PNACP Annual Meeting / Oregon AAPT Spring Meeting
March 8-9, 2019
Vernier Software & Technology
Beaverton, OR

"Innovations in Instrumentation: Labs and Demos"

Schedule

Friday Morning (PNACP Board Members Only)
Classroom

9am-12pm Board Meeting
12:00-1:00 Board Lunch

Friday Afternoon (Meeting)
Classroom

1:00-1:30pm Registration and Coffee (Kitchen and Lobby)

1:30-1:55pm Contributed Talk: **Robert Close,** Clark College, "A Hand-Held Model of Special Relativity"

1:55-2:20pm Contributed Talk: **Dan Roth,** Olympic College, "Choose your own adventure" project-based labs for introductory physics."

2:20-2:30pm Break

2:30-3:00pm Contributed Demonstration: **John Gastineau**, Vernier Software & Technology, "Vernier Equipment Demonstration"

3:00-4:00pm-2pm Invited Talk: **Steve Montgomery,** U.S. Naval Academy, "Optics Demos and Labs at the U.S. Naval Academy"

4:00-4:15pm Break

4:15-5:15pm Invited Talk/Gerhart Lecture: **Bethany Wilcox,** University of Colorado, "Research-based assessment of students' beliefs about the nature of experimental physics: Key findings and implications"

Friday Evening (Banquet)
North and South Multipurpose Rooms

5:15-6:00 Social hour
6:00-7:00 Banquet

7:00-8:00 Banquet presentation: **Roger Gonzalez,** University of Texas at El Paso, "Helping the Poorest of the Poor Walk Again: How We Can All Take Steps to Change a Life"

Saturday (Meeting)
Classroom

8:30-9:00am Breakfast & registration (Kitchen and West Lobby). Tour of Vernier available.

9:00-9:10am **Dave and Christine Vernier**, Welcome from the hosts

9:10-9:35am Contributed Talk: **KC Walsh**, Oregon State University, "Building a Lightboard Studio for Professional Lecture Videos on Any Budget"

9:40-10:05am Contributed Talk: **David Sokoloff**, University of Oregon, "Technology for Active Learning of Mechanics: IOLab vs. Vernier and PASCO"

10:05-10:20am Break

10:20-11:20am Invited Talk: **Dimitri Dounas-Frazer**, Western Washington University, "Taxonomy of teaching practices during group projects in lab courses"

11:20-11:30am Break

11:30-12:30pm **ORAAPT/PNACP Business Meetings** (ORAAPT: Classroom/PNACP: North Multipurpose Room)

12:30-1:30pm Lunch (Tour of Vernier Available)

1:30-2:30pm Invited Speaker: **Billy Scannell,** University of Oregon

2:30-2:40pm Break

2:40-3:05 Contributed Speaker: **Matthew Geske,** Gonzaga University, "Cloud chamber measurement of electron cross section for upper division lab"

3:05-3:30 Contributed Speaker: **Yufeng Zhao,** Corban University, "Aesthetics for Inspirational Teaching of Physics"

3:30-4:00pm Vernier Tour Available

4:00pm Meeting adjourns

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Invited Talk Abstracts

Dimitri Dounas-Frazer, Western Washington University, "Taxonomy of teaching practices during group projects in lab courses"

> Compared to other formal learning environments in undergraduate physics programs, multiweek group projects in lab courses give rise to unique interactions between students, their peers, their instructors, and apparatus. What does teaching look like in these contexts? How do instructors change their teaching practices as students transition from proposing project topics to carrying out experiments and reporting on results? To answer these and related questions, my colleagues and I conducted a multiple case study of group project implementations in upper-division labs at five universities. In this presentation, I draw on data from interviews and surveys with instructors and students to identify a variety of teaching practices. I further describe the intended purposes and perceived impacts of these practices. Preliminary data analysis suggests that group projects may be a shared endeavor in which students and instructors have asymmetric apprenticeship-style roles and responsibilities.

Roger Gonzalez, University of Texas at El Paso, "Helping the Poorest of the Poor Walk Again: How We Can All Take Steps to Change a Life"

> Often, the poor in the developing world are relegated to live without many of the technological advances that we take for granted. Yet, while we can transplant our technology into their environments, many times they fail to help the poor for a variety of complex reasons. LIMBS International (LIMBS.org) has spent 15 years developing cost effective and sustainable prosthetic solutions for the poorest of the poor amputees in the developing world. LIMBS has developed the world's lowest cost polycentric prosthetic knee system that can be effectively maintained by the poor in their environment, and has been implemented in almost 50 countries worldwide.

