DEPARTMENT OF
Engineering Physics
UNIVERSITY OF WISCONSIN–MADISON

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UW-Madison leading $2.6 million effort to improve solar plants

Mark Anderson

The U.S. Department of Energy (DOE) recently awarded $2.6 million to a research collaboration led by Research Professor Mark Anderson that aims to advance the technology of utility-scale concentrating solar power (CSP) plants.

The team combines the expertise of two universities, two national labs and two private companies. Anderson and Kaiser Professor of Mechanical Engineering Greg Nellis will collaborate with Robert Braun at the Colorado School of Mines, Matthew Carlson at Sandia National Laboratory, Ty Neises at the National Renewable Energy Laboratory, Zhijun Jia at the Wisconsin-based company CompRex, and Richard Gradle at the Texas-based corporation FlowServe.

CSP plants use large solar collectors to focus and transfer the sun's heat to a fluid whose thermal energy can be converted to electricity. Reducing the cost of CSP-generated electricity, however, requires improving the efficiency of this conversion.

To that end, Anderson's team will design two CSP units based upon an advanced power cycle called "supercritical carbon dioxide." After fabrication, the researchers will test these units at UW-Madison and Sandia's prototype facility in Albuquerque, New Mexico.

Following a detailed economic study of the advanced cycle's advantages over conventional power cycles, the group will design a novel regenerator, the unit that converts thermal to mechanical energy. Compared to the recuperator currently used for this conversion, the new regenerator is expected to be easier to fabricate and have better capabilities for internal heat transfer and energy storage. This will help lower operation and maintenance costs.

The group will also develop a so-called pre-cooler unit that will release heat into the atmosphere at lower temperatures than current power cycles, minimizing waste energy. Because of its dry cooling capability, this unit will help reduce the large water needs of currently operating CSP plants.

While the proposal, which is being run through the Wisconsin Energy Institute, focuses on solar energy, the same advanced power cycle can also be used for electricity generation with nuclear, geothermal and fossil energy sources.

"We are excited to begin this innovative research project," Anderson says. "Ultimately, our work will help achieve DOE's goal of making solar energy cost-competitive with fossil fuels by 2020."

Douglass Henderson

Since I took over as chair of the Department of Engineering Physics eight months ago, I've been enjoying working with all the exceptionally talented, collegial and supportive faculty and staff who make this department a great place to work. I'm proud of our many achievements in the past year and would like to share just a few highlights.

In the fall, Brewster Shaw (BS EMA '68, MS '69), who led several space shuttle missions in the 1980s, visited campus to present the Astronaut Scholarship Foundation's annual scholarship to one of our students *(see story on p. 3)*, and he gave a talk to a standing-room-only audience of students. It was great to have such a prominent alumnus on campus to answer students' many questions about space exploration. Shaw's talk was such a hit that the Badger Aviators student group is bringing him back to campus this spring.

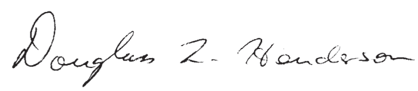
I'm also pleased to report that our student chapter of the American Nuclear Society won the competitive process to host the 2016 ANS Student Conference, which is set for March 31-April 3. It's a great honor to host this conference in Madison and it offers excellent visibility for our program.

When alumni support our department, they make a tremendous difference. We are very thankful for the generosity of Jim Meister (BSNE '78) and his wife, Connie, who made a gift to establish the Jim and Connie Meister Graduate Fellowship for the nuclear engineering program through the UW-Madison Nicholas match. Support for undergraduate scholarships and graduate fellowships is one of our top fundraising priorities, and the Meisters' donation will greatly benefit our students.

Another top priority is providing our faculty with financial support that gives them the ability to conduct cutting-edge research. I'm happy to announce that Professor Chris Hegna has received the Harvey D. Spangler Professorship in the College of Engineering, which will provide him with a flexible source of funding to pursue innovative research.

The college has implemented a new direct-admission policy for students, and so far the transition has been going well. We are seeing a strong demand for engineering among incoming students, with increased enrollment in nuclear engineering, engineering physics and engineering mechanics.

Thank you for your continued support of our department. ON, WISCONSIN!



