

## Texas-Sized APS March Meeting Benefactor Jay Jones Funds New APS Medal

The APS March Meeting is heading to the Alamo in 2015. It will take place in the Henry B. Gonzalez Convention Center in San Antonio, Texas from March 2 through 6. It is the largest yearly physics meeting in the United States and will feature about 110 invited sessions, more than 600 contributed sessions, and a total of more than 8,500 papers presented. Organizers are expecting almost 10,000 people to attend. The meeting highlights the latest research from the APS Divisions of Atomic, Molecular, and Optical Physics; Biological Physics; Chemical Physics; Computational Physics; Condensed Matter Physics; Fluid Dynamics; Materials Physics; and Polymer



Physics, as well as the topical groups on Statistical and Nonlinear Physics, Magnetism and its Applications, and Quantum Information.

This year's Kavli Foundation Special Session theme will be "Frontiers of Light," in conjunction with the International Year of Light in 2015 and the 2014 Nobel prizes awarded for advances in light and optics. Physics laureate Shuji Nakamura of the University of California, Santa Barbara will speak about the creation of the blue LED. Chemistry laureate W. E. Moerner of Stanford University will discuss the visualization of single molecules in biological systems.

**MEETING continued on page 6**

By Michael Lucibella

The newly-created APS Medal for Exceptional Achievement in Research will be the first Society-wide annual award to recognize achievement of researchers across all fields of physics. It is funded by a generous donation from Jay Jones, the founder and former president of Olympic Medical Corporation.

"This is the largest single-donor gift that APS has ever received," said APS President Malcolm Beasley. "The donor is a person of remarkable personal character who wanted to do something that would make a difference. It is fitting therefore that he has enabled a new APS-wide medal that signifies an enduring belief in the importance of fundamental research across all fields of physics."

Because of the broad scope of the prize, a special awards com-



Recognizing exceptional philanthropy: (L to R) Darlene Logan, APS director of Development; Jay Jones and his wife Mary Jayne Jones; Kate Kirby, APS executive officer; Malcolm Beasley, 2014 APS President.

mittee will be established by the Council to decide the winners. The Council gave its formal approval to the establishment of the prize on November 22. The first \$50,000 award will be presented in 2016.

"On behalf of the APS, I thank Jay Jones for his extraordinary generosity," said Kate Kirby, APS's executive officer. "Both his love of physics and his deep appreciation

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## 2014 PhysicsQuest Winners Announced

By Michael Lucibella

The APS outreach department announced the winners of this year's PhysicsQuest competition for middle-school students. The first place winner is Wendy Goodwin and her students at the Discovery School in Huntersville, NC.

"PhysicsQuest is a program in which we create kits with everything you need to do four physics experiments and then we wrap everything in a story about our laser superhero 'Spectra,'" said Becky Thompson, the head of APS Public Outreach. "It's important because we want to make sure these kids have an exciting and fun experience with physics."

The theme of the kits and the accompanying comic book this year was quantum mechanics, which featured the APS laser superhero squaring off against the nefarious Pauli Black of the Blackbody Repair Shop. The four experiments had students analyzing the color spectra of an LED shining through dyed water, detecting reflected ultraviolet light using a glow-in-the-dark panel, analyzing the topology of folded clothes, and deducing ways to connect power utilities to houses without crossing electrical lines in a donut shaped universe.

"It's very difficult to teach middle schoolers about quantum mechanics specifically, so we talked about things like absorption spectrum, how different colors of light have different energies, and then expanded it to incorporate other, so-called modern physics [concepts]," Thompson said.

Goodwin and her class have been participating in the program since it was started in 2005. Her class received a set of autographed comics, a prize pack, and a \$500 gift certificate to the science education supply company Educational Innovations, and each student in her class will receive a new iPad. "I think the experiments are good," Goodwin said. "Every year we've done it they're really excellent. They're simple and they get the point across."

She added that her students were excited to get the iPads and she hoped to integrate them with their curriculum. "We're really excited that someone who has been with the program for so long and continues to participate got a chance to win this year," Thompson said.

The second place winner is Christine Stewart's Gamma Rays C from the Governor French Academy in Belleville, IL, whose class received a set of autographed comics, a \$300 gift certificate to Educational Innovations, and a prize pack. Third place went to Caleb Rohler, a homeschooler from New Oxford, PA, who received an autographed comic, a \$200 gift certificate and a prize pack.

Each year APS sends 13,000 kits to more than 3,500 teachers. This year kits went out to every state in the US. The competition is open to any group who signs up, which included neighborhood science clubs, Boy Scout and Girl Scout troops, and church youth groups.

The PhysicsQuest kits were first

**WINNERS continued on page 4**

## APS Members and Council Vote "Yes" on Corporate Reform

The APS Council voted unanimously on Saturday, November 15, to ratify a revised *Constitution & Bylaws* as part of the Society's corporate reform efforts. This followed the recent vote by the membership to approve the new governing documents.

The effort to reform the Society's governance and leadership structures began officially in September, 2013 when the APS Executive Board formed the Committee on Corporate Reform. Following months of work and discussion at the APS Leadership Convocation, and at Town Hall meetings

at the APS March and April meetings, the preliminary version of the proposed plan was submitted to the APS Council in June, 2014.

On August 16, the Council met in Chicago and voted to forward the proposed *Constitution & Bylaws* and *Articles of Incorporation* to the members for comment. Having considered their responses, the Council voted on September 27 to place these documents before the membership for approval. Member voting started on October 6 and ended on November 10.

In the membership vote, the APS corporate reform initiative passed

overwhelmingly, 94% to 6%. Altogether, 8,101 people voted, or about 17% of the membership, roughly the same as an average APS general election. "The result of this vote is a stunning affirmation by the APS membership of the future of their Society," said APS President Malcolm Beasley.

"The member vote was a critical part of this deliberative process, and getting to this point required the sustained hard work by our dedicated volunteer leaders and our wonderful APS staff," said Kate Kirby, APS executive officer, who

**REFORM continued on page 4**

## Historic Sites: Muon Time Dilation Experiment



Mount Washington Observatory

In the early 1960s, David H. Frisch and James H. Smith measured the rate of detection of muons at the observatory on top of Mount Washington in New Hampshire (elevation 6289 feet) and again at sea level, obtaining agreement with the time-dilation prediction of special relativity. They published their results and made an educational movie (available at [www.scivee.tv/node/2415](http://www.scivee.tv/node/2415)). In commemoration of this combined research/outreach event, on September 6, 2014, APS President Malcolm Beasley presented a plaque (inset), as part of the APS Historic Sites Initiative, to Mount Washington Observatory Executive Director Scot Henley and Director of Summit Operations Cyrena-Marie Briédé.

Want to nominate a site? See Page 7

Here in the early 1960s David H. Frisch and James H. Smith performed classic experiments showing that the observed lifetime of the muon (a particle 207 times more massive than the electron) traveling close to the speed of light is lengthened in precise accord with the predictions of the special theory of relativity.

HISTORIC PHYSICS SITE, REGISTER OF HISTORIC SITES  
AMERICAN PHYSICAL SOCIETY

# Members in the Media



“Physics has enormously helped me in life—the logic and power of it. ... Once you see what a combination of calculus and Newton’s laws will do and the things you can work out, you get an awesome appreciation for the power of getting things in science right. It has collateral benefits for people. And I don’t think you get a feeling for the power of science—not with the same strength—anywhere else than you do in physics.”

**Charles Thomas Munger, Berkshire Hathaway, on his gift to the Kavli Institute for Theoretical Physics, University of California, Santa Barbara, Forbes, October 24, 2014.**

“First and foremost it’s a victory for everyone who believes in strengthening the middle class.”

**Bill Foster, U.S. House of Representatives, on his reelection in Illinois, Chicago Tribune, November 5, 2014.**

“When you approach a black hole, the black hole is distorting space in its vicinity, and this was captured beautifully. ... I enjoyed watching the surrounding imagery get distorted. ... It’s a sophisticated ray-tracing problem, and if you’re a movie producer and you can get it right, then why not?”

**Neil deGrasse Tyson, American Museum of Natural History, on watching the film “Interstellar,” NBCNews.com, November 7, 2014.**

“It’s been surprising to me that there have not been widespread images of what a wormhole would really look like, as seen from the outside.”

**Kip Thorne, Caltech, on working with the special effects team on the film “Interstellar,” Air and Space Magazine, November 13, 2014.**

“I was a little nervous that she could maybe not stick true to the science or not be able to convey it properly. ... For some artists, the art trumps the reality. But as soon as I saw her first piece, I knew this was not the case.”

