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New "Piggyback" Journals
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2016 APS President — Homer Neal

By Emily Conover

Homer Neal, a particle physicist from the University of Michigan and a member of the ATLAS experiment, took over as 2016 APS president on January 1. In 2015 he served as president-elect and as vice president in 2014. At the University of Michigan, Neal has served as interim president and vice president for research, and as chair of the physics department. He has also served as vice president for academic affairs and provost at Stony Brook University, and dean for research and graduate development at Indiana University. Neal was a member of the board of directors of Ford Motor Company for 18 years, and has served on numerous advisory committees for national labs and other scientific institutions. He received his Ph.D. in physics in 1966 from the University of Michigan.

During a recent visit to APS headquarters in College Park, Md., Neal recalled his childhood in the small town of Franklin, Kentucky, a place he described as "highly segregated," with separate schools and separate waiting rooms in the doctor's office for white and black patients. Neal's childhood hobby was ham radio, and he became close friends with another ham operator in his town, who was white. But, as Neal is African-American, leaders in the town disapproved of their relationship.

Emily Conover

Homer Neal

"We were both astounded, and agreed to stop our communications," Neal said. "But it did teach me that basically when individuals are working on a scientific project together, the color of one's skin doesn't matter. It mattered to others, but it didn't matter to us."

APS News sat down with the new president to hear about his priorities for his year leading the Society.

Wrapping up Corporate Reform

Corporate reform, which began after members voted in its favor in November 2014, restructured APS senior management and redefined the roles of the Council of Representatives and the Board of Directors. "There are several dangling issues that will need follow-up," Neal said.

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APS April Meeting Bound for Salt Lake City

By Emily Conover

Coming soon to Salt Lake City, Utah: the 2016 APS April Meeting! The meeting takes place Saturday, April 16 through Tuesday, April 19 at the Salt Palace Convention Center. The meeting will feature research from the APS divisions of astrophysics; computational physics; nuclear physics; particles and fields; and physics of beams, along with a variety of forums and topical groups.

Organizers expect about 1300 attendees. With 71 invited sessions, 94 contributed sessions, three poster sessions, and over 1000 papers presented, attendees should have plenty to do.

Three plenary sessions throughout the meeting will feature distinguished speakers and important topics.

Saturday's plenary session features talks on physics and society. Mei Bai of the Institute for Nuclear Physics in Jülich, Germany, will discuss the importance of accelerators to society; Marcel Demarteau of Argonne National Laboratory will discuss the tools of particle physics and their impact, and Helen Quinn of SLAC National Accelerator Laboratory will talk about physics and education.

The Fred Kavli Plenary Session will take place on Monday, and

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New DOE Science Director Sets Sights on "Pasteur's Quadrant"

By Emily Conover

The new director of the Department of Energy (DOE) Office of Science, Cherry Murray, has just a year to accomplish her goals before her term ends with the Obama administration's exit. But Murray still has plenty of plans in store. "It's a short time, but I actually think there can be some accomplishment," Murray says. "So, of course I have a gazillion priorities, but I am very much focusing on several of them."

First on her list is maintaining the Office of Science's support of fundamental research. "We are the biggest supporter of physical science in the U.S., and I want to absolutely maintain that," she says. But she hopes also to expand the Office of Science's focus on research that falls within "Pasteur's quadrant." Such research, like that of 19th century chemist Louis Pasteur, sheds light on fundamental scientific questions but is also inspired by potential applications.

"I come from industry, and I think it is absolutely essential for advancing technologies — such as energy technologies or national security, which is another role of the department — to have breakthroughs in science." To this end, she plans to collaborate with other offices within DOE, like the Office of Energy Efficiency & Renewable Energy (EERE), that work on

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DOE

The swearing-in of Cherry Murray (at left) as Director of the Office of Science by Secretary of Energy Ernest J. Moniz. December 18, 2015 at DOE Headquarters, Washington, D.C. The third person is Cherry Murray's sister, Nancy.

Art and Science in the Gallery of Fluid Motion

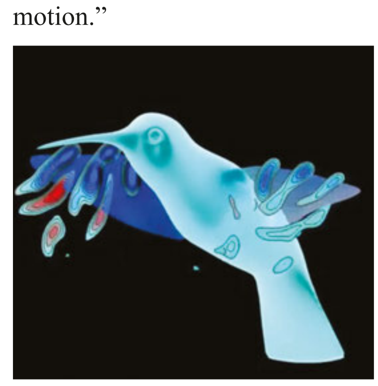
By David Voss

Attend the APS Division of Fluid Dynamics (DFD) meeting and you'll be served a fairly conventional menu of plenary talks and technical sessions. Off the beaten path, however, you might find a feast for the eyes.

Each year the meeting hosts the division's Gallery of Fluid Motion (GFM), which showcases the winners in the annual contest for the best short videos and colorful poster presentations. These highlight how modern visualization methods and computer power can convey the complexity of fluid behavior (GFM is at gfm.aps.org).

And it's not just science—also included is the aesthetic pleasure of motion, color, sound, and light. GFM coordinator Ken Kiger remembers his first encounter with the gallery: "As a first year grad student, I went to the DFD with my advisor," Kiger recalls, "and they had this gallery up. I was captivated." Kiger is a physics professor at the University of Maryland and has been running the gallery since 2010. "I've always felt there was an aesthetic quality to the fluid motion."

"Jellyfish" pattern created by a vortex ring falling through a stratified ambient liquid. (Poster P0050 at gfm.aps.org, winner of a Milton van Dyke award.)

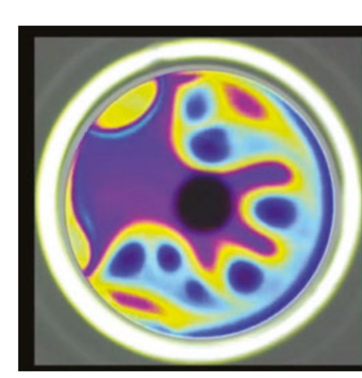


Simulation of the airflows created by hummingbird wings during maneuvering flight. (Video V0088 at gfm.aps.org, winner of a Gallery of Fluid Motion award.)

This year's gallery featured videos and posters ranging from colorful simulations of hummingbird flight to gruesome but effective models of blood loss and hemorrhaging produced by a projectile passing through a human leg. Applied work involving new kinds of spray nozzles was displayed next to fundamental vortex ring dynamics. One clever video titled "A Day in the Life of a Fluid Dynamicist" showed many of the ways that we interact with fluid phenomena whether we know it or not.

The inspiration for the gallery came in the 1980s when physicist Milton van Dyke compiled a photo album to help teach fluid mechanics. "He solicited images from the community, and got over a thousand," says Kiger. "Then, in 1983 [fluid dynamicist] Helen Reed organized the first Gallery of Fluid Motion at the division meeting. Apparently there was pent-up demand because they got 70 entries." That number is even more significant when you consider that three decades ago the meeting had only 400 attendees, compared to over 3000 now.

Back then, the gallery entries were poster presentations. "Video entries came a decade later," Kiger explains, but even then it was cumbersome. "They had to be sent in on VHS tape, local organizers had to dub a master tape, then put it in a VCR and have it loop. It was tedious."



Optical patterns produced by chaotic flows on the surface of a soap bubble. (Video V0040 at gfm.aps.org, winner of a Milton van Dyke award.)

After a few years of tape wrangling, the division reached out to APS, which now hosts the gallery online. At modern-day DFD meetings, the videos are displayed on eight flat-screen monitors next to the poster presentations. And at this

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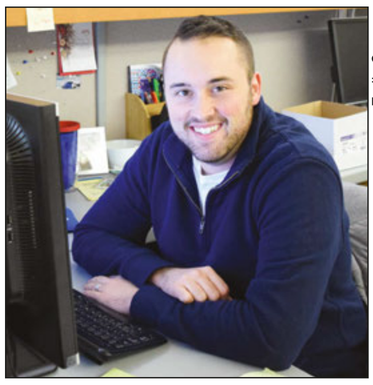
Revised 4/11/16

Inside APS

Jonathan Burkin, Units Coordinator



In this series of articles, *APS News* sits down with APS employees to learn about their jobs, their goals, and the things that make them tick. This month we chat with Units Coordinator Jonathan Burkin, who serves as the intermediary between the Society and its units — the member-led divisions, sections, forums, and topical groups.

What does the units coordinator do?

The units coordinator was a new position when I was hired. The idea was that it would bridge the gap between the units' executive committees [which include the chair and other leaders of the unit] and the Society itself. They needed someone to get everyone on the same page, and be the liaison or the concierge to the units. So if the executive committees need anything, the coordinator takes care of it. That is what I initially started doing and that's mainly what I do now, but also, this position took on the Leadership Convocation [an annual meeting of APS leadership, including the executive committees of each unit] and planning the APS Medal event [a new annual Society award].

