WOOSTER
Physics

2022–2023 Annual Report
physics.wooster.edu

A NOTE FROM DR. NIKLAS MANZ, DEPARTMENT CHAIR

Greetings,

Last academic year was exciting in many ways.

Laura DeGroot started her tenure-track position, after being in the department for several years in various positions. Therefore, she is eligible for her 4th-year review in the fall 2023 semester and will have her first sabbatical semester in the fall of 2024; her first leave in 12 years!

Megan Nieberding, our one-year visiting professor in 2022-23, did a fantastic job switching from being a Ph.D. student to being a professor in about one month. We are happy to have her as our colleague for one more year while Cody Leary and Niklas Manz will have one-semester leaves in 2023-24.

The department had its 10-year review during the spring semester. There is always anxiety preparing all the documents for the reviewers' on-campus visit. But during their visit, they supported many of the ideas we have how to improve our curriculum and the department. They also had some other interesting suggestions based on their long experience reviewing undergraduate physics departments. Stay tuned.

After many conferences were cancelled in 2020 and 2021, we are finally back in giving our students the experience to present their research at scientific meetings. Last academic year, physics students had 10 poster presentations and gave 5 talks at the national APS March meeting and three different regional APS meetings.

During Commencement in May 2023, we celebrated the achievement of our newest departmental alumni. Nine seniors finished their Senior I.S. here at Wooster, while one student transferred into the 3-2 Engineering program at Washington University in St. Louis. And we are proud to have the most dedicated group of students in our department. The physics department was again leading in declared first-year students at the college, not just by percentage of projected majors, by total number: seven students came to me and told me that they would like to declare a physics major. It's always a big decision to declare a major. This is one of the exciting aspects of being the chair.

This summer, we welcomed twelve students to our 10-week, NSF-funded summer research program. One of those twelve students was our first 'Koontz Research Scholar', made possible through the establishment of the Koontz Endowed Fund, which will support, among other things, one College of Wooster physics student in an experimental project each summer.

I am excited to chair again in the fall and let Susan lead the department in the spring semester when I am on leave.

Niklas Manz

2023 CONVOCATION

Dr. Lehman addressed students, faculty, and staff on the topics of curiosity and humility.

CLASS OF 2023

Front (L to R): Dean Brown, Davis Patterson, Michael Scarberry, Harrison Clayman
Back (L to R): Connor Streeter, Daniel Cohen Cobos, Olivia Green, John Schmidt
Not pictured: Raisa Raofa

3/2 Engineering Dual Degree Program

Sara Wargo

2023 COMMENCEMENT

SENIOR INDEPENDENT STUDY

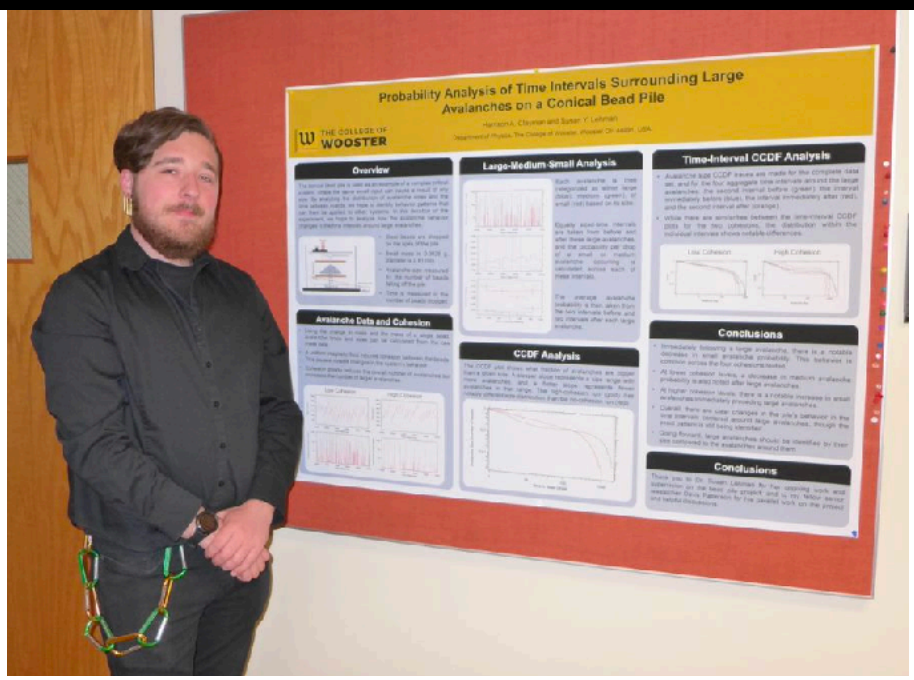
Dean Brown

Improving the Accuracy of GALFIT in Measuring the Morphological Properties of Multi-Component Disk Galaxies

Advised by Dr. Laura DeGroot

The goal of this project was to improve the accuracy of GALFIT in measuring the morphological properties of multi-component disk galaxies such as magnitude, effective radius, axis ratio, and Sersic index. This research was done by first simulating realistic galaxies by examining real data captured by the Hubble Space Telescope from the CANDELS survey. These simulated galaxies were then added to a real Hubble image, which was then fed to a python photometry package from Astropy called PhotUtils. PhotUtils then output photometric data for the galaxies, which was in return used as input to GALFIT so that GALFIT could be tested. GALFIT would take this photometric data and output morphological properties for each galaxy, which were then plotted against the known simulated values for those properties to determine how accurate GALFIT was. GALFIT was run on each galaxy 10 times, and it was run a total of five times on all of the galaxies with differing constraints and initial parameters. GALFIT had the best accuracy estimating the magnitudes of the components of a given galaxy, as at its maximum, GALFIT was 75% accurate in determining the magnitude within a 10% difference of the simulated value. GALFIT had very little success deterring axis ratio and effective radius, as throughout the five runs, GALFIT never accurately determined the effective radius or axis ratio for more than one galaxy. While the accuracy of the magnitude estimations for GALFIT was increased, there was no success increasing the accuracy of the effective radius results or the axis ratio results. The results of this project show that the method used for multi-component fitting in GALFIT is not accurate, nor is it easy to improve.

