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Q & A with New Director of National Science Foundation
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Physical Review Letters Publishes BICEP2 Paper on Possible Evidence for Cosmic Inflation

On March 17, 2014, researchers from the Background Imaging of Cosmic Extragalactic Polarization (BICEP2) experiment announced that they had obtained evidence of cosmic inflation–the theory that after the big bang, the universe expanded by 60 orders of magnitude in about 10^{-35} second. In a paper published on June 19 in *Physical Review Letters* (http://journals.aps.org/prl), the BICEP2 team presents their data and analysis in a peer-reviewed venue.

In addition to the BICEP2 paper, *Physical Review Letters* has published several theoretical analyses and a special editorial comment. Accompanying the research papers, *Physics* features a Viewpoint commentary (http://physics.aps.org/articles/v7/64) by Lawrence Krauss and a *Focus* article (http://physics.aps.org/articles/v7/65) by David Lindley.

If the inflationary origin of the signal is confirmed by upcoming studies, the result will be a "milestone in the history of cosmology," the editors note. The next chapter of the story will be written when other experiments, such as the European Space Agency's Planck satellite, release their results later this year.

"Open Data" Policy a Cause for Optimism and Concern

By Michael Lucibella

Plans are moving ahead slowly for making public the raw data obtained by federally funded scientists, though how that ultimately might take shape is still unclear. Experts expressed both excitement and apprehension about the final form the new policy might take.

On February 22, 2013, the administration's Office of Science and Technology Policy (OSTP) released a memorandum stipulating that all federal agencies that fund more than $100 million in research come up with a plan to open up peer reviewed results and raw data to the public.

"Most of the noise has been around the literature, not the data, but the data is likely going to have the longest term impact," said John Wilbanks, the chief commons officer at Sage Bionetworks, and who had previously run Creative Commons' Science Commons project.

In March 2014, OSTP collected, reviewed and returned proposals from 23 agencies. The proposals haven't been released to the public. Over the next several months, OSTP will meet with agency representatives to continue to refine proposals.

"I certainly expect that by the end of this year we'll see the plans," Wilbanks said.

More than a year after the memo was first issued, there has been no official word as to how the federal agencies plan on implementing the opening of scientists' datasets. However, data experts are not worried and have applauded the administration for its deliberative pace.

"They recognize that this is a very difficult problem, far more difficult even than open access [for publications]," said Michael Lubell, director of public affairs for APS.

There are several outstanding questions about the policy, including what kind of data is covered and where it will be stored.

The memorandum defines data generally as "digital recorded factual material commonly accepted in the scientific community" and goes on to say that items like notebooks, physical objects, peer review reports and preliminary drafts and analyses wouldn't be included. However, pinning down precisely what might be included and what might not be could prove to be tricky.

"The agencies are struggling with how to deal with datasets," said Bonnie Carroll, CEO of Information International Associates. "The problem with datasets is people don't really have a good definition of what is included and what isn't."

Carroll added that because there

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Keen Minds Prep for the International Physics Olympiad

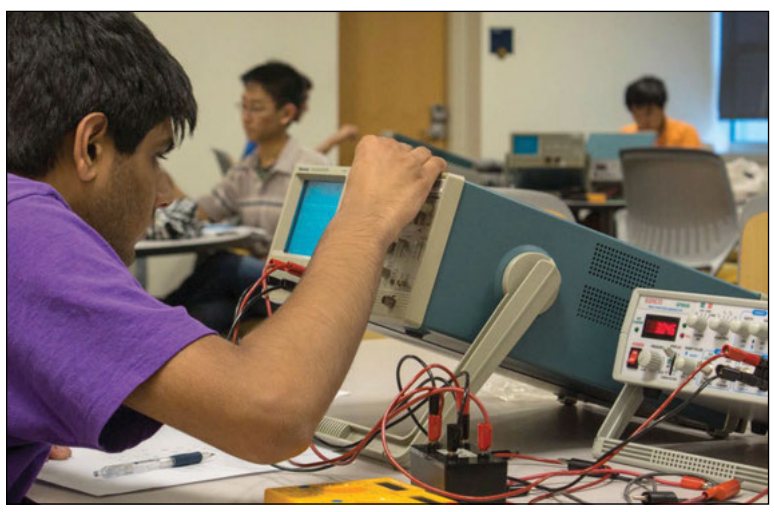
By Jessica Orwig

By itself, a flexible, plastic "Hot Wheels" toy car track is pretty mundane. Add a can of racket balls and a team of the top high-school physics students in the country, and you have the makings of an intriguing science experiment.

Each year, the American Association of Physics Teachers and a number of member societies of the American Institute of Physics sponsor a two-week competitive training camp held on the University of Maryland campus at the end of May. The purpose is to select five high school students, from a pool of about 20, who will represent the US in the International Physics Olympiad (IPhO) annual competition. This year, the Olympiad will take place in Astana, Kazakhstan from July 13-21.

It's essentially physics boot camp, but instead of climbing walls and jumping hurdles, the students take on obstacle courses that challenge their intellectual capacities. Each day, students attend lectures covering topics like optics and special relativity, take written exams, and conduct laboratory experiments.

Although the complex problem sets and activities are akin to what first and second-year college students see, the experiments can be surprisingly simple and easy for any physics teacher to coordinate. One of this year's eight lab activities involved no more than a Hot Wheels race track, racket balls and a stopwatch.



Michael Lucibella

Rohan Kodialam, a junior from High Technology High School, Lincroft, NJ, is one of the students who participated in the training camp for the International Physics Olympiad.

"What you get out of it is actually interesting," said assistant coach, Andrew Lin, who has been part of the coaching team for 14 years, and was a member of the U.S. Physics Olympiad team in 1998 and 1999. "You can tell how hollow the racket ball is." By timing how long the ball takes to roll down the track, students can calculate its moment of inertia and from that estimate the volume of empty space inside.

Two weeks of non-stop physics would be a daunting prospect for many high school students, but these young adults are unique. This past January 4,277 students took the "F=ma" exam, which consists of multiple choice physics-based questions. The students with the top 300 to 400 scores then completed a free-response, calculus-based exam and from that pool, the 19 students with the highest exam scores packed their suitcases for Maryland.

Most of these students just completed their junior or senior year in high school. For the graduating seniors, this boot camp is one of the last steps before they enter college. Many of them will be attending MIT, Stanford, or the California Institute of Technology this fall.

Some of the younger students, who are still in high school, have yet to take a class in physics, but that does not stop them from seeking out physics topics on their own. Such is the case for the youngest member of this year's boot camp

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Supernova Explosions Now in 3D

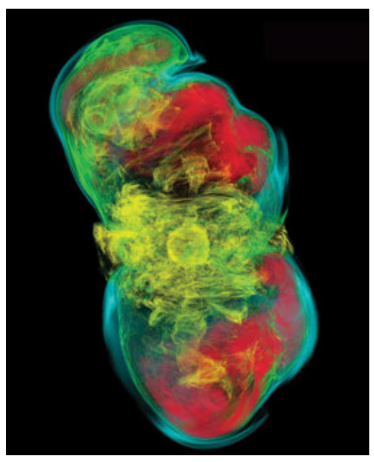
By Calla Cofield

At the 2014 APS April Meeting in Savannah, Caltech theoretical astrophysicist Christian Ott presented the first 3D computer simulation of a rapidly rotating, highly magnetized core-collapse supernova. The new work reveals a much more asymmetric picture of these monsters than previous 2D models, and may also provide insight into how the collapsing matter becomes a black hole.

The simulations by Ott and colleagues look specifically at a so-called "engine driven" core-collapse supernova, which is characterized as hyperenergetic, even by supernova standards. These supernovae eject material into space at nearly the speed of light and produce gamma ray bursts in the process.

Previous models of rapidly rotating and highly magnetized supernovae assumed symmetry around the vertical axis of the star, thus showing changes in only two dimensions. The ejected plasma forms two symmetric jets along the vertical axis–blossoming out along the pole lines, reaching the same height and forming the same shape.

"Our simulation…looks fundamentally different," said Ott at a press conference in Savannah. The new model shows a notably asymmetric explosion: The plasma appears to emerge along the axis once again, but rather than forming jets, it spreads out into two lumpy, asymmetric lobes.



Moesta/Ott/Richers, California Institute of Technology

SImulation of a rapidly rotating and highly magnetized supernova

The asymmetry appears to arise from a "kink instability" which develops in the 3D model, and cannot emerge in models with only two dimensions. This type of instability is also seen in tokamak reactors, which use magnetic fields to confine plasma and control its shape.

