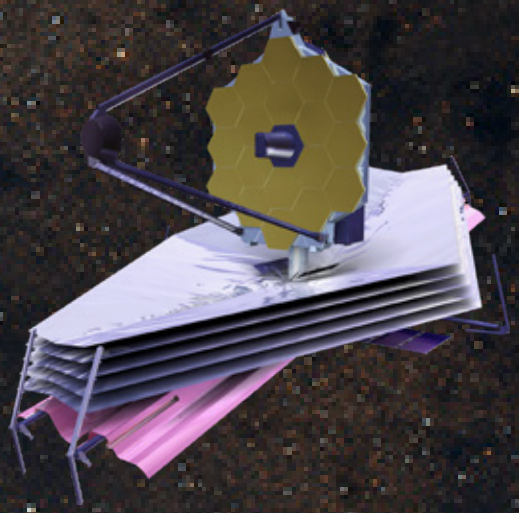
INTERACTIONS

THE DEPARTMENT OF **PHYSICS** AND **ASTRONOMY** WINTER 2022



Danny Milisavljevic, assistant professor of physics and astronomy in Purdue University's College of Science, is leading a research team using the world's most powerful telescope: The James Webb Space Telescope.

Pages 8 and 9

PURDUE UNIVERSITY®

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Interactions is an annual publication
Photos included have been provided by either Purdue Marketing and Communications or from persons mentioned.
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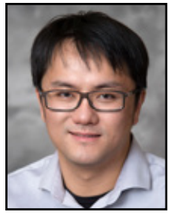

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FACULTY MEMORIALS

Professor Robert "Bob" Bading Willmann - March 14, 2021

Bob Willmann, age 89, of San Diego, passed away at his home on Sunday, March 14, 2021. Bob was born and raised in Seguin, Texas. He was a graduate of Seguin High School, Texas A&M University and obtained a PhD in physics from University of Wisconsin-Madison. He was a physics professor at Purdue University for 30 years. He enjoyed traveling, was an avid golfer, and followed Purdue basketball and the San Diego Padres, Chicago Cubs, and St. Louis Cardinals. Bob achieved the rank of Life Master in bridge. He served in the Air Force where he taught physics to pilots.

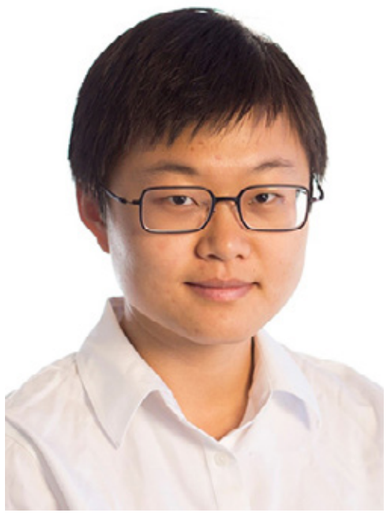
Yok Chen - September 30, 2021

On Thursday, September 30, 2021, Yok Chen, age 90, passed away. Yok, a resident of Henderson, Nevada, grew up in China before emigrating to the United States. He attended the University of Hawaii and received his BS in Chemistry from the University of Wisconsin and his PhD in Physics from Purdue University. Yok was a program manager with the Department of Energy, Office of Basic Energy Sciences and the Division of Material Science. He also worked at Oak Ridge National Laboratory where he won two prestigious R&D 100 Awards and was an American Physical Society Fellow.

PHYSICS & ASTRONOMY WELCOMES NEW FACULTY

DR. QI-YU (GRACE) LIANG

Fall 2021 new faculty member



The Department of Physics and Astronomy at Purdue University welcomes a new assistant professor to the faculty in the fall of 2021, Dr. Qi-Yu (Grace) Liang. Liang brings with her a substantial knowledge of atomic, molecular, and optical (AMO) physics. She explains that Purdue has a fast-growing AMO community and will expand her research here while also teaching Physics 172. She is looking to continue her passion of research and mentoring the next generation of talent.

"I tried AMO experiments out of curiosity" says Liang. "I fell in love with them because on the one hand, they are simple enough to be bench-top experiments; on the other, they are complicated and require a team of a few people and many different skills, including but not limited to programming, lasers and optics, electronics, etc. This unique combination allows one to learn a lot and see all aspects of the research, in contrast to experiments that can be performed by one person or hundreds. Another reason is the high controllability of ultracold atom experiments. They are relatively close to ideal systems, without having to worry about defects, etc."

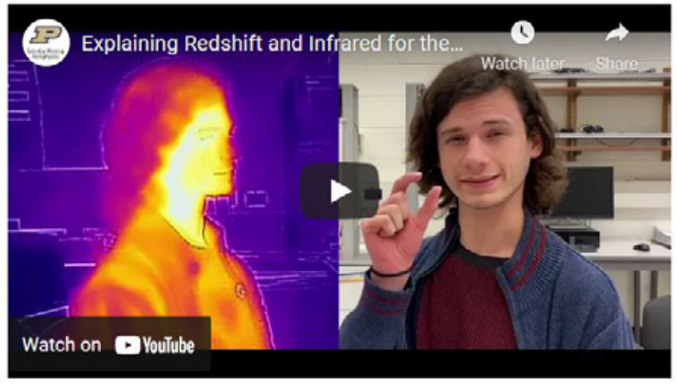
Liang was born and grew up in Beijing. She entered Peking University (also known as Beijing University) in 2005 to study physics. In the latter two years as an undergraduate, she studied surface modification for assembly of colloidal crystals under the guidance of Prof. Ziqiang Zhao.

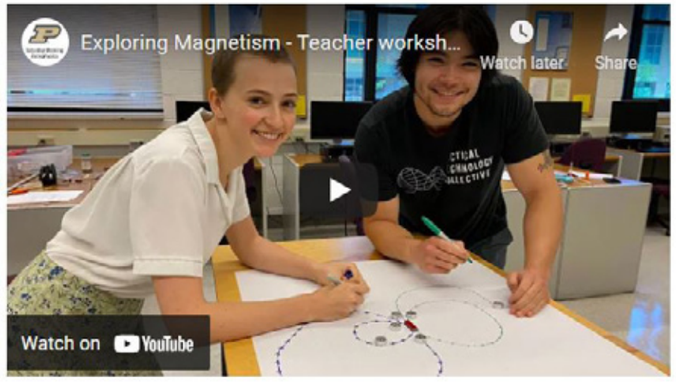
In 2009, she was accepted to the Department of Nuclear Science and Engineering (NSE) at MIT. She then switched to the Physics Department and has studied quantum nonlinear optics by coupling the photons to highly interacting atomic Rydberg states. The lab was finishing up a hollow-core fiber experiment when she arrived. Together with her labmates, she built the new Rydberg experiment. They first demonstrated single-photon nonlinearity with this then new approach involving highly-excited Rydberg states. Later, they observed symmetry-protected collisions between a propagating photon and a stored one. Most of her efforts, though, were dedicated to creating bound states of photons. She received her Ph.D. degree in 2017.

Liang has a collaborative scientific drive that pushes her to explore a variety of sciences. Although her Ph.D. research fascinated her, she has been curious about Bose-Einstein condensate and has always wanted to make one. Therefore, she joined Dr. Ian Spielman's group as a postdoc. They study ultracold atoms in optical lattices subject to Raman-induced spin-orbit coupling. The system is an ideal platform to simulate particles moving in two-dimensional lattices with a uniform magnetic field perpendicular to the lattice plane. With this extensive background, the Department of Physics and Astronomy looks forward to seeing where Liang's scientific drive takes her and her students.

K-12 OUTREACH

SATURDAY MORNING ASTROPHYSICS AT PURDUE





Did you know that the Department of Physics and Astronomy keeps K-12 students around the world engaged in science education? Through the pandemic, David Sederberg Director of Physics & Astronomy Outreach, needed to switch gears to help all of the teachers who were suddenly teaching remote.

He helped students across the globe learn about physics and astronomy from the comfort and safety of their living rooms. In addition to his standard array of outreach programs, Sederberg added a YouTube channel offering out-of-this-world lessons.

