

The Fuel of Stars and Structure

Roughly 570 miles north of the Nielsen Physics Building, construction of a premiere scientific complex hums along. While the host is Michigan State University, **UT's physicists play a key part in driving the science behind what will be the world's most powerful radioactive beam facility.**

Every physicist knows that protons and neutrons are building blocks of the atomic nucleus. Isotopes are sort of first cousins, with equal numbers of protons but different numbers of neutrons. Rare isotopes are among the most elusive members of the family: their lives are short and they aren't typically found on Earth. The Facility for Rare Isotope Beams (FRIB, pronounced F-Rib) will provide the world's most intense beams of rare isotopes, giving scientists vastly wider access to these nuclei. But why, exactly, do physicists want to study them? Professor Kate Jones explained:

"The first reason is really fundamental, and it's just understanding the structure of the nucleus," she said. "Then there are applications. For instance, understanding how nuclear reactions happen in stars and in stellar

explosions. Nuclear reactions are the fuel of a star, and without them stars would collapse under their enormous gravity."

Here on Earth, rare isotope studies can illuminate the energy dynamics crucial to energy applications and nuclear stewardship.

"When an isotope fissions, you produce two new isotopes, and also some neutrons and some gamma rays," Jones explained. "Understanding which isotopes are produced in different decays and then understanding the energy spectrum of the neutrons—that can help understand new fuel cycles and also what happens when a nuclear reactor has to shut down quickly."

This also folds into understanding the subatomic workings of the country's nuclear weapons stockpile. FRIB will provide the unique capability to pursue these questions—fundamental to practical—through unprecedented beam intensity.

A Needle in a Haystack

Jones explained that FRIB's radioactive beams will be made through a process called fragmentation, where a beam of heavy ions is trained on a thin target.

"Heavy ions really means anything heavier than hydrogen (or) helium, and they impinge on a target that's thin enough to let the reaction products out," she explained. "They're still traveling quite fast. You use electromagnetic separators to choose what you want."

It's a little like getting a needle out of haystack, and if there's only one needle, the best tool for the job is a magnet.

"That's what you're doing here; you're trying to find your needle in the haystack," Jones continued. "So you have lots and lots of reactions. Most of them produce things that you're not at all interested in and you want to throw them away. But you use a magnet to bend the thing that you are interested in and you keep that. Unfortunately you can't necessarily, with one magnet, select just one isotope, so it's actually a complicated system of magnets, but that's essentially the idea."

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Message from the Department Head



Hanno Weitering
Professor and Head

State of the Department

At the beginning of this new academic year, it is always a great pleasure to welcome our new graduate and undergraduate physics majors. Fifty-seven incoming freshmen students declared physics as their major; an increase of 14 students compared to last year and 27 the year before. Thanks to the generous gifts of our alumni and friends, we were able to offer departmental scholarships and small book grants to our top recruits. Not all of the 57 students will remain in physics but the upward trend is promising. We are reaping the benefit of our enhanced recruiting effort through, e.g., the open house events and faculty visits to local area high schools.

We are also welcoming 21 graduate students. While most of us still enjoyed the lingering days of summer, our incoming graduate students have already been very busy. Apart from filling out the necessary hiring paperwork and receiving instructions on policies and procedures by the office staff, all new students are required to take a placement exam for advising purposes. International students furthermore have to take the English speak test. Then comes academic advising. The biggest event on the August calendar, however, is the new-GTA workshop. It prepares the students for the lab courses they will be teaching, including laboratory safety protocols. In addition, students are educated on teaching methods and pedagogy, professional conduct, and Title IX policy and procedures. The GTA orientation is in fact one of the busiest times of the year. It truly represents a team effort of faculty and staff, making sure that all our GTAs are off to a good start. We wish all of our new students the best with their academic studies, their new role as teaching assistants, and adjustment to Knoxville student life.

Kudos to **Dr. Jaan Mannik**, who was promoted to associate professor with tenure, and to **Dr. Kate Jones**, who was promoted to full professor on August 1. I am also pleased to introduce to you our two new assistant professors, Drs. **Miguel Madurga** and **Maxim Lavrentovich**. Miguel obtained his PhD in physics from the autonomous university of Madrid and completed his postdoctoral research here at the University of Tennessee in 2014. He then received a prestigious CERN Research Fellowship to build a Neutron Detector Array at the radioactive ion beam facility in Geneva, Switzerland. Miguel is joining the low-energy nuclear physics group of **Robert Grzywacz** and **Kate Jones**, and will be heavily involved with the Facility for Rare Isotope Beams, currently under construction at Michigan State University.

Max obtained his bachelor's degree in physics and mathematics in 2008 from Kenyon College in Gambier, Ohio. He completed his PhD in physics at Harvard in 2014, and conducted his postdoctoral research at the University of Pennsylvania. Max's dissertation and postdoctoral work covered topics in biophysics, non-equilibrium statistical mechanics, and soft matter physics. His most recent work focused on pattern formation in pollen grains and in liquid crystal droplets. Max will continue his biophysics research at UT and will have a joint faculty appointment with Oak Ridge National laboratory. You can find a more detailed profile of Max and Miguel in our December newsletter.

