

Physics and Astronomy Communiqué

Autumn 2019

Alumnus' Generosity Benefits Department

By Sheena Rice, MU News Bureau (edited for style)

When Ronald J. Boain, a 1965 graduate of the University of Missouri, made his first donation to his alma mater, the gift was small—just \$5—but it was the first of what was to become 50 years of financial support. On August 23, MU officials announced that Boain recently gifted a total of \$1.28 million to the Department of Physics and Astronomy in the College of Arts and Science to support student success.

"The same year that Ron supported the first manned mission to the moon while working with NASA, he also made his first gift of \$5 to his beloved alma mater—Mizzou," MU Chancellor Alexander N. Cartwright said. "Now, 50 years later, Ron and Cathy continue to be some of our most loyal donors. Today's \$1.28 million commitment to help expand professional development opportunities for our students underscores that loyalty."

The Ronald J. Boain and Catherine J. Rangel Boain Endowment fund was established with a bequest of \$1.25 million. The endow-

ment will provide support for both undergraduate and graduate students studying astronomy and physics for expenses related to professional development, such as on-campus speakers, career fairs, and support of students participating in internships. Additionally, Boain gave

ued to give back to the very program that he credits for his career. These new gifts will ensure that many students who want to study the stars can have the same success after graduation that he experienced."

Boain, a devoted alumnus with

two degrees from MU, knew he wanted to attend the same school his father attended. Unlike his father, who came to the university to play football under Don Faurot, he wanted to study astronomy, as he loved observing the planets and stars. He enrolled in the College of Arts and Science in 1961 and completed his bachelor's and master's degrees by 1967.

After graduation Boain began a career in the aerospace industry, eventually working for NASA's

Jet Propulsion Laboratory, where he was involved with several space projects, including planetary exploration projects and designing special satellites to observe the water content of clouds around the globe. His work with satellites earned him an Exceptional Achievement Medal

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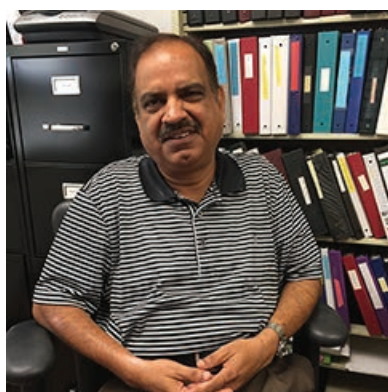
Department of Physics and Astronomy Chair Sashi Satpathy, Arts and Science Dean Pat Okker, Cathy Boain, Ron Boain, and Chancellor Alexander Cartwright at the gift announcement.

\$30,000 to set up the Boain PhD Dissertation Award in Physics and the Boain PhD Student Travel Fund to support graduate students.

"Ron and Cathy's generosity will have an amazing impact on students," says Patricia Okker, dean of the College of Arts and Science. "For five decades, Ron has contin-



From the Department Chair



Dear alumni, colleagues, and friends,

The University of Missouri continues to show a decidedly positive trend, and we are cautiously optimistic that the trend will continue. Mizzou's freshman class showed a strong upturn in number this year, going up from 4,700 last year to 5,600 this year, and for the first time in several years, the total enrollment increased over the previous year, to about 30,000 students now. Last year, Mizzou celebrated its first Nobel Prize winner, George P. Smith, who was awarded the Nobel Prize in Chemistry.

The physics department has thrived in spite of the budget challenges of the past. In the past five years, we have hired five new faculty members. Our graduate student number has remained stable, fluctuating between 45 and 55 students over the past decade. This year, eight doctoral students graduated and 12 new students joined the department, bringing the total number of graduate students to 48. The number of undergraduate physics majors remained more-or-less stable above 100 over the past several years. The department has about 10 postdoctoral fellows. The faculty size, currently 25 including three non-tenure-track faculty members, has suffered a dip this year due to retirements and departures. We hope to get additional faculty positions as the budget situation of the university improves in the coming

years. In terms of the student credit hours (SCH) taught, some 15,000 SCHs were taught in physics last year, which is a little more than 4 percent of the total taught by the College of Arts and Science in the same period.

I am happy to report that our faculty search last year was successful, and **Maria Mills**, formerly a postdoctoral fellow at the NIH in Washington, D.C. has joined the department as an assistant professor. Maria's expertise is in experimental biophysics, and she joins a very active group of biophysicists in the department. The department is also proud to recognize and congratulate **Deepak Singh**, an experimental condensed-matter physicist, who was awarded tenure and became an associate professor. After many years of service to the department, three faculty members, **Meera Chandrasekhar**, **Linda Godwin**, and **Bowen Loftin**, retired this year. Bowen will move to Texas, but I'm delighted to say that Meera and Linda will stay in Columbia and continue their association with the department. Meera will continue to oversee her \$1-million WIPRO program, and Linda will continue part of her outreach activities. In addition to the retirements, **Angela Speck** moved to the University of Texas, San Antonio as physics chair, and **Karen King** moved to Rock Bridge High School in Columbia, Missouri, to be a physics teacher, her long-time passion.

We have redoubled our efforts to improve the quality of our undergraduate program and in the recruitment of physics majors, e.g., with new outreach activities and introduction of honors courses. **Silvia Bompadre**, the director of undergraduate studies, spearheads that effort. Silvia is also the coordinator of student internship, both for graduate and undergraduate students, and we hope to place some of our students as summer interns in industry and government labs.

We would appreciate any help our alumni and friends can provide in our effort to find appropriate internship positions.

The productivity of our faculty and students remains high, and they continue to garner impressive awards, many of which are listed in this newsletter. According to a recent report by the provost's office, four of our faculty members (**Guang Bian**, **Aigen Li**, **David Singh**, and **Giovanni Vignale**) were placed in the top 50 among all MU faculty members in terms of number of published papers, with David topping the entire list. **Sergei Kopeikin** published his singularly impressive single-author 109-page article containing his original research work on equations of motion of extended bodies in *Physical Review D*, a highly respected research journal. In terms of grants and contracts, the faculty received new external grants amounting to a little under \$3 million this year. This is a remarkable achievement in light of the tight funding situation.