The channel, named Saturday Morning Astrophysics at Purdue, has had thousands of view and has reached an untold number of students, teachers, and people generally interested in astrophysics.

This channel grows weekly, so be sure and like and subscribe so that you can keep up with the growing library of lessons provided by Physics and Astronomy K-12 Outreach.

YouTube

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Danny Milisavljevic, assistant professor of physics and astronomy in Purdue University's Col lege of Science, is leading a research team using the world's most powerful telescope.

Purdue University photo/ Rebecca McElhoe

Purdue scientist helps guide the eyes of Webb Space Telescope, successor to Hubble

Brittany Steff, Purdue News

This article originally published by Purdue News.

The sight of the stars the first time he peered into a telescope floored Danny Milisavljevic. There, right before his eyes, was an entire universe full of planets and details, unexplored and unexpected.

Now, as an assistant professor of physics and astronomy in Purdue University's College of Science, Milisavljevic (pronounced milli-sahv-la-vich) is helping bring details from the world's newest and most powerful telescope: the James Webb Space Telescope (JWST), the successor to the Hubble Space Telescope, which allowed humans to see farther into space and deeper into time.

Since its launch in 1990, discoveries from Hubble have changed humanity's understanding of the stars, of its place in them and of physics itself. JWST launched successfully on December 25, 2021. Milisavljevic and many of his collaborators watched the launch and provided live commentary on the science and plans for the JWST's future.

The JWST is bigger, is more complex and will orbit farther from the Earth than Hubble, allowing it unprecedented opportunities for interstellar sleuthing. JWST will look even farther into space and time, and with an unprecedented range of wavelengths and strength of definition. The knowledge it uncovers may help scientists take the next small steps out into the universe — and discern where humans want to go next and why.

Milisavljevic leads a team of nearly 40 scientists and researchers from more than 30 institutions — including Harvard, Princeton and Johns Hopkins universities, as well as Los Alamos National Laboratory and the SETI Institute — in studying Cassiopeia A, one of the more puzzling objects in the galaxy. Cassiopeia A comprises the remnants of a supernova explosion and has at its heart a neutron star that doesn't behave the way scientists think neutron stars ought to behave.

"JWST is going to allow us to look at stellar objects at wavelengths and resolutions we've never been able to use before," Milisavljevic said. "Supernova remnants are leftover explosions — that's what we'll be studying. We'll be able to study what type of star was there before the explosion, the physics of the explosion, the type of dust it generated and what made it all happen. Supernova explosions make all the materials for life — the oxygen we breathe, the iron in our blood."

Bigger, farther, better

JWST is larger than Hubble. Its primary mirror is about 20 feet across, while Hubble's is just 8 feet across. Hubble's telescopes looked primarily at objects in the ultraviolet, visual and near-infrared wavelengths. But many objects that astronomers want to see and study — like the universe's oldest galaxies, exoplanets and stars — are hidden behind swaths of dust. Infrared wavelengths allow scientists to get a clearer view than visual wavelengths of light could give them.

Hubble rode into space aboard the shuttle Discovery. Hubble's orbit is about 350 miles up. JWST will orbit Earth from nearly a million miles away — four times farther away than the moon and 2,500 times farther out than Hubble.

JWST's destination is a special spot in space called L2, or the second Lagrange Point. It's a place where, thanks to the orbital dynamics of Earth, the moon and sun, it will stay in a fixed position with respect to Earth — always keeping Earth between itself and the sun. This is an ideal location from which to observe the universe because the satellite won't have to use too much of its fuel in adjustments to its orbit, a vital consideration since it will be so far away from its home planet.

The outbound trip took approximately a month, and the journey started on one of the European Space Agency's Ariane 5 rockets. It launched from the Guiana Space Centre in French Guiana in South America.

Eyes on the sky

Milisavljevic is collaborating on several JWST projects and is serving as principal investigator in looking at Cassiopeia A, a supernova remnant about 11,000 light-years away.

The project will take place during the first year of JWST's research, beginning after it reached L2 on January 24, 2022. JWST will use infrared imaging and spectroscopy to examine Cassiopeia A. Scientists want to study how it formed and look at the neutron star, an X-ray source in the heart of the cloud of starstuff.

"This proposal, like the telescope itself, has been years in the making," Milisavljevic said. "Proposals usually take a couple of weeks; this one took years. There are a lot of people involved, with a lot of overlapping and potentially competitive research interests. I was able to convince them that united as an ultimate dream team of investigators, we are stronger than our individual parts."

Supernovae resulting from collapsing stars are among the most influential phenomena in any galaxy when it comes to building stars and planetary systems. But they are also not at all well understood. Insights into how Cassiopeia A formed will help scientists understand more about how stars live and die, how metals are distributed throughout galaxies, and potentially even probe the origin of life itself.

"One of the things we're going to be able to do is peer deeply at these objects," Milisavljevic said. "Having access to mid-infrared wavelengths with the same resolutions possible with existing near-infrared and visual data, allows us for the first time to probe the formation of stellar debris that will give us critical clues about how the explosion proceeded. Up until now, we didn't have all the components needed for an answer. JWST is giving us the opportunity to observe at wavelengths and resolutions we never have before."

Hubble's heir

Purdue engineers and scientists have designed the space systems and equipment that are humanity's eyes in the sky since the very first American satellites launched. That heritage of space exploration — including footprints left on the moon by Purdue astronauts — is part of what drew Milisavljevic to Purdue.

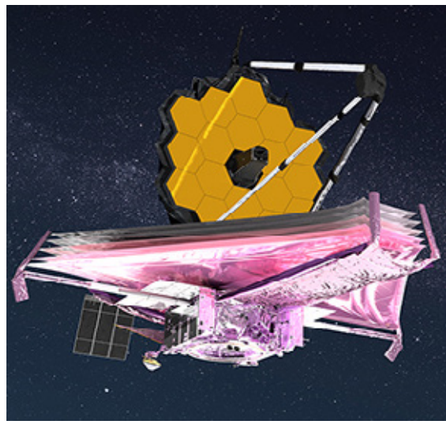
As a child, Milisavljevic vividly remembers being "beyond the moon" when offered the opportunity to write about the planets of the solar system (nine of them, back then) in a two-pronged folder. As an undergraduate, he continued to study the solar system, helping discover four moons of Uranus — one of which, Ferdinand, he got to name — and five moons of Neptune.

Purdue graduates worked on the rockets that took the first unmanned American satellites —on the heels of Sputnik — into space. They were instrumental in the Mercury, Gemini and Apollo programs as astronauts, researchers and engineers. Drew Feustel, a Purdue astronaut from the same department as Milisavljevic, was on the final mission to fix Hubble and restore its ability to send clearer images back to Earth.

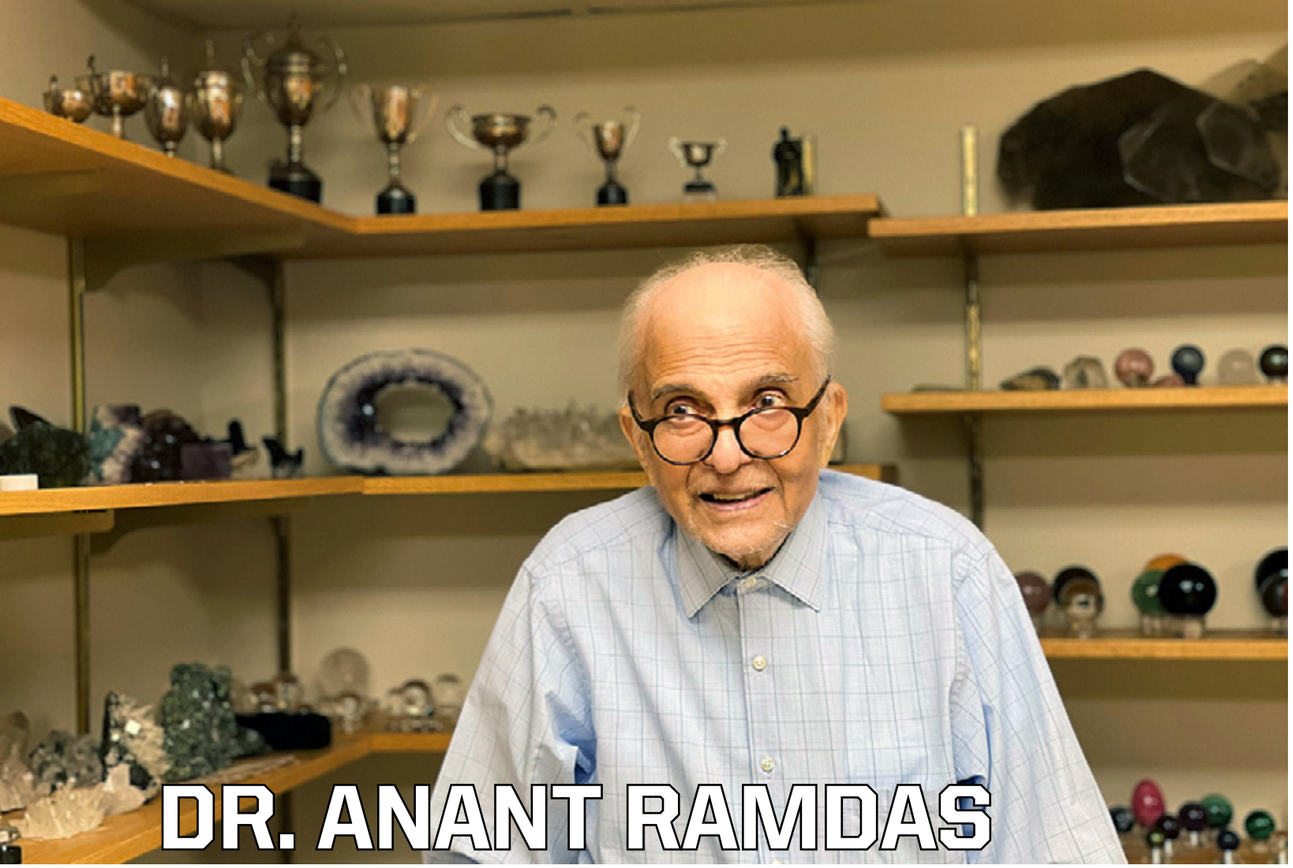
Another Boilermaker had a concrete role in boosting JWST into space. Katherine Gasaway, a current doctoral candidate in the College of Engineering's School of Aeronautics and Astronautics, was an intern at Northrop Grumman in 2016, where she helped the team working on the structural testing of one of the carbon fiber sun shield beams. Because JWST is going to be so far from Earth, it needs to be as sturdy and fail-proof as possible. No handy space shuttle will be able to easily haul engineers to fix it if something goes amiss.

As with so many other rockets, satellites and telescopes, Purdue hands helped build it, and Purdue eyes will be watching it.

"The whole mission is incredibly exciting," says Danny Milisavljevic. "We are investigating the stars with longer wavelengths of light that is going to let us explore in unprecedented detail. We are going to be able to study things that were impossible to study before."



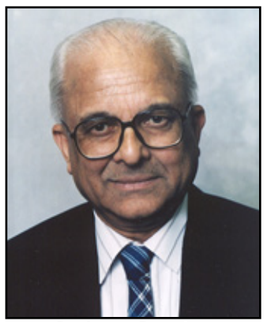
An artist's rendering of the James Webb Space Telescope, the Hubble's successor. It will orbit Earth four times farther out than the moon and employ an unprecedented range of wavelengths and strength of definition. Credit: (NASA GSFC/CIL/Adriana Manrique Gutierrez)



DR. ANANT RAMDAS

A courageous pursuit of science propelled a life-long passion for physics

By Cheryl Pierce



Dr. Anant Ramdas, Physics archives photo

Soon after obtaining his PhD in 1956 from the Raman Research Institute in Bangalore, India, a newly titled Dr. Anant Ramdas had some decisions to make. He had just finished his studies under the tutelage of Nobel Laureate Professor C. V. Raman. And although this alone was an amazing accomplishment, in many ways, young Anant's life as a physicist was only just beginning. The world was at his feet, he need only decide which direction to take.

While contemplating his career, he came across an article by Professor H. Y. Fan of Purdue University. West Lafayette, Indiana seemed a world away from India, but the science these two shared was a magnetic force that pulled Anant toward a major move: America.

The article written by Prof. Fan was titled, "Solid State Spectroscopy" and it captured Anant's interest. He then corresponded with both Fan and Professor Karl Lark-Horovitz, the then department head of the Physics Department known for attracting amazing scientific talent to Purdue University. He was soon hired by Lark-Horovitz as a Research Associate and became a Professor in 1960. This wasn't the only life altering

change happening in Anant's life at the time. It would be impossible to discuss Anant's accomplishments without including his partner throughout life, Mrs. Vasanti Ramdas.

"I am very grateful to my wife because she was with me throughout and helped me the whole time," says Anant.

At the time Anant had applied and been accepted to Purdue, the families of Anant and Vasanti were discussing a much different life altering decision: marriage. Their families knew of one another because the families were originally from the same small town in India.

"In 1955, his family came to visit mine in Dehra Dun," says Vasanti. "My father was in England at the time for work training. So, my mother, I, and my five-year-old brother went to meet Anant's family. His father, mother, and grandmother came to visit and, of course, him. This was the first time I saw him and the first time he saw me. I had just finished high school. The custom in India is usually an arranged marriage. After they left, they corresponded that this nice young man and this nice young lady should get together. I was agreeable and he was agreeable. That was in about May or June and were married in September. And then about a month later, we left for the United States."

Taking a trip from India to the United States is a jet-plane ride these days, but back then, it was an epic adventure. The couple first had to fly to London on a propeller plane which meant halting at various places, which included Cairo, Beirut, Lebanon, Paris, and then London. They spent a week sightseeing in London and then boarded a cargo ship. Cargo ships weren't set up for travel, they were set up for cargo delivery. This part of their journey took 14 days. It made stops at ports in France and in Portugal. It didn't have typical sleeping quarters so the couple slept in separate rooms beside one another.

"We had never taken a plane or a ship," says Anant. "And it was a cargo ship! I had never experienced sea sickness before and throughout this trip, I was seasick. Once I was on terra firma, I was ok."

Dr. Anant Ramdas, Physics archives photo
They had made it. Once they got off the cargo ship, a train ride brought them to West Lafayette. His passionate pursuit of physics brought them to a small home in a small city in rural Indiana. It is believed that Anant is the first Indian professor at Purdue University. Anant was fluent in five languages and both he and Vasanti knew English which helped them fit into this new life much easier. Anant was also an avid tennis player which allowed him to make friends on the court and helped ease him into this new life. The couple met routinely with a group of Indian students at the Union. They shared tips and ideas, like how to bring the flavors they loved from home to this rural American area.

CONTINUES ON PAGE 12

Dr. Anant Ramdas and Mrs. Vasanti Ramdas

In his years at Purdue, he held the positions of Research Associate, Assistant Professor, Associate Professor, then Full Professor and eventually was honored with the title of Lark-Horovitz Distinguished Professor. He guided 35 students to get their PhDs and has a copy of each of their theses in a treasured spot on his illustrious and impeccable book shelves.

When discussing why he came to Purdue, he said, "I was working with Professor Raman and he gave absolutely top-quality education. He had also taught my father. Professor Raman didn't have high level resolution spectrometry in his lab, an instrument which we've got here at Purdue. I wanted to have access to that kind of instrument."

When talking to Anant, it is difficult to get him to speak about his own scientific pursuits, of which there are many, because he energetically longs to hear and tell about the academic pursuits of his students and colleagues. He shows complete joy when learning about a discovery or accomplishment by a colleague. But Anant's achievements list is too long to contain in just one article. He was honored as Fellow by multiple groups. He made significant contributions to the study of spectroscopy. His work has been cited boundlessly throughout decades. He was also the director of the Materials Research Lab which was a major National Science Foundation (NSF) funded lab at Purdue University.

