Summer 2016

THE UNIVERSITY OF TENNESSEE KNOXVILLE

DEPARTMENT OF PHYSICS & ASTRONOMY

CrossSections

The Newsletter for UT Physics Alumni & Friends

Open for Business

The Joint Institute for Advanced Materials brings UT's materials researchers under one roof

It's not uncommon that the building of a house falls behind schedule. When the house is 144,000 square feet and has to accommodate furnishings and residents ranging from delicate scientific instruments to graduate students, delays can be expected. A tour through the Joint Institute for Advanced Materials (JIAM) proves, however, that it's worth it.

The building features long corridors lined with bright, light-filled offices punctuated by open common spaces with white boards, break areas, and river views. There's also ample laboratory space for materials synthesis and characterization.

The Joint Institute for Advanced Materials opened earlier this year as the first building on the university's Cherokee Farm Innovation Campus.

JIAM is one of five joint institutes in the UT-Oak Ridge National Laboratory family. It came to life in 2005 with plans for a collaborative space to christen the Cherokee Farm Innovation Campus—the university's scenic research outpost on the banks of the Tennessee River. The idea was to bring together scientists and engineers with materials-related research under one roof. After a few postponements, the doors of the new facility opened earlier this year, including space for the condensed matter physics (CMP) group.

"Essentially it's all of experimental condensed matter that goes to the JIAM building," said Hanno Weitering, physics professor and department head who also serves as the institue's deputy director. "We (also) have office space for theorists."

The institute's research covers advanced materials in three areas: structural materials, soft and hybrid materials, and functional materials and devices. The CMP group works in the latter, which comprises studies in superconductivity and magnetism, among others. Physicists are moving their labs there to conduct their own research and work across disciplines. Some equipment is "theirs" from years back, while other components were funded by the NSF and/or the central administration through the joint institute.

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What's Inside

Hanno Weitering
Professor and Head

Diversity Matters

With two publications of *CrossSections* each year, I often worry if we have enough interesting stories to fill the newsletter. Luckily, the answer to this question is always affirmative. With twenty pages, this particular issue is bigger than most, and much of what you are about to read concerns our new faculty, lecturers and staff, and the excitement they bring to our department. We also showcase our award winners, which includes a surprisingly large number of undergraduates. Physics clearly captured the spotlight during the annual Chancellor's Honors banquet last April and you can read about this on page 15.

We are pleased to see that the number of UT/ORNL Joint Faculty is once again on the rise. With the recent addition of Cristian Batista and Mike Fitzsimmons (both featured in this newsletter), we now count eleven joint faculty appointees, three of which are based at ORNL. All of them are supported with UT base funding and DOE funds at the lab. The Joint Faculty program was formally instituted in 2001 although shared appointments existed long before then, beginning in the 1980s. These joint appointments strengthen our collaborations with ORNL and offer the great advantage of shared resources and expertise. The lab provides extraordinary learning opportunities for our students, while staff scientists at the lab like to work with students. The joint faculty arrangement is clearly a win-win situation for the two institutions.

In 2012, the department also began hosting a number of ORNL staff researchers with variable UT appointments. The UT share of their appointment is funded through external grants. The number of these so-called "soft money" joint faculty appointees increased rapidly and currently stands at fifteen. They are becoming increasingly successful in bringing grants to UT and currently account for 12 percent of our total research expenditures. This money is mostly spent on UT students and postdocs, while the department gets to keep a fraction of the F&A. This construction clearly works well for physics.

The spring has also been a tumultuous time at UT. Recent actions by the state legislature are having an impact on the College of Arts and Sciences and the department. The legislature is posing constraints on UT's policies toward promoting a diverse and inclusive work environment. Other contentious issues included the proposed outsourcing of facilities management and other services, and the easing of restrictions on bringing firearms to campus. While it may be too early to tell how these policies will affect the department in the long run, there definitely is a concern that they will adversely affect the recruitment and retention of students and faculty.

Now, why should a physics department care about diversity, or as Chief Justice John Roberts pondered during a recent Supreme Court oral argument: *"what unique perspective does a minority student bring to a physics class?"* This question drew many interesting responses from within the physics community and you can find many of those online. While cultural diversity can be very relevant in a social science setting, it probably isn't all that relevant in classroom discussions on best strategies towards solving **F**=m**a**. However, the core business of a physicist is researching the unknown; trying to unravel the mysteries of nature. In a collaborative research setting, diverse perspectives among researchers foster an intellectually stimulating work environment where new ideas thrive. Physicists working in large international collaborations experience this every day. The founders of quantum mechanics realized all too well that they needed to set aside their own prejudices and preconceived ideas in order to think far, far outside the box.

A perhaps less abstract argument is that faculty serve a broad spectrum of students. It is our obligation to create an atmosphere and learning environment that is welcoming to all. As our society is becoming increasingly diverse, we can no longer be complacent about the lack of diversity in our teaching profession. We need strong role models that can be so much more effective in compelling minority students to pursue and, most importantly, complete a physics degree. This is about creating equal chances for success in later life. Society pays a heavy price if it fails to engage the diverse talents and human potential of underrepresented groups.

We have a long way to go. The physics discipline has a quite dismal record when it comes to diversity. Granted, we have recruited a very diverse faculty with sixteen different countries of origin from the Americas, Europe and Asia, but we lack representation from minority populations born and raised in the US. Not only are there few women physicists and minority faculty on the market, they are also heavily recruited by other universities.

So what can we do? Again, it all starts with the recruitment of future role models. The department has made some strides in hiring more female faculty, thanks in part to target hiring initiatives that were sponsored by the college and the university's Office of the Provost. With seven female faculty on board, the female representation currently stands at 20 percent, which is slightly above national average. It's a simple start that has already made a very positive impact on the department.

Financial hardship and poor college preparation tend to be more prevalent in minority student populations. This problem is much harder. The department is doing what it can by awarding need-based scholarships, sponsored from private donations. For some, it makes all the difference. For others, it will just be a drop in the bucket. The department is currently assessing how to best target these scholarship awards.

Finally, we would like to recruit a more diverse pool of PhD candidates. While many of our graduate students come from abroad, the majority of our students are from the US. The department recently joined the APS bridge program as a member institution. This program is developing a national network of doctoral-granting institutions where eligible underrepresented minority students receive additional training and mentoring that would help them transition into a doctoral program. As a member institution, we become part of a network of institutions that actively promotes diversity in physics, and we intend to increase our participation in future years.

Clearly, the problem is complex and a single department can only do so much. This is why UT's centrally-led diversity initiative is so important. Together we can make a difference. But above all, the message to our future recruits should be loud and clear: we deeply care. Please help us get this message out.

"The founders of quantum mechanics realized all too well that they needed to set aside their own prejudices and preconceived ideas in order to think far, far outside the box."

