

PNACP 2024 Agenda

Organization: Pacific Northwest Association for College Physics

Local Organizer: Libby Schoene, South Seattle College

Dates: Friday and Saturday, May 3rd and 4th, 2024

Last update: 2024-04-01

Friday, May 3rd, 2024

Location: Olympic Hall 120 (unless otherwise state below)

Time	Title	Speaker
10:00 – 12:30	Board Meeting: Olympic Hall 101 Zoom option:	
12:30 - 1:30	Lunch / Registration	
1:30– 1:50	Welcome	Libby Schoene, South Seattle College
1:50 – 2:50	<u>Invited Speaker</u> : The Search for Dark Matter: from theory to experiment and back again	Tien-Tien Yu, University of Oregon
2:50 – 3:10	Contributed Speaker: Characterizing the most Earth-like of all planets	David Syphers, Eastern Washington University
3:10 – 3:30	Break	
3:30 – 4:30	<u>Invited Speaker</u> : The Search for Lumbering Giants: Listening to the whispers of Behemoth Black Holes	Jeffrey Hazboun, Oregon State University
4:30 - 4:50	Contributed Speaker: Reimagining and Reinventing the Workshop Physics Curriculum	James Butler, Pacific University

Banquet

Time	Title	Speaker
5:00 - 6:00	Social Hour Location: Northwest Wine Academy	
6:00 – 9:00	Banquet: Shadows in Astrophysics: Sizes from 100 microns to 100 Mega-Light-years Location: Chan Education Center	Woodruff (Woody) Sullivan, Emer. Prof. of Astronomy and History of Science, University of Washington

Saturday, May 4th, 2024

Location: Olympic Hall 120

Time	Title	Speaker
9:00 - 9:10	Welcome	
9:10 - 10:10	<u>James Gerhart Lecture</u> : Enhancing students' physics motivational beliefs and academic performance by improving the inclusiveness of learning environment	Yangqiuting (Doris) Li, Oregon State University
10:10 - 10:30	Break	
10:30 – 11:30	<u>Invited Speaker</u> : How low can you go?: Creation of ultra-low-background materials to enable ultra-sensitive nuclear measurements	Emily Mace, Pacific Northwest National Laboratory
11:30 - 12:40	Lunch Please click here for a list of nearby recommended restaurants.	
12:40 - 1:40	<u>Invited Speaker</u> : Gravitational wave observatories: progress and plans	Michael Landry, LIGO Hanford Observatory/Caltech, for the LIGO Scientific, Virgo, and KAGRA Collaborations
1:40 – 2:00	Contributed Speaker: Dimensional Analysis and Logarithmic Function	Eric Kincanon, Gonzaga University
2:00 - 2:20	Break	
2:20-3:20	<u>Invited Speaker</u> : Mapping the Cosmos from the South Pole: News from the IceCube Neutrino Observatory	Karen Andeen, Marquette University
3:20-4:20	<u>Invited Speaker</u> : Taking antimatter to new heights: testing the gravitational acceleration of antimatter with ALPHA-g	Tim Tharp, Marquette University

Abstracts

Invited Talks:

The Search for Dark Matter: from theory to experiment and back again

Tien-Tien Yu, University of Oregon

What is Dark Matter? This is one of the most outstanding questions in physics and has led to decades-long efforts on both the theoretical and experimental fronts. In this talk, I will highlight my efforts to search for and understand candidates of particle dark matter in which the mass of the dark matter is less than a proton; these candidates are known as sub-GeV dark matter.

Historically, the sub-GeV mass range was relatively unexplored due to the difficulty of detecting such light dark matter with traditional techniques. In this talk, I will explain some of the theoretical principles and experimental strategies needed to detect sub-GeV dark matter candidates, and show how we have leveraged these strategies to create the first dedicated sub-GeV dark matter direct detection experiment: SENSEI. I will show how my group is exploring the properties of dark matter and more generally Beyond the Standard Model physics using sub-GeV dark matter direct detection experiments.

The Search for Lumbering Giants: Listening to the whispers of Behemoth Black Holes
Jeffrey Hazboun, Oregon State University

The Universe whispers to us across the vastness of spacetime, telling us about black holes, neutron stars and other compact objects. Only recently have we been able to listen to these whispers in the form of gravitational waves- a prediction of Einstein's theory of general relativity unseen until this century. Pulsar timing arrays open a new band of the gravitational wave spectrum by building a galactic-scale GW detector. I will discuss recent evidence for the observation of gravitational waves, thought to be from the unresolvable background formed by supermassive black hole binaries (SMBBHs) at the centers of merged galaxies in the cosmological neighborhood- a hum of lumbering giants.

(Banquet) Shadows in Astrophysics: Sizes from 100 microns to 100 Mega-Light-years
Woodruff (Woody) Sullivan, Emer. Prof. of Astronomy and History of Science, University of Washington

Throughout history astronomy has analyzed the visual spectrum, but over the last century this extended to the entire electromagnetic spectrum, cosmic ray particles, and meteorites. More recently we have samples returned from interplanetary spacecraft, as well as the exciting new ability to detect gravitational waves. This talk focuses on photons, or to be more exact, what we can deduce from observing their absence, in particular their shadows.

