

Grad Forum 05/06 Physics and
Astronomy Department
Submitted by Mary K. Hudson

We are pleased to welcome a new faculty member to the department this fall, Robyn Millan, who first arrived in Fall 2002 as a NASA Space Grant Visiting Young Scientist. Robyn received her PhD from UC Berkeley in 2002, and has been a Research Assistant Professor in the department for the last three years. Last January, she and graduate student Leslie Wooder traveled to Churchill, Manitoba to launch two high altitude balloons to study relativistic electron losses from Earth's radiation belts. Each 300,000 foot Helium-filled balloon carried a 50 pound payload to an altitude of 110,000 feet. The instrumentation consisted of a NaI scintillator to measure X-rays produced by precipitating electrons, a magnetometer, and an H-beta optical photometer to measure proton aurora. The flights lasted 16 and 18 hours respectively and were terminated over Greenland and off the coast of Iceland. Dartmouth students Chelsea Lalla ('07) and Elysa Corin ('08) also worked on the project, which was supported by the National Science Foundation and the Churchill Northern Studies Centre. The project was part of a larger balloon campaign involving researchers from U.C. Berkeley, University of Washington, University of Houston, University of Natal and the Aerospace Corporation. Four similar balloons were launched in Antarctica during the same time period, providing the first multi-point measurements of relativistic electron precipitation. For more information, see the Dartmouth Balloon Group website at <http://www.dartmouth.edu/~rmillan>.

Graduate students Nick Bunch and Rob Michell attended an NSF-sponsored radar summer school in Alaska in August, joined by Professor Jim LaBelle who served as their faculty mentor. As part of the summer school, the students planned, performed, and reported on experiments performed with the high-power ionospheric radar HAARP in Gakona Alaska. Graduate student Zhengrui Qin attended the Center for Integrated Space Weather Modeling summer school at Boston University, along with Yonggang Hu and Sumi Kobayashi. Graduate student Shengyi Ye travelled to the South Pole Station in January to update his experiment to measure fine structures in auroral radio emissions. He presented a poster on this topic at the American Geophysical Union Spring Meeting in New Orleans. Shengyi Ye and graduate student Chris Colpitts are both presenting posters at the December American Geophysical Union Fall Meeting in San Francisco. Finally, former graduate student Marilia Samara completed her PhD thesis in June, leaving Dartmouth to take a postdoctoral position at Southwest Research Institute in San Antonio.

PhD student Kristen Frederick-Frost, working with Professor Kristina Lynch, has made great strides in the construction of a laboratory plasma facility in Wilder. The "Elephant" vacuum chamber can be seen on www.dartmouth.edu/~aurora; it reached base pressure this summer and she is currently constructing a microwave plasma source to generate plasmas. Emeritus Professor Bill Doyle is a great advisor for this project (and having lots of fun). Rob Michell is planning a

winter field research trip for aurora observing using cameras and radars in Alaska, while Joo Hwang has been using data from the Fast Auroral Snapshot satellite to analyse auroral structures and recently submitted two journal papers on her work. She and Kristen attended a conference in Tromso, Norway this summer.

Astronomy faculty Brian Chaboyer and Rob Fesen just returned from the inauguration of the new S.A.L.T (South Africa Large Telescope) telescope which will allow viewing of galaxies and stars one billion times more faint than those visible by naked eye viewing. The telescope is hoped to give scientists a glimpse into the past at the origins of our universe. The telescope is situated in South Africa's arid Karoo region which was chosen for its remoteness from city lights. Dartmouth has a 10% share in observing time. Also in attendance at the gala inauguration were Rob McClung and Mary Lou Guerinot from Dartmouth, along with the President of South Africa. In other news from Chaboyer's group: Andrea Kunder attended a Conference on Astrophysics of Variable stars in Hungary last summer. There, she gave a talk on her investigation of the chemical and dynamical properties of RR Lyrae stars at the center of our galaxy, and presented a poster elucidating her preliminary studies of galactic dust. She also biked 450 km across Hungary, from Budapest to Pecs. Andrea is now expanding her research, beginning a thorough investigation of the stellar properties of the nearby galaxy, the Large Magellanic Cloud.

