THE SOURCE

ALUMNI MAGAZINE • FALL 2021

UT'S GATEWAY TO ENGINEERING OPENS FOR FALL SEMESTER

T NUCLEAR ENGINEERING

Keeping Crowds Safe / Breakthrough for Molten Salt Reactor Safeguards / Rods, Reels, and Rivers

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TCE Interim Director of Communications
Melissa Callahan

Project Manager
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Photographers
Steven Bridges
Shawn Poynter
Yvette Gooden

Writers
Brian Canever
David Goddard
Élan Young

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University Printing and Mail

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On the Cover:
The Zeneah Engineering Complex, the largest academic building on campus.

From the Department Head

Last year, when I wrote this message, we were in the midst of the COVID pandemic and trying to navigate back to normality. Here we are a year later, and with the gift of a vaccine, we are back to having in-person classes, students working together in laboratories, and with little out of the ordinary other than wearing masks while indoors. The past year taught us that we can persevere and use technology to a much greater extent in classes, for meetings, and for virtual conferences. I wonder if our heavy travel schedules will ever fully return. With that said, it's great to be back in person and working with our fabulous team of faculty, staff, and students. I feel that those face-to-face interactions are a catalyst for the creativity that energizes some of our greatest research breakthroughs.

We are now celebrating the opening of the Zeanah Engineering Complex (ZEC) that we will soon call home. The vision for ZEC began a decade ago and has matured into a $129M, six-floor complex which opened for classes in August. The contractors are putting the final touches on our offices and administrative spaces, and we plan on relocating in October. Our teaching labs are already open and the rest of the twenty-three new state-of-the-art laboratories should be finished by November. It has been a long journey with funding, programming, design, and construction, but the final product is simply breathtaking. Overlooking the Tennessee River and situated next to Neyland Stadium, it is a jewel.

Our undergraduate and graduate students continue to impress. This issue of *The Source* highlights many of those talented scholars. Our enrollment remains strong, with our PhD program continuing to be the largest in the country six years running. This is fueled by our faculty who continue to grow their research portfolios and provide PhD students with opportunities to work on impactful projects. Last year 64% of our graduating undergraduates had an undergraduate research experience, which was a new high for us, and additional evidence to the great mentorship and training our faculty provide.

This was our first year offering our new undergraduate minor in Nuclear Safety and it was the most utilized minor of our graduating class. We are thankful for Bechtel's partnership in developing this program and Professor of Practice Chip Lagdon spearheading the new licensing class. I have received positive feedback from several companies and the US Nuclear Regulatory Commission on this program.

I wish to thank our alumni for continuing to engage with the department, influence our direction, and partner in our success. Several have stepped up to name rooms in our new building, and I am excited to see the impact of those investments. Please continue to partner with us to meet and surpass our extraordinary goals.

J. Wesley Hines

Worth Their Weight in Salt, Molten Reactors Hold Huge Potential

By Élan Young.

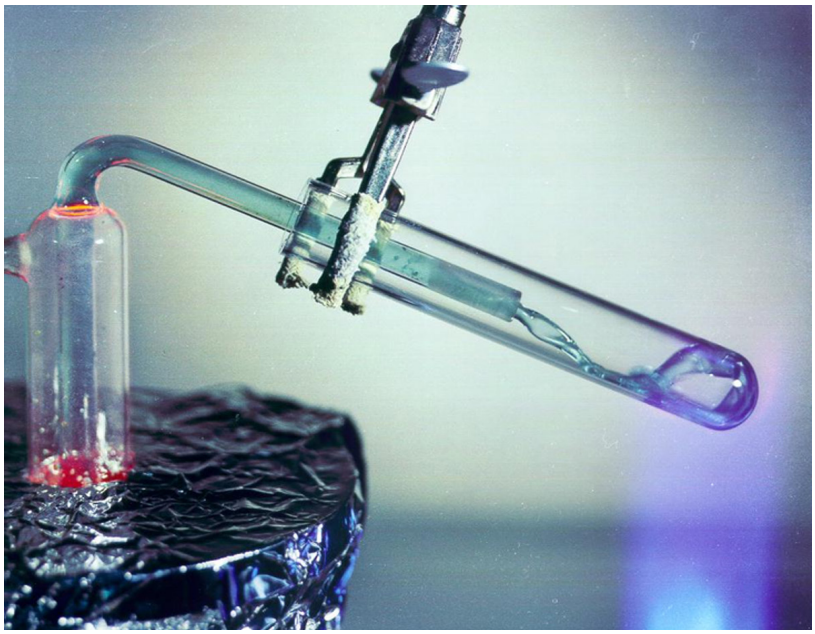
Research Assistant Professor Ondrej Chvala studies Molten Salt Reactors (MSR) not just with an eye for the future but also with the lens of history. The Joint Committee on Atomic Energy, a US congressional committee that operated from 1946–77, had the sole responsibility to oversee legislation on nuclear power in the country.

That body ultimately made decisions that would impact the direction of the nuclear industry for decades, most notably that the light-water reactor design would prevail over other nuclear reactor designs. This, despite that fact that Oak Ridge National Laboratory pioneered MSR technology in the 1950s, and in late 1960s ran the first and only MSR with significant power generation in the world—the Molten Salt Reactor Experiment—which proved that the MSR technology is feasible.

Now, with aging and decommissioning of light-water reactors, MSRs are trying to make a comeback. Chvala believes that MSRs can and should play a role in proving this much-needed power. These reactors use molten salt as liquid fuel and coolant and could be a major contributor to the nuclear energy sector by offering benefits including safety, efficiency, and flexibility in fuels and applications, but there are still barriers.

"One of the barriers is the lack of knowledge of these systems because they are not taught in curriculum," said Chvala. "The most powerful MSR that operated for the longest was quite a while ago. People have reasons to think that MSRs will be cheaper and more effective than coal; however, we do not know until we can build not just one but a whole fleet of reactors. Long-term experience will be necessary to judge economic competitiveness of any new reactor technology."

Chemical stability of molten salts results in large range of liquid temperature, between 700–1700K (800-2600 Fahrenheit), at atmospheric pressure. This allows for thinner walls of pipes and other components of the reactor loops, improving operational safety and reducing cost.



Courtesy of Oak Ridge National Laboratory, US Department of Energy

One of the most unique aspects of MSRs is that they can be fueled with comparative ease using nuclear waste from weapons and other reactors, due to liquid nature of the fuel which simplifies fuel manufacturing and burning it up over time.

Also, due to higher operating temperature they can utilize air-cooling efficiently and do not need to be located near large body of water like coal plants or light-water reactors. Overall, the relative simplicity of the design and operation make them potentially cost effective while helping to meet the growing energy demand.

Dynamic Model a Breakthrough for Molten Salt Reactor Safeguards

By Élan Young.

DEPARTMENT OF NUCLEAR ENGINEERING doctoral student Alex Wheeler, who is studying under Research Assistant Professor Ondrej Chvala, led research with Chvala and Joint Faculty Associate Professor Steve Skutnik that leveraged their dynamic system model to devise a new method for the underexplored topic of safeguarding Molten Salt Reactors (MSRs). Their findings were recently published in *Annals of Nuclear Energy*.

Every nation that signs the Nuclear Nonproliferation Treaty has to verifiably declare that all of its nuclear material remained in peaceful use each year. Solid fuel assemblies can keep track of plutonium simply by using a serial number and an accounting system, but this is a challenge for MSRs that use liquid fuel and can't be so easily tagged.

Alex Wheeler

The research team devised a way to determine if plutonium is diverted from the reactor using the reactor's frequency response, offering a breakthrough for safeguarding MSRs. Specifically, it was discovered that the evolution of plutonium concentration impacts a particular and easily discernible pattern in frequency response. This pattern correlates with the amount of plutonium present in the MSR core.

"Using the response to different frequencies of reactivity insertions in an MSR, we can tell many of the operating parameters of the reactor including whether or not plutonium has been removed," said Wheeler.

In addition to the difficulties of storing liquid fuel in a way that can be tracked, it is also difficult to install instrumentation on an MSR reactor that would safeguard the nuclear material simply due to the high temperature, radiation, and the corrosive nature of the fuel salt environment.

The advantage of the presented method is that it only requires very simple and potentially robust additional instrumentation, needing a neutron flux detector and a device capable of inserting a tiny amount of reactivity.

As an MSR that is fueled by low-enriched uranium undergoes burnup, plutonium will build up in the fuel salt and increasingly contribute to fissions. As a result, the kinetic parameters, mean neutron generation time and delayed neutron fraction, evolve with depletion.

The induced effects are large enough to be discerned as unique patterns in the MSR system frequency response. Likewise, a specific pattern emerges if there is a removal of plutonium.

This study uses Serpent 2 coding to determine fuel concentration since it can model continuous material feed and removal, and it also calculates core kinetic parameters.

Keeping Crowds Safe

Safe Backpack Allows for Improved Mobile Radiological Threat Detection

By Élan Young.
Photography by Shawn Poynter.

Someone wearing a backpack and looking at their phone with earbuds in as they walk seems normal, even if that person is really monitoring a crowd for possible terror threats. That's how the Department of Homeland Security (DHS) likes it. Two professors recently completed a five-year project funded by DHS to develop and prove the concept of a portable nuclear or radiation detector that could be used with minimal awareness from the public or possible terror cells.

Picture a scene. It's Super Bowl Sunday, February 6, 2022, at SoFi Stadium in Los Angeles, California, home of both the NFL's Rams and Chargers. The stadium is near the center of a sprawling metropolis of nearly 19 million people, and more than 100,000 fans have descended on the stadium to watch the event in person, with millions more tuning in from around the nation and the world.

