for interfaces and related features which are invisible in the inspection of conventional microscope preps under polarization and Nomarski differential interference contrast. A more recent, dual beam light profile microscope design has enabled the separation of the attenuation contrast from the matrix contrast. This permits the resolution of depth maps of optical absorption to be made from depth-resolved images of scattering and/or photo-luminescence. Depth profiling by LLPM has been evaluated against a number of samples of known depth structure, such as homogeneous films, layered structures, spray cast, and thin films of poly(vinyl chloride) PVC (photo-degraded under short wavelength UV light). These latter structures have also been characterized by reference methods of analysis, based on destructive and photothermal mechanisms. A number of examples from recent work in this laboratory will be presented.

[1] J.F. Power and S.W. Fu, U.S. Patent Pending.

TU-A9-4 **12 h 00**

P.R. **HERMAN***, University of Toronto

Advanced Lasers for Shaping Optical Components and Photonic Circuits

The photonics industry requires precise manufacturing tools to shape miniature optical components into functional photonic circuits, and thereby serve the unrelenting demand for Internet "bandwidth" in today's communication industry. Laser microfabrication offers several opportunities for such precise shaping and tuning of glass-based photonic systems. This presentation describes two extreme approaches – ultrafast lasers and deep-ultraviolet lasers – in shaping and tuning refractive index structures inside fused silica and germanosilicate glasses. We describe optical waveguides fabricated with ~60-fs pulses of 800-nm light and contrast photosensitivity responses with that provided driven by ~15-ns pulses of 157-nm light from the F2-laser. We compare processing windows, spatial resolution, and writing speed for these two laser approaches, and discuss prospects for the fabrication and trimming of optical devices.

* In collaboration with K.P. Chen, D. Coric, M. Wei, Department of Electrical and Computer Engineering, University of Toronto.

PLENARY SESSION / *SESSION PLÉNIÈRE*

[TU-P1] **MEDAL OF ACHIEVEMENT IN PHYSICS WINNER** — **TUESDAY, JUNE 19**
RECIPIENDAIRE DE LA MEDAILLE DE L'ACP POUR CONTRIBUTIONS EXCEPTIONNELLES À LA PHYSIQUE — ***MARDI LE 19 JUIN***
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE A144

TU-P1-1 **13 h 30**

WILLIAM J.L. BUYERS, National Research Council, Chalk River Laboratories

Surprises in Quantum Magnetism

The microscopic behaviour of magnetic systems, as seen through the eye of the neutron, provides a microcosm of fundamental physical concepts. Spin fluctuations are not the waving of classical magnets, as the textbooks say. Solitons, spinons, quantum mass gaps and multiparticle continua are the norm in the "real" world of one dimension and are strikingly different in real crystals with integer and half-integer spin. For magnetic moments in metals, the fight between localized and itinerant behaviour suppresses static magnetism, but can maintain dynamic spin fluctuations and enhance superconductivity.

[TU-P2] PHOTONIC MATERIALS / *MATÉRIAUX PHOTONIQUES*

TUESDAY, JUNE 19 / ***MARDI LE 19 JUIN***
IMMEUBLE HSD BUILDING, ROOM / SALLE A240

TU-P2-1 **14 h 15**

MICHAEL BRETT, University of Alberta

Applications of Porous Thin Films with Engineered Nanostructures

Traditional thin film coatings are often optimized for durability, density and uniformity. However, recent interest in porous nanostructures has led to the development of Glancing Angle Deposition (GLAD), which combines the features of glancing incidence flux at the substrate with controlled substrate motion to engineer film structures on the scale of 10's of nanometres. Whereas «normal» evaporated or sputtered thin films usually possess a columnar structure that is densely packed, in the GLAD process extreme self shadowing from nuclei leads to greatly increased separation of columns and growth of isolated nanostuctures. Structural shape may be tailored by substrate motion to produce, for example, helices, pillars, chevrons, and S-curves with feature sizes from 10 nm to 20 micrometres. In this manner, GLAD has been utilized for simple one-step fabrication of films of high surface area and controlled nanoscale geometry from dielectric, semiconductor, metal, and alloy materials by sputtering, evaporation, and pulsed laser deposition. Although the stochastic nature of the deposition normally leads to random column nucleation, large area periodically arranged micropost or microhelix arrays may be easily created by deposition over patterned seeds on the substrate. This talk will present details of the deposition process, characterization and description of film microstructures, fabrication of inverse (ie: helically perforated) structures, and of hybrid optical materials combining chiral films and nematic liquid crystals. Results of investigations or of opportunities for the use of nanoengineered films in optics, thermal barriers, sensors, and as high surface area devices, will be discussed.

TU-P2-2 **14 h 45**

JEFF F. YOUNG*, University of British Columbia

Engineering Photonic Bandstructure in Semiconductor-Based Photonic Crystal Waveguides

I will briefly review our research that led to a detailed understanding of, and the ability to fabricate, a class of planar photonic crystals based on high-index-contrast, 2-dimensionally textured III-V semiconductor slab waveguides. I will then go on to describe how we have successfully engineered such structures for specific purposes related to their nonlinear optical properties. In particular I will demonstrate a structure in which one of the photonic bands exhibits virtually no dispersion along the X direction of a square 2D crystal. A novel means of directly measuring the dispersion and lifetimes of these modes will also be presented.

* In collaboration with W.J. Mandeville[a], A.R. Cowan[a], and S. Johnson[b], (a) University of British Columbia and (b) Arizona State University.

TU-P2-3 **15 h 30**

PAUL ROCHON, Royal Military College of Canada

Holographic Imaging Using Azopolymer Films

Azopolymer films can be used to record holographic images either in the bulk of the film, in the form of optically induced birefringence, or on the surface of the film, as a surface relief structure. The images are stable for temperatures up to 120°C and more in some polymers. The images can also be erased optically or thermally, and another image can be written on the same spot. We will present examples of dynamic imaging of polarization holograms, dynamic optical cross-correlation imaging using the birefringence effect, as well as present examples of waveguide coupling and resonant optical filtering using surface relief gratings. We will also present the more recent results on the optically-controlled volume density change that we have recently observed. This later effect could also lead to some interesting applications in photonics

TU-P2-4 **16 h 00**

ALAIN HACHÉ, Université de Moncton

Nonlinear Photonic Crystals and Their Applications

Multi-dimensional periodic structures made with nonlinear materials -- semiconductors or dielectrics -- are interesting for many applications in photonic and signal processing. When exposed to light at high intensity, refractive index changes, due to the Kerr effect and other optical nonlinear processes, modify the properties of the crystal in such a way that it can be used for optical switching, optical limiting, waveguiding, and the transmission of solitons. This talk will survey some of the most interesting developments in this field of research and discuss experimental work we have done in that area. In particular, the effect of nonlinear excitation (multi-photon absorption) of free carriers on the optical properties of a periodic silicon structure will be discussed.

TU-P2-5 **16 h 30**

TIGRAN GALSTIAN, Laval University

New Infrared Sensitive Photopolymer Liquid Crystal Materials Open New Avenues for Information Routing

Our recent results in developing new near-infrared sensitive photopolymer materials will be presented. The high sensitivity and diffraction efficiency of these compounds, and the possibility of the optical and electrical control of their optical properties, make them unique for *in-situ* micro fabrication of a new family of reconfigurable photonic components for information routing. Some aspects of the infrared photo polymerization mechanisms in polymer liquid crystals and corresponding device properties will be detailed.

[TU-P3] BIOPHOTONICS / *BIOPHOTONIQUE*

TUESDAY, JUNE 19 / ***MARDI LE 19 JUIN***

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D288

TU-P3-1 **14 h 15**

STEEN MADSEN, University of Nevada

Optimizing Light Delivery for Photodynamic Therapy of Brain Tumors

Although glioblastoma multiforme is often thought to be a disseminated tumor in the brain, failure of treatment is usually due to local recurrence at the site of surgical resection - in 80% of all cases, recurrence is within 2 cm of the resected margin. This would indicate that a more aggressive local therapy, such as photodynamic therapy (PDT), could be of benefit. The aim of PDT is to eliminate the nests of tumor cells remaining in the margins of the resection cavity, however, it is unlikely that standard "one-shot" intraoperative PDT treatments can accomplish this goal. This is primarily due to the limited penetrance of light in brain tissues, and the resulting long treatment times required to deliver sufficient light doses to depths of 1 to 2 cm in the resection cavity. The effects of various light delivery schemes in a human glioma spheroid model are presented. The results suggest that PDT efficacy may be improved by fractionating the light dose, and by using low dose rates. These findings provide the rationale for the development of an indwelling balloon applicator that will allow PDT treatments in patients over extended time periods. Mathematical models of optical and thermal distributions surrounding the applicator are presented.

TU-P3-2 **14 h 45**

Treatment Planning for Laser Thermal Therapy*, **S.R.H. Davidson***, W. Whelan[b,c], L. Chin[c], M. Sherar[a,c], (a) *Princess Margaret Hospital/University Health Network*, (b) Ryerson University and (c) University of Toronto — Laser thermal therapy is a minimally invasive method being investigated as a treatment of diseased tissues, including cancers. The goal of this treatment is to raise the temperature of the diseased tissue to greater than 55° C, resulting in coagulative necrosis (tissue damage). One focus of our investigations has been the treatment of localized prostate cancer, in which the challenge is to deliver a therapeutic energy dose to the cancerous tissue while sparing adjacent normal structures. Our approach has been the use of interstitial optical applicators coupled to a near infrared laser (heating source). The strategic location of the applicators, combined with an appropriate choice of the laser power delivered to each, may allow for the high degree of control over the shape of the resultant volume of coagulated necrosis that is required for safe and effective treatment. The utility of cylindrical diffusing optical fibers, which emit optical energy along a finite length, is currently being investigated for laser thermal therapy. In order to determine whether these fibers are capable of producing the volumes of coagulated tissue required to treat prostate cancer, an optical/thermal treatment planning simulation has been developed. The Finite Element Method (FEM) is used to solve for optical propagation from multiple fibers inserted in the prostate, which is then input into a FEM temperature calculator. The simulation also incorporates thermally-induced dynamic changes in the tissue optical properties resulting from tissue coagulation. Preliminary validation results of the optical propagation model will be presented. Predicted optical fluence from the FEM simulation for a single, 1 cm cylindrical diffuser agreed with measured values obtained by an in-house optical sensor in a series of tissue mimicking phantom experiments.

* Work supported in part by NCIC (with funds from the Canadian Cancer Society) and NSERC

TU-P3-3 **15 h 15**

I. ALEX VITKIN, University of Toronto and Ontario Cancer Institute / University Health Network

Optical Polarization Studies in Random Media: Applications to Biological Tissue Analysis

Biological tissues are characterized by extensive multiple scattering at the red and near-infrared wavelengths, effectively scrambling the polarization state of the incident optical beam. Thus, polarized light examinations of such random turbid media are compromised by the loss of potentially useful information encoded in the beam's polarization parameters. Recently, we and others have shown that tissue diffuse reflectance can, in fact, exhibit partial polarization preservation. A simple system capable of detecting this small polarized fraction in the largely depolarized background will be described. Results from studies of tissue-like phantoms and *in-vivo* tissues will be presented. The possibility of detecting optically active species (e.g., glucose) in diffusive scattering using polarization modulation and synchronous detection methods will be discussed.

TU-P3-4 **16 h 15**

WILLIAM M. WHELAN*, Ryerson University and the University of Toronto

Utility of Optical Monitoring During Laser Thermal Therapy **

Interstitial laser thermal therapy is a minimally invasive technique used to destroy solid tumors. Tissue temperatures are raised to above 55°C, resulting in coagulative necrosis (tissue damage). Investigations have demonstrated the feasibility of this technique in a number of sites, including brain, liver and prostate; however, induced thermal lesions are variable and unpredictable due to variations in blood perfusion and thermally-induced changes in tissue optical properties. It is therefore important to include on-line monitoring and feedback control to compensate for these factors. Most on-line monitoring systems for thermal therapy generally rely on point temperature measurements or volumetric imaging in tissue. The effectiveness of point temperature measurements to control heating is in question, due to the time delay in the arrival of thermal energy to a temperature sensor, especially sensors placed at the boundary of the target volume. Alternatively, optical fluence monitoring provides almost instantaneous detection of coagulation-induced changes in optical propagation. Initial feasibility studies of interstitial optical monitoring in tissue-mimicking phantoms and *in vivo* porcine kidney will be presented. The results indicate that dynamic changes in optical propagation during heating may be used to predict the onset of tissue coagulation.

* In collaboration with L.C.L. Chin[a], M.D. Sherar[a,b] and I.A. Vitkin[a,b], (a) Ryerson University, (b) University of Toronto and (c) Princess Margaret Hospital/ University Health Network.

** Work supported in part by NCIC (with funds from the Canadian Cancer Society) and NSERC.

[TU-P4] THE MATTER AT STAKE / *LA MATIÈRE EN QUESTION*

TUESDAY, JUNE 19 / *MARDI LE 19 JUIN*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D111

TU-P4-1 **14 h 15**

FRANCOIS CORRIVEAU, McGill University

QCD Physics with ZEUS at HERA

The ZEUS experiment at HERA provides a rich testing ground for the study of processes governed by quantum chromodynamics (QCD). The coupling constant of the strong force, alphas, and the structure of the proton have both been measured to great accuracy. Complementary to LEP, results on dijet production are also becoming important in constraining the structure of the photon. Along with these, measurements of heavy quark and jet production and diffractive processes, are all providing rigourous tests of QCD and its implementation in theoretical calculations. A review of the recent measurements from ZEUS and their impact within the high-energy physics program will be discussed.

TU-P4-2 **14 h 45**

MANUELLA VINCTER, , University of Alberta

New Results from HERMES

One of the primary goals of the HERMES experiment at the DESY Laboratory is to make a detailed determination of the spin structure of the proton. The proton consists of three valence quarks. Gluons are exchanged between these quarks and occasionally split to produce quark-antiquark pairs (known as sea quarks). All of these components including the orbital angular momentum of the quarks and gluons could in principle contribute to the spin 1/2 of the proton. The quark helicities' contribution to the proton's spin is being measured precisely at HERMES. A first attempt is also made at determining the, as yet unknown, gluon contribution. It has been recently suggested that the orbital angular momentum may be accessed via exclusive photon or pion production processes. Such results will also be presented. HERMES now embarks on the second stage of its spin physics program: measurements of quark transversity. A brief outlook on HERMES run 2 will also be discussed.

TU-P4-3 **15 h 45**

CHRISTOPHER HEARTY, University of British Columbia

First Physics From BaBar

The BaBar experiment successfully completed its first year of data collection in October 2000. Both the accelerator and the detector operated well, with PEP-II reaching design luminosity of 3×10^{33} and BaBar collecting 20 fb^{-1} of data on the Upsilon(4S) resonance and 2.5 fb^{-1} just below. This talk will present the first physics results from BaBar, which are expected to include the most precise measurement to date of the Unitarity Triangle (CP violation) parameter sin(2 beta). Other results will include B mixing, B lifetime, and a number of charmless B-decay branching ratios, which are critical for the determination of sin(2 alpha). The talk will also review the status of the second year of data collection.

TU-P4-4 **16 h 15**

Measurement of Pion Multiplicities at HERMES, **M.C. Vetterli**, *TRIUMF / Simon Fraser University*, on behalf of the HERMES collaboration — Data on hadron production in the deep-inelastic scattering of 27.5 GeV positrons on hydrogen at HERMES are presented. Charged and neutral pion multiplicities are shown as a function of z, where z is the fraction of the energy transferred in the scattering process carried by the pion. Results for neutral and charged pions are compared to test for consistency with isospin invariance. The multiplicity distributions have been integrated over z and the energy fractions carried by charged and neutral pions have been determined. For fixed z the measured multiplicities depend on both the negative squared four momentum transfer Q^2 and the Bjorken variable x. The observed dependence on Q^2 agrees qualitatively with the expected behaviour based on Next to Leading Order QCD evolution, while the dependence on x is consistent with that of previous data after corrections have been made for the expected Q^2 dependence.

TU-P4-5 ***16 h 30***

Study of Multiparameter Fit for β-meson Mixing Rate, Lifetime and Lepton Spectra at an Asymmetric e+e- β-factory, **Karene Chu** and Thomas Mattison, *University of British Columbia* — Dilepton events from Upsilon(4S) decay can be used to measure semileptonic branching ratio and the energy spectra of leptons directly from β decays and from charm cascade decays. At an asymmetric e+e- collider, the two β decays are separated along the beam direction, and the separation of the two lepton tracks allows the β lifetime and time-dependent mixing to be measured. Methods for extracting multiple physics parameters from such data are investigated. A Monte Carlo simulation of β meson production, β and D meson decay, and lepton reconstruction in a typical β-factory detector is used to demonstrate the feasibility and statistical power of the multiparameter fit.

[TU-P5] PROGRESS IN PHYSICS WITH COOLED AND TRAPPED ATOMS II / PROGRÈS EN PHYSIQUE DES ATOMES FROIDS ET PIÉGÉS II

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D287 — TUESDAY, JUNE 19 / MARDI LE 19 JUIN

TU-P5-1 **14 h 15**

LOUIS ***MARMET***, , *National Research Council Canada*

The Ultimate Accuracy of Cooled-Cesium Atomic Clocks: Only Time Will Tell

The recent progress in laser cooling has allowed the reduction of the velocity of thermal atoms by orders of magnitude. Atomic clocks have benefited from this since the allowed interaction time with the Cesium atoms has been increased, resulting in greater accuracy. To replace the thermal beam of our traditional Cs clocks, we are building an atomic fountain where the Cs atoms are trapped, cooled and launched vertically through a microwave cavity. The fountain at NRC uses three orthogonal pairs of beams in a 110 configuration to trap and launch the cold atoms. A pair of anti-Helmholtz coils produce the magnetic field gradient for the magneto-optical trap which uses six laser beams, 7mW in each and having a diameter of 19mm. The trap can contain up to one billion atoms cooled to 3μK. The cold atoms are accelerated over a 15mm distance to a preparation region 45cm above the trap, then follow the trajectory to the microwave cavity, made from a rectangular waveguide and excited on the TE012 mode. We observed Ramsey fringes with a 1.3Hz wide central fringe. Along with these results, we will discuss the challenges encountered in the operation of the Cs fountain and the expected accuracy of this new clock.

TU-P5-2 ***14 h 45***

T.G. **WALKER**, University of Wisconsin-Madison

*Collisions and Cold Atoms**

Atomic collisions play an important role in atom trapping and cooling experiments. In magneto-optical traps, absorption of photons at long range by colliding pairs of atoms places key constraints on the number of atoms that can be trapped. These collisions are of intrinsic interest due to their sensitivity to light fields and photon-mediated changes in interatomic forces that can be many orders of magnitude in size. Even ground state processes such as spin-exchange collisions show surprising sensitivity to the presence of light in traps. Experiments in magnetic traps are sensitive to inelastic loss in collisions due to spin-exchange and spin-axis interactions; at low temperatures these processes exhibit a number of novel features. In a remarkable demonstration of the unity of atomic collision physics, measured key inelastic collision rates due to the spin-axis interaction have been correlated over 8 orders of magnitude in collision energy from spin-loss in magnetic traps to spin-relaxation in high temperature optical pumping experiments. Atom traps can also be used as targets in scattering experiments; they are advantageous for making absolute cross section measurements in a straightforward manner. Each of the above features of atomic collisions in traps will be illustrated with examples from our laboratory and from others.

The possibility of studying atomic collisions at higher densities and lower temperatures in conservative light-force traps promises future advances. A new apparatus for cooling in far-off-resonance traps will be described, along with a new "spatial heterodyne" method for non-destructive imaging of optically thick trapped atom clouds.

*This work is supported by the US National Science Foundation.

TU-P5-3 **15 h 45**

WILLIAM .A. VAN WIJNGAARDEN, York University

Laser Cooling and Trapping of Cesium Atoms

A magneto-optic trap has been constructed using a pair of anti-Helmholtz coils. About 5 million atoms are trapped in a spherical volume having a diameter of less than 1 mm. The temperature is determined to be 40 microKelvins by observing the expansion of the cold atom cloud after the trap has been turned off. We shall discuss the characterization of our trap as well as experiments using cold atoms. The latter includes generation of a slow atomic beam and observation of electromagnetically induced transparency.

TU-P5-4 **16 h 15**

Spectroscopic Studies of Highly-Ionized Atoms using an EBIT*, **E.H. Pinnington***, E. Traebert[b] and P. Beiersdorfer[c], (a) *University of Alberta*, (b) University of the Ruhr, Bochum, Germany; (c) LLNL, Livermore California — The advent of the electron-beam-ion-trap (EBIT) has opened up some valuable new possibilities for atomic physics. One of these is the study of forbidden transitions in highly-ionized atoms. In this talk I will outline the advantages of using an EBIT for such studies and then illustrate the technique by discussing two applications. The first of these concerns the measurement of the radiative lifetime of the upper fine-structure level in the ground state doublet P term in K XI (fluorine-like potassium) and K XV (boron-like potassium), for which we obtain values with two-sigma errors of 2.5%. These results will be compared with calculation and with values found previously for other ions in these isoelectronic sequences. The second application concerns the observation of spin-changing transitions within the n=3 configuration in Au LXVII (aluminum-like gold) and Au LXVIII (magnesium-like gold). Again these results will be compared with previous measurements and with calculation.

**Work supported by NSERC, the German Research Foundation, and the US Department of Energy.*

TU-P5-5 **16 h 30**

Theoretical Modelling of Charge Transfer Collisions, **A.Szott***, M. DeJong*, R.I. Thompson*, H.A. Schuessler[b], H. Walther[c], M. Welling[c], (a) *University of Calgary*, (b) University of Texas A&M, (c) Max-Planck-Institut fur Quantenoptik, Germany — An energy resolved study of the collisional charge transfer reaction $Mg^+ + C_{60} \rightarrow Mg + C_{60}^+$ in a linear geometry ion trap was performed in the Max-Planck-Institut fur Quantenoptik. Through theoretical/computational modelling of this experimental data, we attempt to derive the shape of the interaction potential between ground state C_{60} and Mg^+. Initial analytical solutions are confirmed or rejected by considering solutions derived through numerical integrations. It is found that the probability of charge transfer is directly related to the kinetic energy of the magnesium ion and the physical size of the C_{60} molecule. It is also shown that the kinetic energy of the magnesium ion that produces the maximum probability of charge transfer is determined by the Massey Criterion.

[TU-P6] MAGNETISM AND PHASE TRANSITIONS / MAGNÉTISME ET TRANSITIONS DE PHASE

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D103 — TUESDAY, JUNE 19 / MARDI LE 19 JUIN

TU-P6-1 **14 h 15**

Reconstruction of Magnetic Domains from Coherent X-Ray Scattering, **A. Rahmim**, T. Tiedje, *University of British Columbia* — We have explored, theoretically and numerically, the reconstruction of magnetic domain patterns from coherent soft x-ray scattering for two different situations where we have used experimentally realistic parameters[1,2]: i) reflection from the surface of a rough, antiferromagnetically ordered sample, and ii) transmission through a ferromagnetically ordered multilayer thin film with the magnetization perpendicular to the multilayer plane. In the reflection geometry we have used experimental PEEM images of the antiferromagnetic domains to compute simulated magnetic scattering patterns (speckle) with varying amounts of noise added in the simulation. We have applied the concepts of error-reduction and hybrid input-output algorithms to reconstruct the shape of the antiferromagnetic domains. Using these methods we have been able to accurately retrieve the phase from the magnitude of the Fourier transform of the magnetic surface, by imposing appropriate

constraints. In the reconstruction procedure, we first tune the x-ray energy slightly away from the resonant energy of the material to eliminate the magnetic contrast. Under these conditions the roughness of the sample may be reconstructed using conventional iterative methods. Then with the x-ray energy tuned to the resonant energy of the magnetic material, the scattered intensity (suitably over-sampled) can be used to reconstruct the magnetic pattern with the previously reconstructed roughness as a constraint. In the case of the multilayer sample in the transmission geometry, both linear and circular polarization of the input beam are considered. For linear polarization, it is shown theoretically that the roughness scattering can be separated from the magnetic scattering. This separation means that the reconstruction is more effective since the roughness and magnetization can be reconstructed independently. Iterative algorithms are developed for both cases and results are shown to be very successful with oversampling of the scattering patterns.

[1] S. Eisebitt *et al.*, to be published.
[2] L. Sorensen *et al.*, private communication.

TU-P6-2 **14 h 30**

Correspondence of Micromagnetic Simulation to Time-Resolved Experiment, **G.E. Ballentine**, W.K. Hiebert, B.C. Choi and M.R. Freeman, *University of Alberta* — Magnetization dynamics of permalloy $Ni_{80}Fe_{20}$ are observed stroboscopically using Time Resolved Scanning Kerr Effect Microscopy (TR-SKEM) [1]. All three components of its vector magnetization state are measured simultaneously using a quadrant detection system. This can capture the repetitive portion of magnetization dynamics. Several different situations are observed including 180 degree magnetization reversals in different geometries and out of plane ferromagnetic resonance oscillations are observed. The results are compared to a micromagnetic simulation of the phenomenological Landau-Lifshitz-Gilbert equation solved numerically using finite element methods. This is one of the most stringent tests of the LLG equation to date.

[1] G.E. Ballentine, W.K. Hiebert, A. Stankiewicz and M.R. Freeman, *J. Appl. Phys.*, **87**, 6830 (2000).

TU-P6-3 **14 h 45**

Spin Stiffness of Stacked Triangular Antiferromagnets*, **B.W. Southern** and A. Peles, *University of Manitoba* — Numerical results are presented for the spin stiffness of the classical antiferromagnetic Heisenberg model on the 3D stacked triangular lattice. Finite sized scaling methods are used to extract the critical exponent characterizing the behaviour of the stiffness at T_c. Our calculations support the picture of a continuous phase transition belonging to a new chirality universality class.

*supported by NSERC

TU-P6-4 **15 h 30**

Studies of Impurities In Magnetic Insulators Using Low Temperature Nuclear Orientation, **J. Pond**, M.R. Benam, L. Goehring, A. Kotlicki and B.G. Turrell, *University of British Columbia* — Although the effects of impurities in metallic magnets have been extensively studied there have been far fewer experiments on impurities in insulating magnets. Low Temperature Nuclear Orientation (LTNO) has been used to study radioactive ions in insulating magnetic hosts both by implantation and by incorporating them during the growth of the crystal. Significant γ-ray anisotropies were observed after implantation of ^{56}Mn into $MnCl_2.4H_2O$ and $CoCl_2.6H_2O$. The site occupancy of the implanted ions was close to unity in the former host and about 50% in the latter. However, there are questions about where the implanted ions go to in the lattice. The NMRON line of ^{54}Mn in $MnCl_2.4H_2O$ doped with 4% cobalt is significantly broadened compared to the line in the pure crystal, and shows structure. The nuclear spin-lattice relaxation time is lower by an order of magnitude. ^{54}Mn has also been used to investigate $FeCl_2.4H_2O$ for which a four-sublattice structure has been proposed. The motivation for these studies is to apply LTNO techniques, which are very sensitive, to investigate currently interesting systems such as "giant spin" systems, e.g. Mn-12 acetate, and frustrated magnets.

