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Why LaserFest ?
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APS Panel on Public Affairs Tackles Nuclear Non-Proliferation and the Electricity Grid

By Lauren Schenkman

A pair of forthcoming studies by the APS Panel on Public Affairs brings scientific expertise to bear on two modern challenges—strengthening nuclear verification and upgrading America's electricity grid. The studies, slated for publication in early 2010, will clarify the science and technology underlying both issues for an audience of policy makers and politicians.

In an agenda-setting speech in Prague last April, President Obama vowed to reduce and, eventually, eliminate the world's store of nuclear weapons. Since then he has put renewed emphasis on nuclear verification, outlining a replacement for the Strategic Arms Reduction Treaty, shepherding a new resolution through the United Nations Security Council, and planning a key summit on the Nuclear Nonproliferation Treaty next year. Jay Davis, the chair of the POPA nuclear verification study, said that as the world reduces its stockpile, the challenges of verifying nuclear weapons actually increase.

"As you go further down to lower and lower numbers, inspection regimes are more intrusive and more extensive out of necessity," he said. "To go to zero, you have to… put all the production and disposal [of nuclear fuel] under international control, and that has economic and corporate issues associated with it, as well as political and national security issues."

Before retiring in 2002, Davis spent 32 years at Lawrence Livermore National Laboratory as a nuclear physicist. His résumé covers two decades of nuclear policy experience, including leadership in arms control inspections and support of United Nations inspections in Iraq in 1991 and 2001. Davis is leading the panel in examining technology and protocol improvements that could make the tension-fraught waters of nuclear verification easier to

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Three Masters of Light Share 2009 Nobel Prize

The Royal Swedish Academy of Sciences awarded the 2009 physics Nobel Prize on October 6th to three researchers for their work developing optics technology integral to the modern information age. Dubbed "The masters of light," Charles K. Kao won half the prize for his work improving long distance fiber optics, while Willard S. Boyle and George E. Smith shared the other half for developing devices to capture images electronically.

"This year's Nobel Prize in Physics is awarded for two scientific achievements that have helped to shape the foundations of today's networked societies," the academy said in their announcement, "They have created many practical innovations for everyday life and provided new tools for scientific exploration."

While working for the British postal service in 1966, Kao developed a critical underlying principle for much of today's high speed fiber optic cables. At the time, fiber optic cables could only

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A Most Ingenious Paradox

Photo by Ken Cole

The APS Committee on Committees chooses members for all those (and only those) committees that do not choose their own, leading to the question: who chooses the membership of the Committee on Committees? Unperturbed by such logical conundra, the CoC met in late September to consider candidates for open positions on many important APS committees. Shown here tackling some of the tough choices are committee members Heather Galloway, David Hammer, and Paul Wolf.

Physics Majors Pull In High Starting Salaries

Students with a bachelor's degree in physics often receive some of the top starting salaries after graduating from college. A survey by the National Association of Colleges and Employers of starting salaries offered by campus recruiters shows that students graduating with a bachelors in physics can make up to $64,000 per year when starting right out of school. More commonly, the survey found that physics graduates can expect a starting salary between $46,000 and $58,000 per year.

This generally exceeds the starting salaries of graduates in most other science fields. The mean starting salary for a physicist is higher that of graduates who majored in chemistry, psychology or biology. Graduates with physics degrees also tend to outpace other fields outside of the sciences, including those graduating with degrees in marketing, accounting and even finance.

On average, graduates with engineering degrees were one of the few groups whose mean starting offers were higher than physicists. Chemical, electrical, and mechanical engineers' mean starting salary falls between $59,000 and $65,000 per year, while civil engineers are about even with physicists. Computer science degrees yielded average offers similar to those with electrical engineering degrees.

Nation's Capital Hosts APS "April" Meeting in February

The 2010 "April" Meeting will take place between February 13th and 16th at the Marriott Wardman Park Hotel in Washington DC. Though the meeting usually takes place in springtime, this year's has been pushed forward to February, to join with the annual Winter Meeting of the American Association of Physics Teachers, which has been moved from its usual January date. In addition there will be a joint plenary session with the National Society of Black Physicists and the National Society of Hispanic Physicists on February 13th.

Including both APS and AAPT, attendance at the meeting is expected to reach about 2,000. Among the major research fields represented are astrophysics, gravitation, particle physics, cosmology and nuclear physics. All told the APS meeting has scheduled 72 invited sessions, 96 contributed sessions, and three plenary sessions.

APS units participating in the "April" Meeting include the Divisions of Astrophysics, Computational Physics, Nuclear Physics, Particles and Fields, Physics of Beams, and Plasma Physics; Forums on Education, Graduate Student Affairs, History of Physics, International Physics, and Physics and Society; as well as Topical Groups on Energy Research and Applications, Few-Body Systems, Gravitation, Hadronic Physics, Plasma Astrophysics, and Precision Measurement & Fundamental Constants.