What services do you provide for the unit leadership?

The biggest service — the one that keeps me most busy — is email communication. Executive Committee officers will send me an email for their membership. I take care of formatting it; I submit it to the communications staff, which gets it ready to send; I approve it; and then it goes out. So that's what occupies most of my day. In addition to that I take care of writing membership reports and running membership campaigns.

How many emails do you typically handle?

Last year we did 464.

Is it hard to keep track of all the different units and their needs?

I think it just comes with the position. I've learned each unit over time. Usually the unit leaders are pretty good at keeping up on their unit statistics. They're pretty good about keeping in contact with me, and I tell them, "Use me for whatever you need."

Why should members get involved in a unit?

I think being in a unit helps to classify you within a more specialized group of people. It brings a group of over 50,000 people together in each area of study and I think that's important, because you're not just a member of a huge organization, you're also a member of a subset of people that have similar interests.

Do you have any big projects that you're working on right now?

I have two big projects right now. The Leadership Convocation is a large undertaking, as is the inaugural APS Medal ceremony. So my desk is filled with menus and programs and stuff. Roughly 100 executive committee officers from the units will participate in convocation. I work closely with our meetings department to book their hotel rooms, pick their meals for the week; and then I take care of all the reimbursement. And for the medal ceremony, I work closely with an event planner, and we have developed the text for the program and the invitation, and the meal.

What is your background?

My background is in marketing and communications. I went to Mount St. Mary's University in northern Maryland. It's a small private school.

Did you have any interest in physics before you started?

None whatsoever. However, I think that helps, because I don't have any bias towards units or towards what their studies or what their goals are. I can just do my job from a marketing and a communications standpoint because that's what I've been trained to do.

You spend a lot of time interacting with physicists. Do they live up to the stereotypes?

No, I think that the stereotype is definitely stronger than how physicists actually behave. All of

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This Month in Physics History

February 1811: Amadeo Avogadro Enumerated the Molecular World

By Richard Williams

Amadeo Avogadro, (1776-1856), lived in a time of flux and uncertainty, in physics and in the governance of his community. In physics, the very nature of the elements was debated by the leading scientists: Was oxygen an atom or a diatomic molecule? In governance, Turin, and the Piedmont Region where he lived were ruled successively by the Dukes of Savoy, the King of Sardinia, and Napoleon Bonaparte, and threatened by the army of the Austro-Hungarian Empire.

Finally Turin was returned to the house of Savoy, all of this during Avogadro's lifetime, while he lived in the same home. He resolved the molecule question in physics, and, to the detriment of his career, gave his support to a political cause during the aftermath of Napoleon's legislation. His discovery of the fundamental numerical property of gases underlies our understanding of the molecular world. His political activities cost him his professorship at the University of Turin, but he was reinstated in the next political cycle, not long after.

Amadeo Avogadro explained experimental data on chemical reactions by proposing that equal gas volumes contain equal numbers of molecules, under the same conditions of temperature and pressure.

His full name was Lorenzo Romano Amedeo Carlo Avogadro, from a family with a long history in the legal profession. Their name derives from *avvocato*, Italian for lawyer. He followed the family profession for some years, then, self-taught, began to work in physics. He became professor of physics at the Academy at Vercelli, and later at the University of Turin.

Much of physics, at the time, was focused on the nature of gases. The French physicist Joseph Louis Gay-Lussac observed that, in reactions of gases, the relative volumes of reactants and products appeared to be in the ratio of small whole numbers. Avogadro went on from there [1].

He concluded that the only way to explain Gay-Lussac's observation was that, under identical conditions of temperature and pressure, for all ideal gases, any given volume must contain the same number of molecules. Avogadro's number, N_A, is the number of molecules in the volume occupied by a gram molecular weight of an ideal gas. The magnitude of N_A was determined in many later experiments, converging on the now-accepted value: $N_A = 6.023 \times 10^{23}$ particles per mole. The equal-number-per-unit-volume concept is now known as Avogadro's law.

The other major question at the time was whether the elemental gases, hydrogen and oxygen, were atoms or diatomic molecules. Avogadro neatly resolved this question as well. He noted that if the gases were atoms, the reaction:

$$2H + O \rightarrow H_2O$$

would give a volume of H_2O gas equal to the volume of oxygen. On the other hand, if hydrogen and oxygen were diatomic molecules,

$$2H_2 + O_2 \rightarrow 2\,H_2O$$

would give a volume of H_2O twice that of the oxygen. The experiments clearly confirmed that the latter equation was the correct one. This resolved the question once and for all. Avogadro was the first to understand that hydrogen and oxygen were diatomic molecules. To appreciate the prescience of Avogadro's achievement, note that, curiously, a century later, some influential scientists in the physics community still questioned the very existence of individual molecules. Illustrating this remaining difference in views, the citation [2] for Jean Baptiste Perrin's 1926 Nobel Prize in Physics read, "for his work on the discontinuous structure of matter, and especially for his discovery of sedimentation equilibrium." At the time, referring to Perrin's work, one scientist noted, "This put an end to the long struggle regarding the physical reality of molecules."

When he first published his work, the scientific community took little note of Avogadro's discovery. In part, this was because he made no effort to visit scientists in France and Germany to explain his ideas. Also, there were apparent exceptions to the law that all ideal gases contain the same number of molecules per unit volume. For example [3], solid NH_4Cl dissociates as it vaporizes to form the molecules NH_3 and HCl:

$$NH_4Cl \rightarrow NH_3 + HCl$$

Thus, for a given quantity of NH_4Cl, the vapor contains more molecules than it would if the NH_4Cl vaporized intact. This and some similar systems, appeared to invalidate Avogadro's law. When the dissociation became known and understood, this was no longer the case. Eventually, in 1860, the Italian chemist, Stanislao Cannizzaro, defended Avogadro's work before the leading European scientists at an International Chemical Congress in Karlsruhe, and the validity of Avogadro's law was finally recognized. Unfortunately, Avogadro had died several years earlier.

Today, 200 years after he proposed it, Avogadro's law is taking on a new life in physics. In an article, "*A More Fundamental International System of Units*" [4], David Newell explains how the system of units will now be based entirely on physical constants. Physical objects, such as the long-used standard meter, with two marks on a platinum bar, and the standard kilogram, a platinum weight, both maintained under controlled conditions in Paris, were long among the reference standards for physical units. Nowadays, the units are defined by seven physical constants, one of which is Avogadro's number. The others are: the velocity of light in vacuum, Planck's

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Inside the Beltway

The Dichotomy Between Obama's Mind and Skills

By Michael S. Lubell, APS Director of Public Affairs

As I watched President Obama deliver his State of the Union Address a few weeks ago, it struck me: Here is a man who has the noblest intentions but—by his own admission—lacks the skills to meet his own expectations.

Historians will probably write that he had extraordinary character and intellect but not the ability to persevere on the muddy playing field of national and international politics. In other words, he was a right honorable gentleman, to use British parliamentary lingo, but he lacked the instincts and savvy that great presidents have.

He admitted as much when he said, "It's one of the few regrets of my presidency—that the rancor and suspicion between the parties has gotten worse instead of better. There's no doubt a president with the gifts of Lincoln or Roosevelt might have better bridged the divide, and I guarantee I'll keep trying to be better so long as I hold this office."

The self-deprecation came late in the speech. Earlier he took a not-so-veiled swipe at his Republican critics when he remarked, "After all, it's not much of a stretch to say that some of the only people in America who are going to work the same job, in the same place, with a health and retirement package, for 30 years, are sitting in this chamber."

Of course, when it comes to partisan rancor, there's plenty of blame to go around. Republicans, who have controlled the House of Representatives since 2011, called a vote to repeal Obamacare so many times, I've lost count. They knew each time that either Democrats in the Senate would kill the repeal legislation or the president would veto it. They did it just to score political points.

Washington is where the blame game is playing out, but it's state capitals where the seeds of hyper-partisanship were sown. State legislators and governors conspired to gerrymander districts that created safe seats for each political party, removing all incentives for cooperation across the aisle in Washington.

Following the 2010 election, Republicans gained single-party control of 21 state governments (house, senate, and governorship), relegating Democrats to just 10. In most states, legislatures and governors control the redistricting that occurs following each decadal census. And in 2011, Republicans took full advantage of their position — as Democrats had done many times before — setting the stage for decade-long GOP domination of the House of Representatives.

President Obama was dealt a lousy hand by the financial collapse of 2008 and the "Great Recession" that followed. But he has to bear responsibility, in large part, for the 2010 election that swept Republicans into power across the country.

He entered office in 2009 with what he saw as a mandate for change, having won 365 of 538 electoral votes in the presidential election. He also entered office with his eyes set on two bold initiatives: enacting universal health care legislation and tackling climate change.

Despite his obvious intellect, he was a political novice. And although many of the pros in Washington—including Rahm Emanuel, his then chief of staff—cautioned him that such grandiose legislative goals demanded bipartisan buy-in, he elected to go it alone with his sizable Democratic congressional majorities. To make matters even worse politically, he pushed his groundbreaking legislation at a time when the nation was suffering economically.

He was able to ram the contentious Patient Protection and Affordable Care Act (Obamacare) through both chambers without a single Republican vote, and he succeeded in mustering 219 House votes for the equally contentious America Clean Energy and Security Act (Waxman-Markey bill) with only eight Republicans supporting it. Waxman-Markey ultimately died in the Senate, but Obama was able to go to the 2009 Copenhagen Climate Change Conference boasting at least partial success.

The president had a blockbuster first year: In addition to health care and climate change legislation, he shepherded the $787-billion economic stimulus plan and the $80-billion auto bailout. But he paid for his lack of political savvy in 2010, when voters turned their backs on him and handed control of the House over to Republicans, led by a phalanx of tea party newcomers. His presidential life has been a misery since.

Had his skills matched his mind, it would have been a boon for science, because there has been no president in my memory who had a greater passion and appreciation for science. He has elevated science, technology, engineering, and math (STEM) in the White House to levels I have never seen. And he has used his bully pulpit to take the case for science to the public.

Even in his State of the Union address he used science to highlight the importance of immigration reform, when he said, "I see [our future unfolding] in the Dreamer who stays up late at night to finish her science project, and the teacher who comes in early, and maybe with some extra supplies that she bought because she knows that that young girl might someday cure a disease."

It may be many years before we see another occupant of the White House who values science as much as President Obama. Perhaps the next one will also have the political skills to implement a STEM agenda more effectively.

New Physics Classification Scheme Unveiled

By Emily Conover

Watch out physicists: There's a new taxonomy in town. At the beginning of January 2016, APS unveiled the Physics Subject Headings (PhySH) classification system, which will replace the Physics and Astronomy Classification Scheme (PACS) previously used to organize APS journal articles into subject areas. The new system will serve as a tool for readers of the APS journals — allowing for easier navigation through papers and topics of interest — and will help APS assign papers to editors.

The American Institute of Physics (AIP) — an organization of scientific member societies, of which APS is one — created PACS in the 1970s. However, in 2010, AIP decided to stop maintaining it. A statement on AIP Publishing's website says, "The continuing evolution of indexing, search, and technology has brought into focus the inherent limitations of PACS and as a result, AIP decided that PACS 2010 would be the final version."

This left a void, with no up-to-date classification system available for APS journals. "Of course new concepts in physics are appearing all the time, so it was starting to be problematic for new fields of physics," says APS Chief Information Officer Mark Doyle. Topological insulators, for example, are not included in PACS. As a result, Doyle says, "We decided we were going to build our own." The system has been under development since 2012.

PhySH categorizes papers according to "concepts," which are tags that indicate the subject matter of the paper and the discipline it belongs to. During submission, authors select these from a list of about 3000. These concepts belong to "facets" — broad categories that indicate the nature of the concept. The facets currently include research areas, physical systems, properties, techniques (computational, experimental, and theoretical), and professional topics. "The idea is to try to distinguish the 'what' and the 'how' from each other," Doyle says. Concepts also belong to disciplines — subfields of study within physics, such as nuclear physics, biological physics, or fluid dynamics. These two dimensions by which concepts are organized (facets and disciplines) allow readers to browse articles across subject matter, techniques, disciplines, or other qualities.

Concepts can belong to more than one discipline and more than one facet. Solitons, for example, belong to two facets: research areas and physical systems, as well as a number of disciplines: condensed matter and materials physics; fluid dynamics; nonlinear dynamics; particles and fields; plasma physics; and statistical physics.

The concepts also follow a hierarchy going from broader to narrower subject matter. Loop quantum gravity is a narrower concept than quantum gravity, for example. Concepts are also connected to other, related concepts. For example, spontaneous symmetry breaking is associated with the related concepts of symmetries and Higgs bosons.

The faceted hierarchy system should make it easier to browse papers and understand the connections between related papers and topics, Doyle says, as compared to PACS, which has a more rigid hierarchy.

An additional challenge with PACS, Doyle says, is that it was not designed for the modern web environment. PhySH is designed to support "linked data," which would allow computers to read and analyze data about the papers.

PhySH is also designed to be simpler for users to understand. "The huge plus is that it's word-based; there are actual English words rather than cryptic alphanumeric codes," says Abhishek Agarwal, associate editor for *Physical Review Letters,* who helped coordinate the development of PhySH. "It's much more intuitive; it's transparent."

Currently, APS is still collecting PACS with submitted articles because internal peer review processes depend on them, but authors are now able to add PhySH terms voluntarily. (For the newest APS journal, *Physical Review Fluids*, authors are required to select PhySH terms.) In the coming months, APS journals will phase out the use of PACS entirely.

Agarwal emphasizes that PhySH should not yet be considered a finished project, but, he says the feedback so far is "extremely encouraging."

"The information that's coming in from the authors is very accurate so far," Agarwal says. "It's very early days, but authors are using it and they are using it largely the way we envisioned they would use it."

APS editors plan to continue refining the system with input from the physics community. "It's still very much under development," says Doyle. "We're looking for feedback on it. We're looking to iterate."

More information about PhySH is available at physh.aps.org

A comparison between PACS and PhySH shows the differences between the two classification schemes for a single paper. As seen below, PACS often has more detailed terms, with numbers associated to indicate their location in the PACS Hierarchy. In PhySH, terms are generally simpler, and each term is assigned to a facet: In this case, the two facets represented are research areas and physical systems.

PACS:
03.75.Lm: Tunneling, Josephson effect, Bose-Einstein condensates in periodic potentials, solitons, vortices, and topological excitations
42.65.Tg: Optical solitons; nonlinear guided waves
05.45.Yv: Nonlinear dynamics and chaos

PhySH:
Research Areas: Bose-Einstein condensates, Optical lattices
Physical Systems: Solitons

2016 Budget Boosts Funding for Science in U.S.

By Emily Conover

In mid-December, U.S. lawmakers finally ironed out the details of the 2016 budget, and science "fared reasonably well," says APS Director of Public Affairs Michael Lubell. The $1.1-trillion omnibus spending bill lays out the funding landscape for government agencies through September 2016. Thanks to the budget deal Congress hashed out in October, which rolled back spending caps established by the Budget Control Act of 2011, the bill increases overall discretionary spending by 5.2 percent above 2015, and for the most part, science funding agencies received a fair share of the increase.

The Department of Energy's Office of Science received a boost of 5.6 percent. The biggest winner within the Office of Science was Advanced Scientific Computing Research, which received a 14.8 percent increase, in a strong show of support for advanced supercomputing. On the other hand, the U.S. contribution to ITER, the international fusion project in France, is capped at $115 million, and the bill requests a report from the Secretary of Energy on the future of the project.

NASA was a big winner, with a 7.1 percent increase overall and a 6.6 percent increase to its science programs. Planetary science received the largest increase of NASA's science programs, at 13.4 percent. And the National Institutes of Health received a hefty increase of nearly $2 billion.

The National Science Foundation received a relatively small increase of 1.6 percent, but avoided large cuts that had been proposed for geosciences and social sciences, although social sciences funding was held flat.

The Department of Defense's science and technology programs received a significant 8.2 percent increase, but basic research saw only a 1.4 percent increase. The National Institute of Standards and Technology received an 11.6 percent bump, and the National Oceanic and Atmospheric Administration received a 5.8 percent increase.

Next year's budget is now in the works. As *APS News* went to press, President Obama's 2017 budget request to Congress was scheduled for release on February 9. Thanks to the October budget deal, the 2017 budget will be "essentially a cost of living increase," says Lubell, and "the expectation will be that both the president and Congress are likely not to do too much tinkering."

Letters

Members may submit letters to letters@aps.org. APS reserves the right to select letters and edit for length and clarity.

Neon Lights and the National Bureau of Standards

In the December 2015 *APS News*, "This Month in Physics History" has the headline "December 1910: Neon lights debut at Paris Motor Show." What took the French so long? Neon light signs debuted in 1904.

The National Bureau of Standards [now the National Institute for Standards and Technology] displayed a neon light sign spelling out "NBS," and a helium light sign spelling out "Helium," in 1904. These were placed in the NBS pavilion at the Louisiana Purchase Exposition held in St. Louis in the summer of 1904. The Bureau's enclosed electrical exhibit was cooled by a 10-ton air conditioner. Besides being a great exhibit, the electrical judges spent considerable time enjoying "the cool." NBS was awarded a grand prize.

