

## Atom by Atom

Assistant Professor Jian Liu joined the faculty in August and brings with him an expertise in creating new materials, one atomic layer at a time.

A condensed matter experimentalist, Liu first developed an interest in nanoscale science as an undergraduate. His alma mater (Nanjing University in China) has a strong program in condensed matter physics, along with a national laboratory on microstructures.

“There are a lot of professors there doing condensed matter physics and I got opportunities to interact (with) them,” he said. “I got interested in condensed matter, and that’s also part of the reason I went to the University of Houston.”

After earning a master’s in physics at Houston, his interests next led him to the University of Arkansas.

“My Ph.D. advisor was also junior faculty at the time, so he had this exciting new research program direction going on,” Liu said. “I got into contact with him and he was looking for a bright student,” he said, laughing, “so I ended up going there to do my Ph.D.”

“The reason I’m interested in condensed matter,” he continued, “is because (it) has always amazed me in the fact that it deals with millions and billions of particles at the same time. Condensed matter physics is able to describe them very adequately just using very simple and elegant, fundamental principles.”

At Arkansas, he said, physicists were actually scaling condensed matter back to the atomic scale.

“Instead of dealing with a crystal, which contains  $10^{23}$  numbers of particles, the program there is try-

ing to scale this material back down to just a single monolayer. So that kind of strategy gave me a very new microscopic perspective. You don’t just look at the broad (scale)—you have so many particles and you have to figure out a smart way to study them—we’re actually trying to build artificial crystals one atomic layer at a time.”



**Jian Liu is a new assistant professor with a specialty in materials by design.**

## Materials by Design & the Holy Grail

Creating new materials that are engineered at the atomic level serves two purposes: it tells us more about how physics works at the nanoscale, and it offers the promise of new and improved functionalities, especially in terms of electronics.

“There are essentially two phases in this type of materials-oriented research program,” Liu explained.

“One phase is basically the very hard-core physics phase, where you’re sort of exploring; trying to make discoveries. The type of many-body physics problem that I have been dealing with cannot be described by conventional theory based on single-particle approximation. So you have to try different parameters and different materials in order to discover whether

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there's a new phenomenon and depict the physical mechanism in the play. On the other hand, because we are building artificial condensed matter from an atomic approach, you have all these different 'knobs' to tune and tailor the material's property. That's sort of the material by design approach."

If you ask most condensed matter physicists, Liu said, there's a clear favorite for the most-coveted functionality in these tunable materials.

"The Holy Grail would be having room-temperature superconductivity," he said. "Once you have that in hand, you can imagine all the modern electronic applications—everything would be just completely transformed."

An advantage UT has in this quest is the combined strengths of condensed matter theory and experiment. Liu's interests include, for example, transition metal oxides, which Professors Elbio Dagotto and Adriana Moreo study from the theory vantage point.

"(This) interaction could really help us understand what's going on experimentally, and we can work with them to essentially facilitate the material by design approach," Liu said. "Say they propose a new structure based on our understanding and predict what should happen in this new material. Then we go in the lab and we make this material and test whether that works."

On the experiment side, his work complements the efforts of fellow Assistant Professor Haidong Zhou, who grows bulk crystal materials. Liu makes new materials using thin-film deposition, where an

ultrathin layer of one material (often only a few nanometers thick) deposited onto a wafer. He explained

that a bulk crystal might have given functionalities, but "to make it into a real device you have to make thin film. And that's where the interaction comes in. Whatever interesting material they grow, we can try to make a thin film, essentially to build functional devices. I think having a local crystal growth effort like Haidong's group is very important for thin film researchers. Not that many places have that kind of advantage. I can collaborate with almost anyone in the condensed matter program here."

Liu's lab will be in the new Joint Institute for Advanced Materials, scheduled to open this winter, which affords even more opportunities for collaborations across disciplines. He is also working with a few students on a trial basis to see if they'd like to explore his research, and has beamtime lined up at the Advanced Light Source, the Advanced Photon Source, and SOLEIL.

Liu has a good idea of how such facilities work, having won a couple of fellowships at Lawrence

Berkeley National Lab and serving on the Users' Executive Committee for the ALS. He is also a referee for several scientific journals, including *Physical Review Letters*. As a faculty member, he shares his experience not only with students in the lab, but also in the classroom.

## Monitoring Math & Base Running

When Liu joined the faculty this fall semester, he jumped directly into instruction, teaching Physics 231 for engineering majors. He has an easy sense of humor about the evolution of the classroom since he finished his bachelor's degree in 2004.

"I have been amazed by how modern college teaching is being done," he said. With the high technology tools available, he added, "I have to teach myself those first."

Because his students aren't physics majors, he tries to emphasize fundamental concepts and make sure the required math doesn't trip them up. He's careful to monitor that in homework and tests to see how they're doing. Away from the lab and classroom, Liu has other interests to engage his sense of discovery, at least one of which he can attribute to his graduate school days.

"I'm always looking to explore new things," he said. "And baseball is very interesting. The pace may look slow, but actually you have to keep thinking, every second."

It was his time in Houston that led him to baseball, and as such made him an Astros fan.

"We were very sad when they moved us to the American League," he said. "We like watching the base running; stealing bases."

He's also discovered an interest in skiing, which wasn't an option in his hometown of Guangzhou.

"I never skied back in China. I grew up in the Southern part," he laughed. "It never snowed."

His wife, Yi Zhang, is a scholar in her own right, but far removed from nanoscience.

"She studied Chinese literature back in China," he said. "She's definitely not interested in physics."

Instead, she's exploring connections with UT's Confucius Institute, which, interestingly enough, is a partner with Southeast University in her hometown of Nanjing. Reflecting on that, Liu made a point befitting an international researcher who just happens to study the world atom by atom.

"The world is small," he said, smiling.

Learn more about Jian Liu:  
<http://www.phys.utk.edu/faculty/faculty-liu.html>

## New Faculty



Hanno Weitering  
Professor and Head

## Change

This semester, we again witnessed quite a few personnel changes. Dr. Jim Parks announced that he will be retiring in spring 2016 and so we needed to find a new director for the undergraduate laboratories. We also needed to appoint a new associate department head. The latter task turned out to be easy as Dr. Kate Jones took over Jim's role as associate head, effective August 1, 2015. Kate joined the department in 2006 and built a highly successful career in experimental nuclear physics. Besides research and teaching, she also cares deeply about many other important issues facing our department, such as curriculum development, advising, diversity, and program development. Kate's vision and enthusiasm for the department are very inspirational and we can all be confident that she will make a very positive impact on how the department is run.

Finding a new lab director was definitely more complicated. A search committee, led by Dr. Marianne Breinig, conducted an open search and interviewed three viable candidates. The committee selected Dr. Christine Cheney as the best candidate for the job. Christine holds a PhD in physics from Vanderbilt University and brings many years of experience as a postdoctoral research associate, research faculty member, and lecturer. Lately, Christine has been in charge of running and revamping the modern physics laboratory for our undergraduate physics majors. Christine has demonstrated excellent teaching, mentoring, and supervisory skills and appears well prepared for the new job.

