SPECTRUM

Firing on All Cylinders:
Atomic, Condensed Matter, and High Energy Groups All Win Large New Research Grants

FOR THE ALUMNI AND FRIENDS OF THE DEPARTMENT OF PHYSICS & ASTRONOMY
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University of Nebraska Lincoln

Aaron Dominguez leads the collaboration involving eight universities to upgrade the Compact Muon Solenoid (CMS) particle detector at the LHC in Switzerland. The illustration shows an event captured by the CMS in 2012 that provides evidence for the Higgs boson.

Firing on All Cylinders:

Atomic, Condensed Matter, and High Energy Groups All Win Large New Research Grants

The Department's ability to compete successfully for substantial new research funds in an increasingly difficult grant-funding environment was clearly demonstrated in 2014 and 2015. Within less than a year, new multimillion-dollar research grants were awarded to all three of the Department's major research groups (atomic, molecular, optical, and plasma [AMOP] physics; condensed matter and materials physics [CMMP]; and high energy physics [HEP]). All of the new grants were awarded to large, multi-investigator teams of researchers both in the Department and elsewhere.

The first to be announced in mid-2014 was a five-year, $11.5 million grant from the National Science Foundation (NSF) awarded to the HEP group and collaborators at eight U.S. universities. The purpose of the grant is to upgrade the detectors in the Compact Muon Solenoid (CMS) at the Large Hadron Collider (LHC) in the CERN laboratory in Switzerland. The aim of the improved detectors is to study the newly discovered Higgs boson in greater detail.

Next came the August 6, 2014 NSF announcement of a three-year, $6 million Research Infrastructure Improvement Track-2 award to the Department's AMOP group and collaborators at UNL, Kansas State University, and the University of Kansas. The award was made through NSF's Experimental Program to Stimulate Competitive Research (EPSCoR) and called explicitly for the formation of regional partnerships of researchers from two different states. The subject of the Nebraska-Kansas consortium's research is "Imaging and Controlling Ultrafast Dynamics of Atoms, Molecules, and Nanostructures."

Finally, on February 18, 2015 NSF made the announcement of a five-year, $9.6 million renewal grant for UNL's Materials Research Science and Engineering Center (MRSEC). The University of Nebraska MRSEC concerns "Polarization and Spin Phenomena in Nanoferroic Structures" and, according to NSF, "is likely to have a significant impact that results in energy-efficient electronic devices." The grant supports two Interdisciplinary Research Groups (IRGs) led by CMMP faculty and involving a total of 21 UNL faculty in five departments.

Abbreviated and slightly edited versions of UNL news releases (dated July 7, 2014, February 25, 2015, and April 20, 2015 respectively) written by Gillian Klucas (UNL Research and Economic Development) for each of these three major grant awards appear on the following pages.

HEP Group and Collaborators Receive $11.5 Million for LHC Upgrade

The world's largest atom smasher, the Large Hadron Collider (LHC) at CERN laboratory in Switzerland, has proved invaluable at answering fundamental questions about the nature of the universe, including finding the Higgs boson, but much remains unknown. A team of UNL physicists and collaborators at eight U.S. universities have received a five-year, nearly $11.5 million grant from the National Science Foundation (NSF) to increase the effectiveness of a vital component of the LHC that made the Higgs discovery possible.

The UNL team was part of the multi-institutional collaboration that built the original Compact Muon Solenoid (CMS) experiment, one of two large particle detector experiments at the LHC. With this new NSF grant, they now lead a large research partnership to upgrade the detector in stages through 2019. Their collaborators are at the universities of Kansas, Illinois-Chicago, Rutgers, Cornell, SUNY-Buffalo, Purdue-Calumet, Notre Dame, and Northeastern.

"As the accelerator has ramped up in intensity and in energy, our detectors will no longer be able to keep up with the rate of data coming out of the collisions, and they get damaged by radiation present near the collision point," said Professor **Aaron Dominguez**, who leads this collaboration. "They have to be replaced and upgraded to improve our sensitivity." (Dominguez is Associate Dean for Research and Global Engagement in the College of Arts & Sciences.)

UNL's role is to build new modules for the pixel detector that will be capable of taking 40 million images a second at a total resolution of more than 120 million pixels. The images are used to create a kind of movie of the particles' paths in less than 10 micron increments. "This will be the largest, most precise pixel tracking detector ever built," Dominguez said. "It should allow us greater sensitivity to see the Higgs boson and to see and discover new forms of matter."

The other university partners are upgrading the CMS hadron calorimeter and trigger system, as well as assisting with aspects of the pixel detector. The calorimeter measures the energy of hadron particles, such as protons, which helps detect if new particles were formed during the collision; the trigger system is a sophisticated method to capture the relevant data out of the billions of interactions that occur within a collision.

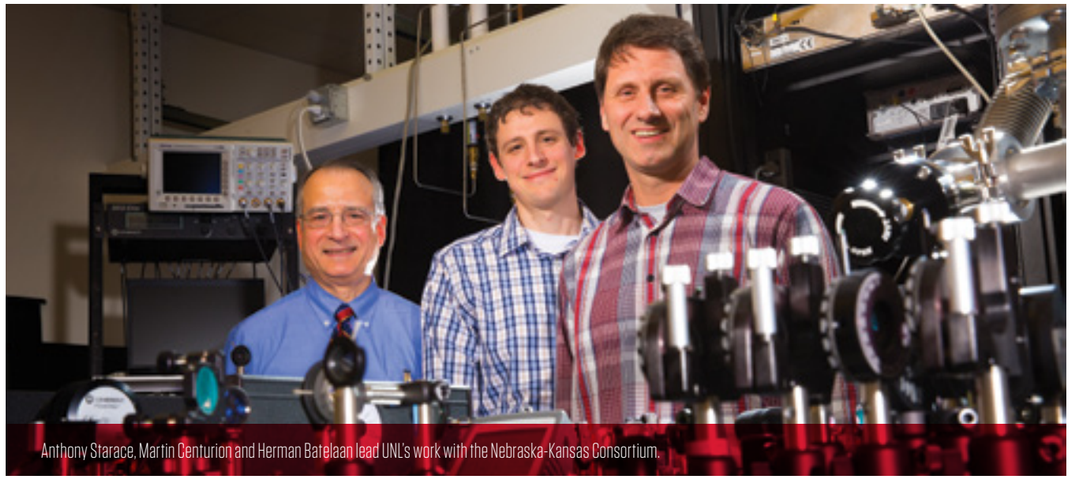
Though often called the "theory of everything," the Standard Model is far from complete, Dominguez said. It doesn't address important phenomena such as gravity, dark matter or the even more mysterious dark energy.

Prem Paul, UNL Vice Chancellor for Research and Economic Development, said, "Big scientific projects require collaboration with others throughout the world. Our physicists know this well and have played an important role in the experiments at the Large Hadron Collider since its beginning."

UNL also is one of seven U.S. CMS Tier-2 sites in the Worldwide LHC Computing Grid, which combines the computing power of more than 140 independent computer centers in 34 countries to analyze results from the LHC's experiments. Associate Professor **Ken Bloom** is project manager for the U.S. CMS Tier-2 sites and co-coordinator for Tier-2 sites worldwide. The university's Holland Computing Center provides Nebraska's supercomputing horsepower for this project.

In addition to Dominguez and Bloom, UNL's HEP team includes Professor and Chairman **Dan Claes**, Associate Professor **Ilya Kravchenko**, and Professor **Gregory Snow** as well as computer scientist David Swanson, Director of the Holland Computing Center.

AMOP Consortium Awarded $6 Million to Investigate Ultrafast Processes



Anthony Starace, Martin Centurion and Herman Batelaan lead UNL's work with the Nebraska-Kansas Consortium.

Observing what happens in one-trillionth of a second—the opening moves in photosynthesis, for example—requires precision and extremely fast devices. UNL physicists are expanding their experimental and theoretical arsenals to help reveal how light interacts with atoms, molecules and nanostructures. Their discoveries could one day lead to much faster computers, more efficient solar technology, and other enhanced light-based technologies. New devices are being built at UNL that will enhance capabilities for observing ultrafast processes.

"This will really build up the infrastructure at UNL to produce new science," said **Anthony Starace**, George W. Holmes University Professor of physics. "Ultrafast science is the next step in humanity's ability to understand nature and ultimately control these processes."

Thirteen UNL physicists and engineers are collaborating with colleagues at Kansas State University and the University of Kansas to form a Nebraska-Kansas Consortium aimed at expanding all three universities' capacity in ultrafast atomic, molecular and optical physics. The tools they develop could have applications in laser technology, solar energy capture, nanotechnology and optoelectronics.

The National Science Foundation's Experimental Program to Stimulate Competitive Research (EPSCoR) awarded the consortium a three-year, $6 million award, of which Nebraska received $3 million. It's one of three science and engineering consortia funded by the program nationwide.

The consortium is taking two approaches to observe and control ultrafast processes. The first approach is based on the premise of stop action made famous by 1925 UNL alumnus Harold Edgerton and his iconic image of a bullet piercing an apple. Today, scientists use electron and laser pulses to capture ultrafast processes in images recreated from electron scattering. This approach is helping physicists understand and, ultimately, control the molecular changes that occur when light strikes molecules, during photosynthesis or human vision, for example.

Some processes happen too fast to capture with current technology. To overcome these limitations, Associate Professor **Martin Centurion** and Assistant Professor **Matthias Fuchs** are designing and building a new source of electron pulses, using high-powered lasers, that may elucidate ultrafast transformations in solids. This breakthrough would open new avenues in materials science research. When completed, this new equipment is expected to be the first to have achieved this level of detail, Centurion said.

The second approach uses light pulses to overcome the relatively slow speed of electronics, which is based on the movement of electrons. Particles of light [photons] travel significantly faster than electrons, so merging light with electrons near specially created nanostructures may result in much faster computers and other electronic devices. The EPSCoR grant enables collaboration between researchers who can make nanostructures and those who are experts at controlling short pulses of laser light and electrons.

The consortium includes 30 physicists, chemists, computer scientists and electrical engineers at UNL, KSU and KU. Starace and Centurion, as well as Professor **Herman Batelaan**, lead UNL's consortium participation. Overall project leaders are Fred Choobineh, UNL electrical engineering professor and director of Nebraska EPSCoR, and Kristin Bowman-James, KU chemistry professor and director of Kansas EPSCoR. The consortium also will provide educational and outreach activities to broaden the participation of small Nebraska and Kansas colleges in research, including students underrepresented in science and engineering. Other activities include expanding student participation in UNL's annual Undergraduate Women in Physical Sciences conference and hosting high school teachers at summer workshops.

UNL Researchers Awarded $9.6 Million to Study Nanoferroic Materials

The National Science Foundation awarded UNL's Materials Research Science and Engineering Center (MRSEC) a $9.6 million renewal grant to support its nanotechnology research through 2020. UNL's is one of 21 NSF-funded MRSECs nationwide. UNL established its MRSEC in 2002 with a $5.4 million NSF grant. In 2008, NSF awarded UNL $8.1 million to continue the center. UNL was one of 12 universities nationwide that received grants in the latest round of competition.

"With this award from NSF, we continue to be part of a prestigious group of institutions recognized for our expertise in materials research and education through the MRSEC program, which includes Columbia, Harvard, MIT, the University of Chicago, Penn State and Ohio State," Chancellor Harvey Perlman said.

The center receives a new name with this latest funding—Polarization and Spin Phenomena in Nanoferroic Structures—to reflect its expanding research focus on nanoferroic materials, which may one day transform electronics and computing technologies.

"Our MRSEC scientists are doing research at the frontiers of materials and nanoscience and although this is very basic research, it leads to advanced technologies and products that affect our everyday lives," Prem Paul, Vice Chancellor for Research and Economic Development, said.

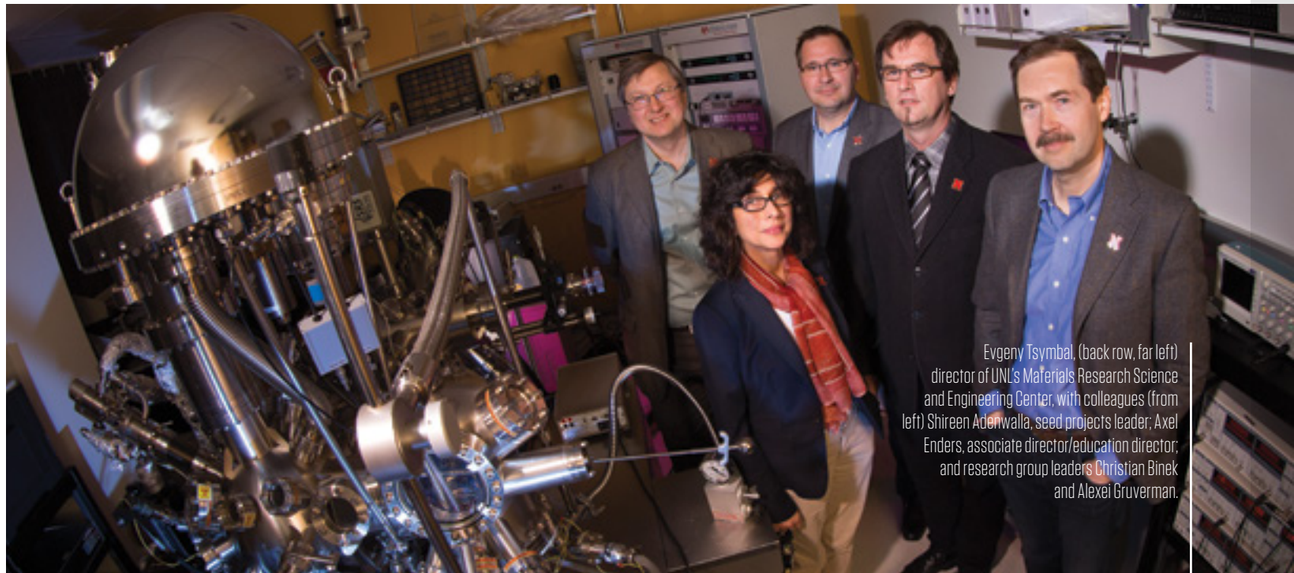
The center's success is based on several major accomplishments in understanding the properties and performance of nanomaterials, said **Evgeny Tsymbal**, George Holmes University Professor of physics and MRSEC director. These discoveries have led the center to focus on two key areas: magnetoelectric materials and functional interfaces, and polarization-enabled electronic phenomena.