Steve Montgomery, U.S. Naval Academy, "Optics Demos and Labs at the U.S. Naval Academy"

> The two semester required core physics course at the U.S. Naval Academy in Annapolis, MD serves about one thousand students and includes a lecture demonstration program where multiple sections meet in a large lecture hall three times each semester for lecture/demonstration. It is long tradition at USNA that continues to evolve. This talk will focus on some of the recent innovations brought to the program, with particular emphasis on optical phenomena. Also covered: labs and demos that the speaker has developed to support an optics course for senior level physics majors.

Billy Scannell, University of Oregon

Bethany Wilcox, University of Colorado, “Research-based assessment of students' beliefs about the nature of experimental physics: Key findings and implications”

Within the undergraduate physics curriculum, students' primary exposure to experimental physics comes from laboratory courses. Thus, as experimentation is a core component of physics as a discipline, lab courses can be gateways in terms of both recruiting and retaining students within the physics major. Physicists have a wide variety of explicit and/or implicit goals for lab courses, including helping students to develop expert-like beliefs about the nature and importance of experimental physics. To assess students' belief, attitudes, and expectations about the nature of experimental physics, there is currently one research-based assessment instrument available -- the Colorado Learning Attitudes about Science Survey for Experimental Physics (E-CLASS). Since its development, the E-CLASS has been the subject of multiple research studies aimed at understanding and evaluating the effectiveness of various laboratory learning environments. Here, I will presents a description of the E-CLASS and a summary of key research that has been done using E-CLASS data with particular emphasis on the aspects of this work that are most relevant for instructors. This research includes investigations of the impact of transformed curricula, the importance of focusing on skills vs. concept development, the impact of gender on students' performance, and the development of students beliefs over time and multiple lab courses.

Contributed Talk Abstracts

Robert Close, Clark College, “A Hand-Held Model of Special Relativity”

In the early 1900’s many scientists, including Albert Einstein and Louis de Broglie, studied the possibility that stationary matter consists of standing waves. Although this model of matter is no longer in vogue, it is a very good model for teaching special relativity. A simple model of standing waves is created by drawing lines of constant phase (i.e. wave crests) on a transparency sheet, then rolling it up along an axis parallel to the wave crests to represent waves propagating in circles. This behavior is similar to that of de Broglie waves in a central potential. Propagating waves are represented by rotating the orientation of the wave crests so that the gradient direction has an axial component. Comparison of the stationary and propagating waves reveals relativistic time dilation, length contraction, frequency shift (kinetic energy), and the de Broglie wavelength.

Matthew Geske, Gonzaga University, “Cloud chamber measurement of electron cross section for upper division lab”

A measurement of the total cross section of electrons traversing a cloud chamber can be made by students using relatively simple data acquisition. We have developed this into a lab activity for our modern physics lab course. Development of image recognition software is ongoing, and we hope to train a machine learning algorithm to identify particle tracks in order to expand the measurements we can make.

Dan Roth, Olympic College, “Choose your own adventure" project-based labs for introductory physics.”

I have been dissatisfied with my traditional laboratory exercises using a "cookbook" style approach and following a "flavor of the week" schedule which often does not align with content in the lecture. I did not feel that my students were learning the course material (an opinion that has been backed up by some research) or gaining an understanding of the experimental process, including measurement uncertainty. Simply paring down on instructions in an effort to encourage more critical thought did not seem to improve outcomes, and a single lab period is not enough time to fully develop an experiment, take preliminary data, consider uncertainty, and revise their experiments. So, I have developed what I call "choose your own adventure" lab projects which the students work on over the course of several lab sessions.

David Sokoloff, University of Oregon, “Technology for Active Learning of Mechanics: IOLab vs. Vernier and PASCO”

RealTime Physics is an active learning curriculum for the introductory laboratory that uses computer-based tools to enhance student learning. It is now available in its third edition from John Wiley and Sons. This talk compares the use of “older” sensors and carts from Vernier and PASCO to the self-contained IOLab “smart cart”—developed at University of Illinois (and marketed by MacMillan)—with RealTime Physics. The hardware will be compared, and the advantages and disadvantages of each will be discussed. Research on student conceptual learning using the Force and Motion Conceptual Evaluation (FMCE) will be presented.