The meeting will also be a major kickoff event for the yearlong celebration in 2010 marking the fiftieth anniversary of Theodore Maiman's construction of the first working laser in 1960. To commemorate this historic achievement, APS is sponsoring LaserFest, in partnership with the Optical Society of America and SPIE, emphasizing the history of lasers, their importance in today's society and the importance of basic science research as a whole. Events planned

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Stimulus is both Short and Long Term Investment for National Labs

In addition to supporting local economies, the American Recovery and Reinvestment Act, passed by Congress in February, provided the country's national labs funding to bolster their fundamental physics research programs. The Department of Energy allotted billions of dollars in recovery money to the different labs for research, construction projects, and environmental cleanup.

Despite the infusion of funds, labs are being very conservative about hiring new personnel, opting instead to contract for overdue construction projects, and building improvements. The recovery act was designed to quickly inject billions of dollars of capital into the economy, with the requirement that it all be disbursed by 2011. After that, budgets throughout the government, including the national labs, are expected to return to more or less current levels.

Pier Oddone, director of Fermilab, said that hiring more permanent staff would lead to a budget crisis after the stimulus ended and funding returns to normal. Instead, using the stimulus to buy needed tools eases the requirements on the laboratory's future budgets while at the same time benefitting today's economy.

"The stimulus funding was always represented by the government as a stimulus fund; a onetime thing," said Oddone, "The bulk of the funding…the vast majority is really being put out to industry, so there is no great big shock when the funding stops."

Basic physics research stands to get a big boost from stimulus package. Steve Gourlay, director of the Accelerator and Fusion Research Division at Lawrence Berkeley Lab, highlighted the construction of two long-postponed, large scale experiments. Ground will soon be broken on the Berkeley Lab Laser Accelerator (BELLA) and work has already begun on the Neutralized Drift Compression Experiment Facility (NDCX-II), both relying heavily on stimulus funding.

"They've been in the books for a while," Gourlay said, "Both of

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Members in the Media

"Good or bad, moral or immoral, people are going to make markets and trade via computers, and this is a natural area of financial engineers."

Emanuel Derman, *Columbia University, describing what he sees as the future role of Wall Street "Quants,"* The New York Times*, September 13, 2009.*

"It's a bit of an embarrassment for our field, because what it really means is, we don't seem to understand gravity."

Greg Landsberg*, Brown University, referring to the extreme weakness of gravity compared to the other fundamental forces,* U.S. News and World Report*. September 11, 2009.*

"We have codes to protect buildings in earthquake-prone cities like Toyko…We don't have anything like that in the financial world"

Eugene Stanley*, Boston University,* ABCNews.com*, September 15, 2009.*

"In the post-Cold War era, potential U.S. adversaries will no longer be backed by a state (i.e., the former Soviet Union) posing a strategic threat to the U.S. homeland,"

Dean Wilkening*, Stanford University, taken from a 1995 report for the RAND Corporation predicting the future of conflicts.* Time Magazine*, September 17, 2009.*

"The canceled European deployment would have added only marginally and at high cost to the full coverage of the United States already afforded by the existing ground-based interceptors,"

Richard Garwin*, IBM, on the cancellation of the missile shield program,* USA Today*, September 17, 2009.*

"You can look at each cell rather than averaging it out, and say, 'the cell on vertex number 348 did this,'…When you actually have 10,000 of them to analyze the data, you can understand stat distributions that we normally would not have gotten in ensemble measurements, and that's a huge thing."

Ratnasingham Sooryakumar*, Ohio State University, describing his new technique of manipulating individual cells using magnetic fields,* FoxNews.com*, September 21, 2009.*

"They aren't something you can walk up to and touch, but they are not purely mathematical constructions, either."

Jerrold E. Marsden, *Caltech, describing the complex structures formed in turbulent water,* New York Times*, September 27, 2009.*

"What draws me to Williams, above all else, is the remarkable

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these projects have been waiting on the order of years."

When completed, BELLA will use one of the world's most powerful lasers to accelerate electrons up to 10 GeV over a distance of about a meter. NDCX-II represents the next step in fusion research by probing plasmas at high energy densities. The construction of this new induction linear accelerator, slated for completion in March of 2012, will be funded entirely using stimulus funding.

"The fusion program was looking at a dead end until this came along," Gourlay said, "Funding has been flat for many years"

Though labs are hiring few permanent employees, many are expanding their workforce by taking on more postdoctoral researchers. These positions are typically set up for two to three years, with the possibility of being renewed up to five. Argonne National Lab's Division of Mathematics and Computer Science is taking on additional post-docs to work in their supercomputing division.