Associate Professor **Christian Binek** leads the magnetoelectric materials and functional interfaces research group based on Binek's work with spintronics, which manipulates electron spin, in addition to charge, to generate power and store digital information. Traditional magnetic memory devices use an electric current to reverse the magnetic direction. Binek's team discovered how to switch magnetization using voltage instead, which doesn't generate heat and thus opens the avenue to energy-efficient computing.

Professor **Alexei Gruverman** leads the polarization-enabled electronic phenomena research group. This research takes advantage of nano-thin ferroelectric oxide, a material with both positive and negative polarization directions that, like spintronics, can be read out as a binary code using less energy than current technology.

The work is driven by Tsymbal's theoretical prediction and Gruverman's experimental demonstration of quantum tunneling across nano-thin ferroelectrics. By experimenting with tunnel junctions, in which an ultra-thin barrier made of ferroelectric oxide is placed between two electrodes, they have shown that reversing the polarization changes dramatically the resistance through the tunnel junction. Measuring that resistance would allow devices to read the binary polarization direction, and thus, the information it contains. Each of these nanomaterials holds promise for overcoming the limitations of traditional silicon-based electronics.

UNL's MRSEC includes 21 faculty from the departments of physics and astronomy, chemistry, electrical engineering, mechanical and materials engineering, and teaching, learning and teacher education. The MRSEC will interact closely with UNL's Center for Nanoferroic Devices to develop device applications. The latest NSF funding also will support expansion of the center's traditionally strong education and outreach programs. Associate Professor **Axel Enders** will lead several ongoing and new initiatives, including those designed to encourage women and minorities to become involved in materials science research.



Evgeny Tsymbal, (back row, far left) director of UNL's Materials Research Science and Engineering Center, with colleagues (from left) Shireen Adenwalla, seed projects leader; Axel Enders, associate director/education director; and research group leaders Christian Binek and Alexei Gruverman.

FROM THE CHAIR

External Funding Reaches Record Total

Dan Claes, Chair

In polite company we always insist "it is not about the money." The simple fact, of course, is that without sufficient funds we cannot pursue cutting edge research. Nor would our graduate and undergraduate students receive the associated training that makes them competitive in the scientific workforce. That's, of course, what it really is about. When I arrived on campus the fall of 1995 as a new assistant professor, the Department of Physics and Astronomy was a vibrant, exciting, and rapidly growing enterprise. At the time, we were justifiably proud to report federal grants that topped $2M annually. "Rapidly growing" was particularly evident when that figure doubled within seven years, and again the next seven. Looking at that performance, with a strategic plan calling for additional hiring to expand our programs, we were optimistic that the growth would continue. Certainly the College, the Office of Research, and Central Administration kept looking to our Department to lead in grant funding growth.

Recent years of ever-tightening federal budgets (especially for basic research) have impacted physics departments across the country. It may have seemed overly optimistic when we were preparing the self-assessment study for our 2013 Academic Program Review to predict that the trends in our Department could continue, but we nonetheless set a goal for ourselves of "an increase in federal research expenditures (from $11.75M to $15M) by 2018."

As of this past academic year (2014-15), however, we can already report external expenditures of $15.26M!

We reached that benchmark *early* by taking the lead on a number of huge, and hugely important, interdisciplinary and multi-institutional grants (see the lead story in this issue), securing industry support for new centers, and identifying areas where we can contribute to the University's partnership as a University-Affiliated Research Center with the United States Strategic Command (see last issue). Contributing as well have been the rapid achievements of our newest faculty. Every new faculty member appointed in the past dozen years quickly succeeded in not only securing initial single investigator funding, but became an integral part of larger collaborative efforts. Eleven of the fifteen new faculty members we welcomed during that time, including the last five new faculty in a row, have been recipients of highly competitive, coveted, and prestigious young investigator awards. These included an AFOSR Young Investigator Research grant, a DOE Outstanding Junior Investigator award, a DOE Early Career grant, an NSF POWRE Career Development Grant, and seven NSF Career awards.

Since it isn't just "about the money," let me mention a number of other activities we're equally proud of.

Saturday Science turned 40! Professor **Duane Jaecks**, dissatisfied with the limited exposure to scientific ideas in the middle school curriculum, created this outreach program in the spring of 1974. Run in collaboration with the Lincoln Public Schools (LPS) district, our four-week-long program now brings about 100 5th grade students each Saturday in February to campus for exciting physics demonstrations, hands-on lab experiments, and student-built take-home apparatus. Professors **Edward Schmidt** and **Roger Kirby** each directed the program in turn for several years. Since l987 its director has been Dr. **Clifford Bettis**, our Lecture Demonstrations Manager. We're grateful and excited that the J.A. Woollam Foundation has made a generous $40,000 matching pledge to the Lincoln Public Schools Foundation in an effort to raise an endowment to help sustain and grow the program (see page 11).

This fall, we will help host the 7th annual Conference for Undergraduate Women in the Physical Sciences (WoPHYS15). Created in 2009 by Associate Professor **Axel Enders**, the popularity of WoPHYS has grown every year. Registrations fill quickly, attracting applicants from all over the country, far in excess of the 75 we can accept. The program always boasts an impressive slate of nationally prominent and world-renowned speakers, along with invited plenary talks and poster presentations by the student participants.

If you're in town (especially in mid-October or any Saturday in February), drop in to see our faculty engaging students, and sharing the enthusiasm that a well-funded research program can generate.

Sincerely,

Daniel R. Claes
Professor and Chair

DEPARTMENT NEWS

Fuchs, Kovalev, and Xu All Receive Initial Grant Awards

Matthias Fuchs

Alexey Kovalev

Xiaoshan Xu

Within the past year, all three of the Department's most recently appointed faculty have succeeded in obtaining prestigious grant awards for their proposed research projects: **Matthias Fuchs** has been awarded a Young Investigator Research Program Grant by the Air Force Office of Scientific Research (AFOSR); **Alexey Kovalev** has been awarded an Early Career Award by the Office of Science of the Department of Energy (DOE); and **Xiaoshan Xu** has been awarded a Faculty Early Career Development (CAREER) award by the National Science Foundation (NSF). The successes of these young researchers testifies that their research is at the cutting edge of their fields and that their proposed approaches are compelling.

Assistant Professor **Matthias Fuchs** was awarded a $120,000/year three-year grant by the AFOSR Young Investigator Research Program, which supports promising researchers who "show exceptional ability and promise for conducting basic research." Fuchs, who joined the Department's AMOP group in 2013, said the goal of the research supported by this grant is the development of a novel technique that could shrink the size of high-power X-ray sources from a typical footprint of more than a dozen football fields to roughly that of a dining room table. The technique uses intense laser fields as undulators that induce accelerated electrons to radiate in the X-ray regime. This technique should significantly improve the quality of X-ray emissions by producing radiation at least a trillion times brighter than the Sun's. It will also generate X-ray pulses lasting only a few femtoseconds. "Such ultra-short pulses allow us to take a deep look into matter on the atomic scale," Fuchs said. "We can spatially (examine) individual atoms, and with the extremely short duration of the pulses, we can look at atomic motion in real time. These combined properties allow us to make 'molecular movies' of atomic dynamics." This advanced insight into atomic processes, Fuchs said, could ultimately contribute to the next generation of clean energy, bolster the speed of information technology, and inform the design of novel materials.

Assistant Professor **Alexey Kovalev** was awarded a $150,000/year five-year grant by the DOE Early Career Research Program, which is designed to bolster the nation's scientific workforce by providing funding support to exceptional researchers during their crucial early career years, when many do their most formative work. Kovalev joined the Department's CMMP group and the Nebraska Center for Materials and Nanoscience in 2013. His research is in the field of theoretical spintronics, which is concerned with quantum phenomena in materials related to the spin degrees of freedom. New materials with novel properties and new functionalities are often based on manipulating the spin degrees of freedom. However, understanding these new materials and their novel properties often requires rethinking the phenomenology and including additional interactions. Kovalev's project is titled "Non-Collinear Magnetism and Dynamic Effects in Dzyaloshinskii-Moriya Magnets." Kovalev said, "This could not be possible without the support and help of my colleagues in the Department. This is my chance to build my group and to do great science at UNL. Having funding for five years will allow me to work on more challenging, high-risk projects, and build a more coherent research program."

Assistant Professor **Xiaoshan Xu**, who joined the Department's CMMP group in 2013, was awarded a $118,000/year five-year CAREER award by the NSF for his proposal to investigate "Hexagonal Ferrite Thin Films for the High-Temperature Magnetoelectric Memory Effect." The NSF CAREER program supports junior faculty who excel in the integration of education and research. Recipients exemplify the spirit of "teacher-scholars" who are leaders in both research and education to further the mission of their home institution. Xu's project explores the possible static couplings between electric and magnetic fields in a new family of materials—hexagonal ferrites—by elucidating the connections between their electric, magnetic, and structural properties, and fine-tuning the materials using advanced material preparation methods. The "static" couplings between the electric and magnetic fields in a material (e.g., switching the north and south poles of a magnet using an electric field) are expected to have major applications in compact and energy efficient information storage and processing, sensors, and actuators. These applications are much desired since the demand for information storage and processing is ever increasing while the capabilities of current technology are becoming exhausted. The educational component of the grant will also impact UNL students, who will gain knowledge of fundamental physics and research techniques through laboratory experiences.

DEPARTMENT NEWS

Starace Awarded Honorary Doctorate

Anthony F. Starace, George W. Holmes University Professor, received an honorary doctorate from Voronezh State University (VSU), Russia, on June 20, 2014. The D.Sc. degree was awarded to Starace in recognition of his scientific work in the field of intense laser field interactions with matter, as well as in the new area of attosecond physics, and for his long term partnership with faculty at VSU.

Starace has collaborated with VSU Professor of Theoretical Physics **Nikolai L. Manakov** since 1998. To date, they have published nearly 70 joint journal articles. He has also hosted numerous students and postdoctoral researchers from VSU in Lincoln. These include graduate students **Andrei Istomin** (UNL Ph.D. 2005) and **Tatiana S. Sarantseva** (2011) and former postdoctoral research associates **Mikhail V. Frolov** (2002-2004), **Evgeny A. Pronin** (2005-2010), **Alexander V. Flegel** (2011-2014), and **Aleksander N. Zheltukhin** (2012-2013). Manakov and Frolov visit UNL frequently and hold adjunct faculty appointments in the Department. Frolov and Flegel currently hold faculty positions at VSU.

The five days that Starace and his wife Katherine visited Voronezh were filled with meetings with VSU administrators, with escorted tours of Voronezh and the surrounding region,

Anthony F. Starace (in VSU academic garb) being congratulated by Professor Dmitry A. Endovitsky, Rector of Voronezh State University.

and with get-togethers with the many friends they have made there over the years. Following the award of the honorary degree, Starace gave a public lecture on "Attosecond Physics: Probing and Controlling Matter on Its Natural Time Scale." A VSU report on the event can be seen at this URL: http://www.vsu.ru/news/index.do;jsessionid=3E52BF043391BAF0798770D1E2EA6DE7?id=4486.

Woollam Named National Academy of Inventors Fellow

John A. Woollam

Editor's Note: The article below is a slightly abridged and edited version of a December 16, 2014 article by Steve Smith, News Director of UNL's Office of University Communications. John A. Woollam is also a professor of physics and astronomy.

John Woollam, George W. Holmes University Professor of electrical engineering at UNL, has been named a Fellow of the National Academy of Inventors (NAI).

Woollam, an internationally known expert in ellipsometry and a member of the UNL faculty since 1979, also is founder and president of the J.A. Woollam Co., a university spin-off that has emerged as a worldwide leader in the production of spectroscopic ellipsometry instrumentation. Spectroscopic ellipsometry is a process that uses reflected polarized light to detect properties of materials and make precise measurements of films that are only an atom or two thick.

The J.A. Woollam Co. manufactures ellipsometers for a wide range of applications and, with distributorships in more than a dozen countries, has sold over 2,500 ellipsometers worldwide. Woollam is named on 57 patents and his company has secured more than 100 patents to date.

His research results appear in more than 430 peer-reviewed publications and he has delivered more than 475 presentations at society meetings. Woollam also is a Fellow of the American Physical Society (APS) and the American Vacuum Society. He received the 2013 Prize for Industrial Application of Physics from APS for sustained contributions to commercialization of spectroscopic ellipsometry.

Election to NAI Fellow is a high professional distinction accorded to academic inventors who have demonstrated a prolific spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on quality of life, economic development and the welfare of society. The 170 Fellows named this year bring the total number of NAI Fellows to 414, representing research universities and governmental and nonprofit research institutions.

The Deputy U.S. Commissioner for Patent Operations from the United States Patent and Trademark Office inducted the NAI Fellows on March 2015 at the California Institute of Technology in Pasadena.

DEPARTMENT NEWS

Dreiling Receives 2015 Folsom Thesis Award

Joan M. Dreiling

Joan M. Dreiling (M.S. 2010, Ph.D. 2014) received the Lowe R. and Mavis M. Folsom Distinguished Doctoral Dissertation Award at the UNL Graduate Studies Award Luncheon on February 5, 2015. Dreiling completed her dissertation titled "Asymmetric Interactions Between Spin-Polarized Electrons and Chiral Molecules" under the supervision of Professor **Timothy Gay**. Dissertations for the Folsom Awards are judged based upon the work's clarity, scholarship, methodology, and contribution to its field. Dreiling's thesis experiments involved attempts to observe chirally-sensitive chemical reactions when spin-polarized electrons bombard chiral molecules. One of the experiments yielded the first evidence in support of the Vester-Ulbricht hypothesis, which provides an explanation for the origins of biological homochirality. A paper based upon this dissertation research was published in *Physical Review Letters* and received national and international attention (see the Research Highlight on page 16).

According to Gay, Dreiling brought "a remarkable amount of ingenuity" to her thesis project. Gay added that she was "particularly impressive in the way she systematically hunted down systematic sources of error and noise in the experiment and eliminated them." This was absolutely necessary, because the chiral asymmetries they sought were of the order of one part in 10,000. Besides her thesis work on chiral molecules, Dreiling undertook two other experiments as part of her doctoral research: one involving optical pumping of rubidium as a means to produce polarized electrons and another concerning how "twisted" light couples to electron spins in semiconductors. These experiments resulted in three additional published papers.

Dreiling did her undergraduate work at Fort Hays State University, where her chief adviser was **Kenneth Trantham** (Ph.D. 1996, Adviser: **Timothy Gay**), who is currently chair of the Physics and Physical Science Department at UNK. Trantham mentored Dreiling in many valuable experimental skills, involving vacuum technology, electronics, lasers and optics. Dreiling broadened this experience with summer stints in Carl Wieman's laboratory at the University of Colorado at Boulder and in Matt Poelker's group at the Thomas Jefferson National Laboratory in Newport News, VA.