Shadows have played a surprisingly important role in better understanding the Universe. I will discuss many examples from the past and present — sundials that allowed measurement of the Earth's day and year; solar eclipses that measure the Earth's decreasing rotation period over millennia; transits of Venus in front of the Sun that measured the scale of the solar system; eclipsing binary stars that allow accurate stellar masses to be determined; transiting exoplanets orbiting their host stars, thus allowing their properties (including habitability) to be deduced; and radio shadows that indicate super-massive black holes at the center of distant galaxies. Lastly, the "100 micron" shadow in the talk title refers to a recent nanotechnology feat, a working sundial that my son-in-law and I recently built.

James Gerhart Lecture: Enhancing students' physics motivational beliefs and academic performance by improving the inclusiveness of learning environment
Yangqiuting (Doris) Li, Oregon State University

Students' motivational beliefs and academic performance at the end of a physics course are important course outcomes. Prior studies have shown that factors such as students' prior preparation, quality of teaching, and sociocultural factors can influence students' motivational beliefs and academic performance. However, very few studies have investigated the effect of

students' perceptions of the inclusiveness of the learning environment on their motivational beliefs and academic performance. In this talk, I will share research results about students' perception of the inclusiveness of the learning environment and its relationship to gender, motivational beliefs, and academic performance in introductory physics courses. These findings suggest that instructors play an important role in developing a more equitable and inclusive learning environment, in which all students can thrive.

How low can you go?: Creation of ultra-low-background materials to enable ultra-sensitive nuclear measurements

Emily Mace, Pacific Northwest National Laboratory

Join Physicist Emily Mace for an inside look at Pacific Northwest National Laboratory's (PNNL's) Shallow Underground Laboratory. This unique laboratory enables scientists to perform cutting-edge, ultra-sensitive nuclear measurements. This talk will cover how scientists at PNNL produce the world's lowest background (most radiopure) copper materials, how that copper is used to build ultra-low-background radiation detectors, and how those detectors are used to make ultra-sensitive nuclear measurements for applications in national security, fundamental physics, and environmental science. Specific applications include measuring ^{39}Ar to age-date groundwater aquifers, measuring ^3H and ^{14}C in landfill gas, and measuring ^{37}Ar for treaty verification.

Gravitational wave observatories: progress and plans

Michael Landry, LIGO Hanford Observatory/Caltech, for the LIGO Scientific, Virgo, and KAGRA Collaborations

The first detections of gravitational waves from binary black hole mergers and collisions of neutron stars have launched a new field in high-energy astrophysics. About 90 events detected over three observation runs have begun to answer questions about strong gravity, the nature of black holes and neutron stars, and origins of heavy metals. In this talk we review some key LIGO-Virgo detections, give the status of the current, fourth observation run (O4) of the gravitational wave network, and sketch a path forward for future observation runs and new, more sensitive detectors Cosmic Explorer and Einstein Telescope.

Mapping the Cosmos from the South Pole

Karen Andeen, Marquette University

The IceCube Neutrino Observatory at the Geographic South Pole is creating new maps of the universe using cosmic rays. Dr. Andeen will introduce IceCube and cosmic rays and share some of IceCube's exciting new results. Dr. Andeen will also talk about her path to astroparticle physics.

Taking antimatter to new heights: testing the gravitational acceleration of antimatter with ALPHA-g

Tim Tharp, Marquette University

The ALPHA collaboration at CERN recently published a paper showing that antimatter atoms fall down (toward the Earth) just like matter atoms. What is antimatter? How did we make it? What are the implications of these gravity tests? In this talk, Dr. Tharp will discuss ALPHA's

anti-Hydrogen gravity experiment, the challenges of building an antimatter trap, and how incredibly cool it is (4 Kelvin!) to work on this experiment at CERN.

Contributed Talks:

Characterizing the most Earth-like of all planets

David Syphers, Eastern Washington University

Exoplanets are a fascinating source of information for our theories of planet formation, but in this talk I'll focus on the most-Earthlike of all planets—Earth itself. One of the lesser-known stories in the history of science is how views on the shape of the Earth evolved rapidly in the Renaissance. No, educated Europeans c. 1450 didn't think the Earth was flat, but they did have a profoundly different view of the shape than we do today, and this is why the voyages of Columbus and subsequent explorers were so consequential in the development of our understanding of the world.

Reimagining and Reinventing the Workshop Physics Curriculum

James Butler, Pacific University

After nearly thirty years of use, the Workshop Physics curriculum utilized in the introductory, calculus-based physics course at Pacific University needs revision and rethinking. Therefore, a completely new open access, active engagement curriculum is being developed. The curriculum builds on faculty experience of what worked well and what did not in Workshop Physics, incorporates physics education research-based pedagogical techniques, and presents physics content in innovative and approachable ways. Some features of the new curriculum include (1) student engagement in dialogs about the history and use of scientific language as well as embedded scaffolding to introduce students to scientific writing in physics; (2) an affirming approach to student life experience through discussion and comparison of their years of casual observation of the physical world with rigorous scientific data that they collect; (3) non-traditional approaches to the introduction of the scientific concepts such as force and torque in order to reduce confusion and misconceptions. In this presentation, I will describe the progress that has been made as well as next steps in this reinvention of the course.

Dimensional Analysis and Logarithmic Function

Eric Kincanon, Gonzaga University

Students are often confused by units when dealing with a logarithmic function. This is frequently dealt with by stating that the function gives a unitless result. Though correct, it does not address the deeper question of why the logarithm is unitless but has different values for different systems of units. This paper explains this by considering the logarithm as a transcendental function and how that relates to the determination of units.