BROWN PHYSICS

imagine

FALL 2025

2025

THE YEAR OF QUANTUM

The Year of Quantum Science and Technology

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CHAIR'S MESSAGE

BROWN
Department of Physics

Welcome to the eighth edition of Imagine magazine as we celebrate the International Year of Quantum Science and Technology!

On June 7, 2024, the United Nations proclaimed 2025 as the International Year of Quantum Science and Technology (IYQ). According to the proclamation, this year-long, worldwide initiative will “be observed through activities at all levels aimed at increasing public awareness of the importance of quantum science and applications.” Brown Department of Physics celebrated IYQ with prominent global quantum researchers such as Professor Stefano Carretta of the University of Parma, who gave a lecture at Brown titled, “Molecular Nanomagnets and Chiral-induced Spin Selectivity: Two Interesting Tools for Quantum Technologies.”

I reflect on a momentous year, marked by faculty accolades, the arrival of exciting new researchers Aaron Hui and Leenoy Meshulam and fascinating faculty research published in prestigious journals, such as Mike Kosterlitz’s use of machine learning to find out how layered gases and metals melt, and student research that garnered prestigious awards, such as Ilija Nikolov, who won Best Poster Prize, WE-Heraeus Seminar, Hamburg. Our faculty continues to receive the highest recognition from Brown University, as assistant professors Loukas Gouskos and Leenoy Meshulam have been elevated to named chairs by the Brown University Corporation Board.

Our colleague, Professor J. Michael Kosterlitz, a Nobel laureate, received the highest honor that Brown confers—the Rosenberger Medal of Honor—during Commencement Weekend. Prof. Kosterlitz was also our speaker at the Physics Department’s Diploma Ceremony, where he inspired our graduates to seek out that which makes them happy.

Our amazing alumni returned to Barus and Holley during Commencement and Reunion Weekend 2025 for our first annual “Back to Barus Alumni Event.” We met graduates from the classes of 1960, 1965, 1980, and 1970, among others. Jesse Thaler ’02, the featured speaker at the Maurice & Yetta Glicksman Forum, sponsored by the Division of Research as part of Brown's Commencement Weekend activities, gave a talk titled "Deep Learning + Deep Thinking = Deeper Understanding.’’ Jesse talked with us about his time at Brown Physics in “Distinguishing Between Type I & Type II Fun: Four questions with Jesse Diaz Thaler ’02,” in our alumni spotlight section.

This year, our Physics Exploratorium, an outreach initiative from Brown Physics Department’s Physics Fundamentals, hosted local school children in the Engineering Resource Center for an afternoon packed with over 20 new physics demonstrations. The excitement these demos engendered surely inspired future physicists among the schoolchildren in attendance! Another outreach initiative, the first annual Astrophotography Contest, saw awe-inspiring submissions from within Brown and the larger Providence community, inspiring our audience to look ever upward.

For the second summer, we hosted the Simons Puerto Rico Brown Exploration, with eight physics students from the University of Puerto Rico participating, which you can read about in our Special Topics Schools section.

Graduates from our outstanding master’s and doctoral degree programs, which continue to train our students to excel in research and provide unparalleled preparation for the highest levels of the job market, are prepared to continue their research and excel in careers at the pinnacle of our field. We invite you to read about their many successes in their time at Brown in our Student Spotlights section.

PASSAGES

HUMPHREY MARIS

The most successful inventor in the history of Brown University

Professor Humphrey J. Maris, who passed away on 27th August, 2025, was one of the world's foremost low-temperature physicists and a beloved mentor to generations of students. Over a career spanning more than five decades, his pioneering research fundamentally advanced our understanding of quantum fluids and solids, and his intellectual breadth extended across condensed-matter physics and ultrafast acoustics. Equally admired for his humanity and generosity, Humphrey left an enduring legacy—both through his transformative discoveries and through the many students he inspired.

Humphrey's research in low-temperature physics shaped entire subfields. He developed foundational theory and experiments on phonons in superfluid helium, elucidating their scattering, decay, and roles in quantum hydrodynamics. He carried out groundbreaking studies of electron bubbles in liquid helium, using them as exquisite probes of quantum properties and of interactions with phonons and vortices. He also brought key insight to the supersolidity debate in solid helium by showing how elastic effects can mimic "supersolid" signals in torsional oscillators, reframing the interpretation of early experiments. Beyond helium, he co-pioneered picosecond ultrasonics—an optical pump–probe method for launching and detecting coherent acoustic pulses—now widely used for nondestructive thin-film and semiconductor metrology. He also co-initiated the HERON project (Helium: Roton Observation of Neutrinos) with George Seidel and colleagues at Brown, aiming to detect low-energy solar neutrinos in superfluid helium through quantum evaporation and roton sensing. In later years, he proposed related quantum-evaporation techniques for low-mass dark-matter detection using field-ionization readout.

The breadth and depth of his contributions earned Humphrey many of the highest honors in his field. He received the Fritz London Memorial Prize in 2011 for original theories and experimental discoveries in liquid helium—work spanning phonons, Kapitza resistance, levitation, nucleation, electron bubbles, and vortex imaging. He was elected a Fellow of the

Professor Humphrey Maris.
Photo: Courtesy of Faye Maris

American Physical Society and was appointed George Chase Professor of Natural Science at Brown in 1991; he later held the title Hazard Professor of Physics and ultimately Professor Emeritus. His other distinctions include the Alexander von Humboldt Research Award (1989), the Klemens Prize (Prize for Phonon Physics) (2007), Brown's Award for Technical Innovation and Commercialization (2005), the Philip J. Bray Award for Excellence in Teaching in the Physical Sciences (2009–2011) and in 2023 the inaugural Brown Technology Innovations Career and Innovation Impact Award.

Beyond his research achievements, Humphrey was a gifted teacher and a deeply committed mentor. His scientific rigor, boundless curiosity, and generous guidance shaped the careers of many students who have gone on to make their own significant contributions not only in academia but also in the deep-tech industry. Several of his former Ph.D. students are now professors around the world, while others are leading innovation in quantum technologies, cryogenics and advanced instrumentation, a testament to his influence as an educator and his role in cultivating the next generation of scientific leaders.

Professor Humphrey J. Maris will be remembered as a brilliant physicist whose insights redefined our understanding of quantum matter, and as a mentor whose kindness and wisdom left a lasting imprint on his students and colleagues. His passing is a profound loss to the low-temperature physics community, but his scientific legacy and the inspiration he gave to so many will endure.

His scientific rigor, boundless curiosity and generous guidance shaped the careers of many students who have gone on to make their own significant contributions not only in academia but also in the deep-tech industry.

Among his many accolades, Professor Maris received the inaugural Brown Technology Innovation Impact Award. Accompanied by Interim Provost Lawrence Larson and Neil Veloso, executive director of Brown Technology Innovations, Vice President for Research Jill Pipher presented the award to Professor Maris's spouse, Faye, who accepted the award on his behalf at the 7th annual Celebration of Research Ceremony in 2023.

Vice President Pipher credited Professor Maris' testing technology with setting the worldwide standard for quality control and manufacturing of computer chips, saying, "Professor Emeritus of Physics, Humphrey J. Maris, is the most successful inventor in Brown University history. Since Prof. Maris came to Brown in 1965, he has been awarded 57 patents, some of which cover the leading method to conduct non-destructive testing of materials. His testing technology has become the worldwide standard for quality control and manufacturing of computer chips. In addition to his prolific inventions, Prof. Maris has advised 50 Ph.D. students in the course of his career."

Faye Maris (pictured) accepts the Career Innovation and Impact Award on behalf of her spouse, Humphrey (not pictured), from Jill Pipher vice president for research, and Brown Technology Innovations executive director Neil Veloso during the 2023 Celebration of Research.

In his remarks at the Celebration of Research, Neil Veloso emphasized the profundity of Professor Maris's impact on his field, the nation, and the world. "The field of non-destructive evaluation utilizes Dr. Maris's research in ultrafast ultrasonics in the development and fabrication of semiconductor materials. This understanding around material properties gives insight into the transport of heat in semiconductors, and by extension, thermal management of electronic devices. Dr. Maris has 25 invention disclosures and 57 issued patents. The licensing of his work to one of the world's leading semiconductor metrology companies has amplified the impact of this research beyond the university to (in the words of Brown's mission) "serve…the nation and the world".

In 1999, Professor Maris obtained a graft of Sir Isaac Newton's apple tree, which was planted at the corner of the Barus and Holley lab. According to Brown Alumni Magazine, Maris said he was concerned that a full-size apple would outgrow the spot in which it's planted, but this one is tiny, almost shrublike. "There are degrees of dwarfishness," Maris [said] with a smile, "and I wish I'd chosen one a little taller."

Brown faculty confers highest honor on preeminent physics scholar

By Corrie Pikul and Kevin Stacey

Editor's note: The story from the original publication has been updated to feature the Department of Physics faculty member who was honored. Prof. Terrie Fox Wetle was also a Rosenberger honoree.

J. Michael Kosterlitz, a longtime Brown University faculty member who is an accomplished researcher, leader and educator, received the Susan Colver Rosenberger Medal of Honor during Brown's 257th Commencement on Sunday, May 25, 2025.

The medal is the highest honor the Brown University faculty can bestow, having been awarded just 36 times since its establishment in 1919. Among past honorees are University presidents and chancellors, pioneering Brown scholars and esteemed public servants.

The faculty recognized Kosterlitz for decades of leadership, scholarship and mentorship, said Kristina Mendicino, chair of the Faculty Executive Committee and a professor of German studies at Brown.

"The work that Michael Kosterlitz has done at Brown has had enormous impact in his field, as well as on campus and around the world," Mendicino said. "As his colleagues, we are proud to bestow upon him the highest honor that faculty can offer."

Exploring the universe's mysteries

On the morning of October 4, 2016, the Brown community awoke to the news that its own J. Michael Kosterlitz had won the Nobel Prize, the most prestigious prize in physics. It was at that moment that much of the world learned of Kosterlitz's groundbreaking contributions to science, but his physics colleagues had long been aware of his

Photos courtesy Sean Ling

Xinsheng Sean Ling celebrates with Prof. Kosterlitz at Commencement

renowned theoretical work in topological order and phase transitions.

Physicists had tried and failed for years to explain how phase changes could occur in two-dimensional systems like helium films and other materials that lack long-range symmetrical order. But working with mathematician David Thouless, Kosterlitz helped to introduce the idea of topological order to explain how phase transitions occur in these materials.
The pair published their pioneering work in 1973, but it took the Nobel committee more than 40 years to recognize it. That's probably because the paper was "so ahead of its time," said Vesna Mitrović, chair of Brown's Department of Physics. In recent years, scientists have recognized the importance of topological order in a wide range of unexpected places — superconductors, liquid crystal displays, electronic devices and even Earth's climate system.

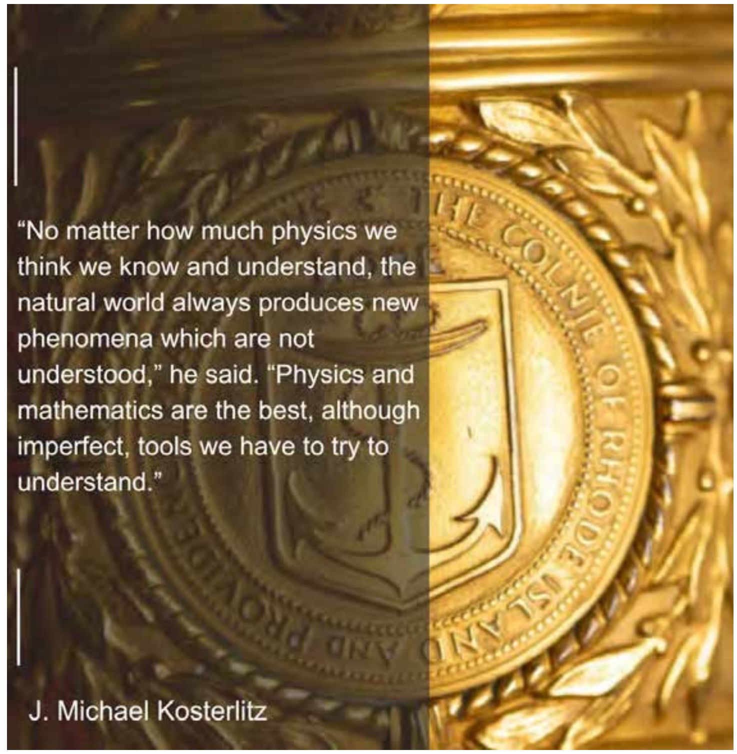
FACULTY AWARDS

THE ROSENBERGER AWARD J. MICHAEL KOSTERLITZ

Kosterlitz has been a member of the Brown faculty since 1982. Both before and after the Nobel Prize, he has been a generous colleague and teacher, his colleagues say, his door always open to students and fellow faculty alike. His work continues to inspire and inform the work of physicists at Brown and all over the world.

In addition to the Nobel, Kosterlitz has won the Maxwell Prize from the British Institute of Physics and the Lars Onsager Prize from the American Physical Society. He is an elected member of the National Academy of

Photos courtesy Sean Ling



Kosterlitz says he's pleased and honored — and a bit surprised — to be recognized by his Brown colleagues with the Rosenberger Medal.

"I never thought of myself as a particularly good teacher," Kosterlitz said in typically self-deprecating style. "My main interest has always been in trying to understand, through physics, the natural world, which is much more mysterious than we can imagine. I am pleased that my own small contributions to this effort have been recognized by my peers."

Kosterlitz plans to retire from teaching after this academic year, but his curiosity about the mysteries of the universe will remain.

"No matter how much physics we think we know and understand, the natural world always produces new phenomena which are not understood," he said. "Physics and mathematics are the best, although imperfect, tools we have to try to understand."

Large Hadron Collider experiment, including Brown physicists, awarded Breakthrough Prize

By Kevin Stacey

This year's Breakthrough Prize in Fundamental Physics was awarded to experimentalists at the Large Hadron Collider, where Brown physicists have played key roles in revealing the deepest mysteries of the universe.

The Breakthrough Prize Foundation has awarded its 2025 prize in fundamental physics to the major research collaborations at the Large Hadron Collider (LHC) headquartered in Geneva, Switzerland. The awardees include the team behind the Compact Muon Solenoid (CMS) experiment, to which Brown University researchers have made key contributions for decades.

"This prize, widely known as the Oscars of particle physics, has rewarded groundbreaking and novel measurements at the LHC, many of which have substantial contributions from the students, postdocs, and faculty of our CMS group at Brown," said Greg Landsberg, a professor of physics at Brown who served as CMS publications chair at the time the award was presented. "Two dozen of our current and former members are the recipients of this prestigious prize as members of the CMS and ATLAS experiments.

