PHYSICS ILLINOIS NEWS

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Interdisciplinary Science– The Physics of Everything

Nigel Goldenfeld and Bruce Fouke with postdoc George Bonheyo doing sampling at Mammoth Hot Springs, Yellowstone National Park

BY RICK KUBETZ

"I just think that one of the ways that physics grows is by entering into nontraditional areas and applying physics concepts and physics tools to those areas," said Nigel Goldenfeld in a recent interview. "I work primarily in condensed matter theory, but increasingly have become interested in problems related to biological complexity, ecology, and evolution. Because physicists have a unique approach to problem solving, that means that we can come up with insights that other specialists might not see."

"In our research group, the scope of our work covers mainstream condensed matter physics, quantitative biology, applied mathematics, and non-equilibrium pattern formation," he said. "We apply mathematical tools from theoretical physics to solve problems in metallurgy and materials science. We've even recently done a paper with Simon Baron-Cohen, at Cambridge, on autism and cognitive styles.

"We mainly study how patterns evolve in time, be they snowflakes, the microstructures of materials, the flow of fluids, geological formations, or even the spatial organization of microbes. Our other focus is on emergent states of matter—the new laws of physics that arise in a system, due to the collective behavior of its parts. Superconductivity is one example; the complexity of living organisms and ecosystems is another."

Understanding the relationships between otherwise unrelated phenomenon is the common denominator in this equation, and the impetus for Goldenfeld's interdisciplinary interests. In his paper, "Simple Lessons from Complexity," (N. Goldenfeld and L. Kadanoff, *Science* **284,** 87–89, 1999), he offered an explanation:

"The complexity of the world is contrasted with the simplicity of the basic laws of physics. In recent years, considerable study has been devoted to systems that exhibit complex outcomes. This experience has not given us any new laws of physics, but has instead given us a set of lessons about appropriate ways of approaching complex systems.

"Every place we look—outside the physics classroom—we see a world of amazing complexity," he wrote. "The world contains many examples of complex 'ecologies' at all levels—huge mountain ranges, the delicate ridge on the surface of a sand dune, the salt spray coming off a wave, the interdependencies of financial markets, and the true ecologies formed by living things." To Goldenfeld, the idea of expanding physics concepts and physics tools into other fields has contributed significantly to new understanding.

"The most spectacular example would be the advent of molecular biology, which came about at Cambridge, but there are others," Goldenfeld said. "My PhD was with Sam Edwards, who took the tools of high-energy physics and applied them to understand the thermodynamics of polymer solutions. For my postdoc, I worked with Jim Langer, who took tools from statistical physics and applied them to metallurgical phase transformation kinetics. So I've always worked with people who were expanding the frontiers of physics."

Goldenfeld's research group is also active in renormalization group theory, scaling phenomena of all kinds in physics and biology, solidification patterns, superfluid dynamics, polymers and liquid crystals, phase transition kinetics, critical phenomena, partial differential equations, fluid dynamics especially turbulence, high temperature superconductivity, microbial ecology and evolution, and financial derivatives and market dynamics.

Financial derivatives and market dynamics? Goldenfeld's interest in the physics of finance was piqued when his first PhD student at Illinois, Fong Liu (MS '87, PhD '90) ended up working for Goldman Sachs on Wall Street. (He's currently at Merrill Lynch). Several years ago, Goldenfeld cofounded a high tech company, NumeriX, which markets fast numerical software products for derivative risk management and is now based in New York, London, and Tokyo.

Goldenfeld is currently collaborating with Professor Bruce Fouke in the Geology Department at Illinois on an interdisciplinary project that may unlock some ecological doors, not only on Earth, but on other planets as well.

The goal of this project, as Fouke explained, is to determine how the biodiversity and activity of specific

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Ha Tapped as One of Nation's Most Promising Scientists

The Howard Hughes Medical Institute (HHMI) has announced that Taekjip Ha, associate professor of physics, is one of 43 of the nation's most promising biomedical scientists who have been selected as new HHMI investigators. The 32 men and 11 women are drawn from 31 institutions nationwide, representing traditional biomedical research disciplines, as well as engineering, physics, chemistry, and computer science.

"This is a highly competitive and highly prestigious award that will provide substantial funding over a long term for Taekjip's research program," stated Jeremiah Sullivan, head. "It will also enable him to expand his research program in new directions."

By many accounts, physics is going to drive many of the breakthroughs in molecular biology during the next 20 years and beyond. Likely to lead that push is Taekjip Ha, who is developing novel physical methods to tag and manipulate single molecules to evaluate their behavior and interactions.

"Taekjip is what we call an 'experimental biological physicist'," Sullivan added. "He is one of several members of our department doing research in biological physics, and we value that highly, as it is an area of importance in all leading physics departments."

"This is a great honor for me and for my young research group," Ha responded. "We have made concerted efforts to make an impact in biology using the new physical tools we have

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Photo by John Dixon/AP

Letter from the Head

August 2005 will mark the fifth anniversary of my appointment as head of the Department of Physics. Much has happened over the past four-and-a-half years. Nine new faculty members have been recruited, seven have received tenure, and five have been promoted to full professor. Remarkably, there has been only one retirement during this period. Sadly, one member of the faculty recently moved to another university, and a second will be departing next year. We expect to begin academic year 2005–06 with a total of 66 faculty members and, depending on the results of current searches, may have an additional one to three new hires.

The pace of faculty retirements is certain to increase over the next several years, and it is also certain that outside departments seeking to boost their rankings will continue to bid aggressively for Illinois Physics' faculty. Faculty recruitment and retention will remain competitive, dynamic, and essential to our future.

We are in the midst of major changes in the higher levels of the central university and campus administrations. On January 31, 2005, Joe White became the new president of the University of Illinois system. He spent nearly three decades at the University of Michigan at Ann Arbor, where he received his doctorate in business administration in 1975. He also served there as interim president, dean of the business school, and faculty member. In addition, White has strong connections to the world of finance. Later this semester, a new chancellor for the campus will be announced and, shortly thereafter, national searches for a new provost and a new dean of the College of Engineering will get underway. (Richard Herman, the current provost, is presently serving as interim chancellor, and Dean David Daniel was named the new president of the University of Texas, Dallas, on February 10.)

Applications to our graduate program have set new records, and the quality of the pool has increased again this year. It is too early to know how close we will come to our goal of an entering class of 50. The number of applications to our undergraduate curricula is also increasing, and we are anticipating a further increase in the size of the incoming class of freshman physics majors.

Fiscal problems brought on by state under-funding of higher education in Illinois remain a serious problem. The budget for the University of Illinois system overall and the Urbana campus in particular is unknown for the coming academic year and may be flat again for another year, which is a problem because of certain costs that are not controllable by the university. A new and potentially devastating problem is the likelihood of reductions in federal support for basic science across the spectrum of agencies that have provided such funding in the past.

This issue of *Physics Illinois News* spotlights a very important group of our alumni—those who use their analytical skills and physics knowledge in a wide variety of careers. This group constitutes the largest fraction of our alums, and its members demonstrate every day the ways in which physics training has enduring value in an ever-changing technological world. We are making new efforts to expose our undergraduate and graduate students to this array of careers in physics and to give them the skills they need for a lifetime of new challenges. Our revised undergraduate curricular options, which went into effect last fall, provide our students much greater flexibility in preparing for a wide variety of career choices, while maintaining the traditional intellectual rigor of physics. I'm sure you'll enjoy reading about these talented alumni and the fascinating stories they have to tell. ■

Jeremiah D. Sullivan

Interdisciplinary Science

living microbes and/or microbial communities are required to create the terraced architectures universally observed in high-temperature and low-temperature carbonate spring geological deposits.

"Our field work is primarily carried out at the Mammoth geothermal system in Yellowstone National Park, which exhibits a spectacular diversity gradient downstream of the actual vent," Goldenfeld stated. "The Mammoth Hot Springs system creates a spectacular carbonate landscape that represents a fascinating pattern formation problem in its own right. We are studying the dynamics of carbonate precipitation also, using minimal models incorporating fluid and precipitation dynamics.

"We actually help collect samples and take measurements at the site and help in doing statistical analysis of the microbial DNA that we collect," Goldenfeld added. "Then we are modeling the water chemistry, and we are modeling the dynamics of the landscape that we are observing.

"We are also developing techniques in microbial ecology, a field that is still in its infancy," he stated. "It is only now beginning to emerge from the era of simply estimating diversity from environmental DNA. Trends that we are exploring include the quantification of community-wide genomes (metagenomics) in diverse ecosystems, and computer-intensive statistical methods for estimating microbial abundance distributions cheaply and quickly from environmental DNA stored in clone libraries."

According to Fouke, "One of the burning issues we have is that we want to understand how to tell the difference between a calcium carbonate mineral that was precipitated under sterile conditions versus those precipitated where there are bacteria—abiotic vs. biotic mineral precipitation. The reason that is important is that we want to be able to analyze a sample returned from Mars and know whether or not bacteria were present on Mars when that rock was formed. The Mammoth Hot Springs is the type of environment on Earth that is analogous to what we expect on Mars."

But there are hazards to doing interdisciplinary work, according to Goldenfeld. "Everyone sees only a little bit of what you do, and no one really sees the whole picture."

"When I came to campus I didn't know that Nigel existed," Fouke remarked. "I had started work on this hot springs project and realized that I needed to find someone with advanced mathematical skills who could help me. I couldn't find anyone in the usual places. I even looked outside the university."

Actually, Fouke and Goldenfeld did find each other in the usual way—at a neighborhood party for their children. "I have three very young children and Nigel has two children about the same age," Fouke explained. "We met at a friend's house where there was a party for the kids.

"I was looking for someone with the skills to do mathematical and statistical analysis of natural pattern formations," Fouke explained. "When I met Nigel at the party, and we started talking, he said, 'I don't know if you know this, but that's exactly what I do.' We made the connection that night and started the process.

"Then this major NSF-grant opportunity opened up at the same time. We decided to do the proposal and it was funded." ("Geobiology and the Emergence of Terraced Architecture during Carbonate Mineralization," National Science Foundation Grant EAR0221743)

Carbonate terraces at Mammoth Hot Springs

"We both come at these things from such wildly different worlds and backgrounds," Fouke continued. "The things we learn from each other make it really special. You have to enjoy working with someone in a setting who knows something you don't.

"We come to the table with no ego. It's the most inspiring and most fulfilling way to do science that I have yet experienced. I think it is so indicative of why Illinois is so strong," Fouke concluded. "We have this strong community that brings people together."

Goldenfeld is also working with University of Illinois microbiologist Carl Woese, the recipient of the 2003 Crafoord Prize in Biosciences given by the Royal Swedish Academy of Sciences. Woese, the Stanley O. Ikenberry Endowed Chair at Illinois, changed the way scientists classify life on Earth by his discovery of the archaea, the third domain of life.

"I'm studying the evolution of microbial genomes—trying to understand the early roots of life," Goldenfeld said. He is using his expertise in emerging states of matter and phase transitions, applying those statistical tools to genomics. "I'm working on a paper which studies phase transitions in the genomes of microorganisms. There is a major problem in biology with how to classify microorganisms, so we are trying to use physics ideas to do that."

As he pursues his wide-ranging studies, Goldenfeld credits his students for managing this diversity of research.

