American Nuclear Society Student Section at The Ohio State University

September Newsletter

Welcome back! ANS has an exciting semester planned! Read the monthly newsletters to stay up to date on what's to come!

This Month's ANS Events:

ANS Welcome Event

Join us on **September 3rd** from 4-7 PM in Scott Lab E100 for a fun filled event and a chance to meet ANS members, and learn about our organization. Come enjoy games, snacks, and pizza while you reconnect with others and maybe even meet new people! Fill out this form if you are interested in attending!

Seminar with MPR

Come learn about MPR, "a specialty engineering and management services firm", during a seminar with speakers Cade Mottice and Paul MacDonald. Join us on **September 23rd** in Scott Lab E100 from 7-8:30 PM for the chance to learn more about this organization and enjoy pizza and refreshments! Fill out this form if you are interested in attending!

ANS General Body Meeting: Executive Board Elections

Do you want to be on the ANS board or vote for your fellow members? Well join us for the ANS executive board elections on **September 30th** from 7-8:30 PM in Scott Lab E100 to vote on the President, Vice President, and Treasurer postions, and learn more about other board postions you can take on! Fill out this form if you are interested in being on the board!

For more information about our upcoming events take a look at our website!

Stay Connected with the "Nuclear World" at OSU!

Nuclear Engineering Minor Classes

Are you looking to switch a class? Well take a look at the classes the Nuclear Engineering Minor has to offer on their webiste!

MAE Seminars

Attend a seminar put on by the Department of Mechanical and Aerospace Engineering on September 25th from 1:30-2:30 PM in Scott Lab E141, and learn about optical diagnostics of plasmas. This seminar is given by a guest speaker, Marien Simeni, an assistant professor from the Mechanical Engineering Department of the University of Minnesota. Look on the MAE website to learn more about this event!

ANS Announcements:

Graduate Student Highlight

This month, check out the first video in our new video series called Graduate Student Highlights on our socials and website. Where we interview a graduate student each month about their research related to the nuclear field, and we learn about an instrument in their lab that they use for research. This month learn more about **Luke Shoen**, a grad student in Dr. Cao's lab, and his research!

ANS Executive Board Interest

Are you interested in being on the ANS Executive Board? If so, take a look at this form to learn more about what positions are eligible to you and how to get involved. Please fill out the form if you are interested!

National Laboratory Panel Event Interest Form

If you are interested in attending our National Lab Panel Event on October 21st at 6PM, please fill out this interest form. This event will feature a panel with scientists from several national labs from across the country. Come with questions!

FESTIM Workshop Event with Dr. James Dark

ANS is hosting a workshop on Finite Element Simulation of Tritium in Materials (FESTIM), an open source software, on November 18th with Dr. James Dark, the Lead Developer of FESTIM! If you are interested in attending this event, please complete the interest form. Stay tuned for more details as we further plan this event! No prior FESTIM knowledge is required. Open to undergraduate and graduate students, researchers, and faculty! To get an idea of what FESTIM is check out this website.

ANS GroupMe

For more information about all things ANS and a platform to connect with ANS members, join our GroupMe platform!

Faculty Spotlight

Dr. Raymond Cao



Dr. Raymond Cao is Professor and Program Chair of the Nuclear Engineering Program at The Ohio State University (OSU) and serves as Director of the OSU Nuclear Reactor Laboratory. He received his B.S. in Nuclear Physics from Lanzhou University in 1994, M.S. from the China Institute of Atomic Energy in 2002, and his Ph.D. in Nuclear and Radiological Engineering from The University of Texas at Austin in 2007. He joined The Ohio State University in 2009 after completing postdoctoral training at Harvard Medical School and the U.S. National Institute of Standards and Technology (NIST).

Dr. Cao's research focuses on nuclear instrumentation, radiation detection and advanced nuclear technologies for both fission and fusion applications. He has authored more than 200 peer-reviewed publications and holds 33 issued and pending patents. Dr. Cao serves as Senior Editor of the IEEE Transactions on Nuclear Science. He previously served as Chair of the American Nuclear Society (ANS) Isotopes and Radiation Division (2015–2016) and has held several leadership roles within ANS. In 2024, he was appointed by the Governor of Ohio to serve on the Ohio Nuclear Development Authority. He also serves as a technical advisor to AwareAbility Technologies and Hadron Energy, supporting the development of advanced nuclear technologies, including microreactors.