The Breakthrough Prize was created to celebrate the wonders of the scientific age, according to its founding sponsors Sergey Brin, Priscilla Chan and Mark Zuckerberg, Julia and Yuri Milner, and Anne Wojcicki. Six prizes of $3 million each are awarded each year in life sciences, fundamental physics and mathematics. The CMS experiment shared the fundamental physics prize with the other large experiments at the Large Hadron Collider: ATLAS, ALICE and LHCb.

"This prize highlights the scientific achievements of the thousands of researchers who contributed to the experiments at the LHC," said Ulrich Heintz, a professor of physics at Brown who has worked with the CMS experiment for more than a decade. "The LHC is the largest scientific instrument ever built, and it

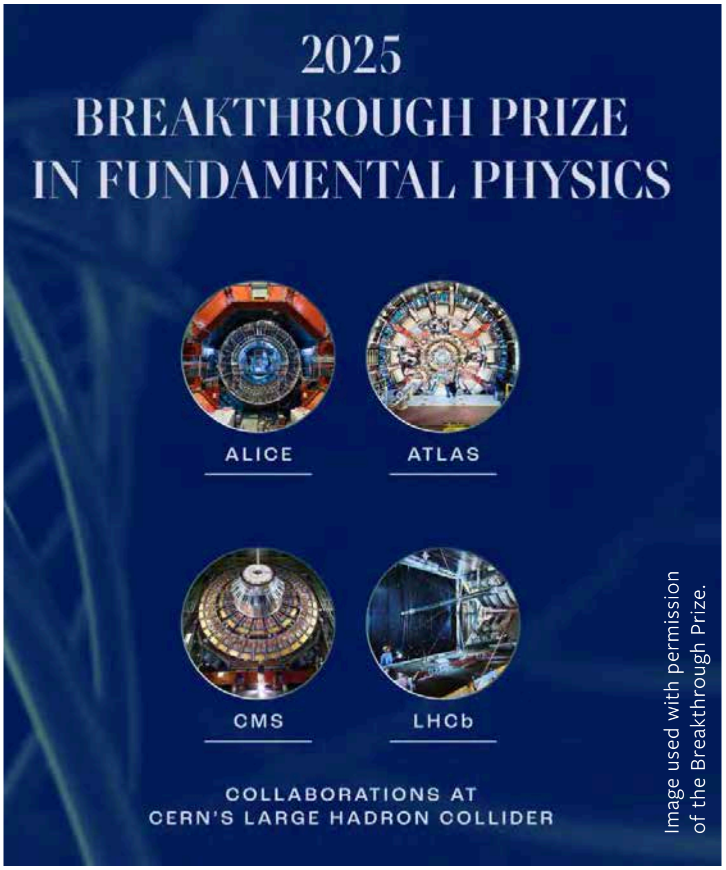


Image used with permission of the Breakthrough Prize.

shows what we can achieve if we work together across national and other boundaries to pursue a common goal."

As the world's largest particle accelerator, the LHC uses superconducting magnets to whip particles around a 17-mile circle at near the speed of light. Collisions between those particles reveal details about the fundamental properties of matter, energy and the universe itself. Data from the collisions are collected by enormous and exquisitely sensitive detectors, including the CMS detector. Brown faculty, potdocs, and students have been active at the LHC since before it opened in 2008, developing components for CMS and helping to guide the experiment.

Among the accomplishments noted in the prize announcement was the 2012 discovery of the Higgs boson. The Higgs boson is the physical manifestation of the phenomenon that gives some elementary particles

Brown faculty Breakthrough Prize recipients: Loukas Gouskos (top left), Ulrich Heintz (top center), Matt LeBlanc (top right), David Cutts (lower left), Gregory Landsberg (lower center), Jennifer Roloff (lower right), Gaetano Barone (right center).

Photos courtesy David Cutts and Gaetano Barone

Photos: Valerie DeLaCámara Brown University

their mass and was considered the final missing piece of the Standard Model of Particle Physics. Current and former Brown faculty and students — including professors David Cutts, Heintz, Greg Landsberg, and the late Meenakshi Narain — played key roles in the work that led to the Higgs discovery.

Narain would later chair the collaboration board of U.S. institutions at the CMS, the largest of the experiment's international teams. In that capacity, Narain helped to guide CMS in looking for physics beyond the standard model, including searches for dark matter and particles associated with supersymmetry and string theories.

Brown faculty continue to work on the next phase of the CMS experiment. Heintz's lab is currently building sensor components that will be included in the next iteration of the CMS detector. More recent additions to the Brown faculty — assistant professors Gaetano Barone, Loukas Gouskos, Matt LeBlanc and Jennifer Roloff — continue to research the Higgs mechanism, quarks (the fundamental building blocks of protons and neutrons), as well as new machine learning and AI approaches to sorting the astronomical amount of data produced by billions of particle collisions per second.

"Together we are preparing for a new high-intensity phase of the LHC in the coming decade," Heintz said.

Brown scientist to Congress: Quantum science investments will boost economy, protect national security

Brown chemist and physicist Brenda Rubenstein.

By Kevin Stacey

As the dawn of the quantum computing age nears, Brown University scientist Brenda Rubenstein urged members of Congress to support the American economy and national security by investing in quantum science research at the nation's universities.

"Critical to realizing advances in the quantum sciences is establishing and securing a well-educated quantum workforce," said Rubenstein, an associate professor of chemistry and physics at Brown, and incoming director of the University's Data Science Institute. "As with all great endeavors, American ambitions of leading in the quantum sciences rest on ensuring that we have a large and renewable pool of talented, motivated and dedicated people educated not only in quantum mechanics and computing, but also in important adjacent fields such as electrical engineering, chemistry, biology and mathematics."

Rubenstein's remarks came during a Tuesday, June 24, hearing of the U.S. House of Representatives Oversight Committee's Subcommittee on Cybersecurity, Information Technology and Government Innovation. The hearing focused on the security implications of advances in quantum computing.

Quantum computers are expected to be exponentially faster than today's machines in performing many computations, with the potential for calculations that would take centuries on even the world's fastest supercomputers to take mere seconds. While that new computing power promises tremendous advances in drug development, weather forecasting and myriad other areas, it would also render today's encryption and cybersecurity measures obsolete. Researchers across the country, including at Brown, are racing to create new encryption algorithms that are quantum safe.

The hearing panelists, which also included representatives from government and industry, all stressed the importance of keeping the U.S. at the cutting edge of quantum research. At the heart of that endeavor, Rubenstein said, are American universities, which are the critical training grounds for American scientists and researchers.

"Although industry and the government unquestionably contribute invaluable training through internships and other tools, they cannot practically scale to accommodate the hundreds of thousands of students that pass through our institutions of higher education," Rubenstein said. "Thus, most trainees interested in the quantum sciences receive their first practical introduction to the field in basic science laboratories throughout this country. Our institutions of higher learning can therefore be thought of as incubators that grow the future quantum workforce that supplies industry and the government."

Though scientific training in American universities is envied around the world, that system is threatened by plans for dramatic cuts to the National Science Foundation and other federal research funding agencies, Rubenstein argued.

"Recent reductions will substantially reduce our quantum preparedness and competitiveness," she said. "It is crucial to think fruitfully about how we will sustain our long-envied training pipeline through the combined resources and brain trust of industry, government, academic and other partners, including through cross-institutional fellowships and internships as well as consortia that bring industry, government and academia to bear on the greatest quantum and regional challenges of the day."

Other panelists at the hearing were Brown alumnus Scott Crowder, vice president for quantum adoption at IBM; Marisol Cruz Cain, director of information technology and cybersecurity at the Government Accountability Office; and Denis Mandich, chief technology officer at the cybersecurity firm Qrypt. A full video of the hearing is available on the website of the House Oversight Committee.

Brown University professor wins prestigious Fulbright U.S. Scholar Award

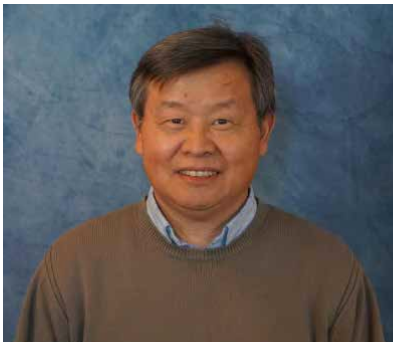


Photo: Valerie DeLaCámara

By Kevin Stacey

Xinsheng Sean Ling will travel to the University of Buenos Aires to study phase transitions in type-II superconductors.

The U.S. Department of State and the J. William Fulbright Foreign Scholarship Board have selected Brown University professor Xinsheng Sean Ling as a 2025 Fulbright U.S. Scholar

Fulbright Scholar Awards are prestigious and competitive fellowships that provide unique opportunities for scholars to conduct research and teach abroad. Ling, a professor of physics, will travel to the University of Buenos Aires to investigate a longstanding question about phase transitions in a special class of superconductors — materials that conduct electricity with zero resistance in strong magnetic fields.

These "type-II" superconductors are already used in medical imaging and certain types of high-speed trains, and could one day be used in energy storage devices and more efficient power grids.

"I'm excited to work with Professor Gabriela Pasquini at the University of Buenos Aires," Ling said. "Both of our labs have studied what's known as the peak effect problem in type-II superconductors, and now we have an opportunity to join forces and revisit this puzzle together."

In type-I superconductors, such as aluminum, a strong magnetic field can completely destroy the superconducting state. But type-II superconductors, such as niobium and copper oxide-based materials, behave differently. In these materials, magnetic fields penetrate in the form of tiny vortices — microscopic tubes of magnetic flux quanta surrounded by circulating superconducting currents. These vortices are confined to small regions, allowing the rest of the material to remain in the superconducting state and continue carrying current with zero resistance.

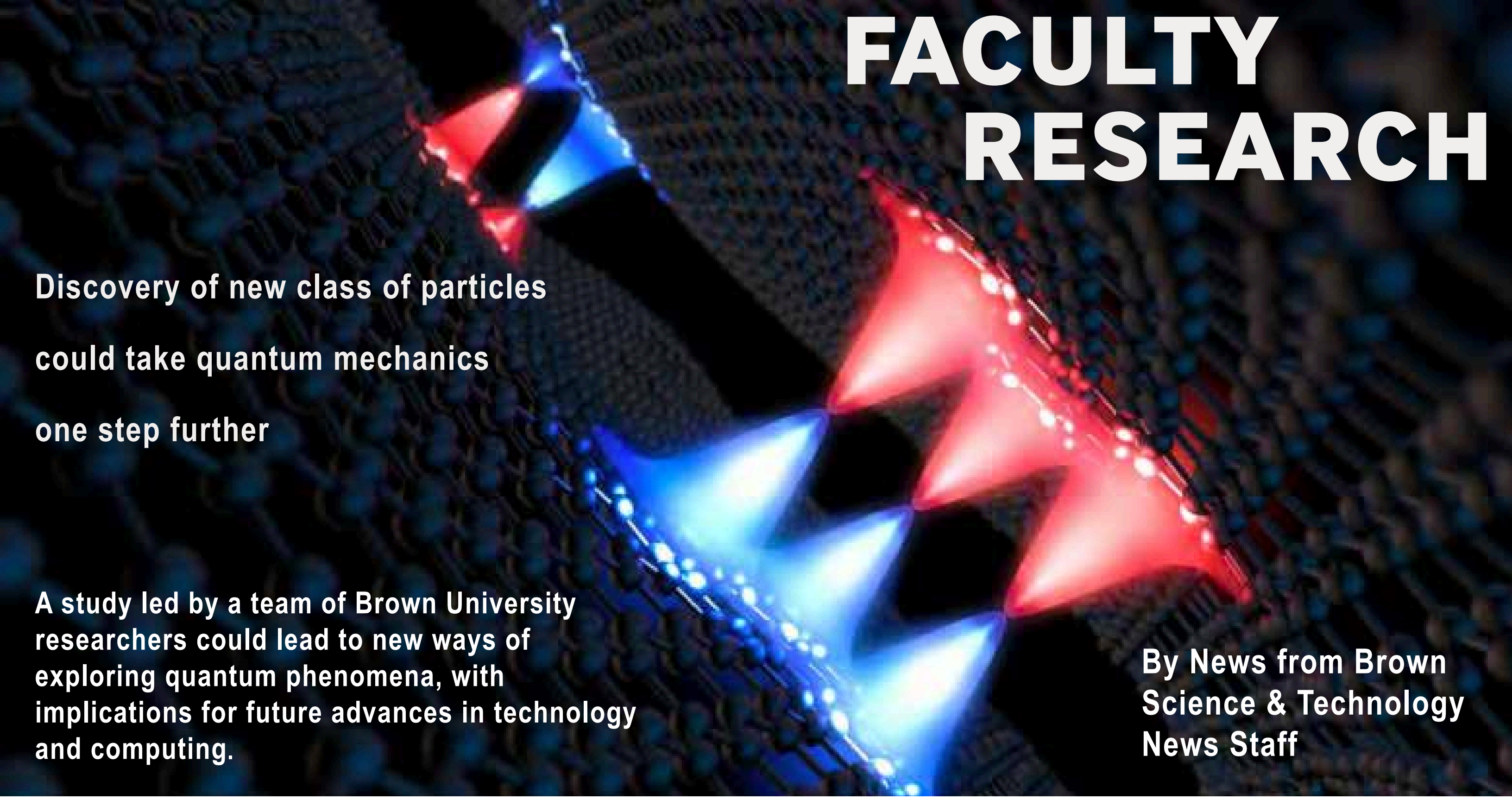
The peak effect problem that Ling and Pasquini will explore involves a strange and counterintuitive phenomenon: as the strength of the magnetic field increases, there comes a point just before superconductivity breaks down when the material's ability to carry current briefly improves. This peak in performance appears to be tied to how the magnetic vortices arrange themselves inside the superconductor. Ling and Pasquini aim to determine whether this change in the vortex structure during the peak effect is a true phase transition, similar to how a solid melts into a liquid.

"There's a famous theorem — the 'Imry-Ma theorem' — that says systems like this with impurities shouldn't undergo real phase transitions," Ling said. "But studies conducted independently by my group at Brown and Professor Pasquini's group indicated there might, in fact, be a true phase transition at play."

The researchers hope their renewed collaboration will not only reveal new insights into how superconductors work, but also contribute to a deeper understanding of phase transitions in complex systems throughout nature.

Ling is also looking forward being immersed in Argentine culture.

"During the past few years, my wife and I became acquainted with the Argentine tango, a physical activity keeping us healthy and happy," he said. "So visiting the birthplace of Argentine tango is also a big draw for me."