"One reason this is possible is the students," he stated proudly. "I have fantastic students who are willing to roll up their sleeves, take risks, and work hard on unconventional projects." ■

Music of the Spheres

Although the lab is located on the top floor of the Engineering Sciences Building tower, it was easy to find the room on this particular Friday lab session. After following the sound of guitar riffs, one enters the room to see Professor Steven Errede standing in front of the class strapped to his Gibson Les Paul guitar. The long, narrow room also sports a Hammond organ at one end, plus numerous benches containing computers, amplifiers, individual drums, and various instrument mock-ups.

Through the use of a few "blues licks" and twists of the amplifier's controls, Errede explains his instrument's tonal characteristics, based on the variables of materials used, pickups, signal chain, and amplifier.

"The 199 course is a lecture-lab where we have hands-on direct learning experiences for the students," he said. "As a first-year Discovery Program course, the enrollment is restricted to freshmen. Over the course of the semester, we cover the physics of sound (propagation of sound waves), the physics of hearing (psycho-acoustics), and the physics of music (all musical styles). We also look at music in the natural world (living organisms and physical processes), and the physics of musical instruments (brass, wind, strings percussion, song, electronic, computer and beyond).

"I think physics and music are analogues of each other," said Matthew Winkler, a first-year graduate student and teaching assistant for Steve Errede's Physics 199POM class. "You start by learning a few rules, and before long you are experimenting."

"This class is all about getting people actively engaged," Errede said. "This is a way to teach students the same physics that they would learn in other physics courses, and with the same technical rigor, such as differential equations, Fourier analysis and complex variables (for the upper-level Physics 498POM course). But, by being actively involved in a hands-on way, students wind up learning this same material much more easily, much more naturally, and at a much deeper level. They can see, touch, and hear precisely how the mathematics associated with these physics topics connects to the 'real world'—vibrating strings on a guitar, vibrations of the guitar itself, and the electronics involved.

"I wish someone had originally used musical examples to explain Fourier analysis to me," he added.

"I grew up playing piano and violin. My father worked at 3M, and we spent five years (my early teen years) in England. I picked up guitar when the Beatles came out, and eventually got into the blues." Although Errede played in various blues bands in high school and college, he—fortunately, for his many grateful students—decided to do science instead of music.

Then, about 10 years ago, Errede got back into playing music again, and discovered "about half of the time I was playing music, I was doing it for enjoyment," Errede remarked. "The other half was spent analyzing what was going on." Through his own analysis, Errede found that what he learned about the physics of music and musical instruments can be used for other physics problems such as astrophysics, insights which he continues to share with students.

Joseph Yasi, 2004 Physics REU participant

During summer 2004, Joseph Yasi, who is pursuing a double major in computer science and physics at Rensselaer Polytechnic Institute, Troy, New York, worked with Errede on the development of a MATLAB-based software package to analyze periodic waveforms—extracting frequency, amplitude, and phase information.

"My interest in musical instruments brought me to the project," Yasi explained. "I was searching for REU (Research Experience for Undergraduates) projects that were involved with acoustics, because the variation of tone of different models of instruments has always intrigued me.

"I've been playing trumpet for 11 years and play in the jazz band at school. The mathematics that is inherent from playing the instrument (each partial on the trumpet is one note higher in the harmonic series) is also fascinating to me. Electronic generation of sound and physical synthesis of musical instruments also interests me, and I wanted to study musical instruments in hopes of improving them and designing new ones.

"I learned a lot about digital signal processing, discovered that the reason a Tibetan bowl pulsates is because it has two fundamental frequencies that beat off of each other, and learned a lot about the difference in electronic technology of old guitar amplifiers versus newer ones," Yasi explained. "We also starting studying the effects of the relative phase of the harmonics on the sound of musical instruments because it has mostly been ignored in the past."

For his REU project (supported by the Department of Physics and the National Science Foundation), Yasi developed a tool in MATLAB for analysis of recordings of musical instruments for the Physics of Music/Musical Instruments course. According to Errede, the development of this research tool will be useful for analyzing waveforms from all kinds of musical instruments and sounds in general, as well as many other potential applications, such as frequency-modulated atomic force microscopy (FM-AFM), analysis of gravitational wave data, e.g. LIGO from the soon-to-be-operating LIGO/Virgo gravitational wave experiments, and cosmology associated with evolution of the early universe—dark energy and dark matter.

Errede says the idea of teaching a class about the physics of music "gelled" in 1996; however, it wasn't until 1999 that the first class started. Today, his PHYS 498POM reflects a similar content to the introductory physics of music course, but it is aimed at students who already have some physics under their belts.

In *Physics of Electronic Musical Instruments,* he expands on the introductory material, covering physics associated with electric stringed instruments, electric keyboard instruments, and amplifiers—how and why they work the way they do, and how the characteristic sounds of rock and roll, blues, and jazz music are created. For their semester projects, students may learn how to design and build their own electronic musical instrument and/or amplifier.

"I originally thought that it would not be considered as serious study by my colleagues."

But it wasn't long before Errede realized that there were enough musicians in the department to form a small orchestra, and in fact, he has gotten back into performing as well. His Chicago-style blues band, "The Painkillers"—with fellow physicist David Hertzog on drums—plays occasionally at the Iron Post in Urbana. Other band members, who also leave their PhD's at home, include geography professor David Wilson, and harp player—harmonica, for the uninitiated—David Adcock, whose day job is as an elementary school principal.

In fact, music appreciation runs deep within Illinois physics as Errede rattled off a number of fellow musicians within the department, including his wife, Debbie (piano and acoustic guitar), Mats Selen (guitar), George Gollin (guitar), Scott Willenbrock (classical guitar, banjo), Tony Liss (classical and electric guitar), Lee Holloway (jazz guitar and piano), Paul Goldbart (drums), Laura Greene (voice, guitar), Becky McDuffee (voice), Todd Moore (drums), Alison Sibert (bass guitar), and Larry Nelson, whom he describes as a "church organ fanatic."

"There may well be others," he added. "I am just not aware of what they do at home."

Through the department's Physical Revue over the years, several professors have opened the door to their "other lives." Errede noted that Lance Cooper's piano prowess has delighted audiences on several occasions, and last year, Nigel Goldenfeld brought out his guitar for an on-stage duet with his cousin, Paul Goldbart.

"Lance Cooper is an excellent pianist," said Paul Debevec, whose work in the department revolves around experimental nuclear physics. He also plays bassoon.

"I picked it up in junior high school because it was such a unique instrument, and I didn't have to purchase one," he said. "After high school, I didn't play for a number of years. Then I found one at an instrument repairman's garage sale about 20 years ago. He wanted $150 dollars for it so I purchased it." It wasn't long before Debevec traded his garage-sale find for a better instrument.

John Coltman, (PhD '41) playing one of his 200+ flutes

"It's a Fox, which I have had for 20 years." He still performs with a quintet at weddings and social events, as well as with other local groups.

Debevec doesn't consider his music to be related to his physics. "It's one of those things that keeps me sane."

David Hertzog agreed. "It's a release for me. I don't associate the drumming

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Music of the Spheres

with physics. "There is a lot of beautiful physics of music and I've taught it several times," Hertzog explained. "But when I'm playing I never think of it." So why the drums?

As Hertzog recalled, "My father played. I found a drum in the attic and started playing when I was very young. I stopped completely when I was in high school and college. I got back into playing about eight years ago when my son—a guitar player—was learning. He passed me up very quickly and now is at the Berklee College of Music in Boston."

According to Professor Emeritus Don Ginsberg, he had his first lesson "50 years late—at age 55." He played the flute in the Parkland Orchestra for about eight years. "I have a personal interest in music, like so many people, although my motivations would be slightly off-beat.

"I played a number of instruments in my childhood: ocarina, harmonica, and recorder, and I could strum on the guitar and sing off-key. I took up the flute in order to develop a hobby for my retirement," he added. "I have never taught the physics of music; I did introduce and develop a course (lectures and lab experiments) in the physics of photography."

Ginsberg also uses music as a personal therapy to keep his voice from fading away, one of the usual effects of Parkinson's disease, an illness that also caused his left hand to tremble, eventually forcing him to give up playing the flute in public. Now, he says, he still sings or plays the flute to amuse himself.

"Almost everyone likes music," Ginsberg related. "Albert Einstein, of course, was a good, amateur violinist. There is a story about his playing informally one evening in Princeton with the Tokyo String Quartet. In order to accommodate his abilities, they played a little slower than usual. At the end of the evening he said it was very enjoyable, but their tempo was 'a little slow'."

In an interview last fall, Charlie Slichter, whose son is a professional musician, talked about tuning up his guitar again, now that he is spending less time in the lab. Slichter's long-time friend and colleague, David Lazarus, noted that he's been at it for a long time.

"When we first came here, we had children and Charlie didn't at that time, so he would come over and bring his guitar and play for them."

But it does seem difficult for some to separate art and science.

According to alumnus John Coltman (PhD '41), "The first thing that I did when I got to Illinois was to audition for (U of I Band Director) Austin Harding…and I made it! I got to play second chair in the Concert Band, but in order to do so, I had to miss one of the two weekly department meetings in physics." One of his favorite memories is playing the piccolo part of Souza's *Stars and Stripes Forever* off of the original manuscript, recalling that it was quite a thrill.

A renowned physicist and retired research executive of the Westinghouse Electric Corporation, Coltman has received many honors for his invention and development of the X-ray image amplifier, now universally used in medical fluoroscopy. He is a member of the National Academy of Engineering, holds 22 patents, and has published some 70 technical papers.

He has devoted much of his spare time to the study of the flute in its musical, historical, and acoustical aspects. His research in musical acoustics has contributed significantly to what is known today about the behavior of the flute and organ pipes.

"My father was an amateur flautist, and I guess I got the idea of taking up the flute from him," Coltman stated. "He was also a research chemist, so maybe that goes hand-in-hand."

"I've written more papers on musical acoustics than on electronics and physics. Actually that started before I left Westinghouse. When I was promoted to management, I had less and less opportunity to work with people in the lab, so I built myself a little laboratory at home. I started at looking at some of the questions of how the flute operated."

While an undergraduate at Case Western Reserve University, his acquaintance with Professor Dayton Miller sparked an interest in the acoustical and historical aspects of the instrument, and in the 1950s he began a collection of instruments of the flute family which now numbers about 200.

According to Coltman, "The oldest piece in my collection comes from the Mixtec culture in Mexico—which preceded the Aztec, about 1100 AD—a pottery whistle flute. Most of my collection was built up before collecting became hot and instruments became so expensive." Although it is quite valuable now, he is planning to leave the collection to his granddaughter who is finishing up her PhD in marine biology; she's also a talented flautist.

"I think I've contributed some explanations to what makes the flute sound and some of the physical relationships required for sounding the flute," he said, "along with other aspects of the instrument such as acoustic losses. As far as tone quality is concerned, that's almost an unknown territory. How the instrument generates tone is almost unknown. There is a lot to be learned yet.

"There's a certain logic involved in both of them (physics and music). I think music, especially classical music, is orderly, has causal relationships, and sits with ideas scientists have interest in."

Today, at age 89, Coltman plays in a woodwind quintet that includes two physicists, two computer scientists, and a chemist. ■

See You in the Symphony

To make ends meet in college, some students tutor, others sling hamburgers. Irina Marinova's gig is a little classier. A senior in physics and Chancellor's Scholar, Marinova is also a violinist with the C-U Symphony.

"It has been a lot of fun. It is not very time-consuming—just about one week a month," she said. "It is very fulfilling to play with professionals and we usually have a packed concert hall, which is very nice."

As a professional, Marinova is paid for rehearsals and concerts, which she has used for spending money. "It is a little different type of job than most of my classmates'."

"I've played since I was five—so, 16 years. I just decided to play music when I was younger. I wanted to play piano, but we decided just to focus on the violin." She continued taking private lessons until she came to the university in 2001.