The department has been able to maintain its activities thanks to the new revenue streams such as supplemental fees, online teaching incomes, and generous donations from alumni and friends, for which we are deeply grateful. We are indebted to Physics Leader **Ronald Boain** and his wife **Catherine Rangel Boain** for their major \$1.28-million gift to the department, announced this past August. I express my sincere gratitude to the physics alumni, leaders, and friends for their continued support, and for their time, interest, ideas, and commitment to the department.

I thank the faculty and students for maintaining an intellectually stimulating and collegial work atmosphere in the department. Many of us were drawn to physics for the intellectual challenge of the field. During the recent gift announcement, Ron Boain quoted his for-

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A Need for Speed: NSF Awards Grant for Ultrafast Laser System

By Jordan Yount, College of Arts and Science

A University of Missouri team of researchers has been awarded a Major Research Instrumentation award from the National Science Foundation (NSF) that will allow the team to purchase an ultrafast amplified laser system that will facilitate research in condensed-matter physics, material science and engineering, chemistry, chemical engineering, biology, bioengineering, and medicine. Principal investigator **Suchi Guha**, a professor of physics, says probing materials with ultrafast short laser pulses allows researchers to capture some of the most fundamental physical processes that occur at extremely short timescales.

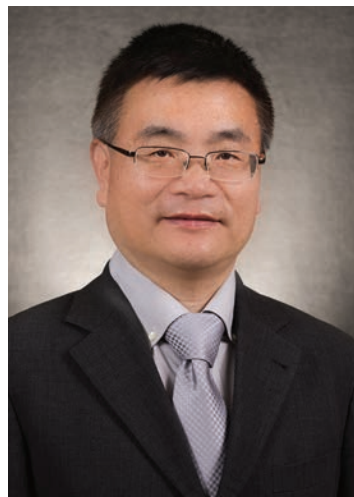
"Electrons are not stationary—they move very fast, so how do we capture that?" Guha asks. "One of the examples I give my students is, 'If you have a ceiling fan, and it is going very fast, and you cannot switch it off to figure out how many blades there are, what do you do? If you blink you can determine the number of blades, so you need some kind of pulsed technique to figure out the dynamics.'"

Guha says another example is photosynthesis, in which light changes to chemical energy.

"Chlorophyll absorbs the light, and then the electrons are transferred to an acceptor, and that's a very fast process—about one picosecond (one trillionth of a second)," she says. "In materials science, the same process occurs in donor-acceptor solar cells. So how do you study these processes that have to do with dynamics and transfer of charges? These things happen very

fast, so a tool like this ultrafast laser helps us."

In fact, Guha says improved solar cells could be one application of this new technology. Current solar cells are silicon based, but her team has been conducting research into



Professors Suchi Guha and Ping Yu

organic or plastic solar cells that are flexible and bendable and could, in theory, be printed onto fabrics or flexible windows. Right now, Guha says plastic solar cells have shorter lifetimes and are less efficient, but by understanding processes like photosynthesis and charge transfer processes, they may overcome the limitations of the new technology.

Unimaginably Fast

The NSF award will allow the team to acquire a femtosecond laser system that is capable of multi-dimensional spectroscopy. A femtosecond is one quadrillionth of a second. The system includes a femtosecond oscillator (laser), a femtosecond amplifier, and a nonlinear optical parametric amplifier that can be used to change the wavelengths of the amplified femtosecond laser pulses into a wide range of wavelengths, allowing scientists to study different materials for research projects.

For example, Guha says another team member, Assistant Professor of Physics **Guang Bian** is conducting research into quantum materials, two-dimensional materials, and nonlinear optical phenomena. Guha says the new system also will allow

researchers like Bian to study the symmetry of materials and symmetry-breaking phenomena, which she says is at the heart of condensed-matter physics.

Physics Professor **Ping Yu**, also a co-principal investigator, says the short pulsed laser system can be used for diagnosing disease as well as for some laser surgeries. He says the system also can be used for high-resolution bio-imaging, producing three-dimensional images of a patient.

"I'm working on this project now—the imaging of the human eye and 3-D images of the retina and of skin cancer and those kinds of applications," Yu says. He says other applications include looking at carrier dynamics—the heart of electronics—to create exceedingly fast switches, which would be needed for quantum computing. Another co-principal investigator, Associate Professor of Biological Engineering Heather Hunt, is interested in fabricating micro- and nano-structures using the ultrafast laser system. Rainer Glaser, formerly with the MU Department of Chemistry, who now chairs the Department of Chemistry at Missouri University of Science and Technology in Rolla, synthesizes molecules with non-linear optical phenomena and will utilize the new laser system for his research. It is this collaboration across different disciplines and different educa-

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Need for Speed

Continued from Page 3

tional institutions that most excites the members of the team, as well as a proposed center for nonlinear optics.

Center for Nonlinear Optics

"All of the parts are there. It's just a question of putting people together," Guha says. "We've already formed a group that includes condensed-matter theorists at MU and other collaborators at Lincoln University and Missouri State University."

Yu says the NSF grant has an educational component for undergraduate and graduate students. Some of the students who will be trained to use this new system will come from Lincoln University.

"The physics chair was a post-doc of mine, and he's an expert on ultrafast lasers," Yu says. "Not only will students be exposed to this sort of knowledge, but also they will be trained to learn how to solve problems in a way that uses this system."

In applying for the NSF award, the team said the transdisciplinary

breadth of available expertise is unmatched in the region, "empowering STEM students to obtain a competitive edge by hands-on experiences, and preparing them for employment in nanotechnology, biotechnology, materials science and engineering, and semiconductor-based academic research or industry."

Guha says, "There may be several uncharted areas that we still have not thought of, but the new instrumentation award could lead us in that direction."

Boain Gift

Continued from Page 1

from NASA in 2007.

