

CSAAPT Spring 2022 Semi-Virtual Meeting



Chesapeake Section of the
American Association of Physics Teachers
Spring 2022 Semi-Virtual Meeting
April 2, 2022 @ **RADFORD** UNIVERSITY

Report of Contributions

Contribution ID: 1

Type: **Talk**

The science fiction of quantum measurement instruction

Saturday, April 2, 2022 8:30 AM (15 minutes)

Quantum mechanics instruction needs to be updated to teach quantum information science to the future quantum workforce. Physics departments should modify their curriculum to support this, especially on the quantum sensing side, which is often neglected in the rush to teach quantum computing. One key element is to no longer teach a fictionalized version of quantum measurement, which seems to be devoid of any reality. Measurement does not involve a quantum system entangling with a classical device and moving a pointer with wavefunction collapse occurring at some ill-defined moment. Instead, we need to teach students what measurement really is by removing the science fiction and bringing back the science facts. In this talk, I will discuss some representative experiments used to measure single quanta, and explain why their paradigm is different from what textbooks say.

Primary author: FREERICKS, James (Georgetown University)**Presenter:** FREERICKS, James (Georgetown University)**Session Classification:** Morning Session 1

Contribution ID: 3

Type: **Talk**

Gravitational Wave Astronomy: Current and Future

Saturday, April 2, 2022 10:30 AM (15 minutes)

Einstein predicted the presence of gravitational waves, ripples of spacetime. In 2015, LIGO detected these waves from colliding black holes for the first time and gravitational-wave astronomy has begun. In this talk, I will give a very brief overview of the current status of gravitational-wave observations and what comes next.

Primary author: YAGI, Kent (University of Virginia)**Presenter:** YAGI, Kent (University of Virginia)**Session Classification:** Morning Session 2

Contribution ID: 4

Type: **Talk**

New State Guidelines for Advanced Physics

Saturday, April 2, 2022 9:00 AM (15 minutes)

State guidelines for the course Advance Physics were recently written. The Virginia Department of Education is seeking input on the guidelines. This talk will review the research that supported the writing process and direct participants on how they can provide feedback on the guidelines.

Primary author: MACDOUGALL, Gregory (Virginia Department of Education)

Co-author: ME

Presenter: MACDOUGALL, Gregory (Virginia Department of Education)

Session Classification: Morning Session 1

Contribution ID: 5

Type: **Talk**

How to Work with the Air Force Office of Scientific Research

Saturday, April 2, 2022 9:15 AM (15 minutes)

The technological superiority of the Department of the Air Force depends on the availability of experienced, well trained scientists, engineers and a science literate public. The Air Force Office of Scientific Research is committed to improving scientific literacy among students, educators and the public to foster a highly skilled workforce and promote STEM advocacy. AFOSR's education funding opportunities and community-based program initiatives promote the engagement of diverse stakeholders in understanding and contributing to technological advances. This session will share funding opportunities for educators and principal investigators committed to supporting learning experiences for K-16 students.

Primary author: JACOBY MORRIS, Kimberly (Air Force Office of Scientific Research)

Presenter: JACOBY MORRIS, Kimberly (Air Force Office of Scientific Research)

Session Classification: Morning Session 1

Contribution ID: 6

Type: **Talk**

Impulse and Concussions

Saturday, April 2, 2022 3:15 PM (15 minutes)

Football players experience repeated impacts to their bodies and heads. Football helmets are designed to reduce the damaging effects of impacts. In this project, students apply the concept of impulse to design and test padding systems constructed from repurposed packing materials. Students use accelerometers to measure the overall peak acceleration and rotational velocity, then apply those values to impact criterion formulas.

Primary author: FLOREK, Mike (Roanoke County Public Schools)

Presenter: FLOREK, Mike (Roanoke County Public Schools)

Session Classification: Afternoon Session 1

Contribution ID: 7

Type: **Talk**

Examples of DEI Activities in a Research Course

Saturday, April 2, 2022 2:15 PM (15 minutes)

Since 2019, I have been running a curriculum-based particle physics research stream within UMD's FIRE general education undergraduate program. Over the lifetime of my stream, I have organized activities and created modules and assignments which addressed various aspects of DEI in particle physics research. I will highlight some of these activities and share my experiences, with the hope of inspiring others and brainstorming for further ideas.