"I stopped taking lessons, but I wanted to keep playing so I joined the Champaign-Urbana Symphony. I never played in a professional orchestra before, just the high school orchestra. I tried out and I made it."

Marinova's family emigrated to the U.S. from Bulgaria. (Her father came in 1991; Irina, her mother, and younger sister joined him in 1993.) "In the early '90s there was an economic revolution in Bulgaria," she explained. "The economy was bad, so they decided to leave." Both parents—who were physicists in Europe—are now working as computer programmers. They commute to Chicago from their home in suburban Glen Ellyn.

Although she spoke no English when she came here, Marina remembers starting school almost immediately. She learned quickly and credits her musical training for some of her success.

"Looking back, I see that learning and playing music helped a lot; memorizing and learning. I love listening to classical music. It is very relaxing to do homework to. My favorite composer is Pablo de Sarasate (Spanish composer). His work is very romantic—violin and piano pieces—very pretty. But actually, I listen to all kinds of music. I don't really have a type that I'm really interested in."

During her time at Illinois, Marinova has excelled in physics as well. "I wanted to go somewhere close that had a good science program," she said. "I'm really glad I came here. I loved it." She claims astrophysics as her favorite subject, citing a recent course she took with Frederick Lamb. Her favorite teacher: Lance Cooper, who taught her senior thesis class.

Now in her last semester at the U of I, Marinova has been working with Susan Lamb since last summer's REU (Research Experience for Undergraduates) project, developing numerical simulations of galaxy collisions.

"I would like to get a PhD and do research and teach at a university," she said. "I have been accepted to the Astronomy Department at the University of Texas at Austin."

What about the music?

"I'm definitely going to look into it wherever I go," she grinned. "It's relaxing and fun." ■

Alumni News

IBM Fellow Shares Life in Industry With Students

In February, Joan L. Mitchell (MS '71, PhD '74), an IBM Fellow, visited Urbana to share her experiences as a physicist in industry with undergraduate and graduate students. Mitchell met with women graduate students, the Physics Society, and the Physics 498IPR class, sharing her unique insights and giving invaluable advice about mentoring, balancing work and life, problem-solving, and networking.

"I was well into my IBM career as a scientist before recognizing the importance of written goals, remembering names, networking, giving back, reaching back, selling your ideas, and leaving an auditable paper trail," she said. "It took me several years to realize that the term 'politics' doesn't have to be a dirty word." Mitchell also offered an entertaining look at the patent process by explaining each step in her trying but ultimately successful effort to patent a novel scuba wet suit.

Immediately after graduate school, Mitchell joined the Exploratory Printing Technologies group at the IBM T. J. Watson Research Center. Since 1976, she has worked in the field of image processing and data compression and is co-inventor on 56 patents. She was a member of the ISO and CCITT international Joint Photographic Experts Group that standardized the color image JPEG compression algorithm. She was the final editor of JPEG Part 1 and in 1992, published (with co-author and long-time collaborator William Pennebaker) the "must have" book for anyone who wanted to understand the JPEG standard, *JPEG: Still Image Data Compression Standard.*

Mitchell has received six IBM Outstanding Innovation Awards for achievements ranging from improved image compression algorithms to the Q-coder. In 2001, she was awarded an Outstanding Technical Achievement Award for "Algorithms for Improved Printer Performance," and in 2003, she was awarded the 24th Invention Achievement Plateau Award. She was elected to the IBM Academy of Technology in 1997, and named an IBM Fellow in 2001, the highest distinction that the company awards to its employees. In 2004, she was elected a member of the National Academy of Engineering. She is also a Fellow of the Institute of Electrical and Electronic Engineers and recently became a certified PADI Dive Master. ■

Psaltis Awarded 2005 Bodossaki Prize

Dimitrios Psaltis (PhD '98, Astronomy), a former graduate student with Frederick Lamb, has been awarded one of four 2005 Bodossaki Foundation Academic Prizes. Psaltis is currently an assistant professor of physics and astronomy at the University of Arizona, where he is a member of the Theoretical Astrophysics Program.

"My research focuses on the physics of neutron stars and black holes, the transport of photons in relativistic flows and in curved spacetimes, and the testing of the theory of general relativity in the strong-field regime," Psaltis explained. "I routinely solve problems that involve hydrodynamics and photon transport in extreme physical conditions, using both analytical and numerical tools. Our theoretical studies are also closely related to observations made with X-ray telescopes, such as the Rossi X-ray Timing Explorer, the Chandra X-ray Observatory, and XMM-Newton."

The Bodossaki Foundation, established in 1993 to honor the visionary Greek industrialist Bodossakis Athanasiadis, promotes education, health, and environmental protection. The annual Bodossaki Academic Prizes, which are awarded in science, applied science, social-economic sciences, and biology and medicine, are intended to recognize outstanding young scientists and scholars of Greek descent. Psaltis, who was born and received his undergraduate education in Greece, is excited that he will be able to shake the hand of the president of Greece at the awards ceremony in June in Athens. Psaltis is only the third physicist to receive the Bodossaki Prize. ■

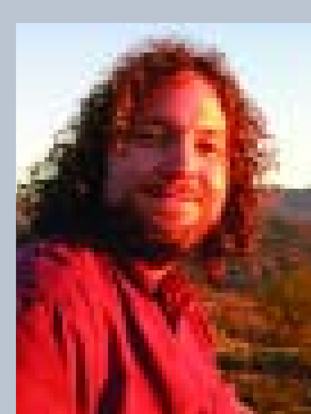
Bhatt and Hall Named AAAS Fellows

In September, the American Association for the Advancement of Science elected 308 members as Fellows of AAAS, including Physics' alumni Ravindra N. Bhatt (MS '74, PhD '76) and Dennis G. Hall (BS '70). They were recognized for their contributions to science at the Fellows Forum, which was held on February 19, 2005, during the AAAS Annual Meeting in Washington, D.C.

Bhatt is a professor of electrical engineering and of physics at Princeton University. He is a theorist who has contributed to our understanding across a broad range of condensed matter physics, including disordered and correlated electronic systems, metal-insulator transitions, doped semiconductors, the quantum Hall effect, spin glasses and other random magnetic models, high-temperature superconductors, quantum fluids and solids, charge density waves, and structural phase transitions.

Hall, a highly regarded scholar in the field of optics, is currently associate provost for research at Vanderbilt University. Before taking the Vanderbilt position in August 2000, Hall was the director of the Institute of Optics at the University of Rochester. He joined the institute in 1980, after serving as a research staff member for the McDonnell Douglas Corporation in St. Louis and as an assistant professor of physics at Southern Illinois University. ■

Rudnick Named Leo Goldberg Fellow



Gregory Rudnick (BS '96) was named the 2004 Leo Goldberg Fellow at the National Optical Astronomy Observatory. He entered graduate school at the Steward Observatory (University of Arizona) in 1996, and completed the last year and a half of his thesis research at the Max-Planck-Institute for Astronomy in Heidelberg under the supervision of Hans-Walter Rix. He received his PhD from the University of Arizona in 2001, and then moved to the Max-Planck-Institute of Astrophysics in Garching, Germany. Rudnick's research focuses on tracing galaxy evolution and formation, both in field environments and in clusters.

The Goldberg Fellowship at NOAO is a unique five-year postdoctoral fellowship that supports young astronomers of outstanding promise to carry out research at NOAO-North or NOAO-South. The fellowships allow young researchers to design and implement challenging long-term research programs while preparing for university careers. ■

Our New 2005 APS Fellows

In December 2004, Professor Paul R. Selvin and three distinguished alumni were elevated to Fellow status in the American Physical Society. The APS fellowship program recognizes members who have made significant contributions to physics research or the application of physics to science and technology. Each year, no more than 0.5 percent of the current APS membership may be elected as fellows of the Society. Our heartiest congratulations on achieving this significant career milestone!

Paul R. Selvin, Professor of Physics, *for imaginative use of single molecule fluorescence to visualize movements of a molecular motor at the nanometer level.*

Paul R. Avery (MS '76, PhD, '80), University of Florida, *for leadership in developing grid computing resources for high-energy physics and other sciences.*

Robert J. Beichner (MS, '79), North Carolina State University, *for his efforts in advancing the field of physics education research and promoting the application of its findings in the nation's classrooms.*

Stephen S. Pinsky (BS, '64), The Ohio State University, *for pathbreaking research on glueballs, light-cone field theory and supersymmetric discrete light cone quantization.* ■

So, what did you do with your physics degree?

Researcher…teacher…astronaut…quantitative analyst?

"It is all about the scientific method. It is still research. You synthesize your facts and come up with some solutions and recommendations. That training is something you use your entire life." After a career in the U.S. Air Force, Col. James F. Shunk (BS '63) has taken his analytical background into a new career as a financial consultant for Salamon, Smith, Barney in Minneapolis.

"I was in the ROTC program," Shunk explained. "After I graduated from Illinois, my first assignment was to go to Texas A&M to get a master's in physics, and later, I went back there for my PhD." After 23 years in the Air Force, Shunk retired—for the first time—and went to work for Pratt & Whitney, a division of United Technologies Corp. There, he worked on the space program in Huntsville, Alabama, before moving to Minneapolis, where he became general manager for Jet Edge. But as his "second retirement" came around, he started looking in a new direction. So why financial planning?

"Because I have worked with stocks and bonds over the years—sort of like an avocation," Shunk stated. "When an opportunity came up to work at that full-time, I thought it was better than retiring (for the second time).

Actually, a number of physicists have taken their toolkit to the bank. "Not surprisingly," Jennifer Ouellette wrote in *The Industrial Physicist* (Dec. 1999), "the problem-solving skills of physicists are useful in this capacity, as are their abilities to view a problem in a broader context, separate small effects from larger ones, and translate intuition about how something works into formal models."

Henry Eickelberg graduated from the University of Illinois in 1957 with a bachelor's degree in engineering physics. He later earned an MBA from the University of Chicago. From 1972 to 1982, Eickelberg was president and chairman of the board of Ni-Tec, Inc., a manufacturer of night vision equipment. He began trading commodities for his personal account until the late 1980s, when he became a senior consultant for William A. Golomski & Associates, Inc., an international consulting firm, consulting and lecturing on the principles of business management. Since 1991, he has been actively involved in developing commodity trading systems employing computerized technical trading methods. Today, he is chairman of the board of Eickelberg and Associates in Lake Zurich, Illinois, a business that he shares with his son, Charles (whose undergraduate degree was in computer science).

At Illinois, Professor Nigel Goldenfeld added a "Finance for Physicists" page to his personal website. "The page arose because I am often asked for advice and suggestions about how to prepare for and get a job on Wall Street as a quantitative analyst. Students registered for the University of Illinois Physics PhD can be enrolled in the Master's in Finance program and receive credit for their physics courses. In other words, you can get a master's in finance for relatively little extra work. This is highly recommended for students contemplating a career as a 'quant' on Wall Street."

Jay H. Anderson (MS '75, Physics; MS '81, Electrical Engineering) took his technical degrees to law school, and today works as a patent attorney for IBM's Microelectronics Division. "I meet with inventors—engineers at IBM—and I help them to get their inventions patented. That sometimes involves writing the patent application. Every patent attorney must have a technical education in addition to a legal education. Before you can be registered to practice at the U.S. Patent and Trademark Office, you must have some background in a technical area."

