



Momentum

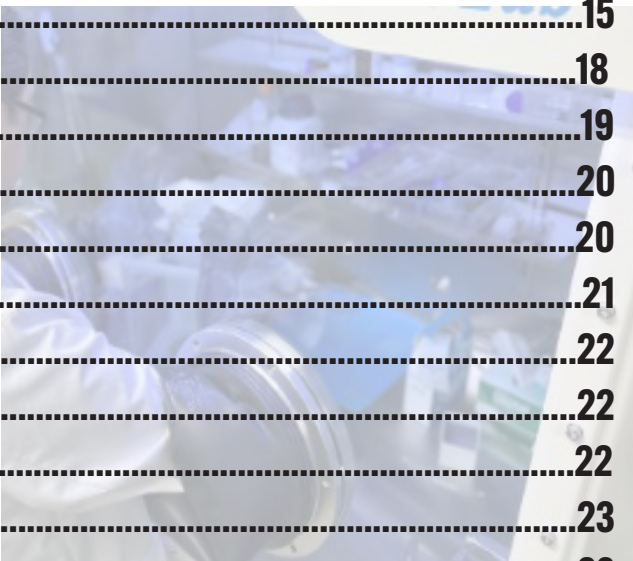
Newsletter



2022 MSU Physics, Astronomy, and Materials Science Newsletter

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Letter From Department Head



Dear Alumni and Friends of MSU Physics, Astronomy & Materials Science Department,

Academics in the department had returned to much more manageable levels in 2022 despite the ongoing Covid-19 pandemic. The majority of our classes were conducted in person throughout the year, while maintaining some online course offerings. In general, academic and scholarship activity increased allowing our students and faculty to be more engaged.

Several faculty in the department won awards and made notable accomplishments in 2022. Ridwan Sakidja was awarded the DOE Visiting Faculty Program fellowship for the summer of 2022. Ridwan worked with Dr. Kirsten Persson's group at the Molecular Foundry lab, UC Berkeley Materials Science & Engineering Department. Kartik Ghosh was awarded the USAFL Air Force Lab fellowship for SU 22 and spent the summer in Dayton, OH,

working on projects at the lab. Dave Cornelison won the student-nominated & selected CNAS Excellence in Teaching Award. Evan Frodermann won the MSU General Education Assessment award and Sarah Morrison won the student-nominated Nontraditional Student Service Award in 2022.

We were able to return to holding a number of in person outreach events. Several faculty visited Carthage High School for demonstrations and discussions about physics and astronomy research. An astronomy class from Warrenton High School, hosted by Mike Reed, came for a visit at the department to learn about astrophysics research. Dave Cornelison led several students in a PhyzBiz demonstration event at Seuss Day, sponsored by Ozarks Public Television and the Springfield YMCA. PAMS also held several public viewing nights at Baker Observatory in 2022 that were well attended. We would like to thank our PAMS Advisory Board members for a successful meeting that was held during homecoming on October 28, 2022. Our undergraduate and graduate students presented on their impressive research accomplishments during a poster session at the advisory board meeting.

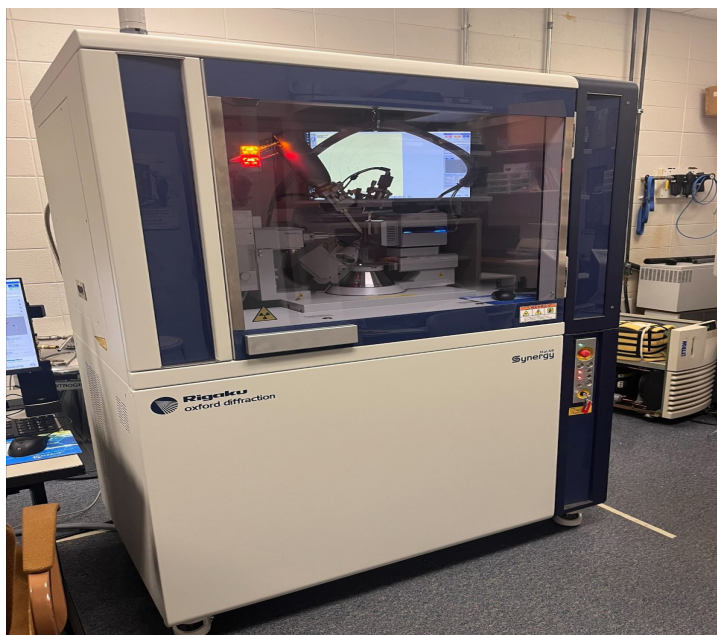
We would like to thank our alumni and friends for an especially notable year for gift giving. We received a gift that established a new scholarship for our students and additional funding to support students, faculty and general operations. We also received generous gifts that will enable future growth in the department in terms of facilities and faculty funding. If you would like to provide a gift to the department, please feel free to contact me or you can make a donation online at <https://www.missouristatefoundation.org/colleges-and-departments.htm>.