JIAM, continued from page 1

"There are a couple of pieces of equipment that were acquired with JIAM funds and funds from the Office of Research," Weitering explained. "The idea was that once the machine was up and running that people from other departments or even from outside UT can come and use the machine. It would be supervised use. Or they would just bring their samples and we could do the measurements for them. But they have to pay a user fee for that. The fee is just to sort of create a pot of money so that we can keep the instrumentation up and running and to pay the salary for those people who would be responsible for those pieces of equipment."

As scientists and equipment fill the building and activities begin to hum along, the institute's program will come into sharper focus. Weitering explained that JIAM includes a mix of personal and shared equipment with a recharge center to provide the financial framework.

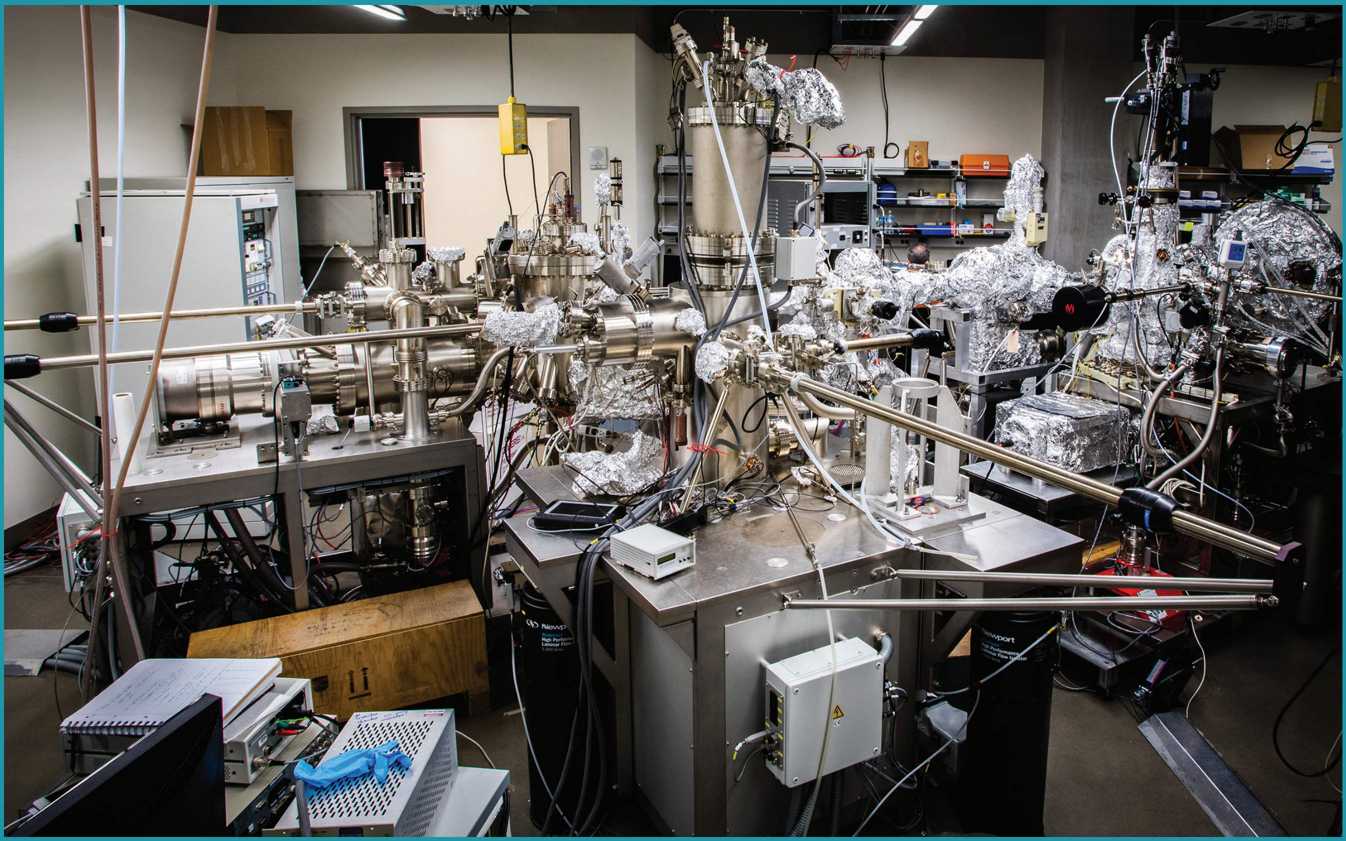
"We're talking about a very big building," he said. "We need staff to make sure that we take care of shipping and receiving. There's a building manager. We have a business manager and an office manager. There's technical support. Ideally, you want the program development to grow and generate overhead that you can reinvest in the science."

Weitering has been part of the process from the beginning, not only as JIAM scientist but also as deputy director.

"My main responsibilities initially were to try to help with program building and bringing people together, but there was also a lot of activity related to the building itself—getting the people in the right lab space and assigning office space."

In the past year he's been working on a plan for equipment acquisition, and with the building now open he can focus on program building. He'll work closely with Veerle Keppens, department head in Materials Science and Engineering, who took over as JIAM director in June. Weitering said he hopes to see departments involved in

JIAM at Work



Condensed matter lab for thin film synthesis, scanning probe microscopy, and electron spectroscopy. (Photo courtesy of Dr. Jim Parks.)

JIAM coordinate hiring efforts and would also like to see more joint appointments with Oak Ridge National Laboratory. He pointed to how Mike Fitzsimmons and Cristian Batista are paired in condensed matter experiment and theory, for example. Both have joint UT-ORNL appointments (see pages 6-7). For JIAM-affiliated faculty, there are certainly benefits.

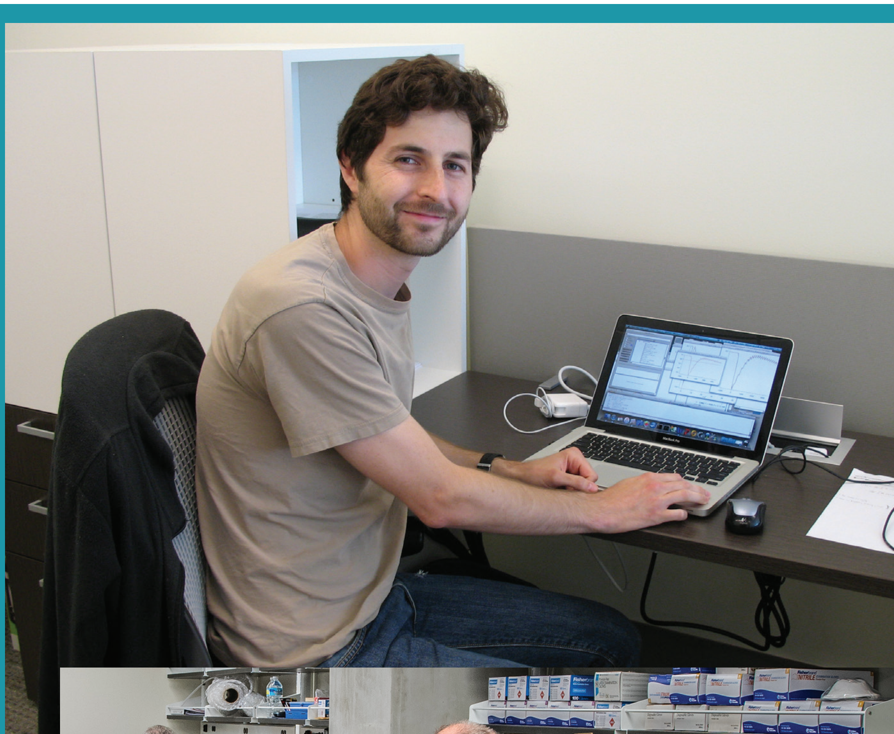
"The biggest advantage is that you're going to have a presence in the building," Weitering said. "It has lots of open spaces—areas where people can sit and have discussions. There are whiteboards. There are coffee machines. It's very conducive for interactions. Once you get a really good group of people together working in the same area, then you're more competitive for larger-scale proposals."

