WOOSTER PHYSICS

2019-2020 Annual Report

physics.wooster.edu

A Note from Dr. Cody Leary, Dept. Chair

Greetings from Cody Leary, Chair of Physics. The physics department had plenty of good news to report this year, notwithstanding the surprise transition to remote courses in the spring! Here are a few items of note that I would like to highlight:

- We were very pleased to be able to begin awarding our new Ann C Mowery Endowed Scholarship, awarded this year to Abigail Ambrose ’20. This scholarship was established in 2018 with a gift from Wooster chemical physics major Ann C. Mowery ‘82, in honor of her parents. The award is presented to a senior student who has demonstrated a genuine love of doing physics, creative thinking in a research project, and who intends to pursue a career in science, engineering, medicine, entrepreneurship or education.

- We are also excited to announce the new Koontz Physics Endowment, established in 2019 Nancy Koontz Malville ’59 and her husband, John M. Malville, in memory of Nancy’s father, Philip Grant Koontz, a prominent experimental physicist. During his 36-year career, Dr. Koontz served as a member of University of Chicago’s Metallurgy Project (1942-1943), the Manhattan Project (1943-1946) and Critical Assembly Group (1955-1971) at Los Alamos Scientific Laboratory, and as The College of Wooster’s Associate Professor of Physics (1946-1955). Income from this fund will provide financial support to Wooster students who are engaged in experimental physics research projects!

- Although the American Physical Society March Meeting, where our students often present their research, was cancelled this year, a number our students had the opportunity to attend other conferences earlier in the year such as The Conference for Undergraduate Women in Physics at Carnegie Mellon University, and The American Astronomical Society Meeting in Hawaii!

- While we had a healthy number of physics colloquia while still in person, a highlight of the year was welcoming Amanda Steinhebel ’15 for a virtual presentation from her appointment at the CERN particle collider on the French-Swiss border. Amanda is currently pursuing her PhD in particle physics from the University of Oregon, and presented her talk *High Energies and High Hopes: Graduate School in Particle Physics* at the invitation of our Physics Club.

Wishing each of you well this year and hoping that we can stay in touch!

2020 VIRTUAL COMMENCEMENT

Forever Scots!

Monday, May 11, 2020

CLASS OF 2020

Ben Hessman, Abigail Ambrose, Christian Julius, Nicky Rosner, Adam Deeley

3/2 Engineering
Dual Degree Program

Ben Hessman (Physics Major from Magnolia, TX)

SENIOR INDEPENDENT STUDY

Abigail Ambrose (Physics Major from Coshocton, Ohio)

Using the Gaia DR2 to Observe Stellar Streams and Dark Matter Distribution in the Milky Way

Advised by Laura Degroot (Physics)

Using data from the second Gaia data release, we have observations of the positions and motions of many stars within our Galaxy and we can use this information to construct a rotation curve for our Galaxy. From the rotation curve, it is known that the total mass of the Galaxy is more than the expected mass from luminous matter. From this rotation curve, we can also find the dark matter density within the Milky Way. With information about the dark matter density of the Milky Way, we can study other impacts of dark matter such as changes in the motion of stars. From this, we can gain a further understanding of the detailed dark matter distribution within the Galaxy. By observing how the stars are perturbed within stellar streams, we can detect dark matter subhalos within the dark matter halo of the Milky Way galaxy. In order to do this, we are using the second Gaia data release to observe the stars within the GD-1 and Sagittarius stellar streams. We are replicating the work done by Price-Whelan & Bonaca (2018) [1] on the GD-1 stellar stream and applying the methodology to the Sagittarius stellar stream. By looking for deviations in the uniform distribution of stars in the stream, we can begin to see where dark matter subhalos are, furthering our understanding of the dark matter distribution in the Milky Way. We found similar density variations as found by Price-Whelan & Bonaca (2018) for GD-1. We then began applying the methodology for Sagittarius which shows areas we expect may have density variations. In order to do this accurately, we cross matched the data with Pan-STARRS DR2 to determine the metallicity of the stars in the stream and how it varies from the stars in the Milky Way.

SENIOR INDEPENDENT STUDY

Adam Deeley (Physics Major from Youngstown, Ohio)

Studying Avalanches on a Conical Bead Pile

Advised by Susan Lehman (Physics)

The height in which beads are dropped was investigated as a tuning parameter for a conical beadpile oscillating through critical states. The change is driven by dropping beads one at a time on to the apex of the pile. By comparing the probability distribution function of avalanche sizes to previous data, we are able to verify the use of a new set of beads used for the experiment. Also explored was the effect of drop height and threshold value on the
inter-event time probability density. By varying the threshold we can closer approximate the shifting point where small avalanche regime behavior ceases. The point is determined by how well the data are fit by a Weibull distribution versus a Brownian passage-time distribution, typically used to fit data from small to large thresholds, respectively.
This experiment determined that with a drop height of 2 cm and no added cohesion, small avalanche behavior ceased at thresholds greater than or equal to 350 beads. For a drop height of 4 cm, small avalanche behavior ceased at thresholds greater than or equal to 375 beads. For a drop height of 6 cm, there was no threshold which displayed a shift from small to large avalanche
behavior. The shift most certainly occurs somewhere, however the data sets do not have enough data points to accurately determine the peak of the probability density function, as there are a very small number of avalanches greater than 300 beads at this drop height.

