

# PHYSICS AT WABASH



## Welcome!

There has been a lot of activity on campus this summer. In Goodrich, we had five interns working on various research projects. Outside, construction crews have been busy digging holes everywhere as the College updates its infrastructure and prepares to take down Sparks to make room for the new Community Center.

As we get ready for the upcoming year, we hope you'll enjoy reading about everything that went on in our department during 2023-24. As always, keep up-to-date by following us on Facebook, and let us know what you are doing so we can include it in next year's newsletter.

## Faculty & Staff Update



**Jim Brown** received a \$424,670 grant from the NSF's Major Research Instrumentation Program. It was part of an effort to support the Modular Neutron Array (MoNA) collaboration's development of the next Generation Neutron array (nGN). (Last year Jim served as MoNA's Executive Director.)

This summer, interns Tim Smith ('26) and Arlie Benson ('26) worked on setting up and testing a simulation facility using silicon photomultipliers (SiMPs) at Wabash for this project. Jim also spent some time working on transitioning the collaboration's web presence to a new domain (<https://www.monacollaboration.org>). With several approved experiments in the pipeline, the collaboration anxiously awaits the completion of a new beamline at the Facility for Rare Isotope Beams (FRIB) that will make those runs possible.

Jim has been teaching mostly the intermediate-level sequence in recent years, and this year had the privilege of working with great group of young men whose interests range between post-graduate research and engineering. He is looking forward to teaching a Freshman Tutorial this Fall and an advanced course in nuclear physics as well. Jim has been thinking a lot about how to incorporate the new "fourth hour" requirement into his non-lab courses and was pleased to see how dedicated our students were to taking on this challenge as it was piloted in the spring semester.



**Jill Keller** served as our Academic Administrative Coordinator again this past year. She has always appreciated collaborating with the Physics Department; however, she will not be with us this year as she is relocating to a warmer climate. Her husband's job has been transferred to Arizona, where she

looks forward to enjoying outdoor activities in January, rather than dealing with snowy weather. Jill will be leaving her sons in Indiana, with one completing his studies at Hanover College and the other attending Indiana University this Fall. Jill plans to visit us occasionally to stay in touch. We wish her the best of luck in this new chapter and look forward to seeing her again.



**Dennis Krause** remains our department chair. He was pretty busy in the fall, teaching freshman tutorial, "It's About Time," on how science views time. In addition, he taught PHY 111 (Physics I-Calculus) and PHY 315 (Quantum Mechanics). For the latter, he made significant revisions of the quantum mechanics textbook heavily influenced

by the work on entanglement done by his interns during the summer 2023. During the spring semester, Dennis was again teaching PHY 112 (Physics II-Calculus) and PHY 314 (Electrodynamics).

Dennis's research has been focused on the 95% of the universe we don't understand—dark matter and dark energy. He's been studying ultralight dark matter (ULDM) models, where the putative dark matter particles are so light that ULDM can be considered to be a classical scalar field that oscillates with a frequency proportional to its mass. The virtual exchange of ULDM would lead to new long-range forces, an area he's been interested in for many years. This summer, Dennis had two summer interns working on ULDM. Prasun Panthi ('27) studied how ULDM can form galactic halos, while Evan Baldwin ('26) studied ULDM "wake forces." At Purdue, Dennis joined the graduate committee of Robert Orlando and has been guiding his research on constraining models of dark energy using laboratory experiments and astrophysical observations.

Finally, Dennis and Nikolai Jones ('24) had their paper, "How can a quantum particle be found in a classically forbidden region?" accepted by *The Physics Teacher*. The answer to the title question was found during Nikolai's 2022 summer internship. You'll have to wait till the paper appears to learn what it is!



**Jessica McClamroch** joins us as our Academic Administrative Coordinator for Physics and also Math and Computer Science Departments. She proudly calls Crawfordsville home with her husband, Tom, and their two children. Prior to joining Wabash College, Jessica worked with the local Montgomery County high schools in

Career and Technical Education. With a background in business administration and education, Jessica brings a passion for assisting others and event planning. In her free time, she enjoys volunteering, directing the Strawberry Festival Queen Scholarship Program, and spending time with family and friends



**Matt Roark** continues to enjoy hiking and backpacking, taking a summer trip to Zaleski State Forest and Hocking State Forest in Ohio. The curvy, hilly roads and trails reminded him that the Appalachian Mountains are not far away. Matt also returned to Red River Gorge for a February campout in some rare Kentucky snow.

