Firing on All Cylinders: 
Atomic, Condensed Matter, and 
High Energy Groups All Win Large 
New Research Grants
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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 research groups (atomic, molecular, optical, and plasma physics; condensed matter and materials physics; and high energy physics) research teams 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 subject of the Nebraska-Kansas consortium’s research is “Imaging and Controlling Ultrafast Dynamics of Atoms, Molecules, and Nanostructures.”

Finally, on February 26, 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 Gillion 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, 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 Northwestern.

“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 provide evidence for the Higgs boson. In addition to Dominguez and Bloom, UNL’s HEP team includes Professor and Chairman Dan Cates, Associate Professor Ilya Kravchenko, and Professor Gregory Snow as well as computer scientist David Swanson, Director of the Holland Computing Center.

Aaron Dominguez led 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 provided evidence for the Higgs boson.
AMOP Consortium Awarded $6 Million to Investigate Ultrafast Processes

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 observe the relatively slow speed of electrons, 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 36 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 schools in the center.

“The center’s success is based on several major accomplishments in understanding the properties and performance of nanomaterials,” said Eugene Tyusmon, George Holmes University Professor of Physics and MERSEC director. These discoveries have led the center to focus on two key areas: magneto-electric materials and functional interfaces, and polarization-enabled electronic phenomena.

Associate Professor Christian Binek leads the magneto-electric 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 more 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 Tyusmon’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 MERSEC 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. Assistant Professor Alex Enders will lead several ongoing and new initiatives, including those designed to encourage women and minorities to become involved in materials science research.
External Funding Reaches Record Total

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 1999 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 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 on 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 is- sue). 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 becoming a central part of all our 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 grant, a DOE Early Career grant, an NSF POWER 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 are equally proud of. Saturday Science turned 40! Professor Duane Jaccks, dissatisfied with the limited exposure to scientific ideas in the middle school curriculum, created this outreach program in the spring of 1978. 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 1987 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 sustain and grow the program. (see page 11).

This fall, we will help host the 7th annual Conference for Undergraduates in the Physical Sciences (WoPHYS). 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 hosts 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-Octo- ber 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
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 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 former postdoctoral research associates Mikhail V. Frolov (2002-2004), Evgeny A. Pronin (2005-2010), Alexander V. Flegel (2011-2014), and Aleksandr 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, and with get-togethers with the many friends they have had 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.yu.ru/news/index.doluzhidorid-352890439181AD796752531L2A45837E754-4486

Woollam Named National Academy of Inventors Fellow

John A. Woollam, a professor of physics and astronomy, is the founder of the University of Nebraska’s J.A. Woollam Co., and has been named a fellow of the National Academy of Inventors (NAI). The NAI is the world’s largest association of inventors and innovators.

His research has been recognized with a number of awards, including the J. A. Woollam Foundation’s Advanced Research Fellowship, the National Academy of Inventors’ National Inventor of the Year Award, and a patent award from the United States Patent and Trademark Office.

Woollam earned his Ph.D. in physics from the University of Colorado Boulder in 1979 and has been a member of the UNL faculty since 1979. He has served as director of UNL’s Office of University Communications and as a member of the UNL faculty, and was the first director of UNL’s Office of University Communications.

Dreiling Receives 2015 Folsom Thesis Award

Susan 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 research involved experiments to observe chiral-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 advisor 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 an atomic physics laboratory, technology, electronics, lasers and optics. Dreiling broadened this experience with summer stints at Carleton College and with associate professor Alex Enders at the University of Colorado at Boulder and in Matt Pfeffer’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 Alex 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 (Ph.D. 2014) received the Warren 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 interfacial phenomena.

The Nottingham Prize is considered the most important 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

DEPARTMENT NEWS

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

A ssoicate Professor Ken Bloom has been appointed the software and computing manager for the United States participation in the CMS experiment. CMS is an experiment at the Large Hadron Collider (LHC), the world's largest proton collider. The experiment involves 4,300 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 Darien Dominguez, and Gregory R. Snow and Associate Professor Ilya Kravchenko.

The CMS experiment is responsible for the U.S. contributions to the commissioning, operation and maintenance of the CMS detector and contribution 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 has 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.

Dr. Leo Sartori, Vice Chairman, and Dale Rathe, deputy manager since 2010, and leader of the Tier-2 program 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, Jacobs taught all lecture and 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 spectroscopy 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 colorless entries depicting the spectra of different lights. When studying time, each student built a pendulum 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 has 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 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 Redder, 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 efforts 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 experiences, 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 a local supervisor.

