

LSU

College of Science
Department of Physics & Astronomy

NEWSLETTER

2014-15

Special Features

LaCNS \$4.9M Grant
Nuclear Physics
Big Data
Medical Physics
Magnetocaloric Research

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For more info visit:

www.phys.lsu.edu

Or contact Mimi LaValle
External Relations Manager
mimi@phys.lsu.edu
225-578-2261

Listening to the Universe

ADVANCED LIGO COULD PROVIDE BREAKTHROUGH DISCOVERY



LIGO-Livingston

Advanced LIGO, the upgrade to the LIGO detectors that will provide an increase by a factor of 1,000 in the number of gravitational wave candidates, was officially dedicated on July 31, 2015. LIGO, together with its sister interferometers VIRGO and GEO in Europe and the planned KAGRA facility in Japan and LIGO-India, will look for the predicted signals from compact binary inspirals and mergers in neutron star and black hole systems, together with the stochastic signal from the Big Bang and unanticipated bursts of gravitational waves from distant cosmic events. Cooperative arrangements have been made with observers at wavelengths from radio to gamma rays to look for counterparts. Both the Livingston and Hanford detectors have achieved lock, and the first science run with Advanced LIGO is scheduled to begin in September. See www.ligo.caltech.edu/LA for more information about LIGO and its Livingston Lab.

Summer REUs on Campus

For the fifth summer, the department has hosted two Research Experiences for Undergraduates programs -- one in physics and a second, in cooperation with the Louisiana Alliance for Simulation-Guided Materials Applications (LaSIGMA) program and CCT, in computational materials. The 2015 physics program brought 15 students to campus to work with faculty in astrophysics, particle and nuclear physics, condensed matter, atomic physics, quantum computing, and medical physics. Forty additional students in the computational materials program learned to use some of the nation's largest supercomputers, participated in the setup and management of large-scale simulations, and took part in the analysis and visualization of simulation results. For more info visit: <http://bit.ly/1Lvdpr0>



2015 P&A REU Participants and LSU Faculty



LA-SiGMA & CCTREU Participants and LSU Faculty

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Despite the State's difficult financial outlook, the Department continues to move forward. We hired a new tenure-track assistant professor (Joyoni Dey in Medical Physics) and a new instructor (Dalgis Mesa) in August 2014. Scott Marley joined the Department as an assistant professor in Nuclear Physics in August 2015, Rui Zhang started as an assistant professor in Medical Physics, and Nayeli Zuniga-Hansen as a new instructor. John Wefel has retired but will continue working on his CALET Space Station experiment and LaSPACE. Bobby Beard has left us to take an instructor position at Rice, and Brandon Lohmann has left his position as undergraduate lab supervisor to move to Kansas State; we will miss them both and wish them good luck. As of August 2015, the number of tenure-track and tenured faculty will be 47, with 2 research faculty and 7 instructors. We are approved to conduct two new searches in 2015-16 for faculty in theoretical Astrophysics and Subatomic Physics.

Sponsored research expenditures from state, federal, and private sources amount to approximately \$8.5M annually, up from \$7.9M last year and well above the total of \$5.8M six years ago. Highlights of the faculty's and students' research can be found on the Department's website at www.phys.lsu.edu. Twelve students received bachelor's degrees in Physics in 2014-15. According to the department's records, the number of undergraduate majors as of Summer 2015 is 116. 19 new PhD students and 4 Medical and Health Physics Masters students joined the Department in Spring - Fall 2014. In Fall 2015, 15 new PhD students and three MS students are expected to join the department. Twelve students received PhDs and 11 received MS degrees during 2014-15.

As you can see inside and on our department website, our students, faculty, and alumni are winning departmental, College, University, and national awards. We continue to produce noteworthy research in all the areas in which we are involved – and we are working hard to involve our students in that research activity starting in their first year. Approximately 75 undergraduates are on the payroll working with research groups, and another 45 undergraduate students this

year worked as Learning Assistants running recitations for our first year Physics courses.

As examples of the new and continuing projects in the department: John DiTusa received a \$4.9M DOE award to establish a Louisiana Consortium for Neutron Scattering (LaCNS). Greg Guzik has been named the new statewide director of NASA EPSCoR and LaSPACE, which will receive \$4.4M in new funds over the next 3 years. Ken Schafer and Mette Gaarde are leading a \$2M/yr NSF Ultrafast Science program involving LSU, Ohio State, and Univ. of Virginia, and are part of a \$12.5M 5-year DOD Multi-University Research Institute award for fast laser physics. Phil Sprunger is Co-PI of a \$20M 5-year DOE award for a Consortium for Innovation in Manufacturing and Materials. John Wefel is the U.S. spokesperson for the Japan-U.S.-Italy CALET project to measure the spectrum of high energy cosmic ray electrons, nuclei, and gamma rays. CALET was launched to the International Space Station in August 2015, and plans to collect data for 5 years.

The department's public outreach program continues to be active: The Student Physics Society makes presentations at local schools and had a major presence at the LSU Space Day event that we put on last year together with the College of Engineering, NASA, and Lockheed Martin. The Highland Road Park Observatory operated by the Baton Rouge park district (BREC) and LSU remains popular with the public. Nanodays organized by department faculty has now become an annual event. The Masters in Natural Science program has provided science and pedagogy training to local physics and chemistry teachers, the Louisiana Space Consortium (LaSPACE) provides programs and funding for students and faculty across the state, and the Saturday Science lecture series brings high school students and their teachers to campus every month.

We have included news about alumni in this newsletter. Please send us your news and we will gladly include it in the next edition. If you are here in Baton Rouge, let us know and we will be delighted to show you around Nicholson Hall – and if you would be interested in meeting with our undergraduate and graduate students as part of our "What I Did with my Physics Degree" series, please let me know. (We even promise to feed you pizza with the students!)

Crawfish Boil

The annual Department crawfish boil, held on the Friday of finals week, featured 500 pounds of crawfish, 50 pounds of potatoes and 250 pieces of corn. More than 150 people socialized outside of Nicholson Hall for the event. To view a photo gallery of the event, visit www.phys.lsu.edu and click on the photo gallery link.



(l-to-r) Dana Browne, Joyoni Dey, and Doug Granger enjoy the weather and festivities.

Awards and Graduates

2014-15 Graduates

Summer 2014 Graduates:

M.S.: Margaret Hernandez, Melissa Lamberto, Bart Morris, and Benjamin Rusk
Ph.D.: Brajesh Gupta, Keibei Jiang, Rebecca Ringuette, and Amir Shadkam

Fall 2014 Graduates

B.S.: Collin Hawkins and Nutsinee Kijbunchoo
M.S.: David Byrd, Derek Freund, and Manish Gupta
Ph.D.: Ryan DeRosa, Joseph Prestigiacomo, and Bhaskar Roy Bardhan

Spring 2015 Graduates

B.S. Nicholas Chason, Jonathan Curole, Haggai Davis, Adrian Galan, Mark Morreale, Jason Mueller, Thu Phan, Cadron Pickett, Evan Rabeaux, Kenneth Suterland, and Cedric Williams
M.S.: Anthony Mazza, Edward Montiel, Noah Morris, and Alok Shankar
Ph.D.: Anamaria Effler and Chinedu Ekuma

Summer 2015 Graduates

B.S.: Mark Morreale
M.S.: Hatim Chafi, Christopher Johnson, Nicholas Petersen, Haoyu Qi, Ryan Schurr and Runyon Woods
Ph.D.: Christopher Granier, Kaushik Seshadreesan, and Mengxi Wu

LSU College of Science Choppin Honors Convocation

- Robert Beard, Will McElgin, Dubvra Rupnik – College Teaching Award
- Catherine Deibel College of Science Research Award
- Mark Wilde LSU Alumni Association Rising Faculty Research Award
- Mette Gaarde LSU Alumni Association Faculty Excellence Award
- Jonathan Curole Keen-Morris Award
- Jason Mueller Outstanding Senior Award

