



# the SPS Observer

Volume XLIX, Issue 2

Summer 2015

## Grow Your Community

SPS OPENS DOORS TO A MUCH LARGER WORLD



the **SPS Observer****Guest Editor**

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**SPS is Your Village**

by Sean Bentley  
Director, Society of Physics Students and Sigma Pi Sigma



**SEAN BENTLEY** (and his buddy Albert) pose for a photo in front of the Lincoln Memorial in Washington, DC. Photo courtesy of Sean Bentley.

**While the idea of the lone scientist has long been popularized, odds are you won't solve the problems of 21st-century physics by sitting in an orchard and waiting for inspiration (in the form of an apple, perhaps) to strike.** The recent 5,000+ author paper from the CERN Collaboration is an extreme example of a simple truth: most scientific advances are made by teams of researchers.

This need for a network goes far beyond research. To make the most of any effort, it indeed takes a village.

A strong community is often founded around a shared purpose. The thousands of undergraduates in physics and astronomy that make up the SPS community are united by the common goal of obtaining personal and professional enrichment that goes beyond traditional curricular training.

That starts at our 750 college and university chapters, where many strong connections are built and active programs are implemented. As a chapter advisor, I spent my first few years working in isolation with my students.

Then I realized how much the larger SPS organization had to offer. It was not until we connected to SPS at the national level that our chapter truly

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thrived. With programs to support outreach, research, interactions with alumni, career training, inclusiveness, and more, the SPS National Office helps chapters to best serve their members.

The most prestigious and transformative experience available to SPS members is the internship program. Each summer it brings members to our nation's capital to work in science policy, fundamental research, science history, and educational outreach. The interns become a community in their own right, building lifelong friendships and valuable professional connections.

The SPS National Office also creates opportunities for members to interact with each other and the larger scientific community. SPS organizes events at national scientific meetings of other societies, including the American Physical Society (APS), the American Astronomical Society (AAS), the American Association of Physics

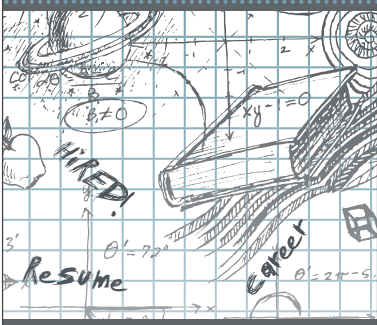
Teachers (AAPT), The Optical Society (OSA), and the American Crystallographic Association (ACA). We provide SPS members with funding to attend these meetings. Zone meetings, which bring together members regionally, can receive financial and programmatic support from SPS National. (See page 10 for stories from recent zone meetings.) The SPS National Council, made up of student and faculty representatives from each of the 18 regional zones, meets each year to plan the future of your society.

Every four years, SPS and its associated honor society, Sigma Pi Sigma, hosts the largest gathering of undergraduate physics students in the world. With 1,200 of your peers expected at the next Quadrennial Physics Congress to be held in San Francisco in November 2016, you will not want to miss it! (See Brittney Hauke's story on page 26.)

Able to open doors to a much larger world, SPS truly is your village. //


# SPS JOBS

<http://jobs.spsnational.org>



## UNDERGRADUATES & RECENT GRADUATES!

*Search SPS Jobs for the latest summer research opportunities & entry-level science jobs!*



*Get a Job!!!*

Part of the AIP Career Network

TO MAKE THE MOST OF ANY EFFORT,  
it indeed takes a village.



### ON THE COVER

This mosaic was created from thousands of SPS photos submitted by SPS chapters in their annual chapter reports, contributed by SPS award recipients, and taken by SPS staff. Created by Tracy Nolis-Schwab using Mosaically.com.

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The American Institute of Physics is an organization of scientific societies in the physical sciences, representing scientists, engineers, and educators. AIP offers authoritative information, services, and expertise in physics education and student programs, science communication, government relations, career services for science and engineering professionals, statistical research in physics employment and education, industrial outreach, and the history of physics and allied fields. AIP publishes *Physics Today*, the most influential and closely followed magazine of the physics community, and

is also home to the Society of Physics Students and the Niels Bohr Library and Archives. AIP owns AIP Publishing LLC, a scholarly publisher in the physical and related sciences. [www.aip.org](http://www.aip.org)

**AIP Member Societies:** American Association of Physicists in Medicine, American Association of Physics Teachers, American Astronomical Society, American Crystallographic Association, American Meteorological Society, American Physical Society, Acoustical Society of America, AVS-The Science & Technology Society, The Optical Society, The Society of Rheology

**Other Member Organizations:** Sigma Pi Sigma physics honor society, Society of Physics Students, Corporate Associates

**AIP** | American Institute of Physics

# Spring 2014–15 Award Recipients

SPS CONGRATULATES THIS YEAR'S WINNERS

*Thank you to the generous Sigma Pi Sigma donors whose support makes these awards possible.*



THE 2015 SPS INTERNS with Dr. John Mather.  
Photo by Matt Payne.

## 2015 SPS INTERNS

SPS internships are awarded on the basis of collegiate record, potential for future success, SPS participation, and relevant experience. Interns are placed in a variety of organizations and work on research, policy, or education projects. See the interns' profiles and blogs at: [www.spsnational.org/programs/internships](http://www.spsnational.org/programs/internships).

### CONNOR DAY

**Agnes Scott College**

Project: History of Women and African Americans in the Physical Sciences

Host: American Institute of Physics

### AMANDEEP GILL

**Sonoma State University**

Project: Bringing Physics to the Public

Host: American Physical Society

### ELIAS KIM

**Vassar College**

Project: AIP Mather Policy Intern

Host: US House of Representatives Committee on Energy and Commerce

### SHAUNA LEFEBVRE

**Union College**

Project: SPS Science Outreach Catalyst Kit and NIST Institute for Middle School Science

Teachers

Host: SPS and National Institute for Standards and Technology

### PATRICK MANGAN

**Ball State University**

Project: AAPT/PTRA Teacher Professional Development Intern

Host: American Association of Physics Teachers

### VERONICA MARTINEZ-VARGAS

**Salisbury University**

Project: Identifying Biomolecules in Solution

Host: National Institute for Standards and Technology

### RACHEL ODESSEY

**Claremont Colleges Joint Science Department**

Project: Following Eta Carinae Across Periastron

Host: NASA's Goddard Space Flight Center

### HANNAH PELL

**Lebanon Valley College**

Project: SPS Science Outreach Catalyst Kit

Host: SPS

### BREAN PREFONTAINE

**Drexel University**

Project: History of Women and African-Americans in the Physical Sciences

Host: American Institute of Physics

### DREW ROBERTS

**University of North Carolina at Chapel Hill**

Project: AIP Mather Policy Intern

Host: US House of Representatives Committee on Science, Space, and Technology

### MAX TORKE

**Sonoma State University**

Project: Detecting Cosmic Microwave Background Polarimetry

Host: NASA's Goddard Space Flight Center

### TERESA C. TURMANIAN

**Juniata College**

Project: Identifying Biomolecules in Solution

Host: National Institute for Standards and Technology

## SPS AWARD FOR OUTSTANDING UNDERGRADUATE RESEARCH

Awards are made to individuals for outstanding research conducted as an undergraduate. Recipients represent the United States and SPS at the International Conference of Physics Students and receive \$500 for themselves and \$500 for their SPS chapters. Learn more at: [www.spsnational.org/awards/outstanding-undergraduate-research](http://www.spsnational.org/awards/outstanding-undergraduate-research).

### AMANDA LANDCASTLE



**The College at Brockport: SUNY**

*Point Contact Spectroscopy: An Undergraduate Investigation into Superconductivity and Quantum Criticality*

### ARIEL MATALON



**University of Chicago**

*Development of a Prototype for a Fluorescence Detector Array of Single-Pixel Telescopes*

# 2015 SPS SCHOLARSHIPS

Several awards of up to \$2,000 or more are made each year to individuals showing excellence in academics, SPS participation, and additional criteria. Learn more and see photos and bios of the recipients at: [www.spsnational.org/awards/scholarships](http://www.spsnational.org/awards/scholarships).

## SPS Outstanding Leadership Scholarship

**BRADLEY DICE**  
William Jewell College

## SPS Leadership Scholarships

**BROOKE ADAMS**  
Florida Institute of Technology

**ADAM ANTHONY**  
Juniata College

**CLAIRE BAUM**  
University of Illinois at Urbana-Champaign

**ADITYA DHUMUNTARAO**  
Arizona State University

**CHLOE GOODITIS**  
Goucher College

**P. EVAN LINN**  
Grove City College

**ANGELA LUDVIGSEN**  
University of Wisconsin-River Falls

**CHRIS MARBLE**  
Tarleton State University

**ARIEL MATALON**  
University of Chicago

**GREGORY J. OTTINO**  
University of New Mexico

**CHRISTOPHER PHENICIE**  
University of Minnesota Twin Cities

**NATHAN PRINS**  
Towson University

**STEPHANIE SCHNEIDER**  
Susquehanna University

**HALLIE STIDHAM**  
High Point University

**PHIL TRAVIS**  
University of Illinois at Urbana-Champaign

## Herbert Levy Memorial Scholarship

**SAMANTHA CHRISTINE COBB**  
William Jewell College

## Future Teacher Scholarship

**KAYDEE STRATFORD**  
Utah State University

## Peggy Dixon Two-Year Scholarship

**CODY BIBLER**  
Chemeketa Community College

## SPS/AAPT Mary Beth Monroe Memorial Scholarship

**JONATHAN VAN SCHENCK**  
Seattle Pacific University

## Science Systems and Applications, Inc. Academic Scholarship

**HELEN MESKHIDZE**  
Elon University

## Science Systems and Applications, Inc. Underrepresented Student Scholarship

**KAREEM WAHID**  
University of Texas-Pan American

## AWIS Kirsten R. Lorentzen Award

**CLAIRE M. WEAVER**  
Hofstra University

# BLAKE LILLY PRIZE

Several awards of the three-volume set *The Feynman Lectures on Physics* are given each year to chapters or individuals that engage in physics outreach activities and share feedback from participants. Learn more at: [www.spsnational.org/awards/blake-lilly](http://www.spsnational.org/awards/blake-lilly).