After completing his undergraduate work (at Illinois), Anderson was

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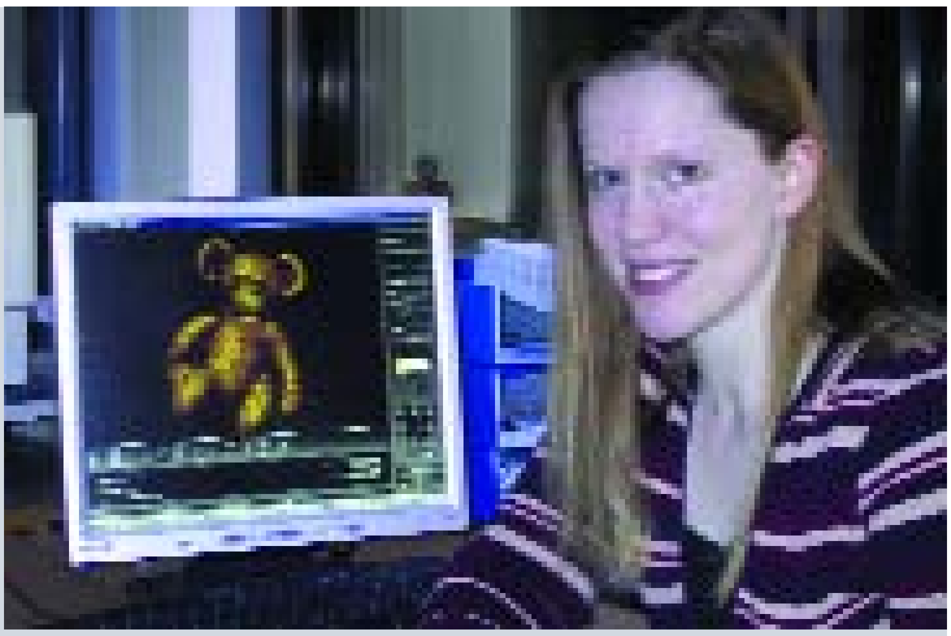
Can you say "molybdenum?"



As part of the Campus Honors Program, Elizabeth Vokurka (BS '94) enjoyed the diversity of her classes and contacts.

"I guess I liked variety and that is pretty much the reason I ended up as an exchange student," she said. "Unfortunately, I had taken Latin at high school, and therefore I had two choices—either go to a different country to take intensive language courses or go to an English-speaking country and take physics courses. I wanted to keep my degree on track, so I opted for the latter."

After talking to an English postdoc who had recently joined the Department of Physics, she opted for the University of Manchester in England.

"He spoke highly of both the department in Manchester and the city itself, and he wasn't wrong on either count," Vokurka explained. "So for my junior year I became an exchange student in the home of the industrial revolution, New Order, Joy Division, the first stored-program computer, Bohr, and Rutherford.

"I had been doing a lot of physics work outside of studying before I went to England. I had worked at Argonne over the summer before university, went to SLAC's summer school in Stanford, and helped build and install detectors at Fermilab for the guys at Loomis. It didn't seem unusual for me to try and do some extra work for a bit of pocket money at Manchester. It took me months, but I finally convinced the person who eventually became my PhD supervisor to give me a little job writing educational particle physics software for the equivalent of high school students.

"After my exchange year at Manchester, I came back, finished my degree a semester early and worked for the other half of the year as a research assistant for the nuclear physics department. (A fond memory of that year was helping Mats Selen, founder of the Physics Van. "I had the honor of being the first emcee for the Van.")

After graduation, Vokurka sought and won a Marshall Scholarship, which allowed her to do a PhD with the high energy group at Manchester.

"As many particle physicists do, I ended up at CERN for my experiment," Vokurka said, admitting that skiing also had something to do with her relocation. "Particle physics was changing quite dramatically as I was nearing the end of my degree in 1998."

At the same time, other life events were also starting to affect Vokurka's life. During her senior year at Illinois, she had been diagnosed with multiple sclerosis, as had her mother, her aunt, and her grandfather.

"The University of Manchester had an excellent medical imaging research group, and one of their projects was on multiple sclerosis. I tormented the head of the group once a week until he caved and gave me a postdoc. For the next three years, I did MRI research for brain tumors, eye disease, and spine problems."

After completing the postdoc, Vokurka and her future husband—whom she had met at CERN—were struggling with career and location questions when a colleague suggested she consider doing research for the BBC.

According to Vokurka, "The head of my particle physics group just happened to have a girlfriend who used to direct TV programs, including the equivalent of *America's Funniest Home Videos* and a prime-time quiz show in a 'college bowl' format called *University Challenge*. I phoned her up and asked about the work.

"I went to the filming thinking I was going to just sit and watch. One of the guys who wrote science questions didn't show, so I ended up having lunch with the BBC's equivalent of Alex Trebek, telling him how to pronounce 'molybdenum,' and how not to give points if they answer 'relativity' (because the answer is 'general relativity' not 'special'). I've been checking and writing questions for the program ever since."

Ever the seeker of new challenges, Vokurka gravitated to Voxar, a small medical imaging company, in Edinburgh.

"Initially, I did random things like grant proposal writing, product design, market analysis, and technical research. One day, I came back from holiday to find that a patent of one of our major competitors had been discovered, and it looked like we were potentially infringing on it with our main product. Many of the senior engineers had spent a week trying to find some 'prior art' or earlier publications to invalidate the patent. They were unsuccessful. I was sent out to the library, because I didn't have anything on that day.

"Within two hours, I had found a nice two-page paper describing exactly what they did two years before their patent. And I've been doing the same thing ever since. Over the last four years, I have gained a lot of experience through growing the intellectual property department from virtually nothing to something with a strong portfolio in the field and a reasonable idea of what to steer clear of from our competitors. Last September, we were bought by Barco, the company that makes the radar screens for AWACS planes and the video screens at Kylie Minogue concerts. They valued the patent portfolio alone in the millions, so we must have done something right."

Today, Vokurka is assistant IP manager at Barco, and credits her diverse education for some of that success.

"I think my experience in physics has helped me in several ways. There have indeed been John Bardeen and HAL 9000 questions set for the quiz show. I am certainly not fazed by any tricky mathematics or technical jargon at work, and my broad liberal arts education has helped me move into something that is not purely science." A physicist really can do anything. ■

So, what did you do with your physics degree?

offered a job at IBM and moved to New York. Although he enjoyed working his engineering assignment, job security was an issue.

"I wanted have a means of making a living that I could carry around with me in my head," he explained. "Engineers make their livings using their brainpower, but in this day and age, most need a good-sized corporate infrastructure." In 1993, Anderson started attending law school at night, and soon after, IBM began to lay people off. He left the company to avoid being laid off, returning as a patent attorney in 1998.

"I think IBM is the finest company in the history of the world, and you can quote me on that," Anderson said enthusiastically. Today, he lives in Fishkill, New York, in the Hudson Valley about 60 miles outside New York City. "I like it," he said, "but my wife misses the flatlands."

"For me, it was a combination of developing interest more in the problems of people than the laws of physics in the laboratory," explained Robert Doan (MS '50). A native of Chicago, Doan's father was a physicist and worked at the Idaho Nuclear Division of Phillips Petroleum Co. "There were always physicists around the dinner table."

"I always had an interest in history and politics," Doan remarked. "I initially had in mind drawing on my physics background and going into patent law. I had my first year of law school at George Washington University and was also serving as an instructor in physics there."

After the outbreak of the Korean War, he was called back into the Air Force briefly and took a position at the ballistics research laboratory in Aberdeen, Maryland. During law school, he continued working on theoretical physics with Strategic Air Command—a project to look at all of the airborne armament—developing a computer model to simulate missions over Russia. He also served a two-year stint at the National Bureau of Standards. After graduating from law school, he interviewed with several law firms and corporations, choosing to work at Union Carbide.

"One of the attractions of working for Union Carbide—which had been involved in the Oak Ridge endeavor during the war—was that it appeared to be a good opportunity to make use of my physics background." That technical orientation, along with the company's diversity, cutting-edge technical developments, and mergers and acquisitions, kept Doan's interest for 26 years. After taking early retirement in 1985, he joined the law department of the New York City Housing Authority.

"The involvement with physics and my technical background was certainly helpful in my years at Union Carbide, especially in the acquisition of small, technically oriented businesses," Doan added. "Even at the Housing Authority, it was also helpful as the organization—and especially the law department—moved into the computer age. Today, it is more computerized than most law offices in the commercial sector." Doan retired for the second time in fall 2004. He is now a practicing grandfather in Washington D.C., where his daughter is an attorney.

"I originally started in physics because I was good at math and science, but I really didn't know what I wanted to do," said Edward Feldman (BA '79, English; BS '80, Physics). "I found that I liked chemistry a lot, but didn't like the lab work. I was beginning to think about law school, so I switched over to English. By my senior year, I was thinking about practicing environmental law, and I thought it would be useful to have a more technical background. Physics is such a fundamental science that I thought it would be valuable."

Feldman got his second bachelor's degree in physics, and after graduation, he got a teaching assistant position in the department, teaching Physics 106, which was the introductory mechanics course for engineers and physics majors.

"I think that one thing that helped me get into Harvard was having a physics degree, which kind of distinguished me from the general pack of applicants," he related. "My impression in law school was that people with hard science backgrounds actually did better. In terms of rigor, physics is much more rigorous than law. After trying to figure out quantum mechanics, law seems easy."

After graduating from Harvard in 1984, Feldman returned to Chicago, where he is a partner with Miller Shakman & Hamilton. His practice includes in a wide range of general commercial litigation and civil rights work, but he still thinks about his early training.

"It comes up in two ways—almost every day generally, and sometimes more specifically. In the general way, the analytic tools you use—critical thinking, analysis, logic—all of that is very useful for legal practice. I had one case two years ago involving a steam turbine that blew up. I knew enough that when I was talking to the engineers and looking at the drawings, I could grasp the information quickly."

Although he is not earning his daily bread as a physicist, Charles Laughlin (BS '77) feels good about his educational choices.

"My diploma hangs on the wall and everyone knows where I'm from. I was hired directly from the U of I and worked overseas for a French engineering firm—Schlumberger—as an engineer. I lived overseas for 10 years in Pakistan, Dubai, and Saudi Arabia, and I worked on a lot of off-shore oil rigs.

"Now I sell boats. I'm the owner of a medium-sized company that sells a lot of boats," said Laughlin, who also worked as general manager at WPGU while at Illinois.

One of the critical things with large boats is the engineering—communications, generators, power plants, and the like, he added. Over the past 17 years, Laughlin's dealership, St. Barts Yachts, has grown to serve about five southeastern states.

"This is different, but it's not. You still have to be able to install computers onboard and have them work with all the electrical systems. These are some of the practical, problem-solving types of things that I learned at Illinois. I can work with vendors that are trying to sell us new equipment, and I'm not afraid to talk to my service department. At any one time we have about 30–75 craft available. My day-to-day life is a mixture of business and sales.

"But I use my physics training all of the time, so it really isn't an alternate career." ■

***Editor's Note:** Calling all recycled physicists! Do you have an interesting story to share about how you used your physics training in a second (or third, or fourth) career? We'd like to hear from you! Please write to the Editor at Physics Illinois News, 1110 West Green Street, Urbana, IL 61801-3080 or cmelliot@uiuc.edu.*

EOH traces its origins to Physics

In 1906, the Department of Physics held its first annual open house, becoming the precedent and inspiration for the present-day Engineering Open House (EOH). The public was invited to tour the department's teaching laboratories (university professors did not do research at that time) in Engineering Hall, then the home of the Department of Physics.