SENIOR INDEPENDENT STUDY



Harrison Clayman

Probability Analysis of Time Intervals Surrounding Large Avalanches on a Conical Bead Pile

Advised by Dr. Susan Lehman

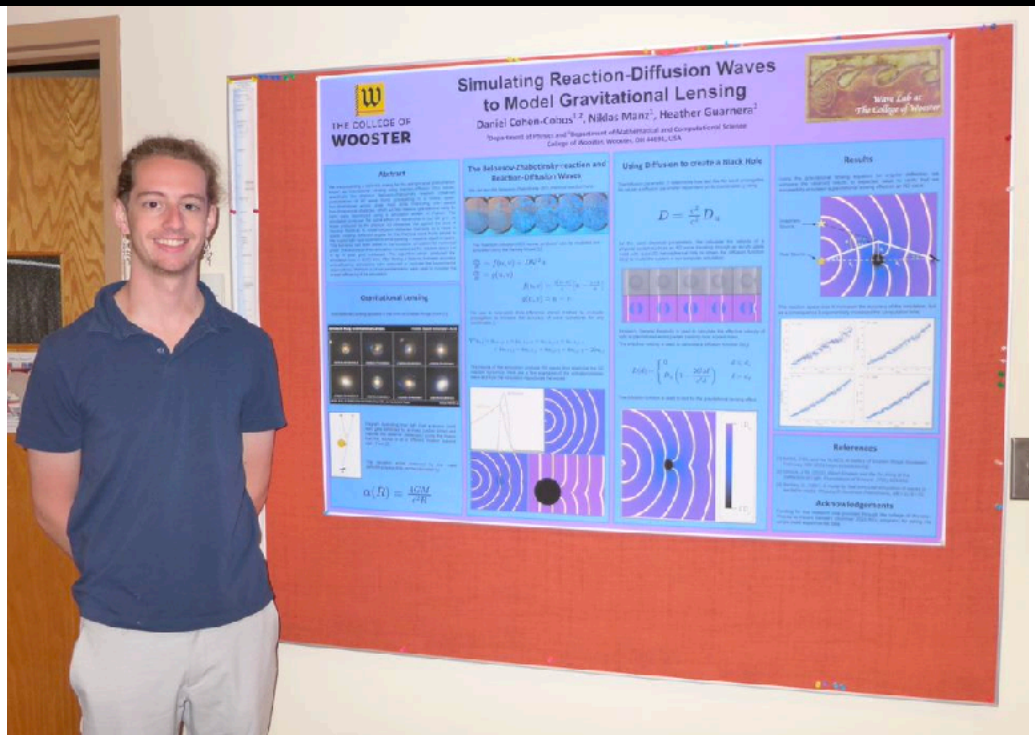
A conical cohesive bead pile is used as an example of a complex critical system where events of any size may occur given the same small input. Using this model, we investigate the probability of certain avalanche sizes occurring depending on the state of the pile, specifically regarding whether a large avalanche is about to occur or has just occurred.

The pile is formed by dropping a single steel bead onto the center of the pile whenever the pile becomes stable. A tuning factor of cohesion is generated through the magnetic field from a Helmholtz coil surrounding the pile. The current was varied between values of 0, 300, 500, and 750 mA. For each run, the complementary cumulative distribution and fractional occurrence of avalanches was calculated, for Bothe the size distribution of avalanches and the time intervals between them.

This thesis expanded upon previous works by analyzing the pile's behavior in smaller time intervals surrounding large avalanches. Complementary cumulative distribution analysis of the avalanche sizes during the intervals reveals noticeable trends in the four time intervals between the four runs. An additional method of analysis was develeoped and tested for avalanche behavior over smaller time intervals surrounding large avalanches, which takes the non-large avalanches and categorizes them as either small or medium, then calculates the probability of an avalanche of that size range occurring per drop. The method of identifying large avalanches and establishing time intervals is still in its early stages, and needs improvement.

The avalanche size distribution from this iteration of the experiment was also compared to those from a previous iteration, where different beads had been used. Analysis suggests a slightly increased cohesion in the new beads compared to the old set.

SENIOR INDEPENDENT STUDY



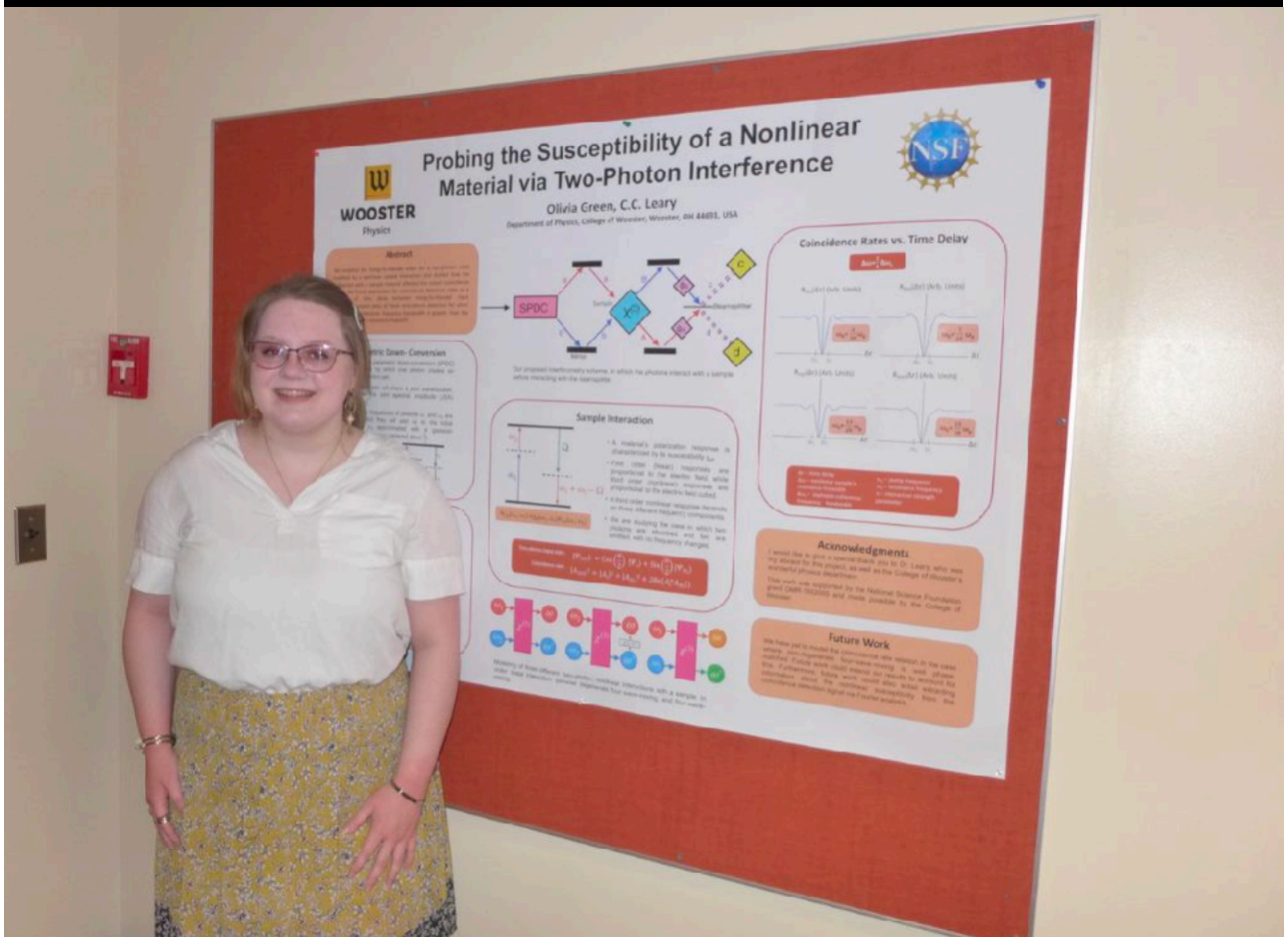
Daniel Cohen Cobos

Simulating Reaction-Diffusion Waves to Model Gravitational Lensing

Advised by Dr. Niklas Manz (Physics) and Dr. Heather Guarnera (Computer Science)

