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The Wisconsin Physicist

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***The Wisconsin Physicist* is the newsletter for alumni and friends of the:**
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Page 9: (top) Romulo Ueda / Ueda Photography
Page 11: (right) CMS collaboration
Page 14: Provided by Woody Mo

On the Cover

UW–Madison graduate students Joel Siegel and Margaret Fortman, along with colleagues in Engineering, submitted this photo — one of 12 winning entries — to UW–Madison's 2021 Cool Science Image contest. This scanning electron micrograph shows mazes of tiny structures less than 15 billionths of a meter across and made of some of the smallest ribbons of graphene — layers of carbon just a single atom thick — ever fabricated. These structures represent an important step toward graphene-based telecommunications devices.

And, be sure to check out two other contest winners from Physics on the back cover!

Stay Connected!

Please continue to send us your professional and personal news! We will be happy to include updates from alumni and friends in *The Wisconsin Physicist*. Send updates to: news@physics.wisc.edu or fill out our online form at: physics.wisc.edu/alumni-update

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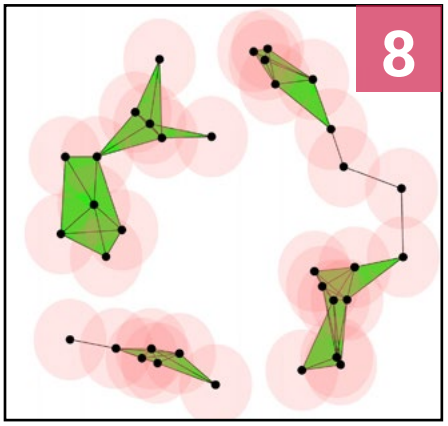
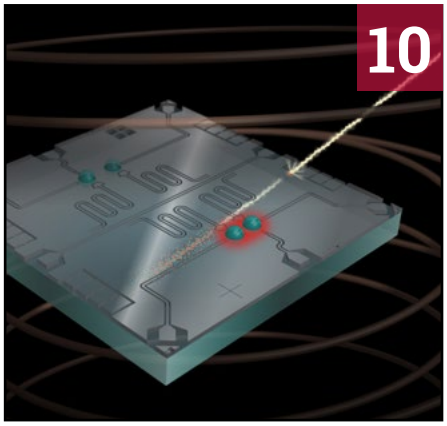




Greetings from the Chair

Dear Alumni and Friends,

As I write this letter from my office in Chamberlin Hall, I can see the sidewalks of University Avenue and Charter Street bustling with students, and I am reminded how much has changed in the past year.

This Fall semester the university welcomed its largest freshman class in history. Chamberlin Hall is buzzing, and our department is once again teaching in-person courses to over 3,200 students.

In Physics we welcomed 29 incoming PhD students this fall and 13 new students into our MS in Physics – Quantum Computing program. We also added a new leadership role in the department, naming Kevin Black as the Associate Chair for Graduate Studies. He joins Jeffrey Schmidt, the Director of Graduate Studies, Bob Joynt, the MSPQC Director, and Sharon Kahn – our new graduate program coordinator – in leading our graduate programs.

Reaching this point required tremendous effort. I start here with a deep sense of gratitude and thanks to Sridhara Dasu, who provided outstanding leadership during his four years as chair, and who guided our department through what we all hope has been the bulk of the pandemic. COVID-19 required our university and department to adapt with ever-changing policies and procedures. Special thanks are due to Mark Rzchowski, Mark Saffman, Jim Reardon, Steve Narf, Brett Unks, Allison Tredinnick, Aimee Lefkow, and many others for responding thoughtfully, quickly, and with great flexibility both to ensure safety and to continue our high level of performance in education and research.

Our department said farewell to two dear friends this year: emeritus professors Barney Webb and Willy Haeberli passed away. Their contributions to our department and their fields have been innumerable.

Barney earned both his bachelor's ('50) and doctoral ('56) degrees from our department, returning in 1961 as a tenured associate professor. His research focused on surface physics, using especially low-energy electron diffraction and scanning tunneling microscopy. He served as Department Chair, University Committee Chair, and Athletic Board Chair. In memories shared by former students of his, one thought was repeated by many: Barney was a wonderful mentor.

Willy joined the faculty in 1956. His research focused on studying spin effects in nuclear processes and in fundamental interactions. He was also an accomplished teacher, co-developing the still-popular course Physics 109: Physics in the Arts, and teaching in the department for nearly five decades. Pupa Gilbert perhaps said it best: "Willy is a giant in my life. He was career changing, life changing, teaching changing, everything. Just the most amazing person I could have ever met."

For much more about both Barney and Willy, please see page 7 of this issue.

On January 1 of this year, three new assistant professors joined our department. Ke Fang is an astroparticle physicist, a member now of WIPAC, who uses theory and experiment to study the universe through ultrahigh energy cosmic rays, gamma rays, and high-energy neutrinos. Lu Lu, also an astroparticle physicist and with WIPAC, is searching for sources of ultrahigh-energy particles, and in this quest she is working to develop next-generation astroparticle detectors. Moritz Münchmeyer, a theoretical and computational cosmologist, focuses on theory and analysis of data from multiple observatories. He is also pursuing the development of machine learning techniques to probe fundamental physics with cosmological data.

We expect to grow the physics faculty again in 2022. First, we will be welcoming our own alumnus Kyle Cranmer, PhD '05, back to UW–Madison. Kyle has been named the Director of the American Family Data Science Institute, and his professorial home department will be Physics. He will start in July of this coming year.

We currently are searching to fill two open faculty positions: the Dunson Cheng Endowed Assistant Professor of Physics and a Professor of Quantum Science and Engineering. We are grateful to Dunson Cheng, mathematics and AMEP '66, for generously endowing this professorship, which will allow us to make a highly competitive offer to a promising early-career condensed matter physicist. Our other search is part of a campus-wide cluster in Quantum Science and Engineering. Emeritus Professor Chun Lin's generous financial support has been critical in enabling outstanding startup funding for this hire. Both hires will work closely with the Wisconsin Quantum Institute, as well as the multi-institutional Department of Energy and National Science Foundation quantum centers — Q-NEXT and HQAN, respectively — in which UW–Madison plays a prominent role.

This year, the department was proud to host an investiture ceremony honoring Uwe Bergmann, the Martin L. Perl Endowed Professor in Ultrafast X-ray Science. The installation of an endowed professorship — the first for our department — is a ceremony of dignity with many academic traditions. We hope that Uwe's ceremony was the first of many to come. We will be searching in the

near future for a Carl J. and Brynn B. Anderson Endowed Professor, established by a generous gift from Carl (MS '76, PhD '79) and Brynn. We will also be seeking to fill the Bernice Durand Faculty Fellowship, established with the leadership of our Board of Visitors. These professorships and fellowships are critically important to our department's teaching and research, and we are deeply grateful to the donors that make them possible.

Our faculty received well-deserved university, national, and international acclaim this year. Ellen Zweibel was elected to the National Academy of Sciences for her many contributions to plasma effects in astrophysical systems. Zweibel also was elected as Fellow of the American Association for the Advancement of Science, "for distinguished contributions to quantify the role of magnetic fields in shaping the cosmos on all scales."

Francis Halzen was awarded the Homi Bhabha Medal for his "distinguished contributions in the field of high-energy cosmic-ray physics and astroparticle physics over an extended academic career." Halzen and the IceCube Collaboration were awarded the Bruno Rossi Prize "for the discovery of a high-energy neutrino flux of astrophysical origin". Halzen also was named a UW–Madison Vilas Research Professor. These awards and others to our faculty are described in detail on pages 12 and 13 of this newsletter.

Even through the pandemic this past year, our students, faculty and research staff continue to publish extremely high-quality physics research in top journals. The IceCube collaboration published in Nature the observation of a Glashow event, as we highlighted in a quarterly e-newsletter earlier this year. Graduate student Chris Wilen with his advisor Robert McDermott and their collaborators, published in Nature a characterization of a multi-qubit quantum chip. Pupa Gilbert, Mikhail Kats, and their collaborators published in PNAS a new method for nondestructive imaging of biominerals. For more highlights, please see pages 10-11 of this publication, and feel free to check the frequently updated news section on our department website.

Our department has also taken three large steps in reinvigorating our long and strong tradition of scientific outreach. After a successful Day of the Badger fundraising campaign and generous matching funds from emeritus professor Clint Sprott, the Department is thrilled to have welcomed Haddie McLean and restarted The Wonders of Physics traveling show. Cierra Atkinson joined us to focus on the Ingersoll Physics Museum. With NSF funding, we welcomed Mallory Conlon as our Quantum Science outreach coordinator. You can learn more about the department's continued commitment to outreach on page 14 of this issue.

In closing, it is an honor to serve as the chair of the Department of Physics. At a time of transition for the University, as we start the process of emerging from a pandemic that is not yet over, I am pleased to report that our department is well-positioned to build on our past and current strengths to transmit, curate, and develop new knowledge across the amazing breadth that is the field of physics.

— Mark Eriksson, Department Chair and John Bardeen Professor of Physics

Announcing the Hubert Mack Thaxton Fellowship

By Keith Bechtol, Assistant Professor of Physics and Thaxton Fellowship Program Director

In 2020, The American Institute of Physics (AIP) National Task Force to Elevate African American representation in Undergraduate Physics and Astronomy (TEAM-UP) released a report that provides a recent comprehensive review of the persistent challenge of underrepresentation of African Americans in undergraduate physics programs in the United States. The report found that "the persistent underrepresentation of African Americans in physics and astronomy is due to (1) the lack of a supportive environment for these students in many departments, and (2) to the enormous financial challenges facing them and the programs that have consistently demonstrated the best practices in supporting their success."