KC Walsh, Oregon State University, “Building a Lightboard Studio for Professional Lecture Videos on Any Budget”

Lightboards are the ideal tool for making professional engaging lecture videos while maintaining the ability to write physics like you would at a whiteboard. The clear glass allows filming through it, creating an effect where the lecturer appears to be writing with a neon light in mid air. While building our grant funded studio we discovered you could build a functional system for a fraction of the cost. I'll share with you the basics of a lightboard, what features are necessary for professional quality productions, and how you can build one in half a day's time.

Yufeng Zhao, Corban University, “Aesthetics for Inspirational Teaching of Physics”

In this presentation, we will show that aesthetics can be applied to teaching of physics and physical sciences. The basic idea is to recognize idealization and message revealing as the foundation of science. The teaching approach is based on two aesthetic principles: (1) Diversity in unity; (2) Novelty in canonicity. These basic idea and principles are introduced through comparison of Chinese culture with Western culture, in particular, through analysis of the Chinese and Western classics. Then we employ them to address the aesthetic implications of important discoveries in physics and scientific revolution. Also we will show a few examples

to apply the method to teaching general physics in a liberal art university. Based on the feedback from the students, we found this approach can inspire critical thinking and help the teacher and the student to identify deeply hidden misconception.

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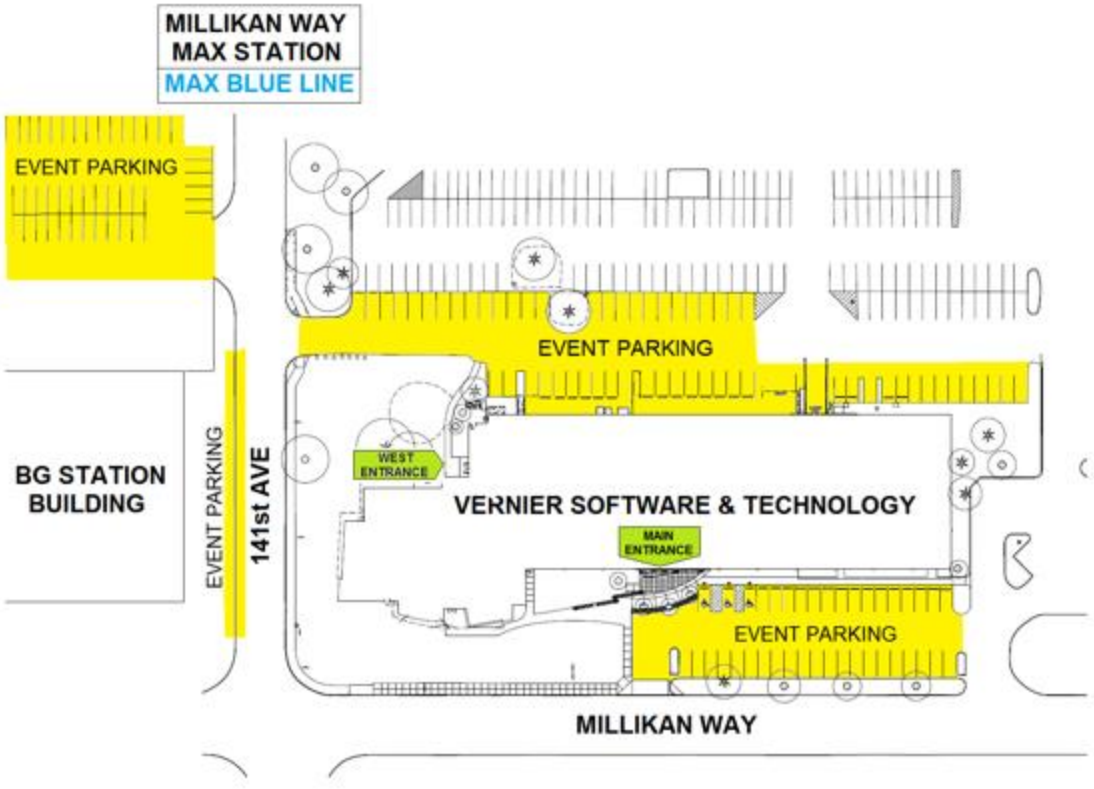
Maps and Parking Instructions

There is plenty of parking available at Vernier. The lot at the back of the building is divided. White stripes and white signs designate Nike parking, while yellow stripes and signs are for Vernier parking. Please do not park in the Nike spots. Below is a map of available parking, which includes street parking on 141st Ave (also available across Millikan Way), areas behind the building across 141st Ave from Vernier, as well as in front of and behind the Vernier building. Participants should come in the front door of Vernier during the day on Friday, but those coming for the banquet only on Friday and on Saturday can come in the west door.



Vernier Building Map: