Spotlight

On Richard Ott and Robert Schroll

By: Karrie Sue Hawbaker, editor

Usually, in this section of The Photon, we feature an alum who is already established in a successful and interesting career. This month, I want to introduce you to two of our younger alumni who are still at the beginning of very promising professional journeys. For you undergraduates, I hope you take their words as guidance, as you look past graduation day. And for those of you who have moved beyond this youthful career phase, I hope you take a moment to remember your early years and that you are encouraged by the talent and exuberance of today's young physicists.

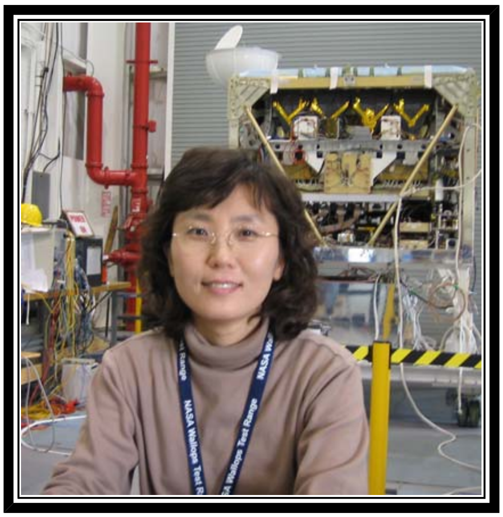
Richard Ott, B.S., 2003

During his undergraduate years here at Maryland, Richard Ott excelled in his class work, was active in the Society for Physics Students (SPS) and took advantage of the opportunity to do research as an undergrad. He worked with Professor Christopher Lobb's group in the Center for Superconductivity for a year and a half. During that year and a half, he spent most of his time working with graduate student Matthew Sullivan researching the YBCO (yttrium barium copper oxide) superconductor, looking closely at scaling dynamics like current voltage scaling. By the Spring of 2003, when he graduated, he had his name as an author on three papers and had received the Department's Jerry B. Marion Award, a $1000 scholarship.

In his senior year, Ott had begun applying to graduate schools: Massachusetts Institute of Technology, University of California, Berkeley, California Institute of Technology, University of Wisconsin-Madison, University of Maryland and University of Illinois Urbana-Champagne. It's an impressive list of schools and he was accepted to them all. He took his time to consider, but admits that he had virtually decided on MIT before he even took a trip to Boston. The visit confirmed the fact that its physics department was strong in a variety of programs. So, if, during his graduate study, he decides to change fields of physics, he'll still benefit from a strong program. And, he has the opportunity to cross-enroll with some of the other universities in the area like Harvard University. He also thought Boston would be a pretty fun town and a President's Fellowship from the university, which paid his way for the first year, was an attractive offer.

Now in his second year at MIT, Ott has been working with Professor Young Lee on high-temperature superconductors, quantum magnets and correlated-electron systems. Specifically, he's working on the cobalt oxide system, which was discovered about a year before he started graduate school. Given its novelty, physicists know very little about it - a situation that has both advantages and disadvantages. The all-good news is that he finds his research group very collaborative and professionally

Spotlight



Flying Balloons in Antarctica for Cosmic-Ray Research

By Eun-Suk Seo

Our Galaxy is filled with a relativistic gas of high-energy protons, electrons, and heavy nuclei. These energetic particles from extraterrestrial sources are a direct sample of matter from outside our solar system. The interstellar energy density of these so-called cosmic rays is ~1 eV cm $^{-3}$ - comparable to the energy density of the galactic magnetic field or the thermal energy of the interstellar medium. Cosmic-ray energy spectra extend to a maximum energy above 10^{20} eV, well above the energy that man-made accelerators can generate on Earth. (A single atomic nucleus at this energy has more energy than the fastest baseball ever thrown!) High-energy particles are an important and distinguishing feature of radio galaxies, quasars, and active galactic nuclei. The direct measurement by space and balloon experiments of their charge distribution, mass composition, and energy spectra provide information on the cosmic-ray source regions within our Galaxy, on their injection and acceleration processes, and their transport through interstellar space. Observations from radio, gamma-ray, and X-ray astronomy define the distribution of energetic particles throughout our Milky Way Galaxy and establish their presence in extragalactic sources. The interpretation of these observations is significantly aided by the detailed study of cosmic rays near Earth, while our understanding of the sources and distribution of galactic cosmic rays is strongly dependent on the data from these allied fields.

Professor Seo's research employs satellite and balloon-borne instruments to make direct measurements of these particles from space over more than six orders of magnitude (factor of a million) of the cosmic-ray energy spectrum. The names and overlapping energy ranges of the complementary projects she is pursuing to obtain precise data from ~$10^{8}$to ~10^{15} eV are summarized in Fig. 1.