A photograph of the signs and some history appear at go.aps.org/1Pxj45g

Stanley D. Rasberry
Lottsburg, Virginia

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the executive committee leaders that I come in contact with have been really great. I think at the end of the day you have to remember that they're just trying to do their job, and they're extremely intelligent people.

There's a rumor that you have an unusual talent. Do you want to share it?

Sure. So at four years old I started competitive baton twirling. I've been twirling since I was four so that's twenty-one years. Once I got to college I found there's a team in Maryland that is one of the world's best teams. So, a lot like Olympic gymnasts will do — they'll move to Texas to train with the best gymnastics coaches — I moved to Maryland to train with the best twirling coaches. And since 2010, I have won 12 world gold medals. We've been all over the place for the world championships. We were in Belgium, Switzerland, England, and just this past April I was in Italy. And we've been successful at each one, which was good. Probably the better talking point is I was a semifinalist on *America's Got Talent* in 2008.

What do you like about baton twirling?

I have no idea. I don't know. People say, "Why baton?" I couldn't tell you. I have no idea. It's like this weird addiction. We call it a sickness.

This interview has been edited and condensed.

Physics in the City

In a recent American Institute of Physics report it was stated that African Americans are underrepresented in the physical sciences, and that the number of degrees in physics remained flat between 2003 and 2013. As a retired high school inner city physics teacher I can positively state that there is a great deal of physics potential in the inner city. What turns on most students to become physics majors is a positive high school physics experience. Many students in the inner city are weak in their math skills in my experience and they need reviews of their basic math and algebra and repeated help in problem solving until they become proficient at it.

Some physics teachers simply give the students physics problems to solve without much guidance and help and let the students try to solve the problems mostly on their own or together, resulting in turning off most students and making the high school experience in physics a negative one for most students. Some teachers give a physics course with little problem solving, and the result is an incompetent student in a college physics course.

I have found that many high school students do well in problem solving if the students are given drills and practices on the various types of physics problems in the high school texts, with examples on how to solve the given problems, with the physics teacher going around the classroom helping the students with the problem solving. This type of high school course will turn on most students, of any color, to physics.

Stewart Brekke
Downers Grove, Illinois

Civility and Science

In the November 2015 issue of *APS News*, Michael Lubell wrote an article questioning whether science bears any responsibility for today's political discontent. Although his article emphasized the gains in productivity without corresponding gains in living standard, I believe that there is another important example in the climate change dilemma. The statements on both sides are getting meaner and meaner. Members of Congress who believe in man-made climate change are threatening RICO (Racketeer Influenced and Corrupt Organizations) prosecutions of scientists who are skeptics, and congressmen on the other side are threatening to look into the government funding of the scientists who are believers in human-induced climate change. Perhaps we can expect no better of our politicians, but when prestigious scientists sink to the same level, they do real harm to the credibility of the entire scientific enterprise. I hope that in the scientific world, scientists on both sides of the issue treat opponents with more respect and avoid statements like "The science is settled"; it almost certainly is not. Earth's atmosphere is extremely complicated and we do not understand it that well.

Wallace Manheimer
Allendale, New Jersey

Science and Politics

Michael Lubell's "Inside the Beltway" column (*APS News*, November 2015) asks whether science bears responsibility for today's political discontent. My view differs in that it is [scientists'] failure at the task of advocating understanding of science that may be most responsible. I find it alarming when two of the three leading presidential candidates question matters such as evolution and global warming. Are they wiser than the many more who offer strong evidence favoring these? Much of the media also shares the responsibility for publicizing showmanship rather than logical thinking. Mr. Lubell criticizes Mr. Sanders for his "Brooklyn accent" and for "being just a plain old socialist," while many do not understand that his socialism comes closer to the beliefs of many respected politicians than to those of despised communists. Perhaps we need to achieve responsibility by fostering better interaction of scientists with the media in an effort to clear up some of these misconceptions.

Richard S. Stein
Amherst, Massachusetts

Supreme Court Hits a Nerve with Comments on Diversity

By Emily Conover

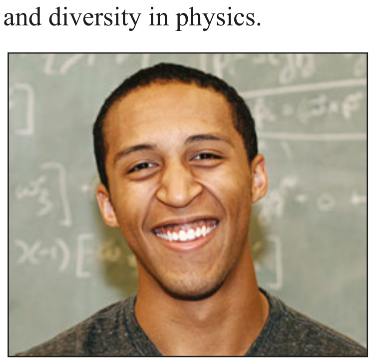
"What unique perspective does a minority student bring to a physics class?" Supreme Court Chief Justice John Roberts asked this question — drawing a distinction between humanities classes and the hard sciences — during oral arguments on December 9, in the case Fisher v. University of Texas.

The case challenges affirmative action policies at the University of Texas at Austin, which considers race as a factor in admissions to help it ensure a diverse student body. It centers on Abigail Fisher, who contends that her application for admission to the University of Texas was unfairly rejected based upon the color of her skin: white.

In controversial remarks that were roundly condemned by African-American and civil-rights organizations, Justice Antonin Scalia stated, "There are those who contend that it does not benefit African-Americans to get them into the University of Texas where they do not do well, as opposed to having them go to a less-advanced school ... a slower-track school where they do well."

Large numbers of physicists responded, affirming the importance of diversity in the field, and critiquing the justices' comments. Nearly 2500 physicists signed a letter to the Supreme Court drafted by the Equity & Inclusion in the Physics & Astronomy Facebook group. 2015 APS President Sam Aronson issued a statement on diversity in physics and the National Society of Black Physicists issued a press release. Astrophysicist Jedidah Isler of Vanderbilt University penned a *New York Times* op-ed on the case.

APS News spoke with three accomplished African-American physicists at different stages of their careers, to hear their thoughts on the justices' comments, and the importance of affirmative action and diversity in physics.



Guy Marcus

Guy Marcus is a Ph.D. student at Johns Hopkins University at the Institute for Quantum Matter, where he uses neutron scattering to study quantum magnetism. He is an NSF Graduate Research Fellow, a 2013 recipient of the APS LeRoy Apker award for his undergraduate research at Wesleyan University, and was an APS Minority Scholar. He was recently named one of *Forbes*' 30 Under 30 in science for 2016.

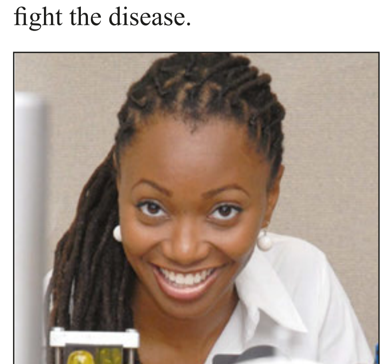
"The problem isn't their answer to the question, it's that the question is being asked," Marcus says, "because no one's asking why we need to have white men in physics." He adds, "I think not restricting how someone is supposed to look in order to do science is part of not imposing any particular way of thought onto how we solve problems."

Affirmative action policies at universities are "part of the solution," Marcus says, but the problem goes beyond just who is admitted. Some minority students, Marcus says, "Look at a department filled with white men — that's what all their professors look like, that's what all their peers look like — and that's a deterrent." Therefore, he says, such policies alone won't solve the problem.

Marcus says he understands the sentiment that race shouldn't be a factor in admissions." Yes, race shouldn't matter, but it does, and this is the problem," he says. "Maybe in some ways our society isn't there yet. You can look out at the field and see immediately that it's not there yet."

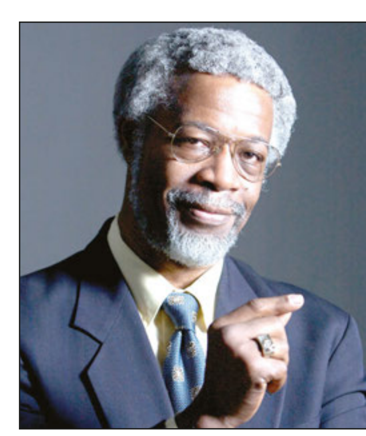
As he is often the only black physicist in the room, Marcus says he sometimes feels as if he representing his entire race. "This is part of what provides some base drive for me, because I feel that greater responsibility. But that's also something that's an extra weight to be carrying around."

Hadiyah-Nicole Green is an assistant professor at Tuskegee University developing a treatment for cancer using nanoparticles activated by laser light. She recently received a \$1.1-million career development award from the U.S. Department of Veterans Affairs Office of Research and Development. She began her career in fiber-optics research, but after the aunt and uncle who had raised her were each diagnosed with cancer, she changed direction, and now uses her optics expertise to fight the disease.



