

# PHYSICS OUTREACH & ENGAGEMENT

## Letter from the Chair

The dramatic observations of the past two years in astrophysics captured the imagination of the world. Beyond the usual flurry of excitement over Nobel Prize worthy discoveries, there is the real prospect of having a new window on the cosmos through gravitational waves and the combination of information from them and multi-EM wavelength observations. However, the excitement for physics extends well beyond any particular subfield. The prospects across our science have never been brighter and the inherent dangers to humanity of having the public ignore physical science have never been greater. This all underscores the importance of continually building enthusiasm in our community to “tell our stories.” FOEP is the home within APS for the large number of physicists carrying out a vast array of outreach engaging the public activities. Distribution outlets such as blogging, video and multimedia distribution allow essentially any physicist to address a worldwide audience. FOEP stands ready to encourage ever more APS members to “engage the public as partners in the enterprise of physics.” Please join us!

One of the best ways to find out more about the diverse means by which physics is being publicized is to come to the invited sessions at the APS March and April meetings. We have a terrific line up of speakers including Joe Niemala (ICTP), Sam Sampere (Syracuse U.), Jorge Cham (PhD Comics), Tatiana Erukhimova (Texas A&M) and Clara Moskowitz (Senior Editor at Scientific American). For the April meeting we have (to be confirmed) Lucianne Walkowicz (Adler Planetarium and Library of Congress), Renee Horton (NASA), and Becky Thompson (APS). The breadth of experience in engaging the public is spectacular!

*Continued on page 2*

### JOIN US

To join FOEP at no cost prior to renewing your APS membership, send an email to [membership@aps.org](mailto:membership@aps.org) with your request to add FOEP to your membership. Please note that if you currently belong to two or more forums, FOEP will be added at no charge for the remainder of your membership term. On your next membership renewal notice, you will see a Forum subtotal that will include \$10 for every Forum membership over two.

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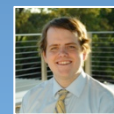
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*A publication of The Forum on Outreach and  
Engaging the Public - FOEP -  
A forum of the American Physical Society*

## Welcome to our new members

I want to welcome the new members of FOEP and especially point out the newest member of the FOEP leadership, Jim Kakalios of the U. of Minnesota. Don Lincoln moves from Vice Chair to Chair-Elect. Both Jim and Don have extensive outreach portfolios in addition to being superb physicists. I also welcome Kathleen Hinko and Shireen Adenwalla to the Executive Committee in the Members-at-Large slots and thank them in advance for their work to come for FOEP.

The current FOEP Executive Committee members are:

Past Chair: Itai Cohen

Chair: Larry Gladney

Chair-Elect: Don Lincoln

Vice Chair: Jim Kakalios

Secretary/Treasurer: E. Dan Dahlberg

Members at Large: Heide Doss, Rachel Henderson, Kathleen Hinko, Shireen Adenwalla

APS Staff member: Rebecca Thompson

Assigned Council Representative: Gay Stewart

Editor of the FOEP Newsletter: Heide Doss

## Give a non-technical talk in addition to your technical talk at APS meetings

I would like to remind the community and the FOEP members in particular that they can give a non-technical talk in addition to their technical science presentation at the APS meetings. I encourage you to do so. The diversity of outreach is extensive as the field of physics itself. Please share your work and enthusiasm for outreach!

Larry Gladney

## Forum on Outreach and Engaging the Public

FOEP's goal is to increase the public's awareness of physics by providing a forum within APS for the large number of physicists currently involved in a diverse array of outreach and public engagement activities. FOEP fosters the development and dissemination of outreach activities such as blogging, multimedia, video, pop culture, popularizations, press relations, politics, "amateur" and distributed science, science cafes, and public shows and lectures. The Forum organizes and sponsors sessions at the March and April APS meetings and will issue a semiannual newsletter.



Letter from  
the Chair,  
continued

continued  
the Chair  
continued

## Spotlight on Outreach and Engaging the Public of FOEP Nominated APS Fellow

Questions and Answers with FOEP nominated APS Fellow James Kakalios (2015) and our forum's newly elected Vice Chair. Answers are edited for clarity as needed.

Kakalios, James [2015]

University of Minnesota - Minneapolis

*"For innovative efforts to engage the public in the excitement of physics through popular science books, general audience talks, and on-line videos that use examples taken from popular culture."*

**Q. You are widely known for your work on the physics of superheroes (both in books and movies), but I'd like to start with your physics research. Which research project has been your favorite to work on so far, and why?**

In my day job I'm a mild-mannered condensed matter experimentalist, whose research spans from the 'nano' to the 'neuro.' Dating back to my Ph.D. thesis at the University of Chicago, I've studied the electronic properties of amorphous semiconductors. I'm still trying to understand these materials, and have branched out to exploring nanocrystalline semiconductors, either as free-standing thin films or when embedded in an amorphous matrix. Studies in my lab of conductance noise in disordered semiconductors led to collaborations with professors in Neuroscience and Bio-Medical Engineering, where we use techniques developed to study noise in semiconductors and apply them to voltage fluctuations in the brain. My favorite work of late is the identification, contrary to what I and everyone else assumed for decades, that conduction in amorphous silicon is non-Arrhenius but rather has an  $\exp[-(T_0/T)^{3/4}]$  temperature dependence. I believe this is telling us something important about charge transport in disordered systems – but I have no idea what.

**Q. What made you think of designing a physics course based on comic books?**

Back in the 1990's, when teaching an Introductory Physics class, I introduced examples of the principle of momentum conservation or electromagnetic induction taken from superhero comic books, simply as a way of livening up my lectures. In 2001 the University of Minnesota had introduced Freshman Seminars, and encouraged faculty to create engaging classes not tied to any curriculum. I thought an



James Kakalios  
University of Minnesota -  
Minneapolis

interesting experiment would be to see if I could teach an entire physics class, from Newton's laws to modern physics, where the only examples and illustrations came from superhero comics. The course was intended to be open to anyone, not just science and engineering majors, and it proved to be a fun and accessible way to discuss basic physics concepts.

**Q. Which comic book was your favorite pre-graduate school, and which is your favorite since graduate school?**

I never had a strong DC or Marvel tribal identity. As a kid I loved DC comics' The Flash – the notion of being able to run at super-speed really grabbed me for some reason, and Marvel comics' Fantastic Four. The FF's leader, Mr. Fantastic, had elastic powers AND he was the world's greatest scientific genius. I read comic books as a kid growing up in the 1960's but gave them up in high school upon discovering girls (a discovery I'm not given enough credit for in the scientific literature, but that's a different argument). In graduate school, while waiting for the results of the Candidacy Exam that would determine whether I could continue my post-graduate studies, I picked up a stack of comics at a card shop. Some were not very good, but others, such as an early Frank Miller Daredevil or the X-Men at the start of the Dark Phoenix saga, were highly effective at getting me re-hooked. I continued collecting and reading them initially as a stress-release while working on my dissertation. I don't think of it as a 'guilty pleasure' as I don't believe in 'guilty' pleasures. You like what you like, and don't need to feel guilty about it. Post-graduate school, my favorite comics are both limited series graphic novels at opposite ends of the light/dark spectrum: Alan Moore and Dave Gibbons' Watchmen and Darwyn Cooke's DC: The New Frontier (both highly recommended).

**Q. Did you ever work out any of the physics in the comic books you read before you were in graduate school?**

Not really, no. But I do have a strong memory of one of the first times I realized that there were physics constraints on the use of super-powers. In Flash no. 167 (published in Feb. 1967), the Flash had lost his 'protective aura' that shielded him from the effects of air drag. That is, he could still run at super-speed, but when he went too fast, he would burn up, not unlike a meteorite entering our atmosphere. I had never heard of the Flash's 'protective aura' before, but more important, I was chagrined that it had never occurred to me that the Flash would need such a power to avoid this natural consequence of super-speed. This was the first, but certainly not the last time that I would consider the real world consequences of super powers.

**Q. What was it like to work on movies like The Watchman or Spiderman? Are there any other movies or shows that you are working on or plan to?**

It is a blast. The National Academy of Sciences has a program called the Science and Entertainment Exchange, that connects academics with film and television creators. The consulting done by scientists is on a volunteer basis for outreach purposes. Watchmen director Zack Snyder and Production Designer Alex McDowell were following Moore and Gibbon's classic graphic novel very closely. If I were to protest that a certain scene or event was not scientifically accurate, they would be faced with the choice of alienating a million rabid Watchmen fans or one physics professor from Minnesota. (I know what choice I'd make – and I'm the physics professor from Minnesota!). But they nevertheless wanted to know how a character's powers could possibly work. They used this information to create a believable fake reality, knowing that any moment the audience questioned what was on the screen, was a moment they were not paying attention to

the story. With *The Amazing Spider-Man* I was brought in before a script was finalized, and they asked me to brainstorm how Spider-Man's and the Lizard's powers might function or be neutralized. Later on they asked me to create an equation that would serve as a "MacGuffin" in the film. That was a fun opportunity to take some real science, add some mathematical glitter, and create something that appeared on thousands of movie screens. Both *Watchmen* and *Amazing Spider-Man* led to YouTube videos where I discussed some of the science in these films, greatly expanding the audience that I could reach.

**Q. How do you manage juggling outreach and research?**

With great difficulty. There are obviously only so many hours in the day, and in addition to outreach and research, my teaching, service and most importantly, my family are all priorities. I'm reminded of the Robert Benchley essay: *How I Get Things Done*, which argues that there is no limit to what can be accomplished in a day – provided it is not what you are supposed to be doing! Deadlines help focus the mind. But most days I wish I were a better juggler, or better still, had super-speed like the Flash!

**Q. What advice would you give to others about doing outreach?**

If you are going to be a scientist communicator, do not neglect your scientist job in favor of the communicator. The better a scientist you are, the better you will be able to engage with non-scientists. This works both ways. Finding ways to communicate scientific concepts and research results using non-technical or non-mathematical language will often deepen your understanding of the problems you are addressing. Decide whether your goal is to describe jargon or basic principles. I've said that, in my opinion, most people are not anti-intellectual, but they are anti-snobbery. No one likes to be talked down to or lectured (as the father of three, I have experimentally verified this point). You'll find more success if you can construct a narrative about the science you wish to describe. I use stories taken from superhero comics and movies, but anything (ideally something you are already interested in) can work.



## Dwight Nicholson Medal for Outreach

The Forum on Outreach and Engaging the Public assumes responsibility for this prize. This important APS prize consists of the Nicholson Medal and a certificate that includes the citation for which the recipient has been recognized.

The prize shall be awarded to a physicist who either through public lectures and public media, teaching, research, or science related activities has

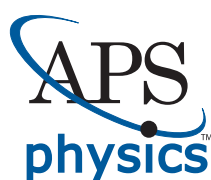
1. successfully stimulated the interest and involvement of the general public on the progress in physics, or
2. created special opportunities that inspire the scientific development of students or junior colleagues, or has developed programs for students at any level that facilitated positive career choices in physics, or
3. demonstrated a particularly giving and caring relationship as a mentor to students or colleagues, or has succeeded in motivating interest in physics through inspiring educational works.

Full details are at: <http://www.aps.org/programs/honors/awards/nicholson.cfm>

Nomination deadline is usually in June.

*Contributed by: E. Dan Dahlberg*

*Know someone who would be deserving of the Nicholson award or worthy of being an APS Fellow? Don't wait!!! Start the nomination process now.*



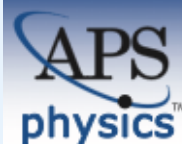
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ENGAGING THE PUBLIC**



MPO

*Dwight  
Nicholson  
Medal for  
Outreach*



MPO



# Congratulations to FOEP's 2017 recipient of the Dwight Nicholson Medal for Outreach

## Neil deGrasse Tyson

Hayden Planetarium – American Museum of Natural History

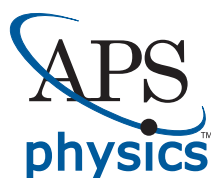
"for his wide-ranging and awe-inspiring contributions to the public understanding of science, and for his passionate and effective advocacy of the values of critical scientific thinking in a democratic society."