Matt has been busy designing and printing 3D models. He updated the parallax lab in Astronomy with more accurate sighting equipment and prototyped a new setup for the solenoid and magnetic field lab in the introductory physics sequence.

Matt skipped the campus eclipse party and watched from his hometown of Ladoga, Indiana. To add to his good luck, the backyard of his family's home was predicted to be a good location to see Bailey's beads. Totality lasted for 3 minutes and 25 seconds and created a 16°F temperature drop. Matt sourced specialized equipment, 3D printed mounts, and spent hours researching techniques and settings to photograph the different parts of the eclipse. "Great pictures require a fully manual exposure, a bit of luck with the weather, lots of preparation and practice, and some artistic vision to develop the photos." Two of Matt's composite pictures are now on display in the main hall of Goodrich and he is selling prints. Send an inquiry to [mroark07@gmail.com](mailto:mroark07@gmail.com) to get an order form.



**Gaylon Ross** is entering his seventh year at Wabash. At the beginning of the 2023-2024 academic year, the word "visiting" was dropped from his title, and the word "teaching" was added, making him the first *Associate Teaching Professor of Physics* at the college. As stated in the Wabash Faculty Handbook, this

new appointment reflects Gaylon's continuing commitment to the college and its mission, without the expectations or guaranteed duration of appointment that is associated with tenure-track faculty.

Gaylon taught astrophysics as a special topics course last fall, with 12 physics majors and minors in the class. It was the first time in almost 30 years he had the chance to lead discussion on these topics at this level since the basic astronomy course is designed for non-majors with limited math skills and even more limited physics background. Although it took time for the class to develop the proper rhythm, by midterm students were showing an enthusiasm for the material and an ability to solve problems in an area that is often absent from an undergraduate physics student's education. While he may not have the opportunity to teach the course again, it was a true highlight of Gaylon's time at Wabash.

Gaylon also taught astronomy and the associated labs both semesters, along with Enduring Questions, part of the Freshman Year Experience classes required of all incoming students. This fall, he will tackle Classical Mechanics, the only course in the standard physics curriculum he has never had the opportunity to teach before this. In the area of service to the department and college, Gaylon coordinated and emceed our local Sigma Pi Sigma banquet on April 24, 2024, with the Wabash chapter inducting one new student member into the national honor society. He served as a senior member of the Lilly Scholarship Committee on campus, which selected three incoming freshmen to receive full scholarships to Wabash, and he has committed to a sec-

ond three-year term beginning this fall. In an attempt to fully embrace the liberal arts experience, Gaylon will join the Visiting Artists Planning Committee to select talented persons to give performances, present lectures, and/or host workshops on campus during the 2025–26 year.

Finally, the total solar eclipse of April 8 offered the Wabash community an opportunity to witness a literal once-in-a-lifetime event on campus. Gaylon gave several radio and newspaper interviews to help prepare the Montgomery County area for the experience, and he and Associate Professor of Mathematics and Computer Science Colin McKinney provided an After the Bell Zoom talk on April 3 to alumni and friends. On eclipse day, several hundred people enjoyed the afternoon together at Little Giant Stadium, and while there were only about 30 seconds of totality on campus, numerous attendees commented that sharing this awe-inspiring experience with friends and family made it a truly special day.



**Nathan Tompkins** finished his seventh year as a member of the Physics Department, received tenure, was promoted to Associate Professor, and will be on sabbatical in the spring. This past year he taught the Physics I/II - Algebra sequence, Advanced Laboratory I/II, debuted the new Physics Senior

Seminar, and advised several independent study courses including Microfluidic Design and Rocket Design.