"In a way…the post-docs could stand to benefit the most from the recovery because they're getting a career out of it," said Eric Isaacs, director of Argonne, "These are people whose careers are being made with the stimulus funds."

Energy Secretary Steven Chu has said he wants to put greater emphasis on the department's fundamental research sections, hoping that discoveries in these areas will spur innovation in energy technology. Investments at the national labs from the recovery act put them in a strong position to implement the secretary's vision.

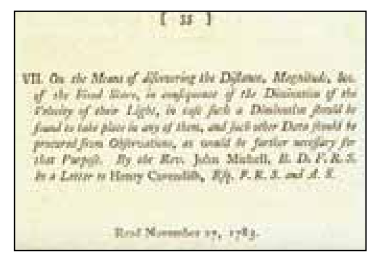
"It's been a great opportunity for us," said Gourlay, "There's going to be a payoff for many years to come."

This Month in Physics History

November 27, 1783: John Michell anticipates black holes

We think of black holes as a 20th century invention, dating back to 1916, when Albert Einstein first published his theory of general relativity and fellow physicist Karl Schwarzschild used those equations to envision a spherical section of spacetime so badly warped around a concentrated mass that it is invisible to the outside world. But the true "father" of the black hole concept was a humble 18th century English rector named John Michell–a man so far ahead of his scientific contemporaries that his ideas languished in obscurity, until they were re-invented more than a century later.

Born in 1724, Michell attended Cambridge University and wound up teaching there for a time, before becoming rector of Thornhill, near the town of Leeds. He is described somewhat unflatteringly in contemporary accounts as "a little short man, of black complexion, and fat," who was nonetheless "esteemed a very ingenious Man, and an excellent Philosopher." For a small-town rector, he had some pretty impressive scientific connections: Benjamin Franklin, Joseph Priestley, and Henry Cavendish all visited him at some point in his career.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VII. On the Means of discovering the Distance, Magnitude, &c. of the Fixed Stars, in consequence of the Diminution of the Velocity of their Light, in case such a Diminution should be found to take place in any of them, and such other Data should be procured from Observations, as would be farther necessary for that Purpose. By the Rev. John Michell, B. D. F. R. S. In a Letter to Henry Cavendish, Esq. F. R. S. and A. S.

Read November 27, 1783.

Michell's research interests spanned several areas of science. He started out looking into magnetism, demonstrating that the magnetic force exerted by each pole of a magnet decreases with the square of the distance. After a major Lisbon earthquake in 1755, he proposed that earthquakes propagate as waves through solid earth, thereby helping establish the field of seismology. He won election to the Royal Society for that insight.

In the realm of physics, he conceived and designed the experimental apparatus later used by Cavendish to measure the force of gravity between masses in the laboratory to obtain the first accurate value for the gravitational constant ("G"). And he was the first to apply statistical methods to astronomy. He studied how stars were distributed in the night sky and argued that there were far more "pairs" or groups or stars than would happen with random alignments. His analysis provided the first evidence for binary stars and star clusters.

But it was a paper Michell wrote in November 1783 to Cavendish–later published in the Royal Society's journal–that proved the most prescient. His intent was not to "invent" exotic objects, but to discover a useful method to determine the mass of a star. Michell adhered to Isaac Newton's corpuscular theory of light, and since light was made of particles, he reasoned that when they were emitted by a star, that star's gravitational pull would reduce their speed, producing an observable shift in the starlight. He thought he could measure how much the speed of light was reduced by passing it through a prism; it ought to be deflected differently because of the reduced energy. He could conceivably compare the refracted images of different stars to determine the difference in their surface gravity, and from that, calculate their respective masses.

It was a sensible enough scheme based on what was known at the time: Ole Roemer had measured the speed of light the century before, so Michell had a ballpark figure with which to work. He also understood the concept of "escape velocity," and that this critical speed would be determined by the mass and size of the star. Specifically, Michell pondered what would happen if a star were so massive, and its gravity so strong, that the escape velocity was equivalent to the speed of light. He concluded:

"If the semi-diameter of a sphere of the same density as the Sun in the proportion of five hundred to one, and by supposing light to be attracted by the same force in proportion to its [mass] with other bodies, all light emitted from such a body would be made to return towards it, by its own proper gravity."

This would render that star invisible to astronomers. He thought there could be many such objects in the universe, undetectable because they emitted no light. Today, astronomers believe there are black holes at the centers of most galaxies.

Michell did think it might be possible to indirectly detect such "dark stars" if they had a luminous "twin" circling them, making him doubly prescient: such binary star systems are indeed one of several different methods modern astronomers use to infer the existence of black holes. He was only wrong about the speed of light: Einstein proved in 1905 that light travels at a constant speed, regardless of the local strength of gravity. Michell's original intent of using this to determine the mass of star would not work, although modern spectroscopy uses identifiable notches in a star's spectrum of light as references for spectral shifts–a similar concept to the scheme Michell proposed.