"So this is physics we're familiar with," he said. "It's just the first time that we actually see that in a supernova."

Running on the Blue Waters supercomputer at the University of Illinois at Urbana-Champaign, the simulation requires 6 terabytes of memory to run, with a total simulation output of 500 terabytes of data.

The model also differs from previous 2D models by showing that as the explosion takes place, matter may still accrete onto the central neutron star that forms when the

SUPERNOVA continued on page 7

Members in the Media

"If the world wants to do this science, then the world should organize, with Fermilab as the host, to solve the problems and make it happen."

***Steven Ritz**, Santa Cruz Institute for Particle Physics, on the P5 report's recommendation on internationalizing the Long-Baseline Neutrino Experiment,* NBCNews.com *May 21, 2014.*

"What CERN did for the Higgs boson, we want to do with the neutrino."

***Joe Lykken**, Fermilab, on future neutrino experiments outlined in the P5 report,* The Associated Press, *May 21, 2014.*

"Nobel prizes were predicted and scores of theoretical models spawned. The announcement also influenced decisions about academic appointments and the rejections of papers and grants. It even had a role in governmental planning of large-scale projects."

***Paul Steinhardt**, Princeton University, on the BICEP2 controversy,* PBS News Hour, *June 4, 2014.*

"I believe that the scrutiny the BICEP2 results have received indicates what an exciting discovery this will be, if confirmed…. Personally, I am looking forward to the information from Planck and other measurements that will hopefully shed light on whether we really have found a Rosetta Stone from the early universe, or simply some unexpected interstellar dirt."

***Marc Kamionkowski**, Johns Hopkins University, on the BICEP2 controversy,* PBS News Hour, *June 4, 2014.*

"We actually have some evidence of what happens when a high technological culture meets a low-technology culture…. Our species bears this out multiple times in the history books, and it doesn't bode well for the culture that has less technology. But I would say to fear an alien for that reason is more a reflection of how we know we treat each other than it is on how we could ever possibly suspect an alien to treat us. And so why should we be the measure of hatred in the universe?"

***Neil deGrasse Tyson**, American Museum of Natural History, on alien invasions,* The Washington Post, *June 5, 2014.*

"They want to bulldoze it, which is really atrocious to me…. It's like burning the Alexandria Library."

***Dennis Papadopoulos**, the University of Maryland, on the plan to demolish the High Frequency Active Auroral Research Program in Alaska,* National Public Radio, *June 10, 2014.*

"To throw the ball that hard and that quickly (after all, he didn't have time to 'aim') with that accuracy is truly an amazing feat. Everyone who has seen the throw knows that already, but now we've quantified exactly how amazing it was."

***Alan Nathan**, University of Illinois, analyzing an out made by Oakland A's fielder Yoenis Cespedes on June 10,* The Los Angeles Times, *June 12, 2014.*

"At these twinning boundaries, the crystals on each side are bonding together much better."

***Bo Xu**, Yanshan University in China, on creating a new class of diamond structure stronger than any previous natural or synthetic diamond,* The Los Angeles Times, *June 11, 2014.*

"The result of such an attempt will be broken teeth of the fork."

***Natalia Dubrovinskaia**, the University of Bayreuth in Germany, sharing her concerns about Xu's method of determining his diamonds' strength by comparing it to testing a steel knife by pressing it against an aluminum fork,* The Los Angeles Times, *June 11, 2014.*

"Seven years, I can wait that long…. I've had a good career, but I'll be a lot happier if I can see a break-even fusion device before I kick off."

***Nicholas Krall**, on consulting with the EMC2 Fusion company,* NBCNews.com, *June 13, 2014.*

"If you're going to rely on that as an operational system, one shouldn't be too surprised that it does tend to fail more than you'd like."

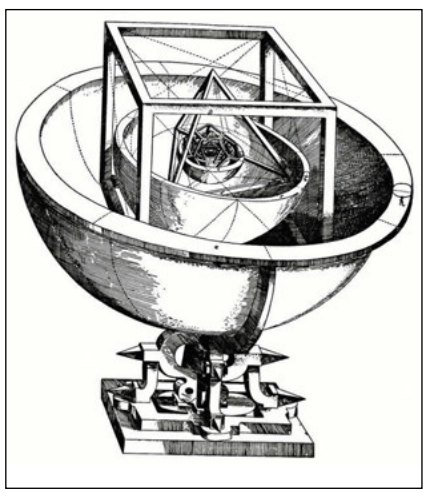
MEMBERS continued on page 7

This Month in Physics History

July 19, 1595: Kepler's Insight Leading to *Mysterium Cosmographicum*

Today, we think of physics and astronomy as being inexorably linked, but this was not the case in the 16th century, when the former was deemed natural philosophy, while the latter was linked to mathematics and liberal arts. One scientist who helped break down that barrier was Johannes Kepler.

Born in December 1571, just west of modern-day Stuttgart, Kepler was the grandson of a former lord mayor, the youngest of four children. By the time of his birth, the family's financial circumstances were much reduced, and his father eked out a living as a mercenary, abandoning the family when young Johannes was just five years old. His mother was a healer and herbalist–a dangerous profession in that superstitious age.



Wikimedia Commons

(Top) A 1610 portrait of Johannes Kepler by an unknown artist. (Bottom) Kepler's Platonic solid model of the Solar system from *Mysterium Cosmographicum* (1596).

A bout with smallpox crippled his hands and hampered his vision, but Kepler showed a gift for mathematics early on. He fell in love with astronomy at age six, when his mother took him out to watch a comet streak across the night sky. He experienced his first lunar eclipse a few years later. He studied philosophy and theology at the University of Tübingen, where he gained a reputation as a skilled astrologer–still considered a legitimate branch of astronomy at the time–and embraced the then-relatively-new Copernican heliocentric system for the motion of the planets, eventually becoming a math and astronomy teacher in Graz.

On July 19, 1595, while lecturing on the periodic conjunction of Jupiter and Saturn, Kepler had an insight: There might be a geometric underpinning to the universe. He worked out a scheme in which the five Platonic solids–octahedron, icosahedron, dodecahedron, tetrahedron, and cube–could be encased within spheres and then nested within each other. This produced six layers, which in Kepler's view corresponded to the six planets known at the time (Mercury, Venus, Earth, Mars, Jupiter and Saturn). He even worked out a preliminary formula connecting the size of each planet's orb to how long each took to complete one orbit around the sun, although he later discarded it in favor of something more precise.

This became the basis for one of his earliest treatises, *Mysterium Cosmographicum*, among the first defenses of the nascent Copernican system to appear in print. His labors over its publication nearly ended his engagement to a rich young widow named Barbara Müller. Her father initially opposed the match, despite Kepler's noble birth, because the astronomer was so poor, but eventually relented. Kepler married Müller in April, 1597. The marriage was not a particularly happy one, and Müller died of spotted fever in 1611. (His second marriage, to Susanna Reuttinger in 1613, proved more successful.)

Mysterium Cosmographicum was an unusual scientific treatise, given the inclusion of a detailed chapter attempting to reconcile the Bible with the geocentrism of Copernicus. Those passages were removed before the book was published late in 1596. This work cemented his reputation. He sent copies to several noted colleagues, including Danish astronomer Tycho Brahe, who initially offered a rather harsh critique of the German scientist's model.

Kepler was keen to address those criticisms and make further progress on his ideas. Since Brahe had amassed far more accurate observational data from his private observatory than that readily available to Kepler, he visited Brahe in Prague early in 1600, studying Brahe's data on Mars to test the theory laid out in the *Mysterium Cosmographicum*. The following year, he moved his entire family to Brahe's observatory–in part because he had been banished from Graz for refusing to convert to Catholicism.

When Brahe died soon after, Kepler succeeded him as imperial mathematician; his Lutheran faith was tolerated in the Prague court. His duties mostly consisted of providing horoscopes to the emperor. Kepler despised much of astrology, dismissing it as "evil-smelling dung," but–a creature of his era–he believed a scientific approach to the subject could be useful. He later published a treatise attempting to find middle ground between the overselling of astrology and what he thought was a kneejerk rejection of it by many scientists.

Brahe's observational data proved invaluable to Kepler's research, which expanded to include the laws of optics. In 1604, he published *Astronomiae Pars Optica*, which helped lay the foundation of modern optics. Those insights proved useful when he studied the newly invented telescopes used by Galileo and designed an improved Keplerian model using two convex lenses, rather than one convex and one concave. Kepler also witnessed a supernova in October 1604, which became the basis for *De Stella Nova*, published two years later.