TU-P6-5 **15 h 45**

Random Field State in the Dilute Stacked Triangular Lattice Antiferromagnet $CsCo_{0.83}Mg_{0.17}Br_3$, **B.D. Gaulin***, J. Van Duijn*, and W.J.L. Buyers[b], (a) *McMaster University*, (b) NPMR, NRC, Chalk River — Critical neutron scattering studies have been carried out on the dilute Ising-like stacked triangular lattice antiferromagnet $CsCo_{0.83}Mg_{0.17}Br_3$. Pure $CsCoBr_3$ orders antiferromagnetically near 28 K into an unusual three sublattice Neel state in which spins within a triangular plane form an up-down-paramagnetic structure. Our critical scattering studies on the dilute sample clearly show a two component lineshape to the critical scattering, with the onset of the sharp component at 28 K. We interpret this scattering as a consequence of non-magnetic dilution, which pins domains of this superstructure such that non-magnetic Mg sits at the paramagnetic site. This gives rise to a novel random field Ising state in the absence of an externally applied magnetic field.

TU-P6-6 **16 h 00**

Random-Field Critical Behaviour of As-Doped KDP* **D.R. Taylor** and Y.K. Chang, *Queen's University* — Since KH_2PO_4 (KDP) and its isomorph KH_2AsO_4 have very similar transition temperatures and properties, in As-doped KDP the effects of random fields arising from ionic size mismatch should dominate those due to random interactions. Random fields are expected to modify the critical properties of Ising systems so that the critical exponents correspond to an Ising system with reduced dimension. We carried out dielectric permittivity measurements to determine the susceptibility exponents for pure KDP and $KH_2As_{0.4}P_{0.6}O_4$. For KDP our critical permittivity data were accurately fitted by a mean-field dependence with logarithmic corrections, confirming that the effective dimension of the pure system is at the upper critical dimension (4) for Ising systems. This contrasts with previously studied random-field magnetic and Jahn-Teller systems where the effective dimensions of the pure system are lower and higher by one, respectively, than the upper critical dimension. The mixed sample showed a well-defined transition and an increased power-law susceptibility exponent attributable to random fields. The accuracy of the fitted exponent was limited, however, by its sensitivity to the fitting range and the possible influences of crossover effects and rounding of the transition by inhomogeneities. Our estimated value of 1.45 ± 0.15 is consistent with the expected reduction in dimension of approximately two.

TU-P6-7 **16 h 15**

Non Universal Critical Exponents in Monolayer Nitrogen, A.K. Sallabi and **D.B. Jack**, *Concordia University* — Monte Carlo simulations of a monolayer of nitrogen adsorbed on an NaCl(001) surface are used to test the validity of the theory of critical phenomena and its applicability to molecular systems. The simulations predict that this system undergoes a continuous order-disorder transition near 25 K with a logarithmically divergent heat capacity. The values of the critical exponents for the order parameter and susceptibility are calculated and found to deviate significantly from the Ising values but still satisfy Rushbrooke's scaling law. This behaviour is typical of the universality class containing the XY model with cubic anisotropy where the critical exponents are functions of the anisotropy and thus non universal.

[TU-P7] THIN FILMS AND SURFACES / *COUCHES MINCES ET SURFACES* — TUESDAY, JUNE 19 / *MARDI LE 19 JUIN*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D110

TU-P7-1 **14 h 15**

Equilibrium Theory of Coherent Quantum Dot Formation, **R. Budiman**, *University of Toronto* — An equilibrium theory for three-dimensional coherent islanding transition is presented, providing a unifying framework for both transition thickness-marking the onset of coherent island formation-and equilibrium shape of coherent islands. The order parameter for the transition is determined to be the shear strains along growth direction. An application to $Si_{1-x}Ge_x/Si(001)$ islands yields good agreement with experimental results.

TU-P7-2 **14 h 30**

Morphological Instability and Surface Decomposition of Strained Alloy Films Growth*, **Zhi-Feng Huang** and Rashmi C. Desai, *University of Toronto* — The mechanisms of stabilization and decomposition processes during epitaxial growth of strained alloy films have attracted intense interest from both theorists[1] and experimentalists[2]. Recent attention has been focused on the dislocation-free growing alloy films which could exhibit a morphological instability without nucleation. Based on a nonequilibrium continuum model and a linear analysis, we study the stability of film morphology as well as the surface spinodal decomposition of such strained films. We consider some new and realistic factors of epitaxial growth, including deformable film-substrate interface, composition-dependent elastic moduli, and differing substrate-film elastic constants. We show that the stability properties are determined by the couplings of film-substrate misfit strain, compositional stress, deposition rate and temperature of the growing film. The results from the previous stability studies are recovered by taking appropriate limits and some new properties are obtained. Our results are applied to some real alloy growth systems and compared with recent experimental observations.

*Work supported by NSERC.

[1] B.J. Spencer, P.W. Voorhees, and J. Tersoff, *Phys. Rev. Lett.* **84**, 2449 (2000); F. Leonard and R.C. Desai, *Phys. Rev.* **B 57**, 4805 (1998).
[2] P. Sutter and M.G. Lagally, *Phys. Rev. Lett.* **84**, 4637 (2000)

TU-P7-3 **14 h 45**

Time-Dependent Surface Morphology Associated with Growth Interrupts in GaAs Molecular Beam Epitaxy, **A. Ballestad**, B.J. Ruck, J.H. Schmid, T.Tiedje, *University of British Columbia* — We have used ex-situ atomic force microscopy to study the time evolution of the surface morphology of GaAs during growth by molecular beam epitaxy. Transient shallow mounds are observed when the starting surface is rough, but these gradually smooth out during growth. The initial large amplitude roughness is caused by thermal cleaning of the native oxide. The mound formation has been successfully modelled [1] by the nonlinear Kardar-Parisi-Zhang equation, using AFM images of thermally desorbed surfaces as the initial condition. This model provides an alternative explanation to the often cited unstable growth caused by the Ehrlich-Schwoebel energy barrier. Continuum growth equations that attempt to describe surface morphology evolution during constant growth flux are in the form of constant coefficient partial differential equations. We have performed elastic light scattering experiments that probe the surface roughness at 30 and 41 μm^{-1} during growth and post-anneal. Transient effects in the light scattering signal induced by growth interrupts indicate that the coefficients in the growth equation are flux and time dependent. The transition from a constant flux scenario towards a thermodynamical equilibrium on the surface, where islands and step edges settle into a more energetically favourable configuration, is proposed as an explanation for the decaying smoothing rate.

[1] Ballestad, Ruck, Adamcyk, Pinnington and Tiedje, *Phys. Rev. Lett.* **86**, 2377-2380 (March 12, 2001)

TU-P7-4 **15 h 30**

Passivation of GaAs(110) by Ga2O3 thin films deposited by ECR plasma-assisted molecular beam epitaxy, **Danny Kim***, Genmao Chen*[,b], Xiang-Yang Mei*, Harry Ruda*, **University of Toronto*, [b]Filtronic Solid State, Santa Clara, CA — We present the first report on the deposition of Ga_2O_3 thin films by reaction of oxygen ECR-plasma and a Ga molecular beam on GaAs(110) surfaces for passivation. It has been previously shown that gallium oxide effectively passivates GaAs (100) surfaces deposited by e-beam evaporation of $Ga_5Gd_3O_{12}$, and also by rf-plasma oxidation of Ga. Using an ECR-MBE process obviates the possibility of surface state introduction by impurity incorporation and surface damage, associated with the previous two processes, by using ultra-high purity sources and ECR plasma (ion energies: 10-30eV). In addition, properties of (100) and (110) surfaces differ; further investigation of the Ga_2O_3-GaAs(110) interface is required, especially for optoelectronic applications. Ga_2O_3 films were deposited on ex situ wafers, where native oxides were removed in situ by hydrogen ECR plasma, and also on in situ cleaved surfaces, in a UHV chamber. XPS depth profiling at the interface for Ga3d core level spectra shows a sharp transition from Ga-O to Ga-As bonding, and As3d core level spectra show that Arsenic is bound only to Gallium. Using a 20° take off angle at the non-profiled Ga_2O_3-GaAs interface detects no elemental Arsenic or Arsenic Oxides. The effectiveness of this film for passivation is corroborated by room temperature photoluminescence enhancement: for Zn doped (10^{19} cm^{-3}) p-type GaAs, a PL enhancement greater than an order of magnitude is observed; for Si doped (10^{18} cm^{-3}) n^+-type GaAs, peak intensity doubles. There was no peak shift for thin coverages, but at thicker coverages, a peak shift as much as 7nm to a shorter wavelength was observed, indicating surface strain. These PL enhancements infer a reduction in surface recombination velocity, which is attributed to the reduction in non-radiative recombination channels created by arsenic-induced gap states.

TU-P7-5 **15 h 45**

Structures and Stability of CO and N2 Physisorbed on MgO: Descending The Devil's Staircase, **A.K. Sallabi** and D. B. Jack, *Concordia University* — Metropolis Monte Carlo simulations are performed to study the structures and stability of CO and N_2 and molecules physisorbed on the MgO(001) surface. Below 41 K the CO molecules form a c(4x2) structure which consists of alternating rows of densely packed tilted molecules separated by rows of less dense perpendicular molecules. Above 41 K and at low pressures, this phase undergoes a transition to a less dense disordered phase via the expulsion of molecules. A further transformation to a p(3x2) phase is possible by converting tilted to perpendicular molecules. A model to test the relative stability of the c(4x2) and p(3x2) phases shows that at sufficiently high pressures and temperatures the p(3x2) phase is more stable than the c(4x2) phase as found experimentally. We propose that a sequence of transitions through a set of (nx2)-type structures with ever decreasing density is possible under suitable conditions of temperature and pressure. This sequence of transitions is an example of devil's staircase phenomenon as has been suggested by LEED experiments. A similar devil's staircase sequence is found for nitrogen. These structures are in agreement with neutron and helium atom scattering results.

TU-P7-6 **16 h 00**

Modelling the Oscillatory Zoning Observed in Synthetic (Ba,Sr)S0, Crystals, **Ivan L'Heureux*** and Björn Jamtveit[b], (a) *University of Ottawa* and (b) University of Oslo — Oscillatory zoning is a type of pattern formation commonly found in many natural minerals. It is characterized by a more or less regular variation of the chemical composition of a mineral along a core-to-rim profile. Synthetic crystals of barium-strontium sulfate have been produced from precipitating aqueous solutions by Putnis and his group. Many such crystals exhibit oscillatory zoning. We present here a model of oscillatory zoning in this system. The model combines diffusion-controlled growth kinetics with the presence of a rough crystal-solution interface. Linear stability analysis and numerical computations indicate oscillatory profiles with a scaling consistent with the observations. This model might help understanding the formation of oscillatory zoning in hydrothermal environments, such as those generating garnets in metamorphic rocks.

TU-P7-7 **16 h 15**

Dependence of Brillouin Light Scattering Spectra on the Number of Bilayers in Fe/Ag Multilayer Specimens, **Milton From***, Li Cheng[b], Zaven Altounian[b], (a) *Western Washington University*, (b) McGill University — We have measured the Brillouin Light Scattering (BLS) spectra of [Fe/Ag] x N sputtered multilayers as a function of N, the number of bilayers in the multilayer. The thickness of the Fe and Ag layers was 1.5 nm and data was collected for samples with N = 5, 10, 25, and 40.The BLS instrument used was a 4-pass Fabry-Perot interferometer operated in the back-scattering geometry with 514.5 nm laser light. The number of peaks seen in the BLS spectra are seen to increase with N. Two peaks are seen for N=5, and four peaks are seen for N=10 and 25. For N = 40, we see two broad manifold peaks and a sharp surface mode peak. This N dependence and the detailed dependence of peak frequency on applied magnetic field are in good agreement with a recent model calculation that takes into account out-of-plane anisotropy and interlayer exchange coupling.

PLENARY SESSION / *SESSION PLÉNIÈRE*
[WE-A1] **(CAP/COMP)**
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE A144
WEDNESDAY, JUNE 20
MERCREDI LE 20 JUIN

WE-A1-1 **08 h 30**

CHERYL R. DUZENLI, B.C.Cancer Agency

3-D Radiation Dosimetry using Polymer Gels

Recent developments in high resolution, quantitative measurement of radiation dose in 3D volumes using polymer gels will be described. An overview of the importance of these developments in the field of radiation oncology will be given. Raman and NMR spectroscopy studies have led to better fundamental understanding of radiation induced processes occurring within dosimeter gels. The impact of gel composition, manufacture, radiation type and measurement technique will be presented. Clinical applications of gel dosimetry making use of optical and x-ray computed tomography and magnetic resonance imaging techniques will be discussed.

PLENARY SESSION / *SESSION PLÉNIÈRE*
[WE-A2] **(DCMMP/DMBP)**
IMMEUBLE MACLAUREN BUILDING, ROOM / SALLE A144
WEDNESDAY, JUNE 20
MERCREDI LE 20 JUIN

WE-A2-1 **09 h 15**

MICHAEL HALLETT, McGill University

Bioinformatics, Genomics and Proteomics

The intention of this talk is to give a brief overview of two of the major research efforts in Bioinformatics currently underway. Over the past several years, there has been tremendous excitement surrounding the development of DNA microarrays to explore the expression of thousands of genes simultaneously. This technology along with techniques from statistics, numerical computing and non-linear dynamics promise unparalleled insight into cell behaviour, primary/secondary response of genes and transcription factor networks. On a different note, Computational Proteomics has also begun to generate considerable excitement. Computational techniques that use spectra produced by mass spectrometers with peptide fragments have spawned several new and powerful techniques for protein and cellular identification and, like the DNA microarray, these techniques promise deep insight into cellular mechanisms. This talk will survey some of the current frameworks and directions in both of these areas.

[WE-A3] **INSTRUMENTATION AND METHODS**
INSTRUMENTATION ET MÉTHODES
IMMEUBLE MACLAUREN BUILDING, ROOM / SALLE D103
WEDNESDAY, JUNE 20
MERCREDI LE 20 JUIN

WE-A3-1 **10 h 00**

MADHU S. DIXIT, TRIUMF & Carleton University

Advances in Gas Avalanche Micro-Detectors

The proportional wire counter was invented in 1908 by Geiger and Rutherford. The invention in 1968 of the multi-wire proportional chamber by Charpak was a significant advance over the single wire proportional counter since it made possible fully electronic measurement of ionizing radiation. Driven largely by the requirements of modern experiments for high spatial resolution and detectors faster than wire chambers, the past decade has seen the development of a new class of multi-channel proportional detectors which can be constructed using industrial micro-fabrication techniques. The new micro-detectors such as the Gas Electron Multiplier (GEM) and Micromegas have the potential to significantly improve the performance of charged particle tracking systems. Applications in the area of radiation protection and medical x-ray imaging are also foreseen where the micro-detectors have many advantages over the existing technology. An overview of developments in field will be presented.

WE-A3-2 **10 h 30**

JIM WADDINGTON, McMaster University

TIGRESS at ISAC: A Versatile Gamma-Ray Detector Array

We propose building a new high-efficiency gamma-ray array for the radioactive beam facility ISAC at TRIUMF. The ideal gamma-ray array for a radioactive beam facility should have different properties than those of conventional spectrometers. Since ISAC will necessarily have currents that are much smaller than those available at stable beam facilities, an array must have a high efficiency. For many experiments, this cannot be achieved by simply moving the detectors close to the target because of Doppler broadening problems. Therefore the gamma array for a radioactive facility must have a large volume and be highly segmented. A proposed modular array that could be configured for a variety of experiments will be described.

WE-A3-3 **11 h 30**

DAVE A. HUTCHEON, TRIUMF/University of Alberta

The DRAGON Mass Separator at TRIUMF/ISAC

In explosive-burning events such as novae, x-ray bursters and some supernovae, radiative capture of protons by unstable nuclei can become important. Such reactions affect the rate of energy release, the elemental abundances and the isotopic ratios of the products of nucleosynthesis. The intense radioactive ion beams available at TRIUMF's ISAC facility will permit measurement of these capture cross sections at the low energies of importance in nuclear astrophysics. Proton capture is measured in inverse kinematics, with the heavy unstable reactant as the accelerated beam and the proton as target. The DRAGON facility is designed to detect the rare products of radiative capture. Its main components are a windowless gas target, an array of BGO scintillators to detect the capture gammas, an electromagnetic mass separator to separate the heavy reaction product from beam particles, and a detector of the heavy recoil particles. The system is expected to provide suppression of beam particles by 12 to 15 orders of magnitude. Results of first studies using DRAGON with accelerated beams will be reported.

WE-A3-4 **12 h 00**

E761, a Second Generation 221 MeV pp Parity Violation Experiment at TRIUMF. **W.D. Ramsay**[a], J. Birchall[a], D.A. Homing[a], L. Lee[a], S.A. Page[a], A.A. Rauf[a], G. Rutledge[a], W.T.H. van Oers[a], P.W. Green[b], G. Roy[b], A.A. Hamian[c], C.A. Davis[d], C.D.P. Levy[d], N.A. Titov[e], A.N. Zelenski[e], J.D. Bowman[f], R.E. Mischke[f], N.T. Okumusoglu[g], (a) *University of Manitoba*, (b) University of Alberta, (c) University of Washington, (d) TRIUMF, (e) INR Moscow, (f) Los Alamos National Laboratory, (g) Karadeniz Technical University, Turkey — TRIUMF experiment 761 is a second generation parity violation experiment designed to make a very accurate measurement of the parity violating longitudinal analyzing power, A_z, in pp scattering

at 221 MeV. The incident proton energy is chosen so that the experiment selects a single parity violating transition amplitude, $^3P_2 - {}^1D_2$, and consequently constrains the weak meson-nucleon coupling constant h_ρ. However, because of the small magnitude of A_z at 221 MeV, a very accurate measurement is required to impose a significant constraint on h_ρ. TRIUMF experiment 497 has now completed data taking and has produced a preliminary result for A_z, but the accuracy of the result is limited by corrections for first moments of transverse polarization. E761 aims to produce an A_z measurement of much improved accuracy. The main advance has been in instrumentation for measuring the first moments of transverse polarization. The new devices use large solid angle (40 msr) detectors operating in current mode to measure elastic scattering from carbon in the CH_2 scanning targets. The new detectors are operated at the same time as, and can be calibrated against, the previous full coincidence, counting mode detectors using elastic scattering from hydrogen. The first moments of transverse polarization can now be determined to ±0.34μm in one hour, compared to ±6μm with the old equipment. Other upgrades have been made, including better digitization of the main ion chamber signals.

WE-A3-5 **12 h 15**

A New Measurement of the Weak Pion-nucleon Coupling Constant via n + p → d + γ, S.A. Page, *University of Manitoba*, for the npdgamma Collaboration — The npdgamma collaboration will make a new precision measurement of the weak pion-nucleon coupling constant f_π, by measuring the asymmetry A_γ in the emission of 2.2 MeV γ-rays with respect to the neutron spin direction following capture of polarized cold neutrons on hydrogen. The experiment will be carried out at the LANSCE spallation neutron source at Los Alamos National Laboratory. A_γ will be measured to ±10% of theoretical predictions, improving our knowledge of f_π by an order of magnitude as compared to existing nuclear parity violation data, which set only upper bounds on its possible value. The weak pion-nucleon coupling is uniquely important for its sensitivity to hadronic weak neutral currents and its role in setting the scale of the only long-range component of the weak nucleon-nucleon interaction. The predicted asymmetry is -5×10^{-8}. Gamma rays will be detected in a 48-element CsI array, read out in current mode, surrounding a liquid parahydrogen target. The neutron beam will be polarized by transmission through a nuclear-polarized ^{3}He gas cell, reversed at 20 Hz by a resonant rf spin flipper downstream of the cell. Time of flight information from the pulsed beam structure will provide an important diagnostic tool for systematic errors. Apparatus and a new beamline are currently under construction, scheduled for commissioning in 2002. The experiment will require a full year of data taking to measure A_γ to $\pm 5 \times 10^{-8}$; systematic errors are expected to be at or below the 10^{-10} level.

[WE-A4] YOUNG INVESTIGATORS IN BIOPHYSICS AND MEDICINE
JEUNES CHERCHEURS EN BIOPHYSIQUE ET MÉDECINE
IMMEUBLE HSD BUILDING, ROOM / SALLE A240

WEDNESDAY, JUNE 20
MERCREDI LE 20 JUIN

WE-A4-1 **10 h 00**

Novel Sensor to Detect the Kinetics of Protein Adsorption, **A.J. Clark**, L.A. Whitehead, A. Kotlicki, C.A. Haynes, *University of British Columbia* — Proteins in aqueous solutions adsorb to solid interfaces and often change their conformation as they unfold on the surface. This unfolding process renders the protein biologically inactive and is the cause of bio-fouling on contact lenses and medical implants. Hence, measuring and understanding the kinetics of protein adsorption to solid surfaces is of considerable interest. We have developed a device that is not only sensitive to the adsorption of protein but also, we believe, to the kinetics of the conformation change. We monitor in real time the change in resonant frequency of a round elastomeric (25 micron) film as the protein is exposed to the surface. Since the mass of a monolayer of the protein or other adsorbent is an extremely small fraction of the mass of the sensor, the change in resonant frequency is due to changes in the surface tension of the film. We observe a continuing change in resonant frequency for more than 24 hours, which is well beyond the time it would take for the population of proteins on the surface to equilibrate under diffusion limited kinetics. This long slow response is likely due to the surface energy changes of the sensor as the protein changes its conformation. We will present a description of the fundamentals behind the operation of this sensor as well as some examples of the sensor response at different bulk protein concentrations.

WE-A4-2 **10 h 15**

Inverse Planning Anatomy-Based Dose Optimization for High Dose Rate Brachytherapy Using Fast Simulated Annealing Algorithm and Adaptable Objective Function*, **E. Lessard**[a,b] and J. Pouliot[c], (a) *Centre Hospitalier Universitaire de Québec*, (b) University of California San Francisco — High dose rate (HDR) brachytherapy is a method of delivering radiation using temporarily implanted catheters. A programmable remote afterloading unit move a single radioactive seed (^{192}Ir) along catheters. With this flexible system a variety of dose distributions can be generated. It has been demonstrated for several anatomical sites that increasing radiation dose to the tumor improves local tumor control and survival. This dose escalation can only be tolerated if it is achieved without increasing the dose delivered to normal tissues. Instead of planning the treatment to distribute the dose to agree with the clinical criteria, our approach uses the physician's prescription to guide a optimization algorithm towards the best treatment plan. This change of perspective is called inverse planning. An inverse planning anatomy-based dose optimization algorithm has been developed to automatically and rapidly produce a highly conformal dose coverage of the target volume while minimizing dose to organ at risks in the delivery of an HDR brachytherapy. Anatomical structures, target volumes and dwell positions are extracted from a CT scan acquired after catheters implantation. The dwell times are optimized using the Inverse Planning Simulated Annealing (IPSA) algorithm governed by an adaptable objective function reflecting the physician's prescription and constraints. Those criteria are imposed by several hundred dose points uniformly generated on the contours, extremities and inside the target volume and organ at risks. The IPSA algorithm can automatically generate a treatment plan with reduced dose to organs at risk while providing a conformal dose distribution around the target. The optimization is achieved in a short time (1 to 3 minutes of CPU time for 200000 iterations) for clinical applications. The ability of the algorithm to emphasize dose coverage, dose uniformity or organ at risk protection depending on dose constraints was clearly observed. No manual dwell time adjustment is needed. Details of the simulated annealing algorithm and the adaptable objective function will be presented along with a clinical example. With this inverse planning approach, the focus is on the physician's prescription, therefore improving the control on the treatment. The achievement of highly conformal dose coverage to the target volume opens the possibility to deliver a higher dose without inducing overdosage to organ at risks.

* We acknowledge financial support from the National Cancer Institute of Canada (NCIC) with funds from the Canadian Cancer Society and from Le Fonds pour la formation de Chercheurs et l'Aide à la recherche (Fonds FCAR-Québec).

WE-A4-3 **10 h 30**

The Effect of Ceramides on Phospholipid Bilayers: a Deuterium NMR Study, **Ya-Wei Hsueh**, Ralph Giles[a], Tyler Luchko[a], Neil Kitson[b] and Jenifer Thewalt[a], (a) *Simon Fraser University*, (b) University of British Columbia — Ceramide has been found in many important processes, participating in specialized membrane subdomains and acting as a messenger in signal transduction, while its behavior in the membrane is not well understood. In this work, we investigated POPC/C16:0-ceramide membranes using deuterium NMR. The fatty acyl chain of either lipid was deuterated, and NMR spectra were taken as a function of temperature and composition. It is found that the coexistence of gel/liquid crystalline phases occurs over a wide range of temperature and composition. Microdomains of different composition and phase state are present in the membrane. The acyl chains of liquid crystalline phase POPC are ordered by the presence of the ceramides. Moreover, a significant difference in the POPC and ceramide chain ordering is observed in the liquid crystalline phase.

WE-A4-4 **10 h 45**

Optimal Use of Photon Counting Photomultipliers for Biophoton Measurements of Cartilage Tissue and Cultured Fibroblast Cells, **Binod KC**, Dave Irvine-Halliday, Robert I. Thompson[a], Ken Muldrew[b], Cyril B. Frank[b], Nigel G. Shrive[b], and Kevin Forrester[b], *University of Calgary*, (a) Department of Physics and Astronomy, (b) Department of Surgery — A photon counting method is employed to detect and process a low-light chemiluminescent signal. A fast photomultiplier is used for detection and equally fast electronics are used to count the arrival of individual photons. This method provides excellent linearity, signal-to-noise ratio and precision over a dynamic range of 100,000:1. We optimized the performance of the counting method by reducing the noise and the dark counts of the system. This paper highlights the various optimization techniques we incorporated. We measured biophoton activity from tissues and cultured cells both with and without external stimulation. Biophotons are the endogenous light produced by living cells, either as a byproduct of normal metabolism or for an as yet undiscovered purpose. We used hydrogen peroxide and TGF-beta growth factor as the stimulants. The results showed that the emissions are higher with stimulation. The emission intensity also depended upon cell vitality and injury to tissues. These results suggest the possible application to minimally invasive diagnosis of soft tissue injury or pathology. Future work is focused on probing the fundamental significance of biophotons: whether they are simply a by-product of metabolism or, possibly, an agent of intercellular communication.