These research projects address three basic themes: (1) searches for exotic matter such as antimatter and dark matter; (2) precise measurements of galactic cosmic rays in the energy range where they are most abundant (~10^8 to ~10^{12} eV) to understand their origin, acceleration, and propagation; and (3) precise measurements with large aperture instruments at higher energies (~10^{12} to ~10^{15} eV) where the fluxes are extremely low, in order to explore the limit of supernova shock wave acceleration.

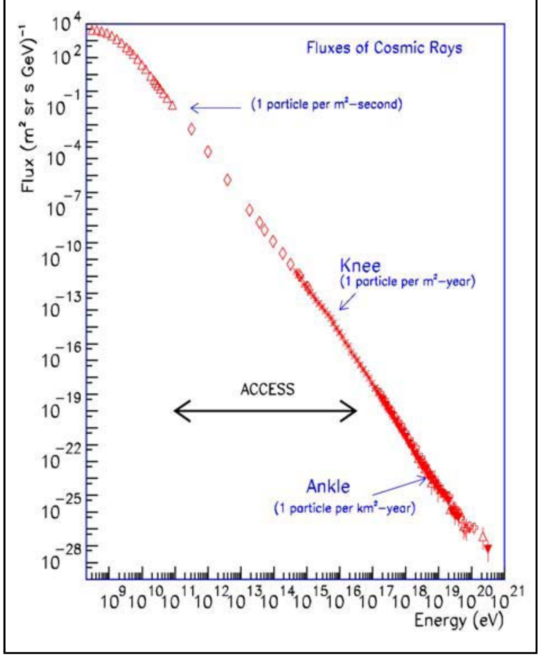


Fig. 1 All particle flux as a function of total energy per particle. ACCESS: Advanced Cosmic-ray Composition Experiment for the Space Station.AMS: Alpha Magnetic Spectrometer ATIC: Advanced Thin Ionization Calorimeter BESS: Balloon Experiment with a Superconducting Spectrometer CREAM: Cosmic Ray Energetics and Mass

The BESS balloon-borne instrument has many of the same goals as AMS, a large space experiment almost ready for launch to the International Space Station. Equal amounts of matter and antimatter were produced at the beginning of the universe as described by the Big Bang scenario, and yet we now seem to see only matter around us. Since cosmic rays are a direct sample of matter from outside the solar system, they can probe the distant universe for the existence of antimatter. Antiparticles are exactly the same as particles except for the opposite charge sign, so they bend in opposite directions in a magnetic field. Both BESS and AMS employ state-of-the-art superconducting magnet technology to identify antiparticles as well as particles. BESS has been flown annually since 1993 to search for antimatter. AMS-01 was flown on a Space Shuttle in 1998, and AMS-02 is scheduled for launch to the International Space Station in 2008.

Professor Seo's ATIC and CREAM instruments are basically smaller scale prototypes of the ACCESS instrument, with the same science goals, which were given high priority in National Academy of Science reports. Whereas ACCESS would be a flagship space mission, she is planning a series of balloon missions with the ATIC/CREAM instruments, each lasting 10 - 100 days, to achieve many, if not most, of the ACCESS objectives. High energy particles are very rare, so large collecting power is required to obtain meaningful data. The instrument has to be large enough to collect a sufficient number of particles with good charge and energy resolutions, and yet light enough to be flown. Professor Seo received a 1997 PECASE award (Presidential Early Career Award for Scientists and Engineers) in recognition of her innovative approach for making high quality measurements of cosmic rays over an energy range that had not previously been possible. Precise measurements with these balloon-borne experiments provide unprecedented improvements in spectral data on the rare, high-energy cosmic rays, so they check the long-standing, still unproven theory of cosmic-ray acceleration in supernova (exploding star) remnants, one of the most powerful accelerators in the universe.

It should be noted that Professor Seo's precision measurements fill the gap between the space and ground based research activities of other groups on campus. They are particularly complementary to Professor Jordan Goodman's ground based observations. The ATIC, BESS, and CREAM balloon-borne instruments are based on particle detectors like those used at accelerators, but the payloads are like large space experiments. They are for the most part built in-house by students and young scientists, many of them currently working in the on-campus laboratory Professor Seo developed to pursue her scientific interests. Her current research group includes about 20 research scientists, engineers, technicians, graduate students, and undergraduate students. The BESS and CREAM payloads are both currently in Antarctica waiting for their balloon flights. Visit the home page of the cosmic-ray physics group http://cosmicray.umd.edu/homepage and follow the link to the CREAM project or go to the CREAM home page http://cosmicray.umd.edu/cream/cream.html to follow the development. Once each payload is launched, real time tracking of its balloon trajectory will be available along with some basic science instrument housekeeping data.