SENIOR INDEPENDENT STUDY

Christian Julius (Physics Major from Lantana, Texas)

Phase Memory of Photons

Advised by Cody Leary (Physics)

This experiment explores what happens to a laser beam when different polarization states of light are sent through an interferometer with a changing effective phase retardance between vertical and horizontal polarization states. This was tested in a Mathematica simulation and then in the lab with three different types of birefringent crystals: A zero-order, a multi-order, and a beta barium borate (BBO) crystal. After investigating the effects of the first two crystals, the BBO crystal was tested and the results were inconclusive. Data was taken by rotating the BBO crystal and recording the intensity at every 0.5○ rotation. The calibration data was either at a peak or a trough which agreed with our theory, Chap. 2. This was modeled in a Mathematica notebook Fig. 2.3 During the second run with an incoming polarization state of 45○, we attempted to match the calibration data by recording the intensity at every 0.5○. From this we were able to see an intensity difference , but no shift in peaks relative to the horizontally polarized case. We took another data set with an incoming polarization state of 45○ but measured the intensity at every 0.33○ rotation of the BBO crystal and we were able to see a shift in peaks relative to the horizontally polarized case. Even though there is a shift in peaks between the two tested cases, the results of the experiment were inconclusive because there is not enough evidence to claim that there is a phase shift that is consistent with our predictions.

SENIOR INDEPENDENT STUDY

Nicky Rosner (Physics Major from Wooster, Ohio)

Quantification of Disk Galaxy Formation through Ultraviolet Light

@ 0.08<z<1.2

Advised by Laura DeGroot (Physics)

In this study, the goal was to produce evidence that would suggest how galaxy disks form, with the leading two theories being inside-out growth and outside-in growth. To accomplish this task, we selected a sample of 2,094 galaxies in the GOODS-South field that were in the peak star formation redshift range of 0.8 to 1.2. These galaxies also had to have images in rest-frame visible light (using the F105W filter or F125W filter aboard the Hubble Space Telescope) and in ultraviolet light (using the F275W filter or F336W filter) because rest-frame visible light tells us where established star populations are and rest-frame ultraviolet light tells us where new stars are forming. We then cut out postage stamps of each galaxy in both types of light. Bad-pixel masks were created for each postage stamp to eliminate light sources other than the target galaxies. After this, we used GALFIT to model the light distribution and extract the morphological information about each galaxy. After limiting the sample to galaxies with successful and accurate models, our final sample contained 288 galaxies. We compared the effective radii of our final sample of galaxies in rest-frame ultraviolet versus rest-frame visible light to determine where new stars were forming in galaxy disks. We found that 75%, or 216, of our 288 galaxies had larger effective radii in rest-frame visible light than in rest-frame ultraviolet light, supporting the theory that galaxy disks form outside-in. This means that only 25%, or 72, of our 288 galaxies had larger effective radii in rest-frame ultraviolet light than in rest-frame visible light, supporting the theory that galaxy disks form inside-out.

2019-2020 COLLOQUIUM SERIES

- **Matthew Vossler, M.S.**, Cleveland Clinic, **Medical Physics as a Potential Career**, 27 February 2020
- **Intro to the major, Information Session**, 20 February 2020
- **Research opportunities with CoW Physics faculty**, 23 January 2020
- Senior I.S. progress reports, **Sr. IS Oral Presentations**, 5 December 2019
- Junior I.S. Self-Designed Experiments, **Jr IS Oral Presentations**, 3 December 2019
- **Emily Griffith**, Ohio State University, **Abundance Ratios in GALAH DR2 and their Implications for Nucleosynthesis**, 7 November 2019
- **Lydia Kisley**, Case Western Reserve University, **Physics at the Ultimate Concentration Limit... Measuring One Molecule at a Time**, 22 October 2019
- **Paul Voytas**, Wittenberg University, **Weak interaction through nuclear beta decay**, 3 October 2019
- Physics Department Safety Training, 24 September 2019
- Scott Crawford, Washington University, St. Louis, MO, **3-2 Engineering Dual Degree program**, 26 September 2019
- Jared Miles, Wright Patterson AFB, **Atomic localization and Refractive index engineering**, 17 September 2019
- Megan Fisher '21, Matt Klonowski '21, Mili Barai '21, Maya Lapp '20, **I don't know what you did last summer: Physics majors share summer research experiences**, 5 September 2019
- Abigail Ambrose '20, Melita Wiles '22, Handeul Son '21, Fish Yu '21, Carlos Owusu-Ansah '21, **I don't know what you did last summer: Physics majors share summer research experiences**, 29 August 2019

HONORS & AWARDS

FOR PHYSICS MAJORS

The Arthur H. Compton Prize in Physics
Adam Deeley
Abigail Ambrose

The Joseph Albertus Culler Prize in Physics
Teague Curless
Ben Stern

The Mahesh K. Garg Prize in Physics
Abigail Ambrose

Karl T. Compton Scholarship
Teague Curless
Ben Stern

Ann C. Mowery Scholarship
Abigail Ambrose

JUNIOR
INDEPENDENT STUDY
SELF-DESIGNED EXPERIMENTS

Megan Fisher
Using a Light Bulb Filament to Verify Power-Temperature Proportionality in an Approximate Blackbody Radiator

Matt Klonowski
Brief Exploration of Superconductivity's Temperature-dependence

Craig Klumpp
Measuring the Drag Coefficient of a Swimmer with a Parachute

Andrew Kunkel
Estimating G Using a Gravitational Torsion Balance

Katie Shideler
Measuring Energy Dissipation Within Various Granular Matter by Means of Hacky Sacking

Huiking Qian
Using laser to achieve a delay of particle

Ariel Xie
Coulomb's Law and Leakage of Charges

Fish Yu
The Stefan-Boltzmann Law

FACULTY

Cody Leary

Associate Professor of Physics

TEACHING

Modern Physics + Lab
Electronics for Science Lab
Quantum Mechanics
Math Methods for Physical Sciences
Senior Independent Study advisor

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Although Dr. Leary kept himself quite busy chairing the department for the 2019-20 academic year, he still found time to escape back to Eugene, Oregon to attend the Southwest Quantum Information and Technology (SQuInT 2020) conference. At SQuInT, Dr. Leary presented results from Quantum Optics research that he performed while on leave at the University of Oregon in Fall 2018. He also carved out time to grab lunch with physics alumni Deepika Sundaraman '14, Nicu Istrate '15, and Haidar Esseili '19, all currently pursuing their physics Ph.D.'s at Oregon.