A few years after Michell's extraordinary insight, mathematician Pierre-Simon Laplace suggested a similar concept of light being trapped by objects with very high gravity in his book, *Exposition du Système du Monde*, published in 1796. "It is therefore possible that the greatest luminous bodies in the universe are on this account invisible," Laplace reasoned.

Newton's corpuscular theory of light lost favor with the scientific community after Thomas Young's 1799 experiment demonstrating that light behaves like a wave, and since Michell's hypothetical "dark star" was based on that assumption, it too was abandoned. Nonetheless, Michell's unexpected insight about trapped particles of light has withstood the test of time. The revolutionary physics breakthroughs in the 20th century, from Einstein and Schwarzschild to Robert Oppenheimer and Stephen Hawking, made the concept almost mainstream. The term "black hole" was coined by physicist John Wheeler in 1968 in a lecture to the American Astronomical Society.

It might be said that John Michell, that short, fat humble village rector, was born under a dark star. He never achieved sufficient escape velocity for his ideas to break out of Thornhill. He died in quiet obscurity, and his notion of a "dark star" was forgotten until his writings re-surfaced in the 1970s. Finally, his ideas found their way into the light.

Image: Title and excerpt from Michell's 1783 paper in which he first described the concept of a "dark star." Source: Philosophical Transactions of the Royal Society of London*, Vol. 74, p.35, 1783*.

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Consulting Firms Make Use of Physics Skills

By Alaina G. Levine

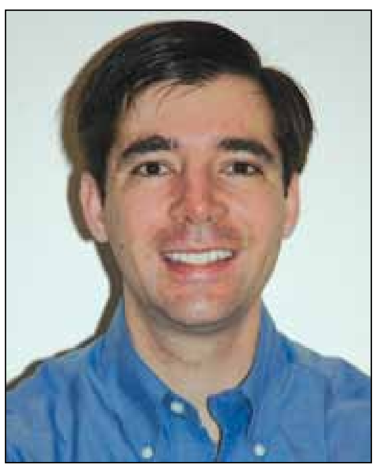
Philip Farese was in the middle of bucolic Princeton contemplating CMB, the field of cosmology, and his career when he came to the realization: "I wasn't god's gift to science."

It was fall 2004 and as he entered his 3rd year as a postdoc at Princeton University, Farese had begun to question whether he wanted to stay in academia. He saw inefficiencies in the way large projects were being run, and he was concerned about whether the research in the future would provide him with the opportunity to be more of the "entrepreneurial, discovery-type" person he was, he recalls.

"I had a sweet deal at Princeton to do stuff," Farese jokes. But as he identified project ideas, "I saw that there were already researchers [pursuing] these ideas. I realized I'm not Einstein… I realized I wasn't going to fundamentally change the world of physics."

Farese started looking around for opportunities in which he felt he could make a difference and found the world of consulting. Through his network at the university, he learned about McKinsey & Company, one of the world's largest and most prestigious management consulting firms.

He joined McKinsey in 2005 and found exactly what he was looking for: opportunities to be entrepreneurial and innovative in an environment that fostered efficiency and growth in large-scale problem solving. Today, Farese is an Engagement Manager and operates out of McKinsey's Stamford, CT location. His job involves working in small teams with other McKinsey consultants to solve business and management problems for clients in the non-profit, technology, and energy/utilities sectors.



Philip Farese

"What an [advanced degreed person] brings to McKinsey is a very sharp analytic mind and sophisticated problem solving," says Farese. "A person with a doctorate, particularly in physics," he argues, can "look at a problem, pull it apart, understand the underlying structure,…[and] understand what you need to know more deeply and systematically to go about solving it." In fact, he continues, "the consulting industry craves physicists, because of the skills they bring to the table."

For example, Farese cites, if he is working with a bank, projects might center on helping the client deal with the fallout of the credit crisis, identify and understand risk of exposure in certain markets, and seek out operational improvements. His advanced degree in physics helps him in the way he approaches problems. Most of the problems consultants solve in their first years at the firm are of a scope set by the client/McKinsey partnership, explains Farese, but at the level of an Engagement Manager and higher, your job involves developing a deeper relationship with the clients and understanding of their business to help them identify potential problems or opportunities on the horizon.

Jay Jubas, whose PhD in physics was awarded by MIT, is a Director (i.e. Senior Partner) with McKinsey. He contends that "technical aspects of physics do not really make much of a difference [here],…[although] most of what we do involves some statistics, some probability," he says. However, "there's a little bit of how to think quantitatively, how to be precise in defining a problem" that comes from learning physics. There is also an indirect "pedigree benefit" from being a physicist, Jubas asserts, in that an advanced degree in science, particularly from a prestigious institution "is a mark that a person is a smart person, an accomplished person," and can help the consultant gain confidence with certain clients.