In 2016, upon retirement, Boain and his wife, Cathy, returned home to Columbia from California.

"Throughout my career working in a field that I loved, I faced new problems and challenges," Boain says. "In many cases, the solution to these problems drew from the basic principles I learned during my study of physics. That is why it was an easy decision for Cathy and me to set aside a portion of our estate

as an endowment to the University of Missouri and the Department of Physics and Astronomy. It is my hope it will help other students, like me, see opportunities in industry, government, and private and public research facilities during their years beyond graduation."

Photos at: physics.missouri.edu/news/alumnus-gifts-128-million-support-physics-astronomy.

From the Chair

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mer colleagues at the Jet Propulsion Laboratory saying, "If it ain't physics, it ain't," which Ron thought was perhaps a tad bit arrogant, but which nevertheless succinctly summarizes why many of us came to physics. It is that singular love for physics that makes us toil every day to discover the beauty beyond the boundaries of knowledge and impart that knowledge to the future generations to come.

Wishing everyone another successful year, both on the professional and personal front,

Sashi Satpathy

Sashi Satpathy
Department Chair and Curators'
Distinguished Professor

Check the department website for department news and updates:

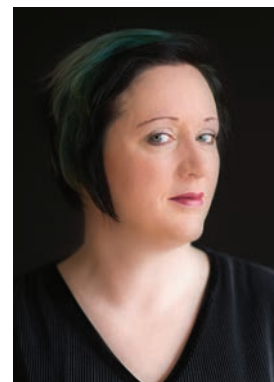
- A frequently updated Recent Faculty Publications list with links to articles
- Updated Physics Leaders page
- Department news and calendar

- Alumni: Please visit physics.missouri.edu/alumni-and-friends to learn how to update your contact information or submit an online profile that will be added to the page.

- Visit often: physics.missouri.edu
- To ensure you receive the latest news, please send your updated email address to umcasphysics@missouri.edu.



Department Departures



Meera Chandrasekhar, Linda Godwin, Karen King, Bowen Loftin, and Angela Speck

The department of Physics and Astronomy said goodbye to five faculty members earlier this year.

Meera Chandrasekhar retired from her position as a Curators' Professor of Physics and Astronomy following a 41-year career in the department. Chandrasekhar's research interests are in the area of optical spectroscopy. She developed a strong interest in the education of young students, leading to her Physics First grant, a \$5-million multi-year grant from the National Science Foundation (NSF) to address the challenge of improving secondary physics education.

Though retired, Chandrasekhar will continue her work in the department as professor emerita working with professors Dorina Kosztin, Karen King, and Marcelle Siegel from the College of Education, to administer a four-year \$1.1-million grant to support 60 mid-Missouri K-12 science teachers in their science teaching through leadership and collaboration. The grant is funded by Wipro, a global information technology, consulting, and business process services company. Her numerous awards include a William T. Kemper Fellowship for Teaching Excellence from the University of Missouri, an Alfred P. Sloan Fellowship, and election as a fellow of the American Physical Society in 1992.

She received the Baylor University Robert Foster Cherry Award for Great Teaching in 2014.

Linda Godwin retired from the department of Physics and Astronomy. She received her doctorate from the department in 1980 and returned as a professor in 2011, following a 30-year career with NASA. She plans to continue supporting the department in a small role with alumni outreach and online teaching. She has received the MU College of Arts and Science William Francis English Scholar-in-Residence, and the MU College of Arts and Science Distinguished Alumni Award.

Karen King, an associate teaching professor of physics in the department for 10 years, left to join the science faculty at Rock Bridge High School in Columbia, Missouri. King was very active in promoting physics education, and she was responsible for obtaining multiple grants, including a major three-year Phys-Tec grant (Physics Teacher Education Coalition). King also coordinated the department's Research Experience for Undergraduates Program for several summers.

Bowen Loftin retired from his position as professor and plans to return to Texas. He first joined the University of Missouri as chancellor in 2014, with tenure awarded in the

Department of Physics and Astronomy. He assumed duties as a faculty member in the department in 2017. Previously, Loftin served as vice president and CEO of Texas A&M University Galveston from 2005 to 2009 and as the president of Texas A&M University from 2009 to 2014.

Angela Speck accepted an offer to become chair of the Department of Physics and Astronomy at University of Texas, San Antonio. Speck will continue her research and also lead the department's effort to build its science research and influence. Speck was a professor of astrophysics and the director of astronomy and received over \$2 million in external funding from NSF and NASA during her time at MU. She received numerous awards including the William T. Kemper Fellowship for Teaching Excellence and was very active in department outreach.

Congratulations, Graduates!

Fall 2018 PhD in Physics

Ernest Knight
Bradley Mills
Matthew J. Prosniewski

Spring 2019 PhD in Physics

Amrit Laudari
Anna Pittman

Summer 2019 PhD in Physics

Ashutosh Dahal
James Torres
Milica Utjesanovic

Fall 2018 MS in Physics

Alex Daykin

Spring 2019 MS in Physics

John Baron

Summer 2019 MS in Physics

Rodney Helm

Fall 2018 BS in Physics

Nicholas Cardoza, *emphasis in biophysics*
Camden Eck
John Kelly
Sarah Marcum, *emphasis in astronomy, department honors*
Thomas O'Neil, *emphasis in astronomy*
Madison Schwinn, *emphasis in material science, department honors*
Finis Stribling
Jason Weinzierl

Spring 2019 BS in Physics

Andres Rodriguez Carrion
Chi Chen
Michael Dotzel, *summa cum laude*
Martha Gahl, *summa cum laude*
Maria Howell, *summa cum laude*
Xiangyu Lin
Buyuan Luo
Kyle Roberts, *emphasis in astronomy*
Joshua Sadler
Noah Schwarz, *emphasis in biophysics, summa cum laude, department honors*
Sarah Van Hoesen
Jonathan Williams, *emphasis in biophysics*

Summer 2019 BS in Physics

David Hackett
Mikael Brooks Wood

Summer 2019 BA in Physics

Won Yong Ock



Fall 2018 doctoral graduates, from left: Bradley Mills, Matthew Prosniewski, and Ernest Knight.