Bob Mayanovic

New Faculty and Equipment



Dr. Ruma Dutta- Visting Instructor: Dr. Ruma Dutta joined us this year from Columbus, Ohio. Dutta got her Ph.D. in Mathematical Astrophysics at Tata Institute for Fundamental Research in India in 1995. Her thesis was on 3D MHD flow Model Equation and Stellar Collapse Stud. Dutta has since published many papers, her latest being titled “Phytochemical screening and antioxidative property evaluation of lipid-producing fungi.” Although her Ph.D. is in math and astrophysics, Dutta has done extensive research in Biophysics and related topics. Dr. Ruma Dutta loves working with the students in her classes. Although she is only here for a short amount of time, she has made an excellent addition to our staff.



New XRD- X-ray diffraction (XRD) is a technique based on the elastic scattering of x-rays from the atomic arrangement within a sample. This technique provides information on the structural atomic arrangement of a solid, powder or thin film sample.

With a \$342,000 grant from the National Science Foundation’s Major Research Instrumentation program acquired in 2021, the XtaLAB Synergy-S diffraction System from Rigaku was purchased. The new machine has a new diffractometer with dual x-ray source, a microfocus x-ray source, a hybrid photon counting detector, variable divergence slits, and a cryosystem utilizing drytogen nitrogen gas for measurements in the temperature range of 80-400K.

AI Work Station. Our Dept. just recently acquired a new Lambda workstation designed specifically to boost the immersion of AI into our courses and research activities. Nowadays, thanks to the great technological advancement of Graphical Processing Unit (GPU) architecture, tens of thousands of processors can be packed into seemingly an ordinary desktop computer. Thanks to the additional support from the Provost and CNAS, the new workstation is equipped with the state-of-the-art GPUs units. The workstation is already equipped with a wide range of AI based codes and algorithms that can be used to solve a wide range of complex problems in physics, astronomy or materials science. Our plan is to adapt it for teaching as well as for research. The dept has designed room 209 as the AI workstation room.



Events

PAMS always has something fun going on! Let's look back at some awesome events that were held this last year....



We had a successful fall Public Viewing Night Season. We had a great turn out to both nights. One review we received from a 'space crazy' 9- year old:
"This is the best day of my life! A place with so many telescopes!"

The first one was on September 16 and had an estimated 600 people! The viewing was made of Saturn, Jupiter, Alcor and Mizar, Andromeda, Vega, and the Ring Nebula.

The second one was held on Friday, October 21 and a few hundred people attended. We looked at the Andromeda galaxy, the Ring Nebula , Jupiter (and its moons), Saturn (and its rings), Alcor and Mizar (binary star), and the M15 Globular Cluster.





This year PAMS had its first annual fall picnic! There was plenty of food and fun for the whole department. Dr. M took on cornhole while Dr. C threw around the ol' pigskin. Can't wait till next year's picnic!





