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Department of Physics and Astronomy

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CROSS SECTIONS

SPRING/SUMMER 2007

Ultrathin Metal Alloys as Potential "Hydrogen Sponge"

UT's Physicists Win $1.2 Million for the President's Hydrogen Fuels Initiative

UT physicists, together with ORNL scientists, have won $1.2 million to study hydrogen storage; an endeavor built on metal, magic, and the power of one tiny electron.

The Department of Energy grant actually began with "Tuning the Quantum Stability and Superconductivity of Ultrathin Metal Alloys," published in the June 15 issue of *Science*. Professors Jim Thompson, Hanno Weitering, and Zhenyu Zhang co-wrote the paper with lead author Murat Özer (Ph.D., 2006) and Yu Jia, a visiting professor from Zhengzhou University (ZZU) in Zhengzhou, China.

The UT/ORNL/ZZU collaborative team reports on an alloy made from lead and bismuth, as well as the discovery that thin films made from these metals can be "tuned" at the atomic level. While they have had previous success using lead alone to grow very flat, smooth films, the addition of bismuth revealed some interesting new ideas about how materials behave at the nanoscale.

Ultrathin films are typically only five to 20 atoms thick. While a metal or an alloy may be well understood in bulk form, in quantum systems like this, Weitering explains, all bets are off.

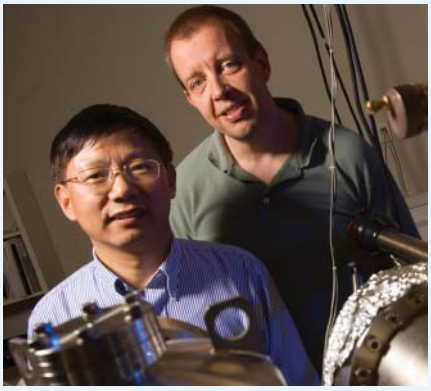
"Small scale materials can just behave very differently," he says. "The properties are dictated by quantum mechanics."

As he explains it, the group drove the bismuth-lead alloy into the "quantum regime" by changing the temperature. Bismuth and lead sit side-by-side on the periodic table, with bismuth having one more electron than its neighbor.

"That extra electron does the trick," Weitering says. By changing the number of electrons in the film, "we've found that you can tune the growth morphology. That means you can do microscopic measurements as a function of thickness, where you know exactly what the thickness and compositions are. To have that perfect control is usually very hard."

Although scientists have grown thin films for years, in the past it was difficult to control their size and structure because extremely thin films usually self-destruct, forming tiny droplets. Weitering explains that it wasn't until the late 1990s that researchers discovered how to clear those hurdles. Zhang and his collaborators, in fact, discovered "magic layer thicknesses" in these tiny systems that can stabilize the film, making it possible to grow smooth layers.

The UT group found that by fine-tuning the way a film develops, they can determine its behavior.



Zhenyu Zhang and Hanno Weitering

"By tuning the growth mode," Weitering says, "we were able to tune superconducting properties."

That discovery inspired them to consider the idea that if you could tune the physical properties of quantum systems, perhaps it's possible to change their chemical properties as well, in effect devising "a knob" of sorts to tune chemical reactions.

Quantum Leap to Hydrogen

When DOE requested proposals for research supporting the President's Hydrogen Fuel Initiative, UT's physicists saw an opportunity to apply their quantum tuning concept to hydrogen chemistry.

"The hydrogen grant proposal was inspired by this quantum growth," Weitering says.

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IN THIS ISSUE

Department Head
Soren Sorensen

STEM Initiatives and Physics Education Research

Slowly our nation is realizing that we have a looming crisis on our hands: we do not graduate a sufficient number of people with degrees in the STEM (Science, Technology, Engineering, and Mathematics) fields. After a rapid increase in STEM degrees in the 1960s and '70s as a result of educational and research investments done due to the Sputnik scare, the interest in STEM has been decreasing for the last 25 years relative to other fields in the humanities and social sciences. However, the economy and defense of our nation needs a steady supply of people with a strong background in STEM areas. Furthermore, we need these people here in the US in order to stay competitive with the rapidly expanding economies overseas, in particular in Southeast Asia. The report from the National Academies, *Rising Above the Gathering Storm*, (http://www.nap.edu/catalog/11463.html) points out that "Economic studies conducted even before the information-technology revolution have shown that as much as 85% of measured growth in US income per capita was due to technological change." And a few years ago Alan Greenspan pointed out that the major reason for our strong economy over the last 15 years has been improvements in technology. This is likely to be even more pronounced in the future as more and more simple production jobs go overseas, and we have to keep our economy strong by relying on our capabilities to produce advanced products and services.

The publication of *Rising Above the Gathering Storm* has fortunately created a lot of awareness about this problem among politicians and educators. And not just awareness: it now looks like there are several legislative initiatives likely to be passed that will try to address the problem through increased funding for research in the STEM fields and, in particular, for educational initiatives aimed at increasing the number of STEM graduates. A key element in all the various bills is the strong support for increased production of competent K-12 teachers in STEM fields. It is at this level our nation initially will need to "harvest" more young people for STEM. Both at the national and state level there are now initiatives for additional scholarships for students in these fields who promise to become teachers afterwards. Several federal agencies have increased funding for educational initiatives at the university level for improving STEM teaching and STEM student production.