Contributions Sought

In order to ensure the continued success of Saturday Science, George W. Holmes University Professor of electrical engineering, John Woollam, has committed up to $40,000 to the LPS Foundation as a challenge grant to support Saturday Science. If matched by mid-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://wwwfoundation.lincoln.ne.us/give/systm.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 here 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.
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 2004, 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.

Thermal Physics Textbook

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 and/or beginning graduate students, and is written on the subject, thermodynamics, takes advantage of the modern student’s familiarity with the atomic level structure of matter as well as a guide to 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 application to gases, solids, magnetic materials, and blackbody radiation. Phase transitions and the statistical basis of computer simulations are also discussed.
BRIEFLY NOTED...

Simon Publishes “The Ballad of St. Katherine”

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 Corinne 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

A ssociate 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 commentator 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 episode?’” Bloom said. “I suggested that to David, who said, ‘Yeah that’s 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 know roughly who the characters were, but I didn’t double-check everything to make sure I had the names right.”

News Media Consult Gay on Deflated Footballs

O n 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 Isaac Newton’s quantum diaries were 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.

Other News:

Newton’s Apple Tree Planted Near Jorgensen Hall

News Media Consult Gay on Deflated Footballs

P rofessor 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 of 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.
Why is DNA Right-Handed? Gay-Dreiling Experiment Provides Possible Answer

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 reason why only DNA that exists today. Gay-Dreiling experiment provides 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 detected these electrons to study target molecules, a method called bromocarboxymethyl, 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 to a halt at various times when other things have happened, 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."
**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 fundamental nonlinear X-ray process. 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 a weak 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.

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 currently the only two of them in the world (called SLAC). 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 that conducted this 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 Germany. 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 we 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.

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**In the News...**

Richardson-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 Inventors' Program; Science, 349, 489 (2015). Rebecca Richardson-Kortum's bio sketch can be found 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 Richardson-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. Richardson-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, Richardson-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 focuses on high-throughput laboratory systems that can be tailored to meet the needs of developing countries. “I’ll never forget the first time I saw a baby 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 Imadaddin Al-Omari (Ph.D. 1996; Adviser: J. Macek), 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 87,500.

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 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.

Reed to Head IUPAP

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 acts as 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.
Tara (McA-)

has forged a successful career outside a typical academic

career. 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
donald graduates. A distinguished alumna is invited back
to campus to address our graduates, usually someone who
has forged a successful career outside a typical academic

career (with which our students are already quite familiar). Tara (McA-

voy) 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 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 Fredericks-

burg, 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 deposition and etch process engineer. Applied Magnetics, Göteborg, Sweden, and private corporations worldwide.

Email: jonathan.beezley@kitware.com

Bark, Lauren (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. Bark received a Ph.D. in physics from the University of North Carolina in 2013.

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

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: beegao@physics.utoledo.edu

Gilbert Conder, 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.gilbert@stonybrook.edu

Rybnicek Speaks at 2015 Recognition Luncheon

Tara Rybnicek (B.S. 1997) 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 Eary (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.ncla.harvard.edu/keystone-conference-center.

We Heard That...

Email: afreese@unl.edu

Hilbert, Shawn (M.S. 2007, Ph.D. 2009, Adviser: Herman Bajelj) joined Berry College in Mount Berry, GA, as assistant professor of physics in 2014. Email: shillbert@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 humankind’s impact on 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: k.kirby@unimic.com

The workshop group photo is experimental.
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 Derivative Pricing Evaluator with Thomson Reuters in New York, NY. In February 2015, she was previously a postdoctoral fellow at Pacific Northwest National Laboratory from 2013 to 2014. Email: lingmeikong@gmail.com

Kraus, 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: akubik@physicstamu.edu

Lagrange-Kanita, Germain (Postdoctoral Researcher, 1999-2002, Adviser: Anthony Starace) has been working in the Department of Medical Physics at the Charles-Lemoyne Hospital in Brossard, Quebec, Canada, since 2009, when he received his M.Sc. degree in medical physics from McCaill University. Email: glagmago@yahoo.ca

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

Macquard, 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: macquardp@wyoming.edu

