



Department of Physics and Astronomy

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Department of Physics and Astronomy

Message from the Chair



John Berlinsky

the ISAC facility at TRIUMF. He is also a former Director of the McMaster Accelerator Laboratory. However Jim will likely be remembered by many of the readers of this newsletter as one of their best professors.

In 2003 Jim's superb teaching record led to his receiving the President's Award for Excellence in Instruction which recognized the fact that he had established himself as the best teacher in Physics & Astronomy over a period of 33 years. Jim has been an inspiration to generations of students. He believes strongly in involving undergraduate students in research, and many of the students whom he supervised have gone on to pursue successful careers in Physics. Jim continues his involvement in the department's teaching through his participation in the new "Big Questions" courses for which he will have administrative responsibility over the next few years. He also plans to remain active in research.

In honour of Jim Waddington's retirement, the department has decided to establish a prize which will be called "The Jim Waddington Prize in Physics & Astronomy." This prize will be awarded each year to the student with the best performance in Physics 1BA3 who then enters an Honours Program in Physics or Astronomy. The rationale for creating this award is as follows: One of Jim's main teaching assignments in recent years was Physics 1BA3, the second semester of Physics for 1st year students who are heading toward the physical sciences. This course is a gateway into Honours Physics & Astronomy, and Jim has acted as a beacon,

The department already raised a significant amount toward endowing this prize from colleagues and friends in advance of Jim's retirement party on January 27, 2004. However, the hope is to raise sufficient funds (at least \$12,500) so that the prize can be elevated to become an endowed scholarship of \$500 per annum. We would be delighted if those of you who were students of Jim or who just want to support the training of new physicists would contribute to this endowment fund. Contributions are tax-deductible, and a tax receipt will be issued. Just to make things easy, we have printed a pledge form on the back of this newsletter.

This third issue of our newsletter continues the introduction of faculty, students and post-docs and the announcement of recent major grants and awards. Of particular interest are the Polanyi Prize awarded to Cecile Fradin and the Tier I Canada Research Chair received by Catherine Kallin. The passing of Nobel Laureate and inventor of inelastic neutron scattering, Bertram Brockhouse, occurred one day before the announcement of the International CFI Project on Neutron Scattering at the Spallation Neutron Source at Oak Ridge, Tennessee, led by Bruce Gaulin of McMaster. Another large-scale CFI project, ALMA, involves faculty member Christine Wilson as Canadian Project Scientist. Finally, there is a feature article about a new initiative in the Faculty of Science, the Origins Institute, led by Ralph Pudritz of our department. I hope you enjoy the issue.

With best wishes,
John Berlinsky
Professor and Chair
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New Faculty Profiles



Alan Chen

I was born in Kingston and seven years later, my family moved to Natal, Brazil, where I stayed until I finished high school. I took my first physics course in grade 10. My math skills were reasonably good, but I struggled at first to grasp the connections between mathematics and a quantitative description of natural phenomena. Thanks to some much-needed remedial lessons given to me by my father - lessons that I detested at the time - physics eventually began to click for me, as I finally figured out when the second train would catch up with the one that had left earlier, etc. At the time, athletics was my first passion, and I was excited to discover that according to the physics of kinematics, I would break the state record for the long jump by one metre if I could take off at an angle of 45 degrees, at full speed. I experienced the meaning of the "point mass" concept, when I landed short of the record by one metre instead. In time I discovered that I sufficiently enjoyed the rigor and the process of physics to want to "study it for the rest of my life" (that's how I put it to myself back then).