## Background

<http://www.haydenplanetarium.org/tyson/profile/about-neil-degrasse-tyson>

**2017 Selection Committee Members:** Yvan Bruynseraede (Chair), Don Lincoln, Ivan Schuller, Amber Stuver

*Know someone who would be deserving of the Nicholson award or worthy of being an APS Fellow? Don't wait!!! Start the nomination process now.*



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ENGAGING THE PUBLIC



*Dwight  
Nicholson  
Medal for  
Outreach*



# FOEP Nominations for APS Fellows



## What

APS Fellowship constitutes recognition by one's professional peers of exceptional contributions to the physics enterprise. Only a small fraction of the APS members reach the level of fellows and therefore this is an important recognition.

## Who

Only APS members who are members of FOEP can be nominated for fellowship through FOEP. The deadline for Fellowship nominations is usually in May. We strive to have a diverse group of nominees and encourage the nomination of members of all underrepresented groups.

Who

## How

Nomination is done entirely on-line. Complete instructions for the nomination are available at: <http://www.aps.org/programs/honors/fellowships/nominations.cfm>.

How

The process consists of: providing the nominee's contact and professional information, uploading nomination letters documenting the accomplishments of the nominee and explain why he or she is deserving of recognition. Note that it is the responsibility of the nominators to provide a compact however complete nomination.

## Evaluation

Nominations are evaluated by the FOEP nomination committee, reviewed by the full APS Fellowship Committee, and finally submitted for approval to the APS Council.

## Subject

Outreach is a broad enterprise, spanning academia, industry and national laboratories, as well as freelance professionals such as writers, journalists and bloggers. Outreach activities are often overlooked and undervalued. Thus it is important to think about and propose people who have an exceptional track record in this area.

## Why

Nominating someone for APS fellowship takes time; however, it is a great way to emphasize the importance of reaching out to and engaging with the public. At the personal level it is very satisfactory to get recognition of your peers.

*Contributed by: Ivan K Schuller*



## FOEP at the March Meeting 2018



**MARCH MEETING 2018**  
**LOS ANGELES MARCH 5-9**

### **FOEP's Invited Session: Innovative Ideas for Engaging the Public** **Room: LACC 408A , Tuesday, March 6, 2018**

8:00AM - 8:36AM E32.00001: TBD, Invited Speaker: Joseph J. Niemela

8:36AM - 9:12AM E32.00002: Physics as a street art, Invited Speaker: Tatiana Erukhimova

Celebrating physics with the community – is this utopia or a mission of every university? There are more and more science festivals around the country, but how can we reach out to people who would never come to campus on their own accord? Can physics outreach become not only a service provided by an academic department to the public but also a unique learning opportunity for students?

This talk will discuss what it takes to build a successful physics outreach program, which includes everything from the annual Texas A&M Physics & Engineering Festival attended by thousands of people to shows and summer schools for K-12 students and teachers, physics demonstrations on downtown sidewalks, and of course Game Day Physics (we are in Texas). Perhaps the most important ingredient for success is to make every outreach project student-centered. As one example, teams of undergraduate students mentored by graduate students and faculty work throughout the school year on the design and fabrication of physics demonstrations. The same teams show these demos at the outreach events. The benefits for the students and the department are obvious. Students practice teamwork and obtain hands-on experience, learn how to communicate science effectively, and get to know graduate students and faculty. The department gets a lot of new demos to be used in regular classes. Last but not least, showing physics on the streets is a lot of fun!

9:12AM - 9:48AM E32.00003: TBD, Invited Speaker: Samuel Sampere

9:48AM - 10:24AM E32.00004: TBD, Invited Speaker: Jorge Cham

10:24AM -11:00AM E32.00005: Laws of War and Fighting a Disease, Invited Speaker: Neil Johnson

The last place one might expect to observe order and robust patterns is among the horrors of human conflict. Indeed, the phrase 'fog of war' has quite rightly been used throughout history to capture the chaos that is typically witnessed. However, in this talk I will share with you some insights from Physics concerning patterns that emerge in the timing and severity of violent events within human warfare. The underlying data are drawn from across geographical scales from municipalities up to entire continents, with great diversity in terms of terrain, underlying cause, socioeconomic and political setting, cultural and technological background. Despite these implicit heterogeneities, the patterns that emerge are remarkably robust. I argue that the ubiquity of these patterns reflects a common way in which humans fight each other, particularly in the asymmetric setting in which one weaker but more adaptable entity confronts a stronger but potentially more sluggish opponent. I propose a minimal generative model which reproduces these patterns while offering a physical explanation as to their cause. In addition, I show how simple ideas of kinetic theory are able to dispel some alarming claims that have been made concerning deaths in the Iraq War, and discuss the wider context of other struggles, including cyber-based attacks. I also argue that the lessons learned can help advance understanding of the immune system and its battles against dangerous diseases such as cancers.

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**Double your exposure by giving an outreach talk in addition to your science talk!**

The Forum for Outreach and Engaging the Public will have contributed talk sessions at the March and April meetings. *Importantly, these talks do not count against you, so you can still submit a scientific presentation.* We look forward to hearing about your work!

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## FOEP at the March Meeting 2018

### FOEP Session F02: Public Outreach and Physics

History: Exploring physics topics beyond the lab

Chair: Rebecca Thompson, American Physical Society

Room: LACC 150B, Tuesday, March 6, 2018

**MARCH MEETING 2018**  
**LOS ANGELES MARCH 5-9**

|                   |  |
|-------------------|--|
| 11:15AM - 11:27AM | F02.00001: Presenting the value of your research to the public<br>Shireen Adenwalla, Jocelyn Bosley, Leigh Smith, Paul Sokol   |
| 11:27AM - 11:39AM | F02.00002: University of Minnesota Physics Videos Outreach Program<br>E. Dahlberg, Production Staff  |
| 11:39AM - 11:51AM | F02.00003: Physics Wonder Girls Camp<br>Roberto Ramos  |
| 11:51AM - 12:03PM | F02.00004: Using Marie Curie video production to inspire interest in STEM in MRSEC outreach<br>Daniel Steinberg, Christin Monroe, Sara Martinez, Jen Myronuk   |
| 12:03PM - 12:15PM | F02.00005: Quizics: A Dynamic Technique for Physics Outreach<br>Francisco Ayala Rodriguez, Rebecca Thompson, James Roche   |
| 12:15PM - 12:27PM | F02.00006: Lakota Cosmology Meets Particle Physics: An Interdisciplinary Collaboration<br>Megan Bowers Avina, Gregory Cajete, Agnes Chavez, Marcus Dorninger, Steven Goldfarb, Steven Tamayo, Shane Wood |
| 12:27PM - 12:39PM | F02.00007: SPS Outreach: Beyond the SOCK<br>Zackary Noel   |
| 12:39PM - 12:51PM | F02.00008: Using Superheros in a Physics Communication Approach for the General Public<br>Barry Fitzgerald   |
| 12:51PM - 1:03PM  | F02.00009: The Politics of Science<br>Eleanor Hook   |
| 1:03PM - 1:15PM   | F02.00010: Quord: Music, Visualization, and Playing Quantum Mechanics<br>Aaron Grisez, Michael Seaman, Justin Dressel  |
| 1:15PM - 1:27PM   | F02.00011: Visualizing the Physics of Nanotechnology Using 3D Animations<br>Maxwell Grossnickle, Nathaniel Gabor   |
| 1:27PM - 1:39PM   | F02.00012: International Young Physicists' Tournament in United States<br>Chrisy Xiyu Du, Andrei Klishin   |
| 1:39PM - 1:51PM   | F02.00013: Physics Competition Startups: Lessons from Chile and United States<br>Andrei Klishin, Xiyu Du   |
| 1:51PM - 2:03PM   | F02.00013: Do experiments in physics need to be reproducible?<br>Vitaly Pronskikh  |



**The Outreach Happy Hour/FOEP Business meeting will be Tuesday the 6th from 6-8, place TBD. We hope to see you there!**

## FOEP at the March Meeting 2018

### A Staged Reading of the Play: *Silent Sky*

Wednesday, March 7

8:00 p.m. - 9:30 p.m.

Location TBD



MARCH MEETING 2018  
LOS ANGELES MARCH 5-9

*Silent Sky* is based on the true story of 19th-century astronomer Henrietta Swan Leavitt as she experiences a woman's place in society during a time of immense scientific discoveries, when women's ideas were dismissed until men claimed credit for them. When Henrietta Leavitt begins work at the Harvard Observatory in the early 1900s, she is not allowed to touch a telescope or express an original idea. Instead, she joins a group of women "computers," charting the stars for a renowned astronomer who has no time for the women's probing theories. As Henrietta, in her free time, attempts to measure the light and distance of stars, she must also take measure of her life on Earth, trying to balance her dedication to science with family obligations and the possibility of love.

The playwright Lauren Gunderson is from Atlanta. She received her BA in English/Creative Writing at Emory University, and her MFA in Dramatic Writing at NYU Tisch. She was named the most produced playwright in America by American Theatre Magazine in 2017 and was awarded the 2016 Lanford Wilson Award from the Dramatist Guild.

### Performed by:

[International City Theatre](#), Long Beach CA

Some of the play actors as well as a historian-scientist will be available for a talkback discussion after the play reading.

### Produced by:

- Brian Schwartz, CUNY and Smitha Vishveshwara, University of Illinois

### Sponsored by:

- APS Forum on the History of Physics
- APS Forum on Outreach & Engaging the Public
- APS Forum on Physics & Society
- APS Committee on the Status of Women in Physics
- APS Division of Astrophysics

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## FOEP at the March and April Meetings 2018



### **Pre-meeting Workshop: Finding Your Scientific Voice: Improving Your Presentation Sunday, March 4**

**Two opportunities to attend: 9:30 a.m. - 12:30 p.m. or 1:30 p.m. - 4:30 p.m.**

You've spent years designing, carrying out, and wrapping up your research. Now it's time to communicate your results to your peers and the broader community!

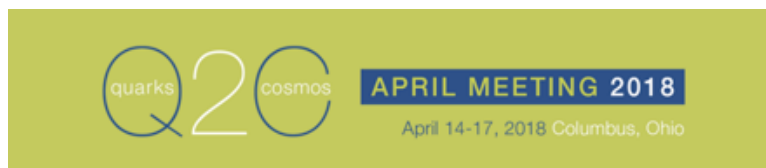
The Forum for Outreach and Engaging the Public (FOEP) will host two workshops on improving communication skills of students and postdocs. Each 3 hour workshop will focus on how to improve the 10 minute talks for the meeting as well as give participants instruction on how to communicate with the lay public about their work.

**Who Should Attend?** This workshop is restricted to APS graduate students and postdocs.

**Registration Fee:** Graduate Students & Postdocs: \$20

#### **Registration Information**

- Register when you register for the meeting
- Preregistration required



For the April meeting we have (to be confirmed) Lucianne Walkowicz (Adler Planetarium and Library of Congress), Renee Horton (NASA), and Becky Thompson-Flagg (APS). The breadth of experience in engaging the public is spectacular!

There is also a FOEP/GPMFC session at April Meeting that is currently scheduled for Sunday at 1:30pm and titled "Low-Energy Precision Tests of the Standard Model"

### **Double your exposure by giving an outreach talk in addition to your science talk!**

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## Why Do Outreach?

by: James Kakalios

*Reprinted with permission from APS Forum on Society and the Public Newsletter*

The March 1962 episode “Little Girl Lost” of the television anthology program *The Twilight Zone* added some speculative inter-dimensional physics to a suspenseful science fiction tale.[1] In this story a small child rolls out of her bed in the middle of the night and disappears. Her parents become frantic when they can hear her calls for help, but cannot see or touch her. Fortunately they know what to do in just such an emergency – they call for their neighbor Bill, who is a physicist. He determines that the girl has accidentally fallen through a portal into another dimension. With his aid, and the help of the family dog, they manage to retrieve their daughter. Whether this portal was to one of the extra dimensions predicted by String Theory is open to interpretation, but the show clearly demonstrated the utility of a friendly neighborhood physicist.