Having all that attention makes the event an attractive target for those who would want to do harm to the United States.

In a worst-case scenario, they could obtain an improvised nuclear device filled with enough enriched material to create an actual nuclear explosion. Though less likely due to the safeguards surrounding most of the world's supply of such material and the amount of material required, it is a nightmare scenario that has played out in a number of movies and television shows throughout the years.

Alternately, they could be hoping to spread radiological material through a conventional explosion—a so-called "dirty bomb." Thanks to an ingenious device that has been tracking their illicit cargo with every movement, their plans are thwarted.

"What we've designed is a detection array that can help pinpoint radioactive sources with a calculated degree of certainty," said NE Associate Department Head for Graduate Studies and Research, Professor, and UCOR Fellow Jason Hayward. "It fits inside a normal, everyday backpack, which gives the user a better ability to blend into the crowd as they conduct their security sweeps."

It's all part of a program called Wearable Intelligent Nuclear Detection (WIND) that both the DHS and the Department of Energy's National Nuclear Security Administration (NNSA) have supported. UT began work on the project in 2015, with Hayward focused more on the detection portion of the design and Gonzalez Family Professor Hairong Qi, of the Min H. Kao Department of Electrical Engineering and Computer Science, taking the lead on the parts of the project related to tracking and monitoring suspects.

Hayward pointed out that the system is unique due to its combination of concepts that are each groundbreaking in their own ways, with an unprecedented combination of portability and a detection system that provides near-continuous location estimates and tracking of potential suspects through low-cost imagery.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UT's Gateway to Engineering Opens for Fall Semester

After much anticipation, the Zeanah Engineering Complex (ZEC) opened its doors to students on August 18th.

The Department of Nuclear Engineering will begin moving into their new space in ZEC later this fall.

As a figurative Gateway to Engineering, the complex is a transformative facility designed to welcome and immerse students into the community of engineers—with spaces that advance the state-of-the-art of education and research, including first-year engineering programs, interactive and collaborative maker spaces, and administrative offices, in addition to nuclear engineering.

ZEC spaces are built with growth in mind for researchers at undergraduate and graduate levels. Flexible-use labs throughout the complex employ a variety of utilities, benching, and mechanical infrastructure, allowing for research in a wide range of engineering sub-disciplines.

The department can now house its faculty, classes, research, and staff in one building, ending decades of having spaces stretched across multiple buildings: the Pasqua Nuclear Engineering Building, the Science and Engineering Research Facility, Ferris Hall, the Howard H. Baker Jr Center for Public Policy, the Joint Institute for Advanced Materials, and, most recently, in the building that previously housed the Department of Earth and Planetary Sciences.

"It's not just that being together will be nice, but rather it's more about what the new space will allow us to accomplish," said Department Head Wes Hines, who is also both a Chancellor's Professor and Postelle Professor in the department. "We will have three times as much space, with twenty-three new state-of-the-art laboratories dedicated to nuclear engineering, classrooms, offices, study areas, and lounges. This move will improve and enhance everything we do, not just now, but far into the future."

It opened with 29 labs equipped with fume hoods and the ability to add 30 more as new research calls for them. These include 17 wet labs, with chemical usage expected; nine dry labs, with non-chemical usage expected; and seven support labs that offer tools and equipment that enhance the work in the other labs.

Eventually, the building will also house a fast neutron source, allowing students and researchers to design the reactors of the future in a safe, easily programmable way.

"No one else in the country has a fast flux facility like that," said Hines. "It will help us prepare our graduates for

By David Goddard. Photography by Steven Bridges.

QUICK FACTS

About the Zeanah Engineering Complex

The **LARGEST**
academic building on campus

$129 million
228,000-square-foot
BUILDING

More than **40 percent** of the building is flexible laboratory space that can be used by all engineering disciplines.

The Min H. and Yu Fan Kao
Innovation and Collaboration Studio
will provide students hands-on experiences.

The new home of the **TOP-RANKED** Department of Nuclear Engineering.

The ***new*** home of the college's administrative suite and student support units.

The northern entrance **opens to the Hill**—the historic heart of the university.

Where ***student design and exploration*** can lead to future technologies and devices.

A fourth-floor outdoor terrace facing the Tennessee River which, when combined with adjacent indoor space, ***can hold a gathering of 100 people.***

This is the sight greeting visitors to the building if they look up from its entrance from the Zeanah Engineering Complex plaza facing Perkins Hall. It was designed by the firm McCarty Holsaple McCarty, in association with SmithGroup, to give distinct views up and down from every floor, and gives the illusion that the building's main stairwell is suspended in space.

With first-year studies and support labs for senior design projects both housed in the building, nearly all Tickle College of Engineering students will see a variation of this view at some point in their time on campus.

work in a variety of nuclear-related fields in ways that other universities can't, while at the same time presenting faculty with an avenue to conduct novel research. We're excited about the possibilities, to say the least."

Spaces adjacent to the labs are designed to encourage collaborative moments, even when researchers are not actively engaged in their work.

"All kinds of different sorts of utility capabilities are met, to be able to adapt and house different strategic initiatives," said Bill Dunne, associate dean for research and facilities. "At the east end of the building on every floor, there is a kitchenette area and a small conference room. They're quite informal and meant to create the opportunity for interactions and discussions and doing simple things like eating lunch or dinner."

This inherent design for innovation and collaboration ensures that the Zeanah Engineering Complex will remain a launching point for our Engineering Vols to light the way in their professional futures.

This giant machine, located just outside the southeast corner of the new building, is known as a bumpy torus. It is an early fusion research device, with magnetic arrays inside helping close the circular reactor chamber, or torus, which has been said to vaguely resemble a doughnut.

The "bumpy" part of the name was due to the behavioral nature of the plasma produced within, in particular its tendency to pool and flow irregularly. While research on different models of bumpy torus-like fusion devices continued into the mid-1980s, including notable efforts at Oak Ridge National Laboratory, this particular device came to UT from NASA's Lewis Research Center in Cleveland, Ohio.

This archway and façade greeted students, faculty, staff, and visitors to Estabrook Hall for 120 years from 1898-2018 from its entrance on what was originally a carriage route, then Lower Drive, and now the plaza in front of the Zeanah Engineering Complex. The building was named for Joseph Estabrook, who served as UT's president from 1834-50, during which time the engineering program was created.

Several colleges had courses in the building during its history, but it was closely tied to engineering throughout its lifetime, including housing the college's diversity and first-year studies programs right up until its closure. There are plans to eventually have an interactive kiosk in the space explaining the Tickle College of Engineering's history.

Nuclear Engineering Rooms Named in ZEC

The Zeanah Engineering Complex (ZEC) has approximately 170 nameable spaces available throughout the building with 11 of those named so far. Three of those spaces have been named in the Nuclear Engineering Department.

Dr. Cecil & Kristine Thomas Office

Cecil Thomas earned a BS ('64), MS ('66), and PhD ('71) in nuclear engineering, all at UT. He worked in nuclear engineering at Tennessee Valley Authority and retired from the Nuclear Regulatory Commission, where he held a number of senior management positions. Kristine Thomas earned a BS in nuclear engineering at the University of Michigan and held various licensing positions at the NRC. Together they established the Nuclear Engineering Excellence Endowment.

Pietro F. Pasqua Classroom

In honor of Dr. Pietro "Pete" F. Pasqua (1922-1992), the first head of the first Department of Nuclear Engineering in the nation, established at UT in 1957. Among his many outstanding contributions to education, he played a role in founding the Nuclear Division of the American Society of Engineering Education and for many years served on the Oak Ridge Associated Universities Council and Alcoa Board of Education.

Mark Lane Williams Group Study Room

Mark Lane Williams ('79), a distinguished scientist in nuclear engineering, developed methods for contribution transport theory, sensitivity and depletion perturbation theories, and thermal reactor physics. He served as director of the Nuclear Science Center at Louisiana State University and as a professor at UT. He was a distinguished researcher at Oak Ridge National Laboratory and patented a radiation emitter for cancer therapy. He was elected a Fellow of the American Nuclear Society in 2012 and received the prestigious Eugene Wigner Reactor Physicist Award in 2016. Gayle Williams ('77) established the Dr. Mark Lane Williams Endowed Scholarship in Nuclear Engineering in his memory.

There are several rooms and spaces still available for naming. If you are interested in naming a room or space in ZEC, please contact the Office of Engineering Development at 865-974-2779 or engrdev@utk.edu.

