

## Notre Dame Physics REU celebrates 25 years

One of the oldest, continually-funded Research Experience for Undergraduates (REU) programs in the country, the Physics REU at the University of Notre Dame marked its 25th year of National Science Foundation funding this summer.



University of Notre Dame Physics REU 2011

Each year, the NSF has provided funding for 12 students from other universities while funds from the College of Science, other programs and individual faculty research grants have supported about eight students from Notre Dame. The REU started as a regional program, drawing students from five nearby states, but now receives students from as far as California, Pennsylvania, Florida and

Arizona. More than 280 undergraduates applied this year for the twelve positions.

The REU program provides realistic research experiences to undergraduate students. The participants work with a faculty mentor on a research project for 10 weeks and are exposed to physics research in other areas via weekly seminars,

workshops, interactions with other participants, and field trips to nearby national laboratories. They prepare a research report at the end and make oral presentations at the REU Symposium.

“Many of those students are now professors of physics,”

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### Contact information

Phone: 574-631-6386  
Fax: 574-631-5952  
E-mail: physics@nd.edu

225 Nieuwland Science Hall  
Notre Dame, IN 46556

Web site:  
physics.nd.edu

Alumni—please send us a note with your recent achievements and appointments. We look forward to hearing from you!

## NISMEC trains teachers in guided inquiry

The Northern Indiana Science, Mathematics and Engineering Collaborative (NISMEC) hosted workshops this summer for local intermediate and high school science teachers, focused on best-practice approaches to science education, guided inquiry, and the new Indiana science standards that take place this fall. Led by Prof. Gordon Berry and the South Bend Community Schools

Corporation, NISMEC received two grants totaling more than \$600,000 to support the workshops.

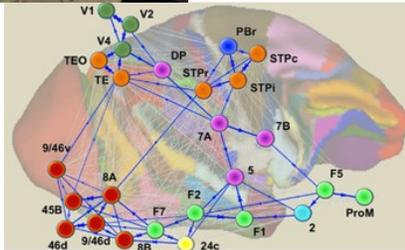
In June, 45 intermediate center teachers developed science investigation modules using portable measuring devices, called Vernier probes, for investigations in temperature, water quality, blood pressure, magnetic, and electric fields. In July,

high school teachers from northern Indiana studied the “modeling” approach to teaching chemistry and physics developed at Arizona State University a decade ago.

Find more information on this program at <http://physics.nd.edu/news/22860-nismec-trains-local-teachers-in-guided-inquiry/>

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## Notre Dame iCeNSA collaboration results reveal new brain information

Research by Maria Ercsey-Ravasz and Zoltan Toroczkai of the Interdisciplinary Center for Network Science and Applications (iCeNSA) and Department of Physics, in collaboration with a group of neuroanatomists in France, has revealed previously-unknown information about the primate brain.

The researchers published an article in the journal *Cerebral Cortex* showing that the brain is characterized by a highly consistent, weighted network among the functional areas of the cortex, which are responsible for such functions as vision, hearing, touch, movement control and complex associations. The study revealed that such cortical networks and their properties are reproducible from individual to individual.

Ercsey-Ravasz, a postdoctoral associate, and Professor Toroczkai analyzed 70 man-years' worth of data on macaque brains collected by a large group led by Henry Kennedy in

Lyon. The Kennedy team injected ink tracers into a portion of the brain and scanned thin brain slices to track the movement of the chemical through the nerve cells' branches, called axons, to the soma of the cells. Kennedy enlisted iCeNSA for its expertise at analyzing networks, which has also been applied to fields as diverse as the spread of disease and the social networks. Their analysis identified the consistency of connectivity among the areas of the brain.

The study is part of a broader investigation of brain function and intelligence that has accelerated in recent years as researchers abandoned the once-promising analogy between computer circuitry and human intelligence, a project that stalled in the 1970s. "It turns out the brain is not just this beautiful circuitry you could just back-engineer," Toroczkai says. "It is an amazingly complex system and this is why it is very hard to understand why it works."

The adult primate brain contains 100 billion neurons with

branches that connect at more than 100 trillion points. A top-down approach called functional decomposition, identifying bundles within the brain, helps overcome the sheer data volume. The macaque brain has 83 such areas, the human brain more than 120. "What we find is a network of connections between the functional areas," Toroczkai says. "That's important because we now have more detailed information about how the brain is wired on a large-scale, functional level."

Toroczkai and Ercsey-Ravasz will continue research in the field with US and international collaborators, aimed at understanding how information received through the senses and converted to electric pulses is processed in the brain. "It looks like there is some sort of general algorithm that is being run in this brain network," he says. "The wiring is very strange. It is not something you would expect. It constitutes one of the major motivations for this study, the Holy Grail of this research, if you will."

## A warm welcome to the newest department members

**Mariano Quiros:** Visiting Professor of Physics from Madrid, he is spending the fall semester working with the HEP theory group.

**Rebecca Surman:** Visiting Associate Professor from Union College, she is spending the year here collaborating with the nuclear physics group.

**Tomasz Wojtowicz:** Visiting Professor of Physics from War-

saw. He will spend October here working with Profs. Jacek Furdyna and Margaret Dobrowolska.

**Renaté Crawford:** Prof. Crawford has been appointed as an Adjunct Associate Professor. She is co-teaching the PHYS I (and possibly PHYS II) course with Prof. Dobrowolska this year.

**Micha Kilburn:** Dr. Kilburn is a Postdoctoral Research Associate

working on outreach efforts with JINA.

**Heather Christensen:** Heather is an administrative assistant in the main office. Her duties are focused on undergraduate student support and the physics REU program.

