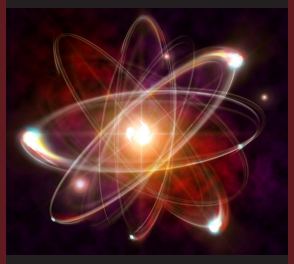
MomentuM

PHYSICS | ASTRONOMY MATERIALS SCIENCE

Newsletter 2020



A Note from the Department Head

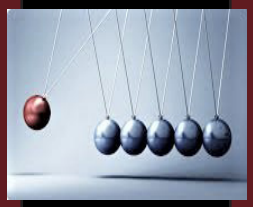
As expected, 2020 was most memorable for the Covid-19 virus pandemic and how it affected the day-to-day operations in the department. Early-to-mid March 2020, we received news that the entire region was going on lockdown and classes would have to be moved to virtual or online format. Spring break was extended for an additional week to allow faculty, staff and students to prepare for the transition. For a department that only had one course that was consistently offered online, converting our curriculum within a two-week period, especially lab courses, was indeed a very demanding task. The university enabled utilization of it's Zoom classrooms, which several PAMS' faculty used to hold virtual classes. Others in the department used higher quality camcorders to either deliver or record lectures or lab content from home. Initially during the lockdown, other than for utilization of the Zoom classrooms, the campus was almost completely shut down. This was particularly difficult for faculty and students attempting to carry on research efforts in laboratories and the observatory.

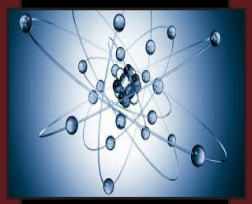
Starting in April, faculty and students were allowed to begin returning to research spaces but only on a very limited occupancy, both in total number and time duration, and with all safety protocols against the Covid-19 virus in place. Graduate students nearing completion of their studies were given priority to have limited lab access so that they could complete their thesis projects. Summer classes, including lab sections, were given only online in the department. Because the pandemic situation had improved sufficiently, MSU held classes in Fall 2020 predominantly in hybrid or blended format, having both online and in-person seated classes with limited occupancy allowing for social distancing. At the beginning of the semester, our introductory Physics labs had to go completely online for two weeks due to an initial spike of transmission of Covid-19 among undergraduate students. Later analysis showed that the overwhelming majority of this transmission occurred off campus. By October or so, the PAMS department was able to conduct classes, research and related activities in a safe and uninterrupted manner.

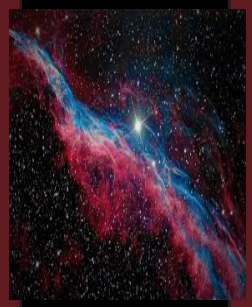
Many of the normal activities of the department were curtailed or came to a complete stop as a result of the pandemic. For example, PAMS was unable to hold public viewing nights at Baker Observatory during 2020. The PAMS Advisory Board held its annual meeting virtually on Nov. 13, 2020. A research poster presentation was made virtually by our undergraduate and graduate students at the meeting. Travel to scientific meetings by faculty and students ceased beyond March 2020; attendance during this period was restricted to virtual format only. The department held virtual seminars in Fall 2020. The virtual seminars were well attended and enabled the department to have more speakers from outside of the region.

The department hired Dr. Bradley Mills as an instructor in Fall 2020. Bob Patterson retired in July 2020, after more than forty years of being a faculty member in PAMS. Bob taught astronomy courses during this entire time and was a fixture at the public observing nights at Baker Observatory. Bob also served as interim chair in 2009-2010, as well as interim department head of PAMS during 2010-11. Laura Rios, who was an Administrative Assistant in PAMS, retired in December 2020 after 14 years of service. Laura took care of a number of critical day-to-day operations in the department during her employment at MSU. More details on various events within the department can be found within the newsletter.

Dr. Robert Mayanovic







Reading the stars through Kepler's map

Dr. Mike Reed describes his latest research on stars' vibrations.

While the science of astronomy originated centuries ago, our understanding of late-evolution stars has origins in more recent decades. The creation of NASA's Kepler space telescope made studying such stars and their detailed set of vibrations possible. In his paper, "K2 observations of the pulsating subdwarf B stars UY Sex and V1405 Ori," Dr. Mike Reed studies the traits of late-evolution stars using their periodic vibrations.