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Two EP alums receive top college honor

On October 16, 2015, during a daylong celebration of engineers, Greg Piefer and Kirk Schnoebelen were among 12 influential engineering alumni to earn accolades from the College of Engineering for their outstanding professional accomplishments.

While pursuing his PhD at UW-Madison, Greg Piefer set his sights on commercializing his fusion research to address a major healthcare challenge—the dwindling global supply of medical isotopes used to treat and diagnose millions of patients.

Piefer founded SHINE Medical Technologies Inc. in 2010 and currently serves as the CEO of the company, which seeks to become the world leader in producing medical isotopes for diagnostic imaging of various conditions, including heart disease and cancer. SHINE's revolutionary accelerator-based process allows for low-cost, environmentally friendly production of medical isotopes without a nuclear reactor.

Greg Piefer

With 30 employees in its Monona, Wisconsin, office, SHINE received financial support from angel and venture investors, the Morgridge Institute for Research and U.S. Department of Energy. In 2014 alone, SHINE has executed a term sheet for $125 million in debt and equity financing in order to begin construction of a production facility in Janesville, Wisconsin (with a goal to be operational in 2018), obtained more than $2.4 million for operating costs, and signed long-term agreements to supply its product to GE Healthcare and Lantheus Medical Imaging, two of the three medical isotope distributors in the United States. SHINE's target medical isotope market is approximately $1 billion worldwide, serving more than 55,000 patients per day in the United States.

After earning a BS in electrical engineering and physics from UW-Madison in 1999, Piefer went on to earn his MS and PhD degrees in nuclear engineering and engineering physics in 2004 and 2006. As a graduate student, he was the chief technical officer of Gillware Inc., a leading data recovery and backup company. While pursuing his PhD, he founded Phoenix Nuclear Labs (PNL), an early-stage company that has developed a new generation of high-yield neutron generators for defense and medical applications. PNL has 35 employees and has brought in significant revenue and equity financing since its inception. Piefer served as PNL's president until 2010. He has remained on the company's board of directors since stepping down as president to found SHINE.

Piefer lives in Middleton, Wisconsin. Outside of work, he enjoys CrossFit and running as well as dabbling in computers and other electronics.

Guerin flies high with structural dynamics research

Brewster Shaw presents Lorraine Guerin with her award from the Astronaut Scholarship Foundation.

Lorraine Guerin is no stranger to difficult languages. The UW-Madison senior, a double major in Latin and engineering mechanics and astronautics, is a 2015 recipient of the Astronaut Scholarship Foundation's annual scholarship.

Guerin received the scholarship after being nominated by her advisor, Matt Allen, for her research on nonlinear vibrations. The research required a high level of understanding of the language of vibrations—the physics of oscillating motion. Specifically, Guerin studied the vibrations of thin members, such as the metal panels that form airplane wings.

The vibrations are difficult to predict, Guerin says. "The driver of my research is that it's hard to analyze and predict the response in wing panels," Guerin says. "My research will hopefully help industry by allowing us to understand the vibrations a little bit better."

Guerin, from Verona, Wisconsin, will graduate in spring 2016. She hopes to continue her research in graduate school and plans to apply to several master's programs in aerospace engineering in the next couple months. "I'll eventually try to get a job in industry or in a research lab," Guerin says, adding that her study of Latin has been more for personal enjoyment than anything.

The Astronaut Scholarship Foundation was founded more than 30 years ago by the surviving *Mercury 7* astronauts—the so-called "Original Seven" astronauts of the early U.S. space program. The foundation continues to be led by subsequent generations of American astronauts. It awards scholarships to students from 32 member research universities across the country who conduct research in the STEM (science, technology, engineering and math) fields.

"I really appreciate that professionals are willing to provide incentive for students to challenge themselves," Guerin says.

Guerin was nominated by her research advisor; the scholarship is helping pay her tuition this year.

"Receiving the scholarship has been really important to me," Guerin says. "It reinforces my willingness to try new research on a difficult topic. Through research, we are able to gain some understanding of wing panel vibrations or some other area of study. When many of these studies are compiled together, we are eventually able to help industry and society by improving some process or some component with our findings. In the end, it's all about being innovative and embracing the Wisconsin motto: Forward."

Guerin was recognized during a dinner on October 22, 2015. Brewster Shaw (BS EMA '68, MS '69), who led several space shuttle missions in the 1980s, spoke at the event and presented Guerin with her award.


