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LETTERS

Greetings, and welcome to the 2011 Canadian Undergraduate Physics Conference!

We are excited to have all of you attend this year's conference in Saskatoon, Saskatchewan. This is the first time the CUPC has been held here since 1993, and it's difficult to imagine just how much has changed in the world of physics since then. From the establishment of centers of research such as the Canadian Light Source, Sudbury Neutrino Observatory, Perimeter Institute for Theoretical Physics and Triumf, to the continuing work of the Canadian Space Agency, Canadian physics has never been so prominent on the world stage.

It is important to us that you get a chance to see the exciting research and development happening in our city. Over the course of the weekend, you'll get to go on internal tours of University of Saskatchewan research featuring the Scanning Tunneling Microscopy lab and the Plasma Physics Laboratory (the site of Canada's first tokamak), as well as tours of larger facilities such as the Canadian Light Source synchrotron and SED systems.

We have invited four extraordinary speakers, which I hope will leave a lasting impression. I would like to thank Dr. Bill Unruh, Dr. Lee Smolin, Dr. Stephen Wolfram and Dr. Mike Bradley for helping us make this an exciting and informative event.

With all the mind-expanding knowledge you'll be receiving this weekend it'll be all the more important to balance it out with a less formal atmosphere. A time and place where you can take off your thinking caps and come together to enjoy social events. We will shuttle you around local venues on one night, and the next night we'll be hosting a private event on campus featuring a local band.

There is a long standing tradition of exciting and ground breaking developments first being announced, discussed and debated in an atmosphere very much like the CUPC. I can't help but think of the Solvay Conference, which hosted young and upcoming thinkers like Albert Einstein and Erwin Shroedinger long before long before their discoveries were famous. Other noted attendees include Dirac, de Brogile, Bohr, Born, Planck and Curie. It was at a conference like this that they announced the ideas that we continue to study; the ideas for which we admire them today.

The future of our discipline is charted out by great minds like yours, which is why it's an absolute honour that we get to have you here. On behalf of the CUPC 2011 Committee, we hope you feel welcome and have a wonderful time here this weekend.

David Leacock
Chair
CUPC 2011

Welcome from the Department Head,

It is an honor and a pleasure for the U of S Department of Physics and Engineering Physics that our Students' Society hosts the 2011 Canadian Undergraduate Physics Conference.

This is a great time to be a Physicist or Engineering Physicist, as a deep understanding of advanced Physics is becoming ever more relevant to new developments in science and technology. Virtually all projected or ongoing developments in new technologies require an understanding of advanced quantum mechanics at a level that is usually only taught in graduate courses in Physics. Therefore what is often denoted as the "quantum boundary" or "quantum limit" in technology is rather a quantum opportunity from a Physics perspective, both in terms of new ideas and required expertise. At the same time, we also need an ever higher level of scientific literacy in the public service and in the corporate sector, to make informed decisions at all levels of business and government.

Many of these developments transcend the traditional boundary between applied and fundamental research. New results in condensed matter physics have direct implications not only for materials science and the design of nanoscale systems, but also for our fundamental understanding of the role of quasi-particle excitations in complicated many particle systems. Scattering of photons by DNA molecules not only reveals electronic structure and conductivity properties, but also helps us to understand the biological role of electromagnetic interactions at the molecular level.

The Canadian Light Source on the campus of the University of Saskatchewan provides us with a unique opportunity to contribute to many of these interesting new developments in materials science, bio-medical applications of physics, and nanotechnology. The presence of the only Canadian plasma physics group with an operational Tokomak combined with an active research program in plasma-based materials processing contributes to the unique strength of our University as a Canadian centre for fundamental and applied research in materials science. I would be remiss if I did not also draw your attention to the great history and strength of our Institute for Space and Atmospheric Studies. ISAS researchers have a long tradition of excellence in satellite and radar observations of space weather and electromagnetic and chemical processes in the upper atmosphere.

Further, the new joint nuclear initiative of the University and the Government of Saskatchewan lead to the formation of the Canadian Centre for Nuclear Innovation to study and advance all things nuclear both from applied and fundamental perspectives. This provides an opportunity to continue and enhance a great and long-standing Saskatchewan tradition in nuclear physics that goes back to the instalment of the first Canadian betatron accelerator in the Physics building in 1948.

It is a great time to be in Physics, and it is a great time to be in Saskatchewan.

On behalf of the Department of Physics and Engineering Physics, I wish you a successful and inspiring conference, and I hope you enjoy your stay in Saskatchewan!

Rainer Dick, P.Phys.
Acting Department Head, Physics and Engineering Physics

On behalf of the Government of Saskatchewan, it is my pleasure to welcome you to the 2011 Canadian Undergraduate Physics Conference.

Studying and researching in physics and the sciences in general is tremendously important to the people of the City of Saskatoon and the Province of Saskatchewan. It is an honor for our province to host a conference of 200 students that promotes innovation and research. Those who engage in sciences benefit from the knowledge and skills obtained which, in return, contributes to a prosperous society.

This event is an opportunity for delegates to introduce themselves to industry through the presentation of their projects. It is also an opportunity for industry to preview the talent that will lead us into the future.

I would like to thank the Physics Students' Society and the University of Saskatchewan for hosting this important event. Best wishes for a successful conference.

Brad Wall
Premier

WELCOME & HISTORY

The first Canadian Undergraduate Physics Conference in 1965 launched an annual tradition of excellent undergraduate run conferences across the country.

This is the University of Saskatchewan's second time hosting the event, and our first in over fifteen years. The university's excellent physics facilities have grown significantly since then, and we're excited to show you around the campus.

Every year, CUPC provides undergraduates in physics and engineering physics (and even related fields) with the opportunity to network with other students, watch plenary talks by leading physicists, partake in industry and university tours, and experience a long weekend at a new university campus. Generally, students present any research they have performed through coursework or summer employment, but no one is forcing you to give a talk or poster; you can come for the experience alone.

The University of Saskatchewan boasts the Canadian Light Source (CLS), a 2.9 GeV synchrotron used for probing the structure of matter, advanced medical imaging, and material science research. We also possess the STOR-M tokamak, Canada's first tokamak, and the only tokamak device in Canada dedicated to magnetic fusion research.

Our Institute for Space and Atmospheric Studies (ISAS) was formed in 1956, and is a research institute devoted to studying ionospheric and atmospheric events, solar activity and climate, and the aurora. With 35 members, the institute is the largest and most comprehensive space-terrestrial physics institute in Canada.

We also boast one of the few engineering physics programs in Canada, and our unification of engineering physics and physics under one roof makes us uniquely able to seamlessly merge application with theory.

The city itself is about 220,000 people, so it's big enough to have plenty to show you, but small enough that there's a lot to do in a weekend, and not so much that you'll really get lost. The U of S campus is one of our two core bus stations, along with one downtown, and if you want to explore, bus passes run at $2.75 per trip, with discounts for all day passes and the like.

A notable perk is the free city-provided wireless internet all through the downtown core and on campus.

You're responsible for a couple of your meals while you're here, so if using UrbanSpoon with all that free wi-fi doesn't quite cut it, we've got you covered. Your delegate package should include a list of restaurants for you in all of the core parts of town if you ever get hungry.

And, of course, if you need help with anything while you're here, just come talk to one of us in a yellow shirt. We live here and have all the inside information to help you enjoy the city as much as possible.

Welcome to the 47th annual CUPC in Saskatoon, everyone.

Previous CUPC hosts

2010 **Dalhousie University**
2009 **University of Alberta**
2008 **University of Toronto**
2007 **Simon Fraser University**
2006 **University of New Brunswick**
2005 **University of Western Ontario**
2004 **University of Victoria**
2003 **McGill University**
2002 **Dalhousie University**
2001 **University of Manitoba and University of Winnipeg**
2000 **Université de Laval**
1999 **University of Alberta**
1998 **Queens University**
1997 **University of British Columbia**
1996 **University of Guelph**
1995 **University of Calgary**
1994 **McMaster University**
1993 **University of Saskatchewan**
1992 **University of Ottawa**
1991 **University of Alberta**
1990 **Université de Laval**
1989 **University of Waterloo**
1988 **Dalhousie University**
1987 **University of Calgary**
1986 **McGill University**
1985 **University of Manitoba**
1984 **University of New Brunswick**
1983 **University of Toronto**
1982 **University of Victoria and Royal Roads Military College**
1981 **Queens University and Royal Military College**
1980 **University of British Columbia**
1979 **University of Alberta**
1978 **Dalhousie University**
1977 **University of Toronto**
1976 **Carleton University**
1975 **Université de Laval**
1974 **Simon Fraser University**
1973 **University of Western Ontario**
1972 **McMaster University**
1971 **University of British Columbia**
1970 **University of Alberta**
1969 **University of Waterloo**
1968 **University of Manitoba**
1967 **McMaster University**
1966 **University of Toronto**
1965 **McGill University (with University of Toronto)**

ORGANIZING COMMITTEE

We're all wearing the yellow t-shirts, in case you need us for anything

Chair
David Leacock

Grad Fair
Sarah Purdy

Promotions
Victoria Martinez

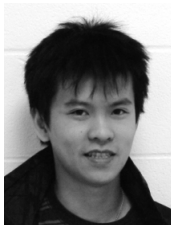
Sponsorship
Phil Boutin

Tours
Seth Dueck

Social Events
Nicole Nagy

Finance
Colleen Ambler

Webmaster
Wilson Brenna



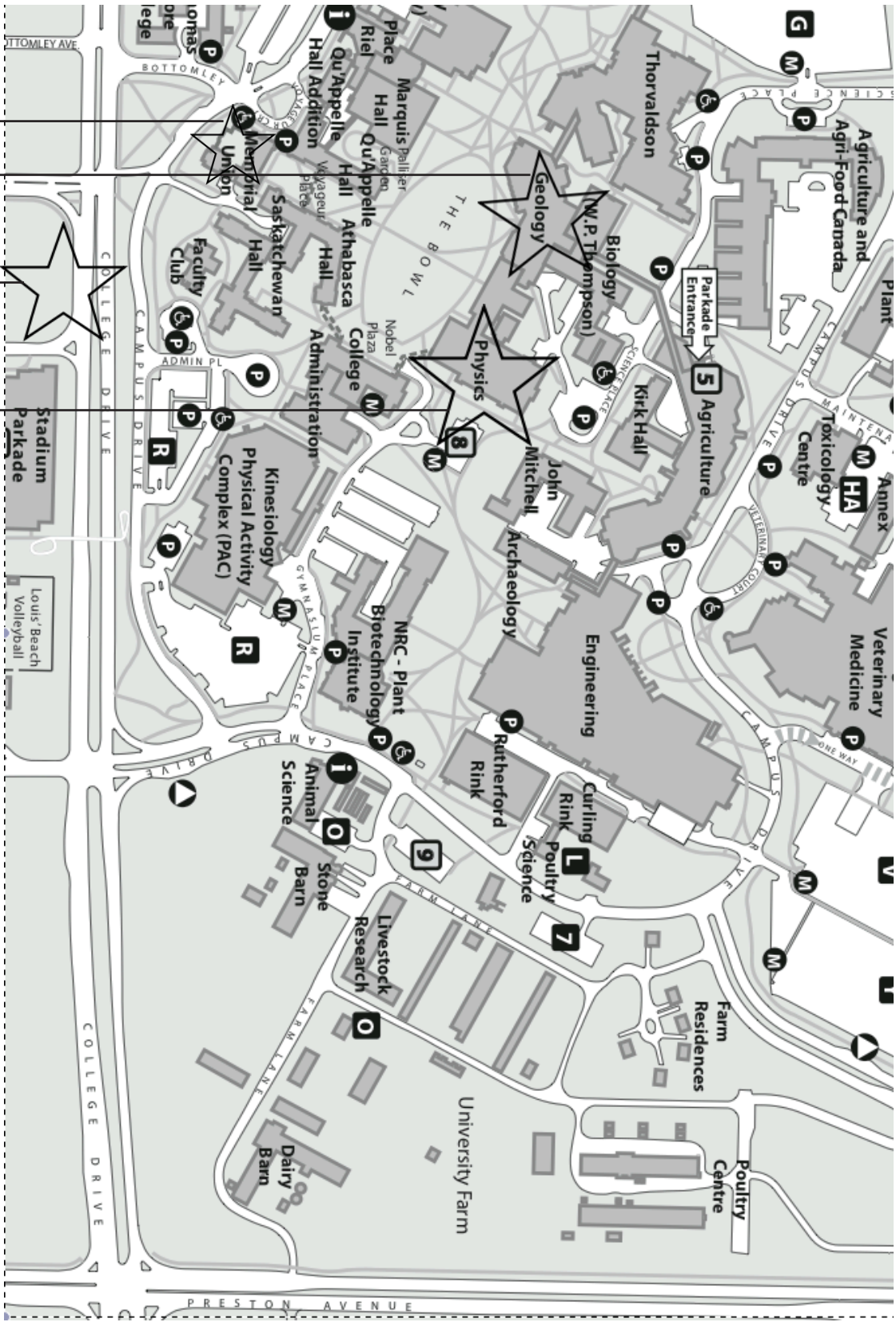
Volunteer Coordinator
Barry Tran

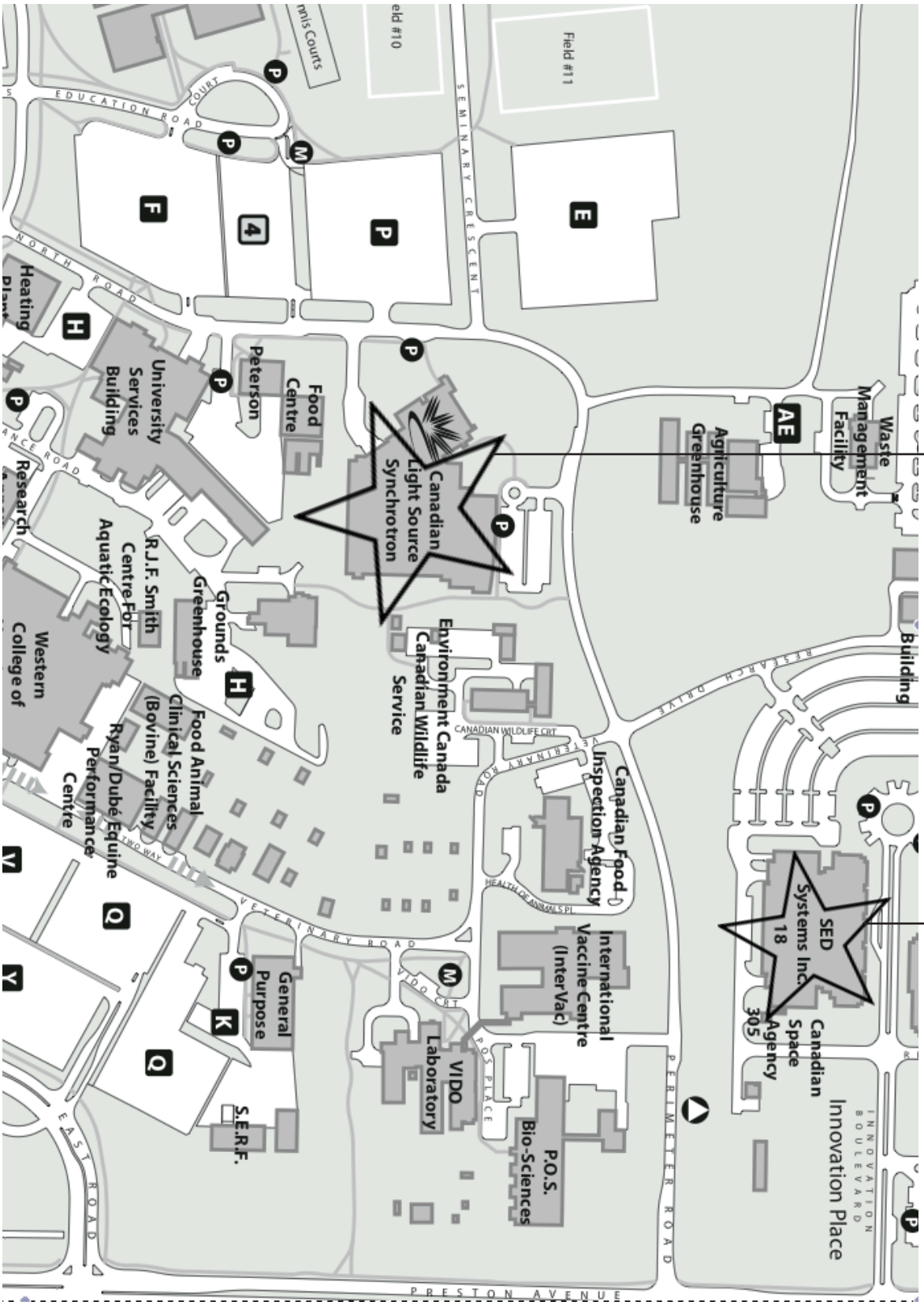
Accomodations
Sarah Toderian

Awesome volunteers who made this conference happen

Shiny Brar (Graphics) · Bradley Boutin
Jordan Rudderham · Ronan Lefol (Photo) · Rosemary Mason