The position comes with great responsibilities. The department not only provides physics instruction for physics majors but also delivers a large number of physics and astronomy lectures for our general education and service courses. The laboratory enrollment in these lower division courses is about 1,400 students each fall, and growing. The director's responsibilities include: maintaining and modernizing instructional laboratory experiments and demo equipment for our general education and service

courses; developing the laboratory manual; scheduling labs; and working with instructors to set up integrated, active-learning environments. Moreover, Christine will be responsible for the training and daily supervision of about 50 graduate teaching assistants. This job is definitely no sinecure. With the appointment of Christine, we can all sleep a bit better knowing that our undergraduates are in good hands.

Jim's vast knowledge of the inner workings of the department, his connections with other organizations on campus such as facility services and UT's laboratory safety committee, and his relations with alumni and former physics affiliates have been a tremendous asset. Replacing him is difficult but above all, we will miss him as a wonderful colleague and friend. Fortunately, he will stay around a few more months to ensure a smooth transition. You can read more about Jim's truly remarkable career in our next newsletter.

This semester we also welcomed Sean Lindsay, who replaced Steve Daunt as astronomy coordinator, and Jian Liu, who joined the condensed matter faculty. You can read more about Sean and Jian in this newsletter. We are also very glad that Margie Abdelrazek will be joining the faculty as a full-time lecturer in January. Margie has been with us since 2006 as a part-time lecturer, and has always done an excellent job teaching our service courses, primarily for the architects and interior design students.

On a sad note, we mourn the loss of Professor Emeritus Solon Georghiou. Solon joined the physics faculty in 1973 and retired in 2007. His area of research was molecular biophysics and his passion was teaching. Many of us knew him as a very thoughtful sensitive person with a warm personality. We also lost our distinguished alumnus Dr. Warren Keller. Warren was recognized by the department in 2014 for his leadership in space science and exploration at NASA through the Voyager and Hubble Space Telescope

programs. It truly was an honor to get to know Dr. and Mrs. Keller and learn about Warren's accomplishments. We are deeply saddened with his passing.

As the year draws to an end, quite a few faculty and students are packing in preparation for the big move in January/February to the new UT/ORNL Joint Institute for Advanced Materials (JIAM), which is located on UT's Cherokee campus. The condensed matter faculty, nine in all, will hold offices in JIAM. About 30 graduate students, postdocs, and other research affiliates will move there as well, and about 6,000 square feet of prime research space in SERF will need to be vacated. Some of the equipment requires very special handling by specially trained engineers, so all in all this will be a costly and time-consuming operation. The research space and layout of the new building are far superior to what we currently have. To alleviate the inconvenience of JIAM's off-campus location, a shuttle bus will run every hour between the two campuses for much of the day. While I am a

little bit concerned about maintaining departmental cohesion after the move, physicists have always experienced diaspora as they travel to remote locations to conduct their experiments. Some of us are already located away from campus (ORNL, UTSI), and even on campus we are used to living in three or four different buildings.

Change is happening in our department. Many changes are happening at UT. Look at the buildings, the faculty and staff that we hire, and the students that are better than ever before. Not all changes may be welcomed but many of them are making us better, stronger, and more accountable. We'll have to get used to this. Change is here to stay.

I wish you a wonderful holiday season and a happy and fulfilling 2016.

## Let's Take It from the Beginning

Sean Lindsay likes beginnings. Be it the origins of comets or the evolution of a species, the common thread running through his scientific interests is how the whole business started. That's a fitting attribute for his debut as the department's first full-time astronomy coordinator.

The job, which began August 1, capitalizes on Lindsay's education, experience, and contagious enthusiasm. A UT physics and math graduate, he earned master's and doctoral degrees in astronomy at New Mexico State University before taking on postdoc positions with UT's Earth and Planetary Sciences (EPS) Department and the University of Oxford. When he heard about the astronomy coordinator position, he leapt at the chance to return to Tennessee.

"I was supposed to be at Oxford for another year and I left my postdoc there early to take this job," he said. "I'd been aiming to come back to Knoxville."

### A Day at the Circus

Lindsay left the UK with the blessing of his supervisor, who in fact wrote one of his recommendation letters. They stay in touch on matters of asteroid research, an

important component of the insight Lindsay offers in a job where he supervises astronomy labs and teaching assistants, develops the astronomy curriculum, and teaches general education astronomy courses. The last element has been a particularly demanding one. Though Lindsay has teaching experience from his graduate school days, walking into a classroom as an instructor with 180 students—most of them freshman—was a bit eye-opening.

"I knew that first semester teaching is a circus," he said. "Or a train wreck. Maybe a train wrecking into a circus. I designed my entire first exam ... and I thought I had made it too easy. It really tested concepts rather than memorization. Now, picture the circus tents on fire and the train coming directly into them. That's pretty much what happened with that test."

It took him 30 hours to grade, sorting through 720 responses to open-ended questions and making notes on each exam. He learned students often struggle with reviewing material and really thinking about it. So he adapted his approach and puts in extra time to hold study sessions, keeping an eye on what students understand and what eludes them.

"I'm trying my best to stay as involved as possible ... caring about their education" he said, adding that he wants to impart that college isn't about jumping through hoops just to get a prize.

"Does the prize mean anything if you just jump through the hoops and you don't even know what the hoops were?" he said; adding with a smile, "and now we're back at the circus."

His efforts have not gone unappreciated. One of his students invited him to Lunch Hours, a Dean of Students program encouraging students to invite a faculty or staff member they admire to lunch, free of charge.

Lindsay can draw on these kinds of student interactions and feedback to enhance the astronomy curriculum. Although he returned to campus with what he called “high-minded” ideas for the program, he’s found a way to balance aspiration with pragmatism and is taking a measured approach with both short- and long-term goals. He’ll work with his six astronomy TAs to re-write the lab manual and wants to integrate the planetarium as much as possible into labs, outreach, etc. Down the road he’d like to explore the development of some 300-level courses, crossing over with EPS, and also get more involved in outreach through talks and school presentations.

## Dinosaurs & Asteroid Defense

Lindsay knows firsthand how an early curiosity about science can translate into a career, as his interests go back to his days growing up in Maryville.

“Everybody was interested in dinosaurs and outer space,” he said. “I happened to be interested in both, but I ended up (studying) outer space, not dinosaurs. As far as I know, we still haven’t found dinosaur bones on the moon.”

His path to astronomy was strung together from moments of inspiration. He has a vivid memory of going out to Foothills Parkway to see Comet Hale-Bopp, and also spent a summer in the UT Governor’s School program, where Steve Daunt taught astronomy.

“It gave me this book right here,” he said, tapping a copy of *Astronomy Today* on his desk, the first textbook he read in its entirety.

As a student at Maryville High School he also did a senior project on the Life Cycle of a Star. But once he came to UT as an undergrad, he shifted gears a bit. He started out in physics, but after a couple of years other interests tempted him. He flirted with anthropology and psychology majors before signing up for Astronomy 151 after it caught his eye in the catalog. He then took Honors Astronomy with Professor Kermit Duckett.