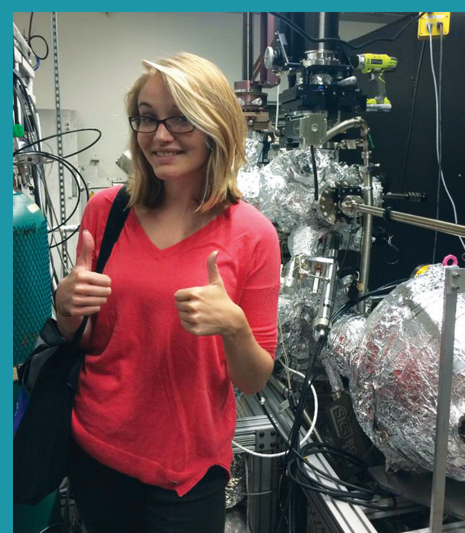
There's also space allotted for graduate students and postdocs. If a student is working with a JIAM faculty member, there's a good chance that student will be spending lots of time on the Cherokee campus. While there will be some JIAM affiliates who don't have assigned space in the building, they'll still have access to its resources. JIAM is the first structure to go up in the research park, which has a total of 16 sites for both academic and non-academic purposes. A second, private sector building is under construction.

"It offers opportunities for really strong involvement with industry," Weitering said of the institute, which is also poised to bring the university even more scientific talent.

More on JIAM
www.jiam.utk.edu

"When you have activity in a building like that it becomes more attractive for people to come here," he said. "It should help with recruiting faculty. It just opens up more possibilities and we can become more competitive."





Physics Graduate Student Nick Sirica (above left) is working at JIAM with Associate Professor Norman Mannella in condensed matter physics. Undergraduate Taylor Stevenson (above) spent the summer working with Mannella, commissioning a spectrometer. Physics Research Scientist Pablo Vilmercati and Machinist Randy McMillan (left) are part of JIAM's staff (photo courtesy of Dr. Jim Parks).

Michael Fitzsimmons

Physics at the Boundaries

Michael Fitzsimmons is a scientist at the boundaries in more ways than one. In a broad sense he's both a physicist and a materials scientist. In a quantum sense, his research lies at the nanoscale divide where different materials come together, creating new possibilities for real-world applications.

Fitzsimmons joined the department in February as a joint faculty professor. He's also the group leader for thin films and nanostructures in Oak Ridge National Laboratory's Quantum Condensed Matter Division. He spent 25 years at Los Alamos National Laboratory and brings with him considerable expertise in novel materials.

Fitzsimmons is interested in how interfaces—regions between dissimilar materials—can give rise to properties those materials don't possess on their own. From there, his curiosity lies in how to govern those properties for applications.

"Right now our interest is in understanding how you can use something easy to produce—like an electric field—to control magnetism," he said. "You have a technological motivation for why you'd want to do that. Then you start to think about how to make a material's magnetic properties respond to an electric field."

In Fitzsimmons' case, that starts with putting together different kinds of materials with lots of interfaces. It's a cross between condensed matter physics and materials science.

"The condensed matter part is understanding how electric fields could affect the magnetic structure," he said. "The materials science part is trying to develop techniques to synthesize these materials."

Even if you can control magnetism with an electric field, he explained, it's got to be with samples large enough to be used effectively.

"You can imagine scenarios in memory storage, where they could be very small devices, but you could also think about wanting to make better magnets for your electric motor in your car," he said.

The Privilege of Doing What You Want

Fitzsimmons gives a lot of thought to how his work impacts life outside the lab. He even audited Physics Professor Tom Handler's course on science, technology, and public policy this spring.

"He's always making this point that we're doing what we want to do because somebody's paying us to do it, and often it's the taxpayer," Fitzsimmons said. "So you've got to be cognizant about what you give in return for the privilege of doing what you want."

Materials science, for example, has had considerable success in that area, especially with how magnetism research has impacted data storage.

"We can record information so cheaply now," he said. "That has enabled lots of things. It enables the Internet. It enables us to have videos on our phones, and music and so forth."

Fitzsimmons will work with like-minded researchers at the Joint Institute for Advanced Materials (JIAM), a UT-ORNL collaboration that brings together scientists and engineers across disciplines to study and develop advanced materials and functional devices. He should have little trouble interacting with colleagues from different fields, not only because of his amiable nature but also because of his background.

Physics to Materials Science and Back Again

When Fitzsimmons left his native Texas for undergraduate studies at Reed College in Oregon, he had a plan in mind.

"I was going to be an engineer all along. But actually I really enjoyed physics classes, so that changed into just doing physics," he said. "After that it was time to go to grad school. My thesis mentor was telling me I should really think about materials science because it was an up-and-coming field."

So much for the plan. After finishing a bachelor's degree in physics, he headed to Cornell University, where he was introduced to the Cornell High Energy Synchrotron Source, or CHESS.

"It's this huge piece of scientific equipment that just sort of fascinated me," Fitzsimmons said. "That's pretty much why I got into facility science. And that's what I've been doing ever since."

He graduated in 1988 with a PhD in materials science and accepted a Fulbright Fellowship to Ludwig Maximilians Universität in Germany, then a postdoc position that took him to Los Alamos, where he stayed until coming to Tennessee. He said he had always wanted to take a step into the academic world, but found it was hard to make the transition from a national lab to a university straightaway.

"What's nice about ORNL is that it's co-located with UT," Fitzsimmons said. "So when I came out here to talk to people at Oak Ridge I also made it a point to talk to Hanno (Weitering, physics department head) and also people in the materials sciences department."

The area is a good fit for Fitzsimmons and his wife, Kate, who enjoy tennis, kayaking and biking—even though there have been a few surprises.