Indeed, in the early 1960’s, the U.S. Government had similarly concluded that it was worthwhile to have physicists and other scientists on call. Following the Manhattan Project; the development of radar; and the proximity fuse in World War II the value of scientists and engineers to national security was accepted by the general public. In 1942 West Virginia Senator Harley Kilgore had proposed legislation calling for federal support of scientific research and in 1945 Vannevar Bush’s report *Science, The Endless Frontier*, [2] forcefully argued that it was in the nation’s best interest to develop and maintain strength in what we now would refer to as STEM fields. In 1950 Congress responded with the establishment of the National Science Foundation.

The situation today is very different. There is no longer broad agreement among the public of the value of scientific research.[3] Which is ironic, for this same public has enthusiastically embraced personal electronics and technology that is enabled, in part, through federally funded research. As expressed a few years ago by a Dean at M.I.T., never before in human history have so many become so wealthy solely through education. [4].

It is clear that in the 21<sup>st</sup> century, physicists can no longer rely on the good will engendered during the middle of the 20<sup>th</sup> century. Rather than simply curse the darkness, some have taken to lighting candles, devoting time and effort to communicating the fruits of scientific research to the general public. I would argue that it is in the best interests of the physics community to support and encourage science outreach and engagement with the public, many of whom are voters and taxpayers.

Though sometimes conflated, outreach is not the same as education. Improving science education, particularly at the K-12 level, is of course vitally important. But as noted by Dr. Neil deGrasse Tyson: “The problem is adults not knowing science. They outnumber kids 5 to one, they wield power, they write legislation.”[5] We’re familiar with the concept of an elevator pitch, where you find yourself on an elevator with a powerful person, such as a captain of industry, and have only eleven distraction-free seconds to make a proposal. Do you use your time to teach this individual some aspect of physics, or to try to convince them of the value of scientific research? There are many demands on the attention of the general public, and windows of opportunity for engagement are rare. Of course I would like everyone to know some physics and indeed most outreach involves relating some aspect of physics or a recent discovery to a general audience. But in communicating science, I would argue that an important goal is to instill a positive attitude

toward science and scientific research. After all, everyone loves their smart phones, even though few know (or care) what goes on ‘under the hood.’

There already exist excellent channels for science communication, from NOVA on public broadcasting to popular science magazines on the newsstand to exhibits and events at science museums. These are all necessary, but not sufficient. Those who are reached via these means typically already have a positive attitude toward science. While it is important to preach to the choir, we must also find ways to grow the congregation. One method of outreach involves mining topics of entertainment, such as NASCAR, professional sports, Hollywood blockbusters, television sitcoms or superheroes, and using these subjects as springboards for discussions of science. Another method involves embedding the science directly into the source of recreation, an effort championed by the National Academy of Science’s Science & Entertainment Exchange [6] which connects academics with television and movie creators, with the goal of improving both the science content and representation of scientists in popular entertainment. Other approaches involve the creation of content that can then be broadly disseminated via the internet. But just as we are driven to innovate in our research, creative new methods for outreach are needed, particularly to reach underserved low-income and minority populations.[7]

While improvements in engagement with the public will, in my opinion, benefit all of us in physics, I am not arguing that everyone in physics should be active in outreach. Every member of a professional baseball team is a highly trained and skilled athlete, but rarely would a centerfielder do well if called upon to pitch, or even play shortstop. We all have our strengths and weaknesses, and just as not every physicist is best suited for research in String Theory or for working in a femtosecond laser spectroscopy lab (though sometimes it does seem as if every physicist is working on graphene), not everyone need be involved in outreach.

Years ago my wife (who is not a physicist – it’s a mixed marriage) and I attended a general audience public talk by a distinguished physicist. I was able to follow his talk, though with effort. As we left the auditorium after the presentation, my wife commented: “Well, I learned one thing tonight. He belongs to a club that does not want me as a member.” It takes considerable effort and practice to communicate effectively to a nonscientifically trained audience. A few years ago I was fortunate to see first hand the training and devotion that a group of young physicists put into short presentations of their research for a general audience as part of a Physics Slam event associated with a Particle Physics conference held in Minneapolis. During this event the physicists would have ten minutes to convey their complex fields of study. In preparation they received guidance and instruction from professors in theater studies, and the attention to craft paid off in their presentations, rewarded by an enthusiastic response from the audience.

Often I will hear physicists lament the public’s lack of appreciation of the value of their research, typically followed by a related complaint concerning the dearth of research funding. As a community we should support (and not just tolerate) those who make an effort to do the hard work of engaging with the public, and at least not make their jobs harder.

After all, you never know the next time that someone’s daughter will fall through a breach in the spacetime continuum.

James Kakalios is the Taylor Distinguished Professor in the School of Physics and Astronomy at the University of Minnesota, and the author of *The Physics of Superheroes* (Avery, 2009) and *The Amazing Story of Quantum Mechanics* (Avery, 2010). His efforts at outreach have been recognized by the American Institute of Physics’ 2016 Andrew Gemant Award for Significant Contributions to the Cultural, Artistic or

Humanistic Dimension of Physics and the 2014 American Association for the Advancement of Science Award for Public Engagement with Science.

You can learn more about James at his website: [www.kakalios.com](http://www.kakalios.com)

## References

[1] “Little Girl Lost,” directed by Paul Stewart and written by Richard Matheson, *The Twilight Zone*, originally aired Mar. 16, 1962.

[2] *Science, The Endless Frontier*, A Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development, July 1945.

[3] Shawn Otto, *The War on Science: Who’s Waging It, Why It Matters, What We Can Do About It* (Milkweed, 2016).

[4] Marc Kastner, private communication.

[5] While the original youtube video from which this quote is obtained is no longer available, Dr. Tyson expresses similar views in “Children Are Not the Problem”:  
<https://www.youtube.com/watch?v=vDFgLS3sdpU>

[6] Erich Schwartzel, “Scientists Help Movie Writers Make Films ‘Plausible-ish,’” *Wall Street Journal*, Jan. 10, 2016. Information about the National Academy of Sciences’ Science & Entertainment Exchange can be found at  
<http://www.scienceandentertainmentexchange.org>

[7] Emily Dawson, “‘Not Designed for Us’: How Science Museums and Science Centers Socially Exclude Low-Income, Minority Ethnic Groups,” *Science Education* 98 981 (2014).



