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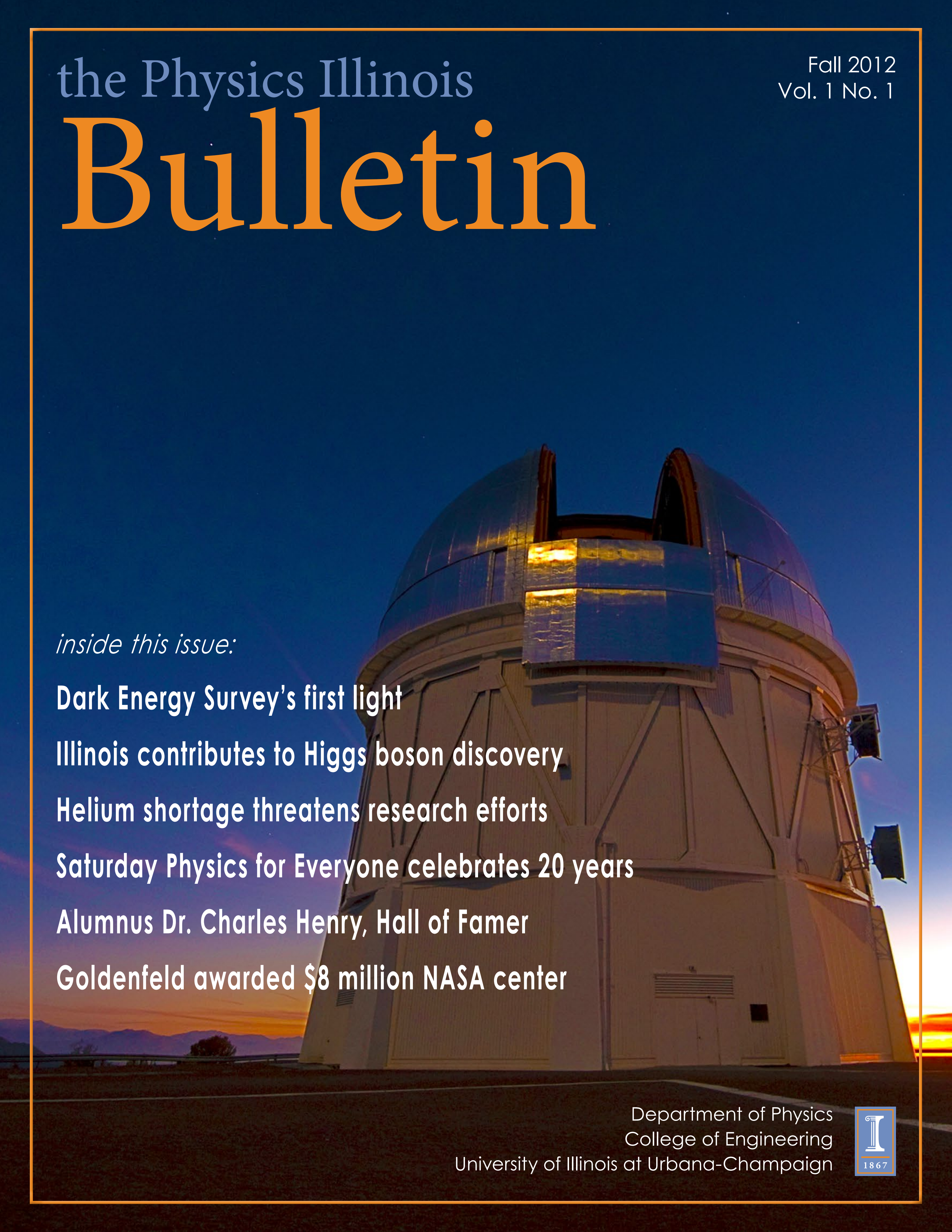

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Department of Physics
College of Engineering
University of Illinois at Urbana-Champaign

A Message from the Head

To Illinois Physics colleagues, alumni, and friends,

We in the Department of Physics at the University of Illinois are at an important and exciting crossroads in our history. For the last several years, we have faced difficult challenges brought about by financial pressures, leadership changes in the University administration, increasing student enrollments, and declining faculty and staff sizes. Because of the dedication and creativity of our Physics community at all levels and the steadfast support of our loyal alumni, we survived and even thrived in that period, maintaining our scholarship, commitment to learning, and the unique camaraderie within the department that is one of our greatest and most treasured assets. On balance, we have done rather well, but it is never easy or much fun to be looking behind us and hoping to survive.

Now, the landscape has changed dramatically—we are able to look forward and the view ahead is much brighter. Due in part to downsizing and in part to the implementation of sound fiscal policies by the University in the last few years, there is a stable financial situation that will allow increased hiring across campus, investment in new initiatives, and long-overdue rewards for our talented and dedicated faculty and staff. There is a strong leadership team on the campus, one with particular knowledge and appreciation for scientific discovery and creativity—Chancellor Phyllis Wise, a biologist; Provost Ilesanmi Adesida, an electrical engineer; and Vice Chancellor for Research Peter Schiffer, a physicist. And most of all, there is a pervasive feeling across campus that this is our time to grow and take on new challenges.

That is not to say that all is perfect—far from it. The State of Illinois continues to have long term financial problems that will almost certainly bring decreases in State support for the University, increases in tuition for our students, and major changes in the pensions and benefits of our faculty and staff. It is possible, actually likely, that there will be significant reductions in federal funding for science, making it crucial that we compete aggressively for these resources. Along with that are increases in cost of doing research, especially for some essential commodities such as energy and liquid helium for cryogenic research. Resources will continue to be limited, compelling us to be thoughtful in our planning and the choices we make. These are real problems, but no more difficult than the research problems that we embrace and address every day in our labs and offices, so we are confident that we can control and even solve them.

So what we see in the next few years is a unique window of opportunity to shape the Department of Physics and the University of Illinois and to put ourselves in a strong position for the future. In Physics, this is already happening:

• Faculty: After four years of no faculty hiring and a nearly 20-percent reduction in our numbers from 65 to 50, we hired three faculty members last year, four this year, and have four more faculty searches in progress for next year. In addition, we are engaged with two exceptional senior professors at other institutions whom we hope to attract to Illinois. We are hoping to grow back to our target size of 60 faculty in Physics, which we believe to be a productive and sustainable size for our faculty.

• Staff: We have also made a number of investments in growing our staff over the last few years, hiring coordinators for advancement, communications, undergraduate advising, and course delivery. These steps are helping us to enhance the educational experience of our students and to share our accomplishments and plans with our peers, our alumni, and the public.

• Educational programs: Enrollments all over campus have risen sharply in the last five years but nowhere more than in Physics. We are now teaching over 5,000 students per semester—an increase of 30 percent over the last five years—and the number of graduate research students and undergraduate Physics majors is at an all-time high. To respond to this rapid growth, we have revised our introductory course sequences, developed new upper-level laboratory courses, and designed and presented new courses that fulfill our multiple missions to teach the substance of Physics and its excitement to people of all ages. The increased number of Physics students creates real problems, but it is a good problem to have, indicating the importance of and interest in our field.

• Infrastructure: We have launched a series of initiatives designed to increase the size and quality of our classrooms, offices, and laboratories in the Physics complex. Remodeling is currently underway to modernize the main department office and to renovate some of our instructional spaces with the help of funds from the College of Engineering and the campus Academic Facilities Maintenance Fund Assessment, a student fund directed to improve the educational experience for students. We are planning conversion of the space behind the library that formerly held our research journals into a flexible interactive classroom and a faculty-staff lounge area adjacent to the Physics Interaction Room. We are also in the process of carrying out feasibility studies to generate a design and cost estimate for an addition to Loomis Laboratory over the lecture halls and a new Advanced Experimental Research Building to be located next to MRL. These are ambitious projects, but Physics is an ambitious department and we want to position ourselves for opportunities for major capital projects that may come up from the State, University, or the help of our loyal alumni.

• Alumni: As we grow in our size and our reach, it has never been more important for us to keep in contact with our alumni, former colleagues, and friends. You serve as role models for our students, reminding them where they can go and what they can do with a Physics degree, and we greatly appreciate your loyalty to Illinois that you have demonstrated through your gifts and service to the department. We are stepping up our efforts to keep you better informed about our activities and accomplishments, and increasing opportunities for you to visit the department and share your story with our students.

As I enter my seventh year as head of the Department of Physics, I continue to be honored by the opportunity to serve our talented faculty and staff and to strive to maintain and enhance our cherished legacy of excellence in education and scholarship. It a good time for Physics. A time to be thoughtful. A time to be aggressive. A time to think big, reach high, and become even greater as a department.

the Physics Illinois
Bulletin

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Cover image: The silvered dome of the Blanco 4-meter telescope, which holds the Dark Energy Camera at the Cerro Tololo Inter-American Observatory in Chile. Photo credit: T. Abbott and NOAO/AURA/NS

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Physics welcomes three new faculty members

Peter Schiffer is an extensively published condensed matter experimentalist whose research interests include magnetic oxides, geometrically frustrated magnets, and magnetic nanostructures. Working with novel magnetic materials provides his research group with excellent model systems in which to explore new physics; this work has important implications for future developments in technologies.

Schiffer's research group is currently looking at geometrically frustrated magnets, in which the spins enter cooperative spin liquid and spin ice phases at low temperatures; exotic oxides that display both magnetic and electronic order; and frustrated lattices of interacting ferromagnetic nanostructures, in which the local accommodation of frustration can be directly observed through magnetic force microscopy.

Schiffer earned his doctorate in physics from Stanford University in 1993 with thesis advisor Douglas Osheroff, and his bachelor of science (with distinction) from Yale University in 1988. After two years as a postdoctoral member of technical staff at AT&T Bell Laboratories in Murray Hill, New Jersey, he became an assistant professor of physics at the University of Notre Dame.

Vice Chancellor of Research and Professor of Physics Peter Schiffer

He moved to Pennsylvania State University in 2000 as an associate professor of physics and was promoted to professor in 2003. In 2007, he was appointed associate vice president for research and director of strategic initiatives at Penn State.

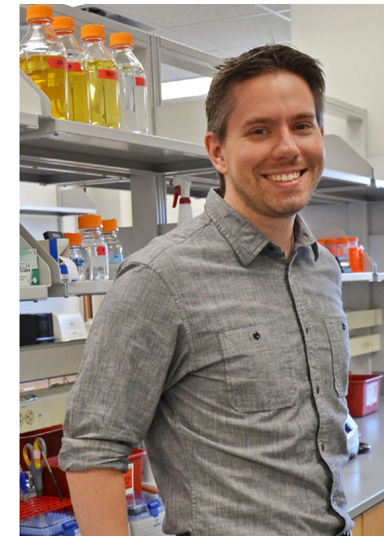
Schiffer has led numerous committees and task forces and has achieved numerous honors, including a Presidential Early Career Award for Scientists and Engineers in 1997, a Faculty Early Career Development Award from the National Science Foundation in 1997, and an Alfred P. Sloan Research Fellowship in 1998. He was named a fellow of the American Physical Society in 2004 "for pioneering studies of novel magnetic materials including colossal magnotoresistance manganites and geometrically frustrated magnets."

He also received the Faculty Scholar Medal in the Physical Sciences at Penn State in 2006, and won the Ruth and Joel Spira Award for Teaching Excellence at Penn State in 2008.

Schiffer said he is looking forward to his new role on the Illinois campus: "The faculty and other researchers at the UI are already among the very best in the world, and their work has wide-ranging impacts both within their fields and for the public good. My goal as the vice chancellor for research is to continue to build on the tradition of excellence, to foster an environment in which Illinois researchers can be creative and productive, and to facilitate their efforts in whatever ways I can."

Chancellor Phyllis Wise said, "In Peter Schiffer we were able to find an extremely successful researcher, an award-winning teacher and a strategically minded administrator. These are exactly the combination of skills that will allow him to lead our efforts to increase our broad research and discovery mission."

Also joining the Illinois family is Schiffer's wife, Sharon Hammes-Schiffer, who was hired as a faculty member in the department of chemistry. She had been the Eberly Professor of Biotechnology at Penn State. She earned her doctorate in chemistry at Stanford University in 1993. ■



Assistant Professor Thomas Kuhlman

Biological physicist Thomas E. Kuhlman performs *in vivo* genome manipulation experiments that have tremendous implications for our understanding of how gene expression is controlled and contributes to the development and propagation of genetic diseases.

Kuhlman's work has focused primarily on the genome of the bacterium *Escherichia coli*. With the aid of cutting-edge single-molecule microscopy, Kuhlman's experimental manipulation of the *E. coli* genome exposes how transcription factors regulate genes and reveals the consequences of genome organization on gene expression.

Kuhlman's experimental findings are used to construct theoretical models, which in turn motivate further *in vivo* experiments.

"By disrupting and rearranging the spatial and genomic organization of regulatory networks in *E. coli*, my lab attempts to directly observe, quantify, and theoretically describe potential biophysical forces that determine the architecture and organization of genomes," said Kuhlman.

Kuhlman's molecular-engineered tools—now in use at dozens of labs around the world and licensed to several commercial biotech companies—allow the precise integration of large synthetic gene constructs into any desired location of the *E. coli* chromosome.

As just one example of the kind of research enabled by these tools, Kuhlman and his colleagues were able to disrupt and rearrange the organization of genes on the *E. coli* chromosome, and to measure how these rearrangements affected the distribution of transcription factor proteins in the cell and their ability to regulate gene expression. Since the fundamental mechanisms of gene regulation are similar over all domains of life, these observations may have implications for understanding gene regulation in higher organisms as well, including humans.

Kuhlman received his Ph.D. in physics from the University of California, San Diego in 2007. While at UCSD he worked at the interface of theoretical physics and experimental biology, studying and validating statistical mechanical models of transcriptional and post-transcriptional gene regulation in *E. coli*.

From 2008 to 2012, he was a postdoctoral fellow in the Department of Molecular Biology at Princeton University, working in the lab of Professor Ted Cox.

This semester, Kuhlman is teaching Physics 101, College Physics: Mechanics and Heat. ■

Assistant Professor Gregory MacDougall

In his lab, condensed matter experimentalist Gregory MacDougall explores emergent magnetic properties of novel correlated-electron materials. Once assembled, MacDougall's research group will synthesize novel compounds and grow large single crystals. MacDougall will use probes such as neutron scattering and μSR as tools to study orbital order, the effects of magnetic frustration, the interplay between magnetism and superconductivity in correlated materials, and the coupling between spin, charge, and lattice degrees-of-freedom in condensed matter systems.

It was the department's international reputation in his area of research that attracted MacDougall to Illinois.

"Illinois has this long tradition of condensed matter physics," said MacDougall. "The fathers of this field—Bardeen, Legett, Slichter—are from here, and the current faculty specializing in condensed matter are very well known in the field."

“I was very impressed by how collaborative the faculty here is. Collaborations can bring together scientists with different areas of expertise to interact with one another on bigger projects.”

By improving our understanding of magnetism at the atomic level—particularly in new materials exhibiting geometric frustration—MacDougall hopes to contribute to the development of heretofore unimagined new applications.

“Having the ability to create your own materials opens the possibility of discovering some new phenomenon,” said MacDougall.

MacDougall received a bachelor’s degree in mathematical physics from Simon Fraser University (Burnaby, B.C., Canada) in 2002 and a Ph.D. in physics from McMaster University (Hamilton, Ontario, Canada) in 2008. His doctoral research focused on exploring the magnetic properties of unconventional superconductors using techniques such as μSR, magnetometry and neutron scattering.

For the last four years, MacDougall worked as a post-doctoral research fellow in the Quantum Condensed Matter Division of Oak Ridge National Laboratory. There he used primarily neutron scattering facilities at the Spallation Neutron Source and the High-Flux Isotope Reactor to explore material properties of frustrated antiferromagnets, high-temperature superconductors, and thin-film multiferroics. Throughout his research career, MacDougall has maintained a strong interest in the growth of large single crystals of novel compounds.

This semester, MacDougall is teaching Physics 211, University Physics: Mechanics. ■

iRise and Denos get middle school students hooked on science

Sharlene Denos (right) discusses a lesson plan with teachers during iRISE professional development. Also helping with the professional development are Barbara Hug (standing, left) and grad student Yan Zhou (standing, center). Photo by Andrew Stengele

by Elizabeth Innez

One of Sharlene Denos’s passions is to expose middle school students to hands-on activities that pique their interest in science, to inspire a life-long interest—possibly even a career. Denos hopes to give today’s middle school student opportunities she didn’t have.

“I never had an opportunity to do any of these things when I was in school. I never once met a scientist or an engineer before I came to the university. We have an inquiry-based, hands-on focus to all of the lessons that we develop, and that’s also something that I didn’t have the benefit of. The schools I went to weren’t that great. In middle school I didn’t do one single lab, ever, in my entire time there.”

Edison Middle School AVID student lowers the stage during a lesson Matthew Alonso presented on rapid prototyping (3D printing) in May 2012. Photo by Elizabeth Innez

It was this passion to change the way science is taught to K–12 students that brought Denos to her current position, K–12 Education Coordinator at the Center for the Physics of Living Cells (CPLC) and Director of iRISE (Illinois Researchers in Partnership with K–12 Science Educators).

As a grad student, Denos was a National Science Foundation K–12 Fellow. In this program, she was paired up with a local teacher to develop a curriculum to teach together. This meaningful experience served as the basis for the iRISE program’s current emphasis on three audiences: graduate students, middle school teachers, and middle school students.

Graduate students are involved through the Physics 598SE course, in which students create hands-on lessons for use by middle school science teachers.

Denos said, “It really does build their ability to develop curricula, and also their teaching skills. It’s a chance for them to develop a complete lab or lesson from scratch.”

Denos points out, teaching college students is different from teaching younger students: “The kind of teaching that you do with undergrads, you sort of warn them of what they have to learn, and then they go and learn it. But with the younger students, it takes a lot of skill to be able to communicate these very complex ideas. So this exercise really helps to develop grad students’ communication skills.”

And, Denos said, the benefits of these communication skills go well beyond teaching: “People often say that if you’re writing something for the general public, you should aim for an eighth-grade level in terms of reading ability and scientific understanding—maybe even less than that. So in this way, this program also trains future scientists to communicate really well with the public.

“If they can communicate their research to a seventh-grader, then they can communicate it to the general public, who is in charge of whether or not they get funded to do their research. So it’s really crucial that scientists have the skill to explain to the public, ‘OK, here’s what I’m doing, and this is why it’s important.’”

Of course, a primary objective of iRISE is to provide science-based professional development for middle school teachers. In last summer’s iRISE teacher workshop, Physics 598SE students shared the lessons they had developed with program participants—all middle school teachers. During the workshop, the teachers had the chance to try out the hands-on activities they could later opt to use with their middle school students.

Teachers enjoy a hands-on activity at iRISE 2012 summer workshop on the Illinois campus. Photo by Elizabeth Innez

According to Denos, these lessons are beneficial because “they tie the curriculum together with current research in science and engineering and with important social issues. If there’s something that people are talking about a lot in the news, the graduate students will pull from that and turn that into a lesson, and talk about the science behind it.”