**CLEVELAND STATE UNIVERSITY**  
Project Leader: Christian Gunder  
Faculty Advisor: Kiril Strelitzky

**PURDUE UNIVERSITY**  
Project Leader: Patrick Kelley  
Faculty Advisor: Rachel Lang

**THE GEORGE WASHINGTON UNIVERSITY**  
Project Leader: Srividya Murthy  
Faculty Advisor: Gary White

**UNIVERSITY OF DENVER**  
Project Leader: Sierra Ashley  
Faculty Advisor: Mark Siemens

**UNIVERSITY OF RICHMOND**  
Project Leader: Katharine Domitrovich  
Faculty Advisor: Con Beausang

**UNIVERSITY OF TENNESSEE, KNOXVILLE**  
Project Leader: Louis Varriano  
Faculty Advisor: Jon Levin

## THANK YOU

*Thank you to the members of the 2014–15 SPS awards committees for dedicating many thoughtful hours to the award selection process.*

- Dave Dunlap, University of New Mexico
- Brooke Haag, American River College, CA
- Diane Jacobs, Eastern Michigan University
- Dwight (Ed) Neuenschwander, Southern Nazarene University, OK
- Willie Rockward, Morehouse College, GA
- DJ Wagner, Grove City College, PA

## LEARN MORE

- For more information on SPS awards, recipients, and future deadlines, visit [www.spsnational.org/awards](http://www.spsnational.org/awards).





# Starting an SPS Chapter from Scratch

## TOP TEN TIPS FOR BUILDING A STRONG CHAPTER

by Gary D. White

Editor, *The Physics Teacher*

Adjunct Professor of Physics, George Washington University in Washington, DC

SPS Director, 2001–2012



**THE NORTHWESTERN STATE UNIVERSITY SPS CHAPTER** hosts a 1999 outreach event in Natchitoches, LA. Photo courtesy of Gary White.

**How do you go from an inactive SPS chapter to a vibrant community of physics students that can play a key role in the evolution of your department? Having faced this question twice at two very different institutions, and having watched others succeed, I have some ideas. In fact, my own experiences have led me to draw a few conclusions about some things that work. David Letterman's recent departure from *The Late Show* has got me in a Top Ten List mode. So, here's the short list, followed by some elaboration:**

### 01 FIND OUT WHAT PEOPLE WANT.

At the departmental meet-and-greet at the beginning of the semester, we made a poster that included a variety of items arranged in a grid (movie night, GRE prep session, career workshop, science outreach at a local school, grad student panel discussion, road trip to science museum, astronomy night, liquid nitrogen ice cream welcome party, etc.).

We asked the students in attendance to cast votes for their three favorite items. The officers and departmental leadership were then able to use the votes to prioritize what to plan for the year. Letting everyone know that the activities were based on the preferences of the students resulted in better ownership of the activities.

**02 EMBRACE A BIG TENT PHILOSOPHY.** In many departments, there are not enough physics majors around to imagine doing any kind of group activity, so it is important to open the doors wide at the beginning. Advertising that "Science Club" will have its first meeting next Friday to discuss bringing in an expert on medical imaging is likely to draw in more people and generate more interest than inviting the physics majors to talk about bringing in a PET scan physicist, especially if you invite all the first-year physics classes. We started with "Science Club" events, which proved to be much more inclusive, and eventually we segmented ourselves into a chemistry club and an SPS chapter that still met jointly for certain activities. In any case, it took several semesters to build up enough interest in physics-exclusive events to risk promoting them without the "Big Tent" philosophy.

### 03 PLAN FOR THE LONG TERM.

While it is important to have something in the near term to look forward to, my sense is that most chapters need to be looking forward to something big out there on the far horizon too. Attending the Sigma Pi Sigma Congress (November 2016, in California's Silicon Valley) is an excellent example of a long-term goal that can help inspire your chapter and generate excitement; other physics association meetings can serve the same purpose, as can local science events.

### 04 START A TRADITION OR TWO.

One of the easiest ways to maintain community in your physics department is to develop some local physics traditions that everyone appreciates. "We always have a liquid nitrogen demonstration at our annual physics BBQ . . ." is the kind of statement that can inspire people to action without a lot of pleading and cajoling. Traditions bring a sense of identity that can extend far beyond the campus walls proper, helping to draw in alumni and prospective students in a way that few other things can.

### 05 GET INVOLVED WITH SCIENCE OUTREACH.

Everywhere I have taught, I have found that



**SPS MEMBERS FROM THE GEORGE WASHINGTON UNIVERSITY** (Sri Murthy and Zoe Pierce) guide outreach activities at Life Pieces to Masterpieces in Washington, DC. Photos courtesy of Gary White.

one of the best activities for bringing people together around physics is science outreach. Few people, physicists least of all, can resist the allure of sharing the wonder of rainbow diffraction glasses and spectra with the uninitiated; exploring the weirdness of oobleck with school children; or introducing rocket science into a campus open house via roller skates, Diet Coke, and Mentos. Combine cool stuff like that with the idea that you are helping people learn or appreciate science, and usually outreach results in a win-win-win situation for the department, the presenters and the audience, with the biggest winners being the people presenting the science (because invariably, they end up learning the most).

## 06 MAKE YOUR INVITATIONS PERSONAL.

Sometimes it pays to take the time to send out 10 individual invitations rather than one mass invitation to 10 people.

## 07 LEVERAGE SPS NATIONAL.

Make it a point to highlight one item from SPS National at every SPS meet-

ing—whether it be the SPS sessions at national meetings, the Marsh White or Blake Lilly Awards, the undergraduate research events, the scholarships and funding opportunities, the numerous career resources, or just the presence of that mother ship [www.spsnational.org](http://www.spsnational.org) out there, hovering over us all and taking care of us. There are a lot of things to share with your chapter.

## 08 EIGHT LETTERS: ROAD TRIP!

There are few ways to build camaraderie better than traveling together to a fun physics event such as an SPS zone meeting; I recommend building this into your chapter plans once a semester. Even a short trip, say to an astronomy night or a science museum, can be a blast.

## 09 SOCIALIZE, AND BE SURE TO INCLUDE FOOD.

This is probably the most obvious item on the list, but it is surely important. Pizza is the staple everywhere I've been, but establishing your own local favorites (liquid nitrogen

ice cream and strawberries is one of ours) can provide an extra dose of fun.

## 10 DONT FORGET THE PHYSICS!

SPS members always appreciate it when the usual fare is spiced up with a side of physics, so next time you're planning the first SPS meeting or the physics banquet or the tutoring orientation or the open house display table or the training for the science fair judges, consider adding physics to the mix, and invite your chapter members to showcase one of their favorite science demonstrations. Building community is all about giving everyone a chance to shine. //

## LEARN MORE

Find more tips for chapters, along with examples of recent chapter activities, on the SPS website at: [www.spsnational.org/resources/chapters](http://www.spsnational.org/resources/chapters).

# How to Build a Muon Detector

## A RING-IMAGING CHERENKOV (RICH) DETECTOR FOR A LESS-THAN-RICH UNIVERSITY

by Kris Pritchard

Class of 2016, Missouri Southern State University



**KRIS PRITCHARD** holds a fixture that was 3-D printed to hold the magnesium fluoride radiator. Photo by Curtis Almeter.

**A ring-imaging Cherenkov detector (RICH) is not something you'd find in most universities. Designed to identify subatomic particles, it's an expensive piece of equipment. So what do you do when you want a RICH detector in a less-than-RICH university? You have to think outside the box.**

The story of our detector starts during my sophomore year, when particle physicist David McKee joined my university's teaching staff. When I was a junior, I had to design my own research project for an advanced lab. Shemaiah Khopang, who had been my lab partner since our freshman year, teamed up with me and we chose to work under Dr. McKee to make a RICH detector. We decided to use commercial off-the-shelf products. Our goal was to come up with a design that could be made

available for other universities that, like us, wanted to study the muon energy flux.

To do this, we would need a camera, a data acquisition system, a transparent medium with an appropriate index of refraction, and a lot of math.

The muons we hoped to spot raining down upon our creation start as cosmic rays, high-energy particles that arrive from outside our planet's atmosphere. When cosmic rays encounter the atmosphere, they produce secondary particles, including muons, which constantly strike Earth from all different directions at nearly the speed of light. A muon ( $\mu$ ) is an unstable subatomic particle with a mean half-life of approximately 2.2  $\mu$ s.

What is really cool about muons is that they are one of only a few secondary particles from cosmic rays that actually reach

sea level. If you were to hold out your hand, one muon will pass through it, on average, every second.

Cherenkov radiation occurs when a subatomic particle shoots through a medium faster than light moves through that particular medium. Detect Cherenkov radiation, and you can measure the energy and angle spectrum.

To create Cherenkov radiation, we needed a transparent medium with an index of refraction high enough to create Cherenkov radiation but low enough to avoid total internal reflection, which we calculated to occur at  $n = 1.41$ . We chose magnesium fluoride as our medium. Magnesium fluoride has an index of refraction of  $n = 1.37$ , and although it is a salt, it will not dissolve in Missouri-level humidity.

To spot the radiation, we chose a Sony A3000 camera. It has a removable lens and a powerful complementary metal-oxide semiconductor (CMOS) image sensor. In order for our design to work, the CMOS image sensor needed to be placed flush against the magnesium fluoride to eliminate errors that would be caused by Cherenkov radiation traveling through air, which has a lower index of refraction,  $n = 1.003$ . With the medium flush against the sensor, a muon should hit the magnesium fluoride, create a cone of photons emitting at Cherenkov angle  $\theta$ , and hit the CMOS detector creating an ellipse or "ring" of light. If a gap of air is left in between the detector and medium, then we would end up with an additional angle  $\phi$  added to  $\theta$  because of the index of refraction of air. This effect would most likely lead to the photon ring missing the detector all together. Another problem that could arise is if the magnesium fluoride has a slight angle with respect to the CMOS. In this case, a possible outcome could be that our ellipse would be elongated or of a different shape than expected. Thus, our goal was to capture the ring of photons at an angle  $\theta$  solely dependent upon a muon's energy and angle, as well as the index of refraction determined by the magnesium fluoride.

The layout of the Sony A3000 is such that the CMOS image sensor is located deep within the camera base. The only way to get the CMOS flush with the magnesium fluoride was to completely disassemble the camera, modify it, and reassemble it.



# WITH ONLY TWO WEEKS LEFT TO OBTAIN THE "CHERENKOV IMAGES" ... IT WAS time to ask for more help.

Seems simple enough, right? Wrong! Once we got the camera taken apart and the magnesium fluoride installed, we had to put the device back together, which was difficult. Because of the thickness of the magnesium fluoride, about 5 mm, we would need longer screws. Not that big of a problem, you might think. But the screws needed to be 1.6 mm in diameter. That was a problem. Apparently this particular diameter of screw is not readily available in the United States, or anywhere else as far as we could tell.

Luckily, Shamrock Bolt and Screw, a local hardware store, was able to get what were apparently the last 39 1.7-mm screws in the United States. Thank goodness they worked for our application, even though they were oversized in diameter by 0.1 mm.

As we struggled with this technical challenge, we had a deadline fast approaching. I was to present our research at the 2015 April Meeting of the American Physical Society. But we had nothing to show, just a seemingly failed engineering attempt.

With only two weeks left to obtain the "Cherenkov images" that I had applied to present, it was time to ask for more help. Physics major Chase Garrett had expressed interest in our project and decided to join our team. We worked in-between classes, late into the night, and even on weekends.

Eventually we got the camera built and functioning properly!

Taking pictures of Cherenkov radiation is a bit different than snapping shots of your child playing in a soccer game. To capture the image, we needed complete darkness. We obtained this darkness by wrapping the camera about six times in black felt, turning off the lights, and sticking our hands inside the felt blanket to click pictures. We played around with exposure times and videos. Eventually we decided to stick with a 10-second exposure time. After 30 minutes of taking snapshots at these exposures and analyzing the images, we found exactly one photon ring.

We were ecstatic! Our one photon ring was all we had to bring to APS, but let me tell you, that felt way better than no photon rings. The presentation went really well. Just attending my first APS conference was an out-of-this-world experience. I learned so many things in that weekend that can't be taught at school.

I recommend conferences such as this one to any undergraduates planning on attending graduate school. The lectures were educational, but the real education was given to us by SPS sessions arranged just for undergrads. Advice was given to us about graduate school and career choices.

Being able to hang out and spend one-on-one time with grad students and ask them for advice will prove most helpful moving forward in my education, I am sure (see the article on p. 31 for more).

Moving forward, we plan to work on improvements to our design and gather more data. We will extract the angle of incidence, judged by the shape of the photon ring. We will work out the Cherenkov angle, judged by the size of the ring. Eventually, we will be able to analyze the muon energy flux.

We will then compare our data to that of large facilities. One of our future goals for this equipment is to transition this project into tomography by attempting to view cave hollows.

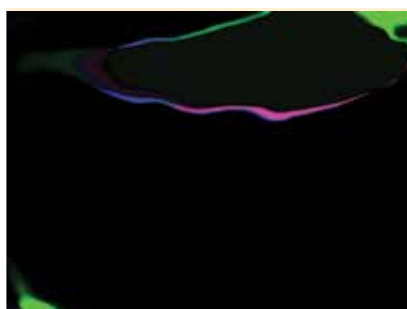
I plan to attend graduate school but am currently unsure as to which subfield I will end up studying. I originally wanted to do theoretical astrophysics to find out what the universe is made of and possibly help future generations find a way to travel through space. I've thought about doing particle astrophysics research that will further educate humanity about the particles that meet our atmosphere and the roles these particles play in our universe. I've considered nuclear physics to come up with some new clean energy that will help cut down on carbon dioxide emissions. And I've thought about being a geophysicist to try to come up with an economical solution to replenishing our groundwater.

I just hope that, whichever direction I choose, one day I can do something to help and further the knowledge of mankind. This project was a great first step in that direction. //

## GET MONEY FOR CHAPTER RESEARCH

- SPS chapters are eligible for up to \$2,000 in funding for research projects through the SPS Chapter Research Award (formerly the Sigma Pi Sigma Undergraduate Research Award).
- Applications are due November 15 each year.

■ For details see [www.spsnational.org/awards/chapter-research](http://www.spsnational.org/awards/chapter-research).



A PHOTO OF THE DISASSEMBLED CAMERA and the chip that was installed in it (left), and an image of a photon ring (right). Photos courtesy of Kris Pritchard.

## Zone Meeting Highlights

### Zone 18

by William Tokumaru, Anastasia Bizyaeva, and Manuel Silva, Class of 2016, University of California, Berkeley



**EVENTS INCLUDED** poster presentations, such as the one at left from Doris Lee (photo by Cee Gould), as well as a tour of UC Berkeley (photos by Joe Costello).

**Our zone 18 SPS meeting brought together students from all over California.** We met at the University of California, Berkeley, where the fun began on a Friday afternoon with a tour of one of the brightest synchrotron light sources in the world, the Advanced Light

Source Facility at the Lawrence Berkeley National Lab (LBNL). On Saturday morning the main events of the meeting kicked off with an introduction and overview of how SPS operates at a national level. A campus tour, a student poster session, and a physics careers workshop followed. In the careers work-

shop the students explored the possibilities a physics degree opens up beyond academia. The day concluded with presentations from two special guest speakers. Dr. Natalie Roe, head of the physics division at LBNL, shared her journey as a physicist working in a national lab. Finally, UC Berkeley

physics professor and dean of undergraduate studies Dr. Bob Jacobsen gave an inspiring talk that encouraged students to explore their interests and get involved with research. He emphasized that you do not need to know what you are going to do for the rest of your life to be successful. //

### Zone 14

by Richard Krantz, Professor and Chairman, Department of Physics, Metropolitan State University of Denver in Colorado

**After our SPS zone 14 meeting, an attendee was overheard remarking, "Geez, I thought he was a graduate student!"** He was talking about Evan Shapiro, an undergraduate researcher and president of the SPS chapter at the University of Colorado Denver, who gave a talk at the meeting. Kudos to Evan for representing his department and research group so well!

Our spring meeting was held in collaboration with the Colorado-Wyoming section of the American Association of Physics Teachers. The keynote speaker was Shapiro's advisor Dr. Doug Shepherd, who uses light to

investigate biomolecules. There were eight other contributed presentations by faculty and students representing six other institutions in Colorado. Dr. Wendy Adams, faculty member from the University of Northern Colorado, gave a mini physics education research (PER) workshop. "People find it easier to learn about topics that interest them," she said. "Recent neuroscience research has demonstrated that memory is improved when learning about material we are curious about." She used these findings to make the case that a student's initial contact to

physical phenomena should take place in a fun, curiosity-inducing, and thereby motivating laboratory setting, with follow-up occurring later in the classroom. //

**AUDIENCE MEMBERS** listened to a variety of talks including one by Wendy Adams and another by Evan Shapiro. Photos courtesy of Richard Krantz.

**For information on the joint MSUDenver/UCD SPS chapter, see <http://spsdenver.blogspot.com/>.**





# Zone 13

by Megan Cromis, Class of 2017,  
Abilene Christian University in Texas

The joint meeting of the Texas sections of the American Physical Society (APS), the American Association of Physics Teachers, and SPS zone 13 took place in March at Lee College in Baytown. This was a very special conference for the students who attended. In addition to the stellar keynote speakers and APS speaker series, SPS had its own speaker series and provided opportunities for students to present posters as well. This allowed students to gain presentation experience and enjoy presentations geared more toward undergraduates. My favorite part about the conference was the opportunity for outreach. Local elementary schools participated in hands-on science experiments. Making connections with the next generation of scientists and engineers really brought together the entire conference. //



**STUDENTS ATTENDING THE OUTREACH EVENT** learned about physics while playing ball, messing around with rainbow diffraction glasses, and bending images on television screens using magnets. Photos courtesy of Megan Cromis.



# Zone 7

by Christopher Baltes, Class of 2018,  
Wayne State University in Detroit, MI

The physics department at Wayne State University in Detroit had the privilege of hosting a SPS meeting for zone 7 in March.

About 20 students attended, representing four universities. Many great presentations were given by professors and students. In between the presentations, lunch and a solar telescope activity acted as breaks during which attendees mixed, talked, and got to know each other. An undergraduate research panel was held. The panel gave great advice to students on very important topics, including the act of balancing

schoolwork and research, the qualities that professors look for in Research Experience for Undergraduates (REU) candidates, and other topics.

Meeting other physics students and sharing our experiences made the meeting worthwhile for us as hosts and a day to remember. It was great to hear about the interests and experiences of students at other universities. All in all, it was an awesome day for zone 7 of the Society of Physics Students. //

**ATTENDEES MADE LIQUID-NITROGEN ICE CREAM**, enjoyed talks such as Renee Ludham's presentation about active galactic nuclei (far left), and observed the sun through telescopes. Photos by Rachael Merritt.





## Zone 6

by Kathryn Gill, Class of 2015,  
SPS Treasurer, Auburn University in Alabama



**HIGHLIGHTS INCLUDED** chatting about posters, eating lunch with friends, and holding this war eagle. Photos courtesy of Kathryn Gill.

**Our conference started with a talk about quantum mechanics, and ended with a talk about birds.** Professor Allen Landers of Auburn University spoke about work being done in his laboratory to better understand the quantum mechanical dynamics of electrons and ions when molecules fragment. In a presentation from the Auburn University Raptor Center, guests were able to see various birds of prey, including one of our very own War Eagles, and learn about their traits and habitats.

In between we heard from other Auburn University professors, who gave talks about their research on the structure of Earth's magnetosphere and magnetic confinement fusion experiments. Professor Francis Robicheaux from Purdue University in West Lafayette, Indiana, spoke about the difficulty of stably capturing antihydrogen formed from antiprotons and positrons at CERN. He described his theoretical work and the experimental apparatuses used to capture the antiatoms,

as well as the impact this work could have on understanding why the universe is primarily composed of matter instead of antimatter. Ten students also presented posters detailing their research that were judged by faculty members.

The conference was very enjoyable. Students from all across zone 6 had the opportunity to learn about different aspects of physics, tour Auburn's beautiful campus, and see many ongoing research projects at the university (including

our tandem particle accelerator and Auburn's Compact Toroidal Hybrid experiment). //

### GET IN THE ZONE

- Learn more about upcoming zone meetings and how to host one of your own at [www.spsnational.org/meetings/zone-meetings](http://www.spsnational.org/meetings/zone-meetings).