WE-A4-5 11 h 00

Proteinquakes: Observations of the Dynamics of Heme Proteins Using Diffractive Optics-Based Heterodyne Detected 4-Wave Mixing **J.P. Ogilvie**, M. Plazanet, Gami Dadusc, M. Armstrong, and R.J.D. Miller, *University of Toronto* — The relationship between structure and function is of fundamental importance for understanding biological systems. The heme proteins hemoglobin and myoglobin provide ideal model systems for studying this relationship because they have well characterized structures and functions and are amenable to optical probes, allowing their functional processes to be initiated by photodissociation. Diffractive optics-based heterodyne detected 4-wave mixing provides a uniquely sensitive probe of the dynamics that follow photodissociation, yielding information about changes in protein radius of <0.001A. The highly sensitive nature of the technique has provided the first direct observation of ligand exit from carboxymyoglobin. The CO ligand appears to follow a single exit pathway, and is accompanied by a large segmental motion, or "proteinquake" as it escapes into the solvent. Dynamics on the femtosecond timescale are also being explored, with unprecedented time resolution afforded by the diffractive optics technique. Together these studies will provide a complete characterization of the functional processes of the heme proteins over 12 decades in time.

WE-A4-6 11 h 15

A Proton NMR Study of the Molecular Motion of Human Normal and Psoriatic Stratum Corneum, **C Laule**[a], C.L Chia[a], I.M Vavasour[b], A.L MacKay[a,b] and C.N Kitson[c], (*a) Department of Physics*, (b) Department of Radiology, (c) Division of Dermatology, Department of Medicine, *University of British Columbia* — The human body is a complex system surrounded by a selective envelope that is probably the most resilient of all organs: skin. The outermost layer of skin, the stratum corneum (SC), is in continuous contact with our harsh environment, yet still manages to perform its principal role of keeping foreign agents out and water in. However, sometimes pathological conditions arise whereby this remarkable barrier can no longer completely fulfil its function. One such disease is psoriasis, a dry skin condition in which there is a higher rate of skin cells being formed than being worn off. This leads to a thickening of the SC and dry skin results. The cause of this dry skin state is unknown. To determine the pathological origin of psoriasis, ^{1}H NMR measurements were performed on human SC afflicted with psoriasis and normal human SC as a function of hydration. Four psoriatic and two normal SC samples were studied. For each hydration, three NMR experiments were performed. A free induction decay was collected and used for determining solid and mobile signal intensities. A CPMG pulse sequence was used to further characterise the mobile signal, T_2 decay curves were decomposed into an arbitrary number of exponentials using a regularised NNLS algorithm. A modified inversion recovery (IR) sequence was used to determine the T_1 relaxation times, a T_1 distribution was obtained using the same NNLS algorithm as for the T_2 relaxation times. All measurements were obtained on a proton spectrometer operating at 90 Mhz. The normal SC samples hydrated to a water content more than twice that of the psoriatic SC. The FID showed that the completely dehydrated sample still contained approximately 15% mobile component for both psoriasis and normal SC. The proton density of the solid component (thought to be keratin in the corneocytes) was on average 0.05gH/gH_2O for the normal SC samples and 0.055gH/gH_2O for the psoriatic samples. These results suggest that the compositions of the solid in the SC samples, whether afflicted with psoriasis or not, were similar. The T_2 distribution for both the psoriatic and normal SC contained one peak assigned to water and a group of peaks thought to be lipids. As hydration decreased, the T_2 peak corresponding to water decreased in size and increased from 3 to 5ms. The other peaks remained constant in size and location for both psoriasis and normal. At high hydrations for both psoriasis and normal SC there was a relatively narrow single T_1 peak at 200ms. As hydration approached zero, the peak became smaller and broadened. By studying the NMR properties of normal and psoriatic human stratum corneum we hope to gain insight into the underlying physical processes which dictate the pathological progression of the disease. The NMR results from normal and psoriatic SC samples were qualitatively similar at similar hydrations, however, the normal samples achieved a much higher water content. This suggests that a key difference between the two types of stratum corneum may be related to their hydration mechanisms.

WE-A4-7 11 h 45

Site-Directed Biomineralization Using Scanning Probe Lithography, **W. Price**, G.Y. Liu, *WayneState University* — Our research targets one specific question: can biomineralization be controlled or regulated by engineering arrays of nanometer sized nuclei? Our approach to this problem utilizes a scanning probe lithographic technique to produce nucleation sites in a non-reactive matrix. Utilizing the technique of nanografting developed in our lab, we are able to fabricate patterns of carboxylic terminated thiols into an alkane thiol matrix. These carboxylic acid terminated thiols act at nucleation sites for the growth of calcium carbonate crystals. We have fabricated patterns ranging in size from 2x2 nm2 to several hundreds of nm2 and have initiated growth onto these patterns. This work will examine the critical factors involved in the initiation of calcium carbonate growth and in the progress of the crystal growth.

WE-A4-8 12 h 00

Fuzzy Logic PID Controller for Laser Thermal Therapy in Prostate: A Numerical Study*, **Vanessa Choy**[a] and William M. Whelan[a,b], (a) *University of Toronto* and (b) Ryerson University — Laser thermal therapy is a minimally invasive technique used to destroy solid tumors while minimizing damage to adjacent normal tissue. Thermal therapy, delivered using small optical fibers and implanted into the target volume, raises tissue temperature to above 55°C and results in coagulative necrosis (thermal damage). The wide spread use of thermal therapy is currently not probable in the near future because thermal damage volumes are highly irregular and unpredictable, a result of the dynamic changes in the tissue properties during treatment. To compensate for this dynamic behaviour, a closed-loop Fuzzy-Logic Proportional Integral Derivative (PID) controller was developed and initially tested for simulated laser thermal therapy of 5 mm and 10 mm diameter tumors in prostate. In the simulation, a single spherically emitting optical source fiber was placed at the center of the tumor. The tissue was treated as a "black-box" system for the purpose of the control. Input laser power was modulated to control the temperature field in an attempt to reach set point temperatures at the source (90°C) and at the target boundary (55°C). Typically, the power ramped up to approximately 2.5 W in the first few seconds of treatment such that the temperature at the source rapidly approached the set point temperature of 90°C. In all simulations the thermal damage reached the target boundary.

* Work supported by NSERC and NCIC (with funds from the Canadian Cancer Society).

WE-A4-9 12 h 15

Orientation of Glycine and Glutamine Residues in Spider Dragline Silk using Solid State NMR, **P.T. Eles**, C.A. Michal, *University of British Columbia* — The unique physical properties of the golden orb weaver spider Nephila clavipes dragline silk have been attributed to highly ordered crystalline regions (in the form of β-sheets) embedded in an amorphous matrix. Initial results are presented from a study using a new variation of the Direction Exchange with Correlation of Orientation Distribution Evaluation and Reconstruction (DECODER) experiment to determine the orientation of ^{13}C-labelled carbonyl carbons in glycine and glutamine residues. DECODER is performed by physically changing the orientation of the sample about an axis perpendicular to the B-field and correlating the NMR frequencies in the two orientations. This takes advantage of the anisotropy of the chemical shift tensors of the carbonyl carbon whereby the resonant frequency depends on the angles that the molecular frame (defined by the amino acid backbone and the carbonyl bond) makes with the magnetic field. Because of the complex sample geometry (wrapped and flipped about the x-axis) and uniaxial symmetry, direct reconstruction of the angular distribution is impossible. Approaches to extracting the orientation distribution will be described. Implications of these results on the molecular origin of silk's impressive mechanical properties will be discussed in light of current efforts elsewhere to synthesize a silk-like analog.

WE-A4-10 12 h 30

Correlation Enhanced Information Transfer and Signal Detection in P-type Electroreceptors, **M. Chacron**, *University of Ottawa* — Accurate detection of signals is essential for the survival of a species. However, individual neurons are often noisy and very unreliable. We look at the effects of correlations in the interspike interval sequence on the neuronal capacity to encode time varying signals. This is assessed using two approaches: (1) signal detection theory that aims to determine the presence versus absence of a signal; (2) information theory which quantifies the reliability of the neural response to a repeated stimulus. In each case, we show that negative correlations lead to a dramatic improvement of the neuron's capacity to encode stimuli. However, the improvement is maximal over different frequency ranges. Thus, a single neuron can transmit information about both high and low frequency stimuli by using one of the two approaches.

WE-A4-11 12 h 45

Can Cross Relaxation Between Solid and Water Protons Account for T_2 Relaxation Times in Brain?, **Irene M Vavasour** and Alex L MacKay, *University of British Columbia* — Brain tissue consists of fast relaxing solid protons (found on macromolecules) and slower relaxing water protons. In human white matter, the water protons can be separated into three pools based on their T_2 relaxation time. The shortest T_2 (10-50 ms) has been attributed to water trapped in between myelin bilayers. Myelin is an insulating sheath which speeds up nerve conduction. The intermediate T_2 (80-200 ms) arises from intra/extracellular water and the longest T_2 (>2s) from cerebrospinal fluid (free water surrounding the brain). Due to interaction with solid protons, the first two water pools have their T_2s reduced significantly from the pure water T_2 time of about 3 s. This brain tissue cross relaxation process was measured on 7 bovine brain samples using a specialised NMR sequence. The results show that this cross relaxation process contributes substantially to the shortening of T_2 in brain although other mechanisms may also be present.

[WE-A5] LOOKING FORWARD / *UN REGARD VERS L'AVENIR*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D101

WEDNESDAY, JUNE 20 / *MERCREDI 20 JUIN*

WE-A5-1 **10 h 00**

BRIGITTE VACHON, University of Victoria

New Particles Searches at LEP2

Searches for excited states of charged leptons have been performed using data collected at the LEP e+e- collider. No evidence for new particle production has been observed. From the search for pair production, lower limits on the masses of excited leptons are derived. From the search for singly produced excited leptons, upper limits are determined for the ratio of the coupling to the compositeness scale, f/λ, for masses up to the kinematic limit.

WE-A5-2 **10 h 30**

Supersymmetry at CDF-II, D.M. **MacQueen**, *University of Toronto* — The mass of the Standard Model Higgs boson is very sensitive to corrections due to the energy scale where new physics occurs. If the next energy scale is close to the Planck mass, these corrections result in a Higgs mass about 15 orders of magnitude higher than experimentally favoured. Supersymmetric models, where each fermion has a bosonic superpartner and vice-versa, can allow these corrections to cancel, resulting in a more reasonable Higgs mass. The recently upgraded CDF detector at Fermilab's Tevatron is well positioned to search for new physics at the TeV scale. The physics program will include searches for signatures of a variety of supersymmetric models. This talk will focus on the sensitivity of CDF-II to some of these signatures.

WE-A5-3 **10 h 45**

The Next Galactic Supernova and SNO, **C.J. Virtue**, SNO Collaboration, *Laurentian University* — The Sudbury Neutrino Observatory is ready and waiting for the next galactic supernova. The neutrino flux from such a galactic event would produce hundreds to many thousands of interactions in the SNO detector and would shed further light on the physical properties of neutrinos as well as on details of the supernova dynamics. Through the Supernova Early Warning System (SNEWS), SNO and other neutrino detectors will provide a fast and highly reliable advance warning to the astronomical community. This talk explores some of the opportunities for measurements made possible by the unique capabilities of the SNO detector and its participation in SNEWS.

WE-A5-4 **11 h 30**

PATRICK R.B.SAULL, Penn State University and Tel Aviv University

High-Q^2 and Exotic Physics with ZEUS at HERA

Benefitting from a huge range of available momentum transfers, $\sim 0.1 < Q^2 < \sim 40\,000$ GeV^2, the HERA ep collider provides a view of the inside of the proton over six orders of magnitude in the Bjorken scaling variable x. As the world's only ep collider, HERA has also yielded some of the tightest limits on physics beyond the standard model. The latest ZEUS measurements of proton structure at high-Q^2 and constraints on exotic processes are presented. Prospects for physics after the on-going HERA upgrade, which will yield an increase in the luminosity by a factor of five and enable longitudinal polarisation of the lepton beam, are discussed.

WE-A5-5 **12 h 00**

PEKKA K. SINERVO, University of Toronto

The High-Energy Frontier: The CDF II Experiment at Fermilab

The Run II programme at the Fermilab Tevatron is producing the highest-energy matter-antimatter collisions ever observed in a collider environment. The CDF II detector has been designed to record these collisions, which will open up new vistas on the high-energy frontier. This talk will describe the scientific goals of the CDF II experiment, ranging from detailed studies of the strong and electroweak interactions and heavy quark physics to the search for new interactions and particles. An update on the first phase of Run II and plans for a higher sensitivity run will also be provided.

[WE-A6] SEMICONDUCTORS / *SEMICONDUCTEURS*

IMMEUBLE MACLAURIN BUILDING., ROOM / SALLE D111

WEDNESDAY, JUNE 20 / *MERCREDI LE 20 JUIN*

WE-A6-1 **10 h 00**

PATRICK DESJARDINS, École Polytechnique de Montréal

Semiconductor Thin Film Growth Under Highly Kineticaliy Constrained Conditions

Microelectronics have been, and will continue to be in the foreseeable future, primarily a Si-based technology due to the lost cost of Si substrates, the stability of SiO_2, and the enormous investment which has been made in Si processing and device fabrication. We are currently developing a unified approach, combined with a detailed atomic-level understanding and predictive models, for the growth of epitaxial layers of an entire family of group-IV semiconductors with room temperature optical band gaps ranging from nearly zero to approximately 3 eV for microelectronic and optoelectronic applications. Epitaxial growth is carried out in highly kinetically-constrained conditions to control surface reaction pathways, microstructure development, and surface morphological evolution at the atomic scale. This requires the development of hybrid growth techniques that combine the inherent advantages of chemical vapor deposition (choice of precursor chemistries for site specific reactions, self-limiting surface terminations, surface-mediated reaction kinetics, and conformal coverage) with those of molecular beam epitaxy (clean UHV processing compatible with *in situ* microstructural and microchemical analyses, low deposition temperatures) and sputter deposition (the use of energetic particles to overcome activation energy barriers for surface processes). Examples will be given for (i) the growth of direct band gap metastable Ge(1-x)Sn(x) alloys and Ge(1-x)Sn(x)/Se superlattices, (ii) the ultra-high B and As doping of Si(1-x)Ge(x), and (iii) the surface morphology evolution of Si(1-x)Ge(x) layers grown by GS-MBE.

WE-A6-2 **10 h 30**

HARRY RUDA*, University of Toronto

Formation and Characterization of InAs Self-Assembled Quantum Dots on GaAs and InP

Our presentation discusses highlights of our research on self-assembled (SA) semiconductor quantum dots (QD) including a proposed model for their formation, their growth by molecular beam epitaxy (MBE) and chemical beam epitaxy (CBE) on both patterned and unpatterned substrates, and their characterization by optical and photoelectrical techniques. The growth

model, based on a three-dimensional elastic energy representation, is shown to furnish the transition thickness, as well as the equilibrium shape of the quantum dots. MBE growth was used to grow multiple layer, vertically SA InAs QD on GaAs (001), while CBE was used for selected area epitaxy of InAs QD on InP (001) mesa structures prepared using electron beam lithography and chemically assisted ion beam etching. Influence of mesa stripe orientation, ridge width, growth interruption time and amount of InAs deposited, on photoluminescence (PL) and polarization-dependent PL characteristics were studied in the latter case. For the MBE grown material, values of transition energies, broadening parameters, QD size distribution, and activation energies for both the InAs QDs and InAs quantum using PL, surface photovoltage spectroscopy, and photoreflectance measurements are presented

* In collaboration with B.D. Chithrani[a,b], C. de Souza[a], A. Budiman[b], R.L Williams[b], J. Lefebvre[b], G.C. Aers[b], and P.J. Poole[b], (a) University of Toronto, (b) National Research Council of Canada

WE-A6-3 **11 h 30**

MICHAEL L.W. THEWALT, Simon Fraser University

Photoluminescence of isotopically-Pure Silicon

The recent availability of relatively large quantities of high purity stable isotopes of many of the elements has opened up a number of new areas of research in semiconductor physics. The effects of isotopic composition on band gap, thermal conductivity, and phonon energies and lifetimes have been studied previously in both isotopically purified Ge and C. Isotopically purified ^{28}Si is in fact being investigated for commercial applications as a substrate material for microelectronics, since it has a room temperature thermal conductivity approximately 60% larger than that of natural Si. We report here on the first succesful photoluminescence studies on 99.9% pure ^{28}Si crystals. Even though natural Si is already composed of ~92% ^{28}Si, clear shifts in the band gap, phonon energies, and phonon lifetimes have been determined.

WE-A6-4 **12 h 00**

Electronic and Optical Properties of Vertically Coupled InAs Self-Assembled Quantum Dots, **Marek Korkusinski** and Pawel Hawrylak, *National Research Council of Canada* — We present the results of calculations of electronic and excitonic states in a pair of vertically-stacked and electronically-coupled InAs self-assembled quantum dots as a function of the dot radius, height, and dot-dot separation. The calculation proceeds first with the calculation of strain. The strain enters the Bir-Pikus Hamiltonian and allows the determination of the effective band offset and the splitting of the light holes and the spin split-off band. The large splitting of light and heavy hole bands justifies the use of the effective mass approximation. In this approximation the electronic levels of coupled dots are calculated both by the recursive Green's function method and in adiabatic approximation. The semianalytical formulas for single-particle wavefunctions obtained in adiabatic approximation are further used in the calculation of a single exciton spectrum. To make a connection with the quantum information content of the problem, a mapping of the coupled dot problem to the problem of a single spin is carried out. The electron-hole complex is shown to be equivalent to entangled states of two interacting spins. Theoretical results are compared with recent photoluminescence experiments on a single pair of coupled dots demonstrating coupling and entangling of quantum states in the artificial molecule[1]

[1] M. Bayer, P. Hawrylak, K. Hinzer, S. Fafard, M. Korkusinski, Z.R. Wasilewski, O. Stern, A. Forchel, *Science*, **291** (19 January 2001).

WE-A6-5 **12 h 15**

Interfacial Quality and Optical Properties of GaSb/GaAs Quantum Wells Grown by MOVPE, **O.J. Pitts**, S.P. Watkins, C.X. Wang, J.A.H. Stotz, and M.L.W. Thewalt, *Simon Fraser University* — We present a study of the growth by metalorganic vapour phase epitaxy (MOVPE), and of optical properties, of strained ultrathin GaSb quantum well (QW) layers in a GaAs host crystal. We use *in-situ* monitoring by reflectance difference spectroscopy (RDS) to determine the influence of growth conditions on the segregation of Sb and resulting asymmetric interfacial properties. The periodic nature of the RDS signal for multiple quantum well structures allows us to construct time-resolved RDS spectra, showing the evolution of the surface anisotropy during growth. We show how X-ray diffraction (XRD) data may be used to determine the graded compositional profile resulting from Sb segregation at the GaAs/GaSb interface. The photoluminescence (PL) peak from the QWs shows a strong shift to higher energy with increasing excitation power, which is consistent with calculations indicating a staggered band lineup for the strained GaSb/GaAs interface.

[WE-A7] SPECTROSCOPIC AND DYNAMICAL STUDIES OF ATOMS/MOLECULES I
SPECTROSCOPIE ET DYNAMIQUE DES ATOMES ET MOLÉCULES I
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D288

WEDNESDAY, JUNE 20
MERCREDI LE 20 JUIN

WE-A7-1 **10 h 00**

ERIC A. HESSELS, York University

*High-Precision Measurement of the 2 Triplet P Intervals in Atomic Helium**

The n=2 triplet P J=1-to-J=2 and J=0-to-J=1 fine-structure intervals in atomic helium have been measured at the kHz level of precision. The measurements are made in a thermal beam of metastable n=2 triplet S helium atoms which are excited up to the n=2 triplet P state using a 1.083-micron diode laser. The fine-structure transitions are driven using microwave fields. The 2.3 GHz J=1-to-J=2 measured interval, when compared to highly-precise QED calculations for the interval, provides a strong test of QED, and in particular can be used to verify the accuracy of the 2 triplet P QED calculations. Comparison of the measured 29.6 GHz J=0-to-J=1 interval to the calculated prediction for this interval allows one to extract a new value for the fine-structure constant.

* This work is funded by the Natural Sciences and Engineering Research Council of Canada, by a Premier's Research Excellence Award, by the Canadian Institute for Photonic Innovations, and by a Canada Research Chair.

WE-A7-2 **10 h 30**

NASSER MOAZZEN-AHMADI, University of Calgary

Internal Rotation and Intramolecular Energy Transfer

What happens when energy is rapidly deposited in an isolated molecule? The study of intramolecular vibrational redistribution (IVR) is a key question for chemical physics and for laser chemistry. In order to understand IVR, we need to know more about the interactions between low frequency vibrations (like internal rotations) and high frequency ones (like C-H stretches). This can be done from the analysis of the vibrational spectra of molecules with one or more large amplitude internal degrees of freedom. Studies of these spectra require very high resolution IR spectroscopy, because the absorption bands are very congested. Thus high resolution studies of the vibration-torsion-rotation spectra give direct information on the pathways for energy flow in molecules, often with more details than is possible with time domain studies of relaxation. In this talk, I will concentrate on the analysis of the high resolution vibration-torsion-rotation spectra of symmetric top molecules with a single torsional degree of freedom. Symmetric rotors CH_3CH_3, CD_3CD_3, CH_3SiH_3, and CH_3SiD_3 will be used to illustrate that the presence of internal rotation in these molecular systems gives rise to large tunneling splitting of rovibrational levels. This splitting can then be used to formulate the vibration-torsion-rotation Hamiltonian and subsequently to determine the leading coupling mechanisms such as Coriolis-like and Fermi-like interactions.

WE-A7-3 **11 h 30**

RICHARD A. HOLT, University of Western Ontario

Atomic Lifetime and HFS Measurements for Astrophysics

Dynamical processes within the interiors of stars reveal themselves in the varied abundances of chemical elements in the photosphere. These can be deduced from stellar spectra, provided the necessary atomic data are available. The equivalent width of a spectral line is determined by the column density of the atomic species, the oscillator strength of the transition, and broadening mechanisms, including stellar rotation, microturbulence, and hyperfine structure (HFS). I will describe the fast-ion-beam laser-induced-fluorescence technique, as well as recent and planned measurements of atomic lifetimes and HFS on lanthanides and iron-group elements.

WE-A7-4 **12 h 00**

Laser Spectroscopy of Holmium Containing Molecules*, **C. Linton**[a], M.J. Dick[a], A.K. Kristoffersen[a], J.L. McBride[a], A.G. Adam[a], P. Crozet[b] and A.J. Ross[b], (a)*University of New Brunswick*, (b) Université Lyon I, France — As part of a continuing investigation into the properties and structure of molecular species containing lanthanide atoms, a laser spectroscopic study of holmium containing molecules is presently in progress. A laser ablation source is used to obtain low resolution survey spectra using pulsed lasers and high resolution spectra are obtained with both laser ablation and oven sources using a cw ring laser. The results of the survey and high resolution studies will be presented. At present, high resolution spectra have been obtained for several bands of the A9 - X8 and B8 - X8 transitions of HoF and the A9 - X8 transition of HoCl, all of which show hyperfine structure due to the I =7/2 spin of the Holmium nucleus. The results of the analyses of the rotational and hyperfine structure will be presented and discussed in terms of the electron configurations of and interactions between the electronic states.

*Work supported by NSERC

WE-A7-5 **12 h 15**

Gas Dynamics of a Metastable Atomic Beam Source Initiated by Direct Discharge and Interfaced to a Mmass Spectrometer Ion Source, **S. Letarte**[a], P. Picard[b], M. Baril[a], R. Paquin[c], (a) *Université Laval*, (b) Phytronix Technologies Inc., (c) Ministère de l'alimentation, des pêcheries et de l'agriculture du Québec (MAPAQ) — Free jet expansion and molecular beam skimming theories have been applied to the sampling of a metastable atomic beam developed for the Penning Ionisation Mass Spectrometry (PIMS). The fundamental requirements for the optimum mechanical interface are described in this presentation. The properties of this specific interface are compared and contrasted to those of typical Glow-Discharge and Inductively-Coupled-Plasma ions source. The equations describing the pressure, density, temperature and simulation of a free-electron gas DC discharge are applied to the PIMS interface. This interface consists of two apertures: a conventional sampler and a skimmer used as a collision cell. The flow through the sampler and the skimmer is sequentially continuous, effusive and transitional. An ion optics simulation program has also been used to determine the trajectories of ions produced in the source and how they are deflected from the skimmer entrance to prevent ions from entering the collision cell.

[WE-A8] INSTRUMENTATION AND MEASUREMENTS IN INDUSTRIAL AND APPLIED PHYSICS
INSTRUMENTATION ET MESURES EN PHYSIQUE APPLIQUÉE ET INDUSTRIELLE

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D114 — **WEDNESDAY, JUNE 20 / *MERCREDI LE 20 JUIN***

WE-A8-1 **10 h 00**

ANDREAS MANDELIS, Photothermal and Optoelectronic Diagnostics Laboratories, University of Toronto

Lock-in Common Mode Rejection Demodulation: A Novel Background-Suppression Signal Generation Methodology

This talk should be of interest to any experimentalist who deals with low signal-to-noise ratio (SNR) phenomena, coupled with low dynamic-range signal-processing instrumentation. The ability of conventional single-ended techniques with low signal dynamic range (such as photothermal detection) to detect weak inhomogeneities in a given material is mainly limited by two instrumental factors: the SNR and the amplitude dynamic range. The amplitude level is limited by the output signal baseline, which may be too high to monitor relatively small variations introduced by the presence of weak inhomogeneities. The purpose of this talk is to introduce a novel signal generation methodology, the principle of which can be broadly applied to any technique utilizing a lock-in analyzer demodulation scheme of periodic signal waveforms. Unlike the conventional single-ended periodic excitation wave form, which uses 50% duty-cycle square wave or sinusoidal modulation of a signal generating source (e.g. an intensity- modulated heating laser), a more complicated periodic modulation waveform is employed, resulting in the equivalent of differential-signal modulation. This results in enhanced signal dynamic range due to the efficient suppression of the baseline and a substantial improvement in the SNR. Our first photothermal results obtained using laser infrared radiometry on Zr-2.5Nb shot-peened samples will be presented and compared to those obtained by temporally modulating the pump laser beam intensity as a 50% duty-cycle square wave. Furthermore, new thermophysical measurements using water mixtures with methanol and a photopyroelectric cavity sensor (Shen and Mandelis, *Rev. Sci. Instrum.* **66**, 4999 (1995)) will also be presented and compared to conventional frequency-scanned photothermal detection. These experiments show that the new measurement methodology is quite promising for nondestructive detection of minute damage in solids, such as that created by shot-peening, and for thermophysical monitoring of small solvent concentrations in fluid mixtures. It will be concluded that the novel measurement technique as implemented with laser photothermal systems affords detectivity well beyond the capabilities of conventional photothermal techniques.

WE-A8-2 **10 h 30**

JEAN-PIERRE MONCHALIN, National Research Council of Canada

Optics-Based Diagnostics for Industry

In this presentation, various diagnostics based on optics, and in development at the Industrial Materials Institute of the National Research Council of Canada, will be outlined. They include first Laser Induced Plasma Spectroscopy, a technique that consists of producing a plasma at the surface of a material with a pulsed laser and in analyzing the spectra of the emitted light to find material composition. Applications to pharmaceutical products, metallic alloys and mineral ores will be presented. Probing optically opaque materials is performed by generating ultrasound with a pulse laser. The technique (laser-ultrasonics), which operates at a distance and includes also a second laser coupled to an interferometer for detection, allows us to find flaws, measure thicknesses and evaluate material microstructure. Development of photorefractive interferometers for detection and examples of industrial applications in the aerospace and steel industries will be presented. Finally, developments and applications relating to the measurement of interface locations and surface profiles by interferometry with a short coherence length source (Optical Coherence Tomography) will be presented. Examples include, in particular, the determination of the profile of a small hole and of the crater produced by laser ablation.

WE-A8-3 **11 h 15**

KIRK H. MICHAELIAN, CANMET Western Research Centre

Photoacoustic Infrared Spectroscopy and Thermophysical Properties of Hydrocarbons

Photoacoustic (PA) infrared spectra of condensed-phase samples are readily obtained with a commercially available gas-microphone cell and Fourier Transform Infrared (FT-IR) spectrometer. In PA spectroscopy, modulated light is absorbed by a sample and converted to heat via radiationless processes, the resulting thermal wave gives rise to a pressure wave in the carrier gas, which can be detected by a sensitive microphone. The microphone signal is amplified and then recorded by the FT-IR electronics: no optical detector is utilized. Modulation of IR radiation in the interferometer at acoustic frequencies is effected in one of several ways: 1) continuous or stepped motion of the movable mirror; 2) vibration of the fixed mirror (phase modulation); 3) chopping the recombined beam (amplitude modulation). The main advantages of PA infrared spectroscopy are minimal sample preparation, and its capability

for depth profiling of layered samples. The propagation of the thermal wave and the exchange of heat between sample and carrier gas depend on thermophysical properties such as thermal conductivity and thermal effusivity. These quantities are measured in separate experiments. In this seminar, PA infrared spectra and thermophysical properties of hydrocarbons and carbonaceous solids are presented. These data allow characterization of difficult industrial samples, many of which are not amenable to traditional analytical methods.

WE-A8-4 **11 h 45**

Nonlinear Acoustic Imaging and Quantitative Acoustic Microscopy. Review, **Roman Gr. Maev**, Centre for Imaging Research and Advanced Materials Characterization School of Physical Sciences, *University of Windsor* — In terms of acoustic imaging an obvious implication of the higher harmonic generation in the nonlinear medium is an improvement of an image resolution for a focused acoustic beam configuration. Another important conclusion from the various recent results presented by different research groups is that the contrast of the nonlinear acoustic image is determined by local material nonlinearity and can be substantially enhanced in the presence of micro-inhomogeneous defects. In this presentation, the effect of these two factors on the operational capability of acoustic imaging instruments, and primarily an acoustic microscopy imaging and signal processing, will be considered. Some new opportunities for the nonlinear material characterization using such parametric acoustic imaging will be also discussed. Improvement of imaging resolution using higher harmonics is one of the priorities on this way. Since the spatial resolution attainable with ultrasound detection equipment is dependent ultimately upon the wavelength of the ultrasound used, the chosen frequency of operation should be high if the size of the object under study is small. In practice, a compromise must be established between these two conflicting effects by choosing a transducer of suitable center frequency. One possible method of enhancing the quality of ultrasound images is to exploit the effect of nonlinear propagation on the acoustic signal. The higher harmonic signals generated as it travels through the media can be used to enhance the capability of the traditional ultrasound method. The most popular quantitative technique in acoustic microscopy is the V(z) method, in which acoustic velocity and attenuation of leaky surface acoustic waves as well as a reflectance function can be determined from the output signal V of the transducer acquired as a function of specimen displacement z. In this presentation we will demonstrate a new technique for acoustica parameters measurement called A(z) method for transmission mode and V(x,t) method for reflection mode. It will be shown that the velocity of the leaky wave is equal to the ratio of the scanning distance and time delay. Also, based on angular spectrum approach, establish the waveform of V(x,t) which can be expressed as an inverse Fourier transformation of the reflection coefficient and transfer function product. Velocities of leaky waves are measured for some isotropic materials in reflection mode by a pair of line-focus transducers. Obviously, due to directivity of the transducers, this experimental setup can also be applied to anisotropic specimens. Further, this method can be generalized to a transmission mode and point-focus transducers can be used.

WE-A8-5 **12 h 00**

Chlorine-Assisted Laser Micromachining of Silicon, **Marc Nantel**, Yuri Yashkir, Seong-Kuk Lee, Bernard Hockley, *Photonics Reseach Ontario* — Machining silicon has been an important technique for the semiconductor industry for decades. While this has traditionally being done through wet chemical etching, other techniques are worth exploring. This is especially true for efforts in the pursuit of integrating photonics devices on a single chip to facilitate their production. For this, a non-wet, non-contact, arbitrary-shape milling of silicon would be best. Laser micromaching provides an alternative with significant competitive advantages. To explore the laser micromaching alternative, a kilohertz-repetition-rate diode-pumped frequency-tripled YLF laser (100-ns, 351-nm) is focused on the surface of silicon wafers in a chlorine atmosphere for enhanced magnitude and control of the ablation rate. In the chlorine atmosphere, much less debris is generated on the surface around the cut, sub-damage threshold machining is achieved for a better control of the ablation depth, ablation rates ranging from 20-4000 micron-cube/second are possible (more than 10 times the rates without chlorine). This technology has the potential to have broad application to the photonics industry.

WE-A8-6 **12 h 15**

The Meteorological Service of Canada (MSC) Celebrates its 130th Birthday in 2001, **Ann McMillan** and Denis Bourque, *Atmospheric Environment of Canada* — Recently, there has been unprecedented change within the service, which is expected to continue. The service remains the major employer of meteorologists in Canada, most of whom are physicists by background. This paper will provide an update on the current state of play with respect to the Meteorological Service.

[WE-A9] THERMAL AND QUANTUM SYSTEMS / *SYSTEME THERMIQUES ET QUANTIQUES*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D110

WEDNESDAY, JUNE 20 / *MERCREDI LE 20 JUIN*

WE-A9-1 **10 h 00**

Properties of D-Brane Black Holes, **G.W. Semenoff**, *University of British Columbia* — Some possibilities for using the holographic dual of ten dimensional supertravity for a first principles computation of the classical thermodynamic properties of black brane solutions is discussed.

WE-A9-2 **10 h 15**

Approach to Equilibrium in an Interaction Field Theory, **G. Kunstatter**, *University of Winnipeg* — We examine a field theory model for two systems initially at different temperatures. Using standard approximation techniques we calculate the master equation that describes the time evolution of the distribution functions for the two systems. By making further, reasonable assumptions, we reduce the (initially very complicated functional differential equations) to a pair of ordinary, coupled equations that we solve numerically. Our results provide remarkably accurate descriptions of the approach to equilibrium for these systems. To the accuracy of the calculation, both particle number and total energy are conserved during equilibration.

WE-A9-3 **10 h 30**

A Study of the Spin 1/2 XXZ Model on the Square Lattice,* H.Q. Lin, *J. S. Flynn, *D.D Betts and *A.W. Sandvik, (a) Chinese University of Hong Kong; (b) *Dalhousie University*; (c) Finland University — The spin one-half XXZ model on the infinite square lattice at zero temperature has been studied by the authors and is presented here. Our methods using finite square lattices have been exact diagonalization and quantum Monte Carlo. The physical properties estimated per lattice vertex include ground state and first excited state energy, staggered magnetization and susceptibility in the parallel and perpendicular directions, spin stiffness and spin wave velocity. In the range from the Ising model to the Heisenberg model our estimates of a) energy per vertex and b) staggered magnetization on the infinite square lattice compare very well with estimates of the same properties published in other papers using five other methods. In the range between the Heisenberg model and the XY model there is little in the literature to compare with our estimates of energies, spin wave velocities, etc. on the basis of the perturbative theory in small external electromagnetic fields. Using the Δ contribution to the paramagnetic polarizability of the nucleons, the reasonable values of magnetic polarizabilities $\beta_p = (5 \pm 3) \times 10^{-4}$ fm^3, $\beta_n = (7.6 \pm 3) \times 10^{-4}$ fm^3 are estimated. As a result there is no magnetic crisis as one occurs in the nonrelativistic quark model.

WE-A9-4 **11 h 15**

Division Algebras and Supersymmetry*, **P.F. Kelly** and T.G. Pilling, *North Dakota State University* — In the formulation of Supersymmetric quantum field theories it is generally taken for granted that the product of two superfields yields another superfield and, furthermore, that the resultant field is non-zero unless one or both of the original fields is zero. This seemingly innocuous, and quite physical, requirement is the essential characteristic of Division Algebras. Surprisingly, there are only four distinct types of Division Algebras (which include an identity element) and these correspond to the Real, Complex, Quaternion, and Octonion Numbers, with minimum dimensions 1, 2, 4 and 8 respectively. We will describe the progress of our efforts to analyse SUSY from this viewpoint.

*Work supported in part by the National Science Foundation.

WE-A9-5 **11 h 30**

Supersymmetric Calogero-Moser-Sutherland Models and Jack Superpolynomials*, **P. Desrosiers**, L. Lapointe* and P. Mathieu, *Université Laval*, (a) McGill University — The Calogero-Moser-Sutherland (CMS) models describe systems of N particles interacting pairwise through long-range (inverse square) potentials. The classical and quantum versions of

these models are integrable. In this conference, we focus on the supersymmetric extensions of the quantum CMS models. The eigenfunctions of the supersymmetric CMS models are built explicitly. They constitute a new generalization, with fermionic variables, of the Jack polynomials. Furthermore, various new results for the supersymmetric version of the CMS models are presented: the Lax formulation, the construction of the Dunkl operators and the explicit expressions for the conserved charges. The reformulation of the models in terms of the exchange-operator formalism is a crucial aspect of our analysis.

* Work supported by CRSNG, FCAR and Fondation J.-A. Vincent.

WE-A9-6 **11 h 45**

From Energy Levels to Spectral Distributions. **Steffon J. Luoma** and Rizwan Haq, *Laurentian University* — For a quantum system of interacting particles, the distribution of eigenvalues has been of long standing interest to mathematicians and physicists. Starting from the study by Weyl (1912) regarding the asymptotic mode density, the introduction of spectral distributions in nuclei by French (1967), and the ansatz by Bohigas and Giannoni (1980) concerning the spectral fluctuations of chaotic systems, the question of information content of spectra continues to be important. The problem is to describe the distribution in terms of a smoothed eigenvalue density and fluctuations around this average. It is clear that the information contained in the smoothed distribution will be significant if the fluctuations carry little information (since these are usually ignored) and that there exists a sharp separation between the two parts of the density. In this work, we study certain important aspects of spectral distributions following a method developed by Strutinski (1967) for incorporating the shell correction in the smoothed binding energy of nuclei. We show that starting from the eigenvalues, it is possible to converge to the characteristic distributions corresponding to the two ensembles: the Gaussian Orthogonal Ensemble (GOE) and the Two-Body Random Ensemble (TBRE). Note that the TBRE may be regarded as a special case of the Embedded GOE (EGOE). The sharp separation between averages and fluctuations is clearly demonstrated for the TBRE.

WE-A9-7 **12 h 00**

Completeness of Dual Tensorial Sets and Their Liouvillian Quasiparticle Algebras: Explicit Role of Time-reversal Invariance -Based Scalar Invariants under Symmetric Group Projective Mapping for $[A]_{n,10 \le n \le 24,60}$ Nmr Spin Ensembles -- as Models of (Nmr) Quantum Infomatic Entanglements. **F.P. Temme**, *Queen's University* — Dual tensorial set structure and its time-reversal invariance(TRV) -based scalar invariants(SIs), defined via the cardinality of the S_n democratic auxiliary "v"-labels (which themselves correspond to the YC subduction irrep route-maps), are re-considered in the context of $[A]_n$: ($10 \le n \le 24, 60$) *n*-fold uniform, NMR spin ensembles and the limitations imposed by geometric algebra based on regular 'solid-figures'. Analogues of these dual adapted tensorial bases clearly correspond to the (high-indexed) coherent super-positional bases of recent topical interest, as in discussing quantum informatics via (NMR) modelling-realised in terms of "entanglements", or the foundations of quantum physics. The general nature of (Landau) S_n decompositional mapping in evaluating the numbers of independant SIs for auxiliary tensorial labelling is contrasted with the original Weyl approach. The conceptual value of Lie-based quasi-particle algebras over Liouville space and their dual group -based carrier spaces is demonstrated in a way which augments our [*Physica* **A198** 245 (1993)] original work on the topic of (Liouvillian) superboson mappings

[WE-A10] PHOTONIC MATERIALS AND EDFAS II / *MATÉRIAUX PHOTONIQUES ET EDFAS II*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D287 — **WEDNESDAY, JUNE 20 / *MERCREDI LE 20 JUIN***

WE-A10-1 **10 h 00**

HENRY M. VAN DRIEL*, University of Toronto

*Ultrafast All-Optical Band Edge Control in Two-Dimensional Silicon Photonic Crystals***

We present experimental results demonstrating the ultrafast control of the band edge of a two-dimensional silicon photonic crystal via optically injected free carriers. A parametric amplifier (with a 250 kHz repetition rate) is used to pump the photonic crystal at a wavelength of 0.8 microns and probe the band edge reflectivity at a wavelength of 1.9 microns. We observe a maximum photonic band edge blueshift of 30 nm at a pump fluence of approximately 3 mJ/cm^2, with the shift occurring over the timescale of the pump pulsewidth (approximately 400 fs). Our measurements are interpreted in the context of a simple Drude model for the plasma and are consistent with band structure calculations incorporating a Drude form of the dielectric function. These results highlight the possibility of using optically-injected free carriers in photonic crystals for all-optical ultrafast switching and ultrafast band gap control.

* In collaboration with S.W. Leonard, University of Toronto and J. Schilling, F. Muller, R.B. Wehrspohn and U. Gösele, Max-Planck-Institute of Microstructure Physics, Germany

** We are grateful to Photonics Research Ontario and the Natural Sciences and Engineering Council of Canada for financial support.

WE-A10-2 **10 h 30**

Nonlinear Bragg Grating*, **H.Zowa**ll and J.W.Y. Lit*, *University of Waterloo*, (a) also at Wilfrid Laurier University — We have considered Bragg gratings which have alternate strips with positive and negative nonlinear coefficients[1]. We have found that such gratings possess switching capabilities and optical limiting behaviour at resonance. Off resonance, strong gratings give bistability phenomena. When such a nonlinear grating is coupled in series with a linear one, the combination gives the familiar S curve of bistability that is very suitable for switching. The properties of such gratings may be very well controlled by varying the different parameters. This paper will present the mathematical theory of such gratings and the important numerical results.

[1] Optical signal processing using nonlinear Distributed feedback structures. L. Brzozowski and H. Sargent. *IEEE J. Quantum Electron.*, **36**, NO.5, MAY 2000.

* Research supported in part by CIPI and NSERC.

WE-A10-3 **10 h 45**

Multiwavelength Operation of an Elliptical Erbium -Doped Fiber Laser.* **Gautam Das** and J.W.Y. Lit*, *University of Waterloo*, (a) also Wilfrid Laurier University — Multiwavelength fiber lasers have important applications in sensing and in instrument testing. They are also extremely useful for wavelength division multiplexing in communications. A comb filter has been used to produce many lines[1]. By cooling an erbium-doped fiber with liquid nitrogen, over twenty lines have been obtained[2]. Another method is to make use of the anisotropic effects[3]. Although the number of lines that could be produced by this method is not large, the method is appealing because it is simple. In this paper we shall present the study of a multiwavelength laser made with an elliptical erbium doped fiber. The number of lines produced may be changed by controlling the polarization state of the waves. Our results show that stable lines may be produced at room temperature. We could control the intensities of the lines by using the polarization controller in the resonating loop. We shall present the experimental results obtained with the laser that we have constructed.

[1] Chow J. *et al.*, "Multiwavelength generation in an erbium-doped fiber laser using in-fiber comb filters", *IEEE Photon. Technol. Lett.*, **8**, 1996, pp. 60-62.
[2] Namkyoo P. and Paul F. Wysocki, "24-line multiwavelength operation of erbium-doped fiber ring laser", *IEEE Photon. Technol. Lett.*, **8**, 1996, pp.1459-1461.
[3] Juan Hernandez-cordero *et al.*, "Polarization effects in a high-birefringence elliptical fiber laser with a Bragg grating in a low birefringence fiber", *Appl. Opt.*, **39**, 2000, pp. 972-977.

*Research supported in part by CIPI and NSERC.

WE-A10-4 **11 h 30**

L-Band Multi-Wavelength Laser with Erbium-Doped Fiber Ring Cavity*, **Q.H. Mao** and John Lit*, *Wilfrid Laurier University*, (a) also University of Waterloo — Multi-wavelength fiber lasers are very cost-effective sources for wavelength division multiplexing (WDM) systems and networks. Such lasers have been built with erbium-doped fiber (EDF) for the C-band (1529 to

1565nm) with various intra-cavity comb filters inserted into linear and ring cavities [1-3]. We have studied an L-band (1568 to 1610nm) multi-wavelength erbium-doped fiber laser (EDFL) by using a tunable Fabry-Perot etalon as the intra-cavity comb filter. We have succeeded in making such a laser by suppressing the backward ASE and reusing it to improve L-band gain, and by optimizing the cavity Q factor to keep the gain spectra of the EDF flattened. The number of lasing wavelengths increases as the FSR of the etalon decreases, but the stability becomes more critical because of multi-mode competition. At room temperatures, we have successfully obtained 5 stable lines separated by 2nm. This separation is limited by the inhomogeneous boarding effect of the gain medium.

[1] A.J. Poustie, N. Finlayson, and P. Harper, *Opt. Lett*, **19**(10), 716(1994).
[2] J. Chow, G. Town, B. Eggleton, M. Ibsen, K. Sugden, and I. Bennion, *IEEE Photon. Technol. Lett.*, **8**(1), 60(1996).
[3] N. Park and P. F. Wysocki, *IEEE Photon. Technol. Lett.*, **8**(11), 1459(1996).

*Research work supported in part by CIPI and NSERC.

WE-A10-5 **11 h 45**

Ultrafast Light Emission from Poly(1-methoxy-4-(2-ethylhexyloxy-2,5-phenylenevinylene)) (MEH-PPV). **Dongfeng Qi**, Jeff Young, Katja Rademacher, Andras Pattantyus, Mike Wolf, *University of British Columbia* — Femtosecond time-resolved spectroscopy is used to study the decay dynamics of the photoluminescence from thin films of the conjugated polymer, MEH-PPV. The time-resolved decay profiles of film samples exhibit decay constants that vary from less than 15ps to 400ps, depending on the emission energy. These time constants are significantly longer than those measured on thin films of the unsubstituted parent polymer PPV. One interpretation of these rapid decay constants is based on a model where the polymer chains are made up of several "coherent segments", joined by "defects". The decay constants are then associated with intrachain transfer of the photo-excitation in these bulk samples. To help understand the origin of the decay process, we compare the CW and time-resolved emission spectra of MEH-PPV with those obtained when MEH-PPV is supported in a nanoporous alumina host, where the overlap of polymer chains may differ from thin films of the polymer.

WE-A10-6 **12 h 00**

MBE-Regrowth on *in-situ* Etched $Al_xGa_{1-x}As$ for Buried High Index Contrast Gratings. **J.H. Schmid**, M. Adamcyk, A. Ballestad, R. Mar, B. J. Ruck, T. Tiedje, *University of British Columbia* — We present results of experiments on molecular beam epitaxial regrowth of gallium arsenide on flat and patterned GaAs and $Al_xGa_{1-x}As$. Since $Al_xGa_{1-x}As$ with a high aluminum content forms a stable oxide upon exposure to air, we use samples with a GaAs cap layer that is pre-patterned without exposing the $Al_xGa_{1-x}As$. We then perform an *in-situ* thermal chlorine etch to propagate the pattern down into the $Al_xGa_{1-x}As$ layer. This etch is carried out in an ultra high vacuum chamber which is connected to an MBE system, allowing regrowth to proceed without intermediate exposure to air. During the thermal Cl_2 etch, the sample is heated up to 200-500°C in a low pressure (10^{-4}-10^{-6} Torr) Cl_2 atmosphere. We show results on the evolution of surface roughness during this etch and during regrowth obtained by real-time elastic light scattering measurements. Characterization of the overgrown films by high resolution XRD and AFM will be presented. We explain how this process can be used to fabricate high index contrast gratings made of GaAs and aluminum oxide (AlOx) or air space buried in waveguides. These gratings can be one-dimensional for strongly coupled distributed feedback lasers or two-dimensional as a novel photonic bandgap material.

WE-A10-7 **12 h 15**

Lateral and Depth Resolution of Laser-Induced Breakdown Spectroscopy at Low Energies. **M. Taschuk**, G.W. Rieger, Y.Y. Tsui, R. Fedosejevs, *University of Alberta* — In this paper we present an investigation of the spatial resolution capabilities , both lateral and depth, of laser-induced breakdown spectroscopy (LIBS) using nanosecond 10-200 mJ pulses from a KrF laser. LIBS is a rapid material characterization technique that makes use of a laser-induced plasma to obtain knowledge of the composition of materials. As the expanding laser-induced plasma cools, electrons and ions recombine, giving off light that is characteristic of the constituents of the original target. This radiation is analyzed with an intensified gated spectrometer, and precise knowledge of the composition of the target may be obtained. A two dimensional map of elemental composition of a sample surface may be obtained by scanning a focused laser beam across its surface. In our experiments a 10X microscope objective is used to focus the beam, allowing lateral spatial resolution on the order of a few microns. Layered targets are also used to investigate the limitations of depth resolution using LIBS. Lateral and depth resolution will be characterized with respect to pulse energies and, in addition, the tradeoffs between high sensitivity versus high lateral resolution will be investigated. Preliminary experimental measurements will be presented.

PLENARY SESSION / *SESSION PLÉNIÈRE*
[WE-P1] BROCKHOUSE MEDAL WINNER — WEDNESDAY, JUNE 20
RÉCIPIENDAIRE DE LA MEDAILLE BROCKHOUSE — *MERCREDI LE 20 JUIN*
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE A144

WE-P1-1 **13 h 30**

MARK **SUTTON**, McGill University

Intensity Fluctuation Spectroscopy Using Coherent X-rays

Speckle is a graininess seen in the intensity of scattered light when using coherent light to illuminate a sample containing disorder. It depends on using coherent light and is not seen for conventional incoherent illumination. If the disorder of the material changes with time, then the speckle pattern fluctuates and measuring these intensity fluctuations leads to a technique called "intensity fluctuation spectroscopy" (IFS). IFS is an ideal way to study the thermodynamic fluctuations in a system provided that the scattering intensity is sufficient for the time scales of the system under study. For the last three decades or so, it has been extensively used with light scattering to study a large variety of systems. Recently, the technique has been extended into the x-ray region where it has the advantage of accessing opaque materials, probing shorter length scales and providing a more direct interpretation of the results. The prime disadvantage of x-rays over visible light is the much lower intensity levels of coherent x-ray beams. In this talk, I will describe the technique and describe recent results for both equilibrium and non-equilibrium systems.

[WE-P2] PARTICLE PHYSICS TECHNIQUES — WEDNESDAY, JUNE 20
TECHNIQUES EN PHYSIQUE DES PARTICULES — *MERCREDI LE 20 JUIN*
IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D287

WE-P2-1 **14 h 15**

TWISTING with FORTRAN90. **A. Olin**, *TRIUMF* and University of Victoria for the TWIST Collaboration — The TWIST experiment adopted FORTRAN 90 as the language for their analysis code 1.5 years ago. I will discuss some of the new features available in F90 emphasizing features that TWIST uses heavily. Rather than provide a tutorial on F90 syntax, the talk will emphasize the new functionality and usage in a physics context.

WE-P2-2 **14 h 30**

Muon Identification in the BaBar Experiment. **D. Thiessen**, *University of British Columbia*, representing the BaBar Collaboration — The BaBar experiment has just made the world's most precise measurement of CP violation in the B_0 system. Lepton identification played a critical role in accomplishing this task. Leptonic and semi-leptonic decay modes provide the cleanest signals for reconstructing the B_0 and its daughter particles. These provide the data for measuring not only CP violation, but also B lifetime and mixing, CKM matrix elements, and many other interesting physics quantities. The BaBar detector is designed to allow muons to be identified with high efficiency and with a low misidentification probability. The design of the detector and of the algorithms for muon identification will be discussed.

WE-P2-3 **14 h45**

JAMES PINFOLD, University of Alberta

The ATLAS Detector -- A Discovery Device

The ATLAS Detector is a general purpose LHC device capable of efficiently detecting most potential new particle physics signatures at the LHC energy scale. The design of ATLAS will be discussed in terms of three basic systems. The first is the energy and missing energy measurement system consisting of the electromagnetic and hadronic calorimetry in the barrel, endcap, forward and very forward regions. The second is the lepton identification and measurement system, this again includes the calorimetry as well as an extensive muon detection system. The third is the inner tracking and vertex detection system. These three systems will be discussed in terms of their efficacy in the discovery of new physics. Lastly, the current construction status of the ATLAS detector will be presented.

WE-P2-4 **15 h 45**

Nanometer Vibration Control by Interferometer-Based Active Feedback, **T. Mattison**, J. Thompson, K. Yau, *University of British Columbia* — Future linear e+e- colliders require megawatt beams focused to nanometer dimensions to obtain adequate luminosity. Vibration of the final focusing elements at the nanometer scale will prevent the beams from colliding. We are developing technology for active vibration control. Our approach is to measure the position of the mass to be stabilized relative to a distant stable reference point with an optical interferometer, and control its position with piezoelectric actuators. The feedback is implemented as a kernel module in a PC running Linux with an ADC/DAC card. Results for interferometer stability and mirror-position feedback with various air path lengths are presented. We have also constructed an interferometer-stabilized one-degree-of-freedom test stand with a variable mass of up to 100 kg, variable stiffness support, feedback and excitation piezo actuators, and a capacitive position sensor to monitor the performance. Results for feedback performance with different platform mass and stiffness values for various algorithms are presented.