Earth-bound labs cannot reproduce the conditions within late-evolution stars. Yet, by using the naturally occurring labs within stars, Reed and others in his field can understand the physical conditions inside of each star. The stars' inner features are of scientific interest due to their potential as clean energy sources.

"By understanding these stars, we understand the conditions of materials undergoing fusion and high-temperature, high-pressure environments," Reed said.

Use of Kepler space telescope data has allowed Reed, his students and his colleagues to write over a dozen papers about late-evolution stars. While the topic of their research may be familiar, studying the stars continues to spark further discoveries that increase our knowledge.

"With each new star we examine, we find new features; the sense of discovery is real in my work. That makes each new star exciting to work on," Reed said.

Reed's paper was recently accepted for publication by the professional journal Monthly Notices of the Royal Astronomical Society. Due to funding from NASA's Missouri Space Grant Consortium, undergraduate students Matt Yeager and Alyssa Slayton were able to assist Reed with his research efforts.

Connecting passions for the planetary sciences

Astronomy students recently took part in the 2020 AAS DPS Meeting.

The 2020 American Astronomical Society Division of Planetary Sciences (AAS DPS) Meeting took place virtually Oct. 26-30. Seniors Yadira Gaibor and Meredith Vogel from the Department of Physics, Astronomy and Materials Science presented at the conference.

Gaibor presented "Constraints on Warm Jupiter Formation and Evolution from Planetary Companions."
Vogel presented "Orbit Perturbations of Habitable Zone Planets and Implications for Habitability."

"The conference allowed us to connect with other researchers. We learned a lot about the state of the field," Vogel said. "It also let us get involved in efforts to involve greater diversity and inclusion in astronomy."

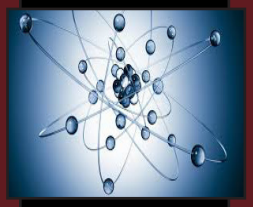
Dr. Sarah Morrison, assistant professor of astronomy and Gaibor and Vogel's advisor, co-authored their papers. She also took her AST 313: The New Solar Systems students on a virtual field trip to the AAS DPS meeting. A donation to the Missouri State Foundation made the trip possible. The students participated in professional development activities at the conference.

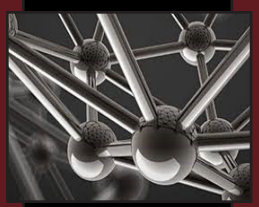
"They gained exposure to areas of ongoing research in the planetary sciences," Morrison said. "This was especially useful for those intending to go to graduate school."

Students in the class applied research from the meeting to their term project. They designed a mission or scientific effort to advance the planetary sciences.

"The realistic, mid-sized project has a budgetary scope of a few hundred million dollars. This isn't typical for the undergraduate level," Morrison said. "But the project develops students' skills in managing tasks and connecting state-of-the-art research to a larger scale effort. Such skills can help prepare them for the workforce and their future education."

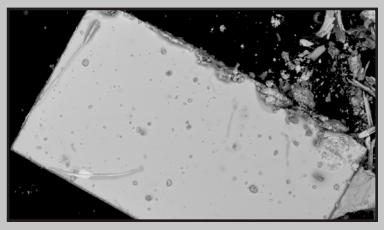
Gaibor appreciated the conference's specific focus on planetary sciences that allowed more focused discussions about her research. She was glad the conference also allowed participants to interact in a less formal setting. The informal events included daily science chats, a discussion forum on women in planetary science and a trivia night.





Growing the materials of modern life

Dr. Tiglet Besara, assistant professor of physics, reflects on his latest materials research efforts.



Much of modern life relies on synthetic materials. The technology we use every day, like computers and cell phones, contain materials developed through lab research.

Dr. Tiglet Besara, assistant professor of physics, is among those leading materials research at Missouri State. His work helps ensure materials develop and advance as needed to keep up with our ever-changing world and the technology that runs it. Besara grows crystals of new materials and explores their properties. Part of his research relates to finding new thermoelectrics. These materials can capture and reuse the heat lost when converting to energy.

"Technology loses energy in the form of heat, like through electronics in our computers when they warm up," Besara said. "Such a waste of heat is the biggest waste of electricity generation in this country and all over the world."
Besara does not focus solely on protecting the heat materials produce. He also strives to improve the performance of conducting materials. Besara does this by growing topological materials, which conduct electricity along the materials' surfaces.
"These materials conduct electricity much better and faster at small scales and could lead to use of smaller circuits," Besara said.

