

Department of **Physics & Astronomy Newsletter**

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Message from the Chair

Greetings from the Rutgers Department of Physics and Astronomy, as we end another year of outstanding contributions to education, research and reaching out to the public. I am Ronald Ransome, an experimental nuclear physicist, now completing my first year as chair of the Department. I am delighted to have this opportunity to share with you some of the recent accomplishments of our department's faculty, students, and alumni.

There are far more things to tell you about than we can report in this newsletter, but we'll keep you updated with current activities in our future letters. We also post regular updates on our web site <http://physics.rutgers.edu>, which we hope you will visit often. I would also like to hear from you, our alumni and friends, and present highlights of your achievements as a regular feature of this newsletter. You are invited to go to our "For Alumni" page to register and tell us about yourself.

The undergraduate program is one of the largest in the country and recent graduates have gone on to many of the best graduate programs in the country. Our graduate students have won university wide awards for top quality dissertations, with three winners since 2005. Our graduates have gone on to successful careers in academia and industry. We also continue to attract exceptionally talented postdoctoral scholars who become leaders in academia and industry.

The Department's 62 faculty members are doing research in a wide variety of areas and have won widespread recognition for their efforts, including substantial external funding for their research, with over \$11 million in external grants in 2010.

The Department's faculty, staff and students also reach out to students and teachers in our schools, as well as to the broader community. As just one example, every year about 1000 people attend the highly popular Faraday lectures for the general public.

Professor Ronald Ransome
Physics & Astronomy Department Chair

AWARDS AND HONORS

The 2010-11 academic year saw many of our faculty and students recognized for their outstanding achievements. Professors **Tom Banks** and **Greg Moore** were elected to the *American Academy of Arts and Sciences*, one of the nation's most prestigious honorary societies and a leading center for independent policy research. Professors **Eva Andrei** and **Karin Rabe** were named Fellows of the *American Association for Advancement of Science* and Professor **Steve Schnetzer** was named a Fellow of the *American Physical Society*. The *American Physical Society* recognized Professor **Sasha Zamolodchikov** with the *Lars Onsager Prize* for his outstanding contributions to theoretical physics and Professor **Noémie Koller** with the *Nicholson Medal for Human Outreach* for her advocacy of human rights and leadership in advancement of women in science. Professor **Sang-Wook Cheong** was named *Rutgers Board of Governors Professor* in June 2011. Professor **Saurabh Jha** won the *Harvard Bart. J. Bok* award for outstanding research by a Harvard Astrophysics Ph.D. 35 or younger. Graduate student **Curtis McCully** received a 2011 Chambliss Astronomy Student Achievement Award from the *American Astronomical Society*. Junior **Kiersten Ruisard** won the prestigious *Barry Goldwater Scholarship*, awarded to 275 students nationally across all the natural sciences, math, and engineering.

Many other notable achievements of our faculty, students, and staff can be found at our website <http://physics.rutgers.edu/physicsnews/news.shtml>.

RESEARCH NEWS

Our faculty engage in a wide variety of research. In 2010 alone they published over 300 articles in refereed journals. A few highlights of this years research are given below.

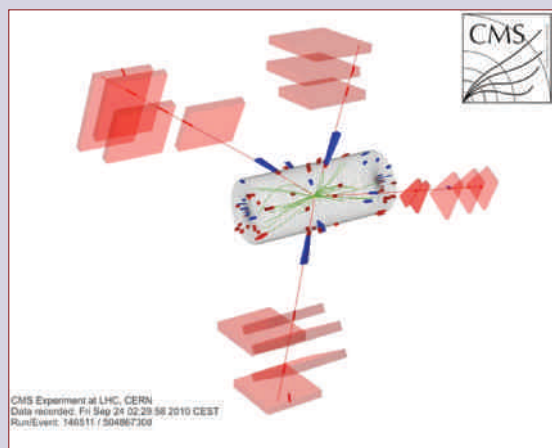
High Energy Physics:

The Large Hadron Collider offers the greatest opportunities in a generation for discoveries in particle physics. The Rutgers High Energy Experimental faculty, Professors **Halkiadakis, Gershtein, Lath, Schnetzer, and Somalwar**, and their postdocs and students will be searching for the Higgs particle, and for many other types of new physics, such as extra dimensions, supersymmetry, dark matter, and new forces of nature that arise in technicolor or hidden valleys. In these activities they will be working closely with Rutgers theorists, Professors **Shih, Strassler, and Thomas**, and their postdocs and students. Finding the needle of new physics in the haystack of background processes is a huge challenge.