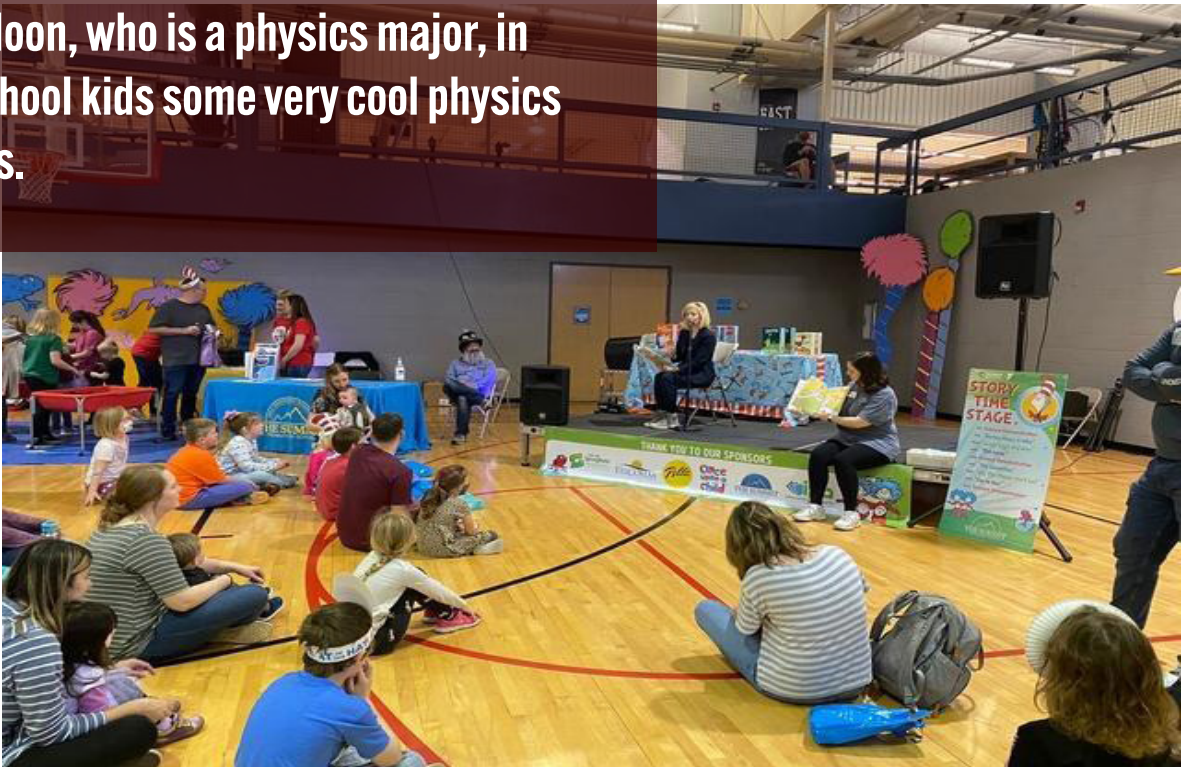
Graduates and undergraduates got to show off their work at the Fall 2022 PAMS advisory board meeting.





Seuss Day 2022!

Dave Cornelison and his PhysBiz team participated in the Seuss Day 2022. Seuss Day is a STEM based event organized for elementary school children by the Ozarks Public Television and the Springfield YMCA. This year, Dave was assisted by Becky Baker, our Instructor Emeritus, and Yashasvi Moon, who is a physics major, in showing the school kids some very cool physics demonstrations.



Conferences

In this section, we are celebrating those students who represented PAMS in conferences around the world!

Student Noah Singer presented at the 10th Annual Meeting on Hot Subdwarfs and Related Objects in Belgium as well as the American Astronomical Society Meeting in Seattle. Here's what Noah had to say about his work:



"I'm a 5th year senior (from Kansas City, Missouri) pursuing a Mathematics/Physics dual major. My Physics major is technically "Physics with an emphasis on Astronomy and Astrophysics", which is directly applicable to my research (studying physical stellar parameters). With Dr. Mike Reed, I am attempting to calculate the masses and radii of a specific type of star, known as Subdwarf B (SdB) stars. SdB stars are smaller, hotter, and in a later stage of evolution than our sun. To calculate masses and radii, you have to match model data to observed data. The difference between these data sets acts as a proxy from which we can derive stellar radii. Then, with the radii calculations, we can calculate stellar masses. I have been working on this project for just over a calendar year, and it is planned to be completed by the end of the 2023 spring semester.

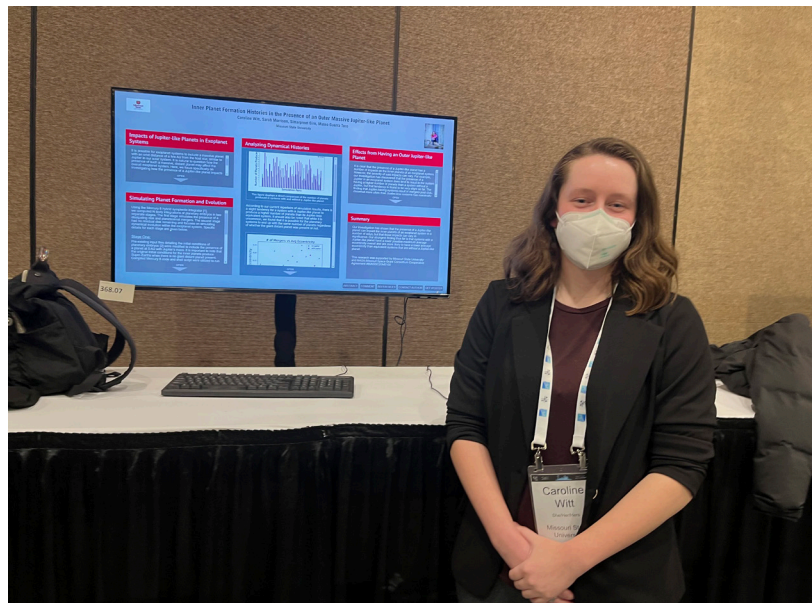


The only difference between my two presentations was, for the one in Belgium, I gathered observed data by hand (by physically going to each database and copying the results). For my presentation in Seattle, though, I implemented "Astroquery" which gathers all of the necessary observed data right from my python code. This makes my research more reproducible, and much quicker."

PAMS undergraduate student Caroline Witt and Dr. Morrison presented their research, and attended the winter American Astronomical Society meeting in Seattle, Washington January 8-12, 2023. This is one of the largest astrophysics conferences in the world.

Caroline said about her research “We use a program called Mercury 6 to perform integrations to simulate what would happen in a planetary system with no distant giant planet versus an identical system. We use the numerical results to then analyze what kinds of effects the added presence of a ‘Jupiter’ ends up having on the formation of planets.”

Caroline is also working for the NASA- Missouri Space Grant Consortium.



Student Mateo Guerra Toro also presented at the Seattle conference. Mateo is an international student from Ecuador currently pursuing a major in physics. He is pursuing astronomy and mathematics minors and a computational science certificate. He presented his work titled “Re-evaluation of the Effect of Brown Dwarfs’ Viewing Geometry using a Bayesian Framework.”

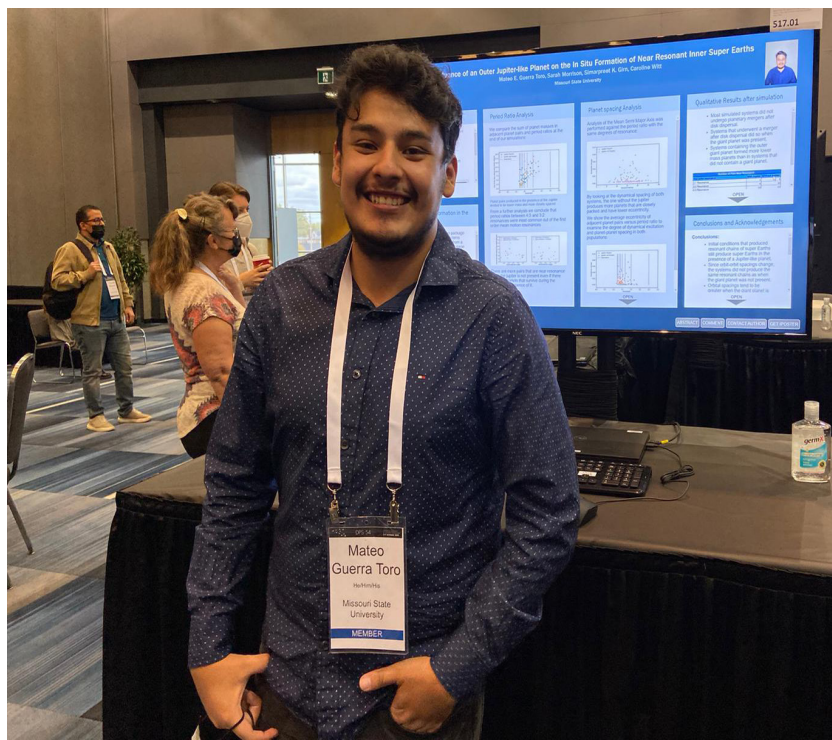
“We developed a Bayesian method to explore how different characteristics, like color anomaly or variability amplitude, are affected by the inclination of these objects,” Guerra Toro said.