Upon joining the Department's graduate program in 2008, Dreiling was awarded an Othmer Fellowship. In her second year, she was selected in a national competition to join over 600 young researchers from over 60 countries to participate in the 2010 Lindau Nobel Laureate meeting in Lindau, Germany (see the Fall 2011 issue of *Spectrum*). In addition to her research and teaching, Dreiling served the Department from 2011 to 2014 as co-chair (with Associate Professor **Axel Enders**) of UNL's annual Undergraduate Women in Physical Sciences Conference. Currently Dreiling is a National Research Council Postdoctoral Fellow at NIST in Gaithersburg, MD.

Kunkel Wins Nottingham Prize

Donna A. Kunkel

Donna A. Kunkel (Ph.D. 2014) received the Wayne B. Nottingham Prize at the annual Physical Electronics Conference held in LaCrosse, WI, in June 2014. This international conference focuses on surface science and the physics and chemistry of interfaces. The prestigious Nottingham Prize, first given in 1966 at MIT, consists of a certificate and a $1,500 award given for the best student paper presented at the conference that is based on the student's Ph.D. thesis. According to Kunkel's Ph.D. adviser, Associate Professor **Axel Enders**, the Nottingham Prize is considered the most important student award in condensed matter physics in the U.S. Kunkel, a GAANN Fellow in the Department, received the award for her pioneering research on polarization phenomena in organic nanostructures conducted in Enders' group. Following receipt of her Ph.D. degree in August 2014, she joined the Dow Chemical Company in Houston, Texas.

Bloom Appointed Software and Computing Manager for CMS

Editor's note: Below is an edited version of a UNL Today story published on February 13, 2015.

Associate Professor **Ken Bloom** has been appointed the software and computing manager for the United States Compact Muon Solenoid (CMS) operations program. CMS is an experiment at the Large Hadron Collider (LHC), the world's largest proton collider. The experiment involves 4,300 particle physicists, engineers, technicians, students and support staff from 179 universities and institutes in 41 countries. The experiment, along with the complementary ATLAS experiment, gained international attention for its discovery of the Higgs boson in 2012. UNL has collaborated on the experiment since 1993, under the leadership of five department faculty members: Bloom, Professors **Daniel R. Claes**, **Aaron Dominguez**, and **Gregory R. Snow** and Associate Professor **Ilya Kravchenko**.

The U.S. CMS operations program is responsible for the U.S. contributions to the commissioning, operation and maintenance of the CMS detector and contributions to the CMS software and computing infrastructure—all of the elements of the experiment that make the analysis of LHC data possible. In his new role, Bloom oversees an annual budget of $16.5 million, which supports 60 full-time equivalent staff members and funds computing hardware at Fermilab, the Department of Energy laboratory in Batavia, Illinois, and seven "Tier-2" computing sites at universities nationwide. UNL has hosted one of these sites since 2005. Bloom had served as software and computing deputy manager since 2010, and leader of the Tier-2 program since 2005. To help fulfill the new responsibilities, Bloom has accepted a guest scientist appointment at Fermilab.

Saturday Science: Going Strong for Over 40 Years

In 1974, Professor **Duane Jaecks** realized that our Department faculty could teach elementary school children basic physics concepts. With this vision in mind, he worked with Chairman **Leo Sartori**, Vice Chairman **James Samson**, and Dale Rathe, Lincoln Public Schools (LPS) Science Coordinator, to establish Saturday Science. Over the past 40 years, the Saturday Science program has reached several thousand elementary school students in a direct and meaningful way.

The first Saturday Science program was offered on six Saturdays in Spring 1975 to 50 students in fourth through sixth grades. The demand was sufficiently high that a second six-week session was held, while some students were placed on a waiting list for the following year. Each Saturday included a lecture/demonstration in Brace Laboratory, followed by a hands-on laboratory activity. During the first two years, Jaecks taught all lecture/demonstration sessions, and, with assistance from Department graduate students, developed and coordinated the laboratory sessions. Lecture Demonstrations Manager **Menno Fast** was an invaluable resource in setting up the many "gee whiz" demonstrations that kept students on the edge of their chairs. The students were encouraged to ask and answer questions such as: "What would happen if we made the pendulum longer?" "Why is it that way?"

Students did investigative lab work in our introductory laboratories in Ferguson Hall. In addition to the experiments, the lab activities always involved building a tool or device that students could take home. For example, the students studied light by making a grating spectroscope from a paper towel tube, a plastic replica grating, cardboard and masking tape. The students were asked to use their spectroscopes at home to study and record light coming from such sources as an incandescent bulb, a fluorescent lamp, a candle and street lights. The students brought back colored charts depicting the spectra of different lights. When studying time, each student built a pendulum

Duane Jaecks c. 1989

with which the students timed each other in a race up and down the Ferguson hallway. The passage of time was measured in oscillations of the pendulum.

The program has evolved over the past four decades as new topics were introduced and as the manner of demonstrations changed. In 1975, the personal computer did not exist, whereas today it is ubiquitous; the use of lasers was in its infancy and classroom lasers were not available. Recording sound-wave traces with a fast oscilloscope and a Polaroid was still considered top of the line; but new methods were just around the corner. The first significant use of computers occurred when students were permitted to make "voice prints" by digitally recording the output of a microphone while they sang. The subsequent voltage vs. time data were Fourier transformed to show students that singing higher or lower could change the frequency of sound and that many frequencies could be formed at the same time if several students sang simultaneously.

There is also evidence of collateral learning from the labs transferring to the classroom setting. Bob Reeder, LPS Science Consultant from 1982 to 1998, commented on the rise in physical science entries in the yearly District Science Fair and the number of students bringing the "take home" devices to school and sharing their Saturday Science experiences with teachers and classmates.

The popularity—and hence longevity—of the Saturday Science program is largely due to the enthusiasm of those who managed the program in the 1980s, 1990s, and into the 21st century. Professor **Ed Schmidt** coordinated the program for two years. Professor **Roger Kirby**, with the active support of his wife Sue (an LPS teacher and liaison for the program) helmed the program for many years, while introducing new subjects and teaching methods. Sue's roles included ensuring that the topics overlapped with LPS Science Objectives and dealing with occasional rambunctious students. The early success of Saturday Science led to the enlisting of more faculty members to give weekly lectures. Department faculty responded enthusiastically, and this tradition of broad faculty participation has continued to this day. Undergraduate students in the Department's Society of Physics Students have served as laboratory assistants, bringing their own brand of youthful enthusiasm to the program.

Research Associate Professor **Cliff Bettis**, with the aid of his wife Linda (an LPS mentor), has continued to carry the program further, adding new astronomy topics, varying experiments, and adjusting lecture demonstrations. Since the LPS curriculum has changed and Grade 6 has moved to middle school, Saturday Science now only serves Grade 5 students. In order to accommodate changes in LPS and UNL schedules, the program is now offered on the four Saturdays in February. A morning and afternoon session of 80 kids each are hosted each Saturday. Sessions include a lecture/demonstration on a particular topic (usually including sound, light, electricity, forces and motion) followed by related learning and building activities in our laboratories. Topics are elucidated with demonstrations from the Department's huge inventory. As many as 30 demonstrations can be performed in a one-hour period, often inducing oohs and aahs, wide-eyed responses, and many questions.

LPS administrators advertise Saturday Science and accept applications on a first-come, first-served basis. There is a $40 tuition fee, which LPS collects. The program is always oversubscribed. Department faculty and others contribute funds to provide scholarships for those students who cannot afford the fee (LPS selects scholarship recipients). The tuition money is used to pay a modest stipend to the lecturers (usually members of our faculty), to purchase laboratory and take-home materials, and to pay laboratory assistants. At least six graduate or undergraduate students assist with laboratory experiments. An experienced elementary school teacher continues to serve as program liaison and as local supervisor.

Saturday Science students engrossed in hands-on lab activity.

Woollam Challenge Grant – Matching Contributions Sought

In order to ensure the continued success of Saturday Science, George W. Holmes University Professor of electrical engineering, **John A. Woollam**, has committed up to $40,000 to the LPS Foundation as a challenge grant to support Saturday Science. If matched by mid-March 2016, the LPS Foundation will have an $80,000 endowment, the income from which will support the continued development of our Saturday Science Program. To make a matching contribution, you can mail a check to The Foundation for Lincoln Public Schools, 5905 O Street, Lincoln, NE, 68510 noting "Saturday Science" on the memo line. Alternatively, you may contribute online at this URL: http://www.foundationforlps.org/give/funds/stem.html. Click on the link "Donate to a STEM Fund" and on the form that then appears, clicking on "Donate to" provides a drop down menu from which you can select "Saturday Science." A number of faculty and staff have already donated, but more contributions are needed; please note the mid-March 2016 deadline.

John Woollam has a courtesy appointment as professor of physics and has supervised the theses of a number of our physics Ph.D. students. He initiated and developed the J.A. Woollam Company in Lincoln, which is one of the world's most successful manufacturers of ellipsometers. In 2013, Woollam won the American Physical Society's Prize for Industrial Applications of Physics. Most recently, he has been inducted into the National Academy of Inventors.

Conference for Undergraduate Women in Physical Sciences (WoPhyS) Continues to Grow

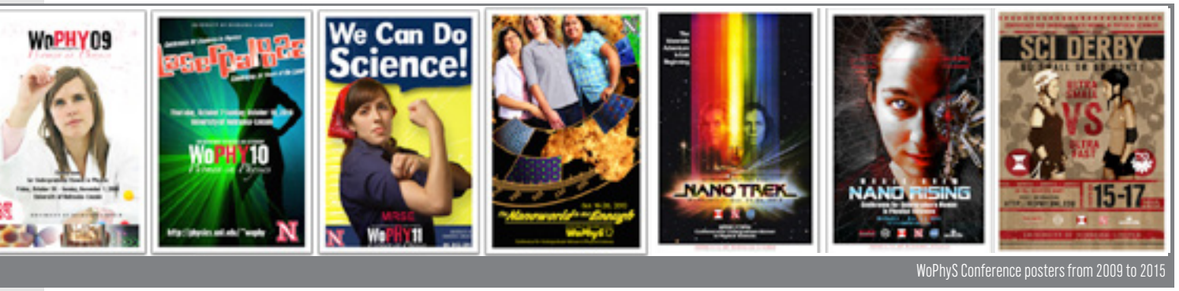
WoPhyS 2014, chaired by Axel Enders (first row, right)

The Department's Conference for Undergraduate Women in Physical Sciences (WoPhyS), chaired by Associate Professor **Axel Enders**, has attracted a growing number of participants from around the U.S. Held annually since 2009, registered participants reached 84 in 2014. WoPhyS is an important part of UNL's efforts to make studying and working in physics and other STEM disciplines enjoyable for undergraduate women, to create a climate that offers equal chances for women and men, and ultimately to encourage U.S. students to pursue scientific careers. The primary goal of WoPhyS is to provide for all of its undergraduate participants great opportunities to present their scientific work and to share their experiences with their peers.

Now in its seventh year, the conference highlights research breakthroughs in the physical sciences through a series of plenary talks by outstanding faculty from around the U.S. What makes WoPhyS unique as compared to similar conferences in the U.S. is its focus on undergraduate research, with opportunities for selected research-active undergraduate students to give invited talks upon nomination by their school and selection by the conference program committee. Poster sessions allow participants to present their work to faculty and peers. Participants are offered tours of UNL's research labs, shared facilities and research centers and have opportunities to learn about its graduate programs and to meet and interact with UNL faculty.

WoPhyS has grown considerably in reputation over the past years, as seen from the numbers of students and the stature of plenary speakers the conference attracts. It has had a positive impact on recruitment of minority and women students into UNL's graduate programs. WoPhyS 2015 was themed "Sci Derby" and was held October 15-17, 2015.

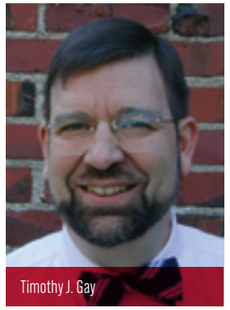
The conference is co-sponsored by the Materials Research Centers at UNL, including MRSEC P-SPINS, CNFM, and NCMN. Additional support comes from the new NSF EPSCoR Track 2 Collaborative Research Grant on Ultrafast Processes, the EPSCoR Space Grant, UNL's AMOP Program of Excellence, the Office of Research and Economic Development, and the College of Arts and Sciences.



WoPhyS Conference posters from 2009 to 2015

Gay Elected APS Councilor

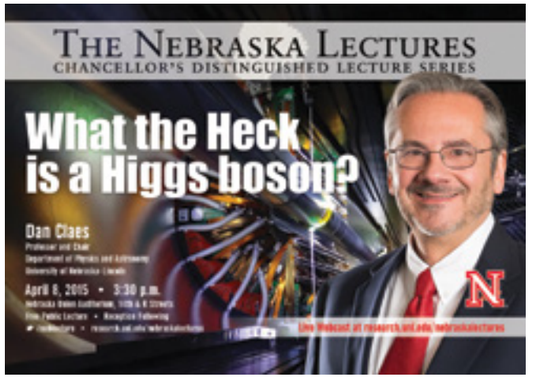
Professor **Timothy J. Gay** was elected to represent the American Physical Society (APS) Division of Atomic, Molecular, and Optical Physics (DAMOP) on the APS's Council of Representatives. Gay's term extends from 2015 through 2018, during which he will be a member of DAMOP's Executive Committee. Gay also serves as the Assigned Council Representative for the APS Topical Groups on Precision Measurement and Fundamental Constants (GPMFC) and Quantum Information (GQI). The APS Council focuses on all matters of science, including science policy, as well as APS membership issues. It is specifically charged with establishing and exercising oversight of the publications of the APS, approving APS policy statements, exercising oversight of APS meetings and conferences, approving election of members to Fellow of the APS, and approving winners of APS prizes and awards, among other matters.