The reach of Besara's work is no small matter, even if it is dependent on combining atoms.
"We discover something new, a combination of atoms that did not exist before," Besara said. "We make materials from scratch."
Besara stresses that materials research has potential for long term growth.
"The field will not diminish as there's always a need to discover new materials or make the current ones more efficient," Besara said.

Student researchers at Missouri State often grow materials under Besara's supervision. Sometimes, they encounter unknown properties. Besara then works with other labs across the country that have equipment for testing that is not available in the department or at MSU. His research also stretches across disciplines. He shares his university lab space with a professor from the chemistry department. Besara anticipates that the shared space will foster greater collaboration between the disciplines.
"The process of growing and making materials falls into a gray area between chemistry and physics," Besara said. "Uniting the disciplines' expertise can lead to greater scientific understanding and success."

Dr. Dave Cornelison

A Professor of physics, astronomy and materials science, Dr. Cornelison has had years of experience in leading the Department. Now he serves as the curriculum committee chair, advisor to Society of Physics Students (SPS), liaison to local schools, faculty senator, and provides an array of other service leaderships that together help the Department meet the expectation of the society. Over the last several years, he arranged and led trips (between 12 and 22 SPS students) to Boulder, CO to visit NIST, JILA, NCAR and other scentific institutions; Chicago, IL to visit Argonne and Fermi National Laboratories; and Houston, TX to visit Johnson Space Center and Rice University's Center for Quantum Materials. Dave has also worked tirelessly to build relationships with local businesses, including Northstar Battery, 3M, Dynatek, EaglePicher and others. This has allowed for internship opportunities for students and, in some cases, small contract funding for graduate student and faculty research. However, perhaps more importantly, it has opened up important communication opportunities between PAMS and local industry.

Dr. Cornelison also grows our knowledge, covering all matters of STEM on his weekly podcast, **STEM Spots**, on KSMU. Making science exciting and relatable to the public is his mission. To access these fascinating talks with local experts on-various advances, issues and theories of STEM, visit the STEM Spots page on the KSMU website.
https://www.ksmu.org/programs/stem-spots#stream/0

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Intellectual Contributions

Missouri State University
January 1, 2020 - December 31, 2020

Department of Physics, Astronomy, and Materials Science

Besara, Tiglet (Assistant Professor)
Cornelison, David (Full Professor)
Ghosh, Kartik C. (Distinguished Professor)
Mayanovic, Robert A. (Distinguished Professor)
Morrison, Sarah (Assistant Professor)
Reed, Michael D. (Distinguished Professor)
Sakidja, Ridwan (Full Professor)

Despite 2020 proving to be quite challenging for the development of scholarly works due to the Covid-19 pandemic, the faculty and students of the department still accomplished publication of 23 peer reviewed articles in scientific journals. Presentations at meetings was severely curtailed in early 2020 as meetings were canceled due to the Covid-19 lockdown in early part of the year (e.g., APS March Meeting and MRS Spring Meeting). Faculty and students were able to make presentations on their research virtually in the latter part of 2020, including at the Materials Science & Technology (MST) conference, the American Astronomical Society (AAS) Division of Dynamical Astronomy meeting, the Minerals, Metals & Materials Society (TMS) meeting, the American Physical Society (APS) Prairie Section meeting, the PAMS Advisory Board meeting, and the CNAS Undergraduate Research Symposium poster session.

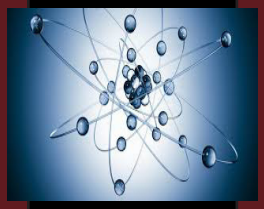
Please follow our link to see all of the many outstanding intellectual contributions made by our faculty and students in the last year.
https://physics.missouristate.edu/nwsltr-refs.htm

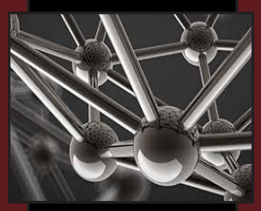
Faculty Awards

Dr. Ridwan Sakidja - 2020 Outstanding Thesis Advisor Award

Dr. Kartik Ghosh - awarded an NSF-Rapid grant in collaboration with Kansas State University researchers on developing materials that are resistant to contamination with the Covid-19 virus.