CAMPUS MAP


Louis'
Geology
Subway
Starbucks
Dairy Queen
Physics
Louis' Beach Volleyball
Stadium Parkade
Thomas More College
Place Riel
Qu'Appelle Hall Addition
Qu'Appelle Hall
Athabasca Hall
Saskatchewan Hall
Memorial Union
Faculty Club
College Administration
Marquis Pallier Garden
Nobel Plaza
Voyageur Place
THE BOWL
Geology
Physics
Biology (W.P. Thompson)
Thorvaldson
Agriculture and Agri-Food Canada
Parkade Entrance
Agriculture
Kirk Hall
John Mitchell Archaeology
Engineering
Kinesiology Physical Activity Complex (PAC)
NRC - Plant Biotechnology Institute
Animal Science
Stone Barn
Livestock Research
Dairy Barn
Rutherford Rink
Curling Rink
Poultry Science
Toxicology Centre
Veterinary Medicine
Annex
Farm Residences
Poultry Centre
University Farm
COLLEGE DRIVE
CAMPUS DRIVE
ADMIN PL
GYMNASIUM PLACE
FARM LANE
PRESTON AVENUE
BOTTOMLEY AVE


Canadian Light Source Synchrotron
SED Systems
Waste Management Facility
Agriculture Greenhouse
Innovation Place
Canadian Space Agency
SED Systems Inc.
18
305
Canadian Food Inspection Agency
International Vaccine Centre (InterVac)
VIDO Laboratory
P.O.S. Bio-Sciences
Environment Canada Canadian Wildlife Service
Canadian Light Source Synchrotron
Food Centre
Peterson
University Services Building
Heating Plant
Western College of Veterinary Medicine
R.J.F. Smith Centre For Aquatic Ecology
Greenhouse
Grounds
Food Animal Clinical Sciences (Bovine) Facility
Ryan/Dubé Equine Performance Centre
General Purpose
S.E.R.F.
Field #11
Field #10
EDUCATION ROAD
COURT
SEMINARY CRESCENT
NORTH ROAD
RESEARCH DRIVE
INNOVATION BOULEVARD
PERIMETER ROAD
CANADIAN WILDLIFE CRT
VETERINARY ROAD
VIDO CRT
POS PLACE
HEALTH OF ANIMALS PL
EAST ROAD
PRESTON AVENUE

CAMPUS MAP

HOSTING CUPC 2012

It is time again to start thinking about hosting the next CUPC. Bids will be submitted and heard at the annual general meeting (AGM) Sunday afternoon. Before you place a bid, here are some things you should be aware of:

This conference is run completely by student volunteers. That means that in order to host it you need a student body that is willing to put in the time to make it work. You might not want to tackle this project alone, therefore if people aren't interested in working hard for a year to make the conference the best it can be it might not be a good idea.

The conference is expensive. It may not seem like it, but the budget for running a CUPC is close to $100,000. That means that it is necessary to get corporate and government support. But not only that, you have to make sure that your department has the resources to help you out financially. If they don't have the budget, it will make it difficult for you to get started.

A lot of facilities are needed. Make sure your department has, and will let you use, the facilities required for a conference of this magnitude. You will also need to make sure that there is a hotel around that can hold a couple hundred people.

Make sure the faculty and department are on board with the idea. It makes things a lot easier if your entire department agrees that hosting the CUPC is a good idea. MAKE SURE TO ASK THEM BEFORE YOU PLACE A BID.

That's about it. If you have any more questions about what hosting a CUPC entails, don't hesitate to email us or ask us in person any questions you've got.

The bids will be placed and voted on at the AGM and the winner will be announced immediately after the voting.

To all those thinking about hosting CUPC 2011, good luck and I hope you are able to do so!

SCHEDULE

THUR 10/13		
13:00:00-21:30	Registration	Commonwealth Ballroom
18:30:00-20:00	Reception	Commonwealth Ballroom
20:00:00-21:30:00	Stephen Wolfram Keynote	Commonwealth Ballroom
FRI 10/14		
7:00:00-8:30	Breakfast	Commonwealth Ballroom
8:30:00-11:00	Student Talks	North, South, and Central Ballroom
11:40-14:50	Tour	SED/Vecima
15:00:00-16:00	Bill Unruh Keynote	Commonwealth Ballroom
17:00:00-18:00	Lee Smolin Keynote	Commonwealth Ballroom
19:00:00	Pubcrawl Meet	Jax
20:00-23:00	Pubcrawl Departure	Jax
SAT 10/15		
7:00:00-8:30	Breakfast	Commonwealth Ballroom
8:30:00-11:00	Student Talks	North, South, and Central Ballroom
11:20:00-15:00:00	Tour	CLS synchrotron
12:40:00-15:00:00	Tour	SuperDARN
15:00:00-17:30:00	Grad/Posters	U of S Geology Building
	Campus Tours	U of S Physics Department
20:00:00-1:00:00	Louis Event	Louis' Campus Pub
SUN 10/16		
7:00:00-8:30:00	Breakfast	Commonwealth Ballroom
8:30:00-11:45:00	Student Talks	North, South, and Central Ballroom
Afternoon, time TBA	Annual General Meeting	Location TBA
17:00:00-21:00:00	Banquet	Commonwealth Ballroom
20:00-21:30:00	Michael Bradley Keynote	Commonwealth Ballroom
MON 10/17		
7:00:00-8:30:00	Breakfast	Commonwealth Ballroom

SPEAKER: STEPHEN WOLFRAM

President & CEO of Wolfram Research, Mathematica developer

Stephen Wolfram has been responsible for three revolutionary developments: the Mathematica computation system, A New Kind of Science, and the Wolfram|Alpha computational knowledge engine.

Wolfram was educated at Eton, Oxford and Caltech, receiving his PhD in theoretical physics at the age of 20. Wolfram's work on basic science led him to a series of fundamental discoveries about the computational universe of possible programs. Summarized in his best-selling 2002 book A New Kind of Science, these discoveries have not only launched major new directions in basic research, but have also led to breakthroughs in scientific modeling in physical, biological and social domains---as well as defining a broad new basis for technology discovery.

Launched in 1988, Mathematica has revolutionized the way technical computation is done, and has been responsible for countless advances over the past two decades. Starting from a set of fundamental principles devised by Wolfram, Mathematica has continually grown, integrating more and more algorithmic domains, and spawning such technologies as the Computable Document Format (CDF).

Building on Mathematica and A New Kind of Science, Wolfram in 2009 launched Wolfram|Alpha---an ambitious, long-term project to make as much of the world's knowledge as possible computable, and accessible to everyone. Used every day on the web and through apps by millions of people around the world, Wolfram|Alpha defines a fundamentally new kind of computing platform that is turning science-fiction computer intelligence into reality.

In addition to his scientific and technical achievements, Wolfram has been the CEO of Wolfram Research since its founding in 1987. Under Wolfram's leadership, Wolfram Research has become one of the world's most respected software companies, as well as a powerhouse of technical and intellectual innovation, and a major contributor to education and research around the world.

Adventures in Physics and Beyond

Dr. Wolfram's talk is at 8:00 p.m. Thursday, October 13.

SPEAKER: LEE SMOLIN

Perimeter Institute research, author of *The Trouble with Physics*

Lee Smolin was born in New York City in 1955 and raised there and in Cincinnati. After leaving high school early, he attended Hampshire College and the University of Cincinnati, graduating from Hampshire in 1975 with a degree in Physics and Philosophy. He attended Harvard University for graduate school receiving a PhD in theoretical physics in 1979.

Smolin held postdoctoral positions at the Institute for Advanced Study in Princeton, The Institute for Theoretical Physics (now KITP) in Santa Barbara and the Enrico Fermi Institute at the University of Chicago. This was followed by faculty positions at Yale, Syracuse and Penn State Universities, where he helped to found the Center for Gravitational Physics and Geometry. He also held visiting positions at various times at Cambridge and Oxford Universities and at SISSA and the Universities of Rome and Trento in Italy. He was a Visiting Professor at Imperial College from 1999 to 2001. In September of 2001 he moved to Canada to be a founding member of the Perimeter Institute for Theoretical Physics, where he has been ever since.

Lee's main contributions to research are so far to the field of quantum gravity. He was, with Abhay Ashtekar and Carlo Rovelli, a founder of the approach known as loop quantum gravity, but he has contributed to other approaches including string theory and causal dynamical triangulations. He is also known for proposing the notion of the landscape of theories, based on his application of Darwinian methods to Cosmology. He has contributed also to the foundations of quantum mechanics, elementary particle physics and theoretical biology. He also has a strong interest in philosophy and his three books, Life of the Cosmos, Three Roads to Quantum Gravity and The Trouble with Physics are in part philosophical explorations of issues raised by contemporary physics.

Lee's hobbies include jazz guitar and dingy sailing. Recently he enjoys making a fool of himself on an old contender.

The principle of relative locality

Several current experiments probe physics in the approximation in which Planck's constant and Newton's constant may be neglected, but, the Planck mass, is relevant. These include tests of the symmetry of the ground state of quantum gravity such as time delays in photons of different energies from gamma ray bursts. I will describe a new approach to quantum gravity phenomenology in this regime, developed with Giovanni Amelino-Camelia, Jersy Kowalski-Glikman and Laurent Freidel. This approach is based on a deepening of the relativity principle, according to which the invariant arena for non-quantum physics is a phase space rather than spacetime. Descriptions of particles propagating and interacting in spacetimes are constructed by observers, but different observers, separated from each other by translations, construct different spacetime projections from the invariant phase space. Nonetheless, all observers agree that interactions are local in the spacetime coordinates constructed by observers local to them. This framework, in which absolute locality is replaced by relative locality, results from deforming momentum space, just as the passage from absolute to relative simultaneity results from deforming the linear addition of velocities. Different aspects of momentum space geometry, such as its curvature, torsion and non-metricity, are reflected in different kinds of deformations of the energy-momentum conservation laws. These are in principle all measurable by appropriate experiments.

Dr. Smolin's talk is at 5:00 p.m. Friday, October 14.

SPEAKER: BILL UNRUH

Founder of CIFAR Cosmology and Gravity Program

Fast Facts

Born: Winnipeg, 1945

BSc(Hon): U Manitoba 1967

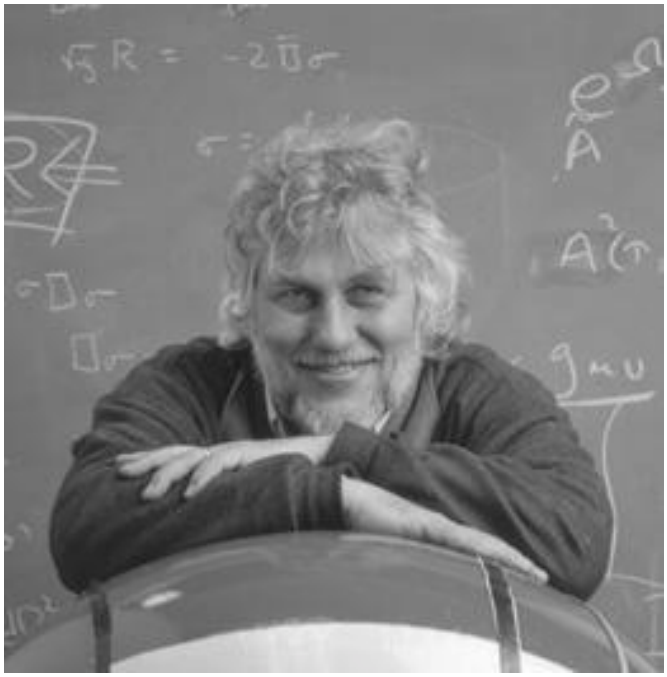
PhD: Princetone 1971, Under John Wheeler, who coined the term "black hole".

Post doc: NSERC, Birkbech College 1971-72 under R. Penrose.

Miller Fellow: UC Berkeley 1973-74

Asst Prof: McMaster U. 1974-76

Asst Prof and Prof: UBC 1976-present.



William (Bill) Unruh is a Canadian physicist born in Winnipeg, 1945.

His education brought him through University of Manitoba (B.Sc. Hon), Princeton (Ph.D. under John Wheeler), and to an NSERC post doctoral position at Birkbech College under Roger Penrose. Unruh was a Miller Fellow at UC Berkeley from 1973-1974, an assistant professor at McMaster University from 1974-1976, and since then has worked to a professorship at UBC, a position which he still holds.

Unruh is the founder and was director of the CIFAR Cosmology and Gravity Program (1989-99), which you may have heard of for its contributions through hiring top Canadian researchers. Unruh currently holds the status of a CIFAR Cosmology and Gravity Program fellow.

In 1976, he discovered the Unruh effect, which predicts that an accelerating observer will observe black-body radiation, but an inertial observer would not.

His awards include the Steacie Fellowship, Killam Prize, Canadian Association of Physicists Herzberg Medal, CAP Gold Medal, Fellow of the Royal Society of Canada, Fellow of the Royal Society of London, Honorary Foreign Fellow of the American Academy of the Arts and Sciences, and an honorary degree from McMaster University.

The measurement of Hawking Radiation in an Analog system

A year ago, a group of physicists and civil engineers at UBC measured the emission of radiation from an Horizon as predicted by Hawking in 1974. This experiment created a horizon in a tank of flowing water, and, using the stimulated emission from that horizon, showed that it had a thermal spectrum. This talk will give the background to that experiment, the results and argue, that while the quantum effect itself is too small to measure, the measurements made guarentee that this system would emit a thermal spectrum of radiation whose temperature is given by the properties of the horizon if one could measure it.

Dr. Unruh's talk is at 3:00 p.m. Friday, October 14.