Kepler also tried his hand at more fanciful writ-

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Education Corner

APS educational programs and publications

Award for Improving Undergraduate Physics Education
Created by the APS Committee on Education, the award recognizes departments and programs that support best practices in education at the undergraduate level. Nominations for the award are being accepted until July 15. More information can be found at http://www.aps.org/programs/education/undergrad/faculty/award.cfm

Joint Task Force on Undergraduate Physics Programs
The American Association of Physics Teachers and APS have formed the Joint Task Force on Undergraduate Physics Programs (J-TUPP), which is charged with engaging the physics community to develop a report that answers the question *What skills and knowledge should the next generation of undergraduate physics degree holders possess to be well prepared for a diverse set of careers?* By providing guidelines and recommendations on content, pedagogy, professional skills and student engagement, the report will give physics departments across the country a blueprint for enhancing their undergraduate programs.

J-TUPP will be led by Paula Heron (University of Washington) and Laurie McNeil (University of North Carolina at Chapel Hill). The other members of J-TUPP are Douglas Arion (Carthage College), J.D. Garcia (University of Arizona), S. James Gates (University of Maryland-College Park), Elizabeth McCormack (Bryn Mawr College), Duncan Moore (University of Rochester), Helen Quinn (Stanford Linear Accelerator Center), Quinton Williams (Jackson State University), and Lawrence Woolf (General Atomics Aeronautical Systems). The group will seek input from physicists (including physics students) in academia, national laboratories and business and industry, and professionals in other STEM disciplines that employ physics graduates and whose students take physics courses. J-TUPP expects to finish its report by mid-2016.

Save the Date for PhysTEC
The Physics Teacher Education Coalition (PhysTEC) Conference is the nation's largest meeting dedicated to physics teacher education. The 2015 PhysTEC Conference will be held February 5-7, 2015 at the Marriott Seattle Waterfront in Seattle, WA. The conference will focus on Thriving Programs and will feature a pre-conference Learning Assistant Workshop on February 5, a post-conference workshop on Building Thriving Programs on February 7-8, and a joint poster session on February 6. More information can be found at: http://www.phystec.org/conferences/2015/

Graduate Education in Physics Conference Report Released
The 2nd APS Graduate Education in Physics Conference was held January 31-February 2, 2013, at the American Center for Physics in College Park, Maryland. The report from this successful conference was released this month and expands on the two major recommendations from the conference: increasing diversity in physics and improving the professional training of students in physics graduate programs. The final report will be sent to all physics departments in the United States this summer and is now available free of charge on the APS website. For a link to the report, see http://www.aps.org/programs/education/graduate/

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ing, penning an allegory called *Somnium* (*The Dream*) in 1611–arguably the earliest work of science fiction, since it centered on a trip to the moon and speculated about what astronomy would be like if conducted on another planet. Many years later, *Somnium* would be used as evidence in his mother's 14-month imprisonment and trial for witchcraft; it described a woman who summons a demon for help in mixing potions. (He revised the work after her acquittal to make the allegorical aspects crystal clear for the too-literal minded.)

Of course, Kepler is best known for his Laws of Planetary Motion. The planets move in elliptical orbits around the sun (Law of Ellipses); if you draw an imaginary line from the center of the sun to the center of a given planet, that line will sweep out equal areas in equal amounts of time (the Law of Equal Areas); and the ratio of the squares of any two planetary periods is equal to the ratio of the cubes of their average distances from the sun (the Law of Harmonies). The first two laws formed the basis for his treatise *Astronomia Nova*, and all three appeared in his most influential work, the *Epitome Astronomiae Copernicanae*.

Kepler died on November 15, 1630, and while the location of his grave has been lost over the intervening centuries, the epitaph he penned for himself survived:

Mensus eram coelos, nunc terrae metior umbras:

Mens coelestis erat, corporis umbra jacet.

I measured the skies, now the shadows I measure

Skybound was the mind, earthbound the body rests.

Profiles In Versatility

Interview with France A. Córdova, New Director of NSF

By Alaina G. Levine

On March 31, 2014, France A. Córdova was sworn in as Director of the National Science Foundation (NSF). An astrophysicist with a doctorate in the subject from Caltech, she started her educational career as an English major at Stanford University. Córdova has served in a variety of administrative and leadership positions in higher education and government, including Chief Scientist of the National Aeronautics and Space Administration (NASA), Vice Chancellor for research at the University of California, Santa Barbara, Chancellor of the University of California, Riverside, and President of Purdue University. These are excerpts from an interview, with the full text available online.

AGL: What was it about physics that attracted you in the first place?

FC: My first real encounter with physics was in the 7th grade and we were doing science fair projects. I saw the Bohr model of the hydrogen atom in an encyclopedia and I was smitten. I just couldn't believe that scientists could infer something so beautiful, so strange from observations and data. But…I had no role models or mentors in science and there were also a range of things that I really did enjoy, including literature and poetry and writing. So when I went off to college, I majored in English Literature and it wasn't until after I graduated and was doing a project back east that I saw a television special on neutron stars which had recently been discovered. And the very next day (I was living in Cambridge), I went down to MIT and asked for a job at the Center for Space Research [now the Kavli Institute for Astrophysics and Space Research] and they hired me and that was my entry into science, so it was a very unusual pathway.

NSF

France A. Córdova

AGL: I love your boldness. You set a good standard and role model for many people.

FC: Well it's either boldness or obtuseness. [Laughs]

AGL: You stayed in physics for a little bit and then you moved into service, management in academia and in government. You're back in government now. What is it about government and more broadly service that really attracts you?

FC: The head of NASA asked me to interview for the [NASA] Chief Scientist position, and I did, and he asked me to join NASA, temporarily leaving Penn State to do that. That was my first policy/governmental position and I just found that I really enjoyed it. I loved collaborating with the other agencies, being a part and [taking] a leadership role in the National Science and Technology Council on their subcommittee on science. Penn State had given me a leave for 3 years–and [when] I was due to go back, I was offered positions in administrative science leadership, and I accepted one at UC Santa Barbara, which was Vice Chancellor for Research. I loved that position because I was close to science and scientists, but I was also able to further a research agenda and move the needle forward, especially in interdisciplinary research, and that really got me interested in and comfortable in the world of administration.

AGL: Was there anything par-

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2014 Kavli Prizes go to APS Members

Four APS members and an APS Prize winner were among the recipients of this year's Kavli Prizes.

The Kavli Foundation announced awards for research into the early inflation of the universe and for pushing the resolution limits of nano-optics. The winners were named during a live online broadcast from the World Science Festival on May 29 in New York City.

Alan Guth of MIT, Andrei Linde of Stanford University and Alexei Starobinsky of the Landau Institute for Theoretical Physics at the Russian Academy of Sciences won for their exploration of the brief period of hyperexpansion in the very early universe. Guth previously won APS's 1992 Julius Edgar Lilienfeld Prize for his work on cosmic inflation, and Starobinsky is an APS fellow.

Members Stefan Hell of the Max Planck Institute for Biophysical Chemistry and John Pendry of Imperial College London shared the nanoscience award with Thomas Ebbesen of the Université de Strasbourg, France, for their independent work on using nanotechnology to improve the resolution of optical microscopes to less than 200 nanometers, an achievement once thought to be impossible. Pendry previously won APS's 2013 James C. McGroddy Prize for New Materials.

Kavli Astrophysics Prize Winners
Alan Guth, Andrei Linde, Alexei Starobinsky

Kavli Nanoscience Prize Winners
Thomas Ebbesen, Stefan Hell, John Pendry,

For photo credits, go to http://kavliprize.no, click on "Media" and then on "Photo Archive."

Presented in conjunction with the Norwegian Academy of Science and Letters, the annual awards recognize pioneering science in astrophysics, nanoscience, and neuroscience. The winners in each category share a $1 million cash prize, and each receive a medal and scroll honoring their accomplishment. The Kavli Foundation was established in 2000 by a donation from entrepreneur Fred Kavli, who passed away late last year.

International News

...from the APS Office of International Affairs

Doha: A Beacon for Science in the Middle East

By Hussein M. Zbib

Most of the news we read and hear about the Middle East points only to instabilities and chaos in countries like Egypt, Syria, and Iraq, which have been known historically to be the scientific powers in that part of the world. However, I want to share with you some observations regarding scientific developments in Qatar that, unfortunately, do not receive the attention they deserve in the media. These positive developments present a beacon of hope for the reemergence of science in a region that was once known as a destination for scholars from afar to seek knowledge and to contribute to arts and sciences.

