

## Installation of new accelerator underway

The installation of a new nuclear accelerator in the [Nuclear Science Laboratory](#) (NSL) is underway. A huge crane has been set up to facilitate the transport for the accelerator unit to its final position in the center of the NSL research facilities. Construction will continue on this project for the next few months.

The National Science Foundation (NSF) funded 5 MV accelerator represents a major equipment upgrade for the nuclear research group and is the first accelerator NSF has funded in nuclear physics in nearly a quarter century.

The new vertical accelerator will be housed inside a new 40-foot tall tower located above the existing NSL in the center of Nieuwland. This location and the weight of the accelerator tank (nearly 20,000 pounds) required the use of a large



crane visible from most parts of the campus. The structural steel frame for the tower was installed during early October followed by the accelerator tank and then the concrete walls. Building construction will be complete by the end of 2011.

The accelerator will replace the KN accelerator and provide high intensity heavy ion beams for experiments at Notre Dame's St. George recoil separator and

will also increase the intensities for protons and alpha beams. The accelerator will be primarily used to expand the research program of Notre Dame's Institute for Structure and Nuclear Astrophysics (ISNAP) and the [Joint Institute for Nuclear Astrophysics](#) (JINA), a Physics Frontier Center of NSF.

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**Alumni**—let us know about your recent achievements and appointments. We look forward to hearing from you!

### Mitchell Wayne,

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## Notre Dame astrophysicist invited to Nobel Prize Ceremony

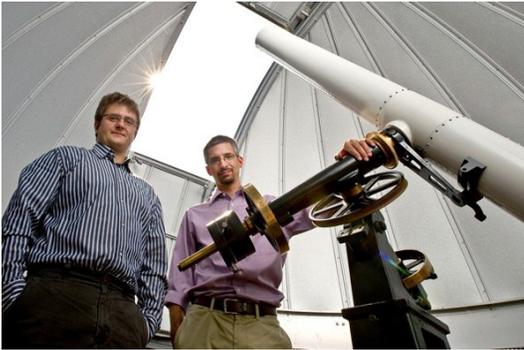
Notre Dame astrophysicist [Peter Garnavich](#) has been invited to the Nobel Prize Award Ceremony in Stockholm, Sweden on Dec. 10 when Nobel Laureates Brian Schmidt, Adam Riess, and Saul Perlmutter will receive the 2011 the Nobel Prize in Physics for the discovery of the accelerating expansion of the Universe through observations of distant supernovae.

Garnavich, who wrote the team's first paper that included supernovae data from the Hubble telescope, was a part of the High-Z Supernova Search Team led by Schmidt. Riess was a member of the same team, and Perlmutter was the leader of the rival Supernova Cosmology Project. The researchers demonstrated in the late 1990s that the universe is accelerating, leading to the now-standard

understanding of dark energy in the universe.

The High-Z Supernova Search Team which was composed of about 20 members in 1994 was looking for very distant supernovae. "We were trying to measure the density of matter, which we thought was the only thing in the universe," Garnavich said.

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## Astronomers find that galaxies are the ultimate recyclers

A team of researchers from several universities and institutions including [Chris Howk](#) and [Nicolas Lehner](#) has

demonstrated how galaxies continue to form stars by recycling vast amounts of hydrogen gas and heavy elements across billions of years. The researchers also identified large masses of previously undetected material surrounding galaxies, and described the large-scale flows of this gas. The results were published in three papers in the Nov. 18 edition of *Science* magazine. The leaders of the three studies are Nicolas Lehner of Notre Dame, Todd Tripp of the University of Massachusetts at Amherst, and Jason Tumlinson of the Space Telescope Science Institute in Baltimore.

The researchers used the Cosmic Origins Spectrograph (COS) on the Hubble Space Telescope to detect the mass in the halos of the Milky Way and more than 40 other galaxies. The process uses absorption lines in the high-resolution spectra of background quasars or stars to detect the gases in the clouds, which are invisible to other kinds of imaging. Data from the Large Binocular Telescope in Arizona, Keck in Hawaii, and the Magellan Telescope in Chile were also key to the studies by measuring the properties of the galaxies.

“We show that not only is there enough mass in the gas flows in halos of galaxies to sustain star formation over billions of years, but also the mass in the hot halos of star-forming galaxies is phenomenal—as large as the mass of gas in the disk of a galaxy!” says Lehner.