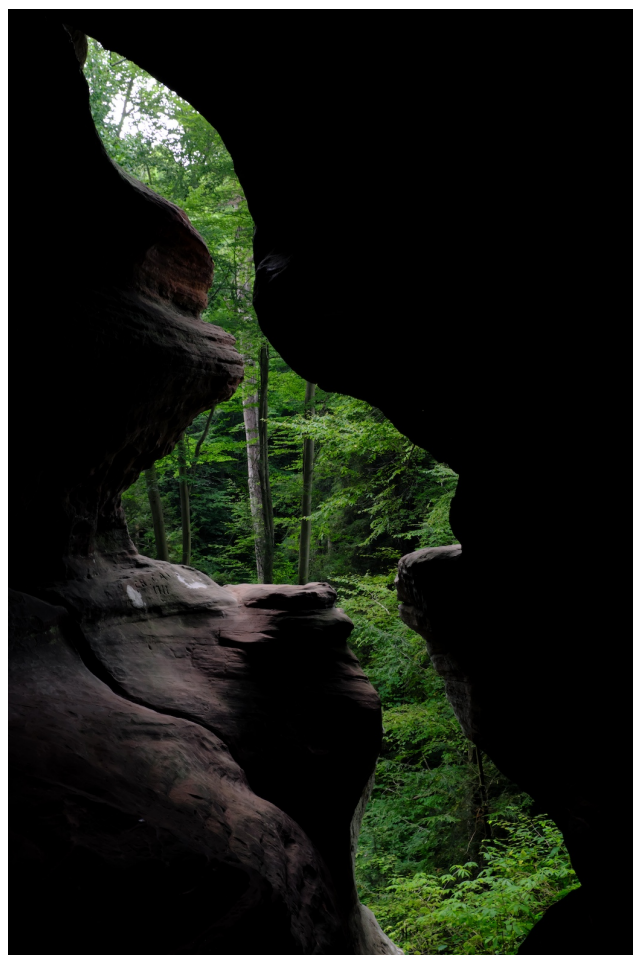
Recently Nate has worked on creating cobalt hydroxide membranes in a microfluidic device in the presence of an electric potential. This work with students Bryan Cherry '24, Aiden Orcutt '24, and Raymond Arebalo '25 was presented at the Gordon Research Conference on Oscillations & Dynamic Instabilities In Chemical Systems in Les Diablerets, Switzerland this summer. In the fall Nate intends to prepare these results for publication.

To continue this research during the demolition of Sparks and construction of the new Community Center, Nate applied for a vibration isolation platform from Minus K Technology as part of their Educational Give-away program. Nate's application was successful and the department received a Minus K BM-4 Bench Top Vibration Isolation Platform which has been installed in the microfluidics laboratory.

The microfluidic fabrication facilities within the Physics Department have continued to grow, adding a 20W

laser module to the Snapmaker A350 in addition to the Minus K vibration isolation platform. The Microfluidics Lab already includes two LulzBot 3D printers, a Snapmaker A350 combination CNC mill/laser cutter, a Leica Emspira 3 automated inspection microscope, both Leica S9 and Zeiss 508 data collection stereo microscopes, a Diener ZEPTO plasma chamber for PDMS bonding, a Pico 24-bit data acquisition system, three Chemyx Fusion 200 rate controlled fluid injectors, a custom pressure controlled fluid injector system, a Thinky ARE-310 planetary mixer for PDMS casting, a vacuum chamber for degassing, and a PDMS curing oven.

This upcoming year Nate is looking forward to teaching the introductory algebra sequence again, working with the Advanced Lab courses again, and working in the laboratory with students.



Matt Roark took this photo from The Rock House formation in Hocking Hills State Park, Ohio. Erosion has opened up natural windows along the tunnel-shaped cave, allowing views from the midst of a sandstone bluff 150 feet tall.

## Student News

### Graduating Seniors

Seven physics majors (Bryan Cherry, Gabe Cowley, Fardin Hoque, Nikolai Jones, Thomas Joven, Bernardo Morales, and Aiden Orcutt) and one minor (Matt Meyer) graduated this year. Bryan worked with Purdue Applied Research Institute Microelectronics Lab as a microelectronics research intern this summer. Afterward, he plans to transition to full-time as an Associate Environmental Safety Technician at Purdue. Long-term, he plans to pursue a career in medical or health physics. Fardin is starting work as a software engineer with Amazon Web Services. Nikolai is going to medical school at Indiana University. Thomas is attending Marine Officer Candidate School this summer, and in August starting law school at IU Maurer School of Law where he was named a Wabash Law Scholar. Bernardo is a research & development engineer at Rahal Letterman Lanigan Racing. Aiden plans to study mechanical engineering at Washington University-St. Louis as part of the dual-degree program. Matt will be starting the second part of the 3-2 engineering program at Purdue also studying mechanical engineering.