WE-P2-5 **16 h 00**

Monte Carlo Simulation of QCD Corrections to Electroweak Processes at High Energy Hadron Colliders*, **M. Dobbs**, *University of Victoria* — A brief introduction to Monte Carlo tools for simulating QCD corrections to electroweak processes at hadron colliders will be presented. Hadronic WZ diboson production will be used as an example to illustrate the benefits and drawbacks of fixed order simulations, the parton shower approach, and matrix element corrections to the parton shower. Finally a new technique for combining the full next-to-leading order matrix element with the parton shower approach will be presented.

*Work supported by NSERC.

WE-P2-6 **16 h 15**

Electroweak Vector Bosons Fusion will be a Copious Source of Information at the LHC, **R. Mazini**, *Université de Montréal* — I will present the discovery potential with the ATLAS detector from those processes in the framework of the Standard Model as well as in some extended theories involving strong symmetry breaking and new interactions.

WE-P2-7 **16 h 30**

A 3-D Calculation of Atmospheric Neutrino Fluxes*, Y.Tserkovnyak*, R Komar, C.Nally, **C.E.Waltham**, *University of British Columbia*, (a) now at the Physics Department, Harvard University. — We present a fully three-dimensional calculation of atmospheric neutrino fluxes using accurate models of the geomagnetic field, hadronic interactions, tracking and decays. Results are presented for the Super-Kamiokande (SK) and Sudbury Neutrino Observatory (SNO) sites. We discuss departures from previous 1-D calculations, particularly with regard to overall fluxes, east-west asymmetries, and the recently reported geometrical enhancement of low energy, horizontal neutrinos[1].

[1] P. Lipari, hep/ph-0002282 (2000) and hep/ph-0003013 (2000).

*Work supported in part by NSERC.

[WE-P3] RADIOACTIVE BEAMS AND HEAVY IONS / *FAISCEAUX RADIOACTIFS ET IONS LOURDS*

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D111 — **WEDNESDAY, JUNE 20 / *MERCREDI LE 20 JUIN***

WE-P3-1 **14 h 15**

JORDI JOSE, Universitat Politecnica de Catalunya

Astrophysical Reactions and Explosive Nucleosynthesis

From Big Bang to a wide variety of astrophysical sites, nuclear reactions have been crucial, not only as energy sources but also as triggers for the synthesis of chemical elements. Usually, nucleosynthesis calculations involve sophisticated numerical codes linked to large nuclear reaction networks. In a number of cases, some of the key reactions are affected by large uncertainties, with a dramatic impact on the synthesis of specific nuclear species. In this talk, we will focus on the role of nuclear uncertainties associated with a handful of nuclear reaction rates for a number of explosive sites, with special emphasis on classical nova outbursts. Among others, we will discuss ^{21}Na(p,γ), ^{22}Na(p,γ), ^{25}Al(p,γ) and ^{26}Alg(p,γ), together with a preliminary analysis of reactions involving heavier species, of interest for nova or x-ray burst nucleosynthesis. Their impact on studies of gamma-ray emission from novae, on meteoritic anomalies, and on the role of nova outbursts in the Galactic abundances will also be presented.

WE-P3-2 **14 h 45**

BRIAN R. FULTON, University of York (England)

Novae and X-Ray Bursters: Measuring Breakout from the Hot-CNO Cycle at TRIUMF

Novae and X-ray bursters can readily be observed as a result of their prodigious energy output. The outbursts are thought to be powered by a thermonuclear runaway, which occurs in matter accreting onto a white dwarf or neutron star. They are also believed to be a possible site for the r-process, which is responsible for producing many of the heavy elements. In this talk we will look at current astrophysical models of these phenomena and at the nuclear reactions which might provide the breakout paths from the Hot-CNO cycle, providing the seed nuclei for the subsequent rp-process. ISAC, the new radioactive beam facility at TRIUMF, provides low energy beams which are ideal for these nuclear astrophysical experiments. The initial focus of the research programme will be on these breakout reactions, and we will look at the equipment which has been developed to carry out these measurements.

WE-P3-3 **15 h 45**

LOTHAR R. BUCHMANN, TRIUMF

Two More Years of Nuclear Astrophysics

An overview of recent accomplishments in Nuclear Astrophysics at TRIUMF is given. This includes a measurement of the ^{7}Be(p,γ)^{8}B reaction, a discussion of the ^{12}C(α,γ)^{16}O problem, and an overview of radioactive beams research.

WE-P3-4 **16 h 15**

MICHAEL HASS, Weizmann Institute, Rehovath, Israel

A New Measurements of the ^{7}Be(p,γ)^{8}B Cross-Section With an Implanted ^{7}Be Target

The nucleus ^{7}Be plays a central role in relating to the physics of the sun and to the "solar neutrino puzzle" and neutrino masses. In particular, two reactions, the ^{3}He (^{4}He,γ)^{7}Be fusion reaction that produces ^{7}Be and the ^{7}Be (p,γ)^{8}B capture reaction that is the source of high-energy ^{8}B neutrinos, are of major importance to this research. We report here on a new determination of the cross section of the ^{7}Be (p,γ)^{8}B reaction [1], measured at the Van de Graaff accelerator of the Weizmann Institute. We also present preliminary results of the ^{3}He(^{4}He,γ)^{7}Be reaction.

For ^{7}Be(p,γ)^{8}B, we utilize an implanted ^{7}Be target of 3.10^{15} atoms produced at ISOLDE (CERN) and a uniformly scanned particle beam larger than the target spot, eliminating the issue of target homogeneity. We have also recognized and accounted for the backscattered ^{8}B nuclei from the target assembly. The present results extrapolate to a value of $S_{17}(0) = 20.3$ eV barn and are in good agreement, albeit somewhat higher, with recent results. Measurements at lower proton energies are currently underway. For the ^{3}He(^{4}He,γ)^{7}Be, we have commenced a series of measurements to determine its cross section by single-atom counting of ^{7}Be by the Accelerator Mass Spectrometry (AMS) method [2] carried out at the heavy-ion Koffler accelerator of the Weizmann Institute. The present measurement hence utilizes a technique entirely different than previous measurements of counting prompt fusion γ rays or ^{7}Be decay γ rays. We report on preliminary results of this experiment and discuss future plans.

[1] M. Hass *et al.*, *Phys. Lett.* **B462**, 237 (1999); E.G. Adelberger et al., *Rev. Mod. Phys.* **70**, 1265 (1998); F. Hammache *et al.*, *Phys. Rev. Lett.* **80**, 928 (1998).
[2] See, e.g., S.K. Hui, M. Paul *et al.*, *Nucl. Inst. Meth.* **B172**, 642, (2000).

WE-P3-5 **16 h 45**

Improvement in Source Selection of Small System With Discriminant Analysis, **F.Grenier**[a], M.Samri[a], L.Beaulieu[a], L.Gingras[a], Y.Larochelle[a], X.Qian[a], R.Roy[a], C.St-Pierre[a], G.C.Ball[b], and D.Horn[b], (a) *Université Laval*, (b) AECL, Chalk River Laboratories — Complete events with at least 83% of the total charge of the ^{24}Mg + ^{12}C system have been investigated at 45 MeV/nucleon with a large multidetector array. A Statistical Discriminant Analysis Method is used to select central single-source events. The method is applied here to the multivariate moments of the kinetic and mass energy of the event. For the simulation, the DIT code creates the entrance channel and the Gemini code de-excites the quasi-projectile (QP) and quasi-target (QT) or composite system excited nuclei. Common global variables (flow angle, sphericity, etc.) are used to show that the Discriminant Analysis allows good source selection. The charge asymmetry of the event, and its reconstructed excitation energy, permit to cut off some pollution introduced by orbiting phenomena at low excitation energy and high asymmetries selected as single-source events.

WE-P3-6 **17 h 00**

Correlation Functions in Nuclear Reactions at Intermediate Energy*, **Dany Thériault**, Luc Gingras, Yves Larochelle, René Roy, *Université Laval* — Characteristics of nuclear matter far from stability are probed via the study of hot nuclei formed in intermediate energy (30-100 MeV/nucleon) nuclear reactions. Information such as charge, mass and velocity of the reaction products is obtained using a multidetector array. To get a good insight about the time of emission of an excited nucleus, the size of the hot nucleus, and the presence of fragments in excited states, correlation functions are used. Uses and results from correlation functions in the context of intermediate energy nuclear reactions will be discussed.

*In collaboration with INDRA.

WE-P3-7 **17 h 15**

Measurement of the Resonant dμt Molecular Formation Rate in Solid HD, **T.A. Porcelli**, *TRIUMF* — Muonic Hydrogen Collaboration Measurements of the muon catalyzed dt fusion ($d\mu t \rightarrow {}^4He + n + mu^-$) in solid HD have been performed at TRIUMF. The theory describing the energy dependent resonant molecular formation rate for the reaction μt + H D → [(dμt)pee]*, a key process in the dt fusion cycle, is compared to experimental results in a pure solid HD target. Using an experimental technique which employs solid layers of hydrogen isotopes, the energy of molecular formation via time of flight and dt fusion time spectra in solid HD have been measured. Constraints on the rates are inferred through the use of a Monte Carlo computer code developed specifically for the experiment. From the time-of-flight analysis of fusion events in 16 and 37 μg · cm^2 targets, an average formation rate consistent with $0.897 \pm (0.046)_{stat} \pm (0.166)_{syst}$ times the theoretical prediction was obtained. The sensitivity of this scaling factor to variations in the assumed theoretical model will be discussed.

[WE-P4] SPECTROSCOPIC AND DYNAMICAL STUDIES OF ATOMS/MOLECULES II
SPECTROSCOPIE ET DYNAMIQUE DES ATOMES ET MOLÉCULES II

WEDNESDAY, JUNE 20 / ***MERCREDI LE 20 JUIN***

IMMEUBLE MACLAURIN BUILDING, ROOM / SALLE D110

WE-P4-1 **14 h 15**

JAMES D.D. MARTIN, University of Waterloo

*Stabilization of Predissociating Rydberg Molecules using Microwave and Radiofrequency Fields**

The study of molecular Rydberg states is often complicated by a non-radiative decay mechanism not present in atoms, namely predissociation. For example, np Rydberg states approaching the first ionization limit of NO decay into N and O atoms. In this case, the 50p predissociation lifetime is estimated to be 0.4 ns, roughly five orders of magnitude shorter than the radiative lifetime of the 50p state of hydrogen, which is 23 μs. Thus, there is strong interest in developing techniques for stabilization of molecular Rydberg states against decay. In this talk, three recently demonstrated methods are discussed. All of these involve population transfer from optically accessible, but rapidly decaying, Rydberg states, to ones which are longer-lived but not directly accessible. This transfer is effected using combinations of microwave, radiofrequency and DC fields, aided by the strong transition dipole moments between Rydberg states. These stabilization techniques have important applications in both molecular Rydberg state spectroscopy and ion spectroscopy.

* Work performed in collaboration with E. Murgu and T. F. Gallagher (University of Virginia).

WE-P4-2 **14 h 45**

RAVI BHARDWAJ, National Research Council

Ionization of Atoms and Molecules with Intense Femtosecond Pulses

In intense-field ionization, an electron removed from the atomic/molecular core oscillates in the combined fields of the laser and the parent ion. Thus there is a finite probability for the electron to return to the ionic core and, if it possess sufficient energy, electron-ion collision can result in double ionization and fragmentation. The interplay between the electron oscillations and the ion's coulomb potential is responsible for some physical effects that leads to high yields of doubly charged ions. These effects are: the coulomb focussing of the oscillating electrons onto the parent ion, transient trapping of ejected electrons by the ion and dominant role of collisional excitation of the parent ion followed by laser-assisted ionization.

The total probability of double ionization depends on the number of returns of the ejected electron to the parent ion and therefore on the number of cycles in the laser pulse. We observed such pulse duration dependence of double ionization in Neon atoms using 12fs and 50fs pulses. The electron trajectory can be controlled by the laser polarization and hence double ionization and fragmentation of molecules. In Benzene, we show that double ionization and fragmentation can be turned on/off by changing the laser polarization from linear to circular.

WE-P4-3 **15 h 45**

DWAYNE MILLER, University of Toronto

Femtosecond Laser Source Development/Extreme Optics - a New Initiative for the CLS

This talk will give an overview of the most recent advances in femtosecond laser technology. The emphasis will be on scaling to higher average power and peak power for studies of some of nature's fastest phenomena and creating new states of matter. The combination of these recent advances with the infrastructure to be developed at the Canadian Light Source with respect to x-ray diagnostics promises to bring a unique facility to the Canadian science scene that will make it possible to determine structure and execute high field control of atoms and molecules in concert. This talk will serve as a discussion point for potential programs for the proposed facility.

WE-P4-4 **16 h 15**

Laser Photodetachment Spectroscopy of Atomic Negative Ions, **René C. Bilodeau** and Harold K. Haugen, *McMaster University* — The excess electron in an atomic negative ion is bound in a short-range potential (falling off as r^{-4}), as opposed to the Coulomb potential that binds neutral atoms and positively charged ions. One consequence is that only a very small number of states are bound in a negative ion, typically only the fine structure of one term, in contrast to the infinite number of states bound in other atomic systems. In addition to the important role that negative ions play in areas such as accelerator mass spectroscopy (AMS), atmospheric physics, and astrophysics, the novel structure and binding potential of negative ions have attracted much interest on a fundamental level. Recently, tunable pulsed laser techniques have led the way in high precision measurements in atomic negative ions. This talk will present some recent single- and multi-photon detachment studies conducted with the infrared laser source at McMaster University. Included are the first measurements on the negative ion of osmium, which has provided the first example of an atomic negative ion with bound states of opposite parity. Experiments demonstrating single- and multi-photon threshold laws will also be presented. Finally, selected future perspectives will be discussed.

WE-P4-5 **16 h 30**

Development of a Broadband Laser Plasma X-Ray Source for Application to Femtosecond Time-Resolved EXAFS, **P. Forget**[a], C. Belzile[a], V. Pitre[a], S. Magnan[a], J.C. Kieffer[a], H. Pépin[a] C. Tóth[b], A. Cavalleri[b], C.W. Siders[b], J.A. Squier[c], (a) *INRS - Énergie et matériaux, Université du Québec*, (b) University of California — The use of ultrafast x-ray bursts coming from laser-produced plasmas have proven to be valuable for numerous experiment such as time-resolved x-ray diffraction. A more ambitious goal is to use these sources for absorption study (EXAFS) of complex molecules with a femtosecond time resolution. The progress towards the development of a broadband x-ray source in the multi-keV range will be presented. The x-ray emission obtained with the INRS Nd:Glass laser (400mJ, 400fs, high contrast) and the UCSD Ti:Sapphire laser (75mJ, 20fs, 20Hz) have been characterized with time-integrated and time-resolved spectroscopy. We will also present the experiments planned with the new 10TW INRS laser (600mJ, 60fs, 10Hz) in the intensity range 10^{20} - 10^{21} W/cm^2 on solid targets.

2001 CONGRESS POSTER SESSION ABSTRACTS
RÉSUMÉS DES SESSIONS AFFICHES - CONGRÈS 2001

The poster session abstracts presented here will be on display in this order in the Foyer of the MacLaurin Bldg. from 18h30 - 22h00, on Monday, June 18th / Les résumés présentés en affiches publiés ci-après seront en montre de 18h30 à 22h00, le lundi, 18 juin dans le foyer d'Immeuble MacLaurin.

[MO-POS] ATOMIC AND MOLECULAR PHYSICS / *PHYSIQUE ATOMIQUE ET MOLÉCULAIRE* — MONDAY / *LUNDI*

MO-POS-1

Magnetic Moments of Lithium, **Zong-Chao Yan**, *University of New Brunswick* — The fully correlated calculations of the magnetic moment in lithium are presented. For the ground state lithium, the Zeeman σ factor, relative to the free-electron value, is calculated to a computational accuracy of 200 parts in 10^9, including relativistic and radiative corrections of orders α^2, $\alpha^2 m/M$, and α^3 atomic units. The isotope shifts in g_J are predicted precisely for various isotopes. The extensions to other states of lithium and other three-electron ions are made.

MO-POS-2

Measurement of Lithium Hyperfine Splitting and Isotope Shift, **J. Walls, J.J.** Clarke and W.A. van Wijngaarden, *York University* — Precise measurements of hyperfine splittings and isotope shifts in lithium are of basic theoretical interest. A beam of neutral lithium atoms is excited from the $2S_{1/2}$ state to the $2P_{1/2}$ state using a diode laser operating at 670 nm. The laser is scanned across the resonance and fluorescence is detected using a photomultiplier interfaced to a digital oscilloscope. The frequency scan is calibrated using the well known ground state hyperfine splitting. Part of the laser beam is incident on an etalon to check the linearity of the frequency scan. The nonlinearity of the frequency scan is taken into account when determining results for the excited $2P_{1/2}$ state hyperfine splitting and the ^{6}Li/^{7}Li isotope shift.

MO-POS-3

Spectroscopy of Li$^+$ using an Electro-optically Modulated Laser Beam, **J.J. Clarke**, S. Cauchi and W.A. van Wijngaarden, *York University* — Recent advances in atomic theory for two-electron ions have been made using variational techniques. Comparison of this theory with precision experiments is of importance for testing our fundamental understanding of two-electron atoms. In this experiment the hyperfine splitting and isotope shifts of the $1s2s\,^3S_1$ to $1s2p\,^3P_{0,1,2}$ transition of Li$^+$ are investigated. An optical modulator is used to precisely measure frequency intervals without many of the systematic errors that can affect interferometers. A 5 keV Li$^+$ beam is produced by a low-density electron-bombardment ion source. Approximately 1% of the 150 nA beam emerges from the source in the $1s2s\,^3S_1$ metastable state. A ring-dye laser beam that is frequency modulated at 1 GHz by an electro-optic modulator and overlaps the ion beam collinearly then excites these ions. A set of optics focusses fluorescence produced by the radiative decay of the excited state onto the photocathode of a cooled photomultiplier. Photon counting electronics record the fluorescence intensity as the laser frequency is scanned across the resonances. Each transition is excited by the various frequency sidebands of the modulated laser beam, which in turn permits the scan to be calibrated. Current results will be presented and compared to previous experiments that use different measurement techniques.

MO-POS-4

Excitation of Magnesium by Electron Impact, **R. Srivastava**[a], R. P. McEachran[b] and A. D. Stauffer[c], (a) University of Roorkee, (b) *Australian National University*, (c) *York University* — We have calculated differential cross sections and Stokes parameters for the excitation of the fine-structure levels of the 3D and 4D states of magnesium at impact energies of 20 and 40eV. The relativistic distorted-wave method was used in order to resolve the fine-structure of the atom. We have investigated the sensitivity of the results to the number of states used in the configuration-interaction calculation of the wavefunctions for the bound states. Detailed results will be presented.

MO-POS-5

Extension of GUPIX to ^{2}H, ^{3}He and ^{4}He excitation, **T.L. Hopman**, Z. Nejedly, J.A. Maxwell and J.L. Campbell, *Guelph-Waterloo Physics Institute, University of Guelph* — Particle-induced X-ray emission (PIXE) is a powerful, non-destructive method of elemental analysis. Characteristic X-rays excited by ions (normally protons) accelerated into a target are analyzed to determine the target composition. The ionization cross-section database in GUPIX, the Guelph PIXE software package, is extended to deal with deuterons and helium ions. One set of cross-sections is based upon the basic ECPSSR theory with hydrogenic wave functions and covers the K-, L- and M-shells. The alternative set is derived from empirical reference

cross-sections, but is limited to the K-shell. The new databases are tested through analysis of standard reference materials using pure elemental targets as standards. Deficiencies in the L-shell cross-section database are demonstrated through measurements on standard gold films.

MO-POS-6

Bethe Logarithms and Transition Frequencies for the Bound States of Helium*, **G.W.F. Drake**, *University of Windsor* — Bethe's mean excitation energy (Bethe logarithm) determines the largest part of the QED shift due to electron self-energy. Its calculation for atomic systems more complicated than hydrogen has been a long standing problem in atomic physics. The problem has recently been solved [1] by the introduction of discrete variational basis sets constructed to span a huge range of distance scales. Previous results for the S- and P-states of helium and He-like ions have now been extended to include all states up to $n = 6$ and $L = 5$. For $L \geq 3$, the results are well represented by an asymptotic expansion formula of the form $\beta(1s,nL) = \beta(1s) + [(Z-1)/Z]^4\beta(nL) + 0.316\,205(r^4)_{nL}/Z^6 + b_6(r^6)_{nL}/Z^8 + b_7(r^7)_{nL}/Z^9 + b_8(r^8)_{nL}/Z^{10}$, with b_6, b_7, and b_8 obtained from a fit to the direct calculations. A comparison with high precision measurements of transition frequencies will be presented for both He and Li$^+$.

[1] G.W.F. Drake and S.P. Goldman, *Can. J. Phys.* **77**, 845 (1999).

*Work supported by NSERC

MO-POS-7

Ion Trapping at Low Density Limits, **A. Fisher**[a], R. Thompson[a], H. Schuessler[b], H. Walther[c], M. Welling[c], (a) *University of Calgary*, (b) *University of Texas A&M, College Station, Texas* and (c) *Max-Planck-Institut fur Quantenoptik in Garching bei Munchen, Germany* — Trapping of ionic species at low density allows one to explore how individual ions behave statistically. The linear geometry ion trap that we are incorporating into our laboratory will allow us to observe interactions between individual ions and molecules providing us with insight into interaction potentials, binding energies, and structure of ionic species. As well as discussing the capabilities of our trapping system, this presentation will describe our experimental plans to investigate ion trap mass spectrometry (ITMS), laser spectroscopy, and laser cooling.

MO-POS-8

Electron Scattering from the Aligned Metastable 6s5d $^1D_2$ State of the Barium Atom, **P.W. Zetner** and M. Gilóan, *University of Manitoba* — Investigations of electron scattering from aligned / oriented atomic targets provide additional information about the collision process which is not available from conventional differential cross section data. Specifically, transition amplitudes linking initial and final state (degenerate) magnetic sublevels become accessible to study. We discuss our attempts to measure multipole moments of the aligned (metastable) 6s5d $^1D_2$ level of barium excited by electron impact on the (ground) $6s^2\,^1S_0$ state. The measurement scheme involves the investigation of the time-inverse related process in which aligned D state target atoms are de-excited by the projectile electrons. Aligned D state atoms are produced by radiative cascade from the laser excited 6s6p $^1P_1$ state. Our initial studies have been hampered by a systematic depolarization of the D state which we propose to alleviate by optical pumping using a second laser. We will present results of our efforts to probe and enhance alignment / orientation of the D state.

M0-POS-9

Measurement of radiative lifetimes and hyperfine structure in singly-ionized lanthanide and iron-group atoms, **S. D. Rosner**, R.A. Holt, M. Izawa, C.M. Pinciuc, R. Rivest, T.J. Scholl, A. Sharikova, *University of Western Ontario* — Nuclei of some heavy elements like lanthanides are produced by neutron capture processes in the interior of stars. The abundances of these elements in the stellar atmospheres give valuable information about the processes by which the elements migrate to the exterior of the star. Accurate measurement of the abundances require accurate values of oscillator strengths as well as an understanding of how hyperfine structure contributes to the absorption line profiles. To this end, we have measured radiative lifetimes in Nd II, Pr II, and Mn II using collinear and transverse beam-laser techniques with an uncertainty level of ~ 5%. Using laser-induced fluorescence on a collinear fast ion beam, we have measured hyperfine structure at high resolution, enabling magnetic hyperfine constants to be fit to <1%.

MO-POS-10

Multiphoton excitation and dissociation of diatomic molecules with two laser pulses*, R. Martin and **W.-K. Liu**, *University of Waterloo* — We have studied quantum mechanically the effect of two infrared laser pulses on a diatomic molecule. It has been shown previously that a chirped laser pulse is very effective in exciting a diatomic molecule, and classical studies have found that the addition of a second laser pulse with a fixed frequency substantially increase the dissociation probability of the molecule [1]. We confirm these observations with quantum mechanical calculations, and present our results of the dissoication probabilities as functions of various laser parameters.

[1] W.-K. Liu, J.-M. Yuan and S.H. Lin, *Phys. Rev. A* **60**, 1363 (1999).

* Research supported in part by NSERC.

MO-POS-11

Distorted-Wave Models in Positron Impact Ionization of Atoms, R.I. Campeanu[a], R.P. McEachran[b] and A.D. Stauffer[a], (a) *York University*, (b) *Australian National University* — Since there is a lot of experimental interest in positron ionization, we have investigated this process theoretically. We have formulated a simple distorted-wave model for positron ionization which works well for many atomic and molecular targets over a wide range of positron energies. We have tested it for the noble gases as well as both atomic and molecular hydrogen. Detailed comparisons will be made with experimental measurements for impact energies from threshold to 500 eV.

[MO-POS] ATMOSPHERIC AND SPACE PHYSICS / *PHYSIQUE ATMOSPHÉRIQUE ET DE L'ESPACE* — MONDAY / *LUNDI*

MO-POS-12

Spectroscopic Measurements of Tropospheric CO, C_2H_6, C_2H_2, and HCN in Northern Japan, **Y. Zhao**[a], K. Strong[a], Y. Kondo[b] and M. Koike[a], (a) *University of Toronto*, (b) *University of Tokyo* — Tropospheric column amounts and mixing ratios of carbon monoxide (CO), ethane (C_2H_6), acetylene (C_2H_2), and hydrogen cyanide (HCN) were retrieved from ground-based infrared solar spectra using the SFIT2 algorithm. The spectra were recorded with high spectral resolution Fourier Transform Infrared (FTIR) spectrometers at Moshiri (^{44}°N) and Rikubetsu ($^{43.5}$°N) in northern Japan from May 1995 to June 2000. The retrievals show significant seasonal variations in the tropospheric content of the four molecules over northern Japan with maxima in winter-spring for CO, C_2H_6, and C_2H_2 and in summer for HCN. Over the five-year measurement period, long term trends in the four molecules were estimated. Simultaneous enhancements of the tropospheric concentration of the four molecules were occasionally observed during the observational period, possibly due to the same sources. Abnormally high tropospheric amounts of the four molecules were recorded in 1998. Good correlations between CO, C_2H_6, and C_2H_2 indicated that they had similar sources and underwent similar processes of dilution. Deviation of HCN relative to its seasonal mean values is correlated with the similar deviation of CO, indicating that enhancements of CO and HCN were probably due to the same sources. Trajectory calculations and global fire maps revealed that emissions of biomass burning on the Asian continent were transported eastward to northern Japan. It is most likely that biomass burning that occurred in eastern Siberia from mid-July to early October 1998 was the major cause of the elevated levels in tropospheric CO, C_2H_6, C_2H_2, and HCN observed in northern Japan during the same period.