Some of the lessons offered in last summer’s workshop included *Wind Turbine Design, Carbon Cycle and Bioreactor Design Competition, Asteroid Impacts,* and *Representational Color in Astronomical Images.*

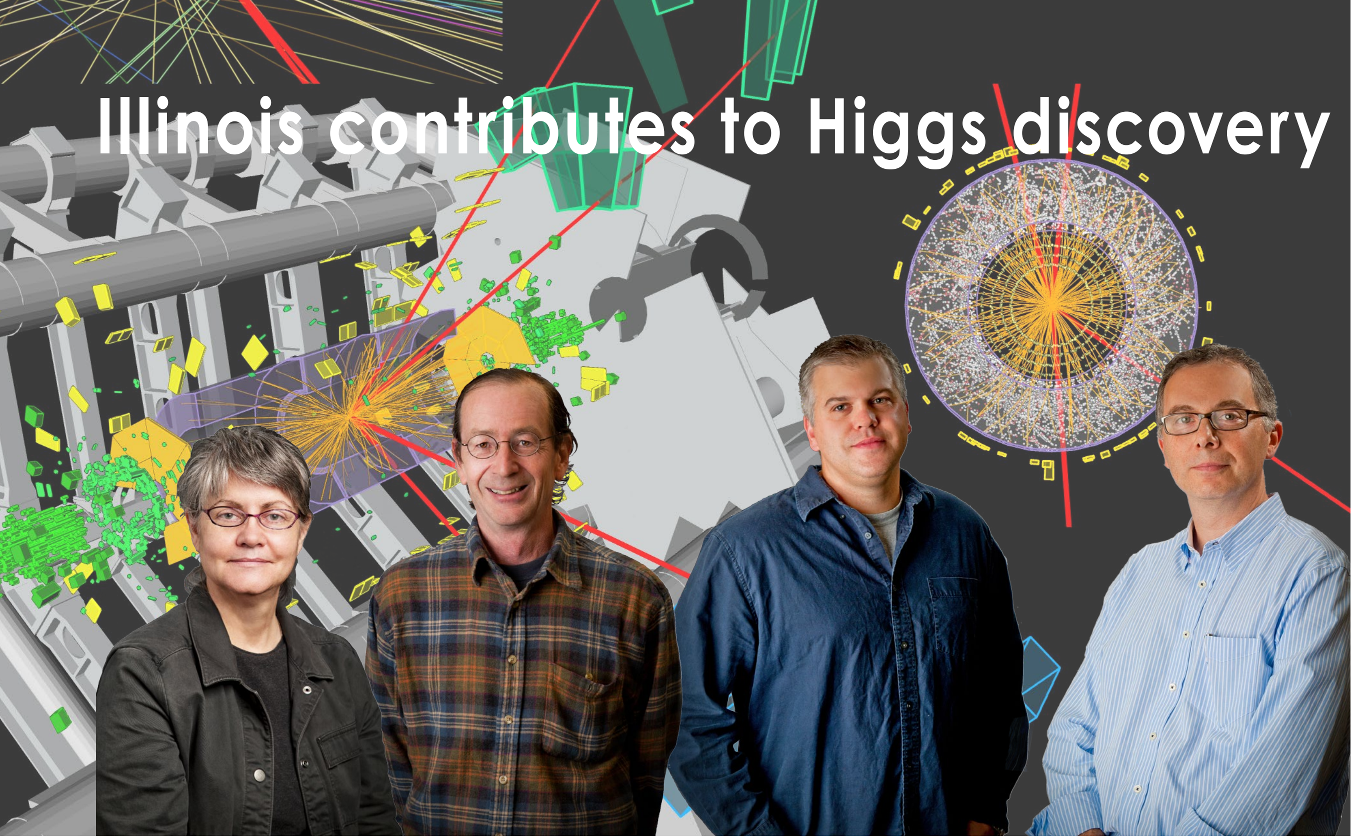
In addition to providing lessons for middle school teachers, iRISE works with middle school students directly. For example, in May 2012, AVID (Advancement Via Individual Determination) students at Edison Middle School who had been involved in iRISE science enrichment activities this past spring visited the Illinois campus. During the field trip, students took part in hands-on lessons taught by iRISE/CPLC graduate students, and by Joe Muskin and Matthew Alonso of Illinois’ Center for Nanoscale Chemical-Electrical-Mechanical Manufacturing Systems.

Denos considers middle school to be a crucial age in science education, based on a research article published in 2006, “Planning Early for Careers in Science,” in the journal *Science.*

Denos said, “The report indicated that a middle school student with a strong science interest and an average test score is more likely to end up with a STEM degree than one with high test scores and low interest. Getting students interested—getting them hooked at this age—is absolutely crucial.” ■

Two teachers at the iRISE workshop prepare to smell a rather putrid-smelling product made from algae. Photo by Elizabeth Innez

Illinois contributes to Higgs discovery



background image courtesy of CERN

University of Illinois physicists celebrated the announcement on July 4 from CERN, the European Organization for Nuclear Research based in Geneva, Switzerland, of the discovery of a new subatomic particle consistent with the long-sought Higgs boson—the final missing piece in the standard model (SM) of particle physics. Since 1994, University of Illinois researchers have been heavily involved in the design, building, commissioning, data taking, and data analysis at the ATLAS experiment at CERN.

The SM describes the fundamental particles from which every visible thing in the universe is made and the forces that govern them. First theorized in 1964, the existence of the Higgs boson would explain how subatomic particles acquire their mass. And while further analysis is needed before this discovery can be positively identified as the Higgs particle, the findings are cause for excitement.

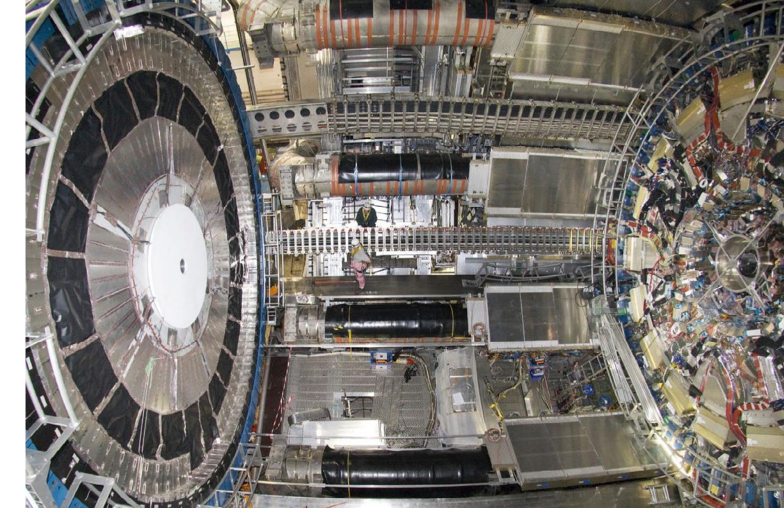
Professor and Department Head Dale Van Harlingen said, “Physics is really defined by creativity and discovery, and this discovery represents a remarkable effort worldwide of scholarship and technology. We are proud of the role our own high energy physicists played, and at the same time want to recognize that the Illinois impact in this discovery goes back to the very beginning, in that the prediction of the Higgs mechanism has its origins in the concept of spontaneous broken symmetry that was introduced in the BCS paper on the theory of superconductivity by our colleagues John Bardeen, Leon Cooper, and Bob Schrieffer. This is indeed a proud time for Illinois physics.”

The discovery is the result of two years of analysis of proton-proton collisions at the Large Hadron Collider (LHC) at CERN. Two independent experiments, ATLAS and CMS, each observed the particle.

University of Illinois high energy physicists Steven Errede, Deborah Errede, Tony Liss, and Mark Neubauer, along with their many team members, have worked on ATLAS since Steven Errede first joined the collaboration in 1994.

In an interview following the worldwide news release, Neubauer said “Before Tuesday’s announcement, all particles in the SM have been definitively observed by scientists except for the Higgs boson. What physicists working on the ATLAS and CMS experiments have discovered is a new particle that looks very much like the elusive Higgs boson. The new particle is the heaviest boson ever produced with a mass of 125 GeV—that’s 133 times the mass of the proton, or approximately the mass of a single cesium atom.”

The discovery was long in coming because the particle itself cannot be directly observed. Since the particle decays a tiny fraction of a second after it is created, detectors at ATLAS and CMS look for secondary particles and



Particle accelerator at CERN: View from above the calorimeter end cap, barrel open. Photo courtesy of ATLAS

sprays of particles called “jets” expected to result from a Higgs boson-type particle. Since other far more common processes can mimic Higgs decay, it has taken a multinational team of physicists years to sort through the data and arrive at this momentous announcement.

The contributions of the Illinois team have been substantial and far-reaching.

Steven Errede, Deborah Errede and their team (including three technicians and more than 20 physics undergraduate students) built and installed a major portion of the ATLAS detector, called the Scintillating Tile Hadron Calorimeter, or TileCal for short.

Neubauer’s group works on a part of the ATLAS detector called the “trigger,” a sophisticated assembly of electronics that analyzes the collisions in real time and determines which results are interesting enough to keep for further analysis. This team played a leading role in the search for a high mass (240-GeV to 600-GeV) Higgs boson that decays to *W* boson pairs that subsequently decay into a high energy electron or muon, large missing transverse energy (from an unobserved neutrino), and two high energy jets.

Neubauer’s group also investigated the 130-GeV to150-GeV excess in ATLAS data using sophisticated multivariate analysis techniques that make maximal use of the available information in the Higgs candidate events.

Starting in 2011, Neubauer also spearheaded a project with senior research physicist David Lesny to build a Tier-2 computing center in collaboration with the National Center for Supercomputing Applications (NCSA) at Illinois. With 15 petabytes of data generated by LHC experiments each year, it is an enormous technological challenge to process and share the data with thousands of physicists around the world.

The Tier-2 center at UI leverages the substantial expertise and infrastructure available to UI researchers in high-performance computing to help meet this challenge as a resource within the Worldwide LHC Computing Grid (WLCG). Online since last winter, the UI Tier-2 center contributed to the processing of the data used in the Higgs discovery.

The Liss group works on the ATLAS muon system, one of the key detector components for identifying the final states of some of the decay modes of the Higgs boson. His group has been studying the top quark, the last big discovery in high energy physics, which is interesting in its own right, and can mimic the Higgs signal and must be understood so it can be separated from the new particle.

A physics undergrad works with Professor Steven Errede (right) and technician Dave Forshier (middle) to produce a TileCal submodule for the ATLAS project in 1999. A large team of undergraduates worked on the project, to produce a total of 193 TileCal submodules. This respresents just one phase of the Illinois team’s contributions to the project.

ATLAS collaborators at the UI Physics Department include Professors Steven Errede, Deborah Errede, Tony Liss and Mark Neubauer; visiting Associate Research Professors Nectarios Benekos, Viviana Cavaliere, and Irene Vichou; Senior Research Physicist David Lesny; systems programmer Larry Nelson; graduate students Markus Atkinson, Austin Basye, James Coggeshall, Philip Chang, Arely Cortes Gonzalez, Ki Lie, Hovhannes Khandanyan (graduated March 2012) and Allison McCarn; and undergraduate UI students Ian Dayton, Matthew Feickert, Tony Thompson, Tim Thorp, and Brian Wang, and REU external student Julia Gonski .

Liss said, “The discovery is of absolutely fundamental importance. The SM has been enormously successful for 50 years and explains nearly every experimental measurement made over that period. But the SM requires a mechanism for separating the electromagnetic and weak forces (weak forces are responsible for some kinds of radioactive decay—such as those that make the sun shine). This effect is called electroweak symmetry breaking (EWSB). In the SM, EWSB occurs via the Higgs mechanism, and the Higgs mechanism requires a Higgs boson. The Higgs boson, in turn, is what gives mass to the fundamental particles.

“We know that electroweak symmetry is broken—this is a measurable fact of nature—the electromagnetic force is much stronger than the weak force. So something has to do it, and now we are on the verge of establishing what it is that does it. I say ‘on the verge’ because even though we have discovered this new particle, we don’t know quite yet that it is the SM Higgs boson; it could be a more exotic Higgs boson. That would be the greatest thing! It would point the way to things beyond the SM, which we know must be there. But that’s another story.”

The ongoing goal for the ATLAS and CMS teams is positive identification of the new particle’s characteristics, and this will take considerable time and data.

Steven Errede said, “In reality, the Higgs work is just beginning.

Said Deborah Errede, “ We have anticipated the discovery of the Higgs particle, fundamental to the fabric of our SM of elementary particles physics, since its introduction by Steven Weinberg and Abdus Salam in 1967, for over forty years. The collaboration of nations accomplishing this achievement is truly remarkable and we at the University of Illinois are proud to have contributed to this.” ■

The High Energy Physics Group is supported by the US Department of Energy, Grant No. DOE DEFG02-91ER40677O/C. MSN is also supported by the National Science Foundation CAREER 1056987.
The conclusions presented are those of the scientists and not necessarily those of the funding agencies.

Tevatron observes separate Higgs decay channel, first predicted by Willenbrock

Photo courtesy of Fermilab.

Fermilab’s CDF and DZero collaborations at the now retired Tevatron collider did not discover the standard model Higgs boson, but their collective contribution to the Higgs boson search was nevertheless an important one.

July 27, the CDF collaboration—including a team of University of Illinois physicists—and the DZero collaboration published the combined results of their analysis of about 500 trillion proton-antiproton collisions since 2001, confirming their July 2 announcement of the likely existence of a subatomic particle consistent with the Higgs boson (observed at a 2.9-sigma level).

The report was, of course, eclipsed by the bigger announcement on July 4 from CERN of a Higgs-like boson discovery at the Large Hadron Collider (LHC). The ATLAS and CMS collaborations independently published their respective data analyses on August 1, with computations from a network of supercomputing centers around the globe, reaffirming the discovery.

ATLAS collaborators now report the observance of a Higgs-like particle with a 5.9-sigma signal, based on analyses of five decay channels using 2011 data and three decay channels (including the *W*-boson pair decay mode) using 2012 data. CMS collaborators report observance of the same particle with a 5-sigma signal, based on analyses of five decay channels using data from 2011 and 2012.

But the Tevatron’s ultimate contribution to the Higgs search was not a small one: the CDF and DZero collaborations observed the Higgs-like subatomic particle through a decay channel—to a bottom quark and antiquark—that was not observed by ATLAS or CMS.

University of Illinois theoretical physicist Scott Willenbrock said, “The Tevatron did play a useful role in finding this particular decay channel of the Higgs-like particle. This has not been seen at LHC because of backgrounds—things that mimic the signal you are looking for.

“At the Tevatron, because the machine is not as energetic as the LHC, the backgrounds are smaller. For this particular decay channel, the Tevatron actually had an advantage.”

In 1994, Willenbrock and his collaborators were the first to propose that the particle could potentially be seen at the Tevatron by looking for its decay to a bottom quark and antiquark. In their paper, “Higgs bosons at the Fermilab Tevatron,” in *Physical Review D*, **49**, 3154 (1994), Willenbrock and his co-authors, Alan Stange and William Marciano, asserted that the observation of the Higgs in this decay mode is strong evidence that it really is the Higgs particle.

“At the time we wrote the paper, no one was thinking about looking for the Higgs boson at the Tevatron; everyone was focused on the LHC. This paper was the contrarian—it said, ‘Hey, we have a chance.’ People paid attention to it, and it was one of the things that motivated people to push Fermilab’s Tevatron to its limit,” said Willenbrock.

Fermilab’s Tevatron near Batvia, Illinois, was turned off on September 30, 2011. In its 24 years of proton-antiproton collision experiments, the Tevatron made many discoveries, most notably, the top quark in 1995. The Tevatron’s observation of the Higgs-like boson is no small part of its great legacy.■

Co-authors of the Tevatron joint paper at Illinois include Professors Steven Errede, Mark Neubauer, and Kevin Pitts; postdoctoral Research Associates Viviana Cavaliere, Heather Gerberich and Olga Norniella; and graduate students Ben Carls (graduated March 2012), Keith Matera, Ed Rogers (graduated December 2010), and Greg Thompson (graduated June 2011). Other Physics Illinois students who have worked on the CDF collaboration include graduate student Benjamin Esham, undergraduate student Stephanie Brandt, and REU external undergraduate students Andrew Kerr and Benjamin Stickel.

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World's most powerful digital camera records first images in hunt for dark energy

Photo courtesy of Dark Energy Survey Collaboration

Eight billion years ago, rays of light from distant galaxies began their long journey to Earth. On September 12, that ancient starlight found its way to a mountaintop in Chile, where the newly constructed Dark Energy Camera, the most powerful sky-mapping machine ever created, captured and recorded it for the first time.

That light may hold the answer to one of the biggest mysteries in physics—why the expansion of the universe is speeding up.

Professor Jon Thaler explains, "The history of the universe, its expansion rate, and the formation of structure shed light on two of the most important questions in modern particle physics and cosmology—the nature of the dark matter and of the dark energy. Because these two entities, about which we know very little, comprise 96 percent of the total energy in the universe, learning more about them is crucial to our understanding of the universe as a whole."

The 570-megapixel camera, roughly the size of a phone booth, is the product of eight years of planning and construction by scientists, engineers, and technicians on three continents. Much of the camera's data acquisition electronics and control software were built in Urbana by an Illinois team led by Thaler.

The first picture from the Dark Energy Camera, a zoomed-in image of the barred spiral galaxy NGC 1365, in the Fornax cluster of galaxies, which lies about 60 million light years from Earth. Photo courtesy of Dark Energy Survey Collaboration

With this device, scientists in the international Dark Energy Survey (DES) collaboration will undertake the largest galaxy survey ever attempted and will use that data—to be stored and processed at Illinois' National Center for Supercomputing Applications (NCSA)—to carry out four probes of dark energy: studying galaxy clusters, supernovas, the large-scale clumping of galaxies, and weak gravitational lensing. This is the first time all four methods will be possible in a single experiment.

"The combined analyses of the scientists in the DES collaboration are expected to contribute significantly to our understanding of the properties of dark energy and dark matter," said Thaler. "The Illinois physics team will look at supernovas to chart the expansion of the universe over time, and at gravitational lensing to determine the history of the formation of structure (galaxies and galaxy clusters).

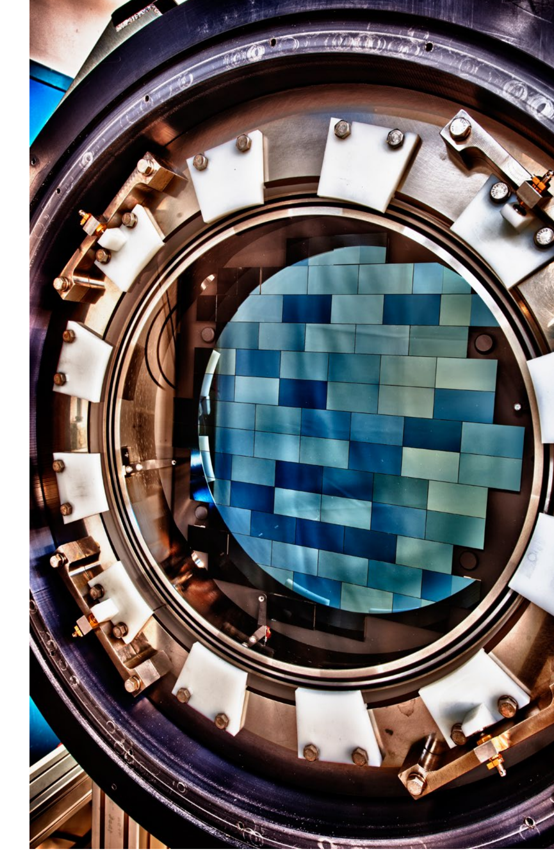
"Gravitational lensing is similar to optical lensing: just like glass, gravity also bends light. Light from distant stars and galaxies bends on its way to Earth as it is pulled by the gravity of objects that it passes—this bending distorts the shapes of distant galaxies. Normal matter and dark matter both have this effect, so measuring this distortion tells us how the dark matter contributes to galactic structure," he said.

Over five years, the survey will create detailed color images of one-eighth of the sky, or 5,000 square degrees, to discover and measure 300 million galaxies, 100,000 galaxy clusters, and 4,000 supernovas.

"Hidden within the galaxy cluster distribution are clues to the nature of the universe we live in," said Dr. Robert Gruendl of the Illinois Astronomy Department.

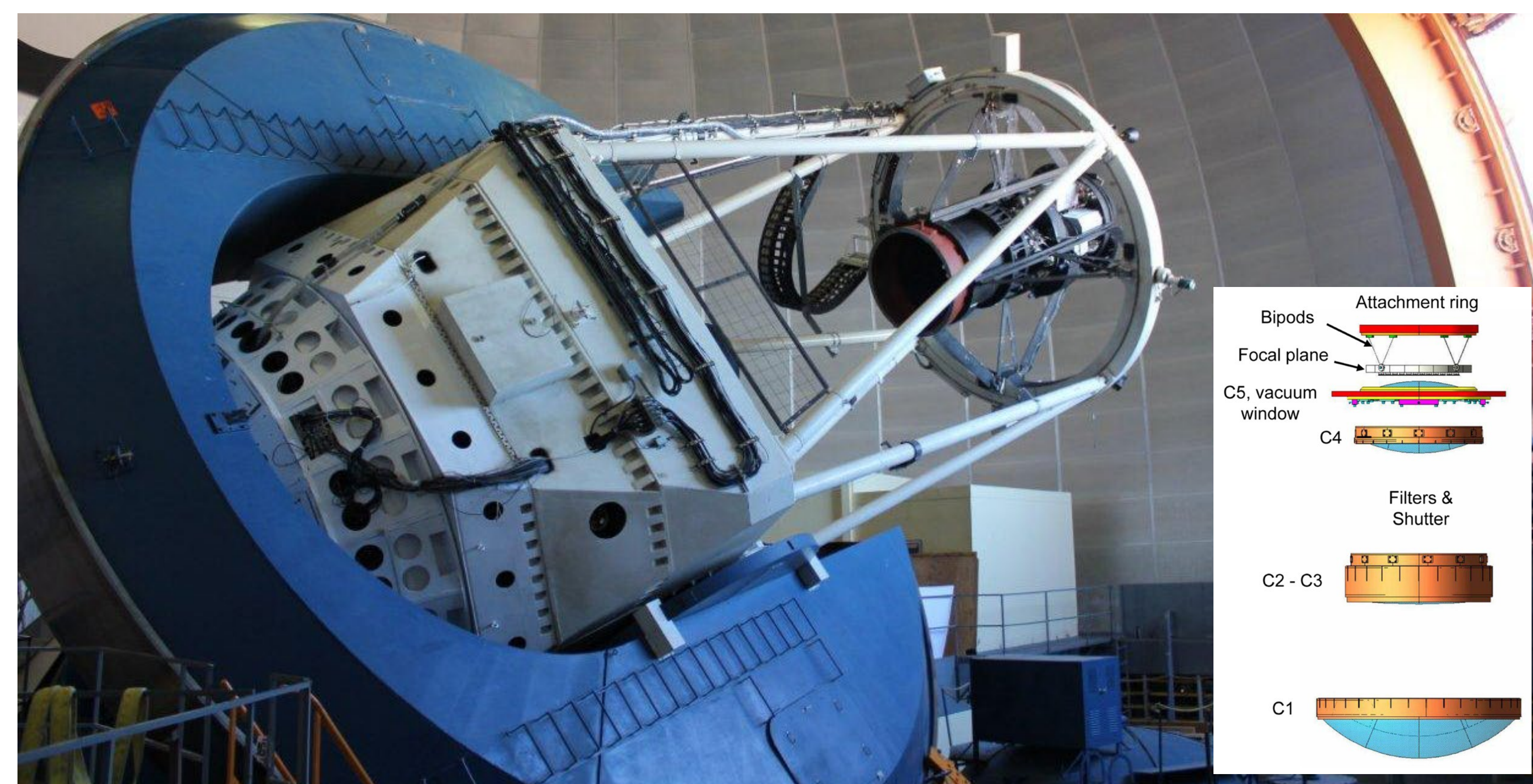
Gruendl, together with Don Petravick of NCSA and other collaborators, has developed and will operate a data management framework for processing, calibrating, and archiving the massive amounts of data—petabytes over the lifetime of the survey—that will be collected for the DES. This system relies on the iForge cluster and a 100-terabyte Oracle database at NCSA and also uses high-performance computing resources provided by the National Science Foundation's Extreme Science and Engineering Discovery Environment (XSEDE) project.