The TEAM-UP report further identified five factors responsible for the success or failure of African American students in physics and astronomy — Belonging, Physics Identity, Academic Support, Personal Support, and Leadership & Structures — and made recommendations to address each of these factors. Among the highest priority recommendations, the TEAM-UP Report emphasizes the importance of creating paid research opportunities for undergraduate students. Participation in undergraduate research can directly address several of the factors above.

To provide more equitable access to physics research experiences for undergraduate students at UW-Madison, the Department of Physics is pleased to announce the Hubert Mack Thaxton Fellowship. Thaxton (MA'36, PhD '38) was the fourth African American to receive a PhD in physics in the United States. He studied nuclear physics at UW–Madison, making significant contributions to the understanding of proton-proton scattering. He went on to a distinguished career in physics research, engineering, and education.

Thanks to generous support from the Ray MacDonald Fund, the Department will support up to five students a year who will conduct up to 250 hours of paid research with a faculty sponsor. They will also present their work at campus and other symposia and conferences. The program is accepting applications for the 2021-22 academic year, and we look forward to sharing the students' successes. Please visit go.wisc.edu/ThaxtonFellows for more info and updates throughout the year.

FACULTY UPDATES

In 2021, we welcomed three new faculty. We also lost two dear colleagues.

Welcome, Professor Ke Fang!

By Madeleine O'Keefe, WIPAC

When you think of scientific meccas throughout the world, Madison, Wisconsin might not be the first place that comes to mind. But for astroparticle physicist Ke Fang, Madison is the place to be. That's because it's home to the Wisconsin IceCube Particle Astrophysics Center (WIPAC): the "leader of particle astrophysics in the world," according to Fang. "Throughout the years, there have been all kinds of meetings and workshops that drive people in this field to Madison because it's the center for particle astrophysics," she says.

Originally from Huangshan, China, Fang earned a B.S. in physics from the University of Science and Technology of China. Afterward, Fang moved to the United States for graduate school and earned her PhD in astrophysics from the University of Chicago in 2015. Following that, she went to the University of Maryland and the Goddard Space Flight Center for a Joint Space-Science Institute fellowship. Most recently, Fang was a NASA Einstein Fellow at Stanford University in California. She joined the UW–Madison faculty on January 1.

Can you summarize your research?

I use both experiments and theory to understand extreme activities of our universe. We receive multiple types of messengers from the universe — all the way from optical light to gamma rays, cosmic rays, neutrinos, and gravitational waves. These messengers can be emitted by a common source, such as a binary neutron star merger. Specifically, I use theoretical models to understand how these astrophysical events produce different messengers, whether theoretical models explain the data, and how the data compare with theoretical models. I also use the HAWC Observatory, the IceCube Neutrino Observatory, and the Fermi Large Area Telescope (Fermi-LAT) to observe or to find sources directly. For example, I jointly analyze the Fermi-LAT and HAWC data to observe gamma-ray sources from 0.1 GeV to 100 TeV — across six orders of magnitude. Studies using multiple messengers and wavelengths are rewarding because they help us get a full picture of what these astrophysical sources look like.

How did you get into your field of research?

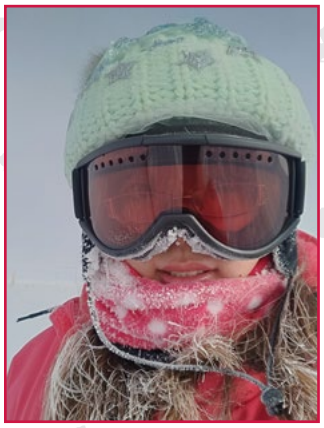
When I started graduate school, high-energy astrophysics was rather new; it's a field that has quickly grown in the past decade or so. High-energy astrophysics traditionally refers to astrophysics with X-ray observations, because X-rays are higher in energy compared to the optical band that astronomers traditionally use. But in the last few years, high-energy astrophysics has had another burst of delving into even higher energies. When we move up in energy, by millions or billions, we see many new sources that were previously not observable in the X-ray band, or different aspects of sources that were previously seen at lower energies. And there are so many unknowns in this field; we can see surprising things at the highest energies, and many of those observations are discoveries. I think that's really intriguing.

What attracted you to UW–Madison and WIPAC?

I think it's pretty fair to say that WIPAC — with IceCube, CTA, HAWC, Fermi-LAT, ARA, and IceCube-Gen2 — is now the leader of particle astrophysics in the world. I think there's a close match between my expertise and what is currently being done at WIPAC, and I'm excited about joining the department and joining these explorations of higher and higher energy neutrinos and gamma rays.

What hobbies/other interests do you have?

Cooking! I like to explore different things. I come from China, so Chinese cuisine is what I started from when I just moved to the United States. But after all these years, I'm getting more exposed to different types of cuisines and starting to explore more, like with Thai and Italian. When I go to nice restaurants, I try to remember the name of the dish and find the recipe online.



Welcome, Professor Lu Lu!

By Sarah Perdue, Department of Physics

New UW–Madison assistant professor of physics Lu Lu's research program combines the past with the future. Her research looks for sources of ultrahigh energy particles, which is done by analyzing data that has already been collected. As she says, "Maybe data is already talking to us, we just haven't looked." But she is also working toward improving future data collection, which will require more technologically-advanced detectors. "My teachers, my great masters, have taught me that the current young generation has the responsibility to look into new techniques to go to the future for younger generations to proceed forward," she says about her work in sensor R&D.

On January 1, Professor Lu joined the Department of Physics and WIPAC. Most recently, she was a postdoctoral fellow at the International Center for Hadron Astrophysics at Chiba University in Japan.

What are your research interests?

My prime interest is astroparticle physics, and my ultimate goal is to find the sources of the highest energy particles in the universe. These particles carry energy of about 10^{20} electronvolts. This is higher energy than what we have from the Large Hadron Collider and human technologies. The real attractiveness here is we don't know how nature accelerates these particles. And once we identify the sources, we can test new theories beyond the Standard Model using sources created by nature.

What are one or two main projects you focus your research on?

I'm involved in two experiments. One is IceCube, the other is Pierre Auger Observatory. I was doing cosmic ray analysis, but cosmic rays are usually charged particles and they are deflected in the magnetic field of the galaxy; they would not travel in a straight line. IceCube studies neutrinos which are neutral particles, they travel directly from the source. Pierre Auger detects ultrahigh energy photons, which are also neutral particles. One thing I want to do is to combine these two experiments to do a joint analysis. We have photon candidates but we haven't really tried to connect them in the multimessenger regime. By combining Pierre Auger photons with IceCube neutrinos, we could possibly find a transient source, a source that doesn't constantly emit ultrahigh energy photons or neutrinos but all of a sudden there's a flare. This type of analysis has never been done, but we have data on disks.

The second thing I'm interested in is using new sensor technologies. In IceCube, we have Gen2 being planned right now, and UW–Madison is taking the lead of designing this future detector. There's also radio technology which doesn't have to go as deep as optical technology. For optical you have to make the detectors very dense, but for radio you can make the antennas further apart, so that means you can have a larger area and detect more events easily. I think radio is the way to go for the future.

You said you have a lot of data collected already and just need to analyze it. How do you analyze the data from these detectors?

We would have to search for photon candidates from the data from Auger, and identify where it comes from and what time this event happened. Correspondingly, do we see neutrinos from IceCube coming from the same direction and at the same time? Because you can never be sure it's a photon. It could be a proton. We then want to build a statistical framework to combine different multimessengers together in real time.

What does it mean if you find a photon in coincidence with a neutrino?

Cosmic rays were first detected more than 100 years ago, and there's a rich history of studying where they come from. The mystery of origins still remains today because our poor knowledge on the galactic/extragalactic magnetic fields and mass composition of cosmic rays. In my opinion, the most probable way to solve this puzzle is to use neutral particles. If we can identify ultrahigh energy photons in coincidence with neutrinos, that is a smoking gun that we are actually looking at a source and we can finally pin down where in the universe is accelerating high energy particles. And therefore, we can study particle physics maybe beyond the Standard Model. It's just like a lab created by the universe to test particle physics.

What hobbies and interests do you have?

I'm afraid I'll disappoint you because my hobby is related to my research: augmented reality. I made an app called IceCubeAR with a group of friends in Tokyo.

Welcome, Professor Moritz Münchmeyer!

By Sarah Perdue, Department of Physics

Theoretical and computational cosmologist Moritz Münchmeyer's research combines theoretical investigation, the analysis of data from different observatories, and the development of machine learning techniques to probe fundamental physics with cosmological data. On January 1, he joined the Department of Physics. Most recently, he was at the Perimeter Institute for Theoretical Physics in Waterloo, Ontario, where he was a Senior Postdoctoral Fellow.

What are your research interests?

I work at the intersection of theory and observation in cosmology. On the one hand we have the mathematical theories of how the universe works, and then we have observations made by telescopes and detectors. The universe, of course, is incredibly complicated. There are many forces and particles and radiation that all interact with each other. And that makes it often hard to go from observational data to the theory that you're interested in. We want to know, for example, what were the laws of physics in the very early universe? Or how does the universe evolve? And so, I develop new methods to use the data to probe the theories.

