"Particles and Waves"
Fall Meeting of the Iowa and Illinois Sections of the AAPT
October 24-25, 2014
Bettendorf High School, Bettendorf, Iowa

Friday, October 24, 2014

9:00 - 5:00  Registration - Commons, near the main entrance of the high school
Payment options include credit card, cash or check (payable to "ISAAPT").
Please Recycle. When you leave the meeting to return home, please place your plastic
name tag holder in the box which will be provided. Thanks.

9:30 - 12:00  Workshop W1
"Why the Millikan Award? A Study of the Life and Influence of Robert A. Millikan"
Bonnie Mitchell, Curator and Richard Rockrohr, Archivist
Jackson County Historical Museum, Maquoketa, Iowa  
D317
We will display items from the archives of Robert A. Millikan and James Van Allen. There will also be a showing of a two-hour video from a recent celebration held at the Jackson County Historical Museum in honor of these physicists.

Robert Millikan was born on March 22, 1868, in Morrison, Illinois. He went to high school in Maquoketa, Iowa. James Van Allen was born in Mount Pleasant, Iowa on September 7, 1914. Van Allen was valedictorian of his high school class in 1931, and received his bachelor's degree in physics, summa cum laude, from Iowa Wesleyan College in 1935.

The first 18 people who register for W1 and W4 will receive a complimentary copy of the DVD. We will be happy to answer questions about the Millikan and Van Allen exhibits.

10:00 - 12:00  Workshop W2
"Data Visualization using Plotly"
Dan Pfeifer, Plotly, Inc., Algonquin, Illinois  
D318
Plotly is a web-based scientific graphing tool accessible from any browser. With it you may import data from experiments or enter it manually into an online spreadsheet. You can easily make scatter plots, bar charts, lines-of-best fit and much more. Plotly is free for all educational institutions.

During this workshop I will cover things such as simple account creation, basic graphing, modeling, statistical analysis, common student pitfalls, specific lessons that work well with Plotly, streamlined feedback and assessment, sharing and collaboration, and other requested topics. Participants will then have time to explore the program.

10:00 - 12:00  Workshop W3
"Using Arduinos in Physics Classes"
Andrew Morrison, Joliet Junior College  
D320
Arduinos are small programmable microcontrollers which are inexpensive and flexible units for using in physics classes. This workshop will be for teachers interested in learning about how to use Arduinos. No prior experience with Arduinos is required. We will provide teachers with a free starter kit, breadboard, and two temperature sensors to get started exploring how to implement the use of Arduinos in their classes.

12:00 - 1:00  Lunch - on your own. A list of places to eat is on the website and is included in your registration packet.
Note: This is a repeat of Workshop W1.

We will display items from the archives of Robert A. Millikan and James Van Allen. There will also be a showing of a two-hour video from a recent celebration held at the Jackson County Historical Museum in honor of these physicists.

Robert Millikan was born on March 22, 1868, in Morrison, Illinois. He went to high school in Maquoketa, Iowa. James Van Allen was born in Mount Pleasant, Iowa on September 7, 1914. Van Allen was valedictorian of his high school class in 1931, and received his bachelor's degree in physics, summa cum laude, from Iowa Wesleyan College in 1935.

The first 18 people who register for W1 and W4 will receive a complimentary copy of the DVD. We will be happy to answer questions about the Millikan and Van Allen exhibits.

Workshop W5

"Advanced Plotly Tutorial and Plotly's Multiple Language Coding"


We will cover advanced options such as creating your own function to fit to data, derivatives, and integrals, embedding plots in HTML, and advanced stylization. Chris Parmer will then demonstrate the power of Plotly's coding potential via screen share in Google chat.

Plotly supports Python, MATLAB, R, Node.js, and Julia. For researchers, Chris can discuss hardware that syncs to Plotly with real time streaming and the enterprise account that funds everything.

Here is the list of those who are doing contributed presentations, Take Fives, and What is it?