**Don Lincoln, Fermilab, on Lindsay Olson, the first artist-in-residence there, Chicago Tribune, November 8, 2014.**

“What might take you hundreds of meters to do in a regular machine, you can do in the space of just a meter, or a couple of feet.”

**Mark Hogan, SLAC, on a new technique to use plasmas to accelerate particles, Los Angeles Times, November 11, 2014.**

“Two weeks after my last contact with the FBI, my world came crashing down around me, as Caltech started a merciless campaign ongoing to this day of retaliation for my speaking to the FBI. ... I’ve been humiliated, degraded, isolated, treated like a pariah on campus.”

**Sandra Troian, Caltech, speaking about her lawsuit alleging that her university retaliated against her for speaking to the FBI, The Washington Post, November 13, 2014.**

“Entanglement insults our intuitions about how the world could possibly work. Albert Einstein sneered that if the equations of quantum theory predicted such nonsense, so much the worse for quantum theory.”

**David Kaiser, MIT, The New York Times, November 14, 2014.**

“We have projections for one or two cases at the most during November, December. ... We do not expect a large outbreak in the United States.”

**Alessandro Vespignani, Northeastern University, on his computer model of the spread of Ebola, CBSNewsBoston.com, November 17, 2014.**

“I knew that someday I would leave Congress and wanted to do it under my own power and my own terms, and some more thought led me to think, this is the time. But it was in the expectation of doing something else worthwhile. And this is as worthwhile as anything I can imagine.”

**Rush Holt, U.S. House of Representatives, on his plans to lead the American Association for the Advancement of Science after retiring from Congress at the end of this year, The Washington Post, November 18, 2014.**

## This Month in Physics History

### December 20, 1951: First Electricity Generated by Atomic Power

Should one happen to drive through the high desert of eastern Idaho, one might stumble across what is now called the Idaho National Laboratory, a federal nuclear research facility that has played a key role in the development of nuclear power. It houses the decommissioned Experimental Breeder Reactor-I (EBR-I), the first nuclear reactor to generate usable electricity via fission. The man responsible for its design and operation was a Canadian physicist named Walter Henry Zinn.

Born in Berlin (now Kitchener), Ontario, in 1906, Zinn was the son of a tire factory worker. While his older brother, Albert, followed in their father’s footsteps, young Walter showed a keen interest and aptitude for math and science. After earning a degree in mathematics from Queens University, he worked for an insurance company, and then went on to complete his PhD in physics at Columbia University with a thesis on the structure and width of x-ray absorption limits in crystals. He supported his studies by teaching at both schools, and he joined the faculty of the City College of New York in 1932.

By 1939, Zinn found himself working with Enrico Fermi, among others, at Columbia’s Pupin Physics Laboratories, researching uranium isotope properties and the element’s potential usefulness for the recently discovered process of nuclear fission, specifically whether it should be possible to achieve a sustainable chain reaction. With the outbreak of World War II and the launching of the top-secret Manhattan Project to develop an atomic bomb, Zinn followed Fermi to the University of Chicago to continue their work.

Zinn was on hand for the first nuclear chain reaction on December 2, 1942, achieved in an abandoned squash court at the university. His job was to remove the control rod from the pile to start the chain reaction, and also to reinsert that control rod after 28 minutes. He stood at the ready with a fallback emergency safety rod, should the pile become too “hot” and the control rod designed to automatically shut down a runaway chain reaction failed. Chicago Pile-1 ran for just three months, since it lacked a radiation shield and was deemed too close to the densely populated city should there be a nuclear accident. Instead, it was taken apart and re-assembled—this time with a radiation shield—at a nearby spot called “Site A,” which would later move to a new “Site D” five miles away and become Argonne National Laboratory.

Zinn remained on the Manhattan Project until 1946, when the Atomic Energy Commission appointed him director of Argonne, now repurposed to focus primarily on problems relating to future reactor development. Under his leadership, Argonne went on to develop several innovative

reactor designs, blossoming from a small wartime research group into an internationally recognized center for nuclear reactor R&D and related science. Alvin Weinberg, director of Oak Ridge National Laboratory during the same period, once described Zinn as “a model of what a director of the then-emerging national laboratories should be: sensitive to the aspirations of both contractor and fund provider, but confident enough to prevail when this was necessary.”

In addition to his responsibilities as director, Zinn was keen on developing a fast breeder reactor design, dubbed Critical Pile-4, or “ZIP,” for “Zinn’s Infernal Pile” (breeder reactors can create more nuclear fuel than they consume).

When ZIP was ready, Zinn moved the assembly to what was then the National Reactor Testing Station in Idaho, a new outpost of Argonne, where it was dubbed EBR-I. On December 20, 1951, Zinn and his crew gathered around an array of four 200-watt light bulbs in the lab and watched them light up as electricity flowed to them—electricity produced by the EBR-I reactor. Within a few days, the reactor was able to supply power for the entire laboratory building, demonstrating that nuclear energy might be an economi-

cally viable alternative energy source: One ton of natural uranium can produce as much electricity as burning 80,000 barrels of oil, or 16,000 tons of coal. Two years later, experiments showed that EBR-I was indeed breeding new fuel. A nearby reactor plant, BORAX-III (based on a boiling water reactor design) later proved capable of powering the city of Arco, Idaho.

In the first decade of experimental nuclear power reactors, there were serious nuclear accidents, including one with fatalities. For example, Zinn supervised the BORAX-I test of boiling water reactors in 1954. He partially withdrew control rods to deliberately produce a power excursion, but the result was an explosion and a meltdown of more than half the core. In 1955, EBR-I suffered a partial meltdown during a test of how the reactor was responding to fluctuations in coolant flow; the culprit turned out to be thermal expansion of the fuel rods.

Seven years later, during the testing of another reactor, a scientist pulled out a control rod too far, melting down the core of an experimental prototype. That mistake produced an explosion of steam strong enough to cause the reactor to jump nine feet into the air, with a shock wave that killed three military personnel in the vicinity. The men were buried in lead coffins due to the massive exposure to radiation they suffered.

Zinn left Argonne in 1956 to found a consulting

**ELECTRICITY continued on page 3**



**Walter Zinn shutting down the Chicago Pile 3 for the last time.**

Argonne National Laboratory

## APSNEWS

Series II, Vol. 23, No. 11  
December 2014

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APS News (ISSN: 1058-8132) is published 11X yearly, monthly, except the August/September issue, by the American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, (301) 209-3200. It contains news of the Society and of its Divisions, Topical Groups, Sections, and Forums; advance information on meetings of the Society; and reports to the Society by its committees and task forces, as well as opinions.

Letters to the editor are welcomed from the membership. Letters must be signed and should include an address and daytime telephone number. The APS reserves the right to select and to edit for length or clarity. All correspondence regarding APS News should be directed to: Editor, APS News, One Physics Ellipse, College Park, MD 20740-3844, Email: letters@aps.org.

Subscriptions: APS News is an on-membership publication delivered by Periodical Mail Postage Paid at College Park, MD and at additional mailing offices.

For address changes, please send both the old and new addresses, and, if possible, include a mailing label from a recent issue. Changes can be emailed to membership@aps.org. Postmaster: Send address changes to APS News, Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844.

Coden: ANWSEN ISSN: 1058-8132

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## Education Corner

APS educational programs and publications



### 2015 PhysTEC Conference

Save the date! The 2015 PhysTEC Conference, the nation's largest conference on physics teacher preparation, will be held at the Marriott Seattle Waterfront in Seattle, WA, on February 5-7, 2015. The conference theme is Building Thriving Programs and will feature a plenary talk by Ron Henderson of Middle Tennessee State University.

- A workshop on Building a Thriving Undergraduate Physics Program will follow the conference on February 6-8.
- The conference will feature a half-day Learning Assistant Workshop on February 5.
- Faculty from minority-serving institutions are eligible to apply for travel grants.

To learn more, go to [www.phystec.org/conferences/2015/](http://www.phystec.org/conferences/2015/)

### Building a Thriving Undergraduate Physics Program Workshop

The Building a Thriving Undergraduate Physics Program Workshop will be held February 6-8, 2015, at the Marriott Seattle Waterfront in Seattle, WA. The goal of the workshop is to assist departments in developing strategies for increasing enrollment of physics majors. Institutions are invited to send teams of two to four faculty members to analyze their current departmental situation and decide how to take actions that will help them sustainably achieve their goals.