The theorists are experts on both the needles and the haystacks and give guidance to the experimentalists on searching through the data. Rutgers is a unique institution within the United States. No other university has such a powerful linkage between world-class efforts in both LHC theory and experiment. These close ties have helped the Rutgers experimentalists, who work on the Compact Muon Solenoid (CMS) detector, to complete five separate searches for new physics using the data from the 2010 pilot run of the LHC. This is a remarkable number, considering how difficult and complex research is at a hadron collider. Meanwhile the theoretical papers emerging from Rutgers are of higher quality, and

of greater usefulness to the experimental community, because their authors are well-informed about the challenging realities of research at the LHC.

One other exceptional effort at Rutgers, pioneered by Professor **Steve Schnetzer**, is the use of diamond for detecting particles in high-radiation environments. His novel detector to measure the collision rate at the LHC will be installed soon in the CMS detector, in a region so close to the beam that other technologies could not survive the onslaught of radiation.



A rare two Z to four muon event, potentially resulting from a Higgs decay. The first seen at LHC was found by Rutgers post-doc Richard Gray.

Astrophysics:

Astrophysics research at Rutgers spans both the electromagnetic spectrum and the history of the universe. Rutgers is a founding member of the Southern African Large Telescope (SALT, pictured), the world's largest single visible-light telescope, and a member of the consortium working to build the Large Synoptic Survey Telescope (LSST), the US astronomical community's top priority ground-based telescope for the coming decade. Several Rutgers astronomers are co-investigators with the Atacama Cosmology Telescope (ACT) and its successor ACTPol in Chile, and Professor **Andrew Baker** serves on the

Scientific Advisory Committee for the Atacama Large Millimeter/submillimeter Array (ALMA). Professor **Jack Hughes** is a member of the International Science Working Group that is building the next US/Japanese X-ray satellite (Astro-H) for launch in 2014. Members of the astrophysics group use many existing ground- and space-based telescopes ranging from radio to X-ray wavelengths, and develop state-of-the-art theoretical models to interpret existing data and inspire new observational programs.

The astrophysics group has strong vertical integration with undergraduate and graduate students, postdocs, and faculty working side-by-side. Multiple projects probe the exotic dark matter and dark energy that govern the expansion of the universe and form the scaffolding for visible objects. Others focus on diverse structures ranging from mammoth clusters of galaxies down to dwarf galaxies, and characterize the many physical processes that influence how galaxies form and evolve. The program in galaxy formation will be strengthened in fall 2011 with the arrival of Professor **Rachel Somerville** as the first Downsbrough Chair in Astrophysics. Still other projects investigate the violent explosions and their remnants that occur when certain types of stars die.

Condensed Matter:

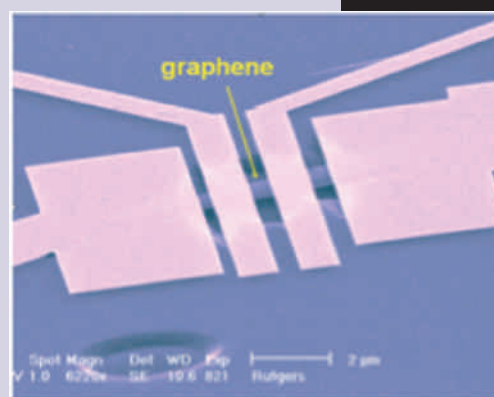
One of the more remarkable discoveries of the past few years was of graphene, two dimensional sheets of carbon. The 2010 Nobel Prize in Physics was awarded for the discovery of graphene. The discovery of graphene has reshaped the way we think about the fundamental physics of electrons in crystalline structures. At the same time, this material with its extraordinary electronic properties, which is also flexible, transparent, and stronger than steel, has opened the way to a new era of graphene-based technological applications, from ultra-fast electronics, to flexible touch-screens,



View of SALT in winter.

to single-molecule sensors. Professor **Eva Y. Andrei** has been one of the leaders in the exploration of the properties of graphene. Graphene's 2D nature gives it a host of electronic properties not seen in thicker films. For example, it has conduction electrons which appear to travel near the speed of light and have zero mass. These "Dirac fermions" as they are called, could make it useful in ultrafast electronic devices. Professor Andrei's group has been trying to understand why Dirac fermions appear in graphene, but not thicker layers of graphite.