We are presenting a table-top analog for the astrophysical phenomenon known as Gravitational Lensing using reaction-diffusion (RD) waves. During the 2022 summer, REU Kiyomi Sanders recorded RD waves propagating across non-planar acrylic glass mold. The glass mold has various quasi-2D hemispherical caps that perturb the shape of waves created by the chemical reaction known as *the Belousov-Zhabotinsky reaction*. For this thesis, a computer program has been written in Python to reproduce the RD wave's shape while moving through the spatial obstacle which acts like a massive gravitational well for light. The simulation no only produces the same effect on wavefronts in 2D, as those produced by the physical 3D obstacle, but it also proves that it can be used for more complicated systems to model waves propagating in other non-uniform systems. We apply the laws of General Relativity to model a diffusion obstacle that acts as a mass in space. Creating deflection angles for a chemical wave front similar to the angles light rays experience while passing a massive object in space. This behavior is then tested in the computer simulation for numerical proof. The accuracy of the simulation increased as the reaction space size N in pixels increased. The algorithm which produced the simulation runs in $\Theta(N^3)$. After finding a balance between accuracy and efficiency, various simulations were executed to replicate the experimental observations. Methods such as parallel compilation were used to increase the overall efficiency of the simulation.

SENIOR INDEPENDENT STUDY



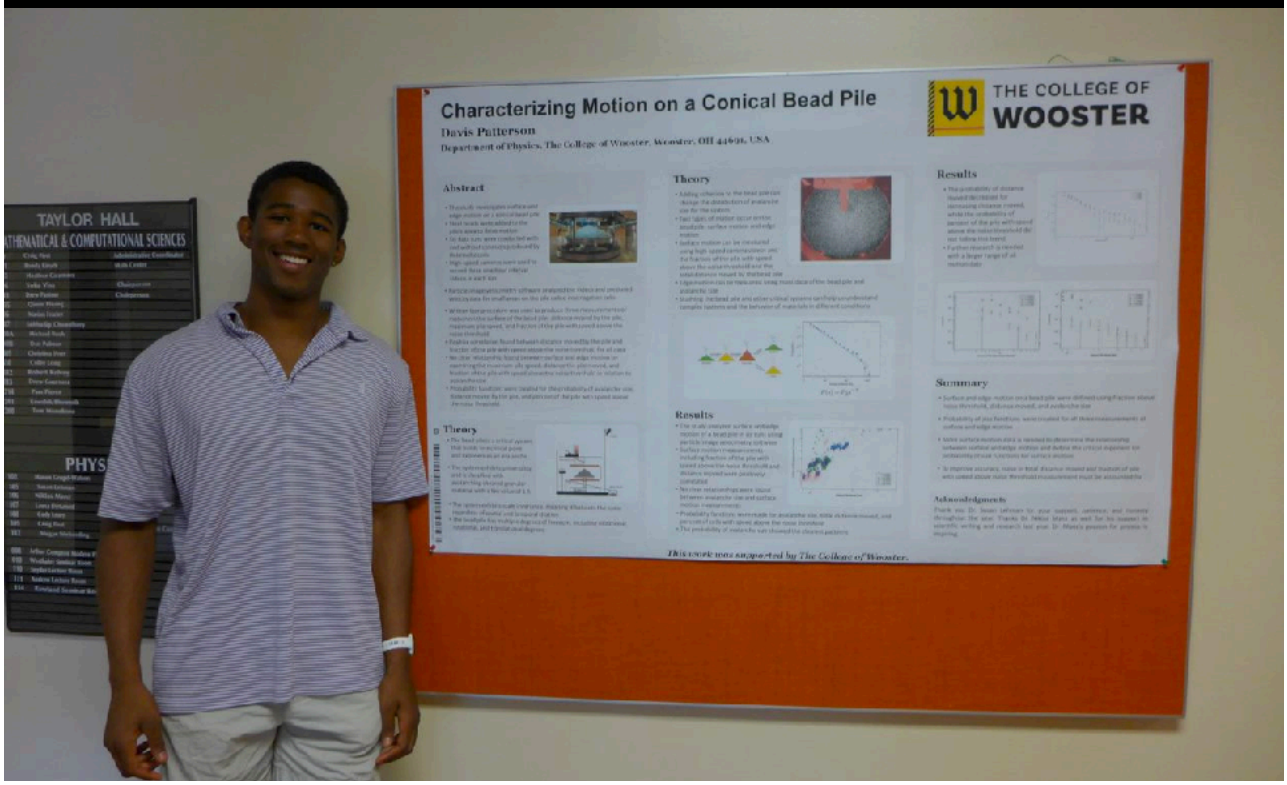
Olivia Green

A Two-Photon Investigation of a Material's Nonlinear Susceptibility

Advised by Dr. Cody Leary

We modeled the Hong-Ou-Mandel effect for a two-photon state modified by a nonlinear sample interaction and studied how the interaction with a sample material affected the output coincidence signal. We found expressions for coincidence detection rates as a function of time delay between Hong-Ou-Mandel input paths. We present plots of these coincidence detections for when the biphoton coherence frequency bandwidth is greater than the nonlinear sample's resonance linewidth.

SENIOR INDEPENDENT STUDY



Davis Patterson

An Investigation of Criticality: Characterizing Motion on a Conical Bead Pile

Advised by Dr. Susan Lehman

Surface motion and edge motion conical bead pile driven by the addition of steel beads on the apex of the pile was investigated. Six data runs were used in this study: two without cohesion and for with cohesion. Cohesion was produced by the Helmholtz coils surrounding the pile. The current was set to 330mA, 500mA, and 750mA. In each run the high speed camera recorded three one hour interval videos of the surface of the pile. Particle image velocimetry software was used to analyze the videos and produce velocity dat for small areas on the pile called interrogation cells on each frame. The velocity data was then run through a written Igor procedure which produced three measurements of motion on the surface of the bead pile: the distance moved by the pile, maximum pile speed, and fraction of the pile with speed above the noise threshold. The measurements of surface motion were compared to each other, distance moved by the pile showed a positive correlation with the fraction of the pile with speed above the noise threshold for all data. Measurements of surface motion were then compared to edge motion by comparing maximum pile speed, distance the pile moved and fraction of the pile with speed above the noise threshold. No clear relationship was found in the comparisons. Probability functions were created for the probability of avalanche size, probability of distance moved by the pile and probability of percent of the pile with speed above the noise threshold.