FACULTY

John Lindner

Professor of Physics

Moore Professor of Astronomy

TEACHING

Sabbatical 2019-2020

First Year Seminar
Calculus Physics I Lab
Electricity & Magnetism
Math Methods for Physical Sciences
Computational Physics
Senior Independent Study advisor

****

"I had the privilege of spending the 2019-2020 academic year as a Visiting Professor at North Carolina State University in Raleigh, where I was able to complete old and new research projects. Working with NCSU's Nonlinear Artificial Intelligence Laboratory, I helped demonstrate that a new physics-informed machine learning algorithm, a Hamiltonian neural network, can learn and forecast nonlinear dynamics through transitions from order to chaos, even for complicated higher-dimensional systems, and without using special "canonical" coordinates. Working remotely with Wooster faculty and students (and a local dentist), I helped show that differential swell implies logarithmic growth of swellable materials, describe benign migratory glossitis or "geographic tongue" using reaction-diffusion equations, and investigate the interaction of reaction-diffusion wavefronts with concave, fractal, and soft obstacles. I am thankful for an interdisciplinary sabbatical involving contributions to machine learning, chemical and medical physics, which has generated six manuscripts, two published and four under review."

Dr. Lindner is a regular contributor to the Department's Physics Blog:
http://woosterphysicists.scotblogs.wooster.edu/author/jlindner/

FACULTY

Susan Lehman

Victor J. Andrew Professor of Physics

TEACHING

Modern Physics
Electronics for Scientists + Lab
Junior Independent Study, fall & spring
1 Senior Independent Study advisee
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Dr Lehman had a busy year of teaching as a large number of junior physics majors meant that we needed to teach both a fall and a spring section of Junior Independent Study for only the third time in department history. In the spring, she also made some changes to the structure of Junior Independent Study to introduce some lab measurement and analysis techniques to groups in the class, since the increased numbers of students in the class overall have made one-on-one teaching less manageable. Continuing the class after the College went remote due to the pandemic was a challenge, but the students rose to the occasion with some great at-home projects including studying the flight of soccer balls, and using a smartphone to measure the electrical signals from the heart.

Dr Lehman was invited to give colloquia on her bead pile research at both Oberlin College and Denison University, and enjoyed catching up with colleagues at both institutions. She also traveled to Louisiana and gave talks on her research and the department's REU program at Southern University in Baton Rouge and at Xavier University of New Orleans.

FACULTY

Niklas Manz

Assistant Professor of Physics

Meeting 177 years of experience in non-linear dynamics

Dr. Manz meeting with Scientist Hermann Haken for BZ-history project

Dr. Manz meeting with Scientist Horst-Dieter Försterling for BZ-history project

TEACHING

First Year Seminar
Calculus Physics
Modern Physics Lab
Senior Independent Study advisor
Sabbatical Spring 2020

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Dr. Manz, on sabbatical during spring semester, spent time in Germany & Russia, doing research, interviewing scientists, and enjoying nature. He attended a conference in Germany and chose to hike the 7 miles each way from the train station to the hotel.

He was also invited to speak on the topic "An Impossible Reaction: Chemical Tales from the Cold War" at Moscow State University, Department of Physics and The Institute of Theoretical and Experimental Biophysics, Russian Academy of Sciences, both in Russia.

Dr. Manz is a contributor to the Department's Physics Blog:
http://woosterphysicists.scotblogs.wooster.edu/author/nmanz/

FACULTY

Laura DeGroot

Visiting Assistant Professor of Physics

Andrew Kunkel, Abigail Ambrose, Maria Cook, Megan Fisher and Dr. Degroot in Hawaii at the AAS Conference.

TEACHING

Calculus Physics I + Lab
Calculus Physics II + Lab
Astronomy of Stars and Galaxies
Senior Independent Study advisor

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Dr. DeGroot took four students to the American Astronomy Society (AAS) conference in Honolulu, HI. At the conference, Laura presented a poster titled "Investigating the radial color gradients in galaxies - do galaxy disks form inside-out?" The four students also presented posters. Abigail Ambrose presented on her senior I.S. research, Andrew Kunkel and Maria Cook presented the work they completed in the 2019 Wooster summer REU program, and Megan Fisher presented on work that she completed in an off-campus REU program.

FACULTY

James Zabel

Visiting Assistant Professor of Physics

TEACHING

Classical Mechanics
Particle Physics
Mechanics & Heat (Algebra based)
Mechanics & Heat Lab (Calculus based)
Electricity & Magnetism (Algebra based)
Electricity & Magnetism Lab (Calculus based)
****

Dr. Zabel came to Wooster from the Houston, Texas area. He received his B.S., Mathematics and Physics from The University of Texas at Austin in 2007, his M.S., Particle Physics from Rice University in 2013, and his Ph.D., Particle Physics from Rice University in 2017. His field of expertise is in High Energy Experimental Particle Physics.

Before coming to Wooster, Dr. Zabel served as an Adjunct Professor at San Jacinto College in Houston, Texas and was a lecturer at Grinnell College in Grinnell, Iowa.

FACULTY/STAFF

Manon Grugel-Watson '99

Physics Laboratory Coordinator and Instructor

TEACHING

Algebra Physics Introductory Lab

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Dr. Manon taught the Algebra Physics Introductory Lab sections again this year. With the transition to remote classes last spring, she redesigned the remaining intro labs, utilizing exploratory simulations as a way for students to investigate various lab topics.

Manon is also taking over as the Project Director for BWISER (Buckeye Women in Science, Engineering, and Research), a science camp for middle school girls hosted by The College of Wooster. Unfortunately, the 2020 camp was cancelled due to the COVID crisis, but she hopes to get it up and running in the coming year.

Dawn Parker

Administrative Coordinator, Taylor Hall

Dawn came to Taylor Hall as the Administrative Coordinator following the retirement of Jackie Middleton. Dawn previously served as the Payroll Administrator here at The College of Wooster and has a background in Accounting, Payroll, and Business Management.