This fall, I am starting my second five-year term as Department Head. Many have asked me how I survive, having to devote so much of my time to administration. My answer is simple. First of all, it truly has been a very rewarding experience, and secondly, I am not doing this alone as I am surrounded by faculty and staff who always come up with good ideas and deeply care. During the past five years, the department has changed dramatically as many young faculty joined the ranks. We hired 10 assistant professors (two appointed in August 2012 under my predecessor Dr. Soren Sorensen), two endowed chair professors, one UT/ORNL Joint Faculty member (JFO), and two full-time lecturers. During this time, the faculty size increased from 30 (24.4FTE) to 35 (29.25FTE) currently, excluding our two lecturers. They all turned out to be excellent teachers, mentors, and researchers. With the hiring of our astronomy lecturer and coordinator, Sean Lindsay, we have seen a dramatic turnaround in the astronomy enrollment. Meanwhile, the technical support staff was strengthened with the arrival of machinist **Joshua Bell** and **Jason Chan**, who is the tech expert for all our electronics needs. Last but not least, **Christine Cheney** took over the role of **Jim Parks** as Director of Undergraduate Laboratories, bringing the number of women in faculty and/or leadership positions up to eight. By far, most of the credit for these excellent hires goes to the faculty and staff who served on the various search committees, and I believe that most, if not all, members of our department are very glad with the choices we made.

Other positive indicators include the increase in the number of physics majors that I mentioned earlier. This has yet to translate into larger graduation numbers, but considering the fall 2017 enrollment in our senior Electricity & Magnetism and Quantum Mechanics courses of about 30 students, I am confident that we will see a gradual increase in our undergraduate graduation rates. Donations are increasing, while research expenditures reached \$12.5M, which to my knowledge is an all-time high. While some of the recent increases originate from several large subcontracts, we have seen an increase of roughly \$2.5M in research expenditures across the various sub-disciplines, as compared to FY 2015 and 2016. These numbers don't tell the whole story: our funding sources are also more diverse than ever. Clearly, our faculty are truly doing an amazing job in times where funding is increasingly difficult to come by.

And then there are things that didn't work out the way I had hoped. The promised curriculum modernization is much more challenging than I originally realized and it will take much more time to complete. We are losing too many undergraduates to other programs and we do poorly when it comes to recruiting women and minorities to our graduate program, regardless of how hard we try. We lost GTA lines while more and more lab sections have wait lists. This directly cuts into the GRA pipeline, meaning that some faculty may find it hard to find students to work on their research projects. Clearly, we should not expect to increase our PhD production by any significant margin within the next few years. Lastly, we have very little means at our disposal to reward excellence.

In the coming years, I expect quite some volatility with regard to the federal budget for basic research, which indirectly affects the financial position of the department. In addition, it is unlikely that we will be able to continue expanding our department at the current rate. Nonetheless, as Dean Theresa Lee had indicated, we have "a superb faculty, a professional and highly motivated staff, and wonderful students." Indeed, this makes me feel optimistic for the future of the department. It will keep me highly motivated to serve the department and Dean for hopefully several more years.

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Finding that needle at FRIB translates into producing, for the first time, most of the rare isotopes created in the cosmos. Because these decay into elements found here on Earth, scientists will in a sense have a much closer laboratory to understand how these elements are formed, as well as a much more vivid picture of how atomic nuclei behave. The facility will be a centerpiece of nuclear physics research, and UT has been involved from the beginning.

Leadership from the Hill

FRIB is a user facility for the Department of Energy's Office of Nuclear Physics with funding from DOE, Michigan State, and the state of Michigan. While UT is obviously a good ways south, the physics department plays a significant role in shaping FRIB's direction. Jones serves on FRIB's Science Advisory Committee, as does Adjunct Professor David Dean. Witold Nazarewicz, who enjoyed a distinguished career on UT's physics faculty, is FRIB's Chief Scientist.

On the experimental side, UT's FRIB physicists include Jones and Professor Robert Grzywacz, as well Miguel Madurga, who will join the department this fall.

"We're driving and enabling the science because we are instrument builders," Jones said.

With help from the department's machinists, they've already built tools like gamma ray detectors that can be used at other facilities, keeping FRIB's capabilities in mind.

"We're doing a lot of development—not just of the tools, like neutron detectors or gamma ray detectors—but also the techniques," Jones said.

UT also has significant involvement with the FRIB Theory Alliance, including faculty, students, and post-docs. Assistant Professor Andrew Steiner is among them.

"In general, the theory alliance provides a lot for the nuclear theory community nationwide: theory fellows, bridge positions, education, etc.," he explained.

Professor Thomas Papenbrock, another of UT's theory alliance members, pointed out that the UT-Oak Ridge National Laboratory Nuclear Theory Group will host a postdoc from China through a FRIB-supported fellowship. The alliance also promotes International Collaborations in Nuclear Theory (ICNT) programs, which address specific needs in rare isotope science. Steiner spoke at the inaugural ICNT meeting last year and is looking forward to FRIB's investigative capabilities for the structure of neutron-rich nuclei and the determination of the properties of hot nuclear matter in intermediate energy heavy-ion collisions. He's long been involved with studies into the origin of matter through the Joint Institute for Nuclear Astrophysics—Center for the Evolution of the Elements, another component of FRIB's research. This center will take the lead on building a recoil separator at FRIB—a nuclear astrophysics initiative that also includes UT faculty.

FRIB is scheduled for completion in 2022 but plans are on track for an earlier opening in 2020.

"They've been running ahead of schedule since the beginning of the project," Jones said, adding that the facility's opening "will not be flicking a big switch," but will involve a ramping up period to test the systems, safety protocols, etc.

In the meantime, UT physics faculty and students will continue their research in the theory and experimental tools and equipment to make FRIB successful and in the process keep the department at the forefront of nuclear and astrophysics studies.

"We have deep involvement," Jones said. "It's an important facility for this department."



Professor Kate Jones (center) serves on the FRIB Science Advisory Committee. (Photo courtesy of MSU/FRIB.)

The Power of Optimism

Laszlo Adler has been an apprentice carpenter, an accessory to an Olympic gold medal-winning basketball team, and a guy who once did a headstand on a trans-Atlantic flight. He is also a Holocaust survivor who brims with optimism and a pioneer in ultrasonics. It's that last one that earned him the physics department's 2017 Distinguished Alumni Award.

Adler was born in 1932 in Debrecen, Hungary, about 140 miles from Budapest. His parents' only child, he excelled at school and after fourth grade was accepted to the selective Jewish Gymnasium. Within a year, however, his education was cut short when the German occupation pushed his family first into ghettos, then into a work camp in Austria. At the age of 11 he was avoiding airstrikes while working 10 hours a day loading bricks onto a truck. At one point his extended family of 13 was on a train headed for the gas chambers when they were ultimately liberated by the Russians. When they returned to Debrecen in May 1945, Adler found most of his classmates had not survived the war.

Adler and his family carried on. He resumed his studies and became an apprentice carpenter at age 14, spending time in Israel working at a kibbutz (a communal farm). He returned to Hungary and enrolled at the Workers' Gymnasium, taking classes from 5 until 9 p.m. and working during the day, first at a furniture factory and later at a medical instrument factory. The gymnasium provided a gateway to higher education, as the system favored those who had not traditionally had access to college.

"I had to have some support to survive," Adler said. "As a worker, I had a much better chance to get into university. Initially I thought to study medicine. I thought it's nice to help people. Then I realized that my strength was more in the natural sciences and mathematics."

In 1953 Hungary, however, he had no choice where he would go or what he would study. The school principal made that call.

"For whatever reason he thought that metallurgical engineering would be a big need, even if I had very little interest," Adler said. "From day one I realized that was not exactly what I would enjoy," he said laughing.

Eventually he transferred to Eotvos Lorand University to study physics and math, where his education



The department honored Laszlo Adler with the Distinguished Alumni Award for outstanding contributions to ultrasonics, nondestructive evaluation, and materials characterization.

would again be interrupted. He explained that in the fall of 1956, writers and journalists began to criticize the Russian occupation. What followed was a failed revolution, which among other things closed down Hungary's universities. Adler walked across the Austrian border and eventually managed to get a U.S. visa—the start of another new chapter.

Next Steps to Knoxville

In February 1957 Laszlo Adler crossed the Atlantic on a U.S. Army plane, sitting on his suitcase the entire flight. He settled in Michigan, close to Michigan State University, where he saw an opportunity to continue his studies. The problem was that he had no transcript of his previous education. Still, he took a chance.

"I walked into the physics department, not having any documentation," he said. "I was just looking to see, 'What can I do?'"

The faculty peppered him with math and physics questions and decided his knowledge was equivalent to a bachelor of science degree.

"So (they) said, 'You have a bachelor of science degree from a Hungarian university.' Even though that degree doesn't exist, it still appears on my curriculum vitae."

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Alumnus Profile, Continued from Page 5

MSU offered Adler a research assistantship in ultrasonics for \$200 a month, a salary he reasoned was probably higher than that of Hungary's prime minister. He was happy to accept, despite knowing nothing about ultrasonics at the time. Ultrasonic waves are sound waves in the inaudible frequency range of above 20,000 Hertz.

"The whole field really started to develop after the Titanic," Adler explained, as the interest in sonar grew with the sinking of the famous ship. One draw for him was that ultrasonic research offered the possibility of a more pared-down program.

"I'm somewhat of an individualist and it's one of the few areas where you can work by yourself," Adler explained. "You don't need large machinery—accelerators and so on."

At MSU he worked with Professor Egon Hiedemann, who he said "developed one of the best laboratories in this field, in the U.S."

Among the group's staff was a research assistant professor named Mack Breazeale. He would later join the physics faculty at UT and become one of Adler's close friends.

"And so this is where my connection started with the University of Tennessee," Adler said.

There were, however, a couple of stops on the way to Knoxville.

Adler earned a master's in physics and accepted a teaching position at the General Motors Institute in Flint. The institute offered a five-year program for engineering students, culminating in a thesis. Adler developed courses on ultrasonics and noise control and travelled to GM plants across the country as a thesis advisor.

"I was the only (faculty member) who dealt with sound waves, and of course unwanted sound is noise," he said. "That's one problem with automo-

biles: to control the noise. So I got involved with noise control problems, and using ultrasonic waves in several projects."

The young Hungarian who knew nothing about ultrasonics as a beginning graduate student was becoming an expert in applying the field to industrial problems. Beyond building a career, he was also building a life. He bowled with a team called the Physicats, started practicing yoga, and agreed to a blind date with a young lady named Vera Princz. They married six weeks later and celebrated their 54th wedding anniversary this past January. Life in Flint was good, but after four years Adler was ready for a change.

"Going to different plants I learned a lot about industry; it was quite useful," he said. "I knew that I didn't want to do that the rest of my life. That's one thing you have to decide. Then you still have to decide the next step."

The next step came with a year-long National Science Foundation fellowship at the University of Göttingen in Germany, a prestigious institution with a strong math and science tradition. Adler relished working with other ultrasonics researchers. It was there he decided he wanted "a real university life." He wanted a PhD.

By then Mack Breazeale was an associate physics professor at UT and a consultant at Oak Ridge National Laboratory. During a trip to Denmark he took a detour to Göttingen to visit Adler. He suggested that his friend come to UT. His teaching experience in Flint would mean he could probably be an instructor fulltime while he earned a doctorate. Adler was sold.

"This was probably the best decision I made in my life," he said.

Teaching Physics (and Geography)

Alvin Nielsen made the official offer, bringing Adler and his family to Knoxville in January 1966. They rented a small house on Taliluna Avenue for \$115 a month and he began teaching engineering and pre-med majors while working toward his PhD. He finished the degree in 1969 and joined the physics faculty.

Adler enjoyed engaging with students. Before the end of one particular term, he saw student evaluations describing him as a good teacher with a good sense of humor, but with a "strong eastern Euro-

Always a professor: Laszlo Adler (with lab notebook) during his UT days, surrounded by (left to right) John Cantrell, Mack Breazeale, Ken Bolland, Jim Baines, Mike Torbett, and Betsy Miller.



pean accent.” Adler marched into his next class and feigned anger, calling out the students for their unintended dishonesty. Hungary, he told them with mock irritation, is in *central* Europe.

At one point he was asked to give a Hungarian language exam to an undergraduate who was in a hurry to get it out of the way, mainly because he was headed to the Olympics in Montreal. Ernie Grunfield passed with flying colors and played for the U.S. gold medal-winning basketball team.

Adler balanced his teaching with research and split his time between campus and ORNL, where he worked as a consultant in the Nondestructive Testing Group. Because ultrasonic measurements are nondestructive in nature, they’re a helpful tool in material flaw characterization, medical diagnostics, etc. His main contribution was in ultrasonic spectroscopy, where different frequencies give scientists different information about a material or system.

“I look at the whole field as a physical interaction between waves and materials. All these interactions: scattering, diffraction—they’re physical phenomena, which depends on the frequency of the wave as well as the size of the object,” he said.

Adler was among the first wave of scientists to do ultrasonic analysis rather than simply testing, winning significant funding from an array of sources including the National Science Foundation, the Rockwell Science Center, the UT Cancer Research Institute, the U.S. Air Force, and the Office of Naval Research. He wrote a book (*Ultrasonic Spectral Analysis for Nondestructive Evaluation*) with his first PhD student. He was a fixture at the International Conference on Acoustics, and in route to one meeting kept to his yoga practice by doing his morning headstand on a flight over the Atlantic. He also established a fruitful collaboration with the University of Paris 7, becoming a professor invitee—a post he would hold for 20 years. In 1979 he was elected a fellow of the Acoustical Society of America “for his contribution to ultrasonic spectroscopy.” Adler’s work was gaining notice, abroad and at home.

An Offer He Couldn’t Refuse

In November 1979, just before he was to begin a one-year sabbatical in Paris, Adler got a phone call from the Ohio State University Department of Welding Engineering. They wanted him to build a nondestructive evaluation (NDE) program. He would have faculty appointments in both welding engineering and engineering mechanics. Adler wasn’t looking to leave Tennessee: he and Vera had two kids in school (Michael and Suzika) and Vera owned her own shop in West Town Mall. But the chance to develop the first U.S. graduate program in nondestructive evaluation proved too tempting.

“I find people fundamentally good,” Adler said. “You can always learn. You can always share. All my life I’ve tried to find the positive, regardless of all the hardship or difficulties. I think fundamentally I’m an optimist.”

“I got an offer I couldn’t refuse, let’s put it that way,” he said laughing.

Even so, out of loyalty he kept the Tennessee license plate on his car for four years.

Vehicle registration notwithstanding, Adler flourished in his new environment. In 10 years the NDE program graduated 23 students. In 1993, he was recognized with the OSU Distinguished Scholar Award. He started a consulting business, winning funding through the Small Business Innovation Research program. Though he took early retirement in 1995 as the Taine McDougal Professor Emeritus, for 10 more years he commuted to Columbus from his new home in Florida to teach classes.