For Reference:

To receive Latin honors from the College of Arts and Science requires at least 54 of the student's last 60 hours to be at MU and:

- 3.7–3.799 GPA for cum laude
- 3.8–3.899 GPA for magna cum laude
- 3.9–4.0 GPA for summa cum laude

Departmental honors requires > 3.5 GPA in physics courses, completion of six credit hours of research, and a publication or presentation (oral or poster).

A certificate in general honors from the MU Honors College requires students to complete 24 hours of courses for honors credit and maintain a 3.5 cumulative GPA.

Recent Alumnus News

Matt Graham graduated in 2018 with degrees in physics and secondary education. He contacted us this past summer with an update:



Matt Graham, BS '18 physics, BS Ed '18.

"It's Matt Graham from Miz-zou! Just wanted to update you and say thanks again for all of the knowledge you gave me throughout college. I finished my first year of teaching at Simonsen in Jefferson City, and though stressful, exhausting, and hectic, it went decently well. I needed a break for the summer, so I ended up working in Wyoming leading stargazing tours in the Grand Tetons with an organization called Wyoming Stargazing. It was awesome.

"In just a few days, I'll be starting my second year at a brand new high school in Jefferson City called Capital City High School. I'm nervous again, but thankful for the preparation I've received the last few years to help me out.

"Just thought you would like to know that I ended up getting an award today in front of the whole district for being one of the few to receive a "New Professional of the Year Award." Again, I don't think I would have been able to do a decent job without your help, so thank you!"

2018–19 Outreach Events

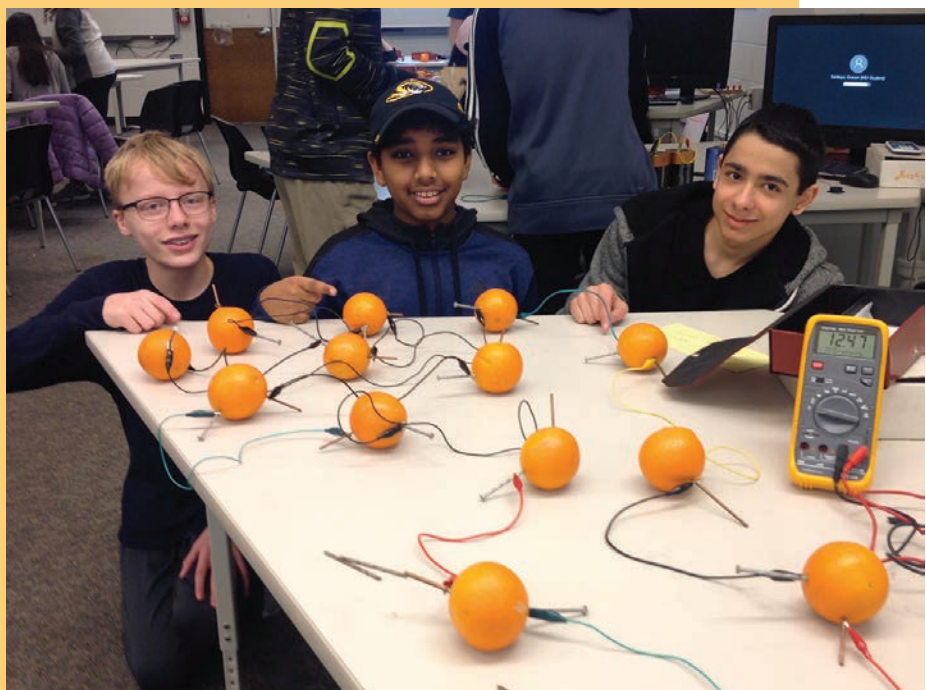
On Nov. 20, 2018, Associate Teaching Professor **Yun Zhang** and graduate students **Todd Lombardi** and **Lisa Shepard** led 12 other graduate students from PAGSA making the largest presence ever at the Columbia Public Schools' STEM EXPO, showcasing more than 40 demos and activities of physics and astronomy. More than 500 people attended this event.

On March 14, 2019, Zhang; Associate Teaching Professor **Karen King**; and **Doug Steinhoff**, an instructor in the department, hosted the Physics Day event for high school students, inviting 130 ninth-grade physics honors students and their teachers from the Rock Bridge High School to an exploration of mechanics, optics, energy, and electricity. Graduate student Todd Lombardi and eight others from PAGSA and two undergraduate students from the School of Education also played active roles leading the activities.

On April 20, 2019, Zhang, Teaching Professor **Dorina Kosztin**, Curators' Professor **Meera Chandrasekhar**, and Professor **Linda Godwin** organized a full-scale open house for the public. Twenty graduate students from PAGSA, one undergraduate student from the School of Education, and two high school students volunteered at the open house. Events included a show of physics demonstrations, more than 60 exploratory physics displays, hands-on activities building spectrometers and kaleidoscopes, and a presen-

tation on space shuttle missions. The event drew more than 250 people of all ages from Columbia and the surrounding areas.

Ninth-grade Rock Bridge High School students enjoy the hands-on experience of learning about electricity during the March 2019 Physics Day event.



Lisa Shepard Selected for ComSciCon-AIP 2019

Graduate student **Lisa Shepard** applied for and was selected to attend ComSciCon-AIP 2019. Selection is competitive, and attendees are sponsored by AIP. ComSciCon-AIP was a two-day event organized in collaboration between ComSciCon (Communicating Science Conference) and AIP (American Institute of Physics) held at the American Center for Physics in College Park, Maryland, on Sept. 23-24, 2019. The ComSciCon workshops empower graduate students to communicate research in science, engineering,

and other technical fields to broad and diverse audiences. ComSciCon-AIP 2019 focused on the physical sciences, and the program included panels on media engagement, policy making, storytelling, opportunities to network, and workshop science communication pieces. Shepard presented a poster about outreach done with Laws Observatory.