SENIOR INDEPENDENT STUDY

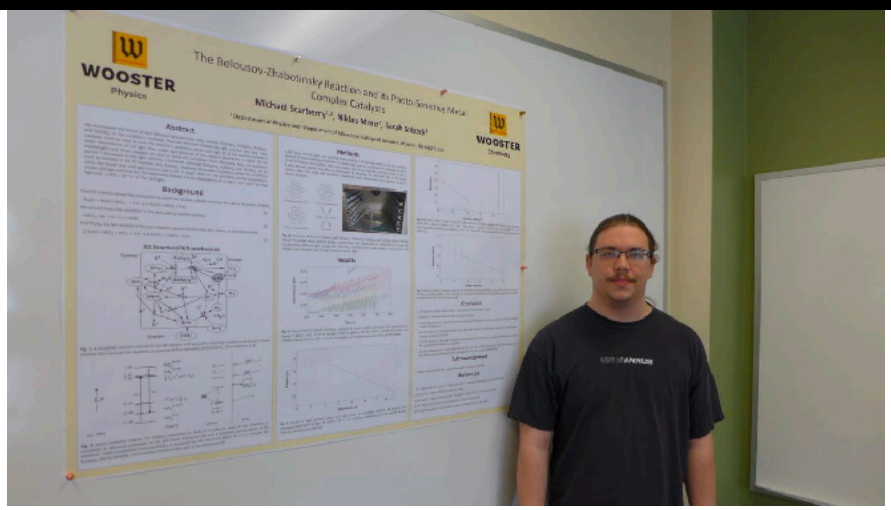
Raisa Raofa

Analysis of Nonlinear Phase Accumulation from Transformations of the Polarization States of Light in Connection to Quantum Information

Advised by Dr. Cody Leary (Physics) and Dr. Michael Bush (Mathematics)

We investigate the extent to which information about the evolution of the polarization state of light may be extracted through a Sagnac dual-path interferometer. We employ a birefringent crystal to change the polarization state of the reference beam. We then model the observable output intensity of the recombined beam. We show how the output intensity contains information about a geometric phase shift that depends on the path of the polarization state evolution on the Poincare sphere. The nonlinear phase accumulation we detect shows no qualitative or quantitative similarities with our theoretical framework. In order to account for the source of this discrepancy, we conclude a better understanding of the optical pieces of equipment used in the experiment is required.

SENIOR INDEPENDENT STUDY



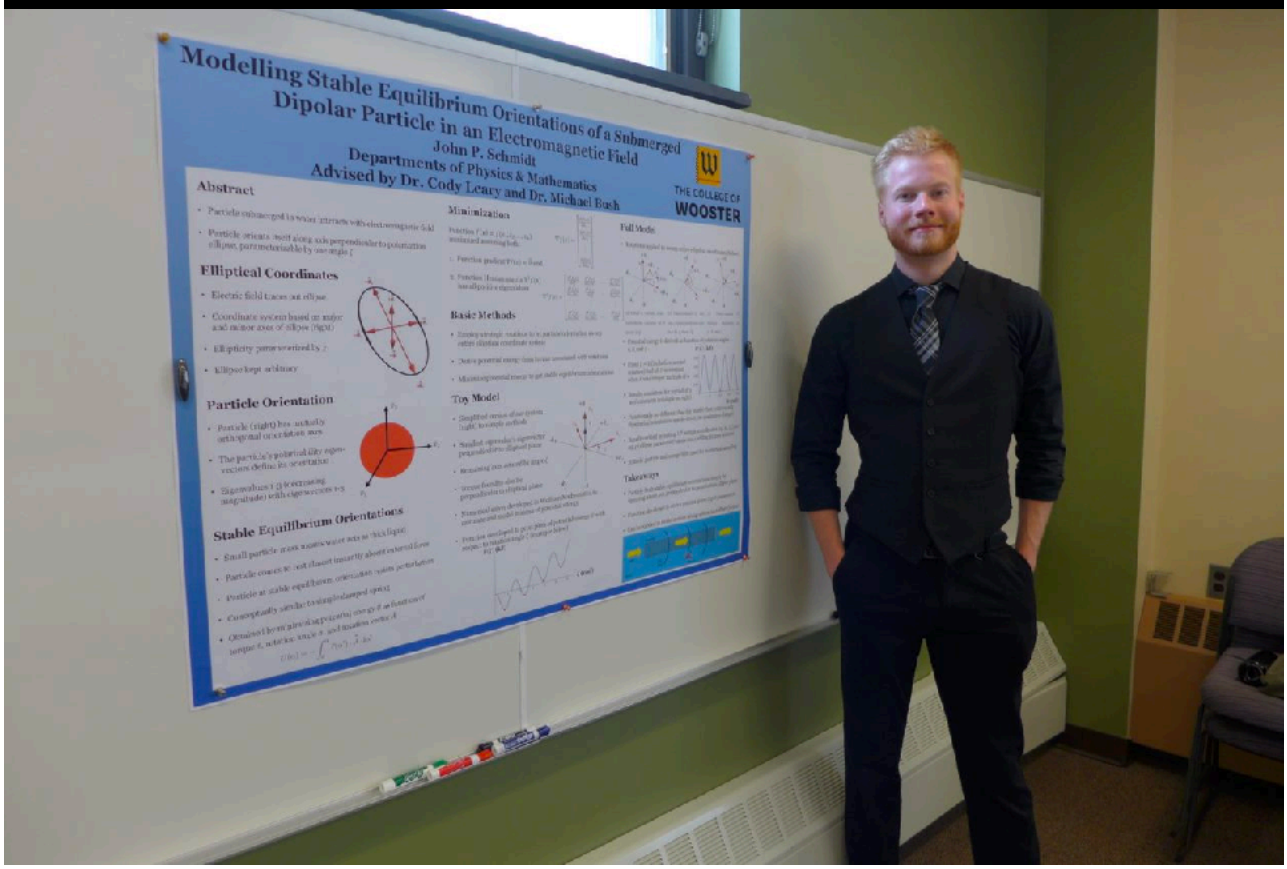
Michael Scarberry

The Belousav-Zhabotinsky Reaction and its Photo-Sensitive Metal Complex Catalysts

Advised by Dr. Niklas Manz (Physics) and Dr. Sarah Sobeck (Chemistry)

This Senior Independent Study investigates the impact of different light-sensitive catalysts in the nonlinear chemical Belousav-Zhabotinsky (BZ) reaction and how these catalysts could be used to tune the reaction's oscillation period with light. The reaction had a larger dependence on UV light sources as the complexes absorbance is higher at those wavelengths then visible light and those energies were able to excite the complexes more effectively. Also as the intensity of light increased the oscillation period decreased. To test this hypothesis, we used a single wavelength monitoring UV-Vis probe while irradiating the reaction flask with different light intensity and wavelengths in a photo reactor. I investigated four different metal catalysts, namely $Ru(bpy)_3$, $Ru(bpm)_3$, $Ru(bpz)_3$, and $Fe(CN)_6$, although only $Ru(bpy)_3$ was tested with a variety of light sources and variable intensity. Although the other 3 complexes appeared to work as catalysts in the system only $Ru(bpy)_3$ displayed observable oscillation under the conditions used. We were able to show that the UVB light sources had a 240% larger affect on the oscillation when compared to the LED. Along with demonstrating the expected decrease in oscillation period as light intensity increases with specific values of $-2.8(9)\ s * cm^2 * mW^{-1}$ for UVB light and $-2.9(5) \times 10^{-4}\ s * lx^{-1}$ for LED light.