Department Holds PicNuke Event for Students

On September 15, the department held a PicNuke event to welcome first-year students into the nuclear community. Students had the opportunity to meet the NE faculty, learn about their research, and find out about student societies. *Photography by Yvette Gooden.*


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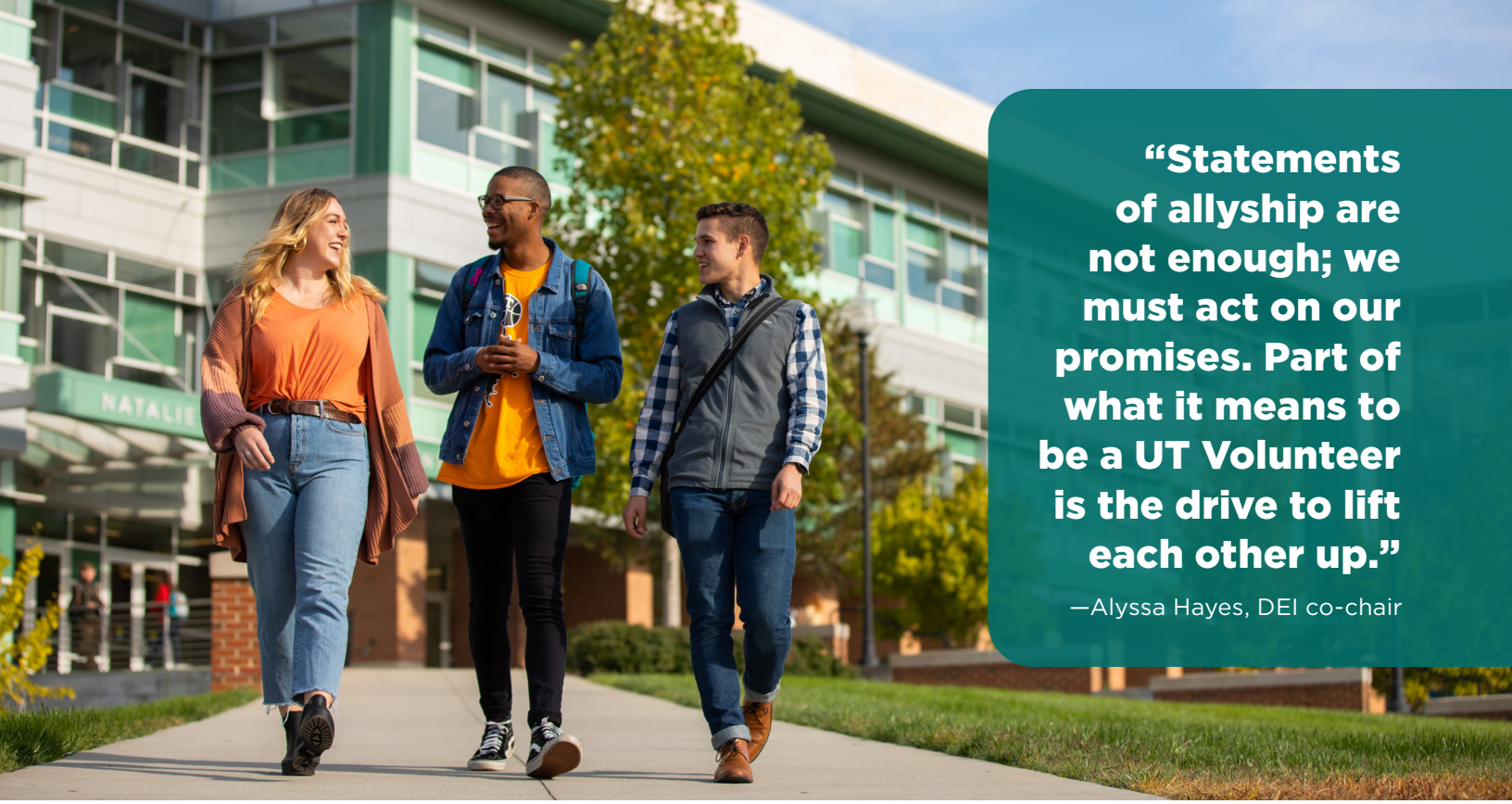
3

1. A large crowd attended and enjoyed free dinner while they learned about nuclear engineering.
2. NE Department Head Wes Hines and TCE Dean Matthew Mench kicked off the event.
3. Associate Professor, Southern Company Faculty Fellow, and Assistant Department Head of Undergraduate Studies and Service Jamie Coble spoke at the event.



"Statements of allyship are not enough; we must act on our promises. Part of what it means to be a UT Volunteer is the drive to lift each other up."

—Alyssa Hayes, DEI co-chair

Pledge for Allyship, Social Justice, Diversity, and Inclusion Spurs Departmental Culture Change

By Élan Young. Photography by Steven Bridges.

In the wake of the murder of George Floyd that put all eyes on the gravity of racial injustice in this country, students and faculty in the Department of Nuclear Engineering began organizing. At the University of Michigan, Department Chair of Nuclear Engineering and Radiological Sciences Todd Allen issued a challenge on social media for other nuclear engineering departments to step up with their own commitments.

At UT, students and faculty rose to that challenge to not only create a pledge for the department's external-facing image through its website but to identify clear, concrete actions they were willing and able to take to make the department more inclusive.

What started as a listening session where everyone was invited to come and share their experiences evolved into a new Diversity, Equity, and Inclusion (DEI) Action Committee. Members felt it would be important to include people from all over the department so that there would be a mix of faculty, staff, and students working on these issues.

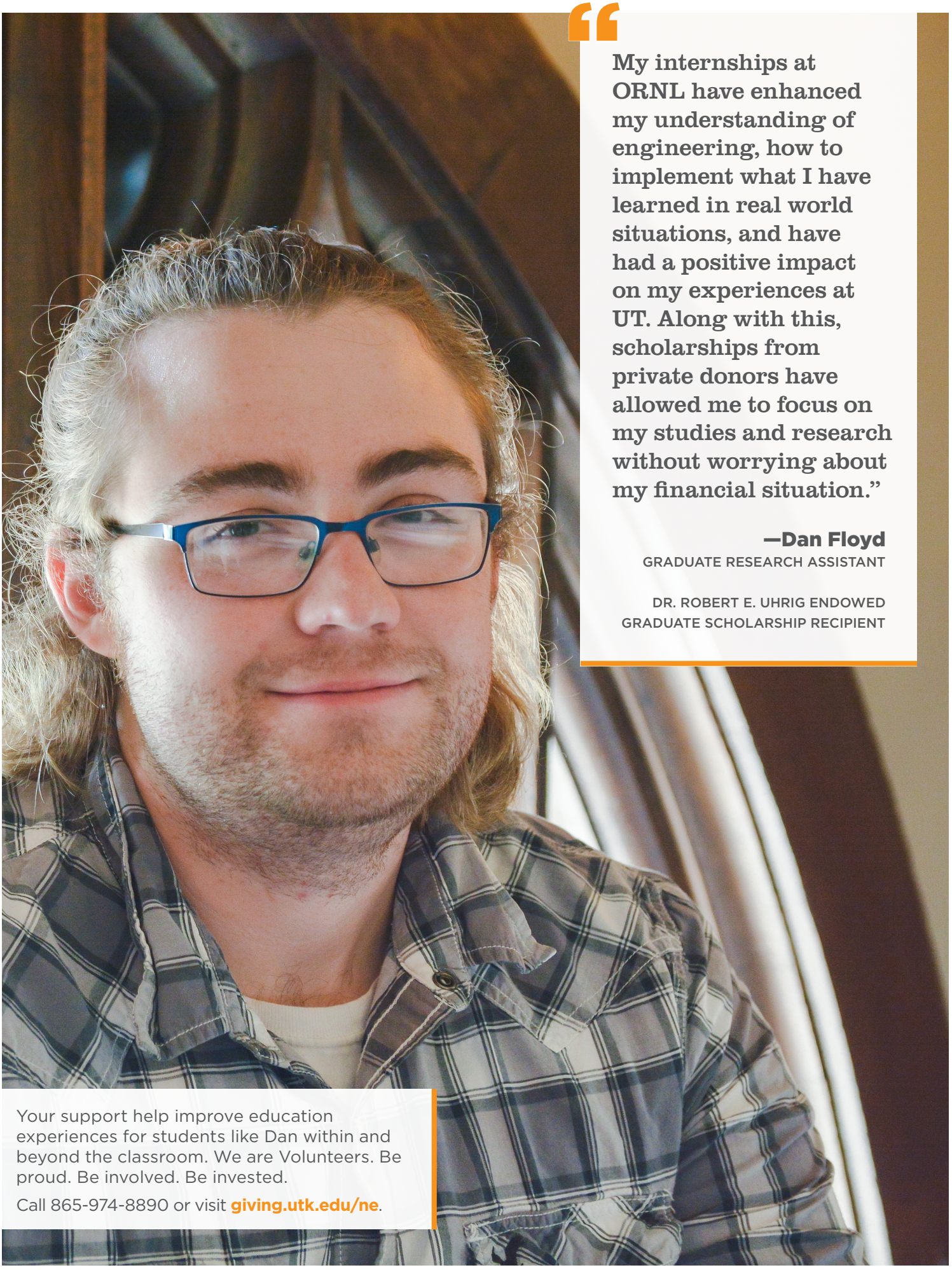
"It's definitely a big task to change culture even in a relatively small department, but we're making good strides," said Associate Professor and Southern Company Faculty Fellow Jamie Coble, who is also the assistant department head for undergraduate studies and service.

The organizational structure of the committee is intentionally nonhierarchical, with two co-chairs: graduate student Alyssa Hayes, and Research Assistant Professor Deborah Penchoff. Out of that listening session, they also came up with two subcommittees that would help accomplish short- and long-term goals. One subcommittee handles recruitment and retention, chaired by graduate student Robby Kile, while the other focuses on training, awareness, and metrics, chaired by graduate student Yogendra Panchal.

"Statements of allyship are not enough; we must act on our promises. Part of what it means to be a UT Volunteer is the drive to lift each other up," said Hayes.

More than one year later, the committee members say they have made progress and are working on an updated pledge, making the DEI activities more visible across the department, hosting outreach events at area schools to establish a recruitment pipeline, and hosting social gatherings for students across the department to get to know each other outside of their classes and research groups. Additionally, the group requested that the department host two town hall meetings per year instead of one.