"I didn't know about all the hills," he said. "I've been getting about 50 percent more climbing activities on my bike here in Tennessee than in the Rocky Mountains."

Also new is the opportunity to involve students in his research, including undergraduates. He knows first-hand how valuable those experiences can be. As a sophomore at Reed, he spent the summer at the Very Large Array telescope in New Mexico.

"That was a blast," he said. "They give you the money, you get on the bus, you show up at Socorro in the middle of nowhere. The whole summer you're housed in the dormitory, but the site is a 70-minute drive, so everybody gets on a bus and goes out to the site for the day and then comes back. That was a great time."

That out-of-the-lecture-hall element has stuck with him. He's woven it into his fall course on X-ray and Neutron Scattering, where students will spend time at the High Flux Isotope Reactor at Oak Ridge to see how diffraction experiments work. Exposure to a research facility can play a huge role in a young scientist's career, as it did for Fitzsimmons back at Cornell.

"In my case," he said, "it was enough to make me go off in that direction."

New faculty Michael Fitzsimmons and Cristian Batista have a penchant for advanced materials.

Zen Physics

Cristian Batista may study some of the most complex and intricate mysteries of nature, but he does so by finding the simplest means. His expertise lies in figuring out how electrons interact and how those interactions can influence the way a material behaves. For Batista, who joined the department February 1 as the new Lincoln Chair in Theoretical Condensed Matter Physics, this all begins with defining the basics.

"I think the most important element is to be able to extract the essential aspects of a problem," he said. "Try to focus on that. It's more like a Zen kind of approach; where you try to extract the simplest and most essential concept and then you build on that."

Batista has been interested in condensed matter physics since his graduate school days, when he earned a PhD at the Instituto Balseiro-Universidad Nacional de Cuyo in his native Argentina. He's intrigued by novel states of matter and seeing how they arise from the diversity of physics.

Continued on Page 8

Cristian Batista

"There are many fascinating topics coming from high energy and statistical physics and different areas," he said. "Many of those beautiful concepts you learn from other areas of physics emerge naturally in condensed matter physics. I like the fact that you can see these theories emerging from something concrete."

Batista's research on strongly correlated materials includes transition metal oxides, organic compounds, and intermetallics to find new and different behaviors. Unconventional superconductivity is a common example, but Batista is interested in finding other exotic states as well. One means is by studying mesoscale structures, which reside in size between the atomic- and nano-length scales.

He explained that while scientists do an amazing job growing nanoscale materials with specific functionalities in a kind of bottom-up approach, "there is also an up-down approach. Instead of fabricating these kinds of structures, you study if it's possible to have them emerging spontaneously from the interactions between your atoms or electrons."

Skyrmions provide one such example. These quasiparticles, surrounded by spins, are attractive for memory storage because they can be moved around with a much lower current than conventional devices require.

"That is one of the most amazing things, I think, about condensed matter physics, Batista said. "You start with very simple interactions—atomic scale, nearest neighbors—and those simple interactions lead to very complex structures that can be exploited for applications."

Batista joins his condensed matter colleagues at the UT-Oak Ridge National Laboratory Joint Institute for Advanced Materials and enjoys working closely with experimentalists to help guide his studies, always working from his basics-first approach.

"We try to find essential ingredients," he said. "That helps experimentalists identify a group of candidate materials that they can start making. In technical terms, you want to find the minimal model. What is the minimum set of interactions that you need to produce a given state of matter?"

Mind-Blowing Discovery

While Batista will work with scientists at ORNL and UT (his appointment is split between the two), his university duties include a teaching element, territory with which he's quite familiar. When he was a teaching assistant in graduate school his students asked that the university make an exception for the first time in history and award the Best Professor in Physics prize to a TA so that he could be the honoree. He spent 16 years at Los Alamos National Laboratory where he was awarded the Distinguished Mentor Award for his guidance of graduate students and postdocs. This academic year he's teaching Quantum Mechanics—the first course he ever helped teach.

"I think it's really the best course, from many points of view," he said. "It's a big discovery course for students. It's when they start defining what they want to do. It blows their minds."

Batista said he enjoys interactions with students: watching them find their individual interests and encouraging them to build on their strengths. He is careful, however, not to steer them in any particular career direction.

"I think they should discover that," he said. "I always tell them that I think they should feel the passion. I think it's the only reason for doing this kind of work."

Batista knows a thing or two about finding your interests and building a successful career. He went to LANL as a Robert Oppenheimer Fellow and won the lab's 2012 Research Prize. He is a Fellow of the American Physical Society whose papers have been cited more than 3,000 times. The move to ORNL, with its UT partnership, held special appeal for him.

"I'm excited about the possibility of bridging UT with the national lab, especially with the Spallation Neutron Source," he said. "I think there are many opportunities there. They complement each other really well."

Batista said the move to Knoxville has been a smooth one for his family, including his wife Monica (a geophysicist with a specialty in seismology), and their daughter Clara. He likes pretty much any outdoor activity (especially soccer) and enjoys reading and travelling outside of physics when he has the time.

"I find the environment here very stimulating; very warm," he said. "Not only at the university but in general. People are very warm and welcoming."

Professor Robert Grzywacz was part of the research team who confirmed the existence of Element 117, named Tennessine. (Photo Credit: Brian Notess, courtesy of UT's *Quest Magazine*)

Rocky Top, Tennessine

Element 117 finally has a name that sounds a little more personal, exceptionally so for the Volunteer State. It's been proposed as Tennessine to recognize scientists in Tennessee (including those at Vanderbilt University, Oak Ridge National Laboratory, and the University of Tennessee) who helped confirm its existence.

Among them is Physics Professor Robert Grzywacz, who helped develop a process to measure the decay of nuclear materials to one millionth of a second—a crucial step in proving the new element existed. Grzywacz also serves as director of the UT-ORNL Joint Institute for Nuclear Physics and Applications .

First discovered in 2010, the element—known as 117 and originally called ununseptium—is part of the "superheavy" family: typically manmade elements with a large number of protons that live very short lives. The advent of new "superheavies" helps scientists continually assess the limits of the periodic table and learn more about how nuclei hold together and fall apart.

After years of collaborative experiments on the part of Russian, German, and American scientists, a joint working party of the International Union of Pure and Applied Chemistry (IUPAC) and the International Union of Pure and Applied Physics (IUPAP) confirmed Element 117, as well as three others, as the newest members of the periodic table, thus completing its seventh row.

The names were proposed this June and will be open for public comment until November 2016 before they are formally approved. Along with Tennessine, which will appear on the table with the symbol Ts, the other elements are Nihonium (Nh) to honor Japan; Moscovium (Mc) to honor Moscow, Russia; and Oganesson (Og) to honor Yuri Oganessian, a pioneering researcher of superheavy elements.