Kirk Schnoebelen

As head of sales for URENCO, Kirk Schnoebelen is responsible for marketing and sales for the largest uranium enrichment company in the western world, with more than $1.7 billion in annual revenues. URENCO's portfolio includes contracts to supply fuel to more than 50 nuclear utilities in 19 countries, with commitments beyond 2025 having a total value of $17.5 billion.

Schnoebelen played a crucial role in enabling URENCO and the energy companies it has partnered with to construct and operate the National Enrichment Facility in New Mexico—the first enrichment plant built in the United States in 30 years. This facility continues to expand and provides about one-third of nuclear fuel used in the United States, or the energy used to power about 1 out of 10 light bulbs. Enrichment facilities are extremely capital-intensive to build, and he was responsible for establishing a sufficient portfolio of contracts with U.S. nuclear utilities to support the multi-billion-dollar investment. His work on the project, which stretched over years, involved developing and executing a marketing plan, working with partners and drafting and negotiating contracts to make the world's newest and most modern uranium enrichment facility a reality.

After earning his UW-Madison bachelor's degree in nuclear engineering in 1982 and his nuclear engineering master's degree in 1984, Schnoebelen worked in engineering roles at various utility companies. He received an MBA from the University of Minnesota's Carlson School of Business in 1997 and went on to work in nuclear fuel procurement/project management at Northern States Power (now Xcel Energy) and then in technical sales and marketing at Cameco Corporation. Schnoebelen became president of URENCO Inc. in 2006 and head of sales for URENCO in 2014.

In addition to preparing him for engineering roles, Schnoebelen says his UW-Madison education also fostered a broad skillset that has proven valuable throughout his career. "Working in procurement/project management and then technical sales would have been very difficult without an engineering background, but absolutely impossible without the communication skills I learned at UW-Madison through labs, projects and a healthy dose of non-engineering courses," he says. "I've also been lucky in crossing paths with fellow alumni in the most unlikely situations. Sharing a UW experience usually provides instant mutual credibility."

Schnoebelen is a former board member of the Nuclear Energy Institute, a key nuclear energy lobbying group. He lives in Fairfax, Virginia, with his wife, Judy, whom he met at UW-Madison. They have two children, Kyle (24) and Sam (21). In his free time, he enjoys traveling, running, yoga and hiking.

A new model for the most advanced fusion energy systems

Harnessing the energy source of the stars is a longstanding dream of humankind. Such an achievement would transform society by providing abundant, safe and environmentally friendly energy.

The tokamak device is the most attractive candidate for a fusion energy system. Using powerful magnetic fields, these doughnut-shaped devices do a superior job of confining the fusion medium—a super-hot, almost fully ionized gas called plasma.

However, tokamaks also pose unique challenges for the global fusion science communities. One of these challenges is taming the plasma instabilities—so-called edge-localized modes—that occur in high-performance fusion-grade tokamaks.

When these instabilities occur at the edge of a plasma, the tokamak's inner chamber walls are bombarded with transient heat and particle loads. This can erode the surface of that inner wall, releasing impurities into the plasma and ultimately degrading the fusion device's performance. These processes also reduce the material lifetimes of the vessel components, hampering the economic viability of fusion as energy source. In ITER, the world's largest tokamak experiment currently being built in southern France, these edge-localized modes pose a severe risk to achieving the goal of the experiment, which is to multiply the energy invested into heating the plasma by a factor of 10.

"With ITER, there's a clear mandate to control these plasma instabilities," says Engineering Physics Assistant Professor Oliver Schmitz. "Without sufficient suppression of these edge-localized modes, we will not be able to operate ITER."