MO-POS-13

Z-Mode Propagation Observed on OEDIPUS C, **R.E. Horita**[a], and H.G. James[b], (a) *University of Victoria*, (b) *Communications Research Centre* — OEDIPUS C carried a tethered transmitter High-frequency EXciter (HEX) on its forward subpayload and a synchronized Receiver for EXciter (REX) on its aft subpayload. The HEX and REX had three different frequency modes: a 0 - 8 MHz sweep, a 0.5 - 2.1 MHz sweep and fixed-frequency operation at 4.5 MHz. Whistler, ordinary and extraordinary wave modes were propagated between the two subpayloads. One significant observation was that the fast Z mode was strong compared to the adjacent wave modes. The intensity of the Z-mode signals was enhanced at frequencies just below the plasma frequency fp for low fp values but enhanced at frequencies just above the Z-mode cut-off frequency fZ for high fp. A possible explanation involves Z-mode dispersion and antenna theory. Previous work involved antenna theory in terms of CW current applied to the antenna drive point. Since the OEDIPUS C transmitter produced 0.3 ms rectangular pulses and because the plasma is dispersive, the variation of the modulus and phase of the total radiated electric field components across the main lobe of the pulse spectrum was

checked. Use of the CW theory was found to be justified. Transmission and reception of the Z-mode signals has been computed combining Z-mode dispersion, HEX and REX characteristics and dipole radiation and impedance theories.

MO-POS-14

Simulation of Dispersive Field Line Resonances in the Magnetosphere*. **J.Y. Lu**, R. Marchand, and R. Rankin, *University of Alberta* — A two-dimensional finite element model is used to investigate the nonlinear interaction of shear Alfven wave (SAW) field line resonances (FLRs) and ion acoustic waves in Earth's magnetosphere. The geomagnetic field is approximated by a dipolar magnetic field and two dispersive effects are considered: electron inertia and electron thermal pressures.

* Work supported by NSERC and Canadian Space Agency.

PO-MOS-15

Comparison of Radar Auroral Spectra at Different Frequencies*. **Don Moorcroft**, *University of Western Ontario* — Radar backscatter from plasma instabilities in the auroral ionosphere (100 - 120 km altitude) have traditionally been classified into a number of different types', largely based on the nature of the spectrum and its relation to the plasma drift velocity. A comparative study of spectral characteristics over a wide range of frequencies (10 - 1000 MHz) raises several new questions and directions for future research. This study indicates that virtually all observed echoes have Doppler velocities which can be written to zero order as $V = \alpha k \cdot V_d + \beta C_s$, where k, V_d, and C_s are the radar wave vector, plasma drift velocity and ion-acoustic speed, respectively. This may provide a useful alternate basis for echo classification. Questions raised by the study include: (i) why are some types of echoes seen at 50 and 140 MHz, but not at either higher or lower frequencies; (ii) are echoes at large geometric magnetic aspect angles truly different at 50 MHz than at UHF, or are the differences the consequence of refraction; (iii) why are type 4 echoes ($\alpha = 0$, $\beta \approx 2$) apparently not seen at UHF? These and additional questions will be presented and discussed.

* Research supported by NSERC.

PO-MOS-16

Solar Magnetic Activity and the Maunder Minimum. **Ken Tapping**[a], Alan Manson[b], (a) *DRAO, Herzberg Institute of Astrophysics*, (b) *University of Saskatchewan* — There are two components to the variation in the solar energy output. There is the long-term, monotonic brightening due to evolutionary processes in the Sun's core, and there is a modulation of the energy flow by magnetic activity. This imposes a small, 11-year periodic variation in solar irradiance. Estimates of the relationship between irradiance and magnetic activity are usually based upon current activity maxima and minima. This may not be correct. Measurements of the solar photospheric magnetic flux show the flux elements to fall into two broad classes: "strong-field elements", which have average magnetic field strengths equal to or greater than 25 Gauss, and "weak-field elements", which are weaker. The strong-field elements are associated with active regions, and follow the 11-year activity cycle, whereas the weak-field elements do not. However, studies of solar active regions, where the strong-field elements are generally located, show that active regions decay at least partially through fragmentation into weak-field structures. During the Maunder Minimum, solar activity fell to a very low level. This was accompanied by a period of cold climatic conditions on the Earth. This is interpreted as being due to a decline in the Sun's energy output produced by a cessation of magnetic activity. However, estimates based upon current activity measurements do not produce sufficiently large drop in solar irradiance. Using the 10.7cm solar flux, magnetograms, sunspot data and irradiance measurements, we estimate the drop in irradiance on the assumption that at least part of the weak-field magnetic flux is due to active region decay, and therefore vanished during the Maunder Minimum. Under these conditions we estimate that the irradiance was about 0.4 w.m^{-2} lower than previously estimated. On the basis of an empirical relationship between irradiance and average global temperature, this would indicate that under solar considerations alone, the average temperature during the Maunder Minimum could have been about 0.4 degrees Celsius lower than previously estimated.

[MO-POS] CONDENSED MATTER AND MATERIALS PHYSICS / *PHYSIQUE DE LA MATIERE CONDENSÉE ET MATÉRIAUX* — MONDAY/LUNDI

PO-MOS-17

Morphological Effects of Annealing Environment in Semicrystalline Polymers. **R.Hutanu**, M.A. Singh, *Queen's University* — We have recently demonstrated the possibility of introducing nanoscale voids into semicrystalline poly(ethylene terephthalate) (PET) by annealing the initially amorphous material in the presence of supercritical CO_2. The morphological effects of this process have been characterized using Small Angle X-ray Scattering (SAXS) techniques to monitor the crystalline morphology as a function of CO_2 pressure and annealing temperature. The results of the SAXS data analyses, together with the Differential Scanning Calorimetry and density measurements that will be presented, suggest a three-stage model of the pressure effect induced by the compressed/supercritical CO_2 in PET. SAXS analyses of the data provide useful information regarding the location and size of the voids as well as details about the pressure effect on the thickness of the crystalline lamellae. Given that the void sizes are below suggested critical values, these results indicate the possibility of developing reduced density industrial polymers with no degradation of material properties.

MO-POS-18

The Background Spectra in Angle-Resolved Photoemission Spectroscopy*. **K.J.E. Vos**, *University of Lethbridge* — Angle-resolved photoemission spectroscopy (ARPES) is a powerful experimental tool for studying the physics of strongly correlated electron systems. The Copper Oxide-based compounds, in particular, are quasi two-dimensional systems, which makes ARPES an ideal method for studying the physics of the charge carriers in these Copper Oxide planes. However, there is little quantitative agreement between the experimental data and the theoretical photocurrent. This lack of agreement is at least partially due to the strong correlations between the photohole-photoelectron pairs, which have a strong influence on the experimental data. A new expression for the photocurrent is presented that takes into account the correlations between the photoelectron-photohole pairs. The modifications give an explanation for the large amount of spectral weight in the incoherent part. A common theoretical model for describing the motion of holes in a Copper Oxide plane is the t - J model. Using exact diagonalization we compare these modifications to the experimental ARPES data for the antiferromagnetic insulator SrCuOCl. The calculations obtained with the modified photocurrent are in good agreement with the ARPES measurements.

* This work is supported by NSERC.

MO-POS-19

A Photoluminescence Method for Detecting Trace Levels of Iron in Ultrapure Silicon. **I. Broussell***, M.L.W. Thewalt*, V.A. Karasyuk[b], (*a) Simon Fraser University* and (b) *JDS Uniphase* — A nondestructive technique is presented for the determination of trace levels of interstitial iron contamination in ultrapure silicon. This approach is based on the well-known ability of iron to undergo a reversible pairing reaction with boron near room temperature. A variety of float-zoned silicon samples with low concentrations of boron (~10^{11} cm^{-3}) were subjected to thermal annealing treatments to study changes in the apparent boron concentration as determined by the standard method of comparing the photoluminescence intensity of the boron bound exciton to that of the free exciton. Changes in the apparent boron concentration were attributed to the formation or dissociation of iron-boron pairs, allowing us to estimate the interstitial iron concentration in these samples. Remarkably, relatively mild thermal treatments can change the apparent boron concentration in some of these samples by up to a factor of ten.

MO-POS-20

Construction of a Low-Temperature Ultra-High-Vacuum Scanning Tunneling Microscope. T. Dyck, B. Wynder, **S.N. Patitsas**, *University of Lethbridge* — We will describe progress made towards construction of a Low-Temperature Ultra-High-Vacuum Scanning Tunneling Microscope at the University of Lethbridge. Our design makes use of a novel magnetic suspension mechanism developed at the U.L. The coarse approach mechansim is an adaptation of the Besocke method. The entire STM will be cooled by a cryostat cooled radiation shield. Designs for sample and probe preparation and transfer will also be presented.

MO-POS-21

Self-assembly of Dithiol Monolayers on Au(111). **A.R. MacDairmid***, M.C. Gallagher*, and J.T. Banks[b], (a) Lakehead University and (b) Acadia University — Over the past decade, the self-assembly of organic molecules onto periodic substrates has attracted a great deal of attention. As the phenomenon of self-assembly becomes better understood, increased control over atomic scale processes can be attained. The primary focus of this discipline has been self-assembled monolayers (SAMs) of n-alkanethiols ($CH_3(CH_2)_{n-1}SH$) on gold substrates. We have investigated the structure of dithiothreitol (DTT), and oxidized DTT SAMs using scanning tunneling microscopy. DTT is an OH functionalized α-ω dithiol (SH termination on

both ends of the molecule). Key features of the dithiol SAMs will be presented and compared with results we have obtained on more conventional alkanethiol SAMs. One of the characteristics of both systems is the formation of Au vacancy islands on the Au(111) terraces during self-assembly[1]. For both alkanethiol and dithiol SAMs we have measured the percent coverage and number density of vacancy islands as a function of solution exposure and temperature. We find the percent coverage and number density of the "conventional" octanethiol SAM reaches equilibrium on the order of minutes. In contrast, DTT SAMs take several hours to reach equilibrium. The slower kinetics, and differences in the percent coverage compared with octanethiol, will be discussed in the context of the proposed mechanisms of vacancy island formation.

[1] C. Schönenberger, J.A.M. Sondag-Huethorst, J. Jorritsma, and L.G.J. Fokkink, *Langmuir*, **10**, 611-614 (1994).

MO-POS-22

A Photoluminescence Investigation of $GaAs_{1-x}Nx$ Alloys Grown by Metalorganic Vapor Phase Epitaxy: Effects of Rapid Thermal Annealing. **J. Ramsey**[a], R.L. Williams[a], G.C. Aers[a], J.A. Gupta[a] and J. Noad Coulas[c], (a) *Institute for Microstructural Sciences, National Research Council*, (b) *Communications Research Centre*, Ottawa, Ontario — $GaAs_{1-x}Nx$ multiple quantum wells and thick single wells have been grown by metalorganic vapor phase epitaxy using trimethylgallium, tertiarybutylarsine and 1,1-dimethylhydrazine sources. For single well samples with Nitrogen compositions in the range 0-5%, we use high-resolution x-ray diffraction measurements and photoluminescence experiments to investigate the bulk bandgap as a function of Nitrogen composition and III/V ratio. For multiple quantum well samples we use both photoluminescence and absorption measurements to investigate the compositional uniformity of the material and to determine the effects of rapid thermal annealing on the temperature dependent behavior of the material.

MO-POS-23

The Measurement of Photo-Induced Order in Amorphous and Liquid-Crystalline Azo Polymers by Stokes Polarimetry. **Dennis Hore**[a], Almeria Natansohn[a] and Paul Rochon[b], (a) *Queen's University* and (b) *Royal Military College* — In addition to the well-studied (linear) orientation of azo polymers in a linearly-polarized optical field, there have been recent accounts of circular anisotropy in these materials upon exposure to a circularly polarized field. In order to properly characterize the nature of the anisotropy in such systems, it is necessary to measure the linear and circular order simultaneously. The linear and circular birefringence Δn_{lin} and Δn_{cir}, and dichroism $\Delta\kappa_{lin}$ and $\Delta\kappa_{cir}$ are the material properties which characterize the optical anisotropy and so describe the order in the system. To arrive at these order parameters, it is necessary to determine the polarization state of light passing through the materials. For this, we have constructed a polarimeter which measures all four Stokes parameters (S_0, S_1, S_2, S_3). Combined with knowledge of the polarization state of the incident light, we can determine how the polarization has been transformed by the sample. This information in turn is used to determine the order parameters of interest. Examples using amorphous and liquid crystalline polymers in our lab will be given.

MO-POS-24

Low Temperature Magnto-Photoluminescence of InSb. **J.A.H. Stotz** and M.L.W. Thewalt, *Simon Fraser University* — InSb has the narrowest band gap and highest mobility of the binary III-V semiconductors and, consequently, has many specialized applications. Unfortunately, photoluminescence characterization of InSb is inhibited by the 300K blackbody radiation coincident on the detector. To avoid such complications, we have used a modified Bomem DA3 Fourier transform spectrometer that has all of its components working at or below 100K. Magneto-photoluminescence on InSb has been studied to explore excitonic and impurity states. High resolution spectra will be presented that reveals many, distinct excitonic features which have previously been unreported. Two-hole bound exciton satellite luminescence has also been observed for the first time in InSb.

MO-POS-25

Thermopower Investigation of a GaAs/AlGaAs/GaAs Double Quantum Well System with Zero and In-Plane Magnetic Fields. **T. Smith**[b], R. Fletcher[a], P.T. Coleridge[b], Y. Feng[b] and Z.R. Wasilewski[c], (a) *Queen's University*, (b) *National Research Council* — GaAs/AlGaAs/GaAs double quantum wells (DQW) have been studied extensively using resistance measurements in large part due to their novel resistance resonance (RR) feature. At RR energy levels in the wells are equal, tunneling produces strong wave function mixing , and electrons are not localized within individual wells. This is in contrast to the off-resonance condition where the wells can be treated as independent conducting planes. In this study thermopower was measured in order to determine what effect the RR condition would have on thermoelectric transport properties. The thermopower was studied in the temperature range from 0.3K to 4.2K. The carrier densities of the 2-DEGs can be varied by an applied gate voltage. The zero magnetic field DQW thermopower contains interesting structure due to the changing individual well carrier densities, but no observable effect on the thermopower was seen as the gate voltage was varied through the RR condition. With the application of a sufficiently large in-plane magnetic field the displacement of the wells' energy-dispersion parabolas in k-space is predicted to produce a divergence in the density of states at the saddle point which is formed at the point of Fermi circle separation. According to the Mott relation the divergence in the density of states is predicted to produce a sharp spike in the diffusion thermopower. This was not observed in the data.

MO-POS-26

*Diffusion Raman résonante dans des puits quantiques ultraminces InAs/InP**. G. Bentoumi[a], A. Lanacer[a], R. **Leonelli**[a], D. Frankland[b] et R.A. Masut[b], (a) *Université de Montréal*, (b) *École Polytechnique* — Les puits quantiques d'InAs de quelques monocouches d'épaisseur présentent généralement un spectre d'émission multibandes attribuées, d'une part, à des régions où les excitons sont délocalisés dans des puits d'épaisseurs différentes, et d'autre part, à des régions ou la présence de nano-îlots d'InAs localisent les excitons[1]. Ces spectres permettent en principe de connaître la structure énergétique des puits, mais une controverse subsiste sur la corrélation entre l'énergie d'une transition et l'épaisseur des couches. Nous avons effectué des mesures de diffusion Raman résonante dans des puits d'InAs afin de déterminer le nombre, la symétrie et l'énergie des phonons confinés. Le nombre de modes confinés observés est en accord avec l'épaisseur nominale des puits déterminée par diffraction de rayons-x, mais leurs énergies ne peut s'expliquer par les modèles standard développés pour décrire les phonons confinés dans des superréseaux.

[1] P. Paki, R. Leonelli, L. Isnard et R. A. Masut, *J. Vac. Sci Technol. A* **18**, 956 (2000).

* Travail supporté par le CRSNG et le Fonds FCAR.

MO-POS-27

Exchange Contribution to the Image Potential. **D.J. Lockwood**[a], G.F. Grom[b], L. Tsybeskov[b], P.M. Fauchet[b], and B. White Jr.[c], (a) *National Research Council of Canada*, (b) *University of Rochester*, (c) *Motorola DigitalDNA Laboratories* — The fabrication of size-controlled Si nanocrystals encapsulated by SiO_2 is complicated by the amorphous nature of SiO_2 and the mismatch in their thermal expansion coefficients. A preferred crystallographic orientation is especially important for Si quantum dots because of the Si indirect-gap band structure and a strong anisotropy in the energy-momentum dispersion. We report self-organization in Si nanocrystals fabricated by the crystallization of nanometer-thick layers of amorphous Si confined between SiO_2 layers[1,2]. Silicon nanoparticles larger than 8 nm spontaneously form brick-shaped crystallites oriented along the [111] direction while smaller nanocrystals adopt a spherical geometry. The preferred orientation and distinct shape result in a relatively narrow photoluminescence. The observed ordering and self-organization is an important step toward reproducible maskless Si nanofabrication and the consequent construction of Si/SiO_2 quantum devices.

[1] Z.H. Lu, D.J. Lockwood, and J.-M. Baribeau, *Nature* **378**, 258 (1995).
[2] G.F. Grom, D.J. Lockwood, J.P. McCaffrey, H.J. Labbe, P.M. Fauchet, B. White Jr., J. Diener, D. Kovalev, F. Koch, and L. Tsybeskov, *Nature* **407**, 358 (2000).

MO-POS-28

Negative Group Velocity of Sound in a Bubbly Liquid. **Del Leary**[a], John R. de Bruyn[a], John H. Page[b], (a) *Memorial University of Newfoundland*, (b) *University of Manitoba* — Negative group velocity occurs when a wave propagates through a medium with anomolous dispersion, that is, when the derivative of the dispersion curve is negative. This can occur when the medium is strongly absorbtive. Negative group velocities for light pulses have recently been reported [1,2]. Here we report on the experimental observation of negative group velocities for pulses of ultrasound propagating ballistically through a bubbly liquid. For frequencies near the resonant frequency of the bubbles, the absorption increases strongly and the group velocity becomes negative. Our experimental results are compared with the behavior calculated theoretically.

[1] L.J. Wang, A. Kuzmich, and A. Dogariu, *Nature* (U.K.) **406**, 277 (2000).
[2] D. Mugnai, A. Ranfagni, and R. Ruggeri, *Phys. Rev. Lett.* **84**, 4830 (2000).

MO-POS-29

A New Way of Looking at the Helium Vapour Compression Effect, **C. Lei** [a], G. Archibald [a], M.E. Hayden [a], P.D. Barnes [b], W.T. Buttler [b], D.J. Clark [b], M.D. Cooper [b], M.A. Espy [b], S.K. Lamoreaux [b], J.-C. Peng [b], and S.I. Penttila [b], (a) *Simon Fraser University*, (b) *Los Alamos National Laboratory* — A neutron-tomography technique has been applied to the study of the liquid-vapour interface of dilute mixtures of ^{3}He in ^{4}He. Measurements of the ^{3}He concentration as a function of position near a free surface yield detailed information regarding the exchange of ^{4}He between the liquid and vapour phases. Application of a heat current drives a net circulation of ^{4}He between the two phases and leads to the establishment of concentration gradients. Analysis of data from these experiments leads to a measurement of the ^{3}He mass diffusion coefficient in the liquid above 1 Kelvin, and provides unique insight into the helium vapour compression (HEVAC) effect.

MO-POS-30

Determination of the Mass Diffusion Coefficient for ^{3}He in Superfluid ^{4}He, **G. Archibald** [a], C. Lei [a], M.E. Hayden [a], P.D. Barnes [b], W.T. Buttler [b], D.J. Clark [b], M.D. Cooper [b], M.A. Espy [b], S.K. Lamoreaux [b], J.-C. Peng [b], and S.I. Penttila [b], (a) *Simon Fraser University*, (b) *Los Alamos National Laboratory* — A narrow and well-collimated beam of cold neutrons with energies in the range 4.9-8.3 meV has been used to map the spatial distribution of ^{3}He impurity atoms in a cell containing bulk liquid ^{4}He at temperatures below 1K. Application of a heat current within the cell causes a redistribution of the impurity atoms. By studying the ^{3}He distribution as a function of the applied heat current one may infer a value for the corresponding mass diffusion coefficient D. We have used this 'neutron-tomography' technique to characterize D for ^{3}He in liquid ^{4}He at temperatures below 0.6 K for the first time. A preliminary analysis of data from our experiment indicates that $D \sim T^{-7}$ is in agreement with theory.

MO-POS-31

Chain Cu NMR study of Ortho-II phase of YBCO, **Z.Yamani** [a], B.W. Statt [a], D.A. Bonn [b], R. Liang [b], W.N. Hardy [b], (a) *University of Toronto*, (b) *University of B.C.* — We report the results of Cu NMR measurements on detwinned Ortho-II single crystal $YBa_2Cu_3O_{6.5}$. The full chain Cu line shape and relaxation rate measurements were performed from 50K to 200K on this sample. These measurements show an anomalous broadening of the line width accompanying by slowing down of relaxation rate for this site at low temperatures. We associate these results with the presence of a charge density modulation in the chains.

MO-POS-32

The 5/18, 1/4, 2/9 and 1/5 Lock-ins in Holmium*, **D.A.Tindall** [a], J.S.Gardner [b], M.O.Steinitz [c], (a) *Dalhousie University*, (b) National Research Council, (c) St. Francis Xavier University — In the temperature region between 20K and 132K holmium is a spiral anti-ferromagnet with the wave-vector, tau, of the spiral increasing from 0.16 to 0.28 reciprocal lattice units. When tau passes through simple commensurate values (like 1/4 at 100K), a magnetic field can cause a "lock-in", where the variation of tau with temperature is arrested over a small temperature range. We used the M_2 magnet mounted on the N_5 triple axis spectrometer at Chalk River Laboratories to measure the width of a number of lock-ins in holmium as a function of the orientation of the applied magnetic field (up to 2.6T) in the (c-b) plane. Results on the 1/4 lock-in are substantially in agreement with Jensen's[1] surprising prediction that the lock-in width should be very rapidly dependent on the magnetic field orientation away from the c-axis. The measurements reported here explore the field-angle dependence of the 1/4 and other lock-ins and compare them to theory[1], where applicable.

[1] J. Jensen (1996) *Phys. Rev. B* **54**, 4021 and private communication.

* Supported by NRC, NSERC and CINS.

MO-POS-33

Role of the Return Field of the Magnetized Grains in I_c Hysteresis of Polycrystalline High T_c Samples, M.A.R. LeBlanc and **M. Rezeq**, *University of Ottawa* — The effect of the magnetization <M> on the critical transport current (I_c hysteresis) of weak-linked granular YBCO plate-like samples at 4.2K was studied by Kwasnitza and Widmer[1]. They observed two very different values for Ic in the same final applied field Ba after two different field-temperature histories where both led to zero net magnetization before I_c was introduced. A simple model which implements the proposal of Evetts and Glowacki[2] that the superposition of the return field of the magnetized grains and the applied field $\mathbf{B}_a$ is responsible for the hysteresis in I_c, is shown, to account for the above apparently paradoxical observations.

[1] K. Kwasnitza and Ch. Widmer, *IEEE Trans. MAGN.* **27**, 1202 (1991).
[2] J. E. Evetts and B. Glowacki, *Cryogenics* **28**, 641 (1988).

MO-POS-34

Brillouin Spectroscopy Investigations of the Phonon Acoustic Modes in $LiKSO_4$ in the Temperature Range from 20 K to 150 K, **M. Bromberek** [a], M.J. Clouter [a] and B. Mroz [b], (a) *Memorial University of Newfoundland*, (b) *Adam Mickiewicz University, Poland* — Lithium-potasium sulfate ($LiKSO_4$) belongs to the family of double sulfates ($ABSO_4$). It undergoes several phase transitions in a broad temperature range. In an attempt to investigate structural changes in this crystal Brillouin spectroscopy has been used to determine the temperature dependence of longitudinal acoustic modes in a lithium-potasium sulfate single crystal over temperature range from 20 K to 150 K. Small anomalies were recorded for the frequencies of the modes propagating in [101] and [011] directions. The frequency of the [100] mode was practically temperature independent. The [001] mode shows a minimum (relative change - 4.5%) at 52 K which corresponds to the phase transition temperature in this crystal. Moreover the results of two sequential runs performed on the same sample (thermal cycling) are compeared and discussed. Also the first low temperature ferroelastic phase transition was observed at 185 K (cooling) and 191 K (heating). A sudden change of the frequency of longitudinal mode propagating along [001] direction was observed at that tempearture.

MO-POS-35

Evolution of the Magnetization of Polycrystalline Type II Superconductors with Temperature in Static Magnetic Fields, **Moh'd Rezeq** and M.A.R. LeBlanc, *University of Ottawa* – The model of Clem and Hao[1] and of Hyun[2], which describes the evolution of the diamagnetic magnetization <M> of hysteretic isotropic single crystals of type II superconductors during slow cooling from T_c and the subsequent behaviour during slow warming in various static magnetic fields $H < H_{c1}$, $H > H_{c1}$, and $H < H^*$, $H > H^*$, the full penetration field, has been extended to account for the observations of <M> vs T for weak-linked granular high and low T_c materials in these circumstances (Jung et al[3] and Wang and Joiner[4]). The model also explains the appearance of a deep diamagnetic valley in the locus of <M> vs T during warming after slow and fast cooling which they report.

[1] J.R. Clem and Z. Hao, *Phys. Rev.* **B48**, 13774 (1993).
[2] O.B. Hyun, *Phys. Rev.* **B48**, 1244 (1993).
[3] J. Jung, M.A – K. Mohamed, I. Issac and L. Friedrich, *Phys. Rev.* **B49**, 12188 (1994).
[4] J.P. Wang and W.C.H. Joiner, *Phys. Rev.* **B50**, 1253 (1994).

MO-POS-36

Plasma-Assisted Synthesis of Carbon-Based Material*, **W. Chen**, C. Xiao, D. McColl, A. Moewes, A. Hirose, *University of Saskatchewan* — Experimental investigation of diamond film deposition on silicon substrates has been carried out. A hot filament device with glow discharge is used for this purpose. Samples have been analyzed with Scanning Emission Microscopy (SEM), X-ray diffraction, and X-ray absorption and emission spectroscopy using synchrotron light. The results show that high quality polycrystalline diamond films have been deposited. More recently, an arc discharge device using graphite electrode has been constructed for fabrication of fullerenes and nanotubes.

* Work supported by NSERC.