Tennessine is only the second element named to honor a U.S. state: the other is Californium. It also pays homage to Tennessee's Native American history, as the state name was derived from the Cherokee word Tanasi.

Learn more about this research from *Quest Magazine*: quest.utk.edu/2016/new-elements/

5 in 5

UT Physics faculty have won five NSF CAREER grants in the past five years—including two in 2016

What Neutron Stars are Made of

When massive stars die, some leave descendants that are extremely cold and dense. Assistant Professor Andrew W. Steiner's interest is in getting to the core—literally—of these objects.

When a star with a mass eight to 20 times that of the sun explodes in a core-collapse supernova, it leaves behind a neutron star with the mass of the sun and a 15-mile diameter. These stars are an excellent lab for astrophysicists because their cores are subject to a powerful gravitational force: one that compresses matter to densities a thousand trillion times that of water. Scientists like Steiner want to know if that pressure forces the core's resident neutrons and protons to transform into exotic particles. They also study neutron stars to understand the broader nature of ultra-dense matter.

"On the astronomy side this is important because it really dictates how neutron stars evolve," Steiner said. "It's hard to say what they're going to do if you don't know what they're made of. On the nuclear physics side this is important because very dense, very cold matter is almost impossible to produce in the laboratory."


Andrew W. Steiner

To explore these questions, Steiner will combine existing models of strongly-interacting matter with new calculations of nuclear structure. From there, he and his students and postdoc will construct state-of-the-art computational models of the neutron star crust and core. They will then calibrate those models with nuclear data and compare them to neutron star cooling, mass, and radius observations.

Steiner explained that some of this nuclear data is currently available, but more is expected from increasingly sophisticated sources such as NASA's Neutron star Interior Composition Explorer (NICER). SpaceX will launch this payload to the International Space Station in early 2017 to study neutron stars through soft X-ray timing. In another five years or so, the Facility for Rare Isotope Beams (FRIB) at Michigan State will provide intense beams of rare isotopes for nuclear studies.

Steiner said that models of the neutron crust and core are continually being developed and he hopes "to be on sort of the cutting edge of those."

The real goal, he added, is to learn the composition of neutron stars.

"I would like to be able to say, with some statistical uncertainty, that we're confident that a neutron star has something exotic inside," he said.

Students will have the opportunity to be part of that quest, through both the research itself and expanded educational components including a Studio Physics course and a web-based visualization of neutron stars. Steiner's $425,000 CAREER grant, titled "The Composition of Dense Matter and Observations of Neutron Stars," began July 1 and is estimated to conclude June 30, 2021.

Steiner said the department has been very successful in hiring good faculty, and "one of the ways you can tell is because we have so many of our young faculty with these kinds of awards."

Steiner earned a PhD from the State University of New York at Stony Brook in 2002. Prior to joining the UT faculty in January 2015, he held postdoctoral positions at the University of Minnesota, Los Alamos National Laboratory, and Michigan State University and was a Research Assistant Professor at the University of Washington Institute for Nuclear Theory.

Calculating Nuclear Reactions

Assistant Professor Lucas Platter is using nuclear theory to devise methods that more accurately describe important nuclear processes—like how energy is generated in the sun.

He uses numerical methods to calculate nuclear reactions and quantify uncertainties that can't be measured with existing tools—how two protons fuse to form a deuteron in the sun, for example. His approach uses effective field theory (EFT), which he defined as "describing the physical process with a minimal set of assumptions to obtain a desired accuracy."

Platter NSF CAREER project will focus on using EFT to explain electroweak processes, which combine electromagnetism and the weak interaction, two of the fundamental interactions in physics.

"Certain aspects of electromagnetic processes are related to weak processes," Platter said. "It's called electroweak because essentially they're two sides of the same coin."

In this case those processes fall into two categories of EFT studies: "pionfull" and "pionless." A pion comprises a quark and an antiquark. Much like a Knoxvillian is also a Tennessean, a pion is also a meson—a subatomic particle that helps bind the components (or nucleons) of an atomic nucleus.

"If you scatter two nucleons at very high or medium energies, in order to describe that scattering appropriately, you need to include the fact that pions are exchanged between the two of them and the pion mediates the interaction," Platter explained.

"But if you go to very, very low energies you don't see the pion anymore, so the nucleons simply look like atoms or like particles that scatter somehow."

In the pionless EFT approach, he will study the decay half-life of tritium, an isotope of hydrogen that decays into Helium-3.

"That particular process fixes a parameter that is really relevant for proton-proton fusion, which is something that happens in the sun all the time," Platter said. "It's the starting point of the energy generation in the sun."

While this has been studied previously using different methods to pin down theoretical uncertainties, Platter's research will investigate the process within a single theoretical approach.

The grant's second aspect involves studying the intrinsic error in Hamiltonians—functions that describe a system's energy based on momentum and positional coordinates—and the associated electroweak currents generated in "pionfull" EFT. Those results will help Platter and his collaborators improve calculation accuracy in decay rates or half-life times that physicists already observe and measure. The research contributes to the way nuclear theory is constructed.

Lucas Platter

Joining Platter in the NSF research are graduate students Sam Emmons and Daniel O'Dell. He also has funding for undergraduate Jose Bonilla, who worked with him through the department's summer fellowship program. The $430,00 grant for "Uncertainty Estimates in Low-Energy Nuclear Physics" began July 1 and runs through June 2021.

Platter earned a PhD at Bonn University in Germany in 2005. He has held postdoctoral fellowships at Ohio University and Ohio State, as well as appointments with the University of Washington, Chalmers University of Technology, the University of Illinois (Chicago), and Argonne National Laboratory. He joined the physics faculty in 2014.

The Faculty Early Career Development (CAREER) Program offers the National Science Foundation's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations. **Andrew Steiner and Lucas Platter** are the latest of the physics faculty to win the honor.

Undergraduate Lab Director and Associate Department Head Jim Parks retired earlier this year, but he's not giving up his gadgets.

The Gadget Man

Some physicists may be lured to the field by the mysteries of the universe, but for Jim Parks, the appeal can be summed up in one word: gadgetry.

In his 55-year career those gadgets have ranged from the simple to the sophisticated and have punctuated stops along his timeline in teaching, research, and industry. When Parks retired as director of undergraduate labs and associate department head in January, many perhaps knew him best as the man who kept the teaching labs running or the guy to call with questions about office or lab space. But that was the only the latest chapter in a scientist's story that began in the mountains of North Carolina.

Respect, Two Days a Week

Parks grew up in Morganton, North Carolina, the oldest of three kids. Like many physicists, he's always had a penchant for figuring out how things work. At Morganton High School he excelled in classwork, particularly math and science, graduating as valedictorian in 1957.

While he said physics intrigued him because of the "gadgetry" involved, he found chemistry less attractive.

"I spilled acid down one of my only two pairs of blue jeans," he said. "It sort of turned me against chemistry."