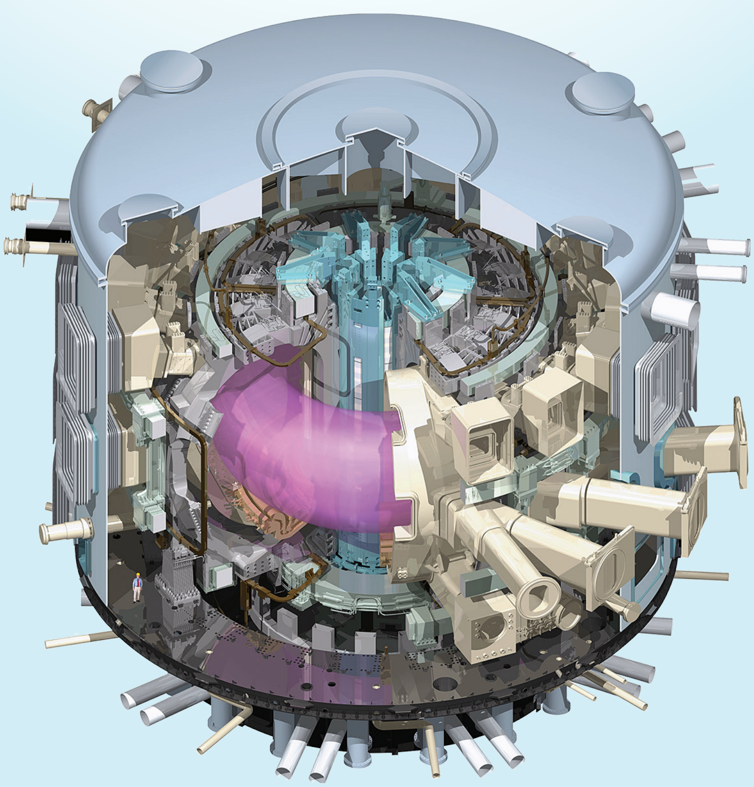
Fortunately, recent research at the DIII-D National Fusion Facility in San Diego, California, demonstrated that applying external 3D magnetic control fields to the device can tame the unruly edges of these plasmas and prevent the edge-localized modes. However, this 3D control field breaks the symmetry of the tokamak's magnetic confinement system, inducing a 3D plasma edge topology and turning it into a 3D system, which Schmitz says might upend standard assumptions about how plasma interacts with material surfaces in tokamaks.

For example, Schmitz says a tokamak with the usual axi-symmetric magnetic fields can be viewed like a doughnut with a smooth, uniform chocolate covering all around it. In this case, the standard assumption is that the plasma edge boundary—the "chocolate covering"—is practically the same all the way around the doughnut's circumference. But for a tokamak with an induced 3D plasma boundary, that's not the case. Measurements have shown that the 3D magnetic control fields deform the edge of the plasma—in effect adding wiggles and bends in the doughnut's chocolate covering. Scientists have also modeled these wiggles with state-of-the-art super-computer codes, which indicate that such 3D shapes in the plasma edge are likely to effect the interactions in the plasma-material interface.

"With this 3D system, we need to understand how to account for these wiggles by determining what the plasma edge boundary looks like at each specific point around the tokamak," Schmitz says. "We hope to understand how the plasma-material interaction changes in this 3D scenario and what effects that will have on material erosion and particle deposition in the device."

With funding from the Department of Energy Early Career Award program, Schmitz is working on establishing a solid foundation for investigating the guiding physics terms for the plasma-material interaction in such 3D plasma boundary systems. He will further develop computational models and numerical tools that can be used to interpret present-day magnetic confinement fusion experiments and guide the design activities for ITER and future fusion reactors.

"No one has really addressed what this 3D plasma boundary system would actually mean for ITER, and it's a crucial issue because this 3D system affects the interface between the plasma and the surrounding vessel structure," Schmitz says. "For instance, we need to account for how much material erosion there will be in ITER, and there currently isn't a model for this 3D system that can tell you what the gross erosion would be for ITER. A variety of sophisticated tools exist for analyzing axisymmetric situations, and I aim to bring them together and apply them in a concerted manner for analysis of 3D effects on the plasma-materials interface."



The ITER Tokamak will be the world's largest tokamak.
(Image courtesy of U.S. ITER)

Ross Radel, president of Phoenix Nuclear Labs in Madison, in front of a research version of the company's neutron generator. Hydrogen ions are propelled by a 300,000-volt electric field and accelerated downward, striking a target at the bottom. Commercial devices are smaller and contained inside a housing.

Heavy-duty neutron accelerators paint promising future for UW-Madison spinoff

A Madison manufacturer of the world's most powerful commercial neutron generators is awaiting final regulatory approval for its first sale outside the research market. The device will be used to calibrate safety detectors at nuclear reactors in the United Kingdom.