## From Cosmology to the Classroom: A Career Inspiring the Next Generation of Scientists

by: Rachel Henderson

*“I recognized that in the long term, I wanted to be involved in work that I felt would matter, and even possibly make a difference, to others. In my new position, we partner with schools, museums, after school programs, etc, and it feels like there is so much more opportunity to make a difference.”*

Rachel Wolf recently finished her PhD in Physics and Astronomy at the University of Pennsylvania. Her research focused on observational cosmology with Type Ia supernovae (SNe Ia); a special type of thermonuclear explosion that cosmologists can use to study how cosmic distance changes over time. Her research interests were in two particular fields of SN Ia cosmology: 1) studying correlations between SN Ia properties and properties of their host galaxies and 2) developing new statistical methods to use SN Ia data to infer cosmological parameters. Throughout her graduate school career, Rachel was a participant in the Dark Energy Survey (DES), an international collaboration of 400+ scientists using multiple probes to study the evolution of the cosmos.



During the latter parts of her PhD, Rachel also became interested in science communication research and studying how scientists, particularly members of DES, communicate and interact with the public. An examination of the online initiatives of the DES Education & Public Outreach (EPO) program was also a part of her PhD thesis. She is also currently leading two analyses focused on improving scientists' involvement in public engagement. Together with others in the DES EPO community, she is studying the ways in which DES scientists are participating in public engagement and motives for/deterrents from such engagement. She believes this work will demonstrate the need for greater cultural and financial support for science communication training and public engagement programming amongst science collaborations and funding agencies.

Currently, Rachel is a Social Science Research Professional with Stanford University's AAALab. The lab focuses on developing pedagogy, learning technologies, and assessments that prepare students for learning inside and outside the classroom. Rachel is very excited to be using her quantitative science skills for education research and to inspire enthusiasm about STEM.

### **What outreach experiences did you have in graduate school?**

I should probably begin my answer by mentioning that when I started graduate school, I knew I wanted EPO to be a significant component of my scientific career. Within the first few months of meeting my advisor, I had a chat with him explaining how I was passionate about EPO and wanted to balance time spent on research with time doing EPO. Of course, research came first, but he was always supportive of all of my EPO endeavors. I am so incredibly grateful for his support and cannot emphasize enough how important I think it is for graduate students to be proactive about having these kinds of conversations with their advisors early on in their careers.



One of the first programs I got involved in during graduate school was with the University of Pennsylvania's TRiO Veterans Upward Bound (VUB) program. Together with a few others in my cohort, we started a math boot camp for the VUB students and volunteered to organize and lead Saturday tutoring sessions for those students who could not attend tutoring during the week. I volunteered as a tutor during the entirety of graduate school, and worked with the VUB organizers and my colleagues to develop a more permanent tutoring partnership between VUB and the Physics & Astronomy department.

About halfway through my PhD, I became one of the co-coordinators of EPO for DES. As a DES EPO coordinator, I designed, managed, and participated in innovative projects that connect scientists and nonscientists through social media initiatives, blog posts, and written summaries of DES science results. I also served as an informal consultant for future EPO efforts for large-scale surveys such as DESI and LSST.

Throughout graduate school, I was also fairly involved with The Franklin Institute (TFI), Philadelphia's premier science museum. I served as a volunteer scientist for many museum programs, including: the Philadelphia Science Festival, Science After Hours, and Night Skies at the Observatory. One of the projects I most enjoyed is the "Meet A Scientist" initiative - a partnership I began with TFI. In this informal education space, I collaborated with TFI's Summer Camp staff to develop inquiry-based activities for third-ninth grade campers across a variety of STEM disciplines. I hope that campers will leave camp learning how to ask questions, how to communicate their curiosity, and feeling that they too could become professional learners. At Penn, I was also active in Penn's Physics & Astronomy department's outreach group and worked closely with Penn's Science Outreach Initiative. I also participated in Active Learning TA training through Penn's Center for Teaching and Learning.

### **What attracted you to Education and Public Outreach (EPO)?**

To be honest, I've loved teaching for as long as I can remember. I tutored all throughout high school and was involved in a variety of EPO activities in college. I think my passion for EPO is primarily driven by the first-hand experiences I've had seeing how my personal experience can change the experience and perspective of others, particularly children. Also, as a woman in science who enjoys communication and engaging with others, I feel like I am in a unique position to really affect positive change.

As an example, when I was in college, I worked at the Griffith Observatory as a museum guide. Part of my job was to stand in front of permanent exhibits and give large talks / chat with the public about them.

***"I believe this work will demonstrate the need for greater cultural and financial support for science communication training and public engagement programming amongst science collaborations and funding agencies."***

One day, a father and his daughter were listening to my spiel about the sun and solar observing. After my talk, they came up to me. The father had lots of great questions and wanted to continue chatting; his daughter, who was maybe 8 years old, seemed timid and was more focused on exploring the rest of the exhibit. She didn't say much, but seemed very interested in the museum and learning more about astronomy. After ten minutes or so of chatting, the father and his daughter continued on through the rest of the observatory.

A couple hours later, the father found me again. He pulled me aside and said, "I know my daughter is a bit shy. But I want you to know that after your talk and our conversation, she told me, 'Daddy, if that girl can be a scientist, then I can too.' Thank you."

We chatted for a little more, this time the daughter was more bubbly and engaged, and then the two of them left the museum.

I was on Cloud 9 for about a week. It's moments like this that have shown me the importance of EPO and just how much scientists can make a difference, even if it's just one inquisitive 8-year-old at a time.

### **How/when did you decide to dedicate your career to EPO full-time?**

While I was in college, I realized just how much I enjoyed EPO. I had always loved teaching, but found a new passion in communicating science in more informal settings. The summer after my second year of college, I applied for a job at the Griffith Observatory in Los Angeles. I loved working at a science museum and getting to chat about astronomy with the general public. My favorite part of the job was working with kids, and seeing their eyes light up when I told them new facts about the universe. Kids also just have the best questions! I wanted to explore other means of science communication and so the summer after my third year of college I interned with Discovery Communications.