His math and physics teacher, Charles Snyder, was a Berea College graduate who helped shepherd Parks toward his alma mater, which provides an education for deserving students in exchange for work. Parks graduated from Berea in 1961 with a degree in physics. (While an undergraduate, he began his work detail in woodcraft, with starting pay at 16 cents per hour.) After graduation he spent the summer working at Oak Ridge National Laboratory for Sam Hurst, a distinguished UT alumnus who introduced him to atomic physics.

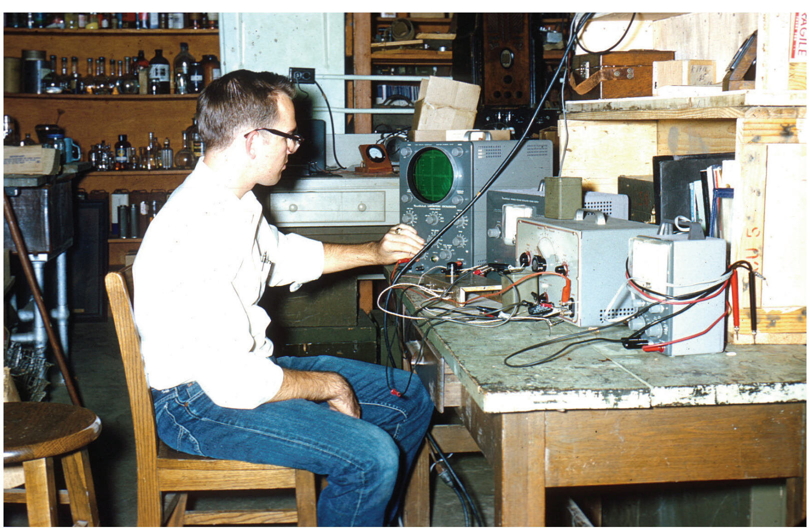
"I measured W values all summer long, sitting in a chair, turning a knob," he said. "That should have turned me against it," he laughed.

It did not. Parks stuck with it and began graduate work at UT that fall (in fact, down the road he would measure W values for his PhD thesis at Kentucky). At one point he was working at ORNL two days a week as a consultant and three days a week as a master's student.

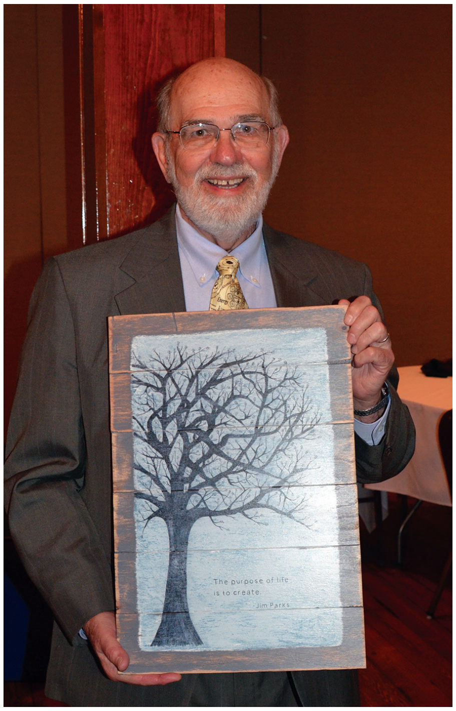
"Sam had somebody make this sign to wear around my neck," Parks recalled. It said 'On Mondays and Tuesdays I'm a consultant: treat me with respect.' On the other side it said 'On Wednesdays, Thursdays, and Fridays I'm a student: give me hell.'"

While the sign was a joke, there *was* a bit of unpleasantness in the way of his thesis research on electron transport in gases.

"The problem was you had to do this deconvolution, which would be easy as pie these days," Parks explained. "My data was put into a computer and they ran it for an hour before they shut it off because they hadn't converged yet on the answer. I had



Jim Parks taking electronics lab in 1959, measuring the frequency response of a triode vacuum tube (left), and preparing physics demos for a Cub Scout group visiting UT in 2010 (right).



Jim Parks with the custom art the department presented to him, which includes his quote,"The purpose of life is to create." Joelle Adajian is the artist.

reams of data. They estimated it would take 24 hours. Computer time was like $600 an hour. It sort of brought my master's thesis to a dead halt."

Undeterred, Parks took a job at Berea as an instructor. In the meantime, Hurst put physicist Rufus Ritchie and programmer Verner Anderson on the job to sort out Parks' data.

"They figured out an analytical way to do it and cut it down to about five minutes of computer time," Parks said.

He wrote the thesis and graduated in December 1965. Soon after, Hurst accepted a position at the University of Kentucky and recruited Parks as a research assistant. So off to Lexington he went, finishing a PhD in physics in 1970.

Mastering the Impossible

With a freshly-minted doctorate, Parks accepted a faculty position at Western Kentucky University while spending most summers working for Hurst at ORNL. He remembered one summer quite vividly.

"He asked me to do the impossible and I did it," he said. "He asked me to build a beamline on the Van de Graaf accelerator, so I had to have vacuum pumps and oil diffusion pumps. I could spend as much money as I wanted to on services, but I couldn't buy any equipment."

Parks found a way: scrounging, recycling, and refurbishing equipment. He was so successful that at the end of the summer Hurst asked him to build a second beamline.

While summers at ORNL kept him busy in research, he still enjoyed the balance of teaching and managing laboratories at WKU during the academic year. Yet after 11 years, though a full-tenured professor, he found himself on 26 different committees and decided to try something new. He took a leave of absence ("but we sold our house") and moved to Oak Ridge to become the technical director at Atom Sciences, Inc. Hurst had founded the company to commercialize resonance ionization spectroscopy, or RIS. It's an analytical method he helped develop where lasers kick electrons out of atoms or molecules, leaving a positive ion and a free electron. These are then counted to help identify elements in a sample.

Parks enjoyed the commercial side of science: developing instrumentation for practical applications. Yet he also saw that the instruments and techniques had limitations. In 1988, when Hurst invited him to serve as director of UT's Institute of Resonance Ionization (IRIS) as well as the Laser Technology Center (governed by the Tennessee Center for Research and Development), he availed himself of the opportunity.

At IRIS Parks found new ways to combine his love for teaching and research. He co-organized international RIS conferences, adding a short course for scientists new to the field. When he was recruited as director of UT's undergraduate physics labs five years later, he won National Science Foundation funding to teach Faculty Enhancement Workshops for faculty from small, four-year colleges in the Southeast, helping them build equipment they could take home.

As IRIS phased out, Parks turned his attention to the physics department full-time. He was named associate head, handling many of the department's day-to-day operations. He became active in Tennessee's section of the American Association of Physics Teachers, rewrote the lab manual, taught modern physics lab, and helped design and implement the studio physics program. His influence was evident in 2015 when physics alumnus Richard Manley and his wife Melissa instituted the James E. Parks Award to recognize his hands-on, innovative physics teaching in a laboratory setting.