At the state level, Tennessee has a severe shortage of competent science teachers and, in particular, physics teachers. According to information from Lynn Champion, Director of Outreach and Communications for the College of Arts and Sciences, Tennessee has only 261 educators with valid licenses in physics and many of them might not even be teaching anymore. Since Tennessee has 731 public and accredited non-public high schools, this means only about one-third of all high schools have a licensed physics teacher! Both the President and our governor have started programs encouraging professionals like engineers to become STEM teachers. But programs like that are stop-gap measures and not a substitute for solving the problems the only correct way: by educating a new generation of dedicated teachers in STEM fields and, in particular, in physics.

Needless to say, the physics department wants to play a major role in educating the next generation of high school teachers in physics. Historically, this is not an area we have excelled in. We have a great program aimed at preparing our bachelor's students for graduate school in physics. Our students are among the best and brightest at UT, with higher average ACT scores than most other programs. However, we do not have many students who manage to graduate with a B.S. in physics who have ACT scores comparable to "average UT students." We need to provide an education in physics to students who wish to become teachers and who have test scores just as good as the average history, German, or social studies major. To do that, we need to generate a new and innovative physics curriculum for our General Concentration with a stronger emphasis on conceptual physics and integrated laboratory exercises and without the current requirement of excellence in advanced mathematics, which is not required in order to become a top-notch K-12 physics teacher.

Based on the deliberations leading up to our new strategic plan, we decided to develop a set of three new upper-division courses: Physics 380, 381, and 382. For the students in our General Concentration, these three courses will partially replace the upper-division core courses in Classical Mechanics, Statistical Mechanics, Electricity and Magnetism, and Quantum Mechanics. (These are required for our majors in the Academic Concentration and provide the background needed to get accepted into a physics graduate program.) Developing and teaching the Physics 380-382 sequence will be a challenging task. Few colleges have a course sequence like this; most generally just teach a "watered down" version of the core courses. However, we are not satisfied with such an approach. Physics education research has made great strides over the last

("Hydrogen Sponge," continued from page 1)

With fellow physicists Zhang and Distinguished Professor Ward Plummer, Weitering submitted a proposal to investigate "Quantum Tuning of Chemical Reactivity for Storage and Generation of Hydrogen Fuels." In May 2007, DOE announced $11.2 million in funding for hydrogen research, and the trio's proposal won one of only seven grants awarded to study novel materials for hydrogen storage and the only one within the DOE national systems to start this year.

Hydrogen has emerged as an attractive candidate for energy purposes because it has a high energy content and produces no harmful emissions when used in fuel cells. How to store hydrogen, however, has been a challenge, in part because in previous efforts the temperature required to absorb or release it has been either too high or too low.

"What we hope to do first is demonstrate that through these quantum effects one can actually modify the desorption temperature of the hydrogen," Weitering says. "Ideally, you want to bring it down."

Instead of using heavier elements like lead and bismuth, UT's scientists will work with magnesium, aluminum, and sodium to test their chemical tuning principles. For possible fuel cell applications in the auto industry, Weitering says, a lightweight material is the best option.

"Magnesium happens to be a lightweight material that soaks up hydrogen," he says. "But it's not only how strongly does the hydrogen bind to the magnesium, but also how easily it goes in; it's what we call kinetics. Thermodynamics tells you about energetics and kinetics about how easy it is to get in and out. We also think we can control that with quantum size effect."

With bulk magnesium, temperatures of around 300 or 400 degrees centigrade are required to release hydrogen. Zhang and Jia have already worked through preliminary calculations predicting that quantum engineering can lower the desorption temperature by at least 100 degrees.

The project is funded for three years, during which Weitering says he and his colleagues hope to demonstrate that hydrogen chemistry—absorption, desorption, and diffusion—can be controlled. He, Zhang, and Plummer all have joint appointments at Oak Ridge National Laboratory and the research will be conducted both at ORNL and on UT's campus. Weitering says it's a good way for joint faculty to contribute to the national laboratory's mission. It's also a return to a niche he first explored as a Ph.D. student working with lead films on silicon.

"Twenty years later," he says, "you can still have fun with these materials systems."

decade, but mainly in how to teach freshman physics for a variety of audiences. What is needed here is a fresh and modern approach for teaching upper-division physics for students who are not aiming at a graduate education in physics. We think that instead of just following way behind others, our department should take on a leadership position and develop these courses in such a manner that other colleges and universities can later emulate us when they wish to educate more K-12 teachers.

Therefore, we wish not just to generate three new courses. We wish to generate a Physics Education Research (PER) program with the initial aim of developing physics educational methods for optimizing the curriculum for future K-12 physics teachers and others whose professions aren't strictly geared toward physics.

Our department already has a strong group of professors who have made major contributions to developing new and exciting physics courses and who will be part of the new PER group. In addition, we have been very encouraged by the fact that the College of Arts and Sciences made a new faculty position in PER one of the priorities in the budget proposal Dean Bursten presented to the UT administration a couple of months ago. Getting a faculty member dedicated to advancing the physics education research program will provide strong momentum for getting external funding for initiatives in this field.