- Experienced faculty from departments that have had large increases in their numbers of physics majors will facilitate workshop activities in small groups and present information on their own experiences through plenaries and case study talks.
- The workshop will follow the 2015 PhysTEC Conference.
- The registration fee is \$250, with a discounted registration of \$150 to participants attending both conferences.
- To learn more, go to [www.phystec.org/conferences/thriving15](http://www.phystec.org/conferences/thriving15)

### Who's on top? Tables of Top Degree-Granting Institutions Now Available

APS generates tables showcasing the top institutions (ranked by number of physics degrees granted) in a variety of categories. These tables are freely available for your use. Access the tables here: [www.aps.org/programs/education/statistics/topproducers.cfm](http://www.aps.org/programs/education/statistics/topproducers.cfm)

### Save the Date! June 5-7 for the 2015 Physics Department Chairs Conference

The American Physical Society and the American Association of Physics Teachers are pleased to announce that the 2015 Physics Department Chairs Conference will be held June 5-7, 2015, at the American Center for Physics in College Park, MD. Registration will open in February. Stay tuned to this site for more details: [www.aps.org/programs/education/conferences/chairs/](http://www.aps.org/programs/education/conferences/chairs/)

### MEDAL continued from page 1

for what physics research contributes to society are inspirational.”

Jones has committed an initial gift of \$1 million to found the award, followed by the pledge of a second donation from the Jay and Mary Jayne Jones Charitable Remainder Trust, for a total endowment of \$2 million.

“He has maintained his passion for physics,” said Darlene Logan, APS director of Development. “He’s very excited about the opportunity to see the recipients.”

Jones’s appreciation of physics began when he was in high school and was inspired to go to college to study the subject. Ultimately, after studying physics in college, he went into business and founded the Olympic Medical Corporation in 1959, which manufactures medical equipment and supplies. Natus Medical Incorporated acquired the company in 2007.

For more information, see [www.aps.org/programs/honors](http://www.aps.org/programs/honors).

### ELECTRICITY continued from page 2

firm in Florida, General Nuclear Engineering, to design and build pressurized water reactors. When the company was acquired by Combustion Engineering eight years later, he headed the nuclear division until 1970, remaining on the board until his retirement in 1986. His boiling water reactor designs were early prototypes of nuclear plants still operating in the US and Japan. He also served on numerous govern-

ment advisory boards during this period, and was the first president of the American Nuclear Society in 1955. He suffered a stroke and died in Clearwater, FL, on February 14, 2000, at the age of 93.

The EBR-I was decommissioned in 1964 and earned historical landmark status in 1966. It remains open to the public during the summer for those inclined to visit the Idaho National Laboratory.

## A Brief History of Stephen Hawking

By Michael Lucibella

Love, fame, triumph, tragedy, and science collide in *The Theory of Everything*, the new film based on the life of acclaimed cosmologist Stephen Hawking. It’s a humanizing portrait of the physicist and his relationship with his first wife, Jane Wilde Hawking.

Following the narrative of their memoirs, the film opens with Hawking and Wilde meeting for the first time at Cambridge University. The spark between them is undeniable, but soon Hawking learns that he has amyotrophic lateral sclerosis (ALS)—Lou Gehrig’s disease—and doctors give him only two years to live.

The story that unfolds veers far from the traditional Hollywood love story. Famously, Hawking beats the odds, living decades longer than anyone predicted, but losing nearly all muscle control in his body. Still, he becomes a best-selling author and one of the most respected physicists in the world. His is a well-known story, but less known are the personal struggles that he and his wife went through in their Cambridge home as his fame grew and the disease ravaged his body.

At the Washington, DC premiere, which was co-hosted by APS and the Smithsonian Institution, screenwriter Anthony McCarten described how he wanted to adapt Jane Hawking’s memoir, *Traveling to Infinity: My Life With Stephen*, which chronicles her marriage to the most famous physicist in the world. “I wanted to do justice to this extraordinary and one-of-a-kind memoir,” McCarten said.

It’s a complicated memoir to adapt because in real life, there’s no neat, happily-ever-after Hollywood ending. For years the love between Jane and Stephen Hawking united them as they struggled against the encroaching disease and Hawking’s growing celebrity. But the film ends shortly after they split in 1990, when Hawking left



Michael Lucibella

APS and the Smithsonian Institution co-hosted the Washington DC premiere of *The Theory of Everything* about the life of Stephen Hawking.

her for one of his his nurses; five years later Jane Hawking married her choir teacher.

It’s Eddie Redmayne’s remarkable performance that brings out Hawking’s humanity throughout his best and worst times. “One of the best things about my job I suppose is being able to jump between different worlds and immerse [myself] in them,” Redmayne said at the premiere.

He spent a number of months with people with different stages of ALS to prepare for his role in the film. The effort paid off: Redmayne completely loses himself in the role and reproduces Hawking’s personality and mannerisms perfectly. Already there’s a tremendous amount of Oscar buzz around his performance.

Though the film’s central focus is the relationship between Hawking and his wife, his influential work developing groundbreaking theories in cosmology is the narrative backbone of the film. “We make no excuses. We did our homework on the science,” McCarten said.

The film does a good job striking the difficult balance between too much and too little science. The discussions of relativity and event horizons sometimes use some awkward metaphors or unusual turns of

phrase, but they rarely feel condescending or overly simplistic.

Black holes had been assumed to emit nothing. But in his big eureka moment, Hawking looks into the burning embers of a fire and has a burst of inspiration. The scene cuts to a lecture he gives to an audience of distinguished physicists about the fundamentals of Hawking radiation. The movie made little mention of the weeks of work he spent developing the theory.

“That might not be the way that Stephen Hawking actually came up with that,” said David Kaiser of MIT who was also at the premiere. “It’s a two-hour film trying to cover a lot of territory.”

Eureka moments aside, it portrays the process of science much better than most other films about scientists. In another scene, Hawking postulates a theory about the nature of the Big Bang. His professor is intrigued, compliments his hypothesis, and then says simply, “Now do the math.” According to Kaiser, the scene “gives us a glimpse of the inherently collaborative and communal process” that scientists engage in.

The *Theory of Everything*, 123 min., produced by Working Title Films, distributed by Focus Features, released in theaters on November 7.

## Black Holes, Hollywood, and *Interstellar*: Q&A with Kip Thorne

The new science fiction blockbuster film *Interstellar* has been turning heads in the science community for its serious treatment of black hole physics and general relativity. It started as an idea in the mind of Caltech physicist Kip Thorne who envisioned a film about interstellar travel using wormholes to traverse the vast distances between the stars. After the movie’s premiere, he spoke to Michael Lucibella about his work on the film. The full interview will be posted on the APS website.

**Why was it so important to make sure that nothing in the film violated the laws of physics? Why have that be such a tenet of the movie?**

Most science fiction is more in the genre of science fantasy and the two films that I sort of put on a pedestal in terms of the kinds of films that I would like to be involved in [are] *2001: A Space Odyssey* and *Contact*. I aspired to be involved in a film equally great and equally

firmly based on science. The one difference is that this film ranges from very well-established science of black hole physics, to very speculative science, in the form of

one gets transformed into another through research.

**What kind of challenges did keeping the science grounded pose for the filmmakers in the development of the narrative?**

I discuss [all of the compromises] that I’m aware of in the book *The Science of Interstellar*. What I loved about working with [director] Christopher Nolan and Jonathan [“Jonah”] Nolan on the screenplay and with the computer graphics folks during production and during the development of the visuals of the black holes and wormholes, was that they aspired to be as accurate as possible, subject to the constraint that you don’t wind up with a totally baffled audience. If the audience is baffled, of course you can always explain to them what is going on but if that is going to get in the way of a fast-paced film, this would never be the great success it is with the general



guesses and speculation and how

**BLACK HOLES continued on page 7**

## Science Collides with Politics

By Michael Lucibella

Tension between the House Committee on Science, Space, and Technology and the scientific community is running at its highest level in years. A Republican-led effort to investigate nearly sixty National Science Foundation (NSF) grants has upset scientists and science advocacy organizations.

Starting in April, 2013, the chair of the committee, Rep. Lamar Smith (R-TX), began requesting the confidential merit review documents used to decide on a number of NSF grants. After a brief fight between the NSF and the committee, the funding agency allowed committee workers to inspect copies of the documents at NSF headquarters, with the names and identifying information of the peer reviewers expunged. The ranking member on the committee, Rep. Eddie Bernice Johnson (D-TX), criticized Smith's requests, saying it was destructive to the peer review process.

Smith soon expanded the scope of his inquiry beyond the initial five grants he named in April. Altogether, the committee has asked for the documents of about sixty NSF grants that he calls "questionable."