Teaching, Parks said, was always his favorite part of work: from his days at Berea through his tenure at WKU to his time at UT.

"I love dealing with the students," he said. "I've made some lasting friendships with students."

He also loved what he called "the business of developing the experiments; trying to make them student-proof, but always losing.

"I like organizing;" he said, "putting the systems together."

His days of student-proofing done, Parks now has more time with his family, including wife Barbara and their four grown children and nine grandchildren. He enjoys genealogy, among other hobbies, but chief among them is photography. Ever the experimentalist, he said, "sometimes I'm more interested in putting the camera systems together than I am than taking the pictures."

Even in retirement, he's still into gadgets.

Spring 2016 Honors

Department Head Hanno Weitering (left) with our 2016 Distinguished Alumni Awardee Glenn Young (BA, 1973)

Physics Honors Day Celebration

Alumnus Glenn Young doesn't actually hold a Bachelor of Science degree from the UT, despite graduating with majors in physics and math. He's actually a Bachelor of Arts graduate. This in no way deterred the physics department from honoring him with the 2016 Distinguished Alumni Award at the annual Honors Day ceremony on April 25.

Young explained that the catalog changed his senior year and getting a BS would mean taking an art history course, so he opted for the BA instead. After graduation, he went on to earn a PhD in nuclear physics from the Massachusetts Institute of Technology and spent 29 years at Oak Ridge National Laboratory. His expertise in nuclear physics led him to experiments at Oak Ridge National Laboratory, Lawrence Berkeley National Laboratory, Michigan State, CERN, and Brookhaven National Lab. In 2009 he moved to Jefferson Lab to lead the effort to build the physics detectors for the 12 GeV Upgrade Project. The department was pleased to honor him "for outstanding leadership in the design and construction of large-scale nuclear physics experiments at ORNL, CERN, BNL, and Jlab."

From left: Associate Professor Norman Mannella with Blaine Heffron; Brooke Carter with Assistant Professor Nadia Fomin

More photos at: www.phys.utk.edu/department/photo-galleries.html

Honors Day Awardees

- Outstanding First Year Student: **Kevin Kleiner**
- Robert Talley Award for Outstanding Undergraduate Research: **Blake Erickson**
- Robert Talley Award for Outstanding Undergraduate Leadership: **Brooke Carter**
- James W. McConnell Award for Academic Excellence: **Daniel Shyles**
- Douglas V. Roseberry Award: **Ryan Whitehead**
- Robert W. Lide Citations: **Brandon Barker**, **Taylor Stevenson**
- Outstanding GTA Award: **Ann Jennings**
- Outstanding Tutor Award: **Will Moffitt**
- Colloquium Award: **Krishna Koirala**
- Paul Stelson Fellowship (Beginning Research): **Blaine Heffron**
- Paul Stelson Fellowship (Professional Promise): **Adam Holt**
- Fowler-Marion Award: **Zhiling Dun**
- James E. Parks Award: **Phil Dee**
- Wayne Kincaid Award: **David McCallister**
- SPS Teacher of the Year Award: **Christine Nattrass**
- Sigma Pi Sigma Inductees: **Jose Bonilla**, **Carrie Elliott**, **Steven Taylor**, **Chima McGruder**, and **Louis Varriano**

Chancellor's Honors

The department walked away with several top honors at the Chancellor's Banquet in April, with recognition in the highest of university ideals—scholarship, teaching, research, and service.

Soren Sorensen, Macebearer
Macebearer is the highest faculty honor at the university, symbolizing the faculty's commitment of service to students, scholarship, and society. Sorensen has won effusive praise from students and also has an impressive research and service record, including 12 years as department head and leadership of the university's STRIDE committee. A nuclear physicist, he is coordinating a 12-institution consortium to upgrade the Large Hadron Collider at CERN.

Geoff Greene, Alexander Prize
The Alexander Prize is named for former UT President and now U.S. Senator Lamar Alexander and his wife, Honey. It recognizes superior teaching and distinguished scholarship. Greene was honored for his accomplishments in fundamental neutron physics and his stellar teaching.

Thomas Papenbrock

Thomas Papenbrock, Research and Creative Achievement Award
These honors are bestowed on senior faculty in recognition of excellence in research, scholarship, and creative achievement. Papenbrock, a nuclear theorist, was recognized for his research on neutron-rich nuclear isotopes.

Chrisanne Romeo, Extraordinary Customer Service
This award is given to a university employee who is consistently optimistic and serves students, faculty, staff, and campus visitors with great care. Romeo, an admistrative specialist, has become the go-to person for physics students and visitors with questions and problems.

Our students were also recognized for: **Extraordinary Academic Achievement** (Blake Erickson, Zachery Markland, and Louis Varriano) and **Extraordinary Professional Promise** (Jason Bane, Blake Erickson, Ghaneshwar Gautam, Blaine Heffron, Zachery Markland, Joel Mazer, Ryan Sinclair, Nicholas Sirica, Louis Varriano, and Da Yang).

Soren Sorensen, Chrisanne Romeo, and Geoff Greene at the Chancellor's Honors Banquet.

Physics Students Won:

25%

of the Arts and Sciences awards for Extraordinary Professional Promise

18%

of the Arts and Sciences awards for Extraordinary Academic Achievement

News from the Physics Family

Faculty

Associate Professor/Associate Department Head Kate Jones has been appointed a member of the Nuclear Science Advisory Committee (NSAC). NSAC is an advisory committee that provides official advice to the Department of Energy and the National Science Foundation on the national program for basic nuclear science research. Jones' research involves experimental studies of exotic nuclei using transfer and knockout reactions. She was awarded a DOE Outstanding Junior Investigator award in 2009 and has been active in the APS Division of Nuclear Physics, serving on the program committee, the mentoring award committee, the nominating committee, and the Bonner Prize committee. She has served on site visit review committees, review panels, and committees of visitors for both the DOE and NSF.

Kate Jones

Staff

Jason Chan is the new electronics shop supervisor. He graduated from the university in 2014 with a bachelor's degree in electrical engineering. His background includes knowledge of circuit design and layout, experience with Linux systems, and programming with MATLAB, C++, VHDL, and LabVIEW. Last December he graduated with a master's in electrical engineering from UT while researching neuromorphic computing with FPGAs. He has been with the department since February and has thus far accomplished various tasks including equipment repair, PCB board design, and projects involving LabVIEW.

In January **Christine Cheney** became director of undergraduate labs. She holds both bachelor's and master's degrees in physics from Wake Forest University and a PhD in physics from Vanderbilt University. She has broad research experience including semiconductor studies, photoluminescence of nanowires, detection of biochemical compounds, X-ray emission spectroscopy, and ultra-fast laser spectroscopy. She has both high school and university teaching experience and has taught undergraduate physics and astronomy courses for the department, including the modern physics laboratory.