Out of more than 8,500 consulting staff globally, McKinsey employs over 400 consultants with physics degrees, most of whom have master's or doctorates, says Hillary Harrow, Senior Manager of Advanced Professional Degrees Recruiting.

It is important to note that not all consulting firms focus on the same problems, clients, and industries. While McKinsey solves strategic problems facing senior management in the public, private and social sectors, other firms focus on strategy and technology problem-solving for clients in government and other arenas.

Lee Knauss

Booz Allen Hamilton is one of those firms. Founded in 1914, it employs approximately 340 consultants with physics degrees out of a total of 22,000 consulting staff worldwide, according to Jennifer Lucas, Associate at Booz Allen. Its clients include government agencies, corporations, and non-profits, and its projects are most often technology-related.

Lee Knauss, an Associate with Booz Allen, has a PhD in physics from Lehigh University and 12 years experience working in the technology industry. Knauss joined the firm in early 2008 to help government clients with the funding process for Research and Development projects. He partners with program managers at government funding agencies to provide "support from a technical standpoint," he says.

With technical specialties in quantum computing and semiconductor analysis tools, Knauss supports program managers in developing Broad Agency Announcements and RFPs, and once a program is launched, "we would help with reading proposals [and] advising [program managers] on areas where they may need additional expertise," he explains. "Once the programs are funded, we help the program managers monitor and report on the process of programs through direct interaction with performers, going on site visits, and assisting in program reviews, all of which keep us closely involved with leading edge science."

Knauss enjoys the fact that he works on only a few projects a year. Unlike strategic management consulting firms, a la

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Media Fellow Fills Science Journalism Gap

By Chris Spitzer

There are some places a particle theorist doesn't usually find himself. Perched on a small platform a hundred feet above the forest floor in central Oregon is one of them. But that's where I was, watching the tree tops sway far below an open steel tower while a strong wind threatened to blow me off. In one hand I clutched a safety line with the hope that I wouldn't need to test its strength.

I was researching a story about the amount of carbon that can be sequestered in the Northwest's forests. It was unusual for a physicist, but just another day in the life of a science journalist.

With support from the APS, that's what I became for the summer. I've long been interested in the interface between science and the public, so when I heard about the Mass Media Fellowship Program it sounded like an ideal way to spend the time between graduating from a PhD program and the start of a postdoc.

Physics graduate school offered many new experiences, but few chances to engage people from outside the field. The Fellowship, administered by the American Association for the Advancement of Science, provided exactly that. I received basic training in how to research and write news articles, and went to work as a reporter for *The Oregonian*, a daily newspaper based in Portland.

It was quite a change from what I was accustomed to. I moved from the isolation of a windowless grad student office to a bustling news floor. I could call anyone out of the blue, from lab assistant to heads of institutes, and they were happy to give me hours of their time.

The journalism business moves fast. By the afternoon of my first day I was already in the middle of a story, on the phone with a psychologist in Germany. I wrote two articles that week, which was a pace that lasted through the summer.

With the help of my excellent editors, in my ten weeks at *The Oregonian*, I learned how to take disparate facts about a particular piece of scientific research and weave them into a strong narrative that kept the readers reading. That is, I discovered how to tell the story of discovery, and place ideas in their "big picture" context.

One of the most exciting aspects of this summer was the range of topics I had a chance to cover. Among others, I dived in to hydrogen fuel (stored using chicken feathers, of course), the connection between forests and climate change, and how we learn about human cancer risks using tens of thousands of trout. I also had ample opportunity to write about my own beloved physics and astronomy, and even managed to sneak some dark matter on to the front page.

My editors were very receptive to the stories, which helped them get good placement throughout the paper. I wrote a number of stories for the front page, a centerpiece for the Sustainability section, and even a business cover story.

Whenever a piece went in to print, I got great feedback from the readers. Many sent email or called to say they were glad to see science receive prominent coverage, and others wanted more details of the research I had written about. There was a particularly gratifying moment about halfway through summer when the Editorial department ran a Sunday Letters To The Editor section on the topic of science coverage in *The Oregonian*. It had half a dozen letters encouraging expanded coverage and a reinstatement of the paper's weekly science section, which had been cut a year earlier.

The recent cut in their original science reporting is symptomatic of the financial difficulties that trouble the industry. *The Oregonian* has weathered the storm better than many papers, but has had its share of buyouts that have contributed to a shrinking newsroom. They no longer employ a reporter whose beat is science. This made them all the more happy to have a Mass Media Fellow on board, as it's the only way they can fill that gap in their coverage given the current economic situation.

Over the summer I gained invaluable experience in the art of science communication, and was excited to try to improve the public's understanding of what scientists actually do. I also learned that people will get very excited about science if you give them a chance.