Gabe Cowley finished all his coursework in December so he spent the spring semester at Oak Ridge National Laboratory. Through the Science Undergraduate Laboratory Internships (SULI) program, he studied the nanophotonic (or cathodoluminescent) properties of beam-sensitive materials, a topic that lies somewhere between condensed matter physics and quantum information science. For the summer, Gabe remained at Oak Ridge for another internship, this time working on "Data and Complexity-Reduced Score Models using Regularized Neural Networks," (the title of the poster he presented), which mostly consisted of machine learning and functional analysis. This fall he will be starting the Ph.D program in applied mathematics at the University of Colorado Boulder.



On the Goodrich steps after graduation: Front Row (left to right): Aiden Orcutt, Thomas Joven, Fardin Hoque, Bernardo Morales, and Nikolai Jones. Back Row: Prof. Krause, Bryan Cherry, Prof. Tompkins, Prof. Brown, and Matt Meyer.



Gabe Cowley missed the group graduation photo, but we eventually found him. Here he is with Prof. Tompkins, Prof. Krause, and Prof. Brown.



Keep up-to-date on what's happening in the Physics Department through our Facebook page:

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

### Awards Chapel

It was a big night for physics students at this year's Awards Chapel. James Szalkie ('25) was awarded the Fuller Prize for the most outstanding junior physics major. As usual, it took the form of the 3-volume Feynman Lectures on Physics. Aiden Orcutt ('24) and Bryan Cherry ('24) were awarded the Phi Beta Kappa Prize for being judged to have produced the most original and meritorious piece of work, whether artistic or analytical, for their research with Prof. Tompkins. Bryan

Cherry was also awarded the Treves Science Award for the member of the senior class concentrating in Division I who has shown the greatest progress academically and as an individual during his junior year. In addition, Gabe Cowley ('24) and Thomas Joven ('24) were inducted into Phi Beta Kappa. Gabe also received the McClain Prize in Classics, while Thomas received the James E. Bingham Award and Irwin-Garrard Prize. Finally, Fardin Hoque ('24) received the Maharry Prize in Computer Science.



Junior James Szalkie receiving the Fuller Prize from Prof. Krause.



Seniors Aiden Orcutt and Bryan Cherry receiving the Phi Beta Kappa Prize from Athletic Director Matt Tanney.



Bryan Cherry ('24) receiving the Treves Science Award from Division I Chair Amanda Ingram.

### Sigma Pi Sigma

This year, James Szalkie ('25) was inducted into Sigma Pi Sigma, the physics honor society, for his exceptional academic achievement and participation in the department. Below, James receives his certificate from Prof. Ross at the annual banquet in Trippet Hall.



## Celebration of Student Research, Scholarship, and Creative Work

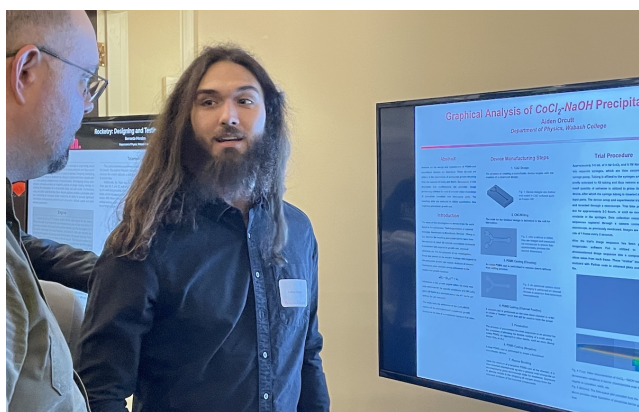
Physics students presented work from summer internships and the advanced lab at the annual celebration in January.



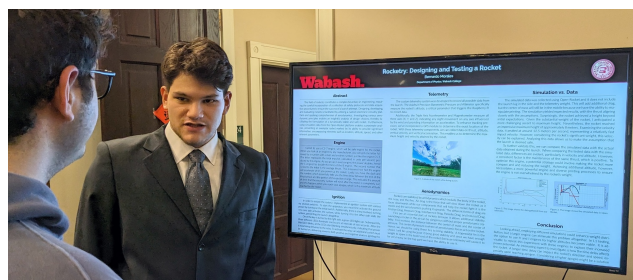
James Szalkie ('25) describes his project at Purdue in David Nolte's lab imaging sound waves in translucent materials. He began the work as part of the NSF Research Experiences for Undergraduates (REU) program last summer, and Prof. Nolte let him continue the work in the fall as his advanced lab project.