Dr. Dave Cornelison - 2020 CNAS Faculty Excellence in Service Award





Supporting Technical Innovation

Dr. Robert Mayanovic recently took part in the Materials Science & Technology 2020 Conference.

Dr. Robert Mayanovic, department head of physics, astronomy and materials science, recently participated in the Materials Science & Technology (MS&T) 2020 Conference. The conference took place virtually Nov. 2-6. Mayanovic presented a talk titled "Investigations of materials under extreme hydrothermal conditions using synchrotron and complementary techniques" at the event.
"In the presentation, I shared results from experiments that could apply to conserving energy," Mayanovic said.
"They could also support providing ceramics with the ability to resist corrosion."

MS&T fosters technical innovation in the fields of materials science and engineering. It unites scientists, students and engineers in discussions about research and technical applications.
"The conference allows researchers like myself to exchange ideas," Mayanovic said.
"It also introduces us to new developments in materials science and technology."

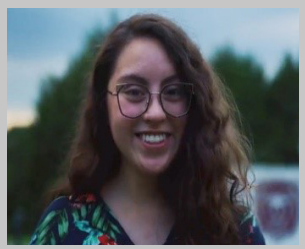
Congratulations to the 2020 CNAS Undergraduate Research Symposium award winners

Physics, astronomy and materials science

1st place – Meredith Vogel
Vogel presented "Orbit Perturbations of Habitable Zone Planets and Implications for Habitability."
Her faculty advisor is Dr. Sarah Morrison, assistant professor of astronomy.

2nd place – Yadira Gaibor
Gaibor presented "Constraints on Warm Jupiter Formation and Evolution from Planetary Companions."
Dr. Sarah Morrison is her faculty advisor.

Honorable Mention – Tyler McGilvry-James
He presented "Reference-Free Interatomic Potential Development and Modeling of Transition Metal Carbides."
His faculty advisor is Dr. Ridwan Sakidja, professor of physics.

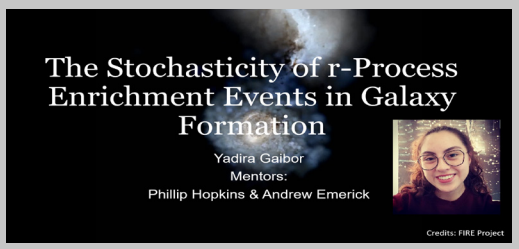


An out of this world opportunity to further galaxy research

Senior Yadira Gaibor shares details of her experience in the WAVE Fellows virtual summer program.

Senior Yadira Gaibor of the department of physics, astronomy and materials science took part in the WAVE Fellows program during the summer of 2020. Due to the pandemic, the program occurred virtually. Gaibor shares how the program benefited her learning and professional growth.
Stars are not always safe in outer space. They can explode or collide with each other and other objects. Gaibor led research investigating these occurrences in the program.
"My goal was to learn how often these events happen," Gaibor said. "I also looked at how much material the stars and other objects eject into their surroundings."
Drs. Philip Hopkins and Andrew Emerick aided Gaibor in her research efforts.
"Together, we used computer simulations to model different sizes of galaxies," Gaibor said. "We also modeled varying yields of material."
Confidence is key to building a career and network. In the WAVE Fellows program, Gaibor connected with other students, as well as professors at Caltech and the National Aeronautics and Space Administration (NASA)'s Jet Propulsion Laboratory.
Building these connections allowed her to gain the confidence she needed to reach out to potential advisors and start discussions about their research.

"I received helpful tips and insight on applying to grad school," Gaibor said, grateful to have had such professional opportunities. "The program really helped me orient my future career decisions. I learned a lot about the field and the research process. It was a great way to spend the summer."



The program fosters diversity in science and engineering by extending opportunities to underrepresented students in these fields. This includes minorities, first-generation college students, women of certain fields and students with disabilities or disadvantages educationally, financially or geographically. Participants work under the guidance of Caltech faculty who serve as leaders in research.

Brightening the Horizon of the Sciences through Star Research and Female Empowerment

PAMS senior Kali Shoaf reflects on her asteroseismology research and conference experience.

PAMS senior Kali Shoaf attended the Conference for Undergraduate Women in Physics (CUWiP) Jan. 17-19 in Norman, Oklahoma. She received the title of "Best Physics" for her conference presentation, along with two other presenters.