"It is a pleasure working with the Faculty in Taylor and with our wonderful students."

PHYSICS CLUB

Taylor Bowl: Each year, both the physics and math clubs and department faculty compete in a bowling competition to win the coveted slide rule trophy. Physics Club won this competition in 2019 for the first time in 10 years. Because this event could not be held this year, the slide rule still resides on the physics floor.

OFFICERS

President: Abigail Ambrose
Vice-President: Megan Fisher
Treasurer: Mili Barai
Secretary: Andrew Kunkel
Faculty Advisor: Dr. Laura DeGroot

EVENTS

Scot Spirit Day: The academic year began with the campus-wide recruiting event for all campus student organizations. This year, the table for the SPS chapter had a telescope pointed towards a flagpole on a golf course off campus. (in the opposite direction of the sun) as well as liquid nitrogen to crush leaves and to fill film canisters for “rockets.” This got many people who would not typically be interested in physics to come to the table with all the excitement.

Luce Dinner: The annual kickstart recruitment event is Luce Dinner. Students, faculty, and staff from the department meet in Luce residence hall and share pizza. After the pizza, liquid nitrogen ice cream and sorbet are made. This event gives incoming students the opportunity to meet the faculty and older students very early on so they are able to form relationships within the department.

PHYSICS CLUB

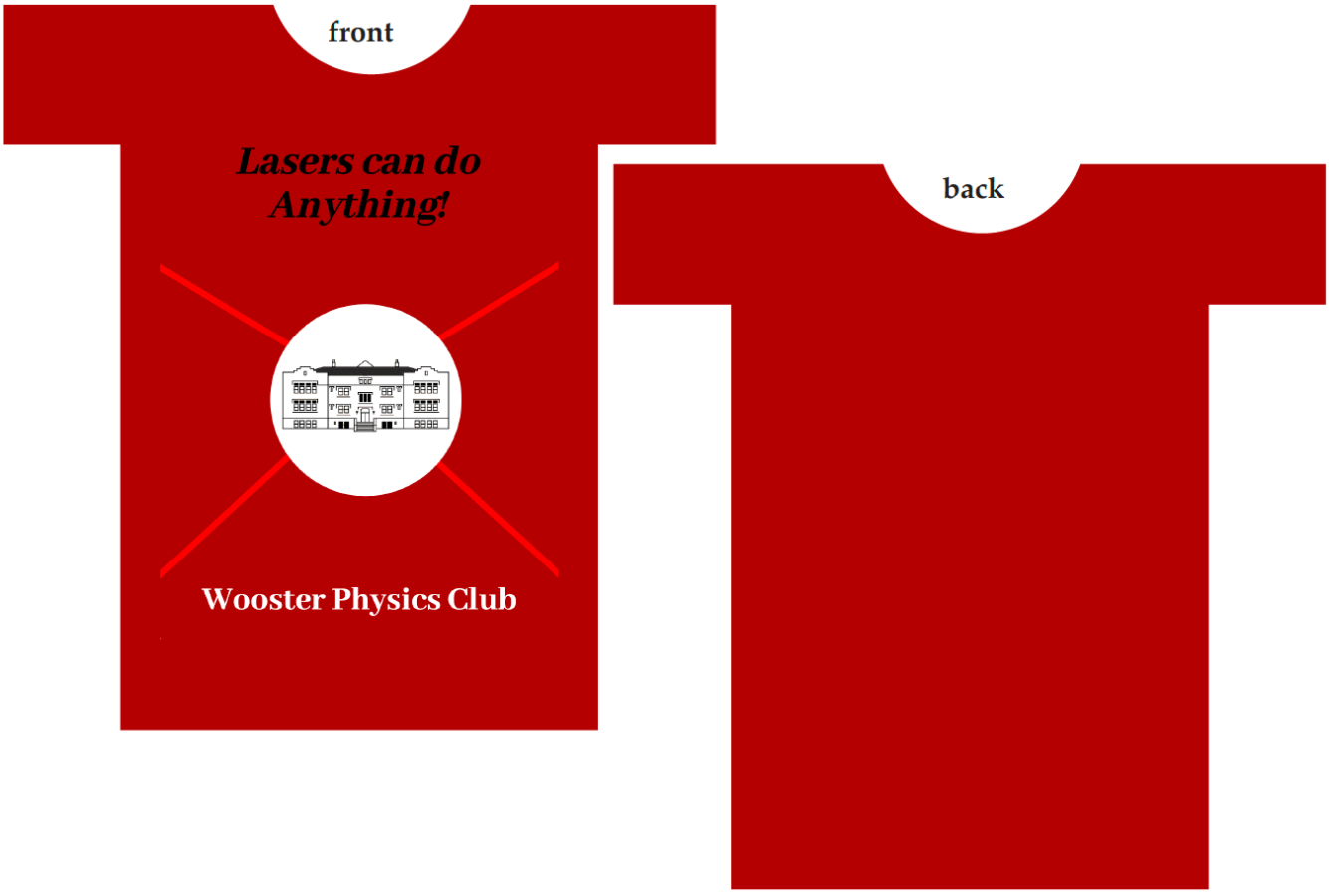
PLANNED EVENTS

STEM bash: The College of Wooster has established a STEM zone, where upper class students who are STEM majors can join as interns and students taking introductory classes can come to ask for help related to their homework, exams preparations, etc.

Astrophotography Contest (cancelled spring 2020): This year would have been the fourth annual astrophotography contest where members of the community can submit photos taken of the sky, either using our campus observatory or their own equipment.

Science Day (cancelled spring 2020): The biggest outreach event of the year where 100-200 elementary students, college students, and community come to Taylor Hall to see science demos from all of the science clubs on campus.

PHYSICS CLUB T-SHIRT



The 2019-2020 T-shirt was focused like a laser!

*A laser is produces a very narrow beam of light that is useful in many technologies and instruments. The letters in the word laser stand for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation.