SENIOR INDEPENDENT STUDY



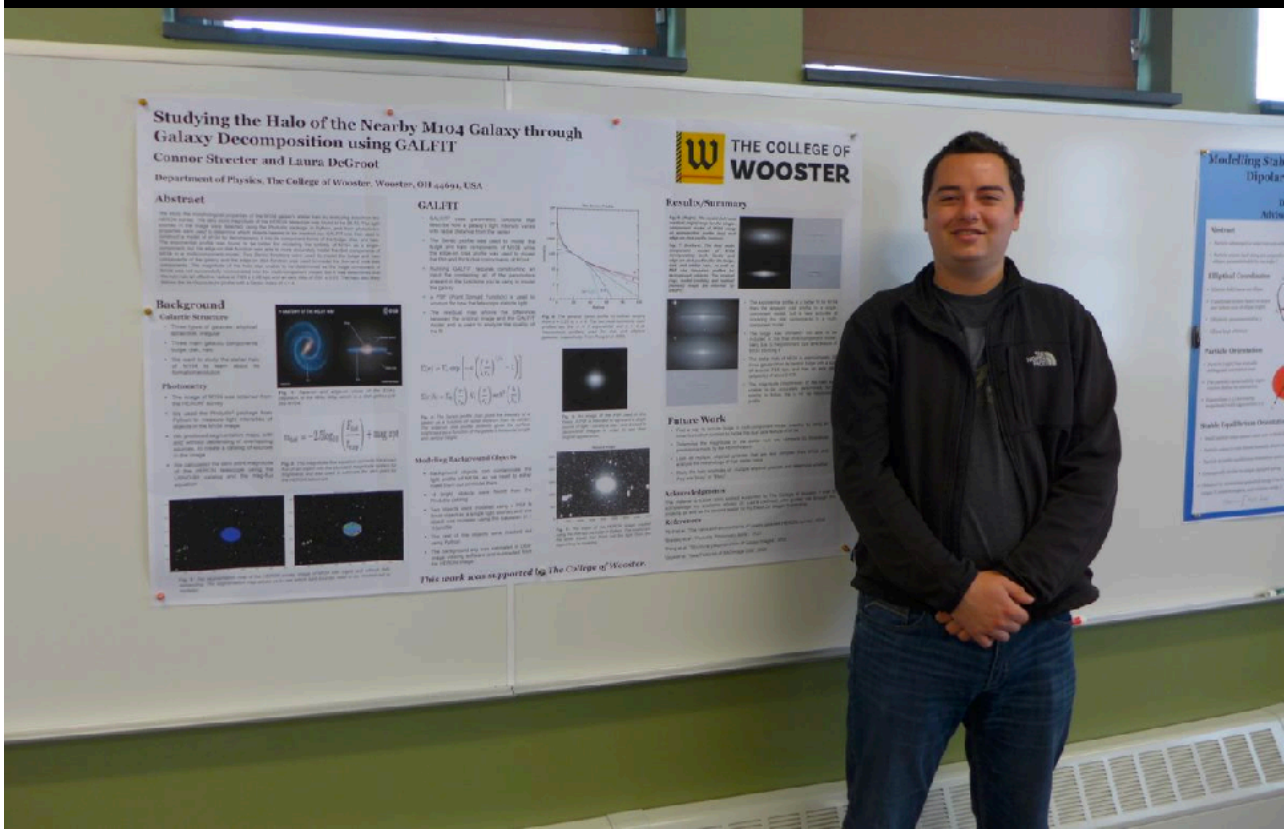
John Schmidt

Modelling Stable Equilibrium Orientations of a Submerged Dipolar Particle in an Electromagnetic Field

Advised by Dr. Cody Leary(Physics) and Dr. Michael Bush (Mathematics)

We developed a model of the torque acting on a subwavelength-scale particle propagating within an electromagnetic field given a water-submerged system, with the particle at any arbitrary orientation. From this, we derived stable equilibrium orientations of the particle and determined that the particle will orient itself along the axis perpendicular to its polarization ellipse, which is traced out by the electric field. We provided numerical methods to find the stable equilibrium orientations of the particle.

SENIOR INDEPENDENT STUDY



Connor Streeter

Studying the Halo of the Nearby M104 Galaxy through Galaxy Decomposition using GALFIT

Advised by Dr. Laura DeGroot

This thesis aimed to study the morphological properties of the M104 galaxy's stellar halo by analyzing data from the HERON survey. The zero point magnitude of the HERON telescope was calculated using data from the USNO-B1 star catalog, and was found to be 28.72. The light sources in the image were detected using the Photutils package in Python, and a catalog containing estimates of the photometric properties of these sources was created. This catalog was used to determine which objects were bright enough that they needed to be masked out due to their light contaminating the model of the galaxy. GALFIT was then used to construct a model of M104 by decomposing it into its component forms of the bulge, disk, and halo. Initially, a single-component model of M104 was made using an exponential profile, and then again using the edge-on disk profile. The exponential profile was found to be better for melding the entirety of M104 as a single-component, but the edge-on disk function was able to more accurately model the disk components of M104 in a multi-component model. Two Sersic functions were used to model the bulge and halo components of the galaxy and the edge-on disk function was used to model the thin and thick disk components. The magnitude of the halo was unable to be determined as the bulge component of M104 was not successfully incorporated into the multi-component model, but it was determined that the halo has an effective radius of 7.65±0.08 pixels and an axis ratio of 0.67± 0.03. The halo also likely follows the de Vaucouleurs profile with a Sersic index of n = 4.

2022-2023 COLLOQUIUM SERIES

Pictured Left to Right:
Clinton Braganza ’03, Asad Khan ’93, Prof. Susan Lehman, Emeritus Prof. Don Jacobs, Nithya Venkataraman ‘04

- Junior I.S. Self-Designed Experiments, featuring Physics Juniors, Tuesday, May 2, 2023
- “Career Paths of Physics Degree Holders”, featuring Joseph Smith ’15, Marietta College, Thursday, April 6, 2023
- “A scientist, a VP, and a CEO walk into a cleanroom…”, featuring Asad Khan ’93, Clinton Braganza ’03, and Nithya Venkataraman ’04, Thursday, February 23, 2023
- Research Opportunities with CoW Physics Faculty, featuring Dr Laura DeGroot, Dr Cody Leary, Dr Susan Lehman, and Dr Niklas Manz, Thursday, January 26, 2023
- Senior IS Fall Semester Presentations, Session 2, featuring Daniel Cohen Cobos, Harrison Clayman, Davis Patterson, Connor Streeter, and Michael Scarberry, Tuesday, December 6, 2022
- Senior IS Fall Semester Presentations, Session 1, featuring Dean Brown, Olivia Green, Raise Raofa, and John Schmidt, Tuesday, November 29, 2022
- Dr Cody Leary, 2022 Nobel Prize in Physics Colloquium, Tuesday, October 25, 2022
- Scott Crawford, Engineering Dual Degree Program at Washington University in St. Louis, Tuesday, October 18, 2022
- I don't know what you did last summer: Physics majors share summer research experiences, Tuesday, August 30, 2022