FACULTY RESEARCH

Discovery of new class of particles could take quantum mechanics one step further

A study led by a team of Brown University researchers could lead to new ways of exploring quantum phenomena, with implications for future advances in technology and computing.

By News from Brown Science & Technology News Staff

Amid the many mysteries of quantum physics, subatomic particles don’t always follow the rules of the physical world. They can exist in two places at once, pass through solid barriers and even communicate across vast distances instantaneously. These behaviors may seem impossible, but in the quantum realm, scientists are exploring an array properties once thought impossible.

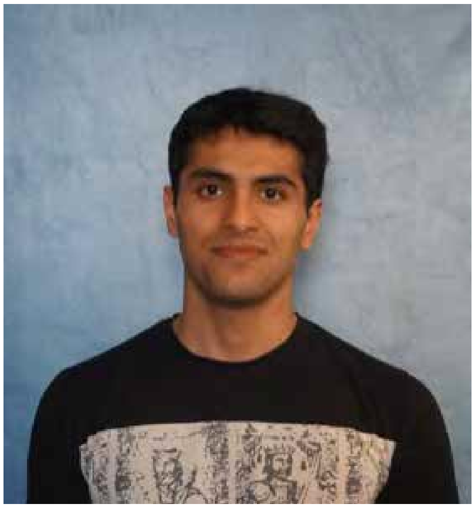
In a new study, physicists at Brown University have now observed a novel class of quantum particles called fractional excitons, which behave in unexpected ways and could significantly expand scientists’ understanding of the quantum realm.

“Our findings point toward an entirely new class of quantum particles that carry no overall charge but follow unique quantum statistics,” said Jia Li, an associate professor of physics at Brown. “The most exciting part is that this discovery unlocks a range of novel quantum phases of matter, presenting a new frontier for future research, deepening our understanding of fundamental physics, and even opening up new possibilities in quantum computation.”

Along with Li, the research was carried out by three graduate students — Naiyuan Zhang, Ron Nguyen and Navketan Batra — and Dima Feldman, a professor of physics at Brown. Zhang, Nguyen and Batra are co-first authors of the paper, which was published in Nature on Wednesday, Jan. 8.

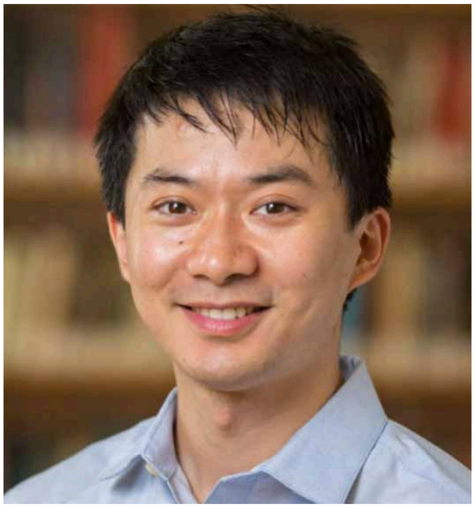
The team’s discovery centers around a phenomenon known as the fractional quantum Hall effect, which builds on the classical Hall effect, where a magnetic field is applied to a material with an electric current to create a sideways voltage. The quantum Hall effect, occurring at extremely low temperatures and high magnetic fields, shows that this sideways voltage increases in clear, separate jumps. In the fractional quantum Hall effect, these steps become even more peculiar, increasing by only fractional amounts — carrying a fraction of an electron's charge.

In their experiments, the researchers built a structure with two thin layers of graphene, a two-dimensional nanomaterial, separated by an insulating crystal of hexagonal boron nitride. This setup allowed them to carefully control the movement of electrical charges. It also allowed them to generate particles known as excitons,



Navketan Batra PhD

Prof. Dmitri Feldman



Prof. Jia Li

which are formed by combining an electron and the absence of an electron, known as a hole. They then exposed the system to incredibly strong magnetic fields that are millions of times stronger than Earth's. This helped the team observe the novel fractional excitons, which showed an unusual set of behaviors.

Fundamental particles typically fall into two categories. Bosons are particles that can share the same quantum state, meaning many of them can exist together without restrictions. Fermions, on the other hand, follow what's known as the Pauli exclusion principle, which says no two fermions can occupy the same quantum state

The fractional excitons observed in the experiment, however, didn't fit cleanly into either category. While they had the fractional charges expected in the experiment, their behavior showed tendencies of both bosons and fermions, acting almost like a hybrid of the two. That made them more like anyons, a particle type that sits between fermions and bosons — yet the fractional excitons had unique properties that set them apart from anyons, as well.

"This unexpected behavior suggests fractional excitons could represent an entirely new class of particles with unique quantum properties," Zhang said. "We show that excitons can exist in the fractional quantum Hall regime and that some of these excitons arise from the pairing of fractionally charged particles, creating fractional excitons that don't behave like bosons."

The existence of a new class of particles could one day help improve the way information is stored and manipulated at the quantum level, leading to faster and more reliable quantum computers, the team noted.

"We've essentially unlocked a new dimension for exploring and manipulating this phenomenon, and we're only beginning to scratch the surface," Li said. "This is the first time we've shown that these types of particles exist experimentally, and now we are delving deeper into what might come from them."

The team's next steps will involve studying how these fractional excitons interact and whether their behavior can be controlled.

"This feels like we have our finger right on the knob of quantum mechanics," Feldman said. "It's an aspect of quantum mechanics that we didn't know about or, at least, we didn't appreciate before now."

UPDATE FROM THE BROWN THEORETICAL PHYSICS CENTER (BTPC)

The BTPC: STIMULATING COLLABORATIVE RESEARCH ACROSS THE BOUNDARIES BETWEEN ASTROPHYSICS-COSMOLOGY, CONDENSED MATTER AND HIGH ENERGY THEORETICAL PHYSICS

By Brad Marston

The Brown Theoretical Physics Center (BTPC) exists to stimulate collaborative research across the boundaries between astrophysics-cosmology, condensed matter and high energy theoretical physics. It also supports interdisciplinary cross-departmental research. BTPC faculty are engaged in research in theoretical particle physics, quantum field theory, mathematical physics, quantum matter, quantum information science, and climate physics.

This year, we welcomed two new faculty members of the BTPC, both based in the Barus building. Assistant Professor Aaron Hui joined Brown in January. He is a theoretical condensed matter physicist who studies strongly correlated and topological systems, with an emphasis on electron transport and phase transitions. In July, Leenoy Meshulam became the June and Howard Zimmerman Assistant Professor of Physics, Neuroscience, and Brain Science. She is a theoretical biological physicist who seeks the physical principles by which large-scale neural dynamics—and more broadly, living processes—give rise to computation and behavior. She develops models that connect microscopic interactions to emergent function, drawing on ideas from statistical physics such as renormalization-group theory, maximum-entropy modeling, and information theory.

Physics Professor Alan Dorsey of the University of Georgia will be making extended visits to the BTPC this year as part of a Simons Pivot Fellowship. He is investigating

Professor Brad Marston, Director of the Brown Theoretical Physics Center (BTPC)

Photo: Valerie DeLaCámara /Brown University

the roles that topology plays in Earth's climate system. We will also host a number of shorter-term visits by distinguished physicists.

It is no secret that science, including theoretical physics, is under tremendous pressure in the United States. Looking back at American history, we find an important 19th-century scientist named Eunice Newton Foote, who not only discovered that carbon dioxide and water vapor are potent greenhouse gases, but also advocated for democracy, including women's rights. (As her maiden name suggests, Foote was a distant descendant of the physicist Isaac Newton). The link between democracy and the scientific method is a natural one because both depend on intellectual freedom. Now more than ever, it is important to support science. Consider donating to Brown's Department of Physics to help support our centers in these difficult times.

BROWN PHYSICS DISTINGUISHED LECTURE

The Arthur O. Williams Distinguished Lecture Featuring Professor Stefano Carretta, University of Parma

TITLE: "MOLECULAR NANOMAGNETS AND CHIRAL-INDUCED SPIN SELECTIVITY"

This spring, in honor of the Unesco Year of Quantum, the Physics Department was honored to present the Arthur O. Williams Distinguished Lecture Series featuring Professor Stefano Carretta of the University of Parma's Department of Mathematics, Physics and Information Science.
Prof. Carretta's talk was titled, "Molecular Nanomagnets and Chiral-induced Spin Selectivity: Two Interesting Tools for Quantum Technologies."

Prof. Carretta described his research with a brief introduction. "We are now experiencing the so-called Second Quantum Revolution and Quantum Technologies promise to open new possibilities in many fields ranging from computing to secure communications.

Molecular Nanomagnets (MNMs) [1] provide an interesting tool for quantum technologies. In fact, they are characterized by a sizeable number of low-energy states that can be coherently manipulated, thus opening the possibility to use them to encode qudits. This in turn offers the possibility of integrating multiple quantum resources into single objects and to reduce the computational costs of some applications.

In my presentation, I will review some recent results on molecular spin qudits/qubits. For instance, I will show that using the many-level structure of MNMs it is possible to encode a qubit with embedded Quantum Error Correction in a single molecule [2], thus circumventing the typically large overhead in the number of physical units. I will also present the first working prototype of a quantum simulator based on molecular qudits [3]. In addition, I will demonstrate that the chiralinduced spin selectivity phenomenon exists at the molecular level [4,5] and could be harnessed to significantly raise the operating temperature of molecular spin qubits/qudits [6]."

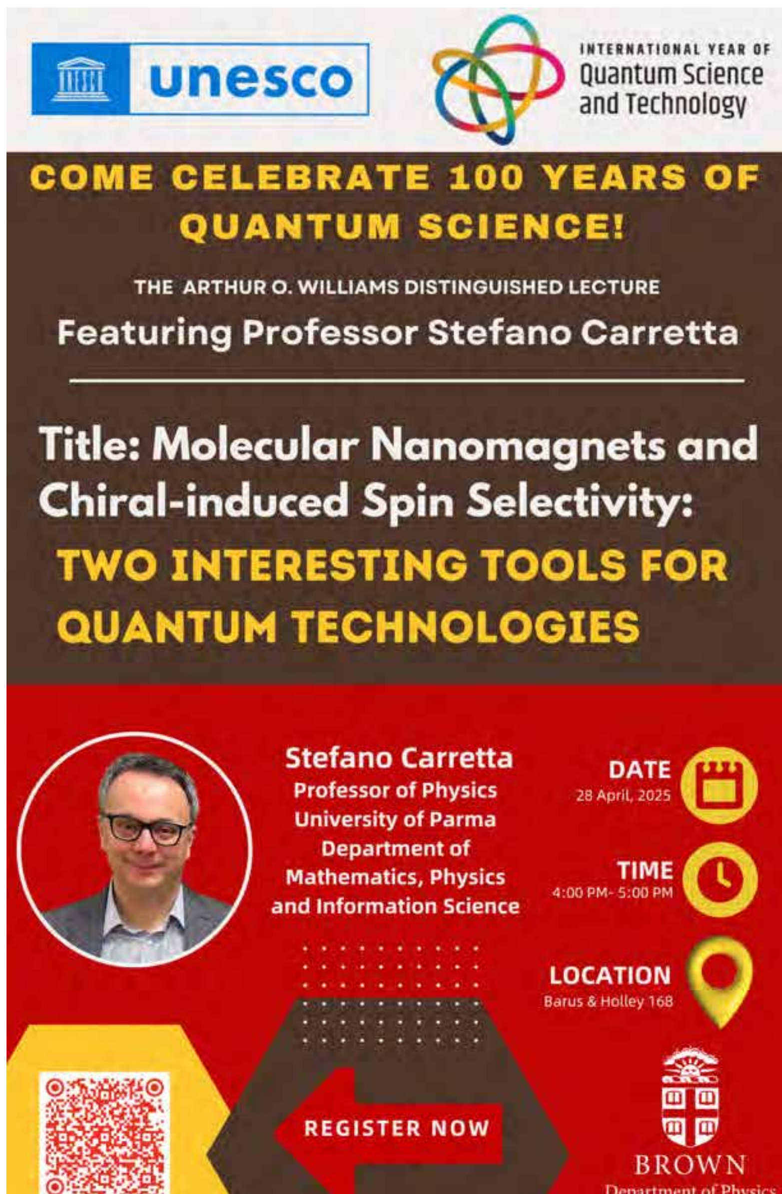


Photo: Valerie DeLaCámara

ULRICH HEINTZ: DETECTOR DESIGN

Professor Ulrich Heintz and his research group are designing and building a critical replacement component for the Large Hadron Collider at the European particle physics lab (CERN), and Brown students have a front-row seat in this fascinating project. In the United States, there are exactly two places where this work is happening: Fermi National Lab and right here at Brown. Brown students have the unique opportunity to contribute to the process, both in Heintz's lab and at CERN.

Heintz elaborates: “We’re building part of a particle detector for the high-luminosity program of the Large Hadron Collider. More specifically, we build modules for the tracking detector of the

Prof. Heintz with a tracker module in his clean room. Photo: Valerie DeLaCámara/Brown University

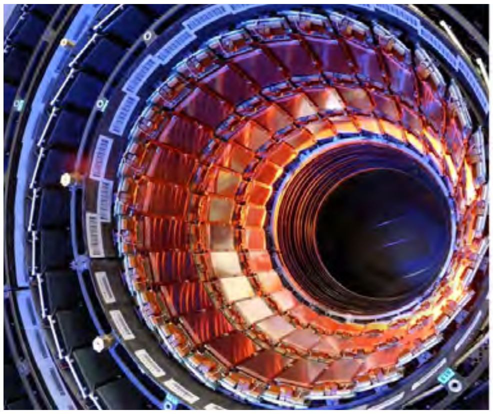
Compact Muon Solenoid (CMS) experiment by precisely assembling silicon sensors and readout electronics here at Brown. These modules will then be transported to Europe, to be integrated into larger sections. Eventually these are assembled at CERN to make up the tracker for the CMS experiment.”

The work at Brown began over ten years ago with extensive research and development. It is hard to

Prof. Heintz's 3D printout of a detector. The gray component, the tracker, is the piece that Prof. Heintz and his students are building for the Large Hadron Collider at CERN. Photo: Valerie DeLaCámara/Brown University

believe, Heintz says, that they are now finally going into production with the assembly of the modules. He says that at every stage, there have been opportunities for students to participate in the development of what sensors to use, how to measure certain properties of the sensors, and how to assemble the components. Students are trained to work with great precision, Heintz emphasizes. “The sensors are very delicate, and they have to be very precisely aligned during assembly because we want to have position resolutions of tens of micrometers.”