By the mid-2000s Adler decided to slow down, at least by his standards. He got into chaos physics and nonlinear problems, which actually cycled back to the work he did for his doctoral thesis. It’s been a Tennessee reunion, as he’s collaborating with UT Physics graduates John Cantrell and Tom Yost of NASA, who worked with him during their student days. The trio presented a paper just last fall at the International Congress on Acoustics.

Altogether, Adler has 336 publications and four patents to his credit, as well as a long list of close friends and colleagues, some going back to his early days in Hungary. He still goes out for his daily run (he and Vera have several marathons between them) and loves to travel, often with his children and grandchildren. The child who grew up during a tumultuous time in world history ended up making a career out of a field that solves problems without causing damage, which fits well with his temperament.

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Where does gold come from? What is everything made of?

Saturday Morning Physics has the answers

ON A SATURDAY MORNING IN EARLY

APRIL, Physics Professor Kate Jones is down front in a lecture hall in UT's Science and Engineering Research Facility. She's explaining how stars are element factories to an audience comprising high school students, parents, teachers, and others who are scientifically curious; many decked out in sweat-shirts and carrying travel mugs of coffee. She asks if anyone in the room is wearing gold jewelry. Reese McNamara, a senior at West High School in Knoxville, just happens to be wearing earrings that fit the bill. When Jones asks where they came from, the answer starts with Mom, which leads to Dad, which leads to a jeweler, which leads to a raw supplier. But where, from the very beginning, does gold come from? That fundamental question gives Jones the opening to explain the rapid neutron capture process in her talk on "Stardust and Atom Smashers," part of the department's Saturday Morning Physics (SMP) series.

UT's SMP program is the handiwork of Kranti Gunthoti, who joined the department in 2016 as a lecturer and outreach coordinator and brought with him a contagious enthusiasm for physics. Over the past year he's worked hard to cultivate relationships with area high schools, as well as homeschool groups. He initiated Saturday Morning Physics to generate public interest in science and showcase physics research at UT.

"The other equally important goal of the program is to also positively nurture the enthusiasm for physics in high school students," he said.

Gunthoti arranged 10 lectures from UT's physics faculty with titles like "What is Everything Made of," "The Ghostly Neutrinos," and "Studying Quantum Mechanics with Light and Computers." The talks ran from February through April, with each Saturday session beginning at 10 a.m. and ending at noon. Roughly 100 people attended the lectures, including

students from 10 different high school/homeschool programs. Parents, teachers, UT faculty and staff, and students enrolled in UT's introductory physics courses also came.

McNamara, who attended with her father, pronounced the series "awesome." She was not alone in her praise. Gunthoti invited online feedback and the comments were overwhelmingly positive. One attendee wrote, "Considering our society is trying to strengthen our foundations in the STEM (science, technology, engineering and math) arena, these lectures serve as a true asset to those who would otherwise not have the opportunity." Another commented: "(What) I enjoy most the Saturday Morning Physics lectures is that they are more accessible to all ages and education levels."

Accessibility was a key consideration for Gunthoti in organizing the series, and not only in terms of content. He streamed the lectures on the physics department's Facebook page using Facebook Live so that even if students couldn't make it to UT, they could still watch the lectures. Others found creative teambuilding ways to come to campus. Tommy Eggleston teaches physics and math at West High School. He and his students would meet at the school and bike to campus.

Erica Johnson (MS, 2009) teaches chemistry and physics (along with a little astronomy) at Halls High School. Her students, like Eggleston's, developed peer relationships through SMP by arranging car-pools, etc. They also liked seeing how science works on a grander scale.

"They liked connecting to chemistry," she said, explaining that the tie-in with their prior knowledge built their confidence. If the physics seemed new and a bit overwhelming, she said the exposure alone was important for them, a point Eggleston echoed.

“I wanted students to get exposure to physics on a college campus,” he said. “I wanted them to hear people talk with different accents. I wanted them to hear the passion of something they’re interested in.”

In the broader outreach picture, both Eggleston and Johnson are also working with Assistant Professor Sowjanya Gollapinni on QuarkNet (see below), an outreach program connecting high school students and teachers with physicists on projects exploring the hidden nature of matter, energy, space, and time. The project is managed by the University of Notre Dame and Fermilab, a national particle lab in Batavia, Illinois, where Gollapinni co-chairs the Saturday Morning Physics program. Other universities, including Texas A&M and the University of Michigan, sponsor SMP as well, but spring 2017 was the first time it’s been done at UT.

Gunthoti was pleased with the results and will build on SMP’s initial success. He plans to offer SMP every spring to keep the general public and area students

engaged in contemporary physics. He’d like to rotate speakers and topics to give the audience different research perspectives, and to introduce interactive learning aids like flash cards, and hands-on (eyes-on) demonstrations. He also sees the recruiting potential of introducing high school students to the physics faculty. One SMP student from the L&N STEM Academy ended up working with Professor Yuri Efremenko this summer as part of that connection.