Gus Sanchez ('26) spoke on the creation and destruction of quantum entanglement, work he did with Professor Krause last summer.



Aiden Orcutt ('24) answers questions on his poster covering designing, fabricating, and characterizing microfluidic devices, work he did in Professor Tompkins' lab.



Bernardo Morales ('24) explains his poster, "Rocketry: Designing and Testing a Rocket," work he did in the advanced lab.



Bryan Cherry ('24) discusses his poster analyzing the voltage induced by a chemical reaction in a microfluidics device, work he did in Professor Tompkins' lab.



Evan Baldwin ('26) explained the meaning of quantum entanglement and correlations, work he did with Professor Krause last summer.

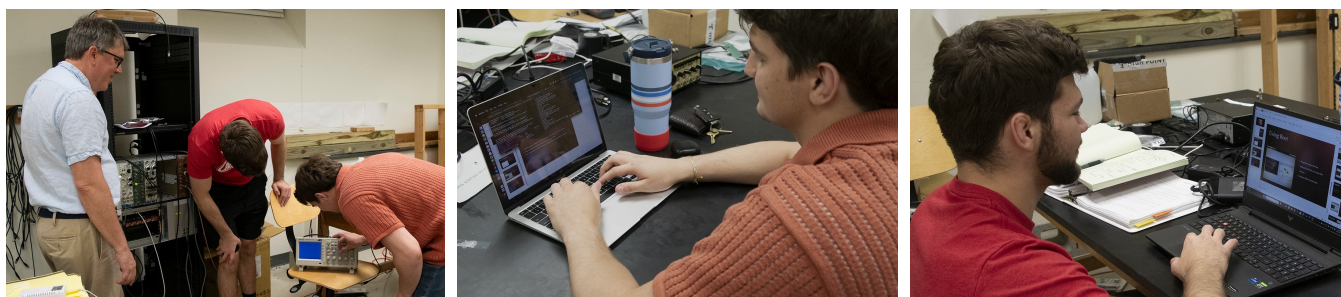
## Summer Research 2024

Many of our students spent the summer conducting physics research. Off-campus, Gus Sanchez ('26) participated in the NSF-funded Research Experiences for Undergraduates (REU) program at Purdue University, while James Szalkie ('25) did nuclear physics research at Michigan State University.

On campus, five students worked in the labs. Each Wednesday afternoon, Physics students joined the Math/Computer Science students to give progress reports on their work, while at noon on Fridays, all the science interns had a cookout at Hays Hall.

### Nuclear Physics

Professor Brown's students Arlie Benson ('26, below center) and Tim Smith ('26, below right) assembled and tested a SiPM (Silicon PhotoMultiplier) detection system, a prototype for the MoNA collaboration.



### Ultralight Dark Matter

Professor Krause's theory students Prasan Panthi ('27, below center) and Evan Baldwin ('26, below right) investigated the Ultralight Dark Matter (ULDM) halo of the galaxy and ULDM "wake forces," respectively.



### Microfluidics

Professor Tompkins' student Ray Arebalo ('25, center) fabricated and characterized microfluidic devices. Below right, Ray describes his progress at the weekly Goodrich group meeting.



## Pi Day: Physics at the Museum

Society of Physics Students and Math/CS students presented demos and activities for Pi Day in March at the Carnegie Museum.



Front row (left to right): Evan Baldwin, Haile Ayalneh, Fardin Hoque, Prasun Panthi, Abdul Tonmoy, Walid Kasab, Md. Arham. Back row: Spencer Phillips, James Szalkie, Gus Sanchez, Prof. Tompkins, Nikolai Jones, Prof. Krause, Prof. Brown, Prof. Ross, Matt Roark.



Top row (left to right): Matt and Abdul demonstrate acoustic levitation, while Haile, Walid, Prasun, and Fardin conduct a race between a solid disk and a ring, and Prof. Ross and Prof. Brown project the sun to display sunspots using the SunSpotter. Bottom row: Walid and Gus watch a girl pump the air out of the Magdeburg hemispheres, Nikolai shows how to suspend a ball with a shop vac, and Arham illustrates the loop-the-loop.