Neutrons are the neutral particles in an atom. Reactor operators measure their level to protect worker health and ensure that the reactor is operating properly.

The powerful made-in-Madison accelerator was built by Phoenix Nuclear Labs (PNL), a UW-Madison spinoff. Phoenix was started in Madison in 2005 by EP alum Greg Piefer *(see page 2)*.

The company's device accelerates a hydrogen isotope against a target; the impact releases a stream of neutrons. The prototype accelerator may look like a prop for a campy, 1950s sci-fi film, but that strong beam of neutrons has many uses. For example, it can alter surface properties in solar-cell manufacturing or create an isotope needed in about 20 million medical diagnostic scans annually in the United States.

One PNL accelerator is being used to detect voids in artillery shell propellant, which can cause an explosion that would kill the gun crew. A reliable, powerful neutron generator allows scanning during manufacture, increasing troop safety.

"Over the past decade, PNL has grown from a custom R&D shop into an industry-leading manufacturer of state-of-the-art neutron-generation and particle-acceleration systems," says Ross Radel, company president, who also holds a PhD in engineering physics from UW-Madison.

Neutrons are released when atomic nuclei break apart in the process of nuclear fusion. Fusion powers most nuclear weapons and the sun.

On a much smaller scale, the Phoenix process creates a limited, controlled fusion reaction: Hydrogen ions are accelerated in a 300,000-volt electric field so they move fast enough to overcome the magnetic repulsion of a target nucleus, and initiate fusion.

The acceleration phase requires a vacuum, while the gaseous target must be dense or else the neutrons will pass right through. Because separating the two phases could block the neutrons, the process requires a clever means of controlling pressure that allows the neutrons to transit the apparatus.

That invention, which Piefer devised in 2005, is the key to the Phoenix accelerator. "I was really excited when I realized this could work," he says. "But when I did a literature search, I found that (UW-Madison medical physicist) Paul DeLuca had done something similar in the '70s."

Finding the precedent "was a blessing and a curse," Piefer says. "It said some of this was out there so we could not lock it all down with patents. But I didn't have to prove to anyone that it worked." Piefer was granted a patent for his separation apparatus in 2014.

Fusion may be best known as the ideal energy source that has never delivered. Fusion produces neutrons and large amounts of energy, but no greenhouse gases and little or no radioactive waste—so it could be an ideal source of electricity. But that goal is still decades in the future.

Piefer credits Grainger Professor Emeritus Gerald Kulcinski for sparking his interest in practical uses for fusion. "Jerry had this idea to use fusion to make money, at a level below energy, and he came up with a roadmap with multiple steps, culminating in fusion energy," says Piefer.

"The university has been involved in more than 60 fusion reactor studies since 1970," says Kulcinski, "with the primary goal being a long-lasting, economical, safe electricity source. But by the mid '90s, it was going a lot slower than anyone had anticipated, so we started thinking, 'What could we do with a fusion source before we could make net energy?' Greg and Ross gravitated to that idea. They are the only people, worldwide, that I know who have shown that you can make a profitable business today using fusion energy and they have done that pretty much on their own."

In 2010, Phoenix received a $25 million federal grant through the Morgridge Institute for Research at UW-Madison to explore isotope production for medical diagnostic tests, and Piefer left Phoenix to start SHINE Medical Technologies to pursue that project. SHINE is planning to build an isotope factory in Janesville, Wisconsin.

Phoenix has attracted private investment during three rounds of fundraising. The company's employees include many UW-Madison graduates. The majority of the 15 interns are UW-Madison students.

As Phoenix builds a market for a device that has never been available before, a key component of its accelerator is also attracting interest. Aided by a Department of Energy grant, PNL is adapting the accelerator's ion generator into a standalone source of charged particles. Even before the novel ion generator is finished, it has elicited interest from a major player in semiconductor manufacturing.

Raluca Scarlat: Researching flouride salt for an advanced nuclear reactor

Raluca Scarlat's research is motivated by a big goal: to develop an advanced nuclear reactor that's economically competitive with natural gas power plants in the relatively near future.