PHYSICS CLUB

Community Service and Outreach

Local students enjoying some Physics demonstrations given by College of Wooster Physics Club members

Outreach:

Each spring semester, The College of Wooster Physics and Astronomy Club members team up to visit some very excited elementary and middle school students. Two to three students travel to local elementary & middle schools twice a week to present interactive modules to students, who participate in demonstrations and ask questions throughout the presentations. Demonstrations include States of Matter, Forces in Motion, Electricity and Magnetism and cover all basic areas of physics.

At the end of each demonstration, students ask follow-up questions and discuss science in general and they also ask questions about college, such as what the life of a college student is like. This program helps educate and inspire young girls and boys to become excited about science by participating in hands-on learning and experiments in addition to their school science curriculum.

Wooster Science Café:

Spoon, a local restaurant in downtown Wooster, hosts a monthly science café for community members to learn more about all areas of science. To start off the year's science cafes, groups were invited to give outreach demonstrations. Members of the Physics Club brought some of their favorite demos, including liquid nitrogen to freeze marshmallows, a vacuum chamber, and the rotational momentum demonstration.

ASTRONOMY CLUB

Independent Eyes, Observing Together

OFFICERS

President: Abigail Ambrose
Vice President: Mili Barai
Treasurer: Megan Fisher
Secretary: Andrew Kunkel
Faculty Advisor: Dr. Laura DeGroot

ASTRONOMY CLUB T-SHIRT

*Redshift and blueshift describe how light shifts toward shorter or longer wavelengths as objects in space (such as stars or galaxies) move closer or farther away from us. The concept is key to charting the universe's expansion.

Visible light is a spectrum of colors, which is clear to anyone who has looked at a rainbow. When an object moves away from us, the light is shifted to the red end of the spectrum, as its wavelengths get longer. If an object moves closer, the light moves to the blue end of the spectrum, as its wavelengths get shorter.

CONFERENCES

STUDENT PRESENTATIONS

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

- **Fish Yu*†, Chase Fuller*†, Margaret McGuire*†**, John F. Lindner, Niklas Manz, Reaction-diffusion waves interacting with fractals, spirals, and concave & soft obstacles, American Physical Society, Denver, CO (March 2020).
- **Melita Wiles*†**, John F. Lindner, Energy Stability of Gravitationally Interacting Rods and Dumbbells, American Physical Society, Denver, CO (March 2020).
- **Dustin Savelli†**, Ariel Xie*†, Cody Leary, Transfer of Linear and Angular Momentum from Evanescent Fields of an Optical Fiber to Isotropic and Anisotropic Dipolar Spheres, American Physical Society, Denver, CO (March 2020).
- **Brian P. Corbin*†**, John F. Lindner, Paul A. Bonvallet, Logarithmic Expansion of Swellable Organosilica Material, American Physical Society, Denver, CO (March 2020).
- **Sam Cavender†, Sam Nash*, Marc E. Manheim***, Niklas Manz, Reaction-Diffusion Waves as a Black Hole Event Horizon Analogue, American Physical Society, Denver, CO (March 2020).
- **Bennett Anderson*†**, Susan Lehman, Automated Measurement of the Profile of an Avalanching Conical Bead Pile, American Physical Society, Denver, CO (March 2020).
- **Andrew Kunkel*†**, Laura DeGroot, GDR2 Radial Velocity Analysis According to Spiral Density Wave Theory, American Astronomical Society, Honolulu, HI (January 2020).
- **Maria Cook†**, Laura DeGroot, Studying the Bulges of Distant Galaxies, American Astronomical Society, Honolulu, HI (January 2020).
- **Megan Fisher***, D. Falconer, R. Moore, S. Tiwari, Improving the Forecasting of Drivers of Sever Space Weather with the New MAG4 HMI Vector Magnetogram Database, American Astronomical Society, Honolulu, HI (January 2020).
- **Abigail Ambrose*†**, Laura DeGroot, Using Gaia DR2 to Observe Stellar Streams and Dark Matter Distribution in the Milky Way, American Astronomical Society, Honolulu, HI (January 2020).
- **Laura DeGroot, Swara Ravindranath, Mili Barai*, Nicholas Rosner***, Investigating the Radial Color Gradients in Galaxies - Do Galaxy Disks form inside-out?, American Astronomical Society, Honolulu, HI (January 2020).