Hadiyah-Nicole Green

In response to the Supreme Court comments, Green says, "At a time where it's necessary for all people to pull together to solve the global issues of cancer, AIDS, clean water, clean air, and global warming, these



Jim Gates

are global issues that need to be addressed, and no one group or no one person can take on all of these problems alone. It has to be a collective effort."

"For someone to say, 'What value does diversity have in a physics class?' it's almost a ridiculous concept to me," Green says. "Is it worth the next four or five generations of people dying from cancer, if the cure for cancer comes from a black person, but we don't train them, or we don't accept them and embrace them?"

"When you start to say 'What value do black people add to science or physics in the classroom?' it's like, 'What value don't we bring?'" she says.

Jim Gates is a theoretical physicist at the University of Maryland,

DIVERSITY continued on page 7

Diversity Update

Bridge Program Now Accepting Student Applications

The APS Bridge Program aims to increase the number of underrepresented minorities who earn a Ph.D. in physics. Applications for fall 2016 are now available. African-American, Hispanic-American, and Native American students interested in pursuing a Ph.D. in physics are encouraged to apply.

Eligibility Requirements: Underrepresented minorities who will complete or have already completed a bachelor's degree in physics or a closely related field and plan to pursue a physics doctoral degree are eligible.

The deadline for applications is March 21, 2016. For more information please visit apsbridgeprogram.org or email bridgeprogram@aps.org

APS Announces 2017 CUWiP Sites

The 2017 APS Conferences for Undergraduate Women in Physics (CUWiP) will be held January 13 - 15, 2017. The following universities are hosting conferences:

- Harvard University
- Montana State University
- Princeton University
- Rice University
- University of California, Los Angeles
- University of Colorado Boulder
- University of Wisconsin
- Virginia Tech
- Wayne State University

The APS CUWiP goal is to help undergraduate women continue in physics by providing them with the opportunity to experience a professional conference, information about graduate school and professions in physics, and access to other women in physics of all ages with whom they can share experiences, advice, and ideas. Learn more at: aps.org/cuwip

Accepting Nominations for the CSWP Woman Physicist of the Month

The APS Committee on the Status of Women in Physics (CSWP) Woman Physicist of the Month award recognizes female physicists who have positively impacted other individuals' lives and careers. Each CSWP Woman Physicist of the Month is featured on the Women in Physics website (WomenInPhysics.org), announced in the Gazette, and recognized at a reception at an APS national meeting.

Nomination is easy: Email a three-paragraph statement explaining why the physicist you are nominating is worthy to women@aps.org

Join the National Mentoring Community at the 2016 APS March Meeting

The APS National Mentoring Community (NMC) provides support for successful mentoring relationships with undergraduate students who are underrepresented minorities in physics. Visit www.aps.org/nmc to register for free as an NMC mentor and then invite a student to join as a mentee through the program. If you are an NMC participant or simply wish to learn more about the NMC, please join us for an informal get-together on Sunday, March 13 from 5:00 p.m. - 6:00 p.m., at the 2016 APS March Meeting in Baltimore. We will provide refreshments, and we welcome your ideas on how to make the NMC as effective as possible.

2016 APS National Mentoring Community Conference

Registered NMC mentors and mentees are eligible for discounted registration and travel funding to our second annual NMC Conference, which will take place on October 21 - 23, at the University of Houston in Houston, TX. For more information, visit go.aps.org/nmc-conference

MSI Travel Grants still available for 2016 PhysTEC Conference

It's not too late! Faculty from minority-serving institutions (MSIs) are encouraged to apply for travel grants to attend the 2016 PhysTEC Conference, the nation's largest meeting dedicated to physics teacher education. This conference will be held March 11 - 13 at the Royal Sonesta Harbor Court in Baltimore, Maryland, immediately preceding the 2016 APS March Meeting. Learn more and register now at: www.phystec.org/conferences/2016/

AVOGADRO continued from page 2

Constant, Boltzmann's Constant, the charge on the electron, the frequency of the cesium-133 hyperfine splitting frequency, and a luminous intensity unit. Thus Avogadro's idea, barely recognized during his lifetime, lives on centuries later as one of the pillars of modern science.

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New Journals Piggyback on arXiv

By Emily Conover

A non-traditional style of scientific publishing is gaining ground, with new journals popping up in recent months. The journals piggyback on the arXiv or other scientific repositories and apply peer review. A link to the accepted paper on the journal's website sends readers to the paper on the repository.

"Proponents hope to provide inexpensive open access publication and streamline the peer review process. To save money, such "overlay" journals typically do away with some of the services traditional publishers provide, for example typesetting and copyediting."

Proponents hope to provide inexpensive open access publication and streamline the peer review process. To save money, such "overlay" journals typically do away with some of the services traditional publishers provide, for example typesetting and copyediting.

Not everyone is convinced. Questions remain about the scalability of overlay journals, and whether they will catch on — or whether scientists will demand the stamp of approval (and accompanying prestige) that the established, traditional journals provide.

The idea is by no means new — proposals for journals interfacing with online archives appeared as far back as the 1990s, and a few such journals are established in mathematics and computer science. But now, say proponents, it's an idea whose time has come.

The newest such journal is the *Open Journal of Astrophysics*, which began accepting submissions on December 22. Editor in Chief Peter Coles of the University of Sussex says the idea came to him several years ago in a meeting about the cost of open access journals. "They were talking about charging thousands of pounds for making articles open access," Coles says, and he thought, "I never consult journals now; I get all my papers from the arXiv." By adding a front end onto arXiv to provide peer review, Coles says, "We can dispense with the whole paraphernalia with traditional journals."

Authors first submit their papers to arXiv, and then input the appropriate arXiv ID on the journal's website to indicate that they would like their paper reviewed. The journal follows a standard peer review process, with anonymous referees whose comments remain private.

When an article is accepted, a link appears on the journal's website and the article is issued a digital object identifier (DOI). The entire process is free for authors and readers. As *APS News* went to press, Coles hoped to publish the first batch of half-dozen papers at the end of January.

To manage the submission and peer review software, the founders of the *Open Journal of Astrophysics* have created a web interface that allows a markup of the article. Reviewers comment on parts of the text and authors can respond, with all discussion occurring in the online interface. Authors make revisions by posting a new version to arXiv. "It's traditional peer review but with a modern interface," says Adam Becker, managing editor of the journal.

Another overlay journal, *Discrete Analysis*, led by mathematician Timothy Gowers of the University of Cambridge, has been accepting submissions since September, with the launch planned for the end of January.

Repeating a refrain common among supporters of open access publishing, Gowers points out that academics write and review articles for free, but then must pay to read them. So the new journal, Gowers says, is "a natural thing to want to do."

Discrete Analysis uses software called Scholastica for managing submission and peer review. Scholastica charges $10 per submitted paper, but Gowers has secured funds from Cambridge to cover the cost.

"Once you start to get thousands or tens of thousands of manuscripts a year, you begin to need additional overhead to track, coordinate, and confirm peer review... . These costs are not negligible."

Gowers is known for having an axe to grind with commercial publishers, particularly Elsevier; in 2012 he sparked a boycott of the company, protesting the high cost of subscriptions to their journals, large profit margins, and practice of bundling journals into packages so that libraries are forced to subscribe to journals that they otherwise wouldn't.

An overlay journal platform called Episciences currently hosts a handful of journals in computer science and mathematics. The two-year-old project is an effort of France's Center for Direct Scientific Communication (CCSD), and it interfaces with arXiv and other repositories, like HAL, a scholarly archive created by CCSD.

Episciences' portfolio already includes some longstanding journals that have moved to the platform, as well as new journals. Additionally, "we are discussing with quite a few journals [that are] interested in joining the platform," says Laurent Romary of the French Institute for Research in Computer Science and Automation (INRIA), a leader in the effort.

Romary says one of the important things such journals do is decouple publication and peer review. He's an advocate of "post-publication peer review," in which the article is available while it's being reviewed, allowing researchers to get their results out as quickly as possible.

Another issue where Romary sees potential improvement over traditional journals is licensing. "The only thing that counts for a scholar is to be cited, so the license should be as unconstrained as possible so that on the one hand anyone can take the material and cite it, and second... you facilitate activities like text and data mining," Romary says.

Proponents of overlay journals hope that others will follow their lead. "But whether they actually will, I don't know," Gowers says. "By being one of the trailblazers I hope we can make it more likely that others will do the same."

"Some people are not convinced," Coles admits. One issue with these journals is they don't have the prestige associated with established journals. But, Coles says, "It's a lot to pay for a status symbol. What we should be doing is paying for the dissemination of scientific knowledge, not the epaulets."