I visited Doha a number of times, mainly on short business trips, to attend a conference, work on research projects with my collaborators at the Texas A&M University campus in Education City, and to give lectures at research institutions. On my last trip in the fall of 2013, I asked the driver who picked me up at the Doha International Airport to drive me around the city before dropping me off at my hotel. I was curious to see the night life in the city that looked, as viewed from the plane above, like any other big modern metropolitan city, shining with lights emitted from dense traffic and high-rise buildings.

Doha indeed has become an international city, attracting business from all over the world and mixing its traditions with cosmopolitan life. This was in sharp contrast to the impressions I had during my first trip in 2005. Since then, Doha has been undergoing unprecedented growth and modernization in all sectors of its economy, infrastructure, industry and educational system. Most attractive to me is the massive investment in education and scientific research. Over the past decade, Doha has been investing heavily in higher education, research infrastructure, and national research laboratories and institutions.

In the spring of 2005, I was among a group of US scientists who were invited to attend a meeting in Doha under the banner "International Conference on Materials

Hussein M. Zbib

Research and Education: Future Trends and Opportunities." This was the first meeting of its kind to be held in Qatar, and the trip was sponsored by the US National Science Foundation (NSF). We met for three days with local and regional scientists to discuss and explore materials science education and research in that part of the world. The meeting took place in Education City, located on the outskirts of Doha. Although there were a few buildings then, there was much construction underway in the surrounding areas, signaling the initiation of a massive project. I learned later that this project was part of a master plan to transform Education City into an international education and research center.

Education City is now the home for branch campuses for renowned universities in the US, Canada, and France. Each one of these branch campuses offers programs that complement the programs offered at the other campuses. For example, the Texas A&M University branch offers degrees in chemical, electrical, mechanical, and petroleum engineering, while the Carnegie Mellon University branch offers degrees in computer science, information systems, and biological sciences. However, Qatar University, the main public university in Qatar, offers programs in all disciplines of arts and science, engineering, law, medicine, education and humanities; the physics program is offered within the department of Mathematics, Statistics and Physics.

Education City and Doha's fast growth is driven by the "Qatar National Vision 2030" report, which outlines ambitious goals and strategies aiming at establishing "Qatar as a knowledge-based economy." This is a document I enjoyed reading: It presents a coherent path to the future to transform Qatar into an advanced country by 2030. One of the four pillars discussed in this document is focused on human resources and education, and the document outlines a set of objectives, some of which are specific to the development of scientific research and higher education. It is refreshing to see that in the midst of chaos and continuous wars in that part of the world, Qatar opted to invest heavily in human development, education and science. Most intriguing is Qatar Foundation's commitment to funding basic scientific research by establishing

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Preparing Physicists for Entrepreneurship

By Michael Lucibella

Physics professors are pushing to incorporate more business and innovation education into their departments' curricula. At a meeting at the American Center for Physics in College Park, MD, on June 5-6, professors from across the country and Canada gathered to develop strategies to encourage their home institutions to teach physics students entrepreneurship skills.

"This meeting is intended to seed a movement," said Crystal Bailey, the careers program manager at APS and organizer of the conference, "Reinventing the Physicist: Innovation and Entrepreneurship Education for the 21st Century."

"It is not going to be a one-off conference where we write a report and we're done. This group is going to continue to meet, continue to share ideas, and continue to build a community of practitioners, and this meeting is the first step in the process."

She added that the organizers are hoping to create a network of college physics departments to share ideas and best practices for building up entrepreneurship physics education.

"We want to make entrepreneurship and innovation education as robust in the physics curricula as it has been in the engineering curricula for the last two decades." Bailey said. "Basically the engineers have been doing this for 20 years, so there's no reason that physicists can't do the same."

Entrepreneurship education would include non-physics courses about finance, intellectual property, business plans, communication, and presentation. Only about 3 percent of students who earn a physics bachelor's degree go on to become tenured faculty and instead enter the private sector or other careers.

"If you go into the private sector, clearly you need to know a whole lot of stuff that isn't physics," said Douglas Arion, a professor of en-

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Report on Graduate Education Released

By Deanna Ratnikova

Most physics graduate students will end up employed outside of academia, yet few physics graduate programs have adapted in recent years to accommodate more interdisciplinary research and interests. A call to better prepare students for diverse careers, the increasing diversity within the field, and recommendations on how to move forward were outlined at the 2nd Graduate Education in Physics Conference. Organized jointly by APS and the American Association of Physics Teachers (AAPT), this conference took place January 31-February 2, 2013 at the American Center for Physics in College Park, Maryland, with 107 participants from 74 different institutions.

Released this month, the conference report–prepared by Renee Diehl (Penn State), Theodore Hodapp (APS), Chandralekha Singh (University of Pittsburgh), Michael Thoennessen (Michigan State), and Lawrence Woolf (General Atomics)–emphasized the need for physics departments to define their overall goals in order to develop a coherent program that builds on their specific strengths, rather than seeking a one-size-fits-all solution. The authors recognize that not all of the recommendations in the report may be appropriate for every department, but they can enrich physics graduate programs if implemented in a way that aligns with departmental goals and strengths.

The report highlighted efforts such as developing a department identity, adding flexibility to the curriculum, teaching students professional skills, and engaging alumni working outside of academia as

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Telling the History of Physics Through Historical Places

By Calla Cofield and Michael Lucibella

Learning the history of physics has for years been centrally focused on the "what," rather than the "where." However, recently historians have started talking more about the locations where discoveries were made, especially to people who aren't historians.

"It makes the history of physics much more real by being in a location where physics was done. You can kind of imagine what went on," said Paul Halpern, a physics historian who put together a physics history tour of Washington D.C. "People can appreciate the history of physics by seeing the sites where scientists worked and lived. I think it makes history more vivid."

Historians in other areas have long focused on the locations of significant events; science history has incorporated the idea relatively recently.

"Civil War courses take their students to Civil War sites all the time," said Gregory Good, the director of AIP's Center for History of Physics. "Any way you can get people into real locations and out of the classroom can help."

He added that countries in Europe have been the most proactive about officially identifying and designating historic scientific sites.

"We're slow with this in the States. The Europeans have been paying attention for a long time to historical sites connected to famous scientists," Good said.

Gerd Kortemeyer, a professor of physics at Michigan State University, explored a number of these landmarks with his students. In 2008 and 2011 he led groups of 18 students on a five-week, physics-themed study abroad trip to Germany, Switzerland and Denmark.

The program focused on the birth of modern physics, between 1905 and 1945, and combined historical sight-seeing with a physics curriculum. Students were asked to learn about relativity, quantum physics and nuclear physics, while also visiting the places where physicists like Schrödinger, Heisenberg, Bohr and of course Einstein, laid the foundations for these subfields.

In Bern, Switzerland, which is littered with Einstein-affiliated landmarks, the group was granted access to the room where Einstein worked as a patent clerk at the Swiss Patent Office. The room, which is not open to the public, overlooks a train station, and inspired some interesting conclu-

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Daniel Schwen,Wikimedia Commons

Places such as Einstein's house on the Kramgasse in Bern, Switzerland, offer opportunities to teach physics history.

Washington Dispatch

Updates from the APS Office of Public Affairs

POLICY UPDATE

Fiscal Year 2015 Budget

Congress received the president's fiscal year 2015 Budget Request on March 4 and has been making steady progress on appropriation bills since then. The House has already passed the Commerce, Justice, and Science (CJS) bill that funds the National Science Foundation (NSF), the National Institute of Standards and Technology (NIST), the National Aeronautics and Space Administration (NASA), and the Office of Science and Technology Policy (OSTP). As has been the case in the past few years, the House elected to reduce spending on justice accounts and allocate some of those funds to science.

Although the full Senate has not yet considered the CJS bill, the spending levels reported out by the Senate appropriations committee would largely reverse the House tilt toward science at the expense of justice. For example, the House would fund NSF at $7.40 B, $0.15 B higher than White House request or the Senate mark. It would also fund NASA at $17.90 B, $0.44 B higher than the request or the Senate mark. By contrast, the House was less generous with NIST, funding it at $0.86 B, $0.04 B lower than the request or the Senate mark. Both the House and Senate would fund OSTP at $5.55M.

Thus far, only the House has taken up Department of Defense (DOD) spending. Compared to the presidential request, the House would increase funding of DOD Basic Research by $0.1 B to $2.03 B and Applied Research by $0.7 B to $4.35 B.