Timothy J. Gay

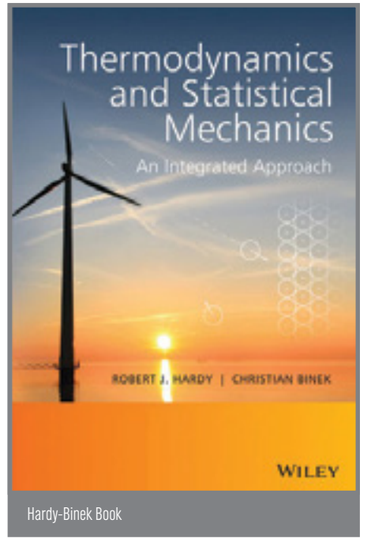
Claes Delivers Nebraska Lecture on Higgs Boson

Professor and Chair **Daniel R. Claes** presented a Nebraska Lecture on April 8, 2015 on "What the Heck is a Higgs boson?" Offered once a semester, the Nebraska Lectures bring together the university community with the greater community in Lincoln and beyond to celebrate the intellectual life of UNL by showcasing the faculty's excellence in research and creative activity. The Chancellor's Distinguished Lecture Series is a collaboration between the Office of Research and Economic Development, the Office of the Chancellor, the Research Council, and the Osher Lifelong Learning Institute. A webcast of Claes' lecture may be viewed at this URL: http://research.unl.edu/nebraskalectures/what-the-heck-is-a-higgs-boson/.



Hardy and Binek Co-Author Thermal Physics Textbook

Professor Emeritus **Robert J. Hardy** and Professor **Christian Binek** recently published a new textbook, *Thermodynamics and Statistical Mechanics: An Integrated Approach* (Wiley, June 2014, 532 pages). The text brings together the fundamentals of the macroscopic and microscopic aspects of thermal physics by presenting thermodynamics and statistical mechanics as complementary theories based on small numbers of postulates. It is designed to give the instructor flexibility in structuring courses for either advanced undergraduates and/or beginning graduate students, and is written on the principle that a good textbook should also be a good reference. The book was written to serve the needs of the Department's courses, *Physics 431 Thermal Physics* and *Physics 912 Statistical Physics*, and has greatly benefitted from student comments and suggestions. Many texts merge the macroscopic and microscopic theories and select the method used according to the result being sought. Although practicing physicists often mix concepts from different theories when researching new phenomena, that is not the best approach when teaching, since it tends to leave students with a hodgepodge of ideas instead of a coherent understanding of fundamentals. The fundamentals, once understood, are available for a wide range of applications.



Hardy-Binek Book

The book's treatment of the macroscopic aspect of the subject, thermodynamics, takes advantage of the modern student's familiarity with the atomic level structure of matter while preserving the logical development of the subject by Clausius and Kelvin. Its treatment of statistical mechanics begins with a unified derivation of the three basic ensembles: microcanonical, canonical, and grand canonical. The tools for predicting the properties of matter from the descriptions contained in their Hamiltonians are then developed by applications to gases, solids, magnetic materials, and blackbody radiation. Phase transitions and the statistical basis of computer simulations are also discussed.

Simon Publishes "The Ballad of St. Katherine"

Corine and Norman Simon

Professor Emeritus **Norman R. Simon**, a theoretical astrophysicist, published in 2014 his first collection of short stories in a small volume entitled *The Ballad of St. Katherine: a novella and stories*. In recent years, Simon has published a number of short stories, and a number of his plays have either been produced or given staged readings in the Midwest and elsewhere. In this collection, Simon's stories are set in eras ranging from the 1960s to the near future. In the words of one of his characters, "The sacred and the profane lie close together, separated by the thinnest membrane, almost nothing." Norman and his wife Corine hosted a book signing party in Lincoln on February 15, 2015 at The Mill coffee house.

Bloom's Blog Featured in Big Bang Theory Episode

Editor's note: This is a slightly edited and abridged version of a February 6, 2015 UNL News article by Scott Schrage.

Associate Professor **Ken Bloom** wrote a blog post that served as a key plot point in the February 5, 2015 episode of the CBS TV sitcom "The Big Bang Theory." The post, which Bloom published on a real blog named *Quantum Diaries*, discusses a research paper "authored" by central characters Sheldon Cooper and Leonard Hofstadter. In it, Bloom touts the fictional study as an admirable example of rare collaboration between a theorist and experimentalist. However, the post concludes with a foreshadowing of the episode's plot: "And Leonard and Sheldon, if you are reading this post – don't look at the comments. It will only be trouble." That trouble comes in the form of negative feedback from a commenter known as General Relativity—later revealed as theoretical physicist Stephen Hawking—whose trolling drives Sheldon and Leonard to defend their research.

Bloom's involvement with the episode came about by accident. His longtime friend David Saltzberg, the show's science adviser and a professor of physics at the University of California, Los Angeles, wanted to bolster the plot by mentioning a real physics blog. Saltzberg contacted his colleague about gaining permission to reference *Quantum Diaries*, for which Bloom has written since 2008. As one of many international particle physicists who contribute to the blog, Bloom didn't have the authority to grant that permission. But he did have an idea for the post itself, which was initially conceived as a simple mention in the episode. "Once I started thinking about it, I said, 'Why don't we just write a real blog post on the site, and then there will be something out in the real world?'" Bloom said. "I suggested that to David, who said, 'Yeah that's an interesting idea. Let me talk to the producers.' They liked it, so we ended up doing it." The pair's work with physicists who propose such theories, Bloom said, inspired Saltzberg's conception of the blog post and Bloom's writing of it.

"Leonard is an experimenter; Sheldon is a theorist," Bloom said. "The blog post is about how it's really very unusual for experimentalists and theorists to collaborate, and how they come from very different worlds. But (in this fictional universe), here's this very interesting example in this paper I came across from these two young guys at Caltech." Bloom said he's seen only a few episodes of the series, which has become one of network television's most-watched comedies during its eight seasons on the air. "I don't really watch any TV," Bloom said. "No disrespect to television—I just don't have the time. I knew roughly who the characters were, but I did double-check everything to make sure I had the names right."


Ken Bloom

Newton's Apple Tree Planted Near Jorgensen Hall

On May 5, 2015, two cloned Flower of Kent trees were planted to the west of Jorgensen Hall. At the May 7 tree-planting ceremony, Laurence Ballard, nursery director with UNL Landscape Services, spoke about the cloning process and George W. Holmes University Professor **Anthony Starace** spoke about York University Professor Richard G. W. Keesing's research establishing the identity of the tree at Newton's Woolsthorpe Manor. The significance of the trees for physics stems from historical evidence indicating that Issac Newton was inspired to develop his universal theory of gravitation upon observing an apple drop from a tree at Woolsthorpe Manor.

As reported in Issue No. 12 of *Spectrum*, on April 4, 1991, an original Flower of Kent tree was planted during a ceremony by the loading dock of Behlen Laboratory. A plaque was placed by the tree that identifies it as a "scion from Sir Isaac Newton's famous apple tree at his birthplace in Woolsthorpe Manor, Lincolnshire, England, [that] was presented to the University by Dr. Keesing of the Physics Department of the University of York, England. This tree is of the ancient cultivar, Flower of Kent." When the Department moved from Behlen Laboratory in May 2010, the Newton Apple Tree was too large to be moved. Instead, Ballard oversaw the cloning of the Newton Apple Tree and produced two new Flower of Kent apple trees that are genetic duplicates of the one by Behlen Laboratory.


Flower of Kent apple tree south of Behlen Laboratory


Cloned Flower of Kent apple tree west of Jorgensen Hall

News Media Consult Gay on Deflated Footballs

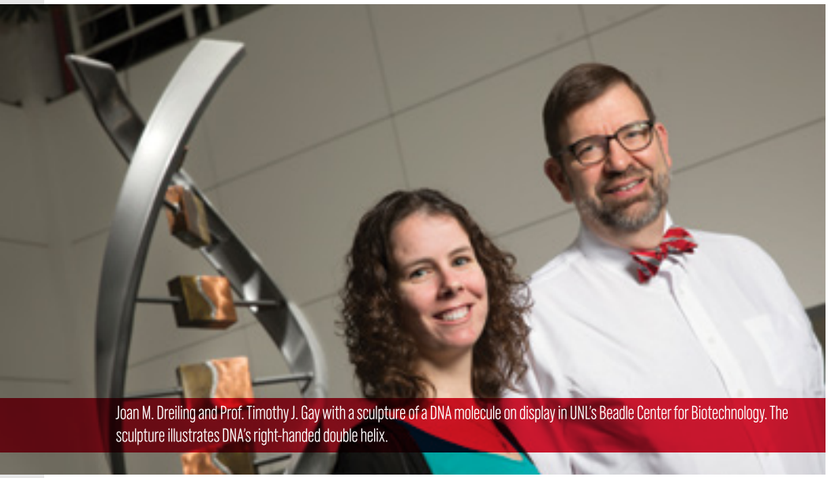
Professor **Timothy J. Gay**, author of the 2005 book *The Physics of Football*, was one of the news media's go-to experts on the controversial 45-7 win of the New England Patriots over the Indianapolis Colts on January 21, 2015 in the AFC Championship game (Super Bowl XLIX). The *New York Times*, *NBC News*, the *Los Angeles Times*, and others quoted Gay's analysis that the deflated footballs may have been due to the cold temperature on the field as compared to the warm temperature inside the stadium where the balls were inflated. Interestingly, Gay and the Patriots' Coach, Bill Belichick, were classmates at prep school at Philips Academy in Andover, MA. Belichick also wrote the forward to Gay's book. For further details, see Leslie Reed's story of January 28, 2015 on UNL Today: http://news.unl.edu/newsrooms/unltoday/article/gay-believes-air-temp-is-key-to-nfls-deflate-gate/.

Timothy Gay

RESEARCH HIGHLIGHTS

Why is DNA Right-Handed? Gay-Dreiling Experiment Provides Possible Answer

*Editor's Note: The recent paper by Professor **T.J. Gay** and former graduate student **J.M. Dreiling** (M.S. 2010, Ph.D. 2014) entitled "Chirally Sensitive Electron-Induced Molecular Breakup and the Vester-Ulbricht Hypothesis" [Phys. Rev. Lett.* **113**, *118103 (2014)] has attracted world-wide attention for the insight it provides on a long-standing puzzle concerning life on Earth. The paper was selected as an "Editors' Suggestion" by Physical Review Letters and was the subject of a Physics Focus article. Internationally, it was the subject of articles in the Neue Zuercher Zeitung, Switzerland's leading newspaper, the CERN Courier, Pour La Science, the French Equivalent of Scientific American, and Nature magazine's online news blog, among others. Below we reprint a slightly edited version of Tom Simons' UNL News article published on September 17, 2014.*



Joan M. Dreiling and Prof. Timothy J. Gay with a sculpture of a DNA molecule on display in UNL's Beadle Center for Biotechnology. The sculpture illustrates DNA's right-handed double helix.

The DNA of every organism on Earth is a right-handed double helix, but why that would be has puzzled scientists since not long after Francis Crick and James Watson announced the discovery of DNA's double-helical structure in 1953. It's a puzzle because no one has been able to think of a fundamental reason why DNA couldn't also be left-handed.

New research by Professor **Timothy J. Gay** and graduate student **Joan M. Dreiling** in *Physical Review Letters* gives support to a long-posited but never-proven hypothesis that electrons in cosmic rays—which are mostly left-handed—preferentially destroyed left-handed precursors of DNA on the primordial Earth. The hypothesis, called the Vester-Ulbricht model, was proposed by Frederic Vester of the University of Saarbrucken in Germany and Tilo L.V. Ulbricht of the University of Cambridge in England in 1961 in response to the 1957 discovery that most of the electrons from radioactive beta decay were left-handed.

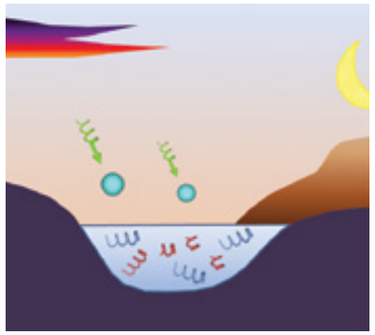
Dreiling and Gay focused circularly-polarized laser light on a specially prepared crystal of gallium-arsenide to produce electrons whose spins were either parallel or anti-parallel to their direction of motion upon emission from the crystal—essentially artificial beta rays. They then directed these electrons to strike target molecules of a substance called bromocamphor, which comes in both right- and left-handed varieties. They found that at the lowest electron energies they studied, left-handed electrons preferentially destroyed left-handed molecules and vice versa. The molecular experiment proves the principle underlying the Vester-Ulbricht hypothesis.

"The circular polarization of the laser light effectively transferred to the spin (handedness) of the electrons emitted by the gallium-arsenide crystal," said Dreiling. "We are able to reverse the spin-polarization of the electrons just by reversing the circular polarization of the light."

"We have done several different checks with our experiment and I am totally confident that the asymmetry exists," Dreiling said. "The checks all came out showing that this asymmetry is real."

Gay said the paper in *Physical Review Letters* culminates a 21-year effort that began in earnest when he came to UNL from the University of Missouri-Rolla in 1993. The research was funded by a grant from the National Science Foundation.

"This has been an incredibly hard experiment," he said. "It has ground two graduate students into the dust. Poor Joan survived. The others got their Ph.D.s in other things and a lot of good science came out on the way, but Joan was clever enough to make this experiment work. What she did was make the first experiment that showed the asymmetry at the molecular, nano level. That's the molecular physics part of it, which is what we're really interested in, but there's also this tie to the origins of life on Earth."



A drawing illustrating how electrons in cosmic rays, which have mostly left-handed spins, could have bombarded pools of proto-organic ooze on the surface of the primordial Earth, preferentially destroying left-handed precursors of DNA, and thus yielding the right-handed-only DNA that exists today.