And it remains to be seen whether overlay journals will be able to move beyond small-scale operations. "I very strongly support these things; I think they're fantastic. But I have concerns about scalability and long-term sustainability," says Paul Ginsparg of Cornell University, who founded arXiv.

"The hidden expenses in these things are never really taken into account when they operate on a small scale," Ginsparg says. "There's either personal or institutional subsidies going into the time, labor, internet connection, and all of the rest."

"I can easily see how it would work for small journals in very specific topic areas," says APS Editorial Director and Interim Editor in Chief Dan Kulp, who oversees the peer-reviewed journals published by APS. "Once you start to get thousands or tens of thousands of manuscripts a year, you begin to need additional overhead to track, coordinate, and confirm peer review. ... These costs are not negligible."

As a result, says Ginsparg, "I don't think they'll ever be big enough to change the entire landscape, and I don't think it makes sense to move the landscape over to this."

"We're still poking around trying to figure out what is the right long term solution for all of this and if nothing else that's one of the reason why these experiments currently remain so important."

But Ginsparg supports the effort. "We're still poking around trying to figure out what is the right long-term solution for all of this and if nothing else that's one of the reason why these experiments currently remain so important."

"We have to keep trying these different things," Ginsparg says, "because we'd like a more functional and a more financially stable model 20 years from now than we currently have."

DIRECTOR continued from page 1

applied energy technologies.

An experimental condensed matter physicist, Murray has held a variety of prominent leadership positions in the scientific community, including the presidency of APS in 2009. She served as dean of Harvard University's Paulson School of Engineering and Applied Sciences between 2009 and 2014. Prior to that, she was the principal associate director for science and technology at Lawrence Livermore National Laboratory (LLNL). After receiving her B.S. and Ph.D. in physics from MIT, she began her career at Bell Labs in 1978, where she stayed until 2004, eventually moving into management roles during her time there.

Murray, whose appointment was confirmed by the Senate on December 10, 2015, took over from Patricia Dehmer, the deputy director for science programs in the Office of Science, who served as acting director after the previous director, William Brinkman, left in 2013. With just a few weeks at the helm when *APS News* spoke with her, Murray says she is happy to be there. After she stepped down as dean of the Paulson School, she says she received a phone call from Secretary of Energy Ernest Moniz, who asked her to take on the job. "I decided, 'Why not?' I haven't been in government before. Been in industry, been in a national lab, been in academia."

Murray highlights the Office of Science's user facilities as another of her priorities. "We provide, I'd say, the lion's share of the scientific user facilities that are world class," she says. Such facilities include the ten national laboratories stewarded by the Office of Science. (DOE has 17 national labs in total; the other seven are associated with other parts of DOE.) Murray's previous experience with national labs will come in handy for this job, she says.

At LLNL, a DOE lab under the National Nuclear Security Administration, Murray says, "I learned about the complexity of the DOE system and the absolutely essential nature for national security." The labs, she says, serve as "emergency expertise" for the country — citing, for example, the technical assistance the labs provided for the negotiations leading up to the agreement reached with Iran last year to dismantle parts of its nuclear program.

Murray also served on the Commission to Review the Effectiveness of the National Energy Laboratories, which released a report in fall 2015, outlining suggested improvements to DOE's national labs. (See *APS News* January 2016.)

Following up on the recommendations made by that commission, Murray says she hopes to merge the review process the Office of Science uses for its labs with other parts of DOE, to create "a review process that doesn't just review the science programs, but the science programs and the applied energy programs" together. She adds, "These labs are an incredible national resource, and the programs don't all necessarily know the capacities that these labs have because they only fund their particular program." Within the Office of Science labs, Murray says, "Some of them have 50% of their portfolio outside the Office of Science and we need to steward that whole responsibility."

Fitting construction of new scientific facilities into the Office of Science budget while maintaining research funding is also important, Murray says. "We have a balance between building the major facilities that are necessary for the community to do world class science, and funding the research so that they can actually do the world class science."

Luckily, Murray says, "The 2016 budget is pretty good for the Office of Science," and she is optimistic about the 2017 budget. [As *APS News* went to press, President Obama's 2017 budget request was scheduled for rollout on February 9.] "The thing that's great about the Office of Science is that science really gets bipartisan support," she says.

To make sure that the most essential science gets funded, Murray highlights the importance of communities setting funding priorities and creating long-term plans, like the 2014 Particle Physics Project Prioritization Panel (P5) report and the 2015 Long Range Plan for Nuclear Science. When a community gets together, she says, "We know what we need to do: We have to fit it in the budget."

Murray attributes her lifelong interest in science to her older brother's influence — and a bit of a competitive spark. Her brother was a graduate student in physics at MIT when she was applying to colleges. "He basically said, 'There's no way you could do physics, and definitely not at MIT.' So I applied to MIT, and I got in!" (Her brother has no recollection of this conversation, Murray says.)

Murray had always thought she would become an artist — she comes from a family of painters. But the hands-on experience she got at MIT clinched her interest in science. "From freshman year on I did research in a lab and that's what really got me hooked on physics," she says.

NEAL continued from page 1

He plans to work with the Board and APS CEO Kate Kirby to ensure "that if kinks develop, that we take steps to resolve them."

APS Strategic Plan

The most recent APS Strategic Plan, which set the goals for the Society, was created in 2012, before the recent corporate reform. "I and the other members of the presidential line believe that it's very important to begin the process of updating the plan, especially since so many major changes have been made," Neal said.

Fundraising plan

Forming a strategic plan for fundraising will be a top priority for Neal and the APS Development Advisory Committee, which Neal says is "composed of some very fine external members."

Impact of open access

With the increasing prevalence of open access publishing, the Society may need to adjust its business model if publishing income declines. "Right now a good fraction of what supports other activities comes from publishing, and if we lost some fraction of the publishing income then that's a big deal," said Neal. "We should be prepared for that."

Interactions with industry

In recent years, APS has worked to boost its contact with industry. Neal would like to continue to strengthen these efforts. Citing his experience as a member of the board of directors of Ford Motor Company, "I believe I have something to offer there," Neal said.

Nurturing relations with other societies

Neal would also like to work together with organizations like the American Institute of Physics (AIP) and the American Association for the Advancement of Science. "What one could do would be to identify areas where we have similar goals." Neal has already met with AIP CEO Robert Brown, he said. "We agreed to continue our discussions about ways we might cooperate."

International activities

Science is an increasingly international effort, and many cutting-edge facilities are located overseas. "I would like to see APS consider study-abroad programs for physics students as something that should be embraced," Neal said. "And if that were to occur, I would propose trying to get an endowment to help support such programs. That would be doing something that I don't think anyone else is really doing."

Diversity efforts

"I've been continually surprised at the small number of minorities choosing physics, so that should be another priority," Neal said. "Diversity efforts are already underway but challenges remain."

The plight of research scientists

Neal hopes to draw attention to research scientists who have received a Ph.D. and done a postdoc, before entering into a long-term, untenured position in a research group. If these scientists lose their funding, "We have situations where 40-year-old, 45-year-old people with a large salary are just being kicked out the door when their work is finished, and it's hard for them to find jobs," Neal said.

APS presence in Washington

Neal plans to maintain the Society's contacts with Congress and scientific agencies. He also hopes to establish a more prominent presence in Washington. Neal is a member of the Council for the Smithsonian National Museum of African American History and Culture, which opens this year on the National Mall in Washington DC. "One of my concerns is what's going to be done to help little kids see that science can be interesting." Neal said. "APS might help in laying out the science exhibits that should go into that museum, both helping with outreach itself, but also giving APS more visibility on the Mall."

MEETING continued from page 1

neutrinos will take center stage, in honor of the 60th anniversary of the first detection of neutrinos by Frederick Reines and Clyde Cowan. The session will showcase talks from the 2015 physics nobel laureates, Arthur McDonald of Queen's University in Kingston, Canada and Takaaki Kajita of the University of Tokyo. Neta Bahcall of Princeton University will speak about the solar neutrino problem and the work of her late husband, John Bahcall.

Tuesday's plenary session commemorates the 60th anniversary of Tsung-Dao Lee and Chen-Ning Yang's proposal to test for the violation of parity conservation in the weak interaction,which was demonstrated by Chien-Shiung Wu. The session's theme is "Symmetries." Gerald Gabrielse of Harvard University will give a talk entitled, "Stringent Low Energy Tests of the Standard Model, Its Symmetries and Modifications," and Xiaochao Zheng of the University of Virginia will speak about experiments probing parity violation using electrons at GeV energy. Finally, Edward Witten of the Institute for Advanced Study in Princeton, will give a talk titled "Symmetry and Geometry." Witten is the winner of the 2015 APS Medal for Exceptional Achievement in Research, awarded for "discoveries in the mathematical structure of quantum field theory that have opened new paths in all areas of quantum physics."