After graduating from high school in 1989, I lived in Boston for about one year, after which I started my undergraduate studies at the University of Toronto. My first two years were spent at the Mississauga campus, which was a good place for me to find my bearings in a "new" country and a large university. I spent my final two years at the downtown campus, finishing my undergraduate degree. During this time, I had the opportunity to work with Dick Azuma, an experimental nuclear astrophysicist, who sent me to Vancouver to work at the TRIUMF laboratory as a summer research student. The resulting experience was invaluable, and I am amazed at how the encouragement and support of one professor has shaped the rest of my career. Dick was influential in my choice of research field and graduate program, and introduced me to my eventual graduate school advisor. I went to Yale in 1993, and for the next six years, I had a wonderful graduate school experience working with Peter Parker, my supervisor (with no relation to Spiderman!). Upon graduation, I returned to TRIUMF as a research associate and worked primarily on developing a new facility to study some of the important nuclear reactions that happen in stars. The facility is now operational and most of my research program is carried out there. By the time my term at TRIUMF was finishing, a few permanent positions in the field were being advertised. After interviewing at McMaster, I left with an excellent impression of the department's people and vision, and since arriving in 2002, that first impression has been corroborated - I am very happy and excited to be here. My spouse (Ruth) and I have enjoyed getting acquainted with McMaster, and we are also slowly integrating ourselves more into the life of the City of Hamilton.



Paul Higgs

When people hear that I work in a physics department and I work on molecular phylogenetics of RNA sequences, they tend to ask "What is a physicist doing studying molecular evolution?" or "What is a physics department doing employing a computational biologist?" Well, here I am, and hopefully neither I nor the departmental hiring committee made a mistake.

I guess I had better establish my credentials as a physicist. My PhD is in statistical physics of polymers, and was done in the Theory of Condensed Matter group at the University of Cambridge, UK. I was looking at theories for elasticity of rubber and of biopolymer networks. I actually have one experimental paper from that time (measuring the squishability of gelatin) but otherwise I have kept to mathematical models and simulations. In soft condensed matter, I have worked on entanglements, polyelectrolytes, membranes, and polymer crystallization.

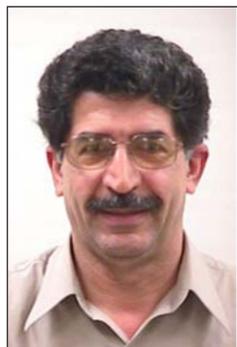
As a postdoc in Saclay, and as a Royal Society research fellow in Sheffield in the early 90s, I began to get interested in biological problems. At that time there was a lot of interest in random heteropolymers, i.e. random sequences of several types of monomers. I began to study RNA folding from this point of view, asking how the thermodynamics of real sequences differs from random sequences. This led me to think about evolution, because the real sequences have undergone natural selection. A second reason for thinking about evolution was because of the parallels between statistical physics ideas (like branching processes and disordered systems) and biological ideas (like the coalescent theory and neutral evolution). One of my papers that I am most pleased with takes a set of theoretical physics papers and shows that they have exactly the same maths in them as a set of population genetics papers, although of course the meaning of the equations is entirely different.

From 1995 to 2002 I worked in the School of Biological Sciences at the University of Manchester. I learned to call myself a 'bioinformatician'. I got used to teaching first year genetics and running tutorials on biochemistry. I forgot a lot of the hard bits of physics. I have been told that I could 'pass for a biologist' (I think this was a compliment), and that I was like a chameleon, blending into my surroundings.

Since coming here, I have fitted well into the interdisciplinary projects of this department. I have just finished teaching the new Molecular Biophysics course with Cécile Fradin. Students should be taking the full Biophysics stream that we designed from next September. I also contributed the biological side of the new Big Questions course. I have been closely involved with the activities of the Origins program (and following the lecture of Stuart Kauffman, I am still waiting for my life to change).

After about 15 months here, I am finding that I like McMaster and Canada, and I have just got my furry hat out ready for its second winter. I am resigned to (but not impressed by) Tim Hortons, and I am almost persuaded that I will need to buy a barbecue next summer.

Another thought about chameleons - If I don't want to stick out, I had better stay sitting down, and I should try not to use words like 'lift' and 'rubbish'.



Reza Nejat

I was born in the small city of Sari in Iran, near the south shore of the Caspian Sea. It was a very nice place to grow up. Sari is the capital of the province with a small community culture in the plain between the Alborz Mountains and the Caspian sea with very beautiful surroundings.

I moved to Tehran for my high school. In 1969 after passing the National Entrance Exam for universities, I was accepted to the physics department of Tehran University. In my fourth year of studies I

had the chance to work at a 5 MW research reactor in Tehran University Nuclear Research Centre. I contributed to a project for building a dry tube in the reactor core. That was the turning point for me, to decide to study in nuclear engineering.

I finished my Physics undergraduate degree at Tehran University in 1974, and went to the engineering campus of the University of Missouri at Rolla to do my graduate studies. I worked on reactor physics for my MSc, and on improving the reliability of a power plant under the guidance of Dr. Nick Tsoulfanidis for my PhD.

I graduated in 1980 with my PhD, went back to Iran in 1981, and joined Guilan University as an assistant professor. Although young and small in size, our group was determined to build a very good Physics department. Before leaving, I established two graduate streams, nuclear and solid state physics, in the department.

My first contact with McMaster goes back to 1991 when I spent a year during my sabbatical leave in the Nuclear Research Center working on conversion of the high-enriched research reactor core to low enriched fuel. I came back to McMaster again in November 1996 as a new immigrant and joined the Physics department in September 1999. I have been teaching several courses at different levels, first year mechanics and waves, electricity and waves, introduction to modern physics, second year analytical mechanics and fourth year nuclear physics. I have taught in small classes of 30-40 students and very large classes of 150-190 students. In all of these classes I tried to apply inquiry methods, which have resulted in more vibrant and interactive sessions.

Graduate Profile



Muoi Tran

highlights of the department is its diversity, not only in research but also in the ethnic background and gender among both faculty members and grad students.

I'm working with Dr. Rajat K. Bhaduri on problems in theoretical quantum statistics, ranging from number fluctuations in bose/fermi gases to partitioning in number theory. My experience at McMaster has been positive from both social and career perspectives. In addition to my research I have had the opportunity to attend a number of international conferences and enjoy the social and extra-curricular activities of the department. In my opinion, one of the

Undergraduate Profile



Sarah Rauscher

three NSERC awards as a member of research groups in both the Physics and Chemistry departments. Her research interests have correspondingly spanned a very broad range – from the supermolecular chemistry of chalcogens with Dr. Ignacio Vargas-Baca to vortices in d-wave superconductors with Dr. Catherine Kallin, both of whom are leading scientists in their fields. She now finds herself fascinated by the field of biophysics as part of her undergraduate thesis. Together with her supervisor, Dr. Paul Ayers, she is looking to elucidate the folded configurations of proteins with a novel approach to the application of Monte Carlo methods.

Sarah Rauscher is an undergraduate student currently in her final year of the Physics program here at McMaster. This year, she was the recipient of both the Dr. Harry Lyman Hooker Scholarship and the Boyd McLay Scholarship in Physics. In addition to her own scholastic endeavors, she also dedicates her time to teaching, as both a teaching assistant and private tutor. One of the most important aspects of her education at McMaster has been summer research. She has received

Alumni - Where are they now?

Rob Wickham (PDF 2003) has left McMaster University to accept a faculty position as Assistant Professor at St. Francis Xavier University in the Department of Physics.

The Origins Institute- A Interdisciplinary Research Institute Takes Shape

During the academic year (2001/02), faculty members in the department's astrophysics group had a series of informal discussions about the development of their field within our department. Some of the members of the group had played a central role in the creation of a comprehensive decadal plan for Canadian astronomy and astrophysics, with Ralph Pudritz as the chair and Bill Harris as a member of the 7 person panel that orchestrated and wrote the report. The result - NRC/NSERC Long Range Plan for Astronomy and Astrophysics entitled "*The Origins of Structure in the Universe*" - is supported by the Government of Canada and is currently guiding the development of what is arguably the most ambitious era of expansion in the history of Canadian astronomy (see www.casca.ca/lrp). The central research theme for this Canadian (and international) program in astrophysics is to study the origins of galaxies, stars, and planets as well as the geometry and structure of the universe itself.

Astronomy and astrophysics have many links with other fields of fundamental science however. Our discussions subsequently lead to a much broader vision to connect up with other areas of fundamental "Origins research" both within our department and across the university. Questions such as "How and why did the universe begin?", "How do galaxies, stars, and planets form?", "How did life begin on Earth, and can it develop on other planets?", "How do multi-cellular organisms evolve?", and "How did intelligent beings and humans evolve?", form a linked set of fundamental questions that are best addressed through interdisciplinary research programs.

The proposal to create the Origins Institute (OI) as an interdisciplinary research institute in the Faculty of Science became a priority for our department during one of our yearly retreats, in Sept. 2002. Over the academic year 2002/2003, Ralph Pudritz spear-headed the effort to reach out to like-minded colleagues across the faculty of Science and beyond. Our group presently includes about 25 prominent researchers who are primarily concentrated in the Depts. of Physics and Astronomy, Mathematics and Statistics, and Biology, with some members from the Depts. of Biochemistry, Geography and Geology, Psychology, and Anthropology. The OI is also linked with the Perimeter Institute (Waterloo U.) and TRIUMF (UBC). The OI rests on three basic pillars - fundamental research, university education through a broad undergraduate Origins specialization, and public outreach in the form of an Origins Public Lecture Series. The Public Lectures were launched, very successfully, in 2003/2004 with Sir Martin Rees as our very first of five speakers.

The proposal was put through the paces for university approval during the last (2003/2004) academic year. Ralph Pudritz presented

and first discussed it at faculty meetings of most of the participating departments and Alison Sills spear-headed a group that prepared plans for the undergraduate program. Bill Harris and a team from our department meanwhile gave the first "Big Questions" course to an enthusiastic, university-wide group of over 180 students. Seed funds for all three pillars of the proposal were provided by the University in early 2004: for the Origins Undergrad program (from Provost Ken Norrie) as well as for the research and public lecture programs (from VP Research Mamdouh Shoukri). With this in hand, the proposal was unanimously approved by a very large vote at the Faculty of Science meeting in March 2003. It has subsequently been unanimously approved by the University Planning Committee (April 2004) and the University Senate (May 2004). The OI is expected to become official on July 1, 2004, with the naming of a Director and hopefully Associate Director and Administrator.

Looking ahead, we expect to see the launch of the Origins undergrad program in Sept. 2005, and to hold our first, month-long Origins science workshop on May of 2005. Invitations for outstanding lecturers for the OI Public Lecture series have already gone out. Over the longer term, we intend to create an OI postdoctoral program. Ultimately, we view the OI as an institute that will have its own advanced-design building as well as several endowed interdisciplinary chairs. The major funds to drive this will be sought in a university fund raising campaign directed at both private and public donors.

The OI should prove to be one of the most exciting, advanced, and innovative research and teaching environments in Canada and to become internationally prominent. While the OI is still very much in its infancy we are excited by its potential to create a thriving environment for fundamental research at McMaster.

Special Events

1st Origins Public Lecture



Martin Rees

Sir Martin Rees delivered an exciting inaugural Origins Public Lecture on "Life in our Universe and Others" to a standing-room-only audience of more than 700 on Oct. 20, 2003 in Togo Salmon Hall. Prof. Rees is Prof. of Cosmology and Astrophysics and Master of Trinity

College at the University of Cambridge, holds the honorary title of Astronomer Royal of Great Britain, and has received many prestigious international awards for his outstanding scientific

achievements. He has written five books on these topics for general readership and has served on many international bodies for the advancement of education, arms control, and international collaboration in science. His talk at McMaster outlined his latest cosmological ideas on the possibility that there could be many “Big Bangs” - some of whose resulting universes could be governed by the “biofriendly” laws that allowed the appearance of life in our own universe.