The PER group will also play a major role in another exciting project related to the STEM issues. Governor Bredesen has decided to create a new high school dedicated to educating the best and brightest of Tennessee's high school students. The Tennessee Governor's Academy for Mathematics and Science will start in August with 24 students at the junior level. The school will be housed at the Tennessee School for the Deaf, located just a few miles from the UT campus. The academy will have a new and exciting curriculum that will be very different from the standard Tennessee high school curriculum. In science it will be based on some of the ideas behind the Physics First program (teach Physics before Chemistry and Biology), and much emphasis will be placed on interdisciplinary studies. Part of our PER group is already intimately involved with the development of the curriculum and most of the laboratory exercises will be done here in the department using our first-class equipment. Getting a chance to develop a complete new high school physics curriculum for highly motivated students is a once in a lifetime opportunity for a PER group. It is like the Governor has placed a new laboratory for the PER group right in our backyard!

It is important to emphasize that the PER group will be responsible for much more than just developing new courses. Like all other physics researchers, the group will be required to publish educational research results in peer-reviewed journals and to obtain external grants to fund their research activities. The support for this Physics Education Research initiative has been strong within our department. Now we just have to hope that the rest of our university will also recognize the importance of having strength in science education, and will support our Physics Education Research initiative as a vanguard for obtaining a strong position for UT in "Rising Above The Gathering Storm."

Nice Work!

Honors Day Rewards Academic, Research, and Teaching Excellence

Physics paid tribute to outstanding achievement on April 23 at the department's annual Honors Day celebration. Each spring, top students are recognized for their academic and research accomplishments, while the students themselves select a faculty member to honor with the Society of Physics Students Teacher of the Year award.

Dr. Loren Crabtree, Chancellor of the Knoxville campus, was the invited speaker for the event. He reflected on C.P. Snow's 1959 Rede Lecture on *The Two Cultures and the Scientific Revolution* and addressed the need for a wider, more all-encompassing view of the world that bridges science and the humanities, borrowing from the strengths of each.

The physics department also honored the late Dr. Edward Arakawa with the Distinguished Alumni Award. Dr. Arakawa, who passed away in March, earned the Ph.D. in 1957 working with Dr. Alvin Nielsen and was an important figure in the lives of many UT physics graduate students. His citation read, "For his outstanding contributions to optical spectroscopy and condensed matter physics; and for his many years of service to graduate education through the mentoring of graduate students working at Oak Ridge National Laboratory." Mrs. Harue Arakawa accepted the award on her husband's behalf. The department instituted the award in 2004. Previous honorees include Sam Hurst, Raymond Murray, Rufus Ritchie, and Robert Talley.

Mrs. Harue Arakawa accepts the Distinguished Alumni Award on behalf of her husband, the late Dr. Edward Arakawa.

The 2007 student honors included a new accolade: The Wayne Kincaid Award. Wayne Kincaid was both an alumnus of the department and a research associate who was deeply interested in educational technology, astronomy education, and scientific writing. He passed away in 2004, and with this award the department recognizes a student who shares his interests and has made similar contributions. The physics department also gave special recognition to the science department and physics teachers of Oak Ridge High School for their valuable contributions in preparing students for higher education in the sciences.

Suzanne Parete-Koon won the inaugural Wayne Kincaid Award.

The student awards and recipients were as follows:

Outstanding First Year Physics Student
John Whittingham

Robert Talley Award for Outstanding Undergraduate Research
John Sinclair

Douglas V. Roseberry Award
Jason King

Robert W. Lide Citations
Billy Grubb, Meagan White, Jay Billings

Outstanding Graduate Teaching Assistant Award
Kyle Schmitt

Wayne Kincaid Award
Suzanne Parete-Koon

Colloquium Award
Hua Chen and Rachel Wooten

Paul H. Stelson Fellowship for Beginning Research
Usama Al-Binni

Paul H. Stelson Fellowship for Professional Promise
Juan Urrego-Blanco

Fowler-Marion Outstanding Graduate Student Award
Stephen Wilson

The **Society of Physics Students Teacher of the Year Award** was presented to Dr. Alex Zucker.

Additionally, the following students were inducted into **Sigma Pi Sigma**, the physics honors society: Jay Billings, Te-Yu Chien, Jack Hunt, Byron Kilbourne, Ozgur Polat, and Alex Woods.

More pictures and awards background are online at: http://www.phys.utk.edu/news.html.

SPS President Steven Boada (right) presents the Teacher of the Year Award to Dr. Alex Zucker.

Finance to Physics

Alumnus Richard Manley

It's a good thing for physics that Richard Manley's career in car sales was not all that successful. Otherwise the department might have missed the opportunity to claim this Navy research scientist as an alumnus.

Speaking by phone from his Florida office, Manley explains how his career didn't exactly originate with the sciences. In fact, the native of Decatur, Tennessee, first graduated from UT in 1992 with a degree in finance and then spent three months working for an auto dealership as a salesman.

"I sold two cars that whole summer," he says.

He left the car lot for a job with a small savings and loan association in Etowah and then transferred to a bank in Sarasota, Florida. That's when he began reviewing his professional interests.

Manley recounts how the mechanics of any system could always capture his attention. When he was about seven years old, for example, he got a toy "shoot'em gallery" with a BB gun and target.

"I played with it a little bit and then tore it completely apart to see how it worked," he says.

Science and the way things work held his interest through high school, when he began reading about markets and economics, eventually deciding on finance as a college major. Yet when he started working for a bank, he says, "I realized it was the analytical part that interested me, not the business part."