Although congressional appropriators have been moving forward, authorizers have been far less successful in advancing legislation to update the expiring 2010 America COMPETES Act, which provided funding targets for NSF, the National Institute for Standards and Technology (NIST), NASA, and the Department of Energy (DOE) Office of Science. The House Science, Space, and Technology (SS&T) Committee elected to split COMPETES reauthorization into two separate bills, the "FIRST" Act, which addresses NSF, NASA, NIST, and OSTP, and the "EINSTEIN" Act, which addresses only DOE. Both bills contain policy provisions that would substantially alter NSF and DOE procedures and priorities which many science and technology organizations have spoken against. Although the House SS&T Committee has a long record of developing bipartisan legislation, the FIRST and EINSTEIN Acts have created a substantial rift between the Republican majority and the Democratic minority. Subcommittee and committee votes on the bills and amendments have been largely along party lines.

WASHINGTON OFFICE ACTIVITIES

ISSUE: MEDIA UPDATE

Roll Call, a leading newspaper on Capitol Hill, published the latest column by APS Director of Public Affairs Michael S. Lubell on May 12. Titled "America Can't Afford to Ignore Science," the piece points out that "science holds the key to increased prosperity for all Americans, not just rich and middle class, but also the poor among us."

In other media news, the *Spokesman-Review* newspaper in Washington published an op-ed on May 24 by Eric Beier, a junior at Washington State University where he is chapter president of the Society of Physics Students. In the piece, Beier makes the case that research should be a priority for the US to ensure that students are prepared for an "increasingly competitive and globalized world."

ISSUE: APS Panel on Public Affairs (POPA)

POPA continues its review of the APS 2007 Statement on Climate Change. More information can be found on the following webpage: http://www.aps.org/policy/statements/climate-review.cfm

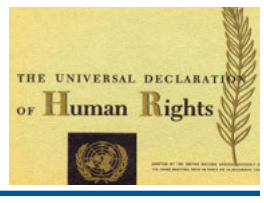
POPA has received Council commentary regarding the POPA-approved rewording of APS Statement 08.1 on the Civic Engagement of Scientists; the APS Executive Board will now review both the statement and these comments.

POPA approved a proposed statement by the APS Committee on the Status of Women in Physics at its June meeting and will now send it to the Council for comment prior to review by the APS Executive Board at its next meeting.

At its June meeting, POPA also entertained a preliminary proposal for a study to explore incentives that could increase the number of well-qualified students entering teaching in key Science, Technology, Engineering, and Mathematics (STEM) shortage areas. The POPA Physics & the Public Subcommittee will prepare a formal proposal for POPA's consideration in the fall.

Use the following link to log in to suggest future POPA studies: http://www.aps.org/policy/reports/

APS Committee on International Freedom of Scientists



CIFS Briefs: Highlighting the Connection Between Human Rights and Science for the Physics Community

Since its creation in 1980, the APS Committee on International Freedom of Scientists (CIFS) has advocated for and defended the rights of scientists around the globe. Recent APS and Committee activities include:

Andrei Sakharov Prize

APS presented its 2014 Andrei Sakharov Prize to Boris Altshuler and Omid Kokabee at the APS April Meeting in Savannah. The Prize recognizes scientists who have demonstrated leadership in defending and supporting human rights. Altshuler, of the P.N. Lebedev Physical Institute in Russia, was recognized *For his life-long struggle for democracy in Russia and for his advocacy on behalf of the rights of neglected children.* Kokabee, physics graduate student and prisoner of conscience in Iran, was honored *For his courage in refusing to use his physics knowledge to work on projects that he deemed harmful to humanity, in the face of extreme physical and psychological pressure.* Since Kokabee is in prison, his sister Leila accepted on his behalf. For more, see the June issue of *APS News*: http://www.aps.org/publications/apsnews/201405/sister.cfm

Petition Calling for the Release of Omid Kokabee

Earlier this year, APS, Amnesty International, the Committee of Concerned Scientists, and United for Iran co-sponsored a petition calling for the unconditional release of Omid Kokabee from prison. To take advantage of the fact that Kokabee was receiving the Sakharov Prize at the APS April Meeting, CIFS set up a booth at the meeting to educate attendees about Kokabee and ask that they sign the petition. These signatures and others from around the world are being collected by Amnesty International to send to Iranian authorities.

When Kokabee's family visited him in prison the day after the awards ceremony, they were able to share photos of the ceremony and of attendees at the booth. Kokabee's sister reported that they appreciate the support that they are receiving from APS.

Alexander Gorsky

In March, Alexander Gorksy was removed from his position at the Institute of Theoretical and Experimental Physics (ITEP) in Moscow. He was fired for "truancy" after he attended a scientific meeting in Stony Brook, NY, to which he had been invited to give a talk. ITEP's administration had placed conditions on approving his travel to the conference–such as receiving a security clearance for his talk that was based on his published research. Gorsky refused to comply with the demands as he deemed them to be "illegal." Numerous colleagues and scientists have spoken out in his defense, and several physicists resigned from the academic council of ITEP in protest.

CIFS wrote to the Russian Ministry of Education and Science to express its concern that a scientist was being fired for what appeared to be trumped-up reasons. CIFS stressed that scientific progress relies on the freedom of scientists to travel and engage in the international scientific enterprise. As CIFS stated in its letter, "scientific progress works best when scientific decisions are made based on scientific merit" rather than "political considerations." The Committee asked that the ITEP administration reconsider its action and reinstate Gorsky to his scientific position.

Particle Physics Panel: US Needs More Global Partnership

By Michael Lucibella

A new top-level government report urges the United States to become more of an international player in the field of high-energy physics.

The Particle Physics Project Prioritization Panel, referred to as P5, submitted its draft outline for the next decade of science experiments funded by the National Science Foundation and the Department of Energy's (DOE) Office of Science on May 22, recommending programs to boost, continue or cut.

"It's more than a collection of cool experiments," said Andrew Lankford, chair of the DOE Office of Science's High Energy Physics Advisory Panel (HEPAP). "It's a ten year strategic plan that's been put forward."

One of the report's top recommendations is that the United States internationalize its biggest planned physics experiment, the Long Baseline Neutrino Experiment.

"The activity should be reformulated under the auspices of a new international collaboration, as an internationally coordinated and internationally funded program, with Fermilab as host," the report reads. "The experiment should be designed, constructed, and operated by the international collaboration."

The project, to be renamed the Long Baseline Neutrino Facility, looks for neutrino oscillations by shooting a stream of neutrinos 800 miles through Earth from Fermilab to a giant detector buried almost a mile underground in South Dakota. Projected budget shortfalls have dogged the project, putting the underground detector in jeopardy.

The report also recommends international investment in the upcoming high-luminosity upgrade for the Large Hadron Collider and some level of support for Japan's International Linear Collider, depending on available budgets.

"Particle physics is global," said Steven Ritz of the University of California, Santa Cruz and chair of P5. "The United States and major players in other regions can together address the full breadth of the field's most urgent scientific questions if each hosts a unique world-class facility at home and partners in high-priority facilities hosted elsewhere."

Although for international consortia large projects are best, the report's authors envision a leading role for the United States in a number of small and medium sized projects. It recommends increasing efforts to develop a range of second-generation dark matter detectors, the Large Synoptic Survey Telescope, and Cosmic Microwave Background experiments.

"Several medium and small projects in areas especially promising for near-term discoveries and in which the US is, or can be, in a leadership position, will move forward under all budget scenarios," the report said.

To help develop this capacity, the panel also urged investing more in building new experiments, by upping the fraction of the DOE Office of Science's construction budget from 16 percent to between 20 and 25 percent.

However a number of other projects were targeted for termination. These included NuSTORM, RADAR, CHIPS and LAr1 neutrino detectors, the MICE and MAP muon experiments and the ORKA kaon experiment. In addition, the report recommended that development of the Dark Energy Spectroscopic Instrument move forward provided that the overall budget increases by at least 3 percent per year.

The House Science, Space and Technology subcommittee on energy seemed positive about the panel's recommendations when they were presented at a June 10 hearing. Members of congress appeared receptive to the report's recommendations and the partisanship that has worked its way into other committee meetings was largely absent.

"While the US remains in a state of fiscal uncertainty, reducing overall federal spending in order to arrive at a balanced budget should be a top priority. Yet during this process, we cannot overlook the fact that the federal government plays a critical role when it comes to the nation's long-term competitiveness in the physical sciences," said subcommittee chair Cynthia Lummis (R-Wyo.).

The P5 largely built their recommendations off the lengthy Community Summer Study 2013, popu-

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sions by the group.