HONORS & AWARDS

The William A. Galvin Award for General Excellence in College Work
Raisa Raofa (1st Prize)

The Tom Neiswander Memorial Award
Raisa Raofa

The Arthur H. Compton Prize in Physics
Raisa Raofa

The Mahesh K. Garg Prize in Physics
Michael Scarberry

Ann C. Mowery Endowed Scholarship
Olivia Green

Joseph Albertus Culler Prize in Physics
Karmellah Buttler
Tali Lansing

Karl T. Compton Scholarship
Karmellah Buttler
Tali Lansing
Madelyn Noll

Koontz Research Scholar
Gus Thomas

Magna cum laude
Dean Brown
Raisa Raofa
John Schmidt
Connor Streeter
Sara Wargo

Cum laude
Harrison Clayman
Daniel Cohen-Cobos
Olivia Green
Michael Scarberry

JUNIOR INDEPENDENT STUDY SELF-DESIGNED EXPERIMENTS

Yohannes Abateneh '24
Force Profiles During a Deadlift

Sahil Bindal '24
Building a Piezoelectric Road

Nick Gaba '24
Empirical Characterization of Fly Rods and Connections to Casting Behavior

Amanuel Jissa '24
The Hysteresis Curve and the Ferromagnetic Domains: Impurity of Crystals

Abrar Khondker '24
Using Gravitational Lensing to Estimate Galactic Masses and Dark Matter Content of Samples from the Sloan Lens ACS Survey

Kelly Kim '24
The Inharmonicity of a Violin

Aidan Mason '24
Creating Stationary Waves in a Reaction-Diffusion-Advection System Using the Belousov-Zhabotinsky Reaction

Kelsey McEwen '24
Determining the Trajectory of an Anisotropic Particle Around an Optical Nanofiber

Luke Wilson '24
Measuring Earth's Rotation with a Compton Generator

FACULTY

Niklas Manz, Associate Professor of Physics and Chair

TEACHING

Calculus Physics I
Modern Physics Lab
Environmental Physics
Calculus Physics II Lab
2 Senior IS Advisees

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Biggest highlight for me: Invited talk at 'my' biannual Gordon Research Conference on Oscillations and Dynamic Instabilities in Chemical Systems in July – 18 years after my first talk.

For the last academic year:
I taught Environmental Physics again, which is always interesting and challenging because of the diverse students: this year ranging from a first-year prospective humanities major to a junior physics major.
A student success showing what perseverance means: after nearly two semesters, a Sorep student was able to recreate a physical oscillator known as the 'Trevelyan Rocker'.
I could use results from the successful 2022 summer REU to give a talk at our regional APS section (Eastern Great Lakes Section - EGLS) fall meeting and was invited to Marietta College. Both presentations covered "Table-top analogues to visualize physical phenomena using chemical waves".
One 2022 REU student, Mahala Wanner, gave her first oral presentation at a scientific conference at the same EGLS fall meeting. She enjoyed it so much that she even decided to give another talk at the national APS March meeting in Las Vegas. This summer, Gus Thomas '25, continued this project "Visualizing electron drift velocity", and we are now in the process of writing a manuscript.
At the end of the spring semester, I was invited to contribute a book chapter to the book "Do you know what you see? – Understanding marvelous patterns in complex system". I decided to show an interesting system I haven't used in Wooster yet, and worked with my other REU student, Aidan Mason '26, to create new images with our new 42 Megapixel color camera.
In April, I finished my one-year term as the chair of the Eastern Great Lakes section of APS and was able to secure the next three meeting locations until Fall 2024. Now I can focus on being 'just' the department chair.

FACULTY

Laura DeGroot, Assistant Professor of Physics

TEACHING

Astronomy of Stars & Galaxies
Computational Physics
Computational Physics Lab
Astronomy of the Solar System
Calculus Physics II
Calculus Physics II Lab
2 Senior IS Advisees

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Biggest highlight: I was thrilled to start my tenure-track assistant professor position in Fall 2022 after many years as a visiting assistant professor.

For the last academic year: This was the first academic year that I taught both introductory astronomy courses: Astronomy of Stars and Galaxies in the fall and Astronomy of the Solar system for the first time in the spring semester. These general education courses have a very diverse group of students, first-year through senior and from a variety of majors across campus, and it is always fun to teach them about the Universe. I also taught Computational Physics for the first time during the fall semester, and I thoroughly enjoyed teaching the students how to use Python programming to answer difficult physics problems computationally. I look forward to teaching Computational again in Spring 2024.

In the spring semester, I teamed up with Dr. Nieberding to lead the "Humpty Dumpty Experiment" at the annual Exploring STEM Day (formerly Expanding Horizons), a workshop for young women exploring STEM. I also continued working with the Physics Club to organize outreach at local elementary schools and the annual Science Day, an event that brings the campus and Wooster community to Taylor Hall to experience different STEM demonstrations and activities.

My 2022 REU student, Karmellah Buttler, attended and presented at two different conferences. She gave her first oral presentation at the regional APS conference (Eastern Great Lakes Section - EGLS), and also gave a poster at the national APS March Meeting in Las Vegas. Karmellah's great work as both a REU and SOREP student is currently being incorporated into a manuscript I am writing on the inside-out formation of disk galaxies.

FACULTY

Cody Leary, Associate Professor of Physics

TEACHING

Calculus Physics I
Modern Physics Lab
Electricity & Magnetism
Thermal Physics
General Relativity
3 Senior IS Advisees

Over the past year, Dr. Leary has continued his research mentorship and collaboration with Wooster students on projects involving the interaction of light with matter. This year, he worked with a sophomore student on an experimental project measuring geometric phases of light, generously supported by the departmental Koontz Endowed Fund. He also mentored a Jr I.S. student, previously supported by Wooster's Sophomore Research Program, as they constructed and improved models of forces and torques due to light-matter interactions in anisotropic media. In addition, he had the pleasure of working with three senior I.S. students on related research. This summer, he attended a three day immersion workshop put on by the Advanced Laboratory Physics Association. The purpose of the workshop was to gain experience with a flexible piece of equipment known as a spatial light modulator, which is capable of replacing a wide range of costly optical equipment in advanced laboratory projects. Dr. Leary will be enjoying a research leave during the fall of 2023, and is looking forward to having focused time to submit for publication some student-driven research results in nonlinear quantum optics and light-matter interactions in anisotropic media.

FACULTY

Susan Lehman, Victor J. Andrew Professor of Physics

TEACHING

Calculus Physics I Lab
Modern Physics
Calculus Physics II
Junior Independent Study
2 Senior IS Advisee

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2022 – 2023 was a good year for me in terms of research, teaching, and exploring ways to better impact students.