"We're trying to make the committee more accessible to those who want to be involved," said Penchoff. "We've created a website, newsletter, and Google document where people can see what trainings and events are happening."



> My internships at ORNL have enhanced my understanding of engineering, how to implement what I have learned in real world situations, and have had a positive impact on my experiences at UT. Along with this, scholarships from private donors have allowed me to focus on my studies and research without worrying about my financial situation."

—Dan Floyd
GRADUATE RESEARCH ASSISTANT

DR. ROBERT E. UHRIG ENDOWED
GRADUATE SCHOLARSHIP RECIPIENT

Your support help improve education experiences for students like Dan within and beyond the classroom. We are Volunteers. Be proud. Be involved. Be invested.

Call 865-974-8890 or visit **giving.utk.edu/ne**.

Critical Details

Nuclear Safety Minor's Success Tied to Safety Courses

By Élan Young.

All the rules and regulations that govern Department of Energy (DOE) or Nuclear Regulatory Commission (NRC) work is in excess of 4,000 pages, so it's no wonder that when a new graduate lands a job in the nuclear industry, it can sometimes take a year to a year-and-a-half for the company to catch them up to speed.

This was the problem that Department of Nuclear Engineering Department Head Wes Hines and Russell Daniel, a member of the Board of Advisors and manager of engineering and principal vice president at Bechtel, wanted to solve. Their vision to streamline the learning curve for new hires from the department resulted in the nuclear security minor, which essentially cuts down the length of training time necessary so graduates can hit the ground running on day one.

Chip Lagdon, chief engineer of nuclear operations and safety for Bechtel and a professor of practice for UT, was a part of the team that designed the minor program for undergraduates and graduate students and also teaches the nuclear licensing class.

"The undergraduate minor is central to the department's safety focus and is designed to provide our graduates with a competitive advantage in the job market," said Hines. "We are excited that so many students see this as being integral to their career path."

Of particular interest to students and industry is the criticality safety material offered in the coursework. The courses teach students about fissile materials handling to make sure they can handle and store nuclear materials safely and without them unexpectedly going critical.

In the first year of the minor, five students were enrolled in criticality safety, a subject that Professor of Practice Ronald Pevey has taught for 25 years. Now, in the second year of the minor, 17 students are enrolled for criticality safety coursework in the fall 2021 semester.

Criticality safety introduces students to a highly specialized field that is hard to fill positions for. With a continuous need for criticality engineers, students who choose this coursework are easily finding work in the field.

Recent graduate Harold Carr credits the safety program with helping him stand out to employers. "The safety minor introduces you to things you normally don't see in the major," he said. "I learned more about regulations, how they're enforced, and how they were created in one class than I did the three years prior."

Carr began working at Y-12 in April, and he credits the criticality safety courses and minor for helping him land the position. "Integration into the working environment was seamless with the knowledge given to me by Dr. Lagdon and Dr. Pevey," he said. "I highly recommend the minor for anyone interested in the safety field."

Elijah Rosenberg, another recent graduate, said the minor helped him find direction within nuclear engineering.

"The nuclear safety minor gave me the opportunity to explore a different perspective in all aspects of our field, whether that is power, security, or medical," he said.

Among nuclear engineering departments, the minor program is unique. Lagdon says he developed the course material almost from scratch and works hard to make sure the courses are interesting and practical.

Courtesy of the U.S. Department of Energy

International Modeling Helps Improve Small Modular Reactors

By Élan Young.

Ondrej Chvala

Ivan Maldonado

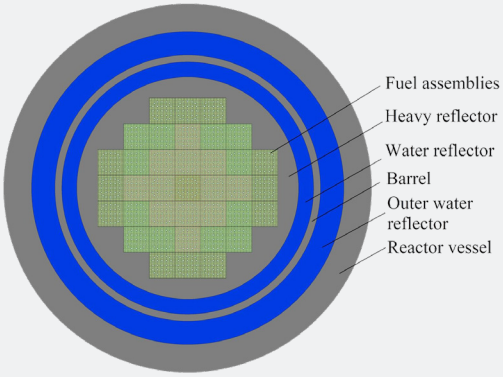
Small Modular Reactors (SMRs) are expected to play an important role in the near-term nuclear energy deployment mix and promise to offer several advantages in comparison to large-scale nuclear reactors. In particular, the passive safety and emergency planning zone bounded by the fence of the power plant will be improved.

Such advantages will enable the exportation of advanced US technology to allied countries that want to reduce their reliance on fossil fuels, which in turn will boost domestic jobs, US leadership in nuclear energy, and geopolitical stability.

Department of Nuclear Engineering Research Assistant Professor Ondrej Chvala and Professor Ivan Maldonado recruited Pavel Suk, an International Atomic Energy Agency-funded visiting research scholar from Czech Technical University for collaboration surrounding SMR advancements. Together they employed a state-of-the-art modeling and simulation tool and applied it to a representative model of the NuScale reactor, which is a leading concept among next-generation SMRs. Their findings were recently published in *Nuclear Engineering and Design*.

The research team used an advanced simulation package for analyzing light water reactors developed by the Consortium for Advanced Simulation of Light Water Reactors (CASL) at Oak Ridge National Laboratory. The computer code, VERA (Virtual Environment for Reactor Analysis), aims to apply and deploy advanced science-based technologies to enhance the operational performance, efficiency, safety, reliability, and economic competitiveness of light water reactors.

The findings from this project show that the CASL VERA predictions are in good agreement with other popular calculation methods, Serpent and Polaris.



A diagram of a small modular reactor

UT Part of $25M Nuclear Research and Development Project

By Élan Young.

UT is part of an 11-member university consortium grant for research and development into nuclear science, engineering, and security. The $25 million grant is funded by the Department of Energy's National Nuclear Security Administration (DOE/NNSA).

The University of California at Berkeley will lead the effort, known as the Nuclear Science and Security Consortium.

Jason Hayward

"We are very excited to take leading roles in radiation detection, nuclear data, nuclear engineering, and computing and optimization in nuclear applications as a part of this work that couples closely to five of our nation's top national laboratories, aiming to send more PhD graduates to the labs while addressing important questions in fundamental and applied nuclear science," said UCOR Fellow Jason Hayward, who serves as UT's PI for this grant and is a professor and associate department head for graduate studies and research in the department.

Eleven universities will partner with five national laboratories: Los Alamos, Lawrence Berkeley, Lawrence Livermore, Oak Ridge, and Sandia to carry out work in five research focus areas:

- Nuclear physics and nuclear data;
- Radiochemistry and nuclear chemistry;
- Nuclear material science;
- Radiation detection;
- Nuclear chemical engineering; and
- Nuclear engineering.

Two overarching efforts are linked by these research areas: computing and optimization in nuclear applications and education in nuclear science, technology, and policy.

FUSION FOR THE FUTURE

Goal of Almost Limitless, Clean Energy Attracts Creative Minds

By Élan Young.

Fusion, the same energy source that powers the sun and the stars, offers the potential to provide the planet with a nearly unlimited source of energy. To be a part of this massive endeavor—which is one of the 14 Grand Challenges for Engineering sponsored by the National Academy of Engineering—is an attractive draw for aspiring engineers like Shawn Zamperini.

With a background in physics from the University of Virginia, Zamperini came to UT's Department of Nuclear Engineering to study under Associate Professor David Donovan, relishing the chance to dive deep into physics research while advancing the aims of fusion technology. Now a doctoral graduate, Zamperini's research experience will send him straight to work with DIII-D National Fusion Facility.

"Shawn has done an excellent job combining measurements collected at a world-leading fusion experiment with state-of-the-art theoretical models," said Donovan, his advisor. "His ability to ask important and interesting questions and his hard work developing solutions make him a great scientist, and I am very proud that he will be representing UT's fusion program in his new career."

With the help of students like Zamperini, UT's fusion program is making waves in the nuclear engineering industry. Zamperini's research takes a closer look at a phenomenon that has, until now, only been hypothesized. For almost four decades, nuclear engineers presumed that the plasma at the edge of the fusion reactor core accumulates impurities from the core.

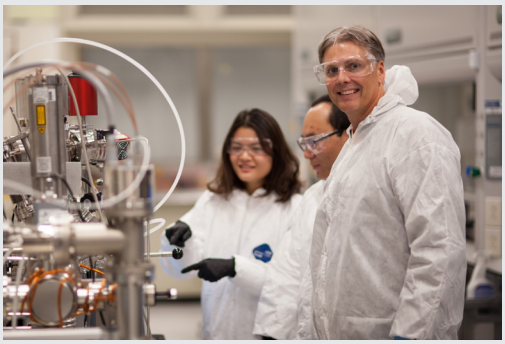
Engineers are interested in observing impurity transport in the edge of the plasma in order to identify the path impurities take before entering and contaminating the core plasma. Zamperini's thesis provides the first indirect measurement of tungsten (an impurity) accumulation in the edge of the plasma through the use of specially machined graphite rods.

The graphite rods are designed and built by the department and are now in demand by other facilities. When stuck into the edge, impurities like tungsten deposit onto them, where the amount of tungsten is subsequently measured and analyzed at facilities like Oak Ridge National Laboratory (ORNL) and Sandia National Laboratory. The measurements for Zamperini's thesis were taken with a high-resolution mass spectrometry system at ORNL that was brought online through a collaborative project between the lab's scientists and UT student researchers.

At DIII-D, Zamperini will work as a staff scientist in the advanced materials evaluation group, which is the same group he worked with when he did his research. UT's close working relationship with the group enabled him to skip the typical postdoctoral research term and go straight to a position as a staff scientist.