Thus far, physics research has largely escaped the scrutiny of Smith and the committee. No grants from the NSF Directorate of Mathematical and Physical Sciences have been called into question; the vast majority that have been questioned come from the social, behavioral and economic sciences, or education and human resources directorates. The committee has asked for the paperwork on nine grants from the geosciences, engineering, and computer and information sciences directorates.

The NSF's Directorate for Social, Behavioral, and Economic Sciences has been the target of repeated Republican attempts to dramatically reduce or eliminate its budget.

On November 10, the Association of American Universities released a statement critical of Smith's actions. In it, the Association said that it was concerned that such investigations were damaging to academic freedom and would lead researchers to pursue only "safe" research that doesn't attract political attention.

"The choice of grants the committee has targeted is certainly puzzling," the statement read. "Several projects are being investigated for no apparent reason other than the sound of their titles. Others are studies related to climate change or to the study of any countries other

than the United States."

Smith responded that he was performing the duty of his office to oversee the money spent on grants by the NSF. "Researchers are free in our country to study any subject they like, but when taxpayers finance scientific endeavors, they are entitled—legally and morally—to know how their money is spent," Smith said in a statement.

The most recent grant to come under the Science Committee's microscope is a project at the University of Indiana called "Truthy," a reference to the term "truthiness" coined by the comedian Stephen Colbert. The research studies the way information flows through social media, particularly Twitter.

"Every year we see research projects criticized and ridiculed based on the reading of titles or on details taken out of context," the team said in an email to *APS News*. "We must not forget that subject-matter experts have to be involved in these discussions before jumping to conclusions."

One of the head researchers on the project, Alessandro Vespignani, a physicist at Northeastern University, has been at the forefront of modeling the potential spread of Ebola using similar methods. Two of the other co-principle investigators, Alessandro Flammini and Filippo Menczer of Indiana University, have received funding for similar research from a number of other federal agencies, including the Defense Advanced Research Projects Agency and the National Institutes of Health.

Controversy about the project ignited on October 17, when Ajit Pai, a Republican member of the Federal Communications Commission, penned an editorial in *The Washington Post* criticizing the research as an attempt to mold the political dialogue of the country. Smith followed up soon afterwards, criticizing the work as well.

"The government has no business using taxpayer dollars to support limiting free speech on Twitter and other social media," Smith said in a statement. "While the Science Committee has recently looked into a number of other questionable NSF grants, this one appears to be worse than a simple misuse of public funds. The NSF is out of touch and out of control. The Science Committee is investigating how this grant came to be awarded taxpayer dollars."

Members of Truthy deny the accusations by Smith and Pai. "Truthy is a set of research projects whose common thread is to

**POLITICS continued on page 6**

## Outlook for Science after Congressional Changeover

By Michael Lucibella

In the recent midterm elections, Republicans gained a majority of U.S. Senate seats, while holding onto their majority in the House of Representatives. Experts say that science funding is not likely to be a particular target for the new Republican majority, but science will almost certainly feel the pinch of shrinking federal budgets.

"Nothing much is going to change in Washington," said Michael Lubell, director of Public Affairs for APS. "The gridlock is, I think, going to continue."

Despite some high-profile controversies, particularly about climate change and green energy technology, science funding generally has not been a fractious partisan issue, particularly for basic research in the physical sciences. The change in control of the Senate is unlikely to dramatically refocus the country's emphasis on research.

"The historic reality is that science in general [has been] well

funded across the aisle, especially basic research," said Roger Pielke, director of the Center for Science and Technology Policy Research at the University of Colorado Boulder. "The science budget has been a pretty constant proportion of the domestic discretionary budget."

Across all the agencies, combined research and development generally makes up between about 11 and 14 percent of the federal discretionary budget. Senator John Thune (R-SD) is currently the ranking member of the Senate Commerce, Science, and Transportation Committee, and he will likely take over as its chair in the next Congress. I think Thune is a pretty strong supporter of science," Lubell said, adding that Thune has spoken out several times about the importance of funding science research.

Similarly, Thad Cochran (R-MS) is considered the top contender to lead the Senate Appropriations Committee, one of the most powerful committees in the Senate because it oversees the federal bud-

get, including the science budget. "Every indication that I've seen and his track record [shows] that he's a big supporter of science. Whether that translates to budget increases is a matter of the overall Republican [priorities]," Pielke said.

Though the proportion of federal money devoted to research and development may be unlikely to change dramatically, the size of the total pot it pulls from is likely to continue to decrease. The economic downturn and acrimonious relations between the two parties in Congress have kept the total federal budget at roughly the same levels since 2009, a net loss when adjusted for inflation.

"Overall, we're looking at least at a constrained budget if not a shrinking budget," Lubell said. "It means that there is going to be less money presumably to be spent on discretionary budgets."

Pielke agrees that even science agencies that have seen their budgets increase at a healthy pace in

**OUTLOOK continued on page 6**

## Retiring Representative Rush Holt to Take Helm at AAAS

By Michael Lucibella

Colleagues and supporters spoke fondly of physicist-turned-congressman Rush Holt (D-NJ) at a congressional farewell party co-hosted by APS. The event was held a day after the departing lawmaker announced he would take the job of Chief Executive Officer at the American Association for the Advancement of Science (AAAS). Formerly a plasma physicist, Holt was a staunch defender of science and science funding in Congress.

"We need scientists in Congress," Holt said. "Until we reach that golden age where all citizens, all well-educated citizens, are comfortable dealing with science, we need actual trained scientists in the legislature. I am honored to have been able to fill that role for now eight terms."

APS executive officer Kate Kirby highlighted his work, including \$22 billion in funding for research in the economic stimulus package of 2009. "He will be missed on Capitol Hill not only for his unending support for science, but also for the intelligent and articulate discourse in which he engaged during his entire political career," Kirby said. "At a time when science is less bipartisan than it has histori-



At his congressional farewell party, Representative Rush Holt (center right) and his wife Margaret Lancefield, talk with Sen. Ed Markey (far left), Alan Leshner, CEO of AAAS, and Kate Kirby, Executive Officer of APS (far right).

cally been, Rush has vociferously called for evidence-based debate, particularly on hot-button issues like climate change."

House minority leader Nancy Pelosi (D-CA) echoed Kirby's comments, highlighting his support for both research budgets and legislation backed by data. "Science has no better friend... because he has been a relentless, persistent, dissatisfied advocate for science and science funding, and he knows of what he speaks," Pelosi said.

Representative Bill Foster (D-IL),

another physicist turned congressman, said that he would miss having Holt's input on complex issues. "You can hardly name an issue that does not have a technological edge to it, and there is no substitute to having someone in the cloakroom and say 'Hey, what's the deal with this?'" Foster said.

Members of Congress in attendance also commented on the changing political discourse regarding science, and Holt's steadfast defense of research. "I'm

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### WINNERS continued from page 1

introduced in 2005 to coincide with the World Year of Physics, celebrating the 100th anniversary of Albert Einstein's "miracle year." The 2009 kit was the first to feature a comic, which told the story of Nicola Tesla and the electrification of the 1893 Chicago World's Fair. Spectra and her arch nemesis Miss Alignment made their debut in the 2010 kits about lasers and optics,

to correspond with LaserFest, the 50th anniversary of the invention of the laser.

"In 2015 [Spectra] will again be battling Miss Alignment," Thompson said. "It will be part of the 2015 International Year of Light, so we wanted to bring back Miss Alignment. All of the experiments will be about light."

### REFORM continued from page 1

added, "With a positive Council vote, we can begin to implement the transition plan, as spelled out in the new *Constitution & Bylaws*."

This document creates a Chief Executive Officer position to directly oversee all day-to-day operations of the Society, in place of the current triumvirate. An amended *Articles of Incorporation*, together with the new *Constitution & Bylaws*, will bring APS into compliance with Washington, D.C. statutes governing nonprofit corporations.

The newly-adopted documents will change the roles of the

existing Council and Executive Board. The Council will become the Council of Representatives, chaired by a Speaker, and will be responsible for all matters of science and membership, including science policy, prizes and awards, units, and meetings. The Executive Board will become a Board of Directors, made up of the Presidential Line, the Treasurer, and nine Council members including the Speaker of the Council. It will be in charge of all matters of governance and finance.

The new rules went into effect

on Monday, November 17, and the Board meeting on November 22 was the first convened under them. At the inaugural meetings of the newly-formed Board of Directors and Council of Representatives, the Board made several appointments, such as choosing an interim Treasurer. Soon the CEO search process will begin, and the Society's updated policies and procedures documents—the manuals for how APS will operate in practice—will be adopted.

