Nuclear, Plasma & Radiological Engineering
THE GRAINGER COLLEGE OF ENGINEERING

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

FALL 2022

NEWSLETTER FOR ALUMNI & FRIENDS

Cutting the ribbon of innovation

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DEPARTMENT OF NUCLEAR, PLASMA, AND RADIOLOGICAL ENGINEERING

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"Our alumni have been steadfastly by our side and lift us up in so many ways."

Dear NPRE Family,

Rizwan Uddin

You may be receiving this newsletter close to Thanksgiving. At NPRE, we have a lot to be thankful for with this school year well and truly underway.

Though our new labs in Talbot have been in use for over a year, we were finally able to host the dedication and ribbon cutting of the Talbot Annex with our friends in Aerospace Engineering earlier this fall. We were proud to have students, faculty, staff and alumni in attendance, along with dignitaries from college and campus.

I am grateful to be serving this department for another year (and another few years after that, thanks to a renewal of my department head appointment). I have also been named chair-elect for the Nuclear Engineering Department Head Organization (NEDHO) for the 2023-24 school year. I will be working with colleagues from all over the country to advance nuclear engineering in higher education.

Speaking of advancement, I am happy to talk about ways we hope to move the department forward.

On the faculty front, we now have the opportunity to hire faculty to multiple open tenure-track positions. We have lost a valuable member of our faculty, as YZ (Prof. Yang Zhang) has accepted another position and has already moved. While we are sad to see him leave, we wish him the very best in his new position at the University of Michigan. We hope to see him further expand collaborations between the two sister departments.

In terms of funding, we are focusing on three priorities: 1) a student development fund to assist in hosting events and other opportunities for our students; 2) the renovation of our student lounge, which currently lags behind many others in the Grainger College of Engineering; and 3) a fund for undergraduate research support, so we can improve the availability of funds for students while they work on research as undergraduates. Our alumni have been steadfastly by our side and lift us up in so many ways. Their gifts and contributions have been invaluable in helping NPRE continue to improve and helping students afford to attend our great university. We are grateful that so many alumni support the mission of NPRE and hope they can be part of what moves us forward.

With that, I invite you to explore these pages and to regularly visit our website and social media to stay up to date on NPRE news.

Sincerely,

Rizwan Uddin

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Zannoni wins prestigious early career grant from IEEE-NPSS

When Elena Maria Zannoni first got the email, she thought it was a mistake. There's no way that she had actually received the ***IEEE NPSS*** Edward J. Hoffman Early Career Development Grant.

"I didn't believe it," Zannoni said of that moment. "I knew it was very competitive... with so many other applications and other great institutions involved."

As strong as the competition was, Zannoni is this year's recipient of the $10,000 grant, given to outstanding early career researchers who have the potential to transform the field of medical imaging. The grant is intended to support the career development of the awardee.

"I'm very happy," she said. "It's a confirmation that the type of research we're doing has potential and is something they believe in and recognize. It also gives motivation."

Though she says she is an engineer first and foremost, Zannoni's research collaborates with hospitals and institutions (including Yale University and Johns Hopkins University) and provides another intersection between medicine and engineering. She plans to use the grant to fund travel to various other institutions for research purposes.

Zannoni is currently a research scientist in NPRE, working in professor ***Ling-Jian Meng***'s ***Radiation Detection and Imaging Group***. Last fall, she graduated with a Ph.D. from the department of bioengineering at the University of Illinois.

Her current projects involve the design, assembly, and testing of advanced medical imaging systems for clinical patients, before the systems are transferred to clinical institutions for use on actual patients. Zannoni said the Hoffman grant will enable her to go out and meet with doctors and patients and get the feedback about what they're designing.

This is an extension of the "huge step" Zannoni said she has taken, moving from the world of a Ph.D. student, where she was involved in more of the pre-clinical phase of research, to one of a post-doctoral researcher, which comes with a wider, clinical scope.

"You have to (learn to) scale out," she said. "It hasn't even been nine months (since completing my Ph.D.), but I can feel the difference in the two approaches."

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NPRE and AE celebrate "truly transformative" Talbot Laboratory addition

Recently, the Department of Nuclear, Plasma & Radiological Engineering—in conjunction with its colleagues in the Department of Aerospace Engineering—held the ribbon cutting and dedication of the Talbot Laboratory addition.

It was an event years in the making, delayed by a pandemic, but the occasion was momentous nonetheless.

Before the ribbon cutting, those in attendance heard remarks from Dean Rashid Bashir of The Grainger College of Engineering and University of Illinois interim provost designate William Bernhard, as well as department heads Rizwan Uddin and Jonathan Freund from NPRE and AE, respectively.

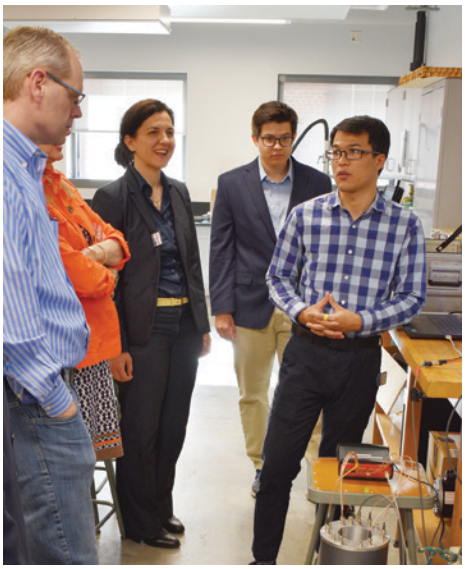
"Our vision for this expansion was to develop a state-of-the-art facility, complete with forward-facing educational spaces and instructional labs, that inspire and empower Aerospace Engineering and Nuclear, Plasma and Radiological Engineering students and faculty to be the best in the world at what they do," Dean Bashir said. "Our programs are more adaptive, facilities state-of-the-art, research bolder and our legacy arguably matchless."

In his remarks, Uddin mentioned the contributions of late professors Roy Axford and Barclay Jones, whose scholarship and leadership were crucial to NPRE's departmental development over the decades. Prof. Emeritus George Miley's leadership was also recognized.

"On behalf of both departments, I'd like to once again thank our university and campus leaders for their support in helping bring this project to fruition," Uddin said. "I would also like to thank all the donors who gave so generously to make this possible. This project is truly transformative for our departments and will benefit generations of students for many years to come."

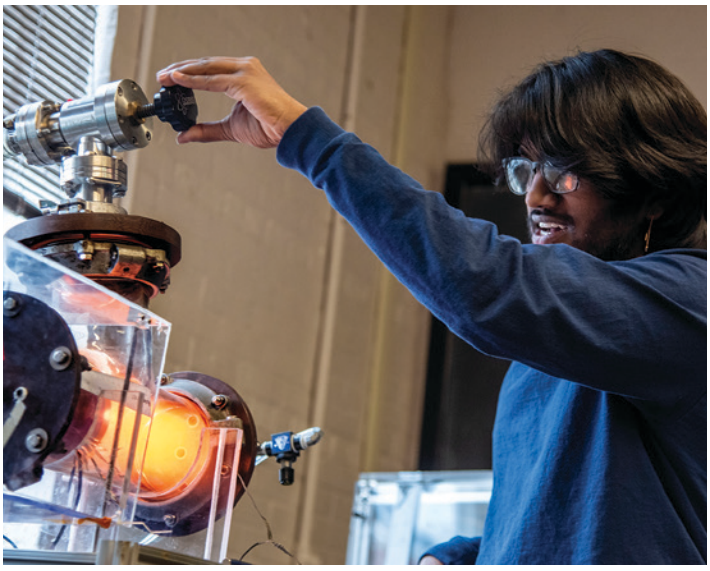
The addition includes labs, research areas and conference rooms for both departments. NPRE's portion gives its students state-of-the-art instructional laboratories in radiation measurement and nuclear materials and gives the department new administrative offices.

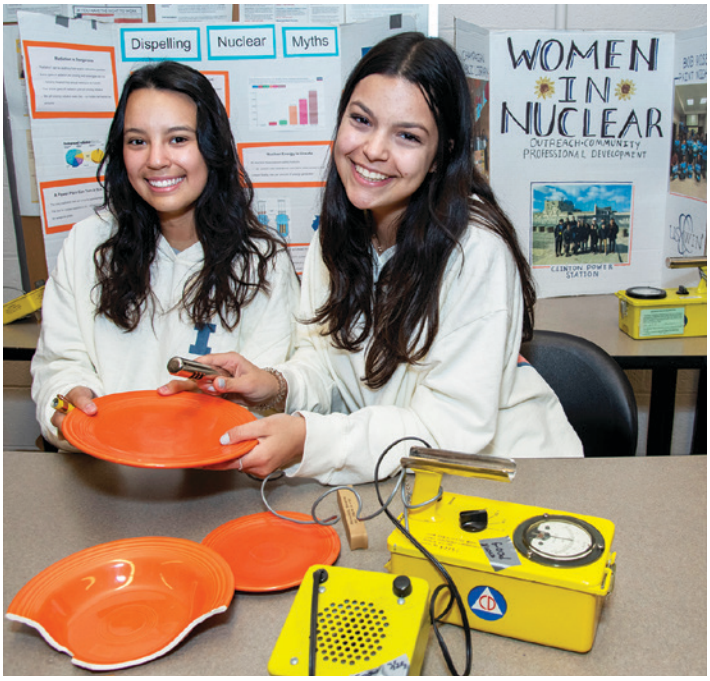
Holding the ribbon for NPRE were Uddin, professor and former department head James Stubbins, assistant professor Angela Di Fulvio, and undergraduate students Madeline Morasca and Nataly Panczyk.