Fig. 2 A picture showing the crates containing the CREAM equipment after arrival at Williams Field, McMurdo, Antarctica, the buildings where the BESS and CREAM payloads are prepared for flight, and Mt. Erebus, an active volcano, in the background.

Fig. 3 A picture of the ATIC launch in Antarctica in December 2002.

Dr. Seo is an associate professor working in the field of cosmic ray physics here at the University of Maryland. She has a joint appointment with the Department of Physics and the Institute for Physical Sciences and Technology. If you have any questions, she can be reached at seo@umd.edu.

Tel: 301.405.3401
1117 Physics Bldg.
University of Maryland
College Park, MD 20742

Contact the editor.
Contact the webmaster.

supportive.

Ott says that, overall, he's had a rather positive experience so far. The classes are difficult but if you put your mind to it you can learn a lot. He likes the encouragement to be independent and do your own work and he appreciates the effort that MIT makes to be supportive in an academic sense as well as helpful in making ends meet.

Each university has a unique character and culture and he can definitely feel differences between Maryland and MIT. For example, he find the undergraduates extraordinarily focused compared to Maryland. What's even more obvious, though, is the undergrad to graduate change, in that the focus has shifted from classes and tests to heavy research.

Ott is currently supported by a research assistantship. But, next year, he is hoping to also gain some teaching experience with a teaching assistantship. He would like to eventually go into academia, especially since he would really like to teach. He gained his first experiences in this area during his senior year at Maryland, when he worked as an undergraduate teaching assistant for the Physics of Music laboratory. He really enjoyed that experience (and learned a lot about how to organize and prepare for a class) and looks forward to gaining additional experience.

Ott says he is getting used to the cold Boston weather. And, while he has enjoyed the city a bit, it's not as much as he would like, given the workload of a graduate student. But, it's his second year. He has time to enjoy Boston - as well as, I'm sure, a plethora of exciting experiences and successes.

Robert Schroll, B.S., 2003
Robert Schroll is another one of our bright Spring 2003 graduates. During his time here at Maryland, he also gained valuable academic and social experiences - and took advantage of two undergraduate research opportunities. He first spent a summer with Professor Theodore Einstein working with atomic-level steps on silicon surfaces. While he greatly enjoyed working with Dr. Einstein and valued his mentorship, the most important result of the experience was finding out that that was not an area of physics that he wished to pursue for a career. So, the next year, he worked with Professor Rajarshi Roy on computer-generated holograms. This experience was also very beneficial in that it convinced him that non-linear dynamics was an area that he wanted to study further.

Schroll's list of prospective graduate schools including the University of Chicago, the University of California, Berkley, the University of Texas at Austin, the University of Washington, the University of Maryland and Princeton University. He received acceptance letters from all but Princeton, leaving him with great options. He went to several of his Maryland professors for their opinions, given his proposed area of research. After evaluating their comments and visiting the campus and the department, he decided on Chicago.

Schroll entered the University of Chicago in the Fall of 2003 with support from a very competitive National Science Foundation Graduate Research Fellowship that will last through his first three years. Now in his second year, he is working with Professor Wendy Zhang on a fluid dynamics problem, based on an experiment conducted by

Jean-Pierre Delville and Alexis Casner, of the Université Bordeaux I in France. In this experiment, a laser beam is used to deform the interface between two fluids. As the power of the laser is changed, the deformation can change shapes rather dramatically. So far, he's enjoying tackling the problem.

Schroll also says his overall experience is going rather well. In addition to being excited about the non-linear dynamics research, he finds that the group - and the department - provides a supportive and collegial environment. He also really enjoys his class. He entered the graduate program with about 20 other students with whom he enjoys doing "fun stuff" as well as homework.

Schroll says the University of Chicago has a very different feel from Maryland. The university has a much larger graduate program than undergraduate program and that creates a different atmosphere. For example, he was a member of the large and rather well-known-about-campus marching band here at Maryland. However, it is Schroll and a few friends who are working to put together a small pep band at Chicago. He also recognizes the differences between undergraduate and graduate school. He finds life in grad school much more focused. It's more "all physics all the time."

As for the City of Chicago, he hasn't had much time to take advantage of it, with so much work to do. However, he does say that his first impression of the area was simple: cold and flat. He's getting used to the cold, but it still feels really flat.

Schroll's future isn't clear; although he's pretty sure he would like to pursue the academic route. However, he has lots of time to sort it out and the path ahead sure does look promising.

If you have questions or comments for either Richard Ott or Robert Schroll, please contact the editor. She will be happy to pass along the message.

College Park, MD 20742