<table>
<thead>
<tr>
<th>Friday</th>
<th>Saturday</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:30 A2. Dave Sykes</td>
<td>8:30 C2. James van Howe</td>
</tr>
<tr>
<td>1:45 A3. Lee Carkner</td>
<td>8:45 C3. Rachel Schneider</td>
</tr>
<tr>
<td>2:00 A4. Christopher Like</td>
<td>9:00 C4. David Schultz</td>
</tr>
<tr>
<td>4:30 B1. Pengqian Wang</td>
<td>10:00 C8. Kristen Thompson</td>
</tr>
<tr>
<td>5:00 B3. William Peterson</td>
<td></td>
</tr>
<tr>
<td>5:15 B4. Eric Olson</td>
<td></td>
</tr>
<tr>
<td>5:30 <strong>Take Fives</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Take Fives</strong></td>
<td><strong>What is it?</strong></td>
</tr>
<tr>
<td>Tom Foster</td>
<td>Ian Spangenberg</td>
</tr>
<tr>
<td>Andrew Morrison</td>
<td>Kristen Thompson</td>
</tr>
<tr>
<td></td>
<td>Ian Kleman</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Session A - Chair: Deborah Lojkutz**

**Performing Arts Center**

1:10 **Welcome** - Jimmy Casas, Principal, Bettendorf High School

1:15 **A1. A Natural: Nuclear Physics, Nuclear War: Was It, Is It, Part of Your Curriculum?**

Ray Wilson
Illinois Wesleyan University

Are educational systems teaching the next generations of politicians, decision-makers, and citizens, about the nature of nuclear war and the importance of a solution to this problem? Do our representatives in Congress who decide our nuclear policies fully understand what the true cost of a nuclear war would be to the United States and to the world? We will relate Wesleyan's experience with a quite popular course. A free PDF book will be offered.

"I have been meaning to email you. I loved the class so much and I was so sad when it was over. The class opened my eyes to so many things that I have never learned about. Thanks for a great May term; I never thought I could be so interested and excited about a class!" -- a student comment to R. Wilson.
1:30 A2. The Age Old Question -- Why Do We Have To Learn This?
Dave Sykes
Lincoln Land Community College
Active Learning
Although the teaching of physics has its traditional purposes including learning physics content and the development of critical thinking skills, it can also afford students the opportunity to use what they're learned for practical purposes. In this talk a variety of examples of using physics concepts and processes for practical uses will be presented along with the reasons physics teachers should always attempt to answer the age old question - why should we learn this stuff?

Lee Carkner
Augustana College
Active Learning
Many key topics in general astronomy involve the concept of measuring angles on the celestial sphere (such as diurnal motion, annual motion, and navigation). General (non-science major) students often have difficulty with angular measure and visualizing points projected onto a sphere. With the use of a planetarium, students can experience the celestial sphere directly and make measurements on the simulated sky. This talk will focus on active learning techniques that can be used in a planetarium to meet general astronomy learning goals.

2:00 A4. Gamification of High School Astronomy
Christopher Like
Bettendorf Community Schools
Teaching Methods
Gamification has arrived in education in a big way. This talk will be an example of how the pedagogy was applied to a unit in a high school science class. The presenter has helped several dozen teachers and school districts implement aspects of gamification in their districts.

2:15 A5. Design and Implementation of a New Junior Level Course on Nonlinear Physics
Narendra K Jaggi
Illinois Wesleyan University
Teaching Methods
I will share the design and implementation details of a new seminar-style course on Non Linear Physics that integrates theoretical, computational and experimental explorations of nonlinear differential equations, nonlinear dynamical systems, nonlinear optics, and nonlinear electronic systems. By combining perturbation theory, linearization of nonlinear differential equations, studying and presenting articles from American Journal of Physics, and building experiments reported in recent issues of AJP, this course design tries to guide the students through an active and deep engagement with this sophisticated topic. Some of the results from the current semester will be shared.

2:30 A6. Oscillating Chemical Reactions Studied via Multispectral Videoanalysis and Thermometry
Rita Xi Lin, Kyle Connour and Narendra K. Jaggi
Illinois Wesleyan University
Research
A handful of exotic chemical reactions have been known to demonstrate repeated and sustained oscillations, as opposed to monotonically approaching equilibrium. We have recorded color videos of oscillating BR and BZ reactions, and analyzed the R, B and G components as a function of time. A number of interesting new features have been discovered. Some color components show a capacitor charging-discharging type of behavior, while others show close to a square wave time-dependence superimposed with sudden jumps. The period of oscillations is not exactly constant, but shows a certain stretching as the reaction proceeds. We have also discovered an unusual dependence of the dynamics upon the dimensions of the reaction vessel.