Also in January **Margie Abdelrazek** moved from a part-time to full-time lecturer. She holds a bachelor's degree in physics and French from UT and a PhD in physics from Florida State University. She joined the teaching staff in 2006 and has taught many of the department's service courses. This fall she is teaching courses for pre-med and architecture majors.

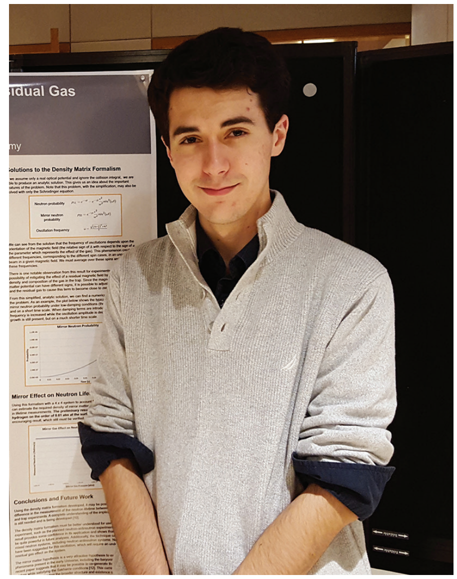
From left: Margie Abdelrazek, Jason Chan, and Christine Cheney

Students

Chima McGruder won first place in the Science Oral Presentations at the 13th Annual Tennessee Louis Stokes Alliance for Minority Participation (TLSAMP) Research Conference in February. McGruder reported on his summer work through the National Astronomy Consortium. The TLSAMP meeting brings together students, faculty, staff, administrators, and professionals in the areas of science, technology, engineering, and mathematics.

Physics Major **Louis Varriano** took first place in the Physical Sciences Division (Arts and Sciences) in the university's 2016 Exhibition of Undergraduate Research and Creative Achievement (EURēCA). This annual event showcases research and creative activities by currently enrolled undergraduate students in collaboration with a faculty mentor. Varriano worked with **Professor Yuri Kamyshkov** on neutron-mirror neutron oscillations in a residual gas environment.

Chima McGruder (center) with Dr. Masood Parang, UT TLSAMP Principal Investigator and Dr. Lonnie Sharpe, Executive Director for TLSAMP.



Louis Varriano

First Physics Open House for High School Students

Thirteen local high school juniors and seniors visited the department February 16 for our inaugural Open House. The small, casual gathering gave them a chance to chat personally with our faculty and undergraduate physics majors, tour our labs, and visit our planetarium. They came from the L&N STEM Academy, William Blount High School, Oak Ridge High School, Hardin Valley Academy, Farragut High School, Webb School of Knoxville, and Daniel Boone High School. Building on the success of the event, the department hosted a second Open House in June for students enrolled in the Governor's School for the Sciences and Engineering.

Physics Major Amos Manneschmidt (far left) and Assistant Professor Nadia Fomin (second from left) meet with high school students at the Open House.

In Memoriam

Professor Jon Levin

The department lost a passionate teacher and valued colleague with the passing of Professor Jon Levin, 63, in April. He was the director of the undergraduate physics program and oversaw the department's scholarship program, among other responsibilities. Levin served on numerous college and university committees and as chair of the undergraduate council. He led an outreach project with Fentress County Schools and in 2010 became the faculty mentor for the UT Society of Physics Students, earning a nomination for the outstanding chapter advisor award. Since 2011, our chapter has won three outstanding chapter awards and one honorable mention. UT SPS also won the national Blake Lilly Prize and a UT Chancellor's Honor for "Extraordinary Community Service" in 2015.

Jon Levin (photo by Richard Prince)

Levin earned a BA in economics in 1976 from Stanford University and a PhD in physics in 1986 from the University of Oregon. He was a postdoctoral research associate at ORNL and a staff physicist at the National Institute of Standards and Technology before joining the physics faculty in 1993. Though his research area was experimental atomic physics, the past few years saw him dedicate more time to teaching and directing the undergraduate program, where he was a profound influence on many of our students. In a 2013 interview with undergraduate Amos Manneschmidt, Levin said "Some flexibility, I think, is a hallmark of a successful scientist: to be able to change directions and see where you should go based on where the field or research takes you, not what someone else tells you."

Levin taught the introductory physics honors courses and introductory physics courses for science majors. He worked with the VolsTeach program, which combines STEM and education majors to put qualified science and math teachers in classrooms. A few of his honors:

- UT Society of Physics Students Teacher of the Year (2004)
- College of Arts and Sciences James R. & Nell W. Cunningham Outstanding Teaching Award (2004-2005)
- College of Arts and Sciences Faculty Outreach Award (2013)
- Nominated for SPS Outstanding Chapter Advisor Award (2015)

Current and former students inspired the department to establish a scholarship honoring Levin's life and contributions. To contribute to this scholarship you may contact Don Eisenberg with any questions at: (865) 974-2504 or don@utfi.org or make a gift online at **volsconnect.com/levin.**

Professor Bill Blass

The physics department was saddened by the death of Professor Emeritus Bill Blass in February. He was 78. He served on the faculty for more than 42 years, where he became a stalwart of the molecular spectroscopy research group. His research included infrared spectroscopy, planetary and stellar atmospheres, laser spectroscopy, and computational physics. Among his many scientific contributions was his spectral analysis that guided the renovation work of the "Star Spangled Banner" at the Smithsonian: the flag that inspired Francis Scott Key to write the country's national anthem.

Blass earned a BA in physics from St. Mary's College in 1959 and a PhD in physics from Michigan State University in 1963. He joined UT in 1967 and in the mid-1980s began working at the NASA/Goddard Space Flight Center in Maryland. He was a NASA Summer Faculty Fellow and worked at Goddard as a continuing visiting scientist for 24 years. Blass retired from the physics department in 2009 after decades of teaching and mentoring many students and serving the university in several posts, including terms with the faculty senate (one as president), the board of trustees, and the university research council. He was also involved with several professional and teaching organizations over the course of his long and fruitful career. He leaves a legacy of science and camaraderie that richly enhanced our department.

Bill Blass

Thank you to our Donors

The department is pleased to acknowledge the generosity of our donors for their support:

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Thank you for your interest in supporting the Department of Physics and Astronomy. You can "help where it's needed most" by giving to the Physics Enrichment Fund, which funds a range of priorities. You can also contribute to a specific scholarship, fellowship, or other support fund. See our website for opportunities at www.phys.utk.edu/alumni-physics/giving.html.

If you'd like to explore more options for supporting students, faculty, equipment or other priorities in physics, Don Eisenberg would welcome your call at 865-974-2504 or your e-mail at don@utfi.org. You can also donate online by going to artsci.utk.edu and clicking on "Give to the College of Arts and Sciences."

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