## Total Solar Eclipse April 8, 2024

On Monday afternoon, April 8, 2024, for less than a minute, Wabash experienced a total eclipse. However, preparations were over a year in the making, including ordering 1000 eclipse glasses well in advance. Professor Ross along with Society of Physics Students President James Szalkie ('25), Colin McKinney, Tori Gregory, Brent Harris, and Buck Waddell helped organize activities on campus to prepare for the momentous event.

### Prelude Activities



Above (left to right): A week before the eclipse, Professor Ross gave a talk, "A Guide to the Great American Eclipse of 2024," which included simulations that explained the physics behind the eclipses and what to expect. For those who were unable to attend Professor Ross's campus talk, he teamed up with Math/CS Professor Colin McKinney to give an After the Bell presentation, "Bashin' the Eclipse," via Zoom. Finally, at lunchtime on the day of the eclipse, Professor Dan Rogers of Modern Languages (and amateur astronomer) spoke to a large crowd in Hays on "Solar Eclipses in History and Culture around the World."

### Wabash Watch Party: Setting Up



The crowd gathers in Little Giant Stadium.



Evan Baldwin ('26) and Prof. Krause setting up the SunSpotter for folks to view the eclipse.



The physics students who helped organize and set up. Left to right: Tim Smith ('26), Broderick Frey ('26), James Szalkie ('25), and Spencer Phillips ('25).

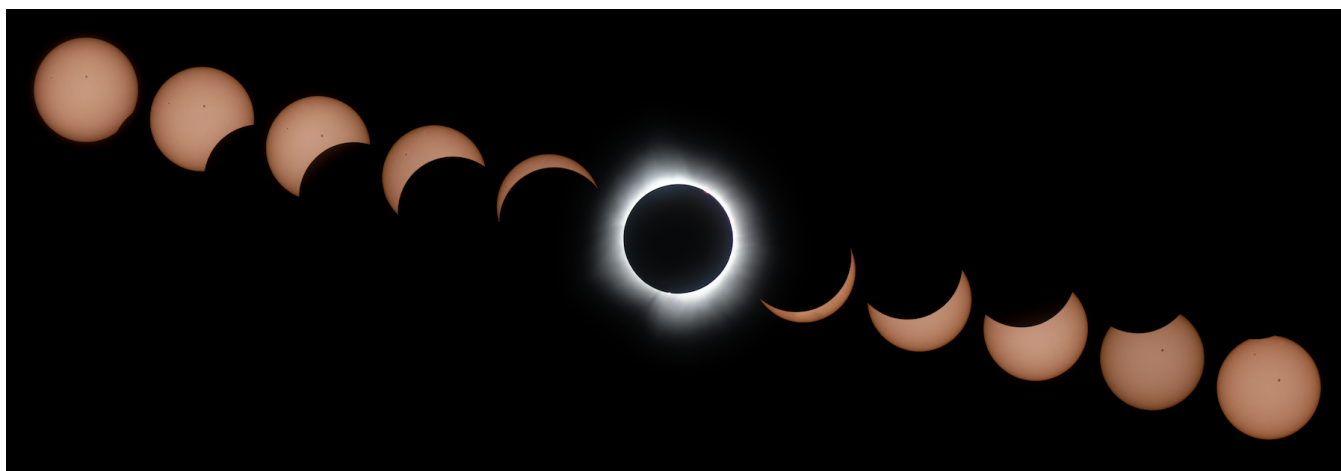
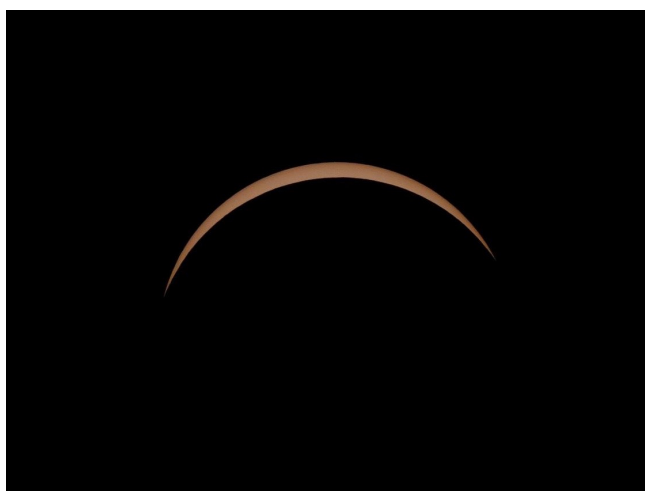


First contact seen using the SunSpotter.