For more information go to [www.aps.org/about/reform/](http://www.aps.org/about/reform/)

## Washington Dispatch

Updates from the APS Office of Public Affairs



### POLICY UPDATE

#### Republicans Take the Senate and Eye Continuing Resolution

With midterm elections over and the Republicans now in charge of both chambers of Congress, the question on everyone's mind is "What next?" News media have already highlighted the big stories: repealing the Affordable Care Act, authorizing the Keystone XL pipeline, immigration reform, job creation, committee chairs, climate change, net neutrality, and of course, who will run for President in 2016. Very little coverage has been devoted to government funding expiring on Dec. 11, 2014.

The latest talk about Fiscal Year 2015 appropriations is that the lame duck session will produce a combination of a few appropriations bills combined into one bill (an "omnibus" bill, or in this case a "mini-bus") and a partial continuing resolution (CR), termed a CROmnibus. The expectation is that funding for the science agencies and the Department of Energy will be done under the CR portion of the CROmnibus bill and funding for Department of Defense will be incorporated into the mini-bus. However, absent further legislation, all funding will be subject to sequestration: across-the-board reductions of 9.7 percent for defense and 7.2 percent for non-defense.

Staff on the Hill are optimistic that the Elementary and Secondary Education Act (ESEA, most recently authorized as No Child Left Behind) will be reauthorized next year given the expectation that Sen. Lamar Alexander (R-TN) is likely to chair the Senate Health, Education, Labor and Pensions Committee. There is bipartisan support to reform Title II (teacher professional development) funding in ESEA and to focus on science, technology, mathematics, and engineering (STEM) education.

The House Science Committee, chaired by Rep. Lamar Smith (R-TX), is likely to be as divided and unproductive in the 114th Congress as it was in the 113th. Rep. Smith continues to insist that the National Science Foundation (NSF) send confidential information on grants to the Hill. NSF has agreed to open up that information to staffers who visit NSF. Ranking member Rep. Eddie Bernice Johnson (D-TX) wrote a letter to Chairman Smith opposed to the release of confidential grant information. The letter also points out that confidential material in those grants already reviewed by Hill staff has been leaked to media outlets such as FoxNews and *The Daily Caller*. It is unlikely that America COMPETES will be reauthorized in light of continued policy disagreements.

### WASHINGTON OFFICE ACTIVITIES

#### ISSUE: MEDIA UPDATE

In a September 26 op-ed in *The Baltimore Sun*, scientist Matthew Bobrowsky wrote about the crucial role science plays in strengthening the US economy.

Similarly, U.S. Rep. Anna Eshoo (CA-D-18th) opined about securing America's scientific future through investment in research in the October edition of the APS newsletter *Capitol Hill Quarterly*.

#### ISSUE: POPA

The APS Panel on Public Affairs (POPA) forwarded a draft Statement on Earth's Changing Climate to the APS Council for comment. The draft was first reviewed by the APS Physics Policy Committee (PPC). After Council comments on the draft statement, it will be reviewed by the APS Executive Board before being presented to APS membership for further commentary. Information about the process can be found on the following webpage: [www.aps.org/policy/statements/climate-review.cfm](http://www.aps.org/policy/statements/climate-review.cfm)

The POPA Physics & the Public Subcommittee will direct a survey that explores pathways that overcome obstacles to recruiting university physical-science students into careers as high school science teachers. This study was approved at the Panel's October 2014 meeting and will be undertaken in conjunction with the APS Committee on Education.

Two proposed APS Statements will be reviewed at the next APS Board meeting; the first is a revision of the current APS Statement on Civic Engagement of Scientists (APS Statement 08.1), and the second is a new statement on the Status of Women in Physics.

A review of APS Statement 09.1, Control of the U.S. Nuclear Complex, continues; a larger discussion on possible revisions to the statement will be held at the first POPA meeting of 2015.

The POPA Energy & Environment Subcommittee is developing activities that address the issues surrounding helium supply and pricing.

With the resignation of the 2014 POPA Chair Elect, a special election will soon be held to fill the currently vacant position.

A template for study proposals can be found online, along with a suggestion box for future POPA studies, at [www.aps.org/policy/reports/popa-reports/suggestions/index.cfm](http://www.aps.org/policy/reports/popa-reports/suggestions/index.cfm).

## PRX Takes on a New Role

By Gene Sprouse

The American Physical Society (APS) launched *Physical Review X* (PRX) three years ago, as a new member of the APS journal family. What is its role in the family?

To answer this question, it may be instructive to look briefly at how the APS journal family, with its current make-up, serves the needs and interests of the physics community. The APS journal family offers authors a variety of venues for their articles. Researchers can choose between *Physical Review Letters* (PRL), our large, selective, broad-scope, letter-format journal that is the most cited in physics, and the other *Physical Review* journals that publish new and significant results in different fields of physics. True to the APS mission to advance

physics and serve the global physics community, our journals belong, not to a for-profit corporation, but to physicists all over the world who work hard for the journals as authors, reviewers, and editorial board members. The decision of which articles to publish is based on their scientific merit, rather than on what is "newsworthy" or "hot," and on their sound scholarly presentation rather than "hype."

In recent years, however, we have seen a strong need of some researchers to have their best scientific contributions published in highly selective and small journals that can disseminate those contributions broadly and offer them high visibility. We have also clearly heard a desire expressed by many in the global physics community

that such a journal be published in the nonprofit and science-first APS publishing tradition. Now, with PRX, APS can offer such a venue to the community.

Recently, an external committee, consisting of a diverse group of physicists, including junior and senior scientists from many different fields and from different regions of the world, reviewed PRX. The committee lauded PRX for its careful review process and adherence to high scientific standards, and for the reputation it has already gained as a journal of high visibility and broad dissemination. They recommended that PRX continue on its upward trajectory and take on the new role by staying small, about 250 papers/year, and becoming much more

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## International News

...from the APS Office of International Affairs



### Learning from Germany's Approach to Global Science

By Cathleen Fisher and Haley Armstrong

In a world of global science and increasing research mobility, participation in international collaborations and exchanges—long a mainstay in physics—is increasingly necessary to a successful scientific career and to the advancement of scientific knowledge in many fields.

The new geography of global science poses significant challenges to the United States, which, for good historical reasons, has had a unique approach to internationalization. US researchers traditionally have been far less mobile than their international counterparts, and many are still apt to see foreign experience as an impediment, rather than a boost, to a successful career. And while many US universities are embracing internationalization with fervor, few provide incentives for global engagement in faculty tenure and promotion criteria. Instead, the US has relied on what might aptly be called a strategy of "brain capture": attract the best talent and hang onto it in perpetuity. It has been a successful approach, thanks to many decades of significant investment in science and the excellence of US research universities. The US global edge of course is not going to disappear overnight. Looking forward, however, US universities will face increasing competition from countries and regions that are investing in science and research to enhance the competitiveness of their universities and economies.

In contrast, Germany has been giving a lot of thought in recent years to the new global geography of science and its implications for knowledge economies. Taking the long view, the German government has launched a number of strategic initiatives, including the "Excellence Initiative," aimed at elevating the global status of select German universities, and a high-tech strategy that gives funding priority to

cutting-edge research in fields that are critical to the German economy and society. Far from pursuing a policy of "brain capture," Germany has long embraced the benefits of "brain circulation," providing sustained federal funding to support student and faculty research exchanges between German and foreign universities.

Among the premier German institutions engaged in "brain circulation" is the Alexander von Humboldt Foundation (AvH). Since 1953, the AvH has supported the independent research of outstanding international scientists and scholars at German universities and research institu-

tians" (including 50 Nobel laureates) in 140 countries, which the Foundation continues to support through opportunities for renewed research stays and other benefits.

Located in Washington, DC, American Friends of the Alexander von Humboldt Foundation (AFAvH) is the professional partner of the AvH in the United States and a U.S. 501(c)3 charitable organization. Our goals and activities include:

- Educating US scientists and scholars about the impact of international research experience more generally, as well as about the specific benefits of the fellowships and awards of the Alexander von Humboldt Foundation, among them: education and training opportunities, access to new ideas and resources; and expanded global networks.
- Encouraging and supporting continued collaboration among US alumni through a nationwide network of "Humboldtians on Campus" and also through support for small-scale alumni activities; and
- Raising Germany's visibility as a center for research through promotions at scientific meetings, university visits and electronic outreach.