2:45 A7. The Summer Science Program: A Month at New Mexico Tech
Luis Martinez
Des Moines Central Academy
Research
A summer experience full of rigorous learning, life long friendships and first hand experience to experimental methods in science. The Summer Science Program (SSP) is one of the oldest and most successful summer enrichment programs for academically gifted high school students. The curriculum is organized around a classic research project in astronomy: observation of a near-earth asteroid and prediction of its orbit around the sun. By day, students learn the astronomy, calculus, physics, computer programming, and methodologies of experimental science they need to perform the project. By night, working in teams of three, they make a series of telescopic observations, measure them precisely, and write the software necessary to fit their observations to an orbit. Their observations are submitted to the Minor Planet Center at the Harvard-Smithsonian Center for Astrophysics.

2:30 - 3:00 Break - Commons
Physicists at Fermilab are moving into the up-and-coming field of neutrino physics with two liquid argon time projection chambers. The MicroBooNE experiment is currently building a large liquid Argon Time Projection Chamber (LArTPC). The detector will be placed in the Booster Neutrino Beam line at Fermilab. The main physics goal of the MicroBooNE experiment is to investigate the puzzling low energy excess observed by the previous MiniBooNE experiment. In addition, MicroBooNE will also measure low energy neutrino cross sections, which are of great interest to the next generation of neutrino experiments. MicroBooNE is now in detector commissioning phase.

I am doing the electronics mapping (database) work and making shower containment studies. The experiment places a LArTPC in a beam whose particle and momentum content is measured independently, allowing us to extract the particle identification efficiency of the detector. I am doing beamline simulation and design, as construction is underway.

Session B - Chair: Christopher Like
Performing Arts Center

4:30 B1. Understanding the Colors of White Light Interference  
 Pengqian Wang  
 Western Illinois University  
 Research

When a white light source is used in an interference experiment, each spectral component will produce its own interference pattern in space. The overlapped interference patterns from all spectral components result in the appearance of a special sequence of colors. Soap bubbles, oil films and minerals observed between crossed polarizers are good examples for various interference colors. In this talk I will describe how to calculate the expected interference colors for a white light source. First the transmitted spectra at various light retardations are calculated. The tristimulus values, which are the scientific representation of the color for a specific spectrum, are then calculated according to the recommendation of the International Commission on Illumination (CIE). The tristimulus values are finally transferred into the RGB (red, green, blue) codes of the computer monitor. The calculated colors are compared with the interference colors of a quartz wedge sandwiched between crossed and parallel polarizers.

4:45 B2. Quizzes or Exams: That is the Question  
 Nathan Frank  
 Augustana College  
 Teaching Methods

Introductory classroom environments come with many challenges including student attitudes and study habits. I have tried various methods of improving study habits and combating negative attitudes about physics with mixed results. After attending the Summer 2014 AAPT, I left with the idea of giving weekly quizzes without major exams. This term I am piloting this idea in Physics 101, which is an algebra-based course covering mechanics and waves. The students are primarily pre-health majors and do not generally have positive attitudes about physics. Preliminary survey data shows that students overall are happy with quizzes instead of exams. The structure of this course along with the survey data will be presented.

5:00 B3. Arduino as a Platform for Electronics Labs  
 William Peterson  
 Augustana College  
 Active Learning

The Arduino is a small, inexpensive, programmable microcontroller platform. I will demonstrate a simple application for Electronics lab, in which the Arduino is programmed to simulate multiple logic circuits, allowing students to experiment and learn about digital logic.

5:15 B4. Using Excel Solver and Data Analysis Add-ins in the Introductory College Lab  
 Eric T. Olson  
 Iowa Lakes Community College  
 Teaching Methods