“I think that was the moment I decided I was going to become an astronomer; in Kermit Duckett’s Honors course,” he said. “There’s a common theme to everything I do: I like the origins of things. Astronomy gave me all that contextual wonder that brought me back into physics.”

While he was looking for summer projects, Professor Bill Blass put him in touch with Nancy Chanover at New Mexico State University, where he spent a summer doing research.

“That’s what linked me up with New Mexico State,” he said. “I’d never even heard of Las Cruces.”

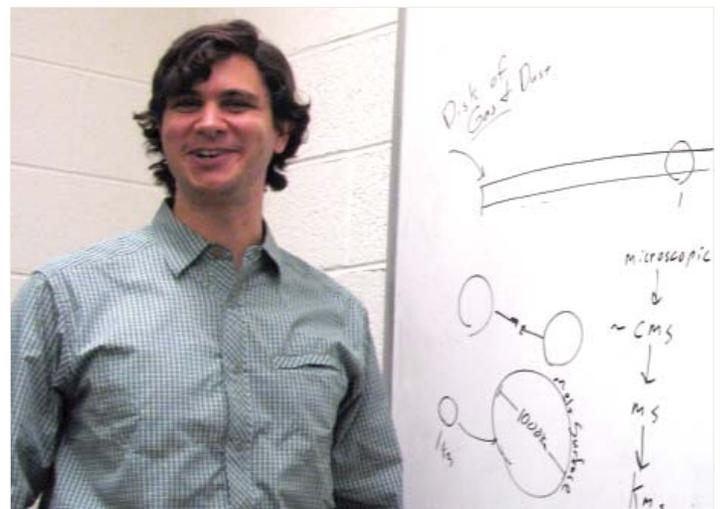
Lindsay graduated from UT in 2006 with math and physics degrees. Interestingly, when he applied to gradu-

ate school at NMSU, he was wait-listed, an experience he describes with self-deprecating humor.

“Advice to undergraduate physics students: if you take the physics GRE, *study* for the physics GRE,” he said. “Don’t just show up and take it. It turns out, if you get the same number right as you get wrong, you don’t get a good score.”

His score was, however, good enough to put him at the top of the waitlist, and soon after he headed back to Las Cruces to start graduate work. He investigated different areas—cosmology, extra-solar planets—before his advisor encouraged him to come up with a project for graduate funding through NASA. He decided on the small bodies of the solar system—comets and asteroids—and won a NASA graduate fellowship to pursue that interest, which he carried through his postdoctoral work.

Lindsay continues his research with colleagues at Oxford, NASA, and right next door in EPS, where he works with Assistant Professor Josh Emery. He also has a paper in press about the spectra of asteroids, which he explained “gives a way of actually figuring out the internal structure . . . how these systems form and evolve. NASA’s really interested in this aspect of it. The internal structure is absolutely important for asteroid defense.”



Physics alumnus Sean Lindsay is back at UT as the new astronomy coordinator.

He said he would love to work at being a mentor, maybe eventually adding a master’s student to his research, and taking on undergraduates for summer projects.

For now, however, he’s focusing foremost on teaching astronomy and coordinating the labs, hoping to share his passion for the celestial world with students coming through the Nielsen Physics Building. To prove the point, he pulled out his cell phone to show pictures from his April trip to Svalbard, Norway, to witness the total solar eclipse.

“I don’t just *like* astronomy,” he said smiling. “I travel for it.”

# Learning What You Want & What You Don't

## Chima McGruder's NAC Summer Internship

It's late on Thursday just before Halloween weekend, and though his schedule is packed with a long night of homework, a Friday pumpkin drop to emcee, and the Nashville half-marathon on Saturday, Chima McGruder is still upbeat with a bright smile and a quick laugh. That optimism and work ethic are part of what landed the physics major a competitive internship with the National Astronomy Consortium (NAC) this past summer.

McGruder's astrophysicist father, Charles, is the William McCormack Professor in the physics department at Western Kentucky University and encouraged his son to apply for the program.

"How NAC works is you apply and go through this whole interview process," McGruder explained, where representatives from multiple groups listen to see which students would be the best match with their respective programs. "I had to tell them specifically what I was interested in, and they fit me accordingly, which was actually really nice. I got accepted to the Space Telescope Science Institute (STScI), but they also have people from Goddard, the National Radio Astronomy Observatory, etc."

NAC interns are paired with astronomy, engineering and physics professionals at universities, observatories, and NASA facilities for a nine-week research project. McGruder worked with Anand Sivaramakrishnan and his graduate student Alexandra Greenbaum at the STScI, who served as his mentors.

"I was working on resolving volcanism on Io with the upcoming James Webb Space Telescope," McGruder said.

The James Webb Space Telescope (JWST) is an international collaboration between NASA, the European Space Agency, and the Canadian Space Agency. Scheduled for launch in October 2018, it will be a large infrared telescope designed to study every chapter of our Universe's history, from the Big Bang



**Chima McGruder having some fun with a space power drill at NASA's Goddard Space Flight Center (left) and with the other NAC interns—he's standing second from the right (below).**



to the evolution of our Solar System.

McGruder explained that Sivaramakrishnan designed the non-redundant aperture mask (NRM) for the telescope. Because the JWST will orbit the sun, some 1 million miles from Earth, troubleshooting any problems with the optics, for example, won't be an option.

"The NRM receives all the data, and we can reconstruct all that we need using the NRM. It's just basically a mini interferometer," he said. "And we get all

the data we need and we can use it even if the optics are a little bit messed up.”

His specific task was to see how well the NRM will work when observing Io, Jupiter’s closest moon. In his project abstract, McGruder explained that Io is the most volcanically active body in the solar system, shining brightly in the infrared during its volcanic outbursts.

“Chima came into the project to determine how well Canada’s instrument NIRISS (Near Infrared Imager and Slitless Spectrograph) could determine the locations and brightnesses of volcanoes that occur on Io,” Sivaramakrishnan explained. “He learned how to simulate what the digital images of Io and its volcanoes, as seen through the instrument’s special mask would look like. He then proceeded to determine, using state-of-the-art statistical methods, how to extract measurements from these high resolution infrared images enabled by the mask.”

“Right now we don’t have anything ground-based that can really resolve Io well,” McGruder said. “We don’t have anything to see Io’s periodic outbursts of volcanic activity. I was testing to see how well we could get the parameters using the NRM.”

The most relevant parameters are the position and flux of volcanic eruptions and Io’s surface brightness. Groundwork like this is important to make sure data from the telescope can be properly analyzed.

McGruder presented his project at the NAC III Workshop in August. Hosted by Howard University in Washington, D.C., the workshop not only gave the NAC interns the opportunity to present their summer work, but also provided networking opportunities for the students and their mentors with representatives from several universities.

## No Tie Required

While the interns certainly had their share of work, the atmosphere was casual.

“The biggest surprise was definitely the laidback work environment,” McGruder said, adding that in the initial e-mail it sounded like a 9-to-5, get-there-on-time, leave-on-time kind of scenario.