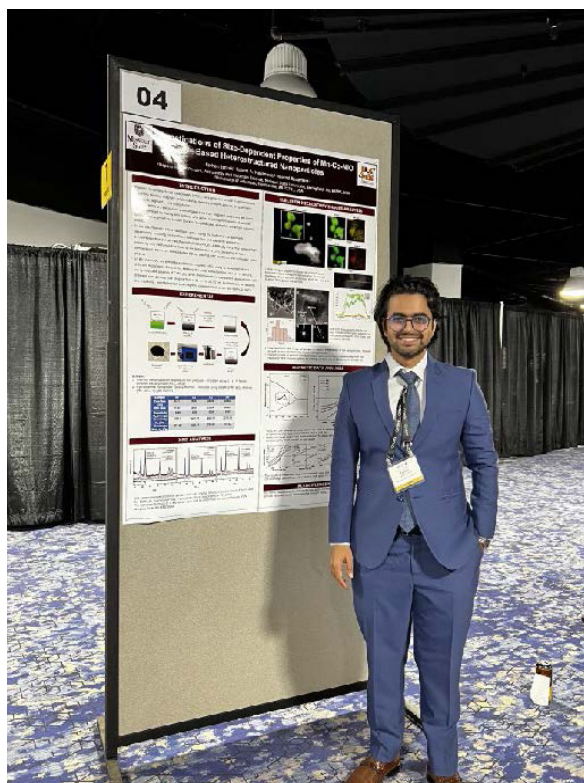
Mateo also works as part of Dr. Sarah Morrison’s research team.



In Fall 2022, PAMS senior Mateo Guerra Toro attended and Dr. Sarah Morrison presented at the American Astronomical Society Division of Planetary Sciences meeting in London, Ontario. The American Astronomical Society Division of Planetary Sciences meeting was held in London, Ontario Oct 2-7, 2022 and presenters gave iPoster presentations at the conference. Dr. Sarah Morrison also chaired a conference session. The conference was a hybrid meeting and featured about 470 total contributed presentations.

Each presentation was regarding planet formation in the presence of an outer giant planet compared to planet formation in systems without one. Dr. Morrison's presentation focused on conditions that form close in super Earth planets, in chains of orbit resonances. Mateo's focused on how the outcomes of those systems that had formed resonant chains compared if the planets were forming in the presence of an outer giant planet.



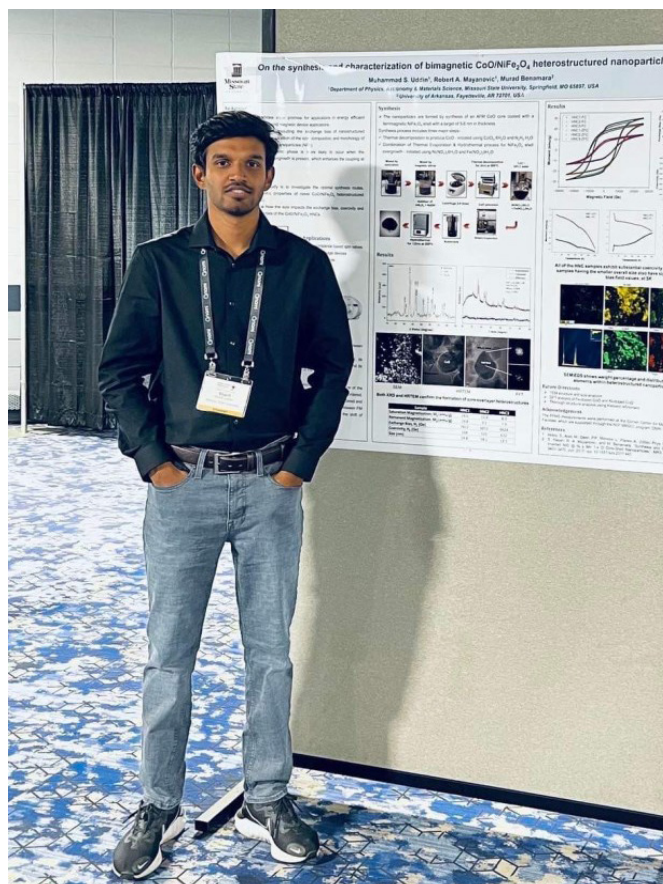


The Magnetism & Magnetic Materials conference was held in Minneapolis Oct. 31 - Nov. 4, 2022. (Clockwise) Students Farhan Ishrak, Md Shaihan Bin Iqbal (Emon), and Muhammad Shariff Uddin attended and presented.

Emon presented his research in the In-depth structural and magnetic study of Ni/NiO epitaxial thin films on single crystalline sapphire grown using pulsed laser deposition.

Farhan presented on the size-dependent magnetic properties of Mn-Co-NiO based heterostructured nanoparticles.