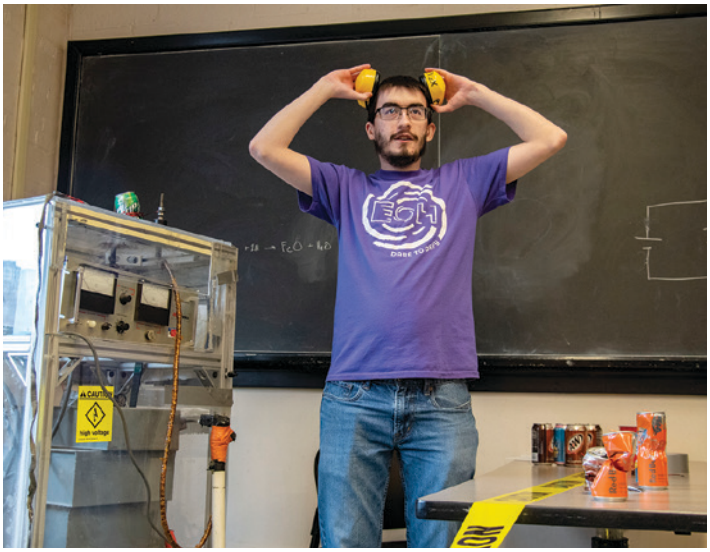


Students show off NPRE at Engineering Open House

As winter draws to a close, engineering students at the University of Illinois Urbana-Champaign set aside a weekend to show off what they have been working on all year long. Students from every discipline of engineering, including NPRE, set up exhibits to remind the general public of the role that science plays in everyday life and to show the difference that technology will make in the future. Primary and secondary schools also bring young students in hopes of passing the spirit of engineering to the next generation.







ANOTHER MARK MILLS AWARD FOR NPRE

Recent PhD graduate **Ibrahim Jarrah** became the third person with an NPRE degree to win the **ANS Mark Mills Award**, an annual award presented to the student author who submits the best original technical paper contributing to the advancement of science and engineering related to the atomic nucleus. Jarrah joins Majdi Radaideh (2019) and Yinbin Miao (2016) as NPRE grads who have won the award.

NPRE 2022 Investitures

From left, Grainger College of Engineering Executive Associate Dean **Philippe Geubelle**, GCOE Dean **Rashid Bashir**, Associate Professor **Yang Zhang (YZ)**, Professor **Mohan Sankaran**, Associate Professor **Davide Curreli**, UIUC Vice Provost for International Affairs and Global Strategies **Reitumetse Mabokela**, and NPRE Department Head **Rizwan Uddin**.

R. MOHAN SANKARAN

Donald Biggar Willett Professor in Engineering

Mohan Sankaran's research program primarily focuses on low-temperature plasmas, including their stable generation at atmospheric pressure and non-traditional applications in nanomaterials synthesis, additive materials processes, and electrified chemical production.

Professor Sankaran's lab facilities include IGNIS (Ion-Gas-Neutral Interactions with Surfaces), a state-of-the-art in-situ experimental surface science facility capable of characterizing surface materials under extreme conditions.

DAVIDE CURRELI

Donald Biggar Willett Faculty Scholar, Associate Professor

Davide Curreli's research focuses on the complex high-density plasma interactions with matter and, in particular, on developing innovative high-fidelity computational plasma physics models and codes that elucidate the edge plasma and its interaction with material boundaries in advanced fusion systems. Professor Curreli's contributions span beyond high-density plasma in fusion devices to the general applications of plasma and plasma physics in areas such as computational plasma physics and plasma chemistry. Professor Curreli has also been extensively involved with the nuclear fusion stellarator community, where he has integrated his advanced computational codes into plasma edge and plasma-material interactions research for complex 3D transport problems in the stellarator edge.

YANG ZHANG (YZ)

Donald Biggar Willett Faculty Scholar, Associate Professor

Yang Zhang (YZ)'s research can be summarized into two words: Matter and Machine. On the Matter side, his group synergistically combines and pushes the boundaries of accelerated molecular simulations, stochastic dynamics theories, and neutron scattering experiments, with the goal of significantly extending our understanding of a wide range of long timescale phenomena, rare events, and far-from-equilibrium properties of materials from the atomic and molecular level. YZ left his position at UIUC this fall for the University of Michigan.

Mohaghegh, National Academies of Sciences, Engineering, and Medicine committee release airplane safety report to FAA

NPRE associate professor ***Zahra Mohaghegh*** recently served on a National Academies Committee on ***Transport Airplane Risk Assessment Methodology*** (TARAM). The committee released its report to the U.S. Federal Aviation Administration (FAA) on June 22nd after many months of deliberation, research, and examination.

TARAM is a process for calculating risk associated with continued operational safety issues in the U.S. transport airplane fleet. TARAM is important because its risk-analysis calculations are used when making determinations of unsafe conditions in transport airplanes and when selecting and implementing corrective actions. This report assesses the TARAM process used by the FAA in its efforts to improve the overall safety of the transport airplane fleet. You can find the report ***here***.

"It was my great pleasure and honor to serve as a member of the National Academies Committee on TARAM and learn from experts in risk analysis and aviation," Mohaghegh, the director of NPRE's ***Socio-Technical Risk Analysis Laboratory***, said. "I look forward to future opportunities to collaborate with colleagues at the University of Illinois along with other national and international experts to advance risk assessment methodologies for the safety of technological systems."

Mohaghegh's strong display on the committee was also recognized by her colleagues.

"Zahra has had a huge impact on the Committee's consensus report, based in large part upon her impressive expertise in probabilistic risk assessment gained through interactions with the Nuclear Regulatory Commission and the nuclear power industry, both domestic and international," said Dr. ***George Ligler***, Professor and Dean's Excellence Chair in Multidisciplinary Engineering at Texas A&M University and the chair of the committee.

"Her input on what gaps currently exist in TARAM as well as constructive recommendations for improvement of that methodology are reflected in numerous places within the Committee's report…As importantly, Dr. Mohaghegh has fit in well with her colleagues on the Committee, who include a retired Vice President of the Boeing Company, a retired Vice President of American Airlines, two National Academy of Engineering members with extensive experience in the aviation industry, and senior professors from UT Austin, Georgia Tech, and Harvard University."

"These comments only re-affirmed what we have known and expect from (Prof. Mohaghegh)," NPRE department head Rizwan Uddin said.

SOTERIA LABORATORY AWARDED GRANT TO ESTABLISH RESEARCH HUB

A proposal led by NPRE's ***Socio-Technical Risk Analysis (SoTeRiA) Research Laboratory*** has been selected for the ***Grainger College of Engineering's Strategic Research Initiatives*** Phase I Award.

The project is entitled "Establishing a Risk-Informed Validation Research Hub." This first-of-its-kind research hub encompasses the full spectrum of risk analysis including advanced physics-human-organization simulations that are integrated with innovative risk assessment and risk-informed validation methodologies and equipped with a regulatory-accredited testing facility. The proposed hub will support the nuclear industry and regulatory agency with the deployment of new technologies.

The Principal Investigator (PI) of this project is Research Assistant Prof. ***Tatsuya Sakurahara, collaborating with the Co-PIs from the*** SoTeRiA laboratory including Associate Prof. ***Zahra Mohaghegh***, Senior Research Scientist ***Seyed Reihani***, Research Scientist ***Pegah Farshadmanesh***, and Research Associate ***Ernie Kee***. In addition to the SoTeRiA investigators, the team comprises Co-PIs from other departments: Associate Prof. ***Hadi Meidani*** (CEE); Prof. ***Tonghun Lee*** (MechSE); Dr. ***Farzaneh Masoud***, Dr. ***Terry Von Thaden***, and Mr. ***Richard Kesler*** (University of Illinois Fire Service Institute).

The ***SoTeRiA*** Research Laboratory, directed by Prof. Zahra Mohaghegh, is advancing Probabilistic Risk Assessment (PRA) science and applications for the safety of complex technological systems such as commercial nuclear power plants and advanced reactors. PRA is a key pillar in the risk-informed decision-making framework of the Nuclear Regulatory Commission (NRC). SoTeRiA's research focuses on improving safety in technological systems while reducing the cost of operations. This scientific work helps create a pathway that would enhance the economic viability of the nuclear industry at a time when carbon-free energy resources play a critical role in mitigating climate change.

Students interested in learning more about the laboratory are encouraged to visit ***soteria.npre.illinois.edu*** or, for further questions, to contact ***riskanalysis@illinois.edu***.

Sankaran part of DARPA project hoping to produce a 'three-ingredient food of the future'

Co-written by Bethan Owen, Department of Bioengineering

Our current methods of food production use significant amounts of water, land, and other resources, all while generating CO2 emissions and other waste. But food production is so essential that there's not much we can do about these inherent costs. Or is there?

What if we could dramatically reduce the amount of resources we need to make food? What if we could produce food with nothing more than air, electricity, and water? It might sound futuristic, but researchers including professor Mohan Sankaran and the Defense Advanced Research Projects Agency (DARPA)—the U.S. government agency that gave them a $10.4 million grant for this very project—believe that this reality might be closer than it seems.