One thing that I'm very excited about now is using techniques from data science and machine learning for cosmology. As everybody knows, there's a machine learning revolution going on which is having an impact on many fields, including cosmology. But the techniques in machine learning are often developed to do things like object recognition in images. They do not necessarily work well for the kind of data that we have, which has very different properties and is described by physical theories. So, I'm trying to adapt these machine learning techniques, or find new ones, that are specifically suited for the problems of cosmology.

I also work on new theoretical ideas to use observational data. There will be a huge influx of new cosmological data in the next decade: many experiments are being built and they are often much better than previous experiments. We'll get amazing new data of the universe and I'm thinking about how to use this data to learn more about fundamental physics, for example by combining different data sources in new ways that have not been explored before.

What is the source of the data you use in your research?

When I started in cosmology, I became a member of the Planck satellite collaboration, which was a Cosmic Microwave Background (CMB) experiment. Many of the best measurements of cosmological parameters, such as the age of the universe, come from Planck. Of course, now we are building even better CMB experiments, such as the Simons Observatory which I am a member of. In about two years it will start to take precision measurements of the radiation from the early universe. I am also a member of the CHIME experiment, which is detecting Fast Radio Bursts, a new exciting source of data for cosmology and astrophysics. In Madison I am looking to also become involved with Vera Rubin Observatory, one the major upcoming galaxy surveys, which can be combined with CMB experiments. Prof. Keith Bechtol in the physics department is a leading contributor to this experiment. As a theorist, I am not involved much in the data taking process, but once the data is taken, my group will work on its analysis with the methods we have developed.

What are the first research projects your group has been working on?

The broad subject we're working on is to learn about the initial conditions of the universe from CMB and galaxy data. We are developing new statistical tools and machine learning methods towards this goal. We will also think about new ideas to use cosmological data, such as the Fast Radio Bursts I mentioned before.

What hobbies and interests do you have?

I have a family with two young children, so I like to go on adventures with them. I also play piano, especially to get my mind off physics. My current favorite sport is Brazilian Jiu-Jitsu. I've also always been interested in entrepreneurship. A few years ago, I co-founded a small company, Wolution, which uses machine learning — not in cosmology, but for image analyses in biosciences, agriculture, and other fields.

Remembering Professor Barney Webb

By Sarah Perdue and Department Archives

Professor Emeritus Maurice Barnett "Barney" Webb passed away January 15, 2021 in Middleton, WI. He was 94.

Born and raised in Neenah, WI in 1926, Professor Webb earned his both his undergraduate ('50) and doctoral ('56) degrees from the UW–Madison Department of Physics. After graduating, he went to work at General Electric Research Laboratory as a staff scientist. In 1961, he returned to UW–Madison as a tenured Associate Professor of Physics.

Webb served as Department Chair from 1971-1973, taking the reins of a department that had been traumatized by the 1970 Sterling Hall bombing. In 1977, he was named chair of the University Committee, the Executive Committee of the faculty and the most important and visible manifestation of faculty governance at UW–Madison. From 1985-1990, he served as Chair of the UW–Madison Athletic Board. He had been an Emeritus Professor with the department since his retirement in 2001.

Remarkably, Barney was as prominent in the scientific community as he was on campus. His research interests included surface physics, low-energy electron diffraction, and scanning tunneling microscopy. In 1987, he was awarded the Davisson-Germer Prize in Atomic or Surface Physics from the American Physical Society "For his contribution to the development of low-energy electron diffraction as a quantitative probe of the crystallography defect structure, and dynamics of surfaces."

A 1996 celebration of Barney Webb (front row, center) and his career was attended by many students and colleagues. From left to right: Jim Schilling, Ray Phaneuf, Art Kotz, Bill Weber, Bill Packard, Barney, Ed Conrad, Bill Unertl, John Unguris, Brian Swartzentruber, Liz Moog, Max Lagally

To read colleagues' tributes, please visit
go.wisc.edu/2j247h for Barney
go.wisc.edu/316a3s for Willy

Remembering Professor Willy Haeberli

By Sarah Perdue, Pupa Gilbert, Baha Balantekin, and Department Archives

Professor Emeritus Willy Haeberli passed away October 4, 2021. He was 96.

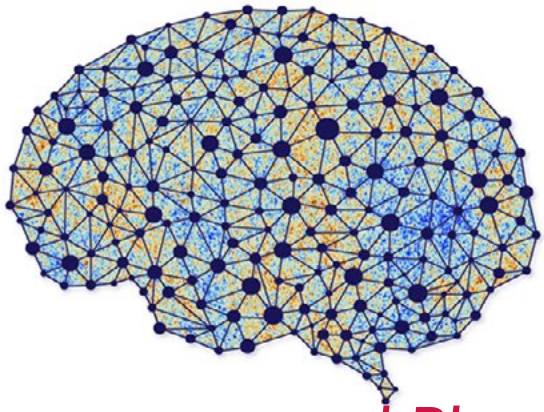
Born in Zurich, Switzerland on June 17, 1925, Haeberli received his PhD from the University of Basel (Switzerland) in 1952. He joined the faculty of UW–Madison in 1956, retiring in 2005.

Haeberli was a world-class experimental nuclear physicist. His research focused on studying spin effects in nuclear processes and in fundamental interactions. He and his collaborators developed spin-polarized gas targets of atomic hydrogen and deuterium. These "Haeberli cells" were used in many experiments worldwide including the Indiana University Cyclotron Facility, Brookhaven National Laboratory, and DESY Laboratory in Germany, and they were crucial for the success of those experiments.

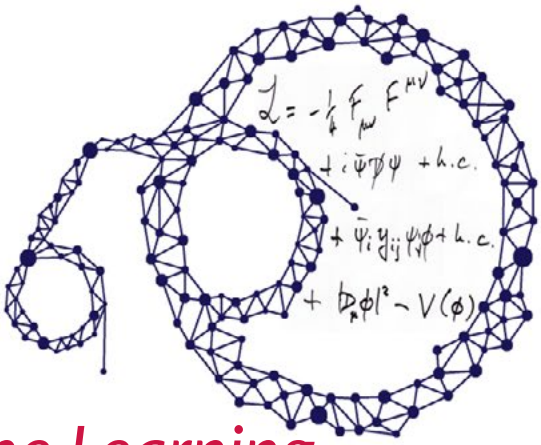
Charles H. Holbrow and Willy Haeberli at the Haeberli Fest symposium in 2005.

Haeberli was the Raymond G. Herb Professor of Physics and a Hilldale Professor. He was elected to the American Academy of Arts and Sciences and the National Academy of Sciences, and he won the American Physical Society's Bonner Prize in nuclear physics in 1979.

In addition to his scientific achievements, Haeberli was an accomplished teacher. He taught physics courses at UW–Madison for 49 years and developed the popular course Physics 109: Physics in the Arts, with Prof. Ugo Camerini. Physics in the Arts has been offered successfully and continuously since 1969, and has been emulated by tens of universities across the country. In the last five years before retiring, he co-taught the course with Prof. Pupa Gilbert. After he retired, Gilbert convinced him to co-write a textbook for Physics in the Arts, published by Academic Press-Elsevier in 2008, and 2011, translated into Chinese and published by Tsinghua University Press in 2011.



Machine Learning meets Physics



— and Physics meets Machine Learning

By Sarah Perdue, Department of Physics

Machine learning and artificial intelligence are certainly not new to physics research — physicists have been using and improving these techniques for several decades.

In the last few years, though, machine learning has been having a bit of an explosion in physics, which makes it a perfect topic on which to collaborate within the department, the university, and even across the world.

"In the last five years in my field, cosmology, if you look at how many papers are posted, it went from practically zero to one per day or so," says assistant professor Moritz Münchmeyer. "It's a very, very active field, but it's still in an early stage: There are almost no success stories of using machine learning on real data in cosmology."

Münchmeyer, who joined the department in January, arrived at a good time. Professor Gary Shiu was a driving force in starting the virtual seminar series "Physics ∩ ML" early in the pandemic, which now has thousands of people on the mailing list and hundreds attending the weekly or bi-weekly seminars by Zoom. As it turned out, physicists across fields were eager to apply their methods to the study of machine learning techniques.

"So it was natural in the physics department to organize the people who work on machine learning and bring them together to exchange ideas, to learn from each other, and to get inspired," Münchmeyer says. "Gary and I decided to start an initiative here to more efficiently focus department activities in machine learning."

Currently, that initiative includes Münchmeyer, Shiu, Tulika Bose, Sridhara Dasu, Matthew Herndon, and Pupa Gilbert, and their research group members. They watch the Physics ∩ ML seminar together, then discuss it afterwards. On weeks that the virtual seminar is not scheduled, the group hosts a local speaker — from physics or elsewhere on campus — who is doing work in the realm of machine learning.

In the next few years, the Machine Learning group in physics looks to build on the momentum the field currently has. For example, they hope to secure funding to hire postdoctoral fellows who can work within a group or across groups in the department. Also, the hiring of Kyle Cranmer — one of the best-known researchers in machine learning for physics — as Director of the American Family Data Science Institute and as a physics faculty member, will immediately connect machine learning activities in this department with those in computer sciences, statistics, and the Information School, as well other areas on campus.

"There are many people [on campus] actively working on machine learning for the physical sciences, but there was not a lot of communication so far, and we are trying to change that," Münchmeyer says.

To learn more about machine learning and AI initiatives in the department, visit ml.physics.wisc.edu

Machine Learning Projects in the Department

Kevin Black, Tulika Bose, Sridhara Dasu, Matthew Herndon and the CMS collaboration at CERN use machine learning techniques to improve the sensitivity of new physics searches and increase the accuracy of measurements.