Shariff's presentation was on the magnetic and structural properties of CoO/NiFe₂O₄ heterostructured magnetic nanoparticles.



REUs

This year, we had a few students participate in REUs and internships over the summer.



Here is what student Jessica Fink said about her summer:

“My summer internship was at UARK-Fayetteville. My project was biophysics, and the focus was the Effects of Applied Magnetic Fields on the Motility of Bacteria. I was partnered with a biology graduate student. Everyone in the lab I worked in had to have a basic knowledge of bacteria and how to culture them as well as use the equipment. Since my lab partner had an extensive knowledge of biology compared to me, I was more in charge of the magnetic fields being applied. One of my major tasks this summer was to design and build a solenoid (an electromagnet) to fit within our experiment’s parameters. I still was required to do bacterial growth curves and cultures, but the magnets were my domain.

As far as my other activities, my program had workshops and seminars we were required to attend. It was not just work however, because the internship also provided (expenses paid by the REU) a trip to Dallas, TX. In Dallas, we toured industry labs such as Texas Instruments and Globaltech. The REU also provided housing, a \$700 stipend for food, and \$5000 as stipend over the summer and separate from the food and housing.

The first picture was of me with a fellow REU student working in the same lab. The second picture shows a grad student (Diksha, to my right) that I worked with after my presentation.”

Student Matthew Bruenning also participated in an REU. Here is what he had to say about his work over summer:

“Over the summer I participated in the NSF REU at the University of Kansas. I was able to work with physicists that are a part of the CMS Collaboration which focuses on the Compact Muon Solenoid detector at the Large Hadron Collider. My focus was on the electronic links that are responsible for transmitting the electronic signals left by constituents of a collision outside the detector to be processes. It was exciting to see how collaborative experimental physics is right now, as I was sitting in on many meetings with researchers based out of KU, CERN HQ, and other universities. With my work on the electronic links in CMS, I was able to present a poster at two symposiums which was an exciting learning experience. Also, I was tasked with implementing a line detection technique on a Field Programmable Gate Array, which I continue to work on remotely. From my work on that, I was able to give an oral presentation at the KU Physics and Astronomy Summer Symposium. I was very happy to get the chance to present my research to a scientific audience and overall, the REU was a fantastic learning experience.”



Faculty and Student Awards



Sarah Longworth (L) and Cory Padgett (R): PAMS 2022 Outstanding Undergraduate Co-Winners

Devon Romine: PAMS 2022 Outstanding Graduate Research Assistant Devon Romine



Christian Stepien: PAMS 2022 Outstanding Graduate Teaching Assistant



Dr. Ridwan Sakidja was awarded this year's Matthew and Patricia Harthcock College of Natural & Applied Sciences Faculty Fellowship Award. Sakidja noted that the award will help accelerate the design process by using artificial intelligence (AI). Recently, the department secured funding to purchase an AI-based computer workstation.



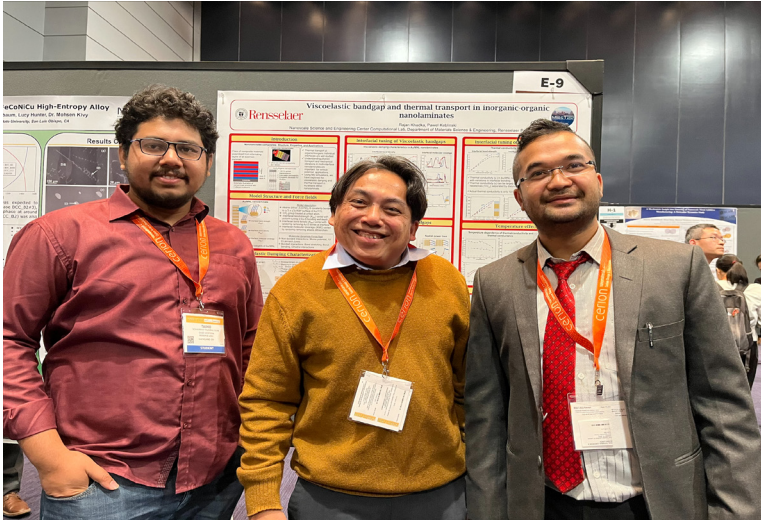
“The award is very timely,” Sakidja said. “The acquisition of the workstation along with the award will help us not only conduct AI-driven computational materials research, but also help us with our teaching starting next semester.” The photograph above shows Dr. Sakidja being congratulated by Dean Tammy Jahnke (R) and Dr. Mayanovic (L).