“After this first SMP session I am positive that younger audience(s) acquired some understanding of what physics research is all about and might hopefully consider careers in physics,” he said. And “who knows: they might even join the UT Physics Department to do their undergraduate and doctoral studies.”

Find more information about UT’s Saturday Morning Physics program (including lecture slides) at: www.phys.utk.edu/saturday-physics/.

QuarkNet Connects High Schools with Physics Research

UT Physics is introducing area high schools to particle physics research via the QuarkNet program. QuarkNet connects students and teachers with physicists on projects exploring the hidden nature of matter, energy, space, and time. The project is managed by Fermilab and the University of Notre Dame, with centers all over the U.S. Tommy Eggleston and Erica Johnson of West and Halls High Schools spent time this summer at Fermilab and UT learning about the MicroBooNE experiment and building cosmic ray detectors for their schools. Assistant Professor Sowjanya Gollapinni is directing UT’s initiative, with plans to add more schools over time.

Get the full story at:
www.phys.utk.edu/news/2017/quarknet.html.



Through the QuarkNet program, Teachers Tommy Eggleston and Erica Johnson built cosmic ray detectors for their high schools, with help from undergraduate physics major Tara Skiba (center). Image credit: Kranti Gunthoti.

Spring 2017 Honors

Honors Day 2017

The physics department hosted the annual honors day ceremonies April 24, recognizing a distinguished alumnus, outstanding students, and the teacher of the year.

Dr. Laszlo Adler won this year's **Distinguished Alumni Award** "for his outstanding contributions to ultrasonics, nondestructive evaluation, and materials characterization." A 1969 PhD graduate, Adler was part of the physics faculty and also enjoyed a long and fruitful tenure as a consultant at Oak Ridge National Laboratory. He then joined the faculty at the Ohio State University, holding chaired professorships in the departments of Welding Engineering and Engineering Mechanics. He developed OSU's interdisciplinary graduate program on nondestructive evaluation: the first such program in the United States. In 1993, he won Ohio State's Distinguished Scholar Award. Read more about Laszlo Adler and his life and career in the alumnus profile beginning on page five.



Professor and Department Head Hanno Weitering (left) presents Laszlo Adler (PhD, 1969) with the 2017 Distinguished Alumni Award.

Physics Awards

- Outstanding First Year Physics Student: **Adam Bryant**
- Robert Talley Award for Outstanding Undergraduate Research: **Brandon Barker**
- James W. McConnell Award for Academic Excellence: **Chima McGruder**
- Douglas V. Roseberry Award: **Louis Varriano**
- Robert W. Lide Citation: **David McCallister**
- Outstanding Graduate Teaching Assistant Award: **Phil Dee**
- Outstanding Tutor Award: **Aaron Kirby**
- Colloquium Award: **Xin Wen**
- Paul Stelson Fellowships | Beginning Research: **Tyler Smith**; Professional Promise: **Shaozhi Li**
- Fowler-Marion Outstanding Graduate Student Award: **Daniel Odell**
- Society of Physics Students Teacher of the Year Award: **Lucas Platter**



Chima McGruder (left) won the James W. McConnell Award, presented by Dr. Christine Nattrass.

Brandon Barker (left) represented the Society of Physics Students, presenting the SPS Teacher of the Year Award to Dr. Lucas Platter.





Chancellor Beverly Davenport (right) recognized physics major Louis Varriano as one of seven Torchbearers, the highest honor given to UT students.

2017 Chancellor's Honors

The physics department had a stellar night at the April 19 Chancellor's Honors, claiming top student and faculty awards. Undergraduate **Louis Varriano** was recognized as a Torchbearer; the highest honor given to UT students and one reserved for graduating seniors who have exhibited academic excellence and service to the university and society at large. He was also named the Undergraduate Researcher of the Year. **Professor Robert Grzywacz**, part of the scientific team that literally put Tennessee on the periodic table (see page 13), was recognized with a Research and Creative Achievement Honor. Nine students were recognized for Extraordinary Professional Promise, including **Chima McGruder**, who was also honored for Extraordinary Academic Achievement. Below is a complete list of physics awardees:

- Extraordinary Academic Achievement: **Chima McGruder**
- Extraordinary Professional Promise: **Kevin Bass, Jose Bonilla, Daniel Odell, Brooke Carter, Brandon Cathey, Ghaneshwar Gautam, Chima McGruder, Mae Scott, Cory Thornsberry (Physics students accounted for 30 percent of Arts and Sciences awardees in this category.)**
- Undergraduate Researcher of the Year: **Louis Varriano**
- Torchbearer: **Louis Varriano**
- Research and Creative Achievement: **Robert Grzywacz**

Preparing the Public for the Great American Eclipse



Solar Sunday with Paul Lewis



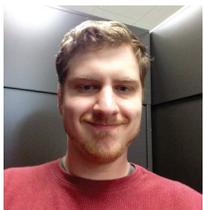
Astronomy Outreach Director Paul Lewis (right) on WBIR's Live at Five at Four program discussing the August 21 Great American Eclipse.