"The goal of this project is rather simple: make food from air and water using electricity," Sankaran said. "The idea is that if we can make food this way, then it would be sustainable (i.e., less of a carbon footprint) and enable it to be made remotely, on demand (using readily available sources from our surroundings)."

"We are trying to develop a new method of food production that allows us to produce food in a sustainable, profitable and scalable way that could address both food safety and climate change," said bioengineering professor Ting Lu, one of the other PIs of the project. "The world population is increasing. It is anticipated that by 2050, there will be about 10 billion people around the world, but our arable land continues to decline. So there's a need to create a novel way of food production that can allow us to overcome the limitations of our current production practices."

Not only is this food production goal much more cost efficient and better for the environment than our current methods, but it's highly portable.

"We can produce food in the Caribbean and at the North Pole, in theory," Lu said. "There are all kinds of applications; you could create food on an island, or on a ship, or on a battlefield."

While the idea is impressive, Sankaran says the method is much more complex. "It requires several steps that are each in their own right complex, and then all the steps must be integrated to work together," he said. "Some of those steps are to 'fix' the N2 and CO^2 in air to compounds such as ammonia and acetate, and then feed these compounds to microbes to produce biomass containing the proteins and carbohydrates that make up food, and then bioprocessing steps to turn the biomass into more palatable forms of food including texture and taste."

"In my lab, we have been studying a plasma process to fix nitrogen from air to ammonia. The plasma is operated at atmospheric pressure using electricity. Thus, it can provide a solution to one of the critical steps, the synthesis of ammonia as a substrate for microbes. Another Co-PI, Prof. Paul Kenis, will be making another substrate for the microbes, acetate, by a different electrified chemical process (no plasmas). Both processes have been demonstrated at smaller scales but will need to be scaled up. He and I will be working together because the processes bear similarities and the scale up challenges are similar."

Mohan Sankaran

Currently, this vision is for the produced food to be more of a supplement than a full meal, with plans to structure this new source of nutrients into three different forms: a shake, a gel, and a dried jerky. Lu has a goal of producing 100 grams of food by the end of next year, and a broader goal of one day seeing production plants that can create this food on a larger scale.

Sankaran is joined in this venture by his co-PIs, including Lu (bioengineering), Kenis (chemical and biomolecular engineering), Christopher V. Rao (chemical and biomolecular engineering), Yong-Su Jin (food science and human nutrition), Keith Cadwallader (food science and human nutrition), and Vijay Singh (agricultural and biological engineering).

"While my role is a smaller part of the whole project, the entire problem depends on each part, which is what makes the project from a scientific perspective so exciting" Sankaran said. "It is truly an example of an interdisciplinary project where experts have to come together, learn from each other, and find a way to solve problems at the interface of different disciplines. Amazingly, all the experts needed are all at Illinois, which makes it even more unique."

ACCIDENT TOLERANT FUEL: ENSURING SAFE, SUSTAINABLE AND RELIABLE NUCLEAR POWER PLANTS

In an article published this summer for the Innovation News Network, NPRE Professor **Brent Heuser** discussed the development of accident tolerant nuclear fuel for nuclear power plants in the aftermath of the Fukushima Daiichi accident. You can find the article by scanning the QR code.

On the surface: Ruzic group develops plasma cleaning method for microchip fabrication

Researchers at the University of Illinois Urbana-Champaign have developed a method that could streamline the way companies produce microchips.

Manufacturing the most advanced microchips requires a technology called extreme ultraviolet lithography (EUVL). This only reached high-volume manufacturing at the end of 2019. Though chips are being produced, a downside of EUVL is that tin contaminates a critical component called the collector mirror, which needs to then be removed and cleaned with hydrogen plasma, a process that slows manufacturing speed and adds extra cost.

The method created by a team led by Professor David Ruzic and consisting of his current and former students (Dren Qerimi, Andrew Herschberg, Gianluca Panici, Parker Hays, and Tyler Pohlman) uses an annular surface wave plasma (SWP) antenna technology that is integrated into the collector for *in-situ* (in their original place) tin removal. They showed that by affixing eight SWP antennas to the mirror—two to the inner cone and six to the outer perimeter—the collector is kept free from tin buildup during etching, eliminating down time in the tool and reducing expense.

"This is the culmination of the work we have been doing with ***ASML***—the company who makes the machines. Their machines pattern virtually every chip in the world, and ASML is funding us in a major way," Ruzic, the Abel Bliss Professor of Engineering, said. "We show how the mirrors can be kept clean *in-situ* (in their original places), greatly extending the lifetime and up-time of their devices. There is also a path to actually have this technology deployed."

ASML-funded work in Prof. Ruzic's group continues looking at ways to improve the drive lasers, how to understand the behavior of Sn atoms and ions in the device, and experiments on stannane, the byproduct of the tin removal.

"This breakthrough is another example of the great work Professor Ruzic does with his students in the Plasma area of our department," NPRE professor and department head Rizwan Uddin said. "Students can get started working on important research projects and be a part of studies like this one as soon as they join the department. The experience they get in groups like Professor Ruzic's is important to their future success."

The paper detailing this research was recently published and highlighted in the Journal of Applied Physics.

Tokamak Energy and University of Illinois receive largest INFUSE grant ever awarded from Department of Energy

Tokamak Energy and the University of Illinois Urbana-Champaign have been awarded a $500,000 grant from the U.S. Department of Energy to collaborate on the development of liquid lithium systems. This is Tokamak Energy's sixth INFUSE award, the largest INFUSE grant ever awarded so far and one of the first to involve a U.S. university, rather than a national laboratory.

The Center for Plasma-Material Interactions (CPMI) at the University of Illinois is the premier university-based lithium technology laboratory in the US. CPMI is developing novel divertor concepts that utilize flowing liquid lithium as a solution to the erosion and impurity accumulation challenges faced by solid divertors. Lithium is very effective at pumping deuterium and tritium and has been shown to improve plasma performance by enabling access to new operating regimes. This new work will add a plasma source to the lithium loop at CPMI to demonstrate that the proposed technology is indeed reactor relevant for fusion energy devices.

The low-recycling concept achieves higher plasma confinement times, higher core-electron temperatures, a more stable plasma and can lead to a much more affordable fusion-energy device. Existing work with Tokamak Energy seeks to create a reactor-compatible flowing-lithium-divertor plate for testing in the company's latest spherical tokamak, the ST40. Earlier this year, the ST40 demonstrated a world first, achieving a plasma temperature of 100 million degrees Celsius, the threshold required for commercial fusion energy. This is, by far, the highest temperature

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ever achieved in a spherical tokamak and by any privately-funded tokamak.

A central question which has not yet been satisfactorily answered is: "How much tritium does liquid lithium pump and how quickly can the unburnt tritium be recovered from the liquid lithium?" This project aims quantifiably answer these questions, which are essential to answer for any fusion concepts which uses lithium. The final outcome will be a model of the fuel cycle within a tokamak fusion reactor, which will describe how much tritium is required on site and how quickly the unburnt tritium is recovered.

"We are delighted to receive our sixth—and largest—INFUSE grant from the US Department of Energy and particularly one that strengthens our collaboration with the University of Illinois," David Kingham, Co-Founder & Executive Vice Chairman of Tokamak Energy, said. "This is further validation that the U.S. Government places great importance on the development of commercial fusion energy. This is vital research which can lead to higher performance and reduced cost of energy from compact spherical tokamak fusion power plants. As a result of this research, we are growing our teams in the US and UK working on lithium systems."

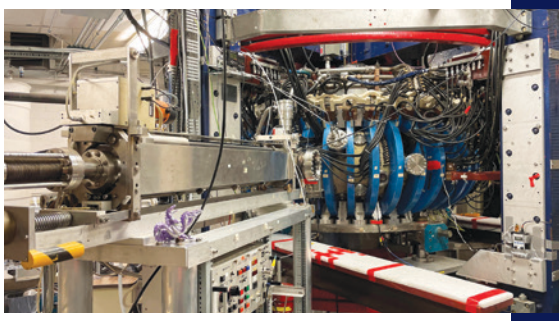
"Tokamak Energy is a great partner," David Ruzic, Abel Bliss Professor of Engineering at UIUC and Director of CPMI, said. "Their concept of a high-magnetic-field spherical torus with lithium walls is the leading concept that could make commercial fusion energy possible. The INFUSE grant will allow us to measure and then find solutions to the tritium recovery issue. This is a very important step in lithium fusion technology development and we are thrilled that the U.S. DOE is in full support of this effort."

HIDRA demonstrates steady state operation and first lithium results

By Research Associate Professor Daniel Andruczyk

NPRE's own Hybrid Illinois Device for Research and Applications (HIDRA) has had a busy year, having demonstrated steady state operations with plasmas being operated for up to 5,400 seconds. This has been one of the main claims of the device that it can operate for much longer discharges than most machines. With this capability, Tokamak Energy, a private fusion company based in Milton Park, U.K., has signed a research contract to study the long-term effects of plasma chemistry with plasmas in such long pulse discharges.