Lisa Randall of Harvard University will give a public lecture titled "Dark Matter and the Dinosaurs: The Astounding Interconnectedness of the Universe."

A welcome reception on Saturday evening will occur in conjunction with the first poster session. At the Nobel Reception on Monday night, attendees will have the opportunity to meet winners of the Nobel Prize in physics. And on Sunday, the APS Prizes and Awards Ceremony will honor scientists who have made significant contributions to physics.


Istock

2016 April Meeting goes to Salt Lake City.

Several events will focus on careers and professional skills. A panel discussion on career opportunities for physicists is aimed at students or physicists early in their careers. Two workshops on communication and negotiation will cover topics ranging from teamwork, to negotiation tactics, to dealing with difficult professional situations.

For physicists looking to learn more about publishing in and refereeing for APS journals, there will be a tutorial with presentations from APS editors, and a reception at which editors will be on hand to answer questions.

The Committee on the Status of Women in Physics (CSWP) is hosting a meet and greet on Sunday evening. Also on Sunday, there will be an Education and Diversity Reception hosted by CSWP, the Committee on Minorities in Physics, and the Forum on Education. All are welcome to attend both events to network and unwind.

For undergraduate attendees, the meeting will feature the Future of Physics Days sessions. On Saturday, a panel of grad students will answer questions about graduate school over lunch. On Sunday, an award ceremony will honor the top undergraduate speakers and poster presentations at the meeting.

For early birds, or those who simply can't pack enough into the four days of the April meeting, there are the pre-meeting events on Friday. These include a workshop on integrating computation into the undergrad physics curriculum, the APS Business Meeting, and a "tweetup" for social media buffs who plan to chronicle the meeting on twitter.

We hope to see you there!

For more information about the APS April Meeting, visit aps.org/meetings/april.

ANNOUNCEMENTS

Reviews of Modern Physics

Google matrix analysis of directed networks

Leonardo Ermann, Klaus M. Frahm, Dima L. Shepelyansky

How can information from communication and social networks in modern societies be processed, classified, and retrieved? For this new mathematical methods have to be invented for a precise characterization of the existing networks and their search engines. This article describes the properties of the Google matrix and its efficiency in analyzing directed networks by way of several examples like the World Wide Web, Wikipedia, world trade, social and citation networks, DNA sequences and Ulam networks, and others. The underlying analytical and numerical tools used thereby originate from fields like quantum chaos and random matrix theory.

journals.aps.org/rmp

DIVERSITY continued from page 4

College Park, known for his work on string theory, supersymmetry, and supergravity. He is a member of the National Academy of Sciences, a recipient of the National Medal of Science, and he serves on the President's Council of Advisors on Science and Technology. He has previously written about diversity in science for *The Scientist* and other publications.

"I was thunderstruck by the question," Gates said, referring to Justice Roberts' question about the importance of diversity in physics classes. "He asked specifically about physics, which for me was stunning. I wondered if he had come across some of Einstein's writings on his perspective on race in America. Einstein actually said that from his perspective racism is a disease."

Gates says the question is a valid one. "I take the Chief Justice's question as a serious question asked by someone whose mind is looking to work things out and is looking for answers. So I think it's a question that especially the physics community really ought to respond to."

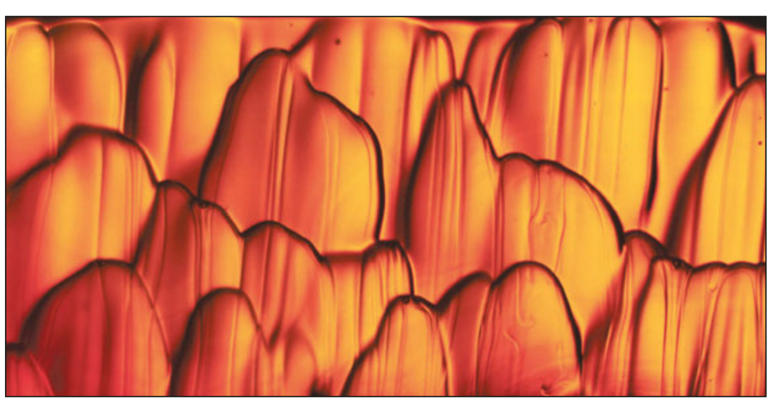
Diversity, Gates argues, is necessary to do the best possible science. "If you want to get the most active, the most innovative, the most rapid-moving science, I believe ... diversity drives higher levels of innovation."

For links to the statements mentioned in this article, visit the online version of *APS News* at aps.org/apsnews.

FLUID MOTION continued from page 1

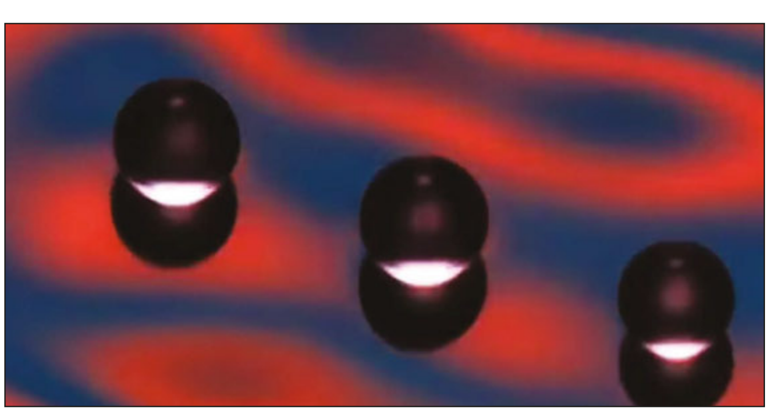
fluids cineplex, red/green glasses are handed out for 3D videos.

Awards are given for the best entries and the criteria vary from meeting to meeting. "For the most part [the judges] are told it's an aesthetic gallery," Kiger says. "There should be some technical relevance, but we have a lot of [other] venues for technical presentations. [The entries] should be primarily visually representative of a phenomenon in an eye-catching or artistic way."



Erosion patterns modeled with water flowing over caramel. (Poster P0051 at gfm.aps.org, winner of a Gallery of Fluid Motion award.)

The artistic side of fluid motion also fascinates Nicole Sharp, originator of the provocatively named website F*ck Yeah Fluid Dynamics (*Editor's note: Fill in the vowel yourself.*) Sharp, a recent Ph.D. graduate in mechanical engineering, serves on the DFD Committee on Media and Science Relations.



Surface waves created by small droplets bouncing on an oil bath. (Video V0064 at gfm.aps.org, winner of a Gallery of Fluid Motion award.)

Her award-winning website features video and photographic examples of fluid motion, along with explanations of what readers are seeing. "I get a lot of comments from people, some of them in the fluid dynamics community," she says. "They really appreciate a lot of different features of the website, like seeing explanations of phenomena they don't see anywhere else, or seeing the visuals and how they relate to everyday life."

Asked about the website name, she admits that is poses a few problems. "I'll hand my business card to someone and they'll crack up two seconds later," Sharp says. She picked the name at a time when several websites catering to fans of actors and television shows had similar monikers. "I didn't expect the website to grow this much, so I might have picked a different name." Occasionally she is asked for a cleaner URL though. "Some people can't load the site at work, and I think the entire country of Saudi Arabia can't get access."

FYFD, as it is more concisely known, has been featured in *Wired* magazine as a recommended science site to visit, and now has 223,000 followers. "I was on that list with Neil deGrasse Tyson and [astronomer and blogger] Phil Plait, which was pretty stunning for me as a graduate student," says Sharp. The website was initially a labor of love, but Sharp has opted to go full-time with it and is working to secure funding.

"One of the things that is neat about the gallery is that they're constantly looking for new ways to innovate with it and to expand it even further," explains Sharp. "It's gotten enormously popular in the past few years — everybody wants to have a video in the gallery and everyone wants to have a shot at winning. I love the website because it provides a ton of material for me."

Both Kiger and Sharp hope to do more public outreach in the future. "The director of the computational science center at Stanford contacted me because they have a large building they display art in," says Kiger. "She thought it would be great if we could print and frame some of our best entries and display them." Kiger thinks some kind of traveling fluid dynamics roadshow would be a way to inform the public about the field.

Now that Sharp is full time at FYFD, she plans to get more involved in science communication. "It's been my source of passion and interest, but I'd like to expand the site to content creation," she says. "The nice thing about making my own videos or working with researchers to make videos is that I can really put the explanation that is the heart of FYFD in with the visuals – have everything together in a single product."