*Check the department's web site for a full listing of seminars, colloquia, and special lectures.*

## REU continued from page 1

says Umesh Garg, director of the REU program since 2000. "Several of our current graduate students are REU graduates, and over the years we have had many students who have chosen to come to Notre Dame. Many of them would not have known Notre Dame if it had not been for the REU."

The program originated informally in the mid-1980s, when professors Bruce Bunker and Randy Ruchti invited students to work in their labs during the summer. Terry Rettig directed

the program from its formal beginning in 1987 until 2000.

Physics faculty mentors have always been available for the undergraduates, says Garg, who matches applicants' skills and interests to laboratories' needs. "My aim is they have a good research experience in something they want to do, and they can do," he says. "A lot of time is spent just training them. Our faculty has made a conscious decision that this is good for the field and the department. We also want to make sure that the

students get real research projects."

A recent extension of the program and the more recent Research Experience for Teachers (RET) will provide \$1.4 million in the next five years, an increase of 22 percent. Over the 25-year history, the REU program has brought more than 400 undergraduate students from across the country to work with faculty in the Department of Physics.



## 2011 REU participants

Andrew Arend,  
University of Wisconsin-LaCrosse

Molly Ball,  
Monmouth College

Brittany Batman,  
Manchester College

Christopher Bell,  
University of Notre Dame

Anna Czerepak,  
University of Illinois

Erin Dahlstrom,  
Rice University

Joshua Ferguson,  
Butler University

Quinn Hailes,  
Hampton University

John Harden,  
University of North Carolina

Zach Harris,  
University of Notre Dame

Robert Heitz,  
Virginia Tech

Janie Hoormann,  
Baylor University

Justin Kelly,  
Northern Arizona University

Kevin McDermott,  
University of Notre Dame

Rubin Medina,  
California State University,  
Dominguez Hills

Nishanth Sasankan,  
University of Texas-Austin

Brandon Summa,  
University of Notre Dame

Bryant Vande Kolk,  
Ripon College

Nguyen Vu,  
University of Notre Dame

## Faculty honors, awards, and appointments



**Professor Michael Wiescher**, Freimann Professor of Physics, is the recipient of the

11th annual Notre Dame Faculty Research Achievement Award. Internationally recognized as one of the foremost nuclear astrophysicists in the world, Wiescher is founder and director of the Joint Institute for

Nuclear Astrophysics and has published more than 300 articles in scientific journals.



**Professor Umesh Garg** was elected the Vice Chair of the next Gordon Research Conference

on Nuclear Chemistry at the 2011 meeting held June 12-17, 2011, at the Colby Sawyer College, New London, NH. He will

become Chair of the subsequent Conference.

**Professor Jacek Furdyna**, the Aurora and Thomas Marquez Professor of Information Theory and Computer Technology, was invited to present a plenary lecture entitled "Exchange Coupling in Magnetic Semiconductor Superlattices and Multilayers" at the European Conference on the Physics of Magnetism 2011, held in Poznan, Poland June 27 to July 1, 2011.

## Visiting French student studies circumgalactic medium with Notre Dame astrophysicists

Julie Bourguet, a master's candidate at the Université Paris Diderot, is spending the summer at Notre Dame in an internship with Nicolas Lehner, research assistant professor in the Department of Physics.

Lehner's current project concerns the properties and evolution of the circumgalactic medium, the gas which surrounds galaxies and is used in the formation of stars. The timeline for gas consumption in star formation is far shorter than the age of the Universe; thus, the fuel must be recycled by processes not yet explained through observation or simulation. Accounting for this is an important goal of modern astrophysics.

Bourguet's role this summer has been to study the gas within the lines of sight to bright, distant quasi-stellar objects (QSOs), whose light originated several billion years ago. By

examining the material in the foreground of the QSOs, she can determine the chemical makeup of the circumgalactic gas at different epochs and compare it to that of galaxies at the same epochs. Her involvement and enthusiasm have been key to moving the project forward.

The project uses high-quality data from both Earth- and space-based state-of-the-art telescopes, including the Hubble, Keck, GALEX, and the Large Binocular Telescope, of which Notre Dame is a contributing partner.

The early results support relatively untested cosmological simulations predicting that cold streams of gas flow into galaxies along dense intergalactic filaments. This observational effort was first led by Bourguet's project mentor, Joe Ribaud, who defended his thesis last



month at Notre Dame under the supervision of Chris Howk and Lehner. His early results have been submitted to the *Astrophysical Journal*.

Lehner recently presented the summer's findings at a conference in Durham, England. He has also been invited to present them next month at the University of Colorado in Boulder and the University of Wisconsin-Madison.

## Former QuarkNet teacher honored as APS Pre-College Teacher of the Year

The American Association of Physics Teachers announced that the 2011 Paul Zitzewitz Excellence in Pre-College Physics Teaching Award winner is Stacy McCormack, a physics teacher at Penn High School in Mishawaka, IN. This award recognizes contributions to pre-college physics teaching and awardees are chosen for their extraordinary accomplishments in communicating the excitement of physics to their students. She was nominated for this award by Prof. Mitchell Wayne, Chair of the Department of Physics.

McCormack has received numerous awards including Indiana State Teacher of the Year 2011, Penn-Harris-Madison 2010 Teacher of the year, and the Martha Lee and Bill Armstrong Teacher Educator award. She has been involved in the Quarknet Research Experience for Teachers program at the University of Notre Dame and she was selected as one of five teachers in the United States to attend a three-week conference at CERN in Geneva, Switzerland during the summer of 2006.



Stacy McCormack, center, Indiana Superintendent of Public Education Dr. Tony Bennett, left, and Steve Hope, Principal of Penn High School, right.