CONFERENCES

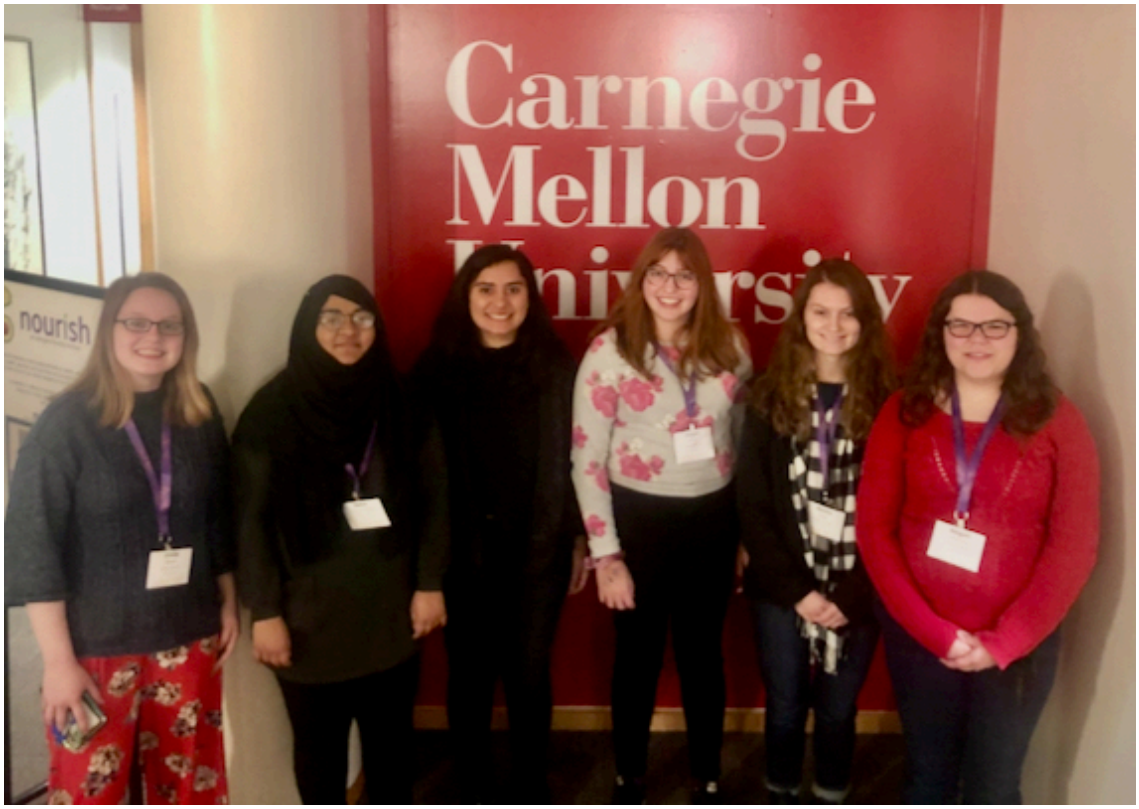
STUDENT PRESENTATIONS

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

- **Chase Fuller*†**, John F. Lindner, Niklas Manz, Chemical diode behavior in the Belousov–Zhabotinsky reaction due to inhomogeneous diffusion (oral presentation), American Physical Society – Ohio–Region Section, Flint, MI (October 2019).
- **Ariel Xi*†**, Cody Leary, Optomechanical Spin–Orbit Coupling, American Physical Society – Ohio–Region Section, Flint, MI (October 2019).
- Yang (Fish) Yu*†, John F. Lindner, Niklas Manz, Reaction–diffusion wavefronts with concave, spiral, fractals and soft obstacles, American Physical Society – Ohio–Region Section, Flint, MI (October 2019).
- **Chase Fuller*†**, John F. Lindner, Niklas Manz, Chemical diode behavior in the Belousov–Zhabotinsky reaction due to inhomogeneous diffusion (oral presentation), Annual Mathematics Conference: Differential Equations and Dynamical Systems and their Applications, Miami University, Oxford, OH (September 2019).
- **Margaret McGuire*†**, John F. Lindner, Niklas Manz, Reaction–diffusion models of 2D surfaces embedded in 3D space and a model of geographic tongue (oral presentation), Annual Mathematics Conference: Differential Equations and Dynamical Systems and their Applications, Miami University, Oxford, OH (September 2019).
- **Melita Wiles*†**, John F. Lindner, Energy stability of gravitational interacting rods and dumbbells (oral presentation), Annual Mathematics Conference: Differential Equations and Dynamical Systems and their Applications, Miami University, Oxford, OH (September 2019).
- **Yang (Fish) Yu*†**, John F. Lindner, Niklas Manz, Reaction–diffusion wavefronts with concave, spiral, fractals and soft obstacles (oral presentation), Annual Mathematics Conference: Differential Equations and Dynamical Systems and their Applications, Miami University, Oxford, OH (September 2019).

CONFERENCES

- **CONFERENCE FOR UNDERGRADUATE WOMEN IN PHYSICS**



Wooster Physics at CUWiP 2020

The goal of APS CUWiP is to help undergraduate women continue in physics by providing them with the opportunity to experience a professional conference, information about graduate school and professions in physics, and access to other women in physics of all ages with whom they can share experiences, advice, and ideas. The national and local organizing committees of APS CUWiP strive to create a welcoming environment for all, including undergraduate women and gender minorities.

The program includes research talks by faculty, panel discussions about graduate school and careers in physics, presentations and discussions about women in physics, laboratory tours, student research talks, a student poster session, and several meals during which presenters and students interact with each other.

CONFERENCES

Wooster Physics at the 2020 American Astronomical Society Meeting in Honolulu

The mission of the American Astronomical Society is to enhance and share humanity's scientific understanding of the universe.

AAS 235th Meeting: Three College of Wooster students attended the American Astronomical Society (AAS) conference in Honolulu, Hawaii in January. Students presented research on behalf of the College of Wooster REU in summer 2019, an ongoing Senior Independent Study Project, and Research from the University of Alabama Huntsville for an upcoming paper.

Andrew Kunkel, class of 2021, presenting "GDR2 Radial Velocity Analysis According to Spiral Density Wave Theory"

Megan FIsher, class of 2021, presenting "Improving the Forecasting of the Drivers of Severe Space Weather with the New MAG4 HMI Vector Magnetogram Database"

Abigail Ambrose, class of 2020, presenting "Using the Gaia DR2 to Observe Stellar Streams and Dark Matter Distribution in the Milky Way"

Students attended astrophysical talks on subjects such as the preliminary results from the Parker Solar Probe, the detection of gamma ray bursts, and new developments in the field of galaxy morphology. They also attended a few professional development sessions on subjects like marketing themselves outside of academia and working on interview skills. Also, the conference being in Hawaii provided a unique opportunity to learn how astronomy impacts Hawaiian culture by attending sessions like how natives use star navigation in voyaging and an open forum about TMT.

CONFERENCES

American Physical Society

March Meeting in Denver, Colorado

APS March Meeting: Three College of Wooster students had planned to attend the American Physical Society (APS) March meeting in Denver, Colorado this past March, which was cancelled due to Covid-19. The students would have presented their research conducted in the summer of 2019 at The College of Wooster, while participating in the NSF REU.