The DES is expected to begin in December, after the camera is fully tested, and will take advantage of the excellent atmospheric conditions in the Chilean Andes to deliver pictures with the sharpest resolution seen in a wide-field astronomy survey. ■



The Dark Energy Camera's 62 charged-coupled devices (CCDs) record 570 megapixels per snapshot. Credit: Fermilab

The DES is supported by funding from the US Department of Energy; the National Science Foundation; funding agencies in the United Kingdom, Spain, Brazil, Germany, and Switzerland; and participating DES institutions.



The Dark Energy Camera, mounted on the Blanco telescope in Chile. Photo courtesy of Dark Energy Survey Collaboration

Goldenfeld leads $8 million NASA center

Research team to uncover the universal aspects of the evolution of life in deep time

"We want to help answer not only the basic questions of 'How does life begin and evolve?' and 'Is there life beyond Earth?' but also 'Why does life exist at all?'"

An interdisciplinary team from the University of Illinois at Urbana-Champaign is among five new research groups selected to join the NASA Astrobiology Institute (NAI) to study the origin and evolution of life. The NAI invitation comes with a five-year research grant totaling about $8 million.

Nigel Goldenfeld, Swanlund Professor of Physics and leader of the biocomplexity research theme at the Institute for Genomic Biology (IGB), will serve as the principal investigator.

"We want to help answer not only the basic questions of 'How does life begin and evolve?' and 'Is there life beyond Earth?' but also 'Why does life exist at all?'" said Goldenfeld. "The NASA Astrobiology Institute is the most far-sighted attempt to address foundational questions that everyone asks at some time. We are thrilled to participate with them in perhaps the most important questions in all of science."

The team's goal will be to characterize the fundamental principles governing the origin and evolution of life anywhere in the universe. The multidisciplinary effort to define and characterize "universal biology" will include leading-edge scientists from the fields of microbiology, geobiology, computational chemistry, genomics, and physics.

The Illinois team will use genomics to explore deep evolutionary time through computer simulations and laboratory investigations, looking for signatures of early collective states of life that would have preceded the rise of individual organisms on Earth.

Goldenfeld said, "With modern genomics, we now have the data and the tools to examine carefully the evolutionary relationships between parts of the cell. And even more than that, theory gives us a clear hypothesis to test: namely that early life was communal, and indeed had to have been, based on general universal biology considerations related to the detailed structure of the genetic code."

In this aspect, the work will build on the 2006 findings of Goldenfeld and his mentor and research partner, Illinois physicist and astrobiologist Carl Woese, winner of the 2003 Craaford Prize. In their paper, "Collective evolution and the genetic code" (*Proc. Natl. Acad. Sci.* **103**, 10696-10701) the researchers assert that in order for the complexity of our genetic code to have evolved in the time span that it did, earliest life—from which our first genomic ancestor sprung 3 billion years ago—had to have existed as a collective.

"In this collective, genetic material would have been exchanged horizontally across generations, rather than just vertically from parent to offspring. Picture microbial organisms that would have sucked each other up and spit each other out. With this, the speed of evolution goes up," said Goldenfeld.

In a complementary study, the group plans to perform laboratory work to investigate how individual cells sense, respond and adapt to changing environments.

"We say that evolution is a random process—it's not clear that this is true," said Goldenfeld. "We will look at cells under stress to quantify how they adapt. Could stress trigger mutation, or does it just select for it? This has never been tested."

Additionally, the team will look for signatures of the major transitions that life must make as evolution changes from communal to individual organismal lineages.

"Why is the genetic code unique? There is only one for all of life on Earth, whether plant or animal," said Goldenfeld. "And the genetic code is designed to be tolerant of noise—if there is a mistake in reading an amino acid, the one you get in place of the correct one will be very similar to it.

"It is important to develop the field of universal biology, because we may never find traces of life on other planets. But if we understand that life is generic, maybe even an expected outcome of the laws of physics, then we'll know for sure that we are not alone."

Co-investigators on the research team include Elbert Branscomb, Isaac Cann, Lee DeVille, Bruce Fouke, Rod Mackie, Gary Olsen, Zan Luthey-Schulten, Charles Werth, Rachel Whitaker, and Carl Woese from Illinois, Scott Dawson from the University of California, Davis, and Philip Hastings and Susan Rosenberg from Baylor College of Medicine, Houston.

The research will be based in the university's Institute of Genomic Biology. IGB Director Gene Robinson said, "This bold research program fits perfectly at the IGB, which was established to help faculty compete for the large grants that are necessary to address grand challenges with a team-based multidisciplinary approach. The NASA award reflects the creativity and vision of the faculty in the biocomplexity research theme, the IGB, and the campus as a whole."

In addition to the research, novel educational activities related to the field of astrobiology will take place. These will include not only formal education in astrobiology at the undergraduate level, but also a massively online open course as part of the university's initiative in this arena. Other public outreach will include a partnership with a science program at the middle school science level, the development of short web-based videos on astrobiology concepts and findings called "AstroFlix," and a new astrobiology course for lifelong learners in the community.

"We are really excited to be a part of NAI. It's a unique group. NASA is the only organization presently trying to answer these questions," said Goldenfeld. ■

The National Aeronautics and Space Administration established the NASA Astrobiology Institute (NAI) in 1998 as an innovative way to develop the field of astrobiology and provide a scientific framework for flight missions.

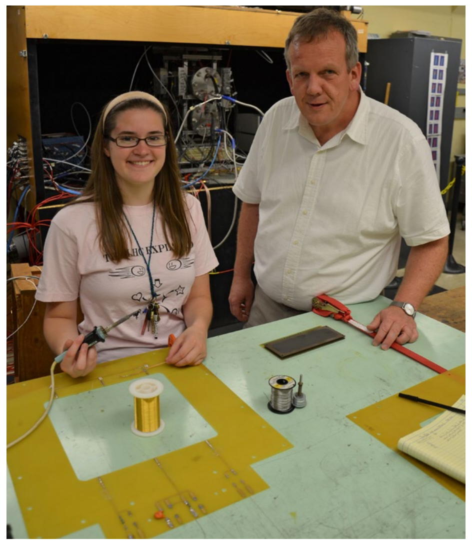
NAI is a virtual, distributed organization of competitively selected teams that integrate astrobiology research and training programs in concert with the national and international science communities.

Read more at astrobiology.nasa.gov/nai/about.

Summer in a big-U research lab

REU program at Physics Illinois hosts 14 students from across US

The Research Experiences for Undergraduates (REU) program of the National Science Foundation supports active research participation by undergraduate students in science, technology, engineering, and mathematics. Physics Illinois has hosted annual summer REU student participants since 1993, giving students from small liberal arts campuses a chance to experience physics at a major research university. There were 14 participants this summer. These are just a few of their stories.



Marie Blatnik, a visiting undergraduate, works with Professor Matthias Grosse Perdekamp in his lab.

Cleveland State junior Marie Blatnik is interested in "the inner workings of everything." The 21-year-old aspires to be a nuclear physicist. In fact, the business card she presents to new acquaintances lists her occupation as "aspiring physicist." For Blatnik, a summer working in the research laboratory of Illinois nuclear physicist Matthias Grosse Perdekamp was nothing short of extraordinary.

"It's shown me how big the field of particle physics is—and how big the world is. This was the commencement of my nuclear physics career," said Blatnik.

During the 10-week program, Blatnik helped to design a prototype of a drift chamber—that's a gaseous subatomic particle detector—for the COMPASS II project at CERN, the European Center for Nuclear Research.

The prototype is one step in the development of the the DC56 drift chamber that will be installed in the COMPASS spectrometer on the M2 beamline of the Super Proton Synchrotron (SPS) particle accelerator.

Blatnik explained that the drift chamber uses high voltages, stretched wires, and gas to detect charged subatomic particles: "The particle passes through the plane of the detector, ionizing the gas along its path. Electrons ejected from the gas feel an electric field from a series of wires, and migrate toward the nearest anode wire. This signal is timed and used to determine the position at which the particle passed through the detector."

Blatnik's part in the project involved determining the specifications for the first prototype. She designed tests to determine the best O-ring materials, studied the mechanical wires, and developed the method of cathode stretching for the chamber.

"The precision with which the mechanical wires are placed determines the precision of the chamber," said Blatnik.

Blatnik and the 13 other undergraduates enrolled in the program had the opportunity to present their work to one another, to attend weekly lectures by various professors about their current research, to participate in special workshops, and to network with future colleagues.

"My REU experience was empowering—it has taken my career plans, which had been theories in my head, and confirmed them," said Blatnik.

A highlight of the program was a field trip to Fermilab, where program participants toured the CDF project.

"Everything was big and beautiful and amazing—if you just ponder the complexity for a moment! All of these tiny particles traveling at different velocities near the speed of light along a complicatedly shaped track, swirling around in a helical orbit—and that beam must be switched from one track to another. It's amazing that we do this, that we can even keep track of that beam, and transition it from track to track with such important but 'impossible' precision."

"The physics here is amazing, and the people are very talented and interesting," she said. "The University of Illinois has been so good to us, from the awesome REU program, to the cutting-edge research. I love it here." ■

Blatnik's summer research was funded by National Science Foundation Grant No. 1062690 and NSF 08555699. The conclusions presented are those of the scientists and not necessarily those of the funding agencies.

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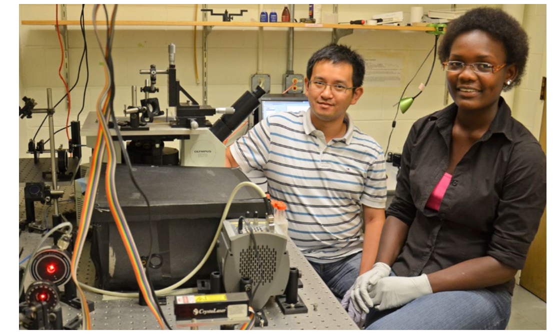

Teckla Akinyi works with postdoc I-Ren Lee in Professor Taekjip Ha's research lab.

Working in one of the Illinois research labs of Professor Taekjip Ha last summer, undergraduate Teckla Akinyi experimentally isolated single-stranded DNA molecules to study the transfer of a key protein from one strand to the next. These molecules are important in maintaining the stability of the genome and in preventing serious threats to human health. Sophisticated new techniques being employed by Ha's research group in the Center for the Physics of Living Cells are providing previously unattainable data on this elementary biological process.

Akinyi learned to apply Ha's own single molecule fluorescence resonance energy transfer technique (smFRET)—now in use the world over—using different experimental setups.

"It's a large lab, with people from different fields, all related to biophysics, all learning together—no superiority of one science over the other," said Akinyi. "About half of the graduate students and post-docs in Ha's lab are looking into developing techniques with even higher resolution to investigate biological events, while the other half are working with smFRET.

"Different grad students and postdocs work on different experimental setups, and they were so open with me, letting me touch and play around with their setups. I learned so much. I wasn't told, I experienced it," said Akinyi.

To help with her research, Teckla was paired with postdoc I-Ren Lee.

"He worked solely with me over the summer, giving me enough attention for me to optimize my learning from him, while giving me enough independence to learn on my own," said Akinyi.

"Being in the Ha Lab has reinforced my career plans for graduate school, to explore techniques used to study biological events," said Akinyi. "Growing up in a society with limited exposure to pure sciences, I hoped someday to work in a company that came up with ideas like MRI and worked with microscopy."

This formative educational experience very nearly didn't happen at all for Akinyi.

When she first looked into applying for a spot in a National Science Foundation REU program, she learned that foreign nationals are not eligible; funding is restricted to US citizens, nationals, and permanent residents. The then-sophomore at Xavier University in Cincinnati, OH, would not be deterred, however, and at last year's Midwest Regional Conference for Undergraduate Women in Physics in Cleveland, she made use of the networking opportunity to share her goals for the summer.

During that conference, Akinyi made a big impression on Celia Elliott, director of external affairs for Physics Illinois, who set the gears in motion to make the necessary funding a reality.

"She is the most engaging, interesting, positive, personable young woman. And she was despondent—she wanted research experience because she knew it's important to getting into graduate school, but she was stymied," said Elliott. "I told her that while I could not make any promises, we did have some discretionary funds—gifts from our alumni tagged for undergraduate research—and I would do what I could."

Elliott worked with Assoc. Head for Undergraduate Programs and Professor Kevin Pitts to secure the funding for Akinyi's participation, in part through the generous support of a private donor, alumnus Dr. John Gardner. The Center for the Physics of Living Cells, an NSF "Physics Frontiers Center" that provides research training for young scientists, also contributed to making Akinyi's dream a reality.

"It was just an amazing opportunity, the exposure to research at a large university, coming from small department. I learned about many different opportunities, and learned just how big the field of physics is—not just its physical size here, but its intellectual size. You learn you can do anything with physics."

"The exciting results as the program comes to an end are the amount of knowledge obtained in the field, the skills from hands-on research, and the hopefully lifelong friends I have made in the program and in the lab where I worked. I leave with much appreciation for the opportunity offered to me by Illinois Physics, Prof. Ha, I-Ren Lee, and the Ha lab in its entirety," said Akinyi. ■

The Center for the Physics of Living Cells is funded by the National Science Foundation Grant No. 0822613. The conclusions presented are those of the scientists and not necessarily those of the funding agencies.

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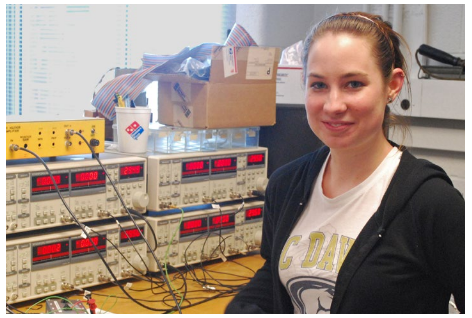

Meredith Powell discovers the physics of music in Professor Steven Errede's lab.

This summer, UC Davis undergraduate Meredith Powell took her lifelong appreciation of music to a deeper level. Powell investigated the physics at work behind the performance of instrumental music.

Through the National Science Foundation's 10-week REU program, Powell had the opportunity to work side by side with Professor Steven Errede, who has been researching and teaching the acoustical physics of music for more than a decade.

"This was really a unique opportunity," said Powell. "The Illinois physics of music lab is the only place that uses techniques to measure the complex, or phase-sensitive, aspects of the sound field, through which a deeper understanding of the acoustical physics of musical instruments is achieved."

For Powell, the two studies—science and music—form a natural union. The fourth-year physics major has been playing piano and viola for as long as she can remember and plans to graduate with a minor in music. And her talents have not gone unrecognized—she has performed as principal violist in the UC Davis Symphony Orchestra and plays regularly around the Sacramento area with her quartet.

In Errede's lab, Powell used an experimental apparatus to measure vibration at various frequencies and to determine the pitches at which her viola resonated. She also measured physical quantities such as sound intensity, acoustic impedance, and energy density across the back of the instrument.

"It turns out that there are significant acoustical differences between the viola and its close relative, the violin," said Powell. "The resonant frequencies of the viola do not lie on the pitches of the open strings, as with a violin. This could contribute to the viola's more subdued, mellower timbre."

Powell said the methods she learned in experimenting with the physics of music taught her about how physics research is approached in general. At the same time, it gave her one more reason to love her instruments.

"Music has given me the opportunity to tour and perform overseas and expand my insights into other cultures. It has not only instilled in me qualities such as teamwork, leadership, hard work, and dedication, but also fostered my creative development which has allowed me to look at physics from another perspective," she said. ■

Powell's summer research was funded by National Science Foundation Grant No. 1062690. The conclusions presented are those of the scientists and not necessarily those of the funding agencies.

Ashley Hicks works with superconducting materials in Professor Dale Van Harlingen's lab.

While temperatures soared outside this summer, University of Central Arkansas senior Ashley Hicks was keeping things cool in the lab. In fact, she was keeping them very cool—at around –262 degrees Fahrenheit.

Through the REU program, Hicks spent her summer investigating high-temperature superconductors, working in Professor Dale Van Harlingen's research laboratory. High-temperature superconductors, despite the name, work only at temperatures way below freezing.

Hicks, whose primary research at UCA is in chemistry and molecular acoustics, said she was stepping out on a limb by applying to be part of a condensed matter physics group, but the risk paid off.

"I've obtained valuable skills, like how to prep materials for creating superconductors, and how to characterize them at low temperatures using liquid helium," she said. "The REU program definitely helps us grow as scientists. Working alongside graduate students and postdocs was helpful. They were always there to answer questions—and I had a lot of questions."

Hicks said she hopes her summer experience at Physics Illinois won't be her last: "The REU program has really sparked an interest in both superconductivity and Illinois as a grad school. I want to come back—and I want to see where the work that the Dale Van Harlingen research group is doing goes." ■

Hicks' summer research was funded by NSF Grant No. 1062690 and EFRC Grant No. A 2779 DOE BNL 150252. The conclusions presented are those of the scientists and not necessarily those of the funding agencies.

Physics Graduate Student Association members meet in the Interaction Room for the "Physics Phridays" ice cream social on July 7. Pictured left to right are Sean Vig, Eric Huemiller, Mark Schubel, and Billy Passias. In the background are Hannah Gelman, Patrick Mears, Yu Gan, and Daniel Sussman.

Interaction Room new intellectual hub

Located on the second floor of Loomis Laboratory in the area that formerly housed the Physics and Astronomy Library, the new Interaction Room is a modern, open space with clean lines and bright colors. It's a place for physicists to come together, form connections, and share their science.

Though not yet fully finished, the versatile room already serves as a meeting place for a wide variety of functions in the department, from the Physics Graduate Student Association's Physics Phridays (ice cream socials), to department celebrations, emeritus luncheons, receptions, CPLC summer school classes, and special talks.

In between scheduled events, the Interaction Room serves as a quiet space set apart for physics faculty, postdocs, graduate students, and upper-level undergraduate students to study. Sometimes, this is a place for aspiring physicists to step back from their coursework and take the time to consider opportunities that might open up their futures.

The Interaction Room fills a void created by the 2009 closure of the Physics and Astronomy Library branch.

As Department Head and Professor Dale Van Harlingen explains, the physics library was always more than the sum of its parts:

"The library represented an extensive resource, most notably, in the intellectual environment it provided, and of course in the remarkable staff we enjoyed over the years," said Van Harlingen. "It really was a hub for intellectual activity and interactions in our department for 100 years. It was a centrally located space that supported our core missions of teaching and research, and it was vital to our ability to promote creativity and train students."

The closure came about as part of a University-wide plan to reduce the number of separate library sites because of a combination of financial constraints and diminished usage—with today's journals and books readily available online, fewer scholars regularly visit library stacks to carry out their research.

Department administrators had managed to postpone the closure for several years, but it would eventually prove inevitable.

Van Harlingen remembers when the first closure notice came, and then Associate Head Jim Wolfe (now emeritus) organized a petition to keep the library doors open.