While walking through a Sarasota bookstore he noticed a book on Einstein's theory of relativity and decided to buy it. He took it home and began reading, although he says the subject matter was pretty daunting at first. Undeterred, he bought a paperback introduction to physics—one that covered the basics from balls dropping to the speed of light. That's when he decided to go back to school and study physics.

"Everybody but me was floored," he says.

Manley returned to Knoxville and with the encouragement of his wife, Melissa, enrolled in the physics program at UT. He jumped headlong into life in the department, working on optical communication and learning to trap and cool rubidium atoms. He was a teaching assistant in Professor Marianne Breinig's optics class and volunteered with the Science Olympiad. He helped set up the department's homecoming booth and was a regular at the Society of Physics Students' weekly coffee and doughnuts gathering, as well as the annual physics picnic.

Manley finished a bachelor's degree in engineering physics in 2001 and a master's in applied physics in 2003. He says getting to know the other students and faculty was his favorite aspect of the department, followed closely by the hands-on physics experience he gained outside the classroom.

He says Jim Parks, director of the undergraduate laboratories, sent him to the lab and told him to learn data acquisition software for undergraduate experiments. Manley proved to be a natural at programming, so much so that he even taught Melissa, an accountant, how to apply Visual Basic software to the spreadsheets she used in her work.

That programming experience landed him an internship with the Naval Surface Warfare Center in Panama City, Florida, in the summer of 2001. When he finished his master's degree two years later, the center hired him full-time as a research scientist. Manley credits Breinig and Parks, along with Professor Stuart Elston, for giving him the background that won him the position.

"I wouldn't be able to do what I do here without those three professors," he says.

What he does is no small assignment. Technically he works for the Department of Defense under the Department of the Navy. His research group takes on projects for all branches of the military and Manley is responsible for the design, development, and testing of optical-based systems. He is the lead scientist on several initiatives, including an underwater optical and micro-display system for Navy divers using high-resolution imaging sonar systems. He also works on sophisticated GPS navigation systems for U.S. Marine special reconnaissance teams flying night-time missions.

As his supervisor Dennis Gallagher writes, the "same UT grad just happens to be the Navy's lead guy for the navigation software, HMD (helmet-mounted display) system, and GPS-microprocessor-sensors-software integration."

Next up is a meeting in San Jose to transition a prototype night vision system into manufacturing. There's a parachute navigation system that's moving into production as well.

Richard Manley

"Usually it takes years to get stuff into the fleet," Manley says, so to have two projects moving quickly in that direction is very rewarding.

Although his work takes him all over the country for field tests and meetings, Manley finds time to run, bike, and swim—three of his favorite avocations (he completed the Gulf Coast Triathlon on May 12). He and Melissa are also the proud owners of Emma, a Great Dane who just celebrated her second birthday.

And these days, he says, he keeps his auto experience to tooling around Panama City.

Research Highlight

A Smashing Good Idea

UT Physics Part of the LHC Collaboration

By Suzanne Parete-Koon

University of Tennessee physicists have joined a worldwide collaboration that will use the Large Hadron Collider (LHC) at CERN to look deeper than ever before into the matter and forces that created our universe. The 17-mile circumference collider, which straddles the border of Switzerland and France, will allow scientists to smash protons together at energies that were present just after the Big Bang. The collisions will occur 600 million times a second, producing an enormous number of particles and vast amount of measurements. Assembling these tiny bits of information into a Big Picture will require breakthroughs in radiation detection, fast communication, and computing. Scientists hope the experiment will lead to an unambiguous detection of the elusive Higgs particle, which is believed responsible for giving all things mass. Also among the wreckage from each collision may be evidence for dark matter, extra dimensions, new particle types, and microscopic short-lived black holes.

Assistant Professor Stefan M. Spanier, who heads the UT contingent of the collaboration, explains the complexity of making sense of the data that will emerge.

"Getting knowledge from these particle experiments is analogous to the process of hitting a clock with a hammer and finding how it works by studying the pieces that come out," he says. "The LHC is the largest hammer ever applied to particle physics."

The UT High Energy Physics group is contributing to the LHC's experiments by preparing the silicon pixel detector, a device that detects incredibly small and short-lived particles. It consists of 66 million individual sensors that have to be inspected 40 million times a second and is the first detector in the line of fire, wrapping completely around the spot where the protons collide. It is part of the much larger assembly of detectors called the Compact Muon Solenoid (CMS), which surrounds the beam line at the collision site like layers of a scroll.

Members of the group will spend their summer at CERN developing data handling algorithms for the pixel detector. Among them will be physics undergraduate Matt Hollingsworth. Hollingsworth will be working with post-doc Jose Lazoflores to develop a system that analyzes how much radiation the pixel detector can safely take. If the proton beam starts to damage the detector, Hollingsworth's programs will be part of the mechanism that warns the scientists and, in the worst-case scenario, shuts down the beam. He is essentially going to be programming the "off switch" for the largest piece of scientific equiment on the planet.

Undergraduate Matt Hollingsworth is working on the Compact Muon Solenoid (CMS) at the LHC this summer.

Hollingsworth says, "It's kind of scary to have this much responsibility, but it is a group effort." Laughing, he adds, "Luckily if there is a problem they will come looking for Dr. Spanier first."

The group will also be writing algorithms that track the paths of the particles as they pass through the layers of the detector.