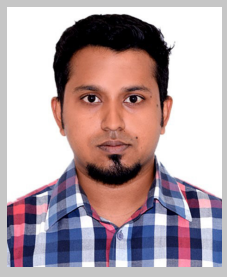
Shoaf analyzes changes in stars' brightness called pulsations using NASA space telescope data from the Transiting Exoplanet Survey Satellite (TESS). After she identified a star with irregular pulsations, Shoaf began researching the cause of the star's unusual structure. "We hope to relate pulsations to temperature, size, mass and gravity to tease out an explanation for the higher frequency we are seeing in this one star," Shoaf said.
Shoaf conducted her research under the guidance of Dr. Mike Reed. She serves as the second author of a paper covering the star research that is set for upcoming publication. In sharing her research, Shoaf aims to offer those of the of the astrophysics field a greater understanding of stars' interiors.

Given her experience with physics as a male-dominated field, Shoaf appreciated that the CUWiP provided women with a strong presence in a scientific environment.
"The most impactful talks I attended were those that covered the obstacles I face as a woman, as well as the even greater obstacles faced by women who are of color or identify as a part of the LGBTQIA+ community," Shoaf said.
Such talks encouraged the women present to work together to overcome the challenges they face within the field.
"It was such a nice reminder that even though you may feel small on your own, there is a growing community of women in the field who can offer support," Shoaf said.

Fellow PAMS seniors Meredith Vogel and Yadira Gaibor also attended the conference.
All presented posters on their undergraduate research projects in astronomy.

Changing values, changing results

Materials science graduate student Abdullah Al Shafe explains his thesis-related research efforts.



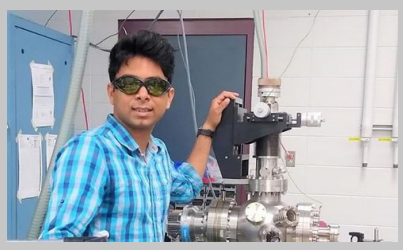
The materials science field of today depends on use of modern technology. This includes electronics and spintronic devices, which harness power from electrons. To increase the devices' value, manufacturers strive to make them smaller and less energy-consuming. Compounds known as magnetic heterostructured nanocrystals (MHNCs) switch between states of spinning electrons quickly. Their use helps manufacturers adjust the size and energy consumption of the devices. Materials science graduate student Abdullah Al Shafe leads thesis-related research on MHNCs. His research shows how changes in pH values influence MHNC's capabilities.

Shafe studies magnetic nanocrystals. These crystals have tiny dimensions, specifically a few billionths of a meter. Nanocrystals make up the nanomaterials used in engineering, medicine and space research. Shafe developed nanocrystals made of two materials: nickel oxide and manganese oxide. The resulting compound abbreviates as MHNC. He investigated how changes in pH values of chemical solutions used to prepare the materials affect MHNC's magnetic and structural properties. Shafe completed his research under the guidance of his advisor, Dr. Robert Mayanovic, department head of physics, astronomy and materials science.

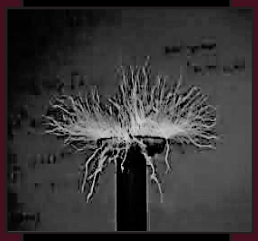
Hard disk drives may someday rely on use of MHNCs' magnetic spins for storing memory data. The small data sources have large capacities. Their use can lead to great results. "Researchers can use MHNCs to create targeted drug delivery systems and track drug release," Shafe said. "They can also serve diagnostic purposes, as used for magnetic resonance imaging (MRIs)."
Nanocrystals' structure changes when exposed to varied pH values.
Shafe discovered a chemical solution pH value that enhanced MHNC's magnetic capabilities.
He also found a source of the structural changes caused by the varying pH values using structural characterization.
"These findings will help the PAMS community identify better nanomaterials," Shafe said. "It will also help researchers find an easier route to synthesizing them."

Building capabilities to reach greater results

Materials science graduate student Sinjan Majumder describes his thesis-related research.



Modern science often requires sophisticated tools. The materials science field is no exception. Novel materials – like thin film devices and semiconductors – form the backbone of the industry today. These materials must be grown using fabrication equipment. Materials science graduate student Sinjan Majumder recently completed thesis-oriented research on such equipment. His results could have a major impact within the department and the greater industry.