Nathaniel Paust is currently preparing a paper verifying that the Dartmouth

Stellar Evolution Program accurately predicts the speed of stellar evolution, and a paper which will present the first wide-field infrared study of globular clusters in the Milky Way. Some of Nathaniel's recent results on the globular cluster M14 will be shown at the Washington DC meeting of the American Astronomical Society in January. Additionally, Nathaniel is serving as the assistant sponsor of a WISP student with Professor Chaboyer.

Aaron Dotter is hard at work on his thesis, completing research, writing up results, and looking for future employment. His thesis focuses on producing a comprehensive database of stellar evolution models including the most up-to-date physics available and then applying the models to the Milky Way's globular cluster population. In June, Aaron and Brian attended an international conference in Rome, Italy. At the January meeting of the American Astronomical Society, Aaron will advertise the new model database by presenting a study of the old, metal-rich open cluster NGC 6791 based on deep infra-red photometry.

In condensed matter, Miles Blencowe reports that Yong Zhang graduated in June 2005 and this October started a postdoc in the Dept. of Physics, U.C. Riverside. While at Dartmouth, Yong carried out condensed matter research with his supervisor Miles Blencowe concerning the theoretical sensitivity limits of a displacement detector based on the single electron transistor. This scheme, first proposed here at Dartmouth, was recently demonstrated experimentally by groups at UC Santa Barbara and U. Maryland (their results

published in Nature and Science). Midway through his graduate studies, Yong took the unusual step of switching from theory to experiment. At U.C. Riverside, Yong will be conducting experiments on carbon nanotubes.

Graduate students Michael Brown-Hayes and Woo-Jong (Andy) Kim are now PhD candidates working on ultracold atom physics projects in the laboratory led by Prof. Roberto Onofrio in Wilder. They have been co-authors of a recent article appearing in the November issue of Physical Review A reporting on an apparatus developed to measure with high precision the Casimir force in a novel configuration. Michael Brown-Hayes is now a recipient of a GAANN fellowship, and Andy Kim has participated in early September in an international workshop on "Quantum Field Theory Under the Influence of External Conditions" (QFEXT'05) held in Barcelona, Spain, presenting a poster on a proposal to detect the dynamical Casimir effect by means of ultracold atoms and nanomechanical resonators. In late November, Andy has also spent ten days at the Institute Laue-Langevin in Grenoble, France, to work on a project involving researchers from Dartmouth, Grenoble and Paris. Graduate student Qun-Wei, now in his second year of the graduate program, has worked during the Summer and the Fall in the Onofrio group building the frequency synthesis apparatus for laser cooling of rubidium atoms, and participating in general to the ongoing team effort.

There are three experiments running currently in Alex Rimberg's group. Postdoc Feng Pan and graduate student Tim Gilheart are measuring a single-

electron transistor coupled to a quantum dot. This work is in collaboration with researchers at the University of Wisconsin, Madison. Graduate students Zhongqing Ji and Weiwei Xue are searching for correlated electron tunneling in a GaAs heterostructure designed to show dynamical Coulomb blockade. Finally, graduate students Madhu Thalakulam and Joel Stettenheim are using a double quantum dot in a GaAs heterostructure to measure the backaction of a superconducting single electron transistor.

Professor Yeong-Ah Soh participated in the National Nanoinitiative Workshop held in Washington DC last June. During the workshop scientists from all over the USA engaged in hot debates regarding the essential role of X-rays and neutrons in nanoscience. In July, Prof. Soh presented a talk at a Workshop on Complexity in Strongly Correlated Electron Systems held at the Kavli Institute of Physics at UCSB. In August, her postdoctoral associate Dr. Kummamuru and graduate student Jia Wang attended a workshop in Boston that discussed frontiers of science within nanotechnology. In October, Prof. Soh and graduate student Jia Wang went to Argonne National Laboratory to perform experiments to study the correlation between the magnetic and structural properties in a material that exhibits colossal magnetoresistance. The experiment was a success, with the results demonstrating the presence of a magnetic superstructure linked to a crystal superstructure.