“It’s not like that at all,” he said. “You should get eight hours a day, but you can do that any time of the day you want. If you want to get there at 4 o’clock in the morning, you can do it. If you want to be working there until 12 in the morning, you can do it, which is great. I started off with a tie every day, then my mentor, Alex, would come in (wearing) basketball shorts and a T-shirt. Soon enough, the tie thing stopped.”

There was also the camaraderie.

“My mentor would invite me to lunch, or the NAC people would invite me to lunch,” he said. “Every

single person I talked to told me to call them by their first name. That’s never happened before.”

The NAC also made sure the students had a break from their projects. They were treated to special tours of Goddard Space Flight Center and a Washington Nationals baseball game. The interns also organized their own outings.

“There were 20 of us in the entire group and they were all cool, social people,” McGruder said. They visited museums, Baltimore’s Inner Harbor, and went to Artscape, the country’s largest free arts festival.

## Changing Directions

While McGruder headed to the Institute with a general idea of his professional future, the experience helped sharpen his focus.

“This internship kind of changed my direction,” he said. “Originally I was on the fence between aerospace engineering and astrophysics. I expressed this in my resume and in the interview. So I got with a professor who does optical astrophysics, which is borderline engineering and astrophysics because all the optical stuff requires a lot of engineering. From that I learned that I definitely want to specialize in just astrophysics.”

The Goodlettsville, Tennessee, native (and Greenbrier High School alumnus) is on schedule to graduate in 2017 and plans to go to graduate school to study astrophysics.

“And not theoretical; I learned that as well,” he said laughing. “I really enjoyed the internship, which showed me what aspects I want to do and what I don’t. It helped me narrow it down.”

Going into astrophysics means, of course, that he’ll be heading into the family business, something he said he tried to but ultimately could not avoid.

“I guess it’s in the blood,” he said smiling.

McGruder also hopes to broaden his undergraduate experiences next summer and is applying to the German Academic Exchange Service.

“I’m hoping this internship, along with recommendation letters and my GPA, will help me get into Germany for the summer internship,” he said.

For now, he plans to spend his winter break back at STScl to tie up some loose ends on his summer project. Given the amount of time he spends in class and doing homework and trying to fit in trips to the gym, he said an eight-hour day will actually be a nice break, even if it means extending his internship a bit.

“I don’t mind,” he said, “because it was a really good experience.”

You can download the NAC III talks, including Chima’s, at: <https://osf.io/view/naciii/>

# Adam Berryhill's Ultra-Cool Career

**“Don’t be surprised if somebody comes looking for me in the middle of this,” Adam Berryhill says, settling in at a conference table at Cryomagnetics, Inc., in Oak Ridge.**

Berryhill, a 1997 physics graduate, is director of engineering for the company and as such is in charge of project management, quality systems, and all engineering operations, which includes a fair amount of troubleshooting on any given day.

Cryomagnetics manufactures top-to-bottom superconducting magnet systems—magnets, cryostats, cryogenic accessories, and related electronic instrumentation. Founded in 1983, the company has doubled in the past year to include 80 employees and four buildings on Alvin Weinberg Drive.

“In simplest terms,” Berryhill says, “we build superconducting magnets for scientists and engineers from both industry and academia.”

On a facilities tour he points out enormous spools of superconducting filaments embedded in a copper matrix, which will be finished off with splices and quench protective circuitry. The company makes their own power supplies, liquid level monitors, temperature meters, etc.; they also do almost all their own machining and use 3-D printing for a few parts. Their most recently acquired building has a wall of enormous wooden crates of cryocoolers stacked floor to ceiling. Each box, Berryhill says, is \$40K; Cryomagnetics systems run from \$100K to \$1M on average.

They’ve developed and produced an MRI for mice, a magnet system with a large room-temperature bore for beamline applications, and technology for proton therapy, among other projects. Berryhill is responsible for all of it, start to finish.

“We build from scratch,” he says. “And it better work, or I’m in trouble.”

The company’s clients are varied both in terms of needs and location: there’s the University of Nebraska, for example; ProNova here in East

Tennessee, and other companies across the U.S. and the world.

“The differences you see are more the differences between small science and big science,” Berryhill explains.

“A single researcher at a university versus an entire accelerator facility, say, in France. The meetings are a little different,” he says laughing. “I’ve been to China more times than I can count. I’ve been to Europe quite a few times. We actually bought a company several years ago in France and so I wound up being the technical liaison, essentially. I got to learn French as a result of that. I took German in college and didn’t use it until just a few years ago, when I spent quite a bit of time in Germany.”

## A Trip Down (Cryogenic) Memory Lane

Growing up in South Pittsburg, Tennessee, travelling the world in cryogenics work never crossed



**Adam Berryhill (B.S., 1997) is director of engineering at Cryomagnetics, Inc., which builds superconducting magnets for industry and academia.**

“Anytime we’ve had to pick up a new technology; learn new things—I’ve had the skills and the background necessary, whether it’s electronics or fluid systems.”

—Adam Berryhill on the advantage of a physics education

Berryhill’s mind. What led him to physics, and the University of Tennessee, was his experience in the UT Governor’s School program during his sophomore year in high school. As an undergraduate he worked for UT’s Institute for Rare Isotope Measurements, and started his first job before ever turning his tassel.

“I actually went to work at ORTEC a semester before I graduated,” he says. “I got out of (sequence) with a quantum mechanics class.”

While finishing his degree he started out in detector manufacturing and then moved into detector research and development.

“In fact, that was part of my introduction to cryogenics,” he says. “I was working on the Electro Cool II project—and eventually what they called the X-Cooler. I built the prototype EXOGAM detector for an accelerator project that, interestingly enough, I’m working on now in France called the S3 spectrometer. That’s at the GANIL spiral tube facility. So I did that prototype detector for (ORTEC) forever ago, and now we’re making superconducting magnets for their S3 spectrometer. It’s kind of a trip down memory lane.”

After four years with ORTEC Berryhill went to Vacuum Technologies before moving to Cryomagnetics in 2004. He became director of engineering in 2014. Having a physics background, he says, has made a significant difference in how he’s been able to adjust to the changing demands of his career.

“It’s allowed me to pick up and learn almost anything,” he says. “Anytime we’ve had to pick up a new technology; learn new things—I’ve had the skills and the background necessary, whether it’s electronics or fluid systems. This company that we bought in France, for example, made dilution refrigerators. My cryogenics career has just slowly crept down in temperature the whole time,” he laughs. “You never quite realize where certain things will take you. If you would have told me 20 years ago that I would have built a system that made 10 millikelvin, I would have thought you were crazy.”

Variation, however, is what he likes best about his work.

“It’s all over the map,” he says. “We may be working on magnetic design. We’re working on the proton therapy system for ProNova and developing their setup for that: something we’re quite proud of. It’s heating fusion plasmas one day and cancer treatment the next. Other days it’s basic research—basic material property measurements. There’s always something different: a new project; a new accelerator; different requirements.”

Berryhill has always had a wide range of interests. He earned three black belts and as an undergraduate and played in the Pride of the Southland Marching Band. He recalls one instance when the band was heading to a bowl game and an unfortunate motorist interfered.

“This car had decided to get in between our bus and the one in front of us, and lo and behold there was a brake check and we crushed that car,” he says.