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The Back Page

Tunnel Visions: A Brief Comparison of the SSC and LHC Projects

By Michael Riordan, Lillian Hoddeson, and Adrienne W. Kolb

Prologue: In late 1993 the U.S. Congress cancelled the Superconducting Super Collider(SSC), an enormous proton accelerator designed to attain a collision energy of 40 TeV, nearly triple that of the Large Hadron Collider (LHC). While the SSC's failure left widespread bitterness and an empty tunnel in Texas, the LHC went on to allow discovery of the long-sought Higgs boson. What follows is an excerpt from Tunnel Visions*, a comprehensive history of the rise and fall of the SSC recently published by the University of Chicago Press.*

While the Large Hadron Collider project at CERN also experienced trying growth problems and cost overruns, increasing from an estimated 2.8 billion Swiss francs in 1996 to more than 4.3 billion Swiss francs in 2009, it managed to survive and eventually discover the Higgs boson — using only about half its original design energy. When labor costs and in-kind contributions from participating nations are included, the total approaches $10 billion, a figure often cited in the press. This achievement in the face of problems similar to what the SSC project experienced, if not as severe, raises the obvious question: why did CERN and its partner nations succeed where the United States had failed?

From its early days, many thought the SSC should have been sited at or near Fermilab, taking advantage of the existing infrastructure there, both physical and human. CERN had done so for decades, building one machine after another as extensions of its existing facilities and reusing parts of the older machines in new projects, thereby limiting costs. Perhaps as important, CERN had also gathered and developed some of the world's most experienced accelerator physicists and engineers, who worked together smoothly as a team. Fermilab had equally adept machine builders, (and substantial physical infrastructure), who could have turned to other productive efforts when the inevitable funding shortfalls occurred during the annual Congressional appropriations process. And the troublesome clashes that occurred at the SSC project between high-energy physicists and engineers from the U.S. military-industrial complex would not have erupted in the already well-integrated Fermilab culture.

These pro-Fermilab arguments however ignore the realities of the American political process. A lucrative new project costing over $5 billion and promising more than 2,000 high-tech jobs cannot be "sole-sourced" to an existing U.S. laboratory, no matter how powerful its Congressional delegation. As politically astute Department of Energy leaders recognized, the SSC project had to be offered up to all states able to provide a suitable site, with the decision based (at least publicly) on objective, rational criteria. A smaller project costing less than $1 billion and billed as a major upgrade of existing facilities *might* have been sole-sourced to Fermilab, given the political climate of the mid-1980s, but not one as prominent and costly as the SSC. It *had* to be placed on the US auction block, and Texas made the best bid according to the official DOE judgment criteria.

Unlike the SSC, the LHC project had solid project management throughout by a single physicist, [Lyn Evans], who had decades of experience with proton colliders. Despite major problems and cost overruns that eventually exceeded 40 percent, Evans enjoyed the strong support of the CERN management, as well as from a deeply experienced cadre of physicists and engineers who worked together without the cultural clashes that occurred at the SSC Lab. And on the LHC project, engineers reported ultimately to physicists, the users of the machine best able to make the required tradeoffs when events did not play out as originally planned. The LHC project encountered daunting difficulties, serious delays and major cost overruns, too, but its core management team led by Evans held together and worked through these problems. They also shared a common technological culture — as well as understood and supported the project's principal scientific goals. Similar observations cannot be made regarding the military-industrial engineers who came to dominate SSC construction.

CERN also enjoys an internal structure, governed by its Council, that largely insulates its leaders and scientists from political infighting in and machinations of individual member nations. Unlike in the United States, the lab director or project manager cannot be hauled before a parliamentary investigations subcommittee and required to testify under oath about management problems or cost overruns. Nor did the project face annual appropriations battles and threats of termination, as do major U.S. projects. Serious problems that arose, for

Fermilab Archives

View along the SSC's main ring tunnel, as seen while under construction in early 1993.

example a large cost overrun in 2001, had to be addressed in the Council, which represents the science ministries of member nations and generally operates by consensus, especially on major new projects like the LHC. This governing structure ultimately helps maintain control of a project within the hands of the scientists involved, instead of allowing politicians or other government officials to intervene.

Because the Council must also address the wider interests of European science ministries, CERN leaders have to be sensitive to the pressures its annual budget, new projects, and cost overruns can exert on other worthy science. In this way, European small science had a valuable voice that was heard within the CERN governing process. The LHC project had to be tailored to address such concerns before the Council would grant it final approval. No similar mechanism existed within U.S. science, except for other, disgruntled scientists to complain openly in prominent guest editorials and before Congressional hearings after SSC costs got out of hand in 1989 - 1991. The consequent polarization of the U.S. physics community helped undermine what had originally been fairly broad House support for the project.

And because of such financial pressures, CERN had to effectively internationalize the LHC project — obtaining major commitments from non-member nations such as Canada, China, India, Japan, Russia and the United States — *before* going ahead with it. These contributions enabled Evans and his team to proceed with a collider design able to reach the full 14 TeV collision energy rather than with the initial phase of a down-scoped, two-phase project that might have been buildable with reduced funding. When the LHC project finally gained Council approval in 1996, it was a truly international scientific project with firm financial backing from more than 20 nations worldwide.

And in the final analysis, the LHC was (somewhat fortuitously) much more appropriately sized to its primary scientific goal: the discovery of the Higgs boson. The likelihood that this elusive quarry could turn up at such a low mass as 125 GeV was not well appreciated until the late 1980s, when theories involving supersymmetry began to suggest that such a light Higgs boson might well occur. But by then the SSC dice had been cast — in favor of a gargantuan 40 TeV collider that would be able to uncover the roots of spontaneous symmetry breaking even if such phenomena were to occur at masses as high as 2 TeV.

After that fateful decision, which was endorsed unanimously by a HEPAP subpanel but added billions to the SSC cost, the U.S. high-energy physics community committed itself to an enormous project that became increasingly difficult to sustain politically amidst the worsening fiscal climate of the early 1990s. With the end of the Cold War and subsequent lack of a hoped-for peace dividend during a stubborn recession, the United States had entered a period of austerity not unlike what is occuring today in many developed Western countries. In this constricted fiscal environment, a poorly understood basic-science project experiencing large cost overruns and lacking major foreign contributions posed an easy political target for Congressional budget-cutters to "sacrifice."

A 20 TeV proton collider — or perhaps just a billion-dollar extension of Fermilab facilities such as the Dedicated Collider proposed in 1983 — would likely have survived the budget axe and discovered this light Higgs boson long ago. For another option on the table during the 1983 meetings of the Wojcicki Supbanel was to have continued construction of Brookhaven's CBA/Isabelle collider while beginning design work on an intermediate-energy 4-5 TeV Fermilab machine, whose costs were then projected at about $600 million. This more conservative approach would have maintained the high-energy physics research vitality of these two productive DOE laboratories for at least another decade. And such smaller projects would surely have been more defensible during the economic contractions of the early 1990s, for they accorded better with the U.S. high-energy physics community's diminished political capital in Washington. Their construction would also have proved much easier for physicists to manage and control without having to involve military-industrial engineers.

Instead, the U.S. high-energy physics community elected to "bet the company" on an extremely ambitious 40 TeV collider so large that it would probably have to be sited at a new scientific laboratory in the American Southwest. Such a choice was to abandon the three-laboratory DOE system that had worked so well for nearly two decades and fostered U.S. leadership in the field. Perceived European threats to this hegemony tipped the balance toward making the SSC a national project and away from it becoming a truly international world laboratory as others were advocating.

Unlike historians gazing into the past, however, high-energy physicists do not enjoy the benefit of hindsight when planning a new machine. Guided partly by the dominant theoretical paradigm, they work with a cloudy crystal ball through which they can only guess at phenomena likely to occur in a new energy range, and must plan accordingly. And few can foresee what may transpire in the economic or political realms that might jeopardize such an enormous project requiring about a decade to complete and costing billions of dollars, euro, or Swiss francs — or, relevantly today, a trillion yen. This climate of uncertainty argues for erring on the side of fiscal conservatism and for trying to reduce expenses by building a new machine at an existing laboratory, thus recycling its infrastructure, both physical and human. Such a gradual, incremental approach has been followed successfully at CERN for six decades now, and to a lesser extent at other high-energy physics labs.

But U.S. physicists elected to stray from this well-worn path in the case of the Superconducting Super Collider. It took a giant leap of faith to imagine that they could construct an enormous new collider with over 20 times the energy of any machine that they had previously built, at a green-field site where everything had to be assembled anew from scratch — including its management team — and defend the project before Congress in times of fiscal austerity. A more modest project sited instead at Fermilab (or Brookhaven) would likely have weathered less opposition and still be producing good physics results today. As one leading high-energy physicist acknowledged in hindsight, the SSC was probably "a bridge too far" for this once-powerful scientific community.

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