Department of Physics & Astronomy Awards

Undergraduate Research Award
Matt Curtis
Austin Baldwin

Department Service Award
Mark Ditusa
Amy LeBleu
Ashley Disbrow
Alison Dreyfuss

Outstanding Teaching Assistant
Terra Hardwick
Jieun Yoo
Joseph Steiner

Callaway Award
Zach Edwards



Allison Dreyfuss and Ashley Disbrow-Hood

Cosmic Ray Research

SUPPORTING THE PIPELINE FROM STUDENTS TO SCIENTISTS

"Cosmic Ray Research: Supporting the Pipeline from Students to Scientists", a symposium in honor of John Wefel, was held at LSU in August 2014. Over 100 colleagues, collaborators, students, and friends gathered for two days to talk about John's cosmic ray experiments from the early experiments on elemental and isotopic composition through the JACEE and ATIC high energy experiments and the upcoming CALET experiment to be flown on the Space Station. There were talks describing his commitment to STEM education and student mentoring, his

leadership of LaSPACE, and the summer schools in Erice. More detail can be found in the most recent LaSPACE newsletter at <http://laspace.lsu.edu/Documents/newsletter/LaSPACE-Newsletter-Fall2014.pdf>

Below: Attendees of 2014 symposium in honor of Dr. John Wefel



Landolt Standards & 21st Century Photometry



The Landolt Standards & 21st Century Photometry Meeting was held at LSU in May 2015 in honor of Arlo Landolt's distinguished career and his service to the astronomical community. Landolt, Ball Family Professor Emeritus, is known for his extensive and carefully calibrated lists of photometric standard stars – "Landolt Standards." As

CONFERENCE HONORING CAREER OF ARLO LANDOLT

described on the occasion of his being honored at the National Optical Astronomy observatory for his 55 years of observing at Kitt Peak and other telescopes (<http://www.noao.edu/news/2014/pr1405.php>), "His most quoted paper, published in 1992, has been cited in the professional astronomical literature over 3,800 times—an average of 172 times per year. For comparison, the number of times a typical astronomical paper is cited is in the single digits per year, and rarely, if at all, after 20 years. To compile the necessary data for the standard stars, Arlo Landolt has spent at least 1,500 nights observing at different telescopes over the

years since 1958: possibly an all-time record for any astronomer! Nor has formal retirement slowed him down; over half of these nights have been in the last 15 years." The meeting at LSU in May featured 12 talks, a panel discussion "From Standardized Photometry to Astrophysics," and posters, and brought together friends and colleagues from Arlo's long and exceptional career.



Attendees to the 2015 Arlo Fest on the LSU Campus

20th Mardi Gras Conference

Hosted by La-SiGMA and the Materials Science Group at LSU's Center for Computation & Technology, scientists from academia and research labs, postdoctoral researchers, and graduate students working in the wide domain of materials science convened at LSU in February 2015 to promote the exchange of ideas, experiences, and research results, and discuss current challenges. Topics included numerically exact descriptions of disordered and interacting electron systems, complex spin and orbital states of correlated materials, strongly correlated superconductors, including strong correlations in density functional theory, spin models, etc.

This conference was sponsored by the Partnership for International Research and Education (PIRE) funded by the U.S. National Science Foundation. The goal of this project is to develop a new international research and graduate education program leveraging cyberinfrastructure investment to study complex phenomena in correlated materials.

High Harmonic Spectroscopy Workshop

In March, LSU was host to a conference on attosecond laser physics jointly organized by Mette Gaarde and Ken Schafer from the Department of Physics & Astronomy and Kenneth Lopata from the Department of Chemistry and the Center for Computation & Technology. Researchers from Italy, Germany, France, the United Kingdom, and U.S. attended the kick-off meeting for the "Time-Resolved High Harmonic Spectroscopy: A Coherently Enhanced Probe of Charge Migration," collaboration involving LSU, The Ohio State University, and the University of Virginia, funded by the Department of Energy. The collaboration is an integrated effort that combines theory (LSU) and experiment (OSU, UVA) from the very beginning.

High harmonic spectroscopy is a new technique that offers the highest possible temporal resolution for the study of charge migration in molecules – perhaps down to the attosecond time scale. It is made possible through the interactions of laser-field driven electrons with their parent molecular ion. The extreme ultraviolet photons generated in these electron collisions are the experimental observables that can encode information on an evolving molecule. This modality is site specific: recombination is likely very sensitive to electron correlation and hole dynamics. The collaboration hopes to explore whether the coherence of the extreme ultraviolet generation process, both in terms of repeated wave packet sampling of the molecule and macroscopic propagation effects, can be exploited to enhance the measurement sensitivity.

OSA Student Chapter

The Optical Society of America (OSA) has announced the formation of the LSU OSA Student Chapter. This newest addition joins more than 325 OSA Student Chapter organizations in more than 55 countries around the world. OSA is the leading professional society for scientists, engineers, students, and business leaders working in optics. "The LSU OSA student chapter will offer more opportunities to students in the field of optics and optics related area," said Chenglong You, graduate student, LSU Physics & Astronomy. For more information, contact Chenglong You at cyou2@tigers.lsu.edu

Physics Block Party

ANNUAL WELCOME FOR NEW STUDENTS TO LSU

This year's Physics & Astronomy Block Party featured a scavenger hunt, Othello and ping pong tournaments, minimum acceleration duels, Jacob's Ladder, pizza, and LN2 ice cream.

For a list of winners, visit: www.phys.lsu.edu and click on graduate programs.

Original Physics Limerick:

There once was a neutral neutrino,
who dreamt that he could be a C.E.O.
He went off to college
to get some knowledge,
but no one would hire him, though.

-By Ali Dreyfuss



Undergrad student Nutsinee Kijbunchoo "duels" with graduate student Kundan Kadam at the 2014 Block Party.

LSU Society of Physics Students

LSU's Society of Physics Students chapter was particularly active this year. The chapter attended STEM Nights at Scotlandville Magnet and Crestworth Elementary, where volunteers demonstrated various laws of physics. The club performed demos at

Earth Day in downtown Baton Rouge, and at Astronomy Day events at the Highland Observatory. The Van de Graff generator was a favorite among children and parents alike. Other demos illustrated angular momentum and inertia, eddy currents,

radiation, and stargazing.

SPS also enjoyed social events: Members attended the fall laser tag event, and the holiday/end of finals party. In the spring semester, several members were able to go on a camping trip to the Clear Springs area of the Homochitto National Forest during which the group was able to stargaze and enjoy nature. For the first time in several years, the chapter was also able to take members on a Spring Break Trip. Thanks to help from the department, the chapter was able to tour the Kennedy Space Center at Cape Canaveral! The group also visited and toured the Orlando Science Center, went to Disney, and thoroughly enjoyed their time on the beach.

If you would like more information on SPS – LSU, feel free to contact the president Amy Lebleu at lebleudogs@bellsouth.net or the Public Relations officer Jory Ball at jball24@tigers.lsu.edu.



LSU SPS tours the Kennedy Space Center at Cape Canaveral

MARS Truck Transports Science

The Mobile Astronomy Resource System (MARS), operated by the Louisiana Space Grant Consortium (LaSPACE) in partnership with the LSU Cain Center, the Highland Road Park Observatory (HRPO), and the LSU Department of Physics & Astronomy, is a light commercial box truck containing computer controlled telescopes, a digital portable planetarium, and

MARS vehicle can travel to sites such as parks, shopping malls, and schools around the state to support public outreach events.

On Sunday, April 19, 2015, the MARS truck was stationed at the Old Governor's Mansion in the designated children's area for Louisiana Earth Day. LaSPACE staff and faculty, LSU LaACES students, and LSU Society of Physics Students



(SPS) staffed three major visitor stations, which featured solar telescopes, scientific near-space ballooning experiments conducted by students, and demonstrations by the SPS students, including a Geiger Counter Demo, Van de Graaff Generator, Angular Momentum / Rotational Inertia Chair Demo, Spectrograph, Faraday's Law of Induction Demo, and a Tube Race Demo. It is estimated

other equipment and materials to provide an astronomy/space science learning experience to audiences at remote sites. A MARS truck program typically includes telescope sky viewing, a digital planetarium show, and science activities and demonstrations, staffed by LSU faculty, LaSPACE staff, and LSU students. The

at least 1,500 visitors of all ages came by the MARS Truck.

For more information or to book the MARS truck for an event, contact Bethany Broekhoven, LaSPACE Education Coordinator at bbroek1@tigers.lsu.edu.