Though I am now about to start a postdoc in particle astrophysics, I hope to continue to develop my skills and incorporate the telling of stories into what I do in the future.

Letters

You Can't Teach Physics by Preaching

Joseph Ganem should be commended for his Back Page article in the October *APS News*. I don't have his experience but I sense he is on the money. I find much of science and math education and outreach is misguided–force feeding of information to young people unable or unready to receive it. In the biographies of great scientists and inventors we continually read of them seeking out knowledge to answer questions of their own formulation–not being proselytized by an army of missionaries. You don't learn how to play baseball by going to Cooperstown or watching ESPN–you learn out on the playground with your peers. We need more critical insight as in this article to move physics ahead.

Tony Loomis
Ridgefield CT

Universe Remains Beyond our Ken

I read with some amusement the two letters about religion in the June, 2009 *APS News*. I recall the admonition of the ancient Hellenes ("Greeks") who said that "When pride blossoms, it reaps a harvest rich in tears." We would do well to avoid stridency or even primacy when it comes to claims that science can inform religion. We are merely creatures who are speculating about the unknown and perhaps unknowable. At present, we can't even predict when some future asteroid or comet will threaten our civilization. I will drolly add, maybe December 23, 2010: Anyway to paraphrase Haldane and Eddington, the universe is not only stranger than we suppose, it is stranger than we can suppose.

Sincerely,

William A. Mendoza
Jacksonville Beach, FL

Carbon Dioxide is Not a Pollutant

I was glad to read that APS is considering a revision to the statement on Global Warming. In the Council's deliberations, I would encourage them to consider the following:

Carbon dioxide is not a pollutant, no matter what the Supreme Court says.

The main greenhouse contributor to the global temperature is atmospheric water.

The concentration of carbon dioxide in the atmosphere is already high enough to absorb almost all the infrared radiation in the main carbon dioxide absorption bands over a distance of only a few km. Thus, even if the atmosphere were heavily laden with carbon dioxide, it would still only cause incremental infrared absorption over current levels.

James McDade
Janesville, WI

Current Climate Statement Moderate, Accurate

I support the current APS Statement on Climate Change. It is a moderate and accurate statement. The proposed statement by Robert Austin et al is a blatant, and political statement, that obscures the issues, and removes the focus from what to do, to whether climate change is occurring. It plays on politically based myths, and prevents a scientific discussion.

The 2007 APS statement is moderate, and does not support unfinished models and analysis, that a different political extreme supports.

Charles Jackson
Huntington Beach, CA

Evidence for Climate Change is Overwhelming

Councillor Robert Austin suggests that APS replace its statement on climate change with a new one. Let's take a look at the proposed alternative:

"Greenhouse gas emissions, such as carbon dioxide, methane, and nitrous oxide, accompany human industrial and agricultural activity.

While substantial concern has been expressed that emissions may cause significant climate change, measured or reconstructed temperature records indicate that 20th/21st century changes are neither exceptional nor persistent, and the historical and geological records show many periods warmer than today. In addition, there is an extensive scientific literature that examines beneficial effects of increased levels of carbon dioxide for both plants and animals."

No climate scientist I know would argue with this paragraph. The problem is that it completely misses the point! Yes, climate is variable. Yes, it has been warmer in the distant past. But CO_2-caused warming is a completely understood, predictable, additional effect. It might be beneficial in certain geographical regions, but the majority of serious scientists rightly worry that large-scale short-term climate change can be dangerous.

They go on:

"Studies of a variety of natural processes, including ocean cycles and solar variability, indicate that they can account for variations in the Earth's climate on the time scale of decades and centuries.

Current climate models appear insufficiently reliable to properly account for natural and anthropogenic contributions to past climate change, much less project future climate."

This paragraph is in direct conflict with state-of-the-art climate models. Solar variability is easily measured and the effects of a variable solar constant are reliably incorporated in all modern climate models. Furthermore, we know how much CO_2 is in the air (direct measurements), that it comes from burning fossil fuel (isotope measurements), and what its warming effects are (measurements and observations of CO_2 absorption levels). It beggars the imagination that serious scientists can ignore this overwhelming evidence.

The possible dangers of a warmer world are serious issues, not to be negated by obfuscating and confused deniers.

Eric Swanson
Pittsburgh, PA

Helping Individuals Matters Most

In her Back Page in the August/September *APS News*, Nina Fedoroff calls on us to help poor countries develop through our expertise in science and technology and by considering ourselves citizens of the world. In 1970, motivated by similar considerations, I went to teach physics in one such country. I'm still sympathetic to this goal, but I doubt that the physics profession can do nearly as much as suggested. Instead, we do well if we help a few individuals from developing countries develop themselves.