Dr. W.J. Julian was band director at the time, and he had quite an earful for the driver who got in the middle of a series of buses with a state trooper escort.

“It was not a good day for that poor soul,” Berryhill says.

These days his job makes hobbies a little harder to schedule, but he does like to hike on occasion, and he and his wife Tristy enjoy spending time with their two school-aged daughters. Tristy is also a UT graduate, with a bachelor’s degree in fine arts and a master’s in curriculum and instruction. She teaches art at Linden Elementary School in Oak Ridge.

“She teaches art and I do physics,” Berryhill says. “We’re about as odd a couple as you can get.”

There is, as Berryhill predicted, a knock on the door during the interview—a question about a welding project he gives some initial direction about and then promises to look at later.

“All day long,” he laughs. “All day long.”

# American Physicist

If you didn't know there's a Wikipedia entry devoted to Professor and Chancellor Emeritus John Quinn, don't feel too bad. He didn't either.

As the page points out, Quinn is a "well-known American theoretical physicist as well as an academic administrator." Fortunately, UT has been the beneficiary of much of his storied career, which includes both leadership of the Knoxville campus and influential contributions to condensed matter physics.

The New York native earned a bachelor's degree in physics at St. John's University in 1954 and then headed to graduate school at the University of Maryland. There he discovered the study of electrons in a solid, the area that became his specialty. He also met a bright young assistant professor named Dick Ferrell.

"He turned out to be a big star at the University of Maryland and he offered me an assistantship," Quinn said. "So I went to work for him. He went off to the Rand Corporation in California every summer, and he left me a problem."

Ferrell was interested in positron annihilation and asked Quinn to find electron density at the position of the positron. So the young physicist used the lowest-order of what he called self-consistent perturbation theory.

"It turned out it was a very nice thing," Quinn said. "(Ferrell) looked at it and said 'That's very good. You should give a paper on that at the New York meeting.' So my first paper was a 10-minute presentation at the old New York (American Physical Society) meeting in January 1956."

The work was very well-received.

"What I had done, I found out about a year later, was to drive what was called the Lindhard dielectric function," he said. "That's what my thesis came out of; sort of that initial problem."

His dissertation, "Self-Energy Approach to Correlations in a Degenerate Electron Gas," presented a new method for calculating the correlation energy of a degenerate electron gas. It launched a career where he would go on to become an expert in many-body theory and help set apart two-dimensional electron systems as a sub-field in condensed matter studies.

"I had no idea that the work I did was as important as it was," he said. "I was only worried about getting a thesis done."

Quinn finished the Ph.D. in 1958 and then accepted a postdoctoral appointment at Mary-

land, not so much because of physics but more because of chemistry.

"I stayed for one year as a postdoc simply because I married this gorgeous 19-year-old," he said. "I was 24."

He had met a young lady named Betsy at a swimming pool and stopped by her parents' house the next week to see if she'd like to go to a movie. Her mother answered the door.

"She said, 'Betsy's not here; she's out on a date. Come on in and have a beer,'" he said. "That happened two or three times. Finally Betsy's mom told her, 'That nice young man will be here on Friday; don't you dare take a date.'"

She kept her schedule free, and she and Quinn celebrated their 57th anniversary this past August.

After the wedding, he said, "I decided I had to get a real job."

## Playing with Power at Brown

Quinn joined RCA Laboratories in 1959, working in the general solid state research group.

"Your job was to work on anything you wanted in condensed matter physics," he explained, "but you had to be available to help people who were doing experiments if they needed help with the physics."

With time to pursue his own interests, he gave lectures on electron-electron interactions on solids. At the time he said there was great interest in why the Sommerfeld model worked as well as it did. His work showed you could treat the electrons in a solid like a Fermi liquid, where interacting and non-interacting electron states are mapped one-to-one. He was subsequently invited to give papers at a huge conference in Seattle and the New York APS meeting. Tenure-track faculty offers soon came from both the University of Pennsylvania and Stanford, but Quinn chose to stay with RCA because he was selected to be their representative in Zurich, a perk reserved for only one employee each year. Shortly after returning to the States, he accepted a one-year visiting professorship at Purdue University before his young family recalibrated again.

"I got offered professorships in a number of places," he said. And with family settled along



John Quinn was honored with the title Chancellor Emeritus after retiring this summer.



John Quinn in his faculty days at Brown.

the East Coast, “we decided that Brown looked good.”

That was the summer of 1965 and began a long career at Brown University for Quinn. He started out on the physics faculty and, after telling a colleague he’d been offered a leadership position at Argonne National Laboratory, got an offer from Brown’s Provost to join the university administration.

“He said, ‘You’re hitting 50 and you’re probably saying I’ve been a full professor for 20 years and maybe I should try something different. It’s called a mid-life crisis. But if you want to go through it, it would be easier to just do it here. Why don’t you become my associate provost for two years?’”

Quinn accepted and worked hard, especially in keeping top faculty from leaving for other schools. That led to his being offered the dean of faculty position.

“I did five years of administration,” he said. “It was a tremendous amount of work, but I found it very fulfilling. I used to interview every faculty member when we were looking to replace or renew a department head.”

He became so attuned to faculty concerns and successes that he transcended the post.

“The political science department made me kind of an honorary member and gave me one of their softball team T-shirts,” he said. It read, “We Play with Power: Political Science.”

Even so, Quinn was ready to get back to the physics department.

“But by then I had received inquiries from the University of Tennessee,” he said. “We thought about it and Betsy and I decided we’d try it and see what it’s like.”

Quinn came to the Knoxville campus as Chancellor and Professor of Physics in 1989 and served as Chancellor until 1992. With a change in university presidents, he returned to the faculty full-time as the Willis Lincoln Chair of Excellence. With his retirement this year, he was named Chancellor Emeritus to honor his distinguished service to the university. It’s one of many honors he’s claimed over the years, including the Physics Department’s Outstanding Graduate Alumnus Award and the Distinguished Alumnus Award from the College of Computer, Math and Natural Sciences, both from the University of Maryland.

With the great story-telling manner of all good professors, however, he is not above recounting stories that have humbled him. He said he was once waiting for a table at a restaurant when a woman who looked to be in her 60s said he looked familiar. He responded that he was often told he resembled the actor Brian Dennehy. She said no, he looked something like a former Chancellor from UT.

“I said, ‘Well that’s funny, I was Chancellor at the University of Tennessee but that was a long, long time ago and I’m surprised anybody would remember it,’” he recalled. “And she looked at me and said, ‘Well, I guess time takes a toll on all of us.’ I thought that put me in my place,” he laughed.

## The Right Choice

Restaurant encounters notwithstanding, Quinn is a highly-regarded scientist, though it wasn’t his initial plan to become a physicist at all.

“I thought I would be a mathematician,” he said.

Convinced by his older brother that all the exciting new developments were in physics, he changed course and declared a physics major when he went to college. But his first instructor at St. John’s hardly inspired him.

“He was older than I am now,” the 80-year-old Quinn said. “I almost gave up on physics.”