There are many layers to materials science. Researchers must fabricate thin films of materials with desired properties for each device. Then, they deposit the films onto slices of semiconductor material called wafers or other substrates. Through modifying the film, researchers form integrated circuits – commonly known as computer chips. Each step of the process is carried out inside of sophisticated vacuum chambers, free from contaminants. Majumder studies the properties of these materials for research purposes in the lab.

"For this to work, they need to grow in a clean environment free from impurities, mainly contaminants," Majumder said.

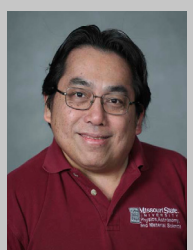
Several clean deposition systems are commercially available. But they are expensive and require high maintenance. Majumder investigated alternative options for his department to fabricate novel materials. This led him to build inexpensive and user-friendly fabrication equipment.

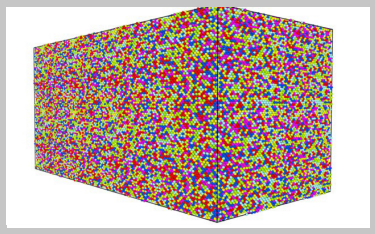
Majumder recently defended the thesis covering his efforts successfully. He completed his research under the guidance of his advisor, Dr. Dave Cornelison. The new equipment will offer the department new, clean deposition techniques. Majumder anticipates this will give them an edge through the quality of materials they can grow in their own facility.

"This tool will allow us to grow materials and study their properties," Majumder said. "It may also allow us to develop and study materials with future applications in the industry."

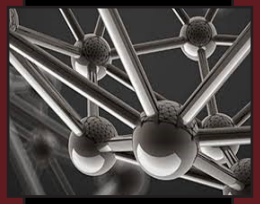
Professor attends conference, creates research collaboration

Dr. Ridwan Sakidja caught up with a Missouri State alumnus.





Dr. Ridwan Sakidja, professor of physics, recently presented at the Worlds Congress on High Entropy Alloys (HEA 2019) in Seattle, WA. High entropy alloys is a newer field that is rapidly expanding. Scientists mix many elements together so it generates unique features that can't be achieved in conventional materials. "Our work and my talk were focused on enhancing the mechanical properties of metallic alloys for structural applications using high entropy alloys," Sakidja said. This HEA structure has close to 900,000 atoms made of six metal elements.



Making a pit stop before heading home, Sakidja also visited the University of Washington on his trip.
He met with Dr. Minqin Zhang, a Kyocera professor in materials science and engineering, to develop a research collaboration. This collaboration includes Dr. Peter Liaw, professor of materials sciences and engineering at the University of Tennessee.
Sakidja also saw Missouri State alumnus Diwash Dhakal. He is working on his PhD at the University of Washington. At Missouri State, Dhakal worked in Dr. Robert Mayanovic's lab.
Dr. Sakidja was grateful for this trip.
"The HAE meeting and visit to University of Washington offered us the great opportunity not only to present our research work, but also to continue building research collaborations and networking that would greatly benefit our research," Sakidja said. "The multi-disciplinary collaboration is certainly key in advancing research progress in materials science."

Artificial intelligence offers real promise for cross-disciplinary research

Explore the NASA-funded research project between CNAS and COB

Artificial intelligence's (AI) visual capabilities extend past those of the human eye. This makes AI a powerful tool for detection. Dr. Ridwan Sakidja, CNAS, and Dr. Sheryl Brahnam, COB, want to see AI used in many new ways.

Sakidja and Brahnam propose using machine learning (ML) to examine materials for defects. This includes composites or high-strength alloys. Electron microscopes can capture high resolution images of materials. These images can help expose materials' interior parts. Yet certain flaws, like micro cracks, are still nearly impossible to see.
"Currently, researchers devote a great deal of time to tedious visual inspections to locate defects," Sakidja said.
AI helps identify key features in images with less time and effort. Sakidja stresses that AI has made significant progress in recent years.
When used with high resolution imaging, AI offers even greater detection benefits. "With our project, we aim to merge these two technological advances," Sakidja said. The NASA-sponsored Missouri Space Grant Consortium (MOSGC) recently awarded their project $10,000.