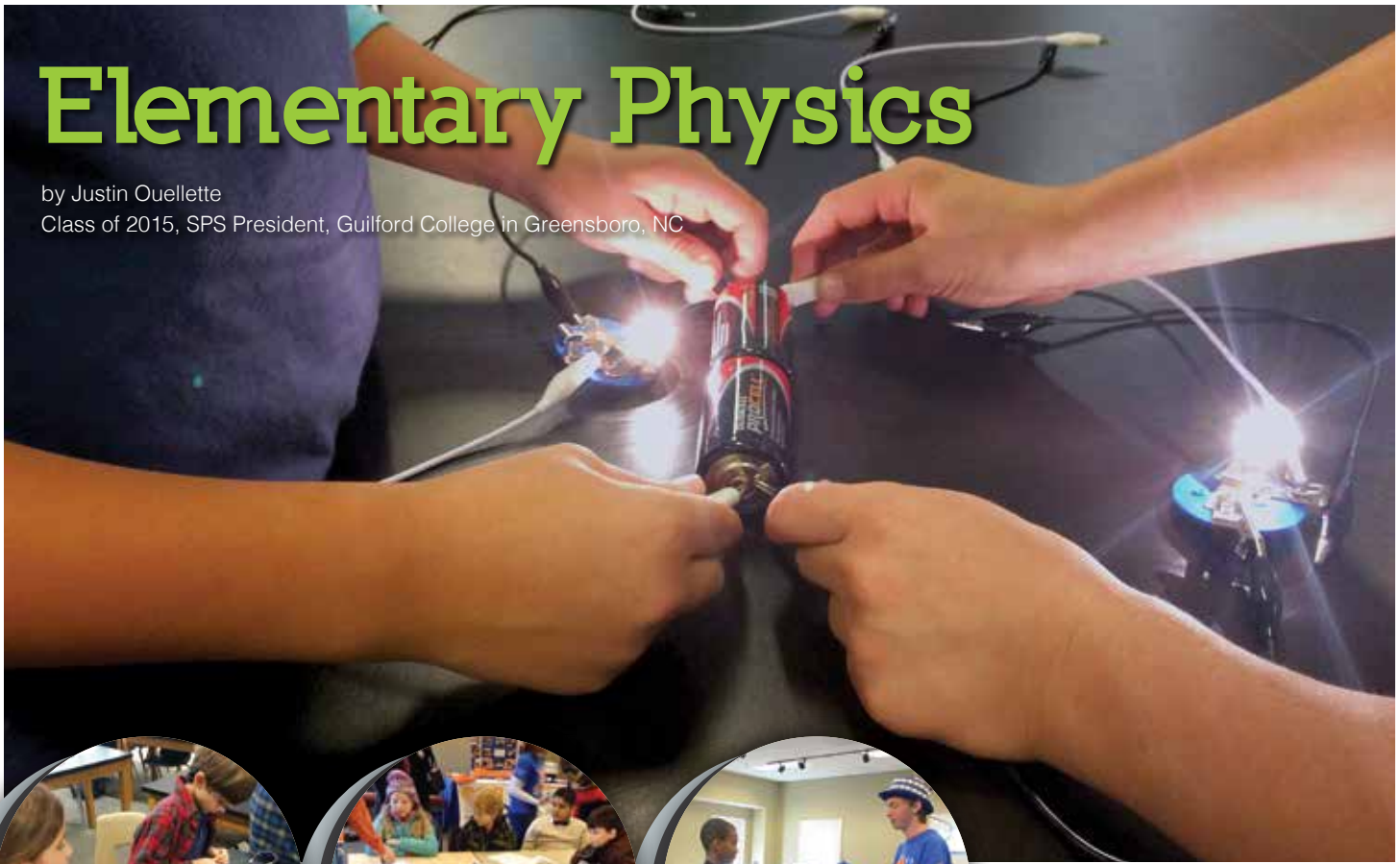
**STUDENTS FROM ALL ACROSS ZONE 6** gathered at Auburn University for their 2015 Zone Meeting. Photo courtesy of Kathryn Gill.



# Elementary Physics

by Justin Ouellette

Class of 2015, SPS President, Guilford College in Greensboro, NC



**ELEMENTARY SCHOOL STUDENTS** build circuits and light bulbs during an after-school program organized by Guilford College's SPS chapter. Photos courtesy of Steven Shapiro.

**With the help of an elementary school's PTA president, our SPS chapter at Guilford College ran a three-week afterschool science program this year.** About five to eight chapter members came to each session, and sometimes we joined forces with the college chemistry club, too.

On one afternoon we gave elementary school students wires, batteries, bulbs, and buzzers. Their first challenge was to use the materials to light a light bulb.

A third grader told me that he didn't know what to do. He had never done anything like this before. I told him to try different things and see if he could figure it out. He was resistant, but I encouraged him again to try.

A short time later his light bulb was shining and he was soon on the way to lighting multiple bulbs at once (with differing brightnesses!), sounding a buzzer, and becoming a confident experimenter. He asked for another battery to try an idea. "Scientists need to try things," he said with an infectious grin.

During another week, students had to figure out how to enlarge and then reduce the image of an object on a screen using optical benches, lenses, and other equipment we brought to the school. When they noticed that the image they produced was inverted, they got busy and figured out how to use two lenses to make the image upright. As another challenge and to create some competitive fun, we drew a target on the whiteboard and challenged each team of students to direct light from a laser to the target via a path that included reflection off of a specified (and increasing) number of plane mirrors. So that students would develop intuition about reflection, and to provide more challenge, we limited the time and the number of tests they could do with the laser turned on.

Visiting this elementary school was one of many outreach activities our chapter participated in during the 2014–2015 academic year. Our physics department also hosted a monthly observatory open house where more

than 200 students, teachers, parents, and grandparents attended a show in our planetarium and observed Jupiter and its moons, as well as galaxies, through our telescopes. We ran a radio astronomy club in which middle school students learned the fundamentals about fast fourier transforms (FFTs) and remotely controlled our radio telescope. We organized a 300-participant Guilford County Schools Science Fair for the second year in a row and judged two elementary school science fairs. It was a busy year at Guilford! //

**'Scientists need to try things,' he said with an infectious grin.**

# MARS Truck

by Colleen H. Fava  
 Manager, Louisiana Space Grant Consortium  
 at Louisiana State University in Baton Rouge

**The Mobile Astronomy Resource System (MARS), recently refurbished after a hiatus of several years, is a light commercial box truck containing computer-controlled telescopes, a digital portable planetarium, and other equipment for providing astronomy learning experiences to audiences at remote sites.** Operated by the Louisiana Space Grant Consortium (LaSPACE) in partnership with the Louisiana State University (LSU) Gordon A. Cain Center, the Highland Road Park Observatory, and the LSU Department of Physics and Astronomy, its main objective is to reach people with limited or no access to fixed-site science centers.

Since the LSU SPS chapter already makes community outreach and K-12 informal education a major part of its mission, partnering with them to get the MARS



Truck back in action was a natural fit. The truck has already been used for two outreach events this year staffed by LaSPACE and members of the LSU SPS chapter: a Family Science Night at Scotlandville Middle Magnet School and the Louisiana Earth Day festival in downtown Baton Rouge. Activities included telescope sky viewing and science demonstrations. LSU SPS students now have access to more resources

**MEMBERS OF THE PUBLIC** peer through telescopes in an astronomy outreach event put on by the Mobile Astronomy Resource System (MARS) truck. Photos courtesy of Bethany Broekhoven.

and equipment, and the LaSPACE and Cain Center team have significantly increased their bench for staffing outreach events. //

**For more information about LaSPACE, visit <http://laspace.lsu.edu>. To learn about the Cain Center, see [www.cain.lsu.edu](http://www.cain.lsu.edu).**

# Show Phyz

by Dana Koczur  
 SPS Chapter President, Class of 2017,  
 Minnesota State University Moorhead

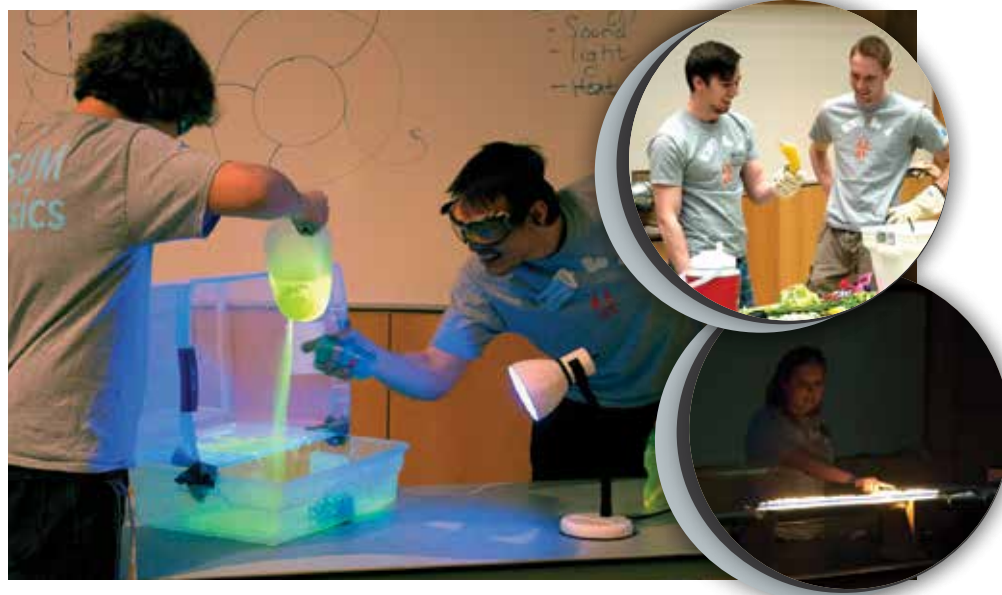
**Fire danced across the top of the Rubens' tube as sound waves of different tones revealed their wave functions.**

A vortex cannon filled with smoke shot rings far across the room. SPS members smashed fruits and flowers frozen with

liquid nitrogen. Balloons dunked in liquid nitrogen flattened as the air inside them cooled, then came back to life, and reinflated when back in the warm air.

This year's Annual Physics Show at Minnesota State University Moorhead was a great success. Demonstrations drawn from the world of physics taught the students and adults who attended about friction, forces, light, magnetic fields, and sound. Fifteen SPS members participated in the show. They were able to gain experience presenting experiments in front of a crowd and also helped in the advertising, radio interviews, and group activities that led up to the show. Our audience was made up of people from Kindred, Fargo, Moorhead, and other nearby cities. We sparked their imaginations and their interest in the physics that surrounds us all. //

**BANANAS FROZEN WITH LIQUID NITROGEN,** glowing soap, and a Rubens' tube were some of the demos on display at our physics show. Photos courtesy of Juan Cabanela.





# Trivia Night

by Quincy Abarr  
Class of 2015, SPS Secretary,  
DePauw University in Greencastle, IN

**“What is the only genus that is also the name of an animal?”**

**“What is the term for the stretching of an object due to tidal forces when it enters a black hole?”**

If you answered “gorilla” and “spaghettification,” you would have done well at the Trivia Night our SPS chapter held in April. Five teams of students and professors showed up to compete and answer questions from six major categories related to science: physics, math, computer science, geology, biology, and chemistry. We also had a good-sized audience for this fun event, intended to make physics and SPS more visible on our campus. Our members wrote the questions and organized the event as a fun way to make physics and SPS more visible on campus. It was the first time we had done a trivia competition, and we hope it will become an annual event. In the future we would like to add more categories, such as psychology and find ways to get more people to compete! //

## GET FUNDS FOR OUTREACH

- Submit your project for a Marsh W. White Award. Proposals are due November 15. Details at [www.spsnational.org/awards/marsh-white](http://www.spsnational.org/awards/marsh-white).

# The Great Hovercraft Race

by Stevie Momaly  
Class of 2015, Eastern Illinois University in Charleston



**COMPETITORS STRUT THEIR STUFF** on top of homemade hovercrafts. Photos courtesy of Stevie Momaly.

**“When I say ‘go,’ MAKE IT SO,” announced the emcee.**

As two teams about to race each other switched on their hovercrafts, the riders on those crafts were lifted off the gym floor by an electric leaf blower and a bouncy castle fan. One team member

waited behind each vehicle to give a push that would provide thrust, while another waited at the other end of the gym to stop the craft and its rider.