Those who work in fusion say it is the Holy Grail of clean energy because it has the capacity to power industry, which requires more power than what renewables currently offer. If all goes as planned, fusion should be viable by the 2040s, though some private startups hope to achieve the goal sooner.

Wirth's Atomistic Modeling to Make Fusion One Step Closer to Reality



Brian Wirth

Brian Wirth, UT-Oak Ridge National Laboratory Governor's Chair for Computational Nuclear Engineering, has received a new grant to fund his research on using machine learning to better understand fusion materials. The project, "Machine Learning Atomistic Modeling for Fusion Materials," received three years of funding totaling $600,000 by the Department of Energy's Office of Fusion Energy.

The project aims to advance fusion energy research by applying machine-learning methods and high-performance computing to atomistic materials modeling of plasma-surface interactions in fusion reactors. This capability will be integrated into a flexible, multiscale workflow and made available to the broader research community.

Ensuring that reactor materials can function in the harsh exposure conditions imposed by a burning plasma environment remains one of the most challenging obstacles associated with the development of magnetically confined plasmas.

Given the scale of the challenges, plasma material interactions and materials development are recognized as top priorities in the fusion energy research community.

In order to guide the development of performance improvements in existing materials and the discovery of completely new materials for use at Office of Science-supported user facilities, advances in existing computational approaches are needed. In particular, robust accurate atomistic materials simulation methods are needed for predictive simulations of hydrogen retention in first wall material.

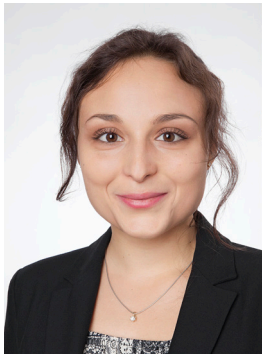
Department Expands with New Hires

The department welcomes two new hires in 2021, Assistant Professor Sandra Bogetic and Assistant Professor and Zinkle Faculty Fellow Livia Casali. Both bring international education and expertise to elevate the department.

Sandra Bogetic

Bogetic received her PhD from the Department of Nuclear Engineering at the University of California at Berkeley in 2020 as the Lawrence Livermore National Laboratory (LLNL) Scholar. Her doctoral research was done within the Nuclear Science and Radiochemistry group at the National Ignition Facility (NIF).

During her doctoral research, she focused on the further development of a metaheuristic (or higher-level procedure) code optimization software package for neutron spectra tailoring, a development which included extensions, modifications, and generalization of the software. The code was initially created as a part of an ongoing collaboration between UC Berkeley Department of Nuclear Engineering and LLNL/NIF, with the goal of optimizing beam-shaping assembly to model neutron spectra for forensic applications.



Livia Casali

Casali joins the Department of Nuclear Engineering from the Magnetic Fusion Energy Division at General Atomics in San Diego where she was a staff scientist at DIII-D, the largest tokamak in the United States. Casali was the leader of the core-edge integration area for the DIII-D tokamak, an expert member of the international tokamak physics activity in support of ITER, and member of the executive committee for the US transport task force.

She received graduate degrees in nuclear and subnuclear physics from the University of Rome Tor Vergata, Italy, and at the Albert Ludwig University of Freiburg, Germany, and a PhD from the Max Planck Institute for Plasma Physics in Garching and the Ludwig-Maximilian University of Munich.

UT Ranks Highest in Nuclear Energy University Program Scholars

NEUP Nuclear Energy University Program

U.S. Department of Energy

The Nuclear Energy University Program, part of the Department of Energy (DOE), recently announced more than $5 million in undergraduate scholarships and graduate fellowships, with UT students receiving a total of 12 awards—double the number of the next highest university.

The recipients are students pursuing nuclear engineering degrees and other nuclear science and engineering programs relevant to nuclear energy, with only 50 scholarships awarded nationwide.

“We are incredibly proud of the caliber of students that our program attracts,” said Department Head and Postelle Professor Wes Hines. “These scholarships are very competitive and demonstrate another aspect of the talent pool that UT cultivates to advance the field of nuclear engineering.”

Undergraduate student scholarship recipients include Jonathan Barthle, Kenneth Bott, David Burgess, Ethan Deters, Dean Forrest, Miller McSwain, Nicholas Militello, Erika Moss, Elizabeth Smoak, Hayden Sobas, Madison Vandergriff, and Ethan Webb.

Through this program, undergraduates will receive $7,500 to help cover education costs for the upcoming year.

The awards also include 31 graduate fellowships, one of which went to UT student Emily Proehl.

This three-year graduate fellowship provides $52,000 each year to help pay for graduate studies and research. Additionally, fellowship recipients receive $5,000 to fund an internship at a US national laboratory or other approved research facility to strengthen the ties between students and DOE’s energy research programs.

Since 2009, the program has given almost 850 scholarships and fellowships totaling approximately $50 million to students pursuing nuclear energy-related degrees.

FACULTY NOTES

Brown Wins Young Member Award from American Nuclear Society

Associate Professor **Nick Brown** is the latest recipient of the Landis Young Member Engineering Achievement Award, bestowed by the American Nuclear Society (ANS). Brown received the award, "In recognition of his technical leadership in advancing the safety case for accident tolerant fuel and cladding" and for helping bring about the licensing of advanced nuclear reactors.

Recognition is reserved for those whose engineering knowledge has resulted in an improvement to an engineering concept, design, safety improvement, method of analysis, or product utilized in nuclear power research and development or commercial application.

"We are proud to see that ANS honored Nick Brown with this award," said Department Head Wes Hines. "He joins a very select list of nuclear scholars. His outstanding contributions to safety analysis of advanced reactors are paving the way for a new generation of nuclear reactors."

Penchoff Elected to American Chemical Society Executive Committee

Research Assistant Professor **Deborah Penchoff**, who is also the associate director of the UT Innovative Computing Laboratory, will now serve an official role with the American Chemical Society (ACS) for the 2021–23 period. In January, Penchoff was elected as member-at-large of the executive committee of the nuclear division at ACS. As member-at-large, she is positioned to support the nuclear community and the larger body of ACS for radio- and nuclear-chemistry needs.

NE Faculty and Staff Receive TCE Awards

The Tickle College of Engineering annually honors outstanding members of the college during the spring Faculty and Staff Awards, recognizing efforts of those who have gone above and beyond to help make the college successful.

Accounting Specialist **Michelle McBee** received the Inspirational Leadership Award, recognizing an individual who inspires others. They influence without authority, often putting the interests of others ahead of their own, and serve as "a champion for staff."

Associate Professor, Southern Company Faculty Fellow, and Assistant Department Head for Undergraduate Studies and Service **Jamie Coble** received the Outstanding Service to the College Award for her dedication to service to many efforts at promoting diversity, equity, and inclusion across campus, the college, and the department.

Associate Professor **David Donovan** received the Outstanding Service to the Discipline Award for his leadership in the Division of Plasma Physics Community Planning Process. This group was assembled to assist the US Department of Energy Fusion Energy Sciences Advisory Committee with long-range strategic planning.

Postelle Professor, Chancellor's Professor, and Department Head **Wes Hines** received the Charles E. Ferris Faculty Award in recognition for distinguished record of research and teaching as well as a record of contributions to the advancement of technology in the local community through local public engagement in the professional discipline.

Associate Professor and Pietro F. Pasqua Fellow **Maik Lang** received the Professional Promise in Research Award, which recognizes tenured or tenure-track faculty members at the assistant or associate professor rank who have received national or international recognition in their fields and show professional promise in their research.

Coble Named Fellow of International Society of Engineering Asset Management

Associate Professor, Southern Company Faculty Fellow, and Assistant Department Head for Undergraduate Studies and Service **Jamie Coble** was elevated to Fellow of the International Society of Engineering Asset Management.

She was first inducted as a member of ISEAM, a professional society dedicated to the development and recognition of asset management as an integrated and important body of knowledge, in 2015. The multidisciplinary organization provides global influence and thought leadership on engineering asset management, a field at the intersection of technical issues of asset reliability, maintenance, safety, and asset performance with the requisite financial and managerial skills to achieve sustainable business outcomes.

Hines Receives Robert L. Long Training Excellence Award

Postelle Professor, Chancellor's Professor, and Department Head **Wes Hines** is the 2020 recipient of the Robert L. Long Training Excellence Award given by the ANS Education and Training and Workforce Development Division's Honors and Awards Committee. The award was established in 1993 and renamed in 2010 to honor Robert L. Long who served as ANS president from 1991 to 1992 and is intended to recognize an individual or group who has demonstrated sustained excellence in nuclear training.

Townsend First from UT to Join International Academy of Astronautics

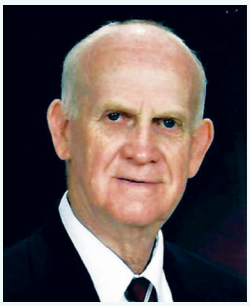
Chancellor's Professor and Robert M. Condra Professor Emeritus **Lawrence Townsend** was recently inducted into the International Academy of Astronautics, joining 1,200 active members in 88 countries. He is the first person from UT to gain acceptance into the prestigious organization, which encourages international scientific cooperation in the areas of space sciences, space life sciences, space technology and system development, space systems operations and utilization, space policy, law and economy, space and society, and culture and education.

IN MEMORIAM

Thomas Howard Scott Touched Lives in Engineering and Beyond

Associate Professor Emeritus **Thomas Howard Scott**, who served on the faculty in the Department of Nuclear Engineering from 1986 to 2008, passed away at the age of 88.