His fortunes changed his junior year with the arrival of a young Australian named Nevil Milford, who was, Quinn said, “a fantastic teacher.” With only three physics majors in the program, he added, “it was like being tutored. It convinced me that I made the right choice to go into physics.”

Making students a priority was a habit Quinn inherited from his experience. Of all his accomplishments, he said, he’s most proud of “turning out a number of extremely fine research scientists who were my Ph.D. students.”

Among them is Sankar Das Sarma, who is now at the University of Maryland as a Distinguished University Professor and Richard E. Prange Chair.

“He is to Maryland what Richard Ferrell—my thesis advisor—was to Maryland when I was a student,” Quinn said.

Another Quinn “alumnus” a bit closer to home is UT Physics Professor Adolfo Equiluz, also a condensed matter theorist. They can still talk shop, as Quinn comes to campus on Mondays and Thursdays and is hardly through with work. While retirement will afford more time for trips to Florida with Betsy, reading, and time with children and grandchildren, he has also begun a collaboration with Shashikant Mulay of UT’s Math Department and the two are currently working on a paper.

Given that he’s spent decades not only guiding campuses but also studying the intricacies of condensed matter, it’s not surprising that Quinn has earned a spot in Wikipedia, except, perhaps to the man himself.

“I had no idea,” he said.

# The Physical Chemist

It only seems appropriate that a boy born in Metropolis should achieve great things. Bob Compton, who retired this summer, was born in that very city in Illinois and went on to successfully navigate the territory between physics and chemistry, rise to the ranks of senior corporate fellow at Oak Ridge National Laboratory, and send students into the world to achieve great things themselves.

Despite his Metropolitan origins, Compton's story in many ways begins and ends with Oak Ridge. His family first moved there when his father was assigned to the Manhattan Project. Compton was in the first grade, which he laughingly admitted he almost had to repeat for lack of focus. That proved not to be the case, however, and he went on to be both a good science student and athlete at Oak Ridge High School. Finding a college, however, proved to be a bit more problematic.

"When I was in high school I was in a class with a bunch of high-achieving kids of Oak Ridge scientists. They were all going to big schools—Harvard, MIT, Caltech," he said. Despite being a good student, he wasn't receiving scholarship offers. With a lack of financial support and the academic year edging closer, he was one week away from joining the Air Force when Berea College intervened.

"Somebody at the high school—it could have been a coach; it could have been the physics teacher; it could have been anybody—found out I wasn't going to college," he said, and reached out to the Kentucky college offering a free education to deserving students through its labor-based program. Compton hadn't heard of Berea College at that time but said "it was something I could afford!"

He enrolled and excelled in the classroom and in track and field. (Professor Emeritus Bill Bugg has told of how Compton outscored the entire UT varsity in a track meet.) He also played basketball as a freshman but stopped to focus on science after the first year. The summers brought him back to Oak Ridge, where he worked at Y-12 and K-25. After graduating in physics, he headed to the University of Florida for

a master's degree; then to UT for a doctorate, working with Dr. Sam Hurst. Though Florida tried to keep him for his Ph.D., he said, "Basically what I wanted to do was get back and work at the (national) lab."

Compton did in fact get back to ORNL, beginning as a senior research scientist after finishing his Ph.D. in 1966. He rose through the ranks as a group leader and ultimately a senior corporate fellow, cited "for experimental studies in atomic and molecular physics, particularly developments in the field of nonlinear laser spectroscopy and the physics of negative ions." In 1979 he also started a mass spectrometry and chemical physics instrumentation company called Comstock with John A.D. Stockdale, which continues today.

In 1996 he left ORNL to become a full-time faculty member at UT in physics and chemistry. He said the transition wasn't that difficult as he had been a Ford Foundation professor in the 1970s and was taking on students at ORNL early in his career there.

"When I finally came over here full time, I found out how hard

people work at a university," he said. "There are always things to do: there are grants to write; theses to go over, etc. When people say it must be easy being a university professor, I say they ought to try it for a year."

Tennessee wasn't his only academic suitor. He accepted a faculty position at Clemson before intuition convinced him it wasn't the best fit. So after a visit there he called Tom Callcott, head of the UT-ORNL Science Alliance at the time, and talked over the situation. Callcott assured him they'd work out a solution at UT.

"I turned it over to Tom and the next thing I know, I was hired here. So Tom Callcott deserves the blame or the credit, whatever the case," Compton said laughing. "But it was the right decision for me."

The decision worked out well for UT as well. When he left ORNL, the agreement was that if he came to UT, the lab would pay half his salary for the first three years and he could have all the equipment he wanted.



**Bob Compton retired this summer after a distinguished career in physics and chemistry at both ORNL and UT.**

“That was a no-brainer,” he said. “To an experimentalist, to do things you have to have equipment.”

## A Tough Man to Pin Down

Compton may be an experimentalist, but he isn't easily pigeon-holed.

“All my degrees are in physics,” he said. “I still consider myself a physicist. The hardest thing I've had to do at UT is teach freshman chemistry. I ended up in chemistry because there's an interface called chemical physics.”

Compton has spent a career expanding that frontier, with leading research efforts in electron and photon interactions with atoms, molecules and clusters; non-linear optics; chirality; and coherent control in chemistry. His work has impacted analytical chemistry and mass spectrometry and has in recent years moved toward hydrogen storage in nanomaterials. In fact, he said his Laboratory Directed Research and Development grant on buckyballs (cages of 60 carbon atoms) helped launch ORNL's nanotechnology efforts.

“When I was at the lab I can say myself and David Geohegan can take credit for the Center for Nanophase Materials Sciences,” he said. “There are a lot of people working in nanotechnology. At least at Oak Ridge we can take some credit for starting that.”

These are a handful of his research efforts, and his collective body of work has not gone unnoticed. He retired as the Paul and Wilma Ziegler Professor of Chemistry, was an Erskine Fellow at the University of Canterbury in New Zealand, and has won the William F. Meggers Award from the Optical Society of America and the Jesse W. Beams Award from the American Physical Society, Southeastern Section. Compton

also holds three patents and, with Chemistry Professor Jan Musfeldt, started a chemical physics program at UT that has sent many students into the professional world. So profound was this influence that this November the Recent Advances in Chemical Physics 2015 symposium in Memphis was themed to honor his retirement. The meeting included top physical chemists and chemical physicists from across the U.S. Many of his former students from around the world also came.

“I was really flattered when (Chemistry Professor and Department Head) Chuck Feigerle and about 20 others brought up many different areas of chemical physics that I had started,” Compton said.

Asked about his proudest accomplishment, however, Compton is quick to answer:

“The students,” he said. “Watching them succeed. And they're all doing really well. I think a professor should be graded not on what he's doing now but on where his students end up.”

His students have ended up as university professors, researchers at national labs, and industry researchers, as well as medical doctors. And Compton himself has not really slowed down. His textbook (*Laser Experiments for Chemistry and Physics*) co-written with M.A. Duncan, was published in November and he's working on his next one. He also plays music with friends in Oak Ridge, though he confessed he's “not ready for primetime yet.” The athlete in him is still there too. He runs every night and is looking at the possibility of master's track and field. The tennis-loving Bill Bugg might also need to warm up a racket.