One of the principal ways AFAvH reaches out to researchers is through collaboration with their scientific societies, including the American Physical Society. With the assistance of Professor Royce Zia, Virginia Tech University, AFAvH was pleased to organize a reception for both US "Humboldtians" and prospective applicants attending the 2014 APS March Meeting in Denver. AFAvH will be hosting a booth and reception at the 2015 APS March Meeting in San Antonio, along with its partners from other German funding agencies, including **GERMANY continued on page 6**



Cathleen Fisher



Haley Armstrong

**MEETING continued from page 1**

Before the meeting, the Division of Polymer Physics will hold its popular annual short courses on recent advances in this field. These two-day sessions run from Saturday afternoon to Sunday evening and will focus on glasses. Also on the Sunday before the meeting there are five tutorials on a range of topics. The tutorials are aimed at graduate students, postdocs, university faculty, and industrial researchers who want to be brought up to speed on a particular field. There will be three tutorials in the morning, followed by a different two in the afternoon. The subjects are quantum annealing, the phys-

ics of climate change, iridates, quantum gasses for simulation, and resources for computational materials science.

The APS prize and award ceremonial session will be held late on Monday afternoon, honoring the outstanding contributions of researchers to their fields. This will be followed by an opening reception for all participants.

There will be a variety of events for students attending the meeting. On Monday evening, students are invited to attend a special welcome reception and career panel highlighting non-academic and non-PhD career paths. There will

also be a Tuesday evening reception where awards will be passed out followed by a dance party. The graduate school fair will be open on Monday and Tuesday for undergraduates looking to learn more about continuing their education. Graduate students can sign up for Lunch with the Experts, where they can enjoy a boxed lunch while having an informal, freewheeling discussion with an expert on their choice of topic.

The Committee on Minorities, in conjunction with the Committee on the Status of Women in Physics and the Ad Hoc Committee on LGBT Issues, will host a Diversity

Networking Reception. Open to everyone, the reception will be a chance for physicists who want to learn about APS diversity efforts to meet one another and network.

The Forum on Industrial and Applied Physics (FIAP) is hosting a number of events at the meeting. Industry Day, scheduled for Wednesday, will feature a number of scientific sessions dedicated to industrial physics on topics important for manufacturing. The Job Expo will run from Monday through Thursday. On Thursday, FIAP will be hosting a special forum on entrepreneurship in physics to help physicists prepare

for careers in private sector. The Sunday before the meeting, science career coach Peter Fisk will host a workshop for researchers to help advance their careers.

The exhibit hall will run from March 2 through 5 and will feature more than 100 exhibitors. And, as at past meetings, the APS Contact Congress booth will be set up for attendees to help them reach their members of Congress to express their concerns about science funding.

For more, see the 2015 APS March Meeting website at [www.aps.org/meetings/march/](http://www.aps.org/meetings/march/)

**OUTLOOK continued from page 4**

recent years shouldn't expect much continued growth. "I think the budget is going to be tight for science," Pielke said. "I don't think you're going to see any dramatic expansion [of the National Institutes of Health research budget] like you saw in the Clinton years and then in the Bush years."

The political winds in Washington also seem to be blowing against any kind of increase to federal budgets in the near future. Many of the newly-elected Republican members of Congress are from the wing of the party most focused on reducing the size of the federal budget.

"These are people who have all gone on the record saying that they want to cut government spending and shrink the role of the federal government," Lubell said.

However, the continued gridlock in Congress is likely to prevent any dramatic reductions as well. "With a Democrat still in the White House, radical across-the-board cuts don't look very likely, and absent those I don't think there is any reason to think that science as a whole would be singled out for cuts by

Republicans," said Daniel Sarewitz, the co-director of the Consortium for Science, Policy, and Outcomes at Arizona State University.

With Republicans in control of both houses of Congress, there's the chance also that compromise is more possible than when control was split between the two parties.

"You also have an opportunity for the House and Senate to get their act together and negotiate with the president with one position," Pielke said.

Lubell, however, is skeptical, predicting instead that Congress will approve a number of bills with provisions that the President finds unpalatable. "I don't believe that the gridlock is going to vanish, Obama is going to veto a lot of bills," he said.

Residual acrimony from the election campaign could pose one of the biggest potential threats to science funding. During the lead-up to the election, a number of independent groups ran ads targeting Republicans as being anti-science, largely because of their opposition to climate change efforts. A par-

ticular target was the conservative James Inhofe (R-OK), who will likely head the Senate Environment and Public Works Committee and who wrote a book calling global warming a hoax and a conspiracy by scientists.

"There are going to be people out there but they don't represent a political party, they represent a particular point of view," Lubell said. "There are plenty of Republicans that don't fit into that mold... There are plenty of Republicans that have a tremendous amount of respect for science."

However, the Republicans, who were by and large the targets of such attacks, are now in control of Congress.

"If there's one thing we've learned over the last election... it's that science issues make very poor issues in politics," Pielke said. "For the science community to do well in the budget process over the next two years, the science community has to make peace with the Republicans, and that's not something that the science community has wanted to do," he said.

**PRX continued from page 5**

selective than it already is now. We have enthusiastically accepted that firm recommendation. We also demand that *PRX* remain true to the mission and the best publishing practices of all of the APS journals. The committee also recommended that *PRX* and *PRL* work together to improve the profile of both journals.

*PRX* and *PRL* will now complement each other, as different choices for authors. *PRX* does not aim to track the full arc of important developments within each field as does *PRL*, but will select only key individual articles from established fields as well as emerging and interdisciplinary areas of physics. *PRX*'s flexibility toward article length allows authors to present their research with both sufficient clarity and context to reach a general audience, and enough detail to serve as a resource for specialists. As an open-access, online journal, *PRX* provides broad dissemination of highly significant research results to all readers without a subscription barrier. This feature should be particularly beneficial to those communities of science, medicine, and industrial research as well as scientific communities in

developing countries that may not have access to our other journals through subscription.

We are excited to have *PRX* take on its new role in our family of journals. At the same time APS will strongly support *PRL* so that it will continue to be the journal with the greatest impact in physics. We now have two journals for papers of the highest quality and trust authors to judiciously choose which they think is the most appropriate venue for their top work. Whether it is *PRL* (<http://journals.aps.org/prl/>) that tracks the full arc of physics or *PRX* (<http://journals.aps.org/prx/>) that selects a small number of articles across all areas where physicists are engaged in research, your choice will give support to the nonprofit and science-first principles of the APS journals, and ultimately benefit the global physics community and its research.

*Gene Sprouse is Editor in Chief of the American Physical Society. This editorial was originally published on October 9, 2014 on the Physical Review X website (<http://link.aps.org/doi/10.1103/PhysRevX.4.040001>)*

**GERMANY continued from page 5**

the German Academic Exchange Service (DAAD) and the German Research Foundation (DFG). Joining us at the booth in San Antonio will be several leading German physicists, who will be available, along with US Humboldtians and representatives of the various funding agencies, to answer questions about the many programs and the funding available for physicists to do research in Germany (Please visit <https://www.americanfriends-of-avh.org/fellowships-awards/> to find a full list of fellowships and awards and <https://www.americanfriends-of-avh.org/events/> to find other meetings and events where AFAvH will have a presence.)

Beyond promotion of research opportunities in Germany, AFAvH is also committed to expanding dialogue across the Atlantic about the key challenges posed by fundamental changes in the global context of science, technology and innovation. Through a series of workshops and public events we are engaging alumni and other thought leaders in exploration of the challenges associated with the globalization of knowledge

production, including the impact of international research mobility on the scientific enterprise; the internationalization strategies of US and German universities; and the role of bilateral cooperation between Germany and the United States in an age of global knowledge production. A new virtual program, the AFAvH blog, features short posts by Humboldtians and other partners as well as relevant reposts in three topic areas: Globalization of Research; Science, Society and Policy; and Transatlantic Research and Professional Cooperation. (You may view the AFAvH blog by visiting <https://www.americanfriends-of-avh.org/blog/>.)

Through these and other activities, AFAvH seeks to become a leading source of expertise and information on the internationalization of science and scholarship and its benefits for US science and scholarship. We believe that the United States and US institutions have much to learn from Germany's experience, and more particularly, from that of the Humboldt Foundation and the researchers it has

supported. We look forward to working with others who share our interest in encouraging new thinking about strategic US engagement in global scientific collaboration.

Additional links:

- American Friends of the Alexander von Humboldt Foundation: [www.americanfriends-of-avh.org](http://www.americanfriends-of-avh.org)
- Alexander von Humboldt Foundation [www.humboldt-foundation.de](http://www.humboldt-foundation.de)
- For more information on promotional activities, please contact Jessica Bell, Promotions and Digital Media Coordinator.
- For more information on AFAvH programs, please contact Natalia Wobst, Director of Programs.