Her research applies to a class of advanced nuclear reactors called fluoride-salt cooled high-temperature reactors (FHR). Unlike conventional reactors that use water to cool down the core, an FHR uses molten (liquid) salt as a coolant. Scarlat, who joined the Department of Engineering Physics in fall 2014 as an assistant professor, says molten salt provides myriad safety and efficiency benefits in an advanced reactor.

"The liquid salt is tremendously good at extracting heat from the fuel and transporting the heat, so it keeps the fuel element hundreds of degrees Celsius away from overheating and reaching its failure point," Scarlat says. "And the fluoride salt coolants work at atmospheric pressures, so we don't operate at a high pressure like water reactors do. Because we're at a low pressure, the strains on the reactor materials are much lower and we're able to safely go to higher operating temperatures."

Operating at higher temperatures is important for increasing a power plant's efficiency, which ultimately lowers the cost of the generated electricity. Since conventional nuclear plants and coal plants produce heat at 400 degrees Celsius and below, they are limited to running steam turbines, which aren't very efficient for power conversion. But FHRs can generate heat in the 600- to 700-degree Celsius range, and can be coupled to commercially available air turbines, which deliver much higher efficiency.

"I knew I could come here, start right away and learn a lot from my colleagues."

"So we're trying to build the nuclear technology that enables us to shift from using steam turbines to these modern, efficient air turbines," Scarlat says. "And getting to the 600- to 700-degree Celsius temperature range allows us to achieve this."

Scarlat's research focuses on a key aspect of this nuclear technology—the fluoride salt. "How effective is the salt at removing heat from the fuel? And how do we design systems that use this salt? Those are the questions that I try to answer," she says. "I think the physics of heat and mass transport in these fluoride salts is really interesting and not very well understood, so there's a wealth of new physics to be studied."

The FHR design Scarlat is working on harnesses the salt's excellent heat transfer capabilities using a heat exchanger, which Scarlat describes as a set of coiled tubes that looks like a big Slinky toy. The liquid salt captures heat from the fuel and travels through the coiled tubes. As air flows through the center of the coil, it is heated by the hot salt and then runs through a turbine, generating electricity.

Scarlat's research group is currently focusing on tritium transport in the salt. Nuclear reactors produce tritium, a radioactive isotope of hydrogen. "Tritium has a half-life of 12 years, and so we want to control where it ends up. We don't want to release it into the atmosphere," she explains.

Graphite pebbles, which are the fuel elements in a specific type of FHR, may provide a way to control the tritium. Because graphite has a high affinity for tritium at the high FHR temperatures, scientists expect that most of the tritium will be absorbed in the fuel and end up in the graphite core. "But there isn't experimental data to show this will happen, and there's not a lot of theoretical understanding for how tritium actually diffuses through the salt into the graphite and how it gets stored," Scarlat says. "So I study the question of how tritium transports in the salt-graphite system."

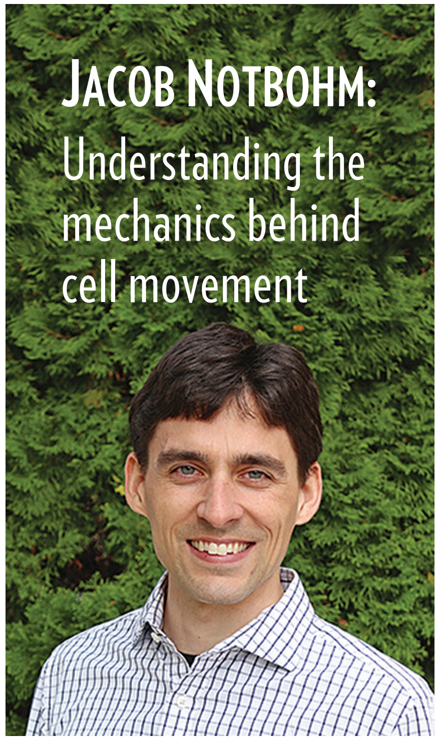
Scarlat is also looking at what happens if the liquid salt cools too much and solidifies, which could plug the heat exchanger tube and cause problems in the reactor. "Overcooling and solidification of the salt is a risk, and we need to demonstrate that we know how to manage that risk and recover from it," she says.