This year was my first one back to teaching since my research leave in 2021-2022. At the very end of the leave, I attended a wonderful Gordon Research Conference on Granular Materials that prompted a lot of new thinking for me about ways to analyze and interpret the data that we have for the bead pile system. My two I.S. students from this year both used these suggestions to start some new directions with the bead pile system which are quite promising. We are using some models from earth scientists studying earthquakes to better describe the time distribution of the avalanches, depending on size.

One of my summer 2022 REU students, Eric Johnson, presented his work at the fall EGLS meeting and won the best undergraduate poster presentation, which was a wonderful recognition for him.

Also in the fall, I had the opportunity to teach one of my very favorite classes, Modern Physics, for the first time in a few years. Modern Physics is such an exciting and surprising area that doesn't match with our everyday experience at all. I love teaching this material and focusing on how we know what we know – what was the experimental evidence that led us to develop quantum mechanics and these extraordinary conclusions about the nature of the atomic world? This iteration of the class also gave me the opportunity to repeat using some reading and reflection assignments, so that all of our physics students have a working knowledge of some of the issues affecting equity and inclusion in physics. These assignments have been well received by the students, and I am working to improve them still for the future.

Since I have taken over as PI of our NSF-REU program, I have been thinking quite a bit about ways that we could improve the program. Fortunately, the other physics REU PIs have created a leadership group where they share resources and discuss common issues and challenges. I attended their workshop in November which provided many new ideas. We've implemented some changes already in the 2023 REU program, and we have more ideas included in our next proposal to renew the grant. I'm excited to be leading this long time Wooster Physics program.

In the spring, I accompanied four of the 2022 REU students to the March Meeting in Las Vegas in March 2023. This was my first return to the in-person March Meeting since the sudden cancellation of the 2020 meeting, and it was great to be back. It was not so great to be in Las Vegas, which was a less than ideal venue in multiple ways, but it was so wonderful just to be back in the multilingual buzz of a crowded hallway outside the presentation rooms, while thousands of scientists talked about their results, prepared their presentations, and made the most of those few days together.

FACULTY

Megan Nieberding,

Visiting Assistant Professor of Physics

TEACHING

Algebra Physics I
Calculus Physics I Lab
Mechanics
Algebra Physics II
Calculus Physics II Lab
Math Methods for Physical Scientists

Biggest highlights for me:
It was my first time celebrating all of the seniors' hard work and achievements at commencement from a professor's point of view. To see the seniors walk across the stage and know how much strength and perseverance it took to get there makes me feel so proud of them.
Additionally, I spent most of my free time during the 22-23 academic year planning my wedding. After months and months of planning, I finally got to celebrate my wedding with all of my friends and family members at the end of May. The whole day I was beaming and filled with so much joy!
For the last academic year:
Back in August of 2022, I started my first year as a professor. I didn't know just how much I would enjoy this new role, and after a year of being a professor here at Wooster, I can say that it brings me so much more joy and satisfaction than I originally imagined. I really enjoy seeing the progress of my students' learning over the course of a semester. And I really love sharing with my students the connections and applications between physics and the real world. I think it makes physics more exciting and inspiring when you can see the laws of physics in action. This next year, I am excited for take #2 as a professor and seeing how much I have grown from my first class.

STAFF

Manon Grugel-Watson '99
Physics Laboratory Coordinator & Instructor, B-WISER Camp Project Director

TEACHING

Algebra Physics Lab
Algebra Physics II Lab
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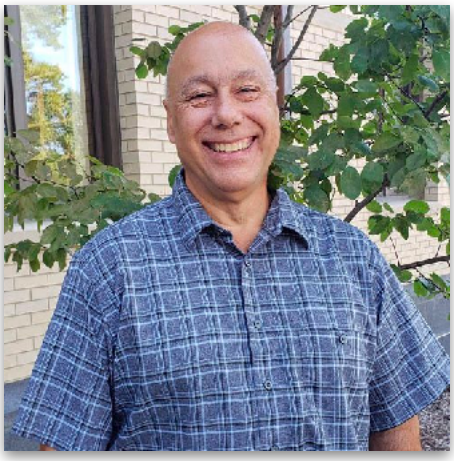
Manon Grugel-Watson is the Physics Department Laboratory Coordinator, Laboratory Instructor, and Project Coordinator for B-WISER science camp for middle school girls. Manon is responsible for the Physics Department's laboratory and demonstration equipment as well as the setup for introductory and advanced lab courses. In addition, Manon taught the Algebra Physics Introductory Lab sections again this past year. She also works throughout the year to secure funding and manage the on-campus logistics of running the Buckeye Women in Science Engineering and Research (B-WISER) institute. The week-long residential program is for girls across the state interested in STEM. B-WISER provides young women with an intensive, cooperative lab-based experience in physics, chemistry, biology, geology, engineering, as well as some advanced topics. If you know any 7th or 8th graders who might be might be interested, please direct them to the camp website: https://bwiser.spaces.wooster.edu/

STAFF

Craig First
Administrative Coordinator,
Physics and Mathematical & Computational Sciences



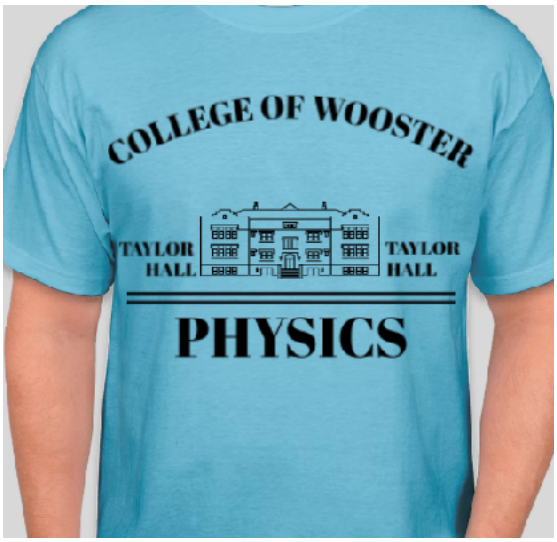
Timothy Siegenthaler
Instrument and Lab Tech/Machinist,
Biology, Chemistry, Earth Sciences, Physics

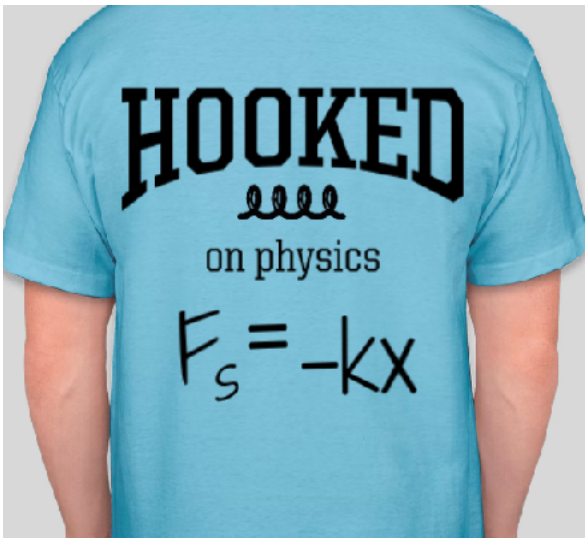
PHYSICS CLUB

OFFICERS

President: Abrar Khondker
Vice-President: Tali Lansing
Treasurer: Michael Scarberry
Secretary: Olivia Green
Faculty Advisor: Dr. Laura DeGroot