Merging AI and high-resolution imaging requires advanced technology for acquiring images.
Last year, the provost's office and CNAS provided Sakidja's department with funding for new equipment.
"With their support, we upgraded our electron microscopy facility to a much more powerful detector," Sakidja said. "This gives us the ability to improve the quality of our image acquisition process and image data."
The new electron microscope equipment will not be the only upgrade to occur, Sakidja explains.
He and Brahnam will also use their project to start upgrading to a new computer system that can perform ML.
"Our timely collaboration will in part use the new and powerful AI-enabled visual technology," Sakidja said. "It will couple this with the new imaging technology added to our electron microscope."

Sakidja and Brahnam's project will engage undergraduate students from both colleges starting this fall. The students will learn to write codes in Python. They will also explore how to use AI for image analysis.
Students will then be able to present their work at the annual meeting of MOSGC in spring 2021.
Sakidja anticipates the project will challenge and excite students.
He is grateful for all Brahnam will contribute to their learning. She is a key leader in advancing visualization research.
"This project will be a stepping stone toward further exploring cross-disciplinary research with a common interest," Sakidja said. "Students who engage in our research will learn the wide applications of machine learning and artificial intelligence."

MOSGC supports aerospace and space-related research of the science, engineering and technology fields.
The organization trains students at all academic levels for careers in professional fields of interest to NASA.
MOSGC offers an award annually to competing Missouri universities as affiliates.
The awarded university must match the organization's funding through in-kind support.

Teaming up to take down COVID-19

Dr. Kartik Ghosh explains his COVID-related research

As a result of COVID-19, many people have developed an interest in understanding how viruses work over the past year. Dr. Kartik Ghosh, distinguished professor of physics, has studied this topic for the past decade. He and other physicists, chemists and biologists started an interdisciplinary group about 10 years ago. Their research could help scientists discover how to stop the spread of COVID-19 once and for all.

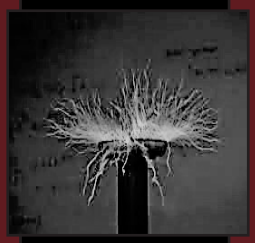
Ghosh and his group study nanotechnology, or how to manipulate matter at the atomic or molecular level. Nanotechnology produces materials with tiny particles called nanomaterials.
They investigate how nanomaterials interact with a small scale, biological environment. This is known as nano-bio interactions.

When COVID-19 struck, Ghosh's group contacted the National Science Foundation (NSF) through their Rapid Response Research (RAPID) program. They proposed a timely use for their research: putting nano-bio materials on personal protective equipment (PPE) devices.
"Any PPE device can trap the virus," Ghosh said. "The goal is to give the devices the ability to also destroy it."
All viruses have three components: a protein, a lipid layer and RNA. Nanomaterials can alter these components to destroy COVID-19.
"Some nanoparticles are more effective at destroying than oth**ers**," Ghosh said. "We will use nano composite materials, particularly those with a zinc-oxide and copper-oxide base, to fight the virus."
NSF provided Ghosh and his group with a grant of nearly $100,000 to help fund their research efforts.

Ghosh and his group will produce the nanomaterials at Missouri State, the place where their research efforts originated. Their studies at the university will allow them to better understand the virus. While Ghosh's group has spread to have members in many other states, it's prominently centered at Kansas State University (KSU) in addition to MSU.
"KSU will study the biological aspects, particularly whether the materials can destroy or not," Ghosh said.
Ghosh and his group plan to write proposals for further funding.
They are also contacting companies that could apply this research on a greater scale.

2020 Scholarship Winners

Andereck Family Scholarship	Alexandria Klingenberg
Banks Family Scholarship	Riley Hochstein
Engineering Program Scholarship	Noah Taylor
Howard Petefish Award	Tyler McGilvry-James
John W. Northrip Memorial Scholarship	Shania Wolf
Kenneth Soxman Memorial Scholarship	Cory Padgett
Leo Day Scholarship (Ozarks Chapter Missouri--Society of Professional Engineers)	Paul Brugh
	Liberty Robinson
PAMS and Friends Scholarship	Tyler McGilvry-James
PAMS Dept. Scholarship Fund	Meredith Vogel
Pre-Engineering/Engineering Physics Scholarship	Caroline Witt
Thomas Cave Astronomy Scholarship	Yadira Gaibor
Thurman Family Scholarship	Blake Smith



Graduates 2020

Spring 2020		Summer 2020		Fall 2020	
Md Ashif Anwar	MS	Shahidul Asif	MS	Nadib Akram	MS
David Beckwitt	BS	Yuxuan Lu	MS	Mohammad Islam	MS
Daniel Fishbein	BS	Sinjan Majumder	MS	Sudha Krishnan	MS
Christian Oldham	BS	Moudip Nandi	MS	David Magness	MS
Dustin Whittaker	BS	Christopher Robledo	MS	Justin Bass	BS
		Joy Roy	MS	Nicholas Rogers	BS
		Abdullah Al Shafe	MS		

Pictured Left:

The graduates from the Department of Physics, Astronomy and Materials Science, together with all of the Spring 2020 graduates from the College of Natural and Applied Sciences, are gathered in front of the MSU fountain by Temple Hall.