What are some projects that you are currently working on that you are most excited about, and what can you tell us about them?

I am very excited about developing silicon carbide and diamond detectors for fast neutron detection. These are wide-bandgap semiconductor detectors that can operate in extreme environments, including high temperatures and intense radiation fields. We've tested our detectors at temperatures up to 300°C, and they perform just as good as they do at room temperature.

We apply these sensors to both fission and fusion systems. In fusion, they can be used for diagnostics by measuring the yield of 14 MeV neutrons, which is critical for understanding and optimizing the fusion process. In fission systems, they could be used for detecting alpha particle emitted from actinides or fast neutrons from Uranium or Plutonium fission as a way of detecting and monitoring special nuclear materials.

Another project I am excited about is tritium production and detection. Tritium is the fuel that will power future fusion reactors, so developing technologies to produce, measure, and quantify tritium is essential for making fusion energy a reality, but it also has a major implication for nuclear non-proliferation. I also work on developing nuclear battery, trying to explore the possibility of turning decay energy directly to small amount of electricity.

How did you first become interested in your specific research area?

It is a long-haul drive. First of all I have to say not everyone is afforded to choose what they are interested in. It is a process of both choosing and being chosen. It is also an expensive journey. Plus, a young man like I was many years ago had no idea what I was interested.

My career began with neutron activation analysis of environmental samples and data analysis to trace polluting heavy metals. It is just a project I was being assigned to for my Master thesis. If I can think deeper, it is just the project my advisor won a grant. Then in my PhD work, I worked on neutron imaging. One day I realized that while I have been using neutrons to probe materials, the reverse was also true: I had been detecting neutrons all along. At that time, there was significant funding available for neutron detector development because of He-3 shortage. Around the same time, I came across an article in IEEE Spectrum about how gallium nitride transformed the LED industry. That piece sparked my strong interest in applying wide-bandgap semiconductors to radiation detection. Over time, my research expanded into other wide-bandgap semiconductors such as silicon carbide (SiC) and diamond, which are ideal for operating in extreme radiation and high-temperature environments.

I am especially grateful to OSU faculty, Prof. Don Miller and Tom Blue, both of whom have worked on SiC detectors since the early 2000s. In certain way, Ohio State is a leading institution in this area, and I am proud to carry the torch forward.

Are you a member of the American Nuclear Society? If so, what have you learned or how have you benefited from being a part of this organization?

Yes. I first became an ANS student member in 2004 while I was a graduate student at The University of Texas at Austin. Since then, I've remained actively involved with the Society. I've served on the ANS Bylaws and Rules Committee, the Isotopes and Radiation Division (IRD) Executive Committee, and as Chair of the IRD during 2015-2026. I also served as the Assistant Program Chair for the ANS International Conference on Methods and Applications of Radioanalytical Chemistry Topical Meeting (MARC), which is held every three years in Kona, Hawaii. I have attended this meeting 7 times since 2006.

Most recently, I participated in a week-long technical tour of France's nuclear facilities organized by the French Local Section of the American Nuclear Society. It was a fantastic opportunity to learn from international experts and see firsthand how another country approaches the nuclear fuel cycle and reactor building and operations, not to mention the best food and wine along the way.

ANS has provided tremendous opportunities throughout my career, not only for technical learning but also for building lifelong professional relationships. It's where you meet people who share the same passion for nuclear science and engineering and speak the same (technical) language. Because my research is highly interdisciplinary, I also attend conferences in other fields. Those meetings expose me to new ideas and often inspire innovative research directions. That said, the ANS Annual Meeting and topical meetings truly feel like home. I'm very grateful to be part of the Society.

Are you connected to the nuclear world outside of academia? If so, how?

I serve as advisor to Awareability Technologies since 2017 and Hadron Energy since 2024, the latter is a microreactor developer. These experiences have given me a firsthand understanding of how industry operates and have provided me with a fresh perspective on how different industry is from academia.