"At the time, I was ambivalent. I used to spend hours in the library, but over time, things had changed. Journals were available electronically," said Van Harlingen.

In 2006, the library closure was once again on the table, and Van Harlingen had a different perspective. Now head of the department, he was opposed to losing such a vital space.

Director of External Affairs Celia Elliott remembers, "That time,

The Physics and Astronomy Library officially closed as a branch of the University of Illinois Library System on Friday, June 12, 2009, fully 100 years after its doors had first opened. The collection moved to Grainger, along with librarian Mary Schlembach. The Physics and Astronomy Library still maintains an online presence to serve faculty, postdocs, and students.

we managed to stave them off by showing them pictures of Tony Leggett reading *Physical Review Letters* in the library. He spent a good deal of time there—he was always in the library at the same table, sitting in the same chair, reading the journals."

Three years later, notice came again that the closure would go forward, and by now, Van Harlingen had come to the conclusion that this could be a positive thing—if the library were replaced with a communal space better equipped to support modern research and teaching.

"Usage had gone way down, and even Tony Legett had already gotten a study room at Grainger," said Van Harlingen.

There was talk at the time of converting the space into offices with cubicles, but Van Harlingen preferred not to break it up. He put forth a proposal to renovate the library space into a Physics Interaction Room at a total projected cost of about $200,000.

Van Harlingen secured $50,000 in matching funds from each the Office of the Provost, the College of Engineering, and the University Library.

To raise its own share of the bill, the department reached out to alumni and friends, and the response was very positive: over 130 individuals have together contributed a total of $17,000 to the Interaction Room Fund.

"Today, we have a very flexible space, and that's hard to come by in an old building," said Van Harlingen.

In the brief time it's been available, usage of the room by students and postdocs has gradually increased. Additional upgrades and renovations are in the works for the space, to make it more functional and able to support the global, interdisciplinary, and collaborative nature of much of physics research today.

With sufficient funding, future plans to complete the space include adding comfortable furniture to the rear room, now a graduate student lounge; procuring artwork; installing a faculty-staff lounge and a multi-purpose classroom with state-of-the-art media capabilities in what had been the journal room; and creating a modern conference room with online video capabilities in what had been a book room.

As Van Harlingen put it, this is "valuable real estate"—a place where all of the department's members can come together and enjoy the camaraderie that comes of being part of a very large enterprise. ■


Department members and friends celebrate the Higgs-like boson discovery at a reception in the Interaction Room following a special talk by Professor Mark Neubauer on July 10.


Emeritus faculty pose for a photo following a luncheon in their honor September 27. Pictured left to right are (back) Charlie Slichter, Miles Klein, Ralph Simmons, Dale Van Harlingen, Andy Anderson, Andy Granato, Jim Wolfe, (front) Gordon Baym, Mort Brussel, Michael Weissman, Alan Nathan, Gary Gladding, Bob Eisenstein, and Jeremiah Sullivan.

For more information, or to make a gift to the Interaction Room Fund, please visit http://physics.illinois.edu/support/interaction-room.asp.


The physics library in the 1970s.

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A brief history of the physics library

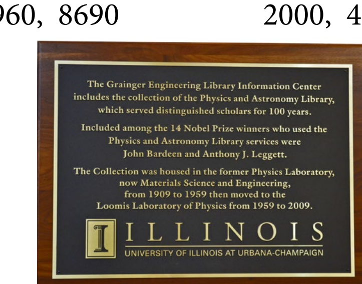
by Assoc. Professor of Library Administration Mary Schlembach

When the original Laboratory of Physics (now the Materials Science and Engineering Building) was built in 1909, a room was set aside for use as a departmental library. The shelving, 120 feet in length, reached no higher than the mantel over the gas fireplace. The furniture consisted of one long conference table in the center surrounded by 12 arm chairs, plus a heavy mission-style oak davenport with two matching rockers and two straight chairs.

There have been several physics librarians over the years. Della Rogers McCown served as both librarian and departmental secretary from 1911 to 1948, when a full time librarian was hired (McCown stayed on as secretary until she retired in 1959). Bernice Lord Hulsizer ("Bunny") was the longest-serving physics librarian, from 1966 to 1986, and she came back part time before David Stern was hired in 1987.

The Library was moved to the new physics building in 1959, into a larger space.The growth of the Physics and Astronomy Library over the years is reflected in the total number of volumes (books and bound journals) in the collection, listed here by year:

1930, 2650	1970, 19,862
1940, 4300	1980, 33,331
1950, 5072	1990, 37,393
1960, 8690	2000, 46,147



Some highlights

1948–1949 A subscription to all materials published by the Atomic Energy Commission is begun (Illinois physics library is one of the first in the nation to subscribe). A telephone is installed in the library. Students prefer to study in the adjacent seminar room where they can smoke and talk.
1952–1953 Dr. Frederick Seitz submits the classification schema for books in solid state physics to the library cataloging department.
1954–1955 In 5 years prior, the number of physics graduate students has grown by nearly 20 percent. All European Center for Nuclear Research (CERN) reports are given to the Physics Library.
1955–1956 The Control Systems Laboratory receives over $3 million dollars from the Armed Forces for research in military physics. Graduate summer school in semi-conductors and transistor electronics is started.
1956–1957 Book collection is reviewed by 26 physics faculty members to determine which books to transfer to the Main Library.
1958–1959 The Physics Library moves into new quarters in the completed half of the new Physics Building on Oct. 18–19. The new space measures 3,740 square feet.
1966–1967 Bernice (Bunny) Hulsizer starts as physics librarian in September.
1977–1978 Mary Kay Newman starts as library clerk in August. INSPEC is added to the library's bibliographic record service online databases.
1979 Astronomy collection merges with physics.
1983 Entire collection is cleaned after Loomis Lab fire.
1986 After 20 years of service, Bunny Hulsizer retires, but returns half time until a replacement is hired.
1987 David Stern starts as physics and astronomy librarian. (He leaves July 1994 to become head of science libraries at Yale University). *High-Tc Update* is the first electronic open-access journal published in superconductivity (ceases at end of 2003).
1988–1989 New Astronomy Building reading room is planned.
1993–1994 Journal room expansion is completed. *Physics Briefs* ceases publication. Content is added to INSPEC database.
1995 Greg Youngen starts as physics and astronomy librarian, then transfers to the Veterinary Medicine Library in January. Physics library administration is transferred to Grainger Engineering Library, and Mary Schlembach becomes the physics/astronomy librarian.
2007 Mary Kay Newman retires in May.
July 12, 2009 Physics and Astronomy Library closes; the collection is moved to Grainger Engineering Library. ■


Above: The original 1909 Physics Reading Room in the former Laboratory of Physics (now Materials Science and Engineering).
Left: A commemorative plaque now hangs in the Grainger Library.

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Saturday Physics for Everyone celebrates 20 years

This fall, University of Illinois physicists are giving high schoolers and the general public access to some of the strangest and most exciting topics at the leading edge of science today. Quantum mechanics in ultrafast computation, how a subatomic microscope is built, the search for life-sustaining planets in distant solar systems, how the body works at the tiniest, atomic scale, the fact and fiction of our global energy challenge—it's all a part of the 20th season of Saturday Physics for Everyone (SPE) at Loomis Laboratory.

Since 1993, SPE has hosted crowds of anywhere from 100 to 300 participants, with lectures by renowned physicists, including two Nobel laureates.

The talks are aimed at a high-school level of understanding, but deal with leading-edge topics that aren't likely to be taught in a high school classroom. It's a chance for scientists at the front of their fields to instill excitement over science in people of all ages.

Retired research physicist Dr. Inga Karliner said, "All children start out curious about the world and how things work. In our science outreach, we want to nurture this curiosity in children and bring it back for adults."

For the last two decades, participants in these Saturday lectures have learned how physics affects our everyday lives by inspiring modern technology and engineering.

Much of today's technology has come about as a direct result of physics research. Magnetic resonance imaging (MRI) has had a huge impact in a broad range of areas from medicine to national security—our world would not be the same without it. Our ability to capture solar energy likewise developed out of the study of physics. Radiation therapy, used to treat many cancer patients, is a by-product of nuclear physics. And the global positioning system (GPS), used by air traffic controllers, the military, and civilian drivers alike, relies on general relativity.

Assoc. Head for Undergraduate Programs and Professor Kevin Pitts said with the recent call for renewed focus on STEM education to meet a growing demand for professionals in science, technology, engineering and math, Physics Illinois is proud of its longstanding tradition of outreach to K–12 schools across the state.

Pitts said he believes the department has an obligation to taxpayers to inspire young students in Illinois with a love of science, and that is what this program is designed to do: "We have had middle school students come and tour our department and watch demonstrations relating to the kinds of investigations our physicists are working on. When the tour is done, they will ask, 'Is science really this much fun?' They think we're trying to trick them into liking science."

The SPE program has received generous support from Physics Illinois alumni who recognize the value of the department's public outreach activities.

For most of its 20 years, the program ran under the name Saturday Honors Physics Program. The first conceptualization for the program under its very first organizer, now Emeritus Professor David Hertzog, had been to invite high school seniors at the top of their respective science classes.

Hertzog had himself been selected to participate in an invitational honors physics program, the Westinghouse Science Honors Institute, as a high schooler in Pittsburgh, and pictured a similar program at Illinois. But from the very first year, it was clear the Saturday talks had a broader community appeal, and no one was ever excluded.

Karliner helped out in those early days by emailing everyone she knew, contacting local high schools, and putting up flyers in libraries, nursing homes, and restaurants.

"The program was a great success," said Karliner. "From the very beginning, we got participation from the top research people—our Nobel laureates on campus and members of the National Academy of Sciences were generous with their time and gave talks. I am very grateful to Tony Leggett for being a great example—he has given two talks."

Karliner remembers the very first lecture, given by Professor Enrico Gratton: *Looking into the Brain with a Laser*.

"He was using visible light to see inside the body. It was very magical," said Karliner. "With this technique, you could see the human brain inside the skull. I thought it was fascinating."

Karliner said over the years, some speakers have drawn larger crowds than average, for example, Doug Hofstadter, a professor of cognitive science at Indiana University in Bloomington and 1980 Pulitzer prize winner, packed the house for his talk *Is Music Composition More Elusive for Computers?*

"When he came, people came from all over to hear him speak—it was a full room. His book, *Gödel, Escher, Bach: An Eternal Golden Braid*, has a cult following," explained Karliner.

A theme that evolved almost by accident, at least one talk each year has focused on careers for physics degree holders that fall outside of academic research and teaching. For example, lawyer and journalist Amy Gajda gave a talk entitled *Law and Physics*, and theoretical physicist and Champaign ophtalmologist Dr. Samir Sayegh, who works as a doctor and a researcher in Champaign, did a talk entitled *From Blindness to Sight: The Physics of Vision Restoration*.

After Hertzog's success with the program in its first two years, others took over directing it. These include Dr. Inga Karliner and Professors Paul Goldbart, Scott Willenbrock, Mats Selen, Jon Thaler, Kevin Pitts, and Naomi Makins. The name change to Saturday Physics for Everyone came just last year, to recognize that the program has always been a well-received community outreach opportunity.

Karliner said some members of the SPE audience have attended regularly since the very first talks two decades ago:

"We are delighted to see the great interest about the many topics we have presented. People are fascinated and want to know more about black holes and what everything is made of; the weird world of quantum mechanics and its applications in quantum computers; properties of new materials such as liquid crystals and superconductors; new developments in medical visualization that rely on very clever theoretical physics; and the fate of the Universe." ■

Left: Professor Paul Kwiat opens the season to a full house with his talk, *The Quantum Information Revolution.* Above: Professor Matthias Grosse Perdekamp demonstrates the quark structure of the proton. Right: Two volunteers toss a medicine ball to demonstrate the energy momentum transfer between two fundamental particles when they exchange photons.

Above: Professor Paul Selvin demonstrates how cells "burn" fuel: ATP, represented as two balls stuck together, is split in two, releasing energy which is then used by the cell and by "molecular motors." Left: A volunteer is propelled backwards by the force of a fire-extinguisher's spray, demonstrating how an optical trap works to measure how much force a "molecular motor" expends.

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Conference for Undergraduate Women in Physics comes to Illinois

Physics Illinois undergrad Shannon Glavin

The 6th Annual Conference for Undergraduate Women in Physics will take place at six campuses across the nation from January 18th through 20th, 2013. About 175 undergraduate students and scholars are expected to attend this year's Midwest regional conference, hosted by the University of Illinois at Urbana-Champaign, with most talks scheduled in Loomis Laboratory.

A distinguished group of invited speakers will form a career panel, a graduate student panel, and an undergraduate research panel. Other events at the Midwest regional include the liquid nitrogen ice cream social, laboratory tours, and campus tours.

All six locations will share over live video stream this year's keynote speaker, Margaret Murnane, distinguished professor at the University of Colorado Boulder and award-winning physicist for her work with ultrafast lasers.

Murnane is a fellow of the American Physical Society, the Optical Society of America, and the American Association for the Advancement of Science. She was elected to the American Academy of Arts and Sciences in 2006 and the National Academy of Sciences in 2004. She is a recipient of the Boyle Medal, Ireland's highest accolade bestowed on scientists.

Murnane will be presenting from the Rocky Mountain regional location, at the Colorado School of Mines.

> *"Events like this conference help to encourage us and remind us that there are a good number of accomplished female physics students, even if we might sometimes be the only girl in the room."*

Illinois Chancellor Phyllis M. Wise will deliver an address at the banquet. Wise is a fellow of the American Association for the Advancement of Science and a member of the National Academies' Institute of Medicine. Wise maintains an active research program in issues relating to women's health and gender-based biology. She has been particularly interested in whether hormones influence the brains of women and men during development, during adulthood, and during aging.

Physics Illinois undergraduate Shannon Glavin is one of the organizers of the regional conference.

"One of the things that I'm really excited about is our diverse career panel," said Glavin. "A lot of physics students aren't aware of all of the career options they have, since they're mostly just exposed to academic and research careers. Our attendees are going to have a chance to hear about lots of different options for careers."

Glavin said she and the rest of the planning committee are working hard to make sure the conference is a success and are excited to be able to host this important career development and networking opportunity for undergraduate women in physics.

"Although over the past few decades the opportunities for women to pursue careers in physics have greatly improved, the playing field between genders still isn't equal," said Glavin. "Events like this conference help to encourage us and remind us that there are a good number of accomplished female physics students, even if we might sometimes be the only girl in the room."

Glavin also commented on the value of fostering diversity among our nation's top scientists:

"Conferences that promote diversity have the potential to advance the entire field of physics. Whether it's differences in gender, culture, education, or background, having a more diverse group supports more innovative problem solving—and physics is all about problem solving."

Conference sponsors include the American Astronomical Society, the National Science Foundation, the American Physical Society, MacMillan Publishers, the Argonne National Laboratory, the American Association of Physics Teachers, the US Department of Energy's Office of Science, the Society of Physics Students, Airgas, Inc., the Fermi National Accelerator Laboratory, the Universities Research Association, Inc., Eastern Illinois University, Millikin University, and the University of Illinois at Urbana-Champaign.

Among the speakers confirmed at the Midwest regional are

Hannah DeBurg, graduate student in biophysics at Illinois;

Aida El-Khadra, professor of physics at Illinois specializing in high energy physics and leader of one of the most successful collaborations working in lattice field theory in the world;

Pamela Gay, astronomer, podcaster, educator, and science communicator at the STEM Center at Southern Illinois University-Edwardsville, and project director of CosmoQuest, a citizen-science astronomy research group;

Laura Greene, professor of physics at Illinois specializing in the physics of highly correlated electron materials and fellow of the American Physical Society and the American Association for the Advancement of Science, and member of the American Academy of Arts and Sciences and the National Academy of Sciences;

Kawtar Hafidi, Argonne National Laboratory physicist specializing in the experimental study of quantum chromodynamics, winner of the 2011 Innovator Award of the Chicago Chapter of the Association for Women in Science, and the 2010 Outstanding Mentor Award of the US Department of Energy's Office of Science;

Young-Kee Kim, Deputy Director of Fermi National Laboratory, Louis Block Professor of Physics at the University of Chicago specializing in experimental particle physics, and fellow of the American Association for the Advancement of Science and of the American Physical Society;

Arlene Modeste Knowles, career & diversity programs administrator for the American Physical Society's Minority Bridge Program;

Sue Larson, associate professor of civil and environmental engineering at Illinois, specializing in experimental, field, and modeling investigations in air quality, and director of the College of Engineering's Women In Engineering Program;

Naomi Makins, professor of physics at Illinois, specializing in nuclear physics, and analysis coordinator for the HERMES experiment at the Deutsches Elektronen-Synchrotron (DESY) in Hamburg, Germany;

Felicia Martinez, Illinois alumna (BS Physics 2011), currently working in the financial industry in Chicago;

Kathy McCloud, program director for the National Science Foundation's Research Experiences for Undergraduates program;

Joannah Metz, geologist/geophysicist at Shell Oil and Illinois alumna (BS Physics 2004);

Lisa Reed of the Communications, Education and Public Affairs Division of Argonne National Laboratory, who coordinates graduate-student research assistant appointments;

Tierney Smith, physics teacher at Alan B. Shepard High School and Illinois alumna (BS Physics 2005 and M.Ed. 2008);

Emily Sprague, Illinois alumna (dual bachelor's degree in physics and piano performance 2012), currently a graduate student in applied physics at Northwestern University;

Cacey Stevens, University of Chicago graduate student studying soft condensed matter physics;

Lauren McNeil Van Wassenhove, Illinois alumna (BS Physics 2007) and University of Michigan doctoral student researching breast cancer progression; and

Sam Zeller, research scientist at Fermi National Accelerator Laboratory, spokesperson for the MicroBooNE experiment, and analysis coordinator for the MiniBooNE (E898) experiment. ■

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Helium shortage threatens research efforts

A nationwide shortage of helium and sky-high prices for the commodity threaten progress in low-temperature physics and superconductivity research in Urbana. "We're in the middle of a serious crisis," said department head Dale J. Van Harlingen.

Over the past years, shortages and price spikes in the global helium market have had an impact on critical users, including NASA, the Department of Defense, medical facilities that offer MRI, national laboratories, and university research groups, including physicists at the University of Illinois.

Between 2006 and 2010, the cost across the nation of liquid helium doubled from $3–5 per liter to $7–10 per liter, according to a 2010 report by the National Research Council (NCR). As of October 2012, the contract cost of liquid helium in the United States was $10 to 11 per liter, but shortages have led some suppliers to charge up to $26 per liter.

Helium's many uses, including cryogenic applications in science, industry, and government, arise from its unique physical and chemical characteristics (including its stable electronic configuration and low atomic mass):

- second lightest element: gaseous helium is much lighter than air, making it very buoyant;
- chemical inertness: where the alternative, hydrogen (the lightest element) is highly flammable;
- temperatures of phase transitions: helium has the lowest melting and boiling points of any element (It liquefies at 4.2 K and 1 atm and solidifies only at extremelyhigh pressures, 25 atm, and low temperatures, 0.95 K.);
- high thermal conductivity;
- low viscosity; and
- high ionization potential.

Associate Professor Nadya Mason said, "My lab spends about $200,000 per year on helium to run two systems full time for seven students and postdocs, so the cost and supply issues affect us drastically."

The current helium crisis is in large part due to passage of the 1996 Helium Privatization Act that required the Bureau of Land Management (BLM) to sell off federal helium reserves by 2015—with an equal volume of gas to be sold each year, regardless of market demand—at a price sufficient to repay the federal government for its total outlays on the helium program.

Liquid helium is collected in a 1,000-l storage dewar following liquefaction of helium gas in the department's Linde 1410 Helium Liquefier. It takes 26.63 cu. ft. of gas to make 1 l of liquid helium.

Since the reserve supplies about one-half of the domestic helium demand and about one-third of the global demand, the straight-line sale without regard to fair market value has unduly influenced the open market price of helium and has deterred domestic helium extraction from natural gas exploration and production, according to the NCR's 2010 report.

To make matters worse, unless further legislation is passed, once the national helium debt is retired—possibly within the next year—the funding mechanism for operation of the Federal Helium Reserve would expire, and operations would cease.

Since the 60s, helium-using research groups at Illinois have been somewhat protected from short-term shortages and price volatility by the Physics Department's foresight in installing its own helium gas recovery and liquefaction system to recycle the helium gas boiled off from cryostats.

But with recent supply shortages disrupting necessary helium gas deliveries and continued price escalation, our research groups are now feeling the pinch. Research budgets simply don't expand and contract with fluctuations in helium gas prices.

"It's the first time we've really faced a change in how we do things," said Van Harlingen. "And it corresponds to a time when new systems are being designed to use less helium. We're caught in a transition period because we have a lot of old equipment.