During the Summer 05, graduate student Winton G. Brown began working on a project related to quantum information

science and quantum chaos under the supervision of Prof. Lorenza Viola. A main goal of the project is to characterize the behavior of complex quantum correlations (multi-partite entanglement) in disordered spin systems which undergo a transition from integrable to chaotic behavior. Results emerging from this study so far will be presented at the upcoming March meeting of the American Physical Society. On August 1, 2005, Visiting Scholar Francesco Ticozzi also joined Viola's group for (at least) a one-year period. Francesco, a Ph.D. candidate in Automatic Control at the University of Padua, Italy, is carrying on research on theoretical issues related to quantum control theory, with emphasis on dynamical decoupling and quantum feedback. A first paper is currently under preparation.

Scott Daniel, Ke Li, and Pengpeng Yu are conducting research in theoretical cosmology and gravitation with Assoc. Prof. Robert Caldwell. Daniel and Yu attended the Stanford Summer Institute which focused on "Gravity in the Quantum World and the Cosmos." Daniel, who is studying dark energy, also participated in the Santa Fe Summer Workshop in cosmology in June. Yu is exploring the effects of dark energy fields on the physics of black holes. Li is beginning a study of the nonlinear gravitational dynamics of galaxies and clusters.

Marcelo Gleiser reports that he gave two talks in July in Paris at the Einstein Centennial Meeting at UNESCO.; in October he gave a plenary talk at a Particles and Fields meeting in Brazil while in November he attended the International Meeting of Astrobiology in

Capri, Italy. David Montgomery has had a busy year, spending time at the National Center for Atmospheric Research in Boulder, Colorado. He reports that at the American Physical Society Division of Plasma Physics Meeting, Elena Belova (Dartmouth Ph.D. XXXX) who worked with Mary Hudson received the Katherine E. Weimer Award, and that Jill Dahlburg (former Dartmouth post-doc with Prof. Montgomery) became the Chair of the Division of Plasma Physics.

Barrett Rogers reports that PhD student Brian Sullivan gave a poster at the spring American Geophysical Union Meeting in New Orleans on forced reconnection, as well as a recent plasma seminar, and an associated article is now in press in *Physics of Plasmas*.

Barrett will be giving some lectures on reconnection at an upcoming workshop at UCLA in January associated with the Center for Multiscale Plasma Dynamics, a multi-institutional Department of Energy initiative of which Dartmouth is a part.

Postdoc Paolo Ricci and Barrett had a poster at the fall American Physical Society Division of Plasma Physics Meeting in Denver about the gyrokinetic simulation of reconnection.

Richard Denton uses the frequencies of Alfvén waves (vibrating magnetic field lines) to infer the mass density of particles in space, and is simulating these waves to investigate ionospheric outflow. He is also involved in studies of magnetic reconnection. Graduate student Yonggang Hu works with Richard studying ion cyclotron waves and their effects on radiation belt electrons, and graduate student Zhengrui Qin works with Richard on magnetic

field models and modeling of electron density using in situ spacecraft measurements.

Several Dartmouth graduate students attended the June Geospace Environment Modelling Workshop in Santa Fe, New Mexico, including Yonggang Hu, Sumi Kobayashi, Kyoung-Joo Hwang, Robert Michell, Marilia Samara, Brian Sullivan and Leslie Woodger. Professor Mary Hudson gave the Geospace General Circulation Modelling invited tutorial at the Santa Fe GEM meeting, also an invited talk at the 10th Assembly of the International Association of Geomagnetism and Aeronomy in Toulouse, France in July.