CFI Symposium



From left to right: Mamdouh Shoukri (VP Research & International Affairs), Carmen Charette (Senior VP CFI), Stan Keyes (MP for Hamilton West), Bruce Gaulin (Principal Investigator of the CFI International Access Fund Award “Canadian Participation at the Spallation Neutron Source [SNS]), Thom Mason (Associate Lab Director of Oakridge for SNS - also a McMaster Alumni), Peter Sutherland (Dean, Faculty of Science)

McMaster University celebrated the launch of the \$15M CFI International Access Fund Award “Canadian Participation at the Spallation Neutron Source (SNS)” on October 17 and 18 of 2003. The SNS is a \$2B science project under construction at Oak Ridge National Lab in Tennessee, intended as the world’s next generation neutron source. This project, led by Bruce Gaulin of Physics and Astronomy, will enable Canadian materials scientists designing and building two state-of-the-art neutron spectrometers at the SNS: VULCAN and SEQUOIA. Both instruments will offer unprecedented capabilities for studying the structure and dynamics of materials. VULCAN will focus on materials engineering problems, while SEQUOIA will focus on problems in quantum materials.

Alumni - Where are they now?

Rachid Ouyed (PhD 1996) who is currently a professor at NORDITA in Copenhagen, joined the Department of Physics and Astronomy at the University of Calgary as of January 1, 2003.

Symposium Day 2003

This year’s symposium day took place on Monday Sept. 2nd. The tradition of having students in their first year of graduate studies give a talk on their current and future research interests now goes back a quarter of a century. This year’s crop was particularly impressive, since no less than ten first year graduate students gave a talk. A prize was awarded to Andrew Croll, and a second prize to Greg MacDougall, for their outstanding presentations on the dewetting of thin polymer films and on the stripe ordering of lightly doped cuprate, respectively (many thanks again to the jury, composed of Roby Austin, Sergey Mashchenko, Brian King and Paul Higgs, for accepting the challenging task to distinguish very good from even better).

Nobel Laureate Speaks



William D. Phillips

This past October, Nobel laureate William D. Phillips (Physics, '79) dropped by McMaster for a two day visit. On October 21, Bill gave an evening lecture open to the general public and entitled “Almost Absolute Zero: The Story of Laser Cooling and Trapping.” As he described the use of lasers and other techniques to cool atomic vapours to thousandths of a degree above Absolute Zero (and colder!), Bill wowed the crowd with inventive demonstrations with liquid nitrogen and levitating magnets. However, the most impressive component of the lecture was Bill’s obvious and infectious enthusiasm for his research and physics in general. People left “fired up” about Physics.

Bill followed up his public lecture with a technical talk the next day, talking about recent work in quantum phase transitions with atoms trapped in optical lattices - a “washboard”-like series of cages for atoms formed from laser light. His visit was much appreciated and left the Department - from undergraduate majors to professors emeriti - informed and excited about recent research in laser cooling and trapping.

Awards/Honours



All eyes on ALMA

Christine Wilson is the Canadian project scientist for the international \$550 million (US) Atacama Large Millimetre Array (ALMA) project, considered the most important development in radio astronomy in this decade. ALMA will be the highest altitude, full-time ground observatory in the world.



John Charles Polanyi Prize

Polanyi Prize in Medicine for 2003 - Cécile Fradin has won this year’s John Charles Polanyi Prize for Medicine for her work on using laser optics to study the dynamics of biological systems such as cells. The prize was awarded at a ceremony at Massey College in Toronto in November. Cécile Fradin is acknowledged as a world-class leader in her field of research.



CRC in Quantum Materials

Catherine Kallin received a Canada Research Chair in Quantum Materials Theory. Dr. Kallin is contributing to our knowledge of new phenomena in quantum materials including novel magnets and high temperature superconductors. Electrons in these materials behave completely differently than in conventional metals, superconductors and magnets. Dr. Kallin’s group is focussed on understanding these novel electron states which may ultimately find uses in new electronic components and quantum devices.



Russell Donnelly

Russell J. Donnelly, Professor of Physics at the University of Oregon and a distinguished alumnus of our department, has been appointed to the Editorial Board of the physical sciences side of the Royal Society of London. The Royal Society was founded in 1660 and its publications have appeared continuously since March 1665. In October, the Department of Physics and Astronomy had the great honour of hosting a visit by Professor Donnelly.