"In the last months, we have seen periods where there was just no helium to be bought. At the same time, we've seen a huge spike in cost; if you are already barely paying for your research, and all of a sudden, you're hit with a 30-percent cost increase in an essential material, it's difficult."

The department's liquid helium facility sells about 6,000 liters per month to labs in physics and other campus departments, according to facilities manager Jerry Cook. The current in-house charge is $14 per liter.

Cryogenic technician Ken Roemer, who manages the department's helium liquefaction system, said good stewardship practices—recovery and conservation—are more critical than ever in light of the current helium crisis.

Crude helium gas is stripped from natural gas deposits after these are extracted from mines. As such, helium is a limited resource. When natural gas mining operations do not strip extant helium, it is lost into the atmosphere.

Cook said at present, about half the helium being used in the department's labs is being recovered, purified, and reused. That is a substantial increase from earlier rates, after the department spent about $50,000 in 2007 to tighten up its recovery system and repair 55 leaks.

Less gas is being recovered from labs in outside departments, and plans are in place to install recovery systems where practicable.

"We are working with the chemistry department, installing recovery lines. That's a half mile to three-quarters of a mile away," said Cook. "With more efficiency, we could get another two weeks on our trailers between deliveries."

"We offer the labs a rebate of 33 cents per cubic foot of recovered gas," said Roemer. "The machine takes the dirty gas and runs it through purification. First, water, oil, and solids are removed in the

Price fluctuations and shortages affect all helium users, but where industrial, biomedical, and larger national-security-related users have some ability to respond, smaller research groups at universities are harder pressed. Several research groups at Physics Illinois rely on the availability of helium for cryogenics, including those led by Professors Nadya Mason, Alexey Bezryadin, Raffi Budakian, and Dale Van Harlingen:

Mason's research group studies the behavior of specialized materials—carbon nanotubes, graphene, nanostructured superconducting materials, and topological insulators—at very low temperatures. The group is particularly interested in the effects of reduced dimensionality and correlations on electron coherence. The understanding and control of electronic coherence is relevant to a variety of systems, including quantum communication, information storage, and qubit control for quantum information processing. The team's work also has ramifications for elucidating high-temperature superconductivity.

Bezryadin and his students study quantum phenomena in one-dimensional superconducting systems. This team has fabricated superconducting nanowires by using individual carbon nanotubes or individual strands of DNA as substrate templates and sputtering these with layers of superconducting materials. The group studies the movement of single electrons through the nanowires (probably the thinnest superconductors ever measured) and attempts to understand the nature of the superconductor-insulator transition found in such samples.

Budakian and his students have achieved high-resolution magnetic resonance force microscopy by using a highly sensitive silicon nanowire mechanical oscillator as a low-temperature NMR force sensor. Budakian's research group can now perform 3D nanometer-scale magnetic resonance imaging with 10-nm resolution, far more sensitive than the millimeter resolution of medical MRI. Ultimately, with further refinements to this technology, 3D imaging of single molecules could become a possibility.

The experiments of Van Harlingen's group are aimed at better understanding the superconducting properties of exotic materials and at determining complex order parameters of subdominant superconductive phase transitions. Recent work is directed toward the understanding of decoherence in superconducting qubits for quantum computing and the search for novel excitations in the newly-discovered topological insulator and topological superconductor materials.

Helium's main commercial application is in MRI scanners; it is also used as a pressurizing and purge gas for rockets, to make magnets for wind turbines, as a protective gas in arc welding, and for growing crystals used to make microchips and fiber optic cables. NASA and the Department of Defense (DOD) use helium to purge and pressurize the tanks and propulsion systems of rockets fueled by liquid hydrogen and oxygen and for various research and development programs funded by these agencies. The DOD also uses helium for balloon- and dirigible-based surveillance systems employed for national security.

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THE FEDERAL HELIUM RESERVE

The Federal Helium Reserve is the number one supplier of helium worldwide today. Its operations are slated for shut down as soon as its $1.3 billion debt is paid down, possibly within the next six to twelve months.

Shortly after US sources of helium were discovered early in the last century, the government recognized helium's potential importance to national interests, particularly for use in dirigible air transport during World War I. In 1925, Congress created a Federal Helium Program that placed production and availability from federally owned mineral interests under strict control. The Bureau of Mines—the predecessor of the Bureau of Land Management (BLM)—was commissioned with the task of constructing and operating a large helium extraction and purification plant that went into operation in 1929.

The Federal Helium Reserve comprises a naturally occurring rock dome near Amarillo, TX, called the Bush Dome Reservoir, an extensive helium pipeline system running through Kansas, Oklahoma and Texas that connects crude helium extraction plants with each other, with helium refining facilities, and with the Bush Dome Reservoir, and various wells, pumps, and related equipment used to pressurize the Bush Dome Reservoir.

Until 1960, the US Government was the only domestic producer of helium. During and after World War II, helium demand increased, and in 1960, Congress passed amendments to the Helium Act, providing incentives to private natural gas producers to strip helium from natural gas and sell it to the government; the amendments required that any debts incurred in helium collection be repaid with funds from the sale of the helium. As a result of these procurement efforts, debt mounted.

By the 1990s, it was clear that federal demand for the gas would not match supply, and Congress passed **the 1996 Helium Privatization Act** requiring the BLM to sell off the reserve to pay down its $1.3 billion debt by 2015.

The National Research Council (NRC) was commissioned to monitor the effects of the sell-off on the helium market. A report issued in 2000 by the NRC found no substantial impact of the sell-off on helium users, based on the then-stable market. The NCR's 2010 report reversed those earlier findings, pointing out that the earlier report failed to address the effects of the mandated sell-off on helium availability or on crude helium prices and also failed to predict the eventual growth in demand from an expanding market in Europe.

The report states, "In response to its charge, the committee finds that selling off the helium reserve, as required by the 1996 Act, has adversely affected critical users of helium and is not in the best interest of US taxpayers or the country."

The 2010 report suggests that a market-based pricing system would encourage new exploration and production of helium, ease current market tensions caused by BLM's helium pricing mechanism, and accelerate payoff of the reserve's debt. It re-evaluates the policies behind the Act that call for the sale of all federally owned helium on a straight-line basis. And it recommends BLM look into the feasibility of extending the Helium Pipeline to other fields with deposits of helium to prolong the productive life of the government's reserve and refining facilities.

The report further urges the federal government to provide financial support to federal agencies and researchers at universities and national laboratories to acquire helium liquefaction systems and gaseous recovery systems to reduce consumption.

The 2010 report also notes that the Middle East and Russia are poised to become the next big suppliers of helium; the United States is likely to be a net importer by the year 2025.

The bipartisan Helium Stewardship Act of 2012, introduced last April by Senators Jeff Bingaman (D-NM) and John Barrasso (R-WY) with co-sponsors Ron Wyden (D-OR) and Mike Enzi (R-WY), draws on recommendations from private helium refiners, retailers, end users, BLM officials, and the National Academy of Sciences.

If enacted, it would change the current sales structure in favor of market-based pricing, to remove current market distortions. It lays out a responsible resource management strategy for the reserve by securing long-term access to BLM crude helium for all Federal users; authorizing continued operation of the Reserve beyond January 1, 2015, on which existing authorizations expire; ensuring remaining helium is managed and sold off responsibly by selling BLM crude helium at prices that recover fair market value for taxpayers; and stimulating development of private sources of helium by adopting market-based prices for BLM helium sales, thus encouraging helium extraction from natural gas exploration and production.

The 2012 helium bill doesn't authorize any new appropriations.

The bill was sent to the Committee on Energy and Natural Resources, which heard testimony on the matter in May. In September, Senator Charles Schumer (D-NY) publicly promised to push the legislation forward.

The first helium airship flight, December 1, 1921. Helium is popularly known for its buoyant properties, though its usage as a lifting gas accounts for the smallest portion of its use.

recovery compressor; then in the liquefier, everything but the helium freezes on a mesh, and this isolates the helium, which is liquefied. The liquid helium is stored in a large 1,000-liter dewar then transferred to smaller storage dewars—we have 35-liter and 60-liter sizes—for distribution to the labs."

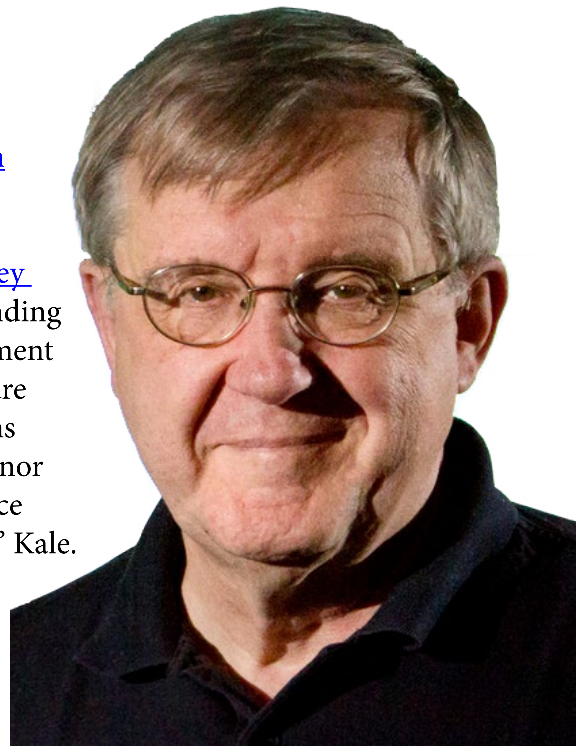
Pushing that in-house recovery rate higher is an urgent goal, and Cook would like to see it as high as 90 percent.

This would reduce helium purchases and would make the department less dependent on external pricing, said Cook.

To that end, Cook has done extensive research on how to improve the rate of recovery, collaborating with cryogenic specialists at similar university facilities in other states.

"Some suggestions for improvement include more efficient meter monitoring for earlier detection and isolation of leaks, slower transfer of gas from dewars to minimize burn off, lining up experiments back to back to minimize usage, and installing booster pumps and auxiliary bags in remote locations to better capture the gas," said Cook. ■

Schulten shares IEEE Computer Society's 2012 Sidney Fernbach Award



Professor Klaus Schulten was selected to receive the prestigious 2012 IEEE Computer Society Sidney Fernbach Award, "for outstanding contributions to the development of widely used parallel software for large biomolecular systems simulation." He shares the honor with Illinois Computer Science Professor Laxmikant "Sanjay" Kale.

The award was established in 1992 in memory of high-performance computing pioneer Sidney Fernbach to recognize outstanding contributions in the application of high-performance computers using innovative approaches.

Schulten is a Swanlund Professor of Physics, directs the Center for Biomolecular Modeling at the Beckman Institute, and co-directs the Center for the Physics of Living Cells in the Department of Physics.

Schulten's research, focused on molecular assembly and cooperation in biological cells, requires large-scale computing. He was the first to demonstrate that parallel computers can be practically employed to solve the classical many-body problem in biomolecular modeling. Thousands of researchers worldwide use his group's software in molecular graphics (VMD) and modeling (NAMD) on personal computers as well as at the world's leading supercomputing centers.

Schulten's group is presently developing a new computational method to assists biologists in solving the structures of the very large macromolecular complexes that form the machinery of living cells.

Schulten holds a *Diplom* degree in physics from the University of Münster, Germany, and a PhD in chemical physics from Harvard University. He was junior group leader at the Max Planck Institute for Biophysical Chemistry from 1974 to 1980 and professor of theoretical physics at the Technical University of Munich from 1980 to 1988, before joining Illinois.

Schulten and Kale accepted the award at the keynote session at SC12 in Salt Lake City on November 13. ■

APS Undergraduate Education Award

Last April, the [American Physical Society] announced the Department of Physics at Illinois was among four programs in the nation selected to receive the inaugural 2012 [Award for Improving Undergraduate Physics Education].

Administered by the APS Committee on Education, the award recognizes programs that demonstrate a commitment to inclusive, high-quality undergraduate education in physics. Recipients are acknowledged for a three-year period.

The exceptional quality of the Physics Illinois undergraduate curriculum and teaching methodologies is the result of almost 15 years of concerted effort by the department's faculty to reform the introductory level courses based on proven research findings. Almost a decade ago, a physics education research group was formed at Illinois and this team's leadership was instrumental in the successful research, development, and implementation of the new teaching model.

The overhaul of the Physics Illinois undergraduate program included a massive curriculum revision of the algebra-based Physics 101–102 series and the calculus-based Physics 211–214 series. The courses now leverage multi-media technologies to provide a better learning environment inside and outside the classroom. Online pre-lecture preparations have proven a very successful aid to conceptual understanding. In class, peer instruction and active learning segments are enhanced by the use of a wireless student response system, the i>clicker, developed at Physics Illinois.

The introduction of Physics 100, a new preparatory course,

represents another major effort to improve the success of undergraduates in physics. This course is designed to provide the foundation needed to do well in the introductory courses. It is aimed at retaining students who have inadequate high school preparation and encouraging minority student participation in STEM fields.

A new comprehensive TA training program was implemented in conjunction with the course revisions, to introduce the new pedagogy to graduate student TAs, who play a vital role in course lectures, facilitating active learning segments.

Professor [Jose Mestre], who specializes in education research, contributed to the design of studies that tested new teaching models before they were developed and implemented under the leadership of Professors [Gary Gladding], [Mats Selen], and [Timothy Stelzer].

"It's been a long effort," said Mestre. "Each year something new gets tweaked and gets better."

Mestre said all changes to the courses have been based on sound research proven not only to improve students' overall understanding of curriculum, but also to contribute to a greater sense of satisfaction from students and teachers alike.

"Students are learning more with less time spent in class and they are much happier with the courses now than they were a few years ago, which is an added bonus," said Mestre.

Department Head and Professor [Dale Van Harlingen] said, "Teaching is very important to us, and we've devoted a good deal of time and resources over the course of many years to improving our undergraduate physics courses. We have in a sense revolutionized the way that physics is taught at this level. This award from the American Physical Society is an honor well-deserved by our physics education research group and by all faculty members who contributed to improving our undergraduate program. Our innovations in teaching certainly place us among the very best undergraduate programs in physics worldwide."

The award letter reads:

All members of the Department of Physics at the University of Illinois, from the greenest assistant professor or teaching assistant to the most distinguished senior researcher, demonstrate their commitment to undergraduate education every day. In the last 15 years, they have collectively and completely recreated the way undergraduate physics courses are taught—to almost 9,000 students per year—by rethinking curricular content, redesigning labs, remodeling classrooms, incorporating innovative educational technologies, and drawing on the results of their nationally recognized physics education research group. The renaissance in undergraduate teaching begun in 1995 at Illinois has involved more than 90 percent of the faculty and has transformed both the introductory classes taken by science and engineering students and the advanced classes and laboratories taken by physics majors. An innovative, integrated model for physics teaching has been created that develops higher-order thinking competencies, promotes collaborative problem-solving, and improves communication and leadership skills. The Illinois approach benefits not only the undergraduate students who take their classes, but it also gives their graduate teaching assistants excellent training in best practices. ■

DeMarco awarded 2012 COE Dean's Award for Excellence in Research

Associate Professor of Physics [Brian DeMarco] received a 2012 College of Engineering [Dean's Award for Excellence in Research]. The award, formerly called the Xerox Award for Senior Faculty Research, is presented annually to outstanding young faculty in the College of Engineering at Illinois for extraordinary research accomplishments. DeMarco was recognized for his ground-breaking work on the behavior of ultracold atoms confined in atomic lattices to simulate the quantum behavior of condensed matter systems. He was presented with the award on Monday, April 23, 2012.

DeMarco received his bachelor's degree in physics with a mathematics minor from the State University of New York at Geneseo in 1996, graduating *summa cum laude*. He earned a doctorate in physics from the University of Colorado Boulder (2001), where he extended magnetic trapping and evaporative cooling techniques used to produce Bose–Einstein condensates to create the first quantum degenerate Fermi gas of atoms. His achievement was ranked as one of the top ten scientific discoveries in 1999 by *Science*.

After serving as a postdoc at the National Institute of Standards and Technology in David Wineland's group at Boulder, where he developed improved quantum logic elements and used trapped ions to scale up quantum information processing systems, DeMarco joined the Department of Physics at Illinois in 2003.

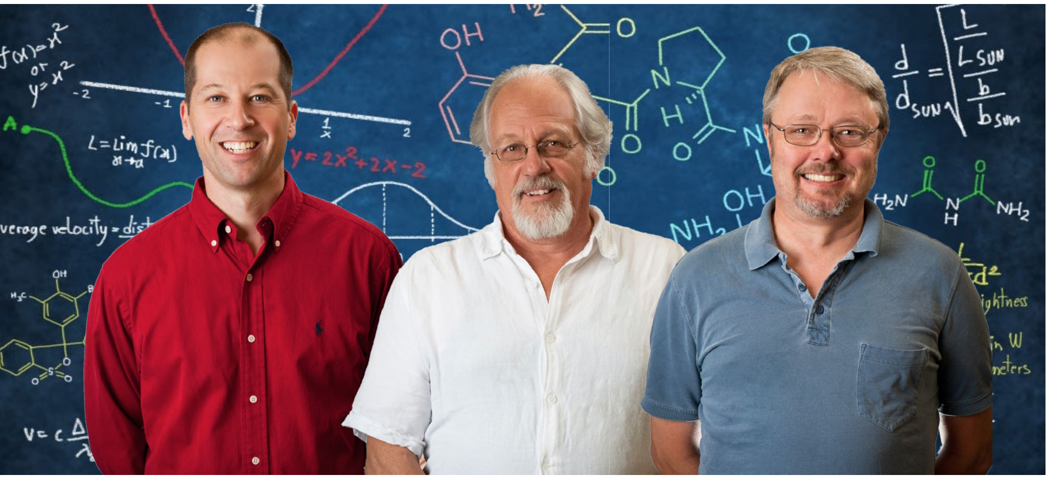
Exploiting the experience he gained on two different quantum systems as a graduate student and postdoc, DeMarco embarked on a bold and aggressive research program to create a laboratory-scale "quantum simulator," using ultracold atom gases trapped in a lattice created by intersecting laser beams.

"Brian's pioneering work has opened a whole new world of opportunities for elucidating the quantum behavior of a wide range of many-body systems that are intractable to even supercomputer modeling—opportunities that many researchers worldwide are just starting to recognize," said Department Head and Professor Dale Van Harlingen. "Brian is at the forefront of this emerging field."

DeMarco and his students made headlines last fall when they were the first to demonstrate three-dimensional Anderson localization of quantum matter waves. Understanding the mechanism of Anderson localization—the cessation of the propagation of waves in a disordered medium—is critical to understanding the effects of impurities and defects in three-dimensional conduction. DeMarco's work thus has important implications for understanding the behavior of ultrasonic waves used in medical imaging, photonic effects in materials, and electron transport in semiconductors and superconductors. ■

Stelzer, Gladding, and Selen win APS's 2013 Excellence in Physics Education Award

smartPhysics methodology and curriculum improve conceptual learning and higher-order thinking



Pictured left to right are Assoc. Professor Timothy Stelzer, Professor Emeritus Gary Gladding, and Professor Mats Selen, co-developers of smartPhysics.

In recognition of their sustained commitment to excellence in physics education, Professors Gary Gladding, Mats Selen, and Tim Stelzer were selected by the American Physical Society to receive the 2013 Excellence in Physics Education Award.

The award citation reads:

For the creative application of physics education research results with components of modern technology to create a new pedagogy for an introductory physics curriculum that substantially changes the roles of the instructors and students and, as measured through research, provides significant and nationally recognized learning benefits.

About five years ago, Gladding, Selen and Stelzer developed smartPhysics, a new learning environment for the first year of introductory calculus-based physics (Physics 211 and Physics 212). And while the foundational subject matter of the introductory courses remains primarily the same, the way this content is introduced and explored with students results in a whole new learning experience.

The smartPhysics curriculum is delivered in three integrated and interactive phases: first, fifteen-minute web-based animated PreLectures introduce students to base content prior to class; then, lecture content is guided by assessments of students' understanding of the introductory material; and finally, an online homework system delivers interactive tutorials and immediate assessments.

"Our most valuable time with our students is the time when we are face to face," said Stelzer. "By providing content in an easily accessible format before the lecture, we can spend more time on activities that actually apply that new knowledge in class."

The demonstrated results of the team's new pedagogical approach include improved overall student comprehension, coupled with a greater sense of enjoyment in learning physics. This in turn directly correlates to higher student retention and an expressed improvement in instructor satisfaction.

The lectures have been transformed to promote instructor-student interaction by incorporating peer instruction and active learning segments. These activities are enhanced by the use of a wireless student response system, the i>clicker, that was jointly invented and developed by Gladding, Selen, Stelzer, and graduate student Benny Brown, and is now in use by over 2 million students at more than 900 institutions.

University of Washington Physics Professor David Hertzog said, "What Gary, Mats, and Tim have done is modernize the delivery of Introductory Physics in a way that just works with today's students. Our department at UW has committed to smartPhysics. It's clever, relevant, accurate, and fun. From an instructor's perspective, it's a delight—I've been re-energized in teaching these materials."

Gladding attributes the success of the smartPhysics project to the long-term commitment of Physics Illinois to continually refining its course offerings.

"This award is an outgrowth of the departmental effort begun almost 15 years ago to improve the instruction in the introductory calculus-based courses," said Gladding. "This project was later extended to improving the introductory algebra-based courses, as well. The success of the project can be attributed to the hard work of many faculty members and the introduction of materials and methods inspired by physics education research."

Boston University Professor David Campbell said, "I was absolutely delighted when I learned that my long-time Illinois physics colleagues Mats, Gary, and Tim had won the 2013 APS Physics Education Award. This is the culmination of an effort begun nearly two decades ago—in 1995, to be precise, when I was head of the department—with the "reform" of our major introductory physics courses. In an article Celia Elliott, Gary, and I wrote about this for the APS Forum on Education Newsletter, we called this 'parallel parking an aircraft carrier,' because we had to make the changes in real time with 2,500 students a semester passing through our courses.

"Importantly, the reform was not a one-shot effort but became a process of continuous improvement which led to the development of the outstanding physics education research (PER) group that now exists in Urbana. They are certainly among the best—my Urbana loyalty leads me to say they are the best—of the PER groups in the country and thus are very deserving of this recognition."

Gladding, Selen and Stelzer currently devote the bulk of their research time to projects in the PER group.

Not content to rest on their laurels, the team has embarked on two new projects this year. First, along with Professor Jose Mestre, the team has begun a project aimed at improving the retention of students with majors in the sciences and engineering. The ultimate goal of this project is to develop two online tools, first a diagnostic tool that can provide an accurate assessment of each student's understanding prior to an exam, and eventually an intelligent tutoring tool that can help students address their areas of weakness.

The second project the team has begun work on is the development and evaluation of an inexpensive hand-held wireless device, called IOLab, that integrates a large collection of sensors (accelerometer, magnetometer, gyroscope, barometer, thermometer, force probe, light intensity, speaker, microphone, EKG, and more) with an online content delivery system, to enable students to explore many key introductory physics concepts on their own. At a unit cost of about $40, the device will also provide a hands-on laboratory experience for online learners and students at underfunded public schools.

The Excellence In Education Award will be presented to the team at a special ceremonial session during the April APS meeting in Denver. ■

Physics students use the i>clicker during an active learning segment in a lecture included in the smartPhysics learning environment.

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MS would like to acknowledge the continued support and encouragement of the Research Corporation for Science Advancement.

Pines Honored by AAPT

The American Association of Physics Teachers (AAPT) has selected Professor Emeritus David Pines for the 2013 John David Jackson Excellence in Graduate Physics Education Award.

This prestigious award will be presented to Pines at a Ceremonial Session of the 2013 AAPT Winter Meeting in New Orleans. Pines was selected to receive the Jackson Award in recognition of his authorship of *The Many Body-Problem* and *Elementary Excitations in Solids,* and the two-volume text/monograph, *The Theory of Quantum Liquids*, written with Philippe Nozières.

These publications served to define and describe significant sub-fields of physics. Additionally, Pines is recognized as the founder of the innovative series, *Frontiers in Physics*, containing over 100 volumes, for which he has served as editor since its inception in 1961. The series has been a significant source of knowledge and inspiration for graduate students in all fields of physics. To quote from the Editor's Foreword: "The series has made it possible for leading physicists to communicate in coherent fashion their views of recent developments in the most exciting and active fields of physics—without having to devote the time and energy required to prepare a formal review or monograph."

Pines said, "I am most pleased to receive this quite unexpected honor and recognition and very much look forward to attending the AAPT Winter 2013 meeting in New Orleans and giving the award lecture, not least because David Jackson is a former colleague and friend of long standing."

Pines is distinguished research professor at UC Davis, research professor of physics and professor emeritus of physics and electrical and computer engineering in the Center for Advanced Study at Illinois, and retired last year as the founding director of the Institute for Complex Adaptive Matter, a global partnership connecting scientists who study emergent behavior in matter in its 71 branches representing 111 institutions.

The award recognizes physicists and physics educators who have made outstanding contributions to curriculum development, mentorship, or classroom teaching in graduate physics education. ■

Eckstein shares Matthias Prize

Professor James N. Eckstein was awarded the 2012 Bernd T. Matthias Prize, a triennial award that recognizes innovative contributions to the material aspects of superconductivity. Eckstein shared the 2012 Prize with colleagues Ivan Božović and Dirk Johrendt. Eckstein was cited for his "pioneering and sustained contributions to the novel synthesis and engineering of superconducting materials."

A distinguished condensed matter experimentalist, Eckstein is best known for his technical expertise in creating high-quality oxide thin films to study fundamental physical properties of cuprate superconductors and magnetic materials. His pioneering development of atomic layer-by-layer molecular beam epitaxy (MBE) has enabled research on complex materials and atomic scale heterojunctions with new levels of precision and sophistication.

His group has developed some of the best planar tunnel junctions ever made using single crystal oxide barrier and superconductor layers. These have revealed unusual behavior of the superconducting state in these materials at ordered interfaces. His work has also been central to research on superconductors using measurements of angle-resolved photoemission and terahertz conductivity.

Most recently, Eckstein has employed MBE, as well as nanoscale lithography and advanced etching methods, to create Josephson devices based on single-crystal superconducting heterostructures aimed at reducing decoherence in superconducting qubits by reducing material defects. His group is also studying novel two-dimensional systems that couple superconducting electrodes separated by topological insulators. Such materials are of great technological importance as potential decoherence-protected qubits for quantum information processing.

Eckstein received his bachelor's degree in physics from St. Olaf College in Northfield, MN, in 1973, and his doctorate in physics from Stanford University in 1978. He joined the department as a professor in 1997. He is a fellow of the American Physical Society and the holder of six US patents.

The Bernd T. Matthias Prize is sponsored by the Texas Center for Superconductivity at the University of Houston. The award was presented to Eckstein at the Materials and Mechanisms of Superconductivity Conference, July 29–August 3, in Washington DC. ■

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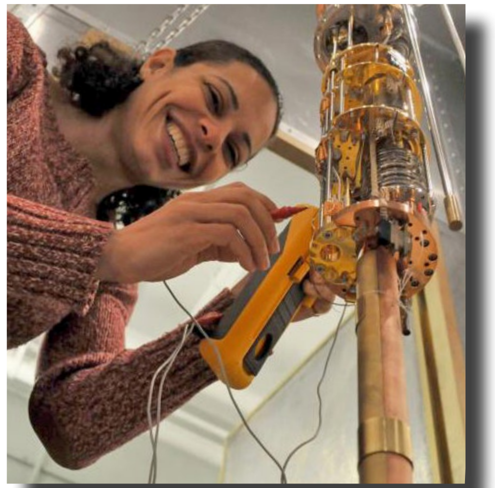


Nadya Mason adjusts a cryostat in her laboratory in the Frederick Seitz Materials Research Laboratory. Photo by Ivan Petrov

Mason receives APS's Maria Goeppert Mayer Award

Associate Professor Nadya Mason was awarded the American Physical Society's 2012 Maria Goeppert Mayer Award. The citation reads:

For innovative experiments that elucidate the electronic interactions and correlations in low-dimensional systems, in particular the use of local gates and tunnel probes to control and measure the electronic states in carbon nanotubes and graphene.

"Nadya is a remarkable young experimentalist who works at the intersection of complex materials, superconductivity, and nanotechnology," said Department Head and Professor Dale Van Harlingen. "She has superb technical skills and excellent taste in selecting important and timely problems and has already made pioneering contributions to the physics and electronic properties of carbon nanotubes and transport in low-dimensional systems at the quantum limit."

Mason earned a bachelor's degree in physics from Harvard University in 1995 and a doctorate in physics from Stanford University in 2001. She returned to Harvard for postdoctoral training, where she was elected a Junior Fellow in the Harvard Society of Fellows. She joined the faculty at Illinois in 2005.

Her achievements have previously been recognized by a National Science Foundation CAREER Award (2007), a Woodrow Wilson Fellowship (2008), the Denice Denton Emerging Leader Award of the Anita Borg Institute (2009), and a fellowship in the UI Center for Advanced Study (2011).

The Maria Goeppert Mayer Award recognizes outstanding achievement by a woman physicist in the early years of her career. In addition to a cash prize, the Award provides travel support for the recipient to present a series of public lectures in the spirit of Maria Goeppert Mayer, recipient of the 1963 Nobel Prize in Physics for her development of a mathematical model describing the nuclear shell structure of the atomic nucleus. Goeppert Mayer was the second woman to win the Nobel Prize in Physics, after Marie Curie.

Mason received her award at a special session of the American Physical Society's annual meeting in Boston in March 2012. ■

Chemla and Neubauer Named CAS Fellows


Asst. Professor Mark Neubauer


Asst. Professor Yann Chemla

Assistant Professors Yann R. Chemla and Mark S. Neubauer were appointed fellows in the Center for Advanced Study (CAS) for 2012-13.

Fellows are selected by the permanent faculty of the CAS in an annual competition. CAS director Leon Dash said , "The Center for Advanced Study supports the extraordinary human and physical resources of the University of Illinois by encouraging and promoting exemplary scholarship in all areas of knowledge. One of the primary missions of the Center is to identify the very best scholars at the University."

The fellows are provided with one semester's teaching release to pursue groundbreaking research activities.

During his fellowship appointment, Chemla is exploiting the capabilities of a unique instrument that he developed, which combines high-resolution optical trapping with single-molecule fluorescence microscopy to study the molecular "nanomachines" involved in genome maintenance.

Neubauer is using his fellowship appointment to launch a new computing facility at the University of Illinois to process and analyze the massive datasets obtained by the ATLAS experiment at the Large Hadron Collider. He is also working on detector commissioning and development of a fast hardware tracker (FTK) for ATLAS. ■

Vishveshwara Receives Fellowship in Theoretical Physics


Assoc. Professor Smitha Vishveshwara

Associate Professor Smitha Vishveshwara was awarded an inaugural Simons Foundation Fellowship in Theoretical Physics for the 2012–13 academic year. The Simons Foundation is a private organization with the primary mission of advancing the frontiers of research in mathematics and the physical sciences.

The 27 scholars chosen in this first-ever nationwide competition were selected by rigorous peer review on the basis of their proposed research plan.

A condensed matter theorist, Vishveshwara is using the fellowship to study topological aspects and quantum dynamics of strongly correlated systems. She has previously made pioneering contributions to our understanding of the quantum-mechanical behavior of both solid-state materials and cold atomic gases. ■

El-Khadra and Makins elected APS Fellows

Professors Aida El-Khadra and Naomi Makins were elected Fellows of the American Physical Society. They are joined in the 2011 class by Physics Illinois alumni Jean-Philippe Ansermet (Ecole Polytechnique Federale de Lausanne), Nicholas Curro (UC Davis), Donald J. Holmgren (Fermilab), Patrick T. Lukens (Fermilab), Jonathan L. Machta (U. Massachusetts, Amherst), and Eric Weeks (Emory University).

The citation for El-Khadra reads: *For contributions to lattice QCD and flavor physics including pioneering studies of heavy quarks on the lattice, semileptonic and leptonic heavy-light meson decays, the strong coupling constant, and quark masses.*


Professor Aida El-Khadra

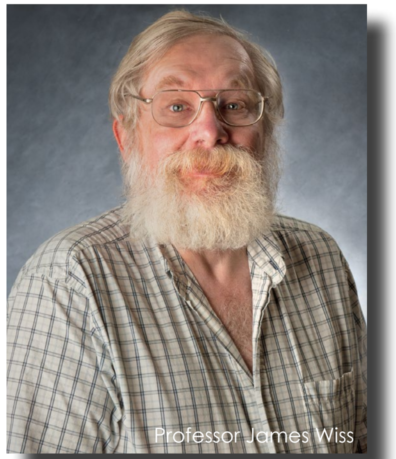

Professor Naomi Makins

El-Khadra was nominated by APS's Division of Particles and Fields.

The citation for Makins reads: *For her contributions to our understanding of the transverse quark structure of the nucleon through the study of polarized semi-inclusive deep-inelastic lepton scattering.*

Makins was nominated by APS's Division of Nuclear Physics. ■

Wiss selected for Nordsieck Physics Award


Professor James Wiss

Professor James Wiss has been selected to receive the Arnold T. Nordsieck Physics Award for Teaching Excellence for the 2011–12 academic year, for his "patient, insightful, and inspiring physics teaching, one problem at a time, that encourages undergraduate students to take their understanding to a new level."

Wiss said his teaching style is inspired by the excellent teachers he learned from in high school and university (at Illinois): "I try to convey the excitement of the physics of the course I am teaching, engage the class with questions during the lecture, and give them relevant and instructive homework problems to solidify their understanding."

Wiss regularly appears on the Incomplete List, a registry of teachers ranked as excellent by their students, compiled by the University's Center for Teaching Excellence.

Department Head and Professor Dale Van Harlingen said, "The enthusiastic comments of the students who have benefited from Professor Wiss's office-hours tutorials attest to the success of his methods and the abiding influence he has had on our students."

The Nordsiek Award is made possible by a memorial endowment from the family of distinguished Professor Arnold T. Nordsieck (1911–1971), a theorist in the mathematics of computation at Illinois from 1947 to 1961. Among his many contributions, Nordsieck built the first computer to be used at Lawrence Livermore National Laboratory, the differential analyzer. This innovative analog computer was assembled in Urbana in 1950 from $700 worth of surplus World War II supplies and is today on display at the Computer History Museum in Mountain View, California. ■

Gardner recognized for distinguished service

Alumnus John Arvy Gardner, Jr., (MS 1963, PhD 1966) was presented the College of Engineering Alumni Award for Distinguished Service at a ceremony held April 21, 2012, "for bringing the world of science and mathematics to the blind through pioneering technologies that allow visually impaired scientists to read formerly inaccessible materials."

Gardner is a distinguished scientist and professor emeritus of physics at Oregon State University and is founder and CTO of ViewPlus Technologies, Inc., in Corvallis, OR.

He is an expert in materials science and has made important contributions to the development of perturbed-angle-correlation spectroscopy and time-differential perturbed-angle correlation spectroscopy. Known for research on the properties and processing of materials at elevated temperatures, he has frequently published on the microscopic structure of materials using nuclear hyperfine methods and developed experimental methods employing perturbed-angle-correlation spectroscopy, Mössbauer spectroscopy, NMR, nuclear quadrupolar resonance, and magnetic susceptibility.

At the age of 48, Gardner lost his eyesight, leading him to develop creative new tools and techniques to access data and carry on his ambitious research program. While a professor of physics and an investigator in the Center for Advanced Materials Research at Oregon State, Gardner founded its acclaimed Science Access Project, which created assistive technologies for visually impaired students. In 1996, he founded ViewPlus Technologies, now recognized as a world leader in the development of assistive technology for people with sensory and learning disabilities.

Gardner has worked proactively with industry to make new technologies accessible to the blind. He was a leader in the national effort that forced Microsoft to incorporate accessibility features in their operating systems, allowing users to employ assistive software and hardware with Microsoft applications. He also worked with Hewlett Packard's Specialty Printing Systems group to incorporate HP inkjet technology into ViewPlus's new ink and Braille products, the Pro Ink Attachment and Emprint Color Tactile Printer.

In addition, Gardner has contributed significantly to the development of MathML, which has become the underlying language for scientific notation and publications on the Web, and to DotsPlus Braille, a two-dimensional Braille that expresses complex mathematical equations in a format similar to standard print math notation. Other innovations include a graphing calculator augmented with audio and tactile feedback that operates on a flexible Windows platform; the Tiger Braille printer, which embosses tactile text and graphics onto standard Braille paper and plastic media; and the IVEO Tactile-Audio System, a hands-on learning system incorporating touch-screen technology. Gardner's collaboration with the American Physical Society, a leader in using accessible markup languages for publishing, will make text, math, and figures in APS online journals accessible to people with visual or other print disabilities.

Gardner has a long history of collaboration with the Division of Resources and Education Services at Illinois. He has served as a colloquium speaker for physics and has addressed the campus working group on accessibility in the Office of the Chief Information Officer. ■

Physics Illinois alumnus Charles Henry (right) with his doctoral advisor, Professor Emeritus Charles Slichter, at the Engineering at Illinois Hall of Fame Ceremony.

Charles Henry, Hall of Famer

Physics Illinois alumnus Charles H. Henry (PhD 1965) was inducted into the Engineering at Illinois Hall of Fame in a ceremony held Friday, September 14, 2012, at the Beckman Institute for Science and Technology in Urbana.

Henry attended with his wife, Helene Henry. Professor Charles Slichter, Henry's doctoral advisor, was also present to see his student immortalized.

Henry was among eight distinguished alumni of the College who were honored for their significant achievements in leadership, entrepreneurship, and innovation of great impact to society.

After graduating from Physics Illinois, Henry spent his entire professional career working in the Physics Research Division at Bell Laboratories in Murray Hill, New Jersey. Over the course of his 32 years as a leading researcher, his many discoveries, observations, and theories truly revolutionized the field of optoelectronics.

Henry is a condensed matter physicist best known for his invention of the quantum well laser, the device that made possible modern optical communications. It was near the end of 1972 when his "greatest idea as a physicist" first occurred to him:

"In the early 70s when I had the sudden realization that the quantum well could be a greatly improved semiconductor laser, I sensed that it was an important fundamental advance in semiconductor laser technology," said Henry. "I am proud that this potential has been realized in the development of lasers and devices used in many fields today that have transformed our lives."

The 1976 patent for the quantum well laser is one of 28 patents Henry holds. Throughout his career, Henry worked at the forefront of semiconductor-based optical technologies and science—LEDs, semiconductor lasers, and integrated optical circuits. He is known as a great inventor as well as a great theorist.

. . .his career involved a rich succession of important contributions to science and technology. . .

In addition to his seminal work on quantum wells and the quantum well laser, Henry established the "alpha parameter" to explain the behavior of semiconductor lasers and initiated a new optical integrated circuit technology that enabled optical routers and multiplexing.

Henry is a recipient of the 1999 IEEE Jack A. Morton Award, the 1999 Charles Hard Townes Award of the Optical Society of America, and the 2001–2002 Prize for Industrial Applications of Physics of the American Institute of Physics. In 2001, he received an Alumni Award for Distinguished Service from Engineering at Illinois.

Henry said the news that he would be inducted into the College of Engineering Hall of Fame 2012 came as a very pleasant surprise.

"I am deeply honored that my work will be remembered in this way," said Henry.

Slichter said Henry was an extraordinary student, one of the most talented he had ever known.

"The citation for his award mentions his most important scientific/technical contributions, in my opinion, but his career involved a rich succession of important contributions to science and technology that are only hinted at in the award," said Slichter. ■

Koster wins AGS & RHIC Thesis Award

Alumnus John Koster (PhD 2010) shared the 2012 Relativistic Heavy Ion Collider & Alternating Gradient Synchrotron Thesis Award with Len K. Eun of the Lawrence Berkeley National Laboratory. The researchers were recognized for their outstanding research conducted at the accelerator facilities at Brookhaven National Laboratory (BNL).

The award was presented by BNL's Steve Vigdor, associate laboratory director for nuclear and particle physics, at the RHIC & AGS Annual Users' Meeting in June. Each honoree received a certificate and a check for $3,000 and presented their findings at the users' meeting.

Koster (now employed by the Japanese Institute for Physical and Chemical Research, RIKEN, in Wako, Japan) was recognized for his work as a postdoctoral researcher at BNL on spin asymmetries in polarized proton-proton collisions, as well as for the development of two compact electromagnetic calorimeters for the PHENIX detector at RHIC.

Koster developed two compact forward electromagnetic calorimeters for measurements of spin asymmetries at small scattering angles in polarized proton-proton scattering at RHIC.

Koster carried out his thesis research at Physics Illinois, working with his adviser Professor Matthias Grosse Perdekamp and in collaboration with Illinois physics researcher Mickey Chiu (now a physicist at BNL).

Koster's thesis focused on the unexpected large single transverse spin asymmetries (SSA) observed in high energy polarized hadron collisions. Koster developed the instrumentation required to measure SSAs for hadrons produced at small scattering angles with high transverse momentum, pT, using the PHENIX detector at RHIC.

The SSA are thought to be a consequence of the strong nuclear interaction, which is mediated by gluons. Measurements at high pT test theoretical ideas that SSAs originate dynamically from interactions based on correlated exchange of multiple gluons. ■

The electromagnetic calorimeters were developed with the support of the National Science Foundation, NSF Grant No. 02-44889, and important in-kind contributions from the Kurchatov Institute in Russia, Hiroshima University in Japan, the University of Massachusetts Amherst, and Brookhaven National Laboratory.

