Department of Physics
UNIVERSITY OF WISCONSIN–MADISON

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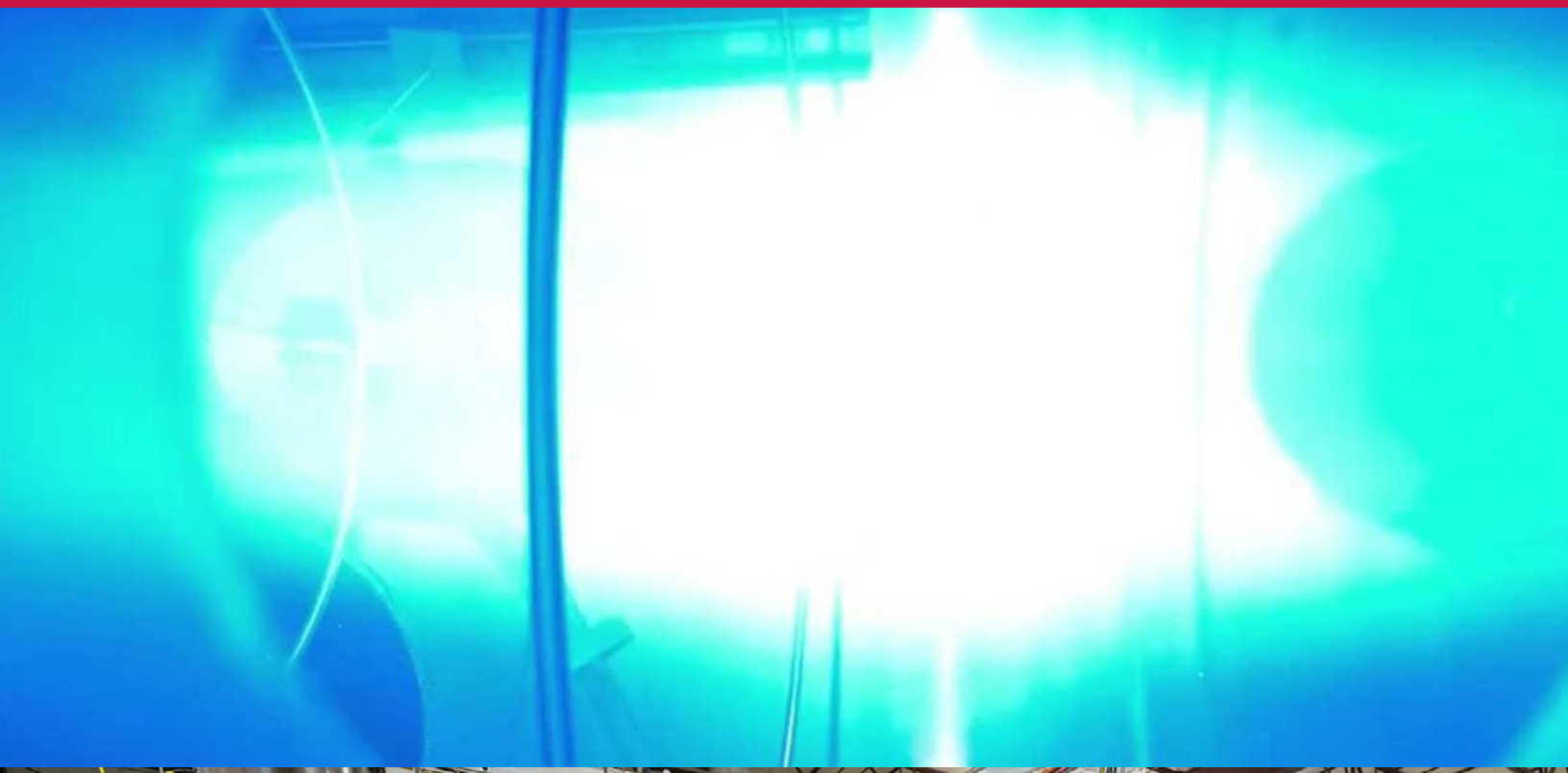

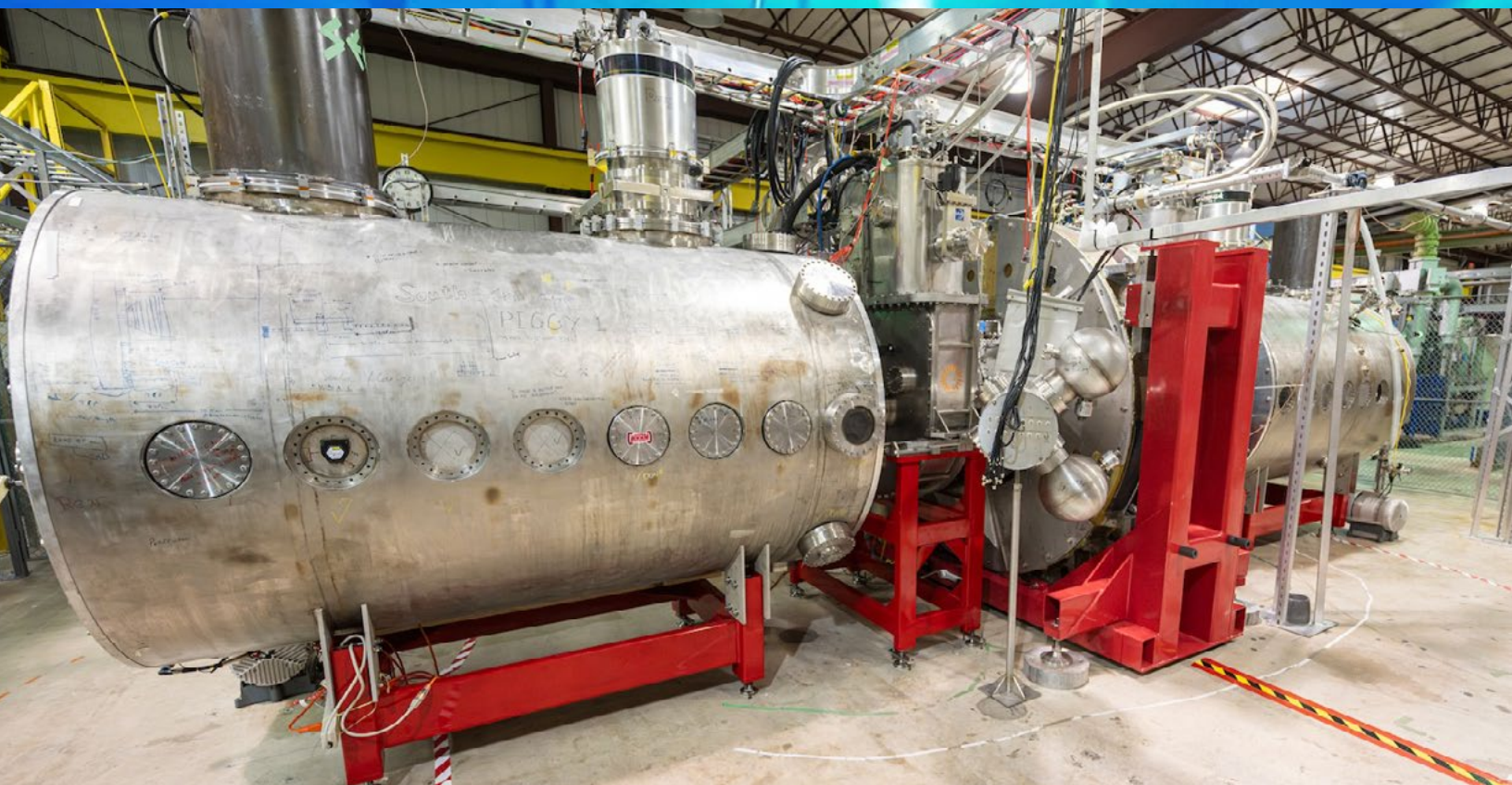

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The Wisconsin Physicist is the newsletter for alumni and friends of the:
Department of Physics
University of Wisconsin–Madison
1150 University Avenue
Madison, WI 53706-1390

Email
info@physics.wisc.edu

Web
physics.wisc.edu

Department Chair
Kevin Black
kblack@hep.wisc.edu

Writer, Editor & Designer
Sarah Perdue

Editing
Cierra Atkinson, Dan Bradley, Carrie Francis, Noah Hurst, Sharon Kahn, Haddie McLean, Katerina Moloni, Sami Robertson, Josh Weber

Donor Contact
Mae Saul, UW Foundation
mae.saul@supportuw.org
(608) 216-6274

Online Giving
physics.wisc.edu/giving

All photos are from UW–Madison, the Department of Physics, or WIPAC, except:

Page 1 (center): Simons Foundation
Page 11 (bottom right): Simons Observatory
Page 15 (top left): provided by Bill Nichols

On the Cover

Over the past four years, a team of UW–Madison physicists and engineers had been constructing and testing the fusion energy device known as WHAM (Wisconsin HTS Axisymmetric Mirror; pictured at the bottom) in UW's Physical Sciences Lab in Stoughton. This summer, the team marked a major milestone when WHAM transitioned to operations mode and achieved first plasma (the blue flash image). WHAM now operates as a public-private partnership between UW–Madison and spinoff company Realta Fusion Inc., positioning it as a major force for fusion research advances at the university.

For more on WHAM, see page 10 of this issue.

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INSIDE THIS ISSUE

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GREETINGS FROM THE CHAIR

Dear Alumni and Friends,

I am honored to be the new chair of the department of physics, a role that I began this past summer. I have spent the past three years serving as associate chair of graduate programs, and I look forward to serving the greater department for the next three years.

I have to begin this letter by thanking the outgoing chair, Prof. Mark Eriksson, for his leadership over the past three years. He oversaw one of the department's largest expansions in faculty and student numbers we've experienced, and I am excited to continue building off the successes he, and previous chairs, have accomplished.

I also have to thank the outgoing associate chairs, Profs. Mark Rzchowski and Sridhara Dasu. Mark served as associate chair for the undergraduate program and academic affairs from 2008-2010 and again from 2011 until this past summer. Accomplishing our academic mission could not happen without someone like Mark looking out for our students and instructors. Sridhara has served as associate chair for the Board of Visitors and alumni affairs since 2021 and was department chair for four years prior.

I am thus pleased to introduce the new associate chairs team of Profs. Maxim Vavilov (undergraduate program and academic affairs), Keith Bechtol (graduate program), and Brian Rebel (Board of Visitors and alumni affairs). I am excited to work with this new team, and I am confident that the energy they bring will lead to new initiatives to keep the department moving forward.