Four teams showed up to our SPS chapter’s DIY rideable hovercraft race, even though no one had ever seen

or heard of such a thing before. The first-place winners, who traveled from one side of the gym to the other in the least amount of time, received \$100 and their names on the Hover Cup. Prizes were also offered for second place, Best Design, and Most Creative. After the competition, participants and some audience members took turns riding the crafts, sharing their experiences, and talking about how the vehicles were made.

We wanted to put on a physics-related activity that many different kinds of people could have fun participating in. We succeeded, and discussions are already underway for next year’s competition, which hopefully will include more teams and even attract high school students. //









# Grow Your Community

A WORD FROM THIS ISSUE'S GUEST EDITOR

by Karen Williams  
 Professor of Physics, SPS Advisor, East Central University in Ada, OK

**Today on Facebook I saw a photo of Dr. Beth Cunningham, executive officer of the American Association of Physics Teachers (AAPT), standing next to a larger-than-life cardboard cutout of Lise Meitner. It isn't very often you see a cardboard cutout of a famous nuclear physicist, is it? How often is it that you see one of a famous female physicist? How I wish I had a photo of me next to a cardboard cutout of my childhood hero, Marie Curie!**

People need other people like themselves in their community. As a physics professor at East Central University (ECU), I am the only female faculty member on my floor. Fortunately, the professional physics organizations I belong to provide me with a diverse community of men



Karen Williams. Photo by Carl Rutledge.

and women who share my love of teaching physics.

My physics community also includes my department chair at ECU, many of my former students, the SPS National Office, the SPS officers and councilors I served with on the SPS Council and three Sigma Pi Sigma Congress planning committees, the Arkansas-Oklahoma-Kansas section of AAPT, the Okla-

homa Academy of Science, and many contacts from AAPT meetings.

The theme of this issue is the importance of building community. A strong community makes its members more successful and more able to persevere.

How broad is your community? Do you go to scientific conferences? Have you attended an SPS zone meeting to get together with students and professors at other universities in state or out of state? Have you sat down to have a conversation over coffee with a physics "star"? Have you left your comfort zone and gone to one of the National Science Foundation's Research Experiences for Undergraduates (REU) in another state or country? Have you applied for an internship, including those offered by SPS?

Communicating on Facebook about cardboard cutouts of female physicists made me excited to engage others and participate in an upcoming photo event. What motivates you to expand your horizons, to meet and share physics with others? What rewards will you get from expanding your community?

Don't be like Sheldon Cooper from *The Big Bang Theory*, always sitting in the same spot. Boldly go forth. You might just discover universes previously unknown to you. //

## CONNECT WITH SPS

Learn more about SPS, its social media channels, and online communities at: [www.spsnational.org/about/society-media/social-media](http://www.spsnational.org/about/society-media/social-media).

### UPPER LEFT: PHYSICS DEMOS FOR STUDENTS

ARE FUN, especially at East Central University, where Karen Williams is a professor. Photos courtesy of Karen Williams.



# Make Your Physics Lounge a “Safe Place”

HOW TO BECOME AN ADVOCATE FOR INCLUSION

by Therese Jones

Class of 2009, SPS President, Pennsylvania State University in University Park

STUDENTS RELAX  
in our comfortable  
lounge. Photo by  
Kristina Kaldon.

**The physics lounge: a location for physics students to gather, collaborate on homework, hang out between classes, or work on SPS projects.** Those of us with such spaces often take them for granted; they help us meet other physics majors, discuss assignments, study for the GRE, and talk about future careers. In short, they provide a supportive network of peers so important for making it through the 3 am study sessions that often characterize our undergraduate careers.

But what if not everyone has access to such a space? Through our language and actions, we can unintentionally erect barriers to access for



Photo courtesy of Therese Jones.

those who need such networks the most. Crude remarks about women's bodies, assertions that affirmative action prevents white men from getting into the graduate programs they

deserve, jokes that describe Muslims as terrorists, and insensitive comments about the LGBTQ+ community are all means of closing off the physics lounge community. Students in the aforementioned groups often disappear from the lounge unnoticed or never make it in the door at all, because they were never part of the “in-group” to begin with.

In defining the physics lounge, therefore, we often miss one crucial descriptor that should be part of every lounge's vocabulary: the “safe space.” A safe space, as defined by the nonprofit organization Advocates for Youth, is “a place where anyone can relax and be fully self-expressed,

without fear of being made to feel uncomfortable, unwelcome, or unsafe on account of biological sex, race/ethnicity, sexual orientation, gender identity or expression, cultural background, age, or physical or mental ability; a place where the rules guard each person's self-respect and dignity and strongly encourage everyone to respect others.”<sup>1</sup>

Creating a safe space in the SPS lounge is a first step in making physics inclusive. But how does one establish a safe space?

<sup>1</sup><http://www.advocatesforyouth.org/publications/607-glossary>.



**Q: WHAT CAN MY CHAPTER DO TO CREATE A SAFE SPACE?**

**A: CREATE A CODE OF CONDUCT.** Establish what language and actions are not acceptable in your lounge and a means of accountability for those who use said language or perform said actions. See examples from the University of Sussex and Glasgow University.

**CODES OF CONDUCT**

“Code of Conduct” @ University of Sussex LGBTQ Society: <http://sussexlgbtq.weebly.com/safe-space-policy.html>

“Our Values” @ Glasgow University Lesbian, Gay, Bisexual, Trans, Queer and Plus Association: <http://gulg-btqplus.com/our-values/>

**Q: I DON'T USE OFFENSIVE LANGUAGE. WHAT IS MY ROLE IN CREATING A SAFE SPACE?**

**A: YOU MAY NOT USE SUCH LANGUAGE, BUT BEING A SILENT PART OF THE IN-GROUP WHEN YOUR PEERS USE THOSE WORDS MAKES**

**READING LISTS**

“Suggested Reading” @ Social Justice Training Institute: [http://www.sjti.org/suggested\\_reading.html](http://www.sjti.org/suggested_reading.html)

Chanda Prescod-Weinstein’s “Decolonising Science Reading List” @ Medium: <https://medium.com/@chanda/decolonising-science-reading-list-339fb773d51f>

Derrick Clifton’s “10 Simple Ways that White People Can Step Up to Everyday Racism” @ Everyday Feminism: <http://everydayfeminism.com/2014/09/non-racist-white-person/>

Franchesca Ramsey’s “5 Tips for Being an Ally” @ Huffington Post: [http://www.huffingtonpost.com/2014/12/05/franchesca-ramsey-video-ally\\_n\\_6275680.html](http://www.huffingtonpost.com/2014/12/05/franchesca-ramsey-video-ally_n_6275680.html)

Frances E. Kendall’s “How to Be an Ally If You Are a Person of Privilege” @ KNOWhomo, <http://knowhomo.tumblr.com/post/10841967918>

**YOU COMPLICIT IN THE ESTABLISHMENT OF A VOLATILE ENVIRONMENT.**

Those who are marginalized by the in-group are often looked upon as overly sensitive if they speak up. Often, noticeable changes in behavior occur only once members of the in-group call out wrong behavior.

**Q: WHAT SHOULD I DO IF SOMEONE THINKS I HAVE USED OFFENSIVE LANGUAGE?**

**A: LEARN HOW TO APOLOGIZE.** Don’t get defensive, assert that your words were misconstrued, or blame the other person. Try to understand the other person’s perspective. Take responsibility for your words and the hurt they created. Express genuine remorse, make amends, thank the person for calling you out, and try to change your behavior.

**MAKING AMENDS**

Jessica Kirkpatrick’s “I was Wrong and I am Sorry” @ Women in Astronomy Blog: <http://womeninastronomy.blogspot.com/2015/04/i-was-wrong-and-i-am-sorry.html>

**Q: I NOTICE A STUDENT OF COLOR/DISABLED STUDENT/WOMAN/MEMBER OF THE LGBTQ+ COMMUNITY WHO DOES NOT HANG OUT IN THE PHYSICS LOUNGE. WHAT SHOULD I DO?**

**A: INVITE STUDENTS WHO ARE NOT PART OF STUDY GROUPS TO JOIN.** If disruptive members make this difficult, form smaller study groups. Listen to the students you have invited if they offer to tell you about their experience, but do not force them to educate you about their underrepresented group.

**Q: NOT USING RACIST LANGUAGE MAKES SENSE. BUT WHY CAN'T I HAVE A HEALTHY DEBATE ABOUT AFFIRMATIVE ACTION OR OTHER RACE-RELATED TOPICS?**

**A: STUDENTS OF COLOR HAVE TO LIVE WITH THE REALITY OF THEIR SKIN TONE EVERY DAY AND CANNOT DISTANCE THEMSELVES FROM THE SUBJECT OF A RACE-RELATED DEBATE IN THE WAY THAT WHITE STUDENTS CAN.** In a debate about affirmative action, students of color are forced to relive experiences where they have been perceived as incompetent based on appearance alone and question their presence in programs that others assert they were admitted to purely based on their color. This cycle perpetuates feelings of inadequacy that persist even in the face of successes, known as imposter syndrome,

**IMPOSTER SYNDROME**

Scicurious’ “Diversity in Science Carnival: IMPOSTER SYNDROME EDITION” @ Neurotic Psychology: <http://scicurious.scientopia.org/2012/04/30/diversity-in-science-carnival-imposter-syndrome-edition/>

that students of color are particularly susceptible to facing, especially in fields where they may not have a single mentor who looks like them. Similarly, subjects such as police brutality are a reality that white students experience primarily via news and social media, but students of color could face any time they walk outside.

**Q: I WANT TO DO MORE. WHAT CAN I DO?**

**A: START A DIALOGUE WITH YOUR DEPARTMENT.** Consult your campus diversity initiative. Read about racism, sexism, ableism, and heterosexuality. For more advanced reading, see Dr. Chanda Prescod-Weinstein’s Decolonising Science reading list. Join the Equity & Inclusion in Physics and Astronomy Facebook group. Ensure everyone knows about conferences organized by the National Society of Black Physicists and the National Society of Hispanic Physicists, as well as the Conferences for Undergraduate Women in Physics. SPS provides funds for attending those meetings. Check whether your university does. //

**ABOUT THE AUTHOR**

■ **Therese is an astrophysicist turned space-policy analyst, who is writing her PhD dissertation on the regulation of commercial human spaceflight at the Pardee RAND Graduate School. She also works on diversity and inclusion in the workplace issues for the US government and is a member of the Equity and Inclusion in Physics and Astronomy group.**

# Hang Out Online with Physicists and Astronomers

GOOGLE PLATFORM ENABLES INTERACTIVE SEMINAR SERIES

by Will Slaton

Associate Professor, SPS Chapter Advisor, University of Central Arkansas in Conway



.....  
**ABBY KAVNER**, a mineral physicist at the University of California, Los Angeles, was only one of many speakers to participate in our Google Hangouts series. Photo courtesy of Will Slaton.

globe via Hangout's live audio/video or text feature, as well as through the Twitter hashtag #GHOSeminar. Most of our presenters are Twitter users. I've found that scientists on Twitter are fearless when trying new technology and eager to share their science with others.