Shepard will present on her ComSciCon experience at a Journal Club this fall.



Lisa Shepard doing community outreach while presenting for Science on Wheels.

Student Recognition

Undergraduate Award

Brian Hybben received the poster prize from the American Astronomical Society during its June meeting in St. Louis.



Graduate student Li Lee with her poster presentation, "Biomedical Imaging: Imaging of Heart Fibrosis."

Graduate Accomplishments

Soma Khanra and **Zachary Buck** were jointly selected to receive the inaugural Ronald J. Boain and Catherine J. Rangel Boain Dissertation award. The shared award came with a certificate and a \$1,000 cash award and was presented at the 2018 Physics Leaders' Banquet. Khanra's advisor is **Suchi Guha**, and her dissertation was *Self-Assembled Peptide Nanostructures for Electrical, Optical, and Magnetic Applications*. Buck's advisor is **Haskell Taub**, and his dissertation was titled *Neutron Scattering Studies of Water Diffusion Near the Interface of Model Cell Membranes*.

The Harry E. Hammond Teaching Assistant Awardees were **Sean Fayfar** and **Matthew Prosniewski** for fall 2019 and **Katherine Schaefer** and **Lisa Shepard** for spring 2018.

Li Lee received the second-place award in the Life Science Innovations category during Life Science

Week. Her advisor is Ping Yu. She also gave two presentations, "T2-Mapping Magnetic Resonance Imaging as a Novel Strategy to Detect and Quantify Myocardial Fibrosis in Mice" and "In Vitro and In Vivo Evaluations of a High Affinity and Specificity Photoacoustic Nanoparticle Targeting to Cancer" at the World Molecular Imaging Congress (WMIC) in Seattle, in September 2018. Her trip to the WMIC conference was supported by travel funds from Department of Physics and the Graduate Professional Council at MU.

From **Gavin King's** research lab: **Anna Pittman** successfully defended her doctoral thesis this past spring and has recently started as a postdoctoral fellow at St. Jude Children's Research Hospital where she will be expanding her expertise from precision force microscopy into the realm of state-of-the-art optical microscopy.

Scholarship Recipients

Many fellowships, scholarships, and other funds have generously been established and supported by our alumni. These students were the recipients of those funds and awards for the academic year 2018-19 and summer 2019.

Undergraduate Student Scholarships

Paul E. Basye Undergraduate Scholarship

Jordan Asmus, Quinn Cunningham, Phillip Hegeman, Tyler Kling, Joshua Miles, Matthew Soehngen, Andrew Tait, Sarah Van Hoesen, Jack Weakly

Rose Marie Dishman Endowed Scholarship in Physics

Benjamin Krewson, Ian Miller, Derik Russell

James L. and Dora D. Ferguson Fund for Excellence in Physics

Johnathan Williams

Newell S. Gingrich Physics and Astronomy Endowment

Benjamin Krewson

Samuel S. Laws Scholarship Fund

Kenzie Holland and Tyler Kling

Donald L. and Lona Lewis Packwood Endowed Undergraduate Scholarship in Physics

Michael Dotzel and Noah Schwartz

O.M. Stewart Scholarship

Lucas Chandler and Madison Schwinn

Clifford W. Tompson Scholarship in Physics

Sean Burke, Spencer Griffin, Maria Howell, Matthew Snyder, Zachary Valleroy

Graduate Student Scholarships

Carl & Brynn Anderson Graduate Student Award in Physics

Ashutosh Dahal, Sean Fayfar, Katherine Schaefer

Rose Marie Dishman Endowed Scholarship in Physics

John Barron

James L. and Dora D. Ferguson Fund for Excellence in Physics

Randy Burns, Jaisen Guo, Rodney Helm, Aditya Putatunda, Pratik Sahu

Newell S. Gingrich Physics Scholarship

Vishal Jayswal, Li Lee, Chenxiaoji Ling, George Yumnam

Newell S. Gingrich Physics and Astronomy Endowment

Todd Lombardi, Ryan Smith, Milica Utjesanovic, Mitchel Vaninger, Jared Williams, Charlie Winborn

Eli Stuart Haynes and Nola Anderson Haynes Scholarship

Lisa Shepard

Eugene B. Hensley Scholarship in Physics

Alexander Daykin

Ernest W. Landen Fellowship in Physics

Payal Bhattacharya, Kanokporn Chattrakun, Jacob Cook, Alexander Daykin

William E. Spicer Fund for the Development of Excellence in Physics

Rodney Helm

O. M. Stewart Scholarship

Matthew Anderson, Randy Burns, Milica Utjesanovic, David Zwick

Awards

Ron Boain and Catherine Rangel Boain Dissertation Award, Fall 2018

Zachary Buck and Soma Khanra

Gerald Fishman Travel Award

Fall 2018

Kanokporn Chattrakun and Lee Li

Spring 2019

Matthew Anderson, Kanokporn Chattrakun, Ashutosh Dahal, Li Lee, Alec Pickett, Anna Pittman, Edward Pluhar, Aditya Putatunda, Lisa Shepard, and Milica Utjesanovic,

Harry E. Hammond Teaching Assistant Award

Fall 2018

Sean Fayfar and Matthew Prosniewski

Spring 2019

Lisa Shepard and Katherine Schaefer

PAGSA Update

By Sean Fayfar

The Physics and Astronomy Graduate Student Association (PAGSA) is a student-led organization that focuses on representing the interests of graduate students and promoting social and cultural events. As the president of PAGSA, I have found the most important part of the organization has been to create a cohesive graduate student community at Mizzou that welcomes new students and aids in the transition from being an undergraduate to becoming a successful graduate student.

This past academic year, we had a strong focus on public outreach events in our community. All of our outreach events were planned in coordination between Professor **Yun Zhang** and **Todd Lombardi**, the PAGSA outreach committee chair. Our first event of the fall semester was an outreach event at Rock Bridge High School in November 2018. We brought multiple introductory physics demonstrations, ranging from spinning a ball that changes size to show conservation of angular momentum to concave and convex mirrors to show how the mirror shapes can change the optical properties. Our demonstrations focus on having visitors interact with the equipment and learn through experimenting. The following semester, we had two outreach events. We invited high school students to visit the physics department in March 2019 where we had five rooms filled with demonstrations, and in April the department held an open house. On June 1-2, 2019, we held a table at Art in the Park at Stephens Lake Park along with a few other departments from the university. Finally, PAGSA hosted a two-hour segment for the IG-NITES Summer Camp in July where we gave the campers a tour of the observatory and had a competition to create the best candy bridge.

Another vital aspect of PAGSA is our Journal Club; we provide graduate students the opportunity to present to their colleagues and receive feedback about their presentations. Presentations are a large portion of how scientific research is communicated, and Journal Club allows students a place to practice a presentation before a conference or research something completely new and create a presentation about their findings. The presentations from this past academic year included:

- **Tim Carleton:** "Properties of UDGs Produced Through Tidal Stripping and Heating"
- **Alec Pickett:** "Interfacial Effects of UV-Ozone Treated Sol-Gel Processable ZnO for Hybrid Photodetectors and Thin Film Transistors"
- **John Barron:** "Organic Field Effect Transistors"
- **Payal Bhattacharya:** "Optical Second-Harmonic Generation Measurements for Probing Organic Device Operation"
- **Randy Burns:** "Hybrid Organic-Inorganic Perovskite Field Effect Transistors"

This past academic year, we have had students give several presentations outside the department. Students participated in the Graduate Professional Council's Annual Research and Creative Activities Forum where their poster presentations showcased their academic projects to an audience of their professors, colleagues, and visiting faculty. PAGSA congratulates **Anna Pitman** and **Alec Pickett** for winning first and second places, respectively, in their category of physical sciences.

PAGSA members also attended the annual APS March Meeting in Boston. Students presented their research to other scientists in their field as well as viewed other relevant presentations.

vant presentations.

PAGSA consistently holds social events to help create a cohesive community in the department, specifically between the students and faculty. This past year **Sarah Parker**, the social events committee chair, planned all of the events. In the fall, we held our annual Welcome Picnic, which included all students and faculty in the department. The new graduate students were able to meet other students in the department at the picnic as well as some of the professors they might have for classes or might hope to do research with. PAGSA hosted a departmental Thanksgiving dinner in November and brought various Thanksgiving foods to share with everyone who attended. In April, PAGSA members participated in a Civil War-themed escape room at Breakout CoMo. This was supposed to be the most difficult room, and they barely escaped with only about four minutes to spare! Lastly, PAGSA held the spring picnic at the end of the year, and students discussed how their years had gone and their plans for the upcoming summer.



PAGSA members working with children at Art in the Park.

Internship Spotlight

Zachary Valleroy, a senior physics and engineering major, spent his summer as an intern with Textron Aviation.

“This summer at Textron Aviation, I had the opportunity to work in a cross-functional team to perform control testing on plating processes. So that strict aviation specifications could be met, I incorporated a multi-disciplinary approach and utilized a team of scientists and chemical engineers to quickly identify and eliminate process problems and hazards. My previous coursework in the Department of Physics and Astronomy prepared me for this role as I was able to effectively use a scanning electron microscope and understand the technical language and terminology used throughout the summer. This internship exposed me to the importance of teamwork and collaboration among scientific disciplines as well as to the discovery of a potential career path in which I can integrate both physics and chemical engineering.”



Senior Zachary Valleroy completed a summer internship with Textron Aviation.

SPS Update

By Phillip Hegeman

The Mizzou chapter of the Society of Physics Students (SPS) is celebrating the past year's successes while looking ahead to a bright new year. The 2018-19 academic year saw many opportunities to explore physics outside of the classroom in a fun, curious environment.

The year began with the introduction of Physics Fight Club, a low-pressure competition in which members went head-to-head answering tricky physics problems. Later in the year, members enjoyed making their own ice cream using liquid nitrogen as the freezing agent—an annual favorite! Physics Jeopardy was a fun time, and ev-

eryone learned from their peers as members presented some of their own research to the group. Using a beach ball dropped from the Virginia Avenue parking garage, we were able to clearly demonstrate the Coriolis effect.

SPS also gave back to the community this year. In the spring, a few members led hands-on demonstrations in the Physics Open House for elementary and middle school students.

In the coming year, SPS will see the continuation of last year's activities, the return of popular events from years past, and the emergence of a few exciting opportunities new to the club! Later in the

fall semester, we will be visiting the MU Research Reactor—a trip that last occurred three years ago. We are also in the early stages of planning a longer trip to Illinois, where we will tour the Argonne National Laboratory and explore the many sights and sounds of Chicago, probably enjoying some deep-dish pizza along the way! SPS is also in the process of gaining access to a new dedicated lab space in the physics building basement, which will allow for more complex demonstrations. The future is looking bright for physics students of Mizzou.



This circa 1906 photo of the Mizzou campus looking north up Eighth Street toward the Boone County Courthouse shows the original location of Laws Observatory—a small domed building just right of center in the photograph. The observatory is where the J School is today, and the old castle-like YMCA is the light-colored building on the west side of Eighth Street. This version was designed in 1879, constructed in 1880, and later demolished in 1919. Courtesy of the Missouri State Historical Society.

The Name's the Same, But...

Laws Observatory is the name of three separate astronomical observatories owned and operated by the University of Missouri from 1880 to the present. The observatory is named after former University President Samuel Laws, who donated personal funds for construction in 1879.

The original University of Missouri observatory predated the first named Laws Observatory and was originally built in 1853 near Academic Hall. The original site is now occupied by the Engineering East building. The original observatory was equipped with a 4 1/6-inch Henry Fitz refractor, and it was the first

observatory in the western United States.

In 1879, MU offered \$500 cash and the Fitz telescope in exchange for a 7 1/2-inch Munich-built equatorial refractor by Merz and Soehne from the failing Shelby College in Shelbyville, Kentucky. Shelby College agreed to the exchange, but MU found that it could not afford the transportation and reassembly of the telescope along with an adequate facility to house it. University President Samuel S. Laws stepped in and provided \$2,000 (almost \$50,000 today) of his own money to transport the telescope and begin construction of a new observatory. When the new observatory was constructed, the part that constituted the cone, clock room, and transit room were actually part of the original observatory (near Academic Hall), and those parts had been moved to the new location for the construction of the new (and newly named) Laws Observatory on the north side of the Quad-rangle in 1880. An office was

added to the building in 1891, and classroom space was added in 1907. An R. Brown Gans-built 4 1/2-inch equatorial refractor was also added to the observatory in 1907. In 1912, a 5-inch Brashear photographic doublet was mounted on the 7 1/2-inch Merz. The observatory was torn down in 1919 to make way for construction of Neff Hall.

In 1920, Laws Observatory (the third overall observatory) was rebuilt in its second location, which is now the site of the west parking lot of the Harry S Truman Veterans Hospital.

Laws Observatory was moved to its current location atop the Physics Building around the time the building was constructed in 1964. The current observatory houses a 16-inch Celestron Schmidt Cassegrain telescope, a computer room, and an astronomy exhibit room and continues to be used for amateur observing and educational outreach for science and astronomy. It is open to the public every Wednesday evening from 7 to 10 p.m., weather permitting and excluding holidays.



LawsObservatory



Close-up photo of the first Laws Observatory. Courtesy of MU historical archives.



The 16-inch Celestron Schmidt Cassegrain telescope in the current Laws Observatory atop the Physics Building.

Physics Leaders Meeting

Fall 2018

The Physics Leaders annual meeting was held in Columbia, Nov. 2–3, 2018. The alumni were briefed on the state of the department by Department Chair **Sashi Satpathy**, Director of Undergraduate Studies **Silvia Bompadre**, and Director of Graduate Studies **Paul Miceli**.

Undergraduate student **Michael Dotzel** discussed Society of Physics Students news and graduate student **Sean Fayfar** summarized Physics and Astronomy Graduate Student Association activities over the prior year.

New George Vineyard Assistant Professor **Se Kwon Kim** presented an overview of his research on quantum spintronics.

Following lunch for alumni, faculty, and students in the physics library, leaders hosted a panel discussion, commenting on their careers in academia, government, industry, and other areas followed by Q&A with students.

The following students gave presentations to the afternoon group of alumni, faculty, and other students:

Undergraduate Presentations

- **Lucas Chandler**, “Single Molecule Measurements of Topography and Force Reveal Mechanisms Underlying General Secretory System Activity”
- **Noah Schwartz**, “Free Energy Profile of Amino Acids Partitioning into Model Lipid Membranes”

Graduate Presentations

- **Alec Pickett**, “Correlating Charge Transport to Structure in Deconstructed Organic Semiconducting Molecules: A Case Study of a Monomer”
- **Li Lee**, “T2-Mapping Magnetic Resonance Imaging as a Novel Strategy to Detect and Quantify Myocardial Fibrosis in Mice”

- **Milica Utjesanovic**, “Multiple Stochastic Pathways in Forced Peptide-Lipid Membrane Detachment”
- **Matthew Anderson**, “Spin Waves in Doped Graphene”
- **Ashutosh Dahal**, “Magnetic and Electrical Properties of 2-D Artificial Honeycomb Lattice”

The Friday-evening reception and banquet were held at Stoney Creek Inn. Sashi Satpathy and Leaders President **Vann Priest** presented the 2018 Physics Leaders Awards for Outstanding Student Presentations and faculty awards were presented to **Guang Bian** and Bompadre.

Satpathy presented the first Ron Boain and Catherine Rangel-Boain Dissertation Award to graduate

students **Zachary Buck** and **Soma Khanra**.

Henry White, professor emeritus, spoke to the group about his perspective and memories of the department from his long career at MU. He was assisted by alumnus and Physics Leader **Philip Chumbley**, who provided historical audio visual support.

On Friday morning, Dean of Arts and Science **Patricia Okker** met with the leaders and faculty to discuss recent university progress and hear their comments and concerns. Current officers for the Physics Leaders are Vann Priest, president, and **Shadi Shahedipour**, vice president.



Physics Leaders, from left: Vann Priest, Robert Cunningham, Chuck Crowder, Shadi Shahedipour, Alan Van Nevel, Sashi Satpathy, Philip Chumbley, Henry White, Ron Boain, John Bogdanor, Carl Anderson, David Rainwater, and John Shumway.



Guang Bian received the 2019 President's Award for Early Career Excellence. As well as writing 58 high-quality research papers at MU, he

established the Missouri Integrated Nano-Analysis System (MINAS), a cutting-edge experimental facility that is unique in the United States. He has also secured two external grants from the National Science Foundation (NSF), which include work on topological superconductors and a project to develop an ultrafast laser platform at MU.

Shi-Jie Chen became a Curators' Distinguished Professor of Physics in recognition of his exemplary service to the University of Missouri. Chen received the award for his exceptional performance, service, and teaching record.



Chen was also elected a 2018 fellow of the American Association for the Advancement of Science. He was acknowledged for his distinguished contributions to the field of computational and theoretical biological physics, particularly for theoretical modeling and computational predictions of RNA folding and function.



Suchi Guha received the Provost's Award for Leadership in International Education. This award recognizes MU faculty who have provided

outstanding leadership in strengthening MU's international dimension. Guha received the award for developing courses and teaching at universities and research institutes in Brazil, India, Taiwan, Denmark, Pakistan, and South Africa. Of her cur-

Faculty Updates

rent grants from the NSF on which she is the principal investigator, three have an international component: one is for conducting a workshop in the area of biosensors for U.S. scientists in Brazil, the second involves research collaborations in the area of organic electronics with scientists in Denmark and India, and the third involves research and educational activities in energy-related science with scientists in South Africa.

Yicheng Guo

uses Hubble Space Telescope's (HST) unique capability of high-resolution UV imaging to study star formation in distant galaxies. He is a co-principal investigator of an approved HST Cycle 26 large (164-orbit) program (Ultraviolet Imaging of the Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey Fields—UV-CANDELS) as well as the principal investigator of an approved Cycle 27 archival program ("UV Light Reveals the Life of Giant Star-forming Clumps"). He also works with postdoc Timothy Carleton to model how dark matter halos change the shapes and sizes of their accreted dwarf galaxies.



rent in green nanotechnology with his first international assignment in Bangkok, Thailand. Katti introduced the concept of green nanotechnology for the first time in the world

The United Nations recently appointed **Kattesh Katti** as a subject expert

at MU as an interdisciplinary area of science and technology. This field has implications in science, medicine, agriculture, energy, and allied disciplines.



Sergei Kopeikin

published a 109-page single-author paper in *Physical Review D*, perhaps a record. The paper, "Covariant Equations of Motion

of Extended Bodies with Arbitrary Mass and Spin Multipoles," appeared in volume 99 of the journal.

Supported by NASA and NSF grants of nearly \$1 million awarded in 2017 and 2018, astrophysics Professor **Ai-**



gen Li has been exploring the universe through tiny agents as small as aromatic hydrocarbon molecules and nanoparticles in the space between stars and in planet-forming disks and agents as large as the cosmological "standardizable candles"—type Ia supernovae—which are considered to be one of the most precise tools for determining astronomical distances. He helped organize several international conferences including the focus meeting "Nano Dust in Space and Astrophysics" for the General Assembly of the International Astronomical Union in Vienna in August 2018; the international symposium "Dusting the Universe" in Tucson, Arizona, in March 2019; the Asian Oceania Geosciences Society (AOGS) Planetary Sciences "In Cosmic Dust We Truly Trust" July/August 2019 in Singapore; the international workshop "Cosmic Dust: Its Formation and Evolution" in August 2019 in Tokyo; and the upcoming "Illuminating the Dusty Universe" July 2020 in Florence, Italy.

David Singh published his 100th paper with a Mizzou address in February. The co-author, Yuwei Li, was



his postdoctoral fellow at MU for two years and just started a faculty position in physics at North China Institute for Aerospace Engineering in

September. The paper, “First Principles Based Screen for Identification of Transparent Conductors,” was published in the *Journal of Materials Chemistry C*.

Application of **Deepak Singh’s** investigations of the throughput of artificial honeycomb lattices to enhance battery efficiency made *The Daily Mail* in London, which boasts more than 42 million unique visitors a month to its website.



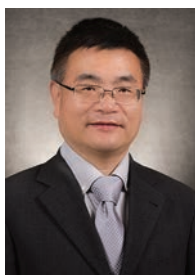
“Although more works need to be done to develop the end product, the device could mean that a normal five-hour charge could increase to more than a 500-hour charge,” said study lead author Deepak Singh, a physicist at the University of Missouri.



Haojing Yan and **Yicheng Guo**, along with Matia Vaccari from the University of Western Cape, have been collaborating on a large project. One of

the subprograms derived from this project has been awarded 16 hours of observing time at the MeerKAT telescope, which is a South African path-finder radio telescope to the Square Kilometer Array and is now just beginning its open access.

Professor **Ping Yu** held a visiting professorship at Technical University of Denmark (DTU) this past summer. He worked on photothermal effect of semiconductor nanostructures and gave two talks at DTU. He also visited Niels Bohr Institute



at Copenhagen University, where he did his post-doctoral training 20 years ago. He published a paper about optical coherence tomography using Airy beam in *Optics Letters* in June 2019. According to information provided by the journal, the paper is in the top downloads list for that month.



Associate teaching professor **Yun Zhang** received a UM System Affordable and Open Educational Resources Initiative grant for her College Physics 1 course. A&OER is an initiative to convert course materials to reduced-cost and/or free content

for students. It takes a significant amount of work and time to accomplish the conversion.

Silvia Bompadre and **Dorina Kosztin** each received a UM System Affordable and Open Educational Resources Initiative grant for their work on a free textbook for Physics 2750 and 2760. A&OER is an initiative to convert course materials to reduced-cost and/or free content for students.

Xiaoqin Zou was elected a 2019

fellow of the American Physical Society for her “outstanding contributions to developing novel physics-based algorithms for modeling protein interactions with applications to structure-based drug design.”



Welcome New Grad Students!



Left to right: Teja Teppala, Ehsan Faridi, Dylan Weaver, Alec Martin, Charles Mentzer, Bo Yang, Creighton Lisowski, Mari Tsumuraya, Zhenfei Jiang, and Amarnath Chakraborty. Not pictured: Pousali Ghosh and Nirmal Baishnab.

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The department appreciates hearing from alumni and friends. Send announcements or milestones to the address listed above.

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Welcome, Maria Mills!

The department is very pleased to welcome **Maria Mills** as an assistant professor of biological physics. She obtained her doctorate from the University of Michigan in 2010. Before joining MU, she worked as a postdoctoral scholar at the National Institutes of Health (NIH), where she was awarded an NIH Career Transition Award (K22).

As a biophysicist, her research has focused on understanding the behavior and interactions of biomolecules from a physical perspective. Mills has used both computational and experimental methods to study the physics of biological molecules, with a particular focus on proteins that interact with and manipulate DNA. This includes proteins that separate the strands of the DNA double helix to facilitate reading, copying, or repair of the genome, as well as proteins that re-

move over- and under-twisting of DNA caused by cellular processes. She has active collaborations with biochemistry groups at the NIH and at Florida International University.

In the future, she will use biophysical methods to understand crucial DNA repair pathways. One system she is studying is essential for the growth of *Mycobacterium tuberculosis* and is a potential drug target for tuberculosis infection. Mills also plans to use force-based experiments to probe the underlying physics of protein motions. She hopes to develop collaborations within the department and in other departments at MU.



Assistant Professor Maria Mills