Illini fans remember old times with friends at homecoming 2012 brunch. Pictured left to right are physics alumnus John Johnson, mechanical science and engineering alumni Emerson and Martha Lacey, and physics Assoc. Dir. of Adv., Erin Kirby.

Physics Illinois invites alumni to stay in touch!

To receive the latest news, please update your contact information.

http://go.physics.illinois.edu/alumni

Illinois alumnus Dr. Frank Lederman, retired chief technology officer and vice president of Alcoa, returns to speak with students about career opportunities for physics PhD graduates in the private sector, on October 17 in the Interaction Room in Loomis Laboratory.

Alumni mentor tomorrow's graduates

There is no question that an advanced degree from Physics Illinois provides a solid foundation for those who would go on to pursue an academic career in research or teaching. But the success of the department's distinguished alumni who work in a broad range of occupations within the private sector and government also speaks to the value and relevance of physics degrees beyond the hallowed halls of academia.

Last spring for the first time, the department reached out to select alumni and asked them to come back to share their career experiences with current students. Many students who turned out for the talks voiced their appreciation for the mentoring these alumni provided through the new Physics Careers Seminar Series.

Zack Dell, president of the Physics Graduate Student Association, attends regularly.

"It is interesting to hear about how people starting in physics ended up in such disparate careers, like becoming a lawyer," said Dell. "Even the more traditional paths, such as working for a national lab, provide some insight and demystify life after graduation. I am fascinated by the variety of options available for physicists, and attending the seminars opened my mind to more career options."

Funded by the Graduate College and co-sponsored by Assoc. Director of Advancement Erin Kirby and Associate Heads Lance Cooper and Kevin Pitts, the series hosted four speakers last spring: Jerome Hubacek, PhD, of Lam Research Corporation; Sam Petuchowski, PhD, JD, of the legal firm of Sunstein, Kann, Murphy, and Timbers; Gregg Franklin, MD, PhD, of the New Mexico Cancer Center; and Peter Gehring, PhD, of the National Institute of Science and Technology headquarters.

A fall series is currently ongoing. Matt Pasienski, PhD, of Ooyala Technologies spoke to students in September. October talks were delivered by Clark Snow, PhD, of Sandia National Laboratories, Frank Lederman, PhD, retired chief technology officer and vice president of Alcoa, and John Smaardyk, PhD, technology development manager for GE Oil & Gas. November talks include Saad Hebboul, PhD, senior asst. editor of *Physical Review Letters* and Francis Slakey, PhD, assoc. director of public affairs for the American Physical Society.

Cooper said, "The Physics Careers series—intended for both graduate and undergraduate students—provides a forum for Physics Illinois and other Illinois alumni to describe the diverse career paths possible for physics PhDs in industry, government, medicine, law, publishing—any field of choice. Our students have also found it useful to hear about the aspects of our graduate program that our alumni found valuable in their respective careers."

Future series are dependent on continued funding. Cooper said he would be interested in hearing from department alumni willing to speak. Call the Physics Graduate Office at (217) 333-3645. ■

Eric Joon Shinn selected for DOE award

Undergraduate Eric Joon Shinn was awarded an Innovations in Fuel Cycle Research Award by the US Department of Energy (DOE). The award recognizes students for original research that contributes to the development and advancement of sustainable nuclear fuel technologies.

Shinn is lead author of the award-winning paper, "Nuclear Energy Conversion with Stacks of Graphene Nano-capacitors," presented his sophomore year at the UI Undergraduate Research Symposium in April 2012.

Said Shinn, "The search for alternatives to fossil fuels for energy has become a growing concern. One such alternative would be nuclear power, though it receives a lot of criticism because of its associated catastrophic dangers and radioactive by-products. By implementing concepts proposed in our research, the negative aspects of nuclear power can be minimized by reducing the size of nuclear reactors, thus decreasing their catastrophic potential, and by reducing the amount of nuclear waste produced in reactors."

Shinn works in Professor Alfred Hubler's Center for Complex Systems research group.

"Conventional nuclear reactors use steam engines to generate electricity. Because small steam engines are inefficient, nuclear power plants are large with large steam engines," said Hubler, "But even the largest nuclear power plants have only about 35 percent efficiency.

"We propose a new reactor design, where the kinetic energy of nuclear reaction products is directly converted into electrical power. The new type of reactor is not only more efficient, but also much safer, because it is small, has no moving parts, no pressurized steam, and contains only a small amount of nuclear fuel."

Shinn, who plans to pursue an academic career in physics, said he is grateful to Hubler for his guidance and to the entire research group for their hard work and support.

"The physics program here has been really good, especially because Illinois is a giant research university with tons of opportunities for research," said Shinn, "The reason why I so eagerly sought out research early in my college career is because I wanted to have a better idea of what I would like to study in graduate school. Of course in order to get there, I need to make sure I work hard and demonstrate my potential."

And that is just what he has done.

Said Hubler, "Eric worked on this difficult project with great determination. He helped to develop the theory and carried out the computer simulations."

The Innovations in Fuel Cycle Research Awards program awarded 24 prizes in 2012 for student publications and presentations. In addition to cash awards, winning students will have the opportunity to present their winning publication during the American Nuclear Society (ANS) winter meeting, to participate in an Innovators' Forum, and to attend the DOE Office of Fuel Cycle Technologies annual meeting.

Shinn said he is looking forward to attending the ANS meeting, and to meeting the other award winners.

Shinn's co-authors are Alfred Hubler, Dave Lyon, Matthias Grosse Perdekamp, Alexey Bezryadin, and Andrey Belkin. ■

Lona wins APS scholarship

Sophomore Stephanie Lona was awarded the American Physical Society's Scholarship for Minority Undergraduate Physics Majors for the 2012–13 academic year. A native of Bollingsbrook, IL, Lona graduated from Nequau Valley High School in Naperville, IL. Her interest in math and science began even earlier, in elementary school, and has never waned.

But it was Lona's high school physics course that most fed her fascination with the way things work and the universe. It was in this course that she first realized she wanted a career in physics.

"At this point in my life, it's nice to know what I'm passionate about. I just love physics!" she said.

Physics and math go hand in hand: Lona's favorite Illinois class to date was Calculus 3 with Professor Nathan Dunfield, because "he made the math so elegant."

"I love calculus," said Lona, "and people give me the strangest looks when I say that. In physics, you use a lot of calculus, and it's also really conceptual, too."

Lona recently transferred from the physics curriculum path in the College of Liberal Arts and Sciences into engineering physics, with plans to choose a professional concentration within her major. Lona's ultimate goal is to work as a researcher at Fermilab or Argonne National Laboratory. She was inspired by a visit she made to Fermilab this past summer.

"It was amazing. I took my little brother, Andy, with me—he's going to be a sophomore in high school this year—and he was inspired, too. He's also really good at science and math," said Lona.

Lona is gaining research experience this year working in the high energy physics group of Professor George Gollin.

It's early days yet, but Lona has already set her sights on graduate school; she plans to apply to programs at the University of Chicago, UC Berkeley, and Illinois.

Lona is an active member and secretary of the campus chapter of the Society of Women in Physics, and an active member of the campus chapter of the Society of Women Engineers. She also participates in the Flippin' Illini Gymnastics Club, competing in the balance beam and floor exercise.

"I'm glad this is where I chose to go to college. In my opinion, it's the best school with the best atmosphere—there are so many things to do and ways to get involved," said Lona.

Lona, a second-time recipient of the scholarship, is one of 39 students nationwide to be selected for the APS Minority Scholarship this year. Past recipients at Physics Illinois include Ricardo Rojas (BS 2001, PhD in Mathematics 2008) and Max Menchaca (BS 2011). The scholarship is part of an APS initiative launched in 1980 to increase the number of students from under-represented groups who obtain bachelor's degrees in physics.

"I am honored and thankful to have been given this award for a second year," said Lona. ■

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Physics Illinois congratulates its remarkable undergraduates


James Antonaglia


Stephanie Brandt


Kiaran Dave


Jennifer Dijohn

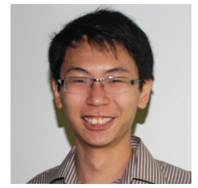

Matthew Feickert


Rebecca Glaudell


Shannon Glavin


Nella Granback

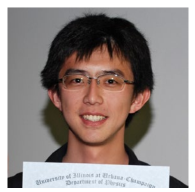

Novarah Kazmi


Maurice Youzong Lee


Colleen Meagher


Jacob Ruf


Emily Sprague


Suerfu


Mae Hwee Teo

Not pictured: Kira Bonk, Clayton Robert Carr, Danylo Hirnyj, Hefei Hu, Conan Huang, Scott Huber, Jack Krieger, Peifeng Liu, Jose Partida, Alan Selewa, Adam Snyder, and Ryan Tapping.

University Honors Bronze Tablet**:** The names of the top performing students from each graduating class (highest three percent from each college) are inscribed on this tablet mounted in the Main Library. From the class of 2012, ***Scott Huber, Jack Krieger,*** and ***Suerfu***.

Phi Beta Kappa, Gamma of Illinois Chapter 2011-2012 inductees were ***Suerfu*** and ***Peifeng Liu***.

James Scholar Honors went to ***Maurice Youzong Lee*** and ***Colleen Meagher***.

The 2012 Yee Seung Ng Award, established by family and friends of alumnus Yee Ng (BS 1974) to recognize an outstanding junior or senior international engineering physics student, went to ***Maurice Youzong Lee***.

The Undergraduate Outreach Achievement Award is presented in recognition of the work of an outstanding undergraduate student involved in the Physics Society and/or with the Physics Van. The 2012 recipient was ***Stephanie Brandt***.

The 2012 Robert E. Hetrick Senior Thesis Award, presented in recognition of an outstanding senior thesis written by an undergraduate physics major, went to ***Jacob Ruf*** and ***Matthew Feickert***.

The A.C. Anderson Undergraduate Research Scholar award is named for Ansel C. Anderson, Physics Illinois alumnus (PhD 1961), faculty member (1962-1992), and department head (1986-1992). Anderson made seminal contributions to low temperature physics, particularly on the thermal properties of metals and glasses. The 2012 recipient was ***James Antonaglia.***

The Yee Memorial Fellowship, named for Illinois alumnus Warren Yee, (PhD Civil Engineering 1943), is presented annually to recognize outstanding research achievements by a Chinese graduate student in the College of Engineering. The 2012 recipient was ***Hefei Hu.***

The People's Choice Undergraduate Research Symposium Award is given in recognition of original research presented at the Physics Undergraduate Research Symposium. The 2012 recipient was ***Clayton Robert Carr.***

The Robert A. Stein Scholarship was endowed by the family and friends of alumnus Robert A. Stein (BS 1955) after his death in 1998. Stein greatly valued the education he received at Illinois, and his family thought the best tribute to his memory would be to provide that opportunity to other youths. The 2012 recipients were ***Conan Huang, Alan Selewa,*** and ***Danylo Hirnyj.***

The Excellence in Physics Scholarship is awarded to support outstanding incoming freshman physics majors. If students remain in good standing, the awards are renewed each semester. The 2012 Recipients, ***Emily Sprague, Novarah Kazmi,*** and ***Jose Partida.***

The Commonwealth Edison Scholarship/Beryl Bristow Endowed Scholarship is presented in recognition of an outstanding woman physics major (freshman or sophomore). This award is named for Beryl Love Bristow, the first woman to receive both a bachelor's degree (1918) and a master's degree (1919) in physics from Illinois. At that time, Illinois had only 5,000 students and 12 buildings, and tuition cost $11 per semester. Beryl was inspired by her own mother, who graduated in 1883 from Illinois with a major in mathematics, the first woman ever allowed to take a math course at Urbana. After graduation, Beryl was employed by the Commonwealth Edison Company in Chicago as a mathematician in the science department. To honor her pioneering spirit, Commonwealth Edison created this award to recognize women in physics. The 2012 recipients were ***Mae Hwee Teo, Jennifer Dijohn,*** and ***Rebecca Glaudell.***

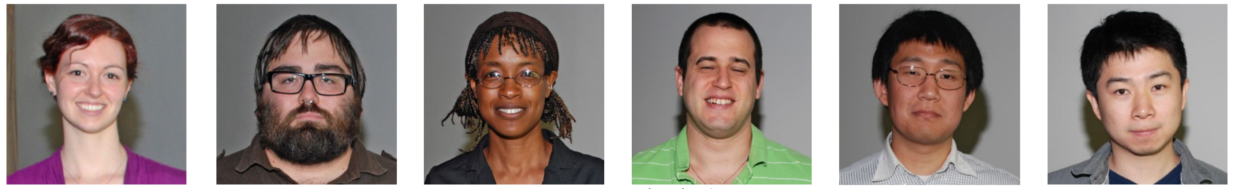
The Laura B. Eisenstein Award is presented in recognition of an outstanding woman undergraduate student in physics. This award was established by the department in cooperation with the American Physical Society and the Committee on the Status of Women in Physics to recognize exceptional woman physics students. It honors the late Assoc. Professor Laura B. Eisenstein (1942-1985), a distinguished biological physicist who made important discoveries of the mechanism of light energy transduction by biomolecules, using a variety of techniques including time-resolved resonance Raman and x-ray absorption spectroscopies. Eisenstein served the department and the biological physics community with distinction. The 2012 recipients were ***Colleen Meagher*** and ***Nella Granback.***

The Ernest Lyman Prize is presented in recognition of the year's outstanding senior in physics. This award is named after Professor Ernest M. Lyman, a distinguished researcher and teacher who served on the department's faculty for 36 years. In addition to making seminal contributions to experimental nulear physics, he was a world expert on electron scattering. Lyman maintained great interest in teaching undergraduate physics and was one of the early proponents of computer-assisted physics education. The 2012 recipients were ***Suerfu*** and ***Kiaran Dave.***

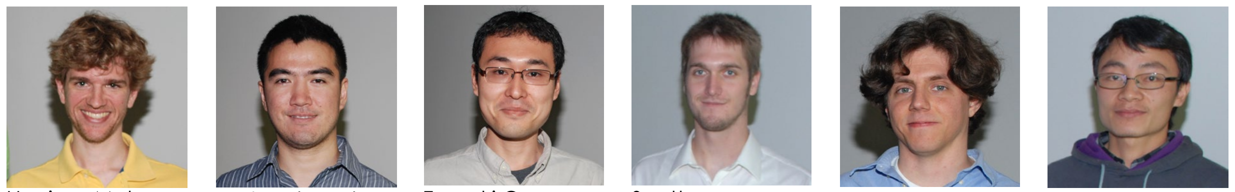
The Lewis C. Hack Scholar award is made possible by a bequest to the University of Illinois to honor Lewis C. Hack, by his wife, Lois E. Hack. Both the Hacks devoted their lives to teaching in the public schools. The 2012 recipients were ***Kira Bonk*** and ***Adam Snyder.***

The Richard Cook Scholarship is presented in recognition of an outstanding undergraduate engineering physics student at the end of his or her sophomore year. This award is named for alumnus Richard Cook (PhD 1935), who spent his entire carreer at the National Bureau of Standards (now the National Institute of Standards and Technology). Cook specialized in ultrasonics and acoustics. The 2012 recipients were ***Shannon Glavin*** and ***Ryan Tapping.*** ■

And hats off to our hardworking grad students, too



Katherine Crimmins | Tyler Earnest | Serena Eley | Nir Friedman | James Lee | Weicheng Lv



Harrison Mebane | Wah Kai Ngai | Tomoki Ozawa | Scott Scharfenberg | Maksim Sipos | Huihuo Zheng

Not pictured: Nathaniel Burdick, Ry Ely, Rebecca Holmes, Martin Leitgab, and Allison McCarn.

The Maurice Goldhaber Research Scholar Award in Nuclear Physics is presented to a graduate student to support research in nuclear physics. Maurie Goldhaber was a department faculty member from 1938 to 1950. His remarkable achievements in research, teaching, and science administration made him one of the world's most distinguished nuclear and particle physicists. The Maurice Goldhaber Research Award at Illinois was instituted on April 18, 2011, in honor of Maurice Goldhaber's centennial birthday. The 2012 recipient was ***Martin Leitgab***.

The recipient of the 2012 National Science Foundation Graduate Research Fellowship was ***Rebecca Holmes***. The 2012 Honorable Mention went to **Nathaniel Burdick, Jacob Ruf,** and **Emily Sprague.**

The Felix T. Adler Fellowship is presented in recognition of outstanding work by a graduate student in nuclear physics. This award is named for Professor Felix T. Adler, a theoretical nuclear physicist who served the department from 1958 to 1979. His work spanned the development of nuclear energy—or control theory, reactor kinetics and stability, neutron transport theory, chemical physics, operational calculus in electrodynamics, accelerator physics, and th eoretical plasma physics. He was an exceptional teacher, noted for his infectious enthusiasm for physics and his painstaking patience with students. The 2012 recipients were ***Wah Kai Ngai and Ry Ely***.

The Giulio Ascoli Award is presented in recognition of an outstanding physics graduate student in high energy physics. This award is named for Professor Giulio Ascoli who served the department with distinction from 1950 until his retirement in 1986. During his career in high energy physics, Ascoli participated in experiments at CERN, Argonne National Laboratory, and Fermi National Accelerator Laboratory. He was versatile and painstaking, both in the design and fabrication of hardware and in the development of algorithms for data analysis. His peers described his contributions as "innovative, elegant, and thorough." The 2012 recipient was ***Allison McCarn***.

The L.S. Edelheit Biological Physics Fellowship is made possible by the generous gift of alumnus Lewis S. "Lonnie" Edelheit (BS 1964, MS 1966, PhD 1970) and his wife, Susan (BFA 1966 and MA in Art Education 1968). In a professional career that spanned 33 years—all but 6 in various capacities with the General Electric Company—Edelheit championed the field of medical imaging. He served as the first project manager for a computed tomography (CT) scanner and went on to oversee GE's emergence in the medical electronics enterprises. Edelheit credits his 3 Illinois degrees with providing him important knowledge in the broad nature of physics and the ability to think about complex systems—electrical, mechanical, computer, and mathematics. The 2012 recipients were ***Tyler Earnest*** and ***Maksim Sipos***.

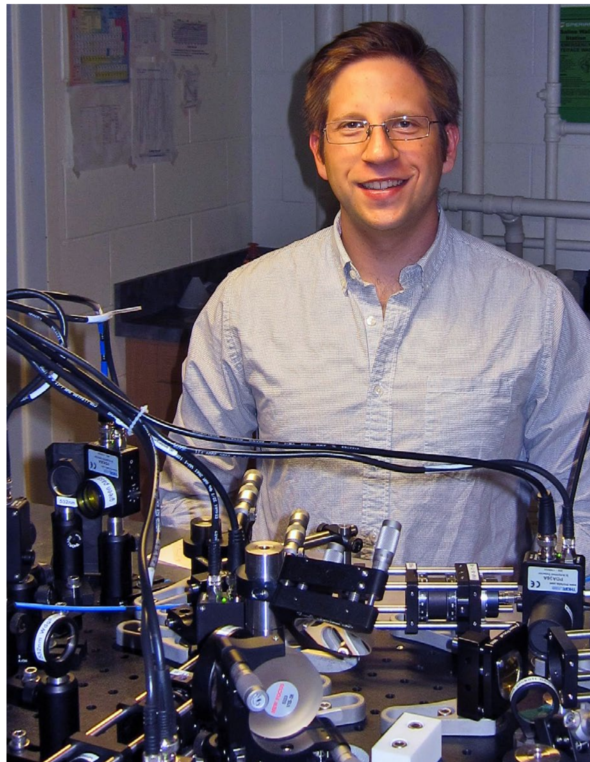
The John Bardeen Award is presented in recognition of an outstanding physics graduate student in condensed matter physics or electronic devices. This award is named for Professor John Bardeen, the two-time Nobel laureate who was a professor of physics and of electrical engineering from 1951 to 1991. During his 60-year scientific career, he made significant contributions to almost every aspect of condensed matter physics, from his early work on the electronic behavior of metals, the surface properties of semiconductors, and the theory of diffusion of atoms in crystals to his later work on quasi-one-dimensional metals. He won his first Nobel Prize in 1956 for his work leading to the invention of the transistor. He won his second Nobel Prize in 1972 for his theory of superconductivity. He was named by Life Magazine as one of the 100 most influential people of the 20th century. The 2012 recipients were ***Serena Eley*** and ***Weicheng Lv***.