Pupa Gilbert uses machine learning to understand patterns in nanocrystal orientations (detected with her synchrotron methods) and fracture mechanics (detected at the atomic scale with molecular dynamics methods developed by her collaborator at MIT).

Moritz Münchmeyer develops machine learning techniques to extract information about fundamental physics from the massive amount of complicated data of current and upcoming cosmological surveys.

Gary Shiu develops data science methods to tackle computationally complex systems in cosmology, string theory, particle physics, and statistical mechanics. His work suggests that Topological Data Analysis (TDA) can be integrated into machine learning approaches to make AI interpretable — a necessity for learning physical laws from complex, high dimensional data.

The Wonders of Outreach

By Sarah Perdue, Department of Physics

When the pandemic put many university activities on hold, some things moved full steam ahead — including the department's commitment to physics outreach.

Thanks to grant funding and generous support from donors, the department made three key outreach hires in 2021: Quantum Science Outreach Specialist Mallory Conlon, and The Wonders of Physics Outreach Specialists Haddie McLean and Cierra Atkinson.

Conlon, who holds BS and MS degrees in astronomy from the University of Illinois and was active in astronomy outreach there, was the first to join in January. She was hired through the NSF-funded Quantum Leap Challenge Institute known as Hybrid Quantum Architectures and Networks, or HQAN, of which UW–Madison is a member. She oversees all outreach programs run through HQAN.

Conlon is working to introduce quantum physics into the department's long-running program, The Wonders of Physics, as well as developing in-classroom or at-home interactive quantum science kits that kids can use with very little instruction while still learning quantum physics concepts. She is also helping to bring HQAN's other outreach programs to UW–Madison and the state of Wisconsin, such as Teach Quantum, a University of Chicago program that trains high school physics teachers to develop quantum physics modules to bring to their classrooms.

"I'm so excited to be in this position because I'm developing programs, engaging people in quantum physics, and helping them figure out where their place is in this field," Conlon says. "Plus quantum is mind-bending and really cool!"

Above: Grad student Kayla DeHolton, Haddie McLean, grad student Jessie Thwaites, and Mallory Conlon present "Quantum Plinko" at Treinen Farm as part of the Wisconsin Science Festival. Treinen Farm made a Schrödinger's Cat corn maze this year. Top: Haddie McLean and astronomy-physics undergrad Ben Havlicek demonstrate angular momentum with a volunteer at Science on the Square.

Over the summer, the department was thrilled to bring back The Wonders of Physics traveling show with the hiring of McLean. The Wonders of Physics has been a tradition in the department dating back to 1983, when emeritus professor Clint Sprott began the annual shows. The Wonders of Physics traveling show started in the late 1980s as an offshoot of the annual shows when two graduate students at the time, David Newman and Christopher Watts, approached Sprott and suggested that they take the show on the road.

Over the years, The Wonders of Physics traveling show has gone from an all-volunteer, graduate student-led effort to one that has employed part- or full-time outreach specialists. The traveling show had been on hiatus for five years due to lack of funding. Now, thanks to the support of generous donors — including a successful Day of the Badger fundraising campaign — the department expects that the traveling show will be run by department staff for years to come.

McLean, a former meteorologist with WISC-TV / Channel 3 in Madison, began her Wonders outreach role in August, and has already developed, booked, and presented several live shows, including the Wisconsin Science Festival's Science on the Square event in October.

"I love talking to people about science. And I love seeing kids' faces light up when they understand a concept or learn something new," McLean says. "My hope for the traveling show is that it's fun and engaging, gets kids excited, and helps spark an interest in the next generation of scientists."

Lastly, in October, the department welcomed Atkinson, a former high school physics teacher with formal training in science education. Her initial focus is on the Ingersoll Physics Museum, where she will be looking at how K-12 students engage with the exhibits, how exhibits can be more interactive, and how the museum can connect with lessons the students are learning in their classrooms.

Atkinson perfectly summed up the overall excitement the department has for this burst of outreach activity that came about in 2021:

"It is really fulfilling to collaborate with others on new ways to engage students in science," she says. "I'm really excited that we have a team for outreach, because together we will be able to develop even more fun and meaningful science experiences for the public."

Want to learn more about our outreach initiatives in fulfillment of the Wisconsin Idea? Please visit:

physics.wisc.edu/outreach

RESEARCH HIGHLIGHTS

A look back at research from across the department in 2021

New nondestructive optical technique reveals the structure of mother-of-pearl

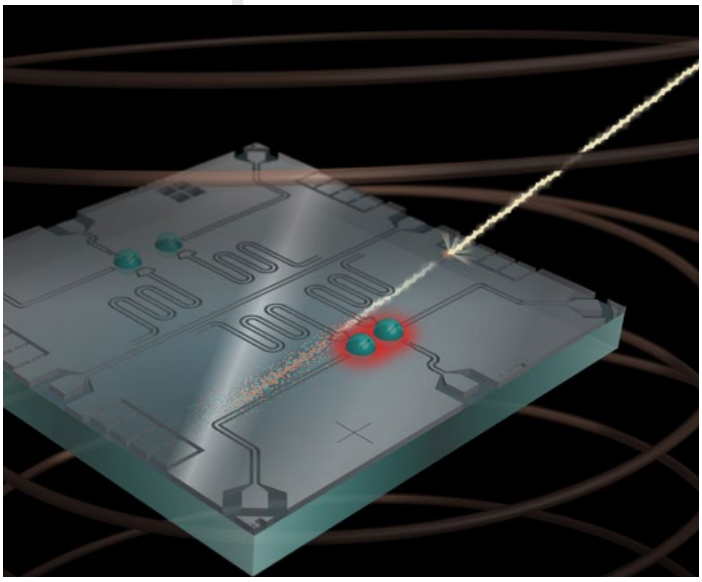
By Jason Daley, College of Engineering

Most people know mother-of-pearl, an iridescent biomineral also called nacre, from buttons, jewelry, instrument inlays and other decorative flourishes. Scientists, too, have admired and marveled at nacre for decades, not only for its beauty and optical properties but because of its exceptional toughness.

"It's one of the most-studied natural biominerals," says Pupa Gilbert, a UW–Madison physics professor who has studied nacre for more than a decade. "It may not look like much — just a shiny, decorative material. But it can be 3,000 times more resistant to fracture than aragonite, the mineral from which it's made. It has piqued the interest of materials scientists because making materials better than the sum of their parts is extremely attractive."

Now, a new, nondestructive optical technique will unlock even more knowledge about nacre, and in the process could lead to a new understanding of climate history. Gilbert, UW–Madison electrical engineering professor Mikhail Kats — who is also an affiliate professor of physics — their students, and collaborators described the technique, called hyperspectral interference tomography, in the journal Proceedings of the National Academy of Sciences.

For the full story, please visit
go.wisc.edu/x096da



Correlated errors in quantum computers emphasize need for design changes

By Sarah Perdue, Department of Physics

Quantum computers could outperform classical computers at many tasks, but only if the errors that are an inevitable part of computational tasks are isolated rather than widespread events.

Now, UW–Madison physicists have found evidence that errors are correlated across an entire superconducting quantum computing chip — highlighting a problem that must be acknowledged and addressed in the quest for fault-tolerant quantum computers.

The researchers reported their findings in a study published in the journal Nature, Importantly, their work also points to mitigation strategies.

"I think people have been approaching the problem of error correction in an overly optimistic way, blindly making the assumption that errors are not correlated," says UW–Madison physics professor Robert McDermott, senior author of the study. "Our experiments show absolutely that errors are correlated, but as we identify problems and develop a deep physical understanding, we're going to find ways to work around them."

For the full story, please visit
go.wisc.edu/8kgiuk

Celebrating IceCube's first decade of discovery

By IceCube Collaboration Staff

It was the beginning of a grand experiment unlike anything the world had ever seen. Ten years ago, the IceCube Neutrino Observatory fully opened its eyes for the first time.

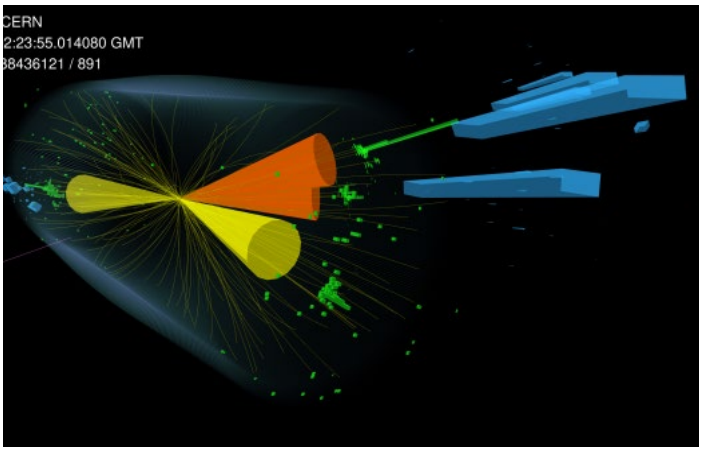
Over the course of the previous seven years, dozens of intrepid technicians, engineers, and scientists had traveled to the South Pole — one of the coldest, driest, and most isolated places on Earth — to build the biggest, strangest telescope in the world. Crews drilled 86 holes nearly two-and-a-half kilometers deep and lowered a cable strung with 60 basketball-sized light detectors into each hole. The result was a hexagonal grid of sensors embedded in a cubic kilometer of ice about a mile below the surface of the Antarctic ice sheet. On December 18, 2010, the 5,160th light sensor was deployed in the ice, completing the construction of the IceCube Neutrino Observatory.

The purpose of the unconventional telescope was to detect signals from passing astrophysical neutrinos: mysterious, tiny, extremely lightweight particles created by some of the most energetic and distant phenomena in the cosmos. IceCube's founders believed that studying these astrophysical neutrinos would reveal hidden parts of the universe. Over the course of the next decade, they would be proven right.

IceCube began full operations on May 13, 2011 — ten years ago this year — when the detector took its first set of data as a completed instrument. Since then, IceCube has been watching the cosmos and collecting data continuously for a decade.

During its first few years of operation, IceCube accumulated vast amounts of data, but it wasn't until 2013 that the observatory yielded its first major results.

For the full story, please visit
go.wisc.edu/34yq16



Does the behavior of the Higgs boson match the expectations?

By CMS Collaboration; adapted by Sarah Perdue

A recent study from the CMS Collaboration, focuses on the events where the Higgs boson decays into a pair of tau leptons using data collected by the experiment between 2016 and 2018. The analysis measures the Higgs boson production cross section as a function of three key variables: the Higgs boson momentum in the direction transverse to the beam, the number of jets produced along with the Higgs boson, and the transverse momentum of the leading jet. New Physics could manifest in excess of events in the frequency distribution of these variables when compared with the standard model predictions.

Says Andrew Loeliger, a UW–Madison physics grad student and one of the lead authors on the study:

"The Higgs Boson is the most recent addition to the standard model of particle physics, discovered jointly between the CMS and ATLAS collaborations in 2012, so a big goal of the High Energy Physics field is to make very detailed measurements of its properties, to understand if our predictions are all confirmed, or if there is some kind of new physics or strange properties that might foreshadow or necessitate further discoveries.

"This work provides a very fine-grained consistency check — alternatively, a search for deviations in the amount — that the Higgs Boson is produced with the amounts/strengths we would expect when categorizing alongside some second interesting property, of which the transverse momentum of the Higgs Boson is a big one. This type of analysis had not been performed before using the particles we used, so it may open the door for far more precise measurements in places we may not have been able to make before, and a better overall confirmation of the Higgs Boson's properties."

For the full story, please visit
go.wisc.edu/o314uh

FACULTY AWARDS & HONORS

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

Professional Society Honors

Ellen Zweibel, National Academy of Sciences and American Association for the Advancement of Science Fellow

Astronomy and physics professor Ellen Zweibel has been honored with membership in the National Academy of Sciences. Members are chosen "in recognition of their distinguished and continuing achievements in original research," and Zweibel was chosen for her work on the way magnetic fields shape the universe, including the physics of plasmas in stars and galaxies and the cosmic rays they throw out into the universe. She was also elected as a Fellow of the American Association for the Advancement of Science. The honor is bestowed annually on members of AAAS who are nominated by their peers and recognized for their efforts to advance science and society. She was elected "for distinguished contributions to quantify the role of magnetic fields in shaping the cosmos on all scales."

Francis Halzen, Bhabha Prize and Rossi Prize

The International Union of Pure and Applied Physics (IUPAP) and the Tata Institute of Fundamental Research (TIFR) in Mumbai, India, have awarded the 2021 Homi Bhabha Medal and Prize to Francis Halzen, the Hilldale and Gregory Breit Distinguished Professor of Physics at the University of Wisconsin–Madison and principal investigator of IceCube, for his "distinguished contributions in the field of high-energy cosmic-ray physics and astroparticle physics over an extended academic career." The 2021 Bruno Rossi Prize was awarded to Francis Halzen and the IceCube Collaboration "for the discovery of a high-energy neutrino flux of astrophysical origin." The Bruno Rossi Prize is awarded annually by the High Energy Astrophysics Division of the American Astronomical Society and is awarded "for a significant contribution to High Energy Astrophysics, with particular emphasis on recent, original work."

Ke Fang, Shakti Duggal Award

Ke Fang has been selected as the recipient of the 2021 Shakti P. Duggal Award presented by the International Union of Pure and Applied Physics (IUPAP). The Duggal Award was established after cosmic-ray physicist Shakti Duggal's untimely death in 1982, and is given biennially "to recognize an outstanding young scientist for contributions in any branch of cosmic ray physics." Fang's research focuses on understanding the universe through its energetic messengers, including ultra-high-energy cosmic rays, gamma rays, and high-energy neutrinos. She runs numerical simulations to study theories of astroparticle sources and analyzes data from HAWC, Fermi-LAT, and IceCube.

Pupa Gilbert, Mineralogical Society of America Fellow

Pupa Gilbert was elected a Fellow of the Mineralogical Society of America. Members who have contributed significantly to the advancement of mineralogy, crystallography, geochemistry, petrology, or allied sciences and whose scientific contribution utilized mineralogical studies or data, may be designated as Fellows upon proper accreditation by the Committee on Nomination for Fellows and election by the Council.

Other External Honors

Victor Brar, Sloan Fellowship

Victor Brar was named a 2021 Sloan Research Fellow, a competitive award given to researchers in the early stages of their careers. More than 1000 researchers are nominated each year for 128 fellowship slots. Brar's research focuses on developing new microscopy techniques to look at quantum systems in ways that current microscopes cannot. He hopes that by applying this technique to complex materials, new particles may be identified and studied.

Sau Lan Wu, Phi Beta Kappa Excellence in Teaching Award

The Phi Beta Kappa, Alpha Chapter of Wisconsin presented the 2021 Phi Beta Kappa Excellence in Teaching Award to Enrico Fermi distinguished Professor of Physics Sau Lan Wu. She was nominated by Yan Qian '21. Phi Beta Kappa is the nation's oldest academic society honoring the liberal arts and sciences.

UW–Madison Awards & Honors

Francis Halzen, Vilas Research Professor

Francis Halzen has been named a Vilas Research Professor. Created "for the advancement of learning," Vilas Research Professorships are granted to faculty with proven research ability and unusual qualifications and promise. The recipients of the award have contributed significantly to the research mission of the university and are recognized both nationally and internationally.

Deniz Yavuz, Vilas Associate

The Office of the Vice Chancellor for Research and Graduate Education named Deniz Yavuz as a winner of the Vilas Associates Competition. The Vilas Associates Competition recognizes new and ongoing research of the highest quality and significance. Recipients are chosen competitively by the divisional research committees on the basis of a detailed proposal.

Cary Forest, WARF Innovation Awards finalist

Each fall the WARF Innovation Awards recognize some of the best of inventions at UW-Madison, and Cary Forest (with research staff members Jay Anderson and John Wallace) are part of one of six finalists teams selected by WARF for their disclosure, "High-Energy Plasma Generator for Medical Isotope Production, Nuclear Waste Disposal & Power Generation."

Yang Bai promoted to Full Professor

Yang Bai was promoted to Full Professor this year. "His creativity and impressive breadth in particle physics research make him a leader not only on dark matter, but also more generally on Beyond-the-Standard-Model Physics," says Eric Wilcots, Dean of the College of Letters & Science.

Deniz Yavuz, John Sarff, and Paul Terry, Research Forward

In its inaugural round of funding, the Office of the Vice Chancellor for Research and Graduate Education's (OVCRGE) Research Forward initiative selected 11 projects, including two with physics department faculty involvement. The two projects from the department are: Compact and efficient terahertz optical modulators, Deniz Yavuz (PI); and Integrated stellarator concept study for a new U.S. stellarator experiment at UW–Madison, John Sarff and Paul Terry (co-investigators).

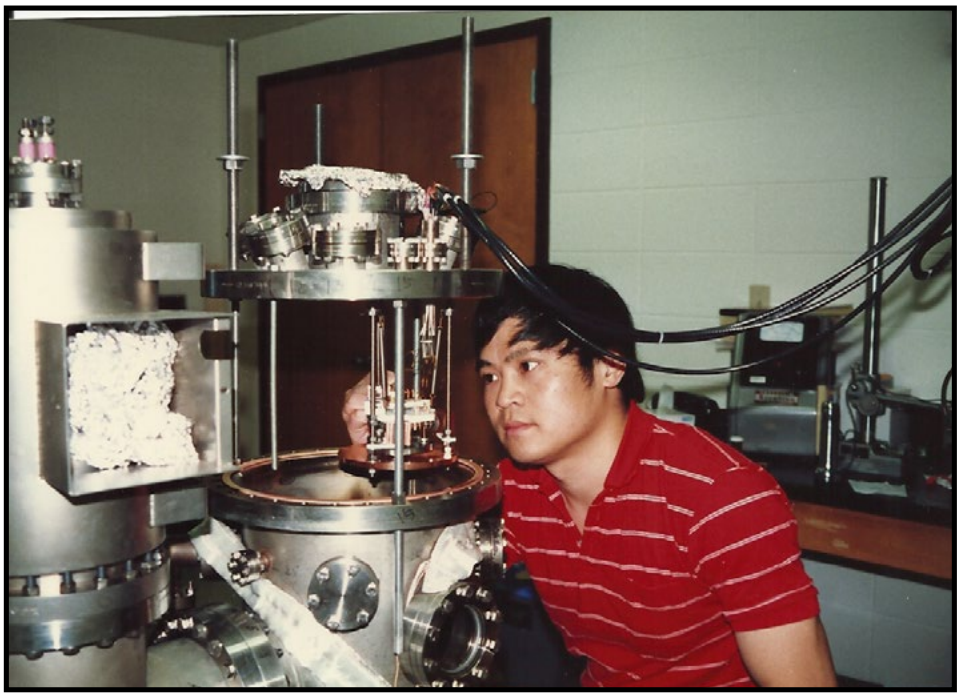
Woody Mo: The Elements of Making Insurance Easy

By Sarah Perdue, Department of Physics

When Woody Mo, PhD '91, applied to physics graduate programs in the 1980s, synchrotrons were a big deal — and UW–Madison's Synchrotron facility was a draw for him.