"Some of our students had to read the original 1905 paper, and they kept talking about trains coming in and synchronization of time between trains," said Kortemeyer. "Well, you look out of [Einstein's] window there and you look out on the main train station of Bern…and you see trains coming by, so that's what you write."

Kortemeyer, a native of Germany, says he was turned on to physics history by a colleague years ago. As a teacher, he slowly realized how history could help convey the true nature of physics.

"In many respects I think with the undergraduate physics classes… we are doing physics a little bit of a disservice," said Kortemeyer. While physics classes teach the students about mechanisms, formulas and laws, he says they "hardly ever convey what physics is really about." He fears students will leave these classes thinking physics is only about putting numbers through different equations to get more numbers out. "And of course that makes them wonder why would anybody do that to themselves."

The United States has a wealth of its own science history that students can draw from. Although the National Park Service's National Register of Historic Places does list science-themed locations, professional societies in the United States have been the primary drivers for identifying and promoting them. IEEE has had a historical milestone center since 1982, the American Chemical Society set up their National Historic Chemical Landmarks program in 1992, and APS started its own Historic Sites Initiative in 2004. So far APS has installed 34 plaques at locations across the country, highlighting the locations where researchers made important discoveries.

Richard Kremer, a history professor at Dartmouth College, has been using the APS list to create a course that traces the history of US physics by way of its institutions. Dartmouth itself was designated an APS historic site in 2012, which first led Kremer to think about using the initiative to explore science history.

"It's not really a physics course, it's not really a history course, it's a writing course," Kremer said. "The approach that I take is history."

This year, he designed a ten-week freshman writing class, with each week focused on a different historic site. The sites include the Hughes Research Laboratory (now HRL Laboratories), Johns Hopkins University, Harvard University, MIT, and Bell Laboratories. The students in the class are the ones in charge of putting together each week's lesson plans and required readings.

The class is designed for students to develop their research skills, so they're put in charge of coming up with the class reading each week. Before each class, a different team of students compiles a list of different primary and secondary source documents to understand both the science of that week's discovery and what Kremer calls "the institutional context," or what it was like to work at a particular laboratory.

"This is new stuff for me and I'm learning things myself about the history of physics," Kremer said. "At the end, the final exam that these kids are going to write is, 'Is there a unique style of doing American physics based on these ten case studies?'"

Though the students don't actually visit the sites in the course, other than Dartmouth itself, Kremer said that using a site to talk about a discovery gives the students a feel for each location's intellectual history.

"The whole course is sort of a question as to whether location matters," Kremer said.

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is so much variety in the kinds of data collected by scientists, it's almost inevitable that exceptions will pop up that haven't been covered by whatever policy a funding agency adopts.

Where data are to be stored presents its own potential issues. Some experiments, especially those in high energy and astrophysics, can collect terabytes or even exobytes of data. It's not yet clear whether the mandates will require agencies to set up a single central database or link to data stored on outside servers.

"I don't think they've even thought about that at this stage," Lubell said. "These are huge huge datasets…. I think the magnitude of the storage problem for a central repository would be extremely large."

Though high energy and astrophysics datasets are large, there are relatively few of them because there are a limited number of large experiments. Most already are open to the public in some way.

"I think it will change physics less than other fields where data starts from a more 'artisanal' source," Wilbanks said. "If biology got to where physics is, I think that we will all declare that a victory."

Right now, scientists are waiting to hear what the administration and the agencies ultimately decide. OSTP did not respond to interview requests.

Lubell cautions about the potential sweep of the requirements. He said that if the mandate on data ends up being overly broad, it could include calibration data that could be inherently misleading or even abused by individuals who want to misrepresent results.

"If you force people to post all their data, including the stuff you rejected…then who in the public knows enough to say that I shouldn't look at something because it's garbage?" Lubell said. "A large amount of data that you take, especially at the beginning of an experiment…is probably not correct."

The reason cited in the mandate for opening the data is to let others use the raw information to innovate and ultimately spur the economy. However, Carroll said that she hopes that this will produce tools and algorithms that can help interpret the data, rather than just linking to reams of raw data alone.

"What ultimately becomes important is the metadata and the linkage to the documentation," Carroll said. "More and more we're linking to the data sets so the boundary between publication and data becomes more and more porous."

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group, Celine Liang from Saratoga High School in California. Liang just completed her second year in high school and has yet to take the physics course her school offers.

"I did a little physics on my own and I liked it so I kept going," said Liang, who at first said she was intimidated by the trip to Maryland. "I thought it would be way different but it turns out to be better."

Liang also qualified for the mathematics Olympiad training camp. Two days after she returns home from Maryland, she is heading off to Nebraska for more numeric fun. And when she's not taking or preparing for exams she plays violin and tennis, and she swims.

Although Liang will not be one of the five students traveling to Kazakhstan, there is always next year, since every student is allowed two tries for the team. This year's team, which will be competing against more than 400 students from 92 nations at the IPhO in Kazakhstan, consists of:

- Alexander Bourzutschky, Montgomery Blair High School, Silver Spring, MD
- Kevin Fei, Carmel High School, Carmel, IN
- Calvin Huang, Henry M. Gunn High School, Palo Alto, CA
- Vikram Sundar, The Harker School, San Jose, CA
- Michael Winer, Montgomery Blair High School, Silver Spring, MD

Paul Stanley, who is the chair of the physics department at Beloit College and lead coach of the U.S. Physics Olympiad team, described this year's team as, "A very cohesive, very supportive group." Stanley will be traveling with the students to Kazakhstan and said he was impressed with both the team the coaches assembled as well as all of the 19 students who attended this year's training camp.

Shortly before they leave for Kazakhstan, this year's team will return to the University of Maryland this July. There, they will have three, physics-filled days of past IPhO experiments to prepare them for the competition against the top young physics minds in the world. This preparation will involve about ten hours each day in the lab, Stanley said.

"In some ways, this is the strongest group I have seen, with a number of campers who would have been outstanding at the IPhO," Stanley said. "The desire to excel in physics and on exams without being competitive was an interesting social dynamic. It was as if each member really wanted all of the members to succeed."

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ways to improve the professional training of students in physics graduate programs. Flexibility in the graduate program and its curriculum is also key to ensuring the success of a diverse group of graduate students, and several talks at the conference focused on the need to engage more students from underrepresented minority groups.

Meg Urry of Yale provided the keynote address on the future of physics graduate education and the diversity challenge facing the field. She stressed that physics PhD programs must expand to include more diverse participants if they want to maintain the highest level of quality. According to Urry, "Graduate education [in physics] must diversify not just because of fairness or equal opportunity–although that certainly ought to concern us–but because it's vital for physics."

With significant input and feedback from graduate students and representatives from industry and national labs, the report from the 2013 conference builds upon the recommendations of the 2006 APS-AAPT Task Force on graduate education in physics and of the 2008 APS Graduate Education in Physics Conference. For example, this latest report recommends additional changes in the student advising process and student career preparation. It also recommends collecting data related to these changes, so APS and the AAPT can analyze and evaluate the progress made toward addressing the challenges of physics graduate education.

This conference, a follow-up to the 2008 Graduate Education in Physics Conference, was held to generate discussions on topics such as preparing graduate students for non-academic careers, enhancing advising, improving diversity, and debating graduate school admissions policies, including use of the GRE. Planning for the event began in 2010 under the leadership of Chandralekha Singh, a member of the APS Committee on Education (COE) and chair of the COE Graduate Education Subcommittee. The National Science Foundation provided support for the conference in late 2012.

The final report will be sent to all physics departments throughout the United States and made available free of charge on the APS website.

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Qatar National Research Fund (QNRF).

In 2009, Eyad Masad, of Texas A&M University at Qatar, introduced me to his colleague Ghassan Kridli in the mechanical engineering department to explore the possibility of submitting a collaborative research proposal to QNRF. At first I must admit that I was reluctant and wanted to learn more about QNRF before committing myself to such an effort. After all, support for science and basic scientific research in that part of the world, despite its tremendous resources and wealth, has been lacking for years. It is no secret that the scientific productivity from countries in that region has accounted for a very small fraction of global output–it is even among the smallest compared to other developing countries. However, as I learned about QNRF, I thought that there is something positive about to happen that may turn things around.

QNRF, much like NSF in the US, fosters original and competitively selected research in engineering and basic sciences. The impact of QNRF is already being felt in the international scientific communities. I now see many scientists at international conferences presenting the results of research supported by QNRF. Scientists from various institutions in Qatar and in collaboration with scientists from across the globe, now compete for research funding from QNRF. In its recent Annual Forum, QNRF announced that it had received 798 proposals and awarded grants for 162 proposals across 22 institutions. This is indeed an impressive accomplishment in a very short period of time.