“I've not been playing much tennis, Compton said, smiling. “But I will be.”



Bob Compton with the Berea College Track Team, circa 1960.

# The Physics Top 10 List: Update

In the past several issues, *CrossSections* has highlighted the Top 10 Most-Cited Papers from our department. A recent review revealed papers that should have been included, including this publication from Distinguished Professor Elbio Dagotto. With 813 citations, it holds the #3 spot on the revised list.

#3

**Title:** Complexity in Strongly Correlated Electronic Systems

**Author:** Elbio Dagotto

**Journal:** *Science* **309** 258 (2005)

**Times Cited:** 813 (as of 12/4/2015)

**Summary:** Courtesy of Distinguished Professor Elbio Dagotto

This publication unveiled a novel perspective applicable to a wide range of interesting materials within the area of strongly correlated electrons, unifying a variety of experimental results and theoretical calculations under the common umbrella of “complexity” that before had been used primarily only in the context of soft matter and biological systems.

Science often focuses on the worthy goal of reducing the description of nature to simple fundamental laws. However, even if succeeding in such a lofty ideal, finding these fundamental laws does not imply the ability to start from those laws and describe phenomena at several length and time scales and involving a large number of particles. In fact, in complex systems the properties and interactions among a few particles are not sufficient to understand large aggregates. These systems are not merely complicated—as the engine of a car—but more analogous to the notoriously difficult to predict weather patterns that involve phenomena ranging from mild breezes to hurricanes. In complex systems “emergence” is expected to develop, namely the generation of properties of the ensemble that do not preexist in a system’s constituents, contrary to the philosophy of reductionism.

The main “punch line” of the publication described here, and the reason for its high number of citations, was to unveil an unexpected link between two previously unrelated phenomena: complexity as described above, widely considered only a property of soft matter such as polymers and liquid crystals, and the behavior of electrons in a variety of hard materials such as transition metal oxides (TMO). In other words, the thesis of this publication was that hard materials, such as a ceramic, could have a soft electronic component: not soft in the physical hardness sense but in denoting the existence of a multiplicity of nearly degenerate configurations of the electronic component. Not all materials are complex: a semiconductor, for example, is not because it can be properly described by one-particle approximations, where the behavior of one

electron is sufficient to understand the full ensemble once the Pauli principle is incorporated in the description.

A smoking gun of the complex behavior of TMO is the frequently observed large nonlinear responses of particular compounds to what should have been a priori a minor external perturbation. For instance, at special chemical compositions of the manganese oxides widely known as “manganites,” their resistivity can change by many orders of magnitude when in the presence of relatively small magnetic fields in a phenomenon dubbed colossal magneto-resistance. This type of behavior can find applications in real devices in the realm of functional materials. Several investigations have shown that these unexpected nonlinearities can be rationalized based on the competition of phases that have quite different properties, such as metals and insulators that often display spin, charge, and orbital order. In these conditions, relatively unimportant events can become crucial, as when the last metallic link completes a percolative network.

Another manifestation of electronic complex matter lies in the rich phase diagrams of these materials, with a plethora of quantum collective states with quite different properties. In addition, particularly near the boundaries between these states, inhomogeneities at the nanometer scale often occur. In complex systems self-organization can spontaneously develop, leading to the formation of large-scale structures. This sometimes involves a distribution of clusters with random sizes and shapes, and in other cases leads to regular patterns such as stripes in copper oxides, which are equally-spaced horizontal or vertical lines where carriers accumulate. This is a complication for theoretical approaches that try to capture the essence of an experimentally unveiled phenomenology by invoking a unique and simple homogeneous state. On the contrary, to address the strong competition among a variety of simultaneously active degrees of freedom (spin, lattice, charge, and orbital) computational techniques using high-speed computers are often required to perform the unbiased calculations needed when different tendencies with comparable strength push for dominance.

In summary, the 2005 publication described here established the novel paradigm of “complexity in correlated electron materials,” helping to focus on the right level of description, on the emergence of electronic textures at different length scales, and on the physics of phase competition.

# A League of Extraordinary Gentlemen



The department gathered at Club LeConte on August 6 to thank **Horace Crater, Joe Macek, Steve Daunt, John Quinn, and Bob Compton** (pictured left to right) for their many contributions over the years and wish them well as they retire. Several members and friends of the department attended, as did **Theresa Lee**, Dean of the College of Arts and Sciences.



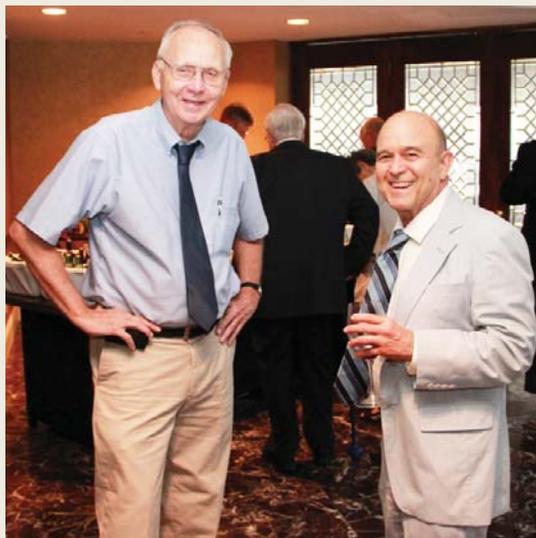
*Hanno Weitering recognizes Joe (and Ellen) Macek*



*John Quinn and Ray Garrett*



*Kuniko Kawahara, Steve Daunt, and Hanno Weitering*



*Bob Compton and Horace Crater*

See the complete photo album on our Facebook page at: <https://www.facebook.com/UTKPhysicsAndAstronomy>



# News from the Physics Family

## Students

Poster prize-winning undergraduate **Jesse Buffaloe** was one of several students representing UT physics at SESAPS 2015: the 82nd Annual Meeting of the Southeastern Section of the American Physical Society, hosted by the University of South Alabama November 18-21. Both undergraduates and graduate students presented their work on a wide range of scientific interests, with Buffaloe taking home the prize for best Undergraduate Poster for "A Singular Value Decomposition of 15 Solar Mass Progenitor Chimera Entropy Data." UT and UT Space Institute students and faculty submitted 19 abstracts to the meeting.