Primary author: KARAGOZ, Muge**Presenter:** KARAGOZ, Muge**Session Classification:** Afternoon Session 1

Contribution ID: 8

Type: **Talk**

Changing the culture in Physics & Astronomy Departments - the SEA Change Project

Saturday, April 2, 2022 11:30 AM (30 minutes)

Many postsecondary physics educators have a sense that the current state of physics education needs to be changed to better serve all. However, knowing what and how to improve physics education is a daunting endeavor. Fortunately, there are many projects and programs that offer support, from materials to guidance/advice to vibrant communities, to make these changes. For the past several years, leadership from the Physics and Astronomy disciplinary societies have been working with AAAS to launch the SEA Change Project in our fields, specifically Physics and Astronomy departments. The aim is to support and recognize post-secondary institutions and departments as they address structural changes to advance equity, diversity, and inclusion. The progress that has been achieved, and also next steps for the SEA Change project will be described in this talk.

Presenter: KNAUB, Alexis (SEA Change)**Session Classification:** Featured Talks

Contribution ID: 9

Type: **Talk**

QuarkNet: Particle Physics....in High School!

Saturday, April 2, 2022 2:45 PM (15 minutes)

Many career and research opportunities in physics today are in the field of particle physics. However, particle physics is often not covered in introductory courses- leaving students in the dark about these career paths! This talk will introduce you to the opportunities and resources (including ready-to-go lesson plans) provided by Fermilab's QuarkNet program for university faculty, high school teachers, and current students. I will present examples of real student work from my classes, and suggestions for the implementation of these lessons. Adaptations I have made to this material for virtual/hybrid instruction will also be featured.

Primary author: JARONSKI, Rebecca (Christiansburg High School, VT QuarkNet)

Presenter: JARONSKI, Rebecca (Christiansburg High School, VT QuarkNet)

Session Classification: Afternoon Session 1

Contribution ID: 10

Type: **Talk**

Doing 3D Printing with Students in Physics Labs

Saturday, April 2, 2022 3:45 PM (15 minutes)

Projects involving 3D Printing allow students to exercise creativity and agency in physics lab. For the past 3 years, 3D Printing has been incorporated into the introductory physics course for physics and chemistry majors at Bridgewater College. In this talk, examples of 3D printing projects will be presented, including a waterwheel, fan cart, and gear box. The PICUP website will be introduced as a public repository for 3D printing projects in physics education.

Primary author: O'NEIL, Deva (Bridgewater College)**Presenter:** O'NEIL, Deva (Bridgewater College)**Session Classification:** Afternoon Session 2

Contribution ID: 11

Type: **Talk**

Optimal shot-put release angle revisited: solving a maximization problem without calculus

Saturday, April 2, 2022 10:00 AM (15 minutes)

It is well known that 45° is the optimal angle to send a projectile, to achieve the maximal range, R (on flat ground). Yet, the best shot putters release at much less than 45° instead. The resolution to this “puzzle” was traced to the landing site being lower than the height of release [Lichtenberg and Wills, AJP, 1978]. A standard problem, its solution typically involves setting to zero the derivative of R with respect to the initial angle. We present an alternative method which requires no calculus, but only geometry (and algebra) in velocity space. In particular, given an initial speed and height of the target, the initial and final velocities are always orthogonal –for the trajectory with maximal R . From this condition and energy conservation, the optimal angle is easily found.

Primary author: Prof. ZIA, R.K.P. (Virginia Tech)

Co-author: Prof. RUIZ, Michael J. (UNCA)

Presenter: Prof. ZIA, R.K.P. (Virginia Tech)

Session Classification: Morning Session 2

Contribution ID: 12

Type: **Talk**

Solving the Time Dependent Schrodinger Equation with Excel

Saturday, April 2, 2022 8:45 AM (15 minutes)

This talk will discuss how Excel can be used to solve the time dependent Schrodinger equation. Example of the tunneling of a wave packet through a potential barrier will be presented.