The ability to run such discharges is allowing a detailed look at lithium operations in a toroidal device. Lithium offers a solution to some of fusion's most pertinent issues, namely the survival of materials in the first wall due to plasma material interactions (PMI) and also transient events and instabilities during plasma operation. The material analysis teststand (HIDRA-MAT) is now in constant use to study the effects of PMI. A new liquid metal droplet injector (LMDI) has been installed and is able to precisely put down lithium droplets of known size [1]. By moving the HIDRA-MAT probe head into HIDRA and interacting with the plasma, the effects of lithium on plasma operation and surfaces can be studied. First operation in helium discharges yielded spectacular and surprising results. During operation, background helium was removed when lithium was detected in the plasma. This occurred when lithium started to evaporate as the surface interacted with the plasmas. The recycled background gas was eventually reduced by over 80% of its original level and allowed an increase of plasma performance by over a factor of 3. This has now been demonstrated every time with helium/lithium discharges. The results of these first lithium experiments have been published in a peer reviewed journal [2].



Lithium operation within HIDRA. Steady state operation allows plasma chemistry and recycled gas pumping to be studied using HIDRA-MAT.

Experiments involving hydrogen are currently underway which have several focuses. The first is to understand in general hydrogen operations with and without lithium. The second is to demonstrate vapor shielding, which has been observed on linear plasma machines, but never on a toroidal plasma device, the steady state operation of HIDRA allows this to happen. The third is to start doing plasma chemistry experiments.

In 2023, a new experimental campaign will be underway as part of the domestic liquid metal plasma facing component (LMPFC) program, funded by the DOE. This is a program administered by UIUC, Princeton Plasma Physics Lab (PPPL) and Oak Ridge National Lab (ORNL). These experiments will focus on the helium retention to understand the actual mechanism that helium is pumped by lithium and whether this is something that allows helium to be removed. A continuation of the vapor shielding experiments will also be undertaken to see if this is viable in a toroidal environment since the Vapor Box concepts being pursued by PPPL will rely on lithium vapor for heat flux handling in a divertor.

References

[1] A. Shone et al., Fusion Engineering and Design, **180** (2022) 113193.

[2] D. Andruczyk et al., Plasma Physics and Controlled Fusion, **64** (2022) 085011.

Di Fulvio wins Dean's Award for Excellence in Research

NPRE assistant professor Angela Di Fulvio has been named the winner of The Grainger College of Engineering's Dean's Award for Excellence in Research (assistant professor division).

"It's a great honor to be recognized for such a prestigious award," Di Fulvio said. "I'm very happy to receive an award for research.

"I hope this gives more visibility to the radiological area of the department. Personally, for my students, I hope this motivates them to continue to do their best."

Di Fulvio said she shares this award with her students, because a lot of the research and experiments she does are carried out by them.

"Angela has been spearheading our research efforts in several directions," NPRE department head Rizwan Uddin said. "Her research program has been steadily growing, and I am glad to see GCoE recognizing her for excellence in research."

Di Fulvio was also recently a ***recipient of a JUMP Arches grant***. Her proposed study hopes to make radiation therapy more targeted for people with prostate cancer.

Among other projects she is working on, is one that looks at non-destructive characterization of nuclear fuel, using neutron multiplicity counting and X-ray computed tomography to create a more accurate picture of ***TRISO fuel*** as it flows through an advanced reactor.

Another project within the framework of the National Nuclear Security Administration (NNSA) Nuclear Science and Security Consortium (NSSC) hopes to produce machine-learning with a limited data set available for training. "This could be very valuable in situations when we don't have the full data set and when we have a partial picture of the data," Di Fulvio said.

Di Fulvio also currently runs the new Radiation Measurement Lab on the first floor of Talbot Laboratory used for NPRE 451 (NPRE Lab) and NPRE 452 (Advanced Radiological Lab). "It's a great space with excellent resources. It's increased our ability to give students unique experimental learning experiences," she said.

She joined the NPRE faculty as an assistant professor in 2018 after spending time as an assistant research scientist at the University of Michigan and postdoctoral work at Yale University. She earned her Bachelor's, Master's and PhD degrees from the University of Pisa in Italy.

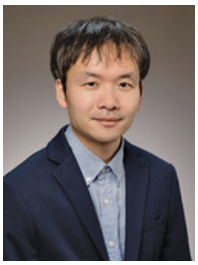
Sakurahara awarded prestigious PRA fellowship

NPRE Research Assistant Professor ***Tatsuya Sakurahara*** has been awarded the ***George Apostolakis Fellowship*** by the ***International Association for Probabilistic Safety Assessment and Management (IAPSAM)***.

The fellowship is intended to honor an individual who may be one of tomorrow's leaders in the advancement of Probabilistic Risk Assessment (PRA). The Apostolakis Fellowship honors Prof. George Apostolakis for his contribution to the science of risk analysis as well as his vision, energy, and guidance generously given to IAPSAM. The George Apostolakis Fellowship is to be awarded to an "early career" individual who is active in the field of PRA.

As the fellowship winner, Sakurahara participated in the PSAM 16 Conference in late June in Honolulu, HI to receive the award during the conference. "The competition this year was very high, but Tatsuya's background and dedication to the field of safety and risk was judged to be an exemplary demonstration of the spirit of the George Apostolakis Fellowship," said Dr. ***Curtis Smith***, PSAM 16 General Chair and the Director for the Idaho National Laboratory Nuclear Safety and Regulatory Research Division.

Sakurahara holds a Ph.D. in Nuclear Engineering from the University of Illinois Urbana-Champaign and is the Chief Scientist in NPRE's ***Socio-Technical Risk Analysis (SoTeRiA) Research Laboratory***, led by NPRE Associate Professor ***Zahra Mohaghegh,*** who was the George Apostolakis awardee in 2012.



Sakurahara came to the University of Illinois after earning his B.S. and M.S. degrees from the University of Tokyo. Tatsuya's Ph.D. thesis, advised by Mohaghegh, focused on developing the Integrated PRA (I-PRA) methodology to increase the realism of risk estimation for nuclear power plants. His Ph.D. research also contributed to advanced techniques for uncertainty analysis, importance measure analysis, and the simulation-informed common cause failure modeling. After finishing his Ph.D., he has been involved in ***multiple large-scale projects*** of the SoTeRiA Laboratory, developing methodologies and computational platforms to advance PRA science and applications for commercial nuclear power plants and advanced reactors.

Most recently, Sakurahara is ***serving as the principal investigator*** on a SoTeRiA project entitled "Establishing a Risk-Informed Validation Research Hub." The project was selected for the ***Grainger College of Engineering's Strategic Research Initiatives*** Phase I Award.

Curreli tokamak research part of $47 million funding package by Department of Energy

The Department of Energy ***recently announced a $47 million, three-year funding package*** for collaborative research efforts involving tokamaks (machines that confine a plasma using magnetic fields in a donut shape for fusion). NPRE associate professor Davide Curreli's research evaluating the viability of tungsten as a plasma fusion component is one of the projects being funded in this package.

Curreli will be continuing this work in collaboration with researchers at Penn State University, the University of Tennessee, Princeton Plasma Physics Lab, and Oak Ridge National Lab.

"You need an element that is stiff, tough, robust," Curreli said. "Tungsten is all of those things, but it is a critical beast to handle. The plasma doesn't like it."

Curreli's group will handle the computational modeling for the experiments done at WEST (Tungsten (W) Environment in Steady State Tokamak), located in France. WEST is an integrated platform for the testing and development of actively-cooled, W Plasma Facing Components (PFCs) under combined heat and particle loads. Demonstrating the sustainability of plasma scenarios over relevant plasma wall equilibrium timescale (more than 100 seconds), as required for steady-state operation, requires integrating the science and technology for scenario control and is an essential step to understanding and preparing for the operation of the future devices, e.g., a fusion pilot plant (FPP).

For this purpose, WEST is paving a path towards actively-cooled tungsten PFCs under proto-typical loads (particularly for the ITER divertor) and at mastering integrated plasma scenarios over relevant plasma wall equilibrium timescales in its full tungsten environment. WEST is an international facility, with partners from China, Europe, India, Korea, and the US, and provides an opportunity to confront these unknowns and identify solutions on the way to long pulse operation before they are encountered in future devices.

The main aim of this project is to address the impact of tungsten (W) as the main plasma facing material (PFM) armoring plasma-facing components (PFCs), in particular for the actively-cooled, long-pulsed, divertor tokamak. This project will focus on integrated analysis to predict and optimize plasma material interactions (PMI) and edge plasma conditions, as well as to investigate approaches for long pulse operations.

Tungsten is a leading candidate PFC in next-step fusion devices for its high resilience to sputtering at the nominal conditions of the wall in fusion devices, particularly as they progress to reactor conditions. These properties lead to a sufficient lifetime of the W components under the hours of plasma exposure expected, as well as negligible or small long-term retention of the hydrogenic fuel (which will eventually contain tritium) in these components. The WEST tokamak provides a full W PFM environment compatible with long pulse operation to help develop and benchmark a full range of PMI modeling codes, i.e., over large time- and length-scales [Gilbert 2021].

Di Fulvio study seeks to improve radiation therapy planning for prostate cancer

A new project from NPRE assistant professor ***Angela Di Fulvio*** hopes to enhance the capabilities of treatment for prostate cancer.

Di Fulvio is heading up one of 20 research proposals that recently received grants from the ***Jump ARCHES program***. The study, entitled "Point-cloud segmentation for daily adaptive prostate therapeutic planning," hopes to make radiation therapy more targeted for people with prostate cancer.

"Prostate cancer (PCa) is a major cause of disease and morbidity amongst men, and it is the second most common cancer affecting men on a global scale," Di Fulvio said. "The prostate is uniquely intertwined with highly radiosensitive tissues; hence, accurate treatment planning is crucial to maximize the tumor dose while sparing healthy tissues."