This year, we are thrilled to welcome six new faculty to our department, bringing us to 56 total members and moving us even closer to our goal of 60. These six new members represent a range of expertise and a balance of theory and experimentation. Alum Dan Hooper, PhD '03 returns to campus as WIPAC Director and professor of physics. Two condensed matter experimentalists, Prof. Britton Plourde and Prof. Tiancheng Song, will build off our already-strong program in that area, boosted by two new condensed matter theorists, Prof. Elio König and Prof. Ben Woods. Finally, astrophysics Prof. Melinda Soares-Furtado joins us on a joint faculty position between the departments of astronomy and physics. We have two active searches underway, one in AMO and one in machine learning/artificial intelligence that is part of a broader campus initiative known as RISE (Research, Innovation and Scholarly Excellence). UW–Madison is truly a thriving place to be doing physics right now!

We are equally excited about the research programs of our current faculty, and the broader physics and science communities seem to agree. Prof. Francis Halzen was inducted into the National Academy of Sciences earlier this year, one of the top recognitions for U.S. scientists. Prof. Baha Balantekin won the 2025 Hans A. Bethe Prize from the American Physical Society, the top annual award for accomplishments in the areas of astrophysics, nuclear physics, and nuclear astrophysics. Prof. Vernon Barger was elected as a Fellow to the American Association for the Advancement of Science. And Prof. Ke Fang was named a Sloan Fellow, an award given to exceptional early-career scientists. Ke was also named the inaugural recipient of our department's Bernice Durand Faculty Fellowship this year.

Of course, with a growing faculty comes the need for more exceptional graduate students, and physics is trending up. We welcomed an incoming PhD class of 43 students. We also welcomed 38 MS in Physics Quantum Computing students, once again the largest class yet and reflecting both the program's success and the continued need for quantum workforce development.

Our department continues to innovate in exciting and creative ways. At the undergraduate level, we recognized that the physics major was narrowly focused on students who are more likely to pursue graduate studies — and in fact, around half our graduates go on to PhD programs each year. However, we know that a physics undergraduate degree prepares students for a wealth of opportunities, especially in industry. After a few years of internal studies and discussion, we have removed the thermal physics requirement, removed the requirement for a second semester of quantum mechanics, and lowered the required number of lab courses from three to two — without reducing the total number of physics credits required — in order to create a more flexible path to a physics major. Our major was already growing, and we expect these new changes will attract even more students. Stay tuned in a few years to hear how this change plays out.

Our mission in undergraduate instruction aims to bring innovations in teaching to both our majors and students from other majors who are required to take our service courses. We began offering more summer majors' courses, easing the path to graduation for students who declare the physics major after their first year. We now offer Physics 103, algebra-based intro physics, as an online summer course, and have quadrupled the number of students we teach compared to in-person summer instruction. Our instructional staff has also worked to revamp or develop new labs — including being awarded a grant to replace some of the old equipment in the general physics labs. In 2023-24, our department taught a total of 29,076 credit hours, representing 4.3% of all credit hours in L&S, both the highest values since 2015-2016.

We are also innovating outside academia. Our department members are pursuing more spinoffs and technology licensing than ever before. Prof. Cary Forest and his team's spinoff company, Realta Fusion, celebrated first plasma in WHAM, their magnetic mirror machine that is at the forefront of fusion energy technology. Prof. Kael Hanson recently started a spinoff company, Navigationis, to develop a new, radiowave-based navigation technique that is immune to the vulnerabilities of GPS. Hanson won a UW–Madison Draper Technology Innovation Fund award to support this new company. Lastly, Prof. Robert McDermott co-founded a superconducting quantum computing company, Qolab, based in Madison. He and Britton Plourde, one of our new hires this year, will both be splitting their time between their faculty appointments and the new company. In fact, amongst other reasons, Plourde cited UW–Madison's support of entrepreneurialism as one of the reasons he joined the faculty.

Our department has a long and proud tradition of physics outreach, starting with the opening of the Ingersoll Physics Museum — the longest operating hands-on science museum in the country — in 1918 and continuing with Prof. Clint Sprott's The Wonders of Physics shows in 1984. I am pleased to announce that the faculty voted this year to change the museum's name to The Ingersoll Wonders of Physics Museum. This change reflects the full breadth of educational outreach offered through our department. We hope visitors to any of our many outreach programs are inspired by the Wonders of our exciting discipline.

Research, teaching, and outreach are the core values of a public research university, and our department will continue to do excellent, cutting-edge research and teach the next generation of scientists both in and out of the classroom. I want to add one more pillar to our department's mission: we must make a commitment to diversity and equity an active component of what we do as a department. To be sure, these efforts are not starting with my tenure as Chair, but instead represent a continuation of earlier department leadership.

The need to add diversity to our mission became evident to me when I saw the list of department chairs who came before me. I was the 33rd white male chair out of 35. The field of physics, and specifically UW–Madison physics, both lack adequate representation of students from marginalized groups. We need to improve diversity at all levels in this department. There's no magic wand. It will take a concerted, sustained effort by everyone who has a connection to our department.

On, Wisconsin!
Kevin Black, Department Chair and Professor of Physics

WELCOME, NEW FACULTY!

Six new faculty members joined the department in 2024

Welcome, Professor Dan Hooper!

UW–Madison alum and theoretical astrophysicist named WIPAC director

By Nastasha Kasulke, Office of the Vice Chancellor for Research

Dan Hooper, PhD '03, has been selected as the new director of the Wisconsin IceCube Particle Astrophysics Center (WIPAC). Hooper began his role at WIPAC on Sept. 9 and as director reports to the Vice Chancellor for Research. Hooper has a joint faculty appointment with the Department of Physics.

Hooper most recently was a Senior Scientist at the Fermi National Accelerator Laboratory and Professor of Astronomy and Astrophysics at the University of Chicago. He also is a fellow of the American Physical Society. Hooper earned his PhD in physics from UW–Madison and completed his postdoctoral work at Oxford University.

Hooper's research focuses on the interface between particle physics and cosmology focused primarily, although not entirely, on studying and exploring particle physics beyond the Standard Model using astrophysics. Areas he has worked on include dark matter, high-energy neutrino astronomy, gamma-ray astronomy and cosmic-rays.

"I'm grateful to Kyle Cranmer, Data Science Institute director, who led the search committee for this internationally recognized leadership position, and to Jim Madsen, senior scientist, for his interim director role at WIPAC," says Cynthia Czajkowski, former interim vice chancellor for research. "Dan's proven track record of innovation and high-impact research, and his vision for WIPAC, makes him the right person to help lead the next generation of the IceCube project and secure the future of UW–Madison's world leadership in astroparticle physics."

WIPAC's three largest projects center on the IceCube Neutrino Observatory, which transformed a cubic kilometer of Antarctic ice at the South Pole into a detector to search for nearly massless subatomic particles called neutrinos. These high-energy astronomical messengers provide information to probe the most violent astrophysical sources: events like exploding stars, gamma-ray bursts, and cataclysmic phenomena involving black holes and neutron stars.

Under cooperative agreements with the National Science Foundation, WIPAC manages and operates the IceCube Neutrino Observatory and supports the research of the international IceCube Collaboration at more than 50 institutions worldwide. WIPAC also leads the IceCube Upgrade project to add seven more densely instrumented strings of light sensors near the center of the existing array.

The IceCube Upgrade project, scheduled for completion in 2026, will dramatically enhance the low-energy sensitivity of the facility, enabling precision measurements of neutrino oscillation parameters. It will also serve as a research and development testbed for new devices and provide new measurements of the ice optical properties, thus enhancing analysis precision for new and archived IceCube data.

"I look forward to being part of the incredible science that is being carried out at WIPAC, and am honored to be entrusted with this role," Hooper says. "I'm fully dedicated to working as hard as I can to ensure the successful implementation of the IceCube Upgrade and IceCube-Gen2."

WIPAC also plays a significant role in radio detection of neutrinos (Radio Neutrino Observatory-Greenland, Askaran Radio Array), gamma-ray astronomy and astrophysics (High-Altitude Water Cherenkov experiment, Cherenkov Telescope Array) as well as several smaller internally and externally funded projects.

In addition to his research and teaching, Hooper is the author of several books including Dark Cosmos: In Search of our

Prof. Dan Hooper

Universe's Missing Mass and Energy (2006), Nature's Blueprint: Supersymmetry and the Search for a Unified Theory of Matter and Force (2008) and At the Edge of Time: Exploring the Mysteries of Our Universe's First Seconds (2019), and a graduate-level textbook, Particle Cosmology and Astrophysics (2024).

Hooper was active in the Snowmass particle physics community research priority planning exercise and has organized several major international conferences. He is head of the International Advisory Committee for the TeV Particle Astrophysics annual conference series. Since 2020, Hooper and Shalma Wegsman have hosted the physics podcast 'Why This Universe?' breaking down some of some of the biggest ideas in physics into easily digestible chunks.

Welcome, Professor Elio König!

Condensed matter theorist and former UW–Madison postdoc studies the behavior of quantum particles in materials

This fall, condensed matter theorist Elio König returned to Madison as an assistant professor of physics. König began his education in Germany and Italy, earning a PhD from the Karlsruhe Institute of Technology in 2014. He joined UW–Madison physics as a postdoc with Alex Levchenko, then completed a second postdoc at Rutgers University. Most recently, König held a group leader position at the Max Planck Institute of Solid State Research in Stuttgart, Germany.

Please give an overview of your research.

I'm a condensed matter theorist, so I study the collective behavior of quantum particles in materials. We study electronic collective behavior — behavior of electronic systems — and I study strong correlations in that regard. We do all of this with an eye on what's happening in the quantum computation world. Our study of quantum materials can serve as a source of inspiration for building useful quantum devices in the context of quantum computers and potentially beyond.

And then reversely, the advances in quantum technology are of great use in our studying of quantum materials. We can use them as new probes, as new experimental techniques, and at the same time there is theoretical and conceptual cross-pollination. I'm inspired by these synergies.

Prof. Elio König

What are one or two main projects your group will work on first?

The main directions that I'm heading in right now are 2D materials and trying to work more into concepts related to or at the interface between quantum materials and quantum information.

In the 2D world, what I'm really fascinated by is frustrated magnetism in these 2D materials, and in particular research on quantum spin liquids. Generally, the idea is to study states of matter beyond the standard concept of spontaneous symmetry breaking. We're interested in topologically-ordered states and quantum order, which is essentially based on the entanglement of many, many particles together. And these states of matter are relevant for topological quantum error correction codes. I think there's also quite a lot of interest at UW already, both theoretically but also particularly experimentally, in 2D materials and I hope to collaborate with my future colleagues in that regard.

On the side of quantum materials and quantum information theory, there are ongoing projects that I want to extend on. I want to look for new setups for very robust quantum computers and topological quantum computation. At the same time, I want to use devices which are available right now for emulation of quantum many body systems.