RESEARCH HIGHLIGHTS

Novel Ferroelectric Tunnel Junctions with Applications to Digital Memory and Logic Devices

*Editor's Note: An international team of researchers led by Charles Bessey Professor **Alexei Gruverman** reported recently a novel combination of graphene and ferroelectric films with remarkable properties. This November 24, 2014 report by Scott Schrage of University Communications is slightly edited and abridged.*

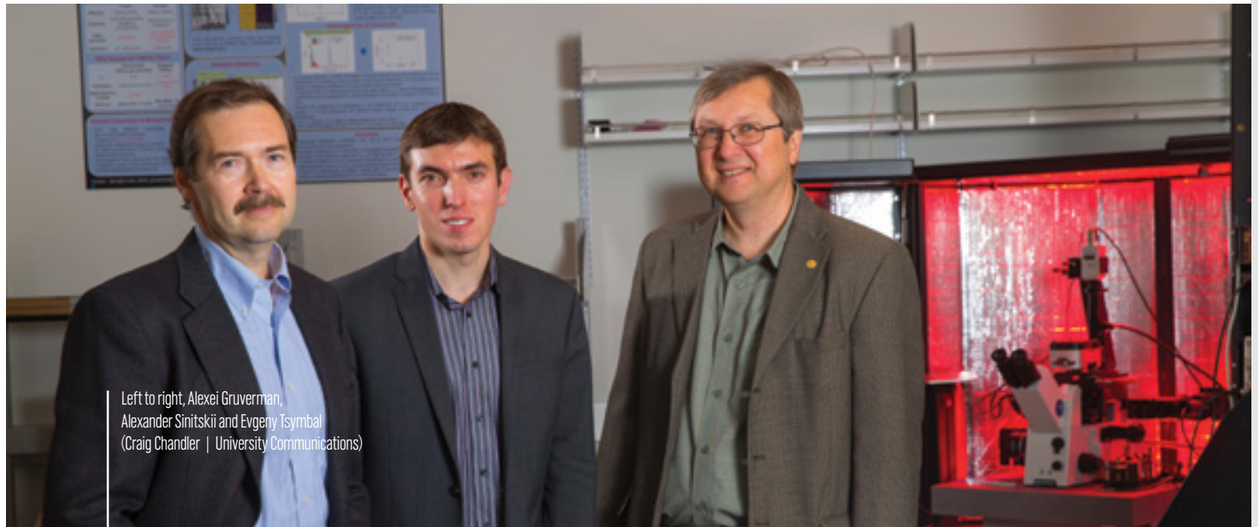
The improvements in random access memory that have driven many advances of the digital age owe much to the innovative application of physics and chemistry at the atomic scale. Accordingly, a team led by UNL researchers has employed a Nobel Prize-winning material and common household chemical to enhance the properties of a component primed for the next generation of high-speed, high-capacity RAM.

The team, which published its findings in the November 24, 2014 issue of the journal *Nature Communications*, engineered and tested improvements in the performance of a memory structure known as a ferroelectric tunnel junction. The junction features a ferroelectric layer 100,000 times thinner than a sheet of paper, so thin that electrons can "tunnel" through it. This layer resides between two electrodes that can reverse the direction of its polarization—the alignment of positive and negative charges used to represent "0" and "1" in binary computing—by applying electric voltage to it.

The researchers became the first to design a ferroelectric junction with electrodes made of graphene, a carbon material only one atom thick. While its extreme conductivity makes graphene especially suited for small-scale electronics, the authors' primary interest lay in how it accommodated nearly any type of molecule—specifically, ammonia—they placed between it and the ferroelectric layer. A junction's polarity determines its resistance to tunneling current, with one direction allowing current to flow and the other strongly reducing it. The researchers found that their graphene-ammonia combination increased the disparity between these "on" and "off" conditions, a prized outcome that improves the reliability of RAM devices and allows them to read data without having to rewrite it.

"This is one of the most important differences between previous technology that has already been commercialized and this emergent ferroelectric technology," said **Alexei Gruverman**, a Charles Bessey Professor of physics who co-authored the study. Ferroelectric materials naturally boast the quality of "non-volatility," meaning they maintain their polarization—and can hence retain stored information—even in the absence of an external power source. However, the infinitesimal space between the positive and negative charges in a tunnel junction makes maintaining this polarization especially difficult, Gruverman said. "In all memory devices, there is a gradual relaxation, or decrease, of this polarization," he said. "The thinner the ferroelectric layer is, the more difficult it is to keep these polarization charges separate, as there is a stronger driving force in the material that tries to get rid of it." Gruverman said the team's graphene-ammonia combination also shows promise for addressing this prevalent issue, significantly improving the stability of the junction's polarization during the study.

Gruverman's UNL co-authors included **Haidong Lu** and **Dong Jik Kim**, postdoctoral researchers in physics and astronomy; Alexey Lipatov, a postdoctoral researcher in chemistry; **Evgeny Tsymbal**, George W. Holmes University Professor of physics and astronomy; and Alexander Sinitskii, assistant professor of chemistry. The study was also authored by researchers from the University of Wisconsin-Madison and the Kurnakov Institute for General and Inorganic Chemistry in Moscow, Russia.



Left to right, Alexei Gruverman, Alexander Sinitskii and Evgeny Tsymbal (Craig Chandler | University Communications)

RESEARCH HIGHLIGHTS

Fundamental Nonlinear X-Ray Process Observed "in Neuland"

*Editor's Note: Assistant Professor **Matthias Fuchs**, together with an international team of scientists, has reported the first observation of a fundamental nonlinear X-ray process [M. Fuchs et al., "Anomalous Nonlinear X-Ray Compton Scattering," Nature Physics **11**, published online August 31, 2015]. The experiment was carried out at the Linac Coherent Light Source (LCLS) at the SLAC National Accelerator Laboratory in Menlo Park, CA. Fuchs and collaborator David A. Reis (of the Stanford PULSE Institute) have written "A Description in Layman's Terms" (unpublished) of the significance of their measurement. Below we reproduce a slightly edited and abridged version of their layman's description.*

In this experiment, we have investigated one of the most fundamental interactions between X-rays and matter. More specifically, we have observed a process where two X-ray photons (particles of light) interact at the same time with an atom. During this process the two photons are converted into a single higher-energetic X-ray photon. Under "normal" circumstances such a conversion does not happen, but we know from experiments using visible light that it can occur for extremely high light intensities. This process was discovered at optical wavelengths in the 1960s using a (back then) revolutionary novel device: a laser. Since then it has been heavily exploited in research and is being used in almost every laboratory that uses lasers. Because the rate of the converted higher-energy photons depends nonlinearly on the incoming light intensity, these interactions are also called "nonlinear processes." However, until recently it has not been possible to observe such interactions at X-ray wavelengths because X-ray sources that can produce sufficiently high intensities have not existed.


Matthias Fuchs

Therefore, we had to use a completely new source of X-rays, a so-called X-ray free-electron laser (XFEL) for this experiment. These lasers are nothing like a "typical" laser, particularly in that they are enormous machines with a length of more than a kilometer. They have only recently become operational after decades of development and to this day only two of them exist worldwide, one at the SLAC National Accelerator Laboratory in California (called the LCLS) and the other one in Japan (called SACLA). These XFELs are capable of generating radiation with unprecedented properties. For our experiment, we took advantage of the fact that they can produce extremely intense X-rays, which are more than a trillion times brighter than the Sun. Experiments at XFELs usually require a broad range of expertise in many different areas. The experimental team for this particular experiment consisted of researchers from SLAC, Stanford University, Bar-Ilan University in Israel and UNL.

During the experiment, we generated an extremely intense X-ray beam by focusing the full XFEL output from the LCLS into an extremely small spot of only 100 nm (1 nm = 1 billionth of a meter). The resulting X-ray intensity is equivalent to a scenario where all of the Sun's radiation hitting the Earth's surface would be combined into a spot size of approximately the diameter of a human hair; however, we directed the X-rays onto a small piece of beryllium metal. We needed such extreme intensities to improve the chances of both of the two photons meeting up at exactly the right place and exactly the right time on one of the many atoms that are illuminated. Even so, the probability that the nonlinear interaction occurs on any given atom is less than winning the lottery. This is because already "normal" interactions using X-rays are very weak (hence X-rays are mostly transmitted through many materials), but in order to be able to observe *nonlinear* X-ray matter interactions requires significantly more intensity than for optical wavelengths (roughly 100 million times more intense).

The experiment was the very first investigation of this kind, which means that we were entering what you would call "Neuland" (uncharted territory) in German. From theoretical predictions and extrapolations of previous optical nonlinear experiments and linear X-ray interactions, we were able to predict the expected signal. However, the signal that we observed did not agree with what you would expect from the existing theory and extrapolations. During the X-ray process an electron can be ejected from the atom at the same time that the higher-energy photon is emitted. The X-ray and electron must share their energy such that their sum is equal to the two initial X-ray photons. Our measurements did not agree with our best theoretical predictions for how that energy is shared. Particularly, the energy of the converted higher-energy X-ray photons was much lower than expected! This shows that the physics of the interaction seems to be much richer and even much more interesting than initially anticipated.

The fact that our measurements do not agree with the initially expected results just shows the tremendous value of basic science. This experiment is just the beginning. We will soon perform even more sophisticated experiments with better instrumentation to better understand this newly discovered phenomena. If our new understanding of this fundamental process can be confirmed by those experiments, it can have significant impact on future experiments that are performed with high X-ray intensities (most experiments at XFELs) and can lead to novel diagnostic methods for matter.

SEE ALSO

In the News...

Editor's Note: Many articles about Department faculty, staff, and students have appeared on the Web. Below is a selection of recent articles and videos that may be accessed by using the URL indicated.

"Moreno, nine others, granted NSF fellowships," UNL Today, 18 June 2014: http://news.unl.edu/newsrooms/unltoday/article/moreno-nine-others-granted-nsf-fellowships/

"Discovery could point to advancements in key electrochemical applications," UNL Today, 1 August 2014: http://news.unl.edu/newsrooms/unltoday/article/discovery-could-point-to-advancements-in-key-electrochemical-applications/

"Team to prepare power-generating material for space flight, security," UNL Today, 4 September 2014: http://news.unl.edu/newsrooms/unltoday/article/team-to-prepare-power-generating-material-for-space-flight-security/

"Project aims to transform STEM teaching," UNL Today, 29 October 2014: http://news.unl.edu/newsrooms/unltoday/article/project-aims-to-transform-stem-teaching/

"Researchers working to advance national security, defense," UNL Today, 13 November 2014: http://news.unl.edu/newsrooms/unltoday/article/researchers-working-to-advance-national-security-defense/

"Study details laser pulse impacts on behavior of electrons," UNL Today, 26 November 2014: http://news.unl.edu/newsrooms/unltoday/article/study-details-laser-pulse-impacts-on-behavior-of-electrons/

"Big Bang Machine: International Science Advances Include Nebraska Element," Nebraska Educational Telecommunications, 14 January 2015: http://netnebraska.org/article/news/954324/big-bang-machine-international-science-advances-include-nebraska-element

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Richards-Kortum Elected to National Academy of Sciences

Editor's Note: This article is based on news releases of the National Academy of Sciences, Rice University, and the AAAS-Lemelson Invention Ambassadors Program; Science **349***, 489 (2015); Rebecca Richards-Kortum's bio sketch on her web page at Rice University; and the web page of the Rice 360 Institute for Global Health.*

In a news release dated April 28, 2015, the National Academy of Sciences announced the election of 84 new members, including **Rebecca Richards-Kortum** (B.S. 1985), Malcolm Gillis University Professor of Bioengineering at Rice University in Houston. The National Academy of Sciences is a private, nonprofit institution that was established under a congressional charter signed by President Abraham Lincoln in 1863. It recognizes achievement in science by election to membership, and provides science, technology, and health policy advice to the federal government and other organizations. Richards-Kortum is also a member of the National Academy of Engineering, which elected her in 2008, one of only a few Academy members to hold such dual memberships. In a Rice University news release on the same date, Rebecca said, "It is such an honor to be recognized and be part of a group like this…. I'd especially like to acknowledge and recognize the contributions of all my students. It has really been my privilege to work with such a wonderful team."

For two decades, Richards-Kortum has focused on translating research that integrates advances in nanotechnology and molecular imaging with microfabrication technologies to develop optical imaging systems that are inexpensive, portable, and provide point-of-care diagnosis. This basic and translational research is highly collaborative and has led to new technologies to improve the early detection of cancers and other diseases, especially in impoverished settings. Microelectromechanical systems (MEMS) use micro-scale technology to design low-cost, reusable platforms for point-of-care (POC) diagnostics. When used with contrast agents, these rugged and portable optical imaging systems detect molecular signatures of pre-cancer, assess tumor margins, and monitor a patient's response to therapy. Richards-Kortum is also director of the Rice 360 Institute for Global Health, which brings together an international group of faculty, students, clinicians, and private and public sector partners to design innovative health technologies for poor settings and to develop and implement entrepreneurial approaches that increase access to these technologies around the world.


Rebecca Richards-Kortum

Recently, Richards-Kortum was selected as one of seven AAAS-Lemelson Invention Ambassadors. At a meeting on July 14, 2015, to introduce the new Ambassadors, Richards-Kortum stated that because a machine that helps babies with underdeveloped lungs is prohibitively expensive in developing countries, she led a team that developed a cheaper alternative. According to a report on the meeting in the July 31, 2015, issue of *Science* [Vol. **349**, p. 489], her group's machine is now used in health facilities in Malawi and other developing countries. "I'll never forget the first time I saw a baby who went on treatment with a device that had been developed by our team," she said. "It was really an amazing moment to see how much that baby just relaxed…but even better was to see the relief on his mother's face."

Al-Omari Wins 2014 Distinguished Arab Researcher Award

The Association of Arab Universities selected **Imaddin Ali Al-Omari** (Ph.D. 1996; Adviser: **D.J. Sellmyer**), professor of physics at Sultan Qaboos University in Oman, for the 2014 Distinguished Arab Researcher Award in the fields of science and engineering for the year 2014. The award was announced in Amman, Jordan, during the January 5th meeting of the executive council of the Association of Arab Universities. Professor Al-Omari received the award during the General Conference of the Association of Arab Universities held on March 25, 2015 in Beirut, Lebanon. The award includes a certificate from the Association of Arab Universities and a cash prize of $7,500.

Al-Omari's award is based on his achievements in teaching, student training, research, service to the scientific community and to the development of science in the Arab world during his entire academic career, especially in the past 10 years. Professor Al-Omari has worked at Sultan Qaboos University for 14 years. He has taught physics to undergraduate and postgraduate students for the past 19 years at Sultan Qaboos University, the University of Nebraska–Lincoln, and Jordan University of Science and Technology. He has published 103 scientific research papers in international referred journals and presented 40 papers at international conferences. He also served as principal investigator of more than 10 research projects. Al-Omari is often a visiting professor of physics at UNL during summers.

Al-Omari's research focuses on the preparation, characterization, and development of different magnetic materials by various techniques. These materials include thin films, alloys, nano-crystalline and nano-particle powders and thin films, and ribbons. His research aims to improve the thermal and magnetic properties of materials, their resistance to corrosion, their preparation and energy costs, and their environmental impacts. His research has advanced understanding of the properties of magnetic materials and advanced their applications. These materials play an important role in the technologies for high density magnetic recording, high coercivity permanent magnets, permanent magnets for high temperature applications, batteries, solar cells, etc.

The Association of Arab Universities, also called the Union of Arab Universities, is an organization working within the framework of the Arab League. It is based in Amman, Jordan. The objective of the organization is to support and connect universities in the Arab world, and to enhance cooperation among them.