"In this project, we are excited to collaborate with oncologist and clinical assistant professor Greg Hermann at OSF HealthCare to improve current algorithms used to design radiation therapy treatment plans. We hope that our work will contribute to making the treatment planning workflow more efficient and prostate radiation therapy ultimately safer and more accessible to the patient."

The Jump ARCHES program is a partnership between OSF HealthCare and the University of Illinois Urbana-Champaign (U of I) and its College of Medicine in Peoria (UICOMP). The funding supports research involving clinicians, engineers and social scientists to rapidly develop technologies and devices that could revolutionize medical training and health care delivery.

In total, the funding for all the grants this fall was $1.4 million.

NPRE has strong showing at annual ANS meeting

The American Nuclear Society Annual Meeting is always a time for reflection, recognition, and renewal. June's meeting was particularly fruitful for NPRE, where several awards and honors went to the department's faculty, students, and alumni.

- PhD student Amanda Bachmann (pictured, right) was given a Presidential Citation "for her service on the Board of Directors and other committees and for her leadership among student members."

  "I am honored to be recognized with this award," Bachmann said. "This award is recognition of all of the work I have done within ANS and for the students of ANS…I have been fortunate enough to be given multiple opportunities to serve the students of ANS, through different committee appointments and being elected to the Board of Directors. I hope to continue to advocate for students in nuclear science and technology, making sure they have the resources and agency to succeed in and out of ANS."

- Associate professor Caleb Brooks received the Landis Young Member Engineering Achievement Award "for his service to ANS, his high-quality and high-impact research in reactor safety, and his continued work to make microreactor technology a reality on campus."

  "The conference was very well attended, and it was great to see people in person again," Brooks said. "The strong technical sessions and a lot of energy and engagement during the talks were clear indications folks were glad to be back.

  "The Landis Young Member Engineering Achievement Award is a great honor. I am thrilled to be named on such a distinguished list of awardees, many of whom I have looked up to over my career. It also doesn't hurt to have people still think you are young."

- NPRE alumna Alyssa Hayes, currently a PhD student at the University of Tennessee, served as a panelist during the president's special session. The discussion was titled "The Nuclear Grand Challenges: Moving the Needle." She was joined on the panel by NPRE associate professor Katy Huff (currently on leave as Assistant Secretary for Nuclear Energy in the U.S. Department of Energy).

"I had never attended an ANS Annual Conference before, but this meeting really transformed my career outlook for the better," Hayes said. "I was able to connect with so many people working in my areas of interest. For instance, I aspire to be a future ANS Congressional Fellow and I was able to have in-depth conversations about the fellowship with the current and past fellows, as well as gain the support of ANS executive members. I joined a couple of ANS Committees and I'm excited to be more involved at the National level.

"Serving as a panelist during the President's Special Session as a student has never been done before to my knowledge. I heard at the ANS Executive Board meeting that this scenario would have been unimaginable a few short years ago. I spoke on public engagement through advocacy, and how to equitably transfer knowledge in order to build greater access to opportunities in nuclear for students in underrepresented minority groups, and foster a more inclusive community in ANS. Throughout the remainder of the conference, I was elated to find that my comments were highly regarded by many influential leaders within the nuclear community."

- Professor James Stubbins was presented the Mishima Award in absentia "in recognition of advancing nuclear science and technology in nuclear materials, irradiation damage and effects, mechanical properties, high-temperature corrosion, stress corrosion cracking, and electron microscopy."

- Alumni Matthew Jasica and Kathryn Mummah also received Presidential Citations.

NPRE Scholarship Impact Statements

CATHERINE PRITCHARD SCHOLARSHIP IN NUCLEAR, PLASMA AND RADIOLOGICAL ENGINEERING

2021–2022 RECIPIENT

PAOLA SILVA

Major: Nuclear, Plasma & Radiological Engineering

Year: Junior

High School: The Village High School

Making A Difference

"I would like to say thank you! As a female Latina in STEM, it can sometimes be overwhelming. These acts of kindness really push me to work harder and show my full potential. I look forward to someday doing the same for others."

Activities and Honors

- Women in Nuclear (WiN)—Treasurer
- Women in Engineering—Department Lead for Nuclear Engineering
- Society of Hispanic Professional Engineers (SHPE), Illinois Student Chapter

Why did you want to become an engineer at The Grainger College of Engineering?
I have always been amazed by science and puzzles. I believe that engineering is a perfect combination of both. I chose nuclear engineering because I truly believe it is the way forward and the best way to help our planet. The Grainger College of Engineering provides one of the greatest programs in the country!

Can you tell us about your classes and extra-curriculars?
Some of my extra-curricular activities revolve around different RSOs on campus. I am part of WIN (Women in Nuclear). I am the treasurer this year and was the professional development chair the year prior. It is a great community that brings our small major together. I am also part of ANS (American Nuclear Society) where I am the recruitment chair for this RSO. Again, an amazing RSO that bring the nuclear community together. In my free time I enjoy spending time with friends and knitting!

What does receiving this scholarship mean to you?
This scholarship has motivated me to pursue different activities. I am starting research next semester! Financially, I am able to apply this scholarship towards textbooks and reading materials for my different courses.

What do you want to do after you graduate? What is your dream job?
I would like to go straight to the working field once I graduate. My dream job is to work at a nuclear power plant and after a few years coming back to pursue my masters.

DAVID N. RUZIC SCHOLARSHIP

2021–2022 RECIPIENT

JOSHUA HOFFMAN

Major: Nuclear, Plasma, & Radiological Engineering

Year: Junior

High School: Great Mills High School

Making A Difference

"I strive to give new and incoming students the same sort of onboarding experience and sense of connection to our student group that I was able to be given when I was a freshman. In this sense, receiving this scholarship inspires me to strive towards branching out into more ways so I can apply the goal of 'paying it forward.'"

Activities and Honors

- Computational Plasma RustBCA Research Assistant
- American Nuclear Society
- Department of Nuclear, Plasma, & Radiological Engineering Undergraduate Teaching Assistant
- Experimental Fusion Research Assistant
- Favorite Classes
- Plasma Laboratory
- Plasma and Fusion Science
- Electromagnetic Fields
- Fluid Dynamics

Why did you want to become an engineer at The Grainger College of Engineering?
The Nuclear, Plasma, and Radiological Engineering program at Grainger Engineering felt unique to other schools in both the academic opportunities it offered and the welcoming atmosphere of the department, which I found compelling.

Can you tell us about your classes and extra-curriculars?
In terms of research, I'm very excited to be working on novel simulation codes that not only produce unique results, but are on the verge of being able to couple together to open entirely new branches of options to look at. My favorite class so far is also the plasma laboratory that I'm in now, as in such a short amount of time I feel as if I've been able to tie together so many seemingly unrelated concepts that I've so far only learned in theory, but now have tangible practical applications.

What does receiving this scholarship mean to you?
As an out-of-state student, tuition is a particularly significant expense and so this scholarship helps take off some of the pressure to earn back as much money as possible during the semester, so that the time can be redirected towards more rewarding goals.

What do you want to do after you graduate? What is your dream job?
After graduation I plan on continuing with a PhD-track program, which will hopefully then lead to a full-time career in plasma research.

2021-2022 RECIPIENT

AMBER HUNTER

Major: Nuclear Engineering

Year: Junior

High School: Naperville Central High School

Making A Difference

"Scholarships like these reaffirm my excitement towards The Grainger College of Engineering. There are people out there who want us engineering students to succeed, and know that this program will do that for us. There are people who believe in us and what we can do. And those people are willing to invest a generous amount of money to kickstart the impact we will provide in the world after our education at Illinois."

Why did you want to become an engineer at The Grainger College of Engineering?
Ultimately, I want to change the world. I want my work to impact people's lives for the better. Through engineering, I can solve problems and challenge myself every day. Specifically choosing nuclear engineering was catering directly to this goal. I knew it would be hard, but I want to make an impact, and the degree I will earn at The Grainger College of Engineering will allow me to do that.

Can you tell us about your classes and extra-curriculars?
Currently, I am an intern at Starfire Industries where I am learning so much about research, the lifetime of a project, and contributing to meaningful work being done for the community. In addition, I'm working with Dr. Kozlowski in his research group, learning more applications of coding and data analytics, which has helped me find another area of nuclear engineering I enjoy being a part of. Outside of engineering, I work as an EMT. When we were sent home because of COVID I worked for a private ambulance company back home for the Spring and Summer, and now I work for Illini Emergency Medical Services and for the Illinois Fire Service Institute. Any free time I have is spent boxing. I joined the Illini Boxing Club this semester. I've been boxing for about ten months now, and I really enjoy it.

What does receiving this scholarship mean to you?
Financially, this scholarship will allow my family and I to save some money and put it towards further education after my undergrad. Further education is made more financially possible by this wonderful scholarship, thank you so much!

What do you want to do after you graduate? What is your dream job?
My dream job has developed from being a nuclear engineer in the Navy, working on the nuclear-powered ships and submarines, to a dream job of working in nuclear medicine, working at a hospital, researching new radiological techniques to battle cancer. Since then, my dream job has grown into research with regards to radiation detection and other applications in the nuclear engineering world.

Every opportunity from this college I was able to capitalize on which all had an impact on what I want to do. As I learn more about the field of nuclear engineering, the more possibilities I learn about will help me decide the career I want in order to help change the world.