Prior to each seminar we set up and advertise a G+ event page with details about the event such as the name of the speaker, the title of the talk, and any background reading or background viewing materials. Because not everyone has used the Google Hangout interface before, I work behind the scenes with the speaker to get them familiar with it prior to the seminar.

A laptop with external speakers and a digital projector helps our local audience see and hear clearly. Why not set up a laptop for your own chapter and join us? Seminars typically last an hour or more with plenty of time for Q&A from the audience. Our

**Does your college or university's physics department have a regular seminar series for undergraduates? If not, do you wish it did?**

Like many undergraduate-only physics departments, ours at the University of Central Arkansas had this problem. Here's how we solved it, and how you can join us!

Over the past academic year seminar speakers gave online talks to our undergraduates on topics ranging from high-energy physics to astrophysics to engineering via live-streamed Google Hangouts. Presenta-

tions by experts from across the United States, Puerto Rico, and Australia covered a range of fields, including many outside the expertise of our institution. The series is currently supported by a grant through the University of Central Arkansas Foundation, which provides \$100 to our seminar speakers for their time.

How does the seminar work?

It would not be financially feasible for us to bring in speakers from such a broad geographic area, so we make use of Google Hangouts. In this way we are building an online physics and astronomy community at the undergraduate level across campuses with a decent Internet connection. Speakers can interact with viewers across the

.....  
**We want you and your SPS chapter**

TO JOIN OUR SEMINAR SERIES!

.....



## JOIN THE CONVERSATION

We want you and your SPS chapter to join our seminar series! Your voices and questions will increase the value of the seminar for other participants and the presenter. And if 20 SPS chapters or their home departments donate \$100 each, we could fund 20 seminars over the course of an academic year. To be informed about future seminars: (1) follow me on Twitter (@wslaton), (2) regularly check the seminar homepage, or (3) follow "UCA SPS" on G+ and our YouTube channel. Let's set a goal of 100 undergraduates participating in seminars by this time next year!

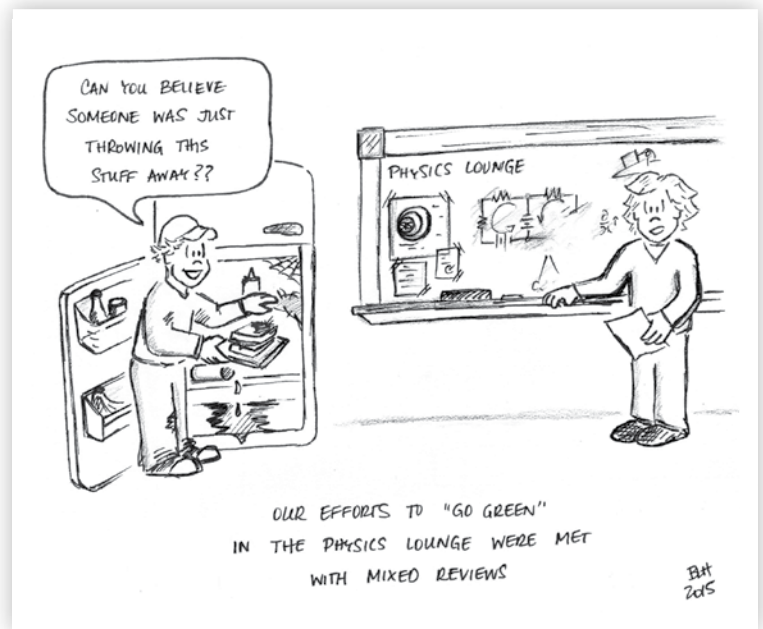
department and SPS chapter split the costs of pizza, drinks, and cookies.

Why participate? Seminar series are important, especially for undergraduates, because they allow exploration of the breadth and depth of physics and astronomy before career decisions are made. Interested in exoplanet research or high-energy physics? Participate in a seminar with someone in that field. Got a question for a practicing scientist about their life or job? Ask! What advice would an astrophysicist give her undergraduate self? She'll tell the entire community. I also believe an undergraduate seminar series is important to show the faces of the people who make up the physics and

astronomy fields. When students at primarily undergraduate institutions don't see people who look like themselves in research positions, they may get the wrong impression about these fields. Representation matters.

If you have suggestions for seminar speakers or topics, please share them with me. If you would like to try a Google Hangout one-on-one before joining a seminar, let me know and we can arrange a date and time. Email me at [wvslaton@uca.edu](mailto:wvslaton@uca.edu).

Our next seminar will be by Dr. Milton Garces of the University of Hawai'i in Kailua-Kona, who will speak about infrasound on September 8th. I hope you will tune in and hang out with us! //



Bobby Logan Hancock.



## CHECK OUT PREVIOUS SEMINARS

- A list of our past speakers with seminar titles and links to the recordings can be found on the seminar homepage, <http://faculty.uca.edu/wvslaton/GHOSeminar.html>, or on our YouTube channel, <https://www.youtube.com/user/UCASPS>.

Sometimes physics students feel isolated. Sometimes physics students are isolated. Whether due to department size, department culture, personal reasons, or other factors, the absence of camaraderie and support within any major can lead to students losing motivation, dropping out, and being at increased risk for depression and anxiety.

On the flip side, a cohesive, supportive department that fosters community can have exactly the opposite effect—it can draw in new majors, as well as people who will never consider a degree in physics but enjoy being

# Finding [or Building] a Community



a part of the group. A community of support can encourage struggling students and offer strength and rejuvenation when students experience "burnout."

Check out Society of Physics Students Programs Manager Kendra Redmond's tips on improving the culture of your department. They're available online in the Winter 2013 issue of *The SPS Observer* (page 23) at [www.spsnational.org/the-sps-observer/winter/2013/finding-or-building-community](http://www.spsnational.org/the-sps-observer/winter/2013/finding-or-building-community).

The culture of your physics department is important. //



# Explore **Research Opportunities** with New Website

.....  
**WREN GREGORY**

(middle) built the new website with the help of Dylan Cromer (right) and Natalie Kamitsuka (left). Photo courtesy of Wren Gregory.

FIND RESOURCES AND COLLABORATIONS AS YOU BUILD YOUR RESEARCH COMMUNITY

<http://zone5physics.wix.com/opportunity>

by Wren Gregory

Zone 5 Associate Zone Councilor, Class of 2015, University of North Carolina at Asheville

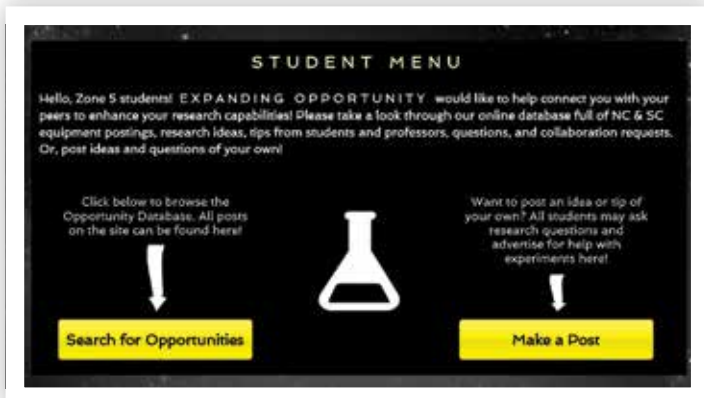
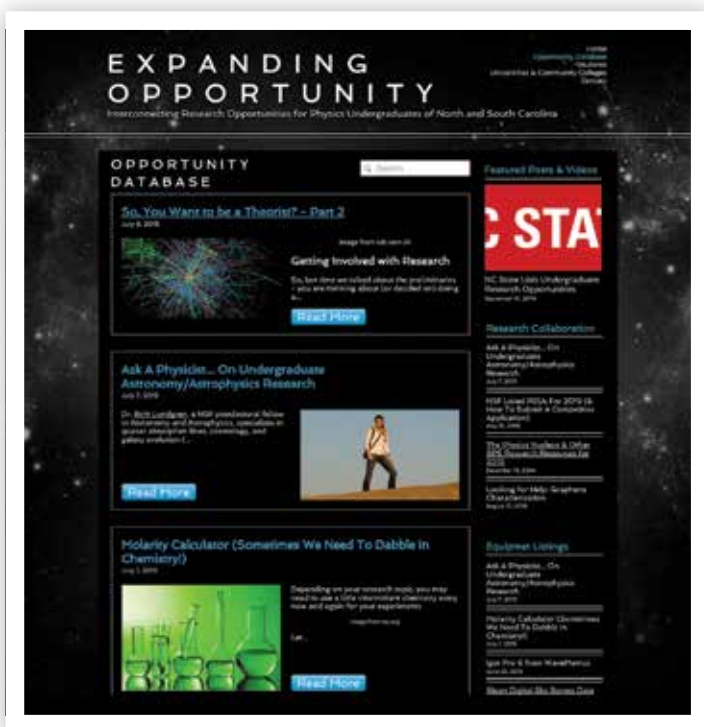
**Physics undergraduates know that hands-on experiences are crucial in preparing us for our futures. Those opportunities shape our passions and guide our goals as physicists. I can remember my first taste of research as a sophomore at my small liberal arts college in North Carolina. Working to calibrate a radio interferometer, I was absolutely thrilled to be a part of something for which the outcome was unknown and my contributions helped to blaze a trail.**

But it wasn't long before I saw the limitations undergraduates interested in contemporary physics research face, especially at

.....  
I began to wish there was a site for physics students

WHERE WE COULD SEARCH FOR EQUIPMENT AND COLLABORATIONS.  
.....





SCREENSHOTS from the Expanding Opportunity site. Images courtesy of Wren Gregory.

smaller institutions. In my case, I lacked the specialized equipment necessary for my experiment. My team began a search for an institution that would collaborate with us and allow us to use their resources to achieve our objective: growing graphene. As I emailed, called, and met with professors I did not know, I began to wish there was a site for physics students where we could search for equipment and collaborations.

Then I thought, "Why don't I just start one?" That led to the creation of Expanding Opportunity ([http://zone5physics.wix.com/opportunity#!form\\_\\_map/c24vq](http://zone5physics.wix.com/opportunity#!form__map/c24vq)).