The exhibits centered around light, sound, wireless telegraphy, and other electrical operations, featuring lectures on the principles involved. The next spring, in 1907, the Department of Electrical Engineering organized the Electrical Engineering Show, and other departments soon followed suit with their own displays. By 1913, the attendance had grown to about 3,000, a crowd that taxed the facilities of Engineering Hall to its limit.

Inspired by this success, the first regular all-engineering open house was held in the spring of 1920, commemorating the centennial of the birth of James Watt. The Physics and Mechanical Engineering open houses were discontinued at this time to give a greater chance for success to the all-college venture. The public was invited to inspect the facilities of the Engineering College and to see displays that had been set up in laboratories, drafting rooms, and shops.

Other open houses, later called Illinois Student Engineering Exhibitions, were organized by Engineering Council and involved students in all engineering departments. Today, EOH continues to be run entirely by students, allowing them to practice their organizational and leadership abilities, in addition to showcasing student projects, university facilities, and new technologies for thousands of visitors each year. ■

Faculty and Alumni Recognized by APS

Illinois Physics' faculty and alumni were well represented in the list of awards made by the American Physical Society for 2005.

Alumnus **David Awschalom** (BS '78) shared the Oliver E. Buckley Prize *"for fundamental contributions to experimental studies of quantum spin dynamics and spin coherence in condensed matter systems"* with Gabriel Aeppli, University College, London, and Myriam Sarachik, City College of New York.

After completing his undergraduate degree at Illinois, Awschalom earned his PhD in experimental physics from Cornell University. He became a research staff member and manager of the Nonequilibrium Physics Department at the IBM T. J. Watson Research Center in Yorktown Heights, New York, and, in 1991, he joined the University of California, Santa Barbara as a professor of physics. In 2001, he was also appointed as a professor of electrical and computer engineering.

Awschalom is presently director of the Center for Spintronics and Quantum Computation and associate director of the California Nanosystems Institute.

Robert H. Austin (MS '70, PhD '75) received the Lilienfeld Prize *"for his pioneering and creative work in applying advanced techniques in experimental physics to significant problems in biological physics, and for his skill in communicating the excitement of his research to a wide range of audiences."*

Austin is a professor of physics at Princeton University. After earning his BA from Hope College in Holland, Michigan, he came to Illinois for graduate studies. Later, he was a postdoctoral research associate at Illinois and then at the Max-Planck-Institute for Biophysical Chemistry in Göttingen, Germany, joining the Princeton faculty in 1979. He was promoted to associate professor physics in 1984, and to professor in 1989.

Austin's research spans a number of topics in biological physics, including fractionation of DNA in micro-lithographic arrays, the study of energy flow in biomolecules, and the study of ultra-rapid diffusion mixing.

Roy J. Holt, a former professor of physics and currently an adjunct professor of physics at Illinois, received the Tom W. Bonner Prize *"in recognition of his pioneering role in experimental studies of the structure of the deuteron and especially for his innovative use of polarization techniques in these experiments."*

After receiving his MPh and PhD degrees from Yale University, Holt served on the research staff there until 1974, when he joined the staff of the Physics Division at Argonne National Laboratory (ANL). In 1994, he became a professor of physics at the University of Illinois at Urbana-Champaign, where he also served as a director of the Nuclear Physics Laboratory and continued experiments at Jefferson National Laboratory, DESY-Hamburg (HERMES experiment) and the Indiana University Cyclotron Facility. He returned to ANL in 2000, where he serves as chief of the Medium Energy Physics group in the Physics Division. His present research interests include the structure of the nucleon and nucleus as well as a search for a non-zero electric dipole moment in ^{225}Ra.

Frederick K. Lamb, the Brand and Monica Fortner Chair in Theoretical Astrophysics at Illinois, was a recipient of the 2005 Leo Szilard Lectureship Award. The prize was given jointly to all 11 members of the APS Study Group on Boost-Phase Intercept Systems for National Missile Defense, co-chaired by Lamb, "*in recognition of the work of the Study Group in producing a report that adds physics insight to the public debate.*"

The award is given for outstanding accomplishments by physicists in promoting the use of physics for the benefit of society in such areas as the environment, arms control, and science policy. Past Szilard Award recipients include alumni Sidney Drell (AM '47, PhD '49) in 1980 and David Hafemeister (MS '60, PhD '64) in 1996, and Physics Department Head Jeremiah Sullivan in 2000.

Lamb is recognized as an international leader in the field of X-ray astrophysics and neutron stars, where his work has provided both a unified model for understanding the basic phenomena of X-ray emission from neutron stars and the tools for exploring other areas of physics, such as general relativity and the theory of dense matter. He is widely recognized as providing fundamental theoretical understanding of many important astrophysical phenomena—from the quasi-periodic oscillations seen in the emission from bright galactic X-ray sources to the radiation processes in accretion systems.

Ivo Souza (PhD '00) received the George E. Valley Prize *"for fundamental advances in the theory of polarization, localization and electric fields in crystalline insulators."*

Souza earned his undergraduate degree in engineering physics in 1995 from the Unversidade Ténica de Lisboa, where he started doing research in solid-state physics with José Luís Martins. He received his PhD in physics from Illinois in 2000 under the supervision of Richard M. Martin, and later spent three and a half years doing postdoctoral work in the group of David Vanderbilt at Rutgers University.

In January 2004, he joined the Department of Physics at the University of California, Berkeley as an assistant professor. His research is in theoretical and computational solid-state physics. He is interested in methodological developments aimed at expanding the range of properties that can be studied from first principles. Current projects include modeling the nonlinear optical properties of polar semiconductors in the far infrared and the vibrational spectroscopy of nanoclusters. ■

L. Doon Gibbs Named Associate Director at BNL

L. Doon Gibbs (MS '79, PhD '82) was named associate laboratory director for basic energy sciences at the U.S. Department of Energy's (DOE) Brookhaven National Laboratory on November 22, 2004. Gibbs joined Brookhaven in 1983 as an assistant physicist and progressed through the ranks to become senior physicist in 2000.

With a staff of 180 and a current annual budget of about $52 million, the Basic Energy Sciences (BES) Directorate is responsible for overseeing research in chemistry, materials science, and condensed matter physics, and for shepherding Brookhaven's new Center for Functional Nanomaterials from architectural drawings to a functioning center by 2007. The center will be one of five being built by DOE's Office of Science at national laboratories around the U.S. for the study of materials at nanometer dimensions.

"I am delighted to have this opportunity to lead Brookhaven's Basic Energy Sciences Directorate," Gibbs said. "Broadly, DOE's goals are to carry out basic research and develop new tools to help secure energy independence for the U.S. With our strong scientific programs and facilities and a great BES management team, I'm excited about our ability to contribute to these challenges in the coming years."

The Laboratory will focus on three major research topics: model catalysts, involving substances that make chemical reactions work more quickly; strongly correlated and complex systems, including high-temperature superconductivity; and interfaces between life and physical sciences, such as using biology to design novel nanomaterials with new properties.

Gibbs envisions Brookhaven scientists working together with university and industrial researchers to make new discoveries in basic energy sciences research. He said, "Facilities at Brookhaven—such as the National Synchrotron Light Source, which uses X-rays, infrared, and ultraviolet light to study materials as diverse as viruses and batteries, and the soon-to-be-built Center for Functional Nanomaterials—will be crucial for helping to solve our energy challenges."

Gibbs was honored with the 2003 Advanced Photon Source Arthur H. Compton Award "for pioneering theoretical and experimental work in resonant magnetic X-ray scattering, which has led to many important applications in condensed matter physics." He is a Fellow of the American Association for the Advancement of Science and the American Physical Society. ■

Faculty News

This scientist really swings

UI physics prof slings photons by day, swing dances by night

BY GREG KLINE, THE NEWS-GAZETTE

Paul Kwiat's business card announces he's a scientist in quantum physics and experimental optics and states: "It don't mean a thing if it ain't got that swing."

The latter doesn't really refer to physics, but rather to the University of Illinois professor's other passion—swing dancing.

Maybe there's a correlation, however. For a Physics Department talent show last year [see *Physical Revue* R^3*: Rejected, Recycled, and Resubmitted* in this issue, ed.], Kwiat and his dancing partner, Cindy Schmidt, did an interpretative swing dance, set to a Count Basie tune, designed to illustrate the principles of quantum physics, although Kwiat admits it was more for fun than serious. Still, when he answers a question about what's difficult to learn in swing dancing, he talks about things like "maintaining the transferred momentum" between partners.

And getting his students to see physics in everyday things is a hallmark of Kwiat's classes, where he has been known to pop marshmallows into liquid nitrogen in explaining thermodynamics.

"I like people to sort of see the relevance of physics to things around them," Kwiat said recently. Physics comes into play in another thing Kwiat is known for—the array of bow ties and suspenders he wears, both teaching and dancing. His collection is large enough that he never wore the same tie to his class lectures last semester.

The suspenders are more comfortable than a belt, he explains, complete with whiteboard diagram, because the upward force they apply on his pants, which naturally have a downward force, doesn't require cinching a belt tightly around his slim waist.

As for the bow ties, well, if you work with lasers, as Kwiat does, it's wise not to wear a tie that can hang down into the beam or otherwise get caught in lab equipment.

Kwiat is an expert in quantum mechanics, laws of physics that describe the often bizarre way things work on an atomic and subatomic scale, which he uses, among other things, to try to create super encryption methods. He and colleagues are turning photons, particles of light, into "keys" for locking and unlocking information in a way that would make it extremely difficult for an eavesdropper to intercept.

Photo by Dom Ricci

Cindy Schmidt and Paul Kwiat demonstrate quantum entaglement in their interpretive dance, Spin Swinglet, *which had its world premiere at the 2004 Physical Revue, December 9, 2004, Illini Union Ballroom*

They do it by applying quantum principles such as "superposition," which says properties such as the spin of an electron or the polarization of a photon can be in a range of different states simultaneously at the atomic level. It's a hot and developing field, both for the window it offers on basic questions in quantum mechanics and the potential applications, in encryption and, perhaps in the more distant future, in extremely powerful computers built on quantum principles, said UI Physics Department head Jeremiah Sullivan.

"We wanted in the department to develop a major initiative in that direction," Sullivan said. "We were very fortunate to find him and attract him here."

Kwiat came to the UI four years ago to take a John Bardeen professorship in physics and electrical and computer engineering, a Sony-funded position named after the UI's late two-time Nobel Prize winner and the inventor of the transistor that underpins the electronic age. He said he was attracted by the worldwide reputation and the collegiality of the UI department and by the quality of its students.

"It's easy to get very good graduate students to work with me," he said. Like a lot of guys, Kwiat, 38, started dancing because of a girl. But the story isn't what you might think. He was practicing the martial art Aikido—he earned a black belt—when the girl, a partner in a demonstration, applied a lot more pressure than expected and severely injured his wrists. Kwiat's Aikido career, 12 hours' worth a week at that point, ended abruptly.

He had just moved for a position at Los Alamos National Lab in New Mexico, where he worked before coming to the UI, and in casting around for a new activity to take up, he came across an advertisement for a swing dance event that included an hour's lesson. Kwiat tried it. Before long, he was hooked on the dance form, which is rooted in the music of the big band jazz era, historic venues like Harlem's Savoy Ballroom and steps such as the Charleston, the Jitterbug and the Lindy Hop.

"I'm a person who really enjoys motion," said Kwiat, who said that was part of the attraction of Aikido, as well as ice skating, which he also does. "I really like swing music, that swing rhythm."