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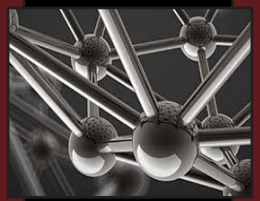
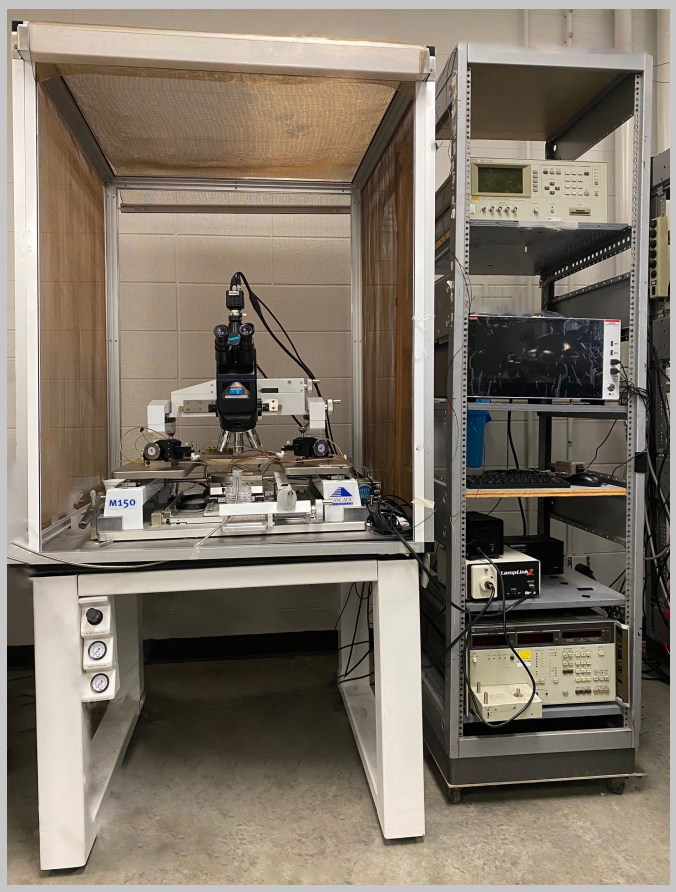


New Lab Instruments for PAMS in 2020



The department added a high-precision Keithley 4200A-SCS electrical characterization station that can be utilized to measure capacitance, dc current, dc voltage, and i-v pulsed mode of semi-conductor devices and thin films.

Funding from Provost Einhellig and Dean Jahnke for the new instrument is much appreciated.

Contributions

Much thanks to Ashley Lenahan, Dr. Bob Mayanovic, and Marla Fritz for their contributions to this issue of Momentum, the PAMS Department Newsletter.

Media & Contact Information

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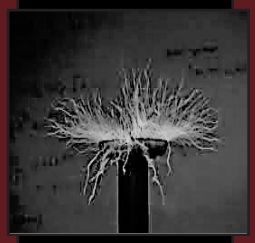

Please take a few minutes to send us an email at: **physics@missouristate.edu**. Include your current contact in formation, graduation year and Missouri State degree. Let us know where you are working now, job title or other career or personal accomplishments so we may include you in the next issue.
Stay current with the MSU Alumni Association at **http://alumni.missouristate.edu**.
Update your contact information online and learn about upcoming alumni events, such as MarooNation.
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To learn more about how you can help, visit **http://physics.missouristate.edu/Alumni.htm**. Please make checks payable to **Missouri State University Foundation** in support of the PAMS department and mail to:

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Springfield, Missouri 65897.
Also, donations can be made online at: **www.missouristatefoundation.org/waysofgiving.asp**.
Select Natural & Applied Sciences/Physics, Astronomy, & Materials Science.

Thank you!

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