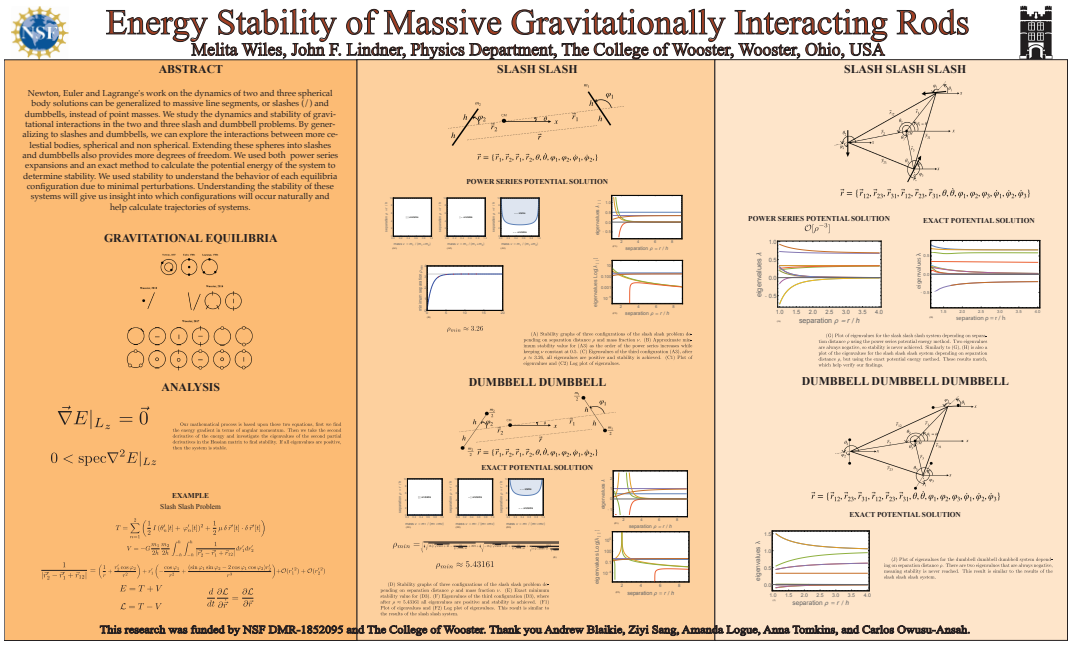
Fish Yu, class of 2021, presenting “Disruption and recovery of reaction-diffusion wave fronts interacting with concave, fractal, and soft obstacles”

Bennett Anderson, class of 2022, presenting “Automated Measurement of the Profile of an Avalanching Conical Bead Pile”

Melita Wiles, class of 2022, presenting “Energy Stability of Massive Gravitationally Interacting Rods”

Three additional students who participated in the College of Wooster REU during summer 2019 from other colleges had also planned to attend and present posters with the Wooster group. Specific information sessions and lectures these students were planning on attending included sessions on careers in the private sector, networking workshops, graduate school fairs, a diversity reception, mental health roundtable, and various scientific sessions.

Although this meeting was cancelled, APS provided an option to post a PDF version of a presentation poster, and **Melita Wiles** ‘22 posted her poster to APS to be shared with other meeting-goers.



CONFERENCES

ComSciCon-AIP

Abigail Ambrose '20 , SPS National Council, Associate Zone Councilor

ComSciCon-AIP: Abigail Ambrose '20 had the opportunity to attend ComSciCon at AIP this year with another associate zone councilor. There they had the opportunity to learn more about science communication and the best methods to reach different audiences. This included sessions on social media, article writing, and telling stories. Abigail Ambrose also wrote an article about this conference for the SPS Winter 2020 Observer which can be found at the link below.

https://www.spsnational.org/the-sps-observer/winter/2020/telling-stories-and-communicating-science-comscicon-aip-2019

Web Articles

Manz, N., Phillips, H., Herndon, C. Ambrose, A.E., and Fenton, F.H., "Dynamics of Table-top Fire Fronts," SIAM News Blog. https://sinews.siam.org/Details-Page/dynamics-of-table-top-fire-fronts

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Journal Papers in Review

Abbott, J.R., Ambrose, A.E., and Zhu, H., "Determining effects of leaf surface roughness and adjuvants type and concentration on impacting droplet adhesion," Submitted to American Society for Testing and Materials Selected Technical Papers.

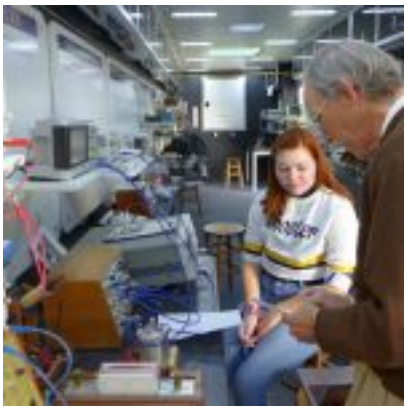
Megan A. Fisher, Dr. David A. Falconer, Dr. Ronald L. Moore, Dr. Sanjiv Tiwari.,"Improving Forecasting of Driver of Severe Space Weather with the New MAG4 HMI Vector Magnetogram Database". Submitted to the American Physical Journal, ApJ.

"THE FOOD TRUCK FOR THE PHYSICS MIND"

TeachSpin's 44 foot trailer visited The College of Wooster on its cross country outreach journey. Described as "A Hands-On Physics Buffet," the trailer is outfitted with a wide variety of advanced physics experiments, all powered up and ready to take measurements.

Students and faculty got a sense of the exciting opportunities available in a modern advanced experimental physics course by participating in HANDS-ON advanced laboratory experiments, including instruments that once led to Nobel Prizes!