Mazelberg, 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 Hays State University in Hays, KS. His teaching and research interests are in the area of experimental atomic, molecular, and optical physics. Email: jmazelberg@hays.us

Namiba, Ryo (B.S. 2007) is a project researcher in theoretical physics (cosmology) at the KeK 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: namiba.ryo@kek.jp

Neukirch, Amanda E. (B.S. 2007) received a Ph.D. in physics from the University of Rochester in 2013. She is currently a postdoctoral fellow at Los Alamos National Laboratory doing research in computational materials science with an emphasis on photovoltaic applications. Email: aneukirch@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 Research at the University of Missouri-Saint Louis. Poddar did research on molecular ferroelectric materials and co-taught an advanced undergraduate course on nonconductive and nanotechnology. The center is funded by the Centers for Research Excellence in Science and Technology program of NSF. Poddar has returned to UNL as a postdoctoral researcher in the molecular ferroelectric 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: ss26@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 Chanhassen, MN. Prososki provides service and support for Auger electric 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@pe.com

Strohaler, 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. Strohauser’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.strohaler@famu.edu

Wang, Jim (Post-doctoral 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: j Wang@umd.edu

Wilde, Robyn S. (M.S. 1996, Ph.D. 2000, Adviser: Byra Fabricant) returned to UNL the week of September 21 to present an AMOP Seminar on “Collisions of Protons 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 Fabricant made plans to collaborate on research involving positron and positronium collisions. Email: Robyn.Wilde@oitr.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: zzhengzheng@aip.org

The master of arts degree with an emphasis in science teaching is a full-time program designed for individuals who earned a graduate degree in an area of science, but are not certified to teach. With completion of the program, graduates will earn their masters degree and certification to teach Grades 7-12 in science in Nebraska schools (and are eligible for certification in other states). This full-time program begins in the UNL First Summer Session in May and upon completion of the program students will graduate in August the following year. A limited number of $12,000 Noyce scholarships are available to cover tuition costs. Complete details on the MAST program are available at http://cehs.unl.edu/ultramasters/degree-teaching-certification/MAst.
M. Eugene Rudd (1927-2014)

Charles E. Skov (1933-2014)

Charles E. Skov (Ph.D. 1963, Advisor: 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 Rivendale, Kansas. He received his B.S. 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. He then 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 his research in condensed matter 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 irresistible 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 work on atomic collisions, and ionization. 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 1999. Moreover, nine students earned their doctorates under his direction: Alan K. Edwards (M.S. 1964, Ph.D. 1967), Donald J. Volf (M.S. 1965, Ph.D. 1968), Geoffrey Carlisle (M.B.S. 1977, Ph.D. 1978, Jonathan B. Crooks (Ph.D. 1974), Robert D. Dubois (B.S. 1972, Ph.D. 1975), Mohammed Bolarizadeh (Ph.D. 1984), Yang Soo Chung (M.S. 1986, Ph.D. 1993), and George Kirby (M.S. 1988, Ph.D. 1994).

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 Northwest 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 DASAOP). After his retirement in 1995, a symposium 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 Gap, drew more than fifty scientists from Argentina, England, Germany, the Netherlands, and the U.S. The two-day 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 his historical technology. He was not content merely to admire his antique scientific artifacts, but viewed them as an opportunity to continue his research career of studying electrons, 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 1999. Moreover, nine students earned their doctorates under his direction: Alan K. Edwards (M.S. 1964, Ph.D. 1967), Donald J. Volf (M.S. 1965, Ph.D. 1968), Geoffrey Carlisle (M.B.S. 1977, Ph.D. 1978, Jonathan B. Crooks (Ph.D. 1974), Robert D. Dubois (B.S. 1972, Ph.D. 1975), Mohammed Bolarizadeh (Ph.D. 1984), Yang Soo Chung (M.S. 1986, Ph.D. 1993), and George Kirby (M.S. 1988, Ph.D. 1994).