His colleague and current Edward M. Purcell Distinguished Professor of Physics and Astronomy, Dr. David Nolte, has high praise for Anant's work.

"The thing about Anant's data is that it's the most beautiful data in the world, because when you look at it, you cannot see any noise," says Nolte. "When you are an experimental physicist, it's always about signal to noise ratios. He has impeccable spectra. Once of the most impressive things to me was when he was able to do ESR by doing infrared spectroscopy. To me that's miraculous. The signal to noise ratio must be astronomical to do that."

Lunches within the department were customary and are spoken of as legendary. Groups of professors would meet at the Union or Stone Hall for lunch and discuss all the abundant discoveries of their day and this ignited a passion for obtaining the next pursuit. For instance, Anant currently holds the record for the hardest known material- the 13C diamond and he credits his drive for this early discovery from friendly competition with his peers.

"Physics is an exciting science," says Ramdas. "When you read the biographies of great physicists, you can experience the same excitement that they felt when they made their discoveries."

Throughout Anant's career in physics, the teachings of Professor Raman always stuck with him. He was impressed with how Professor Raman encouraged his students and Anant was equally encouraging his own students throughout the years.

"Professor Raman was remarkable," says Anant. "As soon as he learned a student had discovered something new, he would tell them it must be published. We worked together on several papers. I had new ideas which I took to him and he encouraged me. He never stamped down anything I suggested. He was like this with all of his students. He started a community of students who were the same age and we encouraged one another. And we all were successful. The same thing happened when I became a teacher. I encouraged people."

This respect is the inspiration for Anant to create the Raman Prize and the Ramdas Award in the department from which he retired. The Ramdas Award recognizes an exceptional senior undergraduate student who has completed a unique research project. The Raman Prize, created as an honor to Professor Raman, recognizes a recent alumni or PhD student for his or her outstanding dissertation. These awards are given annually and bring as much joy to the Ramdas family as it does to the students who are awarded the prizes.

"I enjoyed teaching students at all levels," says Anant. "With these prizes, I wanted to encourage these students."

Dr. Ramdas stands beside a photo of his inspirational teacher, Professor Raman.

Photos by Cheryl Pierce

Student Spotlight: Yicheng Feng

Enjoyment of basic physics grows into frontier research

Yicheng Feng pictured in front of the STAR detector.

By Cheryl Pierce

Graduate student Yicheng Feng had a dream to work on one of the frontiers of physics research: high energy nuclear physics (HENP). When asked what made Feng interested in this particular course of study, he said that impressions were made all the way back in high school and progressed from there. It was a mix of his love of physics and mathematics coupled with exciting news happening at CERN that really piqued his interest.

"When I was a high school student, physics was my best subject and math was the second," says Feng. "I gained confidence and naive interest in physics during that time. After I was admitted to USTC (University of Science and Technology of China) as an undergraduate, I chose physics as my major. In 2013, the Higgs boson research in CERN received the Nobel prize, which drew my attention to the high energy physics field. USTC has a great environment of high energy physics because it collaborates with many experiments like BESIII, ATLAS, CMS, and also STAR. I therefore had the chance to conduct my bachelor thesis research on this field, involved in the BESIII experiment. After that, I chose Purdue so that I could continue research with the STAR experiment."

Currently, Feng, a PhD student, is studying with his advisor, Dr. Fuqiang Wang, Professor of Physics and Astronomy at Purdue University. According to Feng, the Department of Physics and Astronomy at Purdue has a great HENP group which collaborates closely with the Solenoid Tracker at RHIC (STAR) experiment which is why he wanted to apply to this program.

"In the experiments for HENP, the nuclei (also called heavy ions) are collided with each other in colliders like Relativistic Heavy-Ion Collider (RHIC). In those collisions, part of each nucleus is destroyed, and new particles are created from the collision zone. Detectors like STAR can measure those newly produced particles and the residual nuclei fragments at the final state. Some theorists in this field predicted that the possible parity symmetry breaking in strong interactions can lead to a special phenomenon, called the chiral magnetic effect (CME), in those heavy-ion collisions. To search for that, my job is to analyze the STAR collision data, do model simulations, and take shifts to operate the STAR detector."

Working within this group has provided Feng the opportunity to publish multiple times as a graduate student, many times as the first author listed. Those publications include:

- Y. Feng, Y. Lin, J. Zhao and F. Wang, "Revisit the chiral magnetic effect expectation in isobaric collisions at the relativistic heavy ion collider", Phys. Lett. B 820(2021)136549
- Y. Feng, J. Zhao, H. j. Xu and F. Wang, "Deciphering the R correlator in search for the chiral magnetic effect in relativistic heavy ion collisions", Phys. Rev. C 103(2021)034912
- Y. Feng, J. Zhao and F. Wang, "Back-to-back relative-excess observable to identify the chiral magnetic effect", Phys. Rev. C 101(2020)014915
- Y. Feng, J. Zhao and F. Wang, "Responses of the chiral-magnetic-effect-sensitive sine observable to resonance backgrounds in heavy-ion collisions", Phys. Rev. C 98(2018)034904
- H. j. Xu, J. Zhao, Y. Feng and F. Wang, "Importance of non-flow background on the chiral magnetic wave search", Nucl. Phys. A 1005(2021)121770
- J. Zhao, Y. Feng, H. Li and F. Wang, "HIJING can describe the anisotropy-scaled charge-dependent correlations at the BNL Relativistic Heavy Ion Collider", Phys. Rev. C 101(2020)034912
- H. j. Xu, J. Zhao, Y. Feng and F. Wang, "Complications in the interpretation of the charge asymmetry dependent pion flow for the chiral magnetic wave", Phys. Rev. C 101(202)014913

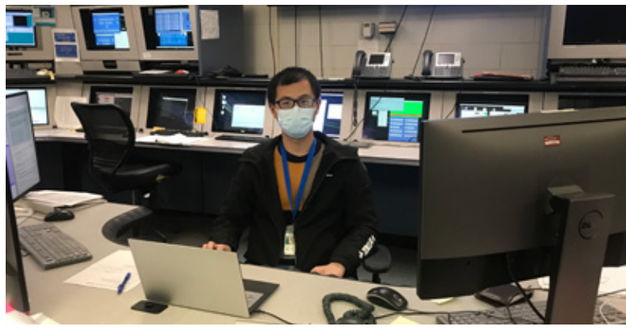
It is a bold step for Feng, an international student, to travel to another country for the pursuit of education, which of course came with some challenges. The language barrier was a challenge according to Feng, but with the help of Purdue community and the PLaCE program, he was quick to overcome this obstacle.

"When I first came to Purdue, I couldn't speak English well. The daily talks like buying a pizza could be difficult for me. Purdue provides an English course for international students. I attended that course for one semester, and my English improved a lot during that time. I really appreciate the help from my English teacher and tutor in that course. After that, I think the language barrier was overcome."

Feng is very close with his family which was another challenge. Thankfully, technology allows him to keep in touch. "Family is one of the most important parts of my life. My family is very supportive to me and my academic pursuit. But, they miss me a lot, so we have a video call every week."

Today, my naive interest in physics has grown up into frontier research," says Feng, "and I will keep moving forward.

Next steps for Feng include pursuing his research further after his degrees are achieved. He plans to continue his research in this field and hopes to become a post-doc within the HENP group at Purdue.



Yicheng Feng, PhD student of Purdue Physics and Astronomy, works in the Solenoid Tracker at RHIC (STAR) Control Room as part of his ongoing research. Photos provided by Yichen Feng.

UNDERGRADUATE STUDENT AWARDS

Mortar Board 2021 Undergraduate Award
Bianca Caminada
Mortar Board awards funds for school fees to current Purdue freshmen and sophomores who have shown excellence in service, leadership, and scholarship. A minimum cumulative GPA of 3.2 is required. In promoting the ideals of Mortar Board, selection of fellowship recipients is based on scholastic record, character, service to campus and community, and stated professional goals.

Honor's College Pillar Award for Sophomore Research
Bianca Caminada
Students in the Honors College excel in a variety of areas both in and outside of the classroom as they engage in endeavors that embody the values of our curriculum. To recognize those students who have achieved above and beyond their peers or who demonstrate great promise of excellence, the Honors College annually bestows the Pillar Awards, a recognition of student work in each of the four pillars of their curriculum: Interdisciplinary Academics, Undergraduate Research, Leadership, and Community and Global Engagement.

Martin C. Jischke Outstanding International Student of the Year Award
Kaustub Parvir Anand
The Martin C. Jischke Outstanding International Student of the Year Award was presented to Kaustub Parvir Anand of Mumbai, India, whomajoredinphysicsintheCollegeofScienceand the Honors College. Established by Martin C. Jischke, President emeritus, the award honors an international Purdue student who has attained a minimum 3.0 grade-point average, demonstrated leadership qualities, achieved academic accomplishments through further research, publications or presentations and participated in service projects. The recipient receives a cash award along with inscription of their name on a plaque in Schleman Hall.

Ramdas Award
YuXin (Vic) Dong (nominated by Danny Milisavljevic)
The Ramdas Award award was establish in 2018 by Anant K. Ramdas, the Lark-Horovitz Distinguished Professor of Physics and his wife, Vasanti Ramdas. The purpose of the Ramdas Award is to recognize an exceptional senior who has completed a unique project in the Department of Physics and Astronomy.

Judith Peters Humnicky Award
Emily J. Kincaid
Judith Peters Humnicky was relentless in pursuitofhergoalsandthisawardhonorsher-memory by recognizing the persistence, diligence, and hard work necessary to obtain an undergraduate degree in physics and enhances the gender diversity of among the Department's undergraduates.This award is made possible due to the generosity of Mr. Michael Humnicky (BS1970).

Spira Undergraduate Summer Research Award
Arianna Meenakshi McNamara
This award supports one or more students working on a research project under the supervision of a faculty member in the Department of Physics and Astronomy and/or the Department of Mathematics. The Spira Summer Research Award is made possible thanks to the generosity of Dr. Joel S. (BS1948) and Mrs. Ruth R. Spira.

Lijuan Wang Memorial Award
Moira Andrews and Megan McDuffie
The Lijuan Wang Memorial award is given annually to one or more outstanding undergraduate physics majors who promote the gender diversity of the department through participation in Women in Physics. Lijuan Wang was a graduate student in the department from 1989 until her untimely death in 1992.

Richard W. King Award
Justin Copenhaver | Outstanding Junior
Andrew Gustafson | Outstanding Senior
The Richard W. King Award recognizes the Department's outstanding physics junior and senior. Prof. King joined the Department of Physics in 1955 as an assistant professor, was promoted to associate professor in 1958, and to professor in 1961. He served as Department Head from 1966 to 1969. During his years at Purdue, Professor King gained a reputation as an inspiring teacher and sympathetic friend of students. He served for many years as the counselor for undergraduate physics majors. With other students he often took the opportunity to promote the value of a broad science background for students pursuing careers such as teaching, law, journalism, and medicine. Following his untimely death in August 1969, Prof. King's family, friends, and colleagues established this award.

Frederik J. Belinfante Scholarship in Physics
Grace Bowling and Arianna McNamara
This scholarship recognizes outstanding physics upperclassmen. The scholarship is possible due to the generosity of Dr. Robert Newcomb (BS 1955).

Shalim and Paula Sargis Memorial Scholarship
Faith Kalee Bergin and Robin Carpenter
The Sargis Scholarship recognizes a physics upperclassman from outside the state of Indiana who also graduated from a U.S. high school. This scholarship is made possible due to the generosity of Dr. James Sargis (BS 1958).

David G. Seiler Physics Scholarship
Darrell Leigh Fischer
The Seiler Scholarship recognizes an outstanding physics upperclassman who is involved in Women in Science or Women in Physics programs. This scholarship is possible due to the generosity of Dr. David G. Seiler (PhD 1969).

Arthur N. Pozner Memorial Scholarship
Bianca Caminada
This scholarship recognizes outstanding physics upperclassmen. The scholarship is possible due to the generosity of the Arthur N. Pozner Trust.

Kenneth S. and Paula D. Krane Physics Scholarship
Aubrey Louise Fuhrman
The Krane Scholarship recognizes outstanding physics upperclassmen. The scholarship is possible due to the generosity of Dr. Kenneth S. (PhD 1970) and Mrs. Paula D. Krane.

Margie and Don Bottorff Undergraduate Physics Scholarship
Taylor Baker and Isaiah Ertel
The Bottorff Scholarship is made possible by a gift from Ms. Celeste Bottorff (MS 1975). The scholarship is a 1-year award made to outstanding physics upperclassmen.

College of Science Honors Convocation Student Honorees
Airanna McNamara - Freshman
Colton Griffin - Sophomore
Darrell Fischer - Junior
Andrew Santos - Senior

Goldwater Scholarship
Justin Copenhaver (2021)
Andrew Gustafson (2020)

GRADUATE STUDENT AWARDS

2020 Raman Prize
Sayan Basak
(Nominated by Erica Carlson)
The Raman Prize recognizes a Ph.D. student or recent alumni for their outstanding dissertation. The award was made possible through the generosity of Anant K. Ramdas, the Lark-Horovitz Distinguished Professor of Physics and Astronomy (emeritus), and his wife Vasanti Ramdas.

Karl Lark-Horovitz Award
Michael Higgins
(nominated by Chris Greene)
Our Department's most prestigious graduate student honor, the Lark-Horovitz Award recognizes outstanding research accomplishments. The award is possible through the generosity of the faculty as well as the family, friends, and associates of Prof. Lark-Horovitz in memory of his great contribution to the growth and development of the Department of Physics and Astronomy.

Gabriele F. Giuliani Award
Dawith Lim
(nominated by Anderzej Lewicki)
Established in 2013 in memory of Prof. Gabriele F. Giuliani, this award honors excellence in teaching by first- or second-year graduate students. These graduate students show dedication and dependability, and, like Professor Giuliani, demonstrate a passion for physics that contributes to a rich learning environment.

George W. Tautfest Award
Yicheng Feng
(nominated by Fuqiang Wang)
This award honors outstanding physics graduate students in high energy particle physics, high energy nuclear physics, or astrophysics. Prof. Tautfest was the leader of the Purdue High Energy Physics group until his death in 1967 at age 41. The award was established in 1969 by his colleagues and the Purdue Alumni Foundation.

H. Y. Fan Award
Cheng-An Chen
(nominated by Chen-Lung Hung)
The Fan Award recognizes outstanding graduate research in condensed matter physics, biological physics, or AMO physics. The award was established in recognition of Prof. Fan's many contributions to condensed matter physics, particularly in the area of infrared studies of semiconductors, and to the Department of Physics and Astronomy.