Microsoft Excel is a powerful and ubiquitous mathematical tool. It offers data storage, plotting, and analysis capability useful in the introductory college laboratory. Two less-well-known functions available in Excel are the Solver and the Data Analysis Ad-Ins. When activated, these options provide quick, sophisticated parameter fitting and statistical analysis. In both our algebra- and calculus-based two-semester sequence courses at Iowa Lakes, we begin with a series of orientation exercises using Excel, including items using Solver and Data Analysis. Then we proceed to use Excel for most labs throughout both semesters. Data Analysis becomes our main method for obtaining statistics and confidence intervals on regression of data fit to linear models, for example freefall, coefficient of friction, Ohm's law, and time constant versus series resistance for RC combinations. We use the Solver to obtain optimized parameters for a calorimeter experiment involving temperature equilibrium for electric resistance heating.
5:30  Take Fives
Tom Foster
"SPOCs" plus "A question of textbooks"
Andrew Morrison
"Bounce test for batteries"

5:40 - 6:00  Free Time

6:00 - 7:00  Banquet - Commons  Banquet buffet by pre-paid reservation only.
Award - Outstanding Illinois HS Physics Teacher for 2013-2014:  David Schultz - Maine East High School, Park Ridge

The following events are open to all meeting registrants and the public.

7:00 - 7:50  "Stormy (Space) Weather: An EMFISIS* on the Van Allen Probes"
Craig Kletzing
Physics Department, University of Iowa
Performing Arts Center

Dr. Kletzing will discuss NASA's Van Allen Probes, a twin satellite mission launched in August, 2012 to investigate the dynamic environment of the Earth's radiation belts - a key discovery by University of Iowa professor James Van Allen in 1958. He will show some examples of the kinds of scientific measurements that are being made with the probes and also describe how the University of Iowa physics and astronomy department continues to expand on Van Allen's research.

*EMFISIS - Electric and Magnetic Field Instrument Suite and Integrated Science

8:00  Physics Demonstrations.  Dale Stille, Department of Physics, University of Iowa  Performing Arts Center

8:00  Planetarium Show.  Peter Bruecken, Physics Teacher, Bettendorf High School  Planetarium
Note:  This show will be repeated at 1:00 pm on Saturday.

8:00  Telescope Viewing.  Karl Adlon, Quad Cities Astronomical Society  Football Field
If we do not have a clear sky, Karl will set up and show his 18" telescope in the Commons

Saturday, October 25, 2014

7:00 - 8:00  ISAAPT Council meeting  -  Presiding:  Don Reid, President.  D313

8:00 - 9:00  Registration  -  Commons, near the main entrance of the high school
Payment options include credit card, cash or check (payable to "ISAAPT").

Session C  -  Chair:  Sara Karbeling
Performing Arts Center

8:15  C1.  Simple, Collaborative, Powerful Data Visualization with Plotly
Daniel Pfeifer
Plotly, Inc

Plotly's educational branch changed the landscape of data visualization and analysis in schools. Plotly, is and always will be free for educational institutions.  It runs on any computer with web browsing capability and stores everything in the cloud. This powerful tool allows students to use less time learning the software and more time extracting meaning from data. Student examples as well as my own high school teaching experience with Plotly will be shared at this talk.

8:30  C2.  Passive, Noiseless, Intensity Amplification for Repetitive Signals
Reza Maram, James van Howe, Ming Li, and Jose Azana
Augustana College
Research

Amplification of signal intensity is essential for initiating physical processes, diagnostics, sensing, communications, and measurement. During traditional amplification, the signal is amplified by multiplying the signal carriers through an active gain process, requiring the use of an external power source. Additionally, the signal is degraded by noise and distortions that typically accompany active gain processes. We show noiseless intensity amplification of repetitive optical pulse waveforms with gain from 2 to ~20 without using active gain. The proposed method uses a dispersion-induced temporal self-imaging (Talbot) effect to re-distribute and coherently accumulate energy of the original repetitive waveforms into fewer replica waveforms. In addition, we show how our passive amplifier performs a real-time average of the wave-train to reduce its original noise fluctuation, as well as enhances the extinction ratio of pulses to stand above the noise floor. Our technique is applicable to repetitive waveforms in any spectral region or wave system.
8:45 C3. Accelerometers, Power Tools, Lightning Talks, Roller Coasters, and More

Rachel Schneider
Des Moines Central Academy
Research

Accelerometers, power tools, lightning talks, roller coasters, and more. Can you picture a female rising senior getting excited about all this and more? That passionate student is me. This summer I spent 4 weeks at MIT’s Women in Technology Program (WTP). My goal in this presentation is to share my experiences and explain what an incredible opportunity it was. I would like to inspire high school teachers to encourage their students to apply. I would also love to see more colleges provide opportunities like this and I hope that professors will choose to be involved in programs like WTP.