## Bashin' the Eclipse



## Matt's Photos



Totality lasted less than a minute on campus but it could be extended by several minutes by traveling only a short distance south and east. The top two photos and the combined phase sequence were taken by Matt Roark in his hometown Ladoga using special optics for his camera that he rented. Profs. Brown and Tompkins drove to McCloud Nature Park only about 30 miles from the college with students and other Wabash folks. There they had about 3 minutes of totality. More photos can be seen on our Facebook page. Photos of the full sequence of phases and a sequence of Baily's beads now grace the main hallway in Goodrich. Contact Matt at [mroark07@gmail.com](mailto:mroark07@gmail.com) if you wish to purchase prints of his photos.

## Alumni News

### Updates

Since our last newsletter, we've heard from...

- **Junaid Razvi ('70)** left full-time employment in the nuclear industry in 2018. He had planned to ride off into the sunset in retirement but decided soon after that much more work remained. Instead, he put his 40-year stint in industry to use to support nascent startups trying out "advanced" designs for reactors to address global warming issues (e.g., off-grid applications). He plans to continue as long as he remains in good health. You can find him and his work at <https://www.canopusenergy.com>.
- **Gary Hansen ('71)** retired from medicine after 40 years as a diagnostic radiologist and is relocating to the Boston area, where one of his daughters is a surgical resident.
- **Gary Wollenweber ('74)** received the American Institute of Aeronautics and Astronautics (AIAA) 2024 Survivability Award which "is presented to an individual or a team to recognize outstanding achievement or contribution in design, analysis, implementation and/or education of survivability in an aerospace system." He was recognized "For exceptional contributions during a long-standing career in aircraft engine thermal design that has led to improved aircraft survivability through IR signature reduction."

Gary also wrote that one of the reasons he has not yet retired is the impact of persistent commercial aircraft contrails on the climate. He has been predicting military contrails for decades and for the past two years, a significant portion of his time has been teaching others how to analyze and predict commercial engine contrails. Multiple scholarly journal articles have shown that persistent contrails migrate to high-altitude cirrus clouds that have a greater short-term impact than the CO<sub>2</sub> produced by the hydro-carbon fuel. GE Aerospace is also developing a hydrogen-fueled engine for a demonstration flight in 2026. They expect that the hydrogen fuel will produce a contrail more frequently but hopefully will dissipate more quickly due to ice particle size and sedimentation rate. He has initiated a lab-scale study of ice particle size vs. nucleator concentration for constant levels of supersaturation which is underway at NASA Glenn's Particulate Aerosol Laboratory. Multiple flight tests are being planned with NASA, Boeing, Airbus, and others. Gary says it is truly an exciting time for contrail science!

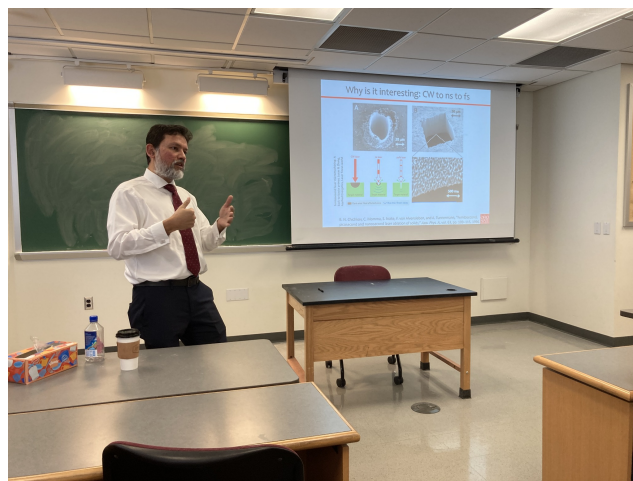
- **Michael Lambert ('80)** created a Physics Affinity Challenge for the Annual Day of Giving to celebrate the Department's continued excellence in

teaching.