READYFORTHEWORLD

"The detector has several layers," Hollingsworth says. "All you see in each layer is a blip of data where the particle went through. You have to write an algorithm to determine if the blips from different layers correspond to the same set of particles and essentially connect the dots to find the track."

The paths can help scientists determine the identities of the particles that made them.

The data amount generated by this experiment will be exceptional: per year the storage of the signals collected from the detector would fill 20 million CDs. The computing power required to search for new phenomena in these data is equivalent to 100,000 conventional desktop computers. To tackle this challenge, a completely new infrastructure with worldwide-distributed computing resources had to be invented. Simply referred to as "the Grid," it will allow scientists all over the globe to share computer power and data storage capacity over the Internet. It is expected to be the next breakthrough after the World Wide Web, with potentially an even greater impact on everyday business. Nodes of the Grid will be located in facilities all over the world. One will be housed at UT's newly acquired Metron building at the west end of Cumberland Avenue. Time on the local Grid node will be available for other UT scientific computing projects when it is not analyzing data from the LHC. The group's prototype cluster already connects UT to the Grid world.

The Large Hadron Collider is scheduled to begin operation in November 2007. The members of the UT High Energy Physics group who participate in the CMS experiment are Assistant Professor Stefan Spanier (Principal Investigator), Professor Thomas Handler, post doctoral researcher Jose Lazoflores, graduate students Giordano Cerizza and Andrew York, undergraduate Matt Hollingsworth and researcher Gerald Ragghianti. Their involvement in the experiment fundamentally integrates into the university's "Ready for the World" initiative.

As Hollingsworth says, "It is empowering to know that many people can come together and make something like this happen that one person couldn't ever do alone."

Suzanne Parete-Koon (M.S., 2001) is a Ph.D. candidate in physics.

The Material Point

UT and Zhejiang University Build a Partnership in Materials Research

Professors Ward Plummer and Lee Riedinger went to Hangzhou last fall and came back with an agreement linking UT with one of the top universities in China.

The November 19 signing ceremony at Zhejiang University is the first step in developing a partnership between the UT-ORNL Joint Institute for Advanced Materials (JIAM) and the Center for Quantum Science and Engineering (CQSE) at ZU. The institutions share an interest in materials science and the signed memorandum of understanding, or MOA, outlines how they can work together to strengthen one another's programs.

Zhejiang University is located in Hangzhou and was established in 1998 with the merger of four Chinese universities. It is home to 24 colleges and more than 40,000 full-time students, with two national engineering research centers and three national engineering technology centers. Riedinger calls it "the MIT of China."

The idea for a joint materials program with UT surfaced when Jian Shen nominated Plummer as Guangbiao Jianzuo Professor of Physics at Zhejiang University. Shen earned a bachelor's degree at ZU and is now a scientist at Oak Ridge National Laboratory with an adjunct position in the physics department. Shen and Plummer traveled to China to celebrate the professorship, and "that's when they (ZU) made this proposal of something much bigger," Plummer says.

Plummer, who holds a joint position as Distinguished Professor of Physics at UT and Distinguished Scientist at ORNL, is the director of JIAM. The multi-million dollar institute is slated to open in 2010 and will be a world-class center for the study and synthesis of new, novel materials designed to meet challenges in areas like information technology, energy, and transportation.

As outlined in the agreement with ZU, Plummer will also be the acting director of CQSE. His primary responsibilities will be to build the program, hire scientists, and work with the Chinese Academy of Sciences to secure funding. He'll spend three months each year in China once the program gets going. Zhejiang University will hire a deputy director from China who will work with Plummer for a few years and then take over as director. Shen will be the associate director and will manage the exchange programs.

The partnership will include joint workshops, exchange programs for faculty and students (both undergraduate and graduate), equipment acquisition and access, and a joint academic degree.

"Partnerships are built around people."

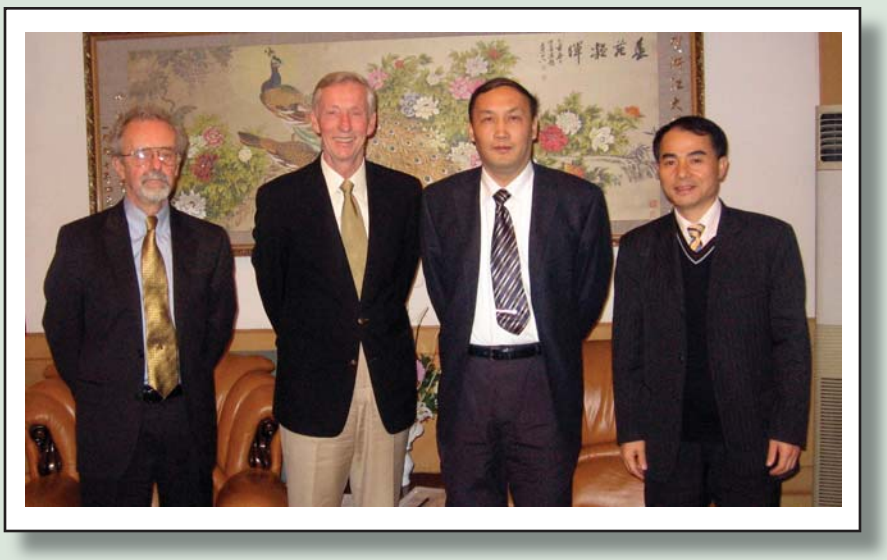
"That's really the thing that's different," Plummer says of the latter, which will give students a doctoral degree from both the University of Tennessee and Zhejiang University. He and Riedinger discussed this and other aspects of the agreement during a *Campus Conversation* with Chancellor Loren Crabtree, which aired in February.