He routinely dances three nights a week now—at events such as the UI Swing Society's weekly gatherings or performances by the Pocket Big Band at the Highdive in downtown Champaign earlier this month—and also travels to out-of-town dance venues like the Jazz Kitchen in Indianapolis.

Kwiat's dancing includes "a lot of big moves that get a lot of attention on the dance floor," said Andrew Reder, president of the UI Swing Society.

Kwiat doesn't confine himself to domestic dancing. Physics is an international business, and he does a fair amounting of traveling for professional reasons. When he does, he looks for opportunities to dance. He hit a swing event in London after a conference in Scotland last summer, for example, and has danced in Spain, Australia, and Japan, among other places.

One day, a couple at an event in California walked up and said they had seen him dancing in Germany. They recognized the bow tie and suspenders. ■

Faculty Honors

Paul G. Kwiat was named a 2005 Optical Society of America Fellow *"for numerous seminal contributions to the field of experimental quantum optics and quantum information science."* Kwiat is the Bardeen Professor of Physics and of Electrical and Computer Engineering at the University of Illinois. He has done pioneering research on the phenomena of quantum interrogation, quantum erasure, and optical implementations of quantum information protocols. He is a primary inventor of the world's only two sources of polarization-entangled photons from down-conversion, which have been used for quantum cryptography, dense-coding, quantum teleportation, entanglement distillation, and most recently, optical quantum gates.

Stuart L. Shapiro has been named a 2005 Fellow of the Institute of Physics (U.K.). According to the IOP, election to fellowship is intended to recognize "a very high level of achievement in physics and outstanding contribution to the profession." Shapiro, professor of physics and of astronomy and senior NCSA research scientist, has broad research interests that span many areas of theoretical astrophysics and general relativity theory, including the physics of black holes and neutron stars, gravitational collapse, the generation of gravitational waves, and the dynamics of large N-body dynamical systems. His research emphasizes the use of supercomputers to solve long-standing, fundamental problems in numerical relativity and computational astrophysics.

Ian K. Robinson has received a Humboldt Research Award from the Alexander von Humboldt Foundation in Bonn, Germany. Each year the foundation grants up to 100 Humboldt Research awards to internationally prominent scientists and scholars, honoring their lifetime academic achievements. Robinson is carrying out research with Harald Reichert at the Max-Planck-Institute for Metals Research (Metallforschung) in Stuttgart, Germany, where he is investigating the electrochemistry of lead-acid batteries and the metal-electrolyte interface that was described by Hermann Helmholtz in the 1800s. Although Helmholtz concluded that the binary ionic fluid would coat a charged electrode with a double layer of ions, there has never been direct experimental proof for the existence of Helmholtz double layers. Robinson is using a small-angle X-ray scattering technique tuned to the layering of the interface ions, which should be able to detect the different densities in the layers and confirm Helmholtz's theory of double-layer ions, thus explaining the electrochemistry in lead-acid batteries.

UI professor concerned with the stars, first strikes

Arms control a major motivator for astrophysicist Lamb

BY GREG KLINE, *NEWS-GAZETTE* STAFF WRITER

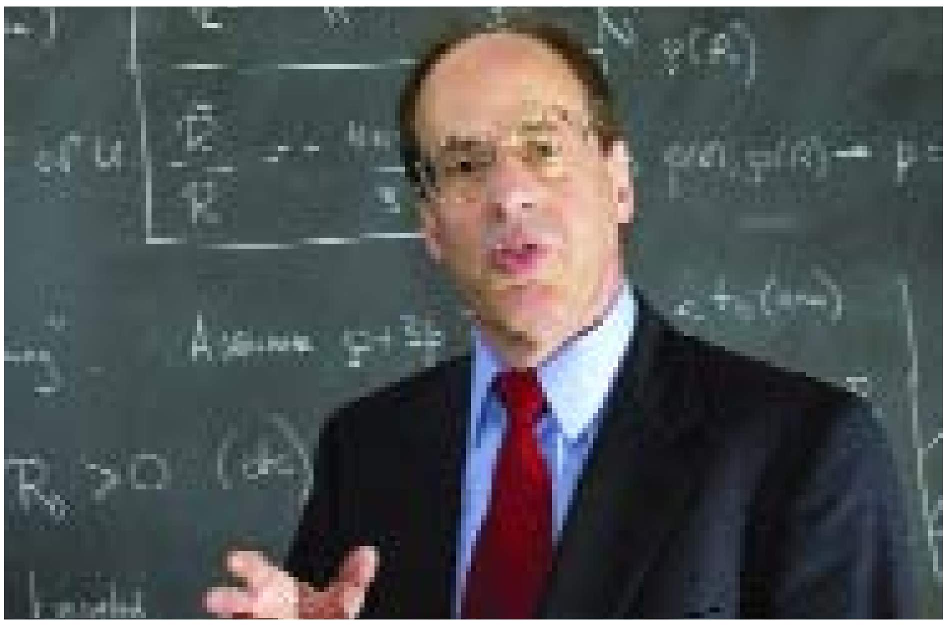


Photo by John Dixon/The News-Gazette

Fred Lamb's voice hitches with emotion as he recalls the time his parents asked their science-oriented teen-age son whether they should build a bomb shelter. The Cold War was hot and the chances of an even hotter atomic shooting war between the United States and the former Soviet Union didn't seem like long odds, when Lamb, now a University of Illinois professor, went to the library in his hometown of Manhattan, Kansas, to research his parents' question.

Among other things, he waded into a government report on the effects of nuclear weapons. "I still remember it like it was yesterday," the physics and astronomy professor said recently. "I started reading it, and I was just horrified. I had a hard time sleeping for several days."

Lamb told his parents to forget the bomb shelter. And he came away believing the only answer was to prevent a nuclear war from ever happening. Lamb, who lives in Urbana, went on to Caltech and Oxford and a career as an internationally known astrophysicist after he joined the UI faculty in 1972. His groundbreaking work on neutron stars, the densest objects known, is wrapped up in scientific efforts to understand the origin and evolution of the universe.

He championed NASA's Rossi X-Ray Timing Explorer satellite project, one of the agency's most successful space data collection initiatives and a boon to Lamb's research and to astrophysics in general.

"He has maintained full-time involvement in theoretical astrophysics," said UI Professor Jeremiah Sullivan, head of the Physics Department. But Lamb never stopped thinking about nuclear weapons. Besides his personal interest, he brought a useful professional expertise to the table in a field that is, to a large extent, about physics. He's become an expert on military uses of space, technical aspects of nuclear weapons testing and arms control verification, and also has been author or co-author of more than 70 papers in books and journals.

He has been a consultant to the secretary of defense; the House and Senate Armed Services committees; and the Los Alamos National Laboratory, birthplace of the atomic bomb. He's studied underground nuclear testing—and testing limitation methods—and, for a while, had a group at the UI that modeled nuclear blasts.

Last year, he made headlines by spearheading an American Physical Society panel study that questioned the feasibility of major elements in the anti-missile system proposal by the Bush administration, which wants to spend $10 billion-a-year on the effort and is set to activate early stages at installations in Alaska this fall.

He ended up doing a lot of the research for the report himself, breaking new ground in the process, said UI Professor Clifford Singer, who directs the UI's program on Arms Control, Disarmament and International Security, of which Sullivan and Lamb are members. Lamb doesn't necessarily rule out the idea of a national missile defense system, as long as it works, offers acceptable protection for the dollar and really leaves us safer.

But he noted American officials have touted—and spent money on—various permutations of such systems since the 1950s with little to show for it.

"We've studied the problem all these years," he said. "This is still a very, very difficult problem. It's an unsolved problem." He thinks the Bush administration plan is a bad one on a number of counts. For example, its success partially hinges on hitting enemy missiles as they're launched—in the so-called "boost phase," the subject of the American Physical Society study—before they rocket into space and unload their packages of multi-target warheads.

The target is singular and easy to see at that point because of the bright heat plume from its rocket booster. But hitting the plume is useless—and the heat actually makes it harder to identify and hit the missile itself, Lamb said. He and his colleagues suggested a way around the problem in their report. But that doesn't do anything to mitigate the severe timing constraints involved, Lamb said.

A missile's boost phase only lasts something like 3 to 4 minutes. It takes a minute to locate the target, assuming you don't have to overcome counter-measures designed to fool the system, leaving just 2 to 3 minutes to home in on the target, deliver an anti-missile payload to it and hit it.

Meanwhile, the more likely threat today, a nuclear attack by terrorists, isn't likely to involve a missile at all, Lamb noted. Think shipping container or suitcase, he said. He views the emphasis on missile defense as a distraction from the country's real nuclear problems, at a time when the focus should be on the terrorist threat and on halting the spread of nuclear weapons to nations such as North Korea and Iran.

For a while there, after the collapse of the Soviet Union and the end of the Cold War in the 1990s, Lamb felt a little better about the whole thing. Not now. He doesn't expect to stop thinking about nuclear weapons soon.

"The only thing that could destroy our country is a nuclear attack," said Lamb, who believes that even biological and chemical weapons can't be placed in the same class. "I have never wavered from the idea that the only approach here is prevention, the only viable approach." ▪

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Ha Tapped as One of Nation's Most Promising Scientists

continued from page 1

developed, and this selection, to me, is a strong endorsement that we are moving in the right direction."

In his research, Ha uses physical techniques to study the mechanism of helicases, DNA-unwinding enzymes that crawl along the DNA helix, separating the double strands as they go. Helicases are important in many genetic processes; when they malfunction, genetic diseases or cancer may follow.

Ha is a pioneer in using fluorescence resonance energy transfer (FRET), a relatively new technique, which relies on transferring energy between "donor" and "acceptor" fluorescent tags on different parts of a molecule to reveal stunning details about the conformational changes molecules undergo during biological processes. Ha's FRET studies have revealed new information about how a helicase moves along a DNA molecule as it unwinds the strands.

In addition to exploring fundamental questions about biological systems, Ha has brought his tools to bear on the problems of human disease. He uses FRET and other new tools to study malfunctioning helicases in human genetic disease. He has also studied the role helicases play in the large protein complexes that regulate chromatin remodeling, a process that regulates gene expression by controlling access to DNA in genes.

Ha also uses FRET to study how RNA enzymes called ribozymes fold from a string-like conformation into the globular shape that enables them to function. Ribozymes are believed to have evolved before the protein enzymes that are now considered the workhorse catalytic molecules of cells.

Using other single-molecule fluorescence techniques in combination with advanced microscopes and manipulation techniques, Ha studies how malfunctions occur in chromosome separation during meiosis, the process that produces sperm and eggs. Such breakdowns are a major cause of birth defects and the leading cause of miscarriages.

HHMI chose the 43 scientists through a nationwide competition that began in 2004 when the Institute asked approximately 200 universities, medical schools, and institutes to nominate candidates who demonstrated exceptional promise within four to ten years of their becoming independent scientists. More than 300 individuals were nominated.

"We are committed to providing these scientists—and the nearly 300 scientists who are already part of HHMI—with the freedom and flexibility they need in order to make lasting contributions to mankind," said Thomas R. Cech, HHMI's president. David A. Clayton, vice president and chief scientific officer of the Institute, said the new competition allows HHMI to respond to new areas of scientific interest and emerging fields.

Cech said the selection of the new investigators means that HHMI will invest more than $300 million in additional support for biomedical research over the next seven years. The Institute's current annual research budget is $416 million.

According to Ha, "This award will provide ample resources to pursue new directions aggressively and to ask deeper questions that may take many years to answer. One of my scientific mentors told me to 'spend the money wisely.' I am planning to follow his advice whole-heartedly, both the 'spend' part and the 'wisely' part."