- **Robert Hogg ('88)** is managing director of Dynamic Controls Limited, BWXT, Advanced Technologies, LLC, which makes parts for US and UK and soon-to-be Australian nuclear submarines and aircraft carriers. "Super interesting nuclear physics and engineering work!"
- **Enam Chowdhury ('95)** came to campus in March to give a physics colloquium and speak with our students. Enam is a professor of Material Science and Engineering at Ohio State University, but he also holds joint appointments in OSU's Electrical and Computer Engineering and Physics departments. His talk, "High and ultra-high intensity laser-matter interaction," gave a fascinating overview of his research involving high- and ultra-high intensity matter-light interactions and their applications.
- **Yang Yang ('17)** received his Ph.D. in physics from the University of Minnesota. He was kind enough to send us a Zoom link so we could attend virtually his thesis defense in October. His dissertation title is "Magnetism from bond-directional anisotropic interactions." He is then off to start a post-doc at the University of Virginia where he is planning to use machine learning techniques to study the Holstein model, the Hubbard model with electron-phonon couplings.

We apologize to anyone we missed and for misspellings or other mistakes made while editing the material sent to us.

In the future, we would be happy to include your news and comments in our newsletter. Not only is it wonderful to hear from you, it is also very useful for us to learn what our alumni are doing and how they got to where they are. Our students wonder what one can do with a physics degree and it is great to have alumni stories to share with them.



Enam Chowdhury ('95) colloquium.

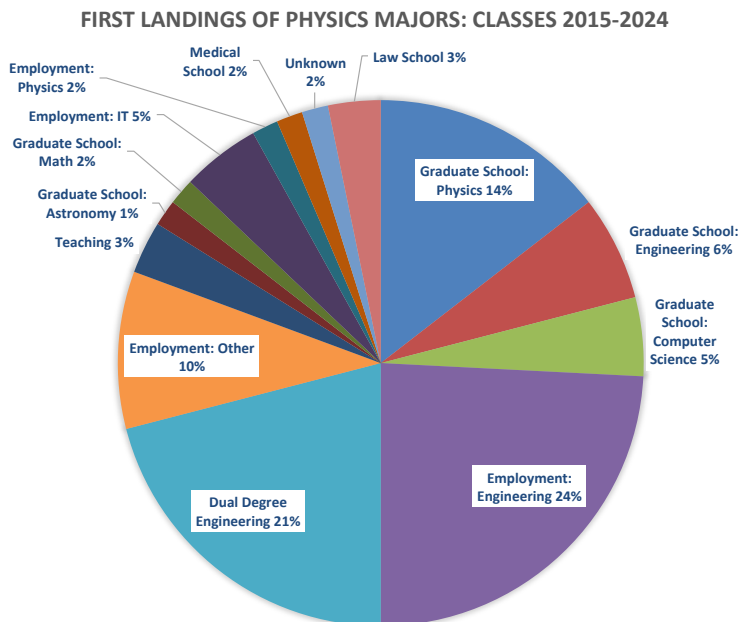
## What can you do with a physics degree from Wabash?

### Some Graduate Schools and Companies

#### Accepting/Hiring Recent Majors

Stanford University  
 University of Colorado  
 Purdue University  
 Indiana University  
 New York University  
 U. of Oregon  
 U. of Minnesota  
 U. of Notre Dame  
 U. of Michigan  
 Michigan State U.  
 U. of Cal., Santa Barbara  
 U. of Southern California  
 Carnegie Mellon U.  
 Auburn U.  
 U. of Mass.-Amherst  
 Florida State U.

Amazon  
 Apparatus  
 Rahal Racing  
 ELANCO  
 Walsh Construction  
 Epic  
 Trans-United  
 Rolls-Royce  
 Backstop Solutions  
 Peerless AV  
 J.P. Morgan Chase  
 FAAC, Inc.  
 F. A. Wilhelm  
 Quest Global  
 Ontario Systems  
 RQAW



## Thank you for your support!!!

The Physics Fund is a special fund established specifically to support physics student-faculty research at Wabash. In the past, we have used this fund to purchase laboratory equipment and provide summer internships—we never want to turn away an eager student! Special thanks go to Jim Clynych ('67), Dennis Henry ('67), Ken Crawford ('69), and the Rippy Family for creating funds to support our students. They were essential to allow us to have five interns this summer. We also thank Roger Alig ('63) and Marc Adams ('77) for their support of the Department over the past year, and all our alumni and friends who in previous years have provided funds that continue to support internships, student travel, departmental prizes, library book purchases, and senior dinners. We apologize to anyone we fail to acknowledge appropriately since sometimes our information regarding gifts to the Department is limited.

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