"The partnership with UT through the signed MOA will break new ground by offering a truly joint Ph.D., something neither side has done before," says Riedinger, who is returning to the physics department after finishing a term as interim Vice Chancellor for Research. He adds that the November trip to China also revealed quite a few differences since he last visited.

"The changes I have seen in China in the last 23 years are amazing, and this is exemplified with what Ward and I saw at Zhejiang University," he says. "They have built a large new campus of more than 30 buildings on the edge of Hangzhou. The vastness of this, and the style and beauty, would be the envy of anyone in higher education in the U.S."

Riedinger attributes the partnership's promise to the reputation Plummer, Shen, and their UT and ORNL colleagues have built with the faculty and administration at Zhejiang University.

"Partnerships are built around people, and we are fortunate to have Ward's leadership taking us in this new direction," he says.



Ward Plummer, Lee Riedinger, Zhejiang University President Wei Yang, and ZU Vice Chancellor for Academic Affairs Gao-Xiang Ye

New Faculty

Magic Nuclei & Movie Magic

Dr. Kate Jones

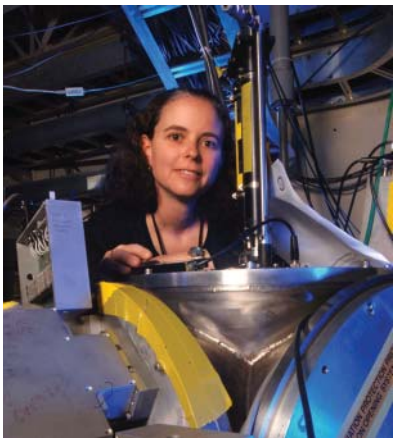
When Kate Jones chose to study physics she had no idea that one day she would work for the Queen of England and somehow get tangled up in publicity with the Bond Girl from *The World is Not Enough*.

Jones, who joined the faculty as an assistant professor in 2006, works in experimental nuclear physics. Originally from Canvey Island off the coast of Essex, England, she says that as a youngster she liked science, was good at math, and had a penchant for music—a combination that eventually drew her into her physics.

"I came in through acoustics," she says, earning her bachelor's degree in physics with acoustics at the University of Surrey in 1996.

Jones worked for a year as an engineering consultant after finishing her undergraduate degree, but says acoustical engineering turned out to be uninspiring at times.

"It would always be in the dodgiest parts of buildings," she says of her work—trolling through basements or hanging out on rooftops to measure background noise from underground trains, air conditioning units, etc. Or sitting in a car for 24 hours with a microphone through the moon roof.



Kate Jones (photo courtesy of Oak Ridge Associated Universities).

Although she says it was nice to walk through London and look at buildings she helped design, it didn't take long before she decided to do something different.

"I realized I wanted to do something more fundamental," she says.

So she returned to Surrey, earning a Ph.D. in experimental nuclear physics in 2001. Along the way, her doctoral research took her to Australia, Germany, and France, where she met her husband, Robert Grzywacz, also a nuclear physicist. (He joined the UT physics faculty in 2003.) She even fielded media questions about being a young female nuclear physicist named Jones after the release of *The World is Not Enough*, a James Bond film that co-starred Denise Richards playing a nuclear physicist named, of all things, Dr. (Christmas) Jones.

In 2003, Jones (Kate, not Christmas) won a Lindemann Trust Fellowship, an honor awarded to graduates of exceptional promise who have shown capacity for achieving original research. The fellowship, which had royal sponsorship, allowed her to work at Oak Ridge National Laboratory through an appointment with Rutgers University.

Jones' research digs into the very stuff present at the start of the world: the nuclei found in the province of astrophysics—supernovae and the death of stars. Specifically, she studies the region around tin-132, whose nuclei comprise 50 protons and 82 neutrons and as such fall into a very special category of nuclei known as "doubly magic nuclei." This is because both 50 and 82 are considered magic numbers as they help make nuclei more stable by virtue of their architecture—they have closed shells. She used a neutron-rich beam of tin-132 produced at the Holifield Radioactive Ion Beam Facility and then transferred a neutron to it to see what influence these doubly-magic properties have on tin-132's next-door neighbor, tin-133.

The research was featured in the Oak Ridge Associated Universities 2006 annual report and was conducted through the Center of Excellence for Radioactive Ion Beam Studies for Stewardship Science. This center is a partnership between ORAU's University Radioactive Ion Beam Consortium and Rutgers University. Jones also works closely with the ORNL Physics Division and is a member of the UT astrophysics group.

After spending a lot of time working on large projects at national laboratories, Jones says she welcomes the contact with students and the wider faculty that comes with her appointment at UT.

"There is a broadening that happens, coming back to a university," she says.

She will teach Physics 232 (Waves, Optics, and Modern Physics) in the fall semester, as well as pursue new research, she hopes with beryllium.

She and Grzywacz have a two-year-old daughter named Anna Louise who Jones says has inherited her parents' love for music. Do they think she'll follow in their footsteps and become a nuclear physicist?