Scott was much beloved in the department and the college, receiving college-level awards for both outstanding teacher of the year and outstanding advisor. His talents as an advisor were also recognized with a Chancellor's Award for advising.



Professor Richard Bennett, the director of the Jerry E. Stoneking *engage*™ Engineering Fundamentals program for first-year engineering students, remembers that Scott was involved in the beginning of the program, which provides a supportive environment for first-year students. Scott was the one and only advisor at that time.

"Tom helped a lot of students," said Bennett. "When we first started our Success Enhancement Program in EF 151, whereby students could earn points back on the first exam by doing certain things, Tom would individually meet with the struggling students. He absolutely loved to do that, and I know he helped a lot of students get on track and be successful."

To this day, Engineering Fundamentals students get to see the former faculty member in one of their homework assignments. Scott, who was an avid collector of antique fire equipment, is pictured leaning his arm on one of his antique fire trucks.

Scott also served as the official photographer of the Oak Ridge Fire Department, and the department escorted the urn with his ashes for a final ride to his memorial service.

Kile Explores Transient Behavior for the Transformational Challenge Reactor

By Élan Young.

Robby Kile

The Transformational Challenge Reactor (TCR) program at Oak Ridge National Laboratory (ORNL) aims to use modern manufacturing, computation, and materials to accelerate the design and deployment of advanced nuclear reactors and to reduce the cost of designing and building them.

One of the most notable aspects of the TCR program is the deployment of additive manufacturing technologies as part of the design process. Doctoral student Robby Kile, studying under Associate Professor Nick Brown, conducted research to verify the performance of the TCR designs under both normal operating conditions and accident scenarios. His findings were recently published in *Nuclear Engineering and Design*.

Hayes Finds Her Passion at Intersection of Politics and Nuclear Energy

By Élan Young.

Graduate student Alyssa Hayes found an interest in state and federal politics in her first year of high school, long before she discovered her interest in nuclear engineering, spending a year as an intern for Illinois State Senator Melinda Bush when she was only 15.

Now at UT, she's become a delegate with the Nuclear Engineering Student Delegation (NESD) to join other nuclear engineering students from across the country to push for federal policies that impact the nuclear industry. Her engagement with this national organization even helped clarify her career goals.

"NESD has opened new doors of opportunity for me to learn about nuclear politics at the federal level and build a network of relationships with staffers and distinguished advocates," said Hayes.

Alyssa Hayes

Nuclear Co-Op Gives Students Enlightening Experience

By Élan Young.

Elijah Brock

Jasmine Toy

Southern Company, headquartered in Alabama, is one of UT's premier cooperative education participants and regularly places as many engineering students into co-op roles in the organization as other colleges of engineering in their region because of the quality of students produced by the Tickle College of Engineering (TCE) and the department.

Two seniors, Elijah Brock and Jasmine Toy, experienced the same co-op rotation with Southern Company at Southern Nuclear's Plant Farley to advance their knowledge of what it would be like working in the nuclear industry. Brock chose to work in the mechanical systems group because he wanted to learn about how a plant operates up close. Meanwhile, Toy worked in design and was able to focus her co-op rotation on gaining skills pertinent to plant safety.

"Students with co-op experience can make postgraduation placement decisions based on firsthand knowledge, and this can accelerate their early career arc by getting them in a position that aligns well with their skills and goals right at the start," said Todd Reeves, director of the TCE Office of Engineering Professional Practice.

Department Offers Layers of Support for All Students to Succeed

By Élan Young. Photography by Steven Bridges.

Students who commit to studying nuclear engineering at UT don't just gain entry to one of the top programs in the country, they also gain access to all the help that comes along the way. The department recognizes five areas of high impact on student success: undergraduate research, internships and co-ops, service-based learning (community service), study abroad, and senior design.

Mentoring and tutoring programs are two of the ways that UT strives to help students achieve success throughout each stage of their educational journey. The department offers tutoring each semester for three core classes of the sophomore and junior nuclear curriculum.

There is typically a primary tutor that will host standard hours each week and a secondary tutor on standby if a student cannot make those standard hours. In addition to these designated tutors, there is usually a graduate teaching assistant for each class.

Tutor selection is first prompted by Professional Advisor Amanda Lovelace based on who successfully completed the class and has already expressed interest in graduate school. Faculty also offer feedback for selection based on interactions inside and outside the classroom.

"The majority of students have found the departmental tutoring to be beneficial not only for additional academic support but also for a sense of camaraderie," said Lovelace. "Departmental tutoring is a small way to provide academic support, to promote a sense of belonging among the nuclear students, and to provide tutors an opportunity to gain leadership and teaching experiences."

Additionally, the department has recently begun a mentorship program, coordinated by Associate Professor and Southern Company Faculty Fellow and Assistant Department Head for Undergraduate Studies and Service Jamie Coble. Through this program, first- and second-year students are paired with upper class students to provide guidance and to integrate into the department community.

Junior and senior students can choose to be paired with a mentor who is a graduate student or nuclear professional depending on the student's postgraduation goals. Mentors from the nuclear industry have volunteered from many of the organizations represented on the department board of advisors.

"The mentoring program provides support to our undergraduate students from the first day they come to campus through their ultimate graduation," said Coble. "We want to support all our students throughout their undergraduate program to help them be successful in their studies and in their ideal career path. This is just one way we want to ensure all our undergraduate students know that they matter and belong in nuclear engineering and at UTNE."

Anyone interested in volunteering to mentor an upperclass undergraduate student can contact Associate Professor Jamie Coble for more information (jamie@utk.edu).

Anthony Tom Finds Value in Tutoring

Senior **Anthony Tom** earned the Outstanding Undergraduate Tutoring Award for tutoring students in the Introduction to Nuclear and Radiological and Introduction to Radiological Engineering courses during the 2020–21 academic year.

"Some of the best experiences were when I was able to help solve a problem we were struggling on for a while, whether it was a small calculator error or something conceptual," he said. "From an academic perspective, it helped me not forget what I had learned in those classes last year."

Outside academics, tutoring gave him a chance to get to know peers outside of his classes. He says that receiving tutoring was always helpful to him, no matter the class, and becoming a tutor gave him an added sense of satisfaction.

STUDENT NOTES

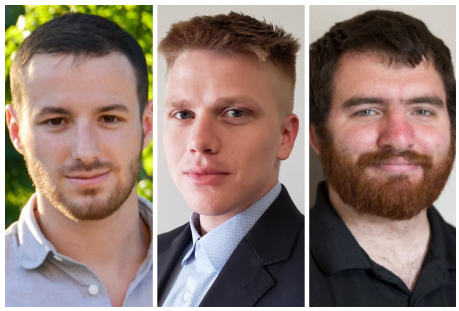
Cureton, Drey Recognized at 2020 Materials Research Society Meeting

Will Cureton

Doctoral students **Will Cureton** and **Devon Drey** were recognized for their outstanding scientific excellence for their oral presentations at the 2020 Materials Research Society Virtual Spring/Fall Meeting and Exhibit. Their presentations were 15 minutes each and came with a prize of $500. Will Cureton's presentation, "Effects of Grain Size on the Radiation Response of CeO2, ThO2, and UO2," discussed the investigation into the effect of microstructure on the radiation response of nuclear fuel materials. Devon Drey's presentation, "Investigation of Disorder in Ho2Ti2-xZrxO7: Pyrochlore to Defective Fluorite Chemical Series," discussed research using neutron total scattering to study in detail all structural aspects of disordering of pyrochlore to defect fluorite.


Devon Drey

Drey also received a 2021 fellowship from the Graduate Advancement Training and Education (GATE) program hosted by the Science Alliance from his time working in Associate Professor and Pietro F. Pasqua Fellow Maik Lang's research group. A total of six recipients were awarded fellowships from a pool of 16 applicants. GATE awardees receive a 12-month appointment, including a $30,000 stipend, tuition waiver, and health insurance.


Devon Drey, Ed Duchnowski, Robby Kile

Drey, Duchnowski, Kile Win R&D Awards

Devon Drey, **Ed Duchnowski**, and **Robby Kile** are among the latest winners of the 2021 Innovations in Nuclear Technology Research and Development Awards sponsored by the US Department of Energy, Office of Nuclear Energy, and Office of Nuclear Fuel Cycle and Supply Chain. Drey won first place in the Material Recovery and Waste Form Development category for his research on complex oxide pyrochlore, which is being investigated as a potential material for the immobilization of nuclear waste isotopes. Kile's research involves modeling two different transient scenarios: a reactivity-initiated incident, and a pressurized loss of forced cooling incident. Duchnowski's research pertains to the High Temperature Gas-Cooled Reactor (HTGR), which is a Generation IV type of nuclear reactor that has applications beyond power generation and is designed around safety.

NE Students Receive Scholarships, Awards from Local ANS Chapter

The Oak Ridge and Knoxville section of the American Nuclear Society (ANS) recently selected graduate student **Madison Ratner** and undergraduate student **Madison Allen** as the winners of its annual scholarship for two students studying nuclear-related coursework within area zip codes. These zip codes include the University of Tennessee, Vanderbilt University, and any other college or university that offers nuclear-related research or coursework, and the awards are for up to $1,000.

Additionally, undergraduate students **Miller McSwain** and **Anthony Tom** were each presented with the Oak Ridge and Knoxville section of the ANS Undergraduate Achievement Award.