Dr. Cody Leary,
Assoc. Prof. of Physics



Megan Fisher
Physics Major '21

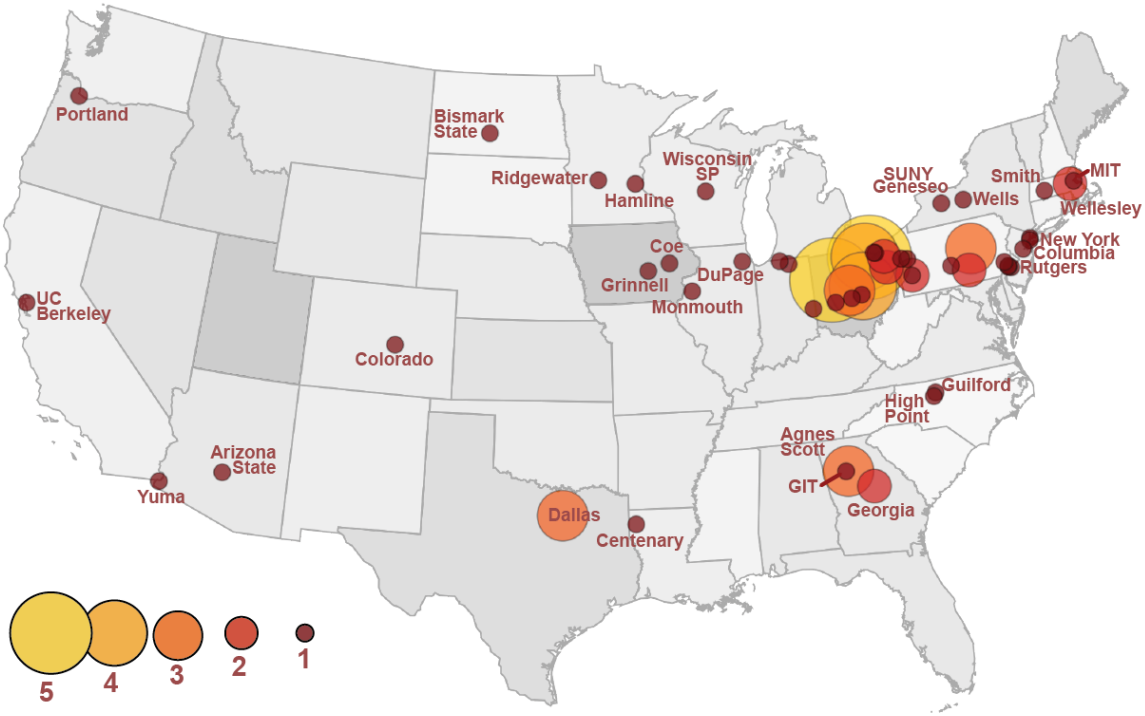
Abigail Ambrose
Physics Major '20

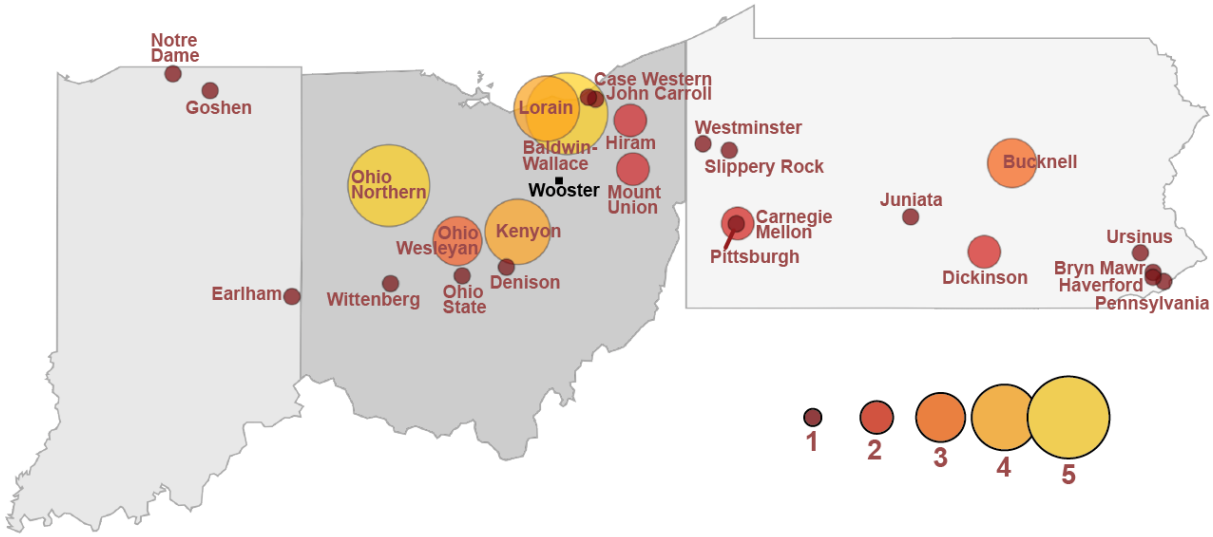
SUMMER RESEARCH

WOOSTER NSF-REU

Wooster Physics NSF REU

has integrated people from 55 colleges & universities with more to come!





SUMMER RESEARCH

WOOSTER NSF-REU

*"Since the mid 1990s, a highlight of my year has been the Physics Department's **National Science Foundation** Research Experience for Undergraduates summer program. Our research assistants come from Wooster and from all over the United States. To date, the program has gathered and meshed people from 55 colleges and universities for research, education, fellowship, and play.*

*Like the **Tokyo Olympics**, the 2020 **pandemic** has postponed — but not cancelled — this summer's NSF REU program until next summer." ….John F. Lindner*

- Shivam Bhasin (Wooster '22 Physics)
- Jayne Blinkhorn (Wooster '21 Chemistry)
- Liz Brown (Swarthmore '23 Physics & Chemistry)
- Ethan Hochmuth (Lakeland CC '20)
- Jonathan Logan (Wooster '22 Physics)
- Kiyomi Sanders (Kapi'olani CC > University of Hawaii '22 Physics)
- John Schmidt (Wooster '23 Physics)
- Cole Sporcic (SUNY–New Platz '21 Physics & Astro)
- Ben Stern (Wooster '22 Physics)
- Taylor Venenciano (Pomona '23 Math & Physics)
- Sara Wargo (Wooster '23)