One good thing the physics community in rich countries can do is to continue to welcome good physicists and promising physics students from abroad, without consideration of religion, class, race, or gender. Providing an environment that allows individuals to reach their fullest potential, with freedom of speech and thought, is obviously much better than having them remain in countries where their lives would be at risk for one characteristic of good physicists, independent thinking, or where lack of funding or being a member of the wrong group leaves no other choice than to vegetate.

The same issue of *APS News* had one example, the Albanian Blewett-scholar Klejda Bega, but other examples abound. Two famous ones are Einstein, persecuted for being Jewish in pre-war Germany, and Salam, declared heretic in Pakistan for being Ahmadiyya. Their scientific accomplishments were ignored in their countries.

One of the suggestions in the Back Page that I can second without reservation is the free sharing of expertise, by open publication and the web. Such open information sharing is equally useful for scientists in the developed countries themselves; the marginal cost is zero, so scientists in poor countries can share for free.

Of course, physicists can make contributions to developing countries the same way as any citizen, by supporting people who do useful work, by funding their projects, or by political involvement (in your own country). But, I fear that scientific diplomacy as advocated has only a marginal effect, certainly compared to diplomacies that reach many more people such as those associated with music or sports.

Nino R. Pereira
Springfield, VA.

PANEL continued from page 1

navigate.

Davis said weapon states often resist inspections because they inevitably reveal sensitive information that inspectors could pass on. "The problem is, if I measure with high-resolution detectors radiation from a nuclear weapon, I not only know it's a nuclear weapon, I know about its design," he said.

He added that inspectors need detectors that provide dependable analysis while protecting proprietary details.

"It needs to be smart enough to do what you want to do, but dumb enough that it doesn't compromise information," he said.

The other forthcoming POPA study tackles upgrading America's half-century-old electricity grid. Since its birth, the grid has been modernized piecemeal as repairs were made; meanwhile, the percentage of US primary energy used as electricity jumped from 10 to 40 percent. By 2030, the amount of electricity carried by the grid will need to increase by 50 percent in the US and to double worldwide. According to George Crabtree, the chair of the POPA grid study, the grid needs major upgrades to accommodate America's growing energy needs, whether or not American transitions to more renewable energy sources.

"We need to send electricity long distances efficiently and reliably," he said. "It's a challenge; [the grid] is not really built to do that, and it's experiencing trouble responding to demands we have."

Crabtree is a physicist with more than two decades of research experience in superconductivity at Argonne National Laboratory, where he directs the Materials Science Division. He participated in a Department of Energy program that explores the use of superconducting materials in the grid, and served as a congressional witness at a House Science Committee hearing on hydrogen fuel.

Using renewable sources like wind will demand even more from the grid, Crabtree said. The study panel is exploring how storage or coupling with non-renewable but on-demand fuels like natural gas could accommodate the intermittency of wind or solar power.

The panel will also examine "smart grid" technology that incorporates decision-making to make the grid more efficient and reliable. Crabtree said he hopes that the study's technical, far-sighted approach will help policy makers take the right first steps.

"Typically, many people with a vested interest in the grid are not thinking broadly or long term, 20 or 30 years from now," Crabtree said. "We want to take a larger view about what technologies might be developed not only in five years, but also over the next two decades."

Both reports will be produced in a short format by the Panel on Public Affairs, said Francis Slakey, Associate Director of Public Affairs, who initiated the POPA reports as a way to inform Congress on physics-related issues.

"These reports have led directly to new federal programs and changes in government policy," he said, adding that many of them have been carried out in response to a congressional request.

zero gravity

By Michael Lucibella

Washington Dispatch

A bi-monthly update from the APS Office of Public Affairs

ISSUE: Science Research Budgets

Another Continuing Resolution Passed

Because the Senate had not completed consideration of all of its FY10 appropriations bills by the end of the Fiscal Year (September 30), including Energy and Water and Commerce, Justice, Science, Congress had to pass a Continuing Resolution as part of Legislative Branch appropriations bill (H.R. 2918); the CR provides funding for all Executive Branch agencies, including DOE, NIST and NSF, at FY09 levels for another thirty days. It became law on October 1 and is set to expire on October 31, 2009. If the Senate fails to complete consideration of the remainder of its appropriations bills within that time, Congress will be forced to consider another CR to keep the government operating. It is also possible that Congress will have to consider a "mini-bus" to get all the bills done quickly: a "mini-bus" would combine a number of the outstanding appropriations bills into one package so they could then be considered en masse.