SPEAKER: MICHAEL BRADLEY

U of S professor, developping watt balance measurement tool

Michael Bradley began his Physics career as an undergraduate student at the University of New Brunswick, earning a B.Sc. with honours in Applied Physics in 1992. Afterwards, Michael attended Massachusetts Institute of Technology until Februrary of 2000 as a graduate student, receiving a PhD in Physics.

Upon graduation, Bradley acted as a Senior, then Principal Scientist at Axcelis Technologies in Beverly, MA until 2003. He then came here to the University of Saskatchewan where he now holds an Associate Professor position in the Department of Physics and Engineering Physics.

Michael's current research is in Plasma Ion Implantation for Silicon Photonics and Doping Exotic Thin Films. In addition, he is a collaborator at the Bureau International des Poids et Mesures (BIPM) on the watt balance being developed there, a device that could be used to provide a better definition of the kilogram.

Superconducting Watt Balance for Precision Measurement of h

A Watt Balance [1] provides a way to link macroscopic mass to microscopic (and inherently quantum-mechanical) electrical standards (namely the Josephson and quantum Hall effects). The output of a watt balance measurement is a high-precision value of h/M, where M is the mass of a macroscopic test mass. If M can be linked accurately to the SI prototype kilogram, this provides a measurement of Planck's constant h. Alternatively, if h were to be defined as a fixed number (as has been proposed), this would provide a route to realizing a new kind of mass standard linked to fundamental quantities. This would then end the reliance on the artifact mass standard (the kilogram) which until now has provided the world's definition of mass via the SI. However, achieving the required accuracy in Watt Balance operation is an experimentally challenging problem. The BIPM's proposed cryogenic Watt Balance plans to take advantage of the zero-resistance properties of a superconducting moving coil to allow simultaneous measurements of force and induced voltage; this would eliminate problems due to time-dependent drifts. This talk will discuss the recent history of watt balances and the progress on the prototype superconducting machine now under construction at the BIPM, as well as possible future fundamental physics experiments inspired by the marriage of the watt balance concept and superconductivity.

[1] B. Kibble, "A measurement of the gyromagnetic ratio of the proton by the strong field method", Atomic masses and fundamental constants, J. Sanders and A. H. Wapstra
Eds., New York: Plenum, 1976, vol. 5, pp. 545-554.

Dr. Bradley's talk is at 8:00 p.m. Sunday, October 16.

MICHAEL
BRADLEY

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B3H 3C3
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Email: chair@ap.smu.ca

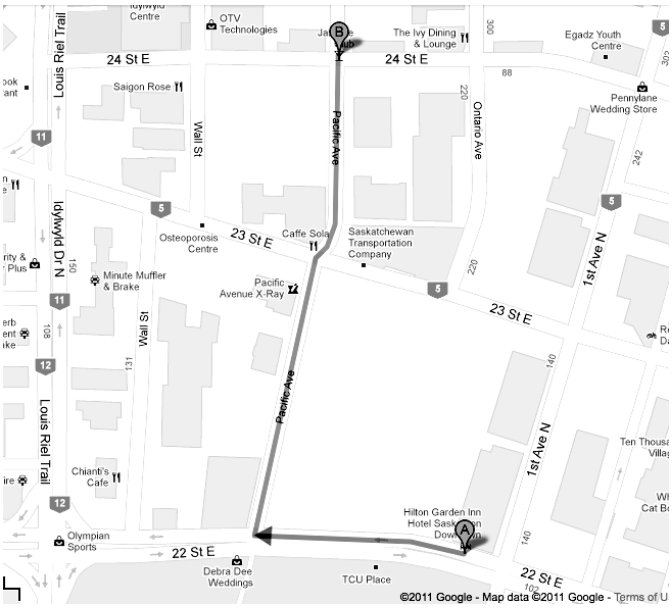
SOCIAL LIFE

Friday Night: Pubcrawl

Everyone has to be at Jax Niteclub by 7:00 p.m. Jax is right by the hotel, just check out the map below. It's got neon palm trees outside and we'll have volunteers to lead the way so you can't miss it. There will be $3 highballs and domestic beer before we leave, at around 7:45 or 8:00.

The we'll go to The Hose and Hydrant, a brew pub and dance club on Broadway, so you get a chance to check out a part of the most lively street in town. There's sit down and dance options, so it's pretty great for everyone. We'll stay for about an hour then head to Outlaws.

Outlaws is a country rock bar, which really, is an essential part of being in Saskatchewan. After an hour here, at about 11 or 11:30, we head back to Jax for the rest of the evening. We'll have volunteers to walk people back to the hotel so noone gets lost, and you can stay and dance as late as you want.



The route to Jax is really straightforward. From the hotel, head down 22nd Street towards Pacific Avenue. Pacific takes you right to the bar!

Saturday Night: Campus pub

Louis' is our campus pub, and also happens to have cheap food options for us and a local band to check out.

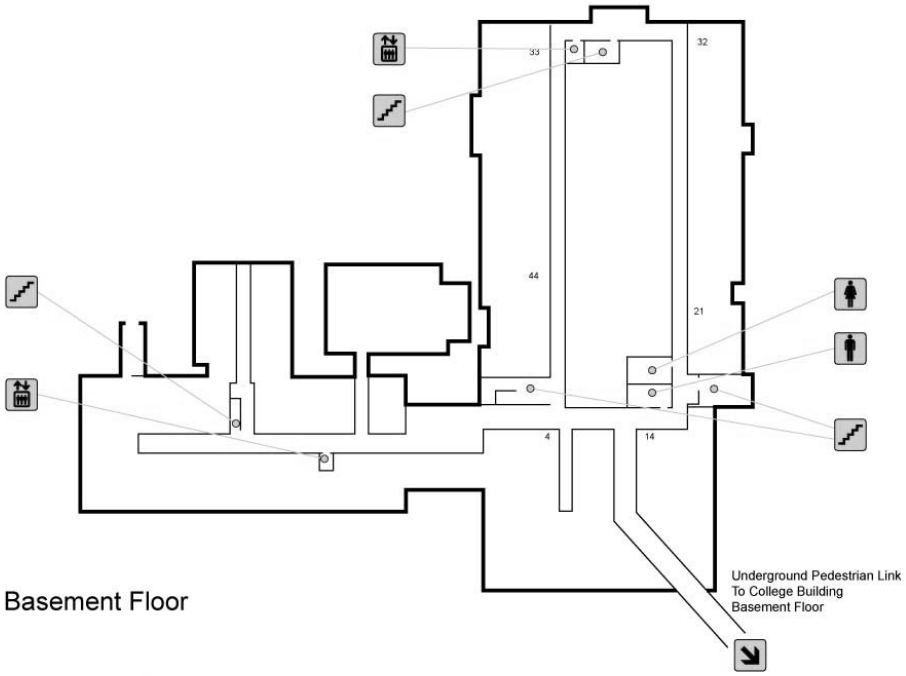
We can start heading over to Louis' for snacks and drinks at around 8:00, then Misterfire will play around 9:30. They're a local reggae-rock-ska group which means you can actually dance, or not, and experience our usual place for after school food.

After the band we'll have a DJ for continued partying until 1 a.m.

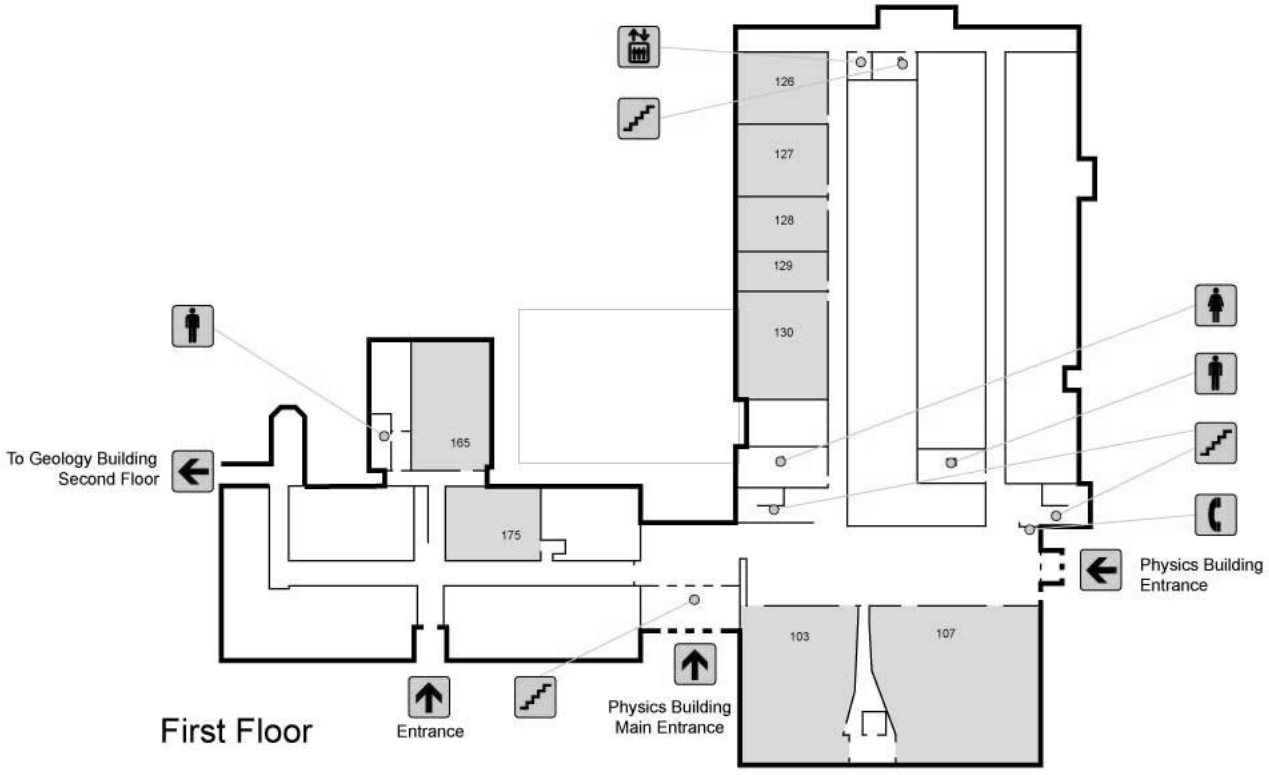
Since you might be on foot, the easiest way to get to campus is heading down 1st Ave (you can skip the little backtrack on this route) all the way to 25th Street. That takes you across the University Bridge to College Drive and campus. Louis' is right by the Bottomley entrance.

INTERNAL TOURS

Internal tours will take place at the University of Saskatchewan Physics department. Here are some maps to help you find your way around. The second floor is pretty straightforward, so we've omitted it.



Basement Floor

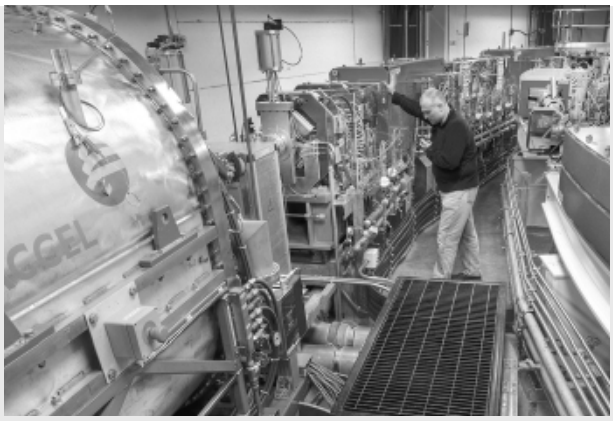


First Floor

EXTERNAL TOURS

Canadian Light Source

Saskatoon is home to Canada's only synchrotron research facilitiy, one of the largest scientific projects in the country's history. The 2.9 GeV accelerator functions as a high-intensity light source used for research in diverse fields, including materials research and biomedical research. Tours of the CLS will be lead by Alex Moewes (Professor, Canada Research Chair in Materials Science with Synchrotron Radiation) and members of his research team, who will discuss the techniques and benefits of synchrotron radiation.



SED Systems

Born on the University of Saskatchewan campus, SED Systems is currently an important supplier of project management, engineering, and manufacturing services to satellite, telecommunications, wireless, and RF/microwave industries. Providers of systems, software, and hardware engineering, as well as manufacturing of their designed products, SED's large range of products has made its way into many household names and products. Their customers include Boeing, MDRobotics, Nortel, RIM, and XM Radio.

SED
a division of CALIAN Ltd.

SuperDARN (Super Dual Auroral Radar Network)

Just East of Saskatoon is one of over 20 sites which make up the SuperDARN network. This network consists of over 20 radars looking into the polar regions of the Earth. These radars can measure the position and velocity of charged particles in the Earth's ionosphere, the highest layer of the Earth's atmosphere. Because the movements of these particles are tied to the movements of the Earth's magnetic field, SuperDARN data provides scientists with information regarding the Earth's interaction with the space environment. Visitors will tour the site and control building, and will talk with the lead project engineer.

Vecima Networks

Vecima Networks designs, manufactures, and sells products that enable broadband access to cable, wireless, and telephony networks. Its products are used by broadband service providers to facilitate voice, video, data, and wireless services. In particular, Vecima focuses on technology to connect networks to the end-user (the "last mile," also the "first mile" from the user to the broadband network) and very high-speed digital signal processing. Visitors will be guided by Dr. Hugh Wood through one of Vecima's facilities in Saskatoon, where broadband-wired and broadband-wireless are manufactured.

Vecima®
networks

STUDENT TALK SCHEDULE

North Ballroom

FRI OCT 14		
8:30:00	Cody Friesen	The Oceans of Jupiter and Saturn
8:45:00	Marielle Douville	Evolution of Colliding Spiral Galaxies
9:00:00	Kaja Rotermund	BORTAS 2011
9:15:00	Chen Karako	Improving Search Methods for Rotating Radio Transients
9:30:00	Charles Cao	T2K and DUET
9:45:00	Stephen Portillo	Towards searching for trapped slepton decays with ATLAS
10:00:00	Sarah Nowicki	Determining Neutrino Mass Hierarchy with IceCube and PINGU
10:15:00	Olivia Wasalski	Cerenkov Calibration Source for the SNO+ Experiment
10:30:00	Radim Barta	Discovering new massive particles at the LHC
10:45:00	Alexander Mechev	Simulations for a Beam Loss Monitor for the Compact Linear Collider
SAT OCT 15		
8:30:00	Rafael Schulman	The Effect of Stellar Metallicity on the Sizes of Star Clusters
8:45:00	Joel Hutchinson	Across the Universe: contraining tilts in cosmological parameters
9:00:00	Cory Hodgson	The University of Alberta – High-Altitude Balloon (UA-HAB) Project
9:15:00	Matt Wessel	Detecting and analysing flux transfer events with SuperDARN
9:30:00	Steven Bachiu	CaNoRock and Space and Atmospheric Physics
9:45:00	Steven Janssens	Measuring the Star Formation Rates of GEEC Survey Galaxies with Spectral Energy Distribution Fitting
10:00:00	Colleen Ambler	The Search of Exoplanets
10:15:00	Farid Qamar	Group and Field Galaxy Pairs
10:30:00	Kaitlynn Buffie	Cosmic Ray Transport
10:45:00	Xuesong Zhang	Statistics of extratropical cyclones
SUN OCT 16		
8:30:00	Bruce Darling	The Application of Powder X-Ray Diffraction to Polymorphism of Fats
8:45:00	Nathan V Lee	Dynamic light scattering can determine platelet function
9:00:00	Alice Liang	In vivo Myelin Water Imaging in the Optic Nerve
9:15:00	Victor Malkov	Atomic force spectroscopy to measure lateral compression in lipid membrane. Experimental and theoretical considerations
9:30:00	Isdin Oke	The physics of slime
9:45:00	Pascal Hogan	Active acoustics in Canadian Arctic
10:00:00	Chief-Ting (Jimmy) Hsu	Quantifying the number of fluorophores in a cell using photobleaching fit with a Bayesian Monte Carlo approach
10:15:00	Robin White	Simulations of bacterial surface motility modes and their influence on early-stage biofilm formation
10:30:00	Mosa Alhamami	Investigation of the Ultrasound-Induced Functional Effects on Neural Tissues
10:45:00	Andrew Urichuk	Immobilization Considerations for Brachytherapy
11:00:00	Alanna Flynn	Dynamics of Uncharged and Anionic Bicellar Mixters
11:15:00	Lam Kin	Synchronous Dynamics of Continuous Attractor Neural Networks under External Excitaion
11:30:00	Kyle Cormier	The effects of irradiation on brain anatomy in mouse pups

Central Ballroom

FRI OCT 14		
8:30:00	Carley Miki	Rheology of Polysaccharide Nanoparticle Suspensions
8:45:00	Bernadine Jugdutt	Optimization of VBS states for S=1/2 Heisenberg antiferromagnet in 1D
9:00:00	Philippa Krahn	Piezoelectric ZnO thin films created using sol-gel processes
9:15:00	Randy Squires	Towards the synthesis of Co-based full-Heusler compounds in solution through solvothermal reactions
9:30:00	Michael Tessier	So You Think You Can Dope?
9:45:00	Garnet Akeyr	Improving a Capacitative Dilatometer for Thermal Expansion Measurements
10:00:00	Jarrett Beck	Antiferromagnetic Ising Model on the Sorrel Net: A new corner-shared triangle diluted triangular lattice
10:15:00	Andrew Morrow	Electrohydrodynamic flow in colloid suspensions
SAT OCT 15		
8:30:00	Paul Fowler	Entanglements of Polymers in Thin Films
8:45:00	Nathan Musoke	Surface Imaging Techniques for CO Oxidation on Pt(110): RAM & PEEM
9:00:00	Kevin Dunphy	Inversion of Pattern Anisotropy during CO Oxidation on a Platinum Sample
9:15:00	Meike Rotermund	Analyzing Pitting Corrosion on Stainless Steel Wires
9:30:00	Vedashree Divekar	Plasmonic nanoantennas
9:45:00	Gabrielle Hodgson	Charge storage processes at ensembles of quantum dots: towards quantum flash memory cells
10:00:00	Alison Kinross	Crystal Growth and Characterization of CoNb2O6
10:15:00	Mike Chomitz	Monte Carlo Study of Disorder in Strongly Correlated Electron Systems
10:30:00	Marianne Girard	Carbon coatings deposited by crossed-beam pulsed laser deposition
10:45:00	Benoit Lefebvre	Méthodes de caractérisation volumétrique et gravimétrique de l'adsorption d'hydrogène dans les matériaux microporeux
SUN OCT 16		
8:30:00	Trisha Roberson	A Comparison of Curvelets and the Generalized Windowed Transform in the Compression of Seismic Data
8:45:00	Nicolas Badeau	The Kondo robot
9:00:00	Samuel Buteau	Effects of Non-Uniform Illumination on Concentrated Photovoltaic SystemsSystems
9:15:00	Mathieu Roy	Bioloid
9:30:00	Roman Nahachewsky	Improvised Explosive Device Triggers and Methods of Neutralization
9:45:00	Kevin Krieger	How I learned to stop worrying and love the laser
10:00:00	Gavin Vankosky	Laser-Guided Stabilization System
10:15:00	Jade Ghaoui	Frequency-Dependent Streaming Potential
10:30:00	Jean-Luc Deziel	Increased domestic radon exposure caused by permafrost thawing due to global climate change
10:45:00	Xavier Dallaire	Panoramic electro-optic imagers
11:00:00	Jeremy McGibbon	New Techniques of Observation of Granular Patterns in Thin Vertically Vibrated Layers
11:15:00	Aarya Shahsavar	Measurement of Total Electron Content of Ionospheric Plasma using Nanosatellites

South Ballroom

FRI OCT 14		
8:30:00	Babak Karamy	Interaction of High Intensity Laser Pulses on Nickel Nanowires
8:45:00	Kimberly Lawyer	Rotational Absorption Spectra and Temperature Scaling of Nitric Oxide using Terahertz Time-domain Spectroscopy
9:00:00	Brenden S Nickerson	Deconvolution and the Digital Inline Holographic Microscope
9:15:00	Chris Luciuk	Rydberg EIT
9:30:00	Thomas Prescott	Production of Zircaloy-4 Thin Films via Sputter Deposition
9:45:00	Magnus Haw	Verification of the Reif Model
10:00:00	Stephanie Mack	Channeling through Bent Crystals
10:15:00	Nima Afkhami-Jeddi	Analysis of suitability of homebuilt diode lasers for precise measurements of gravitational acceleration
10:30:00	Edward Kim	Multiple Scattering in XAFS Spectroscopy of Arsenate
SAT OCT 15		
8:30:00	Samantha Benincasa	Simulations of the Orbital Decay of Black Holes as a Result of Dynamical Friction
8:45:00	Brittany Welsh	Periodically Forced Spiral Waves in Surface Catalysis
9:00:00	Arman Tavakoli	A statistical model for memory in neural networks
9:15:00	Ben Levitan	Why Aren't Bacteria Like Hot Dogs?
9:30:00	Venkat Bala	The Generalized Uncertainty Principle & Self Adjoint Operators
9:45:00	Marius Oltean	Lifshitz Solitons
10:00:00	Danielle Leonard	A Hamiltonian Formulation of Gauss-Bonnet Gravity
10:15:00	Luke Bovard	Randall-Sundrum Black Holes
10:30:00	Wang Zitao	Algebraic Analysis and Stability Study of Networks in the form of Rings
10:45:00		
SUN OCT 16		
8:30:00	Fuluny Jang	X-ray spectroscopy with TRIUMF's Ion Trap for Atomic and Nuclear Science (TITAN)
8:45:00	Brian Kootte	Angular Bite of the DRAGON
9:00:00	Mark Jordison	Gamma Spectroscopy
9:15:00	Alexandra Pulwicki	The Growth of Nano-sized Clusters in Plasma
9:30:00	Benson Guest	Random walk of magnetic field lines in dynamical turbulence
9:45:00	Filip Simovic	Second harmonic generation (SHG) in collagen fibers
10:00:00	Lydia Zajiczek	Spin Wave Dynamics in an Ultracold Bose Gas
10:15:00	Vincent Sasseville	Electrostatic lens under atmospheric pressure

STUDENT TALK ABSTRACTS

Presentation Awards

All of the student talks and poster presentations at CUPC 2010 will be judged by graduate students and faculty members.

The top talks in each category and the top overall poster will each be awarded a copy of Maple software, donated by Maplesoft.

Awards will be presented at the banquet on Sunday, October 16th.

Categories

- Atmospheric and Space Physics / Plasma Physics
- Atomic, Molecular, and Optical Physics / Nuclear Physics
- Condensed Matter and Materials Physics
- Industrial, Applied, and Engineering Physics / Instrumentation, and Measurement Physics
- Medical and Biological Physics
- Theoretical and Mathematical Physics / Particle Physics

NORTH BALLROOM

The Oceans of Jupiter and Saturn

Cody Friesen at 8:30:00 Friday

Evolution of Colliding Spiral Galaxies

Marielle Douville at 8:45:00 Friday

BORTAS 2011

Kaja Rotermund at 9:00:00 Friday

Improving Search Methods for Rotating Radio Transients

Chen Karako at 9:15:00 Friday

T2K and DUET

Charles Cao at 9:30:00 Friday

The Tokai to Kamioka (T2K) second generation long baseline experiment studies muon neutrino to electron neutrino oscillation. The dominant neutrino interaction mode is CCQE (Charged Current Quasi-Elastic) in the energy region that T2K is probing. However, CC1pi (Charged Current Single Pion) interaction can be misidentified as CCQE if the product pion is absorbed in the parent nucleus, distorting the neutrino energy spectrum. Therefore, knowledge of pion interactions will be important in improving the planned measurements. DUET, a pion absorption experiment within the T2K collaboration is underway at TRIUMF, Canada to measure pion interaction cross-sections. This talk will first briefly introduce T2K experiment and the purpose of DUET. Then it will discuss the experimental setup and a few analyses that are related to the Harpsichord detector.

Towards searching for trapped slepton decays with ATLAS

Stephen Portillo at 9:45:00 Friday

Charged sleptons with long lifetimes (~days) are cosmologically favoured in supergravity where the gravitino is the lightest supersymmetric particle. When no proton collisions are occurring, cosmic rays are the major background in searches for decays of sleptons trapped in the ATLAS detector. This project develops a method to suppress this background by distinguishing between upward-going and downward-going muons using timing information recorded by ATLAS's monitored drift tubes.

Determining Neutrino Mass Hierarchy with IceCube and PINGU

Sarah Nowicki at 10:00:00 Friday

Neutrinos, fundamental sub-atomic particles, have three mass states. Although the difference between these states has been measured, the order of the mass states remains an unknown. This neutrino mass hierarchy has two possible configurations - normal and inverted. IceCube, the world's largest neutrino observatory, is a Cherenkov detector in the deep Antarctic ice at South Pole Station. IceCube is able to detect neutrinos with energies as low as 10 GeV using its existing infill DeepCore. Here we present the results of evaluating DeepCore's sensitivity to extracting the neutrino hierarchy from atmospheric neutrino interactions. We also consider a future infill to DeepCore, called PINGU, which would detect neutrinos with energies down to 1 GeV and thus enhance the potential neutrino mass hierarchy measurement.

Cerenkov Calibration Source for the SNO+ Experiment

Olivia Wasalski at 10:15:00 Friday

SNO+ will be a kilo-tonne scale liquid scintillatior neutrino detector. Located 2km underground in VALE's Creighton mine in Sudbury, Ontario, the low background environment coupled with the re-use of apparatus from the SNO experiment gives SNO+ an unique

opportunity to study neutrinoless double beta decay, pep solar neutrinos, geo neutrinos, reactor neutrinos and solar neutrinos. A Cerenkov calibration source has been proposed to use rigorously understood Cerenkov radiation to calibrate the optical properties of the detector. Preliminary Monte-Carlo simulations have demonstrated the feasibility of such a source, and the source is now in the design phase.

Discovering new massive particles at the LHC

Radim Barta at 10:30:00 Friday

Many observations in particle physics indicate that the Standard Model (SM) is incomplete. Numerous models beyond the SM predict the existence of new massive particles that decay preferentially into top anti-top quark pairs. One such model was proposed by Randall-Sundrum where the observation of the Kaluza Klein gluon (KK-gluon) may be the first indication of the existence of an extra spatial dimension. I shall describe how the KK-gluon is searched for with particle colliders, particularly the Large Hadron Collider, and how finding this and other massive particles can help support or disprove proposed theories that extend beyond the standard model. A novel method for flexible generation of signal templates (predictions) for comparison with data collected by the multi-purpose detector ATLAS is described and the latest result on the KK-gluon search is presented.

Simulations for a Beam Loss Monitor for the Compact Linear Collider

Alexander Mechev at 10:45:00 Friday

The Compact Linear Collider (CLIC) is CERN's design for a next generation mutli-TEV electron positron linear collider. It will be considered a complimentary experiment to the Large Hadron Collider currently active at CERN. While the LHC collides protons and heavy nuclei together - protons being hadrons and nuclei composed of hadrons - the CLIC will accelerate electrons and positrons to collide for a centre of mass energy of 3-5 TeV. Due to its dual beam design, the CLIC instrumentation will be subjected to a strong radiation field, requiring an accurate beam loss monitoring system.

The Effect of Stellar Metallicity on the Sizes of Star Clusters

Rafael Schulman at 8:30:00 Saturday

Over several years, observations of globular cluster systems in elliptical galaxies have indicated metal-poor globular clusters to be systematically larger than metal-rich globular clusters. No definitive explanation for this trend has been established; however, there have been several proposed ideas including differences in formation conditions between the clusters and even attributing the differences to observational projection effects. A method of exploring the early evolution of star clusters using computer simulations will be presented. Additionally, the impact of stellar metallicity on the overall dynamics of a cluster will be discussed. The results of the computer simulations that will be presented demonstrate that the dependence of stellar lifetimes on metallicity does in fact lead to a significant relationship between cluster size and stellar metallicity.

Across the Universe: contraining tilts in cosmological parameters

Joel Hutchinson at 8:45:00 Saturday

Large-scale variations of physical constants or cosmological parameters could manifest themselves as gradients across our Hubble volume, leading to correlations between adjacent multipoles of the cosmic microwave background anisotropies. We perform a generic test for these correlations in WMAP data, finding a result which is consistent with published claims of hemispheric power asymmetry. However, we find that the significance of such an asymmetry is highly dependent on the maximum multipole value used in the analysis. If real, the multipole dependence of future estimates of the dipole modulation could enable us to determine which parameter is varying. For example, using a Fisher matrix analysis, we find that the Planck satellite could detect a gradient in the fine structure constant as low as 10^(-4) across our observable volume.

The University of Alberta – High-Altitude Balloon (UA-HAB) Project

Cory Hodgson at 9:00:00 Saturday

Detecting and analysing flux transfer events with SuperDARN

Matt Wessel at 9:15:00 Saturday

A flux transfer event (FTE) is a relatively small magnetic flux tube connected to the both the Earth and the solar wind that carries plasma through the Earth's magnetosphere and ionosphere. An FTE is the result of reconnection, which is the joining of the Earth's magnetic field lines with the magnetic field lines of the solar wind (the interplanetary magnetic field, or IMF). When reconnection occurs, energy from the solar wind can be transferred to the magnetosphere. The plasma connected to the FTE flux tube can precipitate to lower altitudes where it can interact with plasma in the ionosphere, which is the electrically charged layer of the Earth's upper atmosphere. Magnetic reconnection, the most important source of energy in magnetospheric processes, is not well understood; however, much can be learned about it from the study of FTEs. The Super Dual Auroral Radar Network (SuperDARN) is a network of radars operated by an international scientific consortium. The radars are located in the northern and southern

polar regions of the Earth, and they detect plasma instabilities in the ionosphere. The ionospheric signatures of FTEs can be seen in SuperDARN data, and the work described in this talk dealt with the creation of computer programs that automatically find and analyse FTE signatures to learn about the relationship between the IMF and FTEs, as well as to compare northern- and southern-hemisphere FTEs.

CaNoRock and Space and Atmospheric Physics

Steven Bachiu at 9:30:00 Saturday

Measuring the Star Formation Rates of GEEC Survey Galaxies with Spectral Energy Distribution Fitting

Steven Janssens at 9:45:00 Saturday

The Search of Exoplanets

Colleen Ambler at 10:00:00 Saturday

An exoplanet is a planet which orbits a star other than our sun so they are an interesting find if you are so lucky to look in the right spot, especially if you like to speculate about extra-terrestrial life. However, detecting an exoplanet is something that can require error bars to be very small but it can still be done even from ground-based telescopes like the ones we have at the University of Saskatchewan. So, how does one find an exoplanet? Start by looking. The planet itself can't be seen but the evidence that it is there can be. I will discuss what we were hoping to find and what we did as well as the data acquisition and processing including the challenges therein.