Dave Cornelison was one of the four winners for the CNAS Student-Nominated Awards for Excellence. Winners of this award are nominated by students.

The nominating student said, “Dr. Cornelison is the epitome of an ideal professor; someone who will take the time to not only be there for you throughout the ups and downs of class, but also through the ups and downs of life. He truly upholds the tenets of a great professor and a great human.”



Alumni News



In October of 2022, Dr. Mayanovic and Dr. Sakidja attended the Materials Science

& Technology (MS&T 22) conference in Pittsburgh and presented invited talks about the research on materials under extreme environments and the use of AI to design materials at the atomic level, respectively. This well-attended conference was organized by

a consortium of professional societies in materials science including the American Ceramics Society (ACers) and the Minerals, Metals, and Materials Society (TMS).

While at the conference, they got a chance to meet some of outstanding alumni from the Materials Science graduate program. The one on the left was Tauhid Islam, currently a Ph.D. candidate at Case Western University. His advisor at MSU was Dr. M. On the right was Rajan Khadka, also a Ph.D. student at Rensselaer Polytechnic University (RPI). Dr. Sakidja was his thesis advisor then at MSU.



Graduates

Spring 2022

Seth Bayless BS
 Anthony Dorhauer BS
 Cassidy Johnson BS
 Emily Justus MS
 Zachary Kauffman BS
 Niklas Landgraf BS
 Sarah Longworth BS
 Tyler McGilvry-James BS
 Connor Medley BS
 Samuel Nack BS
 Cory Padgett BS
 Devon Romine MS
 Rifat Ara Shams MS

Summer 2022

Luke Helfrich
 Bishwajite Karmakar

BS
 MS

Fall 2022

Farhan Ishrak
 Matthew Kindhart
 Patrick Lambdin
 Sharif Uddin

MS
 BS
 BS
 MS



Scholarship Winners

Betime Begzati: awarded Eugene H. Henderson Memorial Scholarship and John W. Northrip Memorial Scholarship

Quinn Coulter: awarded Eugene H. Henderson Memorial Scholarship and Kenneth A. Soxman Memorial Scholarship

Mateo Guerra Toro: awarded Physics and Astronomy Department and Friends Scholarship

Riley Hochstein: awarded John W. Northrip Memorial Scholarship

Brogan Homburg: awarded Banks Family Scholarship

Ummay Honey: awarded Physics, Astronomy, and Materials Science Department Scholarship Fund

Farhan Ishrak: awarded Physics and Astronomy Department and Friends Scholarship

Rejeena Jha: awarded Physics and Astronomy Department and Friends Scholarship

Seungmin Lee: awarded Thurman Family Scholarship

Ashlyn Manderfeld: awarded Andereck Family Scholarship

Juliana Marganian: awarded Andereck Family Scholarship

Yashasvi Moon: awarded Pre-engineering/Engineering Physics Scholarship

Marium Mostafiz: awarded Physics, Astronomy, and Materials Science Department Scholarship Fund Emily Rapp: awarded Banks Family Scholarship

In Memory: Dr. Howard Petefish

Dr. Howard M. Petefish, Professor Emeritus in PAMS, passed away on December 9, 2022. He was active in the department from 1955 to 1991. Howard obtained his B.S. in 1950 and M.S. in 1955 Physics from Northwestern University. He obtained his PhD in Physics from the University of Arkansas in 1976. David Carleton, who is an emeritus faculty in the department, had this to say about Howard: “As a newbie in the Physics Department in the early 1970’s, I was not familiar with most of the equipment in the Physics storeroom. Dr. Howard Petefish took the time to show me how to use the equipment for demonstration purposes in lectures. Dr. Petefish did not have to show me the nuances of the old, some antique pieces of equipment, but he did. I will be forever grateful Dr. Petefish was generous enough to take time out of his own schedule to help me through my ignorance. Over many years, in many classes, I used what Dr. Petefish had initially demonstrated for me.”

Intellectual Contributions

Dr. Kartik Ghosh (Distinguished Professor)

B. Paul, A. Mamun, A. Haque, M. Paul, A. Zkria, K. Ghosh, Nano-bio effects: Interaction of ZnO and DNA-bases, Nano-Structures and Nano-Objects vol 31, 100898 (2022).