Students played a big role in testing the silicon sensors. Heintz says, “We teach them how to measure the properties of the silicon sensors, determine whether they satisfy our specifications, and whether they can go into the detector. We study how these properties evolve once they are exposed to continuous radiation in the detector over a period of ten years in the LHC. We conduct modeling and perform experiments in which we irradiate samples, exposing them to neutrons, for example, at a nearby research reactor." Students can then measure how the properties of the detector change. “The more proficient students become, the more opportunities they have to become involved with more complicated projects.”



The inner tracker barrel of the current detector in 2006 before it was installed in the LHC.

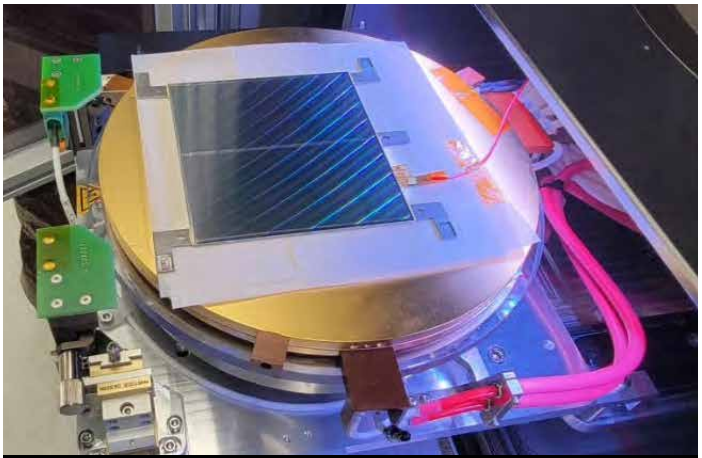
Photo: CERN

The modules are technically complex because they are manufactured at room temperature, around 20 to 25°C but they will be operated at about -30°C. This is a temperature difference of 50°C." When the module cools down, the different elements in the module contract. If they contract at different rates, then the whole thing may crack or deform, Heintz says. The materials must be chosen so that their thermal expansion coefficients are well matched, and the parts must be assembled carefully so that all glue joints are strong. Further explaining the process, Heintz continues, "The modules contain thousands of delicate wire connections between the sensor and the read-out electronics. Nevertheless, they must be designed to be mechanically robust. After the modules are installed in the detector they must work reliably for at least 10 years, as we won't be able to access them anymore.

When students participate in the construction, they learn how such a detector works and how it is built. We aim to educate students in all aspects of detector design, as they will build the next generation of experiments. It's a rather unique opportunity, because the timescale over which these experiments are built is quite long." Emphasizing that the opportunity does not exist at every institution, and certainly not in the United States, Heintz notes that Brown students are fortunate to participate in this work and gain valuable technical skills they cannot get elsewhere.

The Department of Energy funds the group to support students if they participate in the program here. In exchange, they will learn how particle detectors work, how to design and how to build and operate them. Heintz says that there are jobs within the project for students at all levels. Graduate students can see how the detector is made while analyzing data from the current detector. Ultimately, he says, understanding what's involved in making the detector components and how they work, will help the students understand their analysis work better.

The CMS experiment, with which Heintz's group is working, began this effort almost 20 years ago, and it is still about five years away from final installation at CERN. Most students who work on the project ultimately may not be involved at the project's conclusion.

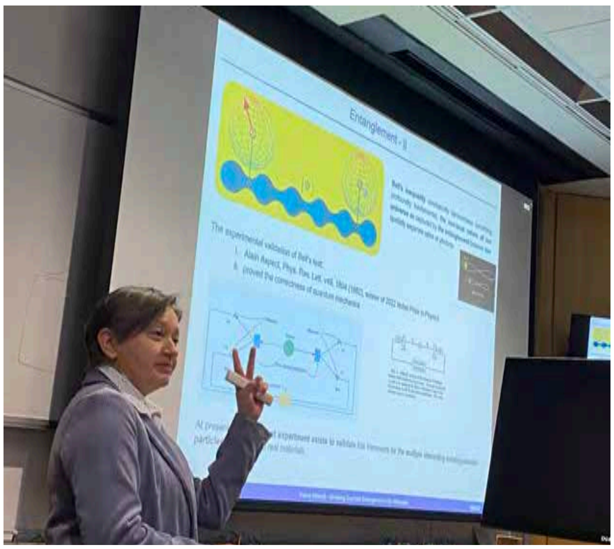


A partially assembled module for the new Outer Tracker under test in Prof. Heintz's probe station..
Photo: Valerie DeLaCámara/Brown University

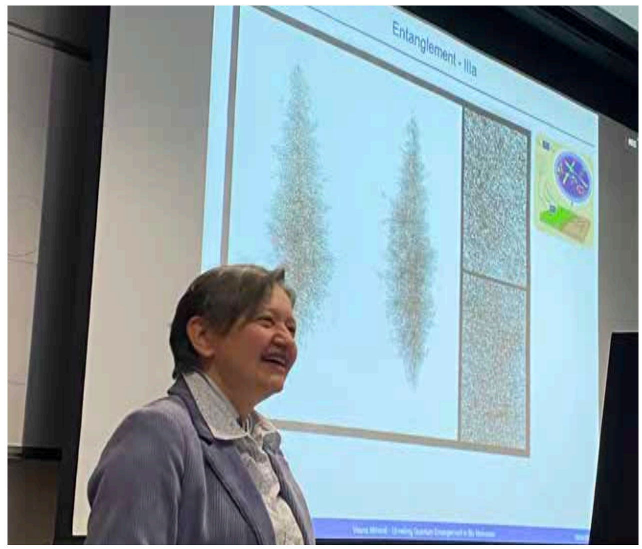
For the next two years at least, Heintz says the focus will be here at Brown. Then the work will move to CERN. He says, "Right now, we have students go to CERN and work on operating the current detector. There's a whole range of things that the students can learn about a detector. They work with our group at CERN on the current detector and understand how that works. They also work with us here at Brown and see how you actually build a detector and put it together." In reflection, Heintz says. "There is no limit to what they can learn."

BROWN PHYSICS
Faculty Research

In honor of the Year of Quantum, Professor Vesna Mitrović, chair of the physics department and world leader in quantum research, gave a colloquium sponsored by the Brown Quantum Initiative (BQI) titled "Creating and Manipulating Entanglement in Bio Molecules at Ambient Conditions."



Photos: Valerie DeLaCámara/Brown University



Prof. Vesna Mitrović discussed her team's recent experimental breakthrough that "allowed us to directly measure entanglement in biological molecules at ambient/physiological (wet & noisy) conditions. In the lecture, Mitrović demonstrated how such entanglement is employed to generate a universal quantum gate set and universal logical quantum bits at ambient conditions.

Explaining further, Mitrović said, "Nature is known to be the best and most efficient engineer. By deciphering nature's underlying mechanisms (e.g., bees' efficient use of space, aerodynamics of birds influencing plane design), we could create the most efficient bio-inspired machines. Such machines would be highly effective and, at the same time, enable control of biological systems.

However, implementing this deciphering process that governs biology requires knowledge of the most fundamental principles, believed to be quantum in nature. Yet, our ability to understand the underlying quantum mechanisms that govern biological systems on the most elementary level is hindered by the complexity of the biological/chemical processes coupled to dimensionality, topology and shape of the molecules. The popular belief that quantum effects do not take place in ambient conditions further inhibits progress.

Nevertheless, the most significant obstruction to making progress in quantum biology is that, on a foundational level, quantum mechanics prevents us from performing fully deterministic measurements about physical systems. Any measurement of even the simplest quantum system yields intrinsically random results and irreversibly alters the system itself. Ultimately, this deceptive image hinders our ability to both advance fundamental knowledge and harness quantum properties of biological systems for transformative applications and control."

BRAD MARSTON

Simons Foundation Pivot Fellowship Mentor

By Valerie DeLaCámara

Congratulations to Brad Marston, who was recently selected as a Simons Foundation Pivot Fellowship Mentor. Marston will mentor University of Georgia (UGA) professor of physics Alan T. Dorsey, a theoretical physicist who will transition to geophysical fluid dynamics and climate modeling.

Launched in 2022, the Pivot Fellowship is open to faculty in the natural sciences, mathematics, engineering, data science, and computer science at academic institutions or equivalent positions elsewhere. The fellowships provide salary support as well as research, travel and professional development funding. Mentors also receive a $50,000 research fund to support training the fellow in their lab. At the end of the fellowship year, fellows will be invited to apply for a 3-year research award in the new field for up to $1.5 million over the three-year period.

According to UGA, Dorsey will leverage his expertise in condensed matter physics to explore recently discovered topological features in equatorial planetary waves and to expand this work to include the effects of nonlinearities and stratification on wave propagation. "The Simons Fellowship opportunity was exactly what I needed to reboot my research after eleven years as dean," Dorsey said. He plans to embed this work in a study of an atmospheric phenomenon called the quasi-biennial oscillation: periodic reversal of zonal east-to-west winds that encircle the planet and act from six to 50 kilometers above Earth's surface.


Photos: Valerie DeLaCámara/Brown University

"Alan is a distinguished theoretical physicist, and I'm honored to work with him on his project, which will span the fields of condensed matter physics and geophysical fluid dynamics," Marston said. "By using the mathematics and physics of topology, we expect to contribute to a better understanding of the fluid Earth climate system."

PODCAST: WattSherpa

Brad was featured on the WattSherpa podcast "Your Guide to an Energy Efficient Future," where he discussed "Quantum Physics & Climate Change" in November.

BROWN PHYSICS MAKING AN IMPACT

Fulbrightprogram.org: Prof. Kosterlitz talks about his Fulbright experience and a lifetime of groundbreaking research


Photo: Valerie DeLaCámara

Professor J. Michael Kosterlitz, a Nobel laureate, talked with the Fulbright Program about his research and how his Fulbright experience "opened his eyes to what physics is all about."

Prof. Marcus Spradlin: WIRED MAGAZINE


Photo: Courtesy M. Spradlin

Professor Marcus Spradlin comments on "surfaceology," a new geometrical method in Wired Magazine: "The Quantum Geometry That Exists Outside of Space and Time."

A decade after the discovery of the "amplituhedron," physicists have excavated more of the timeless geometry underlying the standard picture of how particles move."

Prof. Brad Marston featured in New Scientist


Photo: Valerie DeLaCámara

Carbon removal schemes on farms could change Earth's reflectivity. Those involving enhanced rock weathering should consider whether the rocks they use are lighter or darker than the soil, say researchers.

Brad Marston, together with Manning Assistant Professor of Earth, Environmental and Planetary Sciences and Environment and Society Daniel Ibarra, was recently featured in the New Scientist's article "Carbon removal schemes on farms could change Earth's reflectivity."

Reflecting on the work, Marston says, "Adding charcoal to farmland, fertilizing the seas with iron and spreading rock dust are some of the approaches to remove carbon dioxide from the atmosphere that are being explored to slow climate change. All of these require a significant fraction of Earth's surface area to reach the enormous scales necessary to have an effect. We argue that an unexplored side effect, namely changes to the amount of sunlight that is absorbed by the altered surface, must be investigated as such radiative forcing may overwhelm the reduction in forcing from carbon dioxide removal."

BROWN PHYSICS MAKING AN IMPACT

Aspen Daily News: Prof. Brad Marston

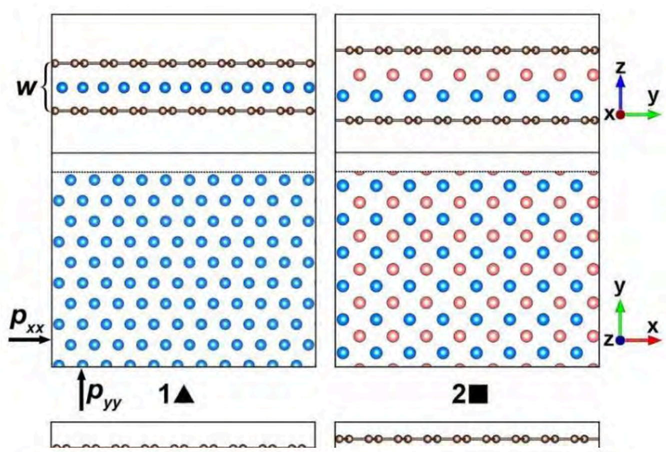
Brad Marton's public lecture at the Aspen Center for Physics Photo: Courtesy Brad Marston

The Aspen Daily News published Brad Marston's article, "On Physics: Removing atmospheric CO2 to stop climate change: Can it be done?"

In advance of the lecture, Prof. Marston gave a public lecture at the Aspen Center for Physics, which he said, "Explored the vital role physics plays in addressing one of humanity's greatest challenges." The lecture was held at the Flug Forum, Aspen Center for Physics.

The lecture can be viewed at https://aspenphys.org/community-events/public-lectures/.

Phys.org: Professor Kosterlitz joins team of physicists using machine learning to find out how layered gases and metals melt



Credit: *Proceedings of the National Academy of Sciences* (2025). DOI: 10.1073/pnas.2502980122

Photo: Valerie DeLaCámara

Prof. Kosterlitz was part of a team consisting of Aalto University's Department of Applied Physics Prof. Tapio Ala-Nissilä, famed Prof. Roberto Car from Princeton University and physicists from Nanjing University in China. Prof. Kosterlitz's 2016 Nobel Prize was awarded for "his work in the similar vein of topological phase transitions."

BROWN PHYSICS MAKING AN IMPACT

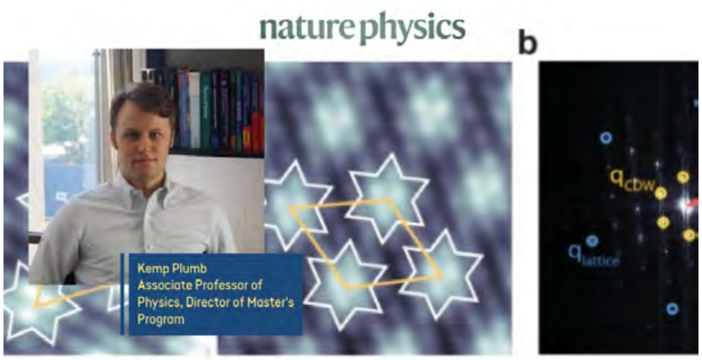
Loukas Gouskos in Symmetry Magazine: ‘Impossible’ Higgs boson measurement within reach, thanks to a detour

Illustration by Sandbox Studio, Chicago with Abigail Malate

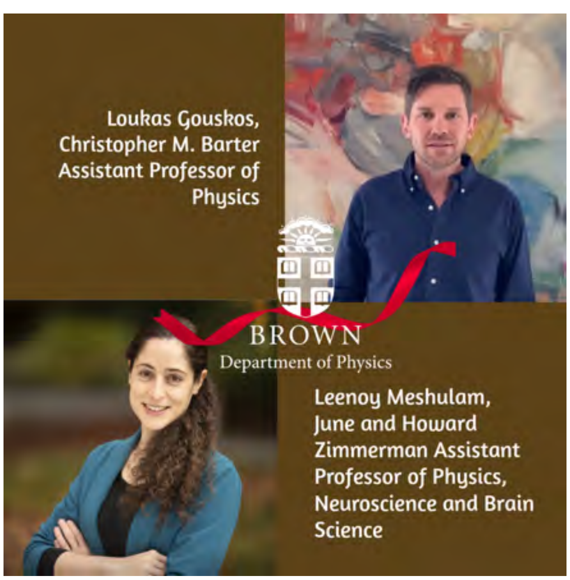
In a new publication detailing his work as part of a team on which his driving idea—developing a new machine learning tool while pausing physics research—paid off big for the team, Loukas Gouskos, Christopher M. Barter Assistant Professor of Physics, tells Symmetry Magazine, "It was Mission: Impossible. Our goal was to make it possible."