As the SPS associate zone counselor for the Carolinas, I started close to home and focused on including schools in my zone. The Opportunity Database collects posts from schools and private research facilities that have volunteered their resources to help

motivated students perform advanced research. We are proud to include contacts for a variety of resources, including North Carolina State University's Analytical Instrumentation Facility, Clemson University's Electron Beam Ion Trap (EBIT), and University of North Carolina Asheville's Lookout Observatory. We also provide links to scholarships, awards, free software, and REUs.

Although we are just getting started, we have big ambitions. My vision is to create a national community of physics students that tackle complicated projects together and copublish results. This would benefit not only savvy students, who can acquire a wider variety of practical laboratory skills, but universities as well. I hope to introduce

students to great projects, mentors, and other motivated students who are interested in the same areas. This community creates contacts with potential graduate programs and employers, and prepares us for serious research as soon as possible.

I am lucky to know Dylan Cromer and Natalie Kamitsuka, two enthusiastic students who, along with our zone counselor, Dr. Randy Booker, have agreed to help me grow this database. I would like to put a call out to any students or professors reading this today. If you would like to encourage the progression of this student-centered avenue for research, we would be happy to have you on board! //

## GET INVOLVED

- Contact us at
- [http://zone5physics.wix.com/opportunity#!form\\_\\_map/c24vq](http://zone5physics.wix.com/opportunity#!form__map/c24vq).



Bobby Logan Hancock



# Visit Washington

BUILDING BRIDGES TO ADVOCATE FOR SCIENCE FUNDING

by Amandeep Gill

Zone 18 Associate Zone Councilor, Class of 2015, Sonoma State University in Rohnert Park, CA

AMANDEEP GILL (third from right) poses with the SPS delegation on Capitol Hill. Photo by Courtney Lemon.



AMANDEEP GILL outside the office of Barbara Boxer. Photo by Courtney Lemon.

Walking into Representative Tom McClintock's (R-CA, 4th District) office in Washington, DC, I was unsure how to approach the topic of science funding with the staffer we were about to meet. I had read up on the representative's topics of interest. Science funding was not one of them.

As we chatted, Rep. McClintock's legislative correspondent, Brittany Madni, reiterated that he is not a strong campaigner for science, technology, engineering, and mathematics (STEM) funding. But she added that he is a fan of space exploration and would like to see US astronauts on Mars

soon, and therefore he generally supports increases in NASA space exploration funding. My goal was to convince her that STEM funding is extremely important for the innovations that will make the representative's dream come true.

I had come to the nation's capitol over spring break to par-





**AMANDEEP GILL** (left) visits the office of Barbara Boxer with fellow undergraduate Simon Patané and SPS Programs Assistant Courtney Lemon. Photo by Matt Payne.

of our own experiences with science research and funding.

After being trained, I met with staff from four offices in my home state, California. I started off in Representative Mike Thompson's office (D-CA, 5th District). It was jarring when staffer Megan Rabbitt went straight to wanting to know our "ask," but because Rep. Thompson is a strong supporter of science funding, the rest of the conversation flowed easily. The offices of Senator Dianne Feinstein (CA) and Senator Barbara Boxer (CA) were also quick to express their support for

increase STEM funding, I told my story of struggling to find research funding during and after the government shutdown of 2013. I also recommended that he read *The Martian* by Andy Weir, which is about the human exploration of Mars and the scientific advances that will make that exploration possible.

I came away from the experience with a new appreciation for STEM on the Hill, which helps to build lines of communication between scientists and Congress that can be rather difficult to develop. //

I HAD READ UP ON THE REPRESENTATIVE'S TOPICS OF INTEREST.  
**Science funding was not one of them.**

ticipate in the 19th Science, Engineering, and Technology Congressional Visits Day. Also known as STEM on the Hill, the event aids communication between scientists and members of Congress. Because my visit occurred during appropriation season, the time after Congress receives the president's budget plan and before it presents its own revised plan, it was important that I share stories demonstrating the need for federal funding in the sciences.

I thought about my own story and how to share it during our first day on the Hill as our SPS group was trained. Aline McNaull, a policy associate at the American Institute of Physics

(AIP), spoke about her experiences. We were cautioned to be flexible; a congressperson may not agree with your views, and you mustn't offend them as you put pressure on them to see the other side. Vice president of AIP physics programs Cathy O'Riordan talked about how to present an "ask," which is a Hill term for the quick and dirty reason you are visiting a congressperson's office. AIP had coordinated an organization-wide ask for predictable and sustained STEM funding.

Between the training and our first visit the next day, my colleague Simon Patané and I practiced how to incorporate AIP's "ask" within the narratives

science research and education funding.

To help influence Rep. McClintock to think differently the next time there is a vote to

### STEM ON THE HILL

Learn more about Congressional Visits Day - STEM on the Hill at: [www.setcvd.org](http://www.setcvd.org).



### REACH OUT TO YOUR REPRESENTATIVE

- To learn more about communicating with Congress, see
- "Communicate with Congress," by Richard Jones, and "A
- Letter to Congress," by Eric Beier, in the Winter 2014–15 issue
- of *The SPS Observer*, [www.spsnational.org/the-sps-observer/issues/winter-2014](http://www.spsnational.org/the-sps-observer/issues/winter-2014).

Bobby Logan Hancock



# Come to Congress

HOW TO START PREPARING FOR THE LARGEST NATIONAL GATHERING OF SPSERS

by Brittney Hauke, Class of 2017, Coe College  
Planning Committee Member, 2016 Quadrennial Physics Congress

## COE COLLEGE ATTENDEES

enjoy a tour of NASA's Kennedy Space Center during the 2012 Quadrennial Physics Congress.

Photo by Ken Cole.

**Physics students: THE conference of a lifetime is fast approaching.** Every four years, hundreds of undergraduate physics majors from all over the country and the world gather for 3 days of insightful workshops, spectacular tours, poster sessions, talks, networking, and, of course, fun. With the next Sigma Pi Sigma Quadrennial Congress approaching in early November, 2016, it's crucial for chapters to start planning how they will attend.

Without a doubt, this event is one of the best places to build a strong sense of community, not just in your own chapter but with others as well. Boasting the highest number of undergraduates of any single SPS/Sigma Pi

Sigma event, the conference is your chance to listen to Nobel laureates, industry leaders, and researchers giving the most exciting talks you could imagine. Networking is abundant, not just with students but also with local scientists in the area. During interactive workshops and other activities, you can really get to know other physics students in only a few short days.

You never know where the

connections you make will take you, and we hope the experiences you have at Congress fuel a strong sense of community throughout not just your undergraduate careers but well into your future in physics and beyond.

With the 2016 Congress only a year and a half away, the planning committee is kicking into high gear. This committee is made up of students and faculty

from around the country, as well as a few SPS staff members. We've been meeting since the winter of 2014 to discuss speakers, tours, workshop ideas, and, most importantly, the theme: "Unifying Fields: Science Driving Innovation." Currently we are focusing on marketing and spreading the word.

We are proud to be welcoming among our plenary speakers Jocelyn Bell Burnell, whose work

WITHOUT A DOUBT, THIS EVENT IS ONE OF THE BEST PLACES  
to build a strong sense of community.



led to the discovery of pulsars; Nobel laureate Eric Cornell, known for first synthesizing Bose-Einstein condensate; Persis Drell, Director Emerita of SLAC; and S. James Gates, a particle theorist featured on *The Elegant Universe*. The confirmed tour sites are the SLAC National Accelerator Laboratory, NASA's Ames Research Center, and Google. Events include a breakfast with scientists, a poster session, an art show/contest, and a dance party.

While the Congress may seem a long way off, now is the time to start preparing! One of the most important things you can do is to start fundraising as early as possible. That means deciding how many students you would like to take on the trip and support financially, and to what

degree. There are many ways to go about getting funding for this trip—here are some fundraising tips from a faculty member on the planning committee, Dr. Steve Feller, and myself:

**01 APPROACH MEMBERS OF YOUR COLLEGE ADMINISTRATION FOR MATCHING FUNDS WELL IN ADVANCE.**

We suggest starting with the college or university president. If possible do so before the fiscal year that includes the Congress, as this makes it easier to budget. In other words, do this now!

**02 IF YOUR SPS CHAPTER IS A RECOGNIZED ORGANIZATION ON CAMPUS, WRITE A PROPOSAL TO THE STUDENT SENATE OF YOUR COLLEGE.**

**03 ASK RESEARCH SUPERVISORS IF THEIR**

**GRANTS CAN SUPPORT TRAVEL FUNDS FOR STUDENTS TO PRESENT POSTERS AT CONGRESS.**

**04 SELL STUFF.** For example, our chapter just designed t-shirts and sold them to both students and alums.

**05 APPROACH ALUMS FOR TRAVEL SUPPORT** (after clearing the idea with your advancement office).

**06 SET A REASONABLE FEE FOR STUDENTS TO PAY.** In 2012, students at our school had to chip in \$400 each to attend, and we focused on raising the rest. Our students saw that as a worthwhile investment.

**07 SAVE ON TRAVEL.** For the last Congress, we

approached United Airlines for a group rate that saved us a few thousand dollars. The group rate also made it easy to secure passage for the whole group on the same plane. Students were responsible for the cab and shuttle rides to and from the airport, as well as for food not provided by the Congress. Thus, students paid, in total, about \$500 or so for their trip to the Congress, including the \$400 we asked them to contribute up front.

**08 SEEK LOCAL SPONSORSHIP IN PLACES STUDENTS FREQUENT.** Examples include restaurants, coffee shops, and technical companies (again, clear this with your advancement office).

**09 SEE IF YOUR COLLEGE WILL ARRANGE FOR DISCOUNTED VAN RENTAL.** You might approach the athletic team's office for this. They either rent vans or they own them.

**10 SEE WHAT THE SPS NATIONAL OFFICE CAN OFFER!** For example, being a chapter reporter for SPS helps cover the cost of some travel.

The Congress will take place November 3–5, 2016, at the Hyatt Regency-San Francisco Airport. Keep an eye out as the event gets closer for an increased social media presence and check out the Congress website: [www.sigmapiSigma.org/congress/2016](http://www.sigmapiSigma.org/congress/2016). See you in 2016! //

**THE 2012 CONGRESS**

included NASA tours, poster sessions, an art contest, and interactive workshops. Photos by Liz Dart Caron and Ken Cole.





"Having the opportunity to talk with the physicists invited to give talks was amazing, but simply talking to physics students from around the country helped to open our eyes to the larger physics community."

—2012 Congress attendees  
from Idaho State University



## Unifying Fields

SCIENCE DRIVING INNOVATION

**SAVE THE DATE: NOVEMBER 3–5, 2016**

[www.sigmapisigma.org/congress/2016](http://www.sigmapisigma.org/congress/2016)



## 2016 Quadrennial Physics Congress

November 3–5, 2016 • Silicon Valley

Hosted by Sigma Pi Sigma, the physics honor society



Once every four years hundreds of physics students, faculty, and Sigma Pi Sigma alumni from all walks of life gather for the Quadrennial Physics Congress. They spend a packed weekend making new connections, interacting with scientists and distinguished speakers, debating common concerns for the discipline and society, and touring iconic scientific venues. Make plans now to attend the 2016 Congress in California's Silicon Valley!