Understanding and managing risks in reactor systems ties in closely with Scarlat's research background in heat transport, thermal hydraulics, and nuclear reactor safety and design. She earned her PhD in nuclear engineering from the University of California-Berkeley, and a bachelor's degree in chemical engineering from Cornell University. Prior to her doctoral studies she worked for GE and ExxonMobil. In 2011, she advised for Hitachi-GE, in Japan, on post-Fukushima changes to severe accident guidelines for the Japanese fleet of reactors.

Scarlat says UW-Madison's very strong nuclear engineering program is one of the things that attracted her, as well as the college's culture of encouraging research collaborations across departmental and disciplinary boundaries. "The university also has a strong overall College of Engineering," she says. "In my area of nuclear engineering research, a lot of the work is cross-disciplinary, so it's important for me to be able to collaborate with colleagues from chemical engineering, mechanical engineering and the Department of Chemistry, and UW-Madison has very strong departments in all these areas."

The engineering physics department's unique capabilities for handling and studying fluoride salts containing beryllium also drew her to UW-Madison, because it's the only university in the country with the safety procedures in place to handle beryllium and with faculty that already have experimental expertise with these high-temperature salts. "At UW-Madison, I can work directly with these kinds of salts and do more involved processes. If I were somewhere else, I'd have to set up that capability and that would take a long time. I knew I could come here and start right away and learn a lot from my colleagues, so that's another reason why I'm very excited to be here," she says.

JACOB NOTBOHM: Understanding the mechanics behind cell movement



A UW-Madison alumnus and Madison native, Jacob Notbohm has returned to his alma mater to conduct research in the integrative field of biomechanics.

Assistant Professor Notbohm is interested in biomechanics on a micro scale: the forces and deformations that cause cells to migrate and contract, and the mechanical processes that coordinate cell movement. These various forms of cell motion contribute to a large number of biological processes in the human body, such as embryonic development.

"When embryos are developing, cells have to migrate into the correct place at certain times," Notbohm says. "All of this is coordinated both due to the mechanical forces at play, and whatever the cells' surroundings are."

Biomechanics also plays a role in the formation and metastasis of tumors, which can involve cells moving in groups. The concept of collective cell migration is at the root of Notbohm's research.

"The best analogy I have for this type of motion is if you're going into a football game at Camp Randall, and say you want to get to your seats faster than anyone around you, you have to shove your way through this big crowd of people," he says. "You see the same thing in collective cell migration. Some cells seem happy to stay in place, whereas others move quickly. You'll get these packs that form where some cells move a lot, and some not at all. The physics and mechanics of that type of motion are very complicated."

He is also interested in the body's soft materials, such as collagen, the main structural protein in the human body. Since scientific understanding of the mechanics of collagen is limited, Notbohm wants to look into how the mechanical properties of the collagen fibers affect and control how cells migrate along them.

Notbohm graduated from UW-Madison with a bachelor's degree in engineering mechanics in 2007. He did undergraduate research related to adhesion between proteins, which is what first got him interested in the application of mechanics to biology.

Now, as a faculty member, he is looking to develop his research group and form the building blocks that will help maintain it for years to come. For Notbohm, the collaborative aspects of his field of interest are a huge reason for why he decided to return to UW-Madison, after completing his graduate studies at Caltech, and postdoctoral research at the Harvard T.H. Chan School of Public Health.

"A big thing about research, especially since I'm in a very multidisciplinary field, is you need to have people you can collaborate with," he says. "And that's here at UW-Madison. For the type of work I'm interested in, there's a lot of good opportunities for collaboration for me, both here in my department and departments like biomedical engineering, as well as the med school."

He also takes a strong interest in teaching and currently is the instructor of EMA 506: *Advanced Mechanics and Materials.* For Notbohm, teaching paired with research creates an important balance on campus.

"I think part of what we're supposed to be doing here is creating knowledge, which is part of the research," he says. "But at the same time, the teaching offers us a way to connect with students, who eventually will be the future of creating new knowledge, using the knowledge that we're creating now."

Fonck named to NAE, honored by AAAS

Professor Raymond Fonck has received two prestigious honors recognizing his advances in fusion plasma spectroscopy diagnostics and leadership of the U.S. fusion program into the burning plasma era.

The National Academy of Engineering (NAE) elected Fonck to its 2015 class of new members. Election to the NAE is among the highest professional distinctions accorded to an engineer, and membership honors those who made outstanding contributions to engineering research, practice or education.