Through its flagship investigator program, HHMI currently employs 298 of the nation's most innovative scientists, who lead Hughes laboratories at 64 institutions. These scientists are widely recognized for their creativity and productivity—more than 100 are members of the National Academy of Sciences and 10 have been honored with the Nobel Prize. ▪

Phillips Organizing Caribbean Conference

"Helping out scientists in the third world is an important motivation," explained Physics Professor Philip Phillips, who recently received a National Science Foundation (NSF) grant to conduct a workshop on theoretical condensed matter physics for Caribbean and Latin American scientists. "I always wanted to have a conference on the forefront of science in my home country, primarily to help out science in Tobago as well as to reestablish ties there. This is a large, international conference, the first one ever to come there. We hope to nucleate ties with physicists there and perhaps motivate students there to come to the States to continue their educations."

The Pan-American Advanced Studies Institute (PASI)—jointly supported by the NSF and the Department of Energy—will present a series of lectures on the topic of "Mottness and Quantum Criticality" to be held in Tobago, West Indies, during June 2005. The conference will focus on questions that are central to the unsolved problems of the origin of superconductivity in the cuprates and organic superconductors and non-Fermi liquid behavior in U and Ce intermetallics (heavy fermions).

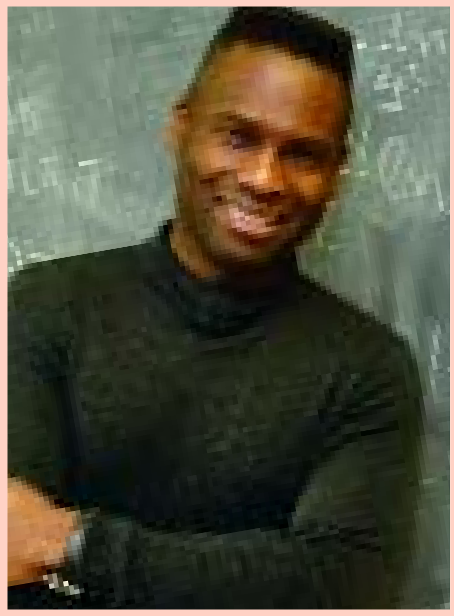


Photo by Bill Wiegand

"Yes, 'Mottness' is my term, and it seems to be catching on in the field," Phillips remarked. "Many years ago, Sir Neville Mott developed a theory for a class of insulating materials now called Mott insulators. What makes Mott insulators insulate is what I call 'Mottness.' That is, it is the strongly correlated electron physics associated with the Mott state.

"Throughout the phase diagram of the cuprates, novel zero-temperature phases emerge upon changing the chemical composition. Chemical doping controls the range of the Coulomb interactions and also introduces disorder via the counter ions. As a consequence, the physics of strong Coulomb interactions that originate from the Mott state, that is, 'Mottness'—a phenomenon distinct from ordering—and the extent to which quantum criticality controls the finite temperature properties of the cuprates have risen to the foreground in solid state physics. As these questions are central to the current debate on strongly correlated electrons, the PASI is timely and is likely to generate further activity in the subject."

The two-week institute will bring together leading researchers in the field. The group will consist of approximately 20 lecturers and 30 graduate students, half from the United States and half from the rest of the Americas, to be selected by the organizing committee. According to Phillips, the invitation list is international.

"I have an organizing committee here in the States," he remarked. "A portion of the conference funding will provide travel and living expenses to support advanced graduate students or postdocs. Students will be chosen on a competitive basis—10 of whom will be from the Caribbean, Mexico, Central and South America."

Phillips is a theoretical condensed matter physicist with an international reputation for his work on transport in disordered and strongly correlated low-dimensional systems. He is the creator of the random dimer model, which shows that Anderson localization fails even in one dimension whenever the defects possess a plane of symmetry. More recently, he has been working on quantum phase transitions and strongly correlated electron systems (*PIN* 2004, No. 1). His work is motivated by experimental observations that challenge the standard paradigms of transport and magnetism in low-dimensional systems. Phillips is a University Scholar at Illinois and a Fellow of the APS. ▪

Phillips Named Bliss Faculty Scholar

In January, Physics Professor Phillip Phillips was recognized with a Bliss Faculty Scholar Award, named in honor of Abel Bliss, a member of the University of Illinois Class of 1875. Phillips is one of five College of Engineering faculty to receive the honor this year. The award, which is targeted for faculty members who are in relatively early stages of their careers, includes a cash stipend to support research and teaching activities.

The Bliss Faculty Scholar Award is the result of a bequest from the late Helen Eva Bliss, in memory of her father, Abel Bliss, Jr. Miss Bliss graduated from the University of Illinois in 1911 with a degree in Liberal Arts and Sciences. Early in her career, she taught engineering at a Shreveport, Louisiana, high school and later did clerical work with the Bureau of Aircraft Production in Washington, D.C. From 1936, until her retirement in 1962, she worked for the Washington law firm of Ivins, Phillips & Barker as an executive secretary.

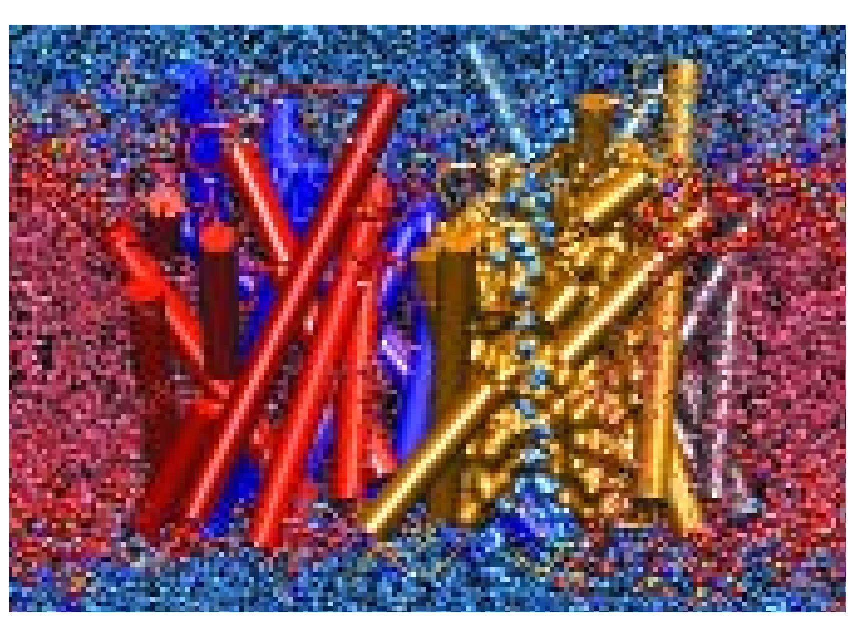
Abel Bliss, Jr. entered the university in 1872 to study civil engineering, but was forced to leave before completing his degree. In June of 1874, the university granted him a partial certificate in civil engineering. His business ventures included agriculture and real estate, and by 1929, he was a partner in the land development and oil production company of Bliss & Wetherbee. Mr. Bliss died in the mid-1930s.

A portion of the Bliss bequest went to support the Grainger Engineering Library and Information Center Endowment as well as other projects for "advancing the scholastic activities of the School of Engineering." ▪

Best Computer Visualization in 2004

Emad Tajkhorshid, assistant director of research for the Theoretical and Computational Biophysics Group (TCBG), and Swanlund Professor of Physics Klaus Schulten were named the winners of the American Association for the Advancement of Science's 2004 Visualization Challenge, Illustration category, for their image of the complex machinery a cell uses to exchange water with its environment. The image was captured in one of the largest atomic simulations ever attempted.

"It was an international contest and about 100 entries from all scientific disciplines were considered," Tajkhorshid explained. "So, we are very proud to have won first place."



Theoretical and Computational Biophysics Group

Their visualization, "Water Permeation Through Aquaporins," is featured in the September 24, 2004, edition of *Science* magazine. According to *Science*, the illustration provides "a revealing look at the complex machinery a cell uses to exchange water with its environment."

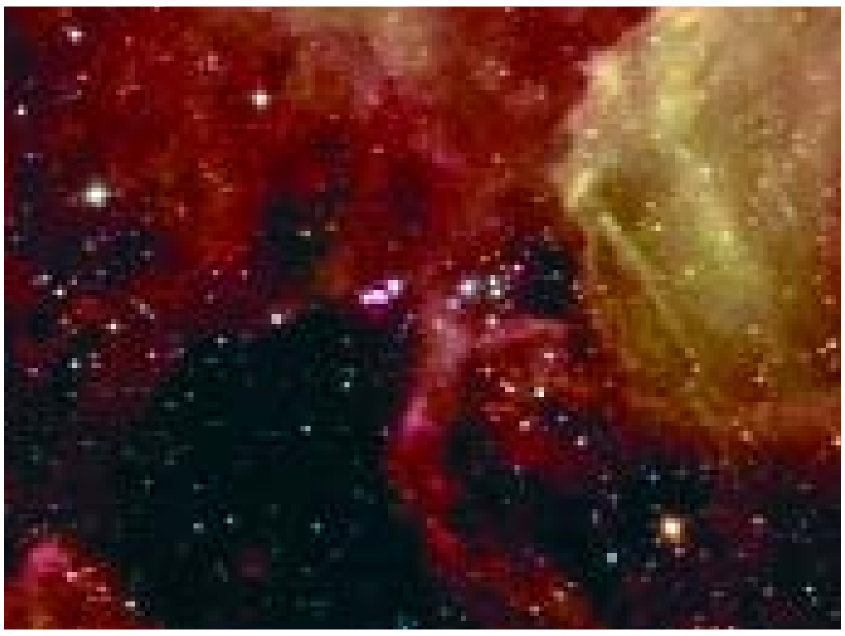
Aquaporin channels provide a conduit for water to cross the cell membrane, but they somehow prevent smaller particles, such as protons, from getting through. To understand this selectivity, Schulten's group constructed one of the largest atomic simulations ever attempted. Four membrane-bound aquaporin channels were assembled from more than 55,000 digital atoms and then "virtual water" was added.

"This is an almost-perfect use of existing [protein-modeling] software," said Felice Frankel, a contest judge. "It intelligently combines many of the methods used to represent proteins while successfully expressing a larger scientific idea." Plus, she said, "it's also very beautiful."

The winning illustration is a snapshot of the simulation in progress. Boomerang-shaped water molecules flip as they march single file through the narrow pore of the gold aquaporin, while the red balls and fibers that make up the cell's membrane keep the outside water (top) from mixing with the cellular pool (bottom). The display allowed the researchers to crack the mystery of aquaporin's discriminating tastes. "The flipping of the water molecules prevents protons from hopping through the pore," says Tajkhorshid, who notes that this novel mechanism of selectivity could not have been determined using traditional experimental methods. ▪

Department News

Dark Energy, Black Holes, and the Search for Killer Supernovae explored at Saturday Astrophysics Program



There's more going on in space than just "space"! This spring, the Center for Theoretical Astrophysics, a joint venture of the Department of Physics, the National Center for Supercomputing Applications (NCSA), and the Department of Astronomy, presented its second annual Saturday Astrophysics Honors Program for high-school students and the public in February and March.

At the first session, Astronomy Professor You-Hua Chu answered the question, "Is a newly discovered, exotic class of black holes sending X-rays in our direction?"

"Dark Energy in Our Expanding Universe" was the topic covered by Professor Joseph Mohr during the second session on February 19. Two weeks later, Professor Brian Fields discussed "When Stars Attack: In Search of Killer Supernovae."

