Message from the Chair

This is our fifth annual issue since we began distributing newsletters in 2002. We hope that you are enjoying learning about new developments and research in the department, and about the activities of graduates new and old. Rather than rely entirely on newsletters, we are now planning an Alumni Reunion as described on page 7, the event will take place on June 7, 2008, and will emphasize social functions where we can renew old acquaintances and make new friends. In addition to the alumni, we expect many of our very active group of Professors Emeritus, current faculty and students, to attend.

In this edition, we introduce a number of people with whom you can get better acquainted at the Alumni Event. These include four new faculty members whose backgrounds in Asia, Europe, the United States and Canada are as diverse as their research, which spans topics from the quantum physics of ultracold atoms to the observation of dark matter in the universe. You will have a chance to talk with our continuing faculty about their award winning research in exotic magnetic systems, clusters of the oldest stars, and the crystallization of polymers (see page 6). Perhaps the most inspiring of all are the outstanding group of undergraduate and graduate students in the department: in the past year students from Physics & Astronomy have won both the Governor General’s Gold and Silver Medals.

McMaster University itself has likely undergone substantial changes since you were last here. Did you know that the current undergraduate enrollment is about 20,000 students? Interested participants will have ample opportunity to see the campus with its new Student Centre and Athletic Centre, as well as the newly renovated undergraduate and research laboratories within the Physics & Astronomy.

More details concerning our Alumni Reunion will soon be forthcoming. I look forward to seeing you here at McMaster next June!

With best wishes,
David Venus
Professor and Chair

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Faculty Profiles

Duncan O’Dell

I was born in Chester in England. My father was a polymer chemist, but after an episode where he invented spray-on clothes that wouldn’t come off he joined an oil company and set off around the world with my mother and me in tow. From age 10 my favourite subject at school was physics, but probably because of my father’s influence I went to Imperial College in London to study chemistry. However, after one semester I read the chapter on Time’s Arrow in Penrose’s ‘The Emperor’s New Mind’ and promptly swapped to physics. At Imperial many of the professors were particle physicists, and I graduated with the impression that physics was solely about discovering the fundamental laws. That changed when I began my PhD with Michael Berry at the University of Bristol. He is a mathematical physicist who defines his interests as ‘physical asymptotics’, e.g. how does one more fundamental theory evolve into another as some parameter becomes very large or small? Are there singularities or emergent phenomena? Towards the end of my PhD Bose-Einstein condensation was observed in trapped atomic gases. BEC is an example of macroscopic quantum mechanics and I wanted to learn all about it. I also wanted to go somewhere sunny. So I headed to the Weizmann Institute in Israel and had a fascinating experience both scientifically and culturally, as well as meeting my future wife (Cecile Fradin). Next I took up a fellowship at the University of Sussex that also allowed me to spend one year with Allan Griffin at the U of T.

Since arriving at McMaster in January I have continued to work on ultracold atoms which are simple systems in which to study quantum physics. In the future I want to focus on open systems and measurement theory since these are the outstanding problems in quantum mechanics. Life is changing rapidly: I have a private office and am responsible for students’ education and sit on 4 committees. We bought a house in July and a canoe in August. And Cecile and I are due to have a baby in late October. The only reason I have to believe that I can survive being a junior faculty member is that all my new colleagues have been through it and they are still smiling!

Sung-Sik Lee

I was born in a small town called Umsung located in the central region of South Korea. My parents had a passion for education, but they have always supported me in whatever I’ve done, except when I tried to quit my undergraduate study to become a monk. I thought that I should empty myself to acquire real freedom, but I came back to school after my father pointed out that I was filled with the very idea that I had to empty myself.

Despite some failed attempts to digress, I have always loved physics. I attended the Korean Institute of Science and Technology for my undergraduate study. During those years, I preferred to spend time thinking about things rather than simply learning what I was taught. I moved to the Pohang University of Science and Technology to pursue graduate study on classical nonlinear dynamics and chaos, but after taking a course on quantum field theory, I realized that there are richer structures in the quantum world, and I switched to studying quantum many-body physics for my PhD.