### Confirmed Speakers

Jocelyn Bell Burnell

Eric Cornell

Persis Drell

S. James Gates

### Confirmed Tour Sites

SLAC National Accelerator Laboratory

NASA's Ames Research Center

Google

Interactive Workshops... Poster Sessions... Art Contest... More details to come!



# Sushi and Sliding Doors

CONFRONTING CHALLENGES IN COMPUTING AT THE 2015 CONFERENCE ON COMPUTING IN HIGH ENERGY AND NUCLEAR PHYSICS (CHEP), APRIL 13–17, OKINAWA, JAPAN

by Robert Mina

Class of 2016, University of Virginia in Charlottesville



**A WHOLE YELLOWFIN TUNA** was carved at the conference banquet. Photo courtesy of Robert Mina.

On the last night of CHEP 2015, the 500 or so conference participants and their guests attended a banquet at one of Okinawa's beachside resort hotels. On the buffet were diverse local favorites, like a pig roast, soba noodles, and several varieties of sushi. The centerpiece was a humongous yellowfin

a visit from Ms. Okinawa to award the "Best Poster Presentation" prizes, and an emphatic rendition of the sliding-door dance by all present. Even if you've never danced it before, I bet you'd pick it up quickly; just step to the left while throwing your arms up on that side of your body, then take a step to the right while

cists to discuss new and developing issues, strategies, and concepts in computing. The most recent session, the 21st, was held at the Okinawa Institute of Science and Technology in Okinawa, Japan, in the second week of April. There were talks about dozens of different experiments from all parts of the world, ranging from well-established projects such as Super-Kamiokande in Japan (which looks for neutrinos), to experiments that are still in their planning stages, such as those at the Facility for Antiproton and Ion Research in Darmstadt, Germany. I presented a poster about software that I helped write for the NOVA experiment at Fermilab, while on either side of me were scientists from the ATLAS experiment at the Large Hadron Collider in Geneva, one British and one American.

Two things stood out as I listened to the presentations and viewed the posters. First, the community of particle physics is diverse in background, with people from all over the world participating in these experiments. Second, and more importantly, it is fairly homogenous in the challenges it faces and in how it approaches them. I think the message of a conference like CHEP is that we do the best science when we bring our diverse perspectives to bear on our common concerns. After all, elementary particles don't act any differently in one country than they do in another. //

**THE CONFERENCE MASCOTS** were these adorable cartoon characters wearing lion head hats. Photo courtesy of Robert Mina.



WE DO THE BEST SCIENCE WHEN WE BRING OUR DIVERSE PERSPECTIVES TO BEAR ON OUR **common concerns.**

tuna, which was carved before our eyes into delicious sashimi.

On tap for the evening's entertainment were a few traditional musical numbers performed with elaborately costumed dancers,

swinging your arms across in front of you. Then back to the left, and repeat. I can't think of a better way to end a physics conference.

CHEP is an international meeting organized once every 18 months to allow physi-

# How to Hide from the Zombie Apocalypse

AND OTHER THINGS I LEARNED AT THE 2015 AMERICAN PHYSICAL SOCIETY (APS) MARCH MEETING, MARCH 2–6, SAN ANTONIO, TX

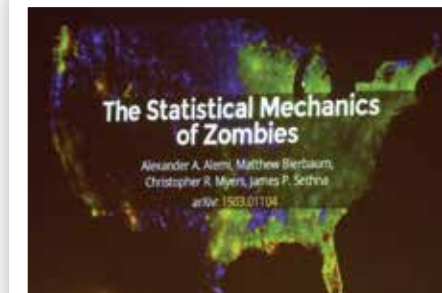
by Justin Flaherty

Class of 2016, Cleveland State University in Ohio

**When my friends asked me what the APS March Meeting was about, I jokingly referred to it as “Comic-Con for Physicists.” Nearly ten thousand physicists attended. Having never been to a March Meeting before, I was amazed by the sheer number of people.**

high level of importance.

Being a reporter was a wonderful experience. The press conferences were held in a small room where about 10 people in the audience listened to speakers who had previously given talks to closer to a hundred people. Being in such a small audience



**A TALK ON HOW TO SURVIVE A ZOMBIE ATTACK** was particularly entertaining. Photo courtesy of Justin Flaherty.

trial and Applied Physics (FIAP). FIAP's goal is to implement methods of outreach that recruit physics students to industry, instead of students having to reach out to industry.

Another talk that I found really interesting was as fun as it was informative. It dealt with the statistical mechanics of a zombie apoca-

## The safest place to hide from the zombies

WOULD BE IN THE ROCKY MOUNTAINS.

I went with fellow undergrad Janna Mino and my optics professor and SPS advisor, Dr. Kiril Streltzyk. They both attended the meeting to present research, while I decided to go just to learn. I was given a reporter award through the Society of Physics Students, which meant that I had a press badge. This badge gave me clearance to attend press conferences and conveyed a

allowed me to connect on a more personal level with the speakers and helped me to understand their research in a different light.

As a student working toward a career in physics, I found a press conference on issues related to industrial physics especially interesting. Speakers from the National Institute of Standards and Technology (NIST) and APS represented the Forum on Indus-

try and Applied Physics (FIAP). FIAP's goal is to implement methods of outreach that recruit physics students to industry, instead of students having to reach out to industry. lypse, a topic outrageous in the best way possible. According to the results presented, a zombie outbreak is most likely to originate in a densely populated city. The safest place to hide from the zombies would be in the Rocky Mountains. Unfortunately, the simulations showed that all humans would be dead within a few weeks. But hey, zombies are cool. The team was kind enough to make their article available for free on the arXiv website. If you want to read it, look up ID number 1503.01104.

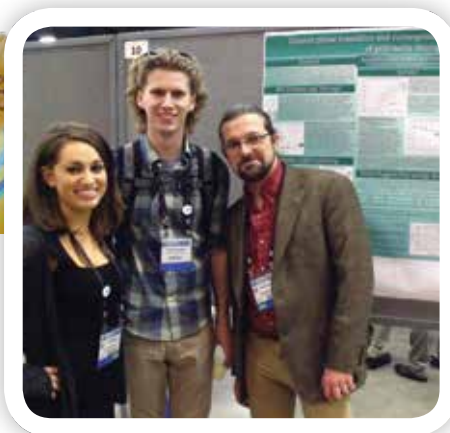
This is what I loved about the March Meeting. I was able to get a better idea of what a career in physics would entail while at the same time being entertained and informed by outrageous, yet clever applications of physics. It was a wonderful experience, and I am looking forward to attending next year. //

### NEXT UP

**The next APS March Meeting will be held March 14–18, 2016, in Baltimore, MD. For more information, keep an eye on [www.aps.org/meetings/meeting.cfm?name=MAR16](http://www.aps.org/meetings/meeting.cfm?name=MAR16).**



**CARDBOARD CUTOUTS** depict some of physicists' heroes: Lise Meitner, Richard Feynman, and Nicola Tesla (above). The author poses with Janna Mino and Kiril Streltzyk in front of their poster on microgels (right). Photos courtesy of Justin Flaherty.





# A Lesson Learned

MY INVALUABLE EXPERIENCES AT THE 2015 AMERICAN PHYSICAL SOCIETY (APS) APRIL MEETING, APRIL 11–14, IN BALTIMORE, MD

by Kevin Vargas-Velez

Class of 2016, University of Puerto Rico in Mayaguez



**UNDERGRADUATES** at a Future of Physics Days event at the 2015 APS April Meeting. Photo courtesy of the American Physical Society.

**After arriving at the APS April Meeting, I took a seat at the back of a large conference room. I had my ID badge, my press pass, and a cup of coffee. I was ready to be amazed.**

The first plenary session did not disappoint. The presenters, collaborators on the IceCube experiment, were excited to present their results.

Later, at an event called “Lunch with the Grads,” other presenters gave us students important advice about graduate school. They told us what to do and what not to do, how to manage our time, and why it’s important to maintain a balance between your studies and your personal lives. I was surprised when they recommended that we focus on choosing an advisor that we could

TAKING A RISK MAKES A  
**positive answer possible.**

As I watched them, I thought about the help that professors, universities, and funding organizations provide to undergraduates and how important it is to support undergraduate research.

establish a good relationship with instead of aiming for a “cool” project. As Crystal Bailey, careers program manager at APS, said, “It could make the difference between graduating or not.”

It was also great to attend the undergraduate poster sessions and learn about experiences students had while doing research—all the difficulties that arose and the creative solutions that allowed experiments to continue. Before coming to the meeting, I thought that I would be seeing only projects related to fields in theoretical physics. That was not the case. As I walked through the posters, I saw results from one experiment that performed X-ray diffraction on a nanomaterial and another that involved an electrodynamic wheel. I was awestruck.

I realized that I, too, could have applied and maybe presented results from the experiments I do at my university. I remembered that one of my professors, Dr. Eric Roura, had encouraged me to apply for a poster presentation. The lesson was learned. If you are not sure about something, ask. Apply to every opportunity, even if the chances are low. Taking a risk makes a positive answer possible.

The APS April Meeting was a great experience. I learned a lot of theoretical physics related to topics such as quantum gravity, gravitational wave detection, the cosmic microwave background, and dark matter. Also, I got good advice about graduate school and getting a job in industry. You, too, can learn a lot from these conferences. If you are wondering if you should attend one of these meetings, I tell you, “Go!” You will not regret it. //

## NEXT UP

- The next APS April Meeting will be
- April 16–19, 2016, in Salt Lake City, UT. For more information watch
- [www.aps.org/meetings/meeting.cfm?name=APR16](http://www.aps.org/meetings/meeting.cfm?name=APR16).

## BECOME A REPORTER!

- SPS offers travel support at a level of
- \$200 for chapters or individual students reporting on a national
- physics meeting for SPS. Find out more at [www.spsnational.org/awards/reporter](http://www.spsnational.org/awards/reporter).

# Physics Connections

Introductory Physics Theory Applied to Real-World Problems



## Lift and Circulation

No matter how much physics you know, it's still amazing to see an airplane fly. The airplane's wings are fascinating to watch too—not only for what you see with your eyes, but also for what you see in your mind, thanks to physics.

Join Ed Neuenschwander, professor of physics at Southern Nazarene University in Bethany, Oklahoma, to discover how air circulation around wings makes flight possible. The full story is available online at [www.spsnational.org/the-sps-observer/physics-connections](http://www.spsnational.org/the-sps-observer/physics-connections).