MO-POS-37

Reductions in the Glass Transition Temperature T_g which Indicates Increased Segmental Mobility, C.A. Murray and **K. Jeffrey**, *University of Guelph* — Reductions in the glass transition temperature T_g have been observed for thin, freely-standing films of linear polystyrene which indicates increased segmental mobility. Despite topological differences between cyclic and linear PS, their bulk rheological properties are similar, apart from a factor of approximately two difference in zero shear viscosity, plateau modulus, and steady state recoverable compliance. We investigate the mobility of freely-standing films of cyclic and linear PS chains with molecular weight M_w - 200k and thicknesses 20 nm < h < 150 nm. Using ellipsometry, we have measured the temperature dependence of h and the index of refraction n of the films. In all cyclic PS films, we observe irreversible changes in h for temperatures $T > 90°$. For

the thinnest cyclic PS films, irreversible changes in n are also observed for $T > 90°C$. We relate the results of these measurements to the determination of T_g, chain diffusion and anisotropy within the films. Chain diffusion was further studied using optical microscopy to measure hole growth in the films as a function of h and T.

MO-POS-65

Morphology of Annealed Metastable Bilayer and Trilayer Polymer Films, **C.H. Schultz-Nielsen** and J.R. Dutcher, *University of Guelph* — By using a combination of spincoating and water transfer techniques, we have fabricated PS/PMMA/Si(001) bilayer and PMMA/PS/PMMA/Si(001) trilayer films, where PS is polystyrene, PMMA is poly (methyl methacrylate), and Si(001) is a silicon substrate. When the bilayer films are heated well above the glass transition temperature, PS dewets on PMMA, while trilayer films exhibit a two-step dewetting process, as determined using optical microscopy, atomic force microscopy, and selective PS etching. We have quantified the changes in morphology obtained after annealing the trilayer films at high temperatures for long periods of time for different PMMA capping layer thicknesses. We have also identified the pathway through which the final morphology is achieved, and we have subsequently used this knowledge to predict the final morphology obtained for PMMA/PS/Si(001) inverted bilayer films.

MO-POS-38

Inelastic Neutron Scattering Study of Water in the Pores of MCM-41, **F. Mansour** and H. Peemoeller, *University of Waterloo* — We present recent quasi-elastic neutron scattering data obtained from water confined in the 25 Angstrom cylindrical pores of mcm-41. Using the High Flux Back-Scattering Spectrometer (HFBS) at NIST Centre for Neutron Scattering in Gaithersburg MD, water molecule dynamics in the nanosecond range are observed for confined water for the first time. A fitting protocol is developed whereby the data is fitted to a convolution of the instrument resolution function and a discrete Fourier transform of a stretched exponential decay. The Q dependence of the structural relaxation time of water in the sample is also presented and compared to theoretical models developed elsewhere. The data shows that the water molecules follow a behavior typical of a single particle confined to diffuse within a sphere of radius ~ 5-10 angstroms. The data also clearly demonstrates that the water molecule diffusion is not affected by the cylindrical geometry of the pores. Q dependence of the data is taken at different temperatures, and a power law dependence extracted. It shows a slight deviation form the Q^2 dependence of the line width, the power increasing from the expected value of 2 as the temperature is raised. The Q dependence of the data at slightly below the freezing temperature of water in the pores is also presented and discussed.

[MO-POS] MEDICAL AND BIOLOGICAL PHYSICS / *PHYSIQUE MÉDICALE ET BIOLOGIQUE* — MONDAY/LUNDI

MO-POS-39

Simultaneous AFM/NSOM for Biological Applications, **C. Hebeisen** and J. Bechhoefer, *Simon Fraser University* — Various scanning probe microscopy techniques are becoming increasingly important tools in many fields of research. We have built a very flexible SPM head, mainly from commercially available parts, which can be used for most SPM techniques with only minor modifications. The possibility of obtaining images using more than one SPM technique in the same scan (primarily AFM and NSOM) makes it especially suitable for biological applications. For example, the ability to map topography via AFM can eliminate the need for one of the fluorescent labels used in dual-labelled samples of combed DNA, all the while increasing the resolution of the remaining fluorescent markers via NSOM.

MO-POS-40

Reducing Scan Time of an MRI Pulse Sequence used for Measuring Myelin Water Content, **C. Laule**, KP Whittall, A. MacKay, *University of British Columbia* — In human white matter, the mobile protons can be separated into three pools based on their T_2 relaxation times [1,2]. The longest T_2 component (~2s) is due to cerebrospinal fluid (CSF). The intermediate component (~100ms) arises from intra and extracellular water and the shortest T_2 component (~20ms) is due to water trapped between the myelin sheath (or myelin water). Measuring the intermediate and short T_2 components allows us to study the structure of both white and grey matter. By investigating any change in T_2 or parameters calculated from T_2 measurement, such as fraction myelin water, demyelinating diseases such as multiple sclerosis (MS) can be probed. However, to investigate multiple sclerosis using T_2 relaxation, the scan time must be clinically feasible. Currently, the MR pulse sequence used to measure myelin water takes over 33 minutes to complete. To shorten this scan time, high order regions of k-space (corresponding to fine detail in MR images) can be collected at a shorter TR time. The goal of this study was to shorten the acquisition time for T_2 measurement by varying TR over different regions of k-space.[3,4] Simulations of 20 possible variable TR combinations were performed. Nine different phantoms with known T_1 and T_2 relaxation times were scanned with a T_2 relaxation sequence at a constant TR of 3800ms. The constant TR scans were compared to scans in which varying numbers of lines of high-order k-space were collected at a shorter TR of 2120ms. Proton density, geometric mean T_2 (GMT2) and X^2 (degree of misfit) were investigated. Five healthy volunteers were scanned with the T_2 relaxation sequence at a constant TR of 3800ms and the variable TR in which 60 out of 128 lines of k-space were collected at the shorter TR of 2120ms. Different white and grey matter structures were investigated. Simulations of the brain images of variable TR showed that excessive image blurring occurred when more than 60 lines of k-space were collected at a shorter TR. Phantom experiments showed that proton density, GMT2 and X^2 were unaffected up to and including 100 lines of k-space at TR of 2120ms. Constant TR and variable TR (60 out of 128 lines at 2120ms) data collected on five volunteers showed no differences in density, GMT2, fraction myelin water and X^2. For the T_2 relaxation sequence, it was found that 60 lines of high order k-space could be collected at a shorter TR of 2120ms without affecting image quality, density, GMT2, fraction myelin water and X^2. The resulting scan time was shortened from 33 to 25 minutes.

[1] A.L. MacKay, K.P. Whittall, J. Adler, D.K.B. Li, D.W. Paty, D. Graeb, *Magn Res Med*, **31**, 673, 1994.
[2] K.P. Whittall, A.L. MacKay, D.A. Graeb, R.A. Nugent, D.K.B. Li, D.W. Paty, *MRM*, **37**, 34, 1997.
[3] Y. Hongyue, P. Narayana, *Proc. ISMRM 2000*, 427.
[4] R.K. Butts, *et al.*, *Radiology*, **180**, 551, 1991.

MO-POS-41

Microalignment of Bacteria on Mineral Substrates, **A. Rutenberg**, *Dalhousie University* — Following observations of anisotropic alignment of iron and sulphur oxidizing acidophile bacteria along the crystallographic axes of substrate minerals, we model the role of microtopography in bacterial adhesion. We find a strong local effect consistent with observations.

MO-POS-42

Wideline NMR Studies of Model Transmembrane Polypeptides*, **Michael R. Morrow**[a], Simon Sharpe[b], Kathryn R. Barber[b], David Goodyear[a], and Chris W.M. Grant[b], (a) *Memorial University of Newfoundland* and (b) *University of Western Ontario* — Models for the transmission of signals across the membrane by proteins such as the receptor tyrosine kinases often invoke lateral interactions between proteins diffusing through the liquid crystalline bilayer. In order to examine the effect of interactions between transmembrane segments on the dynamics of such proteins, deuterium NMR was used to investigate the behaviour of a series of model polypeptides incorporated into POPC bilayers at concentrations ranging from 0.5 to 6 % and temperatures from 30°C to 60°C. Model polypeptides consisting of 17 to 22 alternating leucines and alanines with two lysines at each end were labelled on 1, 2 or 7 alanines by deuteration of the methyl side chain. Observed spectra are consistent with fast axially symmetric reorientation about the bilayer normal but the inequivalence of neighbouring alanines on a given polypeptide precludes fast rotation about the axis of a standard α-helix. Constraint of transmembrane peptide orientation may have implications for ways in which peptide-peptide interactions can be modulated by specific interactions in the bilayer interior.

*Supported by CIHR (CWMG) and NSERC (MRM).

[MO-POS] INDUSTRIAL AND APPLIED PHYSICS / *PHYSIQUE INDUSTRIELLE ET APPLIQUÉE* — MONDAY/LUNDI

MO-POS-43

Development of a Helium Reliquefier for Superconducting Magnets*, **Calvin H. Winter**, T. Templeton, S. Wolfe, *Quantum Technology Corp* — Design work and several years of field experience of high reliability fully automatic helium reliquefiers for whole body Magnetic Resonance Imaging magnets has been completed. A copper cold finger is cooled by a closed-cycle 3W at 4K Gifford-McMahon/Joule-Thompson helium circuit. The helium in the MRI is fully isolated from the refrigeration circuit and recondenses without leaving the MRI. Closed-cycle helium purity is a major reliability requirement. We have achieved purity levels of better than 1 part per million total impurities with purging and cryogenic traps. The high compression ratio needed for the J-T circuit required the development of a scroll compressor for high system reliability. Operating experience exceeds 10,000 hours Mean Time Between Failure.

* Work supported in part by the Science Council of British Columbia and NSERC/IRAP.

MO-POS-44

Measurements of CO_2 and CH_4 Concentrations above Lakes using Near Infrared Diode Laser Absorption Spectroscopy (NIDLAS) along an Atmospheric Open Path. **S. Tranchart** and M. Larzillière, *Laboratoire de Physique Atomique et Moléculaire (LPAM), Université Laval* — The major concern of global warming has stimulated during the last decade a growing interest in evaluating, besides peat lands and other wetlands, the role of hydroelectric reservoirs in the global cycle of CO_2 and CH_4. According to several studies, reservoirs could be considered as a certain source of atmospheric greenhouse gases (GHG) due to the decomposition of flooded terrestrial organic carbon. The goal of this work is to provide a powerful tool for real time monitoring of CO_2 and CH_4 concentrations above the hydroelectric reservoirs of the boreal region. Our experiment is based on NIDLAS techniques : 1570 and 1650 nm telecommunication diodes lasers are used to probe the atmosphere and to derive gases concentrations above the studied area. Preliminary experiments performed above an artificial lake near Québec City and a large reservoir (Robert Bourassa) of Hydro-Québec will be presented.

[MO-POS] DIVISION OF NUCLEAR PHYSICS / *DIVISION DE PHYSIQUE NUCLÉAIRE* — MONDAY/LUNDI

MO-POS-45

Photonuclear Physics Program at the Duke High-Intensity Gamma Source. **R. Igarashi**, J.C. Bergstrom, D.L. Hornidge, J. Ives, N.R. Kolb, R.E. Pywell, T. Regier, *University of Saskatchewan* — The subatomic physics group at the University of Saskatchewan (U of S) is currently focusing its research efforts at the High-Intensity Gamma Source (HIGS) at the Duke Free Electron Laser Laboratory (DFELL). This facility produces 100% polarized, monochromatic gamma rays at energies below pion threshold with high flux. An upgrade to be completed in 2003 will raise gamma-ray energies above pion threshold. Many experiments at HIGS will be natural extensions of previous subatomic research efforts at the U of S from unpolarized to polarized gamma rays. The polarization and high flux will allow high precision measurements of many quantities of interest that were previously inseparable or inaccessible. The U of S program at HIGS includes 4 major areas: Compton Scattering for polarizabilities, the Gerasimov-Drell-Hearn sum rule for the deuteron, few-body physics through photo-disintegration, and near-threshold pion production for p-wave amplitudes.

MO-POS-46

Analysis of Intermediate Energy Heavy-Ion Collisions With Isospin-Dependent BUU Simulations - S. Turbide[a], L. Beaulieu[a], L. Gingras[a], **R. Roy**[a], C. St-Pierre[a], D. Thériault[a], S. Yennello[b] and her research team, (a) *Université Laval*, (b) *Texas A&M University* — In order to investigate the equation of state of nuclear matter, the heavy ion group of Universit Laval investigates nuclear reactions at intermediate energies (10 to 100 MeV/nucleon), often involving multifragmentation of the system. The collisions are simulated with a transport equation that follows the evolution of the hadrons in space-time, according to the BUU approximation. This analysis helps us to understand dynamical processes, such as mass transfer, that happens too fast for the system to reach equilibrium and form a single, excited source. Results from the simulations are compared to experimental data after proper filtering. In this case, the BUU simulations are compared to experimental results from an experiment performed at the Texas A&M University cyclotron, with the HERACLES 4 π array. In order to isolate isospin effects in the reaction dynamical stage, same total mass and projectile-target charge systems like $^{58,64}Ni + {}^{70,64}Zn$ @ 40 MeV/nucleon were studied.

MO-POS-47

Timescale Evolution in Heavy Ion Collisions. **R. Roy**[a], Z-Y. He[a], L. Gingras[a], Y. Larochelle[a], D. Ouerdane[a], L. Beaulieu[a], P. Gagné[a], X. Qian[a], C. St-Pierre[a], G.C. Ball[b], D. Horn[b], (a) *Université Laval*, (b) *AECL, Chalk River Laboratories* — Two-fragment correlation functions have been used to investigate the timescale of intermediate mass fragments emitted from quasiprojectile sources and midrapidity component formed in $^{58}Ni+^{197}Au$ collisions at 34.5 MeV/nucleon. For the latter, the two-fragment correlation functions show a stronger Coulomb suppression than the quasi- projectile source. This Coulomb suppression for the midrapidity component changes very little with the excitation energy of the quasiprojectile source deduced event by event by calorimetry method. An N-body Coulomb trajectory code is used to calculate correlation functions so that an emission time of quasiprojectile source can be extracted as a function of the excitation energy. The emission time decreases monotonically with excitationn energy in the range 2-6A MeV from 550 fm/c to 150 fm/c. Above 6A MeV, it becomes very short and constant, suggesting that the prompt multi-fragmentation occurs in these quasiprojectile sources.

MO-POS-48

The Contribution of the Delta (1232) to the Goldberger-Treiman Discrepancy. **N. Mobed**, L. Miao and R. Lewis, *University of Regina* — The crucial coupling constant of low energy hadron physics is the pion-nucleon coupling constant. So far as chiral symmetry and its explicit breaking by the quark masses are concerned, the pion-nucleon coupling constant is constrained by the Goldberger-Treiman Relation (GTR) and Goldberger-Treiman Discrepancy (GTD). The contribution of the Delta (1232) to the GTD is calculated within the framework of SU(2) relativistic baryon chiral perturbation theory at one-loop level. It is found that the contribution of Delta (1232) loop graphs is small, and hence comparable with that of other loop graphs previously calculated in SU(3) formalism. This result solidifies the claim that chiral dynamics favors the smaller values for the pion-nucleon coupling constant obtained in recent partial wave analyses.

[MO-POS] DIVISION OF OPTICS AND PHOTONICS / *DIVISION D'OPTIQUE ET PHOTONIQUE* — MONDAY/LUNDI

MO-POS-49

Analysis of Dual-Wavelength Oscillation in an External Cavity Diode Laser. **J.-F. Lepage** and N. McCarthy, *COPL, Universté Laval* — Apodizing holographic gratings used in an external cavity have shown to be effective for controlling the modal content of multimode diode lasers, hence providing single mode emission. Holographic gratings can also be fabricated in such a way as to provide reflection at two wavelengths along the same direction. In this presentation we report on experimental results obtained with a diode laser operated with an external cavity providing stable oscillation at two wavelengths. Stable oscillation at two wavelengths is not, however, a common behavior for a homogeneously broadened gain material. We also present results obtained from simulations of the behavior of this laser based on a rate equation analysis. The stability of the dual-wavelength emission regime is considered. The effect of spatial hole burning on two-mode oscillation is examined using an analytical model and then included in the numerical simulations.

MO-POS-50

Intensity Noise Reduction in an Argon Ion Laser and in a Femtosecond Ti:Sapphire laser with an Optical Feedback. **P. Dufour**, G. Rousseau and N. McCarthy, *COPL, Université Laval* — Argon ion lasers are largely used as optical pumps for solid-state lasers. Unfortunately the relatively high intensity noise of their output beam is transferred to the beam of the pumped laser. In this presentation we report on the intensity noise reduction of a 7-W Argon ion laser with a passive external cavity ended by a plane dielectric mirror. With this configuration, the reduction of the low frequency noise components reaches a maximum of 16 dB and an average of 8 dB over the interval from 100 kHz to 800 kHz. It was also possible to reduce the beat frequencies of the longitudinal modes of the laser by 35 dB. This Argon laser is used as the optical pump of a femtosecond Ti:Sapphire laser. With the external cavity coupled to the Argon laser, the low frequency components of the noise of the Ti:Sapphire laser are also reduced. Further work is being done with a meniscus mirror in place of the plane dielectric mirror. The curvature of the mirror is chosen to optimize the overlap of the feedback beam with the intracavity circulating beam and consequently, the output power available to pump the Ti:Sapphire laser.

MO-POS-51

Theoretical and Experimental Analysis of Pulse Propagation by Means of a Pulse Quality Factor. **G. Rousseau**, N. McCarthy, and M. Piché, *COPL, Université Laval* — The Quality Factor of a laser beam is a useful tool to characterize its diffraction with a single number. There is a lack of such an unambiguous means to define the quality of laser pulses without having recourse to the complete characterization of amplitude and phase. Based on an analogy between paraxial free space diffraction and second-order dispersion, we will introduce the definition of a Pulse Quality Factor proportional to the product of the spectral and temporal root-mean-square (rms) widths. Such a definition eliminates the need of an assumed pulse shape to interpret autocorrelation traces and allows for the definition of a generalized dispersion length. We will show that the Pulse Quality Factor is more representative of the pulse quality than the more conventional time-bandwidth product. Attention will be paid to the numerical technique used to retrieve significant values of rms widths in both domains from standard measurement techniques. We will present experimental results obtained with pulses from 10- to 25-fs duration obtained with a prism-controlled Ti:sapphire laser.

MO-POS-52

Structure modale d'une cavité laser avec réseau. **M. Duval**, N. McCarthy, M. Piché, *COPL Université Laval* — Notre travail vise à établir la structure Électromagnétique des modes d'une cavité laser munie d'un réseau effectuant une sélection spectrale. Pour les cavités laser conventionnelles terminées par deux miroirs, on peut résoudre l'équation d'ondes en effectuant une séparation entre les variables longitudinales et transversales. Ceci mène à un spectre de modes longitudinaux qui prend la forme d'un peigne de Dirac, avec une famille de modes transversaux pour chaque mode longitudinal. Ces modes transversaux sont de symétrie paire ou impaire, pour une cavité bien alignée. Lorsque la cavité laser est terminée par un réseau, il existe un axe de propagation différent pour chaque fréquence d'oscillation, peu importe l'alignement de la cavité. En conséquence, on ne peut procéder à une séparation de variables, sauf dans le cas limite d'une très longue cavité. Nous avons abordé l'étude de ces cavités par une approche analytique basée sur un spectre de modes du type Hermite-Gauss. Nous avons considéré la possibilité que le réseau possède un pas variable ("chirped grating"). En présence d'un filtrage spatial causé par une ouverture gaussienne, les modes supérieurs perdent leur symétrie transversale par rapport à leur centre. Nous examinons la discrimination spectrale des cavités laser munies d'un réseau, en fonction des paramètres géométriques de ces cavités

MO-POS-53

Holographic Mirrors for Solid-State Laser Resonators **D. Jeannette**, R. Massudi, M. Piché, *COPL, Université Laval* — Surface holograms inscribed with Gaussian beams can be made in such a way as to combine the properties of variable reflectivity mirrors and curved gratings. When inserted in laser cavities, they can be used to control the amplitude and phase profiles of laser beams, and to tune their oscillation frequency. The holograms we have used were fabricated in photoresist layers covered with metallic films. The degradation of the photoresist due to environmental effects and the low damage threshold of the holograms are limiting factors for the use of such mirrors in high-power lasers. In this presentation we describe a new method of fabrication of holographic mirrors, suitable for high-power operation. The method is based on the replication of relief gratings from a photoresist layer to a dielectric material with a high damage threshold. We will describe our fabrication procedure based on the evaporation of a dielectric such as quartz by a sputtering technique. The replicas of the original gratings were charactenzed with an atomic force microscope, and revealed to be of high quality. The replicas are now being tested in a Nd:YAG laser where they should produce diffraction limited laser beams.

MO-POS-54

Génération de faisceaux Bessel par un obstacle circulaire opaque, **Y. LeChasseur**, M. Piché , G. Rousseau , R. Tremblay, *COPL, Université Laval* — Les faisceaux Bessel possèdent des caractéristiques fondamentales très intéressantes, dont une divergence théorique nulle. Pour mettre en forme ces faisceaux, on a généralement recours à des composantes optiques non conventionnelles. fente circulaire ultra-mince au foyer d'une lentille, miroir ou lentille conique (axicon), réseau circulaire. Nous proposons ici une méthode beaucoup plus simple, soit l'utilisation d'un obstacle circulaire opaque. La diffraction par l'obstacle circulaire génère une onde de bord dans la zone d'ombre au-delà de l'obstacle; la répartition du champ de l'onde de bord est définie à une excellente approximation par une fonction de Bessel. En laboratoire, nous avons utilisé un faisceau laser gaussien produit par un laser He-Ne (λ =632.8 nm) et un obstacle constitué par un dépôt circulaire de cuivre sur une lame de verre. Nous avons vérifié que l'interférence produite par le bord de l'obstacle reconstruit un faisceau centré sur l'axe optique au-delà de l'obstacle; le profil d'intensité de ce faisceau est celui de la fonction de Bessel $J_0(\alpha\rho)$, où r est la coordonnée radiale. Les résultats obtenus montrent que la divergence du lobe central du faisceau Bessel 10 fois moindre que celle d'un faisceau gaussien de même diamètre. La différence entre les minima de la figure d'interférence et les zéros théoriques de $J_0(\alpha\rho)$ est de seulement 2%.

MO-POS-55

Propagation d'impulsions optiques monocycles, **C. Varin**, M. Piché, *COPL, Université Laval* — Les lasers modes synchronisés permettent maintenant de générer des impulsions optiques dont la durée se situe quelques cycles. Ces impulsions peuvent être comprimées par la combinaison d'un élargissement spectral reposant sur des procédés non linéaires, suivi par la propagation travers des lignes dispersives. On entrevoit ainsi la réalisation de signaux optiques dont le profil temporel est limité un seul cycle. Dans notre travail, nous examinons comment on peut décrire analytiquement la propagation d'impulsions monocycles. Nous rappelons certaines contraintes sur le formalisme utilisé pour exprimer des impulsions; en particulier l'intégrale du champ de toute impulsion optique doit être nulle. Nous nous attarderons sur la signification de cette exigence pour diverses situations. La propagation dans un milieu non dispersif (vide) n'est pas sans conséquence sur la forme temporelle du signal propagé; nous décrirons comment évolue le profil spatio-temporel d'une impulsion monocycle Nous indiquerons pourquoi l'usage d'une solution analytique exprimée par des fonctions d'Hermite-Gauss d'ordre impair présente des avantages sur le plan formel.

MO-POS-56

Study of Ordered Polystyrene Microspheres on Silicon and Polystyrene Substrates by FTIR Spectroscopy and Atomic Force Microscopy, Simona Badilescu[a], Yong-Hong Ye[b] and Truong **Vo-Van**[a] ,(a) *Université de Moncton*, (b) Nanjing Normal University — Ordered multilayers of polystyrene (PS) microspheres of different sizes were deposited by convective self-assembly onto silicon, zinc selenide and polystyrene substrates. The polarized infrared spectra of the PS colloidal crystals were recorded both in the transmission and the ATR modes The spectral results showed that, in addition to the electrostatic and capillary interactions, there is a strong attractive van der Waals interaction between the PS microspheres and substrates such as the silicon wafer and the polystyrene film. In these cases, the position and the dichroic ratio of the bands characteristic to the aromatic system reveal an orientation of the sample at the surface of the substrate. The AFM images show the influence of the van der Waals interactions on the degree of ordering on various substrates.

MO-POS-57

Multi-Photon Optical Rotation by Molecules, R. Cameron and **G.C. Tabisz**, *University of Manitoba* — Forward scattering of polarized light by a chiral molecule results in optical rotation Ordinary optical rotation, a single-photon effect, is independent of intensity, I. Multi-photon optical rotation is proportional to I^N-1, where N is the number of photons involved in the scattering event. The ordinary optical rotation changes with temperature, and so the absorption of light can also cause an intensity-dependent change in optical rotation. We used a polarimeter to measure the change in optical rotation with light intensity for several molecules in solution: sucrose, borneol, uridine and phenylalanine. Making use of Faraday rotation, we added a time-dependent rotation of the light to our apparatus. This allowed us to use Fourier analysis to separate the multi-photon optical rotation from the temperature change in ordinary optical rotation and improved the signal-to-noise.

MO-POS-58

Electron Microscopic Studies of Femtosecond Laser Micromachining of Selected Dielectrics, Semiconductors and Metals*, **Q.** Liu, A. Borowiec, M. MacKenzie, G.C. Weatherly and H.K. Haugen, *Brockhouse Institute for Materials Research, McMaster University* — Femtosecond lasers have extremely short pulse durations and very high peak powers. These unique characteristics facilitate high resolution laser micromachining with minimal damage, and also open up novel material processing possibilities. We use a Ti sapphire laser at 800 nm and with 120 fs pulse duration for precise ablation of selected materials including semiconductors (Si, InP, GaAs), dielectrics (fused quartz, fused silica) and metals (Cu, Al, Fe). Detailed materials analyses were performed with various microscopic and spectroscopic techniques, including SEM, TEM and AFM approaches.

* We thank NSERC and MMO for their support of this work.

MO-POS-59

Broadly Tunable Short Pulse Generation Using Mode-Locked Asymmetric QW InGaAs/InGaAsP/InGaP Diode Lasers*, **M.J. Brennan**, J. Milgram, S.G. Wallace, P. Mascher, H.K. Haugen, *McMaster University* — Short optical pulses have been generated with a mode-locked two contact ridge wave-guide semiconductor laser in an external ring cavity configuration. Assuming a Gaussian pulse shape, pulsewidths between 9 ps and 13 ps have been produced with a broad tuning range from 953 nm to 1011 nm. The large tuning range was achieved through the use of asymmetric quantum wells in the active region, in combination with the application of anti-reflection coatings to the angled-facets of the device.