Upon finishing my PhD thesis, I had to leave school for more than two years to fulfill my military duty, because I failed in an exam in English and history, which hundreds of other graduate students passed, which would have exempted me from that duty. During “military” service, I worked in a city hall and spent my free time reading books on areas of physics that I had not had the chance to study before, such as gravity and string theory.

In 2004, I came to the United States to do postdoctoral work at MIT and at the Kavli Institute for Theoretical Physics in Santa Barbara. In the summer of 2007 I joined McMaster University. Currently, I am in love with the idea that various principles which we believed to be fundamental in our own universe, such as gauge symmetries, supersymmetry and general relativity, can dynamically emerge from condensed matter systems which have very simple microscopic rules.
I was born in New Haven and raised in Rochester NY, just down the road from Hamilton. My parents were biologists, and my father worked on the Viking Lander project for NASA. He introduced me to science fiction and astronomy when I was in middle school. Five years later I entered the University of Rochester as a physics major, with a concentration in astrophysics. There I developed an enthusiasm for theoretical astrophysics and met my wife, also a physics major. We married after graduation and went on to graduate school in Boston. There I studied theoretical cosmology with William Press and did my thesis on linear and weakly nonlinear effects in the evolution of cosmological perturbations. After getting our doctorates, we moved, first to New Jersey, where I worked on galaxy formation with J.P. Ostriker, and then to Texas where we joined the faculty of The University of Texas at Austin.

While at Texas I worked on a variety of problems in cosmology, including the generation of secondary perturbations in the cosmic microwave background. My work on galaxy formation also led to an interest in the dynamics of shock waves and their instabilities. I discovered a series of linear and nonlinear instabilities that cause strongly cooling shock waves to develop ripples, and even break up into fragments. Later, I became interested in the dynamics of accretion disks and the nature of accretion disk dynamos. Nine years ago we moved to Johns Hopkins University in Baltimore. At the same time I agreed to become a Science Editor for The Astrophysical Journal, the leading international journal in its field. More recently I became the Editor-in-Chief for this journal. While at Johns Hopkins I became increasingly interested in basic issues in magnetized turbulence, including magnetic reconnection, the fundamental theory of astrophysical dynamos, and the dynamics of strong magnetized turbulence. I continue to be interested in these topics and their application to astrophysical problems.

My first exposure to modern physics and astronomy came during my two-year adventure at the Lester B. Pearson United World College of the Pacific just outside of Victoria, B.C. We studied standard high school physics as well as relativity, quantum mechanics and cosmology. There is a telescope on campus and I was fortunate that my time there happened to coincide with the appearance of two spectacular comets (Hale-Bopp and Hyakutake).

After the intimate setting of Pearson College, I opted to attend the small, liberal arts university Mount Allison. It was during this time that my interest in physics solidified and that I had my first exposure to observational research projects. I spent a couple of nights observing at the Dominion Astrophysical Observatory in Victoria and I spent many long nights in Fundy National Park in New Brunswick monitoring thousands of stars in the hunt for small clumps of dark matter. In the end we found more bats than dark matter, but I was hooked on observational astronomy. After I finished my undergrad I headed to NASA-Ames in California to participate in a summer Astrobiology program.

I continued studying astrophysics at graduate school, focusing on observational cosmology. My Ph.D. at the University of Waterloo involved studying the dark matter distribution of galaxies and groups of galaxies using gravitational lensing. In order to work on these topics I have joined large survey projects that allow me access to enormous, high-quality data sets collected from the best ground- and space-based observatories. I continued observational cosmology work as a post-doctoral fellow at the European Southern Observatory in Germany, where I became interested in astronomy at wavelengths outside of the visible and became involved in the next generation of survey projects.