With much of Tennessee in the path of the August 21 total solar eclipse, **Paul Lewis** has had plenty to keep him busy. Lewis directs astronomy outreach for the department and gave numerous programs on the eclipse, emphasizing the safest way to view it. He organized Solar Sun Day events, opening the roof of the Nielsen Physics Building for solar observing followed by an eclipse simulation in the department's planetarium. He also distributed 10,000 pairs of solar glasses (thanks to Dr. Larry Taylor and the UT Planetary Geoscience Institute) to everyone from elementary school students to UT alumni so they could safely witness the historic event.

Physics Family News

Students

Two UT Physics graduate students won competitive awards from the U.S. Department of Energy this summer to work on neutrino research and neutron scattering at two different national laboratories.



Gray Yarbrough, who works with Assistant Professor Sowjanya Gollapinni, won a Fermilab Neutrino Physics Center (NPC) fellowship to work at

Fermilab (in Batavia, Illinois) on the MicroBooNE experiment, which sends accelerator-driven neutrinos into a detector filled with liquid argon. When the neutrinos collide with argon atoms, the resulting fragments of subatomic particles produce a sort of tracking blueprint scientists can follow to understand more about the neutrinos themselves. Scientists study neutrinos to understand the biggest puzzles in the universe such as the matter anti-matter asymmetry. Yarbrough is the first UT student to win this highly competitive fellowship through the NPC Scholar Program, which brings experimentalists and theorists from the international neutrino community to Fermilab.



Ryan Rawl, who works with Assistant Professor Haidong Zhou, also won a DOE graduate student award, this one through the Office of Science Graduate Student Research (SCGSR) Program. His work is at Oak Ridge

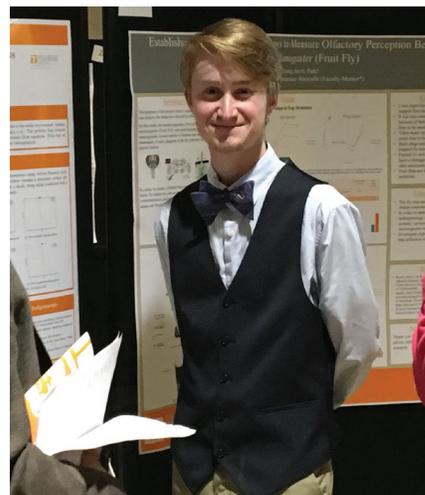
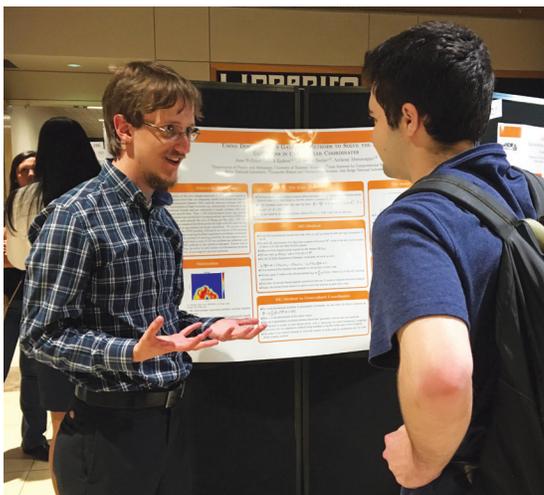
National Laboratory on neutron scattering research and instrumentation. The SCGSR program provides supplemental awards to outstanding U.S. graduate students to pursue part of their graduate thesis research at a DOE laboratory in areas that address scientific challenges central to the Office of Science mission.



Spring 2017 bachelor's graduates **Louis Varriano**, **Jonathon Ferrell**, **Chima McGruder**, and **Brooke Carter** pose in front of UT's iconic Ayres Hall. Physics welcomed 19 total new alumni this spring.

Undergraduate Meg Stuart—a triple major in physics, honors math, and computer science—is one of nine UT students offered prestigious Fulbright U.S. Student Program awards for the 2017-18 academic year. She will study math at the Renyi Institute in Hungary and also plans to pursue research in topology. The Fulbright Program is the flagship international educational exchange program sponsored by the U.S. government and is designed to increase mutual understanding between the people of the United States and other countries.





EURēCA 2017: Physics undergrads again participated in UT's Exhibition of Undergraduate Research and Creative Achievement to show off their work with faculty. **Jessie Buffaloe** (left) and **Brandon Barker** (right) worked with Joint Faculty member **Eirik Endeve** on computational astrophysics research. **Louis Varriano** won the William Franklin Harris III Undergraduate Research Award for his work with **Professor Yuri Kamyshev** on neutron-mirror neutron oscillations.

Faculty

Professor Geoff Greene has been appointed to the Department of Energy/National Science Foundation Nuclear Science Advisory Committee (NSAC). His term runs through April 30, 2020. Greene is the second member of the current UT Physics faculty member on the current 21-member committee: **Professor Kate Jones** is the other. Established in 1977, the NSAC provides advice and recommendations on scientific, technical, and programmatic issues relating to the nuclear physics program.