What attracted you to Madison and the university?

This question is related to the question: why am I coming back to the States? I very much enjoyed my five years in the States, personally but also scientifically. The main aspect that I find more present in the States than in Europe is a more visionary approach to science. And I think this is also true for UW, so this is something that attracted me to UW. I know the department maybe better than other new faculty and it's a fantastic place to work. I know that there are very inspiring colleagues, and I hope that there will be a chance to collaborate with them. And finally, Madison is a very nice place to live. I think it's probably the nicest city of this size that I've seen in the States.

What is your favorite element and or elementary particle? [editor's note: this interview was conducted via Zoom while König was on a cycling trip through the Italian Alps.]

I read some previous interviews, so I knew this question was coming. And when I was biking today, I was thinking about it. Given that I'm mountain biking in the Alps and it's really intense, I decided that oxygen is the element I want to go for. I can't get enough of it right now. Oxygen is of course a symbol for the life that humans and animals have on this planet. Finally, oxygen is also a symbol for the advances of science and scientific revolutions, for example Lavoisier's pioneering work in this regard.

What hobbies and interests do you have?

I really enjoy biking — mountain biking and gravel biking in particular. This is the third time that I'm transversing the Alps. I got very much into dancing in the last three years in Stuttgart. I still dance forró, or Brazilian couple dancing, from time to time. I also like playing sports, particularly soccer and squash.

Welcome, Professor Britton Plourde!

Condensed matter experimentalist looks to increase qubit fidelity in the lab to inform the development of a fault-tolerant quantum computer with local startup company

Condensed matter experimentalist Britton Plourde received his bachelor's in physics and music performance from the University of Michigan. He then went to grad school at UIUC, earning a PhD in physics and a master's in music performance. He completed a postdoc at UC-Berkeley, then began as an assistant professor of physics at Syracuse University in 2005, moving up the ranks to full professor there. In fall 2024, Plourde joined the UW–Madison physics department as a full professor. He is joining the department on a half-time appointment; for the other half, he will be working at Qolab, a quantum computing startup company based in Madison.

Please give an overview of your research.

I work on superconducting quantum circuits. We make microfabricated superconducting circuits that have what are called Josephson tunnel junctions in them. And one of the biggest things we use these for is making qubits. We study all of the various physics related to how qubits work, what limits their performance, and ways to make them perform better so you could eventually build a practical, large-scale quantum computer. My research is similar to Robert McDermott's and Roman Kuzmin's.

What are the first one or two projects that you will have your group working on or continuing to work on when you arrive in Madison?

The company I'm working with, Qolab, is focused on building a quantum computer. My academic research lab at the university will be focused on fundamental physics related to operation of qubits, including the individual components of qubits like the Josephson junctions and to different processes that limit the performance of qubits. At the same time, the company is really focused on the technology of fabricating lots of qubits in a uniform, reproducible way and building them into a quantum computer.

Prof. Britton Plourde

In my group, a significant focus is going to be on understanding quasiparticles in superconducting qubits and how they impact the behavior of those qubits. Quasiparticles are electronic excitations above the superconducting ground state. The superconducting ground state is important because it doesn't have any dissipation. But these quasiparticles are dissipative, and they can degrade the performance of a superconducting circuit. There are various things that can generate the quasiparticles, but one of them is radioactivity: background radiation from radioactive contaminants in the lab or from cosmic rays. My group is going to continue spending time on understanding the physics of those processes and coming up with ways to try to mitigate their effects to make qubits that are more immune to quasiparticles.

We're also hoping to study quasiparticle physics in qubits for the completely opposite reason: instead of trying to mitigate the effects of quasiparticles to make better qubits, it's to amplify the effects of quasiparticles to make better detectors, potentially to detect dark matter particles. Robert and I are co-principal investigators with some particle physics collaborators on two Department of Energy proposals for this work that we recently submitted. This work hasn't been funded yet, but if it is, it is going to be a new and interesting research direction in both of our groups.

What attracted you to Madison and the university?

It's a great department. I've known it for a long time because I collaborated with Robert almost as long as he's been there. I've visited a lot over the years, and I like the area and the city. The university has made an impressive investment in quantum information science, and they're a real leader in that area and have research strengths across multiple different qubit technologies, both experimentally and with a strong team of theorists working on different aspects of quantum information science and condensed matter. It's really a powerhouse place, so I'm excited to join. University leadership has also been very supportive of the startup, they're strongly encouraging of the entrepreneurial direction of faculty, and that's not the case at a lot of other places.

What is your favorite element and/or elementary particle?

My favorite element has to be aluminum. That's the superconductor we use the most. The same aluminum that you could use to wrap a hot dog at a baseball game to keep it warm, you can instead cool it down to below one degree Kelvin and it becomes a superconductor. And it makes great Josephson junctions for qubits.

What hobbies and interests do you have?

Well, I'm still a musician, I'm a flutist. I don't really make money on it anymore, but I was a professional musician for a while. For the last three years of grad school, I had a job in a professional orchestra. I do still play occasionally, and I'll have to see how much time I have when we get to Madison. My wife is a professional musician. She's an oboist and she'll be working part time in the School of Music developing a new monthly recital series.

Welcome, Professor Melinda Soares-Furtado!

Observational astronomer holds a joint assistant professor appointment in the astronomy and physics departments

Melinda Soares-Furtado, an observational astronomer, joined the UW–Madison faculty this fall on a joint appointment in the astronomy and physics departments. She earned her undergrad degree at UC-Santa Cruz, then her doctorate in astrophysical sciences at Princeton. In 2020, she began a postdoc appointment in UW–Madison astronomy, where she subsequently was awarded a NASA Hubble Postdoctoral Fellowship.

Please give an overview of your research.

I'm interested in stars and the planets that orbit them. So far, here at Madison, my team has detected and characterized two young, nearby planets. I want to know as much as possible about the worlds we discover, and part of that investigation includes knowing as much as possible about the stars the planet orbits. We have lines of research focused on the stellar age, its local environment (is it isolated or moving with a large collection of stars?), and its activity. Is the planet orbiting the star in a docile, stable environment or one that makes it more challenging to retain an atmosphere? How can we use follow-up observations both on the ground and with space-based facilities to get new insights into these worlds? Can instruments like the Hubble Space Telescope (HST) and the James Webb Space Telescope (JWST) offer a glimpse of the planet's atmospheric evolution? Given the ever-expanding number of worlds we have discovered over the past three decades, how unusual is our own Solar System?

Prof. Melinda Soares-Furtado

What are one or two main projects your group will work on first?

I have a broad range of research interests, so one or two main projects is sort of hard to narrow down. Right now, I'm most excited about the young worlds we have found in the Solar Neighborhood and the added context we can get with additional observations. I'd like to know the mass of the mini-Neptune-sized planet we recently found and here at UW–Madison, we have access to the institutional resources that will allow us to make this measurement! This planet is compelling, because it is found at the upper edge of a distribution known as the "radius valley." The mass can help us understand the eventual fate of this young planet orbiting an active M dwarf star. I'm also interested to see what we learn with JWST and HST about an Earth-sized planet we found orbiting a Sun-like star. Will we see signs of atmospheric outgassing?

Putting on my stellar astronomer hat, I'm also really intrigued by what more we can learn about stars and ways in which we can better estimate their ages and evolutionary histories. Again, here at UW–Madison, our institutional access makes it possible to probe some of these mysteries in impactful ways — largely due to our access to WIYN/NEID, which offers high-precision measurements of a star's shifting spectral lines.

What attracted you to Madison and the University?

I was drawn to the University of Wisconsin–Madison for its exceptional research environment and the wealth of opportunities available for collaboration. The Department of Astronomy is not only broad in its research pursuits

Melinda Soares-Furtado (back row, left) with UW–Madison students and RADIAL summer interns at the American Astronomical Society Meeting, held in Madison this past summer. Melinda is currently the UW-Madison Site Director of the RADIAL program, which focuses on building collaborations with universities that do not have access to research opportunities.

— it is also notably collegiate, fostering a collaborative and supportive atmosphere among faculty, students, and staff. Access to cutting-edge facilities such as WIYN/NEID, SALT, and NOEMA was a strong attraction, as these instruments enable a range of high-impact research opportunities, from precise stellar characterization to molecular gas studies.

I was also excited to join the Wisconsin Center for Origins Research (WiCOR) collaboration. WiCOR is a multidisciplinary center at UW–Madison designed to unite researchers from diverse scientific departments, including astronomy, chemistry, geoscience, and biology, to study the origins of life in the universe. Recently established with a dedicated research space, WiCOR not only focuses on cutting-edge projects — such as investigating potentially habitable exoplanets with the James Webb Space Telescope — but also emphasizes public outreach and educational initiatives, making it a leader in origins research and science communication.

What is your favorite element and/or elementary particle?

I think everyone in the department knows I have a fondness for lithium! As a PhD student, I worked on the signatures of stars that ingest their planetary companions, finding that lithium excess can sometimes be observed. I predicted which stars would show such an enhancement, and this was verified in large abundance surveys a year later. Lithium is a useful flag for engulfment, because it is readily destroyed in the interiors of forming stars, but never reaches temperatures required for destruction in planets. It therefore can be one to two orders of magnitude higher in these less massive bodies. If a star ingests a planet later in its evolution, that signature is sometimes observable! I like to hunt for such lithium-rich stars and then explore other aspects of their chemistry to better understand the cause of their enrichment.

What hobbies and interests do you have?

I like to garden, read, and spend time with my family. I often hike the Grady Tract Loop not far from my home. I have an app I use to identify plants, fungi, and wildlife. My daughter and I like to use it when we go on walks together. I have a fondness for photography. During my undergraduate years, I worked with

my sister as a family photographer in California. These days I mostly photograph plants and landscapes. I also love to dance cumbia, salsa, and bachata. I danced often when I was growing up and even spent some time on a salsa choreography team in San Jose, California. I also collect and read vintage textbooks — most of my favorites are from the 1930s.

Welcome, Professor Tiancheng Song!

Condensed matter experimentalist with research interests in 2D quantum materials

Tiancheng Song, a condensed matter experimentalist, joined the UW–Madison Physics Department as an assistant professor in May. His research interest lies in two-dimensional (2D) quantum materials with a focus on 2D magnetism, 2D superconductivity and 2D topology. He joins us from Princeton University where he was a Dicke Fellow and won the Lee Osheroff Richardson Science Prize. He completed his PhD at the University of Washington and his bachelor's degree from University of Science and Technology in China. He is originally from Tianjin, China, the son of two theoretical physicists.

Please give an overview of your research.

I work on experimental condensed matter physics and am especially interested in a new family of materials called two-dimensional materials, which resemble "Quantum LEGOs" at the atomic scale. These 2D materials can be exfoliated down to the monolayer limit just using Scotch tape, and each monolayer can act like a LEGO piece. This provides us with a full LEGO set of quantum materials in two dimensions, covering a broad spectrum of emergent quantum phenomena. Within this new material platform of condensed matter physics, I'm particularly interested in three topics: magnetism, superconductivity and topology. With the new tuning knobs uniquely enabled in this new material system, we aim to study these three topics in two dimensions using those LEGOs. There will be a lot of fun because we can use them like building blocks, stack them together like LEGO toys, and uncover new physics emerging from the toys we create!

What are the first one or two research projects you'll work on with your new group here?

Overall, we plan to discover new 2D quantum materials, develop new measurement techniques and explore new physics in this emergent platform. We aim to combine state-of-the-art nanofabrication of 2D materials with various measurement techniques including magneto-optics, quantum transport, thermoelectrics, optoelectronics, optical spectroscopy and microscopy. Our research will explore three directions: 2D magnetism, 2D superconductivity and 2D topology.

What attracted you to Madison and the University?

The University of Wisconsin–Madison is a top public university located in a beautiful city. The Department of Physics is renowned for its exceptional research in many areas of physics. My partner also works at UW–Madison.

What is your favorite element and/or elementary particle?

I usually say chromium or tellurium, but this time I would say technetium (symbol Tc and atomic number 43). This is because my name is Tiancheng, and when I was a kid, my parents called me TC just for fun. Since studying abroad, I have found my name sometimes difficult to pronounce and remember for others, because it is a bit long and complicated. So, I started using this nickname again, and I'm happy to be called TC!

Prof. Tiancheng Song

What hobbies and interests do you have?

I enjoy many sports, such as badminton, tennis and swimming. For those other sports that I am not very skilled at, I enjoy watching rather than playing.

Tiancheng Song is doing an experiment using the 45 Tesla Hybrid Magnet, which produces the highest DC magnetic field in the world.

Welcome, Professor Ben Woods!

Condensed matter theorist works in semiconductor quantum dot theory and semiconductor-superconductor heterostructures

Condensed matter theorist Ben Woods joined the department as an assistant professor this fall. Originally from a small town in North Dakota, Woods studied physics at the University of North Dakota and earned a PhD in physics from West Virginia University. He first came to UW–Madison for a postdoc with Mark Friesen in 2021, and now moves into his faculty role.

Please give an overview of your research.

I primarily work in two main areas of condensed matter theory and quantum information science. The first area is the theory of semiconductor quantum dots, with applications towards building and operating quantum computers based on spin qubits. Quantum dots can be thought of as artificial atoms in which electrons are trapped and manipulated within a semiconductor, such as silicon, by metallic gates that sit on top of the semiconductor. An electron in the quantum dot forms the basis for a type of qubit called a spin qubit, where the quantum information is stored in the spin of the electron. I investigate how we can build higher quality spin qubits. One aspect of this is analyzing and designing single and two qubit gates such that their efficiency and noise resiliency can be improved. Another aspect is studying the materials and design of quantum dot devices to optimize certain properties, such as how the qubits respond to an external magnetic field. I am also interested in quantum dot arrays as a platform for quantum simulation. Here the idea is to engineer the interactions between the quantum dots to emulate a quantum system of interest.

The other area I work in is semiconductor-superconductor heterostructures. Here, you're trying to combine desirable properties of both types of materials to create interesting devices that would otherwise be impossible. I study semiconductor-superconductor heterostructures that can give rise to exotic particles known as Majorana zero modes, which form the basis for topological qubits. These qubits are immune to certain error sources that more conventional types of qubits are not. I am trying to understand the effects of disorder on these heterostructures and develop new schemes in which Majorana zero modes can be realized.

Prof. Ben Woods

What are one or two of the main projects your group will work on first?

One initial project will focus on designing a new qubit architecture for quantum dot spin qubits. In the most conventional type of spin qubit, you have a single electron spin that is manipulated by jiggling it with an electric field back and forth within a single quantum dot. It turns out, however, that these qubits can be manipulated more efficiently if you can hop electrons between multiple quantum dots. Specifically, I've devised new schemes involving three dots in a triangular geometry in which single-qubit gates can be performed quite efficiently. These ideas work in principle, but now it's a matter of quantitatively studying how noise resilient the scheme is and how finely tuned the system parameters need to be for things to go as planned.

A second initial project is more towards quantum simulation using quantum dot arrays. The project will focus on studying magnetism in quantum dot arrays. In other words, asking how the spins of the quantum dot electrons organize due to their mutual interaction. One interesting wrinkle in these quantum dot arrays based on silicon is that there is a valley degree of freedom in addition to the usual spin degree of freedom. The project involves understanding the effects on the magnetic ordering due to this additional valley degree of freedom. Specifically, I am interested in how fluctuations in the valley degree of freedom from one dot to the next can impact magnetic ordering.

What attracted you to Madison and the university?

There were two main reasons. First, my wife had gotten a residency as an anesthesiologist at the UW hospital. So that was an obvious motivation. Second, one of my grad school advisors knew Mark Eriksson and Mark Friesen and thought it'd be a natural fit for me to work with them as a postdoc. Since moving here, my family has enjoyed Madison, and I really like the physics department. The people are very friendly and collaborative. I am incredibly happy to be able to stay in Madison and at the UW physics department.

What is your favorite element and/ or elementary particle?

It has to be silicon, right? It's the material I think about every day. And the world economy is largely based on stuff made with silicon. So that's pretty cool.

What hobbies and interests do you have?

I like to play guitar, read, watch sports, and spend time with my family and friends. I have two kids, three years and six months old, who I like to spend most of my free time on.

RESEARCH HIGHLIGHTS

A look back at key research updates from the past year

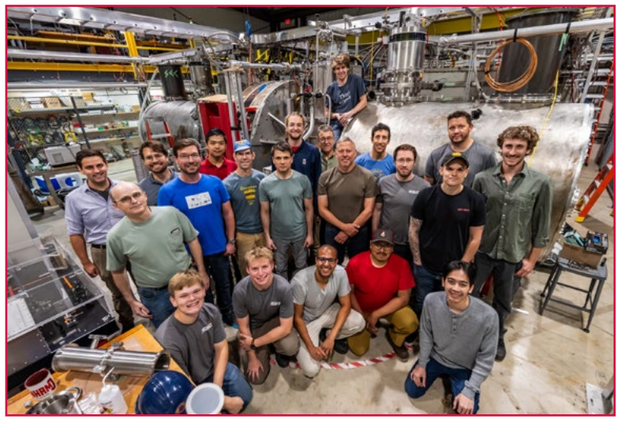
Plasma group announces two big fusion advances

By Sarah Perdue, Department of Physics

On July 15, a mirror machine fusion device generated plasma for the first time, opening a door to making the highly anticipated, carbon-free energy source a reality. Not to be outdone, a second UW team announced a breakthrough on July 29, this time producing a tokamak plasma that is stable at 10 times the Greenwald limit.

First plasma in new mirror machine

Over the past four years, a team of UW–Madison physicists and engineers has been constructing and testing the fusion energy device, known as WHAM (Wisconsin HTS Axisymmetric Mirror). It transitioned to operations mode this summer, marking a major milestone for the yearslong research project that's received support from the U.S. Department of Energy.



WHAM (in back) is a new magnetic mirror machine developed by a team of UW–Madison physicists and collaborators, housed at the Physical Sciences Lab in Stoughton.

"The outlook for decarbonizing our energy sector is just much higher with fusion than anything else," says Cary Forest, a UW–Madison physics professor who has helped lead the development of WHAM. "First plasma is a crucial first step for us in that direction."

WHAM started in 2020 as a partnership between UW–Madison, MIT and the company Commonwealth Fusion Systems. Now, WHAM operates as a public-private partnership between UW–Madison and spinoff company Realta Fusion Inc., positioning it as major force for fusion research advances at the university.

Fusion produces carbon-less byproducts, making it one of the cleanest potential energy sources in terms of greenhouse gases. Its fuel — the inputs of the reaction — is abundant and relatively cheap; one input is deuterium, a form of hydrogen with one neutron that is found in seawater; the other is lithium, an element needed in an amount that is mere fractions of what is required for today's lithium-ion batteries. These are used to create the radioactive isotope tritium. Then fusion occurs when a heated plasma of deuterium and tritium ions is magnetically moved at rapid speeds in a reactor. The ions collide and fuse their nuclei, releasing energy. That energy is captured as heat, which can be used for industrial heating processes or converted to electricity.

"We think fusion will be as good at producing electricity as any energy source would be, and we think it might be even better to use it as a source of industrial heat for making things," Forest says.

Fusion is most efficient when the plasma is physically contained, as the charged particles have a better chance of colliding. Mirror machines try to limit the escape of the particles from the main reactor with inward-facing magnets. But an inability to efficiently contain the plasma — and therefore to achieve net-positive energy production — had greatly limited the function of the machines until recently.

Over the last decade, researchers around the world have developed high-temperature superconductor magnets that are tens of times stronger than the magnets previously used for fusion research. And with new, powerful magnets, developed by partner Commonwealth Fusion Systems, the UW–Madison team is revisiting mirror machines as plasma energy reactors. After receiving the magnets in early July, researchers achieved first plasma on July 15.

First plasma marks the transition from building to operations, and the very beginning of the discovery phase of the research. It is also an important step in a public-private partnership with Realta Fusion, a UW–Madison spinoff that will focus on commercializing mirror fusion. In June 2023, Realta was one of eight companies selected for Department of Energy milestone funding. Forest, a co-founder of Realta, compares the milestone program to the one that NASA used to develop a commercial space program with companies such as SpaceX. Realta has provided both funding and staffing to bolster the WHAM project.

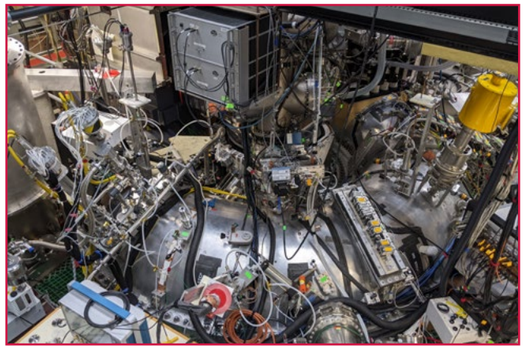
"WHAM is a unique experiment, setting a world record in magnetic field strength for magnetically confined plasmas and equipped with intense heating systems while still being a hands-on experiment for both graduate and undergraduate students," says Jay Anderson, a scientist at UW–Madison and a co-founder of Realta.

The WHAM team has jumped into the discovery phase, beginning to learn as much as they can about improving efficiency and setting the stage for what comes next.