Jones laughs at that one.

"We think she'll be a banjo player," she says.

"There is a broadening that happens, coming back to a university."

Spring 2007 Retirements

The close of the spring 2007 term brought with it the retirements of Professors Tom Callcott, Solon Georghiou, David Pegg, and C.C. Shih. They leave with a collective 146 years of experience in the physics department, but fortunately they'll still be on campus from to time to continue their contributions to research and education. The department honored them with a retirement reception on April 30, recounting the work and wisdom of these four professors.

Professor Tom Callcott

Tom Callcott earned a B.S. in physics from Duke University in 1958 and a Ph.D. at Purdue University in 1965. After three years with AT&T Bell Laboratories, he joined the physics faculty at the University of Tennessee in 1968.

Callcott's research involves soft x-ray fluorescence spectroscopy and he has helped design and build spectrometers for the National Synchrotron Light Source, the Advanced Light Source, and the Center for Advanced Microstructures and Devices synchrotron source at Louisiana State University.

Callcott served as director of the Science Alliance from 1991 until 2000. Under his guidance this center of excellence recruited leadership through the Distinguished Scientist program and supported research efforts in the university's science departments. He also served on the committee that put together the proposal for the university and Battelle to manage ORNL. He is a fellow of the American Physical Society and has been recognized with a Chancellor's Award for Research and the R&D 100 Award for Scientific Equipment Design. He will teach a freshman seminar next year and is also developing an undergraduate physics textbook. He plans to maintain a research program in condensed matter physics.

Professor Solon Georghiou

Originally from Cyprus, Solon Georghiou earned a B.S. in physics at the University of Athens in 1962, followed by M.S. and Ph.D. degrees in photophysics from the University of Manchester in 1965 and 1968, respectively. After finishing his doctorate, he returned to Cyprus and taught for two years at his high school alma mater. Georghiou then worked as a post-doc at the University of Minnesota in Minneapolis and Johns Hopkins University, joining the physics faculty at UT in 1973.

Georghiou's research specialty is molecular biophysics and he has spent 20 years working out the properties of DNA. A venerated teacher who holds the transfer of knowledge as sacrosanct, he estimates that at a minimum he has taught 3,000 students at UT, many of them pre-med majors. Georghiou has been an advisor in the department for two decades and this past year also served as an advisor in the College of Arts and Sciences. His plans include continuing biophysics research and translating texts from the ancient Greek.

Professor David Pegg

David Pegg earned a bachelor's degree in physics at Manchester University in England in 1963. In 1968 and 1970 he received a M.S. and Ph.D., respectively, from the University of New Hampshire. He joined the faculty in 1971.

Pegg's research is in atomic physics. He has done extensive research at ORNL and was principal investigator for a group using the Advanced Light Source at the Lawrence Berkeley National Laboratory. Pegg is a fellow of the American Physical Society and has been a consulting editor for the *McGraw-Hill Encyclopedia of Science and Technology*. In 1997 he held a research position at Chalmers University of Technology in Göteburg, Sweden, which began a fruitful and ongoing collaboration. He has lately become involved in using all sorts of multi-media, so he will spend time in The Studio at Hodges Library to learn more about digital photography and videography. He'll also be at the Vols' home football games, as he's been a season ticket holder since 1970.

Professor C.C. Shih

C.C. Shih earned a B. S. in physics from National Taiwan University in 1961 and a Ph.D. from Cornell University in 1967. He worked for two years each as a research associate at Brookhaven National Laboratory and Carnegie Mellon University before joining the physics faculty in 1971.

Shih's research involves theoretical and particle physics as well as biophysics (he and Georghiou work together on the latter). He also enjoys pursuing experimental research and computational sciences.

For the past several years Shih has tirelessly navigated the department's graduate admissions program, guiding potential students through the process, and, as he says "putting himself in their shoes."

He plans to continue his biophysics work with Georghiou and also to work on developing "gadgets" and tools for people with disabilities.

Physics faculty members honored on April 30 were (front row, left to right): C.C. Shih, David Pegg, Solon Georghiou, and Tom Callcott. Behind them are current and former department heads Soren Sorensen, Bill Bugg, and Lee Riedinger.

News from the Physics Family

Faculty

UT physicists co-authored "Effect of antiferromagnetic spin correlations on lattice distortion and charge ordering in $Pr_{0.5}Ca_{1.5}MnO_4$," published June 26 in the *Proceedings of the National Academy of Sciences of the United States of America*. UT's authors were **Songxue Chi**, **Pengcheng Dai**, **Jaime Fernandez-Baca**, and **Ward Plummer**.

Physical Review Letters chose "α decay of ^{109}I and its implications for the proton decay of ^{105}Sb and the astrophysical rapid proton-capture process" as an editor's suggestion for May 25 issue of the journal. Authors with UT physics ties are **Chiara Mazzocchi**, **Robert Grzywacz**, **Carrol Bingham**, **Agnieszka Korgul**, and **David Simpson**. Papers with this distinction are chosen for their clarity in communicating their message and potential interest in the results presented.

Anthony Mezzacappa co-authored "Pulsar spins from an instability in the accretion shock of supernovae," which appeared in the January 4 issue of *Nature*. He is a an adjunct associate professor and a member of the Oak Ridge National Laboratory Physics Division.