GEORGE H. MILEY—LENR ENDOWED UNDERGRADUATE SCHOLARSHIP

BRADY MOORE

Major: Nuclear, Plasma, and Radiological Engineering

Year: Sophomore

High School: Downers Grove North High School

Making A Difference

"I would like to thank my donor for helping support my education financially. Although I do not have large sums of money required to literally pay it forward, I will try to be nice to those around me and support people in nonfinancial ways. I would like my donor to know that I hold myself to a very high standard in terms of getting the most out of my education. Hopefully, I will be able to positively impact the world someday."

Why did you want to become an engineer at The Grainger College of Engineering?
I always knew I wanted to be an engineer. I think it was the problem-solving aspect that originally drew me to the field and has since kept me engaged. I chose nuclear engineering specifically after taking physics and chemistry in high school. I saw nuclear engineering as the combination of both those subjects and a field with a promising future. I chose Grainger Engineering because of the high program ranking and proximity to my home.

Can you tell us about your classes and extra-curriculars?
I am involved with a wide range of extra-curricular activities on campus including the Men's Rugby Team, the student chapter of the American Nuclear Society, and IRobotics. In addition, I work at the Center for Plasma-Material Interactions. My favorite class so far has been NPRE 247: Modeling Nuclear Energy System, taught by Professor Brooks. It was the first and only class in my major that I have completed, and the subject matter excited me even over Zoom. In my free time I like to read novels.

What does receiving this scholarship mean to you?
This scholarship helps alleviate some of the stress of paying for college and is definitely reducing my student loans. Knowing that I have the funds to continue my education allows me to focus on my classwork and doing research in my free time.

What do you want to do after you graduate? What is your dream job?
After I graduate, I would like to attend graduate school and earn my PhD in a field related to nuclear engineering. Eventually, I dream of doing research and development at a national laboratory.

American Nuclear Society 2022 Student Conference

This past spring, the University of Illinois student chapter of the American Nuclear Society hosted the organization's annual student conference. Hundreds of students and professionals from across the country gathered to take part in panels, workshops, tours and social events in the first in-person conference in three years.

The conference's theme was **Saving the World One Atom at a Time**. This theme reflected the important role the nuclear sciences will play in solving many of the world's grand challenges. It also recognizes the atomic contributions we all make every day. Together, these contributions form the foundations of solutions to these grand challenges. It celebrates the people that make science possible by acknowledging that they came to this conference from an infinitude of backgrounds and experiences. It encourages us to widen our circles and include scientists and engineers with a diversity of thoughts. Finally, it inspires us to be active participants in the solutions to the world's problems.

Zannoni, *continued from page 4*

Last year, Zannoni was the first-place winner of the Physics, Instrumentation and Data Sciences Council (PIDSC) Young Investigator Award at the 2021 Society of Nuclear Medicine & Molecular Imaging (SNMMI) Annual Meeting.

Zannoni graduated with cum laude with a Bachelor of Science degree in Biomedical Engineering from the University of Pisa in Italy. She later enrolled in a Master of Science program there and came to Illinois as a part of an exchange program between The Grainger College of Engineering and the University of Pisa.

At Illinois, Zannoni joined Meng's group as a visiting scholar to work on a state-of-the-art preclinical MRI compatible SPECT system called MRC-SPECT-I system developed in the Meng's Radiation Detection and Imaging Lab. Zannoni returned to Illinois in 2016 as a PhD candidate in the bioengineering department advised by Meng.

Zannoni said she wants to have a career in academia but wants her research to be something that directly improves hospitals and how patients can be treated in a short period of time.

Stubbins wins college award for Excellence in Graduate Student Mentoring

Professor James Stubbins has been named the 2022 winner of ***The Grainger College of Engineering*** Award for Excellence in Graduate Student Mentoring.

Stubbins is the first NPRE faculty member to win the award at any level since 2004, when the late Dr. Roy Axford received it on the campus level.

"My approach to graduate mentoring is an activity carried out on a highly individualized basis," Stubbins said in his philosophy statement. "Successful graduate research mentoring is accomplished by helping each student identify a particular research challenge and allowing them to develop their own capabilities to address the challenges.

"This transformational approach relies heavily on students' own individual development supported by challenging them to become independent critical thinkers and researchers. Guidance along the way comes not from directing them, but rather from actively challenging them to properly define and address their research topics and to defend their findings."

> "It is great to see Jim's long and impactful mentorship of graduate and undergraduate students being recognized."
>
> —*Rizwan Uddin*

Stubbins has been at the U of I since 1980 and has held the rank of full professor since 1991. He was also NPRE's department head from 1999–2017.

"Jim has already won national recognition for his dedication to educating next generation of nuclear engineers," NPRE professor and department head Rizwan Uddin said. "It is great to see Jim's long and impactful mentorship of graduate and undergraduate students being recognized."

"Dr. Stubbins is an inspiring mentor and advisor," PhD alum Xiang Liu, now at Idaho National Laboratory, said. "He always encouraged me to think critically and gave me the freedom to pursue the scientific questions and try my best in research. He is a role model for me, and I am constantly impressed by his passion and dedication in research and also his respectfulness and kindness."

Grunloh joins NPRE as microreactor research scientist

Dr. Timothy Grunloh is NPRE's newest hire, as he was recently named the principal research scientist for the department's microreactor project.

"Dr. Grunloh brings experience acquiring, managing, and executing advanced R&D projects," said NPRE associate professor Caleb Brooks, who also serves as the director of the Illinois Microreactor RD&D Center. "His time working with US nuclear companies who have been developing microreactor designs brings real work experience to the university deployment project with USNC. As the Associate Director of the Illinois Microreactor RD&D Center, Dr. Grunloh will assist in managing the growing RD&D portfolio and accelerate UIUC leadership in nuclear power research."

Before taking his position at NPRE, Grunloh worked as a computational fluid dynamics analyst at X-Energy, a reactor engineer at Oklo, Inc., and a senior research scientist at Illinois Rocstar.

Grunloh received his B.S. degree in Nuclear Engineering from the University of Illinois in 2011, followed by M.S. (2013) and Ph.D. (2016) degrees from the University of Michigan.

"Since completing my undergraduate degree at Illinois, I've maintained a deep respect for the institution," Grunloh said. "The excitement that recent years have imparted on the nuclear industry has been driving a variety of unique opportunities. Among these opportunities is, of course, Illinois' efforts to establish a research reactor on campus. When I saw the opportunity to contribute to this project, in my own community and with my alma mater, I simply could not pass it up."

In addition to working on the development and implementation of the microreactor, Grunloh will be working with some of the department's grad students on meeting their research goals.

"This project offers an opportunity to make a real impact on the future of nuclear energy," Grunloh said. "Many industry participants are seeking to establish, among many considerations, licensing pathways, supply chains, and construction experience to usher in the next phase of advanced nuclear power plants. The University of Illinois microreactor project effort offers an innovative approach to demonstrate key aspects of all these challenging components. I am very excited to have a chance to help drive this forward to make a lasting impact on the future energy portfolio of the country and global community."

2022 Daniel Hang Senior Design Award Winners

The Daniel F. Hang Outstanding Senior Design Award was created in honor of the late Emeritus Prof. Daniel F. Hang, one of the Department's founders.

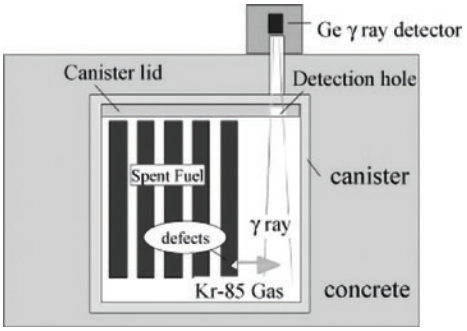
Hang, who died at the age of 95 in December 2013, was passionate about nuclear engineering design, and emphasized the coupling of economics analysis with successful design work. He also strongly advocated students becoming licensed Professional Engineers. The award is presented annually to each year's best senior design team.

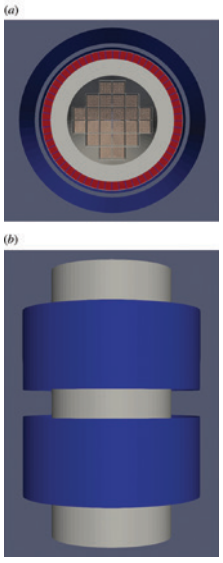
1ST PLACE

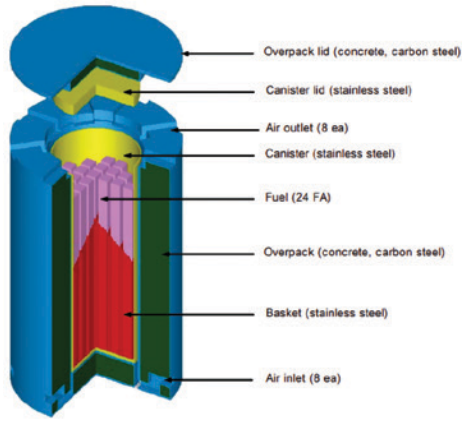
BRAD BOZZETTI, GAVIN DAVIS, ANGELO MINETTI

URANIUM WASTE ROCK CLEANING

Open-pit and underground uranium mining involve the generation of millions of tons of waste rock, which not only poses a risk to human health, but is often left behind to occupy usable space. Waste rock that contains less than 0.12 weight percent of uranium will be referred to as "sub-ore" material because there are radioactive quantities present. This project aims to extract the leftover uranium and decay products from sub-ore material. The easiest method to extract the uranium and transform the waste rock into usable material is with a chemical solution. Using the volume of waste rock generated from the Ranger Uranium Mine in Australia as a basis, the chemical solution would be poured over a pile of pulverized sub-ore and trickle down to extract uranium. This solution will be pumped out and the desired products will be extracted. The solution chosen is a phosphonic acid, for mobilization, mixed with dodecane oil, for migration. The mixture containing uranium is then combined with water. When the uranium migrates to the water due to a higher affinity, the density difference naturally separates the solvent-oil and water. The solvent-oil is collected and reused for the next batch of pulverized sub-ore, and the water is sent for uranium extraction. This process may take multiple passes for full extraction. Our pilot scale volume is a 40-foot shipping container from which we can ideally extract a maximum 58.5 kilograms of uranium per second, assuming total mobilization and a flawless system. Further economic analysis will determine if this project is a practical solution.