Tom Shares Fusion Research at TLSAMP Conference

Anthony Tom, a nuclear engineering senior, presented on fusion research at the 18th annual TLSAMP (Tennessee Louis Stokes Alliance for Minority Participation) Conference. His presentation "Atomistic Molecular Dynamics Simulations of Helium Implantation in Tungsten," relates to a surface nanostructure called "fuzz" that forms on tungsten surfaces when exposed to helium plasmas.


Anthony Tom

Tom, who conducts this research under UT-ORNL Governor's Chair Professor Brian Wirth, investigates how 16keV helium interacts with different tungsten surfaces and grain boundaries.

Stewart Receives Student Environmental Leadership Award for Engagement

Rachel Stewart, a sophomore majoring in environmental justice in Central Asia with a minor in nuclear decommissioning and environmental management, received the Student Environmental Leadership Award for Engagement. This award goes to a student or students who demonstrate

environmental sustainability or environmental justice leadership outside of the classroom, in addition to or separate from their education.

Allen Advances Diversity Initiatives with Marva Rudolph Scholarship

Madison Allen is one of 54 undergraduate students from UT to receive the Marva Rudolph Scholarship from the Office of Diversity and Engagement. The fund was created in 2014 to assist students in their personal development as it relates to diversity and inclusion and to support their initiatives to build a more accessible, equitable, and welcoming campus community. The 2021 recipients are the first to receive scholarship awards. The Marva Rudolph Fund honors the life and legacy of Marva Rudolph, a long-term employee and champion of equity, diversity, and inclusion at UT. Rudolph was passionate about students and creating respectful and inclusive living, learning, and working environments.

Madison Allen

Students Recognized with First Step Awards

One of the ways the department prepares students for a scholarly career is to mentor them on their path to publishing their first scholarly journal. The Student First Step Awards recognizes the work of students who are authors of their first peer-reviewed journal article. This year's recipients include:

Amanda Bachmann—"Comparison and uncertainty of multivariate modeling techniques to characterize used nuclear fuel," *Nuclear Instruments and Methods in Physics Research*

Carl Britt—"Directionality for Wearable, Closely Packed Radiation Detector Arrays," *Nuclear Instruments and Methods in Physics Research*

Naser Burahmah—"Transport model predictions of 225Ac production cross sections via energetic p, d and α irradiation of 232Th targets," *Applied Radiation and Isotopes*

Andrew Decker—"Simulated X-Ray Radiographic Performance of a Bismuth-Loaded PVT Array," *IEEE Transactions on Nuclear Science*

Devon Drey—"Disorder in Ho2Ti2xZrxO7: pyrochlore to defect fluorite solid solution series," *RSC Advances*

Edward Duchnowski—"Reactor performance and safety characteristics of two-phase composite moderator concepts for modular high temperature gas cooled reactors," *Nuclear Engineering and Design*

Micah Folsom—"Characterization of Retroreflective Tape Optical Properties for Use with Position-Sensitive Scintillator Detectors," *Nuclear Instruments and Methods in Physics Research*

Xiong Gao—"Evaluating the Improvement of Cross Correlation-Based Flow Measurement by Periodic Fluid Injection," *Nuclear Technology*

Nathan Gilliam—"Examination of (α,n) Signatures as a Means of Plutonium Quantification in Electrochemical Reprocessing," *Nuclear Science and Engineering*

Igor Gusev—"Local order of orthorhombic weberite-type Y 3 TaO 7 as determined by neutron total scattering and density functional theory calculations," *Acta Materialia*

Robby Kile—"Transformational challenge reactor analysis to inform preconceptual core design decisions: Sensitivity study of transient analysis in a hydride-moderated microreactor," *Nuclear Engineering and Design*

Jose March-Rico—"The effect of local chemical environment on the energetics of stacking faults and vacancy platelets in α,-zirconium," *Journal of Nuclear Materials*

Mairead Montague—"Radiation Hardness Characterization of LKH-5 Scintillating Glass," *Nuclear Instruments and Methods*

Michael Pagan—"Interdiffusion of Elements During Ultrasonic Additive Manufacturing," *Metallurgical and Materials Transactions*

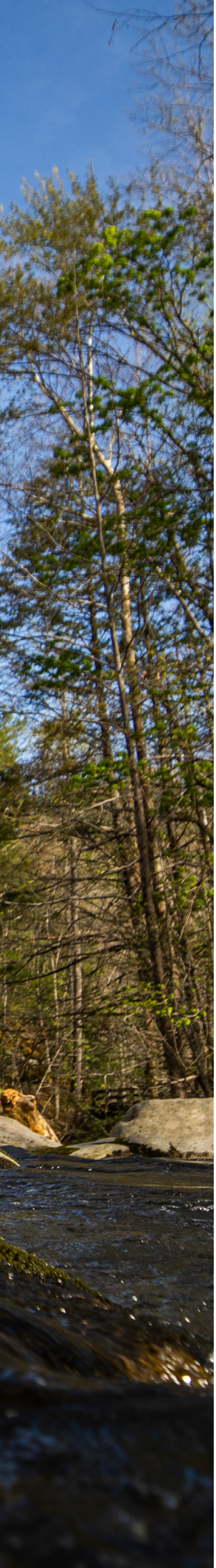
Visura Pathirana—"Scalable modular dynamic molten salt reactor system model with decay heat," *Annals of Nuclear Energy*

Roman Sherrod—"Comparison of short-range order in irradiated dysprosium titanates," *npj Materials Degradation*

Josh Smith—"Thermal processing conditions for the synthesis of near theoretical density Li5La3Ta2O12 ceramics for ceramic dual-mode detectors," *Journal of Alloys and Compounds*

Tyler Steiner—"Steady-State In-Pile Nuclear Thermal Propulsion Experimental Testbed Initial Demonstration at The Ohio State University Research Reactor," *Nuclear Technology*


SIMMS



RODS, REELS, AND RIVERS

A student organization gives students opportunities to get outside, serve others, and catch fish

By Brian Canever. Photography by Steven Bridges.

Growing up a stone's throw from the Holston River, Jonah Duran spent many of his days making the short walk to the water with his canoe and exploring the river. But it wasn't until three years ago, when he inherited some of his fiancée's father's rods and reels, that he decided to get serious about getting on the water to catch fish.

"I started with bait casters and spinning reels for bass and bluegill," says Duran, a nuclear engineering PhD candidate who earned bachelor's and master's degrees from UT in 2015 and 2017.

Then one afternoon while fishing from his kayak on the Clinch River, he met a local guide who gave him advice about how to hook into more and bigger fish. He was going to have to learn to fly fish.

Duran went to a local fly shop, 3 Rivers Angler, for free casting lessons and attended a free fly-tying night at Little River Outfitters in Townsend. "I loved it," he says. "It was a lot of fun."

Looking to get more involved in the fly-fishing community, he attended a meeting of the Great Smoky Mountain chapter of Trout Unlimited, a national organization that focuses on conservation of freshwater ecosystems and habitats for trout, salmon, and other fish species. The chapter president, John Reinhardt, told him about Vols on the Fly, a UT student organization that had been dormant for the past few years after all its leaders graduated.

In late 2019, Vols on the Fly relaunched as a club at UT with Duran as president. In just over a year, the club has grown to more than 30 members.

To provide support to the club, the local Trout Unlimited chapter assigned one of its board members to work closely with the students. Vols on the Fly also was made a partner of Trout Unlimited's Costa 5 Rivers program, a national network of more than 100 college fly fishing clubs.

One of the ways the club is able to make fly fishing accessible to students who have never tried it before or who don't have their own equipment—whether rods, reels, flies, or tents for trips—is by directing them to UT's Outdoor Pursuits program in the Department of Recreational Sports, which offers rentals for under $10 for a weekend. More often than not, however, fellow club members take supporting newcomers into their own hands.

In the end, what Duran hopes Vols on the Fly members get to experience is the camaraderie that comes with spending time together, whether it's tying flies after hours in a fly shop, boating around Fort Loudoun Lake to pick up trash, or catching trout in a local stream.

"Just like I was really excited a few years ago even though I didn't know anything about fly fishing, the beautiful thing about this club is that people get to be out in nature together," Duran says, "and catch fish while they're doing it."

Zhang's Vol Experience Launches Career Success

By Élan Young. Photography by Shawn Poynter.

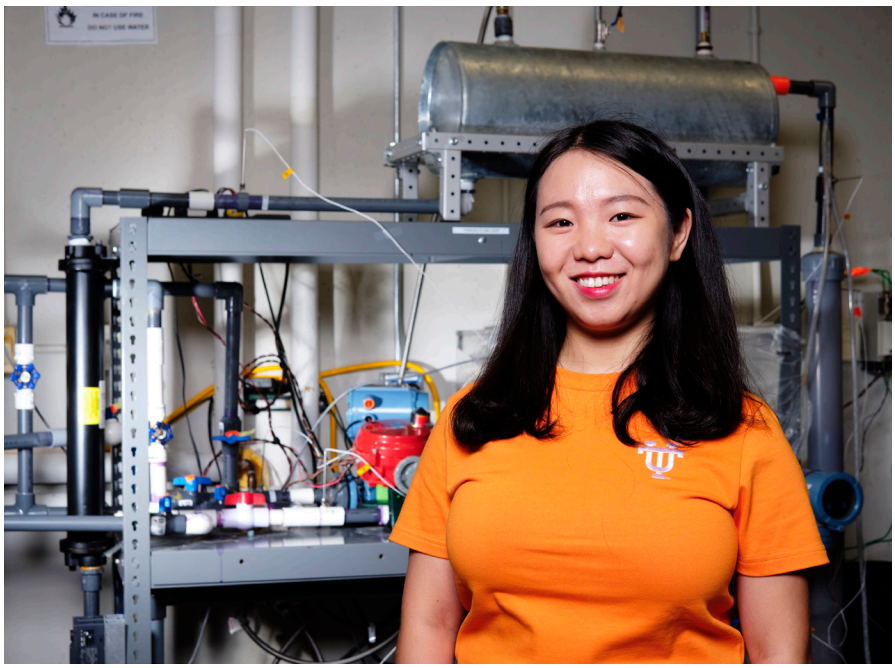
It's a mark of the department's success when it can graduate students who not only join the nuclear industry but also get hired by another top nuclear engineering program to pursue a scholarly career.