LANDOLT ASTRONOMICAL OBSERVATORY

Once a month, on the Saturday (or sometimes Sunday) nearest the First Quarter Moon, with a "rain date" on the next day (Sunday), the general public is invited to observe the sky. Admission is free.

Built in the late 1930s, the Landolt Observatory featured many spectacular viewings this past year, including:

- Tight Mars/Saturn/Crescent conjunction
- Mars meets Antares

- Total lunar eclipse, the Moon 'turned to blood'
- Gibbous Moon passes close by Neptune
- Venus, Jupiter, and Quarter Moon
- Moon on a half-shell
- Orion
- Asteroid whipping close by Earth
- Total lunar eclipse in the dawn

For more info visit: www.phys.lsu.edu and click on LAO Public Observing Night.

What I Did with My Physics Degree

A 2012 PhD alumnus, and six industry speakers visited the LSU campus to share their career experiences.

Alex Brandt, Rackspace- "How I learned to stop worrying and live in business."

Sean Hall, Carver Scientific- "Some surprising thoughts and realizations from a would-be scientist about employment in the 'Real World'."

Peter Reis, 2012 LSU PhD, PosiTech Corporation - "Using Physics and Computation in Industry."

Shell visited campus with four representatives:

Benjamin Anger, Senior Associate Researcher/ Innovation, Research & Dev. - "Basic & Applied Magnetic Resonance Research in a Research Lab"

Madhu Kohli, Geophysics Discipline Lead/ Upstream Americas Deepwater - "Physics: Key to a 'Solid State' Career"

Elizabeth Tanis and Alec Yang, Petrophysicists, shared their progression in the oil and gas industry and explained how their background in physics provided an easy transition into their new roles.

For more information or to participate in the series, please contact Mimi LaValle: mimi@phys.lsu.edu

Saturday Science

Among the many exciting topics covered at the monthly Saturday Science events:

"Quantum information, entanglement and all that jazz" by Mark Wilde

"The evolutionary history of small mammals on tropical islands" by Jacob Esselstyn

"Neutrino oscillations" by Martin Tzanoov

"The nervous system" by Karen Maruska

"Novel nanomaterials for advanced energy" by Ying Wang

Come visit campus on the third Saturday of the month to share in the wonder of science. Visit www.phys.lsu.edu for a schedule of Saturday Science events.

Highland Road Park Observatory

The Highland Road Park Observatory has remained a popular public destination on Friday and Saturday nights in Baton Rouge. You will often find an LSU professor or graduate student operating the telescope on a public night. Public lectures from LSU Physics & Astronomy covered a diverse array of topics including: "NASA's Chandra X-ray Observatory" and "Into the Neutron Star" (Rob Hynes), "Comets" (Greg Stacy), "LIGO: The Fantastic Search" (Amber Stuver), "The Rosetta Mission—Rendezvous with a Duck" (Kundun Kadam) together with annual favorites "The Star of Bethlehem" and "Dating the Crucifixion" (Brad Schaefer).

On April 25, the observatory was the local host for over four hundred visitors to International Astronomy Day. People were educated and entertained by a variety of exhibits and demonstrations through the day from our Society of Physics Students, the Baton Rouge Astronomical Society, the Baton Rouge Amateur Radio Club, and the radio-controlled planes of the Red Stick Flying Club, as well as other groups, the observatory staff, and volunteers.



Families enjoy International Astronomy Day at HRPO

NanoDays - Small Science Wields Big Ideas

Nanoscale structures, such as a single strand of DNA, have been central to numerous discoveries including advanced applications in energy, information storage and medicine. Because of its promising future, organizations across the country celebrate NanoDays, a nationwide festival of programs about nanoscale science and engineering.

For the sixth consecutive year, LSU hosted NanoDays at the Highland Road Park Observatory. The family-friendly event featured several hands-on activities for guests of all ages.

NanoDays activities included:

- How a Scanning Probe Microscope helps scientists explore the nanoworld
- Using nanomaterials to make stain-free clothes
- Playing with liquid crystals and magnets
- Making an Oobleck, a liquid with both

liquid and solid properties

- A solar viewing

"NanoDays demonstrates the power of tiny things," said Juana Moreno, associate professor of both the Center for Computation & Technology and the Department of Physics & Astronomy. "This year, about 100 people visited the exhibits and many graduate students were on hand to share science and discovery with the children and their families."

NanoDays sponsors included the Department of Physics & Astronomy, the Center for Computation & Technology, the Department of Chemistry, the Society of Physics Students, and the Louisiana Alliance for Simulation-Guided Materials Applications.



Aspiring scientists experiment with nano structures

\$4.9M Research Grant from Dept. of Energy



LSU Materials Science and Engineering faculty in the departments of Physics & Astronomy, Chemistry, and Chemical Engineering are leading a multimillion-dollar statewide collaborative research initiative that will expand the fundamental understanding of advanced materials. The Louisiana Consortium for Neutron Scattering, or LaCNS, was granted \$4.9 million of funding for three years from the U.S. Department of Energy's Experimental Program to Stimulate Competitive Research, or EPSCoR, program through the Louisiana Board of Regents in August 2014. The consortium includes faculty and graduate students from Tulane University, University of New Orleans, Louisiana Tech, and LSU.

"This research promises to have a long-

term impact on everything from the amount of memory available in your computer and the speed at which it can be accessed, the efficiency of power transmission lines and the cost and efficiency of devices that convert sunlight to electricity, as well as the discovery of new materials with unexpected properties. All of these aspects need fundamental discoveries to make advances toward new and better devices," said John DiTusa, LaCNS principal investigator and LSU physics professor.

The grant will fund the research for faculty, graduate and undergraduate students at all four Louisiana universities. At LSU, it will fund 10 faculty, eight graduate students, six post-doctoral researchers, and one visiting faculty member.

"Part of our mission is to excite and train the next generation of scientists who will be experts in both the science and neutron scattering techniques," DiTusa said.

Neutron scattering is one of the few techniques available that can probe the structure and dynamics of materials over a broad range

of time, length, and energy scales. LaCNS researchers will use the equipment and facilities and collaborate with the scientific staff at Oak Ridge National Lab in Tennessee, where they will run their experiments.

The LaCNS research team includes experimentalists who have expertise in a wide variety of characterization techniques, spin dynamics, materials synthesis and characterization, neutron scattering and modeling.

"We bring together a diverse group of university faculty who work in concert from the synthesis of new materials to the characterization and understanding of them to the simulation of their properties using computational methods. We have all of that expertise under one roof working together," DiTusa said.

LaCNS hosted its first workshop, "Neutron Scattering in Soft Matter," in December 2014 at LSU, attended by 40 faculty, postdocs, and graduate students. A second "Neutron Scattering Workshop" was held at Tulane in June 2015.

For more information, visit: www.phys.lsu.edu/lacns

Physicists propose new classification of charge density waves

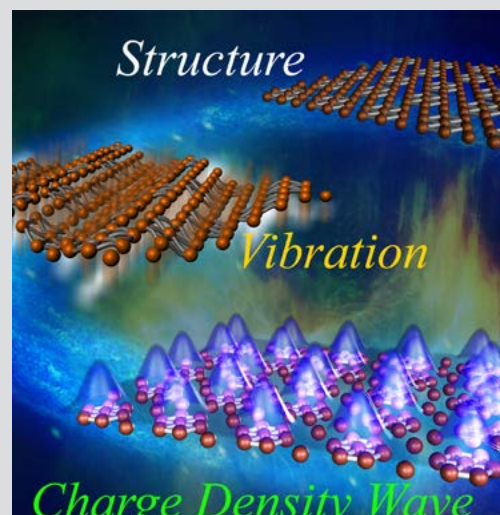
Ward Plummer and Jiandi Zhang, in collaboration with their colleagues from the Institute of Physics, Beijing, China, have published a paper in the *Proceedings of the National Academy of Sciences* (Vol. 112, pg. 2367) titled "Classification of Charge Density Waves based on their Nature." This work is a result of a collaboration funded by the Chinese Academy of Sciences.