PHYSICS CLUB T-SHIRT





Designed by

Tali Lansing

ASTRONOMY CLUB

Independent Eyes, Observing Together

OFFICERS

President: Lily Baker
Vice President: Tali Lansing
Treasurer: Naz Younus
Secretary: Caroline Ward
Faculty Advisor: Dr. Laura DeGroot

ASTRONOMY CLUB T-SHIRT

Designed by

Aeralyn Flynn

CONFERENCES

** denotes Wooster student; † denotes summer research student*

Daniel Cohen Cobos*, Niklas Manz, and Heather Guarnera, Simulating Reaction-Diffusion Waves as an Analog for Gravitational Lensing, American Physical Society – Eastern Great Lakes Section, Rochester, MI (April 2023)

Michael Scarberry*, Niklas Manz, and Sarah Sobeck, Belousov–Zhabotinsky Reaction and its Metal Complex Catalysts, American Physical Society – Eastern Great Lakes Section, Rochester, MI (April 2023).

Karmellah Buttler*†, Laura DeGroot, Using Color Gradients to Study the Inside-Out Formation of Disk Galaxies at 0.8 ≤ z ≤ 1.0, American Physical Society, Las Vegas, NV (March 2023).

Olivia Green*†, Cody Leary, A Two-Photon Investigation of Nonlinear Sample Properties, American Physical Society, Las Vegas, NV (March 2023).

Kyla Koos*†, Cody Leary, A Modeling Interference of a Two-Photon State Using Optical Pulses, American Physical Society, Las Vegas, NV (March 2023).

Susan Lehman, Slip Avalanches on a Conical Bead Pile With Cohesion (oral presentation), American Physical Society, Las Vegas, NV (March 2023).

Mahala Wanner†, Niklas Manz, Visualizing electron drift velocity (oral presentation), American Physical Society, Las Vegas, NV (March 2023).

Left: CUWiP Meeting, February 20-22 Penn State University
Top Right: EGLS Spring Meeting, April 1, Oakland University
Bottom Right: APS March Meeting, March 6-10, Las Vegas, NV

CONFERENCES

** denotes Wooster student; † denotes summer research student*

Karmellah Buttler*†, Laura DeGroot, Using Color Gradients to Study the Inside-Out Formation of Disk Galaxies at 0.8 ≤ z ≤ 1.0 (oral presentation), American Physical Society – Eastern Great Lakes Section, Southfield, MI (October 2022).

Olivia Green*†, Cody Leary, A Two-Photon Investigation of Nonlinear Sample Properties, American Physical Society – Eastern Great Lakes Section, Southfield, MI (October 2022).

Aman Jissa*†, Cody Leary, Measuring the phase accumulation of a changing polarization state of light, American Physical Society – Eastern Great Lakes Section, Southfield, MI (October 2022).

Eric Johnson*†, Susan Lehman, Avalanche Occurrence on a Conical Bead Pile With Cohesion, American Physical Society – Eastern Great Lakes Section, Southfield, MI (October 2022).

John Schmidt*†, Paul Bonvallet, Experimentally Determining the Young's Modulus for Compression of Swellable Organically Modified Silica, American Physical Society – Eastern Great Lakes Section, Southfield, MI (October 2022).

Mahala Wanner†, Niklas Manz, Table-top Analogues Using Chemical Waves: Electron Drift Velocity (oral presentation), American Physical Society – Eastern Great Lakes Section, Southfield, MI (October 2022).

Kiyomi Sanders†, Niklas Manz, Table-top Analogues Using Chemical Waves: Gravitational Lensing Effect, American Physical Society – Far West Section, Honolulu, HI (October 2022).

Niklas Manz, Evolution towards the now accepted name Belousov–Zhabotinsky reaction, Gordon Research Conference on Oscillations & Chemical Instabilities, Stonehill College, Easton, MA (July 2022).

EGLS Fall Meeting, October 20-21, Lawrence Technological University

Click here to see the press release regarding awards received by Eric Johnson and Mahala Wanner.

COMPETITIONS

The 2022 University Physics Competition

The University Physics Competition is an international contest for undergraduate students, who worked in teams of up to three students at their home colleges and universities all over the world, and spent 48 hours during the weekend of November 4, 5, & 6, 2022, analyzing a scenario using the principles of physics, and writing a formal paper describing their work.

In this year's competition 417 teams submitted papers for judging. 230 teams selected "Problem A – Deflecting an Asteroid" and 187 teams selected "Problem B – FIFA Penalty Kicks."

The Wooster Team of Olivia Green '23, Aman Jissa '24, and Raisa Raofa '23 received a Bronze Medal.

SUMMER RESEARCH

WOOSTER NSF-REU

Elliot Candela (Mt Holyoke ’24) (Advised by Laura DeGroot)
Testing GALFIT using Sersic 2D Simulated Galaxies

Aeralyn Flynn (Wooster ’25) (Advised by Susan Lehman)
Analyzing Avalanche Frequency Patterns

Abrar Khondker (Wooster ‘24) (Advised by Laura DeGroot)
Identifying Clumpy Galaxies: Insights from GALFIT and Non-Parametric Measurements

Nico Martinelli (Denison ‘25) (Advised by Susan Lehman)
Using Video Analysis to Track Velocity of Avalanching Beads on a Conical Bead Pile

Aidan Mason (Wooster ‘ 24) (Advised by Niklas Manz)
Effects of Laminar Flow on the Belousov-Zhabotinsky Reaction

Liv McClintock (NC State ’25) (Advised by Paul Bonvallet)
Optimizing the synthesis of 5-phenyldipyrromethane for the preparation of a Porphyrin-PYBOX hybrid

Duyen Nguyen (Franklin & Marshall ’24) (Advised by Laura DeGroot)
Determining the Best Methods to Identify Disk Galaxies

Joshua Patel (Berea ‘26) (Advised by Susan Lehman)
Determining the Global and Local Angles of Repose on a Bead Pile

Hannah Savoy (St Olaf ’25) (Advised by Paul Bonvallet)
Absorption Capacity of SOMS at Cold and Room Temperatures

Veran Stanek (Rochester Institute of Technology ’26) (Advised by Niklas Manz)
Simulating a Black Hole Event Horizon with a Light-Sensitive Belousov-Zhabotinksy system

Gus Thomas (Wooster ’25) (Advised by Niklas Manz)
One-Dimensional Belousov-Zhabotinsky Chemical Wave System as an Electron Drift Analog

Garrett Worden (Lorain County Community College ‘ 25) (Advised by Paul Bonvallet)
Finding Change in Enthalpy Associated with Swelling of Swellable Organically Modified Silica via Calorimetry