These large surveys are trying to address some of the fundamental questions of cosmology, including: How much dark matter is there in the Universe? How is this matter distributed? How much dark energy is there, and what is its nature? How do galaxies form and evolve? This is an exciting time to be an astrophysicist, and I am very pleased to be joining the astronomy group at McMaster where I will continue to pursue answers to these questions.
**Graduate Profile**

I came to McMaster University to study astrophysics after finishing a Physics undergrad degree at the University of Waterloo. After completion of my Master’s degree under the supervision of Dr. William Harris, I continued at McMaster to work on a PhD, focusing on the formation of giant elliptical galaxies. My experience at McMaster has been prosperous in many aspects. I have recently received a three year NSERC scholarship, and have been given many opportunities to present my work at Canadian as well as numerous international conferences in the USA, Australia, and Chile. These opportunities have allowed me to make international research collaborations, broadening my research interests and employment possibilities in the future. In the last year, I have also received the best graduate student oral presentation at the Canadian Astronomical Society (CASCA) meeting from the Graduate Student Committee. The Physics and Astronomy department at McMaster, I believe, is like no other in Canada. The diversity of its members, the opportunities for outreach, as well as the social aspect of this department is very welcoming. I especially enjoy the athletic teams that this department is involved in, most particularly the softball and ultimate frisbee teams.

**Undergraduate Profile**

As a native Hamiltonian, I was familiar with McMaster University from a young age. My interest in Physics was initially piqued in high school by a very enthusiastic teacher of mine and my first year in science at McMaster solidified this interest and created a strong desired to learn more about how the world around me works. Currently, I am completing my fourth and final year of my undergraduate degree. During the past few years, I have had the opportunity to become very involved in the Physics Department. I spent the past two summers working for Dr. Bruce Gaulin in the crystal growth lab. During this time I also traveled to sites such as Chalk River Laboratories in northern Ontario and the NIST Center for Neutron Research in Maryland as a part of neutron scattering experiments. I have also been fortunate enough to present my research at the Canadian Undergraduate Physics Conference (CUPC) hosted by the University of New Brunswick and this fall I will travel to Vancouver as CUPC is hosted by Simon Fraser University. I am also a part of MUPS, the McMaster Undergraduate Physics Society, as VP Academic. The Department of Physics and Astronomy here at McMaster has provided an excellent and supportive learning environment, one which I am proud to be a part of.

**Special Announcements:**

**Norman Glendenning** was awarded the 2006 McMaster University Distinguished Alumni Award for the Sciences at the Fall Convocation. Dr. Glendenning graduated from McMaster University with both Bachelor’s and Master’s degrees in physics in 1954 and 1955, respectively. Dr. Glendenning is an internationally recognized scientist in the area of nuclear physics, particle physics, nuclear astrophysics and cosmology.

(From left: Martin Johns, David Venus, Mel Preton and Norman Glendenning)

**Faculty Awards**

**Kari Dalnoki-Veress**, associate professor and associate chair, has been awarded the 2008 John H. Dillon Medal of the American Physical Society. This medal was established by the Division of Polymer Physics in 1983 “to recognize
outstanding research accomplishments by young polymer physicists who have demonstrated exceptional research promise early in their careers” (10 years or less since PhD).
The citation for Kari’s medal will be “For significant and innovative experiments in glass formation and polymer crystallization at the nanoscale.” He will address the Division of Polymer Physics in a Medal Lecture at the 2008 APS March Meeting. Congratulations to Kari on being awarded this prestigious international medal. As well, a special reception for Kari will be held at the March A.P.S. meeting.

Kari-Dalnoki-Veress

Two Department of Physics & Astronomy professors, Bruce Gaulin and Bill Harris, have received Killam Research Fellowships that will enable them to devote two years to full-time research. Bruce Gaulin’s research focus is Neutron Scattering of Exotic Magnetic Ground States in New Materials and Bill Harris’ area of expertise is The Formation and Early Evolution of Giant Galaxies. McMaster is the only university to receive two Killam Research Fellowships this year. Bruce and Bill join Cliff Burgess, professor, subatomic physics, to make three fellowships awarded to members of the department in the last two years.

Bruce Gaulin

Bill Harris

Dr. Hugh Couchman, Professor of Physics and Astronomy, is also the Scientific Director of SHARCNET. SHARCNET was thrilled to be a recipient of a national award at the Canadian Information Productivity Awards (CIPA). CIPA is Canada’s highest-prestige and longest-running IT awards program which recognizes Canadian organizations for their innovative use of technology. SHARCNET was selected as a Silver Award of Excellence winner for Efficiency and Operational Improvements in the not-for-profit category based on an entry which outlined its use of high performance computing technology over an advanced fibre optics network.

Congratulations to Ralph Pudritz for receiving the 2006 Hamilton Spectator Publisher’s Education Award for his dedication and contribution to community education. Through the Origins Institute and the public lectures, Dr. Pudritz has brought renowned international speakers to McMaster University filling lecture rooms of more than 500 people.

Ralph Pudritz

Student Awards

Congratulations are in order for Sara Cormier and Rob Welch as they were awarded third and first place respectively for their talks at the recent 43rd annual Canadian Undergraduate Physics Conference held this year in Vancouver. Sara, in second year and currently supervised by Kari Dalnoki-Veress, won for her talk “Ellipsometry investigations of a morphological transition in thin diblock copolymer films” and Rob Welch, supervised this summer by Kari and now studying at the University of Toronto, won for his talk entitled “Plateau-Rayleigh instability as a probe for the mechanical properties of confined thin polymer films”.

Michael Massa graduated in 2006 from our Ph.D. program, supervised by Kari Dalnoki-Veress, has been awarded the 2006-2007 Governor General’s Academic Gold Medal. The Governor General’s Academic Gold Medal is awarded to the graduate student who achieves the highest academic standing in his/her graduate degree program.

Graduating student Matt Farrar received the Governor General’s Academic Silver Medal as well as his bachelor’s degree at the spring 2007 Faculty of Science Convocation. The Silver Medal is awarded to the undergraduate who achieves the highest academic standing upon graduation from a bachelor degree program.

The 2005-2006 Jim Waddington Prize in Physics and Astronomy was awarded to Corry Treen, who achieved the highest standing in Physics 1BA3, is currently in Level 3 Honours Physics and is doing a minor in Geophysics.

Alumni - Where are they now?

Chris Ouellet (Ph.D. 2007) has accepted a postdoc position in the Department of Physics and Astronomy at McMaster University.
Research News:

Time-Reversal Symmetry Breaking in an Unconventional Superconductor

by John Berlinsky

Superconductivity results from attractive interactions which bind electrons into so-called Cooper pairs (named after Leon Cooper, the Cooper in the Bardeen-Cooper-Schrieffer BCS theory of superconductivity). Conventional superconductors exhibit “S-wave superconductivity,” which means that the wave function of each Cooper pair looks like a ball. In a more exotic kind of superconductivity, called P-wave, the Cooper pair wave function looks like a barbell, which can be oriented in some direction or which, in certain cases, can spin about its centre of mass. If all the barbells spin in the same direction, this collective spinning breaks time reversal symmetry (since reversing time would reverse the direction of spinning).

A small region of spinning Cooper pairs has a surface current flowing around its edge which creates a local magnetic field that can be detected by magnetic resonance techniques. Graeme Luke (now at McMaster) and his collaborators were the first to detect such local fields using Muon spin resonance, in the superconducting state of a material called Strontium Ruthenate (Sr2RuO4) which they then associated with time-reversal symmetry breaking. Other experiments later provided supporting evidence that Sr2RuO4 is indeed a P-wave superconductor with broken time-reversal symmetry.

If small regions of spinning Cooper pairs produce boundary currents, then large regions should produce macroscopic currents flowing around the edge of a sample. Kathryn Moler of Stanford and John Kirtley of IBM searched for these surface currents using scanning probe methods and found no evidence for them. Working together with Catherine Kallin of McMaster, they were able to place very small bounds on the size of the currents – much lower than predicted by theory. The absence of these currents contradicts the interpretation of a large body of experimental results and has called into question our understanding of P-wave superconductivity in Sr2RuO4.

In order to better understand what is happening, Kallin and Moler have organized a special “Rapid Response Miniprogram” to take place in December at the Kavli Institute for Theoretical Physics, co-sponsored by the Canadian Institute for Advanced Research, where about three dozen experts from around the world will meet to discuss both experiment and theory of time-reversal symmetry breaking in this fascinating unconventional superconductor. It is hoped that the discussions and results presented at this workshop will help clear up the mystery of the missing surface currents or at least suggest new experiments and calculations that will shed light on this mystery.

To learn more about this workshop, see http://www.itp.ucsb.edu/activities/auto2/?id=943.

Alumni Reunion

The first ever Physics & Astronomy Alumni Reunion is now being planned for Saturday, June 7, 2008. The reunion will involve some of our oldest and most prominent grads as well as our newest – the Class of 2008.

Also invited are their professors, present and retired, the most senior being Martin Johns who himself graduated from the department in 1933 and who was the mentor of another grad who hopes to attend, Russell Donnelly, of the University of Oregon. This year Russell has been busy producing a PBS special, “Absolute Zero: four hundred years of thermodynamics made easy.” Other prominent grads include a president of the Universities of California, the Director of the Reactor at NIST, the Director of the Oak Ridge National Laboratories, the Chair of Princeton’s Astronomy Department, and many faculty, department chairs and deans from across Canada and around the world. Hope to see all of you here in June. Maybe we can get a peek at Absolute Zero.

Although the activities are not yet decided, the emphasis will be on social networking – introducing different generations of Mac P&A grads and faculty from across the decades to each other. However one event which is likely to happen is a showing of the 3D movie, “Our Sun – What a Star!” produced at the University of Swinburne with an introduction to 3D movies produced at McMaster, in McMaster’s new 3D theater. Other activities may include a tour of modern first year physics labs, of the physics department, and of our research labs. The day will be capped off with an elegant dinner at the McMaster University Club featuring a selection of outstanding Ontario wines.

At this time we would welcome expressions of interest, questions, and suggestions for the Reunion. Just e-mail us at physics@mcmaster.ca.

Alumni - Where are they now?

Mike Reid (Ph.D. 2004) as of January 1, 2008 he will have a Contractually Limited Appointment as an Assistant Professor in the Department of Physics and Astronomy at McMaster University.
Donations to Physics & Astronomy
Undergraduate Scholarships

One of the distinctive strengths of the department is the quality of our undergraduate students. We go to great lengths to recruit these students and go out of our way to offer them the most stimulating and challenging educational and research opportunities that we can provide. The key to recruitment is to identify talented physics and astronomy students in first year and to coax them into our programs. In particular we focus on students who get at least one A+ in a first year physics course. We coax them with scholarships if they enter one of our second year honours programs, and we offer them summer research jobs. One of the scholarships, the Jim Waddington Prize, goes to the top student in second semester physics who then enters our program. The first Waddington Prize winner, Emma Mazurek, is featured in this newsletter. This special award is in addition to the scholarship that A+ students receive. As students progress through our programs, they continue to do research in the summers, and, in their 4th year they do a senior thesis under the supervision of a faculty member.

The students who emerge from this program are extremely bright and exceedingly well-prepared for a career in Physics or Astronomy or any other field that makes use of their high-level scientific and mathematical skills. This training is resource intensive, particularly the scholarships, and the department relies on two endowed funds to maintain this support, the Jim Waddington Fund and the Martin Johns Fund. Since our program is still expanding and departmental budgets are shrinking, it is important to keep these funds growing. If you would like to support the undergraduate program, please consider contributing to one of these funds, and if you would like to meet some of these great students, come to the Reunion next spring. They’ll be there.

2007 Graduating Class

On Thursday, April 2006, the graduates organized a special celebration in the Dining Room of the University Club where family, friends, professors and staff all joined in the celebration of their graduation.


Front Row: Dustin Crispo, Jesse Rogerson, Kathleen Capriotti, Tom Fazekas, Christopher Acconcia.
I wish to support The Jim Waddington Prize in Physics & Astronomy (see previous page for more info).

With my gift of $ ____________ enclosed or

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