*Work supported by CIPI and NSERC

MO-POS-60

Electrochromic Performance of Flash Evaporated Tungsten Oxide Films, P. Losier, S. St-Pierre and **P.V.Ashrit**, *Université de Moncton* — Tungsten trioxide (WO_3) is a well known electrochromic (EC) material in which a very efficient and reversible optical modulation can be induced through the application of a small electric field. This possibility of controlled optical modulation and the ensuing application potential has attracted the attention of many researchers. The well researched EC behavior of tungsten oxide is known to exhibit a whole range of EC coloration depending on the structure, nature and preparation conditions of the WO_3 films. The composition (including water content), grain size and structure (porosity) play a significant role in fixing the degree and type of optical modulation in these films In order to examine the dependence of the EC performance of the WO_3 films on the film formation kinetics,

thin films of this material have been prepared by the flash evaporation method. Film depositions have been carried out under varying conditions of chamber pressure and treatment. Films have been studied by structural, optical and electrochemical methods. The results are compared with the WO_3 films prepared using other methods. In order to evaluate the application potential of such films in devices, complete EC systems with suitable counter electrodes (CE) have been fabricated and tested for their performance.

[MO-POS] PLASMA PHYSICS / *PHYSIQUE DES PLASMAS* — MONDAY/LUNDI

MO-POS-61

Numerical Solution of Boltzmann Equation, **J.Y. Lu**[a], G. P. Zank[a], R. Rankin[b], and R. Marchand[a], (a) *University of Alberta*, (b) Bartol Research Institute, University of Delaware — Scattering of particles by magnetic fluctuations is the basic mechanism that controls the transport of solar energetic particles, trapped particles in the inner magnetosphere, pickup ions, and cosmic rays. The transport theories are generally based on the Boltzmann equation. Recent approach developed by Lu *et al.* (*Astrophys. J.*, **550**, 2001) and Zank *et al* (*J. Plasma Phys.*, 2001 in press) is generalized to solve the Boltzmann equation for a quasi-linear scattering operator. To avoid the infinite mean free path near 90°, we use the time-relaxation (BGK) approximation to describe the scattering through the resonance gap. The model includes the effects of adiabatic focusing and adiabatic deceleration. A comprehensive numerical investigation of various solutions is addressed. As an example, we use this approach to study the propagation of solar energetic particles, and some results will be presented.

[MO-POS] THEORETICAL PHYSICS / *PHYSIQUE THÉORIQUE* — MONDAY/LUNDI

MO-POS-62

Unstable Isotopes and Biological Information, **Alexander A. Berezin**, *McMaster University* — Biological activity is usually seen as chemical level phenomenon, without direct participation of processes inside atomic nuclei. This is oddish, because almost all "real matter" resides inside nuclei, not in electronic shells. Yet, decays of radioactive isotopes (C_{14}, K_{40}, etc) in biostructures can lead to targetted mutations. Likewise, non-random triggering of individual decay events can perhaps be biologically controlled by mechanisms similar to suggested by John Eccles (1986). Within normal decay statistics (fixed average lifetime), parameters of individual decays (exact decay moments, relative kinetic energies of electrons and neutrinos, and choice of secondary reactions induced by emitted electron) can be controlled by biosystem for its genetic or evolutionary advantages. While, for stable isotopes, informational content (IC) amounts to just a few bits per atoms (say, coded in nuclear spins), for unstable isotopes quasistationary wave functions can support much higher IC. If decaying wave function forms multiparticle time-dependent superposition of all possible impact-induced events within mean free path of emitted electron, the IC increases even further (perhaps, exponentially). Thus, in-spite of very low absolute concentration of C_{14}, its informational share in biostructures can be comparable (if not exceeding) cumulative total of all other stable atoms in biosystem.

MO-POS-63

Robust Chaos in a Smooth System, M. Andrecut and M. **K. ALI**, *University of Lethbridge* — Robust chaos is defined by the absence of periodic windows and coexisting attractors in some neighborhood of the parameter space. The occurrence of robust chaos has been discussed [in *Phys. Rev. Lett.* **78**, 4561 (1997); *Phys. Rev. Lett.* **80**, 3049 (1998)]. It has been shown that robust chaos can occur in piecewise smooth systems. Also, it has been conjectured that robust chaos cannot occur in smooth systems. However, here we give a counter example to this conjecture. We present a one-dimensional smooth map that generates robust chaos in a large domain of parameter space.

[MO-POS] PARTICLE PHYSICS / *PHYSIQUE DES PARTICULES* — MONDAY/LUNDI

MO-POS-64

The Surface Cleanliness and Leaching Test Program for the Sudbury Neutrino Observatory*, **E.D. Hallman**[a], H.C. Evans[b], G.G. Miller[c], P.D. Palmer[c], and M. Yeh[d], (a) *Laurentian University*, (b) Queen's University, (c) Los Alamos National Laboratory (d) Brookhaven National Laboratory — Detector operations at the Sudbury Neutrino Observatory (SNO) require frequent calibrations in which sources (of light, gamma rays or particles) are inserted into the central heavy water vessel. Special precautions have been set up to ensure that no contamination enters SNO's ultrapure heavy water. Surface dust on calibration equipment is regularly monitored through tape lifts and x-ray fluorescence analysis. For new devices, tests for leaching of surface impurities into ultrapure water have been developed and are regularly used. The leach water is tested to ensure satisfactorily low uranium, thorium and decay product levels, using methods including radon emanation and alpha spectroscopy. The techniques developed will be outlined, and results from selected materials tests will be given.

* Work supported by NSERC and the U.S. Department of Energy.

AUTHOR INDEX / INDEX DES AUTEURS

Postdoctoral Research Associates
Experimental Particle Physics

Carleton University, Ottawa, Ontario, Canada

Applications are invited for several Postdoctoral Research Associate positions within the experimental particle physics group at Carleton University. The group is currently participating in the following experiments and projects: solar neutrino physics with the SNO detector at Sudbury; electroweak physics with the data from the OPAL detector at CERN; calorimeter construction and the search for new physics beyond the electroweak scale with the ATLAS detector at the LHC; physics studies and the development of new TPC readout gas detectors for a future linear collider experiment. Positions are available with each project.

We are interested in candidates who have recently obtained a Ph.D. degree (or will graduate soon) in experimental particle physics and who would like to join our group here at Carleton. The initial appointment will be for 2 years, with possible extension. Some travel will be expected.

Candidates should send a curriculum vitae, a statement of their research interests, and arrange for letters from three referees to be sent to:

Prof. Richard Hemingway,
Department of Physics, Carleton University
OTTAWA ON K1S 5B6, Canada

Tel: (613) 520-2600, ext. 1977; Fax: (613) 520-4061
E-mail: ryh@physics.carleton.ca
Website: http://www.physics.carleton.ca/research/

Applications are requested as soon as possible, but will be accepted until the positions are filled. *We encourage all qualified persons to apply.*

UNIVERSITY OF WATERLOO
Lecturer

The Department of Physics, University of Waterloo, invites applicants for a definite term position as Lecturer to begin on or before September 1, 2001. The initial appointment will be for three years with the possibility of renewal.

Applicants should have an M.Sc. or Ph.D. in Physics, and preferably some experience in teaching physics at the university level. Duties include instructing first year Physics classes for science, engineering and mathematics students for all three academic terms as well as assisting in the development of undergraduate laboratories, and academic counselling of science students. Salary range will be commensurate with qualifications and experience.

Candidates should submit, by regular mail, a curriculum vitae outlining their qualifications, experience and teaching goals, and make arrangements for three letters of reference to be sent to:

Dr. W.-K. Liu
Associate Chair, Department of Physics
University of Waterloo
WATERLOO ON Canada N2L 3G1

Tel: (519) 888-4567, ext. 6280; E-mail: wkliu@uwaterloo.ca

Materials should be received by June 15, 2001.

Further information about the Department can be found on our web page http://www.science.uwaterloo.ca/physics.

In accordance with Canadian Immigration requirements, this advertisement is directed to Canadian Citizens and Permanent Residents. The University of Waterloo encourages application s from all qualified individuals, including women, members of visible minorities, native peoples and persons with disabilities. The appointment is subject to the availability of funds.

Professeure ou professeur

En théorie de la matière condensée

L'Université de Sherbrooke sollicite des candidatures pour combler un poste régulier de professeure ou de professeur à temps complet en théorie de la matière condensée pour son Département de physique de la Faculté des sciences.

La personne choisie se joindra à un groupe de quatre théoriciens incluant le détenteur d'une chaire de recherche du Canada. Cette équipe théorique fait partie du Centre de recherche sur les propriétés électroniques de matériaux avancés (CERPEMA), comprenant notamment plusieurs groupes expérimentaux, dont les intérêts vont de la supraconductivité, électrons fortement corrélés, aux applications optoélectroniques. Plusieurs membres de ces groupes théoriques et expérimentaux œuvrant dans le domaine de la supraconductivité sont aussi membres associés de l'Institut canadien de recherches avancées. Des ordinateurs à la fine pointe de la technologie sont disponibles localement, dont un superordinateur IBM-SP et des grappes linux. D'autres types d'ordinateurs sont également disponibles grâce au RQCHP.

Fonction

Enseignement aux trois cycles d'études universitaires, encadrement d'étudiantes et d'étudiants au deuxième et au troisième cycles, recherche, service à la collectivité et participation à la vie universitaire.

Exigences

Diplôme de doctorat en physique (Ph. D.) et expérience postdoctorale. Une expérience de recherche et une formation solides dans au moins un, de préférence plusieurs, des grands domaines de recherche suivants : électrons fortement corrélés, systèmes mésoscopiques et nanoscopiques, supraconductivité, ordinateur quantique, magnétisme.

Exigences

Posséder un talent et un potentiel comme chef de file en enseignement et en recherche dans le domaine de la théorie de la matière condensée. Posséder de solides qualités pédagogiques.

Pour informations sur le département de physique et le Centre de recherche sur les propriétés électroniques de matériaux avancés (CERPEMA), consulter la page WEB : www.physique.usherb.ca/cerpema

Réception des candidatures

Prière de faire parvenir un curriculum vitæ accompagné d'une lettre contenant une courte description des intérêts de recherche et du programme de recherche proposé, un court énoncé sur la vision de l'enseignement et le nom de trois personnes pouvant faire des recommandations à l'appui de la candidature, avant 16 heures, le 15 juillet 2001 à :

Monsieur le doyen
Faculté des sciences
Offre d'emploi n° 01-1-29
Université de Sherbrooke
Sherbrooke (Québec) J1K 2R1

Les conditions de travail sont régies par les conventions collectives en vigueur. L'Université respecte le principe de l'égalité en emploi pour les femmes. Conformément aux exigences prescrites en matière d'immigration au Canada, la priorité, sera accordée aux citoyennes et aux citoyens canadiens et aux résidentes et résidents permanents.

UNIVERSITÉ DE SHERBROOKE

GET PROFESSIONAL PROTECTION FOR YOUR PERSONAL LIFE, SPONSORED BY THE CANADIAN ASSOCIATION OF PHYSICISTS

Do you want to apply the same care and consideration to your personal life that you do to your professional life? Then take a look at the affordable group insurance plan sponsored by your association.

The Professional Plan is very affordable, yet offers you valuable and important features that help you make certain you have ensured your family's future financial security.

This unique combination of low cost and high value is made possible by the ongoing involvement of your association on behalf of members like you. Choose the type of coverage that best suits your needs, including:

Term Life Insurance for you and your spouse • *Child Coverage*
• *Personal Accident Insurance for you and your spouse*
• *Income Protection Insurance* • *Office Overhead Insurance*

Your association makes sure that each type of **Professional Plan** coverage is priced right to help you secure your family's future. No wonder so many of your colleagues have already taken advantage of their membership to join **The Professional Plan**. Isn't it time you took a look at what **The Professional Plan** can do for you?

For free information, and an Application that you can complete yourself, call Manulife Financial toll-free at: 1 800 668-0195 or e-mail: am_service@manulife.com and mention your association by name.

Pour obtenir des renseignements en français, composez le 1 800 668-0195.

PRACTICAL PROTECTION AT LOW GROUP RATES DESIGNED EXPRESSLY FOR MEMBERS OF THE CANADIAN ASSOCIATION OF PHYSICISTS

Sponsored by:

Underwritten by:

Manulife Financial

The Manufacturers Life Insurance Company

CANADIAN ASSOCIATION OF PHYSICISTS
ASSOCIATION CANADIENNE DES PHYSICIENS ET PHYSICIENNES

112-150 Louis Pasteur, Ottawa, ON K1N 6N5
Tel. • Tél.: (613) 562-5614 Fax • Téléc.: (613) 562-5615
E-mail • Courriel: cap@physics.uottawa.ca
Web • Internet: www.cap.ca

Fees valid until December 31, 2001
Cotisations valide jusqu'au 31 décembre, 2001

MEMBERSHIP APPLICATION / RENEWAL FORM
DEMANDE D'ADHÉSION / RENOUVELLEMENT

☐ NEW APPLICATION / NOUVELLE DEMANDE ☐ RENEWAL / RENOUVELLEMENT

MEMBER SINCE / MEMBRE DUPUIS

MEMBERSHIP EXPIRES / ADHÉSION SE TERMINE

TITLE / TITRE ☐ DR / DR ☐ MR / M ☐ MS / MME ☐ OTHER / AUTRE

MAILING ADDRESS / ADRESSE POSTALE ☐ RESIDENCE / RÉSIDENCE ☐ BUSINESS / BUREAU

POSTAL CODE / CODE POSTAL

TEL. (B) FAX (B)

TEL. (R) FAX (R)

E-MAIL / COURRIEL

HOMEPAGE / PAGE D'ACCUEIL

LANGUAGE PREFERENCE / LANGUE PRÉFÉRÉE ☐ ENGLISH ☐ FRANÇAIS

OPTIONAL / FACULTATIF ☐ MALE / MASC ☐ FEMALE / FÉMININ D.O.B. / D.D.N. (Y-A • M-M • D-J)

AREA OF WORK / SECTEUR D'EMPLOI ☐ INDUSTRY / INDUSTRIE ☐ GOV'T / GOUV ☐ UNIV. / UNIV. ☐ RES. INST. / INST. RES. ☐ OTHER / AUTRE

HIGHEST DEGREE / GRADE UNIVERSITAIRE LE PLUS ÉLEVÉ ☐ B.Sc. ☐ M.Sc. ☐ Ph.D.

YEAR OBTAINED / ANNÉE DU DIPLÔME DEGREE IN / SPÉCIALISATION

METHOD OF PAYMENT • MODALITÉS DE PAIEMENT

I WISH TO PAY BY: / JE DÉSIRE PAYER PAR: ☐ CHEQUE / CHÈQUE ☐ MONEY ORDER / MANDAT

OR / OU CHARGE MY / CARTE ☐ MASTERCARD ☐ VISA

CARD N° / N° DE CARTE

EXPIRY DATE • DATE EXP.

X SIGNATURE

☐ REGISTER ME FOR THE AUTOMATIC RENEWAL PROGRAM
INSCRIVEZ-MOI POUR LE PROGRAMME DE RENOUVELLEMENT AUTOMATIQUE

☐ DO NOT PUBLISH MY NAME IN DIRECTORY
NE PAS PUBLIER MON NOM DANS LE RÉPERTOIRE

☐ DO NOT CIRCULATE MY NAME OUTSIDE CAP
NE PAS DONNER MON NOM À D'AUTRES ORGANISMES

☐ DO NOT INCLUDE ME IN THE CAP'S DISTRIBUTION LIST FOR E-MAIL NOTICES
NE PAS M'INCLURE SUR LA LISTE DE DISTRIBUTION DE L'ACP POUR LES MESSAGES ÉLECTRONIQUES

☐ DO NOT SEND ME THE CONGRESS PROGRAM (MAY / JUNE ISSUE OF PHYSICS IN CANADA)
NE PAS M'ENVOYER LE PROGRAMME DU CONGRÈS ANNUEL (PHYSIQUE AU CANADA, ÉDITION DU MOIS DE MAI / JUIN)

FOR OFFICE USE ONLY - À L'USAGE DU SECRÉTARIAT

*	√	MEMBERSHIP FEES • FRAIS D'ADHÉSION	REDUCED / REDUIT	FULL FEE / COTISATION
		FULL MEMBERS / MEMBRES TITULAIRES	69.25	138.00
		AFFILIATE MEMBERS / MEMBRES AFFILIÉS	69.25	91.50
		FULL AND AFFILIATE MEMBERS PERMANENTLY RESIDING OUTSIDE CANADA / MEMBRES TITULAIRES ET AFFILIÉS DEMEURANT À L'ÉTRANGER	74.00	74.00
		RETIRED MEMBERS / MEMBERS NO LONGER GAINFULLY EMPLOYED / MEMBRES RETRAITÉS / MEMBRES QUI N'ONT PLUS D'EMPLOI RÉMUNÉRÉ	N/A	69.25
		HIGH SCHOOL / CEGEP TEACHERS / ENSEIGNANTS DU SECONDAIRE ET DU COLLÉGIAL	55.50	55.50
		FULL TIME GRADUATE STUDENTS / ÉTUDIANTS AU DEUXIÈME ET TROISIÈME CYCLE À TEMPS COMPLET	37.50	37.50
		STUDENT MEMBERS (UNDERGRADUATE) / ÉTUDIANTS AU PREMIER CYCLE	21.00	21.00
		JOINT MEMBERSHIP CAP/OC / COTISATION CONJOINTE ACP/OC	97.00	97.00
		JOINT MEMBERSHIP CAP/COMP / COTISATION CONJOINTE ACP/OCPM	97.00	97.00

FEE • COTISATION AMOUNT • MONTANT

*	√	DIVISION / COMMITTEE FEES / COTISATIONS DE DIVISIONS / COMITÉS		STUDENT / ÉTUDIANTS	OTHER / AUTRE
		ATMOSPHERIC AND SPACE PHYSICS / PHYSIQUE ATMOSPHÉRIQUE ET DE L'ESPACE	DAPP / DPAE	1.00	5.00
		ATOMIC AND MOLECULAR PHYSICS / PHYSIQUE ATOMIQUE ET MOLÉCULAIRE	DAMP / DPAM	1.00	8.00
		CANADIAN GEOPHYSICAL UNION / DIVISION CONJOINTE DE L'ACP / AGC	CGU / AGC	8.00	15.00
		CONDENSED MATTER AND MATERIALS PHYSICS / PHYSIQUE DE LA MATIÈRE CONDENSÉE ET MATÉRIAUX	DCMMP / DPMCM	2.00	5.00
		MEDICAL AND BIOLOGICAL PHYSICS / PHYSIQUE MÉDICALE ET BIOLOGIQUE	DMBP / DPMB	1.00	5.00
		NUCLEAR PHYSICS / PHYSIQUE NUCLÉAIRE	DNP / DPN	1.00	10.00
		OPTICS AND PHOTONICS / OPTIQUE ET PHOTONIQUE	DOP / DOP	1.00	5.00
		PARTICLE PHYSICS / PHYSIQUE DES PARTICULES	PPD / PPD	0.00	5.00
		PHYSICS EDUCATION / ENSEIGNEMENT DE LA PHYSIQUE	DPE / DEP	0.00	5.00
		PLASMA PHYSICS / PHYSIQUE DES PLASMAS	DPP / DPP	2.00	5.00
		THEORETICAL PHYSICS / PHYSIQUE THÉORIQUE	DTP / DPT	1.00	5.00
		INDUSTRIAL AND APPLIED PHYSICS / PHYSIQUE INDUSTRIELLE ET APPLIQUÉE	DIAP / DPIA	1.00	5.00
		SURFACE SCIENCE / SCIENCE DES SURFACES	DSS / DSS	1.00	8.00
		COMMITTEE TO ENCOURAGE WOMEN IN PHYSICS / COMITÉ POUR ENCOURAGER LES FEMMES EN PHYSIQUE	CEWIP / CEFFP	1.00	5.00

*	√	JOURNAL SUBSCRIPTIONS / ABONNEMENTS AUX PÉRIODIQUES		
		CANADIAN JOURNAL OF PHYSICS / REVUE CANADIENNE DE PHYSIQUE	A	60.00
		CANADIAN JOURNAL OF EARTH SCIENCES / REVUE CANADIENNE DES SCIENCES DE LA TERRE	B	75.00
		CONTEMPORARY PHYSICS	C	300.00*
		PHYSICS IN MEDICINE AND BIOLOGY	D	285.00*
		THE PHYSICS TEACHER	F	214.00*
		QUÉBEC SCIENCE	G	35.00
		PHYSICS TODAY	H	108.50*
		PHYSICAL REVIEW LETTERS	I	535.00*
		MEDICAL PHYSICS	J	387.50*
		PHYSICS WORLD	K	193.00*
		PHYSICS EDUCATION	L	104.00*
		AMERICAN JOURNAL OF PHYSICS	M	234.50*
		PHYSICS IN CANADA / LA PHYSIQUE AU CANADA		GRATIS
		CAP MEMBERSHIP DIRECTORY (HARD COPY) / RÉPERTOIRE DES MEMBRES (COPIE EN PAPIER)		20.00

*GST / HST EXEMPT • EXEMPTE DE TPS / TVH

SUB TOTAL • SOUS TOTAL

EDUCATIONAL TRUST FUND (ETF) • FONDS D'ÉDUCATION

☐ VOLUNTARY CONTRIBUTION * / CONTRIBUTION VOLONTAIRE * * TAX DEDUCTIBLE / * DROIT AUX DÉGRÈVEMENTS D'IMPÔTS (SUGG. $25)

OTHER CONTRIBUTIONS • AUTRES CONTRIBUTIONS

☐ $100 SUSTAINING MEMBER DONATION / MEMBRE DE SOUTIEN / DON DE $100

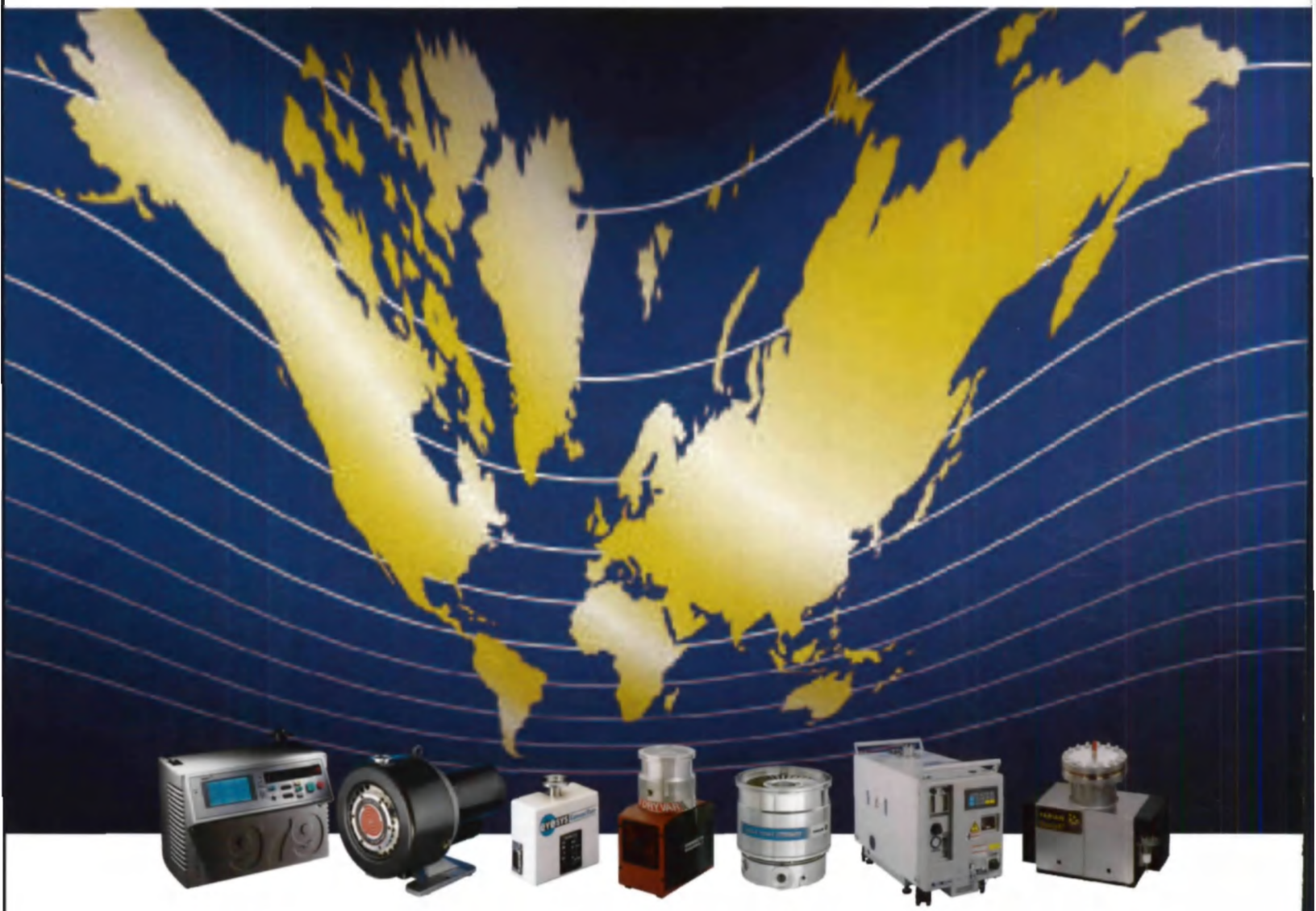
☐ FULL MEMBER / DONATION / MEMBRE TITULAIRE / DON (SUGG. $25)

ANONYMOUS DONATION? / DON ANONYME? ☐ YES / OUI ☐ NO / NON

PLUS GST / HST • TPS / TVH

TOTAL $

Varian Vacuum Solutions Cover the World



Our Extensive Product Line Stretches Your Imagination.

Shouldn't you trust your vacuum solutions to a worldwide leader? Thanks to our broad array of vacuum pumps, instrumentation, leak detectors, and components, Varian Vacuum Technologies provides complete solutions. We're experts at creating, maintaining, and measuring high vacuum and ultra-high vacuum environments in analytical instrumentation, semiconductor equipment, high-energy physics, research laboratories and diverse industrial processes.

In addition, our North American and European manufacturing plants and worldwide sales and service organization offer faster delivery times and immediate technical assistance.

With innovative application designs, responsive technical support, service, training, accessories, and a global presence, Varian Vacuum Technologies is your total vacuum solution provider. Talk to us. We're committed to your success.

Varian Canada Inc
6705 Millcreek Dr
Mississauga, Ont.
L5N 5R9
Phone: 1-800-882-7426
Fax: 905-819-8348

THE NEW VARIAN'S VACUUM CATALOG NOW AVAILABLE. ASK FOR YOUR FREE COPY.

VARIAN