They were the first to show that in a high magnetic field the Dirac fermions condense into a liquid of composite particles, resulting in the fractional Quantum Hall effect. This work was ranked by Science magazine as one of the top 10 scientific breakthroughs for the year 2009. Her work was recently highlighted in [physicsworld.com](http://physicsworld.com/cws/article/news/45585) <http://physicsworld.com/cws/article/news/45585>. Professor Andrei also presented her work at the Nobel Symposium on Graphene in Stockholm, in conjunction with the Nobel Prize ceremony. More information about the work of Professor Andrei's group can be found on her webpage at <http://www.physics.rutgers.edu/~eandrei/>.



Scanning electron microscope image of graphene device in which the fractional quantum Hall effect was observed.



Doug Boyd (r) with physics graduate student Patrick O'Malley.

ALUMNI ACHIEVEMENTS

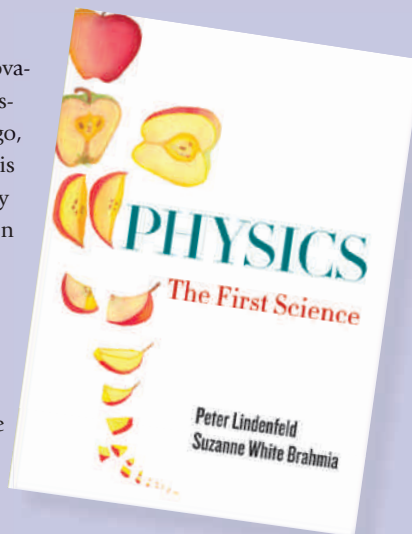
Our many graduates over the years have gone on to a wide variety of careers and made contributions in a remarkable numbers of areas. We'll be featuring some of their achievements in each newsletter.

This issue we recognize Dr. Douglas Boyd. Doug received his Ph.D. in 1968, in association with the Rutgers/Bell Labs Tandem. He went on to Bell Labs, Stanford University and then the University of California at San Francisco, where he founded the Physics Research Laboratory in the Department of Radiology. In 1983 he founded Imatron, Inc., which was acquired by GE in 2001, and remained there until 2004. He since founded several other companies. Doug has contributed to the fields of imaging technology, accelerator and beam physics and medical physics. He developed the first fan beam-Xenon detector CT system, subsequently licensed to GE, as well as the electron beam-based Ultrafast CT and an explosives detection scanner for use in airline security. The electron beam CT scanner has become extremely important in preventive medicine as the only device that can reliably detect and quantify calcification in the coronary arteries and predict the onset of heart disease. In recognition of his tremendous work, Doug was inducted into the Rutgers University Hall of Distinguished Alumni in 2010 and received the Graduate School's Distinguished Alumni/ae Award for Lifetime Achievement in 2009.

EDUCATION

Last month I had the privilege of congratulating 56 graduating seniors at the first joint ceremony of the math physical sciences graduates in the School of Arts and Sciences. In addition 9 students received Master's and 13 students received Ph.D. degrees in physics and astronomy.

Our faculty continue to be leaders in innovation in physics education. Although Professor **Peter Lindenfeld** retired a few years ago, he hasn't slowed down a bit. Following his lifelong dedication to teaching, he recently completed a new textbook in collaboration with instructional staff member **Suzanne Brahmia**. The introductory textbook "Physics: The First Science" has just been published by the Rutgers University Press. The authors think of it as a breakthrough in physics education. You can read sample chapters and more on <<http://www.first.rutgers.edu>>.



TRANSITIONS

Professors **Noémie Koller** and **David Langreth** retired as of July 1, 2010. Noemie joined the faculty of Rutgers College in 1960 as its first female faculty member. David Langreth joined the faculty in 1967. Sadly, David passed away May 27, 2011, after a brief illness. Professor **Paul Leath** retired as of July 1, 2011. Paul joined the faculty in 1967 and served the University and Department in many roles, including as Associate Provost and Provost from 1978 to 1993, and Chair of the Department from 1995 to 2004.

Professors **Terry Matilsky** and **Valery Kiryukhin** were promoted to Professor I, and Professor **John Hughes** was promoted to Professor II, all effective July 1, 2011.

GIVING

I have shared with you just some of the tremendous accomplishments of our faculty and students. Yet our Department faces serious challenges in maintaining quality education, research and outreach programs in light of the economic climate in our state and nation. Do not hesitate to contact me to learn more about how you could help address some of the Department's needs. To help support the education, research, or outreach activities of the Department, you can also make secure contributions on the "Giving to Physics & Astronomy" page on the web site, <http://physics.rutgers.edu>.