Clouds of ionized hydrogen within 20,000 light years of the

Milky Way disk contain enough material to make 100 million suns. About one solar mass of that gas falls into the Milky Way every year, comparable to the rate at which our galaxy makes stars. The cycle could continue for several billion years.

In more distant galaxies, the team found element-rich halos around star-forming galaxies, including surprising levels of heavy elements up to 450,000 light years beyond the visible portion of the galactic disks. COS measured 10 million solar masses of oxygen in a galaxy’s halo, which corresponds to about 1 billion solar masses of gas.

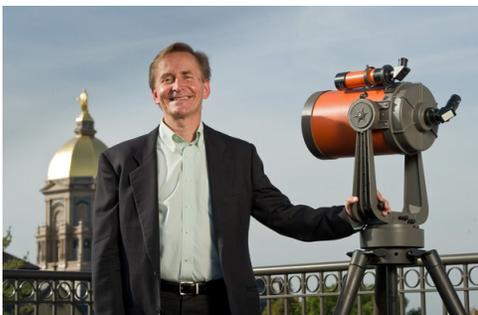
Links to additional information and images:

<http://hubblesite.org/newscenter/archive/releases/2011/26>

<http://hubblesite.org/newscenter/archive/releases/2011/37/>

## Garnavich, continued from page 1

“Researchers at the time were studying whether the universe would continue to expand or whether it would slow and eventually collapse. The first paper didn’t have enough supernovae to detect acceleration, but did show the universe would not ever recollapse.”



By the time Riess wrote the second paper in 1998, the group had gathered sufficient data, including more supernovae data from the Hubble, to show that the uni-

verse’s expansion is accelerating. “This is a big surprise,” Garnavich said. “It requires something that Einstein had postulated, the cosmological constant, but then discarded after it was discovered that the universe is expanding. Now we call it dark energy because we don’t know what it is.” The group went on to study what dark energy might be, and Garnavich was lead author of a paper that constrained the variety of possible models that might produce the acceleration. Since then, researchers have cataloged hundreds of supernovae with ground-based telescopes and hope to collect sig-

nificantly more data with space-based equipment to pursue understanding of dark energy.

The awarding of a Nobel Prize only 13 years after the discovery indicates the significance of the work, Garnavich said. “It was one of biggest discoveries in last 50 years,” he said. “It really did change the view of the universe. It has become kind of a standard model now to have matter in the universe dominated by some kind of dark energy. That’s not something people considered very likely just 20 years ago.”

Story by Gene Stowe

## New accelerator, continued from page 1

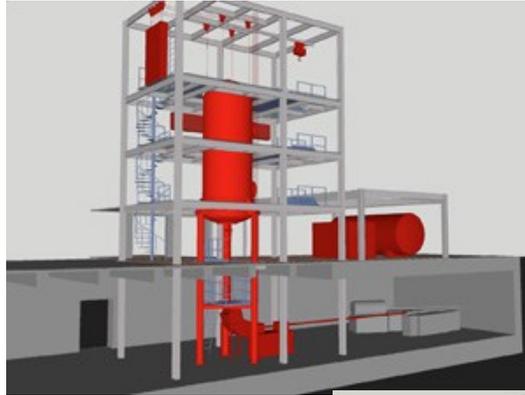
ISNAP is a university research center that operates the NSL at Notre Dame. The laboratory is built around three Van de Graff accelerators operating in different energy regimes and has a broad program in low energy physics. These three accelerators offer ideal conditions for experiments exploring basic nuclear physics questions about the quantum structure of nuclei or the origin of the elements in nuclear reaction processes in stars.

The NSL accelerators have the capability of producing intense particle beams of both stable and unstable nuclei of various types for research interests

including nuclear reactions with radioactive ion beams (RIBS) and nuclear astrophysics associated with stellar explosions. The laboratory has a large number of national and international user groups, including US National Laboratories, who work with the local research groups.

*Story by William Gilroy*

**Construction web cam:**  
<http://www.nd.edu/visitors/sights-sounds/webcams/nieuwland/>



## Department hosts prominent visiting faculty

The Department of Physics hosts visiting faculty throughout the year. The visitors facilitate new and established collaborations between influential scientists. Here are just a few recent visitors.

Visiting professor Rebecca Surman, a Union College astrophys-



icist, is spending the year at Notre Dame working with Ani Aprahamian, Freimann Professor of

Physics. Surman works on the r-process, the rapid neutron capture process which is responsible for the origin of over half of the heavy elements in the universe. Aprahamian studies exotic nuclei, lab-produced for study and present for only a split second, which are thought to play a significant role in the synthesis of these heavy elements.