Besides QNRF, Qatar Foundation is also establishing a number of national organizations. During my most recent visit to Doha in the fall of 2013, my long-time friend and colleague, Mohammad Khaleel, invited me to visit the offices of the newly established Qatar Energy and Environment Research Institute (QEERI). This is one of four research institutions being built by Qatar Foundation to fulfill the goals of Vision 2030. Although these institutions are still in their nascent stage, they are already attracting the best scientists from across the world. Khaleel, a leader from one of the US national laboratories, opted to relocate to Doha to lead QEERI. Under his leadership, QEERI is now attracting top-notch scientists and is building state-of-the art research facilities in computing, materials science and environmental research.

This is only a glimpse of what is emerging in Doha in terms of scientific developments. It seems that the Qatar Foundation is putting together all the pieces of the puzzle for a potentially successful, sustainable, and world-class scientific network. This is rather inspirational in a region with huge wealth and natural resources, yet with tremendous untapped human potential, especially its younger generation. I have enjoyed visiting Doha and observing its transformation into a modern city. Perhaps on my next visit, I will see yet again new and fascinating developments taking place in that part of the world.

Hussein M. Zbib is Professor of Mechanical and Materials Engineering at Washington State University, and a member of the APS Committee on International Scientific Affairs.

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ticularly in your physics background and more broadly in your scientific background that you felt aided you and best prepared you for this career?

FC: I think the characteristic of being curious and attracted to difficult problems is just something that marks me as an individual. It's part of my make-up, from the time I wanted to be Nancy Drew (when I was in grade school) because I loved mysteries and trying to figure out and solve things. I just like going headlong into a challenge. When I go river rafting I like going over the big [rapids]. I like things that look difficult and intractable to solve–they challenge me because they are more interesting to [solve]. So I think that's definitely a characteristic of a scientist, being attracted by what you don't know and what's a challenge and I find it translates into the world of administration and public policy.

AGL: Can you share with me a career highlight or accomplishment that you're especially proud of (so far)?

FC: There are just a few. When I was at UC Riverside as Chancellor, I laid the foundation for a new medical school for an area of California that was really underserved, of 4 million people. A new medical school hadn't been built west of the Mississippi in over 40 years. So that was a big undertaking and we got it done, and I was the one who kind of pioneered that and laid the foundation of the approval of the university regents and most importantly with the medical school deans of the five prominent medical schools that UC already has. So I'm very proud of that. And then the other thing at UC Riverside was we increased the success metrics for minority students, of which there are many. About 30% were Hispanic students and 70% overall were students of what were then minority populations. It was very important for a research institution to demonstrate that students who had more disadvantaged backgrounds could graduate at the same rate as the rest of the student population.

AGL: So thinking forward, what are some of your umbrella goals for NSF? [And related,] you obviously wanted this job for a reason. How can you impact NSF?

FC: First of all, they're doing fabulous things here and I want to do no harm to those things. [NSF] is involved in so many core programs and interdisciplinary programs [as well as] programs that work with other agencies.... But why me? I bring a different background to this position. I am very, very interested in how we can broaden our efforts in preparing the next generation for careers in STEM fields, and so I'm focused on that. We have terrific pocket efforts all around the country, [but] they don't always talk to each other in a systemic and scalable way, so I think we're going to be doing a lot more focusing on how we can take that effort to the next level. There are huge populations of [underrepresented] people that we are not tapping for STEM careers. We're just not reaching them, so I think we can do much better there, and that was one of my reasons for taking the job. And another goal is to increase public communication about the value of investments in fundamental science and engineering, which clearly has kept the US ahead in innovation and discovery. I think you'll see more effort in both formal and informal venues that NSF will be looking at to engage the public to help improve the understanding of the value of basic research and its impact, how it affects our daily lives, and why what we do is worthy of investment.

AGL: Regarding the research areas that NSF supports, what specific areas of research do you think are going to be the most promising, let's say in the next 5 to 10 years. What are you excited about?

FC: There's just so much. One other thing that characterizes me is that I am hopefully interested in everything. It's just I'm exceptionally interested in the last thing that walked into my office [laughs]. I come out of the NASA community [so] I'm extremely interested in everything we find out about the cosmos and all the unique telescopes that we have already built and are doing incredible new observations, and the ones we are involved in that are just getting started. A geoscientist will come in to my office and talk about a research vessel program, and I get excited about seas. There's Antarctica and the Arctic and all the polar programs we have. That's unique, that NSF has the charge of running the polar science facilities for the country and has the leadership position in really the entire world. Basically what NSF does is it supports all fields of science and engineering–that's our real strength.

AGL: What can physicists look forward to at NSF under your leadership?

FC: If there's a message I would ask physicists to help us with, it is to do their part to communicate to the public about the excitement and impact that science and scientists have on the nation and the world. I hope they'll be part of what our aim is, which is affecting the next generation of scientists and engineers, and not just the ones that enroll in their classes but all the ones that are somewhere else on campus…like me, as an English major, who could potentially be the next director of NSF. How can they reach out to that potential scientist or engineer and communicate how wonderful their disciplines are and that it is an opportunity to fulfill our curiosity about how nature works and opportunities to be the first person to see something in nature that nobody's ever seen before?

AGL: You are such a successful woman in science. Do you have any thoughts for women who are in scientific areas that are underpopulated by women, such as physics? Is there some advice you would offer that you've learned from yourself being able to excel as a scientist?

FC: A couple of things come to mind. One is that you have to be a little bit obtuse and single-minded to help you ignore barriers. There are always bumps in the road for men and women and people of every background. Part of it is not to pay attention to all the potential stuff that can bother you, because there's always a lot of that out there, and the other thing is to try to put yourself in a situation that is supportive. For example Caltech, my graduate school, just said "ok so we got an English major here, how do we help her?" and they helped me design a program to fill in my math background. And as long as I was willing to work hard and show that I was very enthusiastic about it they were going to reciprocate and help me to be a success. If you're not in an environment that is supportive, then you find one that is. I feel that you have choices. And your choice should be you don't choose to make things worse for yourself: Try to choose pathways that are more helpful because they exist all around you and identifying them and getting on them is really key. I just have found huge, huge support, and I am absolutely positive that there are people out there who are not supportive, but I haven't heard them [laughs]. I just ignore them.

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larly known as "Snowmass on the Mississippi." The nine-day-long seminar brought together hundreds of physicists from a range of disciplines within high-energy physics to weigh in on the future of tie field. They produced a comprehensive report of several thousand pages that highlighted outstanding research questions, recommended directions for research and possible future experiments.

The P5, appointed by HEPAP and last convened in 2008, has been reviewing the Snowmass report and assembling their recommendations for the DOE's Office of Science since September.

DOE charged the panel to come up with recommendations for the next ten years under different budget scenarios: flat for three years, then 2 percent growth over seven years; two percent growth for the first three years followed by seven years of 3 percent growth, and an "unconstrained budget" which essentially asked the panel to come up with a program for the U.S. to lead the world in high energy physics.

For more information on the P5 meeting, visit http://science.energy.gov/hep/hepap/reports.

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trepreneurship at Carthage College. "The truth of the matter is we all learn by the seat of our pants, but that's not necessarily the best way to do it."

Presenters at the conference said also that a better entrepreneurship program could help recruit and retain physics students. Universities that implemented business-focused programs have seen their department sizes grow.

"We had to think hard about how we get students back into physics," said Randy Tagg of the University of Colorado. "Present conditions are really excellent for student innovators."

In addition to entrepreneurship, presenters also emphasized the need to teach technical skills to undergraduates and high school students. Tagg started an "Innovation Hyperlab" at a high school in Aurora, Colorado, for high school students to get hands-on experience learning the basics of mechanical engineering, electronics, materials science, and even some nanotech by designing and building their own projects.

"I really want to make it a full fledged [Jet Propulsion Lab] in a single building," Tagg said. "Providing space, technical resources, and on-demand learning enables students, teachers and working scientists and engineers to collaborate on innovation that society greatly needs."

Duncan Moore, who teaches entrepreneurship at the University of Rochester, highlighted how many of his students had gone on to start their own companies, and how that in turn benefits both the school and the local community.

"The mission we have is transforming ideas into enterprises that create either economic or social value," Moore said. He added that the skills taught in an entrepreneurship program carry over into almost any career, even if only about six percent of his graduates start their own tech businesses. "I can teach you the elements of being an entrepreneur…. But I can't teach you to actually be an entrepreneur. It's something in your DNA."