Charge Density Waves, or CDWs, are observed in many solids, especially in low-dimensional systems. The existence of CDWs was first predicted in the 1930s by Sir Rudolf Peierls, who suggested that they would exist in an ideal one-dimensional (1-D) chain of atoms, lowering the energy of the system and driving a reconstruction of the lattice. The 1940 paper by Frisch and Peierls described how one could construct an atomic bomb from a small amount of uranium-235. In 1959, Walter Kohn, who received the Nobel Prize in 1998, pointed out that the origin of a CDW in the Peierls picture would result in

what is now known as a "Kohn Anomaly," a simultaneous softening of coherent lattice vibrations, for example, phonon softening. This simple textbook picture of the origin of CDWs does not seem to be correct in most if not all materials.

Therefore, Plummer and Zhang propose a new classification of CDWs based upon their nature. For more info visit:

<http://bit.ly/1FBe9Is>



Nuclear Physics

Tomas Dytrych, Kristina Launey, and Jerry Draayer's article "Symmetry-Adapted No-Core Shell Model" in the McGraw-Hill *Yearbook of Science & Technology* describes their model for ab initio computations of properties and structure of atomic nuclei, including exotic open-shell isotopes that are the focus of current and next-generation rare isotope experimental facilities. The model was implemented in the form of a massively parallel computer code that scales well for hundreds of thousands of processors and possibly beyond, making it possible to carry out numerical modeling of medium-mass nuclei using chiral nucleon-nucleon interactions with unprecedented predictive capabilities.

Fundamental Rate-Loss Tradeoff for Optical Quantum Key Distribution

MARK WILDE'S RESEARCH APPEARS IN NATURE COMMUNICATIONS

Since 1984, various optical quantum key distribution (QKD) protocols have been proposed and examined. In all of them, the rate of secret key generation decays exponentially with distance. A natural and fundamental question is then whether there are yet-to-be discovered optical QKD protocols (without quantum repeaters) that could circumvent this rate-distance tradeoff. A paper by Masahiro Takeoka, Saikat Guha, and Mark M. Wilde, in *Nature Communications*, provides a major step towards answering this question. Here they show that the secret key agreement capacity of a lossy and noisy optical channel assisted by unlimited two-way public classical communication is limited by an upper bound that is solely a function of the channel loss, regardless of how much optical power the protocol may use. Their result has major implications for understanding the secret key agreement capacity of optical channels—a long-standing open problem in optical quantum information theory—and strongly suggests a real need for quantum repeaters to perform QKD at high rates over long distances. For more info visit: <http://bit.ly/1cWDJxB>

Physicist Discovers Material Set to Change Cooling Industry

Refrigeration and air conditioning may become more efficient and environmentally friendly thanks to the patent-pending work of LSU physicists. The team of researchers led by Shane Stadler has discovered a breakthrough magnetocaloric material that may change the energy industry, including air conditioning and food refrigeration.

"The world refrigeration market is expected to increase by about \$7-8 billion by 2018," Stadler said. Therefore, his breakthrough has a significant potential economic impact as well as an impact on the energy industry and environment.

Stadler's research focuses on the next

generation of magnetic cooling technologies, which are simpler in design, quieter and more environmentally friendly than current conventional compressed-gas systems.

The idea is to use a magnetic field to order the material at ambient temperature, which raises its temperature above ambient. The excess heat is removed through a thermal medium, such as water or air, bringing the material back to ambient temperature. The magnetic field is then removed, the material becomes magnetically disordered and its temperature drops below ambient temperature leading to a cooling effect. This "solid state" cooling process is significantly

magnetostructural transition occurs near room temperature is what makes it a strong candidate for magnetocaloric cooling devices of the future."

Stadler's team's technological discovery is a promising alternative for refrigeration and air conditioning that can reduce the use of harmful gas fluorocarbons.

"We are excited about the potential applications that are available for Dr. Stadler's technology," said Andrew Maas, Assistant Vice President for Research and Technology Transfer and Director of the renamed Office of Innovation and Technology Commercialization. "The Department of Energy, General Electric, and other companies around the world have been working with magnetocaloric materials for some time. Dr. Stadler's solution addresses many of the issues that these big players have encountered."

Currently, a local group of entrepreneurs have expressed interest in this advanced technology. After further testing, they will look into developing commercialization opportunities utilizing it for the heating and cooling industry.

Currently, a local group of entrepreneurs have expressed interest in this advanced technology. After further testing, they will look into developing commercialization opportunities utilizing it for the heating and cooling industry.



From front to back: Tapas Samanta (Postdoc), Daniel Lepkowski (Undergrad), Ahmad Us Saleheen (Grad student), Emily Kramer (Undergrad)

Medical Physicists Study Radiation Necrosis

Radiation therapy is, of course, frequently prescribed to attack cancers and can have extremely positive outcomes. In addition to attacking the tumor cells, though, radiation also damages healthy cells, and the injury due to the radiation can also produce life-threatening outcomes. Radiation necrosis is difficult to diagnose and can go undetected on CT scans. Although the cause of this often-deadly side effect is understudied and grossly underfunded, a \$75,000 gift from the Bella Bowman Foundation to the LSU Medical Physics program is supporting research to understand the factors that contribute to radiation injuries to the brain from proton radiotherapy and develop diagnostic and therapeutic approaches to reduce the severity of radiation necrosis and ultimately eliminate occurrences of the rare side effect.

Graduate student Chris Schneider works with Wayne Newhauser on testing, developing, and refining the radiation dose calculation algorithms — looking at how much radiation treatment is administered by the machine — in both X-ray radiation therapy and proton radiation therapy. Andy Halloran is applying 3-D printing technology to the research by printing what Newhauser calls “plastic phantom” replicas of patients. These phantoms reproduce the anatomical structure of the patient’s disease,

so Halloran can test different radiation treatment measurements without harming the actual patient. William Donahue created a prototype database for necrosis cases for his master’s thesis, and is now extending the work for his PhD thesis. Lydia Wilson published a proof-of-concept study with Newhauser in *Phys. of Medicine and Biology* on a novel dose model for radiation cancer therapy. Experimental portions of the work were performed at Mary Bird Perkins Cancer Center. The long-term goal of the study is to enable clinicians to improve outcomes for patients with good prospects for long-term survival, especially to reduce treatment-related side effects.

“We’re simultaneously pushing the frontier of knowledge in several different areas”, said Newhauser, Director of the Medical Physics program operated jointly by LSU and Mary Bird Perkins Cancer Center. “We have very bright young minds who are making a difference through the research they perform as part of their graduate training.”

Additional information about the department’s necrosis research and the Bella Bowman Foundation support can be found in the LSU *Reveille* article at <http://bit.ly/1EnuUqE>.



Prof. Wayne Newhauser (center) with graduate students (l-to-r), William Donahue, Lydia Wilson, Andrew Halloran, and Chris Schnieder

Enhanced Electron Coherence in Atomically Thin Nb_3SiTe_6

Philip Adams and Tijiang Liu have published a paper in *Nature Physics* titled “Enhanced Electron Coherence in Atomically Thin Nb_3SiTe_6 .” The paper explores how the vibrations of atoms in a material change when that material is made very thin. It turns out that electrons move easily through several-atom-thick Nb_3SiTe_6 because atomic vibrations are confined by the thickness of the material. The work supports the predicted suppression of electron-phonon interactions due to quantum confinement in two-dimensional materials and suggests that electronic devices could be fabricated from these two-dimensional materials with superior electrical properties to those of current technologies.

Big Data in Astrophysics, LIGO & Medical Physics

“Big Data,” involving the ability to acquire, process, transport, access, and analyze large quantities of information quickly and efficiently, and “High Performance Computing” are areas highlighted in the Louisiana Office of Economic Development list of state priorities and the LSU Research and Development Office Strategic Plan. LSU’s traditional activities in this area have been focused on computationally intensive problems, such as large numerical simulations, that are characterized by requiring a large number of calculations carried out in parallel across many processors. Big Data problems differ in involving huge volumes of data, often distributed across multiple locations, large memory capacities, and high network bandwidths. They typically involve different hardware and software architectures to address the distinct technical challenges. Big Data is a rapidly developing area, both nationally and at LSU, with direct applications to LSU’s astrophysics and medical physics research efforts.