When I was finishing my time at UCLA, I was conflicted about my path forward. Many of my friends were going to graduate school, but I had this passion for science education and communication that I didn't think would be sated in the typical astrophysics career path. I knew I wanted to pursue EPO as a career, but I just wasn't sure how to do it.

I spoke with many people to get different perspectives (including Neil deGrasse Tyson!), and most people recommended I pursue my PhD. They argued that I would not be taken seriously as a science communicator without my PhD, and so they said that if I was at all interested in graduate school, that I should go for it. At the same time, many of these people warned me that I might be overqualified for EPO jobs after my PhD. They said it was a fine line to balance and one I'd have to navigate once I finished grad school.

When I started grad school, I knew I wanted to pursue a career somehow related to EPO afterwards. I was very upfront with my advisor about it from the beginning, and gave him updates on research (and EPO career ideas and pursuits) along the way.

When I finished my PhD, it was just a matter of finding the right EPO job. I applied for a pretty wide variety of positions, from museum staff to K-12 STEM curriculum development to data science for education technology companies to education research.

### **What is your favorite part about having a full-time career in EPO?**

A large part of my job is designing assessments to determine student knowledge and learning transfer. This includes learning across STEM disciplines, so I need to be able to design problems that cover topics from chemistry to biology to physics. This means I'm reading papers and doing research in a variety of disciplines – and I love it! For one project I'm currently working on, I've read papers about polar bears, sea otters, and monarch butterflies. We also have seminars featuring speakers in education, psychology, neuroscience, learning science, etc., and I am constantly fascinated by the myriad of perspectives and techniques used for education research. The interdisciplinary nature of my work appeals to my love of learning and natural curiosity in a way that is very different from how I connected with my astrophysics research.

### **What are some of the challenges you've faced with assessing EPO?**

I think the biggest challenge for me right now is to familiarize myself with all of the literature. There is amazing work being done in learning science, education, and science communication research, and I've only just begun to scratch the surface. Assessment of EPO programming is essential, but I don't think anyone has figured out the "right" way to do it (or even if there is a "right" way). For example, as social media becomes a more prevalent medium of communication, we'll have to figure out useful metrics to determine if social media projects are making an impact.

I think another challenge is clearly identifying what you hope your audience gets out of their EPO experience. It's really difficult to create a good assessment if you're interested in learning about content comprehension, disposition changes, and future impact.

### **As a member, what do you find to be the most beneficial part of the APS Forum on Outreach and Engaging the Public (FOEP)?**

I think making connections and networking is a crucial part of engaging in EPO. In fact, I'm still reaching out to others in the EPO community to learn more about different EPO positions, build my EPO network, and discuss potential collaborations and partnerships. The FOEP offers an amazing opportunity for those interested in EPO, at all career stages, to communicate and learn from each other. I think the only way to continue developing impactful EPO programs and to improve upon existing programs is to share best practices, research, and experience. Be proactive! You never know who you'll get the chance to meet!



*Talking with some inquisitive kids about the expanding universe at the Philadelphia Science Festival*

## **FOEP Membership – Join Today**

To join FOEP at no cost prior to renewing your APS membership, you can get your ID badge scanned at a meeting, send an email to [membership@aps.org](mailto:membership@aps.org) with your request to add FOEP to your membership, or send a letter requesting membership to APS membership department. Please note that if you currently belong to two or more forums, FOEP will be added at no charge for the remainder of your membership term. On your next membership renewal notice, you will see a Forum subtotal that will include \$10 for every Forum membership over two.

## Outreach: A Graduate Student's Perspective

by: Rachel Henderson

Seth Kimbrell is halfway through his second year of graduate school at Montana State University (MSU). Seth's research interests lie in observational astronomy and the search for black holes within dwarf galaxies. As an undergraduate at Georgia Tech, he worked on several different projects (including examining the electrical activity in the muscles of cockroaches as they run!) before finding a spot in a lab doing data analysis for gravitational wave astronomy.



### **What experiences do you or your University have involving physics/astronomy outreach?**

As an undergraduate, I was a host of a summer program called Physics of Roller Coasters. In this program, middle schoolers and high schoolers spent a week at Georgia Tech learning the physics behind thrill rides, including the science behind stopping safely and why roller coaster loops aren't perfectly round. Now as a graduate student at MSU, I am the graduate student manager of the Space Public Outreach Team (SPOT). SPOT is a program underneath the Montana Space Grant Consortium; we are funded by NASA to train undergraduates to travel across Montana giving presentations to young students about NASA missions and the wonders of science. Our show this year is about Jupiter, and includes some of the latest and greatest images being sent back by the Juno spacecraft, which is currently orbiting Jupiter.

### **How did you get involved in outreach?**

Outreach and education has really always been a passion of mine, going all the way back to recording commercials to encourage recycling for my high school's morning news show. As a Sophomore at Georgia Tech, I and many others participated in the Atlanta Science Festival, during which we presented a particle detector and taught the basics of what the detector did to children and adults alike. Since then, I always knew that I wanted to continue in science outreach and increase science awareness.

During the summer between my first and second years at MSU, I was asked to be the graduate student manager for SPOT and was thrilled to jump on board. Since then, I have talked about Jupiter with elementary schoolers and high schoolers, and I have enjoyed every second of it! We also have undergraduates at MSU and at the University of Montana (UM) who are trained to give the show and continue to participate in outreach events like the Great Falls STEAM (Science, Technology, Engineering, Art and Mathematics) Festival and the Museum of the Rockies Science Night.

### **What is your favorite part of participating in outreach events?**

My favorite part of participating in outreach events is the look on a young child's face when they learn something super interesting about space and get excited about it. My birthday falls during the Perseid Meteor Shower, so when I was a child my parents would drive me out into the countryside of Georgia and we would watch the meteors fall. Watching those shooting stars made me want to know more about why they were there, and how we knew about them so far in advance, which led to me pursuing physics as a career. Knowing that my outreach could be the same kind of catalyst for a young child keeps me excited to do outreach and makes me want to make science as interesting for students as I can.