Research Assistant Professor Fan Zhang graduated from the department with a PhD in 2019 and worked for Assistant Department Head for Undergraduate Studies and Service, Associate Professor, and Southern Company Faculty Fellow Jamie Coble to continue developing her research in cybersecurity of industrial control systems and instrumentation and control. In July 2021, she joined Georgia Tech as an assistant professor.

During her time at UT, Zhang developed cyber-physical testbeds using simulators and physical components to investigate different areas of cybersecurity, including network architecture, authentication, different cyber-attack scenarios, cyber-attack detection methods, and risk assessment strategies. Her other research areas included systems modeling and simulation, online monitoring, fault detection, and diagnostics using statistical models and machine learning methods.

"Since Fan joined my research team in fall 2016, she has shown herself to be incredibly motivated, innovative, and collaborative," said Coble. "She was an outstanding member of our research team for five years, and she will be sorely missed! Georgia Tech is very lucky to have attracted her to their faculty. I'm very excited to watch her career and research trajectory."

Zhang received the 2021 Ted Quinn Early Career Award from the American Nuclear Society based on her outstanding



achievements and dedication to the nuclear industry. This includes her development of patent-pending research, which is helping to enable the production of a minimum viable product for a proposed cybersecurity device. The pending patent received a Technology Maturation Grant from UT Research Foundation and has a research license agreement with startup company Sentinel Devices LLC.

Zhang's area of research has attracted global attention from the International Atomic Energy Agency (IAEA), for whom she has presented findings of her research on the global concern of cybersecurity for nuclear facilities. She initiated the department's involvement in an IAEA Coordinated Research Programme (CRP) on "Enhancing Computer Security Incident Analysis at Nuclear Facilities," the largest CRP to-date at the IAEA with participation from over 20 institutions in 13 countries worldwide.

In addition to her research accomplishments, Zhang has contributed greatly to the department and the UT community. In March 2020, when COVID-19 caused mask shortages in local hospitals, she joined the East TN Chinese/Chinese American Care group (established for COVID-19 help) to raise funds and arrange for PPE purchases and deliveries in the East Tennessee area. They managed to donate 30,000 pieces of PPE to local hospitals, police stations, homeless shelters, senior living facilities, and restaurants and have raised more than $12,000 for the Knox County COVID-19 response fund.

"The department and the whole campus have nourished me and helped me in promoting diversity, equity, and inclusion," she said. "UTNE has been my home for the past five years, and I've been able to grow and thrive there thanks to the environment and people inside. I'll forever carry the Volunteer spirit with me, and I will pass on all the good things I learned here to future students. **Go Vols!**"

POWERED BY CURIOSITY

Jamie Porter Blazes Trails into Space Exploration

By Élan Young.

As a young girl, Jamie Porter loved math but hated science. Biology and chemistry had too much memorization in the beginning, which repelled her.

Now she gets to have the best of both worlds as an assistant group supervisor for the Space Environmental Effects Engineering team at Johns Hopkins University Applied Physics Laboratory (APL) working on NASA missions like the Europa Clipper, which is a mission to a moon of Jupiter that is thought to have liquid water.

Porter came to UT knowing she wanted to be an engineer, but she majored in electrical engineering before a presentation about nuclear engineering in Engineering Fundamentals piqued her curiosity.

"My mom was like, 'but you hate science,'" laughed Porter. "But the science isn't bad. Space radiation is a mix of astronomy, general physics, and engineering. It's more fun for my brain."

A Knoxville native, Porter graduated from UT with a bachelor's, master's, and PhD from the Department of Nuclear Engineering, spending a total of 12 years in the program. Although she didn't realize it at the time, she made history as the first African American woman to graduate from the department.

Whenever Porter can pay it forward, she does. She didn't set out to be a trailblazer, but she has since taken the role of mentor to heart and accepts invitations to speak to minorities in the program and has spoken twice at commencement to the entire department.

More than any other person, Professor Emeritus Larry Townsend was integral to getting her interested in space. It was his mentorship that opened the door for her own curiosity in space radiation, as he was the only faculty member in the department at the time with a connection to NASA.

"He's like my work dad," she said. "He's seen me when I was 18, when I was engaged, when I got married, and then when I had kids. I don't think I would have gone to graduate school if I didn't do that freshmen research with him and stay with him that whole time."

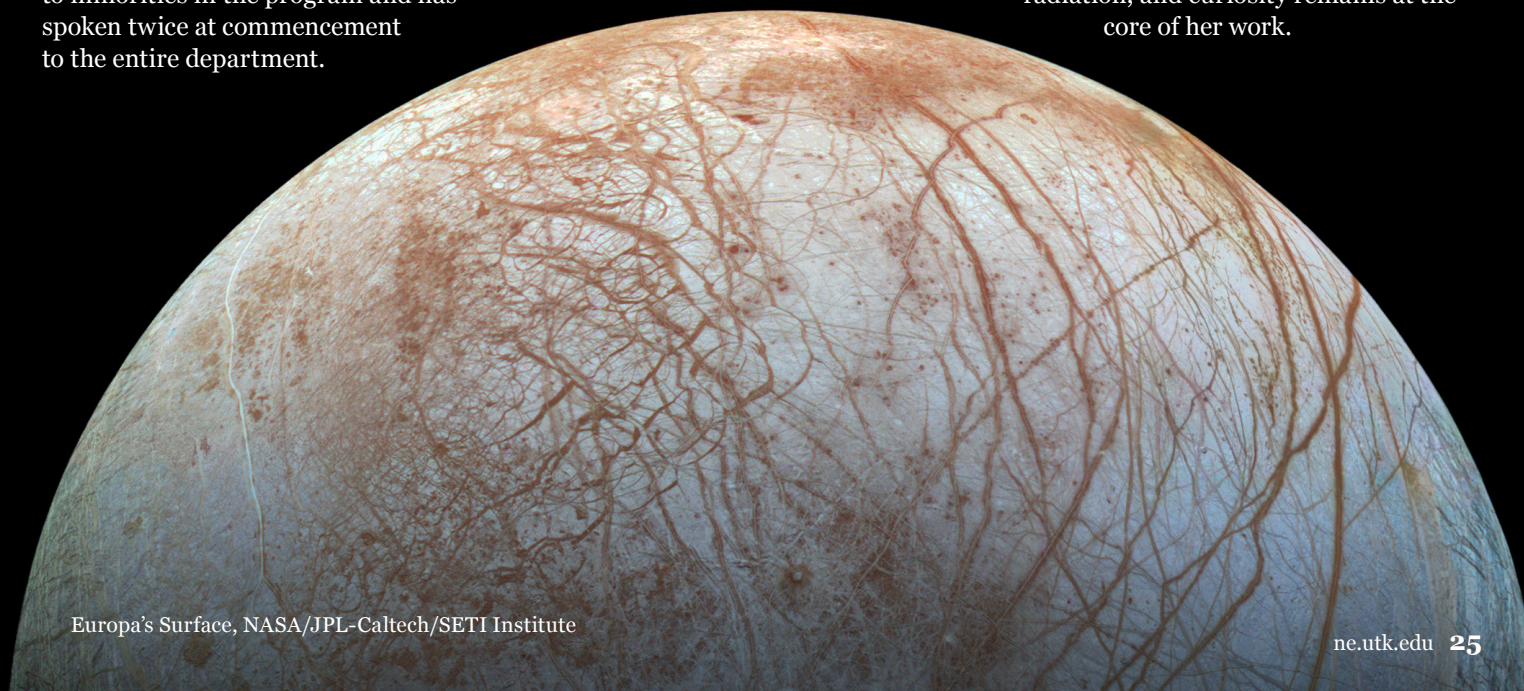
Once she started down the path of space radiation, she never turned back.

"It has nothing to do with power plants," she joked. "When I think about space and a mission like Europa Clipper, it's exciting because we know there is water there," she said, noting that where there is water, there is the likelihood of life.

At APL, she works closely with materials science engineers, astronomers, electrical engineers, etc. One of the tasks of her team is to figure out what missions need to build spacecraft that can withstand and perform properly in radiation environments other than here on the ground.

For her, studying space is all about tapping into curiosity. "I can't imagine doing another job because it keeps me from getting bored. There's always something new and different and challenging."

Curiosity is what led Porter into the world of radiation, and curiosity remains at the core of her work.



Europa's Surface, NASA/JPL-Caltech/SETI Institute

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306 Nuclear Engineering Building
1412 Circle Drive
Knoxville, Tennessee 37996-1410
Phone: 865-974-2525
Email: utne@utk.edu
Web: ne.utk.edu

utnuclear

@utkne

It Takes a Volunteer.

Keeping crowds safe with a portable nuclear or radiation detector. Page 4.