In 1953, he married Eileen Hovland, who remained his lifelong inseparable partner. Their daughter Nancy Schwab, grandson Michael Schwab, and hundreds of his well-taught physics students and admiring colleagues, will treasure the memories of his well-taught physics students and admiring colleagues, will treasure the memories of his

Charles E. Skov

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. 25597)
2) Physics & Astronomy Lecture Endowment Fund (Account No. 32118)
3) Physics & Astronomy Alumni Scholarship Endowment Fund (Account No. 33830)
4) J.E. Ruckman Fund for the Physics Department (Account No. 26787)
5) Bunti & Mela Ram Jaiswal Fund [for undergraduate scholarships] (Account No. 68452)
6) Ted Jorgensen Fund for Physics [for undergraduate scholarships] (Account No. 88458)
7) David J. & Catherine J. Sellmyer Fund [for support of condensed matter and materials science] (Account No. 67818)
8) Menno Fast Memorial Fund [for lecture demonstration equipment] (Account No. 106811)
9) Roger & Suzanne Kirby Fund [for Outstanding Physics Major] (Account No. 312398)

Contributions to any of these may be made conveniently using the contributor information card that is 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 ask their employers.

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

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:


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


The following general accounts at the University of Nebraska Foundation:

1) [for Outstanding Physics Major]
2) [for support of condensed matter and materials science]
3) [for undergraduate scholarships] (Account No. 88458)
4) [for support of capital equipment and materials science] (Account No. 67818)
5) [for undergraduate support of capital equipment and materials science] (Account No. 106811)
6) [for Outstanding Physics Major] (Account No. 312398)

The following general accounts at the University of Nebraska Foundation:

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3) [for undergraduate support of capital equipment and materials science] (Account No. 106811)
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4) [for Outstanding Physics Major] (Account No. 312398)
THE RECORD

2014-2015 DEGREE RECIPIENTS
Bachelor of Science
• Samantha Burtwistle (May 2015) took a postdoctoral research associate position at UNL working with Professor Durrant.
• Savanna McDonald (December 2014) entered the doctoral program in physics at UNL working with Professor Ducharme.

2013-2014 DEGREE RECIPIENTS
Bachelor of Science
• Elena Echeverria Mora (August 2014) entered the doctoral program in physics at UNL working with Professor Dominguez.
• Hector A. Barajas (May 2015) entered the doctoral program in physics at UNL working with Professor Adenwalla.
• Tony Room (May 2015) entered the doctoral program in physics at UNL working with Professor Sellmyer.

Master of Science
• Jonathan Reyes (December 2013) took a postdoctoral research associate position at UNL working with Professor Bludszuweit.
• Savanna McDonald (August 2014) entered the master's program at UNL working with Professor Domingszar.
• Amanda Steck (August 2014) enrolled as a medical student at the University of Nebraska Medical Center (UNMC).

Doctor of Philosophy
• Michael Street (December 2014) entered the postdoctoral research associate position at UNL working with Professor Troymial.
• Ariel Del Guercio (May 2015) entered the doctoral program in physics at UNL working with Professor Shadwick.

2014-2015 SCHOLARSHIPS
• John E. Almy Scholarship
• Banti and Mela Ram Jaswal Scholarship
• Thebas Foundation

2014-2015 FELLOWSHIPS & TRAINEEHIPS
American Association of University Women (AAUW)
• Zhiyong Xiao (May 2014) entered the doctoral program in physics at Kansas Wesleyan University.
• Donnna Kunkel (August 2014) took a position in Dow Chemical in Houston, TX.
• Eric Litaker (May 2014) entered the doctoral program in physics at UNL working with Professor Ducharme.

2013-2014 SCHOLARSHIPS
• Othmer Fellowship
• GAANN Fellowship
• Kurt Meyer Physics Scholarship

The Record

2013-2014 DEGREE RECIPIENTS
Doctor of Philosophy
• Xionglin Liu (December 2014) took a postdoctoral research associate position at UNL working with Professor Troymial.
• Sai Mu (December 2014) took a postdoctoral research associate position at UNL working with Professor Bludszuweit.
• 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 & TRAINEEHIPS
• American Association of University Women (AAUW)

BACHELOR OF SCIENCE
• Samantha Burtwistle (May 2015) is job hunting.
• Savanna McDonald (December 2013) took a postdoctoral research associate position at UNL working with Professor Durrant.