2ND PLACE

PARKER ALLEN, SHYAM UPADHYAY, BEN YODER

USED NUCLEAR FUEL CASK MONITORING

Monitoring spent nuclear fuel inside dry storage casks is an important aspect of national security. Additionally, with advances in spent fuel reprocessing technology, the fuel stored in dry storage casks may become viable for reuse. Current casks are designed to store spent fuel while ensuring that the temperature and radiation produced by the fuel are contained without plans to reopen the cask. Our work aims to design a method to non-destructively monitor spent nuclear fuel inside dry storage casks, which would provide useful information about the fuel sealed in the cask without having to open it. This work specifically investigates incorporating two forms of monitoring into the spent fuel cask—gamma ray spectroscopy to monitor the integrity and composition of the fuel and muon tomography to image the fuel. In this design report, the use of gamma ray spectroscopy and muon tomography as spent fuel monitoring systems is analyzed.

3RD PLACE

ANTHONY EVANS, JULIA ROESSLER, MONICA SAVATH

USED NUCLEAR FUEL SALT REPOSITORY

Within the United States, there is no current long-term storage solution for storing spent nuclear fuel. Several nuclear facilities within the United States have relied on-site interim storage of spent nuclear fuel, but capacity is increasingly becoming limited. In this seminar, a nuclear waste repository aiming to store spent nuclear fuel is proposed and is site-specific to the Tatum Salt Dome located near Baxterville, Mississippi. Aspects such as geological and hydrological properties, as well as an analysis of the radioactive decay heat released within the casks will be assessed to determine ideal properties of the repository design.

Morasca receives ANS Joseph Naser Undergraduate Scholarship

One of the advantages available to students when they start at NPRE is the ability to get in and start working on research quickly. Madeline Morasca has taken that to heart, and in doing so, she has earned the American Nuclear Society's ***Joseph Naser Undergraduate Scholarship***.

The Naser Scholarship is designated for students pursuing undergraduate studies in nuclear engineering with a focus in the field of human factors, instrumentation and controls. An applicant for this scholarship must be a full–time undergraduate student at a North American university interested in technical aspects of human factors, instrumentation and/or controls. The scholarship focus is on the technical disciplines involved in Nuclear Plant Instrumentation, Controls, and Human–Machine Interface Technologies in the context of nuclear power or other nuclear engineering specific applications.

Morasca, a sophomore from Barrington, Ill., originally came to Illinois wanting to study in NPRE's radiological track. She then learned about associate professor Zahra Mohaghegh's ***Socio-Technical Risk Analysis (SoTeRiA) Laboratory*** and emailed Mohaghegh in October of her freshman year. "I was really interested in the work they were doing, so my interests ended up lining up more with the Power track. I've been working in (Mohaghegh's) group for the past two years."

Morasca said she's very interested in the human factor side of nuclear engineering, something she feels is starting to be more prevalent in the department after taking NPRE 461 (Probabilistic Risk Assessment) and now NPRE 561 (Advanced Risk Analysis for Technological Systems).

In SoTeRiA, she's working on incorporating the organizational and human factors in studies and has done a literature review on the theoretical and operationalization techniques for those factors. Morasca is also working on her own models that integrate those factors into probabilistic risk assessment.

"This scholarship is a big honor and a motivator for me to keep researching these human and organizational factors within the SoTeRiA group," Morasca said. "Hopefully it will propel us to continue to learn more about these and incorporate them into the PRA of nuclear power plants."

Morasca, an active member of the U of I's chapter of Women in Nuclear, said she wants to experience more in the classroom and industry before deciding what to do after graduation in a couple years, adding that PRA study is gaining traction in research and the nuclear engineering industry. "Hopefully, I'll have opportunities in whatever path I choose," she said.

In college thus far, the thing Morasca has enjoyed most is getting the chance to be a part of so much research as a freshman and sophomore. "I think the opportunity the department gives (undergraduate students) to not just work under grad students but to do our own research has been really rewarding," she said.

Alkhatib named Mavis Future Faculty Fellow

NPRE Ph.D. candidate ***Sari Alkhatib*** has being selected as one of the ***Mavis Future Faculty Fellows*** (MF3) for the 2022-2023 academic year. Through this program, the Grainger College of Engineering at the University of Illinois aims to train next generation of engineering professors to be proficient in research, teaching, and mentoring.

Since August 2019, Sari has been working as a Graduate Research Assistant at the ***Socio-Technical Risk Analysis (SoTeRiA) Research Laboratory***, directed by NPRE Associate Professor ***Zahra Mohaghegh***. Sari's research focuses on the advancements of risk-informed methodologies for commercial nuclear power plants and advanced reactors. By utilizing fire probabilistic risk assessment (PRA) and FLEX (Diverse and Flexible Coping strategies) as case studies, he is working on establishing a multi-level decision-making framework to achieve substantial reduction in costs while ensuring safety in nuclear power plants.

Sari has participated in two SoTeRiA research projects, funded by the Department of Energy (DOE):

- In an ***academia-industry project***, Sari focused on the enhancement of fire PRA realism.
- In an ongoing Nuclear Energy University Programs (NEUP) project, he has been developing an Integrated PRA (***I-PRA) risk- and cost-informed decision-making algorithm*** to support the deployment of new technologies in nuclear power plants.

Sari received his B.Sc. in Nuclear Engineering from the Jordan University of Science and Technology (JUST) in 2012. In 2014, he obtained his M.Sc. in Advanced Nuclear Systems Engineering at the University of Science and Technology (UST) in South Korea. During this period, Sari worked as a researcher in the Core Design Team of the Research Reactor Development Division at the Korea Atomic Energy Research Institute (KAERI). In 2015, he was employed as a Nuclear Engineer by Jordan Atomic Energy Commission (JAEC) in the Nuclear Safety and Licensing Department at the Jordan Research and Training Reactor (JRTR).

2022 NPRE-ANS Honors Banquet

In April, NPRE hosted its first honors banquet since 2019. Due to safety concerns stemming from the COVID-19 pandemic, the department did not host the banquet in 2020 or 2021. Though the faces have changed over the years, the students, faculty, staff and families who attended this year's festivities had a great time honoring the accomplishments within NPRE.

NPRE Department Awards, Scholarships, and Fellowships

Outstanding Academic Achievement Award to a Graduating Senior
Parker A. Allen
Julia K. Roessler
Shyam M. Upadhyay

Outstanding Undergraduate Research Award
Nicholas A. Dailey
Jasmine L. Dinari
Anthony C. Evans
Anthony G. Leja

Rising Undergraduate Research Award
Sean M. Peyres

Catherine Pritchard Undergraduate Scholarship
Gavin A. Davis
Jasmine L. Dinari
David P. Leonhardt
Paola Silva Mijares

George H. Miley LENR Undergraduate Scholarship
Braden T. Moore

NPRE Visionary Scholarships
Harrison A. Brosius
John Vincent B. Cauilan
Braden R. Dean
Shmuel M. Goodman
Richard He
Olivia N. Hunsberger
Antonio R. Lara
Nataly R. Panczyk
Ryan M. Pierpaoli
Olivia I. Stojak
Riley G. Trendler
Ceser Zambrano

Daniel F. Hang Outstanding Senior Design Award (2021)
Andrew E. Christensen
Kip L. Kleimenhagen
Erik R. Smith

Felix T. Adler Fellowship
Jianxin Zhou

Nguyen Thi Cuong Graduate Fellowship
Daniel O. O'Dea

David Neil Ruzic Undergraduate Scholarship
Braden T. Moore
Oren M. Yang

American Nuclear Society, University of Illinois Student Chapter Awards

Undergraduate Outstanding Service Award
Gavin A. Davis
Nathan S. Ryan

Graduate Outstanding Service Award
Jeremy J.H. Mettler

Students' Award for Excellence in Undergraduate Teaching
R. Mohan Sankaran
Rizwan Uddin

NPRE Staff Award
Phillip K. Kisubika

American Nuclear Society National Recognitions

2022 ANS Student Conference

Chairs:
Amanda Bachmann—Diversity Equity & Inclusion Co-Chair, Sponsorship Chair
Samuel G. Dotson—General Co-Chair
Jeremy J.H. Mettler—Technical Program Co-Chair

Coordinators:
Roberto E. Fairhurst Agosta—Workshop Coordinator
Stephen D. Armstrong—Financial Coordinator
Gavin A. Davis—Hospitality Coordinator
Joshua M. Hoffman—Session Coordinator
Dilan T. Kurukulasuriya—Program Coordinator
Jake H. Mistifer—Tour Coordinator
Nataly R. Panczyk—Social Coordinator
Nathan S. Ryan—Media Coordinator