Immadin A. Al-Omari

Reed to Head IUPAP

Editor's Note: This article is based on a December 23, 2014 news release by Lawrence Livermore National Laboratory.

Kennedy Reed (Ph.D. 1978; Adviser: **J. Macek**), an atomic physicist in the Physics Division at Lawrence Livermore National Laboratory, was elected president-designate of the International Union of Pure and Applied Physics (IUPAP) at the group's general assembly meeting in Singapore in November 2014. Reed is the first American elected to head this global organization since Nobel Laureate Burton Richter, who was president of IUPAP from 1999 to 2002. Reed will serve a three-year term as president-designate, followed by a three-year term as the president of IUPAP, culminating with a three-year term as the organization's past president.

IUPAP assists in the worldwide development of physics, fosters international cooperation, and helps in the application of physics toward solving problems of concern to humanity. Sixty countries are members of IUPAP, and the executive council supervises the activities of IUPAP's 19 specialized international commissions that cover the major physics sub-disciplines. Reed served on the IUPAP Commission on Physics for Development for nine years and was the chair of that commission for three years. This commission seeks to improve the conditions of physics and physicists in developing regions of the world.

Reed is a leader in national efforts to increase opportunities for minority students and professionals in the sciences in the U.S., and has helped develop and direct programs that have expanded research and training opportunities enabling students to pursue advanced degrees in physical science disciplines. Reed served as vice chair of the American Physical Society's (APS) Committee on International Scientific Affairs, and was awarded the APS John Wheatley Award in 2003 for his contributions to physics research and education in Africa—the only time this award has been given for work in Africa. In 2010, President Obama awarded Reed the prestigious Presidential Award for Excellence in Science and Engineering Mentoring.

Kennedy Reed

Rybnicek Speaks at 2015 Recognition Luncheon

The Department organizes an annual Recognition Luncheon a day or two before May graduation ceremonies in order to honor the Department's bachelors, masters, and doctoral graduates. A distinguished alumnus is invited back to campus to address our graduates, usually someone who has forged a successful career outside a typical academic physics career (with which our students are already quite familiar). **Tara (McAvoy) Rybnicek** (M.S. 1997; Adviser: **P.A. Dowben**) was the keynote speaker at the May 7, 2015 Recognition Luncheon. Rybnicek is Principal Engineer II with Raytheon Vision Systems in Goleta, CA.


Tara Rybnicek

Tara grew up in Suffolk County, New York on Long Island, graduating from Centereach H.S. in 1991. She majored in physics at the Mary Washington College (now the University of Mary Washington), a public university in Fredericksburg, VA, where she graduated in 1994. A family move west brought Tara to UNL to pursue her graduate studies in physics. She particularly enjoyed the solid state physics course taught by Professor **Peter A. Dowben** and joined his group.

Following her M.S. degree at UNL in 1997, her first job was at Applied Magnetics in Goleta, CA, where she was a deposition and etch process engineer. Applied Magnetics manufactured magnetic recording heads for disk drives. Her job made use of the vacuum, metrology, and thin film experience she acquired at UNL. Following the bankruptcy filing of Applied Magnetics, in 2000 Tara joined the successor company, Innovative Micro Technology (IMT) in Santa Barbara, CA, a MEMS (micromechanical systems) start-up company. It was run by a small group of innovative thinkers who had patented MEMS technology. Then when the opportunity to work abroad arose, Tara joined ABB Semiconductors, A.G., in Lenzburg, Switzerland, where she was an ion implant process engineer. ABB manufactures high-power semiconductors for transportation and energy transmission applications. Tara was responsible for processes on two ion implant systems, where she employed her hands-on vacuum experience gained at UNL.

Following five years off to have and raise three children, Rybnicek joined Ratheon Vision Systems in 2008 working as a process engineer on the Uncooled Microbolometer team. Raytheon Vision Systems makes high-grade infrared sensors for space, defense, and industrial applications. Microbolometers are MEMS devices that work at room temperature. They must work in vacuum in order to eliminate ambient field effects. Infrared vision capabilities are important for night vision, thermography, astronomy, and missile defense. One of Tara's recent projects is an infrared smartphone camera. Based on her own career, Rybnicek noted for this year's graduates that physics has provided her with valuable and diverse skills that have been attractive to a number of her employers.

Alumni Return for Starace Fest Workshop


Workshop group photo in Jorgensen Hall

A number of Department alumni returned to campus the weekend of August 21-23 to attend a workshop on Saturday, entitled "Insights into AMO Physics and Related Fields" in honor of the 70th birthday of Professor **Anthony F. Starace**. Returning alumni included Starace's former students [**MinQi Bao** (M.S. 1992, Ph.D. 1995), **Bo Gao** (M.S. 1986, Ph.D. 1989), **Chris Greene** (B.S. 1976), **Chien-Nan Liu** (M.S. 1995, Ph.D. 1999), **Chih-Ray Liu** (M.S. 1985, Ph.D. 1988), **Liangwen Pi** (M.S. 2009, Ph.D. 2014), **Siamak Shahabi** (M.S. 1977, Ph.D. 1983), **Hua-Chieh Shao** (Ph.D. 2014), **Gary L. Webster** (Ph.D. 1981)], and former postdoctoral research associates [**Michael J. Cavagnero** (1986-1989), **Ning-Yi Du** (1989-1992), **Suxing Hu** (2001-2003), **Gérard Lagmago Kamta** (1999-2002), **Jean Marcel Ngoko Djiokap** (2010-2014), and **Cheng Pan** (1988-1995)]. A number of out-of-town colleagues and collaborators also attended the workshop, including **André D. Bandrauk** (Université Sherbrooke, Québec, Canada), **Brett Esry** (Kansas State University, Manhattan, KS), **A. Ravi P. Rau** (Louisiana State University, Baton Rouge, LA), **Göran Wendin** (Chalmers University of Technology, Göteborg, Sweden), and **Minghui Xu** (University of Colorado-Boulder). Together with local colleagues and students, approximately 70-80 people attended all or part of the one-day workshop.

The workshop was organized by Professor **Timothy J. Gay** and former postdoctoral research associate and current collaborator **Katarzyna Krajewska** (of the Institute of Theoretical Physics at the University of Warsaw, Poland). Each of the workshop talks addressed forefront topics in theoretical atomic physics including free electron laser spectroscopy, attosecond physics, cold atom physics, the fractional quantum Hall effect, quantum information, and fundamental aspects of quantum mechanics and its symmetries. Former students and postdocs also commonly mentioned how they felt like a member of Starace's family during their time in Lincoln. Links to the workshop talks may be accessed at this URL: http://www.unl.edu/physics/physics-astronomy-hosts-workshop-insights-amo-physics-and-related-fields.

We Heard That...

Beezley, Jonathan (B.S. 2001) joined the Scientific Computing team of Kitware in Clifton Park, NY in February 2014 as an R&D engineer. Kitware, Inc. creates open-source software in visualization, computer vision, medical imaging, data publishing, and software process solutions to a variety of academic and government institutions and private corporations worldwide. Email: *jonathan.beezley@kitware.com*

Burk, Laurel (B.S. 2007) is currently a Medical Device Lead Reviewer at the Food and Drug Administration in Silver Spring, MD. She specializes in premarket and postmarket evaluation of diagnostic x-ray systems, with a particular emphasis on computed tomography systems. Burk received a Ph.D. in physics from the University of North Carolina in 2013.

Corder, Christopher (B.S. 2007) received a Ph.D. in physics from Stony Brook University in 2014 under the supervision of Harold Metcalf. He is currently a postdoctoral research associate in Professor Thomas K. Allison's group at Stony Brook. Email: *Christopher.Corder@stonybrook.edu*

De, Bhola (M.S. 1986, Ph.D. 1990; Adviser: **John Woollam**) joined Skorpios Technologies, Inc. in Albuquerque as senior principal engineer in 2014. His work focuses on developing process flow using foundry process kits to manufacture devices with integrated CMOS silicon and III-V materials on wafer scale to make communication products. He works at multiple foundry sites to improve existing process kits, and introduces additional compatible process steps for particular applications.

Fickler, Debra née Cleveland (B.S. 1988) has embarked on a new career as a nuclear medicine technologist for St. Francis Health Center in Topeka, KS.

Gao, Bo (M.S. 1986, Ph.D. 1989; Adviser: **Anthony Starace**) spent the Fall 2014 semester teaching at Tsinghua University in Beijing, China. Gao is a professor in the Department of Physics and Astronomy at the University of Toledo. Email: *bgao@physics.utoledo.edu*

Gilbert Corder, Stephanie (B.S. 2007) received a Ph.D. in physics from Vanderbilt University in 2014. In February 2015, she joined the experimental condensed matter group in the Department of Physics and Astronomy at Stony Brook University as a postdoctoral research associate. Email: *stephanie.gilbertcorder@stonybrook.edu*

Greene, Chris H. (B.S. 1976) was honored by a workshop entitled "AMO Physics According to Chris Greene" held at the Keystone Conference Center in Keystone, Colorado, during May 27-29, 2015. The workshop celebrating Chris's 60th birthday was organized by Brett Esry (Kansas State University) and Hossein Sadeghpour (Harvard-Smithsonian Institute of Theoretical AMO Physics). A dozen former postdocs and students presented talks on their research and interactions with Chris over the day and a half workshop. The URL for the workshop photo gallery and program is here: https://www.cfa.harvard.edu/itamp/KeystoneChrisFest2015.html. Email: *chgreene@purdue.edu*

Hilbert, Shawn (M.S. 2007, Ph.D. 2009; Adviser: **Herman Batelaan**) joined Berry College in Mount Berry, GA, as assistant professor of physics in 2014. Email: *shilbert@berry.edu*

Kirby, Kathryn H. née Wiese (B.S. 1988) became Deputy Project Manager for the National Ecological Observatory Network (NEON) in 2014 after working for Raytheon in various capacities for 25 years. NEON is located in Boulder, CO, and is a $430 million dollar observatory project dedicated to understanding how changes in climate, land use and invasive species impact ecology. For the next three decades, NEON will collect a comprehensive range of ecological data on a continental scale across 20 eco-climatic domains representing U.S. ecosystems. Email: *kkirby@neoninc.org*

We Heard That...

Kolesnikov, Dmitry (B.S. 2007) began a position with Garmin International in Kansas City, MO, as an Internet application developer.

Kong, Lingmei (M.S. 2009, Ph.D. 2012; Adviser: **Peter Dowben**) took a position as a Derivatives Pricing Evaluator with Thomson Reuters in New York in February 2015. She was previously a postdoctoral fellow at Pacific Northwest National Laboratory from 2013 to 2014.
Email: *lingmeikong@gmail.com*

Kruse, Amanda (B.S. 2009) earned a Ph.D. degree in physics in 2014 from the University of Wisconsin-Madison with research in the area of computational high-energy physics on the Atlas experiment at CERN. Amanda currently is a Data Scientist at Allstate Insurance Co.

Kubik, Andrew (B.S. 2003) joined the Department of Physics and Astronomy at Texas A&M University as a postdoctoral researcher. He obtained his Ph.D. from Northwestern University in early 2014.
Email: *akub19@physics.tamu.edu*

Lagmago-Kamta, Gérard (Postdoctoral Researcher, 1999-2002; Adviser: **Anthony Starace**) has been working in the Department of Medical Physics at the Charles-Lemoyne Hospital in Brossard, Québec, Canada, since 2009, when he received his M.Sc. degree in medical physics from McGill University.
Email: *glagmago@yahoo.ca*

Lewis, Michael (B.S. 1992) joined GE Healthcare in the Seattle area as Segment Leader–Cell Analysis in 2014, after a number of years at Olympus Corporation of America.

Marquard, Paul (M.S. 1986) earned an Ed.D. in instructional technology from the University of Wyoming in 2014. He continues as an physics and engineering instructor at Casper College in Casper, WY.
Email: *marquard@caspercollege.edu*

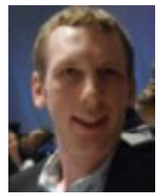
Maseberg, Jack W. (Ph.D 2009; Adviser: **Timothy Gay**) was promoted in April 2015 to the rank of associate professor with tenure in the physics department at Fort Hayes State University in Hayes, KS. His teaching and research interests are in the area of experimental atomic, molecular, and optical physics. Email: *jwmaseberg@fhsu.edu*

Namba, Ryo (B.S. 2007) is a project researcher in theoretical physics (cosmology) at the Kavli Institute for the Physics and Mathematics of the Universe, associated with the University of Tokyo. He received his Ph.D. in physics from the University of Minnesota in 2013. Email: *ryo.namba@ipmu.jp*

Neukirch, Amanda née Fricke (B.S. 2007) received a Ph.D. in physics from the University of Rochester in 2014. She is currently a postdoctoral research associate in the Center for Nonlinear Studies at Los Alamos National Laboratory doing research in computational materials science with an emphasis on photovoltaic applications.
Email: *ajneukirch@lanl.gov*

Poddar, Shashi (M.S. 2011, Ph.D. 2014; Adviser: **Stephen Ducharme**) spent his final semester of graduate study as a teaching and research fellow at the Center for Materials Science at California State University-San Bernardino (CSUSB). Poddar did research on molecular ferroelectric materials and co-taught an advanced undergraduate course on nanoscience and nanotechnology. The Center is funded by the Centers of Research Excellence in Science and Technology program of NSF. Poddar has returned to UNL as a postdoctoral researcher in the molecular ferroelectrics group of Professor **Stephen Ducharme** as a part of a collaboration involving researchers at UNL, CSUSB, the University of Connecticut, and the University of Buffalo (SUNY).
Email: *s-spoddar1@unl.edu*

Porter, Randy (B.S. 1993) was promoted to Assistant Vice President of Project Management at Farmers National Company (FNC) in Omaha, NE, in May 2014. Porter started with FNC in 2010. The company provides farm management as well as a complete range of agricultural services.
Email: *RPorter@FarmersNational.com*



Prososki, Paul (B.S. 2010) is currently an associate support engineer at Physical Electronics, Inc. in Chanhassan, MN. Prososki provides service and support for Auger electron spectroscopy systems for customers across the globe. He received an M.S. degree in atmospheric science from Texas Tech University in 2013.
Email: *paul.prososki@huskers.unl.edu*

We Heard That...