According to Symmetry, "His hope was that the new tool would allow them to narrow in on properties of the Higgs boson—ones that many physicists thought could not be tested at the LHC."

Kemp Plumb in Nature Physics



Kemp Plumb: Nature Physics published the findings of a research group that included Prof. Kemp Plumb. The group used thermal quenching to toggle the properties of 1T-TaS˜, making it behave as both an insulator and a conductor, in "Dynamic phase transition in 1T-TaS2 via a thermal quench."



THE CORPORATION OF BROWN UNIVERSITY APPOINTS PHYSICS FACULTY TO NAMED CHAIRS

The Corporation of Brown University’s recognition of academic excellence included two physics faculty appointed to named chairs. Leenoy Meshulam was named the June and Howard Zimmerman Assistant Professor of Physics, Neuroscience and Brain Science, and Loukas Gouskos was named Christopher M. Barter Assistant Professor of Physics.

In 2023, the Corporation approved the establishment of the Christopher M. Barter '90 Assistant Professorship with the generous support of Christopher M. Barter '90.

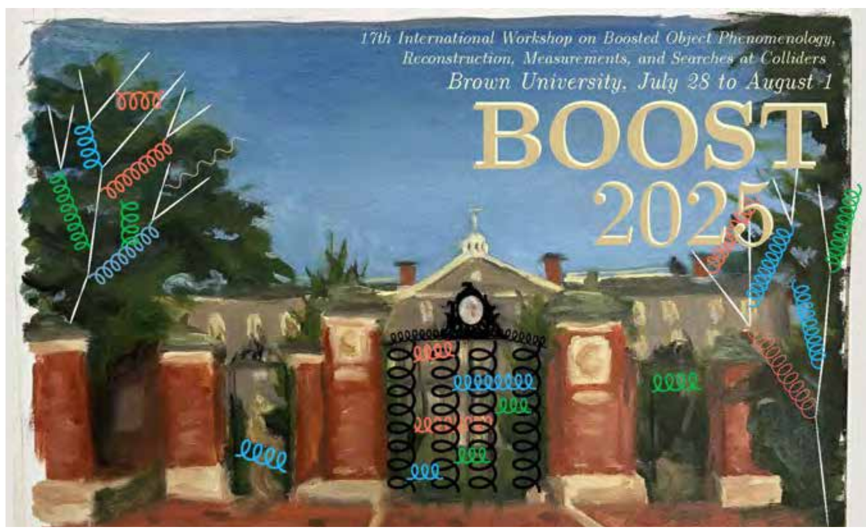
BROWN PHYSICS MAKING AN IMPACT

Physical Review Letters: Prof. Richard Gaitskell

The LUX-ZEPLIN (LZ) Experiment dark matter search results that were presented in August 2024 were recently published in Physics Review Letters, (PRL), the flagship journal of the American Physical Society (APS), “Dark Matter Search Results from 4.2 Tonne−Years of Exposure of the LUX-ZEPLIN (LZ) Experiment."

Professor Rick Gaitskell reports that "The LZ Experiment is working very well. In this paper, we report a significantly improved world-leading sensitivity in our search for particle dark matter. We have excluded many previously favored models for the dark matter."

BOOST at Brown!



Congratulations to Assistant Professors Jennifer Roloff and Matt LeBlanc for chairing the wildly successful BOOST 2025 -- 17th International Workshop on Boosted Object Phenomenology, Reconstruction, Measurements, and Searches at Colliders at Brown this summer!

BOOST 2025 is the 17th conference of a series of successful joint theory/experiment workshops that bring together the world's leading experts in theoretical and experimental collider physics to discuss the latest progress and develop new approaches on the reconstruction of and use of jet substructure to study Quantum Chromodynamics (QCD) and search for physics beyond the Standard Model.

Conference topics included searches for new particles (phenomenology and experiment), QCD calculations and measurements, in-vacuum or in-medium, from any collision system, jet reconstruction, calibration and classification, other aspects of hadronic final state reconstruction, such as pileup mitigation, new observables and techniques, including applications of machine learning, and studies related to future colliders.

‘Bridge’ of stray stars reveals active merger of two galaxy clusters

By Kevin Stacey

Using one of the most detailed sets of observations ever of a galaxy cluster 700 million light-years from Earth, astronomers have captured the faint glow of stray stars in the process of being ripped from their home galaxy and absorbed into another. The ‘bridge’ of diffuse light — spanning roughly a million light years between two galaxies in the cluster Abell 3667 — is the first direct evidence that the two brightest galaxies in the cluster are actively merging.

The findings also imply, the researchers say, that Abell 3667 formed from two smaller clusters, which had themselves merged around a billion years ago.

“This is the first time a feature of this scale and size has been found in a local galaxy cluster,” said Anthony Englert, a PhD candidate at Brown University and lead author of a study describing the findings. “We knew that it was possible for a bridge like this to form between two galaxies, but it hadn’t been documented anywhere before now. It was a huge surprise that we were able to image such a faint feature.”

The new images of Abell 3667 were made using the Dark Energy Camera (DECam) mounted on the Víctor M. Blanco Telescope at Cerro Tololo Inter-American Observatory in Chile. Englert and two colleagues — Ian Dell’Antonio, a professor of physics at Brown, and Mireia Montes, a research fellow at the Institute of Space Sciences in Barcelona, Spain — stitched together a record-breaking 28 hours of observations taken over a span of years by DECam. The findings are published in The Astrophysical Journal.

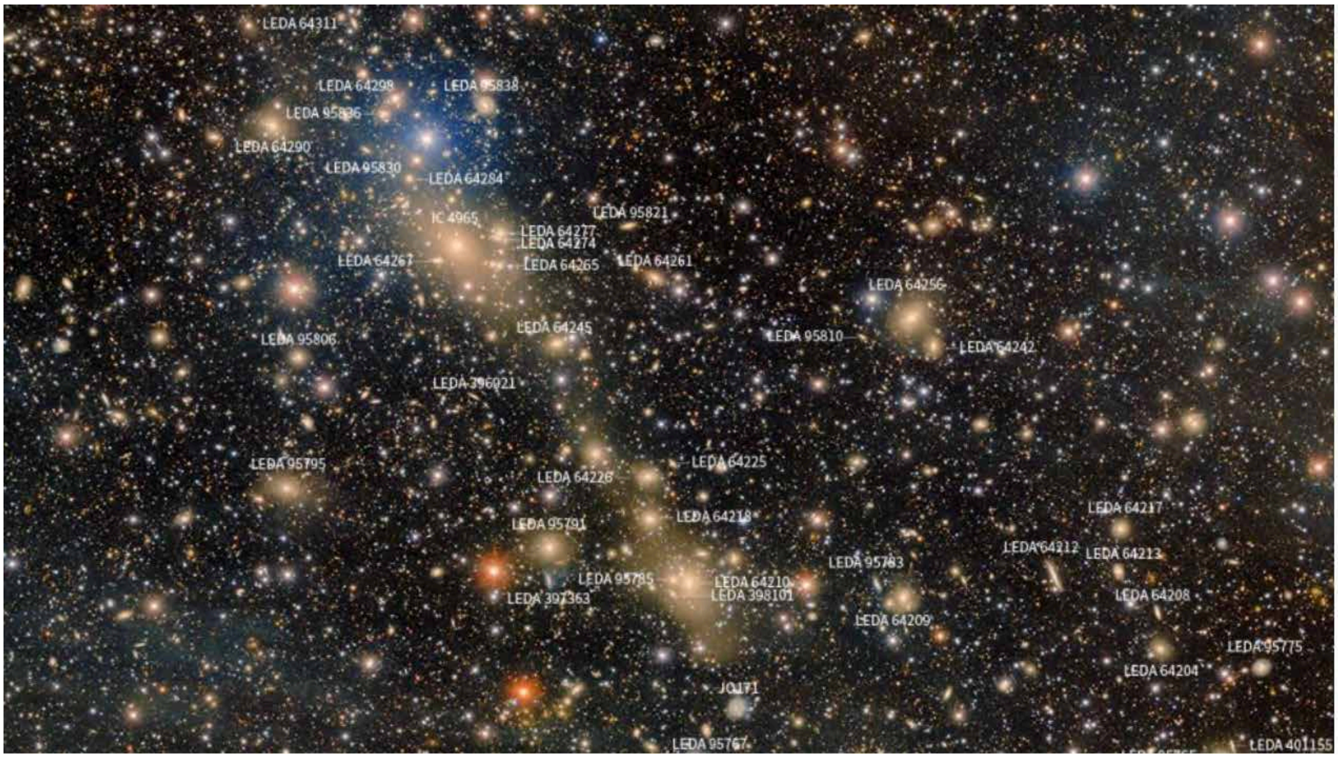
“Because Blanco has been imaging with DECam for the past decade, there is a ton of archival data available,” Englert said. “It was just a happy coincidence that so many people had imaged Abell 3667 over the years, and we were able to stack all of those observations together.”

That extensive observation time is what made it possible to image the dim light of stray stars within the cluster. This type of diffuse light, known as intracluster light or ICL, offers a treasure trove of information about the history of Abell 3667 and the gravitational dance of the galaxies within it.

The ICL imaged by Englert and his colleagues revealed a special type of galactic merger happening in Abell 3667. Normally, Englert says, mergers that involve the largest galaxy in a cluster, called the brightest cluster galaxy or BCG, occur gradually as it steals stars from many smaller galaxies that surround it. But this new research shows something different happening in this case. Abell 3667 is actually made of two galaxy clusters, each with its own BCG, that are now merging together. The ICL bridge discovered by the researchers suggests that the larger BCG is stealing stars from the smaller one — an event known as a rapid or aggressive merger. As the two BCGs merge, so too do the smaller galaxies that surround them, making Abell 3667 the product of two merging clusters. Data from X-ray and radio frequency observations had suggested a rapid merger in Abell 3667, but this is the first optical evidence to back it up.

The appearance of intracluster light in these new images offers a tantalizing preview of what’s to come when the Vera C. Rubin Observatory becomes fully operational later this year or early next. Using a telescope twice the size of Blanco and the largest camera ever built, the Rubin telescope will perform a 10-year scan deep into the entire southern sky, a project called the Legacy Survey of Space and Time.

In a preview of observations that will be made routinely by the Vera C. Rubin Observatory, astronomers found evidence indicating that a galaxy cluster is merging, a first for a nearby (astronomically speaking) cluster.



The merger revealed by this study is between two BCGs (brightest cluster galaxies). BCG1, labeled above as IC 4965, is pulling stars away from BCG2, labeled LEDA 64210. The diffuse glow between the two is the light from those stray stars.

“Rubin is going to be able to image ICL in much the same way as we did here, but it’s going to do it for every single local galaxy cluster in the southern sky,” Englert said. “What we did is just a small sliver of what Rubin is going to be able to do. It’s really going to blow the study of the ICL wide open.”

That will be a scientific bonanza for astronomers and astrophysicists. In addition to revealing the history of galaxy clusters, the ICL holds clues to some of the most fundamental mysteries of the universe, particularly dark matter — the mysterious, invisible stuff thought to account for most of the universe’s mass.

“ICL is quite important for cosmology,” Dell’Antonio said. “The distribution of this light should mirror the distribution of dark matter, so it provides an indirect way to ‘see’ the dark matter.”

Seeing the unseeable — that’s a powerful telescope.

The Victor M. Blanco Telescope and the Vera C. Rubin Observatory are operated by NOIRLab, the U.S. national center for ground-based, nighttime optical astronomy operated by the National Science Foundation. The research was funded by NSF (AST-2108287), the U.S. Department of Energy (DE-SC-0010010) and the NASA Rhode Island Space Grant Consortium.

BROWN PHYSICS
SEED AWARD

Brown's Division of Research recently awarded Assistant Professor Loukas a 2025 Seed Award. This annual program helps faculty develop more competitive research proposals by supporting the generation of preliminary data, pursuing new directions or collaborations in research, and other endeavors

Photo: Valerie DeLaCámara/Brown University

Loukas shared the impact he anticipates the award will have on his work with the Large Hadron Collider.

Research Seed Funding awards are competitively awarded and help faculty more successfully advance competitive research proposals by supporting the generation of preliminary data, pursuing new directions or collaborations in research, and other endeavors. Investigators may propose projects in one of two categories. Category 1 - single PI projects of any type with budgets up to $50,000 for one year; Category 2 - multi-PI projects supporting a new collaboration between two or more disciplines with budgets up to $100,000 for one year.

The Large Hadron Collider (LHC) generates 40 million proton-proton collisions per second, requiring a real-time selection ("Triggering") system to rapidly identify a tiny subset of events for further analysis. This selection occurs in multiple stages, with the most critical step, the Level-1 Trigger (L1T), executed on custom hardware such as Field Programmable Gated Arrays (FPGAs) to reduce the data rate within microseconds. Current L1T selection methods rely on traditional algorithms, which limit sensitivity to rare and complex physics signatures, thereby limiting the LHC discovery potential. AI algorithms on FPGAs remain in their infancy due to extreme latency and hardware constraints.

Our project takes a high-risk, high-reward approach by developing advanced Deep Learning models, such as Graph Neural Networks and Transformer architectures, specifically optimized for FPGA deployment. While Transformers have revolutionized AI, their application in ultra-low-latency environments, with a targeted 1 microsecond (1μs) inference time, remains unexplored and far beyond current industry capabilities. Given these challenges, the project requires an interdisciplinary effort, combining high-energy physics expertise from Gouskos and Landsberg (Physics Department) with cutting-edge AI model development from Bach (Computer Science Department). This collaboration is crucial for designing models that meet the stringent computational and real-time constraints of FPGA-based triggering.

By tailoring these models for real-time physics applications, our research will push the boundaries of AI acceleration in experimental physics, demonstrating the feasibility of AI-driven selection algorithms for high-energy collisions at unprecedented latency.

This SEED award is critical for generating proof-of-concept results that will strengthen future proposals to funding agencies such as DOE and NSF, both of which have shown significant interest in this domain.

By positioning Brown University at the forefront of AI-driven real-time event selection, this project will establish a long-term, interdisciplinary collaboration between the Physics and Computer Science departments, emphasizing the growing connection of AI and fundamental physics, as underscored by the 2024 Nobel Prize in Physics.

Beyond high-energy physics, the AI methodologies developed in this project will have a broader scientific and technological impact, including astrophysics (for transient event detection) and medical physics (for real-time imaging and diagnostics).

- *Loukas Gouskos*

NEW RESEARCHER

Meet our newest researcher, Asst. Professor Aaron Hui

Photo courtesy A. Hui

Physics was not on my radar growing up, but I was always broadly interested in math and science. I originally applied to undergraduate programs under electrical engineering but then found applied and engineering physics. For me, this was the best of both worlds; I could learn about deep and interesting topics but also get the foundational training I needed to keep my career options open. Over time, I eventually meandered my way into condensed matter physics; I spent time doing projects in things like nuclear engineering, theoretical computer science and nanosatellite control before I finally settled in condensed matter theory as a graduate student.

As a condensed matter theorist, I primarily study strongly correlated and topological systems with an emphasis on electron transport. I am interested in emergent novel and exotic behaviors of “thermodynamically large” quantum systems. Much of my research effort has gone towards understanding the newly-discovered hydrodynamic regime of electron transport which has challenged long-held statements in electron transport lore. I’ve also done work on the fractional quantum hall effect and their phase transitions. More recently, I’ve been thinking a lot about non-equilibrium phase transitions in quantum circuits as well as new ways to detect anyons and quantum entanglement in condensed matter systems.

More frankly, I think of condensed matter theorists, myself included, as professional dabblers. The interesting interacting systems that we study are complicated; there’s often no clear path to the answer. Even direct numerical simulations can be controversial. This leads to desperation; I need to draw inspiration from a bunch of disparate fields and connect the dots to get a glimpse of the answer.I can and will throw the kitchen sink. Because of this, I’m always challenged to stay on my toes and push myself to learn something new; I’ve lost count of the times I’ve needed knowledge from something I had once thought irrelevant. What was once aimless wandering became surprisingly critical to my research. This unification of a diversity of ideas is one of the best parts of condensed matter; I get to wear many different hats.

I’m excited to have the opportunity to be at the prestigious institution that is Brown University. Many distinguished condensed matter physicists have passed through these halls, including Leon Cooper and Michael Kosterlitz. Those are big shoes to try to fill. Furthermore, there are many opportunities for collaboration across the disciplines; cutting-edge research is being done all over campus. In my brief time at Brown so far, I’ve already been engaged in discussions with other faculty about topics outside of my usual sphere of research. Brown is an institution that is committed to training its students to succeed. I’m happy to be in a place where I can help train the next generation of students, where I hold the modest hope of helping them meander a bit more fruitfully than I did through my studies.

\- *Aaron Hui*

BROWN Department of Physics | Center for the Fundamental Physics of the Universe

The 2025 AI Winter School Hosted by the Brown Center for the Fundamental Physics of the Universe (CFPU)

By Valerie DeLaCámara with additional reporting by Ariel Green

The 2025 AI Winter School, hosted by the Center for the Fundamental Physics of the Universe at Brown University's Department of Physics, was a four-day online school open to interested graduate students, postdoctoral researchers and advanced undergraduates from any institution.

In its second year, the initiative was a smashing success, with the Organizing Committee reporting a more-than quadrupled number of participants—almost 2,000 total— from Western Europe, India, the UK, Peru, Ghana, Nigeria, Columbia, Macau, Nepal, Thailand, Turkey, South Africa, Algeria, and Greece, with stateside participants from a wide variety of colleges and universities, such as the University of Southern Alabama, Florida State, the University of Mississippi, Louisiana, Missouri, Nevada, Maine, Delaware, Texas, New Hampshire, Hawaii, and Wisconsin among schools participating.

This year's program consisted of six modules, each comprising a lecture session delivered by Brown Physics faculty members and industry experts, followed by practice workshop sessions for participants, with guidance on the use of machine learning tools.

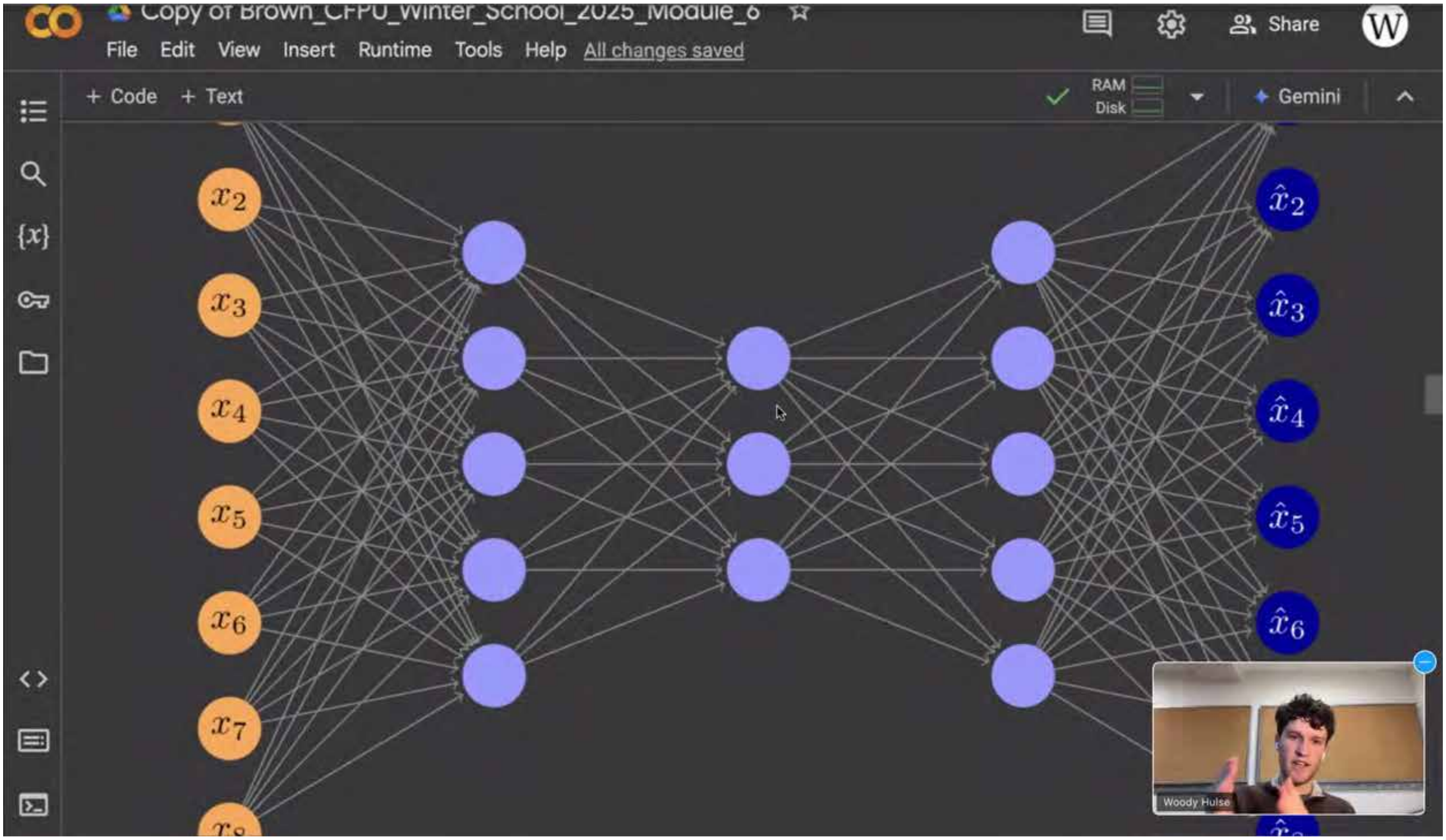
AI Winter School Goals

The goal of the Winter School was to offer examples of the direct applications of machine learning methods to a range of problems inspired by the use of artificial intelligence in physics. Instructors provided hands-on experiences with machine learning tools to help reduce the barriers to engagement with these essential tools for physics research.

Connecting to a "vibrant academic community"

Participant feedback was enthusiastic, with a majority of respondents indicating they were very satisfied with their experience in the virtual machine learning workshop. Arnav Kapoor, an undergraduate Computer Science student at IISER Bhopal, said they are "deeply passionate about machine learning and its interdisciplinary applications." Arnav said that the Brown AI Winter School "was a step toward bridging interests in AI and scientific research." With a master's degree in physics and astrophysics from Cotton University, Bishal Bhatta felt that the Brown AI Winter School aligned perfectly with their interests. "Opportunities like this are rare, especially for students who do not always have direct access to such cutting-edge training. This workshop provided invaluable insights into AI-driven astrophysics research, bridging the gap between theory and application."

The 2025 Winter School program included a Roundtable discussion: "What do we need AI to be capable of to really propel physics forward?" featuring: Jim Halverson (Northeastern University), Max Tegmark (MIT), and Kyle Cranmer (University of Wisconsin-Madison); moderated by Richard Gaitskell (Brown University).



Woody Hulse, Brown Undergraduate, leading the presentation on Module 6 on Autoencoders applied to simulated data from the LZ Dark Matter Experiment. Screengrab by Richard Gaitskell/Brown University

Module: Introductory Module
Presenter: Shawn Dubey (Brown University)

Module: Development and Deployment of Graph Neural Networks in Particle Physics
Presenter: Loukas Gouskos and Lazar Novakovic (Brown University)

Module: Physics-Inspired Operator Learning for Inverse Scattering with Application to Ground Penetrating Radar
Presenter: Yanting Ma (Mitsubishi Electric Research Laboratories)

Module: Unsupervised Learning to Find Interacting and Starburst Galaxies
Presenter: Ian Dell'Antonio and Philip LaDuca (Brown University)

Module: Overview of Large Language Models (LLMs) and RAG
Presenter: James Verbus (Senior Staff Software Engineer, Machine Learning, LinkedIn)

Module: Auto-Encoders for Data Compression in Dark Matter Direct Detection Experiments
Presenters: Shawn Dubey and Woody Hulse (Brown University)

Module: Generative AI, Agents, and Industry Applications
Presenter: Alexis Johnson (Deloitte SFL Scientific), Michael Luk (Deloitte, SFL Scientific)

The Organizing Committee members Director Richard Gaitskell, Associate Director Ian Dell’Antonio, Jennifer Roloff, Jonathan Pober, Matt LeBlanc, Loukas Gouskos, Gaetano Barone, Shawn Dubey, Madhurima Choudhury, and Ka Wa Ho expressed their gratitude to Center administrator Ariel Green, without whose exceptional management and organizational skills this conference would not have been possible.

Given the highly favorable participant feedback, Brown hopes to host the AI Winter School for a third year.

Simons Puerto Rico Winter School in Computational Physics

BROWN
Department of Physics

UNIVERSIDAD DE PUERTO RICO
1903

The 2025 Simons Puerto Rico Winter School in Computational Physics

By Valerie DeLaCámara

The 2025 The Simons Puerto Rico Winter School in Computational Physics is a Simons-funded collaboration among the University of Puerto Rico, Brown University, and the Simons Flatiron Institute to host a one-week institute on the UPR Piedras (winter) and the Brown campus (summer) during which UPR undergraduates will learn about a wide range of computational physics topics from leading experts.

With faculty Carlos Vicente (UPR—Piedras), and Brown faculty Savvas M Koushiappas, Brenda Rubenstein, Ian Dell'Antonio, Kemp Plumb, Loukas Gouskos, and administrator Ariel Green (Brown Physics), the Winter School's second year was a resounding success. Part of the Simons-funded summer Puerto Rico-Brown Exploration (PROBE) Program (hosted on Brown's campus), the Simons Puerto Rico Winter School in Computational Physics brings Brown faculty to the University of Puerto Rico-Rio Piedras (UPRRP) campus for a week-long series of classes and lectures together with UPRRP faculty.

The school consists of general-interest lectures from Brown and UPRRP faculty, followed by computational practica, during which students can engage in programming activities and interact with practitioners. Initial lectures will focus on the microscopic world of quantum, chemical, and biophysics before transcending scales to more macroscopic topics in astrophysics, high-energy physics, and climate physics.

In addition to exposing students to the breadth of computational physics research, the school also serves as an opportunity to connect UPRRP undergraduates with researchers who can subsequently serve as research mentors.

According to Brown Assistant Professor Loukas Gouskos, there were approximately 40 students in attendance at the 2025 Simons Winter School.

Gouskos says a key to this year's success is that returning participants "came in with a clearer sense of what to expect, making the program even more impactful. Their enthusiasm and thirst for knowledge were exceptional, with strong engagement across all subjects, from AI and its applications in physics to cosmology and computational methods. Many students expressed enthusiasm about the role of AI in modern physics. Their feedback highlighted how the Winter School helped them set academic goals, understand what it takes to excel in research and build confidence for future opportunities."

Innovations to the 2025 Winter School included the introduction of the Master Class. According to UPRRP Professor Carlos Vicente, the concept was well received

Enjoying their time in Providence with Leadership Alliance and Brown Physics, Simons Summer PROBE (Puerto Rico Brown Experience) students Alejandra Vela Morales, Rodrigo Gonzalez-Marcano, Damian Ayala-Fernandez, Xavier Ruiz Sepulveda, Yamilet Mirach-Melendez, Jean Torres-Alvarez, Gabriela German Toledo, and Sebastian Hernandez Sterling pause to commemorate their time on the Brown campus.

by the UPRRP students and effectively maintained student engagement with the material. Prof. Vicente felt that the clear tasks outlined in Prof. Jay Tang's master class also helped to ensure student success with the material. He relays that Brown Professor and 2025 Winter School Program Director Savvas Koushiappas' master class, which included a primer on cosmology and related subjects, was a hit with the students.

Prof. Vicente relates that there were hurdles to overcome during the Winter School; for example, the group had to relocate to a different location due to last-minute, week-long power outages at the UPR-Rio Piedras campus. The group ultimately met at the UPR-Carolina campus. He laughs as he recalls that the new location was popular because the Carolina campus has "a culinary school and the meals were quite good!"

It is common for UPR students to face hurdles, such as the fallout from tropical storms or frequent power outages, which can create logistical disasters that could quickly derail their academic pursuits. Their resilience and dedication to their goals are motivated by more than good cuisine: they are single-minded in their pursuit of the excellent physics instruction afforded by the Simons Brown-UPR Winter School.

Each successive year, the Winter School evolves to meet the needs and interests of its students. For example, this year, when the joint faculty introduced the "master class," they devised a setting that included a private lesson with speakers, making it more interactive and incorporating questions and tasks for the students. Prof. Vicente says, "the students loved the master class; it allowed them to interact with the Brown faculty in a workshop environment, which had a high impact on student engagement." He said that while some students had not taken advanced courses, they were eager and quite able to grasp the main ideas.

Prof. Koushiappas remarked on the student experience, saying, "It was rewarding seeing the students being interested not only in the latest problems in physics but also in how to learn and set goals for their careers and accomplish those goals. There is no better reward than seeing students who get inspired, ask many questions, and want to go on and study further." The UPRRP students are "hungry to learn," he says, "and they are very enthusiastic to hear about what we work on, what are the hot topics in each of the research areas we presented, but also what are the fundamental steps that one must take to work in these areas and how to prepare for studies in these fields."

Brown Professor Ian Dell'Antonio embraces the advantages to both students and faculty. He was thrilled to meet many great students, and says the UPRRP students had the unique opportunity to learn from a more varied faculty since there are "very few astrophysics opportunities at UPR."

Key Advantage of the Winter School

Prof. Gouskos says, "The Brown-UPR Winter School in Computational Physics has been an incredibly enriching experience for both the students and me." He stresses that a key advantage of the Simons Winter School is that "undergraduates can participate early in their studies, gaining clarity on expectations and time to develop the necessary skills for high-level research at Brown or another institution." Prof. Gouskos views the impacts of

> "Certainly, there are more candidates that would do well than we have funding for."
>
> **IAN DELL'ANTONIO**
> Professor

the program participation holistically, saying, "I believe the impact of the Winter School on UPR students has been essential; beyond the technical knowledge, it has given them a renewed sense of purpose, a clearer academic trajectory and the confidence to pursue research opportunities.

Of approximately 45 students in the lecture and master class, Prof. Ian Dell'Antonio says he spoke personally to 15 students. With the Summer PROBE Program at Brown in mind, he says, "Certainly, there are more candidates that would do well than we have funding for."

A Deeply Rewarding Experience

While the students are the primary beneficiaries of program participation, the educators also come away with lessons learned; they returned to Providence with a renewed sense of purpose.

Prof. Gouskos enjoyed the UPRRP students' fresh perspectives and enthusiasm, which he says "serves as a reminder that science is a continuous learning process for both students and educators." He says he has benefitted personally and professionally and that teaching at the Winter School was deeply rewarding.

Reflecting on his career, Prof. Gouskos credits the Winter School with fulfilling an early goal of engaging with and mentoring students. "On a personal and professional level, teaching at the Winter School has been deeply rewarding. One of the reasons I transitioned from the role of Experimental Physics Research Staff at CERN in Geneva, Switzerland to a university was the opportunity to engage with students and transfer knowledge and expertise to them. Seeing the UPRRP students' intellectual curiosity and drive underlines the importance of mentorship in shaping the next generation of scientists.'

Gouskos believes the Winter School's impact on UPR students has been essential. "Beyond the technical knowledge, it has given them a renewed sense of purpose, a clearer academic trajectory and the confidence to pursue research opportunities. Programs like this are vital in bridging the gap between aspiring scientists and world-class research, ensuring that talented students, regardless of background, have the support to thrive."

An exciting new initiative for the summer 2025 PROBE Program was the PROBE Seminar Series, the first of which included a lecture by Professor Stephon Alexander, renowned cosmologist and jazz saxophonist, whose lecture was titled "The Jazz of Physics."

EXPLORATORIUM DEMO DAY!

By Valerie DeLaCámara

Physics Fundamentals' Exploratorium Demonstration Day event enthralled over 50 invited students from across Brown and Providence this April. The team from Physics Fundamentals introduced physics concepts to elementary and high school students; for some, it was their first exposure to hands-on science exploration.

The Engineering Resource Center (ERC) reverberated with awe during the event, organized by Demonstrations Manager and physicist Angella Johnson, whose team debuted over twenty new physics laboratory demonstrations.

Much to the delight of students from the French American School of Rhode Island (FASRI), Laboratory Physicist Alexander Lombardi demonstrated the Greek Waiter's Tray, a unique visual illustration of centripetal force that shows how a tray of water-filled glasses can be swung in circles without spilling the water.

Why are physics demonstrations so popular? The possibility of failure is high on the list! With physics, as in life, failure is an exercise in learning. Lombardi says that the "element of danger or high probability that something will go wrong" increases the popularity of a physics demonstration, such as the Tablecloth Trick, which elicited gasps of amazement from the FASRI students, and the Greek Waiter's Tray. "There is a good chance I would get wet or break a bunch of glass. In that regard, my practice paid off, and they were left disappointed, but I think the anticipation still made it thrilling." Lombardi gamely led another student favorite: the Bicycle Generator, demonstrating how mechanical energy from pedaling a bicycle can be converted into electrical energy to power light bulbs. The Bicycle Wheel Gyroscope is Alex's favorite because, "even if you understand the physics, it still feels like a bit of magic."

Lombardi said the older students were inquisitive about the sound tubes and the smoke cannon, specifically, how the sound tubes produced different notes, and were "fascinated by how the Smoke Cannon produced rings." Older students, he says, "mostly wanted to try the demos for themselves, which I was more than happy to encourage!"

Among the demonstrations were the Floating Bubble Density Demonstration, an Einstein Face Illusion, a Van de Graaf Generator with Tinsel Wig, and a Modular Circuits Kit. Approximately 75 students from Brown, Hope High School and FASRI filled the ERC to experience hands-on physics, some for the first time. Professor Rick Gaitskill, overseeing the Floating Bubble Density Demo, posed questions about water density to a student, who said that they were not studying physics, but were intrigued by the unique aspect of the event. When asked what ultimately drew them into the lobby, the enthusiastic reply came quickly. "Well, of course it was the magic of physics!"

SPOTLIGHT ON

Shounak De '25 PhD

Awards: Kavli Institute for Theoretical Physics (KITP) Graduate Fellowship (2025)
Award of Excellence as a Graduate Teaching Assistant (2022)

Photo: Valerie DeLaCámara

What advice do you have for incoming students?

Resilience and patience are essential. Most days in research are slow and unglamorous, replete with routine setbacks. But the rare moments when you uncover something new, however modest, are the ones that make it all worth it. Those incremental advances drive scientific progress and sustain your passion for the subject.

What is the most impactful lesson you learned at Brown?

The most impactful lesson I learned is that the right question often matters more than the correct answer. My PhD at Brown has taught me to seek simplicity within complexity, to challenge assumptions, and to follow the threads that reveal hidden structures in what we thought we already understood deeply.

Who inspired you at Brown and why?

My PhD advisor, Professor Anastasia Volovich, has been a constant source of support, guidance, and inspiration throughout my PhD journey, and I owe her a special debt of gratitude. She has instilled in me the importance of articulating complex research with clarity and simplicity, a lesson that has deeply shaped how I approach both thinking about and presenting my work. Over the past four years, her mentorship has played a pivotal role in my growth as a researcher, guiding me through challenges and helping me evolve into a thoughtful, independent physicist. I will always cherish the faith she placed in me at several crucial moments, and her influence on my academic journey will remain close to my heart!

What Brown Physics faculty member made a significant impact on your journey and why?

I am highly indebted to Professor Marcus Spradlin, who has been very instrumental in my progress during my PhD journey at Brown. His mentorship, unwavering support, and readiness to engage in physics discussions have been invaluable. I have greatly enjoyed our many collaborations, and Professor Spradlin has, in many ways, acted as a second advisor to me. His influence on my development as a researcher has been immense, and I am deeply thankful for the patience, knowledge, and enthusiasm he has shared.

Please tell us the name of the award, how you came to receive it, if an adviser was instrumental in the process, how you feel about it, and the impact the award or fellowship will have on your research.

I'm truly honored to have received the Kavli Institute for Theoretical Physics (KITP) Graduate Fellowship Award. The KITP Graduate Fellowship is a prestigious program that offers select graduate students from around the world the opportunity to spend an extended period at KITP, one of the world's leading research centers for theoretical physics. I was fortunate to be nominated for this fellowship by my PhD advisor, Professor Anastasia Volovich, whose unwavering support and belief in my work have been pivotal throughout my graduate journey at Brown.

This award provided me with the incredible opportunity to spend a semester fully immersed in KITP's vibrant research environment under the mentorship of Professor David J. Gross, the 2004 Nobel Laureate in Physics. Professor Gross is one of the greatest living minds in theoretical physics, whose visionary leadership and groundbreaking contributions to quantum field theory and string theory have shaped the field for decades. It has been an extraordinary and humbling experience to interact and learn directly from him, to engage in discussions that have both deepened my current research and inspired new directions.

The KITP Graduate Fellowship has been transformative for me, exposing me to new perspectives and approaches to problems in theoretical physics. It placed me in close proximity to some of the most brilliant minds in the field, fostering countless valuable conversations and collaborations that have expanded my academic horizons. It has also bolstered my confidence as a young researcher entering the broader scientific community. I am highly indebted to KITP and Professor Volovich for making this experience possible. It is a chapter of my career I will always cherish.

Describe your time at Brown Physics and the people who most directly impacted your research, program experience and your career. This is your time to extend thanks to those people who most deserve it!

Photo: Courtesy Shounak De

My time at Brown Physics has been truly formative, both academically and personally. I am deeply grateful to my advisor, Professor Anastasia Volovich, whose constant support, guidance, and belief in my work have been pivotal throughout my PhD journey. She has shaped the way I approach research, communicate ideas, and navigate the challenges of academia. I am also highly indebted to Professor Marcus Spradlin for his invaluable guidance, steady encouragement, and the collaborative spirit he brought to my PhD experience. Their mentorship has had a lasting impact on both my academic and personal growth.

I would also like to thank the High Energy Theory Group at Brown, particularly Professors Stephon Alexander and JiJi Fan, for their support throughout my graduate years.

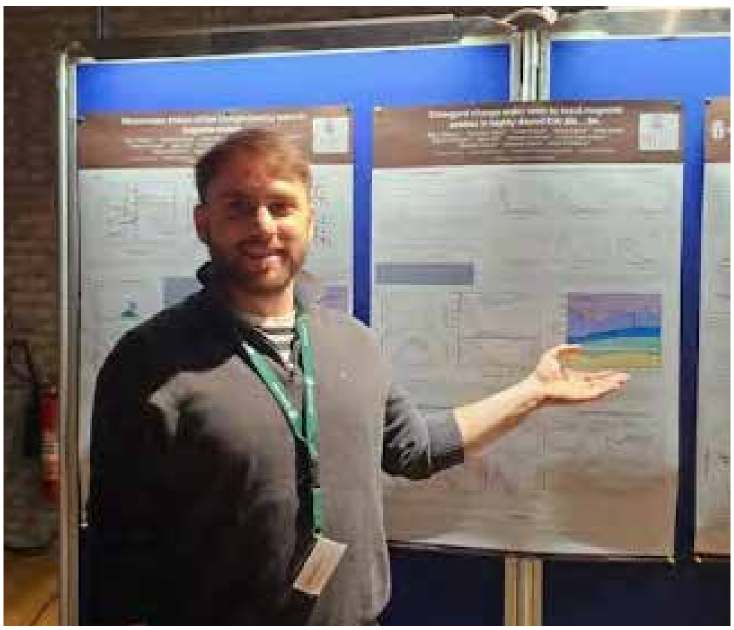
Finally, I owe a great deal to my collaborators and fellow researchers in the Brown High Energy Theory Group for their ideas, encouragement, and friendship. Working alongside and learning from them has been one of the highlights of my PhD!

STUDENT SPOTLIGHT
BROWN PHYSICS
AWARDS OF PRESTIGE AND RENOWN

Spotlight on Ilija Nikolov

824. WE-Heraeus Seminar on Electronic Order in Kagome Metals

By Ilija Nikolov



Ilija Nikolov with his award-winning poster at tha 824. WE-Heraeus Seminar on Electronic Order in Kagome Metals

PhD student Ilija Nikolov was awarded the Best Poster Prize at the 824. WE-Heraeus Seminar on Electronic Order in Kagome Metals for his poster presented December 8 – 12 at the Digital Hub Logistics in Hamburg, Germany, known as a hotspot for quantum materials and quantum technologies.

Of his win, Ilija says, “The experience was amazing not only because I had the chance to learn from world-renowned scientists, but also share the exciting work we have been doing in collaboration with the University of Bologna and University of Parma. I was very happy to describe the power of local, microscopic probes, such as NMR and what they can teach us about these novel quantum materials.”

According to WE-Heraeus-Stiftung’s website, due to their high degree of orbital frustration, Kagome metals have emerged as a platform for correlated and topological physics in itinerant electron systems. The Dirac cone and flat-band physics of toy models is modified in material realizations that give rise to strongly interacting ground states, such as charge order and superconductivity.

Tied to the lattice, these systems promise to realize the long-sought dream of controlling intertwined electronic orders, which both advances our understanding of these materials as well as promises novel applications of quantum materials. With a focus on the AV3Sb5 (A = K, Rb, Cs) class of materials, we address the mounting experimental evidence for a thus-far unexplained state that bears characteristics of a chiral state with delocalized orbital anti-ferromagnetism. The contradictory state of experimental evidence points to extreme sensitivity of this state to external perturbations, a point of focus at the workshop.

With this highly interactive workshop, WE-Heraeus-Stiftung aims for a convergence of a minimal model for the interacting state in such Kagome metals and to derive a roadmap addressing the current open questions on microscopics, proposing complementary materials platforms and solidifying ideas towards interacting topological electronics.

The Wilhelm and Else Heraeus Foundation is a non-profit foundation under civil law to promote research and education in the field of natural sciences, particularly physics. It was established in 1963 by Dr. Wilhelm Heinrich Heraeus

Ilija Nikolov looks on as Prof. Vesna Mitrović discusses his poster in Hamburg. Photo courtesy Ilija Nikolov

Ilija received the Best Poster Award for his poster titled:
"Emergent charge order seen by local magnetic probes in highly doped $CsV_3Sb_{5-x}Sn_x$."

(1900 - 1985), a grandson of the founder of WC Heraeus GmbH in Hanau (today: Heraeus Holding GmbH), and his wife Else Heraeus (1903 - 1987). founder of WC Heraeus GmbH in Hanau (today: Heraeus Holding GmbH), and his wife Else Heraeus (1903 - 1987). Since the mid-1970s, the foundation has worked closely with the German Physical Society (DPG). The Wilhelm and Else Heraeus Foundation enjoys a high reputation among physicists. It is considered the most important private funding institution in the field of physics in Germany.

The purpose of the Wilhelm and Else Heraeus Foundation, as defined in its constitution, is to promote research and education in the field of natural sciences through direct and indirect activities. The foundation is both operational and sponsoring. The purpose of the foundation is realized in particular through:

- Promoting the exchange of scientific ideas in conferences and seminars.
- Supporting gifted students in their education.
- Promoting the further development of teaching and training.
- Grants to tax-exempt institutions to finance or co-finance projects that serve research and teaching.
- Individual projects that serve basic research and the dissemination of its findings, such as visiting professorships, endowed professorships, awards and study contracts on topics of particular social importance.

Certificate

Best Poster Prize for

Ilija K. Nikolov

Participant at the 824. WE-Heraeus-Seminar on

Electronic Order in Kagome Metals

08 Dec - 12 Dec 2024
at the Digital Hub Logistics Hamburg (Germany)

Scientific Organization:
Prof. Dr. Philip Moll (MPI for the Structure and Dynamics of Matter, Hamburg, Germany)
Prof. Dr. Titus Neupert (University of Zurich, Switzerland)
Prof. Dr. Eun-Ah Kim (Cornell University, Ithaca, NY, USA)

Hamburg, December 2024
The organizers

WILHELM UND ELSE HERAEUS-STIFTUNG

BROWN
Department of Physics

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COMMENCEMENT AND REUNION WEEKEND 2025

BROWN

Department of Physics

Welcome

Vesna Mitrović
Chair, Department of Physics
Professor of Physics

J. Michael Kosterlitz
Professor of Physics

Student Speakers

Finnegan M. Keller, Sc.B.

Shawn Khanna, Sc.M.

Navketan Batra, Ph.D.

Awarding of Undergraduate Degrees

Ian Dell'Antonio
Professor of Physics

Fraser Lang, Sc.B. '67
Trustee Emeritus

Awarding of Graduate Degrees

Dmitri Feldman
Director of Graduate Studies
Professor of Physics

Kemp Plumb
Director of Master's Program
Assistant Professor of Physics

Presentation of Awards

Anastasia Volovich
Professor of Physics

Awards

Ph.D.

Forrest Award
(Excellence in Work Related to Experimental Apparatus)

Jade Ducharme, Benjamin Brown

Anthony Houghton Award
(Excellence in Theoretical Physics)

Shounak De, Navketan Batra

Award of Excellence as a Graduate Teaching Assistant

Minh Cao, Benjamin Almquist, Yiru Wang, Caitlyn Altermatt

Ph.D. Fellowship

Galkin Foundation Fellowship

Timothy Rehm

Physics Merit Dissertation Fellowship Award

Navketan Batra and Erin Morissette

Dissertation Fellowship Award

Rishabh Bhardwaj

Jun Qi and Christine Geng Graduate Fellowship
in Condensed Matter Experiment Award

Vineetha Bheemarasetty

Congratulations!

BROWN

Department of Physics

Awards

Undergraduate

R. Bruce Lindsay Prize for Excellence in Physics

Lucas Brito, Tarek Razzaz, Julia Brockland

Mildred Widgoff Prize for Excellence in Thesis Preparation

Samuel Ferraro, Ishika Tulsian

Smiley Prize for Excellent Contribution to the Astronomy Program

Mahmoud Hallak, Finnegan Keller

Master's

Outstanding Thesis Award

Xiuhong Xu

Academic Excellence Award

Feifan Deng

Engaged Citizenship & Community Service to the Physics Department

Sharanya Renjit

Physics Department Chair Award

Shawn Khanna

Undergraduate Degree Recipients

Adnan Aldabbagh[+]
Tobias L. Benetton
Lucas Z. Brito[+]
Julia A. Brockland[+]*
Dhaamin R. Buford[+]
Lucas J. Chan*
Inkeun Chey
Harys Dalvi
Ishan M. de Campos Unni
Richard Dong
Maxwell T. Ebersman[+]
Samuel R. Ferraro[+]*
Alexander K. Green[+]
Mahmoud Hallak[+]
Jiashu Huang[+]*
Finnegan M. Keller[+]*
Alizeh H. Kizilbash[+]
Philip J. LaDuca[+]
Imogen E. Nagle[+]
Jordan Pfeifer[+]
Tarek O. Razzaz[+]*
Vini A. Rupchandani*
Jianing Shan
Ishika Tulsian[+]*
William R. Waite

* Magna cum laude
[+] Honors in Concentration

Congratulations!

BROWN
Department of Physics

Graduate Degree Recipients
Master of Science

Jacob J. Bair*
Tanner Bouwens
Refilwe T. Bua*
Mitchell Burdorf*
Alexander Buzzi
Oliver A. Carey*
Changrui Chen
Yiding Dai
Feifan Deng
Rui Deng
Jash Desai
Bowen Dong
Shutong Dong
Jade M. Ducharme*
Destin K. Encardes
Gillian Foo
Spencer D. Francis
Alyssa R. Hardin
Zirui Hu
Siyuan Hui
Jackson Q. Israel
Rishabh R. Jain*
Zhengyu Jing
Shawn S. Khanna
Morgan E. Lee*
Dongbi Li
Yizhou Liu
Harshadeep Maddali
Liam K. Mitchell
Ron Q. Nguyen*
Lazar Novakovic
Chuyue Peng
Matthew Q. Perez
Max W. Pezzelle*
Peiyu Qin
Chenyang Qiu
Sharanya Renjit
Haichen Rong
Sophia Singh
Tianqi Song
Haoxuan Sun
Samantha Sunnarborg*
Yimeng Tong
Nikhilesh Venka-tasubramanian
Shane A. Weiner
Haoyu Wu*
Thomas Wu*
Xiuhong Xu
Jiatong Yan
Zhe Yuan
Haochen Zhang
Yuanchen Zhou

* Transitional Master's

Graduate Degree Recipients
Doctor of Philosophy

Calvin Bales
Jihyeun Jeanne Bang
Navketan Batra
Aaron Baumgart
Rishabh Bhardwaj
Tatsuya W. Daniel
Donovan J. Davino
Shounak De
Nicholas Drachman
Mary H. Hadley
Silverio G. Johnson
Annalies M. Kleyheeg
Theodora Kunicki
Taeun Kwon
Juan David Lizarazo Ferro
Erin M. Morissette
Timothy D. Rehm
Farrah Medi Simpson
Austin Vaitkus
Qiaochu Wang
Benjamin Zager
Naiyuan James Zhang
Junjie Zheng

Congratulations!

PHYSICS COMMENCEMENT

2025 | BARUS & HOLLEY

Q&A

FOUR QUESTIONS WITH JESSE THALER '02

DISTINGUISHING BETWEEN TYPE I & TYPE II FUN

Jesse Diaz Thaler '02 is a professor of physics at MIT and Director of the NSF Institute for Artificial Intelligence and Fundamental Interactions (IAIFI). He is affiliated with the MIT Center for Theoretical Physics, MIT Laboratory for Nuclear Science, MIT Statistics and Data Science Center, and the MIT Institute for Data, Systems, and Society. He talked with us about his formative experiences at Brown Physics, chief among which was his access to the physics faculty.

Professor Thaler was the featured speaker at the Maurice & Yetta Glicksman Forum sponsored by the Division of Research on Saturday, May 24th, as part of Brown's Commencement Weekend activities. His talk was titled "Deep Learning + Deep Thinking = Deeper Understanding."

Q What advice do you have for our undergraduate concentrators?

I have three pieces of advice that I give to anyone who will listen. The first is to "find mentors." Even now, as a faculty member at MIT, I have around five senior colleagues I regularly turn to for advice. As a younger scientist, having someone (preferably multiple people) looking out for your best interests and giving honest feedback is even more critical.

The second is to "be visible." Somehow, society's image of a physicist is that of a lone genius toiling away in a closed office. The reality is that physics (especially theoretical physics) is a social enterprise, with many research ideas arising at blackboards and around coffee machines.

The third is to "tell a story." Science is a process of discovering the ultimate truths of nature, and while those truths are independent of the research process, the research process is shaped by the personalities involved.

> " To ensure that other scientists (and the public) understand and appreciate your work, you need to make an effort to explain not just the results of your work but also why it is important and how it fits into the narrative arc of the field. "
>
> JESSE THALER '02 SC.B.

What is your fondest memory of your time at Brown?

It's helpful to distinguish between Type I fun and Type II fun.

Type I fun is enjoyable in the moment, and certainly the debaucherous celebration after taking the Physics GRE counts in that category.

Type II fun is enjoyable only in retrospect. I was a jazz DJ on 95.5 WBRU, spinning vinyl records from 2:00 to 5:30...in the morning.

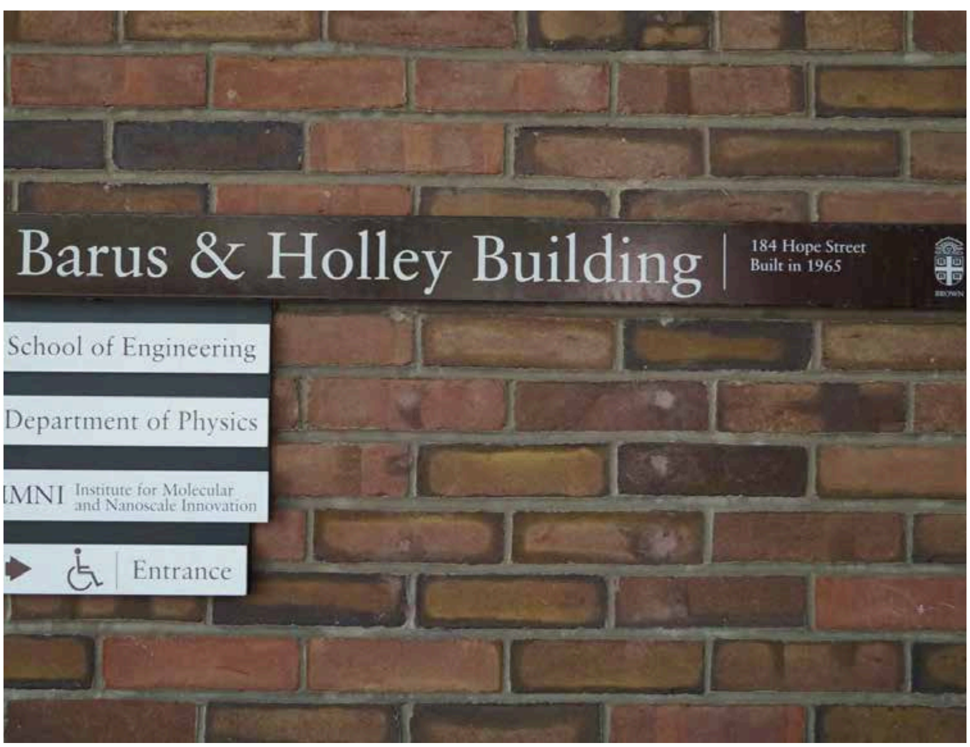
After my shift, I'd grab a breakfast sandwich from Loui's, try to sleep for a few hours, then head bleary-eyed to my 9:00 a.m. Quantum Mechanics class.

Jazz and physics (and insomnia) are my favorite things!

What about being at Brown contributed to your success?

I came to Brown because I wanted a full liberal arts experience. So even as I took many math and physics classes, I also enrolled in as many upper-level humanities courses as possible. These humanities classes taught me how to think clearly and write persuasively, but more importantly, they taught me the value of confronting ambiguity. We don't usually think of physics as ambiguous (at least not the version taught in classrooms), but physics research often involves weighing competing effects.

What I didn't know was how welcoming the Physics Department would be, especially regarding access to professors and opportunities for research. If only I could spend as much time with my current students at MIT as my Brown professors did with me!



Who at Brown contributed the most to your academic journey?

It's wonderful that some of my Brown peers and professors are now my physics colleagues! The aforementioned debauchery was with my classmate, Jahred Adelman '02, who is also a professor working in particle physics. I took a course on "Experiments in Modern Physics" from Prof. Greg Landsberg; I regularly see Greg at particle physics conferences, and based on my course performance, I assume he approves of my choice to pursue theoretical research.

There are many other names I could drop, but the two physics professors who influenced me most were Prof. Bob Pelcovits and Prof. Antal Jevicki; they were essential mentors to me along my physics journey. Bob was a spectacular teacher and conscientious advisor who encouraged me to aim high. Antal was also a great teacher, but more importantly, he was an inspiring research mentor who showed me that you didn't need to know everything to discover something new.

So, while the cinderblock walls of Barus and Holley weren't particularly welcoming, I am grateful to the people inside those walls who made Brown Physics my home. I am looking forward to returning to campus!

WELCOME BACK TO BARUS AND HOLLEY!

Photos: Valerie DeLaCámara

This year, the Department of Physics held its inaugural Welcome Back to Barus and Holley Alumni event. Department faculty, students and staff welcomed alumni from the classes of 1960, 1965, 1970, and 1980, among others, as they returned to Barus and Holley to kick off Commencement and Reunion Weekend!

Image credit: Mahmoud Hallak, Barus & Holley Rooftop Observatory

"This is a one shot image using a long exposure from three six minutes. I started the camera and rotated the dome 270 degrees giving this portal effect.

I captured it using a Canon RA on a tripod, with a 50mm lens while imaging the Orion nebula and testing the 16" for planetary photography and general equipment testing for the future 220 labs."

BROWN
Department of Physics
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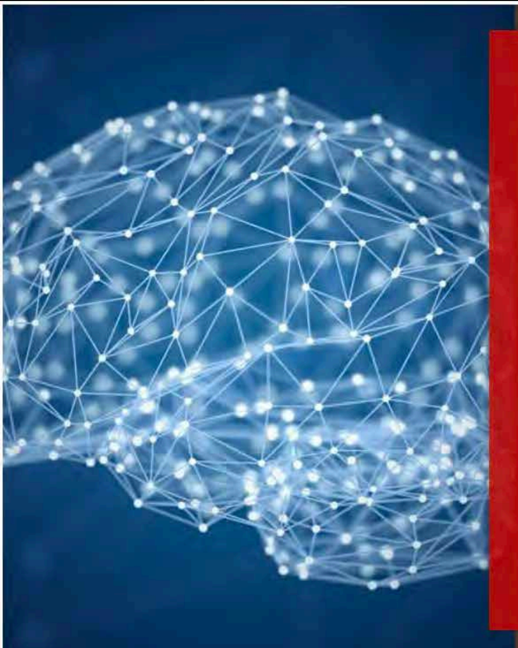
182 Hope Street
Providence, RI 02912



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