Primary author: Dr TRAN, Phuc (John Tyler Community College)

Presenter: Dr TRAN, Phuc (John Tyler Community College)

Session Classification: Morning Session 1

Contribution ID: 13

Type: **Talk**

Pulling a Spool

Saturday, April 2, 2022 10:15 AM (15 minutes)

A spool of ribbon is placed on a rough horizontal table. The ribbon is pulled so that it makes an angle relative to the table, where 0 degrees means the ribbon is unwinding from the bottom of the inner axle of the spool, 90 degrees corresponds to the ribbon being pulled straight up into the air, and 180 degrees implies the string is unwinding from the top of the inner axle. Suppose the spool is oriented so that the horizontal component of the pulling force is always rightward. Also assume the pulling force is sufficiently gentle that the spool rolls without slipping.

With that setup in mind, this talk will address two tricky questions:

- (1) Does the spool roll rightward or leftward?
- (2) Does the static friction force point rightward or leftward?

As a hint, I will tell you that there are up to four different relevant ranges of angles between 0 and 180 degrees. I will explain what those four ranges are and how the answers to these two questions depend on them.

Primary author: Prof. MUNGAN, Carl (U.S. Naval Academy)

Presenter: Prof. MUNGAN, Carl (U.S. Naval Academy)

Session Classification: Morning Session 2

Contribution ID: 14

Type: **Talk**

Using 3D Printing within my Physics Education through Free Computer-Aided Design Resources

Saturday, April 2, 2022 4:00 PM (15 minutes)

The usage of 3D printing and various modeling software is discussed in the context of an undergraduate physics education. There are a variety of free resources for students and teachers to use for designing 3D objects, including TinkerCAD, OpenSCAD, and a student version of AutoCAD software. In addition, each of these CAD (Computer-Aided Design) programs are directed towards a different level of user, allowing even novice students to create objects with ease, while also offering more functionality for advanced students. There are a variety of activities available to instructors through the PICUP website (<https://www.compadre.org/PICUP/>), which allows educators to share computational and 3D printing activities with other educators. This talk offers helpful hints and free resources for anyone interested in learning CAD software and 3D printing, as well as how these skills can be integrated inside the classroom. Lastly, the impact of such an education on the student will be discussed, as well as how it relates to future careers and interests.

Primary author: MCPHERSON, Hannah**Co-author:** O'NEIL, Deva (Bridgewater College)**Presenter:** MCPHERSON, Hannah**Session Classification:** Afternoon Session 2

Contribution ID: 15

Type: **Demo**

Using a hand held DC Generator for a Hands-on Electrical Learning experience.

Saturday, April 2, 2022 4:45 PM (15 minutes)

Having the students use a handheld DC generator to investigate electrical circuits containing light bulbs, is very “enlightening”. They can experience the relationship between the force needed to turn the crank, the rotational rate and the lighting effects. The fact that the turning rate of the generator is proportional to the voltage output, and that they can “feel” the force needed to turn the crank, makes this all possible. We will have a mini-workshop where, in a small group, you can investigate series and parallel circuits with the use of a handheld 6V DC generator.

Primary author: WRIGHT, David (Tidewater Community College)

Presenter: WRIGHT, David (Tidewater Community College)

Session Classification: Afternoon Session 2

Contribution ID: 16

Type: **Talk**

Relativistic Doppler Shift And the Measurement of ct, x

Saturday, April 2, 2022 9:45 AM (15 minutes)

This presentation demonstrates the role light must always play in locating a moving emitter on our “ruler” of fixed locations. This emission must be observed, and from that observation the measurement of the event located at x at time ct . Normally, the event, its observation in another reference frame, and its measurement differ by such a minute amount that this is trivial. However, if the emitter is moving at a significant fraction of the speed of light, Doppler affects the time of observation and the resulting measurement. Thus, the time of the measurement is advanced in the observer’s reference frame, causing the observer to believe the emitter’s clock is running slower. This understanding, demonstrated using a modified Brehme diagram, considerably aids in the understanding of time dilation and length contraction as a Doppler effect on the observer’s measurement of the emitter, rather than some change in the emitter’s rulers and clock.