One of the many challenges in developing treatment regimens for cancer patients is that cancer is not a single disease. It’s hundreds, joined together by a common aspect — uncontrollable cell growth. “Traditionally, cancer treatment options are based off of large-scale clinical trials,” said Wayne Newhauser, Dr. Charles M. Smith Professor of Medical Physics and Chief of Physics at Mary Bird Perkins Cancer Center. “So basically, you’re basing treatment on averages. Modern medicine is moving more toward personalized medicine, which requires Big Data in order to process and analyze your DNA and genetics.” Translated, the ability to handle large, detailed images and test results and quickly analyze the resulting data set can potentially provide low-risk, high-return individual treatment plans based on a patient’s specific genetic makeup. “With the right kind of capabilities, we will be able to use imaging studies to build a genomic profile at even a basic physician’s

appointment,” said Newhauser. “Some of the world’s leading institutions already have this capability. We’re only a few years away from it ourselves.” Using information to diagnose and develop treatment options is known as bioinformatics, and it’s an up-and-coming field of study that stands to revolutionize the way we look at healthcare options. “We’re not there yet in terms of applying all this information to the average cancer patient,” said Newhauser. “But we have the clues, and we know the pathways.”

In the area of gravitational physics, Advanced LIGO is due to begin its initial Science run late in 2015. As described in LIGO’s recent Data Management Plan, the raw LIGO data are combined with auxiliary measurements and environmental monitors, calibrated, checked for quality control, and/or cleaned to build a time series representing the gravitational wave strain signal. Expected data rates for Advanced LIGO are about 10 megabyte/s per interferometer, corresponding to a total rate of about 1 petabyte/year.

Approximately 99 percent of the LIGO data will consist of detector and environment monitoring information. Selecting out and properly analyzing the gravitational wave strain channel will present a major computing challenge. Teraflops of computing power will be required to analyze the data at the rate it is acquired, and the searches for gravitational wave sources will be limited by the ability to manage the data and the computational power available.

In observational astronomy, the *New Worlds, New Horizons in Astronomy and Astrophysics* Decadal Survey commissioned by the National Research Council has recommended, as its two highest priorities for new facilities, the Wide-Field Infrared Survey Telescope (WFIRST) as a space mission, and the Large Synoptic Survey Telescope (LSST) on the ground. Both involve performing astrophysics on a staggering scale with

enormous multiplexing capabilities allowing them to address many scientific projects simultaneously.

The LSST is a large (8.4m diameter), wide-field, optical, and infrared survey telescope designed to cover more than half the sky about 1,000 times over a planned operational period of 10 years. It will operate in a continuous survey mode, simultaneously addressing science questions across the whole of astronomy and astrophysics, from the nature of dark energy to the search for potentially hazardous asteroids. A 3,200 megapixel camera will generate 30 terabytes per night and a 10-year dataset exceeding 100 petabytes. The LSST project will challenge database architecture, with an anticipated source table with 3 trillion rows, and a merged object table with 20 billion unique astronomical objects. Maximizing the scientific yield of this project will require extensive automated processing, and analysis of the data products using sophisticated machine-learning applications. For example, it is anticipated that the LSST will discover at least 100,000 new transient objects every night. These will require automated neural net classification in order to generate worldwide alerts on the most interesting objects within 60 seconds. WFIRST will also operate in a similar survey mode, generating large volume, shared-use datasets. The next generation of astronomers who will exploit the LSST and WFIRST cannot just be astronomers, they must be accomplished data scientists as well who can devise new search techniques and algorithms in this new era of data-driven discovery. The department has discussed hiring a group of three faculty who will work on Big Data Astronomy, and who we would anticipate would also be active in CCT and will collaborate with other Big Data groups at LSU. A Big Data Astronomy group has been proposed as a major fund-raising priority for the department.

Publications

- Daniel Sheehy, Stephen Kudla, and Dominique Gautreau have published a paper in *Phys. Rev. A* titled “Pairing correlations in a trapped one-dimensional Fermi gas.” This work analyzes theoretically the properties of a gas of atoms close to absolute zero and confined to a cigar-shaped optical trapping potential. Studying systems like this helps us learn more about the collective behavior of quantum mechanical systems.
- Jonathan Dowling, graduate student Jonathan Olson, undergraduate Evan Rabeaux, and colleagues have published a paper in *Phys. Rev. Lett.* titled “Linear Optical Quantum Metrology with Single Photons: Exploiting Spontaneously Generated Entanglement to Beat the Shot-Noise Limit.” They show that a very simple scheme, using just single photons, is able to perform quantum measurement with a degree of precision impossible using classical light, ushering in a new era for quantum measurement.
- Geoff Clayton and colleagues on the Heritage Herschel Key Project surveyed the Magellanic Clouds with the Herschel Space Telescope and modeled their global properties in two papers in the *Astrophysical Journal*: “Dust Properties and Insights into the Origin of the Sub mm Excess Emission” and “Variations of the Apparent Gas-to-Dust Ratio with Surface Density and Across ISM Phases.”

Jim Matthews and his Auger group published two papers in *Phys. Rev. D* on the question of the composition of the very highest energy cosmic rays: “Depth of Maximum of Air-Shower Profiles at the Pierre Auger Observatory: Measurements at Energies above $10^{17.8}$ eV” and “Depths of Maximum of Air-Shower Profiles at the Pierre Auger Observatory: Composition Implications”. Matthews also published a chapter “Cosmic Rays” in the latest edition of *Review of Particle Physics*.

Kip Matthews has been named president-elect of the Southwest chapter of the American Association of Physicists in Medicine. The AAPM supports the medical physicist community with a focus on advancing patient care through education, improving safety and efficacy of radiation oncology and medical imaging procedures through research, and the maintenance of professional standards.

Plummer Named Member of American Academy of Arts and Sciences

The American Academy of Arts and Sciences announced the election of 204 new members, including LSU Professor of Physics & Astronomy Ward Plummer. The American Academy of Arts and Sciences was founded by Benjamin Franklin and is one of the oldest scientific societies.

Plummer, who is also Special Assistant to the Vice Chancellor of Research and Economic Development and Director of the Institute for Advanced Materials, is widely considered one of the world’s leading physicists. A member of the National Academy of Sciences, which was founded by Abraham Lincoln, Plummer has served on many national and international committees both to review existing scientific programs and to identify future directions for science and technology.

“LSU is proud to count Ward Plummer among its faculty,” said Vice Chancellor of Research &

Singh Awarded LSU Rainmaker

As a top-tier research institution, LSU research faculty are proven leaders in their fields. The LSU Office of Research & Economic Development, with the support of Campus Federal Credit Union, takes the opportunity each year to acknowledge a few of the outstanding faculty with the Rainmaker Awards for Research and Creative Activity.

Parampreet Singh, an assistant professor in the Department of Physics & Astronomy, was named a Rainmaker in the category of Science, Technology, Engineering and Math Mid-Career Scholar.

“Professor Singh’s work on the fundamental physics of the Big Bang and the structure of space and time attracts international attention to LSU and Louisiana,” said Mike Cherry, professor and chair, LSU Department of Physics & Astronomy. “It excites students and attracts them to science and technology fields that are important for Louisiana’s economic development, and it provides state-of-the-art training for students that is then applicable to a wide variety of careers. LSU is fortunate to be able to attract scholars with the status and reputation of Dr. Singh.”

Singh investigates the origins of the universe and the way properties of space and time emerged during its birth, ideas based in Einstein’s Theory of Relativity.

Faculty members chosen as Rainmakers are those who balance their responsibilities – which extend far beyond the classroom – with external expectations such as securing funding for their research and establishing the impact of their findings to the scholarly community and society as a whole. They garner both national and international recognition for their innovative research and creative scholarship while also competing for external funding at the highest levels and attracting and mentoring exceptional graduate students.

Gaarde Elected Fellow of Optical Society of America

Mette Gaarde has been elected a 2014 Fellow of OSA based on her “significant contributions to the advancement of optics and photonics.” “This year’s class of OSA Fellows has offered prodigious service to OSA and the global optics community,” said OSA President Philip Bucksbaum. “The Optical Society is honored to offer recognition for their outstanding contributions and leadership in the optics and photonics profession.”

Economic Development Kalliat T. Valsaraj. “He is truly one of the world’s leading physicists, so his recognition by the Academy comes as no surprise to us.”

He is author of more than 380 refereed papers and is counted among the 1,000 Most Cited Physicists, a list compiled by the Institute for Scientific Information based on papers published between 1981 and 1997. He has advised or co-advised more than 50 graduate students, hosted more than 30 postdoctoral fellows, and assisted many young scientists in advancing their careers.

Plummer was a driving force behind the creation of a “dual degree” program in materials science between LSU and institutes and universities in China. In 2010, he was appointed to a visiting Professorship for Senior International Scientists by the Chinese Academy of Sciences.

Jiandi Zhang has been named a Fellow of the American Physical Society “for his significant contributions to elucidating the correlation between bulk and surface static and dynamic properties of complex materials.” Zhang’s main research interest explores novel properties of complex materials such as transition metal oxides by the effects of broken symmetry, reduced dimensionality, and spatial confinement, and by controlling lattice strain and chemical composition.

Rob Hynes, graduate students Chris Britt and Chris Johnson, undergraduate Austin Baldwin, and their collaborators published a comprehensive survey of optically variable counterparts to X-ray sources as part of the extensive multiwavelength Galactic Bulge Survey aiming to detect new X-ray binaries and to determine the nature of the faint X-ray sources in our Galaxy: “Variability of Optical Counterparts in the Chandra Galactic Bulge Survey” in *Astrophys. J. Suppl.*

LSU Distinguished Research Master

On April 15, the LSU Council on Research presented the Distinguished Research Master award to individuals elected for their research and scholarship as well as their career achievements.

Jorge Pullin, the Horace Hearne Chair in Theoretical Physics in the LSU Department of Physics & Astronomy as well as the co-director of the Horace Hearne Institute for Theoretical Physics, was named as the 2014 Distinguished Research Master of Engineering, Science, or Technology.

Pullin’s research addresses the interface between gravity and quantum theory, specifically in the area of loop quantum gravity. His research has involved probing how space-time inside black holes is affected by quantum theory. He now also focuses on the foundations of quantum mechanics.

According to Michael Cherry, Roy P. Daniels Professor and chair of the Department of Physics and Astronomy, “Professor Pullin’s work on the connections between quantum mechanics and relativity has received international attention. He and his group have involved students, who have received state-of-the-art training in applying their numerical and computational approaches to fundamental physics. This award recognizes Prof. Pullin’s deep contributions to the physics of black holes and loop quantum theory.”

Schaefer Co-Recipient of Breakthrough Prize for Discovery of Dark Energy

It was previously thought that the expansion of the Universe was slowing. However, LSU Professor of Physics & Astronomy Bradley Schaefer, a member of the Supernova Cosmology Project research team, contributed to the breakthrough discovery that the expansion of the Universe is actually accelerating. Schaefer and his colleagues are recipients of the 2015 Breakthrough Prize in Fundamental Physics for their part in advancing our understanding of the Universe. Their discovery of the previously unknown form of energy embedded in the fabric of space called Dark Energy and its role in the accelerated expansion of the Universe won a Nobel Prize in Physics in 2011 for the project lead, Saul Perlmutter of U.C. Berkeley and Lawrence Berkeley Lab. “I feel honored and lucky to have been part of the Supernova Cosmology Project team that discovered Dark Energy, setting up fun discoveries and mysteries about the origin and fate of our Universe,” Schaefer said.

Both awards recognize his collaboration with 50 other researchers on this discovery. “Dr. Schaefer’s contributions to this effort have been monumental to our understanding of the Universe,” said Cynthia Peterson, dean of the LSU College of Science. “I am extremely proud of his work and the prestige it brings to the Department of Physics & Astronomy and LSU’s research enterprise.” Schaefer and the Supernova Cosmology Project research team share the Breakthrough Prize with the High-Z Supernova Search Team, which arrived at the same finding. In January 1999, both research teams came to the same result: an accelerating expansion of the Universe due to 70 percent of its mass energy being Dark Energy. To determine the distance between galaxies and how fast they are retreating, the scientists observed Supernova 1A explosions, which burn at a known brightness. Schaefer measured the brightness of all the supernovas for his

team’s research from the WIYN telescope located at Kitt Peak in Arizona. The discovery created a new field of study into the nature of Dark Energy. Their groundbreaking finding also offers some scientific predictions of how the universe will end: a consequence of this acceleration is that the Universe will continue expanding forever, becoming colder and emptier as time goes on. Lead investigator of the Supernova Cosmology Project Saul Perlmutter and High-Z Supernova Search Team leaders Brian Schmidt of the Australian National University, and Adam Riess of Johns Hopkins University accepted the new award on behalf of all of the researchers. The Supernova Cosmology Project and the High-Z Supernova Search Team also received the 2007 Gruber Prize for Cosmology, a \$1 million award.

Zganjar Inducted into LSU College of Science Hall of Distinction



2015 Hall of Distinction Honorees with Dean Cynthia Peterson (center) include (l-to-r back row) Meredith Blackwell, LSU System Boyd Professor Emerita in Biological Sciences; Edward Zganjar, Professor Emeritus in Physics & Astronomy. (l-to-r front row) John O'Neill, former director of the LSU Museum of Natural Science; and representing Arnold Bouma, Professor Emeritus in Geology & Geophysics, Mrs. Arnold Bouma.



Ed and Jo Zganjar celebrate with their children and grandchildren at the 2015 College of Science Hall of Distinction.

The LSU College of Science inducted four exceptional individuals into the Hall of Distinction on March 20, 2015, among them Edward Zganjar. Zganjar, LSU Professor Emeritus in Physics & Astronomy, former DeMarcus D. Smith Endowed Alumni Professor and prominent experimental nuclear physicist, earned his Bachelor of Science in physics and mathematics from St. John's University followed by a master's and Ph.D. in nuclear physics from Vanderbilt University. He is known in the nuclear physics community for systematic analysis of complex nuclear spectroscopic data, for designing and building state-of-the-art nuclear spectroscopic instrumentation, and for his contribution to the establishment of a university consortium and laboratory within the Holifield nuclear facility at the Oak Ridge National Laboratory.

Zganjar served as chair of the LSU Department of Physics & Astronomy from 1982-1985 and associate vice chancellor for research and economic development from 1990-1994. He has published over 142 journal articles, 220 published conference contributions, and maintained continuous external funding throughout his career. He is a Fellow of the American Physical Society (APS), and a recipient of the Southeastern Section of the American Physical Society's Francis G. Slack Award for excellence in service to physics in the Southeast.

Established in 2004, the LSU College of Science Hall of Distinction celebrates individuals who make significant contributions to science, business, academia, or government, as well as to their community. 2015 honorees were Meredith Blackwell, LSU System Boyd Professor Emerita in Biological Sciences; John O'Neill, former director of the LSU Museum of Natural Science; Arnold Bouma, Professor Emeritus in Geology & Geophysics; and Zganjar. To view a photo gallery, visit: www.phys.lsu.edu

Gabriela González LIGO Spokesperson

Gabriela González has been re-elected spokesperson of the LIGO Scientific Collaboration for an unprecedented third term. "The world will be watching the Advanced LIGO detectors begin to take data later this year, joined next year



by Virgo and in the future by other detectors in an international network," said González. "The LSC is preparing for analyzing data from gravitational wave detectors thoroughly and promptly to advance astrophysics, expecting significant results in a few years."

González was also appointed chair of the committee that will select the winner of the prestigious Einstein Prize of the American Physical Society.

Physicist's Work to Calculate Reaction Rates of Stellar Explosions Earns DOE Early Career Research Grant

LSU experimental nuclear physicist Catherine Deibel was one of 44 scientists selected from across the nation to receive funding from the Department of Energy, or DOE, Office of Science Early Career Research Program. Deibel is the first at LSU to receive this highly competitive grant.

Deibel's work is at the boundary between nuclear physics and astrophysics - nuclear astrophysics. She and her students study how the elements in the Periodic Table are synthesized in the interiors of stars and especially in violent stellar explosions like novae and X-ray bursts. Radioactive nuclei are created in these thermonuclear explosions in processes in which protons, alpha particles and heavier nuclei fuse together under extreme conditions of temperature and density.

Her DoE project "Determining Astrophysical Reaction Rates for Classical Novae and X-ray Bursts via Indirect Methods," relies on state-of-the-art techniques for nuclear spectroscopy using both stable and radioactive ion beams to calculate the reaction rates of classical novae and Type I X-ray bursts, the most common stellar explosions in the Galaxy. Using these data, important reaction rates will be calculated accurately for the first time, eliminating key uncertainties in understanding classical novae and X-ray bursts.

Deibel's experimental program is primarily housed at Argonne National Laboratory, where she is studying reactions important in X-ray bursts using radioactive ion beams. She also uses a variety of other facilities throughout the U.S. and abroad for her work,

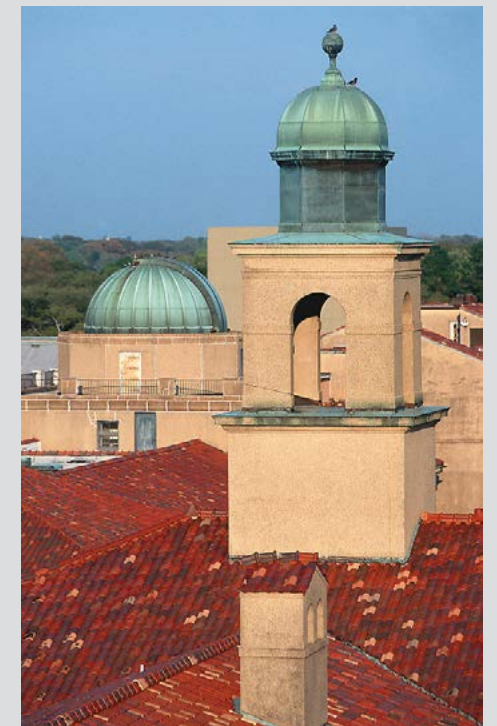
including the National Superconducting Cyclotron Laboratory at Michigan State University and the Superconducting Linear Accelerator at Florida State University. Her laboratory at LSU is devoted to detector and equipment construction and development for her and her students' experiments.

"Catherine is one of our most promising researchers in physics & astronomy. Her work will help us to better understand the inner workings of our galaxy and will greatly add to the outstanding research taking place at LSU," said Cynthia Peterson, LSU College of Science dean and Seola Arnaud and Richard Vernon Edwards Jr. Professor. Under DOE's Early Career Research Program, Deibel is slated to receive at least \$150,000 per year to cover graduate student and postdoctoral salaries and research expenses for five years.

Publications *continued*

- Martin Tzanov, Thomas Kutter, and their T2K collaborators published two papers in *Phys. Rev. Lett.* on the observation of electron neutrino appearance in a muon neutrino beam and on the most precise measurement so far of muon neutrino disappearance: "Observation of Electron Neutrino Appearance in a Muon Neutrino Beam" and "Precise Measurement of the Neutrino Mixing Parameter θ_{23} from Muon Neutrino Disappearance in an Off-Axis Beam."
- Ivan Agullo's paper in *Phys. Rev. D*, "Electric-Magnetic Duality and Renormalization in Curved Spacetimes" shows that a fundamental symmetry of electromagnetism is violated in the

presence of gravity. In the absence of electric and magnetic charges, the Maxwell equations for electromagnetism are completely symmetric (dual) under the interchange of the electric and magnetic fields. However, in nature we observe only electric charges, and not magnetic ones. Therefore, the symmetry is broken, and it is a mystery what is the underlying reason. This paper shows quantum mechanically that, even if no electric and magnetic charges are present, the electric-magnetic duality is broken if gravity is present. This is a new quantum anomaly which may have far-reaching consequences.



NASA Awards \$2.5M for Space-related Research

LaSPACE, the office which manages Louisiana's NASA Space Grant and NASA Experimental Program to Stimulate Competitive Research, or EPSCoR programs, has been awarded three significant multi-year awards from NASA to support space-related research development and higher education programs in Louisiana. The principal investigator for Space Grant and NASA EPSCoR is T. Gregory Guzik, LaSPACE director and LSU professor of physics and astronomy. Financial and management support is provided by the Sponsored Programs Office of the Louisiana Board of Regents. Over the next three years, Louisiana will receive \$2.5 million from NASA, plus a crucial investment of about \$1.9 million from the Board of Regents Support Fund.

"These three awards demonstrate that NASA recognizes the importance of Louisiana's aerospace R&D and workforce development," Guzik said. "The robust and continued investments from the Board of Regents proves Louisiana's commitment to growing STEM-based research and industry."

The National Space Grant College and Fellowship Program Training Grant, first awarded to Louisiana back in 1991, has been renewed for a three-year cycle. The Space Grant award brings in about \$1.4 million from NASA plus a \$750,000 state match from the the Board of Regents Support Fund for programs at 29 affiliated member institutions. The statewide LaSPACE program is administered by a team of professionals

based at the lead institution, LSU, which invests an additional \$225,000. LaSPACE programs fund projects primarily for students in higher education and university-based, NASA-related research, with some secondary support for K-12 teacher development and public outreach. LaSPACE supports faculty and student research in such areas as astrophysics, nanotechnology, aerodynamics, rocket propulsion, and thermodynamic power generation. LaSPACE also supports senior design projects, a statewide scientific student ballooning program, and internships at NASA facilities. Programs for the new three-year cycle opened in June for participating affiliates.

The LaSPACE team, with support from the Board of Regents, also manages Louisiana's participation in NASA EPSCoR. NASA EPSCoR administers two major competitions to eligible jurisdictions: The EPSCoR Research Infrastructure Development, or EPSCoR RID, program which focuses on broad infrastructure investment across the state, especially for new and emerging faculty researchers and the annual EPSCoR Research Cooperative Agreement Notice, or EPSCoR Research. Louisiana's proposals to these NASA EPSCoR programs have been selected for funding.

"Reviewers on the selection committee consistently give us high marks for evidence of support at the state-level. The one to one cash matches from the Board of Regents make us highly competitive," Guzik said.

Student News and Updates

Kaushik Seshadreesan was selected to receive the LSU Graduate School Dissertation Year Fellowship for fall 2014/spring 2015.

Kaushik is a graduate student in the Quantum Science and Technology Group jointly advised by Jonathan Dowling, Hwang Lee, and Mark Wilde.

Alison Dreyfuss, a native of Keene, New Hampshire, who is pursuing her doctorate in physics with a focus on nuclear structure, received an honorable mention as a National Science Foundation Graduate Fellow this year. The rigorous NSF GRFP application includes submission of a research proposal. Since 1952, NSF has provided fellowships to individuals selected early in their graduate careers based on their demonstrated potential for notable achievement in science and engineering.

Simón Lorenzo was selected for the National Institute of Standards and Technology's Gaithersburg (NIST) Summer Undergraduate Research Fellowship (SURF) program in Gaithersburg, Maryland. Lorenzo worked in the Physical Measurements Lab. He is currently a sophomore pursuing an honors physics degree with a minor in math.



LSU Mourns the Loss of Two Graduate Students

The LSU community is mourning the loss of Anton Joe, 25, and Ishita Maity, 28, both graduate students in the Department of Physics & Astronomy, who unexpectedly passed away Sunday, April 26 in Baton Rouge, Louisiana.

"We are deeply saddened to learn of the unfortunate and tragic accident involving Anton and Ishita," said Michael Cherry, chair, LSU Department of Physics & Astronomy. "We would like to extend our condolences to Anton and Ishita's family, friends, and colleagues. Our thoughts and sympathies are with them during this time."

student, were both pursuing their doctorate degrees. Anton was a student working with Professor Parampreet Singh in the area of theoretical gravity, and Ishita was a student of Professor Juhan Frank in theoretical astrophysics.

They will both receive posthumous degrees at the Fall 2015 Commencement.

LSU graduate students have created the following websites in remembrance of Anton and Ishita. Please visit:

<http://ishita-maity.forevermissed.com/>

<http://anton-joe.forevermissed.com/>

FROM A PHYSICS DEGREE TO A NUCLEAR-POWERED VESSEL



Physics major Nigel Payne hopes the combination of skills learned from a physics degree and Tiger Band will be key to a position as a U.S. Navy officer. Payne began the application process for the Navy's Nuclear Propulsion Officer Candidate Program in November 2014. Recently accepted, he will have the rest of his undergraduate program financed by the Navy, and he will become a nuclear submarine officer after graduating in May 2016.

"I decided to be a physics major with aspirations of someday going to graduate school for nuclear engineering," Payne said. "Before I heard about this program, I was going to try to apply for graduate school in my last couple of years at LSU with my physics degree. With this program, I'll be getting nuclear training from the Navy – home of the world's most advanced nuclear technology."

For a program applicant to be selected, they must undergo a rigorous screening process, according to the Navy's website. Then, he or she is selected to travel to Washington, D.C., for a personal interview. The first part of the interview process examines the applicant's knowledge of calculus, physics and other technical courses. Once the applicant passes the test, he or she meets with Admiral John M. Richardson, the current director of the Naval Nuclear Propulsion Program, for a final test. Richardson chooses the prospective officers personally.

"Once I graduate from the 12-week-long Officer Candidate School (OCS) in Newport, R.I., I will officially be a naval officer. From there, I will attend Naval Nuclear Power School (NNPS) for 24 weeks. This will be where I learn the "Navy's way" of doing calculus, thermodynamics, nuclear reactor systems, etc. Everyone I've talked to

says that this was the most difficult period of their academic careers," said Payne.

As a nuclear officer, Payne hopes to hop aboard a submarine or surface warship as the officer in charge of the nuclear propulsion division, which powers the ship. "[Nuclear science] is the study of nuclei and how they have so much potential to release energy," Payne said. "Too many people have the wrong idea about nuclear power. There's a negative connotation because of the bombs [the U.S.] dropped on Japan and the accident in Fukushima. But when you could use that energy to power cities, I think looking into nuclear power as an energy source is the way to go."

When he's not working on academic assignments, Payne is a section leader for the trumpet section of Tiger Band and the Bengal Brass Band. Along with the trumpet, Payne plays the piano and composes arrangements the Bengal Brass Band plays during basketball games.

"I don't know where I would be if it weren't for my involvement with the band," Payne said. "[Tiger Band] requires a lot of time, and it can be rough sometimes to manage it all, but you just have to man up and do your homework on the road. For me, it's all worth it because music and physics play such huge roles in my life."

Payne first joined Tiger Band during his freshman year and became section leader his junior year. Payne said he believes the leadership skills he's learned as a section leader gave him a leg up in the NUPOC application process, because as a navy officer, his primary job would be to lead divisions of hundreds of sailors.

Payne said he hopes to either work in the Navy until he retires or manage his own nuclear power plant design company once his nuclear science education is finished. After retiring, his long-term plan is to return to school for a piano performance degree.

Adapted from an article in the LSU Reveille, by Jose Bastidas http://www.lsureveille.com/daily/tiger-band-leader-hopes-to-gain-nuclear-science-experience-in/article_13a85096-ada6-11e4-a7b4-5bdce314f41d.html

SUMMER SCHOLAR

Ogden Honors College and LSU Physics & Astronomy junior Irene Vargas-Salazar spent her summer break conducting astronomy research at Texas A&M in College Station, Texas. Vargas-Salazar worked at Texas A&M through the National Science Foundation's Research Experience for Undergraduates (REU) Program, which funds research positions for U.S. undergrads.

Vargas-Salazar spent the summer studying photometry imaging from the Hubble Telescope. "What I'm working on right now is improving the signal-to-noise ratio of two fields of view," Salazar said.

"What this means is that I'm working on sets of images of two different galaxy clusters taken by the Hubble Space Telescope, and I'm cleaning and aligning them to produce a clean image that we can do science with."

As a Physics major with a concentration in Astronomy, this research position was exactly what she had been looking for.

"This opportunity fits in really well with my career plans," Vargas-Salazar said. "I've known about REUs since my freshman year, so I just went to the NSF website and found this particular REU among others focusing on astronomy."

One thing Vargas-Salazar has gained this summer? A broader view of her career options. "I want a career doing research in astronomy, but I haven't decided on a specific area of focus," Vargas-Salazar said. "This summer, I've gotten a wider perspective on what other types of research can be done in astronomy. I feel that this, plus my Honors College experience—especially the thesis that I have to write!—will help me to make a clear choice about what and where I want to research in the future."

Article excerpted from LSU's Ogden Honors College summer scholar feature.

Where are they now?

Dr. Leanne Truehart, B.S. 1990, having served as Mental Health Director and Deputy Coroner in St. Tammany, Louisiana, and Chief Medical Officer for the Post Trauma Institute of Louisiana, now serves as Clinical Director for the Behavioral Health Court of the 22nd Judicial District of Louisiana.

Roger McNeil, former Department of Physics & Astronomy Chair, is now Dean of Science at Morehead State University.

Alumni News

LOOKING UP & FINDING OUR COSMIC ADDRESS

Ashley Pagnotta, Ph.D. 2012 and the Kathryn W. Davis Postdoctoral Fellow in the departments of Astrophysics and Education, and Irene Pease, CEO of Friendly Neighborhood Astronomer, at the American Museum of Natural History met with Staten Island writer Todd Simmons before the museum's Astronomy Live! presentation of "Our Cosmic Address." To read the full article, visit: bit.ly/1laQ37n



Ashley Pagnotta, 2012 Ph.D. Alumna



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What are you doing with your physics degree?

We want to hear from YOU! Send updates to alumni@phys.lsu.edu or let us know if you would like to come to campus to give a "What I Did with My Physics Degree" talk to current undergraduate and graduate students.

Alumnus Comeaux Delivers LSU Commencement Address

PHYSICS ALUMNUS AND MARS ROVER FLIGHT DIRECTOR RETURNS TO CAMPUS



LSU alumnus Keith Comeaux, B.S. 1989, who served as flight director for the Curiosity Rover's landing on Mars in 2012, delivered the keynote address, and 657 students received degrees during LSU's 284th commencement ceremony on August 8, 2014.

"I've had the good fortune to experience this rich tradition as a student on four different occasions," Comeaux said. "It's a true honor to share this experience with you today."

Comeaux gave himself two goals for his commencement address: do a favor to the students and be memorable, and share some lessons learned from going to Mars that the class of 2014 might find useful in their careers.

For the first goal, he asked the class to Google "Five Best NASA Scientists Ever." The result shows an article that features a photo of "Jubilant Celebration Guy," who is Comeaux himself celebrating Curiosity's landing.

"Every time you see that blue-shirted blur on a documentary, a commercial, a news reel, or a spoof on NASA, you should now be able to recall that that guy was your commencement speaker," Comeaux joked. "While my colleagues and others may not understand, let it be known that jubilant celebration is not an unusual sight on a Saturday night in Tiger Stadium." Comeaux shared background stories on the different aspects of the Curiosity mission to

Mars and provided lessons learned from the experience.

His lessons included:

- Sometimes you have to turn a problem upside-down to find a solution
- Sometimes you have to stress the small stuff
- Sometimes the simplest solution is the best solution no matter how clumsy or unsophisticated it looks
- Sometimes you have to challenge even your most basic assumptions
- Sometimes you should follow your curiosity even if it leads you away from your ultimate goal
- Sometimes you have to bench your starting quarterback and put your second string in to save the day
- Sometimes you do have to reinvent the wheel
- It takes a village to make the impossible possible
- Shoot for the stars but always follow your curiosity

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(l-to-r) Dr. Mette Gaarde, Mengxi Wu, and Dr. Kenneth Shaefer celebrate Summer 2015 Commencement in the Quad, outside of Nicholson Hall on the LSU campus.

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Alumni Return to Campus for STEM Connect



(l-to-r) A.P. Rau, Robert Cross, Hannah Gardiner, Christopher Peeler, and Department Chair Mike Cherry.

In February 2015, LSU's Office of Strategic Initiatives hosted an inaugural symposium to connect the LSU community with alumni in the science, technology, engineering, and math disciplines, or STEM. The LSU STEM Alumni Connect showcased LSU alumni who are pursuing doctorates and post-doctoral training at various universities across the country.

This unique forum allowed the opportunity for the Department to invite back three of our alumni:

- Robert Cross, 2012 physics
- Hannah Gardiner, 2014 nuclear physics
- Christopher Peeler, 2010 medical physics