One of the biggest differences I've learned is the mindset. In academia, especially as an experimental engineer, we're trained to come up with new ideas, test hypotheses, run proof-of-concept experiments, and maybe build a laboratory prototype. Often, that's where our work ends.

Industry has a very different perspective. It's not enough to prove that something works once in the lab. The challenge is turning that idea into a reliable product through rigorous engineering design, detailed documentation, quality assurance, quality control, and extensive testing. And, of course, every engineering decision has to consider cost, manufacturability, and business viability.

This exposure to industry has given me a fresh perspective on both my teaching and my research. It reminded me that while there are many fundamental scientific questions worth pursuing, we also need to keep the practical engineering challenges in mind. At the end of the day, someone has to build it, manufacture it, license it, and be liable for how reliably it will work.

That experience has also changed the way I think about workforce development. The meaning of "workforce", although used widely, is very different in academia and in industry. In academia, we often emphasize advanced degrees and cutting-edge research. Industry certainly values innovation, but it also needs engineers and technicians with practical skills. I believe there is a real gap. As educators, we need to do a better job of preparing students not only to invent new technologies but also to be an engineer, manufacture, welder , and plant manager. Bridging that gap will be essential as the nuclear industry continues to grow.

Do you have a favorite element or isotope?

Yes, I actually have several favorite elements and isotopes that have become part of my daily vocabulary, it is crazy to think some of them are difficult for most people to even pronounce, like promethium-147. But if I had to choose one, it would definitely be lithium.

Lithium has two naturally occurring isotopes: lithium-6, which makes up about 7.5% of natural lithium, and lithium-7, which accounts for the remaining 92.5%. Lithium-6 is one of the most important isotopes used in neutron detection because it has a very large neutron capture cross section. When it captures a neutron, it split into an alpha particle (helium-4) and a triton (tritium), making it an excellent convertor for detecting neutrons.

Lithium is also fascinating because it connects so many different fields. Lithium-6 is nearly opaque to neutrons, allowing us to visualize how lithium moves inside a lithium-ion battery during charging and discharging by a beam of neutrons. In the fission industry, enriched lithium-7 is preferred because lithium-6 absorbs neutrons and acts as a neutron poison. In contrast, fusion researchers want enriched lithium-6 because it can breed tritium, the fuel needed for future fusion reactors.

At the same time, the electric vehicles use enormous amounts of lithium in batteries. One research idea that I find particularly interesting is exploring whether spent lithium-ion batteries could become a “mini-factory” for isotope separation. Because lithium-6 and lithium-7 travels at different velocity during repeated charging and discharging cycles, there may be opportunities to recover lithium-6 versus -7 in different part of a used battery. Lithium is truly the element that connect nuclear fission, fusion, transportation, energy storage, and advanced materials science.

All About Ohio Nuclear Alliance

What is ONA?

“The Ohio Nuclear Alliance (ONA) is a statewide, industry-backed organization bringing together the many sectors connected to nuclear science, technology, and industry across Ohio.” ONA offers a space for collaboration and shared understanding in the nuclear field across Ohio.

ONA Mission:

"To unite Ohio’s nuclear ecosystem, strengthen coordination across sectors, and serve as a trusted statewide platform for collaboration, information-sharing, and engagement."

Learn more about ONA through their website!

What’s New with Nuclear?

Uranium Hitching a Ride on Cobalt



A study published in Nature Communications by researchers at the University of Wisconsin-Madison and Princeton University calls attention to a blind spot in nuclear nonproliferation. The Democratic Republic of the Congo (DRC) has exported thousands of metric tons of uranium via cobalt exports, and there is no accounting for where it has ended up.

The study was conducted by Sebastien Philippe and Ryan Manzuk, a geologist and research fellow in Phillippe’s group and at Princeton, using countrywide mineralization and geochemical data. They found that from 2000 to 2024 about 2,000-5,000 metric tons of natural uranium were exported from the DRC via the cobalt supply chain, without the knowledge of the International Atmoic Energy Agnecy.

Visit the NuclearNewswire article to learn more!

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