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star initially collapses. This addition of matter means the highly dense body could gain enough matter to form a black hole.

"There is presently a lot of discussion in the astrophysics community if such supernovae/gamma-ray bursts harbor (and are driven by) a neutron star or a black hole," said Ott in an email. "Our model suggests that a black hole may form and could be at the center of the supernova/gamma-ray burst."

It may, in fact, be the accretion onto the newly formed, rapidly spinning black hole that drives the subsequent explosion. This, says Ott, "…would be consistent with observations of the galactic core-collapse supernova remnant W49B, which exhibits signatures of a very aspherical explosion, but shows no signs of the presence of a neutron star."

The work is detailed in the April 20 issue of *The Astrophysical Journal.*

MEMBERS continued from page 2

***Dean A. Wilkening**, Lawrence Livermore National Laboratory, on the shortcomings of the Ground-based Midcourse Defense missile defense system,* The Los Angeles Times*, June 15, 2014.*

"[T]he tunneling process becomes slower and slower the farther the atoms have to hop. This does not bode well for scaling such interaction-shifted tunneling resonances to a larger number of lattice sites…. Fortunately, developing intuition for the quantum dynamics of even five or six particles is already exciting and important."

***Jonathan Simon**, a physicist at the University of Chicago, on the applications of newly developed quantum tunneling system,* FoxNews.com*, June 18, 2104.*

The Back Page

Human Rights: Engaging Physics Students and Current Graduates

By Vikram Singh Prasher

You might assume that young physicists, with their busy and focused lives, have never considered that science could be a tool for protecting human rights, and vice versa.

Many graduate students, myself included, have limited interaction with the world outside of academic groups or annual research conferences, which seldom discuss issues like human rights. Last summer, when I was offered the opportunity to represent APS at the American Association for Advancement of Science, Science and Human Rights Coalition (AAAS SHRC) as a student delegate, I eagerly agreed–despite the fact that I had very little insight as to what exactly that involved. Although I had dived headfirst into unfamiliar territory, I surfaced with not only a newfound awareness of my own responsibilities as a physicist in regards to protecting human rights, but also with the comforting knowledge that my peers and colleagues were willing to embark on this journey too.

Attending the Coalition's July 2013 two-day annual meeting themed "The Right to Enjoy the Benefits of Scientific Progress and Its Applications" in Washington D.C., the heart of political activity, was a revealing experience for me. Throughout the plenary lectures and breakout meetings, immersed in the intersection of the social and natural sciences, I gained a deep, critical understanding of complex issues that relate science and human rights, such as: spreading knowledge through open-access science literature while preserving the viability of peer review, ensuring global access to new technologies, and securing other basic rights for all people through science and its applications.

Wikimedia Commons

Left, the author; right, Abduljalil al-Singace, former professor of engineering at the University of Bahrain, was imprisoned for speaking out about the country's human rights record. The APS Committee on International Freedom of Scientists was involved in advocating for his release.

A similar meeting in January of 2014, "Disability Rights and Accessing the Benefits of Scientific Progress and Its Applications," opened my eyes to the ways in which science and engineering greatly influence the human rights of persons with disabilities. These sessions, while similar in nature to the 2013 convocation, focused more on how access to science and technology can affect the rights of people with disabilities, both positively and negatively. Some of the sessions also explored challenges faced by disabled students, research practitioners, and subjects of research as they seek various opportunities in the science and engineering fields. Now armed with a fresh appreciation for the role of science in protecting human rights, I felt more confident than ever in my ability to successfully fulfill my role as a Student Representative.

The primary role of the Student Representative is to raise awareness of the AAAS SHRC Coalition within his or her organization (APS in my case), with an end goal of increasing participation in the Coalition by students and young professionals. With this in mind, my first objective was to design and draft a survey of current graduate students and early career physicists who are members of APS in order to gauge their knowledge of human rights. The survey included both a range of general questions (such as what APS members think of human rights), and also specific inquiries (for example: their knowledge of specific cases and/or their thoughts on if and how they see the connection between physics and human rights). The survey was sent out to graduate students and junior members of the APS Forums on Graduate Student Affairs (FGSA) and International Physics (FIP) between December 2013 and January 2014.

The members of the Coalition were extremely heartened by the overwhelming response to the survey, which reflected that the majority of student members believe that human rights are important to science and scientific research. It was also encouraging that a modest number of responders replied that they were currently involved, or had previously been involved, in various human rights campaigns, Amnesty International, volunteer work, and demonstrations.

While these data are promising, the survey also suggested that physics graduate students and early career physicists do not believe that what they are currently learning in graduate school will help their generation of scientists understand how their work relates to human rights. When asked what aspects of this subject they were most interested in learning more about, a majority of responders indicated they were curious about the relationship between human rights and the application of physics as well as their personal responsibilities in protecting human rights as physicists. So clearly the desire to learn is there; but how can we make human rights a part of graduate students' personal focus?

"Although I had dived headfirst into unfamiliar territory, I surfaced with not only a newfound awareness of my own responsibilities as a physicist in regards to protecting human rights, but also with the comforting knowledge that my peers and colleagues were willing to embark on this journey too."

APS has long been an ardent champion of human rights, spearheading many human rights campaigns, projects and informational seminars. In February of 2011, physics graduate student Omid Kokabee, of the University of Texas at Austin, while on a visit home was imprisoned in Iran on accusations of "communicating with a hostile government" and "receiving illegal earnings." APS has worked tirelessly to bring awareness and support to the Kokabee case, supporting petitions and lodging protests against his imprisonment. When asked if they were aware of the Kokabee case, many survey responders replied in the negative. Out of the few who recognized the case, a high percentage indicated that they had learned about the incident through APS efforts to bring awareness to the cause.

Survey takers were then asked to describe, in a few words, how the Kokabee case affected them personally. While replies were mixed, the underlying tone of responses were ones of empathy, anger, and concern. In particular, many international students were concerned for their own safety and rights while abroad or in their native country. A large majority of these reactions also portrayed a desire and motivation to participate and partner in efforts to sow seeds of human rights awareness among their peers to help mitigate future tragedies.

While the survey helped to momentarily spark interest and awareness in human rights in relation to science, the issue is still widely misunderstood. When asked to describe, in a few words, any individual cases of their fellow colleagues whose human rights have been violated or are at risk, a large number of responses cited complaints that were not applicable–i.e., failing to receive an extension on a research topic, problems with visa renewals, and other miscellaneous day-to-day grievances. It is clear that graduate students and alumni alike must continue to educate themselves and their peers in order to construct a well-rounded view of this issue.

This can be achieved by actively participating and engaging in efforts by organizations, such as AAAS SHRC and APS Committee on International Freedom of Scientists (CIFS), which are working at local or national level, in this field.

There are a variety of ways to get involved in the AAAS SHRC, from attending its meetings, which are free of charge for student and post-docs, to volunteering in their ongoing efforts. The Coalition recently held a competition to connect directly with students by organizing student poster competitions in its annual meetings. This competition, which asks students to submit a poster that should reflect their understanding on a given related topic, is open to undergraduate and graduate students interested in science and human rights.

CIFS, one of many APS advisory Committees, is charged with monitoring the rights of scientists. The Committee has been advocating for the release of Omid Kokabee as well as advocating for the rights of other scientists such as Abduljalil al-Singace, an engineer in Bahrain who has essentially been imprisoned for speaking out about Bahrain's human rights record. CIFS is also collaborating with the APS Forum on Graduate Student Affairs to ensure that APS student members are aware of CIFS initiatives, so that if they experience any violations of their rights, they would see it as a platform for assistance.

To connect the hectic lives of graduate students to current APS awareness efforts, I feel it is important to bring human rights campaigns directly to campuses and curriculums to more successfully bridge the gap. With the insight gained from the survey responses, APS plans to develop activities, such as educational seminars at its upcoming annual meetings, aimed at engaging APS members in issues related to physics and human rights.

As my tenure comes to an end, I realize more acutely than ever that I have had an amazing opportunity to become part of a community with a laser-like focus on promoting a view of science inseparable from basic human rights. I would like to thank both APS and the AAAS SHRC for allowing graduate students, such as myself, exposure at such an early stage in their careers to the vibrant level of thought, energy, efficiency, and motivation found within an organization that is working diligently to make the world a better place. I also wish to thank everyone who participated in the survey for helping to build a strong foundation to construct future endeavors upon. I extend my hand to my peers in partnership so that we may all continue to learn and benefit from one another as we move forward in our mission to protect human rights as responsible physicists.

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