Best Graduate Presentation in Detection and Measurement
Light Output Response Characterization of Deuterated Trans-stilbene for Neutron Spectroscopy
Jianxin Zhou, Natalie C. Gaughan

Best Graduate Presentation in Isotopes and Radiation
Decay Heat Calculations Using MCNP and ORIGEN
Roberto Fairhurst Agosta

Best Graduate Presentation in Nuclear Installations Safety
Spatiotemporal Probabilistic Physics-of-Failure Analysis in Modeling Interconnections of Safety and Financial Performance of Nuclear Power Plants
Wen-Chi Cheng

Best Presentation in Decommissioning and Environmental Sciences
Geological Considerations for the USNC-UIUC Microreactor Project
Ethan H. Nicolls

Best Undergraduate Paper
First Place
Jasmine L. Dinari

2022 Joseph Naser Undergraduate Scholarship
Madeline M. Morasca

Samuel Glasstone Award
First Place (2020)
Second Place (2021)
Anna C. Balla (2021-22)

Barry M. Goldwater Scholarship
Braden T. Moore

Other Scholarships and Fellowships

NUCLEAR REGULATORY COMMISSION

University of Illinois at Urbana-Champaign Nuclear Engineering Fellowship Programs
Logan Crevelt
Dominic R. Piedmont
Zoe R. Richter
Joseph L. Bottini
Samuel G. Dotson
Kip Kleimenhagen
Lucas A. Wodrich
Oleksandr Yardas
Connor A. Pigg

U.S. DEPARTMENT OF ENERGY

NEUP Fellowships
Lu Kissinger
Amanda Bachmann
Johnathan A. Beal
Luke D. Siefert
Michelle L. McCord
Bruce E. Ciccotosto
Erik R. Smith
Matthew A. Weiss

University Nuclear Leadership Program Scholarships (2022-23)
Ethan Nicolls
Nataly R. Panczyk
Joseph Wunschel

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS' NUCLEAR AND PLASMA SCIENCES SOCIETY

Edward J. Hoffman Early Career Development Grant
Elena Maria Zannoni

NASA

Space Technology Research Fellowship
Carly J. Romnes

LAWRENCE LIVERMORE NATIONAL LABORATORY

Graduate Fellowship
Mikhail Finko

UNIVERSITY OF ILLINOIS

Sloan University Center for Exemplary Mentoring Affiliates
Giovanni C. Diaz
Carly J. Romnes

SURGE FELLOWSHIP

Amanda Bachmann
Giovanni C. Diaz
Carly J. Romnes
Sonata M. Valaitis

GRAINGER COLLEGE OF ENGINEERING—SCHOLARSHIPS

Clare Boothe Luce Undergraduate Research Award
Jasmine L. Dinari

Calvin Barnes Niccolls Memorial Scholarship
Angelo J. Minetti

Dale W. and Wanda L. Weaver Engineering Scholarship
Joshua M. Hoffman

Engineering Visionary Scholarship
Parker A. Allen
Olivia N. Hunsberger
Antonio R. Lara
Nataly R. Panczyk
Julia K. Roessler

Illinois Engineering Achievement Scholarship
Shmuel Goodman
Richard He
Joshua M. Hoffman
Amber H. Hunter

Anthony G. Leja
Braden T. Moore
Nataly R. Panczyk
Olivia I. Stojak
Riley G. Trendler

Olive C. Kuehn & Alfred L. Kuehn Scholarship
John Vincent B. Cauilan

PATHWAY Engineering Scholarship
Jack Anderson
Joseph D. Oliver
Ryan A. Wais
Joseph A. Wunschel
Silvana B. Tabares

Robert M. Stephens Engineering Scholarship
Antonio R. Lara

MASTER OF ENGINEERING IN ENERGY SYSTEMS

Taber International Scholars
Calvin Hu
Alexandre A. Travesset

Faculty/Staff Recognitions

AMERICAN NUCLEAR SOCIETY

Mishima Award (2022)
James F. Stubbins

Landis Young Member Engineering Achievement Award
Caleb S. Brooks

GRAINGER COLLEGE OF ENGINEERING

Award for Excellence in Graduate Student Mentoring (2022)
James F. Stubbins

Dean's Award for Excellence in Research
Angela Di Fulvio (2022, Assistant Professor)

Alpha Nu Sigma Society

ANS established Alpha Nu Sigma as a national honor society with the objective to recognize high scholarship, integrity, and potential achievement in nuclear science and engineering.

Sari Alkhatib
Joseph L. Bottini
Michael Chakinis
Nicholas A. Dailey
Jasmine L. Dinari
Roberto Fairhurst Agosta
Mikhail Finko
Joshua M. Hoffman
Ibrahim Jarrah
Aveek S. Kapat
Alvin J.H. Lee
Jeremy J.H. Mettler
Cody D. Moynihan
Daniel J. O'Grady
Sun Myung Park
Dhruval Patel
Nikhil Patel
Zoe R. Richter
Carly J. Romnes
Steven A. Stemmley
Jan P. Uhlig
Yanqin Zhai
Taiyang Zhang
Erik P. Ziehm

University Honors

Dean's List
Eligible undergraduates must have achieved a GPA for a given semester that places them in the top 20 percent of their college. The following listing is for Fall 2021.

Anthony G. Leja
Harrison A. Brosius
Richard He
Ceser Zambrano
Braden T. Moore
Parker A. Allen
Braden R. Dean
Thomas W. Posthuma
Bruno J. Caruso
Joseph F. Specht
Olivia I. Stojak
Justin B. Hearne
Amber H. Hunter
Elija G. Capps
Gavin A. Davis
Nataly R. Panczyk
Olivia N. Hunsberger
Riley G. Trendler
Joseph D. Oliver
Silvana Tabares
Ethan H. Nicolls
Oren M. Yang
Arthur G. Mazzeo
Paola Silva Mijares
Riley Fisher

Chancellor's Scholars
Chancellor's Scholars are motivated, academically gifted student leaders. Students participate in honors seminars, attend Scholar Adventurers presentations, and participate in social, intellectual and cultural activities, and maintain a minimum cumulative GPA of 3.25.

Anna C. Balla
John Vincent B. Cauilan
Anthony C. Evans
Olivia N. Hunsberger
Amber H. Hunter
Braden T. Moore
Riley G. Trendler

James Scholars (Fall 2021-Spring 2022)
This honors program is named for the University's fourth president, Edmund J. James who believed scholarship and research are fundamental to human progress. During his presidency, from 1904-1920, he brought world-class scholars to campus, developed graduate programs, and fostered community among faculty and students. His achievements helped transform Illinois into a campus of international importance.

Parker A. Allen
Jack Anderson
Anna C. Balla
Bradly M. Bozzetti
John Vincent B. Cauilan
Braden R. Dean
Jasmine L. Dinari
Davin U. Hess
Olivia N. Hunsberger
Amber H. Hunter
Antonio R. Lara
Andrew H. Liu
Braden T. Moore
Emma G.T. Morano
Ethan H. Nicols
Joseph D. Oliver
Nataly R. Panczyk
Aryan Panigrahi
Seonghyun Park
Julia K. Roessler
Lisa Silverstein
Silvana B. Tabares
Ryan A. Wais
Joseph A. Wunschel
Oren M. Yang

GRAINGER COLLEGE OF ENGINEERING HONORS

Mavis Future Faculty Fellows
Sonata Valaitis
Yanqin Zhai

Alumni Recognitions

AMERICAN NUCLEAR SOCIETY

Milton Levenson Distinguished Service Award (2021)
The Distinguished Service Award recognizes ANS members who have contributed in an outstanding manner to the vigor of the Society or who have made outstanding non-technical contributions to the nuclear field. "In recognition of his untiring and continued support for the mission of nuclear energy for over 45 years with ANS as a leader, an advisor, a hard worker, a friend, and a visionary."

Robert F. Penn

NPRE Advocate Award
The NPRE Advocate Award recognizes alumni and friends who have demonstrated their loyalty to NPRE through volunteer efforts, financial contributions, and/or other forms of advocacy.

J'Tia Hart

"To J'Tia Hart, for her impressive career at ANL, DOE-HQ, and INL, her role as advocate for NPRE, and her efforts in promoting black women and other underrepresented minorities' participation in science and engineering."

NPRE Distinguished Alumni Award
The NPRE Distinguished Alumni Award is presented to alumni who make notable advances in the field of nuclear science, and/or lasting contributions to society in general.

Francesco Venneri

"To Francesco Venneri, for his scientific and technological achievements in the development of advanced nuclear fuel, and for his leadership role as CEO and founder of Ultra Safe Nuclear Corporation."

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Urbana, IL 61801
USA

BUILDING TOWARD A BETTER FUTURE

NPRE is prioritizing three areas of support for fundraising:

1) a student development fund to assist in hosting events and other opportunities for our students;

2) the renovation of our student lounge, which currently lags behind many others in the Grainger College of Engineering; and

3) a fund for undergraduate research support, so we can improve the availability of funds for students while they work on research as undergraduates.

With the support of our wonderful alumni and friends, we can build on the fantastic experience NPRE students have and make it better for those to come.

For more information, contact Director of Advancement Jana Zollinger at jmzollin@illinois.edu.

Learn more at npre.illinois.edu/giving