All retired faculty members are invited to meet for an 11:45 a.m. luncheon on the first Thursday of each month at Wong's Palace, 4009 Chapman Highway. For more information, contact Ed Hart at (865) 694-2020.

Students

Congratulations to our May 2007 alumni: undergraduates **Steven Boada**, **John Carruth**, **Joe Hawks**, **David Hill**, **Shaun Kelly**, **Jason King**, **Jesse Ogle**, **John Sinclair**, and **Jason Therrien**; and graduate students **Phil Evans** (Ph.D.), **Junsoo Shin** (Ph.D.), **Gerald Ragghianti** (M.S.), **Zia Tompkins** (M.S.), **Jim Trimble** (M.S.), **Tony Wald** (M.S.), and **Stephen Wilson** (Ph.D.).

Alumni

Watheq Al-Basheer (Ph.D., 2006) is an assistant professor at the Hashemite University in Jordan.

Ted Corcovilos (B.S., 1999) successfully defended his Ph.D. thesis at Caltech in June.

Dharmin Desai (Ph.D., 1997) is an assistant professor in the department of radiation medicine at the University of Kentucky School of Medicine.

Andi Hermanto (B.S., 1997) is a UNIX administrator/NC manufacturing engineer with Boeing Commercial Airplane in Oak Ridge.

Jack F. McMillan (B.S., 1979) is a physics and astronomy instructor at Hawaii Pacific University.

Dustin Osborne (B.S., 2003, M.S., 2005) is an Applications Specialist with Siemens and a Ph.D. candidate in nuclear engineering.

Oscar Restrepo (Ph.D., 2006) is a research associate with the Vanderbilt University Department of Physics and Astronomy.

Accolades

Michael Guidry was honored at the December 2006 Arts and Sciences Convocation with a Senior Excellence in Teaching Award.

Paul Lewis has been honored by the UT Department of Professional and Personal Development with a Program and Student Impact Award.

The physics department was well-represented at the annual Chancellor's Honors Banquet on April 11. Among those recognized were faculty members **Robert Grzywacz** and **Veerle Keppens** for Professional Promise in Research and Creative Achievement, as well as students **John Sinclair** for Extraordinary Academic Achievement and **Jason King**, **Juan Urrego-Blanco**, and **Stephen Wilson** for Extraordinary Professional Promise.

Undergraduate physics major **John Whittingham** was one of the students recognized at the spring Orange and White football game as a Neyland Scholar, one of the most prestigious honors granted by the university. Recipients are chosen for outstanding academic achievement and leadership skills.

John Carruth was honored with a Society of Physics Students 2006-2007 Leadership Award from the national organization. The $2,000 prize commends outstanding academic performance and SPS involvement.

In Memoriam

Edward Arakawa (Ph.D., 1957) passed away March 15. He was an adjunct assistant professor at UT and a consultant at Oak Ridge National Laboratory, where he spent 36 years as a research scientist in the Life Sciences Division. He was a fellow of the American Physical Society and the Optical Society of America and author or co-author of more than 200 publications. For his many contributions, particularly the important role he played in the careers of numerous students, the physics department honored Arakawa with the 2007 Distinguished Alumni Award at Honors Day in April (see page 4).

John David Fox, a member of the physics department's board of visitors, passed away on March 11. A nuclear physicist, he spent more than 30 years at Florida State University as a professor until his retirement in 1986. In recognition of his many contributions as a researcher and teacher, FSU named the John D. Fox Superconducting Accelerator Laboratory in his honor. Fox earned a bachelor's degree from the Massachusetts Institute of Technology in 1951 and M.S. and Ph.D. degrees from the University of Illinois. During his career he served two terms as nuclear physics program director at the National Science Foundation and was elected a fellow of the American Physical Society. In retirement he was

(continued next page)

Thanks to our Donors!

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Giving Opportunities

The UT Department of Physics and Astronomy has several award and scholarship funds to support our vision of excellence in science education at both the undergraduate and graduate levels:

UNDERGRADUATE SCHOLARSHIPS

- The William Bugg General Scholarship Fund
- The G. Samuel and Betty P. Hurst Scholarship Fund
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- The Robert and Sue Talley Scholarship Fund

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- The Douglas V. Roseberry Memorial Fund
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OTHER DEPARTMENTAL FUNDS

- Physics General Scholarship Fund
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If you would like more information on how to make a donation or a pledge to our scholarship funds, please contact the physics department or:

The College of Arts and Sciences Office of Development, Alumni Memorial Building, The University of Tennessee, Knoxville, TN 37996-1320
Telephone: (865) 974-2365 or Web: www.artsci.utk.edu/development/index.asp

a guest scientist and collaborator for both Oak Ridge National Laboratory and Argonne National Laboratory.

David Kent Lewis (B.S., 1968, M.S., 1978) passed away at his San Francisco home on February 8. A native of Maryville, Tennessee, he earned a bachelor's degree in physics at UT in 1968 and a master's in 1978. He went on to earn both a master's and a doctoral degree in mechanical engineering at Ohio State University. Lewis joined Lawrence Livermore National Laboratory in 1986 and earned a Distinguished Service Commendation in 2006.

Pat Shirley, the department's bookkeeper for 27 years before her retirement in 1987, passed away on February 15. Shirley was a well-known author of Southern Appalachia stories and also wrote three books. She received several writing awards, including first place for short story in the Tennessee Mountain Writers' Association.

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