In addition, Fonck was elected a fellow of the American Association for the Advancement of Science (AAAS). Since 1874, members of AAAS, the world's largest general scientific society, have elected fellows based on their scientifically or socially distinguished efforts to advance science.

Fonck, who earned his UW-Madison bachelor's degree in physics in 1973 and his PhD in physics in 1978, joined the Department of Engineering Physics as a professor in 1989. He has played a major role in advancing fusion energy research at UW-Madison, including his leadership of the Pegasus Toroidal Experiment, and deployment of novel plasma diagnostics on national fusion facilities. He has also participated in national efforts to improve communication and coordination among fusion researchers across the country and internationally. A highly respected figure in the fields of experimental physics and fusion research, Fonck has received many distinguished professional honors throughout his career.

IN MEMORIAM

Alumnus Darin R. Kohles

Darin R. Kohles (BS EMA ’89, MS EMA ’94) passed away suddenly on January 9, 2016, at the age of 47.

His UW-Madison engineering education led to his first job as a real-life rocket scientist. His work in space-related design included stints working in simulated micro-gravity, and he secured a patent in the area of rocketry cryogenics.

His penchant for computers and software development drew him into the world of software technology, and he taught himself the top programming languages. This pursuit initially led him to Brazil, where he designed a program to optimize the placement of cellphone towers for the South American telecom industry based on the geospatial relationships with population centers. He eventually moved to Portland, Oregon, where he lived and worked until his death.

Full obituary: go.wisc.edu/darin-kohles

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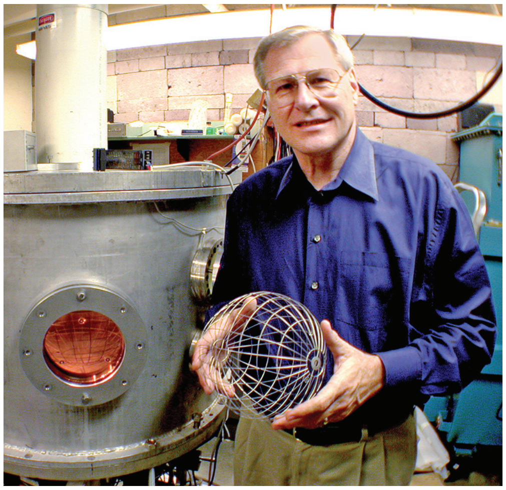
FPA honors Kulcinski with distinguished achievement award

The Fusion Power Associates (FPA) Board of Directors has selected Grainger Professor Emeritus of Nuclear Engineering Gerald Kulcinski to receive its 2015 distinguished career award.



FPA distinguished career awards have been given annually since 1987 to recognize individuals who have made distinguished lifelong career contributions that have benefited fusion energy development.

With the award, the FPA honored Kulcinski for his many years of dedication to advancing the prospects for fusion power, and it especially noted his decades of outstanding career contributions as a scientist and educator in the areas of both magnetic and inertial confinement fusion.

Kulcinski received the award at the Fusion Power Associates 36th annual meeting and symposium December 16-17, 2015, in Washington, D.C.

Kulcinski—who earned his bachelor’s degree in chemical engineering, his master’s degree in nuclear engineering and his PhD in nuclear engineering, all from UW-Madison—joined UW-Madison as a nuclear engineering faculty member in 1971. At that time, he helped found the university’s Fusion Technology Institute, which he still directs.

Kulcinski is a leader in studying the economic and environmental issues of fusion power, including examining the impact of fusion on the energy marketplace, and his research has included energy applications, basic materials research and detailed conceptual design of fusion power plants. Early in his career, Kulcinski performed experiments on radiation damage to materials for the first walls of fusion reactors, which involved innovative research on neutron irradiation to steels and on pulsed-irradiation damage to fusion first-wall materials.

Throughout his distinguished career, Kulcinski has received many prestigious honors. He was elected to the National Academy of Engineering in 1993 and was awarded the NASA Public Service Medal in 1993 and the NASA Exceptional Public Service Medal in 2010. He served on the NASA Advisory Council from 2005 to 2009, and in 2008 he was appointed to the Advisory Committee for the Department of Commerce on Emerging Technology and Research. He has been a fellow of the American Nuclear Society since 1978.