Scarborough, Tim (B.S. 2006, M.S. 2009, Ph.D. 2012; Adviser: **Kees Uiterwaal**) is a postdoctoral researcher at Ohio State University working with Professor Lou DiMauro in the Agostini-DiMauro Ultra-fast Atomic Physics Research Group.
Email: *scarborough.39@osu.edu*

Scheer, Adam (B.S. 2005, M.S. 2006; Adviser: **Paul D. Burrow**) joined Pacific Gas and Electric Co. in San Francisco in August 2014 as an expert strategic analyst. He evaluates and does research on energy efficiency. Adam received his Ph.D. in chemical physics from the University of Colorado-Boulder in 2011. During his graduate studies, he completed the Graduate Energy Certificate Program in the Renewable and Sustainable Energy Institute, a joint institute of CU-Boulder and DOE's National Renewable Energy Lab in Golden, CO. His work there involved research on the combustion of biofuels in next generation engines. Following his graduation, he held a postdoctoral research position in the Combustion Research Facility at Sandia National Laboratory from January 2012 to July 2014.
Email: *ascheer1@gmail.com*

Segura, Rodrigo (B.S. 2005) earned a Ph.D. in aerospace, aeronautical, and astronautical engineering from the Universität Bundeswehr München in 2014 in Munich, Germany. He is currently a postdoctoral researcher at the Institute of Fluid Dynamics and Aerodynamics at the same institution.
Email: *rodrigo.segura@unibw.de*

Strohaber, James (B.S. 2001, Ph.D. 2008; Adviser: **Kees Uiterwaal**) took a tenure track position as assistant professor of physics at Florida Agricultural and Mechanical University (FAMU), a public, historically black university in Tallahassee, FL. Strohaber's research involves the investigation of the interaction of intense fields and ultrashort pulses of radiation with matter, which is a focus of FAMU's Center for Plasma Science and Technology.
Email: *james.strohaber@famu.edu*

Wang, Jin (Postdoctoral Researcher 2003-2005; Adviser: **Anthony Starace**) has been promoted to associate professor of physics with tenure in the Department of Natural Sciences at the University of Michigan-Dearborn. Her research is in the area of quantum optics.
Email: *jinwang@umich.edu*

Wilde, Robyn S. (M.S. 1996, Ph.D. 2000; Adviser: **Ilya Fabrikant**) returned to UNL the week of September 21 to present an AMOP Seminar on "Collisions of Positronium with Atoms and Molecules." Robyn is an associate professor in the Department of Natural Science at the Oregon Institute of Technology (OIT) in Klamath Falls, OR. During his visit, Wilde and Professor Fabrikant made plans to collaborate on research involving positron and positronium collisions. Email: *Robyn.Wilde@oit.edu*

Zhang, Zhengzheng (Ph.D. 2011; Adviser **Peter Dowben**) is currently a science writer in English and Chinese for the American Institute of Physics in College Park, MD. She writes press releases and builds collaborative relationships with Chinese mainstream science media outlets through their Beijing office. She also serves as a translator for AIP when Chinese delegations visit. She previously served as a science writing intern at the Space Science and Engineering Center at the University of Wisconsin-Madison and earned an M.A. degree in journalism there in 2014. Email: *zzhang@aip.org*

Contact Us

Dan Claes, Chair, and Anthony Starace, Editor, encourage you to contact us with your news and comments. Alumni can email physicsalumni@unl.edu with news, address changes, contact information, etc. To contact us individually, our emails are dclaes@unl.edu and astarace1@unl.edu. News about the Department is also posted on our website at http://www.unl.edu/physics. Please join our new LinkedIn group for students and alumni: https://www.linkedin.com/grp/home?gid=8368473.

M. Eugene Rudd (1927-2014)

M. Eugene (Gene) Rudd, Jr., (Ph.D. 1962) died at the age of 87 on November 23, 2014. He was born September 29, 1927, in Fargo, ND, to Millard (Bill) Rudd, Sr. and Stella (Nelson) Rudd. In 1953, he married Eileen Hovland, who remained his lifelong inseparable partner.

Following his service in the U.S. Army Signal Corps from 1946 to 1947, he enrolled in Concordia College (Moorhead, MN), from which he obtained a B.A. degree in physics in 1950. Subsequently he earned an M.A. in physics from the University of Buffalo in 1952 and a Ph.D. (advised by **Ted Jorgensen**) from UNL in 1962. He was professor of physics at Concordia College from 1954-1965, where he obtained two NSF grants to help him conduct research in atomic physics.

Though Rudd had grown up in the Fargo-Moorhead area, and felt at home at Concordia, the offer to join the physics faculty at UNL proved impossible to resist, so in 1965 he moved to Lincoln with his family. He became a full professor in 1968, and served as acting department chair from 1970-1972. As a researcher, Rudd was known best for his pioneering studies of electron- and ion-impact ionization of atoms and molecules. His group provided the first extensive data on differential electron emission in ionizing collisions. These results are still heavily used and referenced in studies of basic atomic collisions, as well as applied work in, e.g., astrophysics, radiation damage, and fusion plasmas. Over the course of his career, he authored or co-authored 5 books and 130 scientific papers.

His excellence in teaching earned him the BNSF Distinguished Teacher-Scholar Award in 1991. Moreover, nine students earned their doctorates at UNL under Rudd's direction: **Alan K. Edwards** (M.S. 1964, Ph.D. 1967), **Donald J. Volz** (M.S. 1965, Ph.D. 1968), **Geoffrey Crooks** (B.S. 1965, M.S. 1967, Ph.D. 1972), **Jonathan B. Crooks** (Ph.D. 1974), **Robert D. Dubois** (B.S. 1970, M.S. 1972, Ph.D. 1975), **Mohammad Bolarizadeh** (Ph.D. 1984), **Yang-Soo Chung** (M.S. 1986, Ph.D. 1993), **Ying-Yuan Chung** (M.S. 1986, Ph.D. 1993), and **George Kirby** (M.S. 1988, Ph.D. 1994).

Rudd and graduate student Donald Volz in the Behlen accelerator laboratory in 1965.

Rudd took three faculty development leaves to broaden his physics research: in the summer of 1972 at the University of Aarhus, Denmark; in 1981 at Battelle Pacific NW Laboratories in Richland, WA; and in 1983 at the Joint Institute for Laboratory Astrophysics (JILA) in Boulder, CO. In addition to being a Fellow of the American Physical Society, in 1980 he was elected Chair of its Division of Electron and Atomic Physics (DEAP – now DAMOP). After his retirement in 1993, a symposium in May 1994 on "Two-Center Effects in Ion-Atom Collisions" was held at UNL in his honor. The two-day symposium, co-chaired by Professors **Anthony Starace** and **Timothy Gay**, drew more than fifty scientists from Argentina, England, Germany, the Netherlands, and the U.S. The four scientific sessions comprised twelve talks and a number of poster presentations by leading physicists in areas pioneered by Rudd.

In the latter part of his life, Rudd developed an interest in historical technology. He was not content merely to admire his antique scientific artifacts, but viewed them as an opportunity to continue his research career by careful study. In particular, he measured the optical prescriptions for the historical telescope objectives he owned as well as those of many others. His collection was extensive enough that these measurements gave him insight into the historical development of the achromatic objective. He shared this interest in historical technology with longtime friend and colleague **Duane Jaecks**, and together they organized an exhibit of antique scientific instruments at the Sheldon Art Gallery in 1978. Rudd was Associate Editor of *Rittenhouse*, a journal on scientific instruments, from 1999-2003. He was a member of the Antique Telescope Society from its inception in 1991 until his death in 2014, and he served as its president from 1997-1999. He helped put together the collection of historical scientific instruments that grace the display cabinets in Jorgensen Hall. In addition to collecting and studying antique scientific instruments, Rudd also collected original early scientific books by such eminent scientists as Aristarchus of Samos (*De magnitudinibus et distantiis solis et lunae*, 1st ed., 3rd century B.C.), Ptolemy (*Almagest*, 1st ed., ca. 150 A.D.), Nicolaus Copernicus (*De revolutionibus orbium coelestium*, 1st ed., Nuremberg, 1543), Galileo Galilei (*Dialogo*, 1st ed., 1632) and many others. Among his other avocations, he sang in numerous choirs over most of his life, beginning with the Concordia College Concert Choir in 1950.

Dr. Rudd is survived by his wife Eileen, sons Eric and Leif, daughter Nancy Schwab, grandson Michael Schwab, and hundreds of his well-taught physics students and admiring colleagues.

Charles E. Skov (1933-2014)

Charles E. Skov (Ph.D. 1963; Adviser: **E.A. Pearlstein**), professor emeritus of physics at Monmouth College in Illinois died on July 5, 2014. He was born on June 29, 1933 in Kearney, NE, and was raised and educated in Riverdale, NE. He earned a bachelors degree at Kearney State Teacher's College in 1954, following which he served in the United States Army Signal Corps from 1954 to 1956 during the Korean conflict.

Skov received his Ph.D. in physics from UNL in 1963. His thesis concerned measurements of nonlinearity in the electrical conductivity of alkali-halide crystals, for which a very sensitive ac method was devised. His measurements confirmed the existence of theoretically-predicted nonlinearities, but found them to be much larger than expected.

Skov served as a professor of physics at Monmouth College for 31 years, during which he was the department chair for many years. He chose early retirement in 1994 and became a professor emeritus at Monmouth College. He was an outstanding teacher who challenged his students, many of whom had successful careers after graduation. He took a leave of absence from Monmouth College during 1971-1972 at the Argonne National Laboratory under the sponsorship of the Associated Colleges of the Midwest. Charles also served on the Human Rights Authority Committee for the State of Illinois during the 1990s working to protect disability laws.

Acknowledgments

The Department is very grateful to the following individuals for their new and continuing financial contributions during the period June 1, 2014-August 31, 2015:

Bao, Minqi (M.S. 1992, Ph.D. 1995) & Jin Jing
Barrett, William A. (B.S. 1952, M.S. 1953) & Jean
Berggren, Matthew M. (B.S. 1997) & Kimberly
Boyer, Larry L. (M.S. 1968, Ph.D. 1970) & Terry
Bryan, Blaine D. (B.S. 1960) & Rita M.
Gray, David M. (B.S. 1977)
Gronniger, Glen E. (M.S. 2004, Ph.D. 2006) & Jennifer
Hamilton, Christopher
Jacobs, Loyd D. (M.S. 1958)
Kelley, Thomas V.H. (B.A. 2011)
Kirby, Roger D. & Suzanne R.
Macek, Joseph H. & Ellen M.
Niva, Gordon D. (M.S. 1975, Ph.D. 1979) & Susan A. Lahr
Pilalis, Labros E. (B.A. 1978) & Jessica
Rashid, Harunor (Ph.D. 1983) & Meher
Ruckman, Jerry E. (B.S. 1962) & Frances A.
Sellmyer, David J. & Catherine J.
Starace, Anthony F. & Katherine F.
Tveten, Alan B. (M.A. 1959)
Van Winkle, Ethan S. (B.S. 2013)

Contributions to the Physics and Astronomy Lecture Endowment Fund in honor of Professor Anthony F. Starace's 70th birthday are also gratefully acknowledged from:

Bao, Minqi (M.S. 1992, Ph.D. 1995)
Green, Thomas L. & Joan D.
Starace, Katherine F.
Starace-Colabella, Linda & Kenneth D. Colabella

How to Contribute

We greatly value your gifts, as they are vital to keeping our program on the cutting edge and to continuing a positive learning experience for our students. Even small amounts make a difference. If you wish to contribute a tax-deductible gift in support of the Department of Physics and Astronomy, please note that we have the following general accounts at the University of Nebraska Foundation:

1) ***Physics & Astronomy Development Fund*** [for unrestricted funds] (Account No. 2557.0)

2) ***Physics & Astronomy Lecture Endowment Fund*** (Account No. 3321.0)

3) ***Physics & Astronomy Alumni Scholarship Endowment Fund*** (Account No. 3303.0)

4) ***J.E. Ruckman Fund for the Physics Department*** (Account No. 1687.0)

Alternatively, former students, friends, and/or colleagues of Professors Sitaram Jaswal, Ted Jorgensen, Roger Kirby, and David J. Sellmyer as well as of Lecture Demonstrations Manager Menno Fast may wish to contribute to the following endowment funds:

5) ***Banti & Mela Ram Jaswal Fund*** [for undergraduate scholarships] (Account No. 6843.0)

6) ***Ted Jorgensen Fund for Physics*** [for undergraduate scholarships] (Account No. 8846.0)

7) ***David J. & Catherine J. Sellmyer Fund*** [for support of condensed matter and materials science] (Account No. 6781.0)

8) ***Menno Fast Memorial Fund*** [for lecture demonstration equipment] (Account No. 10681.0)

9) ***Roger & Suzanne Kirby Fund*** [for Outstanding Physics Major] (Account No. 112318.0)

Contributions to any of these may be made conveniently using the contribution card and return envelope enclosed with the mailing of this newsletter, or through the NU Foundation website at: http://nufoundation.org.

Checks should be made payable to the University of Nebraska Foundation and should indicate for which account the money is intended. Those contributors whose employers have a matching gift program should indicate this.

The Department's accounts at the University of Nebraska Foundation support purchases of major items of capital equipment, an endowed professorship, graduate fellowships, undergraduate scholarships, invited lectures, and other Department needs.

The Record

Editor: Amanda Lager

DEGREE RECIPIENTS

2013-2014 DEGREE RECIPIENTS

Bachelor of Science

- **Marina Bradaric** (May 2014) received a Noyce Urban Science Scholarship to enter the Masters of Science Teaching program at Boston University.
- **Samantha Cajka** (December 2013)
- **Darvy Ceron** (May 2014) took a position as a software development engineer with CSG Media, Inc. in Omaha, NE.
- **Steven Emmel** (May 2014) enrolled in the graduate physics program at the University of California, Los Angeles.
- **Logan Hepp** (May 2014) took a two-year position with the Fellowship of Catholic University Students.
- **Jichao Jiang** (May 2014) is job hunting.
- **Ivan Moreno-Hernandez** (May 2014) enrolled in the graduate chemistry program at the California Institute of Technology.
- **Travis Ray** (May 2014) received an NSF Robert Noyce Teacher Scholarship and John Woollam Foundation Fellowship to enter the Master of Arts in Science Teaching program at UNL.
- **Cristina Riley** (May 2014) took a temporary physics department position at UNL.
- **Dominic Ryan** (May 2014) enrolled in the graduate astronomy program at the University of California, Berkeley.
- **Ethan Van Winkle** (December 2013) took a temporary physics department position at UNL.
- **Patrick Wilcox** (May 2014) enrolled in the graduate astronomy program at the University of Iowa.
- **Lauren Wolterman** (December 2013) is living in Kansas City, MO.

Master of Science

- **Joshua Beck** (May 2014) entered the doctoral program in physics at UNL working with Professor Uiterwaal.
- **Maria Becker** (December 2013) entered the doctoral program in physics at UNL working with Professor Batelaan.
  Elena Echeverria Mora (August 2014) entered the doctoral program in physics at UNL working with Professor Dowben.
- **Yunlong Jin** (August 2014) entered the doctoral program in physics at UNL working with Professor Sellmyer.
- **Rami Kamalieddin** (May 2014) entered the doctoral program in physics at UNL working with Professor Kravchenko.
- **David Korn** (August 2014) graduated with a terminal masters and took a position in industry.
- **Jose Andres Monroy** (August 2014) entered the doctoral program in physics at UNL working with Professor Dominguez.
- **Amanda Steck** (August 2014) graduated with a terminal masters.
- **Zhiyong Xiao** (May 2014) entered the doctoral program in physics at UNL working with Professor Hong.

Doctor of Philosophy

- **Roger Bach** (May 2014) took a postdoctoral research associate position at UNL working with Professor Batelaan.
- **Joan Dreiling** (May 2014) took a National Research Council Postdoctoral Fellow position at the National Institute of Standards and Technology in Gaithersburg, MD.
- **Tom George** (December 2013) took a postdoctoral research associate position at UNL working with Professor Sellmyer.
- **Kristin Kraemer** (December 2013) took an assistant professor of physics position at Kansas Wesleyan University.
- **Donna Kunkel** (August 2014) took a position with Dow Chemicals in Houston, TX.
- **Eric Litaker** (May 2014)
- **Haidong Lu** (December 2013) took a postdoctoral research associate position at UNL working with Professor Gruverman.
- **Munir Pirbhai** (December 2013) took position with the New Products Division of Agilent Technology in Santa Clara, CA.
- **Nathan Powers** (May 2014) took an applications engineer position with KLA-Tencor.
- **Hua-Chieh Shao** (August 2014) took a position as a postdoctoral research associate at Purdue University.

2014-2015 DEGREE RECIPIENTS

Bachelor of Science

- **Eun-gul Chung** (May 2015) is job hunting.
- **James Doyle** (May 2015) enrolled in the graduate engineering program at UNL.
- **Jordan Drelicharz** (August 2015) is job hunting.
- **Matthew Hormandl** (May 2015) will continue conducting research working with Professor Shadwick on a NASA Space Grant Fellowship.
- **Andrew House** (May 2015) is job hunting.
- **Erik Johnson** (May 2015) plans to pursue a masters degree in biochemistry and then enroll in medical school.
- **Anton Lintel** (December 2014) took a position as a statistical analyst for the State of Nebraska.
- **Tyler Newlun** (December 2014) took a position as a Financial Services Professional with Lincoln Federal Credit Union.
- **Yu Hang Ng** (May 2015) enrolled in the graduate physics program at UNL.
- **Charles Nugent** (May 2015) is currently the assistant director of UNL Academic Technologies and plans to pursue a graduate degree at UNL.
- **Mitchell Schmidt** (May 2015) enrolled as a medical student at the University of Nebraska Medical Center (UNMC).

Master of Science

- **Xiaoqian Dang** (December 2014) entered the doctoral program in physics at UNL working with Professor Tsymbal.
- **Yunhao Fan** (May 2015) entered the doctoral program in physics at UNL working with Professor Fabrikant.
- **Om Prakash Goit** (May 2015) entered the doctoral program in physics at UNL working with Professor Ducharme.
- **Shay Inbar** (May 2015) entered the doctoral program in physics at UNL working with Professor Shadwick.
- **Collin McAcy** (December 2014) entered the doctoral program in physics at UNL working with Professor Uiterwaal.
- **Uday Singh** (May 2015) entered the doctoral program in physics at UNL working with Professor Adenwalla.
- **Michael Street** (December 2014) entered the doctoral program in physics at UNL working with Professor Binek.
- **Iori Tanabe** (May 2015) entered the doctoral program in physics at UNL working with Professor Dowben.
- **Omid Zandi** (August 2015) entered the doctoral program in physics at UNL working with Professor Centurion.

Doctor of Philosophy

- **Xiaohui Liu** (December 2014) took a postdoctoral research associate position at UNL working with Professor Tsymbal.
- **Sai Mu** (December 2014) took a postdoctoral research associate position at UNL working with Professor Belashchenko.
- **Liangwen Pi** (December 2014) took a postdoctoral research associate position at UNL working with Professor Starace.
- **Shashi Poddar** (December 2014) took a postdoctoral research associate position at UNL working with Professor Ducharme.

FELLOWSHIPS & TRAINEESHIPS

2013-2014 FELLOWSHIPS & TRAINEESHIPS

American Association of University Women (AAUW)
Joan Dreiling

Bridging Program Fellowship
John Colon Cordova
Paulo Costa
Caleb Fangmeier
Jacob Johnson
Godohaldo Perez Medina
Joaquin Siado Castaneda
Kyle Wilkin

GAANN Fellowship
Maria Becker
Peter Beierle
Caleb Fangmeier
Godohaldo Perez Medina
Thomas Scott
Amanda Steck
Michael Street

NASA Nebraska Space Grant Fellowship
Joan Dreiling
Jonathan Reyes

Othmer Fellowship
Paulo Costa

Undergraduate Teaching Assistant Fellowships
Stuart Brutsche
Peter Cosimi
Matthew Hesse
Hannah Paxton
Travis Ray
Dominic Ryan
Ethan Van Winkle
Patrick Wilcox

Undergraduate Distance Education and Outreach Assistant Fellowships
Cristina Riley
Marina Bradaric
Lauren Woltermann

2014-2015 FELLOWSHIPS & TRAINEESHIPS

Bridging Program Fellowship
Karl Ahrendsen
Colton Fruhling
Apollo Good
Daniel Haden
Alexandra Hotchkiss
Andrew Vikartofsky

Chancellor's Fellowship
Karl Ahrendsen

GAANN Fellowship
Giovanni Baez Flores
Joshua Beck
Maria Becker
Caleb Fangmeier

NASA Nebraska Space Grant Fellowship
Jonathan Reyes

Othmer Fellowship
Elena Krivyakina
Paulo Costa

Undergraduate Teaching Assistant Fellowships
Stuart Brutsche
Robert Carlson
Peter Cosimi
Jordan Drelicharz
Jennifer Hamblin
Matthew Hormandl
Seth Kurfman
Savanna McDonald
Ashton Neylon
Hannah Paxton
Emma Schneider
Zachary Smith

SCHOLARSHIPS

2013-2014 SCHOLARSHIPS

John E. Almy Scholarship
Alexander Johnson
Tanner Pfeiffer

Dr. William L. Bade Scholarship
Pierce Dageforde

Robert M., Stephan M., and Elizabeth Anne Eddy Scholarship
Samantha Burtwistle

Edward J. Hirsch Scholarship
Mitchell Schmidt

Banti and Mela Ram Jaswal Scholarship
Tanner Pfeiffer
Dominic Ryan

Cheunjit Katkanant Memorial Scholarship
Dominic Ryan

Chrysalis Fund of Dr. Ed Kobetich Scholarship
Dominic Ryan

Henry H. Marvin Scholarship
Trevor Hall
Alexander Johnson

Kurt Meyer Physics Scholarship
Dominic Ryan

Joel Stebbins Fund Scholarship
Samantha Burtwistle
Andrew O'Connell
Jordan O'Neal

HONORS

2013-2014 HONORS

Certificate of Recognition for Contributions to Students
Orhan Yenen

NCMN Ambassador Awards
Christian Binek
Stephen Ducharme

NCMN Education and Outreach Certificate
Shireen Adenwalla
Axel Enders
Xia Hong

Mortar Board Black Masque Chapter Professor of the Month April 2014
Orhan Yenen

Outstanding Referee of the American Physical Society
Kirill Belashchenko

Elected to the Fermilab Users Executive Committee
Gregory Snow

American Association for the Advancement of Science Fellow 2013
David Sellmyer

College of Arts & Sciences' Applause Award
Ellen Cox

2013-2014 Society of Physics Students Officers
Darvy Ceron
Steven Emmel
Matthew Hormandl
Patrick Wilcox

Physics & Astronomy Outstanding Graduate Teaching Assistant Award
Alex Stamm

Physics & Astronomy Outstanding Undergraduate Teaching Assistant Award
Travis Ray

Physics & Astronomy Education and Outreach Excellence Award
Marina Bradaric

Physics & Astronomy Undergraduate Award for Excellence in Research
Jennifer Hamblin

Physics & Astronomy Undergraduate Merit Award for Academic Performance
Dominic Ryan

UNL Character Council Franco's List Award
Celeste Labedz

2013-2014 UCARE Award Recipients
Jennifer Hamblin
Seth Kurfman
Celeste Labedz
Yu Hang Ng
Andrew O'Connell
Davis Rempe
Dominic Ryan
Mitchell Schmidt

2014-2015 HONORS

2015 Folsom Distinguished Doctoral Dissertation Award
Joan Dreiling

Air Force Office of Secondary Research Young Investigator Research Program Award
Matthias Fuchs

Certificate of Recognition for Contributions to Students
Herman Batelaan

Charles Bessey Professor of Physics & Astronomy
Alexei Gruverman

Elected to High Energy Physics Advisery Panel, Department of Energy and NSF
Aaron Dominguez

Honorary Doctorate, Voronezh State University
Anthony Starace

NCMN Ambassador Awards
Axel Enders
Xia Hong

2014-2015 Society of Physics Students Officers
Matthew Hormandl
Seth Kurfman
Celeste Labedz
Davis Rempe

Physics & Astronomy Outstanding Graduate Teaching Assistant Award
Yunhao Fan

Physics & Astronomy Outstanding Undergraduate Teaching Assistant Award
Seth Kurfman

Physics & Astronomy Undergraduate Award for Excellence in Research
Celeste Labedz

Physics & Astronomy Undergraduate Merit Award for Academic Performance
Jordan O'Neal

Roger & Suzanne Kirby Outstanding Physics Major Award
Celeste Labedz

UNL Character Council Franco's List Award
Celeste Labedz

2014-2015 UCARE Award Recipients
Jennifer Hamblin
Celeste Labedz
Jordan O'Neal
Austin Schulte

COLLOQUIA

2014 SPRING SEMESTER COLLOQUIA

January 16
Jerry Seidler, University of Washington
"Escape Trajectories from Traditional Condensed Matter"

January 31
Rebecca Harbison, Cornell University
"The Smallest Free Particles in Saturn's Rings"

February 27
Derek Wann, University of York
"Electron Diffraction – from Time-Averaged to Time-Resolved Experiments"

March 14
Timothy Gay, UNL
"Why Isn't God Ambidextrous?"

March 20
Kirill Shtengel, University of California, Riverside
"Anyonics: Designing Exotic Circuitry with Non-Abelian Anyons"

April 10
Wolfgang Kleemann, University of Duisburg-Essen
"Novel States and Functions of Magnetic and Polar Solids at the Nanoscale"

April 15
Robert Pappalardo, Jet Propulsion Laboratory, California Institute of Technology
"The Hidden Ocean of Europa: Exploring a Potentially Habitable World"

April 17
David Griffiths, Reed College
"Hidden Momentum"

May 1
Jun Zhu, Penn State University
"Graphene Plus"

2014 FALL SEMESTER COLLOQUIA

September 4
Ken Bloom, UNL
"Higgs Boson. Now What?"

September 16
Frank Hartmann, Karlsruhe Institute of Technology
"Silicon Sensors in High Energy Physics Experiments"

October 2
Stefan Fliescher, University of Minnesota
"Detection of B-mode Polarization at Degree Scales Using BICEP2"

October 9
David Lederman, West Virginia University
"Interface Physics in Hybrid Materials"

October 16
Dr. David H. Crandall, University of Minnesota
"Why Should You Care about Nuclear Fusion?"

October 23
Thomas Ward, Oak Ridge National Laboratory
"Observation and Control of Electronic Phases in Strongly Correlated Oxides"

November 6
Amber Boehnlein, SLAC National Accelerator Laboratory
"Large-Scale Data-Intensive Physics Computing"

2015 SPRING SEMESTER COLLOQUIA

January 22
Anthony Starace, UNL
"Using Attosecond XUV and Electron Pulses to Control and Image Electronic Motion"

January 29
John Palastro, Naval Research Laboratory
"Modeling of Ultrashort Pulse Laser-Matter Interactions"

February 5
Yachin Ivry, Massachusetts Institute of Technology
"Ferroic Domain Switching is Scale Dependent: the Hidden Role of Nano Ferroelastic Domains"

February 12
David Pappas, National Institute of Standards and Technology
"Role of Materials in Quantum Information Systems"

February 26
Uwe Thumm, Kansas State University
"Attosecond Time-Resolved Photoelectron Emission from Atoms and Surfaces: the Photoeffect Revisited"

March 9
Timothy Gay, UNL
"Why Isn't God Ambidextrous?"

March 12
Michael Strauss, University of Oklahoma
"Measurements of the Properties of a Higgs Boson Using the ATLAS Detector at the LHC"

March 16
Yan Sen, Xi'an Jiaotong University
"Simultaneous Structural Change in Ferromagnetic Transitions"

March 19
Ludwig Bartels, University of California, Riverside
"2D Transition Metal Dichalcogenide (MoS2, MoSe2, etc.) Films: Transport, Optical Characterization, and Growth on Dielectric/Ferroelectric Substrates"

April 2
Peter Milonni, Los Alamos National Lab
"Optical Forces and the Momentum of Light"

April 7
Matthias Schröder, Deutsches Elektronen-Synchrotron (DESY)
"The Search for MSSM Higgs Bosons at CMS"

April 8
Dan Claes, UNL
"Nebraska Lecture: What the Heck is a Higgs boson?"

April 9
Jonathan Wurtele, University of California, Berkeley and LBNL
"Trapping and Probing Antihydrogen"

April 23
Michael Flatté, University of Iowa
"Room-Temperature Electronic Spin Correlations: Towards Spin-Coherent Technologies"

Front cover photos: *atomic, condensed matter, and high energy group laboratories. See articles on pp.2-5.*
Back cover photos (clockwise from top left): *Saturday Science students in a lab activity (see pp. 10-11); Newton's apple tree south of Behlen Lab (see pp.15); research lab equipment; Starace Fest Workshop participants (see pp.22-23); lunar eclipse on the morning of October 8th, 2014 taken by Lab Manager Shawn Langan at the UNL Student Observatory on the Stadium Drive parking garage.*

University of Nebraska Lincoln
DEPARTMENT OF PHYSICS & ASTRONOMY

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