A Nod to Tennessee

Physics Professor Robert Grzywacz was among the scientists invited to Nashville March 27 for recognition of their research adding tennessee to the periodic table of elements.

Tennessee Senate Joint Resolution 0002 “recognizes Oak Ridge National Laboratory, Vanderbilt University, and the University of Tennessee-Knoxville for their contributions to the discovery of element 117 and its naming as tennessee.” It concludes: “through their extraordinary achievements, they have advanced human knowledge and left an indelible mark on the history of science.”

The resolution outlines the contributions of Tennessee's scientists who worked with colleagues at the Joint Institute for Nuclear Research (JINR) in Russia to discover element 117, the second-heaviest element known. From the earliest scientific discussions to the results published in Physical Review Letters to the christening of 117 as “tennessine,” it details the long and fruitful journey that made Tennessee one of only two U.S. states represented on the periodic table (the other is California). Along with Grzywacz, James Roberto and Krzysztof Rykaczewski of Oak Ridge National Laboratory and Joseph Hamilton of Vanderbilt University were also in attendance. Grzywacz and Rykaczewski, as the document explains, “led the development of a new detection and digital data acquisition system that was used in the followup experiments on superheavy nuclei at JINR.”

The resolution was filed in January and signed by Governor Bill Haslam in early February. The sponsor was Speaker of the state Senate and Lieutenant Governor Randy McNally, who represents the 5th District encompassing Anderson, Loudon, and part of Knox Counties.



Krzysztof Rykaczewski (ORNL), Speaker of the state Senate and Lieutenant Governor Randy McNally, Robert Grzywacz (UT Physics), and James Roberto of ORNL (seated).



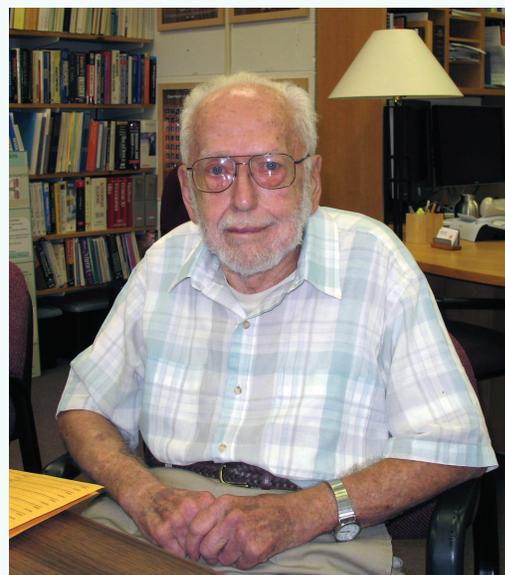
Connecting to the Community

For the past two decades, UT's College of Education, Health, and Human Sciences and the Department of Theory and Practice in Teacher Education have teamed up with the Civil Air Patrol, NASA, and the Tennessee Department of Transportation Office of Aeronautics to offer an **Aerospace Education STEM Workshop for teachers**. Our own **Paul Lewis**, who directs the department's astronomy outreach program, serves as an instructor. Teachers balance classroom learning with hands-on activities and field trips to help them develop STEM-based lessons for their classrooms.

Among the workshop activities are building an egg drop container to survive a fall from the top of the Nielsen Physics Building and constructing and launching model rockets from the lawn in front of Ayres Hall. This kindergarten teacher (left) saw her well-protected passenger land safely during the egg drop.

In Memoriam

Professor Emeritus W. Edward Deeds passed away February 6, 2017, at the age of 96. He was born in Lorain, Ohio, on February 23, 1920. He received an A.B. with Honors in Mathematics and Physics from Denison University in 1941, then went to the California Institute of Technology, where he received an M.S. in Physics in 1943. During his time at Caltech, he worked on topics including cosmic rays (with Carl Anderson) and looking for evidence of black holes (with Fritz Zwicky). After the U.S. entered World War II, he joined a National Defense Research Council war project, studying shock waves from conventional and atomic weapons (and, later, transport of radioactivity from atomic tests), working with physicists such as Jesse DuMond and Wolfgang Panofsky. Following the NRDC project, he returned to Denison University, where he taught Physics from 1947 to 1949. He completed his Ph.D. at the Ohio State University in 1951, his dissertation topic being Vibrational Analysis of Chain Molecules. He joined the UTK faculty in 1952, was elevated to Professor in 1959, and retired in 1990. He was known as an outstanding teacher at both graduate and undergraduate levels, and took pride in having directed 23 Ph.D. dissertations and 36 M.S. theses. He was also an active supporter of UT honors and interdisciplinary studies programs. In conjunction with his university activities, he consulted for a variety of organizations including Redstone Arsenal, Oak Ridge National Laboratory, and the Defense Advanced Research Projects Agency. Even after retirement he maintained an interest in basic and applied science of all kinds, and was a devoted participant in the Science Forum. His wide range of interests led to projects and patents in fields from polymer physics to microgravity.



(Courtesy of **Dean Deeds**, Class of 1973)

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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 865-770-1913 or your email 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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Photo of the Great American Eclipse taken
by our own Paul Lewis, who watched the
event from Spring City, Tennessee.