Students (and Assistant Professor Nadia Fomin, far right) all packed and ready for the SESAPS 2015 meeting in Mobile



See the UT SESAPS photo album:  
<http://www.phys.utk.edu/events/2015-SESAPS/>

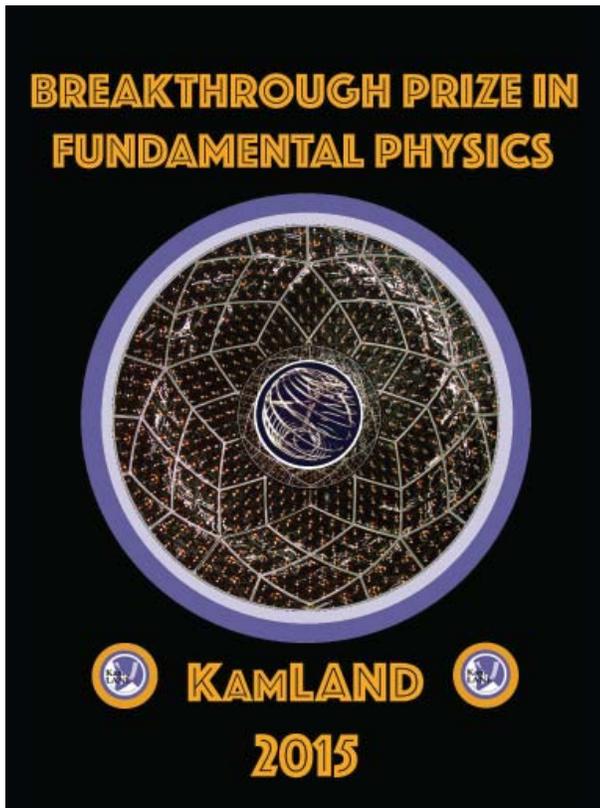
UTSI Graduate Student **David Surmick** brought home the award for Outstanding Spectroscopic Research By a Student Member from the Society of Applied Spectroscopy (SAS). Surmick was recognized for his poster on "Self-Absorption Measurement of Resonant Aluminum Lines" at The Great Scientific Exchange (SCIX) conference, held September 27 through October 2 in Providence, Rhode Island. Surmick earned a master's in physics at UT in 2014 and is pursuing a Ph.D. at the UT Space Institute in Tullahoma, working with **Associate Physics Professor Christian Parigger**.

## Faculty and Staff

When UT's physicists got involved in neutrino physics by joining the KamLAND experiment in 1997, they weren't looking for fi-



David Surmick and Associate Professor Christian Parigger



year to be divided among five neutrino experiments, including the KamLAND Neutrino Detector in Toyama, Japan. UT researchers listed among the KamLAND laureates are: **Mikhail Batygov** (Ph.D., 2006/ UT Physics; now with Carleton University, Canada); **William Bugg** (Professor Emeritus); **Yuri Efremenko** (Professor); **Yuri Kamyshkov** (Professor); and **Alexandre Kozlov** (Former Postdoc at UT; now at Kavli IPMU in Japan).

Congratulations to **Professor Jon Levin** on his nomination for the Society of Physics Students Outstanding Chapter Advisor Award. Levin has been UT's SPS advisor since 2010 and was listed along with seven other faculty members from across the United States as a nominee. The award is the most prestigious of the society's honors and is awarded to one chapter advisor each year. One caveat for selection is that the advisor's chapter must have won an Outstanding Chapter Award in the two years prior. UT's SPS chapter has been recognized as an outstanding chapter three times since 2011.

**Natasha Sharma**, a postdoctoral researcher working with **Assistant Professor Christine Nattrass** in the Relativistic Heavy Ion Physics group, was chosen for Elsevier's Young Scientist Award at Quark Matter 2015, held in late September/early October in Kobe, Japan. She garnered the honor for her work on (anti-)nuclei production in ALICE (A Large Ion Collider Experiment) at CERN.

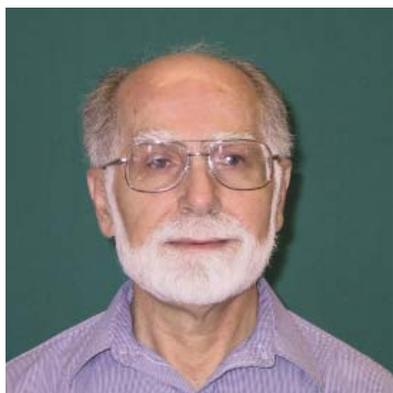
nancial gain. Yet with the experiment's selection for the Breakthrough Awards Fundamental Physics prize, their efforts will, quite literally, pay off. This is the third year for the Breakthrough Prizes, which honor achievements in Fundamental Physics, Life Sciences, and Mathematics. The Fundamental Physics honor brings with it \$3 million in prize money, this

**The Society of Physics Students** has been busy as per usual this fall. On October 30 they dropped pumpkins frozen in liquid nitrogen from a height of 80 feet for Pumpkin Drop 2K15, and also showed off the fun of physics with other demos, including the bed of nails (see below right). The event got a lot of local media attention and you can find links to all the stories and video on the physics website at: <http://tiny.utk.edu/pumpkin2015>. Our undergraduates have also started a new UT student organization for women in physics!



# In Memoriam

The physics department is saddened by recent losses to our physics family:



Solon Georghiou

Professor Emeritus **Solon Georghiou** passed away December 2, 2015, after a gradual decline in health. He earned a bachelor's in physics from the University of Athens in 1962, followed by a M.S. (1965) and Ph.D. (1968) in photo-physics from the University of Manchester. Before joining the UT Physics faculty in 1973, he was a postdoc at the University of Minnesota in Minneapolis and at Johns Hopkins University. Georghiou's specialty was molecular biophysics, with special emphasis on the physical properties of DNA. He was known as a passionate teacher, and by his own estimate he taught well over 3,000 students, many of them pre-med majors. He once said that "if we wanted to have a family doctor who was not my student, we had to work hard." To transfer knowledge, he believed, was sacred. He also served as academic advisor in the department for two decades. He retired from the physics faculty in spring 2007. Since then, he embarked on translating texts from the ancient Greek.

**Alumnus Warren Keller** passed away November 9, 2015. He earned a B.S. in engineering physics in 1953 and a master's in physics in 1957. The department honored him with the Distinguished Alumni Award in 2014 "For His Leadership and Personal Contributions to Space Science at NASA through his Service as Program Manager for the Voyager and Hubble Space Telescope Programs and for Three Decades of Dedicated Service to the Total NASA Program." He began his illustrious career at NASA in Huntsville, Alabama, in 1960 and played a pivotal role in the story of America's space program, including his leadership in gaining approval for the Voyager and Space Telescope missions and serving as program manager for the Hubble Space Telescope. He was honored with several awards over the course of his career, including the NASA Outstanding Leadership Medal and a special American Astronautical Society Award for his contributions to the Voyager mission.



Warren Keller (right) accepting the department's Distinguished Alumni Award in 2014.

Physics Family Full Circle: Warren Keller chaired a NASA committee established to implement the Space Telescope Science Institute, where undergraduate Chima McGruder interned this summer (see page 6).

**Alumnus Richard Maerker**, the youngest Ph.D. graduate of the physics department (1952) passed away on October 31, 2015. A Knoxville High School graduate, he won UT's Freshman Faculty Scholarship in 1946. After a year working for Kodak, he returned to the physics department and became involved in rocket research, which led him to the Redstone Arsenal in Alabama and Tulane University in New Orleans. He returned to East Tennessee in 1959 to work at Oak Ridge National Laboratory, retiring in 1993.

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(Gift records forwarded to the department dated June 1, 2015, to October 31, 2015)

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## Giving Opportunities

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 <http://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](mailto:don@utfi.org). You can also donate online by going to <http://artsci.utk.edu/> and clicking on “Give to the College of Arts and Sciences.”



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