The Scott Anderson Award for Outstanding Teaching Assistants is presented in recognition of the year's outstanding teaching assistants. The award is named for alumnus Scott Anderson (MS 1937, PhD 1940) who founded Anderson Physics Laboratories (APL) in Urbana in 1944. Dr. Anderson, a creative and prolific entrepreneur, developed metal halide lighting systems, and APL now has a 60 to 70 percent worldwide market share of the metal iodides used in metal halide lamps. Until his death in 2006, Anderson remained an active consultant to APL and was a tireless supporter of Physics Illinois. It was through his initiative as president of our Physics Alumni Association and his general philanthropy that the Anderson Award was endowed. The 2012 recipients were ***Katherine Crimmins***, ***James Lee***, ***Ki Lie***, ***Scott Scharfenberg***, and ***Huihuo Zheng***.

The Vijay R. Pandharipande Prize in Nuclear Physics is presented in recognition of the year's outstanding nuclear physics graduate student. The award is named for Vijay Pandharipande, an internationally recognized nuclear theorist who played a leading role in the development of the nuclear many-body problem. Professor Pandharipande served with great distinction on the department's faculty for 34 years. The 2012 recipient was ***Tomoki Ozawa***.

The Drickamer Research Award is presented in recognition of outstanding research by a physics graduate student. This award is named for Professor Harry G. Drickamer, a distinguished member of the University who contributed extensively to the understanding of the physics and chemistry of matter at high pressure. Drickamer's work led to advances in the understanding of the molecular, atomic, and electronic properties of matter and provided the tools to study these properties with greater detail and precision. He was the first to use infrared and uv-vis spectroscopy to study matter at high pressure, thereby discovering that high pressure perturbs different types of electronic orbitals to different degrees. He discovered a wide variety of electronic transitions in solids and molecules and the optical, electrical, chemical, and magnetic consequences thereof. A prolific and influential scientist, he published more than 450 original contributions to the scientific literature. The 2012 recipients were ***Nir Friedman*** and ***Harrison Mebane***. ■

William McGehee attends Lindau Nobel Laureate Meeting



Graduate student William McGehee was one of 580 young researchers worldwide selected to attend the 62nd Lindau Nobel Laureate Meeting in Lindau Germany July 1-6, 2012. More than 25 laureates in the fields of physics, chemistry, and physiology or medicine were in attendance. The annual meeting provides an intergenerational forum for leading-edge scientists to exchange ideas, discuss projects and build international networks. McGehee's participation was sponsored by The National Science Foundation (NSF).

This year's Lindau meeting was dedicated to exploring unanswered questions not addressed by the standard model of particle physics. Participants attended formal talks and discussion panels and took part in less formal focus groups to address current theoretical and experimental research in dark matter and energy. They also looked at the question of how particles within an atom obtain their mass.

McGehee's current research centers on quantum simulation of disordered systems using ultracold atoms, looking specifically at the role of disorder in interacting systems. As a member of Professor Brian DeMarco's experimental research team, McGehee was among the first physicists to experimentally localize 3D matter waves. The team's findings were published in "Three-Dimensional Anderson Localization of Ultracold Matter" in the October 2011 issue of *Science*.

McGehee said he was honored to represent America at the meeting in what proved to be a formative experience: "Learning where this field of science is headed will help me to decide how I want my career to advance."

McGehee said he especially enjoyed a focus session led by 1997 Nobel laureate William Phillips, whom he first met at a meeting of The American Physical Society's Division of Atomic, Molecular, and Optical Physics.

"He is one of the fathers of laser cooling," said McGehee.

After the conference, McGehee delivered a talk at the University of Hanover on Anderson localization of ultracold 3D matter waves.

McGehee holds a bachelor of science in physics from the Massachusetts Institute of Technology. As a student there in 2007, McGehee worked for a semester on the STAR detector, one of four experiments at the Relativistic Heavy Ion Collider at Brookhaven National Laboratory; for this, McGehee developed optical characterization techniques for gas electron multiplier particle trackers.

The same year, McGehee completed a German Academic Exchange Service (DAAD) summer internship in science and engineering at the University of Bonn, during which he designed, built and documented a fast, multi-channel gamma-ray counter that has been collecting data ever since.

McGehee received a department graduate fellowship in 2008 and was an NSF Graduate Research Fellowship semi-finalist in 2009.

McGehee said his keen interest in physics has everything to do with finding answers: "I had always wanted to be a chemist, but at some point, it didn't provide the answers I wanted. In physics, you are looking at what's going on at the lowest level. It's about finding the truth of a system—and that's pretty rewarding." ■

Courtesy of AIP Emilio Segre Visual Archives

Frederick C. Brown

1924–2011

Frederick Calvin Brown, 87, of Everett, Washington, a pioneer in the study of the alkali and silver halides, died on November 18, 2011. He was a Physics Illinois faculty member for 32 years.

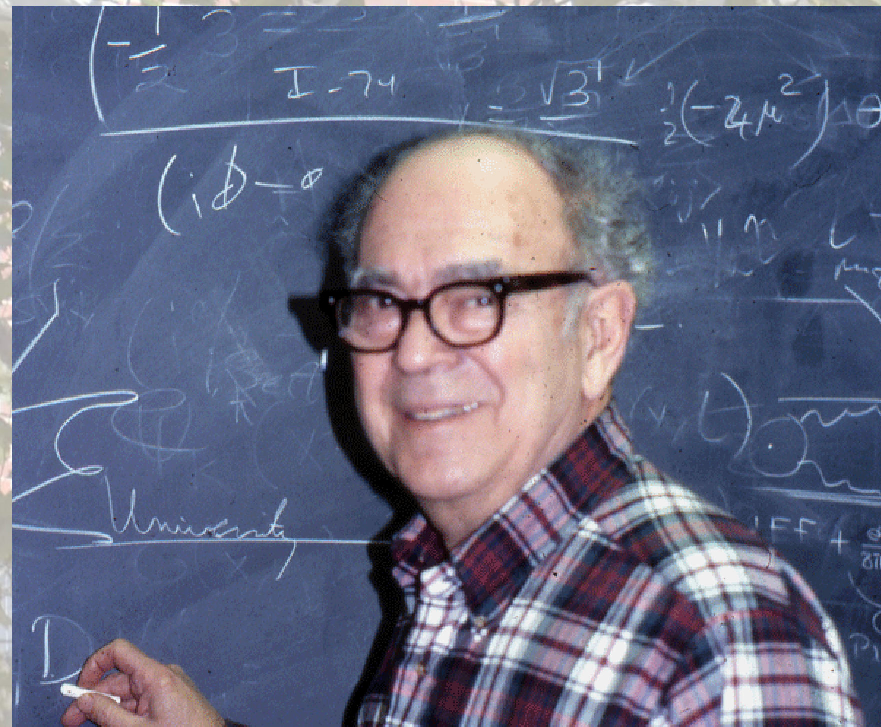
Fred Brown was born July 6, 1924, to Rose and Fred Brown in Seattle, Washington. He graduated in 1942 from Roosevelt High School and received his SB (1945), MA (1947), and PhD (1950) from Harvard University. During World War II, while an undergraduate at Harvard, he worked for the US Navy on radar technology. After receiving his doctorate, he worked as a physicist at the Naval Research Laboratory in Washington, DC, and then at the Applied Physics Laboratory at the University of Washington in Seattle. He married Joan Adele Schauble in Seattle on August 9, 1952. She died in 2003.

Brown taught physics at Reed College in Portland, OR, from 1952 until 1955, when he joined the Department of Physics at the University of Illinois, where he remained until his retirement in 1987. He and his wife then moved to Whidbey Island, Washington. In 1993, Brown was appointed professor emeritus of physics at the University of Washington, where he maintained an office until his death.

Brown's early work on defects in silver halides led to many years as a consultant for the Eastman Kodak Company. Colleagues recalled the 1960s informal meetings of the "Friends of the Silver Halides" at the annual APS March meetings, in which Brown played a prominent role.

Brown was also a pioneer in the development of synchrotron radiation as a probe of defects in crystals, and he was the inventor of "the grasshopper"—an ultrahigh-vacuum-compatible monochromator that opened up the previously inaccessible vacuum uv/soft x-ray spectral range.

An avid outdoorsman, Brown climbed all the mountains in the Pacific Northwest except Glacier Peak. He held a pilot's license for a number of years and was a member of the Aircraft Owners and Pilots Association. ■



David Lazarus

1921–2011

Professor Emeritus of Physics David Lazarus, 90, died on September 8, 2011, his 90th birthday, at his home in Urbana, IL. Lazarus was born in Buffalo, NY, on September 8, 1921, the son of Barney and Lillian Lazarus. He married Betty Ross in 1943; she died in March 2009.

A distinguished condensed matter experimentalist, Lazarus earned his bachelor's (1942), master's (1947), and PhD degrees (1949) from the University of Chicago. His studies were interrupted by World War II service at the Harvard Radio Research Laboratory (1943–1945) where, as part of the Special Reserve of the War Manpower Commission, he contributed to the development of airborne radar jamming devices. He was the holder of three patents on "slot" antennas for aircraft.

Lazarus was recruited to Physics Illinois by Frederick Seitz in 1949 as an instructor, a part of Wheeler Loomis's strategy to establish a world-leading research effort in solid state physics in Urbana. Lazarus was promoted to assistant professor in 1951; to associate professor in 1955, and to professor in 1959. He retired as professor emeritus in 1987.

A pioneer in the study of diffusion in solids, Lazarus and his students made seminal contributions to understanding the fundamental physics of lattice vacancy and motion and other diffusion-related issues. He worked closely with the diffusion group at Argonne National Laboratory for many years. Beginning in the 1960s, his group used high-pressure techniques to measure optical properties of ionic crystals.

Widely recognized for his skills in the classroom as well as the laboratory, Lazarus was an outstanding teacher. He developed two popular physics classes for non-science majors at Illinois and wrote, with his colleague Robert Hulsizer, *The World of Physics*, a high-school textbook.

Forty-four graduate students received their doctorates at Illinois under his supervision. His first graduate student, Carl T. Tomizuka, described him thus: "Dave in the lab was an experimentalist who enjoyed designing elegant mechanical and electronic devices but was also comfortable with theory. Since he was non-critical of his students and open to unorthodox ideas, we felt free to initiate new ideas and argue about subjects not necessarily all related to physics."

Lazarus and his wife Betty were intensely interested in music and the arts and were lifelong supporters of the performing arts. For decades, they made regular Chicago-opera trips with their friends Ned and Lizie Goldwasser and Peter and Shirley Axel.

Lazarus was a John Simon Guggenheim Fellow and a Fellow of the American Association for the Advancement of Science. He served as the editor-in-chief of the American Physical Society (APS) from 1980 to 1991, guiding the editorial policies and practices and the emerging dominance of the *Physical Review* journals, *Physical Review Letters*, and *Reviews of Modern Physics*. While editor-in-chief, Lazarus, with APS treasurer Harry Lustig (MS 1949, PhD 1953), successfully defended the APS journals from lawsuits that sought to breach the confidentiality of the peer-review process, a legal victory that had enormous implications for scientific publishing. ■

In memoriam

C. Peter Flynn

1935–2011

Professor Emeritus of Physics C. Peter Flynn, 76, died on Thursday, October 27, 2011, at Carle Foundation Hospital, Urbana.

Born August 18, 1935, in Stockton-on-Tees, Yorkshire, Flynn was the first of his family to pursue higher education. He graduated from Malton Grammar School in 1953 and was admitted to Leeds University, where he obtained a bachelor's degree (1st Hons.) in physics in 1957 and a doctorate in physics in 1960. He was subsequently awarded an honorary master's degree in physics from the University of Cambridge (1966). Flynn was a fellow of both the American Physical Society and the American Society of Metals, and a Fellow of Christ's College, Cambridge (1966–67).

He made his first trip outside of England in 1960 to accept a postdoctoral research position at Physics Illinois. He was appointed a research assistant professor in 1962 and an assistant professor of physics in 1963. He was promoted to associate professor in 1965 and to professor of physics in 1968. He was the director of the Materials Research Laboratory (MRL) at Illinois from 1978 through 1987. He retired after 51 years' service to the University in May 2011.

Throughout his distinguished career, Flynn made pioneering contributions to condensed matter physics, deftly combining deep theoretical understanding with superb experimental skills. In the 1960s, he utilized magnetic resonance for a fundamental study of the behavior and motion of defects and impurities in solids, an effort that culminated in his book, *Point Defects, an Introduction to the Properties of Imperfect Crystals*. It remains the definitive source for this field. Flynn's later research focused on the magnetic and electrical responses of defects, and he then expanded his interests to surfaces and films, in addition to bulk specimens.

Flynn pioneered the molecular beam epitaxy (MBE) method of growing metallic superlattices and is largely responsible for the creation of the Epi-Center MBE facility in the MRL. He was heavily involved with the acquisition, installation, and commissioning of a low energy electron microscope (LEEM), the first LEEM owned by a university research facility in the United States. An extensive program on the structure and properties of magnetic/non-magnetic superlattices evolved from this work, including the elucidation of the structure and magnetic behavior of rare earth metals grown as single-crystal thin films by MBE.

An avid and talented sports enthusiast, Flynn was a high jumper and played tennis, squash, and soccer in England and continued tennis and squash with colleagues at Illinois. He developed a great passion for hiking in the American West, particularly in the Sierra Nevada mountains. In later years, he took up golf, combining his love of sports and the outdoors. Flynn was also an enthusiastic carpenter and home-improver, and he was hard at work planning and building a conservatory at his death. ■

Cameron B. Satterthwaite

1920–2011

Professor Emeritus of Physics Cameron B. Satterthwaite died on May 28, 2011, at his home in Clark Lindsey Village, Urbana, IL.

Satterthwaite was born in Salem, OH, on July 26, 1920, to William David and Mabel Cameron Satterthwaite. He graduated from Olney Friends School, a Quaker boarding school in Barnesville, Ohio, in 1938. He received his bachelor's degree in chemistry from the College of Wooster in 1942. His graduate training at The Ohio State University was interrupted by World War II; he worked on the Manhattan District Project in Dayton, OH. He received his doctorate in chemistry from the University of Pittsburgh in 1951. On December 23, 1950, he married Helen Foster of Pittsburgh. She survives.

Satterthwaite worked as a research scientist at Monsanto Chemical Company from 1944 to 1947, at DuPont from 1950 to 1953, where he authored two patents on the production of synthetic fibers, and at Westinghouse from 1953 to 1961, where he first undertook low-temperature physics experimental work. His achievements in superconductivity research at Westinghouse led to an invitation to join Physics Illinois in 1961 as an associate professor; he was promoted to professor in 1962.

At Illinois, Satterthwaite and his group made fundamental contributions to our understanding of the metal hydrides, including the discovery of superconductivity in thorium hydride. His measurement of thermal conductivity in aluminum was an early test of BCS theory.

In 1979, Satterthwaite took early retirement from the University of Illinois to become chair of the physics department at Virginia Commonwealth University, Richmond, Virginia, a position that he held from 1979 to 1985.

Satterthwaite had a lifelong interest in politics and government. In 1968, he chaired the Federation of American Scientists and testified before both the Republican and Democratic platform committees to advocate for an antiballistic-missile treaty. He served as a delegate to the 1968, 1972, and 2000 Democratic National Conventions. ■

Professor of Physics Robert McDonald Clegg, 67, died on October 15, 2012, at Carle Hospital in Urbana, IL, of complications related to cancer. He was surrounded by his family.

Clegg was born in Providence, RI on July 18, 1945. He leaves behind his wife, Margitta Clegg, three sons, Benjamin F. Clegg, Niels T. Clegg, and Robert A. Clegg, his sister, Victoria L. Clegg, and his daughter-in-law Jennifer J. Clegg with his unborn first grandson Henrik Robert Clegg. He was preceded in death by his parents, Robert E. Clegg and Lois K. Clegg, and his brother, Douglas A. Clegg.

In his research career, Clegg demonstrated a rare mastery of both biological sciences—specifically biochemistry and molecular biology—and physical sciences, and so was in a unique position to lend the methodologies and capabilities of each to the other.

He was a gifted experimentalist and superb theoretician who worked in many areas of biological physics. With his broad expertise, he was a dynamic force in the department's biological physics program.

Clegg was an expert in leading-edge techniques and theories in optical spectroscopy and fluorescence microscopy, which he applied to his studies of DNA and RNA dynamics, investigating molecular structures of nucleic acids and proteins, as well as quantifying functional properties of complex biological structures in cellular biology. He was a pioneer in the development of full-field fluorescence lifetime-resolved microscopy (FLIM) and its medical applications in endoscopy; FLIM has become a cutting edge tool in the early diagnosis of tumors.

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Robert M. Clegg

1945–2012

Illinois Professor Emeritus of Biophysics, Biochemistry and of Plant Biology Govindjee worked closely with Clegg and Clegg's graduate students over the last several years, and the two collaborators were planning to write a chapter together for an upcoming book, among other projects.

"Bob's leaving us is the greatest shock to me. I am saddened to the extent that I cannot describe it in words. After my retirement, Bob was my only collaborator and he was very dear to me—the kindest friend I had at Illinois," said Govindjee. "He and I understood each other. He was a real teacher of physics to me—I being a biologist. I loved his personal ways of dealing with science, people, and things. He and I were able to discuss many things with great ease—that is also indescribable."

Clegg was drawn to Illinois in part by his desire to teach, and he was a gifted instructor and mentor: he was thorough, thoughtful, personable, and always well versed in the latest technologies and techniques in his field. He was deeply involved with the middle-school STEM-education initiative iRise (Illinois Researchers in Partnership with Science Educators) at the NSF Center for the Physics of Living Cells; through this program, he engaged graduate students enrolled in Physics 598SE to create engaging middle-school science lessons that included hands-on activities.

Postdoctoral research associate Sharlene Denos said of Clegg's rare gifts:

"Bob was a remarkable scientist, educator, and human being. He was a mentor to me as a biophysics graduate student and, later, a wonderful colleague on many K-12 outreach projects. He was passionate about teaching and outreach with the K-12 community. Every teacher and student who interacted with him left feeling empowered and enthusiastic about science."

At Illinois, Clegg played a seminal role in the launch of the Department of Bioengineering, serving on the Committee to Form the Bioengineering Department (from 2000) and providing essential leadership in drafting its graduate curriculum.

Clegg also served on the faculty of the Biophysics Program at Illinois, where he was most recently especially engaged with developing laboratory courses.

Clegg received his bachelor's degree in chemistry from Kansas State University in 1969. While an undergraduate, he spent a year (1966–67) as an exchange student studying at Giessen University in Germany, where he met his future wife. He also studied at Bern University in Switzerland, as a Fulbright scholar (1968–69).

Clegg married Margitta Clegg in 1969.

Clegg earned his PhD in physical chemistry in 1974 from Cornell University. His dissertation, entitled "Relaxation Kinetics Applying Repetitive Pressure Perturbations," was supervised by Professor E. L. Elson. In his doctoral thesis research, he developed a new method for measuring the relaxation kinetics of chemical reactions based on optical monitoring of a reaction system subjected to small repetitive pressure perturbations.

Following graduation, Clegg moved to Göttingen, Germany, where he started work as a postdoctoral research associate in the Max Planck Institute for Biophysical Chemistry. In 1976, he was promoted to senior staff research associate in the Department of Molecular Biology.

There he developed a diverse and very productive research program ranging from the development of state-of-the-art instruments, to investigations of basic problems in the structure of nucleic acids, and to the development of instruments and methods for clinical applications. His accomplishments earned Clegg an international reputation in molecular biophysics, as demonstrated by the wide array of collaborative projects he developed with colleagues in Europe and North and South America.

Clegg was a visiting professor during the 1989–90 academic year at Physics Illinois.

Dr. Clegg remained at the Max Planck Institute until he accepted a position as a full professor at Physics Illinois starting in January 1998. ■

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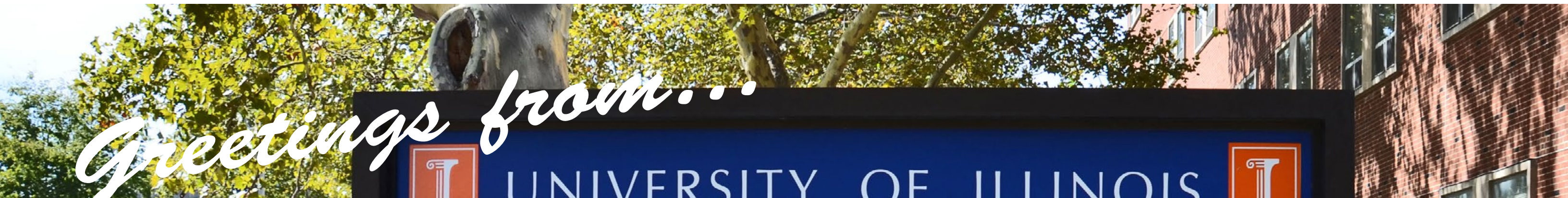

Physics Illinois

not a place, a habit of mind . . .