9:00 C4. Standards-Based Learning Targets in the Physics Classroom

David Schlutz, Tom Foley, Anna Laky, Peter Przekota
Maine East High School
Teaching Methods

With the advent of the Next Generation Science Standards and the Common Core, physics teachers need to adapt their instruction by helping students to take ownership of these standards. Deconstructing the standards into student-friendly language, utilizing them in a meaningful way in daily lessons, and incorporating them into student grades can improve student learning. I will provide examples of how to incorporate standards-based learning targets for physics into classroom instruction and assessment, including ideas for using a standards-based grading system in the physics classroom.

9:15 C5. Helping Students Grok Acceleration

Cherie Bilbo Lehman
Eastern Illinois University
Demonstrations

One of the most difficult concepts for beginning physics students is the idea that the acceleration of an object can be nonzero when its velocity is zero. Demonstrations, when prefaced with questions, can help students visualize this phenomenon. Both an accelerometer and a motion detector will be used to investigate the relationship between velocity and acceleration.

9:30 C6. Standing Waves and Tension: A Laboratory Solution to a Textbook Problem

Wade Sick
Southwestern Community College
Active Learning

Students have relatively little trouble in solving tension problems when a mass is hanging directly in the middle of a line supported on each end, but have a bit more difficulty when the mass is off-center. This brief, 10-minute presentation will demonstrate how one of the standard standing-wave demonstrations, using a 60-cycle vibrator, can be modified slightly to help solve and confirm this off-center tension problem.

9:45 C7. A simple demo to illustrate the nature of light as wave and particle simultaneously

Kishor T. Kapale
Western Illinois University
Demonstrations

I would like to share with the community of physics teachers a simple demo I have developed over the years to demonstrate the nature of light as wave and particle simultaneously in a single demonstration that is suitable for use in front of a large class. The demo uses a standard green laser pointer, a magnetic mount, two sharp razor blades. This demo has been successfully used in introductory astronomy classes while discussing the nature of light. The demo can be easily modified, with added equipment, for more advanced discussion of interference and diffraction of light.

10:00 C8. Extending Arduino Capabilities using Arduino Shields

Kristen Thompson, Daniel Neeble
Loras College
Active Learning

Arduino boards are an inexpensive and versatile microelectronic platform. They can be used in many areas of the classroom, from building sensors to constructing robots. Functionality of this platform can be extended using pre-assembled shields and peripheral boards.

10:15 Take Fives

Cherie Lehman
"Tycho is now SmartPhysics"
Rick Ross
"What to do with Super 8, LaserDisc, and other media?"
Gary Wolber
"Helping students understand the acceleration of an object in free fall"

What is it?
Ian Spangenberg
Kristen Thompson
Ian Kleman
10:30 - 11:00 Break - Commons  Those who chose to stay for lunch will mark their choice of pizza topping on an easel.

11:00 - 12:00  

"Teaching the Physics of Music on Four Continents"

Thomas Rossing  
Center for Computer Research in Music and Acoustics  
Stanford University Professor Emeritus of Physics, Northern Illinois University  
Performing Arts Center  

My interest in music drew me to start teaching courses in the Physics of Music (aka Musical Acoustics) starting in 1957 at St. Olaf College, and I have continued to do so since that time. Over the past 20 years my principal research area has gradually shifted from magnetism to acoustics. I have published several books on acoustics, including a popular textbook, now in its 3rd edition. I will describe various courses in musical acoustics that I have had the opportunity to teach at several universities around the world.

12:00 - 12:45 Pizza Lunch - Commons  Annual Business Meetings of the Iowa Section and the Illinois Section

12:45 - 3:00 Ed. Camp - Starts in the Commons.  
Topics to be discussed will be determined by having attendees key in their physics and STEM interests via a computer, tablet or smart phone. After watching the words evolve on large screens, leaders will announce where particular topics will be discussed. Sessions may be long or short with people coming and going. This event is designed to be very interactive, informative, and customized for those who attend. It sounds exciting! This will be organized by Bettendorf High School physics teacher Christopher Like.

1:00 - 2:00 Planetarium Show.  Peter Bruecken, Physics Teacher, Bettendorf High School  

Planetarium