Bilsland Dissertation Fellowship
The Bilsland Dissertation Fellowship provides support to outstanding Ph.D. candidates in their final year of writing.
Yimeng Wang (nominated by Chris Green)
John Banovetz (nominated by Danny Milisavljevic)
Yicheng Feng (nominated by Fuqiang Wang)
Zhujing Xu (nominated by Tongcang Li)

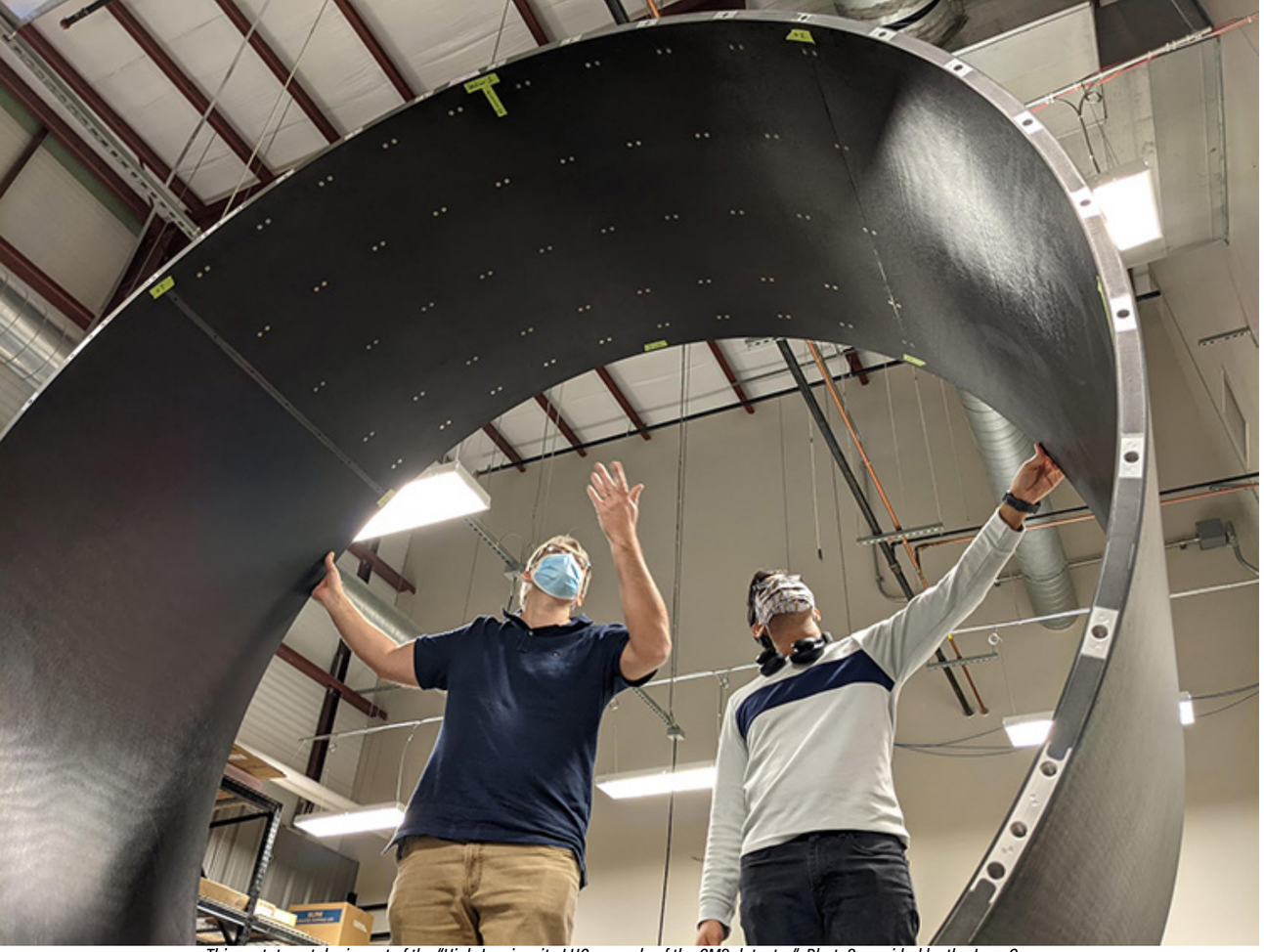
Charlotte Ida Litman Tubis Award
Siddhant Pandey
The Charlotte Ida Litman Tubis Award was established in her memory by her husband, Prof. Emeritus Arnold Tubis, to promote clear and concise communication of scientific ideas beyond the physics and astronomy community.

Dr. Warner Black Award
Siddhant Pandey
(nominated by Niranjan Shivaram)
The Black Award recognizes graduate students whose research has the potential to bring physics to the people and to help them improve their lives by using a deep knowledge of fundamental and applied physics to make practical and useful inventions that have a real and lasting impact.

Edward S. Akeley Award
Hao Zhang
(nominated by Dimitrious Giannios)
This award recognizes outstanding physics graduate students in theoretical physicists. The Akeley Award is made possible through the generosity of Instructor Emeritus Anna M. Akeley.

Akeley-Mandler Award for Teaching Excellence
Abigail Kopec
(nominated by Andrezej Lewicki)
The Akeley-Mandler Award recognizes exceptional graduate student teaching assistants who excel beyond the mere requirements of the job, investing their effort to ensure that they provide the best education possible to their students. This award is made possible thanks to a gift made by Instructor Emeritus Anna Akeley in memory of her husband, Prof. Edward S. Akeley, and brother, Kurt Mandler.

Lijuan Wang Memorial Awards
Bhagya Subrayan
(nominated by Danny Milisavljevic)
Yimeng Wang
(nominated by Chris Greene)
The Lijuan Wang Memorial award is given annually to one or more outstanding graduate student majors who promote the gender diversity of the department through participation in Women in Physics. Lijuan Wang was a graduate student in the department from 1989 until her untimely death in 1992.



This prototype tube is part of the "High-Luminosity LHC upgrade of the CMS detector." PhotoS provided by the Jung Group.

Enormous carbon fiber tube crafted at Purdue will support future hunt for discoveries at CERN

By Cheryl Pierce

A large carbon fiber prototype tube will soon set sail for a trip from Purdue University to CERN in Switzerland. The ring, measuring about 8 feet across, will be used in the Large Hadron Collider (LHC) to support the silicon tracker and timing layer detectors for the high-luminosity phase of the LHC. These detector systems weigh about 4 metric tons and record proton-proton collisions at the world's leading particle accelerator facility aimed at the discovery of new elementary particles.

This prototype tube is part of the "High-Luminosity LHC upgrade of the CMS detector" project which is jointly funded by the Department of Energy and the National Science Foundation. The Compact Muon Solenoid (CMS) Collaboration is one of the largest scientific collaborations which includes over 4,000 scientists across the globe together in a quest to advance humanity's knowledge of the most fundamental laws of our Universe. Purdue University is one of over 200 universities and institutes world-wide that take part in the CMS collaboration.

Most recently, Purdue researchers in the Purdue Silicon Detector Lab (PSDL) and the Composite Manufacturing & Simulation Center (CMSC) have worked together on the challenge of removing 35kW of heat relying on lightweight composite tracker support structures. They have been creating prototype cylinders made of carbon fiber composites and have now officially created a working prototype that will be installed and tested at CERN near the end of 2022. Purdue CMS scientists currently work on more testing, metrology, loading scenarios, and once completed prepare the eventual shipment to CERN for more tests. Once the BTST prototype arrives at CERN and has been tested, the Purdue CMS team will work on design and manufacturing of the final full-length, 5.3m (16.4ft), structure between 2022-2023. This build will rely on an external fabrication partner given the enormous size of the structure.

According to Andreas Jung, Associate Professor of Physics and Astronomy, Purdue University is particularly able to construct this type of carbon fiber prototype. Building these prototype structures made of carbon fiber requires clean-room like practices. The fibers require special handling because they are electrically conductive and need to be contained and cleaned off of all surfaces.

"Without the special capabilities at the Composite Manufacturing & Simulation Center this project would not be possible," says Jung. CMSC is partnering with PSDL to engineer and fabricate at least 6 other unique support structures for the CMS LHC upgrade, varying in scale from a few millimeters to 3m in length. "The Purdue Silicon Detector Lab provides expertise on measurements for thermal conductivities, and other physics properties, which are essential to allow for the required thermal performance of the system."

These composite support tubes are made of carbon fiber because it is light weight, but yet stiff, strong, withstands radiation, and has low Z (number of protons). According to Jung, carbon fiber is the de-facto gold-standard for experimental physics detector support structures.

This work may also have industrial benefits as well. According to Jung, the "airplane and space industry are the prime application, with similar demands for extremely lightweight composite structures providing stiffness and stability in view of large supported masses. Wind turbine blade manufacturers might also benefit."

This project involves funding at the level of around $1.6 million in order to deliver a final BTST structure. Locally, this project involves many people across several disciplines at Purdue University. Notably, Ben Denos (co-PI on the project), Justin Hicks (Postdoc at CMSC), Lucas Richardson (Staff Engineer at CMSC), Jack Wheeler (Research Technician at CMSC), Sushrut Karmarkar (Phd student, CoE), Souvik Das (Physics staff), and Abraham Koshy (PhD student, CoS) are involved in the making of this prototype and related projects as well as many undergraduate students, REU students, exchange students, and nine students who have participated in the Dortmund exchange (since 2018).

The large tube, measuring roughly eight feet across, barely fit through the doors of the lab.

Above: the current CMS detector. *The BTST will be new but the position remains the same: the BTST slides into the CMS detector in the same way as for the current detector- inside of the Calorimeter into the heart of CMS. Photo credit: M.Hoch, CERN Info services*

PHYSICISTS CLOSING IN ON THE MASS OF NEUTRINOS

By Cheryl Pierce

It is estimated that over 100 trillion neutrinos pass through your body every second. The neutrino is a neutral subatomic particle that is the lightest known particle in our universe. They are everywhere. Born of radioactive decay and other subatomic processes, an uncountable number of neutrinos are flying through us, through our planet, and through our universe. Most neutrinos in our solar system come from the nuclear processes in the Sun which produce the Sun's energy. Even though they are one of the most abundant subatomic particles in the universe, they interact so weakly that there is a lot that is not known about them, including their masses.

When the neutrino was first detected in 1956 by Clyde Cowan and Fred Reines, the scientific world was comfortable with the notion that most likely they didn't have any mass at all. By the 1970s, a total of three different kinds, or "flavors," of neutrinos had been discovered (the electron-neutrino, muon-neutrino, and tau-neutrino), but all of them were believed to be massless.

Since neutrinos produced in the core of the Sun by nuclear fusion reactions can easily pass through the Sun and into space, it was natural to try to detect them to learn more about how the Sun produced its energy. However, after the Homestake mine experiment conducted by Ray Davies began running to detect these solar neutrinos in the late 1960s, a discrepancy emerged between the number of electron-neutrinos observed and the number predicted by nuclear physics models. This "solar neutrino problem" puzzled physicists for many years- did the discrepancy arise from a problem with the experiment or the nuclear physics calculations?

It was against this backdrop that in 1996 Dr. Ephraim Fischbach, Professor of Physics and Astronomy at Purdue University, published a 78-page paper entitled "Long Range Forces and Neutrino Mass" in the journal Annals of Physics [ref.1]. In this work, Fischbach argued that neutron stars could not exist if neutrinos were massless. Neutron stars are the remnants of massive stars that have exploded when they have used up their nuclear fuel. With masses slightly larger than our Sun, neutron stars are compressed by gravity down to a diameter of about 12 miles and are essentially made solely of neutrons. Professor Fischbach showed that if neutrinos were massless, the energy associated with neutrino interactions between the neutrons in a neutron star would destabilize it. Only if the lightest neutrino masses were greater than about 0.4 eV, over 10,000 times smaller than the mass of the electron, could neutron stars form. It turned out that the mass of the neutrino also held the key to resolving the solar neutrino problem.

After years of refining neutrino experiments and solar nuclear physics calculations, it slowly emerged that the solution to the paucity of electron-neutrinos arriving at the Earth from the Sun was truly astonishing: neutrino oscillations. The electron-neutrinos emitted by the Sun were transforming into the other two flavors as they traveled to the earth. Since the Homestake mine only detected electron-neutrinos and not the other two flavors, it missed observing the neutrinos that had changed their identities by the time they reach Earth. Later experiments which could detect all three flavors confirmed this results, and Takaaki Kajita and Arthur MacDonald were award the 2015 Physics Nobel Prize for their work on these experiments.

How is the phenomenon of neutrino oscillations related to neutrino mass? If neutrinos were truly massless, they would travel at the speed of light. According to Einstein's theory of relativity, a clock traveling at the speed of light would be frozen in time relative to a stationary observer—it would not tick. Anything massless which travels at the speed of light cannot change. Neutrinos are changing, so they are not traveling at the speed of light. Hence, neutrinos cannot be massless!

Actually, the situation is a little more complicated. The shifting nature of the neutrino flavors means, by the weirdness of quantum mechanics, that the flavor neutrino states do not have definite masses. And the states with definite masses (the mass states) do not have definite flavor. For neutrino oscillations to occur, quantum mechanics tells us that at most only one of the mass states can be massless. This set off an experimental effort to determine the masses of the neutrino mass states.

Fast forward to 2022, and the scientific community is newly abuzz with new neutrino mass chatter. On Valentine's Day this year, February 14th, the Karlsruhe Tritium Neutrino (KATRIN) collaboration published a love letter to the world's physics community in which they presented their latest experimental results: the neutrino mass could be no greater than 0.8 electron volts. This result, when combined with lower limit derived by Fischbach, suggests that the neutrino mass may lie in the narrow range 0.4-0.8 electron volts. In fact, Fischbach has been in contact with the leaders of the KATRIN experiment. He conveys that they feel confident that within the next three years, they will be able to determine the mass of a neutrino even if it as small as 0.2 eV. Getting down to 0.2 eV will be a challenging task, given that a neutrino of this mass would have a mass-energy corresponding to a single infrared photon.

However, once this mass is determined, whatever its value, that will serve as critical input to many calculations in the world of astroparticle physics dealing with the past and future of our Sun, and other related astrophysical questions.

Contributors: Dr. Ephraim Fischbach, Professor of Physics and Astronomy at Purdue University

Dr. Dennis Krause, Adjunct Faculty and alumni of Physics and Astronomy at Purdue University and Professor of Physics at Wabash College

Written by: Cheryl Pierce, Communications Specialist, Purdue Physics and Astronomy

Ref. 1: "Long Range Forces and Neutrino Mass" by Dr. Ephraim Fischbach

Dr. Ephraim Fischbach, (right) Professor of Physics and Astronomy at Purdue University and Dr. Dennis Krause, (left) Adjunct Faculty and alumni of Physics and Astronomy at Purdue University and Professor of Physics at Wabash College, have had a life-long commitment to the study of neutrinos. Photo provided by Dennis Krause.

NEUTRINOS

LAURA BIEDERMANN, PH.D. AWARDED SPARK AWARD

This article originally published on the SWE website.

Laura Biedermann, Ph.D., of Sandia National Laboratories, has been awarded the Spark Award at the annuan SWE 2021 Conference.

For a career-long commitment to peer mentoring; for being a prolific proponent of mentoring the next generation of women in STEM; and for ongoing research that impacts the community.

Laura Biedermann, Ph.D., has an exceptional track record as a dedicated technical and career mentor at Sandia National Laboratories. Her 14 technical and career mentees include professional engineers, Ph.D. candidates, and a post-baccalaureate researcher. In addition to conventional one-on-one mentorship, Dr. Biedermann is a founding member of two novel mentoring programs, the Principal Investigator (PI) Workshop Series and the Peer Mentoring Steering Committee. These mentoring programs have been particularly successful at advancing women's careers.

Dr. Biedermann is a physicist in the electronic, optical, and nano materials department at Sandia National Laboratories. Her current research includes evaluating electrical conduction mechanisms in novel materials, investigating X-ray/material interactions, and conducting material aging and reliability studies. While an esteemed scientist, she's also an acclaimed mentor and an advocate for increasing opportunities for women in STEM, which she has demonstrated through ongoing mentoring, coaching, and leadership development.

In 2013, Dr. Biedermann and three fellow early-career female staff members formed the PI Workshop team, driven by their shared vision to learn the skills necessary to be a successful PI. The PI Workshop team developed a daylong workshop featuring panel discussions, presentations, and networking opportunities. This workshop featured some of Sandia's most talented research leaders sharing their successes and failures leading projects. The percentage of women attendees was greater than the percentage of women on Sandia's staff at the time. This effort increased opportunities for women to network with other PI role models or consider pursuing a PI role as a career path. The PI Workshop gained institutional support and is now an ongoing series with more than 1,000 attendees at the 24 original workshops hosted to date.

Dr. Biedermann has been a prolific leader of peer mentoring at Sandia since co-founding an all-women peer mentoring group in 2012. Peer mentoring is an intentional, lateral mentorship that requires those who become mentors to hold one another accountable. Peer mentors share the responsibilities for setting goals, strengthening career skills, and building networks. Peer mentoring has helped Dr. Biedermann and colleagues prepare for the varied challenges many encounter in STEM fields.

In 2016, Dr. Biedermann and colleagues created the Peer Mentoring Steering Committee to increase cross-organizational relationships and staff retention by providing support for new peer groups. Women currently account for 64% of peer group members.

Dr. Biedermann volunteers as a high school mentor through the Big Brothers Big Sisters Mentor 2.0 program, advising a high school student on college, career, and life skills. Through STEM outreach events such as Take Our Daughters and Sons to Work Day, Sandia's "Dognapping Workshop" for fourth-graders, serving as a science fair judge, and a career speaker for middle school girls, she has inspired hundreds of schoolchildren over the past 20 years.

She is a SWE member and has volunteered at WE Local collegiate competitions, judging posters and lightning talks. A Louisiana native, she is an avid cross-country skier, cyclist, runner, and violinist. She and her husband participate in the annual Bike Multiple Sclerosis fundraiser for the National Multiple Sclerosis Society.

Dr. Biedermann holds a B.S. in physics from the University of Illinois at Urbana-Champaign and a Ph.D. in physics from Purdue University.

A note from Star Murray

Director of Development for Physics and Astronomy

Hello Boilermakers!

As you may know, I took over last year as the Director of Development for Physics and Astronomy, and what an exciting year it has been. I've really enjoyed getting to know the faculty, alumni, and students in this department and learning about the cutting edge science taking place within our historic halls.

This year the department has seen faculty honored by the university, and around world. Michael Manfra was honored by Falling Walls and also had a lecture for having been awarded the Arden L. Bement Jr. Award. Yong Chen was awarded the Herbert Newby McCoy Award. Rafael Lang was honored by the APS Division of Particles and Fields for his excellence in mentoring students. Alex Ma received an NSF CAREER Award. And that's just a few of the many awards and honors our amazing faculty has achieved.

Also happening this year, Astronomy teamed up with Purdue Forestry to create an observatory in a dark corner of the university so students can peer into the vast universe around us. NASA finally launched the James Webb Space Telescope which will be revolutionary for our astronomers and students. Physicists at Purdue have worked in diverse and unexpected areas like cancer research. Physics is being used with Doppler technology to predict a drug's effectiveness. We've hosted the Midwest Cold Atom Workshop, discovered symmetry in the Wigner solid, narrowed the scope in the quest for the chiral magnetic effect, used gold to enhance quantum qubits in a 2D material, analyzed lunar dust from the Apollo 17 mission, and so much more. If this is year one, I cannot wait to see what the next year brings!

I have met with quite a few alumni and plan to meet as many PhysAstro Boilermakers as I can. I've loved hearing the stories of what Purdue was like when they were students and learning how they have used their education to create change around the world. I'd love to hear from you as well, so please feel free to email me at ssmurrary@purdueforlife.org.

Boiler up!

Star Murray
Director of Development
College of Science,
Computer Science and Physics & Astronomy
Purdue for Life Foundation

Professor Ralph W. Lefler

CLICK HERE TO CONTRIBUTE TO THE ENDOWMENT AND ASSIST STUDENTS AT PURDUE

Scholarship Endowment Spotlight: The Professor Ralph Lefler Memorial Scholarship Endowment

Professor's dedication elevated the state of Physics education

By Cheryl Pierce

Professor Ralph W. Lefler's education began in a one room eight-grade school house in rural Indiana. Through his tenacity, he elevated his own education which enabled him to be a Professor of Physics at Purdue University. He described the teachers he encountered in his early education as good, earnest people and noted that his interest in physics grew out of a science class in his high school.

"My interest in physics grew out of a one-year study of the subject, the only science other than general science offered," he wrote in a retrospective about his life's work. "I am certain that our teacher never had a college course in physics, but, he was an intelligent person who could give us some insight into the subject. There were no demonstrations and no lab work. Our equipment consisted of a meter stick and a candle. However, my interest in physics was born in this class."

He began his teaching career in one of the same one-room schoolhouse he had once attended. It ignited a passion for teaching which eventually led him to Purdue University's Physics and Astronomy department. Though his education took him many directions, it always impressed upon him that high school teachers weren't given the proper tools and education to teach physics, and if the United States was to stay at the forefront of Physics, high school teachers would be the stepping stone to getting students to want a college education in Physics.

Fast forward to 1960, Professor Lefler was in charge of a National Science Foundation (NSF) program that ran through 1974 called the Master's Degree Physics Summer Program. Lefler ran this program through 1971 and his input benefited roughly 200 Physics Alumni. The summer program recognized that high school science teachers needed more education and resources with specific regard to physics. Lefler retired in August of 1971 and passed away in June of 1995, but his immeasurable impact lives on through his students.

A group of these students from the Master's Degree Physics Summer Program wanted to honor their mentor and friend so they started the Professor Ralph Lefler Memorial Scholarship Endowment so that Lefler's legacy would be impacting students at Purdue in perpetuity. This endowment allows for scholarships to be given to students in the department of Physics and Astronomy who have an interest and focus on teaching physics.

One of his students, James Jennings, credits Lefler for changing the course of his professional life. He says that Lefler continued to offer assistance to his professional career even after Jennings graduated from the summer program.

"Between the first summer and the second summer, Professor Lefler called me ... and said 'Look, there is a great opportunity in Northwest Indiana in a place called Munster, Indiana,'" Jennings said. "He convinced me to move from Texas to Munster, IN. ... it changed my life. And Lefler did a lot more things for me other than that. He was a tremendous influence on my life and the life of 200-300 other people who participated in this program."

His students not only established this endowment, they passed on their thoughts about Lefler and how each of their lives were forever changed for the better because of the education they received at Purdue and due to Lefler's impact. This endowment is open for additional donations. Friends and alumni who would like to add to the endowment and assist students at Purdue, can do so here.

To sum up Lefler's impact on the Physics education would be exceedingly difficult because his persistent pursuit of educating the educators flows out into so many directions. So, this article concludes with the words of the Purdue alumni who created this endowment, each of whom were greatly impacted by Lefler's passion for physics education.

▶ "Professor Lefler was a kind and caring man who made all of us ... appreciate the joy of teaching physics."

- Richard Born, MS 1972

▶ "Professor Lefler created a very welcoming atmosphere and was very supportive of me when I needed some encouragement that first summer. His goal was quite clear: to improve the quality of physics instruction in the US by fostering better prepared physics teachers. He did just that."

- Donald Cope, MS 1972

▶ "He appreciated hard work and provided direction so that energies were used to most advantage. Ralph was an organizer and put together a wonder team of professors that had heart, dedication, love and caring to help get us through some tough times."

- Aaron Feik, MS 1972

▶ "There are three people who served as key mentors in my life, the first being Professor Ralph Lefler with Purdue University. How important was Ralph? If I had not met Ralph and benefited from his help and counsel, I would never have met the other two."

- Jim Jennings, MS 1967

▶ "He showed his true love of learning by his passion for teaching and advising young graduate students. He prompted students to become educated as well as trained. He made us all feel that we were meant to use the education we received at Purdue for the benefit of our society over benefit for ourselves. He was a Teacher, a Mentor and a fine human being. I will always remember him and thank him for his friendship and guidance."

- Jim Karagianis, MS 1972

▶ "This opened an opportunity that would otherwise not been available to many of us. Personally, it made a great difference in my career because the degree allowed me to finish my teaching career at our local community college."

- John McGuire, MS 1972

▶ "During the time I attended... he was always available and willing to help out. Again, the emphasis was on quality and thoroughness, which was his standard. God blessed all of us with Professor Lefler."

- Steve Sharpee, MS 1972

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JANUARY - DECEMBER 2021

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