2013-2014 FELLOWSHIPS & TRAINEEHIPS
American Association of University Women (AAUW)
• Joan Dreiling

THE RECORD

2014-2015 SCHOLARSHIPS
• John E. Almy Scholarship
• Banti and Mela Ram Jaswal Scholarship
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• 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.
HONORS
2013-2014 HONORS
Certificate of Recognition for Contributions to Students
Orhan Yenen
NCMN Ambassador Awards
Christian Biniek
Stephen Ducharme
NCMN Education and Outreach Certificate
Sharon Ademaala
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 Belaschkenko
Elected to the Fermilab Users Executive Committee
Gregory Stuey
American Association for the Advancement of Science Fellow 2013
David Selmyer
College of Arts & Sciences’ Applause Award
Ellen Cox
2013-2014 Society of Physics Students Officers
Darryl Ceron
Steven Emmler
Matthew Hormandl
Patrick Wilcox
Physics & Astronomy Outstanding Graduate Teaching Assistant Award
Alex Stamn
Physics & Astronomy Outstanding Graduate Teaching Assistant Award
Seth Kurfman
Physics & Astronomy Outstanding Graduate Merit Award for Academic Performance
Anthony Starace
NCMN Ambassador Awards
Axel Enders
Xia Hong
2014-2015 Society of Physics Students Officers
Matthew Hormandl
Seth Kurfman
Celeste LABEDZ
David Rempe
Physics & Astronomy Outstanding Graduate Teaching Assistant Award
Yunbao Fan
Physics & Astronomy Outstanding Undergraduate Teaching Assistant Award
Seth Kurfman
Physics & Astronomy Undergraduate Merit Award for Excellence in Research
Celeste Labedz
Physics & Astronomy 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
2013-2014 UCARE Award Recipients
Jennifer Hamblin
Dominic Ryan
Celeste Labedz
Yu Hang Ng
Andrew O’Connell
Dan Rempe
Dominic Ryan
Mitchell Schmidt
HONORS
2015 Folsum Distinguished Doctoral Dissertation Award
Joan Dreiling
Air Force Office of Secondary Research Young Investigator Research Program Award
Matthew Fuchs
Certificate of Recognition for Contributions to Students
Herman Baudean
Charles Bessey Professor of Physics & Astronomy
Alexei Grusovem
Elected to High Energy Physics Advisory 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
David Rempe
Physics & Astronomy Outstanding Graduate Teaching Assistant Award
Yunbao Fan
Physics & Astronomy Outstanding Undergraduate Teaching Assistant Award
Seth Kurfman
Physics & Astronomy Outstanding Graduate Merit Award for Academic Performance
Celeste Labedz
Physics & Astronomy Undergraduate Merit Award for Excellence in Research
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Dominic Ryan
Mitchell Schmidt
COLLOQUIA
2015 FALL SEMESTER COLLOQUIA
January 16
Jerry Sellard, University of Washington
“Escape Trajectories from Traditional Condensed Matter”
January 31
Rebecca Harbison, Cornell University
“The Smallest Free Particles in Saturn’s Rings”
February 7
Derek Wrack, 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 Shengel, University of California, Riverside
“Anuncios: 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 Oceans of Europa: Exploring a Potentially Habitable World”
April 17
David Griffiths, Reed College
“Hidden Momentum”
May 1
Jan Zhu, Penn State University
“Graphene Plus”
2016 SPRING SEMESTER COLLOQUIA
February 22
Anthony Starace, UNL
“Using Attosecond XUV and Electron Pulses to Control and Image Electron Motion”
January 29
John Palastro, Naval Research Laboratory
“Modeling of Ultrashort Pulse Laser-Matter Interactions”
February 5
Yachan Ivy, Massachusetts Institute of Technology
“Fermic 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 Strauza, University of Oklahoma
“Measurements of the Properties of a Higgs Boson Using the ATLAS Detector at the LHC”
March 16
Van Son, Xian 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 Schilder, Deutsches Elektronen-Synchrotron (DESY)
“The Search for MSSM Higgs Bosons at CMS”
April 8
Dominic Ryan
“Nebraska Lecture: What’s 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
“Anyonics: Designing Exotic Circuitry with Non-Abelian Anyons”
February 16
Frank Hartmann, Karlsruhe Institute of Technology
“Interface Physics in Hybrid Materials”
October 9
David Lederman, Virginia University
“Interface Physics in Hybrid Materials”
October 12
Dr. Michael H. Cramond, University of Minnesota
“Why Should You Care about Nuclear Fusion?”
October 20
Thomas Ward, Oak Ridge National Laboratory
“Obserbation and Control of Electronic Phases in Strongly Correlated Oxides”
November 6
Amber Bothunlie, SLAC National Accelerator Laboratory
“Large-Scale Data-Intensive Physics Computing”
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.45-46); research lab equipment; Staness Fall 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.