*Cathleen S. Fisher is President of American Friends of the Alexander von Humboldt Foundation (AFAvH). Haley Armstrong is Program and Board Assistant at the organization, which promotes German-American research exchange in science, engineering and the humanities.*

**POLITICS continued from page 4**

study the diffusion of information in online social media," the team said in an email to *APS News*. "We were not contracted by the federal government to build tools or websites to track political speech. We do have a website to showcase some demos related to our research. All of our projects are based on public data available from Twitter and vetted by an ethics board, so we don't monitor users without their consent. Our analyses and tools do not intervene in online conversations, so the complaints about impinging on free speech are unfounded."

One of the demonstrations featured on the Truthy website is its "BotOrNot" app. It uses the team's analysis of the behavior of Twitter users to predict if a particular account is operated by a human being or an algorithm. The team's "Political Topics" section of their website, which has been subsequently taken down, analyzed the most popular political

topics, how sentiments changed over time, who were the most influential users, and the dynamics of spreading information.

"[W]e examine statistical patterns of how memes spread through social media networks. Our research is thus entirely apolitical. In a few papers we did report on observations in the realm of politics as an application of our analysis, but those resulted directly from the data without any editorial process about what they could or should represent."

Shortly after publically criticizing the work, Smith sent the NSF a request to review the peer review documents of the Truthy team. "The committee and taxpayers deserve to know how NSF decided to award a large grant for a project that proposed to develop standards for online political speech and to apply those standards through development of a website that targeted conservative political comments," Smith said in a letter to the NSF.

## ANNOUNCEMENTS



# APS Congressional Science Fellowship 2015-2016

All application materials must be submitted online by close of business on January 15, 2015 (5:00 PM EST).

**The American Physical Society** is accepting applications for the **Congressional Science Fellowship Program**. Fellows serve one year on the staff of a senator, representative or congressional committee. They are afforded an opportunity to learn the legislative process and explore science policy issues from the lawmakers' perspective. In turn, Fellows have the opportunity to lend scientific and technical expertise to public policy issues.

**Qualifications** include a PhD or equivalent in physics or a closely related field, a strong interest in science and technology policy and, ideally, some experience in applying scientific knowledge toward the solution of societal problems. Fellows are required to be members of the APS.

**Term of Appointment** is one year, beginning in September of 2015 with participation in a two-week orientation sponsored by AAAS. Fellows have considerable choice in congressional assignments.

**A Stipend** is offered in addition to allowances for relocation, in-service travel, and health insurance premiums.

**Application** should consist of a letter of intent of no more than two pages, a two-page resume with one additional page for publications, and three letters of reference.

**APS physics**

<http://www.aps.org/policy/fellowships/congressional.cfm>



We Want Your Nominations for *Historic Sites*

Each year APS recognizes a small number of historic physics sites in the US (and occasionally abroad). **Nominations received before January 15, 2015 will be eligible for consideration in 2015.**

More information, including sites selected to date and an online nomination form, can be found at [www.aps.org/programs/outreach/history/historicsites/](http://www.aps.org/programs/outreach/history/historicsites/)

## BLACK HOLES continued from page 3

audience if you tried to explain.

### How much influence did you have in shaping the narrative of the film?

Throughout the screenwriting process, first with a sketch of the screenplay by Jonathan Nolan, [and] about three drafts with Christopher Nolan, every few weeks I would meet with them and we would brainstorm about science, they would have ideas they wanted to put in, I would suggest alternatives. This brainstorming gave rise to the idea of gravitational anomalies, which play a central role in the film, for example. [It] was in the brainstorming sessions with Chris where we decided on going into the black hole. A variety of ideas in here that became central to the film came out of that brainstorming, but how the ideas were used, that was entirely Chris's or Jonah's. But they did make them quite central to the story, so I think without that brainstorming, the story would indeed be rather different.

### What was it like for you to see a fully rendered black hole on the big screen for the first time that was based off of your calculations?

What for me was amazing was to receive back from the team at [visual effects company] Double

Negative, from Oliver James and Eugenie von Tunzelmann, film clips with very, very high resolution of things I've only ever seen in very low resolution before. I had seen many years ago an image of an accretion disk with gravitational lensing that Jean-Pierre Luminet in France had made. I had sort of forgotten about it, but when I first saw the gravitationally lensed accretion disk that you actually see in the movie, it was a mixture of amazement on one hand and recognition that "Yes I do remember seeing something like that, years ago." And a bit of awe and excitement that this team at Double Negative had just taken the equations I had given them, laid down their own accretion disk based on artistic models based on astrophysics, and come back to me with a full-blown image of the sort you see in the movie. I was really impressed and gratified that they pulled it off and was so pleased with how it looked.

### What were some of the similarities and differences in working on a Hollywood collaboration versus a scientific collaboration?

I was working with people who were equally as brilliant as the colleagues I work with in science. They have a very deep intuition but of a very different sort than mine,

and very different backgrounds. It really was an issue of a scientist collaborating with artists by and large, though the people I worked with the most hands on at Double Negative were really a mixture of artists and scientists. Working at that interface was very enjoyable. Working with Christopher Nolan and Jonah Nolan and [producer] Lynda Obst was a lot of fun, just because they're coming at this from such a different point of view, and particularly enjoyable was my in-depth conversations with Matthew McConaughey and Anne Hathaway who are deeply curious, really interesting people and were just a joy to talk to. So yeah, I had a lot of fun.

### Do you see this as part of a trend or the beginning of a trend of more scientists and science working its way into Hollywood?

I think it is a trend, and the National Academy of Sciences has tried to foster it through the Science and Engineering Exchange, trying to get connections made between scientists on the one hand and filmmakers on the other. I would hope that this contributes significantly to that. I do believe that having films that are more scientifically based is important for American culture and for world culture. So yes, I think so and I hope so.

## Reviews of Modern Physics

### Spin-polarized quantum confinement in nanostructures: Scanning tunneling microscopy

Hirofumi Oka, Oleg O. Brovko, Marco Corbetta, Valeri S. Stepanyuk, Dirk Sander, and Jürgen Kirschner

A full understanding of electron confinement at surfaces and in nanostructures requires that spin-polarization effects be taken into account. This review exploits energy-dependent and spatially-resolved scanning tunneling microscopy and spectroscopy to elucidate the role of spin-polarized surface states, spin-dependent scattering by magnetic impurities, and the influence of such effects on the transport properties of nanostructures. Experimental results and theoretical insights converge to give a view of how spatial variations of the electron density impact magnetic properties when electrons are confined to structures with sizes comparable to the de Broglie wavelength.

[dx.doi.org/10.1103/RevModPhys.86.1127](http://dx.doi.org/10.1103/RevModPhys.86.1127)

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## HOLT continued from page 4

not a scientist, but I'm smart enough to know what I don't know," said Rep. Jim McGovern (D-MA). "It amazes me at the contempt that some have for science, and it's important for us to elect people like Rush to Congress, who will actually speak out and defend the fact that it's ok to be smart [and] it's ok to rely on smart people to give you the best guidance on how to proceed on certain things."

Holt expressed concern about the direction that debates about science seemed to be going, and promised as the future CEO of the AAAS he would continue to fight for science. "[Rep. McGovern] never thought, nor did I think, that we would have to defend the very idea of science on the floor," Holt said, referring to that day's fierce

floor debate over a bill to limit the Environmental Protection Agency's regulatory power. "I figured there would be arguments about misunderstandings of science...but the idea that empirically based, peer-reviewed work is the best path to reliable knowledge, shouldn't be questioned. But it was even today."

Rep. Jerry McNerney (D-CA) said that AAAS would do well with Holt at its helm. "The challenge is that we need to communicate what science is, its importance and how it affects our lives to the people of this country, and I'm afraid right now we're not where we need to be," McNerney said. "I think having Rush in this position with his dedication and his knowledge and his fine personality, it's really going to make a difference."

### What kind of broader message about science do you hope that the audience will come away with?

A very optimistic message; the powers of science and what can be achieved if we work really hard at

it. I would hope that this film will help to awaken the public to the power of science, and the importance of human inquisitiveness, the quest to understand the universe, the quest to build the tools to deal with whatever nature does to us.

# The Back Page

**“All science is either physics or stamp collecting.”**

—Ernest Rutherford

Like a lot of kids, I had a stamp collection for a while. I never collected anything particularly notable, but going through old letters and boxes of stamps from relatives who had had collections was enjoyable in a quiet way. And putting the individual stamps together to make a larger picture was fascinating. I remember an intimidatingly large three-ring binder with spots for every US stamp that had been issued to that point, and the satisfaction of completing a page. My hobby also gave a sense of history outside the collection—for example, seeing all the stamps of the 1893 Columbian Issue commemorating the 400th anniversary of Christopher Columbus’ famous voyages showed me there was a good deal more to the story than I had heard in grade school.