Before he could start his research, Mo, like many graduate students, began his program as a teaching assistant. He was assigned to late emeritus professor Barney Webb's Physics for Poets course, one of the 100-level courses for non-science majors.

"It was challenging for me because we tend to use a lot of very technical words," Mo recalls. "Barney got me into really thinking about how to explain physics concepts using very simple language, and to create a huge sense of passion and love around how beautiful physics is. Honestly, he made me love physics."



Woody Mo in the lab in 1987.

After passing the qualifier exam, Mo was ready to pursue synchrotron radiation research. But Webb began telling him about a new tool, the scanning tunneling microscope (STM), that allows researchers to see the individual atoms on solid crystal surfaces.

"Barney actually influenced me, and I switched fields," Mo says. "That was a lucky event for me. Barney became my advisor, with Max Lagally in Engineering, and I was in one of the few groups in the whole world to build the first STM and study the surface of silicon."

After a successful PhD that included several publications in journals such as Physical Review Letters and the 1990 Nottingham Prize for the best thesis in surface science, Mo had offers for tenure-track faculty positions even without postdoctoral experience. He ultimately decided on a research scientist position with the IBM T. J. Watson Research Center in the field of surface physics.

He then moved into management consulting with McKinsey & Company, working with the insurance industry and gaining an understanding of the inefficiencies that existed. After five years with McKinsey, Mo left to start his own company, eBaoTech, a global leader in insurance technology, where he has served as President and CEO since 2000. eBaoTech has over 200 customers in over 30 countries, and employs over 1600 people.

"I started a company to make insurance easy. That is still the tagline for our company: Make insurance easy," Mo says.

While physics and insurance may seem like very disparate fields, Mo's physics education prepared him in numerous ways. For example, he uses the Periodic Table of the Elements as an analogy for standardizing methods across any industry. The elements are fundamental principles which can then be combined in numerous different "molecules" to form the applications. Instead of creating new sets of capabilities for each problem, Mo's model reduces inefficiencies by finding shared, standardized capabilities.

Mo points out that a physics education prepares students to solve big challenges and ask the deep, probing questions needed to do so. He encourages students to follow their hearts and find a problem for which they are passionate and apply physics to it.

"There are many, many real problems that are ahead of us — climate change is obviously a huge one — and physics can play a very big role in solving these big challenges," Mo says. "I still believe that a physics education is one of the best foundational educations you can get because a lot of things are changing quickly, but physics, the principles, the laws, the methodologies, are very stable."

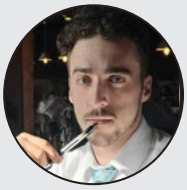
WELCOME, INCOMING GRADUATE CLASS OF 2021!

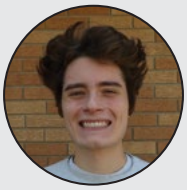
PhD Students

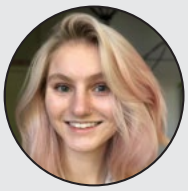

Zain Abhari


Jared Benson


Emma Brann


Theodore Bucci

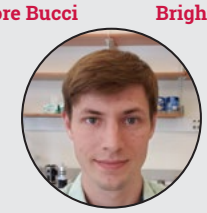

Brighton Coe


Caroline Doctor


Justin Edwards


Carter Fox


Minhal Gardezi


Daniel Heimsoth


Tyler Kovach


Carrie Laber-Smith

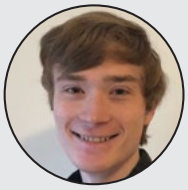

Hong Ming Lim


Ethan Yixiang Lu

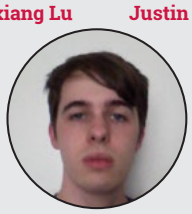

Justin Marquez

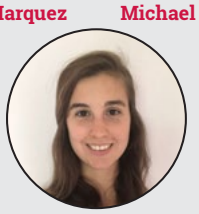

Michael Martinez

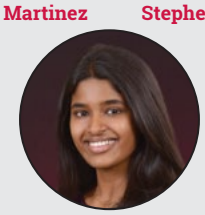

Stephen McKay

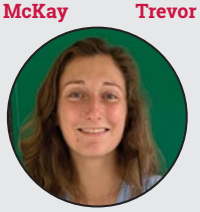

Trevor Nelson


Sam Norrell


Jesse Osborn


Angelina Partenheimer


Priya Rajkumar


Zoe Rechav


Jack Reily


Faizah Siddique


Matthew Snyder


Gabriel Spahn


Spencer Weeden


Hongyi Wu

MSPQC Students


Brooke Becker


Soyeon Choi


Manish Chowdhary


Jacob Frederick

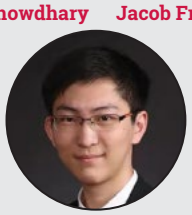

Xunyao Luo


Arjun Puppula


Evan Ritchie


Yen-An Shih


Qianxu Wang


Jiaxi Xu


Anirudh Yadav

Yukun Yang

Jin Zhang

A MESSAGE FROM DEAN WILCOTS, FALL 2021

This fall marks a return to in-person classes and events, and it is exciting to be back on campus with students and colleagues! Our classrooms are full, our labs are humming and the frisbees are flying again on Bascom Hill. The university's COVID-19 protocols are continually adjusted based on the shifting state of the virus. With safe behavior and a campus vaccination rate of more than 90 percent, I am hopeful that we will successfully navigate the fall and winter.

There is much good news to share. UW-Madison welcomed our largest-ever freshman class, with more than 8,400 new students arriving in early September. In October, we celebrate the conclusion of the wildly successful All Ways Forward campaign, which has raised $4 billion for UW-Madison, and $652 million for the College of Letters & Science. Annual giving, too, is on track this year, mirroring strong pre-COVID giving trends. I would like to extend my deepest gratitude to alumni whose unwavering support through the hardest of times enabled us to emerge stronger and ready to meet future challenges.

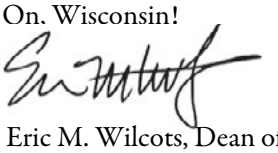
We have great news on capital projects to share. The Wisconsin legislature has approved funding for a new academic building for the College of Letters & Science. Departments and classes currently housed in the deteriorating Humanities Building will be relocated to a modern, interactive and world-class space that will transform the student learning experience.

A new building for our School of Computer, Data & Information Sciences is also underway, paving the way for this powerhouse new unit to meet a global need for students trained in computational thinking, big data, AI and related fields.

Finally – our highly-anticipated new Chemistry Building should open in 2022, and the impact on our STEM programs will be profound.

It feels great to look forward to so much. As always, a heartfelt thank you for all you do to support L&S. It means the world to us.

On, Wisconsin!



Eric M. Wilcots, Dean of the College of Letters & Science
Mary C. Jacoby Professor of Astronomy

Physics Board of Visitors Updates

By Craig Heberer, Chair, Board of Visitors and Bob Joynt, Associate Chair for Alumni Affairs

The Physics Department Board of Visitors (BoV) met online this fall semester on Oct. 7-8. It was a productive meeting. The BoV is now creating a more self-sustaining formal structure, and we were able to push this process considerably forward. We discussed and drafted bylaws that set out goals for the BoV and delineate the responsibilities of the board officers and regular members. This should be helpful in further discovering and implementing best practices followed by other UW–Madison boards. In particular, the Physics BoV has a history of collaborating with other BoVs.

Along the same lines, the BoV is constituting three subcommittees that will have duties during the course of the year. This will enable the BoV to keep momentum between the semi-annual meetings. Three subcommittees are already constituted: one for development, one for department ranking, and one for quantum science. The immediate focus of the development committee will be alumni outreach, with the aggressive goal of establishing one more endowed professorship within two years. The ranking committee is researching the various published rankings with an eye toward advising the department on strategies to raise its ranking. The chief concern of the quantum science committee is to promote new funding models, especially for starting up new labs, since this area of physics is particularly expensive in that regard.

Finally, the BoV is looking for new members! Please get in touch with Craig at craig.heberer@gmail.com or Bob at rjjoynt@wisc.edu if you are interested.

The Year in Photos

Top photos (L-R): After several virtual graduation celebrations, we were able to host an in-person ceremony for the 2021 MS in Physics – Quantum Computing graduates; graduating senior Doreen Dai '21 proudly wears her I ♥ Physics shirt while picking up her graduation swag; Chair Mark Eriksson kicks off the return to in-person Friday colloquium with the annual State of the Department address. Bottom photos (clockwise): The Wonders of Physics annual show was replaced this year by a video contest, with winning entries receiving a plaque (shown) and other prizes; Uwe Bergmann presented his investiture ceremony public lecture at the Discovery Building in September; the graft of Newton's Apple Tree continues to thrive in the Botany Gardens; The Physics Graduate Student Council once again held their annual (virtual, this year) Pi Day bake-off, where department members voted for baked goods — like this Pecan Pi Pie by graduate students Jessie Thwaites, Elise Chavez, and Emily Joseph — based on appearance.

2021

Awards and Scholarships

UNDERGRADUATE AWARDS

Fay Ajzenberg-Selove Award: Briana Wirag

This award is presented to undergraduate women majoring in Physics, Astronomy, or Physics/Astronomy to encourage them to continue their careers in science. Briana Wirag's research interests are in astrophysical topics, more specifically using direct detection methods to find the Dark Matter particle. As a high school student, she interned in the department and worked with a small group of UW–Madison students cleaning and bundling cables for the LZ Direct Dark Matter Detector.