The two researchers share a long-term collaboration, with Surman providing a link between nuclear structure physics and astrophysics.

Antonio Delgado, assistant professor, has published papers with two visiting colleagues in theoretical physics. Over the summer, Alberto Casas of the Institut de Física Teórica in Madrid worked with Delgado to calculate the constraints that the mass of the Higgs particle, which is being researched at the Large Hadron Collider, puts on the masses of other hypothetical particles that may be discovered there. For



the fall semester, Delgado is collaborating with Mariano Quirós Carcelén of ICREA in Barcelona.



They have devised a new model for particle physics which carries intriguing implications for the LHC and are currently discussing it with experimental colleagues.

Tomasz Wojtowicz comes to Notre Dame from the Institute of Physics, Polish Academy of Sciences. He has been working with Notre Dame faculty Margaret Do-



browolska, Jacek Furdyna, and Xinyu Liu for the past two decades; the group has amassed over 100 joint publications in the area of semiconductor physics, with special emphasis on magnetic semiconductors. During his recent visit, he shared his expertise in the fabrication and characterization of nanowires, a research subject of several Ph.D. students. He will

return for a similar visit in the autumn of 2012.

Professor Furdyna's research group has also hosted other visitors recently. Dr. A.V. Scherbakov of the Ioffe Institute in St. Petersburg worked with his group for the month of May. And, Prof. Sanghoon Lee of Korea University, Seoul, is spending his sabbatical here.

Visiting professor Gela Devidze, who is at Notre Dame from



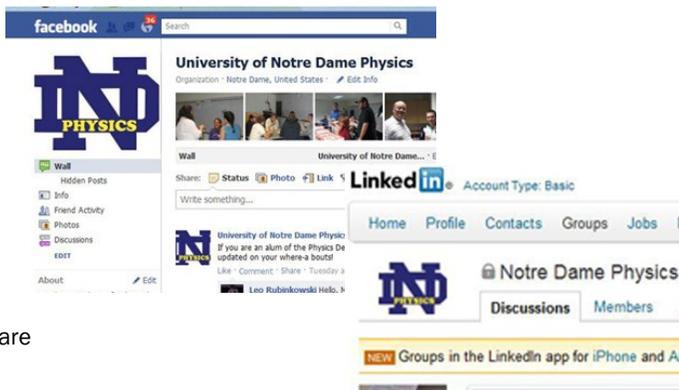
March to November as a Visiting Fulbright Scholar, is based at Tbilisi State University, Georgia. At Notre Dame, he has offered a particle physics seminar and furthered his research on extra dimensions in flavor physics. He is being hosted by Prof. Ikaros Bigi.

## Department expands its social networking presence

The Department of Physics has recently expanded its social networking presence by adding a group page to the [LinkedIn](#) web site. LinkedIn boasts itself as being the world's largest professional network with 120+ million members. Current and former physics faculty, post-

docs, staff, and alumni are invited to join.

Notre Dame physics also has an active [facebook](#) page. Photos from a variety of departmental events are regularly posted.



## Honors, awards, and appointments

Professor [Randal Ruchti](#) will serve as a program officer with the National Science Foundation's experimental high energy physics program. The appointment began in October 2011. He previously held this position from 2005-07.

The Natural Sciences and Engineering Research Council of

Canada (NSERC), a federal agency which administers funding for university-based research, has appointed [Philippe Collon](#), associate professor, to a three-year term as a member of the Scholarships and Fellowships Selection Committee.

[Ani Aprahamian](#), Frank M. Freimann Professor of Physics,

has been appointed to Institute of Physics review panel to examine the health of physics research areas in the United Kingdom focusing on the quality, distribution of effort, future potential, and economic impact. All areas of physics research will be evaluated but the first area is Nuclear Physics.



Ruchti



Collon



Aprahamian

## Celebrate Science Indiana

On Saturday, October 8, Notre Dame College of Science and Department of Physics was well-represented at the first Celebrate Science Indiana. CSI was a public event intended to demonstrate the importance of studying science and the joy of discovery, the economic value of science, and its significance to society. The event provided an opportunity for individuals to conduct hands-on activities, interact with scientists, explore opportunities, and ask questions about educational and professional possibilities in STEM areas. Physics representatives were Nancy Paul (undergraduate student), Matt Bowers and Mallory Smith (graduate students), Micha Kilburn (postdoc), and Debra Notestine (staff).