Beyond the immediate pleasures of building a collection, though, the impulse to collect can be a starting point for science. The most obvious product of collecting hobbies is an array of physical objects, but collecting is also a mental state. Serious collectors develop habits of mind particular to their hobbies—a sort of constant low-level awareness of possible sources of stamps, an ability to spot new specimens, and close observation and knowledge of the fine gradations that separate valuable stamps from worthless bits of colored paper. These habits of mind also serve well in science; the simple act of collecting a diverse array of interesting objects or observations also serves as the starting point for most sciences.

Rutherford’s famous gibe contains a small element of truth, because the physics of his day was more fully developed than other sciences, in terms of successful unifying theories like Newton’s laws of motion and Maxwell’s equations for electromagnetism. But that very development started with the “stamp collecting” of lots of individual bits of data. Newton would not have been able to formulate his laws without decades of carefully recorded astronomical observations and experimental tests by previous generations of scientists. Maxwell’s equations bring together the results of dozens of seemingly unconnected experiments on the behavior of charged particles and magnets. And the amassing of examples continues to be critically important to this day—the Standard Model of particle physics is arguably the most comprehensive and successful scientific theory in human history, but modern particle physics is the ultimate big-data science, with the Large Hadron Collider (LHC) producing hundreds of petabytes worth of experimental data in a year.

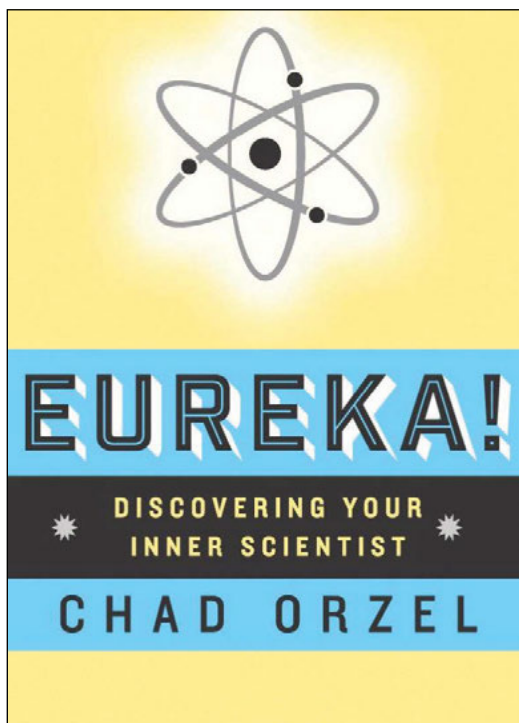
The other sciences at the turn of the twentieth century were nowhere near as fully developed as they are now or as physics was then. In geology, the idea of continental drift was decades off, and scientists still had some trouble determining the age of Earth—the best available estimates from the temperature of the Earth and Sun suggested an age of at most a few hundred million years, a small fraction of the apparent age of rocks. In chemistry, the rules determining bonding of atoms into molecules were known, but the underlying principles were not understood until the development of quantum mechanics; there was even some debate as to whether atoms were real physical entities or merely a mathematical convenience. Biology was probably the furthest along, but even there, the rules of heredity were still being worked out and the discovery of DNA as the mechanism of heredity, one of the crucial foundations of modern biochemistry, was nearly a half-century away.

All of these sciences have made remarkable progress in the past century, matching or even surpassing the development of physics in Rutherford’s day. The development of our modern understanding of all of these sciences began with the collection of a huge number of “stamps,” allowing scientists to determine patterns that are clear only through the accumulation of a vast array of information. So while there is some truth to Rutherford’s snide taxonomy, in another sense, it misunderstands the process of science. Stamp collecting is an essential step on the way to deeper scientific understanding. This is best illustrated by what may well be the most important and controversial scientific book ever written, Charles Darwin’s *On the Origin of Species*.

Although he never needed to work at a trade, Darwin was hardly idle, studying a wide range of organisms in great detail and so obsessively that his children assumed

## Eureka! Discovering Your Inner Scientist

By Chad Orzel



that all fathers spent their days peering through microscopes. One of his sons, visiting a friend’s family, famously asked, “Where does your father do his barnacles?” His books about barnacles won a prize from the Royal Society, and he was an active member of the leading scientific societies of the day. He also carefully tracked the behavior of plants in his gardens and spent many years raising pigeons.

The fruit of all this labor came in 1859, when Darwin published his most important book, *On the Origin of Species by means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. This is the book that launched the modern concept of biological evolution, sparked enormous public controversy, and made Darwin a figure to be reviled or revered by various combatants in the culture wars that continue to this day.

Why, then, does Darwin have iconic status, while earlier evolutionary thinkers are only remembered by historians of science? Darwin’s *Origin* supplanted earlier theories for two reasons. First, he provided a clear mechanism by which evolutionary changes occur: the slow accumulation of small variations that make specific individual organisms more likely to survive and reproduce. Those beneficial changes are passed on to future generations, where further variations occur, with the beneficial changes passed on, and so on.

This mechanism of natural selection places Darwin’s

theory squarely within the realm of science [1]. Erasmus Darwin and Lamarck had invoked vague metaphysical “principles” driving continual improvements in species, as if there were some goal to be attained, which is an uncomfortable basis for a scientific theory [2]. Lamarck provided the first coherent theoretical framework for talking about evolution, and Darwin himself cited it as an influence on his thinking, but without a better idea of the mechanism of

change, Lamarck’s theory gained little traction as science.

The second, equally important, factor that secured Darwin’s triumph came from his years of careful collecting, from the Beagle to his barnacles to the breeding of pigeons. The *Origin* succeeded as brilliantly as it did in large part because Darwin supported his argument with concrete evidence, piles and piles of it. All those years of collecting and cataloging plants and animals like stamps in an album paid off.

While Darwin’s work is probably the highest-profile example of clinching a discovery through the amassing of vast piles of evidence, all sciences start with the collection of “stamps,” small bits of data that may seem no more than faintly interesting curiosities at first glance. This is particularly true of the observational sciences, where researchers attempt to piece together long-ago events that are not easily repeated. The idea that the continents shift position over time began with Alfred Wegener’s observation that the coastlines of Africa and South America seem almost like complementary puzzle pieces. The idea of continental drift didn’t gain acceptance until after multiple lines of other evidence were found to support it: close similarities between rock strata and fossils on opposite sides of the Atlantic, evidence of sea-floor spreading at the Mid-Atlantic Ridge, and matching “stripes” of magnetization in rocks on either side of the ridge, tracing out the history of magnetic pole flips. Thanks to the convergence of all those bits of evidence, the idea that the continents shift position over millions of years is central to the modern theory of plate tectonics, as central to geology as evolution is to biology.

Rutherford’s quip about stamp collecting is usually brought out as either a teasing dig at biologists or an example of the overbearing arrogance of physicists, depending on whether the person citing it is a physicist or a biologist. But given the essential role of data collection to evolutionary biology and other sciences, perhaps Rutherford’s comment should be viewed more as a compliment to stamp collectors. Nearly all progress in science can ultimately be traced to the human impulse to collect and arrange enormous amounts of stuff.

The lesson to take from Darwin and Rutherford and collecting generally, then, is the importance of measuring everything. The first step to bringing your inner scientist to bear on a problem is to collect as much information as you can about the problem—if you want to lose weight, you need to track what you eat; if you want to make better use of your time at work, you need to track what you do through the day. The individual records may not seem meaningful in themselves, but taken all together, they may reveal useful patterns and suggest solutions.

Chad Orzel received his BA in physics from Williams College, his PhD in chemical physics from the University of Maryland, and did postdoctorate research at Yale University. He maintains the blog *Uncertain Principles* and is the author of *How to Teach Physics to Your Dog* and *How to Teach Relativity to Your Dog*. He is now a professor at Union College in Schenectady, New York.

### Notes:

1. By removing the need for any intelligence guiding the process, natural selection also presents a dramatic challenge to religious ideas of divinely-guided creation, creating instant controversy from the day of its publication right down to the present. Although the furor was personally uncomfortable for Darwin, it certainly helped cement his status as an icon of science.
2. Another pre-Darwin evolutionary work, the sensationalist *Vestiges of the Natural History of Creation*, published anonymously in 1844, compounded these metaphysical “principles” with wild speculations that were implausible even in Victorian times. It became a best seller, but the blistering criticism it drew from scientists may have made Darwin more hesitant to publish his own ideas.

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