"We want to find the showstoppers," says Forest. "Can we increase the stability of the plasma, which is inherently unstable? How well can we confine the plasma? These questions will take several years to address well, and if we can understand and predict everything about this device, then it will provide the foundations for the next device, a break-even device."

A different approach to plasma density

Plasma density is important to fusion's success regardless of the device design being used. 40 years ago, Martin Greenwald identified a density limit above which tokamak plasmas become unstable, and the so-called Greenwald limit has at best been exceeded by a factor of two in the ensuing decades.



The Madison Symmetric Torus (MST) runs plasma as both a tokamak and reversed field pinch device.

In a study published July 29 in *Physical Review Letters*, physicists at the UW–Madison produced a tokamak plasma that is stable at 10 times the Greenwald limit. The findings may have implications for tokamak fusion reactors, though the researchers caution that their plasma is not directly comparable to that in a fusion reactor.

"Tokamak devices are considered a leading contender in the race to build a nuclear fusion reactor that generates power in the same way as the sun," says Noah Hurst, a scientist with the Wisconsin Plasma Physics Laboratory (WiPPL) and lead author on the study. "Our discovery of this unusual ability to operate far above the Greenwald limit is important for boosting fusion power production and preventing machine damage."

The device that the WiPPL team used in this new study is the Madison Symmetric Torus, or MST. For many years, MST has operated as one of the leading programs studying the reversed field pinch, a toroidal configuration closely related to the tokamak. MST was designed to anticipate operation as a tokamak, allowing direct comparison of the two toroidal configurations in the same device. Unlike other tokamaks, the metal donut that houses the MST plasmas is thick and highly conducting, allowing for more stable operation.

In 2018, MST scientists received National Science Foundation funding to build power supplies that are programmable, facilitating easier access to a range of toroidal plasma configurations, from tokamak to reversed field pinch. Hurst was hired in 2019 to study MST plasmas in tokamak mode with the new power supply.

"My job was to try to find ways to make the plasma go unstable," Hurst says. "I tried, and I found that, well, in many cases, it doesn't. It was surprising."

Hurst and colleagues looked into plasma density, trying to destabilize the plasma by puffing in more and more gas. They set the power supply to provide whatever voltage was needed to maintain a steady 50,000 amps of current in each plasma (as plasma density increases, it becomes more resistive, and more voltage is needed to keep the current steady). They measured the achieved plasma density with interferometers viewing the plasma along 11 different lines of sight.

The Greenwald limit is just the ratio of the plasma density to the product of the plasma current and cross-sectional area, a simple metric that allows comparison of different devices and operating conditions. Since the limit was defined, only a handful of devices have operated above it.

"Here, we were at a factor of ten," Hurst says. "Future reactor-scale tokamaks will likely need to operate near or above the Greenwald limit, so if we can better understand what's causing the density limit and understand the physics of how we got to ten times the limit, then maybe we have a shot at doing something about it."

Though the researchers feel confident in their results, they are unexpected. The team is actively exploring explanations. Hurst emphasizes that these results are unlikely to be directly applicable to fusion reactors, but he and the team are cautiously optimistic.

"We were the first ones to be able to do this, and you have to start somewhere," Hurst says. "We're going to keep studying these plasmas, and we think that what we learn might help higher-performance fusion devices to operate at the higher densities they need to be successful."

UW–Madison physicists join Simons Observatory

By Sarah Perdue, Department of Physics

Earlier this year, Profs. Peter Timbie and Moritz Münchmeyer, who both research the cosmic microwave background (CMB), were accepted as institutional members of Simons Observatory.

"Simons Observatory is the big new CMB experiment that is upcoming, and it will push the field of CMB science forward," Münchmeyer says. "For us to do state-of-the-art CMB science in the next five to ten years, and to set us up for the future, being in Simons Observatory is very important."

The membership grants them and their research groups full access to the collaboration of scientists and the wealth of data that Simons offers.

The site of the existing Atacama Cosmology Telescope and the Simons Array in Chile's Atacama Desert on the west slope of the Andes.

In addition to being partners in Simons' center-wide projects, such as gravitational wave astronomy, Münchmeyer, Timbie and their research groups have other interests in the CMB field that membership will help them address.

Their membership was supported in full by the UW–Madison department of physics, the Office of the Vice Chancellor for Research, and the College of Letters & Science. Importantly, their physics colleagues were instrumental in securing it.

"Our colleagues from accelerator physics, for example, were very supportive and pointed out that in the early days, before anyone was involved in the ATLAS or CMS experiments, the university had to buy into those collaborations," Timbie says. "And of course, the payoff from that [investment] has been unbelievably large. The hope is something similar will happen for us with the big CMB experiments."

FACULTY AWARDS & HONORS

From University awards to professional society recognition, the department once again had many faculty recognized for contributions to their field

Professional Society and Other External Awards & Honors

Professor Francis Halzen was elected to the National Academy of Sciences. He was one of 120 scientists elected this year in recognition of their distinguished and continuing achievements in original research, according to the academy's announcement of this year's new members. Election to the academy is among the highest honors that a scientist can receive.


Francis Halzen

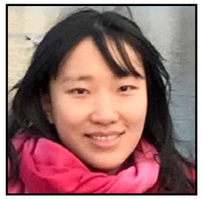
Halzen oversaw the design and development of IceCube and its predecessor experiment, the Antarctic Muon and Neutrino Detector Array (AMANDA). His accomplishments in particle physics, astrophysics and cosmology have garnered him numerous awards and recognitions over the course of his career.

Professor Baha Balantekin won the American Physical Society's 2025 Hans A. Bethe Prize. The Bethe prize is awarded to recognize outstanding work in theory, experiment or observation in the areas of astrophysics, nuclear physics, nuclear astrophysics, or closely related fields. Balantekin won "for seminal contributions to neutrino physics and astrophysics — especially the neutrino flavor transformation problem — both for solar neutrinos and the nonlinear supernova environment."


Baha Balantekin

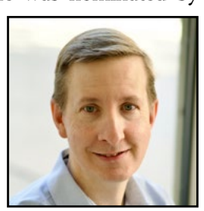
Balantekin works at the intersection of particle physics, nuclear physics, and astrophysics. For much of his career, he has studied theoretical aspects of neutrino transport originating in the Sun, supernovae, or neutron star mergers.

Professor Ke Fang is among 126 scientists across the United States and Canada selected as Sloan Research Fellows. Sloan Fellowships, awarded annually since 1955, honor exceptional scientists whose creativity, innovation and research accomplishments make them stand out as future leaders in their fields. Sloan Fellows are chosen in seven fields, including physics, based on nomination and consideration by fellow scientists.


Ke Fang

Fang studies the origin of subatomic particles — like neutrinos — that reach Earth from across the universe using data from the Ice Cube Observatory and Fermi Large Area Telescope along with numerical simulations.

Professor Britton Plourde was elected to the 2024 class of American Physical Society Fellows. He was elected "for important contributions to the physics and operation of superconducting qubits, including the development of techniques for scalable qubit control and readout, and investigations of decoherence from vortices and nonequilibrium quasiparticles." He was nominated by the Division of Quantum Information Fellowship.


Britton Plourde

APS Fellowship is a distinct honor signifying recognition by one's professional peers for outstanding contributions to physics. Each year, no more than one half of one percent of the Society's membership is recognized by this honor.

Professor Vernon Barger was elected a fellow of the American Association for the Advancement of Science (AAAS). The honor, presented annually since 1874, recognizes efforts to advance science and society, with the fellows chosen to reflect the highest standards of scientific integrity and professional ethics.


Vernon Barger

Barger was honored for "seminal work in studying fundamental particles at colliders and leadership in particle phenomenology, where theory meets experiment." He was one of 502 scientists, engineers and innovators chosen from the AAAS membership to be AAAS Fellows.

Professor Tiancheng Song won this year's Lee Oshersoff Richardson Science Prize. This prize promotes and recognizes the novel work of young scientists working in the fields of low temperatures and/or high magnetic fields or surface science in North and South America. Song is recognized for his efforts in developing and employing various measurement techniques at low temperatures and in magnetic fields to study 2D superconductivity and magnetism in van der Waals heterostructures. His works have uncovered a series of emergent quantum phenomena in 2D superconducting and magnetic systems.


Tiancheng Song

UW–Madison Awards & Honors

Professor Mark Eriksson was awarded a Steenbock Professorship. Steenbock professorships are among the most prestigious and important professorships for researchers at UW–Madison. In the early 1980s, Evelyn Steenbock initiated a program to endow a series of professorships in the natural sciences in honor of her late husband, Harry Steenbock, emeritus professor of biochemistry.


Mark Eriksson

Eriksson's research has focused on quantum computing, semiconductor quantum dots and nanoscience. He is widely recognized for engaging collaborative partnerships with industry, government leaders and other university research institutions to tackle some of the greatest challenges in quantum information science and technology.

Professor Ellen Zweibel has received a Hilldale Professorship. Hilldale Professorships are given to faculty members who excel in scholarly activity, have records of outstanding research or creative work, and show promise of continued productivity.


Ellen Zweibel

Zweibel's work in theoretical astrophysics specializes in plasma astrophysics and focuses on evolution of astrophysical magnetic fields, interstellar astrophysics, star formation, cosmic rays and stellar physics.

Professor Tulika Bose was named to a Vilas Distinguished Achievement Professorship, an award recognizing distinguished scholarship as well as standout efforts in teaching and service. The professorship provides five years of flexible funding — two-thirds of which is provided by the Office of the Provost through the generosity of the Vilas trustees and one-third provided by the school or college whose dean nominated the winner. The awards are supported by the estate of professor, U.S. Senator and UW Regent William F. Vilas (1840-1908).


Tulika Bose

Professor Pupa Gilbert earned two honors this year, including a WARF named professorship. WARF named professorships honor faculty who have made major contributions to the advancement of knowledge, primarily through their research endeavors, but also as a result of their teaching and service activities. Award recipients choose the names associated with their professorships.

Now the John D. Wiley Professor of Physics, Gilbert's research focuses on biomineralization, that is, on understanding the nanoscale formation mechanisms of natural biominerals, especially coral skeletons, but on the side she also studies sea urchin spines, mollusk shell nacre, tooth enamel, and inner ear cochleaer bone. She also strives to understand the evolution of biomineralization.


Pupa Gilbert

Gilbert also earned an Award for Mentoring Undergraduates in Research, Scholarly and Creative Activities. The Office of the Provost offers awards to recognize the important role mentors play in fostering undergraduates' intellectual, personal and professional growth through participation in high-impact practices including research, scholarly and creative endeavors. These awards provide mentors with recognition for their excellence in mentoring undergraduates and their contribution to students' Wisconsin Experience.

Professor Ke Fang (photo on previous page) was named the inaugural recipient of the department's Bernice Durand Faculty Fellowship. This fellowship, given in honor of late Professor of Physics Bernice Durand, recognizes Fang's major contributions to the analysis of data from the NASA Fermi satellite, the High Altitude Water Cherenkov (HAWC) telescope and IceCube, and for fundamental theoretical insights in their multimessenger context.

Celebrating Departmental Staff Awards

Congrats to:

Dr. Jim Reardon for winning a WISCIENCE Lillian Tong Teaching Award, one of the campus-wide awards in recognition of teaching excellence.

Haddie McLean for winning the 2024 Bassam Z. Shakhashiri Public Science Engagement Award. This award honors a staff member who has shown excellence in engaging the public in their work in STEAM (Science, Technology, Engineering, Arts & Math).

Dr. Wasikul Islam, a postdoc with Prof. Sau Lan Wu, for winning a 2024 Wisconsin Initiative for Science Literacy Award for Communicating Postdoctoral Research to the Public.

Dr. Daniel den Hartog for being part of a team that was recently awarded a Progress Award from the Laser Society of Japan. This award is given to research that has shown a significant impact on the advancement of laser engineering.

Gabe Bernhardt on winning the Department's George Ott Staff Award. Ott was a long-time technical staff member who approached his job with dedication, innovation, and collaboration. His family established the Ott Award to recognize similar departmental staff members.

BOARD OF VISITORS AND ALUMNI UPDATES

Opportunities to support the Physics department

By Tom Holley, BoV Chair

If you are open to supporting the Physics Department, "have we got a deal for you!" The Physics Board of Visitors (BoV) is an independent collection of alumni or friends of the department who meet biannually and advise on matters of importance to the Department. The purpose of this article is to whet your appetite to support the Physics Department by highlighting the role of the BoV, including past initiatives and future goals.

Charge of the Physics Board of Visitors

The charge to the Physics Department Board of Visitors as of October 2021 is to:

- Advise and assist the Department in increasing awareness among alumni, students, peers, and the general public of the Department's achievements.
- Assist the Department and the UW Foundation in fundraising.
- Serve as ambassadors and advocates for the Department.
- Advise on mechanisms for optimizing the collective impact of the Department's research activities.
- Provide mentoring, networking, and career assistance to Physics undergraduates, graduate students, and post-doctoral associates.
- Help the Department assess the impact of new research directions on society.

Current Initiatives

The current broad emphasis of the BoV is to enhance the prestige of the Department. Rather than steer to the various survey-type ratings of programs, our focus is on long-term fundamentals which are already strong and getting stronger. Growth of the faculty leads to more impactful research, research awards, and successful graduates. The Physics faculty continues to grow, thanks to the support of Dean Wilcots, and is approaching historic highs.

The UW Physics Department has been strong throughout its history in producing PhDs. for academia, national labs, and industry. The recent specific emphasis of the BoV, at the prompting of the Dean, has been to advise the Department on how to grow the pipeline of undergraduate physics majors who intend to seek employment after their B.S. degree. These students compete with, for example, engineering students, for available positions. A physics degree has always provided a strong basis for such employment. In addition, the AMEP program has a long history of successful alumni. Further, recent changes in the Physics BS curriculum, advised by the BoV and implemented by the department, have increased the flexibility of the degree so that successful students have the flexibility to obtain additional skills, e.g., in computing and analysis of large data sets, which facilitate employment.

With the curriculum improvements approved, the BoV is now engaged in trying to identify summer internships, which are considered crucial by many BS level employers. This initiative has just launched and will require significant effort, which both the BoV and the Department are prepared to exert.

Get Involved!

If you are interested in joining our BoV, the best path is to contact your most familiar faculty member in the Physics Department, e.g., advisor, colleague. The faculty ultimately approves nominees to the BoV. If you are not yet convinced and require more information, feel free to contact Tom Holley, Chair of the Physics BoV, at tkholleyFamily@sbcglobal.net.

BoV Adventures

Service on the BoV is not all work. We also address our own curiosity with research presentations at every meeting, primarily from students, and with field trips. In the recent past, subsets of the BoV have visited:

- CERN in Geneva, Switzerland
- Lawrence Berkley National Laboratory in Berkeley, CA
- The Physical Science Laboratory in Stoughton, WI, home of the Wisconsin High Temperature Superconducting Axisymmetric Mirror (WHAM) plasma fusion device and the construction site for the Digital Optical Modules for the IceCube neutrino laboratory in Antarctica, and
- A tour of FermiLab planned for the near future.

In addition to supporting department initiatives, BoV activities address their own curiosity; for example, on this field trip to CERN in 2019.

Get to know the newest BoV Member

Bill Nichols '75

What is your connection to UW–Madison physics?

I graduated from UW-Madison in 1975 with a B.S. in Physics & Astronomy and immediately entered the workforce, first as a Navy officer in nuclear submarines and then as an engineer in the defense and aerospace industries. After my retirement in 2020, I moved back to Madison and enrolled at UW as a tuition-paying Special Student (UNRS), taking classes to refresh & update my knowledge of Physics, Astronomy and Mathematics.

Why did you want to serve on the BoV?

It's trite to say "giving back", but the physics I learned at UW was foundational to my career in defense and aerospace. I see the BoV as an opportunity to leverage my professional experience to help ensure our students, especially undergrads, will have successful careers whether or not they decide to pursue an advanced degree.

Any BoV projects you're working on that you'd like to highlight or update us on?

Related to the previous question, the BOV has a new initiative to help facilitate industry internships for UW-Madison's physics students, especially undergrads.

Anything else we should know about you?

I'm very much enjoying being a student again and am happy to say that my GPA is significantly higher than when I was an undergrad, nearly 50-years ago!

Distinguished Alumni Awards

Given in recognition of successful careers and the limitless possibilities a physics degree offers, these awards were celebrated at our Awards Banquet in May

John Beacom, PhD '97

By Prof. Baha Balantekin

John Beacom received his PhD working with Prof. Baha Balantekin at UW–Madison in 1997. He is the Henry L. Cox Professor of Physics and Astronomy as well as Arts and Sciences Distinguished Professor of Physics and Astronomy at he Ohio State University. He is the Director of the Center for Cosmology and AstroParticle Physics at Ohio State. He served as the Chair of Division of Astrophysics of the American Physical Society. Beacom's research interests lie at the intersection of the fields of astrophysics, particle physics, and nuclear physics, concerning mostly neutrinos and the weak interactions. Much of his work has been focused on providing theoretical input to what can be measured in neutrino experiments and the implications of the results, for both physics and astrophysics.

Senthil Sundaram, PhD '94

By Prof. Emerit Bob Joynt

Senthil Sundaram received his PhD from the University of Wisconsin–Madison, with Professor Bob Joynt. After spending 25 years on Wall Street in the hedge fund industry, Senthil moved back to Madison in 2019 and co-founded Kula Investments, LLC serving as Chief Investment Officer (CIO). In 2023, he founded the AI-enabled wealth management firm Lyra/MATRIX, where he now serves as CEO.

Alumni Updates

Robert E. Rothe, PhD '64 wrote to inform us of two awards he received over his long career. He was declared worldwide Engineer of the Year in 1980 by the worldwide corporation Rockwell International. Then, in 2007, years after his retirement from his profession as an experimental nuclear physicist in the arena of nuclear criticality safety research, he was awarded a Lifetime Achievement Award by the American Nuclear Society (ANS) at a ceremony in Washington DC.

We received three retirement updates. First, **William Unertl, PhD '72** is now professor emeritus in the Department of Physics & Astronomy at the University of Maine, and **Matthew Vanderhill, PhD 74**, retired from MIT in May 2023 after 45 years with Lincoln Laboratory. **Frederick Kelcz, PhD '75**, MD, writes, "After getting my physics PhD in Madison, I worked as a medical physicist for four years at Columbia Presbyterian Hospital in NYC prior to deciding to go to medical school. Ultimately I became a radiologist, and returned to the UW for a faculty position. I will be retiring as of August 2024, though staying put in Madison."

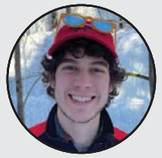
James T. Dobbins III, PhD '85, FAAPM, FSPIE, received a Lifetime Achievement Award in 2023 from the Society of Directors of Academic Medical Physics Programs, Inc (SDAMPP). He is also now retired.

Christopher Allen '18 has a new position as a Research and Development Engineering Specialist with Curt G. Joa, Inc.

Reid Vorbach, MSPQC '21 has been employed within the Pre-Injector research group of BNL's Collider-Accelerator Department as a Physics Associate. He is assisting in research & development of the Electron Beam Ion Source (EBIS), investigating beam alignment physics, and modifying the EBIS stages. He is also assisting in operating & maintaining this stage of the Relativistic Heavy Ion Collider (RHIC) for particle physics experiments performed in later sections of the apparatus.

Welcome, Incoming PhD Class of 2024!


Ahmed Abdalkarim


Isaac Barnhill

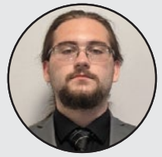

John Batarekh


Benjamin Beyer


Steven Carpenter

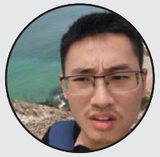

Le-Chih Cho


Riley Crain


Gage Erwin

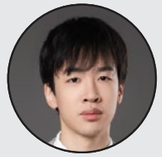

Kayleigh Excell


Zeyu Fan


Shijie Fang


Levi Grantz


Joseph Hammill


Jerry Tianshen He


Faisal Herzallah

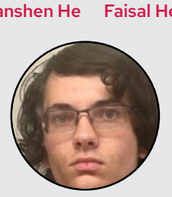

Natalie Hilliard

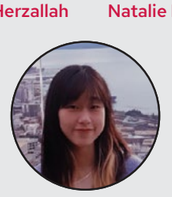

Jifei Huang

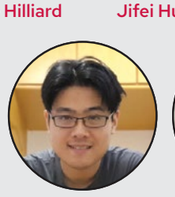

Daniel Humphrey

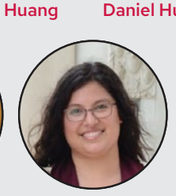

Anna Huynh


Samyak Jain


Nicholas Kapsos


Minyoung Kim

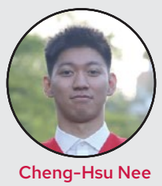

Chen Li


Kyla Martinez


Shiyan Meng

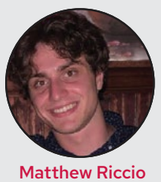

Jihwan Moon

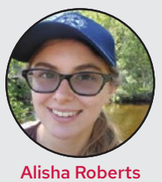

Solomon Murdock

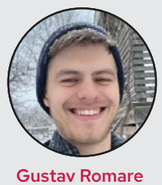

Cheng-Hsu Nee

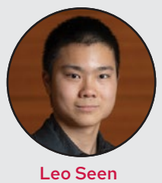

Jihyeon Park

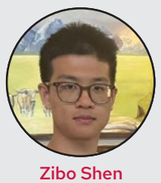

Djin Patch


Matthew Riccio

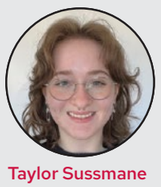

Alisha Roberts


Gustav Romare

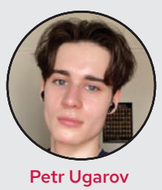

Leo Seen

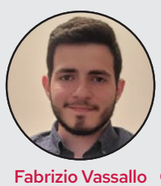

Zibo Shen


Uday Singla


Taylor Sussmane


Matthias Thiesmeyer


Petr Ugarov


Fabrizio Vassallo

Christopher Woolford

Yiming Yang

Yeqing Zhou

Welcome, Incoming MSPQC Class of 2024!

Yash Alapuria

Lucas Anderson

Wyatt Broers

Xu Cai

Ben Cramer

Luke Cvetko

Megan Dalldorf

Nikola Dimitrov

Andre Figueroa

Collin Frink

Hiroki Fujisato

Kanishka Gupta

Prateek Gupta

Su He

Urvi Jain

Xiangxu Kong

Grant Lambert

Dongyang Li

Henry Lin

Harshil Mamidi

Sriram Mudunuri

Abhi Muvva

Modou Njie

David Pagel

Sawatdiwat Poonsawat

Akshat Prakash

Eduard Pretorius

Adam Retana

Lucas Rogers

Bhavyansh Sharma

Kun Shen

George Simonovich

Kunal Sinha

Sparsh Srivastava

Jake Uribe

Jiakai Wang

Siwei Wang

Junxiao Yang

PHYSICS DEGREES AWARDED

Undergraduate Degrees

Fall 2023

Evan Bauer
William Cerne
Ayan Deep Hazra
Yiou Huang
Ye Liu
Abhiram Nallamalli
Nicholas Pederson
Sarah Perlowski
Samuel Pieper
Lucas Rogers
Robert Wheatley

Spring 2024

Paul Aicher
Faith Akervik
Pierce Bartels
Dhanvi Bharadwaj
Kyle Boone
Spencer Bullen
Gillian Cartwright
Nikola Dimitrov
Connor Foust
Alex Geiger
Catherine Gross
Zhiyue Han
Andrii Hopanchuk
Sam Jerabek
Brooke Kotten
Serena LaLuzerne
Seth Luetscher
Charlotte Meyer
Muneeza Munawar
Cheng-Hsu Nee
Casey O'Connor
Henry Popowski
Leo Seen
Jaden Sengkhammee
Lucille Steffes
Connor Strainis
Kendall TerHaar
Petr Ugarov
Jacob Uribe
Annika Vanderberg
Gabriel Voith
Siwei Wang
John Worley
Benek Young

MA/MS Physics Degrees

Joshua Doucette
Winnie Wang
Tian Xie

MS Physics – Quantum Computing Degrees

Fall 2023

Devon Burwell
Dhruvi Kapadia
Liam Scott
Ariela Strimling
Yongxiao Yan

Spring 2024

Preetham Tikkireddi
Atharva Vidwans
Ahmed Abdalkarim

Summer 2024

Jason Baer
Paul Buttles
Tianshen (Jerry) He
Ian Nanez
Jiahao Zhao
Runshi Zhou
Yeqing Zhou

Doctoral Degrees

Fall 2023

Juan Bohorquez
Advisor: Saffman

Michael Bulatowicz
Advisor: Walker

Neil Campbell
Advisor: Rzchowski

Shay Inbar
Advisor: Yavuz

Jeffrey Lazar
Advisor: Halzen

Mitch McNanna
Advisor: Bechtol

Adam Rouhiainen
Advisor: Münchmeyer

Megan Tabbutt
Advisor: Bechtol

Kairui Zhang
Advisor: V. Barger

Spring 2024

Yue Hu
Advisor: Lazarian

Joseph Jepson
Advisor: Hegna

Taweesak Jitsuk
Advisor: Terry

Cristian Vega
Advisor: Boldyrev

Wren Vetens
Advisor: Black

Summer 2024

Yinqi Chen
Advisor: Vavilov

Joey Duff
Advisor: Hegna

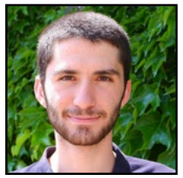
Maria Prado Rodriguez
Advisor: Halzen

Sai Chaitanya Tadepalli
Advisor: Chung

Ho Fung Tsoi
Advisor: Dasu

2024 AWARDS & SCHOLARSHIPS

UNDERGRADUATE AWARDS



Henry & Eleanor Firminhac Scholarship: Ruben Aguiló Schuurs

This award was created by UW–Madison graduate, the late Ralph Firminhac, BS '41 MS '42, in memory of his parents, Henry and Eleanor Firminhac. The Firminhac Award has as a consideration a genuine interest in physics and ability to obtain a degree. Ruben Aguiló Schuurs' research has been in medical physics, where he works on applying interpretability techniques to a hybrid Convolutional Neural Network + Recurrent Neural Network to diagnose Alzheimer's Disease in PET brain scans. He is also developing his career in quantum computing.

Bernice Durand Research Scholarship: Paulina Engovatov

The Bernice Durand Undergraduate Research Scholarship is given with preference to women or to ethnic minorities in physics and astronomy who show research potential, motivation and interest in the discipline. It is named in honor of the late UW–Madison Physics Professor Bernice Durand. Paulina Engovatov is working in Victor Brar's lab, which specializes in researching 2D materials with STM. Later, she hopes to get involved with research relating to quantum computing and quantum machine learning, which she hopes to study in graduate school.

Fay Ajzenberg-Selove Award: Jenna Karcheski

The Fay Ajzenberg-Selove Scholarship Fund supports undergraduate women majoring in or planning to major in astronomy or physics. Jenna Karcheski is interested in Computational Astrophysics and using machine learning to study all scales of the universe. Her main research project involves mentors from Chalmers University of Technology and the University of Virginia. She recently participated in a research internship at the University of Montreal at the Ciela Institute for Astrophysics and Machine Learning as well as the Mila Quebec Artificial Intelligence Institute.

Liebenberg Family Scholarship: Leo Seen

The Liebenberg Family Scholarship is awarded annually based on merit to a junior majoring in physics. Leo Seen is interested in astrophysics and is working on a multi-messenger search for galactic PeVatrons. In addition to doing research, he has been a TA for Physics 207 for two and a half years. In graduate school, he hopes to probe the Galactic Center for neutrino sources.

Hagengruber Scholarship: Zachary Petersen

The Hagengruber Scholarship was established by Roger Hagengruber (BS Physics '66, PhD Physics '72) in gratitude to the Department of Physics for providing opportunities to fund his education while in school and imparting the skills that led to a long, successful career in the field of physics. Zachary Petersen's research focuses on the theory behind quantum computing/condensed matter, using Python to model different conditions of the quantum computer qubit and determine their impact on the wavefunction of the electron.

INGERSOLL AWARDS

Ingersoll Prizes are awarded to students who have done the best work in the undergraduate courses

Physics 247
Carl Yao

Physics 248
Leo Xu

Physics 249
Mihir Manna

GRADUATE AWARDS

Allan M. & Arline B. Paul Award: Rachel Myers

The Allan M. and Arline B. Paul Physics Fellowship is for graduate scholarships in memory of Walter Max Borer, MS '37. PhD student Rachel Myers' research is in plasma physics, specifically in nuclear fusion, and she is working at the DIII-D National Fusion Facility to investigate the origins, growth, and interactions of magnetohydrodynamic instabilities called tearing modes. She will be conducting her own experiments at DIII-D to measure the effect of plasma shaping on tearing mode triggering.

Robertson Leach Graduate Student Award: Paul Buttles

The Robertson Leach Graduate Student Award assists first year graduate students in the Department of Physics. MSPQC student Paul Buttles works in Deniz Yavuz's experimental nonlinear/quantum optics lab, where the team is working to provide the first images of non-transverse electromagnetic waves. Additionally, he is independently working on a problem in quantum game theory, a branch of game theory which introduces quantum effects such as superposition and entanglement to produce a range of new strategies. Longterm, he is interested in experimental quantum foundations.

Van Vleck Award: Utku Saglam

The Van Vleck Award is made possible through the generosity of the Van Vleck Foundation Board of Directors. The fund was established in 1989 and honors John Hasbrouck Van Vleck, one of three recipients of the Physics Nobel Prize in 1977. Van Vleck was a faculty member in the Physics Department from 1928-34. PhD student Utku Saglam works with a team in AMO physics on building an experimental setup for observing the spatial coherence of atoms. He wants to improve the experimental setup and, in the future, he wants to observe these effects on Rydberg atoms.

Charles Mendenhall Award: Priyadarshini Rajkumar

Charles Mendenhall was a faculty member in the Department of Physics from 1901 until his passing in 1935. He was instrumental in making UW–Madison one of the leading centers for graduate work in Physics. The Mendenhall Fellowship supports a graduate student in experimental physics. Priyadarshini Rajkumar's research interests are in condensed matter physics and quantum computing. She is studying the profound effects of quantum mechanical duality in superconducting circuitry. She truly enjoys her time in the lab and the department, as her group is very diverse and fosters a sense of community.

James Nelson Humphrey Award: Georgia Stricklen

James Nelson Humphrey was born in Whitewater, Wisconsin and received his Master's degree in Physics from UW–Madison. He went on to work at the United States Naval Ordnance Laboratory and the University of Maryland, College Park. MSPQC student Georgia Stricklen is interested in using quantum computing techniques to improve the efficiency of optimization algorithms like genetic algorithms and she would like to apply these altered optimization algorithms to problems like power grid optimization for renewable energy sources.

Cornelius P. and Cynthia C. Browne Fellowship: Ho Fung Tsoi

Cornelius Browne received his BA in 1946 in Physics and PhD in 1951 in Physics and Math from the UW–Madison. This award supports graduate students pursuing degrees in experimental physics. Ho Fung Tsoi is interested in AI algorithms to search for new physics beyond the Standard Model with the LHC experiments at CERN.

TEACHING ASSISTANT AWARDS

Joseph R. Dillinger Award for Teaching Excellence
Shu Tian Eu

Best TA Spring 2023
Carter Fox

Best TA Fall 2023
Zachary Jerzyk

Rookie of the Year
Joyce Lin

Outstanding Undergraduate Assistant
Collin Welke

THAXTON FELLOWS

The Hubert Mack Thaxton Fellowship, named after Dr. Thaxton, MA '36, PhD '38, seeks to provide more equitable access to physics research experiences for undergraduates in related fields. Thaxton Fellows collaborate with a faculty mentor in the department on a research project aligned with the students' interests.

Natasha Azad
Valeria Diaz Moreno
Krishna Lakkaraju
Nadia Talbi

WONDERS OF PHYSICS OUTREACH FELLOWS

The Wonders of Physics Outreach Fellows program accepts graduate students who are interested in and committed to conducting physics outreach. Fellows receive mentoring in outreach from professional outreach staff and participate in one or more outreach events over the course of the year.

Ayshea Banes
Gavin Chase
Raheem Hashmani
Mason Kennedy
Joyce Lin
Alicia Mand
Tali Oh
Lael Verace

Senior (returning) Fellows:
Braden Buck
Owen Eskandari
Sam Kramer
Yurii Kvasiuk
Mitanshu Thakore

OTHER STUDENT AWARDS & HONORS

PhD student **Jimena González** joined the UW–Madison chapter of the national Edward Alexander Bouchet Graduate Honor Society this academic year. The Bouchet Society commemorates the first person of African heritage to earn a PhD in the United States. Edward A. Bouchet earned a PhD in Physics from Yale University in 1876. Since then, the Bouchet Society has continued to uphold Dr. Bouchet's legacy.

González also accepted one of Phi Beta Kappa's graduate student induction invitations this year. Meanwhile, physics majors **Will Cerne '23** and **William Griffin** were among the 168 UW–Madison Letters & Science undergraduates inducted to Phi Beta Kappa. UW–Madison's chapter, founded in 1899, seeks to honor students who rigorously explore the sciences, arts and humanities.

PhD student **Justin Edwards** won a prestigious National Defense Science and Engineering Graduate Fellowship. These awards are made to individuals who have demonstrated ability and special aptitude for advanced training in science and engineering. His winning proposal is titled, "Multispectral imaging in the near infrared for next-generation analog night vision systems." Justin is advised by ECE professor and physics affiliate professor Mikhail Kats.

Physics and mathematics major **Nathan Wagner** was awarded a 2024 Goldwater Scholarship, the premier undergraduate scholarship in mathematics, engineering and the natural sciences in the United States. Wagner began research in Prof. Mark Saffman's quantum computing lab in spring 2021 as a high school junior. In Summer 2023, Wagner started research with the Physics Department's High Energy Physics Group, working alongside Prof. Sridhara Dasu and others on future particle colliders design research.

Physics major **Elias Mettner** and astronomy-physics major **Nadia Talbi**, both conducting research in high energy physics, won undergraduate presenter awards at the American Physical Society's April Meeting. The meeting included seven undergraduate oral presentation sessions with six to eight students in each session. The top two students from each session earned "Top Presenter" awards. Mettner and Talbi were the only two UW–Madison students who gave oral presentations, and both won awards. Both students were then invited to present their award-winning talks to the Physics Board of Visitors spring meeting.

PhD student **Joyce Lin** and undergraduates **Brooke Kotten** and **Lucy Steffes** were award winners in the 2024 National Science Foundation's Graduate Research Fellowship Program (NSF GRFP). PhD students **Owen Eskandari**, **Sam Kramer**, **Tali Oh**, and **Julia Sheffler** were awarded Honorable Mentions. NSF GRFs are prestigious and competitive fellowships that help support outstanding graduate research across the country.

Four undergraduate students have earned 2024 Hilldale Fellowships. They are: **Erica Magee**, mathematics and physics major, working with Prof. Martin Zanni in chemistry; **Quinn Meece**, astronomy–physics and physics major, working with Prof. Mark Saffman in physics; **Elias Mettner**, physics major, working with Dr. Abdollah Mohammadi in physics; and **Leah Napiwocki**, astronomy–physics and physics major, working with Dr. Marsha Wolf in astronomy. The Hilldale Undergraduate/Faculty Research Fellowship provides research training and support to undergraduates at UW–Madison. Students have the opportunity to undertake their own research project in collaboration with UW–Madison faculty or research/instructional academic staff.

Cristian Vega, PhD '24 won the Callen Award for Excellence in Theoretical Plasma Physics Research. The Callen Award is awarded annually to a UW–Madison plasma physics graduate student for achievements in plasma theory.

MSPQC student **Preetham Tikkireddi** won second place for his poster, "Understanding security side channel attacks on multi-tenancy quantum computers," at the plenary meeting of the Quantum Economic Development Consortium (QED-C).

Mitanshu Thakore was awarded the LHC Physics Center's Guest and Visitor program support award to carry out research activities for the LHC Physics Center at Fermi National Accelerator Laboratory.

Your gift **matters**

Physics students share what receiving an award means to them

I'm unbelievably grateful for your generosity. As my program draws to a close and my savings run thin, I wasn't entirely sure how I was going to make ends meet without cutting into time for research/classes, much less time for myself and my overall quality of life. This was just the windfall I needed to shore up my finances through graduation so I can focus on what really matters.

Paul Buttles, MSPQC '24
MSPQC student
Robertson Leach Graduate Student Award recipient

I had to take an education loan to pursue my undergraduate studies in the United States. So, I have been allocating a significant portion of my graduate salary toward repaying that debt. Thanks to your generous award, I am much closer to finishing the loan and having the financial freedom to continue pursuing my passion for science. I am deeply grateful for your support.

Priyadarshini Rajkumar
PhD student
Charles Mendenhall Award recipient

This award has given me the opportunity to continue paving a way for other Latinas and Latinos to pursue meaningful careers in physics and it has helped bridge the gap between what I thought was possible for someone like me. Thank you for supporting me in this hard but beautiful journey; I want you to know that you made a difference in the way I see myself in this field!

Valeria Diaz Moreno
Physics and Data Science major
Thaxton Fellowship recipient

I am honored and very grateful to receive this scholarship. It will help me focus my attention on my schoolwork and minimize the need to balance work on top of my difficult classes and marching band schedule. Thank you for your generosity as it has a large impact for us students!

Zachary Petersen
Nuclear Engineering, Physics, and Astronomy-Physics major
Hagengruber Award recipient

I am deeply honored to receive the Dillinger Award. Teaching has been a rewarding journey, and I am grateful for the opportunity to inspire and support students over the semesters.

Shu Tian Eu
PhD student
Joseph R. Dillinger Award for Teaching Excellence recipient

I'm deeply grateful to our donors for making these scholarships possible. As an international student, I rely on donor philanthropy for aid, as I'm ineligible for national scholarships or financial aid. Thanks to this scholarship, I may continue to pursue my research and volunteering opportunities, for the love of physics and outreach!

Ruben Aguiló Schuurs
Physics and Computer Sciences major
Henry & Eleanor Firminhac Scholarship recipient

This award has allowed me to travel to San Diego to finish my dissertation research at the DIII-D National Fusion Facility. Without it, I would not have been able to stay at DIII-D as long as I have and build community there.

Rachel Myers
PhD student
Allan M. and Arline B. Paul Award recipient

Thank you for your generosity and willingness to support future physicists. This money will help me throughout the summer when I won't have income from TAing, so it will allow me to focus more on my research.

Leo Seen '24
Graduated Physics major and now PhD Student
Liebenberg Family Research Scholarship recipient

GIFT GIVING GUIDE

PRIORITY FUND: The Newton Fund

Administered by the Department Chair, this fund aids the department in its research, teaching, and public service roles. The department of physics is in the midst of hiring many new faculty in the wake of the pandemic. There are tremendous opportunities across the amazing breadth of research in our department. Your donation will help launch the research, teaching, and service of the next generation of Wisconsin physics faculty and students.

Please visit ***go.wisc.edu/NewtonFund*** or scan the QR code to give online, or mail in the form on page 24

OTHER DEPARTMENT FUNDS

UNDERGRADUATE

Fay Ajzenberg-Selove Scholarship Fund

Dr. Maritza Irene Stapanian Crabtree Undergraduate Scholarship Fund

Bernice Durand Undergraduate Research Scholarship Fund

Henry & Eleanor Firminhac Physics Scholarship Fund

Liebenberg Family Scholarship in Physics Fund

Hagengruber Fund

Physics Board of Visitors Undergraduate Research Fund

GRADUATE

Allan M. and Arline B. Paul Physics Fund

Carl and Brynn Anderson Graduate Physics Fund

Cornelius P. and Cynthia C. Browne Endowed Fellowship Fund

Joseph R. Dillinger Teaching Award

Albert R. Erwin, Jr. — Casey M. Durandet Graduate Student Fund

Elizabeth S. Hirschfelder Endowment for Graduate Women in Physics

Karl Guthe Jansky & Alice Knapp Jansky Fellowship Fund

Van Vleck Fellowship

Physics Alumni Graduate Award Fund

Phyllis Jane Fleming Graduate Student Support Fund

Gerald W. and Tui G. Hedstrom Physics Fund for Graduate Support

Robertson Leach Graduate Student Fund

Graduate Student Recruiting Fund

Special Physics Graduate Support Fund (Anderson-Huber Fellowship)

Robert M. St. John Graduate Support Fund

Jeff and Lily Chen Wisconsin Distinguished Graduate Fellowship

Raymond G. and Anne W. Herb Wisconsin Distinguished Graduate Fellowship

GENERAL

The Newton Fund

Barschall Enterprise Fund

Ray MacDonald Fund for Excellence in Physics

Friends of the L.R. Ingersoll Museum Fund

Willy Haeberli Fund for the L.R. Ingersoll Physics Museum

The Wonders of Physics Outreach Fund

George E. Ott Award for Staff in the Department of Physics

David Grainger Physics Library Energy Sources College Fund

Physics Community Building Fund

Jane and Clarence Clay Fund for Chaos and Complex Systems

Physics Research Fund for Quantum Science

Raymond G. and Anne W. Herb Endowment Fund in Physics

L.R. Ingersoll Physics Fund

Dalton D. Schnack Memorial Fund

Atomic Collision Research Fund

Elementary Particle Physics Institute Fund

Quantum Computing Research Center Fund

Thomas G. Rosenmeyer Cosmology Fund

John H. Van Vleck Physics Endowment Fund

ENDOWED FACULTY FUNDS

Bernice Durand Faculty Fellowship in Physics Fund

Martin L. Perl Chair Fund

Dunson K. Cheng Chair in Physics Fund

Carl J. and Brynn B. Anderson Professorship in Physics Fund

Please visit physics.wisc.edu/giving/funds for fund descriptions or to make a secure gift with your credit card. A mail-in donation form may be found on page 24 of this newsletter.

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I wish to designate my Gift to the following fund(s) (please see Page 23 for fund details)

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