**As a graduate student, how can the APS Forum on Outreach and Engaging the Public (FOEP) help you become successful with your efforts in physics/astronomy outreach?**

I think that the biggest help that the APS FOEP provides me is all the tips and tricks they provide on their website for outreach. I am always happy when an idea gets brought up or I read some new tip and it gives me some new perspective on outreach that I hadn't thought of before. Exchanging ideas and information is such a great resource, and it definitely contributes to me being better and bringing the world of physics and astronomy to younger audiences.

*Stay tuned for more perspectives on outreach from other Physics & Astronomy Graduate Students!*



30 second exposure, Friday, Aug. 12, 2016 in Spruce Knob, West Virginia. Image Credit: NASA/Bill Ingalls (<https://www.nasa.gov/image-feature/perseid-meteor-shower-2016-from-west-virginia>)

## Outreach Info & Resources

info

### APS Physics Central has an “Outreach Guide!”

The guide provides ideas, opportunities, and information on how to conduct various types of outreach.

Check it out! <https://www.aps.org/programs/outreach/guide/>

And within this guide you'll find information about:

#### Outreach Ideas

- [Physics on the Road](#)
- [Public Lectures - One Time](#)
- [Public Lectures - Series](#)
- [Open Houses](#)
- [Science Cafes](#)
- [Demo Shows \(on campus\)](#)
- [Working with a Museum](#)

#### Outreach Tips

- [Public Relations](#)
- [Working with Children and Schools](#)

#### [Demos List](#)

#### [Experts](#)

### The Institute of Physics has a website devoted to Public Engagement

This website provides ideas for outreach activities, how to run an event, evaluation of an event or activity, as well as sign ups for events (in the UK).

<http://www.iop.org/activity/outreach/>

### The Alan Alda Center for Communicating Science

Has many resources, and classes you can sign up for at Stony Brook University. There is a “Workshops on the Road” program that visits other locations. Check out their website for ideas and information.

<http://www.centerforcommunicatingscience.org/alan-alda/>

## Questions and Ideas



### Want to get more involved?

Email someone on the executive committee. Contact info can be found on the last page of this newsletter or online at:

The Forum on Outreach and Engaging the Public at

<http://www.aps.org/units/foep/governance/officers/index.cfm>

### Newsworthy Items?

Have an idea for something to include in the Newsletter: An outreach activity, an idea for an article, best practices, what does and doesn't work, or something else? Please send your ideas to the newsletter editor at

[FOEPAPSnewsletter@gmail.com](mailto:FOEPAPSnewsletter@gmail.com)

## Web Sites that Engage and Inform the Public

info

Applied Science: [https://www.youtube.com/channel/UCivA7\\_KLKWo43tFcCkFvydw](https://www.youtube.com/channel/UCivA7_KLKWo43tFcCkFvydw)

Minute Physics: <https://www.youtube.com/user/minutephysics>

Veritasium: <https://www.youtube.com/user/1veritasium>

Periodic Table of Videos: <https://www.youtube.com/user/periodicvideos>

Numberphile: <https://www.youtube.com/watch?v=w-I6XTVZXww>

Kurzgesagt – In a Nutshell

<https://www.youtube.com/channel/UCsXVv37bltHxD1rDPwtNM8Q>

Smarter Every Day: <https://www.youtube.com/user/destinws2>

Vihart: <https://www.youtube.com/user/Vihart>

Electronics: <https://www.youtube.com/user/EEVblog>

Fermilab videos: <https://tinyurl.com/drdonvideo>

APS Physics Central:

Physics in Action, Physics in Pictures, Physics +, Physics@Home, and more

<http://www.physicscentral.com>

OSA's Optics for Kids website:

Activities, Celebrities, Timelines, and more

<http://www.optics4kids.org/home/>

IOP Physics.org: <http://www.physics.org>

NASA Outreach Resources

<http://science.nasa.gov/researchers/education-public-outreach/>

Expanding your Horizons Network

<http://www.eyhn.org/aboutmain>

International Particle Physics Outreach Group

<http://ippog.org/resources/types/activities>



## Let FOEP Post Your Outreach Links

Do you have a favorite web site, web article, and or video you like, or perhaps your own outreach website? Send it to us for consideration of inclusion on this page so everyone can enjoy it. Send ideas to: [FOEPAPSnewsletter@gmail.com](mailto:FOEPAPSnewsletter@gmail.com)

## Funding Information

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### **APS grants for public outreach and informing the public**

APS annually awards several grants up to \$10,000 to help APS members develop new physics outreach activities. Programs can be for traditional K-12 audiences or projects for engaging the public.

<http://www.aps.org/programs/outreach/grants/>

**Marsh W. White Awards** are made to Society of Physics Students Chapters "to support projects designed to promote interest in physics among students and the general public."

<https://www.spsnational.org/awards/marsh-white>

### **SPIE education and outreach grants for photonics and optics**

As part of its education outreach mission, SPIE provides support for optics and photonics related education outreach projects.

<https://spie.org/education/education-outreach-resources/education-outreach-grants?SSO=1>

### **AAPT - American Association of Physics Teachers**

#### **Bauder Fund Grants for Physics Outreach Programs**

Can provide funds to obtain and or build and support traveling exhibits of apparatus.

<http://www.aapt.org/Programs/grants/bauderfund.cfm>

### **Alfred P. Sloan Foundation**

The Alfred P. Sloan Foundation offers grants toward promoting science and science understanding to the general public.

<https://sloan.org/grants/apply>

### **IOP Institute of Physics**

Public Engagement Grants – open to all but only for projects that take place within the UK and Ireland

[https://www.iop.org/about/grants/outreach/page\\_38843.html](https://www.iop.org/about/grants/outreach/page_38843.html)

### **EPS European Physical Society**

Two grants that can fall into the outreach category are the EPS grant for Regional Physical Society Meetings that include items outside their usual grant categories, and EPS Award for Pre-University International Physics Competitions.

[http://www.eps.org/?page=support\\_grants](http://www.eps.org/?page=support_grants)

Many institutions have their own internal outreach funding programs.

*Contributed by: H.M. Doss*



**FOEP**

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# PHYSICS OUTREACH & ENGAGEMENT

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The Forum on Outreach and Engaging the Public can be found on the web at <http://www.aps.org/units/foep/index.cfm>