A. Odusanya, I. Rahaman, P. K. Sarkar, A. Zkria, K. Ghosh, and A. Haque, Laser-Assisted Growth of Carbon-Based Materials by Chemical Vapor Deposition, vol C8, 24 (2022). <https://doi.org/10.3390/c8020024>

S. Balijapelly, A.J. Craig, J.B. Cho, J.I. Jang, K. Ghosh, J.A. Aitken, A. Choudhury, Building block approach to the discovery of Na₈Mn₂(Ge₂Se₆)₂: A polar chalcogenide exhibiting promising harmonic generation signals with a high laser-induced damage threshold, Journal of Alloys and Compounds, vol 900, 163392 (2022).

Dr. Robert Mayanovic (Department Head)

A. Al Shafe, M.D. Hossain, Mourad Benamara, V. Roddatis, R.A. Mayanovic, Defects and surface chemistry of novel pH-tunable NiO-Mn_{304±MnxNi1-xO} heterostructured nanocrystals as determined using X-Ray photoemission spectroscopy, Journal of Electronic Materials (online: Nov. 2022), <https://doi.org/10.1007/s11664-022-10047-5>.

Dr. Daniel Moreno (Assistant Professor)

D. Moreno, J. Thompson, A. Omosebi, J. Landon, K. Liu, Electrochemical analysis of charge mediator product composition through transient model and experimental validation. Journal of Applied Electrochemistry. Nov;52(11):1573-84 (2022).

D. Moreno, Using Temperature Variations to Demonstrate Analogous Carnot Heat Engines for Salinity Gradient Energy via Capacitive Mixing. American Society of Mechanical Engineers Power Conference, Vol. 85826, p. V001T07A006 (2022).

J. Thompson, N. Matin, A. Omosebi, D. Moreno, K. Abad, K. Liu, Electrochemical CO₂ conversion to formic acid through the Andora Process. Available at SSRN 4274371. 16th International Conference on Greenhouse Gas Control Technologies, GHGT-16 (2022).

Dr. Ridwan Sakidja (Professor)

A. Tanji, R. Feng, Z. Lyu, R. Sakidja, P. K. Liaw, and H. Hermawan, "Niobium addition improves the corrosion resistance of TiHfZrNb_x high-entropy alloys in Hanks' solution", Electrochimica Acta, Vol. 424, pp. 140651 (2022).

T. McGilvry-James, B. Timalcina, M. Mostafiz Mou, R. Sakidja, "Deep potential development of transition-metal-rich carbides", MRS Advances, Vol. 7, pp. 468-473 (2022), <https://doi.org/10.1557/s43580-022-00289-0>.

D. Romine and R. Sakidja, "Modeling atomic layer deposition of alumina using reactive force field molecular dynamics", MRS Advances, Vol. 7, 185-189 (2022), <https://10.1557/s43580-022-00289-0>.

Dr. Michael Reed (Distinguished Professor)

Mz, Xiao-Yu, et al. (including M.D. Reed), K2 photometry on oscillation mode variability: The new pulsating brown dwarf star EPIC 220422705, Astrophysical Journal, vol 933, 211 (2022).

Sanjayan, S. et al. (including M.D. Reed and J.W. Kern), Pulsating subdwarf B stars in the oldest open cluster NGC 6791, Monthly Notices of the Royal Astronomical Society, vol 509, 763 (2022).

Alumni:

Please take a few minutes to send us an email at: physics@missouristate.edu

Include your current contact information, graduation year and Missouri State degree.

Let us know where you are working now, job title or other career or personal accomplishments so we can include you in our next issue.

Stay current with the MSU Alumni Association at <http://alumni.missouristate.edu>.

Update contact information online and learn about upcoming alumni events, such as MarooNation.

Media and Contact:



<https://www.facebook.com/MSUPAMS2/>



<https://www.instagram.com/msupams2/>



<https://twitter.com/PAMSatMSU>

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Gift Giving:

State universities could not operate without generous contributions from alumni and friends. Your support enables us to provide scholarships, teaching equipment, and more. We hope you will consider making a contribution to the PAMS department or to one of the scholarships; your gift is tax deductible.

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:

The PAMS Department
Kemper Hall 101
901 S. National Ave.
Springfield, MO 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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Momentum:

The Newsletter of the Department of Physics, Astronomy, and Materials Science at Missouri State University.
To submit information for the next Momentum newsletter, e-mail Jessica Quin at: JQuin@Missouristate.edu