Primary author: MCINTYRE, Lewis**Presenter:** MCINTYRE, Lewis**Session Classification:** Morning Session 2

Contribution ID: 17

Type: **Demo**

Mini-Wilson Cloud Chambers

Saturday, April 2, 2022 4:30 PM (15 minutes)

We will demonstrate a small Wilson Cloud Chamber, which is used to visualize radioactive particles. This demonstration is quick and easy to build and uses simple materials.

Primary authors: POLEN, Bekah (Randolph-Macon College); DOMINGUEZ, Rachele (Randolph--Macon College); CAMPANA, Sasha (Randolph-Macon College)

Presenter: CAMPANA, Sasha (Randolph-Macon College)

Session Classification: Afternoon Session 2

Contribution ID: 18

Type: **Talk**

Physics in the Atomic Age: Nuclear Physics for General Education and High School Courses

The story of the development of atomic physics is interdisciplinary, compelling, and deeply human. Therefore, this content is fitting for liberal arts undergraduate courses or for high school courses, providing not only a rich scientific experience, but also an engaging framework for investigating the nature of science and its role in society. I will describe an introductory undergraduate course called “Physics of the Atomic Age” taught at Randolph-Macon College for general education credit. I will discuss content, multi-media resources, and laboratories used in the course.

Primary author: DOMINGUEZ, Rachele (Randolph-Macon College)

Presenter: DOMINGUEZ, Rachele (Randolph-Macon College)

Contribution ID: 19

Type: **Talk**

STEP UP - Inspiring Women to Pursue Physics

Saturday, April 2, 2022 11:00 AM (30 minutes)

Did you know that across the United States, about half of high school physics students are women, but only about 20% of incoming physics majors are women? Further, did you know that if half of high school physics teachers recruited one woman to major in physics, we'd eliminate this gap? The STEP UP Physics Together project is tackling this problem with two research-based lessons and classroom strategies that have encouraged women to major in physics. This interactive presentation will introduce the STEP UP project, and provide an overview of the lessons and classroom strategies. Middle school, high school, and college faculty are invited to participate.

Primary author: ROBINSON, Alma (Virginia Tech)

Presenter: ROBINSON, Alma (Virginia Tech)

Session Classification: Featured Talks

Contribution ID: **20**

Type: **Demo**

Predict, Play, & Process

Saturday, April 2, 2022 4:15 PM (15 minutes)

Participants will be introduced to simple physics demonstrations that can be done with ordinary household materials!

Primary author: ROBINSON, Alma

Presenter: ROBINSON, Alma

Session Classification: Afternoon Session 2

Contribution ID: 21

Type: **Talk**

Best Practices for Effective Support of Student Learning in Algebra-Based Physics Courses

Saturday, April 2, 2022 2:30 PM (15 minutes)

To better serve increasingly diverse learners in college algebra-based physics courses, instructors will need to gain understanding of the backgrounds of their audience and shift the center of instruction from educators to learners. Based on over 15 years of teaching experience of algebra-based physics courses in an urban university and a historically-black university, the speaker will present the best practices in classroom instruction of algebra-based physics courses. Case studies will be presented to substantiate these practices that have effectively enhanced the student learning outcomes. The ultimate goal of these practices is to expand learners' worldview with the physical laws that govern how the universe behaves and the mathematical approaches that lead to the quantitative analysis of the physical world around us.

Presenter: LU, Qi (Delaware State University)

Session Classification: Afternoon Session 1

Contribution ID: 22

Type: **Talk**

Teaching quantum information science to high-school and early undergraduate students

Saturday, April 2, 2022 3:00 PM (15 minutes)

We present a simple, accessible, yet rigorous outreach/educational program focused on quantum information science and technology for high-school and early undergraduate students. This program allows students to perform meaningful hands-on calculations with quantum circuits and algorithms, without requiring knowledge of advanced mathematics. A combination of pen-and-paper exercises and IBM Quantum Experience simulations helps students understand the structure of quantum gates and circuits, as well as the principles of superposition, entanglement, and measurement in quantum mechanics. We also present a simple game that illustrates the advantages of quantum algorithms.

Primary author: BARNES, Edwin (Virginia Tech)**Presenter:** BARNES, Edwin (Virginia Tech)**Session Classification:** Afternoon Session 1