Group and Field Galaxy Pairs

Farid Qamar at 10:15:00 Saturday

In recent studies, it has been found that star formation rates (SFR) in galaxy pairs are not constant for all types of interactions. In fact, the SFR depends on the projected separation of the pairs, their masses, their redshifts, and many other factors. In my summer research, using the CNOC2 survey, I explored the difference between group galaxy pairs and field galaxy pairs, and how being in different environments affect the star formation rates in those pairs. In this presentation, I will be showing the method I used for the selection and comparison of the pairs as well as the results achieved.

Cosmic Ray Transport

Kaitlynn Buffie at 10:30:00 Saturday

Statistics of extratropical cyclones

Xuesong Zhang at 10:45:00 Saturday

The Application of Powder X-Ray Diffraction to Polymorphism of Fats

Bruce Darling at 8:30:00 Sunday

Fats and oils are complex soft materials, composed mainly of triacylglycerol molecules. They are important to a wide variety of pharmaceuticals, edible materials, lubricants, fuels and high performance waxes. Due to the many degrees of freedom available to a triacylglycerol molecule, the phase transformation pathways and phase behaviour of TAG molecules and their mixtures are complex - even the melt of a pure TAG can transform into multiple polymorphic forms on crystallization. Furthermore, many of the metastable states persist for long time periods, the material locked in a local thermodynamic minimum. Importantly, the different polymorphic states can confer widely different physical properties and transport properties to the solid network, which can beneficially or adversely affect its performance in pharmaceuticals, edible materials and other products containing a high percentage of fats and oils. This presentation will discus the use of powder X-Ray Diffraction to monitor in real time, the phase transformations occurring in pure TAGs and binary mixtures of TAGs. The TAGs presented are of significant importance to the fats in chocolate!

Dynamic light scattering can determine platelet function

Nathan V Lee at 8:45:00 Sunday

Platelet transfusions are life-saving procedures for patients who are bleeding or undergoing chemotherapy. The effectiveness of transfusions depends on the number of platelets transfused and the platelet function. Platelet function correlates with proportion of discoid to activated platelets, morphology response to temperature stress, and inversely correlates with microparticle content. ThromboLUX is a novel device that determines platelet function by measuring all of these characteristics using dynamic light scattering (DLS). During periods of stress, such as decreased temperature, cytoskeletal rearrangements will cause normal, discoid platelets to activate and become spiny spheres. The formation of pseudopods of various lengths facilitates the clotting cascade and also increases the apparent size of platelets. ThromboLUX uses a 37-20-37°C temperature cycle that mimics the bleeding, storage, and transfusion process. As the temperature fluctuates, DLS will measure the changing platelet hydrodynamic radius and the size of any microparticles present. ThromboLUX analysis of platelet concentrates in vitro would allow determination of high platelet function units before transfusion and would therefore improve transfusion outcomes and patient safety. This study examined how DLS is able to distinguish between discoid and activated platelets as well as measure the parameters that contribute to high platelet function.

In vivo Myelin Water Imaging in the Optic Nerve

Alice Liang at 9:00:00 Sunday

"Platelet transfusions are life-saving procedures for patients who are bleeding or undergoing chemotherapy. The effectiveness of transfusions depends on the number of platelets transfused and the platelet function. Platelet function correlates with proportion of discoid to activated platelets, morphology response to temperature stress, and inversely correlates with microparticle content. ThromboLUX is a novel device that determines platelet function by measuring all of these characteristics using dynamic light scattering (DLS).

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Atomic force spectroscopy to measure lateral compression in lipid membrane. Experimental and theoretical considerations

Victor Malkov at 9:15:00 Sunday

Biological membrane is an essential part of the cell and plays a crucial role in cell functioning. Lateral compression of biological membrane is an important physical parameter that changes during various cell processes. The measurement and control of the membrane lateral compression is not easily achieved at the nanoscale, but could be very helpful in studying the functions of biological membranes or model membranes. Solid supported lipid membranes (SLM) are widely used as model membranes, and a precise determination of the lateral compression is crucial for understanding their structure and function. Vesicle fusion is a popular technique used for the formation of SLMs or bilayers, but it does not provide the desired control of the surface tension. We propose a new method for determining a membrane lateral compression by measuring the breakthrough forces, obtained with atomic force microscopy. Lipid bilayers of 1,2-dioleoyl-sn-glycero-3-phosphocholine (DOPC) at varying surface pressures were produced by Langmuir-Blodgett/Langmuir-Schaefer deposition onto mica, which permits the control of the surface compression of the resulting lipid bilayer. The formulation of a mathematical model that relates the breakthrough forces and lateral surface compression will also be discussed. The proposed method would help to analyze the lateral compression of a lipid membrane at the nanoscale in a non-destructive manner.

The physics of slime

Isdin Oke at 9:30:00 Sunday

Increased domestic radon exposure caused by permafrost thawing due to global climate change Pascal Hogan Radon, a radioactive element highly carcinogenic causing 9% of lung cancers in Europe and 12% in the United States, would tend to accumulate under and in permafrost. This project was intented to find if permafrost thawing could induce a dangerous Radon pulse. The results indicate that the danger would still be minimal or even nonexistent. The maximum increase is about 10 to 20% (on 3 or 4 days) of the average radon concentration, compared to a situation without permafrost in a normal house. Comsol Multiphysics 3.5a software was used to make the 2D modeling. Various parameters on various possible situations have been studied and most indicate that this increase would certainly be even smaller. For cons, the loss of an excellent protection against Radon that is the permafrost, could be very harmful.

Active acoustics in Canadian Arctic waters

Pascal Hogan at 9:45:00 Sunday

For 8 years, the CCGS Amundsen has been travelling the Canadian Arctic, collecting tons of data with its whole panoply of scientific instruments. Under Mr. Louis Fortier's supervision, our team has gathered acoustical data using a Simrad EK60 split-beam echo sounder. This piece of equipment allows further analysis of marine fauna, such as echo integration and target strength analysis. Considering the vast area for which data are available, the zone of interest was restricted to some stations at the entrance of the Amundsen Gulf. Central focus has been on polar cod. More recently, in a partnership between ArcticNet and Kongsberg , our research group made the acquisition of a new sonar, the Simrad SX90, allowing us to test some of our hypothesis

Quantifying the number of fluorophores in a cell using photobleaching fit with a Bayesian Monte Carlo approach

Chief-Ting (Jimmy) Hsu at 10:00:00 Sunday

Photobleaching of fluorophores (e.g. GFP) is a stochastic process, though it leads to an exponential decay on average. The fluctuations away from the average exponential decay are not white noise, and so traditional least-squares fits of the decay are not appropriate. Since the fluctuations are due to the

photobleach events, which is similar to radioactive decay, we can use them to quantify the number of fluorophores in a cell. However, to extract the fluctuations we need the average decay. What if we have only a single cell? I will present our Monte Carlo Maximum Likelihood with Bayesian statistics approach that allows us to extract information (or "fit") a the photobleach decay for an individual cell.

Simulations of bacterial surface motility modes and their influence on early-stage biofilm formation

Robin White at 10:15:00 Sunday

Chronic infections caused by bacterial biofilms forming on mucosal surfaces are a major medical problem; the airway infection by P. aeruginosa that afflicts people with cystic fibrosis is a prime example. Bacterial biofilms are highly resistant to host anti-microbials and antibiotics due to their tight packing, cooperative behaviour and excretion of exopolysaccharide (EPS) which creates a protective barrier. Recently Hancock's group has shown that human host defense peptide LL-37 inhibits biofilm formation by stimulating bacteria twitching motility. By inducing bacteria movement, this helps to break apart the densely packed film. We propose a generic microscopic model of bacteria behaviour on a surface with the aim of elucidating the macroscopic patterns seen in experiments, while also showing how twitching may inhibit biofilm formation. This model also allows us to pattern the nutrient on a surface thereby creating interesting growth patterns of a colony. The phenomenon of bacterial surface motility is poorly understood; our model suggests that cooperative modes of bacterial movement are necessary to create the motions observed in experiment.

Investigation of the Ultrasound-Induced Functional Effects on Neural Tissues

Mosa Alhamami at 10:30:00 Sunday

Immobilization Considerations for Brachytherapy

Andrew Urichuk at 10:45:00 Sunday

There have been some concerns about possible shifting in the position of the applicator within the patient during the pre-treatment stages of the intrauterine brachytherapy procedure at the Allan Blair Cancer Clinic in Regina. It is necessary to determine the size of these effects before deciding how to deal with them (should they exist). AP X-rays taken before and after moving the patient for CT were used to determine the position of the applicator. I will be discussing how the effect was measured from the films, the results found and briefly what the conclusions of the study undertaken suggests.

Dynamics of Uncharged and Anionic Bicellar Mixters

Alanna Flynn at 11:00:00 Sunday

Deuterium nuclear magnetic resonance (2H-NMR) has been used to study the temperature phase diagram of mixtures of long and short chain lipids, commonly referred to as bicellar mixtures. One type of mixture containing 1,2-dimyristoyl-sn-glycero-3-phosphocholine (DMPC) and 1,2-dihexanoyl-sn-glycero-3-phosphocholine (DHPC), and another type also including the anionic lipid 1,2-dimyristoyl-sn-glycero-3-phosphoglycerol (DMPG) were studied. Spectra were obtained for a 4:1 long to short chain lipid ratio with a varied anionic to neutral lipid ratio in the range 10-54oC. In each mixture, 25% of the long chain lipid was chain perdeuterated (DMPC-d54). Echo decay measurements suggest that slow motions in DMPC-d54/DHPC were more heavily damped than in vesicle samples of DMPC alone. Addition of DMPG progressively altered the mixture properties. These observations provide some new insights into how charge and chain-length mismatch influence morphology of these lipid structures.

Synchronous Dynamics of Continuous Attractor Neural Networks under External Excitaion

Lam Kin at 11:15:00 Sunday

Computational neural networks simplify the complex collective behaviors of a biological neural network and allow one to understand and infer the working mechanism behind human or animal brains. In this presentation, some simulation results by studying a simple continuous attractor neural network with short-term synaptic depression feature will be presented. A key highlight will be the synchronous firing, which is known as the population spike, under the inference of external stimuli. The conditions which population spikes can be sustained are known to be related to the strength of inhibition, depression as well as external stimuli of the system and will be discussed. Since a phenomenological model allows systematic and quantitative analysis, the work aforementioned may be the first step to understand the computational ability of the real neural network with depression mechanism.

The effects of Irradiation on brain anatomy in mouse pups

Kyle Cormier at 11:30:00 Sunday

CENTRAL BALLROOM

Rheology of Polysaccharide Nanoparticle Suspensions

Carley Miki at 8:30:00 Friday

Optimization of VBS states for S=1/2 Heisenberg antiferromagnet in 1D

Bernadine Jugdutt in 8:45:00 Friday

Quantum spin systems are useful models for characterizing various complex phenomena, e.g. quantum magnetism. Numerical simulations are often used in finding, for example, the ground states of these systems ; however, such computational studies are limited by time and memory cost at large lattice sizes. We focus on the S = 1/2 Heisenberg antiferromagnetic chain with nearest and next-nearest-neighbour interactions, representing different states using a reduced valence bond basis rather than spins. We attempt to improve on the scaling and memory cost of the exact diagonalization method by performing optimizations on the weighting of each valence bond state. We begin from the ansatz ψ_α=(Π_(l α) l)^(-p) where l represents the bond lengths in VB state α, the eventual goal being to create a faster algorithm that can handle a larger number of sites.

Piezoelectric ZnO thin films created using sol-gel processes

Philippa Krahn in 9:00:00 Friday

Towards the synthesis of Co-based full-Heusler compounds in solution through solvothermal reactions

Randy Squires in 9:15:00 Friday

"Cobalt based full-Heusler compounds are increasing in popularity due to their high Curie temperature and excellent electron spin polarization.[1] Fe3Si is the only full-Heusler compound that has been successfully made in nanoparticle (NP) form.[2] With that, cobalt based full-Heusler compounds have never been synthesized at the nanoscale: whether or not their advantageous electronic properties are maintained at such small scales remains unknown. In my recent work I have attempted to develop such compounds in NP form. The use of simple metal salts reacted solvothermally under nitrogen has encouraged the development of oxidized NPs and nanorods (NRs). Further attempts are being made to develop Co-based full-Heusler NPs with different compounds using metal carbonyl precursors and air-free methods. If these materials do uphold their properties in NP and NR form, further advancement in electron spin polarization technology may become easier and more cost effective.

References

1.Trudel, S., Gaier, O., Hamrle, J., Hillebrands, B., Magnetic anisotropy, exchange and damping in cobalt-based full Heusler compounds: An experimental review. J. Phys. D: Appl. Phys., 43. 193001 (2010)

2.Dahal N., Chikan* V., Phase-Controlled Synthesis of Iron Silicide (Fe3Si and FeSi2) Nanoparticles in Solution. Chem. Mater. 22 (9), pp 2892–2897 (2010)"

So You Think You Can Dope?

Michael Tessier in 9:30:00 Friday

A variety of interesting electron behaviour, such as superconductivity, can occur in doped transition metal oxides. Doping means substituting atoms in the substance for atoms of a different valence. This is done to change the number of electrons in the material, but it also introduces disorder. However, most theoretical models neglect disorder in their calculations. Our goal was to determine if this neglection is acceptable. We use exact diagonalization to study a model with onsite and nearest neighbour interaction and disorder, known as the Extended Anderson Hubbard Model. Our results show that models that include disorder can have a different behaviour than models that do not.

Improving a Capacitative Dilatometer for Thermal Expansion Measurements

Garnet Akeyr is 9:45:00 Friday

The thermal expansion of a multiferroic, BaNbFeSiO, was investigated along its a-axis using a capacitative dilatometer at low temperatures. It is known that a solid-solid phase transition occurs near 26K, and this has been previously found by measuring the linear thermal expansion along the sample's c-axis. After the initial measurements along the a-axis failed to align with literature values as well as being negative throughout the entire temperature range tested, dierent parts of the procedure in using the dilatometer were altered to determine why the measurements failed to give expected results. In this report, a summary of these changes are presented and the effects they had on the measured thermal expansion.

Antiferromagnetic Ising Model on the Sorrel Net: A new corner-shared triangle diluted triangular lattice

Jarrett Beck in 10:00:00 Friday

X-ray spectroscopy with TRIUMF's Ion Trap for Atomic and Nuclear Science (TITAN) F u l u n y J a n g 10:15:00 Double-beta decay is a rare radioactive decay which is a transition between two nuclei with the same mass number that changes charge by two units. TITAN-EC is an upcoming experiment at TRIUMF that will measure the electron capture branching ratio of intermediate nuclei in double-beta decay. This experiment is important for understanding of nuclear and neutrino physics. In the past, due

to high backgrounds and isobaric contamination, such measurements were hard to make. TITAN-EC will be using a novel technique to overcome those difficulties by using a highly efficient low energy detectors to measure X-ray spectroscopy of ions stored in a penning trap.

Electrohydrodynamic flow in colloid suspensions

Andrew Morrow at 10:15:00 Friday

The ability to control matter on the nano scale has many applications. One way to do this is using dielectrophoresis, in which particles either migrate towards or away from high field regions depending on their permittivity. In this experiment, the behavior of a colloidal system of polystyrene particles in a mixture of Decalin and TCE was examined in a non-uniform AC electric field. The non-uniform field cell was created using two micro-patterned ITO coated glass plates separated by 75 micron spacers. The system was examined in several cells over a range of voltages and frequencies, and electrohydrodynamic flow was observed. This type of flow could be useful in constructing small scale mixers, or for other applications.

Entanglements of Polymers in Thin Films

Paul Fowler at 8:30:00 Saturday

Polymers are long chain-like molecules. The study of polymers is particularly interesting because not all of their physical properties are fully understood. Developing a proper understanding of polymer systems is an important endeavour because of their ubiquitous use in technology, our daily lives and in Tim Horton's coffee cups. Another aspect which makes polymer physics such an exciting field of study is that polymers which have been confined to thin films often exhibit remarkably different properties than those in the bulk state. Further complicating the picture is that some recent literature focusing on the study of polymers in thin films has shown conflicting results and ideas. Entanglements are knot-like formations between polymer chains which contribute to much of the interesting physics governing polymer systems. Here we present experimental results indicating that film preparation affects the density of entanglements in thin polymer films. Since the density of entanglements is such an important and elusive quantity in polymer physics these results may help explain some of the recent controversy among polymer physicists.

Surface Imaging Techniques for CO Oxidation on Pt(110): RAM & PEEM

Nathan Musoke at 8:45:00 Saturday

"Surface Imaging Techniques for CO Oxidation on Pt(110): RAM & PEEM

Pattern formation has been observed in a variety of nonlinear systems, including the catalytic oxidation of CO on Pt(110) single crystals. Patterns formed include islands, target patterns and spirals. Two complementary techniques used to observe these patterns will be discussed. Adsorption of CO has an effect on the surface structure of Pt(110). Reflection anisotropy microscopy (RAM) provides contrast due to the associated change in the surface's optical anisotropy. Adsorption of CO and oxygen cause changes in the surface's work function. Photoemission electron microscopy (PEEM) provides contrast due to variations in surface work function."

Inversion of Pattern Anisotropy during CO Oxidation on a Platinum Sample

Kevin Dunphy at 9:00:00 Saturday

Catalytic oxidation of carbon monoxide (CO) on Pt(110) single crystals is one of many nonlinear systems able to be manipulated far from equilibrium. This provides an opportunity to study in detail spatiotemporal patterns arising from the reaction. While the physics of this heterogeneous reaction is generally well understood, a new phenomenon inverting the pattern anisotropy has recently been explored. An explanation of the oxidation process as well as the pattern inversion will be discussed, and analysis of data will reveal a probable cause of the anisotropy change.

Analyzing Pitting Corrosion on Stainless Steel Wires

Meike Rotermund at 9:15:00 Saturday

We analyze pitting corrosion of stainless steel wire surfaces immersed in salt water using three in situ techniques simultaneously: contrast enhanced microscopy, ellipsomicroscopy for surface imaging, and digital inline holography. They enable us to observe pitting events on the surface, changes in the oxide layer and follow particles injected into the electrolyte directly from the pits at the surface. We compare the sensitivity of the different methods being used. By changing the position of the wire with respect to the pinhole needed for the holography, we are able to analyze minute changes in the solution adjacent to the wire when tiny pits are occurring. This field of research should lead to improvement of corrosion resistant stainless steel wires, particularly for biomedical purposes such as orthodontic wires and cardiovascular stents.

Plasmonic nanoantennas

Vedashree Divekar at 9:30:00 Saturday

Charge storage processes at ensembles of quantum dots: towards quantum flash memory cells

Gabrielle Hodgson at 9:45:00 Saturday

Self-organised quantum dots are nanoscale islands embedded in the crystal

lattice of a semiconductor. Because of their quantized energy levels, as well as optical and magnetic properties, they are often thought of as artificial atoms. These islands represent traps for electrons or holes within the semiconductor, and can be used to store charges. In a transistor structure similar to a flash memory device, the number of charges in these dots can be tuned by applying a gate voltage. The process of charging can be investigated by the interaction with a two-dimensional electron gas. The future goal is to develop a device which operates like a flash memory stick but instead uses a single quantum dot as a memory cell.

Crystal Growth and Characterization of CoNb2O6

Alison Kinross at 10:00:00 Saturday

Monte Carlo Study of Disorder in Strongly Correlated Electron Systems

Mike Chomitz at 10:15:00 Saturday

Systems of strongly correlated electrons (SCEs) have been confounding condensed matter physicists for several years. These systems are thought to play an important role in such phenomena as colossal magneto resistance, and high temperature superconductivity. We are interested in discovering the role of disorder in the electron behavior of SCEs. Specifically, we want to know the impact of disorder on the density of states (DOS). We do this by modeling a lattice of electrons with repulsive on-site and nearest-neighbor interactions, and disordered site potentials. This model is called the Atomic Limit of the Extended Anderson Hubbard Model. The model is studied using the Monte Carlo Metropolis Algorithm in the grand canonical ensemble.

Carbon coatings deposited by crossed-beam pulsed laser deposition

Marianne Girard at 10:30:00 Saturday

Hard carbon coatings have unique properties that lend them to applications in several technological fields, such as the automotive industry. Hard carbon coatings contain a large fraction of sp3 sites (diamond-like carbon) which produce very interesting properties, such as high hardness, high wear resistance, a low coefficient of friction, etc. We produced carbon coatings using a novel technique called crossed-beam pulsed laser deposition. This method consists in ablating the surface of graphitic target by pulsed laser. Carbon, in the form of atoms, ions and clusters, is ejected and interacts with a gas injected near the target in synchronization with each laser pulse. The ablation products and the gas interact with each other before impinging on the surface of a substrate and producing a thin film. We used several techniques for analyzing coatings : the ellipsometry, atomic force microscopy, scanning electron microscopy and Raman spectroscopy. Results showed that amorphous carbon is deposited with a high fration sp2 sites. Solutions are proposed in order to achieve a higher fraction of sp3 sites.

Méthodes de caractérisation volumétrique et gravimétrique de l'adsorption d'hydrogène dans les matériaux microporeux

Benoit Lefebvre at 10:45:00 Saturday

A Comparison of Curvelets and the Generalized Windowed Transform in the Compression of Seismic Data

Trisha Roberson at 8:30:00 Sunday

Recent techniques for obtaining seismic data has led to the availability of high volumes of data describing the structure of the earth. Although seismic acquisition allows for the collection of such tera- or even petabytes of data, even the computing power available today is insufficient for even basic reconstruction, and devastatingly ineffective for the in-depth analysis required. Because of this limit, image processing must evolve to use sophisticated data compression and sparse optimization algorithms. Two approaches to this problem are the Curvelet transform, developed by Candes et al, and the Generalized Windowed Transform, a new technique developed by Mosher. The comparison of these two techniques will regard the specific use of these transforms in the compression of seismic images and show that the Generalized Windowed Transform displays more efficient and effective data reconstruction. This research was performed during a summer internship with ConocoPhillips, an international, integrated energy company and the 12th largest corporation in the world.

The Kondo robot

Nicolas Badeau at 8:45:00 Sunday

I will present what I did this summer during my internship for the robotic laboratory of Laval university. First, I will present the Kondo robot, a small humanoid robot used by graduates students to test a walking platform operated by cable. Secondly, I will explain the forward and inverse kinematics problems that I need to solve. Finally, the Matlab GUI's program made to solve these problem will be shown.

Effects of Non-Uniform Illumination on Concentrated Photovoltaic Systems

Samuel Buteau at 9:00:00 Sunday

We present a mathematical study of partial shading in the context of high-efficiency solar cells systems. A

series of solar cells, called a string, is a complex system. Partial shading drops dramatically the performance of a string. Adding bypass diode to the string solves a part of this problem (it reduces the drop) but, it changes the properties of the string. Without a good understanding of the implication of these changes, it is very difficult to predict the performance of a circuit or to maximize it. We provide a precise understanding of what happens in the case of multi-junctions solar cells. In other words, we calculate the optimal increase in performance you can get by adding bypass diodes and we show how to get that optimal performance (at what voltage to operate the string). All of this is done under various shading conditions.

Bioloid

Mathieu Roy at 9:15:00

Bioloid is a robotic platform developed by Robotis. This presentation will describe how different robots achieve different tasks using multiple types of sensors, notably: infrared, distance meter, gyroscope and sound detector. Also presented, is how the different needed software work, before finally going into the details of some of the mathematical problems related to some robotic movement.

Improvised Explosive Device Triggers and Methods of Neutralization

Roman Nahachewsky at 9:30:00 Sunday

"In asymmetric combat, one of the deadliest threats is the Improvised Explosive Device (IED). This fundamentally simple and critically effective weapons system has been responsible for 75% of Canadian combat fatalities caused by enemy action in Afghanistan (62% total Canadian fatalities)[1]. In this presentation, we will analyze and dissect common IED triggers and discuss possible methods of neutralizing the device.

[1]Canadian Casualties in Afghanistan. (2011, September 20). Retrieved from http://www.ctv.ca/war/"

How I learned to stop worrying and love the laser.

Kevin Krieger at 9:45:00 Sunday

Laser-Guided Stabilization System

Gavin Vankosky at 10:00:00 Sunday

This instrumentation project was to build a self-contained, mobile optical stabilization system to correct for sample position drift in long-term optical microscopy measurements. The performance goal for the system is sub-micron resolution in three dimensions. To this end, a cage-mounted configuration of dichroic reflectors, beam splitters, and mirrors was constructed which enables independent control and measurement of imaging and stabilization beams (here, having wavelengths of 410 nm and 700 nm, respectively). The beams are fiber-coupled to the cage for mechanical isolation of the laser sources from the microscope. Position-sensitive detection is accomplished using a quadrant photodetector (QPD), with final system control via digital feedback using LabView. The status of the system as characterized using a pinhole test specimen will be reported.

Frequency-Dependent Streaming Potential

Jade Ghaoui at 10:15:00 Sunday

Streaming potential is a geophysical phenonmenon which consists of a electic potential appearing when a ionic fluid passes through a rock. Both theory and experiment in this domain are very incomplete, causing that applications are actually being developed without proper scientific background. An apparatus have been developped in order to study and caracterise streaming potential in DC regime for solid samples and an other one in AC regime for solid and disaggregated samples.

Increased domestic radon exposure caused by permafrost thawing due to global climate change

Jean-Luc Deziel at 10:30:00 Sunday

Radon, a radioactive element highly carcinogenic causing 9% of lung cancers in Europe and 12% in the United States, would tend to accumulate under and in permafrost. This project was intented to find if permafrost thawing could induce a dangerous Radon pulse. The results indicate that the danger would still be minimal or even nonexistent. The maximum increase is about 10 to 20% (on 3 or 4 days) of the average radon concentration, compared to a situation without permafrost in a normal house. Comsol Multiphysics 3.5a software was used to make the 2D modeling. Various parameters on various possible situations have been studied and most indicate that this increase would certainly be even smaller. For cons, the loss of an excellent protection against Radon that is the permafrost, could be very harmful.

Panoramic electro-optic imagers

Xavier Dallaire at 10:45:00 Sunday

New Techniques of Observation of Granular Patterns in Thin Vertically Vibrated Layers

Jeremy McGibbon at 11:00:00 Sunday

Measurement of Total Electron Content of Plasma using Nanosatellites

Aarya Shahsavar at 11:15:00 Sunday

SOUTH BALLROOM

Interaction of High Intensity Laser Pulses on Nickel Nanowires

Babak Karamy at 8:30:00 Friday

We studied the interaction of a high intensity 800 nm femtosecond laser pulse on nickel nanowires at ALLS in Montreal. Using two double plasma mirrors the laser pulse was made to be of high contrast. The angular distribution of x-rays was measured and compared to that of bare nickel. An anisotropy in the angular distribution was observed.

Rotational Absorption Spectra and Temperature Scaling of Nitric Oxide using Terahertz Time-domain Spectroscopy

Kimberly Lawyer at 8:45:00 Friday

The rotational absorption spectrum of nitric oxide (NO) has been measured using Terahertz time-domain spectroscopy (THz-TDS) from 0-2.2 THz. Due to spin-orbit coupling, the NO molecule has a complicated absorption spectra, making it more difficult to model than other linear molecules such as CO. Using the laser equation and Boltzmann statistics, the distribution of thermally populated states was modelled and found to agree well with the experimentally measured absorbance. Temperature-dependent shifts in the absorption spectrum were measured and found to be consistent with the model that we used.

Deconvolution and the Digital Inline Holographic Microscope

Brenden S. Nickerson at 9:00:00 Friday

Deconvolution of images in microscopy is an important feature that allows for an increased amount of detail to be seen. Microscopy along with other imaging systems are plagued with the ability to view extremely small objects but not always dierentiate between clusters; therefore limiting their eectiveness on such small scales. There are several methods for removing the blur in images, all of which can be broken into two basic categories: image sharpening tools, and deconvolution algorithms. Image sharpening tools in some circumstances can appear to be the more aective; however it must be seen that one runs the risk of sharpening an image too much, resolving points beyond recollection, and therefore creating a new image where the condence in what one sees is shaky. Therefore the limit of what can justiably be resolved in an image can only come from a true deconvolution and not the repetition of a sharpening tool.

Rydberg EIT

Chris Luciuk at 9:15:00 Friday

We present a novel scheme to detect a narrow EIT signal within a much larger Doppler broadened absorption in Rubidium 85 on the D1 transition in a ladder EIT system. Using phase sensitive detection we attempt to detect this narrow bandwidth signal by modulating our carrier signal and subsequently generate an error signal corresponding to EIT using a lock-in amplifier. This allows for low optical powers to be used (~5mW) as compare to previous work (~180mW). Further, this is used as a non-destructive probe of Rydberg energy levels with applications to quantum information processing.

Production of Zircaloy-4 Thin Films via Sputter Deposition

Thomas Prescott at 9:30:00 Friday

Verification of the Reif Model

Magnus Haw at 9:45:00 Friday

We investigate the scaling dependence, in a vapour cell magneto-optic trap (MOT), of background Rb density and trap depth on the particle loading rate. The filling rate was measured as a function of the background Rb density for a sample of 6 different trap depths. We find that the filling rate is proportional to the Rb density and the square of the trap depth. We therefore experimentally confirm the filling rate scaling predicted by the Reif model. In addition, we demonstrate that this loading rate scaling can be used to reliably extrapolate new trap depths from a single measured depth, as well as providing an estimate of the ratio between MOT capture and escape velocities (v_c/v_e = 1.29+-.12).

Channeling through Bent Crystals

Stephanie Mack at 10:00:00 Friday

Bent crystals have demonstrated potential for use in beam collimation. A process called channeling is when accelerated particle beams are trapped by the nuclear potentials in the atomic planes within a crystal lattice. If the crystal is bent then the particles can follow the bending angle of the crystal. There are several different effects that are observed when particles travel through a bent crystal including dechanneling, volume capture, volume reflection and channeling. With a crystal placed at the edge of a particle beam, part of the fringe of the beam can be deflected away towards a detector or beam dump, thus helping collimate the beam. There is currently FORTRAN code by Igor Yazynin that has been used to model the passage of particles through a bent crystal. Using this code, the effects mentioned were explored for beam energy that would be seen at the Facility for Advanced Accelerator Experimental Tests (FACET) at a range of crystal orientations with respect to the incoming beam. After propagating 5 meters in vacuum space past the crystal the channeled particles were observed to separate from most of the beam with some noise due to dechanneled particles. Progressively smaller bending radii, with corresponding shorter crystal lengths, were compared and it was seen that multiple scattering decreases with the length of the crystal therefore allowing for cleaner detection of the channeled particles. The

input beam was then modified and only a portion of the beam sent through the crystal. With the majority of the beam not affected by the crystal, most particles were not deflected and after propagation the channeled particles were seen to be deflected approximately 5mm. After a portion of the beam travels through the crystal, the entire beam was then sent through a quadrupole magnet, which increased the separation of the channeled particles from the remainder of the beam to a distance of around 20mm. A different code, which was developed at SLAC, was used to create an angular profile plot which was compared to what was produced by Yazynin's code for a beam with no multiple scattering. The results were comparable, with volume reflection and channeling effects observed and the range of crystal orientations at which volume reflection is seen was about 1 mrad in both simulations.

Analysis of suitability of homebuilt diode lasers for precise measurements of gravitational acceleration

Nima Afkhami-Jeddi at 10:15:00 Friday

"Analysis of suitability of homebuilt diode lasers for precise measurements of gravitational acceleration*

Authorlist:

N. Afkhami-Jeddi, R. Marants, R. Berthiaume and A. Kumarakrishnan

We have used a home-built Littrow diode laser that relies on a grating for optical feedback to obtain precise measurements of gravitational acceleration using a commercial gravimeter. The gravimeter consists of falling corner cube Mach-Zehnder optical interferometer. The value of gravity is inferred by fitting to zero-crossings of a chirped fringe pattern that result from change in relative length between the arms of the interferometer as one arm falls in gravity. We analyze the signal from the gravimeter to understand and model the role of external cavity modes associated with the diode laser. We also review the characteristics of a home-built diode laser that relies on feedback from an interference filter and discuss why this laser is expected to improve gravimetric measurements.

*Work supported by CFI, OIT, NSERC, OCE and York University"

Multiple Scattering in XAFS Spectroscopy of Arsenate

Edward Kim at 10:30:00 Friday

The goal of this research is to determine the spectral contribution of significant multiple scattering paths to the X-ray Absorption Fine Structure (XAFS) signal in the arsenate tetrahedron. XAFS spectroscopy was performed on dry powder and liquid samples of sodium hydrogen arsenate heptahydrate (Na2HAsO4 • 7H2O) using the Hard X-ray Micro-Analysis (HXMA) beamline at the Canadian Light Source in Saskatoon, Saskatchewan. Data analysis was performed using the ab initio code, FEFF7, and the data fitting program, Win-XAS. The results will provide a quantitative basis for XAFS analysis beyond the nearest neighbour shell in As(V)-bearing compounds of environmental significance.

Simulations of the Orbital Decay of Black Holes as a Result of Dynamical Friction

Samantha Benincasa at 8:30:00 Saturday

As a massive object travels amongst a uniform sea of lighter objects it experiences a deceleration due to gravity. The deceleration acts like a drag force and can be described using Chandrasekhar's concept of dynamical friction. This idea can be applied to many astrophysical situations. In particular, I will present the results of a study concerning the orbital decay of a black hole. Massive particles were placed in elliptical orbits in NFW profile dark matter halos, and the orbital decay studied through the results of numerical simulations. In this way, it was found that the time necessary for the orbit of the black hole to decay to the centre of the halo is overestimated by Chandrasekhar's equation. Furthermore, it was found that the decay of the orbit is affected by both the starting position of the black hole in the halo, as well as the total amount of particles present within the halo.

Periodically Forced Spiral Waves in Surface Catalysis

Brittany Welsh at 8:45:00 Saturday

A statistical model for memory in neural networks

Arman Tavakoli at 9:00:00 Saturday

Humans are capable of remembering information represented in different formats such as pictures or songs, expect in special circumstances such as injury to the brain or in patients with Alzheimer's disease. This is some evidence that brain cells are necessary for storing and processing memory. I will discuss a statistical model where a group of neurons and connections between them exhibit "memory-like" behavior.

Why Aren't Bacteria Like Hot Dogs?

Ben Levitan at 9:15:00 Saturday

In Gram-negative bacteria such as E. coli, the peptidoglycan sacculus prevents cell rupture despite many atmospheres of internal turgor pressure. Cell growth requires axial extension of the sacculus in situ, and this has been recently observed to occur in a processive manner around the cell. While this appears to support the traditional picture of a holoenzyme that copies existing circumferential glycan chains, no evidence for the holoenzyme or of long glycan chains has been reported. We propose an alternative mechanical view of the process, modeling the sacculus of rod-shaped bacteria as a linear elastic medium with linear fracture mechanics. In our picture, as a crack extends, new peptidoglycan is inserted behind it. We investigate the dependence of the direction of stable crack propaga-

tion on material properties of the sacculus and show why bacteria don't always split like hot dogs.

The Generalized Uncertainty Principle & Self Adjoint Operators

Venkat Bala at 9:30:00 Saturday

"String Theory, Loop Quantum Gravity, Doubly Special Relativity, (DSR) etc strongly suggest the modification of conventional Heisenberg algebra between two canonically conjugate variables to include terms higher order in the momentum. This so-called Generalized Uncertainty Principle (GUP) predict a minimum observable length and maximum observable momentum. The GUP also seems to imply that measurable lengths, areas and volumes are all quantized. We do a systematic study of the modified momentum and Hamiltonian operators involved in this analysis to determine their complete self-adjoint extensions, and thereby put the various results on a stronger mathematical footing."

Lifshitz Solitons

Marius Oltean at 9:45:00 Saturday

Holographic duality has proven to be of appreciably broad theoretical utility ever since the conjecture of the AdS/CFT correspondence. Extended in recent years beyond high energy physics, this idea has now been fruitfully applied to a class of condensed matter theories which model quantum critical behaviour, and are characterized by an anisotropic scaling called Lifshitz scaling. In this talk, I will explore the corresponding (n+1)-dimensional dual theory known as Lifshitz gravity, coupled to massive abelian gauge fields and with a negative cosmological constant. In particular, I will present numerical solutions for Lifshitz solitons (originally referred to as Lifshitz stars), objects with non-singular spacetime geometries obeying this theory's asymptotic structure.

A Hamiltonian Formulation of Gauss-Bonnet Gravity

Danielle Leonard at 10:00:00 Saturday

Lovelock gravity is a higher dimensional theory involving carefully combined higher curvature terms, reducing to General Relativity in the usual 3+1 dimensions. Gauss-Bonnet gravity is the simplest case of Lovelock gravity. Though popular and relatively well-studied, many things are still unknown regarding Gauss-Bonnet gravity. For example: its behaviour under numerical simulations of spherically symmetric gravitational collapse. Moving towards undertaking such simulations, I will present the Hamiltonian formulation derived by myself and my collaborators. I will explain the issues encountered when attempting a Hamiltonian derivation involving higher curvature terms, as well as the means we took to circumvent or resolve these problems. Finally, I will present the equations of motion which we have derived and which may be used to simulate spherically symmetric gravitational collapse under Gauss-Bonnet gravity in n dimensions.

Randall-Sundrum Black Holes

Luke Bovard at 10:15:00 Saturday

In this talk I will discuss results derived extending the properties of extremal black holes in Randall-Sundrum gravity to arbitrary dimension.

Algebraic Analysis and Stability Study of Networks in the form of Rings

Wang Zitao at 10:30:00 Saturday

"In this report, we adopt the algebraic graph theory point of view to analyze the symmetry of the networks. In particular, we compute the automorphism groups and eigenvalue spectra of the networks. The automorphism group of the R(M, N) system is given by $\mathrm{Aut}(R(M, N)) = C2 \times DN$, where C2 is the cyclic group of order 2, DN is the dihedral group of order 2N , and the result holds regardless of its detailed configurations. The eigenvalues of R(M,N) are given by $2\cos(2i\pi) \pm 2\cos(2iM\pi)(0 \le i \le N-1)$. In addition, we did a numerical study on the stability of the networks and verified the various conclusions of R.M.May, thus extending the scope of his conclusion from random topology to fixed topology. We found that the stability of the rings are related to the spectral gap of the individual system.

X-ray spectroscopy with TRIUMF's Ion Trap for Atomic and Nuclear Science (TITAN)

Fuluny Jang at 8:30:00 Saturday

Double-beta decay is a rare radioactive decay which is a transition between two nuclei with the same mass number that changes charge by two units. TITAN-EC is an upcoming experiment at TRIUMF that will measure the electron capture branching ratio of intermediate nuclei in double-beta decay. This experiment is important for understanding of nuclear and neutrino physics. In the past, due to high backgrounds and isobaric contamination, such measurements were hard to make. TITAN-EC will be using a novel technique to overcome those difficulties by using a highly efficient low energy detectors to measure X-ray spectroscopy of ions stored in a penning trap.

Angular Bite of the DRAGON

Brian Kootte at 8:45:00 Sunday

The 3He (alpha, gamma) 7Be fusion reaction is important in understanding astrophysical processes such as solar burning and big-bang nucleosynthesis. Since measuring this reaction rate requires the DRAGON mass separator to operate near the limit of it's angular acceptance, I designed a radioactive source holder to experimentally test how the acceptance varies within the windowless gas target.

Gamma Spectroscopy

Mark Jordison at 9:00:00 Sunday

The Growth of Nano-sized Clusters in Plasma

Alexandra Pulwicki at 9:15:00 Sunday

Cluster formation and deposition has far ranging applications in catalysis, photography, nano-electronics, and thin film deposition. Their unique properties distinguish them from both bulk material and discrete molecules. This experiment used a DC magnetron sputter source to produce a beam of clusters that traveled through an aggregation chamber, through a small orifice, and was then deposited on a target plate. The effect of helium and argon gas flow on the size of silver nano-clusters created by the magnetron was examined. Using a quadrupole mass filter (QMF), the size distribution of silver clusters could be determined and the deposition rate could be measured using the quartz crystal microbalance (QCM). These methods allowed for the investigation of the formation and growth of clusters in a plasma environment created by the magnetron discharge. The clusters examined ranged between 102 and 103 atoms per cluster (about 5nm in diameter). The deposited films were then investigated to examine cluster size by using transmission electron microscopy (TEM) imaging. The project also looked at the effect of the chamber geometry on the deposition of clusters on the target. The alteration of the shape of the aggregation chamber from a cylinder to a cone resulted in a decrease in deposition yield."

Random walk of magnetic field lines in dynamical turbulence

Benson Guest at 9:30:00 Sunday

Filip Simovic at 9:45:00 Sunday

Spin Wave Dynamics in an Ultracold Bose Gas

Lydia Zajiczek at 10:00:00 Sunday

We present and study macroscopic quantum excitations called spin waves in an ultracold gas of {87}^Rb atoms. We excite these spin waves using optical potentials and observe their resultant nonlinear behaviour. These excitations can have a drastic effect on the coherence of the gas system and are described mathematically using Boltzmann transport equations. To fully understand the coherence dynamics, we give a full phase-space treatment to the spin distribution's transport equation. We observe localized collapses and revivals of coherence that depend on the strength of the optical potential.

Electrostatic lens under atmospheric pressure

Vincent Sasseville at 10:15:00 Sunday

POSTER ABSTRACTS

Dynamics of Vertically Vibrated Ball-Chain under Different Exciting Conditions

Jeremy McGibbon

A vertically vibrating ball-chain is used as a mechanical model of polymer molecules, e.g. single-stranded DNA or RNA. In this research, it is found that under varying driving force the chain motion can switch from three dimensional to quasi-two dimensional. The study of topological transformations of chains with the number of beads from 30 to 200 is discussed. High amplitudes of sinusoidal driving force with frequencies within the range 11 - 19 Hz makes the chain motion three dimensional, and spontaneous knotting and unknotting is observed, obeying the random walk theory for knots 3(subscirpt)1, 5(subscript)1, and 7(subscript)1. Survival probability for knots of these three types is experimentally found to be a universal function independent of the length of a chain and the type of a knot. Under smaller amplitudes within same range of driven frequency, the chain motion is confined to quasi-two dimensional when the chain inevitably evolves into a tight spiral over time. A transverse standing wave along the spiral structure is observed under the parametric resonance condition, with a frequency of exactly half the driven frequency. Results of study of spiral formation process and the wave pattern along the chain are reported.

The TASS Sky Survey

Julia Ahadie

"The TASS sky survey collected simultaneous V- and I- band images of northern hemisphere fields between November 11th, 2001 and November 17th, 2005. TASS represented the only continuous record of most of the hemisphere
during that time interval. As such, it is a valuable record of the behaviour of thousands of variable stars. Here we report the resurrection of this resource from 3000 CDs and DVDs. Although a few discs were completely unreadable, due to chemical alterations (due to exposure to sunlight and/or aging) and physical damage (such as scratches), about 85% of the images - raw and processed- were recovered and the data is now saved on a server and backed-up in several forms.

After recovering and organizing the data - a process that took nearly four months - world coordinate system transformations (between pixel x,y coordinates and celestial Right Ascension and Declination) were determined automatically for 120,000+ images using the ""blind"" solving capabilities of programs from astrometry.net.

In our poster, we describe the process of recovering and archiving important information about storage disk and images properties in a MySQL database and provide examples of astrophysically-interesting star's lightcurves over the data acquisition period of the survey.

Finally, we encourage everyone who considered CD-R to be a reliable archival data storage medium to read their discs onto other forms of storage media at their earliest opportunity - if that is still possible."

High-Q Microbottle Resonators Properties and Use in Cantilevers within Atomic Force Microscopy

Tyler Enright

This investigation finds a sustainable method of microbottle creation, intended for use within AFM cantilevers. As such, bottles have been made with a manual setup and with a fusion splicer set up. The results with the manual system were encouraging for further application, but the fusion splicer which used a two step creation process actually created well formed bottles reproducibly, providing a reliable source of microbottles. By using a pipette puller to create tapered fibres, a method of creating bottles with a diameter of 50 micrometres was employed. Finally, a system for testing the optical properties of these bottles was designed.

Simulation Based Search for Nanoparticle Cross-Talk

Daniel Travo

Speed dating with Arctic atmospheric satellite and ground-based measurements; who makes the best match?

Boris Pavlovic

CANDAC Outreach Project: Student-Researchers Atmospheric Collaboration

Mike Maurice

"The Canadian Network for the Detection of Atmospheric Change (CANDAC) is a group of university researchers who strive to improve the state of observational atmosphere research and education in Canada. Our team has been measuring the Arctic atmosphere from the Polar Environment Atmospheric Research Laboratory (PEARL), located in Eureka, Nunavut, since 2005. The CANDAC outreach program provides students and researchers the opportunity to meet and then engage in relevant atmospheric science education. Our outreach team aims to help students make connections between the science curriculum they are learning and the research being conducted at PEARL and across Canada, and to gain an understanding of its relevance to their society and their environment. Hands-on activities, interactive demonstrations, and thought-provoking presentations have been effective modes for engaging students in a range of grades.

Since our school visits have been well-received by students and teachers in Nunavut and Southern Ontario, we decided to offer a new project concept that enabled students to become co-investigators in atmospheric research. Students at Qarmartalik School in Resolute Bay, Nunavut, and Pickering College in New-

market, Ontario had the opportunity to gather data and conduct inquiry-based investigations about current atmospheric conditions using instruments located at their own school. The program aimed to meet the following goals: Provide students the opportunity to collect scientific data on their local environment with a focus on the atmosphere; allow students to share their ideas and collaborate with other students and scientists through the Internet and telecommunications; and promote dialogue about and understanding of atmospheric science and its contributions to global environmental issues.

A pilot project was launched at two schools and then assessed on its successes and areas of potential improvement. The results of the atmospheric measurement project will be discussed and displayed pictorially. A brief history of Resolute Bay, NU, as well as select pictures from the outreach trips in March and May 2011 will be presented to provide a more complete picture of education in the North.

Pulsar Population Synthesis of the Large Magellanic Cloud

Hugo Ferretti

Fabrication of Locally Deformed Tapered Nanofibers

Matthew Mitchell

A tunable tapered amplifier laser for spin wave research

Kelsey Allen

A high-power tunable laser based on a tapered amplifier in an external cavity is presented. This system uses a tapered semiconductor amplifier to achieve output powers greater than 400 mW. It is tuneable over a range of 20 nm centred at 775 nm, and the linewidth of the output light is less than 10 MHz on average. Therefore it has enormous potential for applications at unconventional wavelengths where high output power is desired.

A Discussion on the BRDF of Turf

Michael Boyko

"Using a goniometer and an imaging spectrometer the bi-directional reflectance distribution function (BRDF) of a turfgrass sample was measured. Measurements were taken 360 degrees around the turf, using incoming light zenith angles of 7.5, 15, 30, and 45 degrees from nadir, and having the turf positioned parallel to the ground (flat). The turf was then pitched and several more measurements at various angles were taken. Using the data from the measurements taken while the turf was flat, polar graphs of the BRDF were made, and their characteristics studied. This showed that the BRDF changed with the incoming light zenith.

This trend was then compared to the pitched data to see if it could be related to the flat measurements. It was hoped that by relating the two sets of data it could be shown that an angular model of the surface could be reversed. Due to a lack of data this could not be totally verified. Although using this research as a starting point, it should be possible to achieve the desired results upon the completion of more testing. This may lead to the possibility of determining the angle of a surface using hyperspectral images given sufficient BRDF characterization.

Hydrogen interaction with the chemical vapor deposition of disilane on Si(100)

Perrine Mathieu

"The effect of the presence of hydrogen on the adsorption of disilane (Si_2H_6) on a Si(100) surface was studied by exposing the sample to atomic Hydrogen at 600 K for different lengths of time followed by disilane exposures at 173K. The experiments were performed in Ultra High Vacuum and Fourier Transform Infra-red Spectroscopy was used to identify the species present on the Si surface. It was first found, on a CZ sample, that increasing the hydrogen exposure time decreased the following disilane adsorption on the surface. Issues in the reproducibility of the experiments due to roughening of the sample and an inability to recover the initial clean surface after a sample flash to 1173 K led to performing only one experiment per sample. This revealed that the hydrogen on the surface before disilane exposures maintained the Si_2H_5 configuration on the surface, diminishing the decomposition into Si_2H_4. It was finally found that the roughening was caused by a carbon migration to the surface of the CZ-Si(100) surface viewed using an Atomic Force Microscope which does not occur using FZ-Si(100)."

Synthesis, characterization and comparison of Lu2V2O7 and LuVO4 single crystals grown by the Floating Zone and Travelling Floating Zone method

Casey Marjerrison

Using the Floating Zone method with oxidizing conditions, single crystals of LuVO4 were obtained with a valence of +5 on the vanadium. Synthesizing single crystals of Lu2V2O7 required non-oxidizing or reducing conditions to maintain the valence of +4 on the vanadium obtained during the ceramic preparation. Different magnetic and physical properties emerge from this difference in valence.

Magnetic Contribution to Heat Capacity and Magnetic Entropy of (Erx Y1-x)2Ti2O7

John Niven

"A pyrochlore is a compound whose structure is composed of corner-sharing tetrahedra with the general formula A2B2O7, where A and B are rare earth

transition metals. Erbium titanate (Er2Ti2O7) and yttrium titanate (Y2Ti2O7) are two pyrochlores with similar lattice structures.

Er2Ti2O7 suffers from geometric frustration and is antiferromagnetic below the Néel temperature (TN = 1.173 K). Above TN, Er2Ti2O7 undergoes a magnetic phase transition to a paramagnetic phase. This phase transition can be demonstrated experimentally by observing a peak in the heat capacity curve of Er2Ti2O7 at TN. Y2Ti2O7, however, is diamagnetic at all temperatures and therefore provides a model for the lattice contribution to the heat capacity of Er2Ti2O7.

The structural similarity between Er2Ti2O7 and Y2Ti2O7 makes it possible to create a mixed pyrochlore structure where antiferromagnetic Er+3 ions are substituted with diamagnetic Y+3 ions to create a series of compounds with the formula (ErxY1-x)2Ti2O7. The magnetic heat capacity of (ErxY1-x)2Ti2O7 has been used to deduce the magnetic entropy as a function of x, temperature and magnetic field strength."

Quantum Calculations using the Grid-based projector-augmented wave method

Mercedes Martinson

Density functional theory is used to model many body problems and explore the ground state electronic structure of atoms and molecules. GPAW uses real-space uniform grids and multigrids to represent pseudo wave functions, pseudo electron densities and potentials. As a preliminary introduction to the software, calculations of simple molecules were performed and compared with known experimental results.

Reverse Monte Carlo Modelling of Amorphous Germanium

Lukas Stille

Hydrogen interaction with the chemical vapor deposition of disilane on Si(100)

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Probing the transitive properties of glass in the ultraviolet range using the photoelectric effect

Deborah Chung

"We explore the transitive properties of glass in the ultraviolet range of the electromagnetic spectrum. Using the photoelectric effect, we measure the intensity and kinetic energy of photoelectrons emitted after ultraviolet light has been passed through glass. Light intensity was measured using photocurrent and was found to vary linearly with frequency. Stopping potential also varied linearly with frequency until a steep drop at 340 nm. These results show that glass did not affect the energy of ultraviolet light but did affect the intensity. The photoelectric effect allows light intensity and energy to be examined separately. This technique could be adapted to determine the transitive properties of other materials. This could help determine the appropriate materials for cases requiring ultraviolet shielding. (This was an adaptation of an experiment done for class, put together over 3 weeks, both for course credit.)"

Probing the transitive properties of glass in the ultraviolet range using the photoelectric effect

Aaron Swanbergson

The effects of Irradiation on brain anatomy in mouse pups

Kyle Cormier

Design and construction of light guides for a compact SiPM based PET detector

Eric Berg

A possible alternative to photomultiplier tubes (PMTs) for nuclear medicine imaging applications such as positron emission tomography (PET) are solid-state based silicon photomultiplier (SiPM) detectors. One of the main advantages of SiPM detectors is their insensitivity to magnetic fields creating applications for their use in multimodality imaging involving magnetic resonance (MR) such as PET-MR imaging. Preliminary investigations of SiPM detectors used with a pixelated dual-layer scintillator crystal array shows good crystal resolution in the central area of the SiPM detector while poor resolution in the corners and edges of the detector surface. This work investigates using a custom made light guide in order to improve the resolution in the corners of the detector by redirecting the scintillation light generated in the crystal. A light guide is presented which shows improvement in corner resolution while maintaining good overall resolution. The effects on energy resolution,

photo peak voltage and timing resolution of the detector when a light guide is used are discussed.

A single-multiplexing network for a silicon photomultiplier-based PET detector

Megan McClarty

As a functional medical imaging procedure, Positron Emission Tomography (PET) has proven to be an invaluable tool in diagnostic medicine, especially in the area of oncology. But PET has a weakness: it does not provide significantly detailed anatomical information. The development of a combined PET/MR system would be ideal for rectifying this deficiency, but is not without its challenges, most notably the severe performance degradation which traditional PMT detectors experience in the strong magnetic field of an MR system. Silicon photomultiplier detectors show great promise as a replacement for PMTs. The optimization of the resistive signal-multiplexing network for a 4x4 SiPM Array significantly improves image resolution, energy resolution and timing results, and therefore the viability of this detector setup as a magnetic field-insensitive alternative to PMT detectors.

Prairie Isotope Production Enterprise: New Methods to Produce Tc-99m

Jared Wiebe

Laser-Based Identification of Bacteria using Discriminant Function Analysis

Khadija Skeikh

Laser-induced breakdown spectroscopy (LIBS) proposes a real time way to detect and identify harmful pathogens in clinical samples on the basis of their atomic composition. During the process of LIBS, a quick laser pulse ablates a bacterial target into its atomic components. As the sample cools, the atoms present in the sample emit photons via spontaneous emission. The particular emission lines, produced by the sample, only emit from those elements present in the bacteria and produce a spectrum. Multiple spectra can be collected for a variety of bacterial samples and the differences between them can be used to differentiate between samples. Using the chemometric technique of discriminant function analysis (DFA), each LIBS spectrum can be classified. We explore the setback of sample contamination to see the outcome of the presence of a contaminant on laser-based identification of the primary pathogen.

High-frequency ultrasound backscatter from single cells and microbubbles

Avery Raess

"High-frequency ultrasound (HFU) has shown great potential in detecting the cells' response to chemotherapeutic drugs non-invasively. This is due to the change in ultrasound scattering caused by structural changes during cell death. Moreover, HFU has been used as a molecular imaging modality when used with targeted microbubbles to improve imaging of cancer in vivo. Understanding the interaction of the ultrasound waves with micron sized objects such as cells and microbubbles is important for the further development of these imaging methods. A novel technique was developed in order to determine the efficacy of high-frequency ultrasound in detecting the structural changes associated with cell death (apoptosis) in single AML cells to understand scattering at the single-cell level. The same methodology was used to examine ultrasound scattering from microbubbles to confirm theoretical models of microbubble scattering, either in isolation or attached to single cells. A XenoWorks micromanipulation system was used to position and move glass pipettes made with a Sutter P-97 micropipette puller in order to manipulate individual cells. An Olympus IX71 inverted microscope and CCD camera were used to visualize the cell optically while 25 and 55 MHz transducers and a VEVO 770 ultrasound imaging device were used to image the same cell ultrasonically. Cells were treated with the chemotherapeutic agent cisplatin 24 hours before imaging to induce apoptosis. AML and human umbilical vein endothelial cells (HUVEC-C) cells were exposed to Artenga and Vivistar Integrin microbubbles, respectively.

It was found that there was approximately a 5 dB decrease in ultrasound backscatter for cells undergoing apoptosis (using a 25 MHz transducer) while there was a 0-3 dB increase in backscatter for those cells undergoing apoptosis (using a 55 MHz transducer). Microbubbles attached to cells caused a 3 dB increase in backscatter intensity compared to single cells without microbubbles, whereas the bubbles alone exhibited a backscatter intensity approximately 25 dB larger than the cells alone.

A decrease in backscatter from single cells undergoing apoptosis is contrary to the experimental findings of a large increase in scattering when cells undergoing apoptosis are organized in highly packed cellular aggregates, as in tumors. In these cellular aggregates the dominant scattering structure may be the nucleus of the cell, while when imaging single cells the greatest scattering structure may be the entire cell. Other variables such as the cell size and phase of cell cycle were not controlled and may introduce variability into the results. The microbubble results suggest that microbubble scattering substantially decreased when the microbubbles are attached to cells compared to free microbubbles. In these experiments, the number of microbubbles attached to each cell was not controlled and may introduce variability. For future studies the number of microbubbles attached to each cell, cell size and phase of the cell cycle should be controlled in order to reduce variability in single cell

backscatter experiments."

DNA Methylation Mapping in Nanochannels

Jaan Altosaar

Methylation of DNA silences genes and is crucial in cancer pathogenesis. This technique for detecting methylation patterns of DNA uses methyl binding domain protein fused with green fluorescent protein (MBD-GFP) - a recombinant protein which binds to methyl groups on DNA. The MBD-GFP bound methylated DNA is stretched via molecular combing on silanized coverslips, and its fluorescence pattern is compared to a prediction. This information about gene silencing will be combined with a sequence barcode to align the methylation map to the genome.

A Simple Landmark Registration Method for Multimodal Imaging

Leah Schellenbeg

Multimodality imaging is the process of finding the optimal geometric transformation between two images. A landmark registration method was used to overlay images taken from a portable rat bed from PET and MRI machines by minimizing the distances between the fixed fiducial points on its surface. It works well in simulation but has not yet been tested in vivo.

A Spatial Model of Chemotaxins in Respiratory Infections

Morgan Mercredi

Chemotaxis is the directed movement of cells based upon the chemicals in their environment. For example, a certain type of bacteria could be attracted towards a higher concentration of a chemical. In the human body, certain chemicals released at the site of an infection can recruit leukocytes in the blood to aid in the fight against the infection. Parts of this immune response can be mathematically modeled using sets of equations and then studied with computer simulations. This can potentially allow insight into how a disease spreads, or could possibly be prevented from progressing.

Optimization of 8Li Production and Transport

Nicholas Macsai

String Dualities and Topological Recursion

Andrei Catuneanu

Topological string theory is a theory of maps from Riemann surfaces to a target space. The theory defines fundamental topological invariants of the target space called Gromov-Witten invariants. The "remodeling conjecture" postulates that when the target space is a toric Calabi-Yau threefold, the generating functions for its Gromov-Witten invariants are given by the Eynard-Orantin topological recursion. The conjecture is motivated by a string duality known as mirror symmetry. In the case that the target space is C3, we demonstrated that the free energies computed with the Eynard-Orantin topological recursion reproduce precisely the Gromov-Witten invariants of C3.

Unravelling Entanglement: The Geometric Measure

James Roberts

In the standard geometric approach, the entanglement of a pure state is sin^2(θ), where θ is the angle between the entangled state and the closest separable state of products of normalised qubit states. We consider here a generalisation of this notion by considering separable states that consist of products of unnormalised states of different dimension. The distance between the target entangled state and the closest unnormalised product state can be interpreted as a measure of the entanglement of the target state. The components of the closest product state and its norm have an interpretation in terms of, respectively, the eigenvectors and eigenvalues of the reduced density matrices arising in the Schmidt decomposition of the state vector. For several cases where the target state has a large degree of symmetry, we solve the system of equations analytically, and look specifically at the limit where the number of qubits is large.

Fabrication of Locally Deformed Tapered Nanofibers

Matthew Mitchell

Photonic structures such as silicon microdisks and nanowire cavities are the topic of intense investigation. In order to observe how light fields propagate in such structures it is essential that the near field of these structures be measured, one such method of achieving this is by using a near field probe. An example of a near field probe is a tapered nanofibre; here a standard single mode telecom fibre optic fibre is heated and pulled to create a subwavelength diameter section along the fibre. Using this tapered region, which is typically a few hundred nanometres in diameter, we are able to couple laser light through the fibre and ultimately into the photonic device we wish to investigate. By locally deforming these tapered nanofibres it is possible to make a small bend or "dimple" in the centre of the tapered region. This local deformation then acts as a probe tip much like an oscilloscope probe. Tapered fibres' also allow efficient coherent excitation and collection, which can allow more sensitive detection of resonances than incoherent nanophotonic spectroscopy methods. I have developed an apparatus that is able to pull low loss tapered nanofibres consistently, through the use of a ceramic microheater. This setup can also be used to create the aforementioned locally deformed tapered fibres for application in the testing of photonic lightwave circuits.

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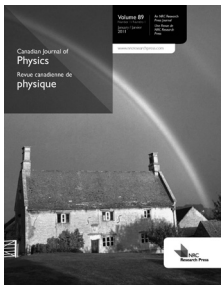

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