Dr. Maritza Irene Stapanian Crabtree Award: Katiya Claire Fosdick

This fund was established by William Crabtree to honor his wife, Dr. Maritza Crabtree, who graduated with a Physics degree in 1971. This annual award benefits undergraduate students in Physics based equally on merit and need. Katiya works with Prof. Eric Wilcots on the evolution of galaxies. She studies galaxy evolution by examining the environments in which galaxies are located: galaxy groups. Her research interests include particle astrophysics, high energy astrophysics, and observational cosmology and large structure formation.

Bernice Durand Research Scholarship: Haley Stueber

This award is given with preference to women or to ethnic minorities in Physics and Astronomy who show research potential, motivation and interest in the discipline. Haley Stueber currently works in X-ray astrophysics with Prof. Dan McCammon, and she is interested in pursuing graduate studies in high energy physics or cosmology. She also enjoys participating in outreach activities that inspire an interest in physics in others.

Hagengruber Scholarship: Gage Siebert

This scholarship was established by Roger Hagengruber, for a Wisconsin resident undergraduate Physics student who shows exceptional promise for a future in Physics. Gage Siebert is a Physics and Mathematics major from Fremont, WI. He is conducting research in Prof. Peter Timbie's group on radio astronomy and cosmology. He is currently working on the optics of NASA's EXCLAIM mission and constructing a periodicity search using the Tianlai Radio Array.

Liebenberg Family Scholarship: David Kwak

This scholarship is awarded to Physics, AMEP or Astronomy majors. It was initiated by the Liebenberg family for the purpose of promoting undergraduate summer research opportunities. David Kwak works in observational cosmology and condensed matter theory. He is involved with understanding instrumental behavior for making the 3D hydrogen map of the universe, and also working on some problems in superconductivity and mathematical physics. He hopes to pursue a PhD with focus on high energy physics theory and cosmology theory.

Albert Agustus Radtke Award: Kenny Jia

The Albert Agustus Radtke award is for undergraduate junior or senior students in theoretical physics or electrical engineering. Haoyi (Kenny) Jia is working in experimental high energy physics, and is interested in general particle physics. His current research is a feasibility study of a novel muon collider for measuring the Higgs self-coupling.

GRADUATE AWARDS

Phyllis Jane Fleming Award: Kayla Leonard DeHolton

This award provides support for a female doctoral candidate in any year of training in physics at UW–Madison. Kayla Leonard DeHolton is a graduate student working on the IceCube Experiment studying neutrino oscillations. The neutrinos that Kayla is interested in are created in Earth's atmosphere by cosmic rays which then travel through the Earth. By the time they are detected in IceCube, their composition has changed. These changes are known as "flavor oscillations" and her analysis is measuring the parameters that govern these oscillations.

Albert R. Erwin, Jr. & Casey Durandet Award: Jimena González

This fund supports graduate students working in experimental high energy physics,. Jimena González works in astrophysics and cosmology, studying the nature of dark energy by analyzing double-source plane lenses (DSPLs). DSPLs are systems composed of a heavy foreground galaxy and two additional galaxies located behind the first one. These systems are interesting because the distances between their galaxy members define a variable that is more sensitive to the dark energy parameters than to other cosmological parameters, making it a terrific statistical candidate for this analysis.

Allan M. and Arline B. Paul Award: Jay Chan

This award is for graduate scholarships in memory of Walter Max Borer, MS Physics, Class of 1937. Jay Chan is a student in Prof. Sau Lan Wu's group, and he works on high energy experiments in which the properties of the Higgs Boson or search for Dark Matter are measured through collisions of protons. He spent three years at CERN in Geneva and now he has moved to the Berkeley Lab to work on the upgrade of the future pixel detector.

Van Vleck Award: Sai Chaitanya Tadepalli and Bindesh Tripathi

This award provides support to graduate students in the department and is made in honor of John Hasbrouck Van Vleck, one of three recipients of the Nobel Prize in Physics in 1977. Sai Chaitanya Tadepalli works in the field of cosmology, and his present research is based on the study of the blue axionic isocurvature perturbations (quantum fluctuations) generated during the early universe. Bindesh Tripathi works in theoretical plasma physics, specifically using its principles in astrophysical problems. His recent work is on plasma astrophysical turbulence.

Karl Guthe Jansky & Alice Knapp Jansky Award: Scott Lucchini

This award alternates annually between an outstanding graduate student in Physics and one in Astronomy. Karl Guthe Jansky received a BA and MA in physics in 1927 and 1936, respectively. Scott Lucchini works on computer simulations of interacting galaxies. He uses the UW high performance computing center's supercomputer to run high resolution simulations that show how the Magellanic Stream could have been pulled out of the Magellanic Clouds to learn more about the galaxies' history as well as the composition and properties of the Magellanic Stream today.

Elizabeth S. Hirschfelder Award: Rachel Sassella

This award assists women graduate students in Physics at UW-Madison. Hirschfelder received a PhD in Chemistry in 1930 from UW–Madison. Rachel Sassella is interested in plasma physics with the goal of developing practical fusion energy sources. The Pegasus Toroidal Experiment, where she works and studies, focuses on startup concepts for fusion devices. She's interested in how turbulence and other nonlinear effects can promote or disrupt desirable equilibrium states.

DEPARTMENT TA AWARDS

Joseph R. Dillinger Award for Teaching Excellence:
Weng-Him Cheung

No Photo Available

Best TA Spring 2020:
Bindesh Tripathi

Best TA Fall 2020:
Daniel Girotti-Hernandez

Rookie of the Year:
Matt Cambria

Pandemic in-person teaching awards

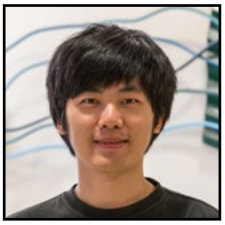
Mrunal Korwar
Piotr Marciniec
Soren Ormseth
Kunal Sanwalka
Richard Toohey
Winnie Wang
Weng-Him Cheung
Yurii Kvasiuk
Linipun Phuttitarn
John Podczerwinski
Arjav Sharma
Keenan Smith

OTHER STUDENT AWARDS & HONORS


NSF Graduate Research Fellowship: Emma Brann and Zoe Rechav

The National Science Foundation's Graduate Research Fellowship Program recognizes and supports outstanding graduate students in NSF-supported STEM disciplines who are pursuing research-based master's and doctoral degrees at accredited US institutions. The fellowship offers three years of financial support.

QISE-NET Graduate Fellowship: Chuanhong (Vincent) Liu



The Quantum Information Science and Engineering Network (QISE-NET) provides selected students with up to three years of funding. Students benefit from the mentorship of both an academic advisor and one from a leading technology company or national laboratory. Chuanhong (Vincent) Liu's mentoring partnership is with NIST.


L&S Teaching Fellow: Daniela Girotti-Hernandez and John Podczerwinski

The Teaching Fellow Award is granted to TAs from the College of Letters and Science who have achieved outstanding success as students and teachers. Winners of this award serve as instructors at the L&S Fall TA Training, which takes place at the start of the fall semester and welcomes 300-400 new and experienced TAs from across campus.

L&S Continuation of Study Award: Gage Bonner

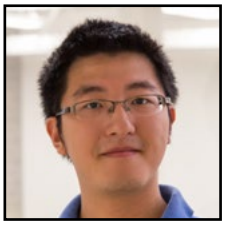
This new award category recognizes graduate students in L&S who provided exceptional continuity of instruction support to their department or delivered exceptional student experience in a remote instructional setting during the COVID-19 pandemic. Bonner was nominated for his work as a TA in Physics 109, Physics in the Arts.

Three Minute Thesis® finalist: Jimena González

Jimena González was one of nine finalists for UW–Madison's Three Minute Thesis® competition. 3MT® is an international research communication competition in which graduate students explain their research to a general audience.

Goldwater Scholar: Gage Siebert

The Barry Goldwater Scholarship is considered the country's preeminent undergraduate scholarship in the natural sciences, mathematics and engineering. The scholarship program honors the late Sen. Barry Goldwater and was designed to develop highly qualified scientists, engineers and mathematicians. Gage Siebert was one of three UW–Madison students to receive the honor.



DOE Office of Science Graduate Student award: Alex Wang

Alex Wang was one of 65 graduate students selected for the Department of Energy's Office of Science Graduate Student Research (SCGSR) program. SCGSR awardees work on research projects of significant importance to the Office of Science mission and that address societal challenges at national and international scale. Awardees carry out part of their research at a DOE national lab, and his host lab is the SLAC National Accelerator Laboratory.

Hilldale Scholars: Gage Siebert, Haley Stueber, Sam Christianson, Renxi Li, Shenwei Yin, and Heqiao (Wonder) Zhu

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. Siebert and Stueber are both conducting research in the Department of Physics, while Christianson, Li, Yin, and Zhu are physics majors conducting research in other departments. Additionally, computer sciences major Nikhilesh Venkatasubramanian received an award for research being conducted in the department.

Physics Degrees Awarded

Undergraduate Degrees

Fall 2020

Brett Danen
Jacob Dwinell
Yixian Gan (AMEP)
Maximilian Grobbelaar
Wilson Hernandez
Arvind Jeyabalan
Yitong Liu
William Ortola Leonard
Henry Rahmes
Zoe Snyder
Yanchao Wang

Spring 2021

James Armstrong
Aaron Bailey
Jacqueline Beran
Kory Byrnes
Joseph Cambio
Benjamin Capistrant
Brandon Cortez
Logan Crooks
Doreen Dai
Jacob Dassler
Victor Fernandez
Quinn Fetterly
Luke Garrity
Jacob Goss
Ethan Grover
Xihe Han
Nicholas Havlicek
Zachary Hebeisen-Verdoorn
Nathanael Hoffman
Drue Hood-McFadden
Dian Jin
Marcus Koseck
Jalyn Krause
Cedric Laseman
Jacob Lundquist
Max McLachlan
Brett Merriman
Eric Meyerson
Daniel Miron Jr
William Mulvaney
Eloise Petruska
Yan Qian
Owen Rafferty
Joseph Schwartz
Adam Shandonay
Saif Shawkat
James David Sinclair
Benjamin Steck
David Szymulewski
Kecheng Wang
Sophia Wells
Yanlin Wu
Lin Zhao

Summer 2021

Nicholas Decheine
Jeremy Ren
Zeyu Gu

MS Physics Degrees

Sina Soleimanikahnoj

MS Physics – Quantum Computing Degrees (August 2020)

Rafael Alapisco
Carter Dewey
Fengguang Liu
Swagat Kumar
Jacob Lenz
Linipun Phuttitarn
Jack Reily
Bradley Shrader
Richard Toohey
Yi Feng

Doctoral Degrees

Fall 2020

Nathan Holman
Advisor: Eriksson

Usama Hussain
Advisor: Dasu

Patrick Vanmeter
Advisor: Den Hartog, Sarff

Blake Wetherton
Advisor: Egedal

Spring 2021

Torrin Bechtel
Advisor: Hegna

JP Dodson
Advisor: Eriksson

Ekmel Ercan
Advisor: Coppersmith, Friesen

Benjamin Hokanson-Fasig
Advisor: Hanson

Gabriel Jaffe
Advisor: Eriksson

Vanessa Lopez Barquero
Advisor: Halzen

Tom McJunkin
Advisor: Eriksson

Chris Yip
Advisor: Saffman

Summer 2021

Michael Cervia
Advisor: Balantekin

Douglas Endrizzi
Advisor: Forest

Qinrui Liu
Advisor: Halzen

William Luszczak
Advisors: Karle

Ariel Rock
Advisor: Everett

Note: Due to an administrative error, Sam Neyens (Advisor: Eriksson) was not listed last year as a Spring 2020 doctoral graduate. We regret the omission.

Alumni Updates

Gerald R. North, PhD '66, has retired from the Texas A&M University Department of Atmospheric and Oceanic Sciences. He now holds the title of University Distinguished Professor Emeritus. The Texas A&M Press has published a book, "The Rise of Climate Science: A Memoir of Gerald R. North" which includes a chapter about his time at UW–Madison. Gerald worked with Prof. Goebel for his graduate work.

Darrel Branhagen '72, MA, wrote to let us know that he is enjoying retirement in Austin, TX. At UW–Madison, Darrel worked with Prof. Barshall.

Maria-Ester Brandan, PhD '79, earned her degree with Prof. DeLuca in Medical Physics and is now a Full Professor with the Institute of Physics at the National Autonomous University of Mexico in Mexico City.

Jean-René Cudell, PhD '87, is currently a Professor at the Université de Liège in Belgium. At UW–Madison, he studied phenomenology of high energy physics with Prof. Halzen.

Earl Scime, PhD '92, is now the Director of the School of Mathematical and Data Sciences at West Virginia University. He was formerly the Dean of the College of Engineering, also at WVU. At UW–Madison, Earl worked with Prof. Hokin in plasma physics.

Nicolle Zellner '93, PhD, writes, "I'm in my 16th year as a faculty member at Albion College, an undergraduate-only liberal arts college in Michigan, where I teach all levels of classes in Physics and Astronomy. I think fondly of my time at Wisconsin, especially my time working in the Space Astronomy Lab and as an observer at the Pine Bluff Observatory and then as a member of the WUPPE telescope team on STS-67. Though I don't have much memory of the class as an undergraduate, one of my favorite classes to teach now is the upper-level course in Mechanics! In 2017, I was named the Phi Beta Kappa Scholar of the Year (Albion Chapter), and in 2018, I was named the Arthur Anderson Teacher of the Year. In 2019 I received the Herbert and Grace Dow Endowed Professorship in the Sciences. To support my research — understanding the effects of impact processes and the flux of impacts in the Earth-Moon system — I've received multiple NSF and NASA grants. I've served three terms on the American Astronomical Society's Committee on the Status of Women in Astronomy and I'm currently the committee Chairperson."

Anthony Gerig, PhD '04, is currently on the faculty of Viterbo University. He recently published "Introduction to Wave Physics" for undergraduate courses on waves/optics, available at introtowavephysics.wordpress.com. At UW–Madison, Anthony worked with Profs. Reeder and Zagzebski.

Tien-Tien Yu, PhD '13, is an assistant professor at the University of Oregon and a recipient of the 2021 New Horizons in Physics Prize. At UW–Madison, she worked with Vernon Barger.

Catherine Steffel '14, PhD, earned her doctorate in medical physics at UW–Madison in 2021 and then started her career in science communication with the UW–Madison Department of Biochemistry, where she is a university relations specialist. As an undergraduate, Catherine worked with Prof. Timbie.

Walter Pettus, PhD '15, joined the faculty at Indiana University as an Assistant Professor of Physics. His research focus is in neutrino physics, with the Project 8 direct mass experiment and LEGEND neutrino-less double beta decay experiment. After graduating, he did postdoctoral work at Yale University and University of Washington. While a graduate student at UW–Madison, he worked with Profs. Heeger and Maruyama on the DM-Ice dark matter experiment.

Niklas Vakil '19 wrote that he is currently a J.D. candidate at Harvard Law School.

Thanks to everyone who shared an update with us! Do you have an update you would like to see in The Wisconsin Physicist? Please fill out our online form at physics.wisc.edu/alumni-update or email us at news@physics.wisc.edu

GIFT GIVING GUIDE

The department relies on donors to help address critical needs now and prepare for the future. In these uncertain times, discretionary dollars are more important than ever and will help the department continue to achieve excellence in research and teaching. Donations to the department's Newton Fund continue to be a critical source of support and are used to address the current needs of students, faculty and staff and help us respond to the most pressing needs of the department.

PRIORITY FUND: The Physics Newton Fund

Administered by the Department Chair, this general, unrestricted fund aids the department in its research, teaching, and public service roles. Donations to this fund provide a crucial, flexible arm of support as they help the department address urgent and present funding needs.

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

E. R. Piore Award Fund

Physics Alumni Graduate Award Fund

Phyllis Jane Fleming Graduate Student Support Fund

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

Roberston Leach Graduate Student Fund

Graduate Student Recruiting Fund

L. Wilmer Anderson & Dave Huber Graduate Support Fund

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

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

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

Wonders of Physics Outreach 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 CHAIRS

Bernice Durand Faculty Fellowship in Physics Fund

Martin L. Perl Chair Fund

Emanuel Piore Professorship Fund

Dunson K. Cheng Chair in Physics Fund

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

Please visit https://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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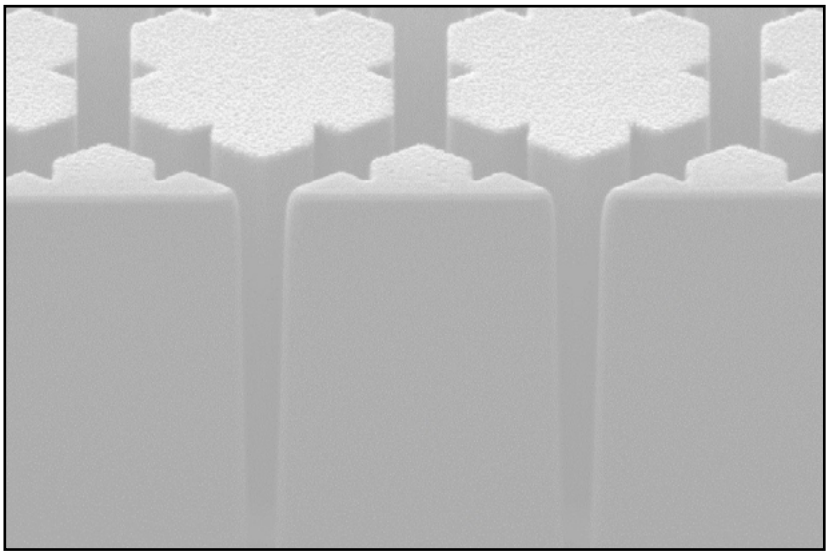
More Cool Science Image Winners

In addition to graduate students Joel Siegel and Margaret Fortman's image on the front cover, Physics had two other winners in UW–Madison's Cool Science Image contest this year. Because, physics is really cool!

Yuya Makino
Assistant Scientist
IceCube Neutrino Observatory

A "winterover" — one of the two staff members who stay through the minus-100-degree Fahrenheit nights of Antarctica's coldest months — hikes underneath the stars and aurora to the South Pole home of IceCube, a UW–Madison-led neutrino telescope frozen in a cubic kilometer of ice.



Gregory Holdman
Physics Graduate Student
Brar Group

By varying the exact size and shape of these micrometer-wide, star-shaped pillars etched into a silicon wafer, researchers can carefully manipulate light passing through a lens to correct for aberrations that would otherwise focus different wavelengths of light on different points in space.