"This series continues to be modeled on the very successful Saturday Physics Honors Program that has just completed its 12th year," explained Susan Lamb, associate professor of Physics and of Astronomy. "As with the Physics Program, the Astrophysics Program is intended to stimulate the curiosity of high-school students interested in the physical sciences." ■

Physics Van is a Snoozeum Hit!

What could be more fun than spending the night under a real 727, nestled near a fairy castle, or camped steps from a toy-making factory…with 1,000 kids?

Armed with a Van de Graaff generator, a couple of Magdeburg hemispheres, a nitrogen cannon, and a few other implements, the University of Illinois' Physics Van crew prepared for the youthful assault at the "Science Snoozeum" event held on February 25, at Chicago's Museum of Science & Industry (MSI).

"Our 'Science Snoozeum,' which takes place several times a year, is designed for organized youth groups of at least ten children ages 7–12," explained Dawnne LePretre-Ryan, manager of public programs at the museum. "We expected about 1,200 attendees, which includes children and their adult chaperones (one adult for every five children in the group)."

"Usually we do assembly-like shows at schools, but this show was a lot more hands-on," explained Physics Van crew member Anthony Karmis. "It was nice because it allowed the kids to actually perform some of the demos, rather than just watch."

"Shows like the one at MSI are great because you have such interaction with the kids and parents," said Kate Jakubas, a junior in materials science. "Each time someone approaches your table, you have to think, 'What is this person interested in finding out?' 'How can I best explain it to them?' You want to get them excited about science, and you want them to learn something too."

In addition to Karmis and Jakubas, the "Snoozeum" crew included Sara Hunsley, Zane Shi, Wing Ho Ko, Bob Pusateri, and Rick Carr, who spent the evening engaged in close-up magic, explaining the science behind the phenomena.

"The most difficult part is knowing your audience," Jakubas explained. "There is so much variance in age to consider. I try and imagine what would have interested me at that age and explain it accordingly. Sometimes older people or parents are around, and you get the chance to explain it in a whole new way with the scientific language that you've acquired from the U of I."

According to Bob Pusateri, a senior in computer engineering and a four-year Physics Van veteran, "We do hands-on shows a few times during the semester; however, never one with this many participants, or with us spending the night afterwards. I thought it went quite well. We had some lines form at times, but everyone was patient and we were able to get all the kids through.

"The overnight part definitely isn't our norm; it was a totally different experience," he added. "I've been on some large overnighters before through my experiences with the Boy Scouts, but never one this big or in a setting like the Museum of Science & Industry."

"Spending so much time with so many children does present some unique challenges, but it has rewards as well," Jakubas added "They are not good at hiding their emotions, so you can really tell when they think something is interesting (which, luckily, is most of the time)."

LePretre-Ryan had nothing but praise for the performances. "We were really delighted to have the Physics Van here and it went really well, I think. They were a very nice and easy group to work with. I believe they enjoyed themselves. I don't know if they counted the number of kids they talked to, but it looked like their tables were busy. We'd love to have to them back."

For Jakubas, the most rewarding part of the trip "was when I had finished explaining to a young girl why balloons shrink when placed in liquid nitrogen. Her friend joined her at the table, and before I could begin to speak to her, the now-expert excitedly did all of the work for me. The fact that she was excited about the physical demo as well as the science behind it means I had done my job well."

Now in its 12th year, the Physics Van (http://van.hep.uiuc.edu) is one of the University of Illinois' most successful outreach programs. Each semester, more than 50 undergraduate physics and engineering student volunteers spend countless hours in the traveling science road show, bringing the wonder of scientific discovery to children.

In addition to the live shows, Van volunteers and physics faculty members staff a web-based, "Ask the Physics Van" service, answering children's questions on such burning issues as: "Why do tennis balls lose their bounce?" (Michael, age 13, Lost Mountain Middle School, Acworth, GA); "How do you get electricity out of a lemon?" (Justin, age 8, Connecticut); and "Do shadows have mass?" (Natasha, age 11, Fort Collins, CO). Questions come from all over the world—Hoopeston, Illinois, PS 153 in New York, the United Arab Emirates, Korea, Republic of Ireland, and Hong Kong.

So, what was it like doing an "overnighter" with a thousand kids?

"The kids were a bit crazy until about midnight or so, so a bunch of us decided to forgo sleep that night, which made the drive home the next day interesting," Karmis remarked.

For Pusateri and others, the MSI show brought back some great memories. "Just being able to be at the museum and then spend the night afterwards—that was the best part," he said. "My parents took me there a lot when I was younger, and I credit those trips with sparking my interest in engineering. I hadn't been there for quite a few years and so much had changed."

As part of this year's Engineering Open House (EOH; March 11–12), the Physics Van crew did a series of demonstrations. The first Physics Van Volunteer Reunion also coincided with the event.

During the weekend of April 1–2, Engineering Council brought the "Best of Engineering Open House"—about a dozen of the best exhibits from this year's event—to the Museum of Science & Industry as part of the Chicago Public School system's annual high school science fair. ■

Building Sandra's House

A little over 15 years ago, Sandra Holloway left Holly Springs, Mississippi, moving north to take advantage of employment opportunities in Champaign-Urbana. Soon after her arrival, she found a job at the University of Illinois, and for the past five years, she has served numerous faculty and students through her job in the Physics library, becoming part of the Physics family.

Although she did have a steady job, having a home for herself and her two daughters remained an elusive dream. But two years ago, Sandra heard about Habitat for Humanity. After contacting the organization, she followed the information trail, attended a homeowners' workshop, and completed an application. Out of several dozen applicants, she and her family were chosen to work with Habitat to build a home. She was touched when her Physics family turned out to help, too.

"Sandra's project is a really wonderful one," explained Laura Huth, executive director of Habitat for Humanity of Champaign and Piatt Counties. "It's not often that we see people from our homeowners' workplaces helping with the building. We have also received several nice donations from her coworkers, and we even have a new board member as a result of this project."

At the end of the nearly two-year process, Sandra and her two daughters—Brianna, 14, and Adrianna, 12—are ready to move into their new home this spring. In addition to her co-workers, the Champaign Rotary Club and WIXY, a local country radio station, contributed to the project. Two brothers from Mahomet, Loran and Logan Shallenberger, hiked the Appalachian Trail to raise money for the Holloway home, and a local bicyclist, Ray Spooner, rode his bike across the country as a fund-raiser—perhaps the first time in history that a bicycle has been used to build a house. The U of I student chapter of Habitat adopted this project, providing the remaining funds and the majority of the labor for the house.

Patricia Collins, staff secretary, and Darren Wright, chief clerk, hard at work on the decking for Sandra's front porch.

Early in the process, Sandra began putting in the sweat-equity hours required for her home by working weekends at Habitat's HOMEWORKS store in Champaign. "Sandra's been an outstanding volunteer," Huth stated. "Not only has she completed her sweat-equity hours (250), but she continues to work in our HOMEWORKS resale store. I think she is setting a very good example for all other prospective homeowners, as well as teaching an important lesson to her daughters."

Brianna and Adrianna, a typical pair of teen–pre-teen sisters, also helped out at the store. Both of the girls have hopes of going to college to become mechanical engineers.

According to Sandra, it's all about the volunteers. "They are giving up their weekend time—their family time—to help me, and I really appreciate that. I enjoy getting up early and working with everyone."

As of February 2005, Habitat for Humanity volunteers have built 36 homes in Champaign and Piatt Counties, giving the dream of home ownership to 162 people, including more than 100 children. Sandra Holloway's new home is one of six more slated for completion in 2005. ▪

Physical Revue R³—Rejected, Recycled, Resubmitted

A standing-room-only crowd packed the Illini Union Ballroom on December 9, 2004, for Physical Revue R³ *(Rejected, Recycled, Resubmitted).* Once again, the audience was treated to a wide variety of the performing arts. Professor Emeritus Donald Ginsberg, in what has become a Physics' tradition, recited several of his original poems, including a tribute to colleague Miles Klein and several stanzas on the satisfactory characteristics of rocks as pets. In keeping with the highbrow tone of the proceedings, the APS 2004 physics haiku contest champion, Celia Elliott, added other deeply insightful poetical works to the program.

Bardeen Professor of Physics and of Electrical and Computer Engineering Paul Kwiat and his dance partner Cindy Schmidt performed an interpretive dance, fusing quantum mechanics and the Big Band, a nice diversion for the astrophysicists and cosmologists, who are more accustomed to thinking about the big bang. With apologies to the Irish, Laura Greene, accompanied by Ian Hobson, sang "O Georgie Boy" to the tune of "O Danny Boy"—a lament about the current administration's science priorities.

In a piece reminiscent of vintage Hollywood musicals, Barry Israelewitz and Rosemary Braun, accompanied by a chorus line of Physics international graduate students, performed a stirring rendition of a song-and-dance number about the difficulty of getting visas for study in the U.S. "Give me your tired, your poor…" it definitely was not.

Images by Rob Dinsmore

Top: Muppets Wendy Wimmer, Eduardo Fradkin, and Paul Kwiat (back row) join Gordon Baym and his first-graders in the uplifting grand finale. No socks were harmed in making the movie. Left: Muppet Gordon Baym as a first-grade teacher. Right: Muppet Nigel Goldenfeld renormalizing the temperature of England, Scotland, and Wales.

Despite the talent and enthusiasm of the live entertainers, however, the show was stolen once again by video. The crowd viewed "Physical Vanity," a documentary examining the sociological ramifications of Physics students, staff, faculty, their cars, and their license plates. A surprising number of particles park in the Loomis lot—PHOTON, PHONON, GLD BSN—where they coexist with DBRANES and other exotica. A definite social stratification appears; very few faculty cars have bumpers held on by duct tape, in contrast to the student cars, which are primarily duct tape. Staff members drive bigger cars than professors, who tend to favor small and sporty. (A ***sporty*** physicist…is that an oxymoron?)

Physical Revue R³ and Rob Dinsmore also made history with the first Physics muppet movie, which featured the search for employment of laid-off faculty after the administration closed Loomis Laboratory. Alan Nathan had a brief but unfortunate stint with the Boston Red Sox, but the hit of the show was Muppet Gordon Baym as a first-grade teacher. Rob played all the characters (and their voices!), with the exception of the real life actors: Joe Gezo and James Reed who did stunts (jumping out of the way of a speeding pizza delivery car), Onur Hosten who played the part of "Ghazi," and the "group singing" voices at the end of the show, which were supplied by many helpful physics students pulled out of the hallway.

A DVD is in production, but don't look for the show at Cannes. ▪

Backward Glance

Physics was famous for its ferocious intramural soccer teams, reigning as campus champions throughout the 1980s. According to a contemporary departmental report, Mike Ma (MS '78, PhD '83) stated in the mid-80s, "They can't pass, they can't dribble, they can't shoot—all they do is score goals." Shown here is the 1987 championship team, the Duke St. Kings. Standing, from left, Phil First (MS '83, PhD '88), Lance Cooper (MS '84, PhD '88), Tim Walhout (MS '85, PhD '89), Tom McGlinn (MS '81, PhD '87), and Elbio Dagotto (postdoc '85–86). Kneeling, from left, Tim Krabach (MS '82, PhD '88), Bill Goff (MS '83, PhD '89), Kevin King (MS '82, PhD '90), Isao Fujita (MS '85, PhD '94), and Jorgen Rammer (postdoc '86–89).

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MISSION

The mission of the Department of Physics of the University of Illinois at Urbana-Champaign is to serve the people of the State of Illinois, the nation, and the world through leadership in physics education and research, public outreach, and professional service.

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