DOE/SC Funding

On September 30, the House/Senate Conference Committee agreed on an Energy and Water appropriations bill for FY2010. In sum, the bill includes a total of $27.1 billion for DOE, $318 million above 2009 and $1.3 billion below the Administration request, to fund five primary mission areas: science, energy, environment, nuclear nonproliferation, and national security. The majority of that decrease resulted from Congress providing no FY10 appropriations for the Innovative Technology Guarantee Program. The Administration had requested that Congress provide $1.5 billion. The program was established in the 2005 Energy Policy Act (EPACT) to authorize the Secretary of Energy to make loan guarantees to qualified projects for accelerated commercial use of innovative energy technologies. It is likely that Congress did not fund the Administration's FY10 request because the program had just received $6 billion in the Stimulus Bill. The House passed the Conference report on October 1, with the Senate following suit on October 15th. The next step is for the bill to go to the President for signing into law. Since this bill will be completed by the expiration of the CR, DOE funding will not be part of a possible "mini-bus" funding package. DOE/SC is funded at $4.9 billion, an increase of 2.7% over FY09. It is also a slight increase over the funding level agreed to in the Senate.

NSF and NIST Funding

As of this writing, the full Senate had not yet considered the Commerce, Justice, Science bill, which contains funding for NSF and NIST. Both agencies are therefore subject to the Continuing Resolution passed by Congress. Given the amount of time remaining until the expiration of the CR, it is possible that the CJS bill will be rolled into a "mini-bus" with other funding bills.

ISSUE: Panel on Public Affairs Activities

In addition to reports on nuclear arsenal downsizing and the electric grid, described elsewhere in this issue, POPA approved a proposal for a study which will examine the scarcity of critical elements for new energy technologies. The study will focus on the demands that would be created by a dramatic increase in the need for a rare element, driven by the widespread adoption of a new technology. The study committee is pulling together a list of possible participants and plans to hold a conference at MIT in early 2010.

The Carbon Capture Study, which examines non-biological CO_2 Capture, is in the final stages of review and production and will be available for release in early 2010.

The National Research Policy Subcommittee is examining the general decline of the physical sciences infrastructure at major universities. The subcommittee plans to conference prior to the first POPA meeting of 2010 and will report back on whether there is a need for ongoing investigation.

Suggestions for a POPA study can be submitted at http://www.aps.org/policy/reports/popa-reports/suggestions/index.cfm .

ISSUE: Media Update

Nobel Laureate Burton Richter authored an op-ed in *Roll Call* newspaper on Aug. 3 titled "The Senate Can Improve on the House Bill," suggesting ways to improve the climate change bill, including adding a Clean Energy Technology Fund that would invest $15 billion per year over 10 years to develop affordable, low-emission energy technologies. The op-ed can be read at http://www.aps.org/policy/upload/Dr-RichterRollCallop-ed.pdf.

The Public Relations Committee of the Task Force on American Innovation recently published a brochure on basic research, highlighting innovations that developed from fundamental research at DOE, NSF, NIST, and DOD. The brochure is available at http://www.aps.org/policy/upload/tfai.PDF.

Log on to the APS Web site (http://www.aps.org/public_affairs) for more information.

INTERNATIONAL News

...from the APS Office of International Affairs

Now is the Time for Scientific Globalization

By Rolf Heuer

I hate to start with a cliché, but sometimes there's no better way: the world is getting smaller. Economic slowdowns notwithstanding, the trend is and has for a long time been towards an increasingly joined-up world in which the different regions hold less and less mystery for more and more people. As with all change, there are those who embrace globalization wholeheartedly, and there are those who reject it. The reality is that there are benefits and drawbacks, and as a society it's the job of all of us to maximise the former and minimise the latter.

Science is without a doubt one of the areas that can profit most from globalization, and that in turn will bring benefit to society. Even in areas that have a long experience of international networking, such as my own field of particle physics, we're on the threshold of a great opportunity to build deeper partnerships and to better organize our resources for the common good. This does not mean that the vast wealth of local and regional science needs to suffer. On the contrary, all science can benefit from increased coordination. Small projects can be done locally, larger ones on a regional basis, while some will require global partnerships from the outset. What's important is that all the research be first-class, that our facilities be open to the free-flow of scientists, and that duplication of effort be kept to a minimum. We should ensure that where the science is worth doing, it is done, while being careful to use resources responsibly.

Since I've taken up my role as Director-General of CERN, I've had many opportunities to work with other labs, and my experience has always underlined my conviction that globalization is right for science. The scientific endeavour is collaborative in nature, and that can serve as a model for other walks of life. Right now at CERN, we are repairing the LHC and making it a better machine. In February this year, we set forth an ambitious plan for getting the machine up and running this autumn. In the meantime, the amount of work that has been

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New Edition 12.7% Funnier, Author Claims

By Michael Lucibella

James Kakalios knows that he will be forever linked to the physics of Spiderman. When he started teaching a freshman seminar class in 2001 based on the physics of superheroes, he had little inkling that it would soon lead to a whole series of popular lectures, a popular book, and even a gig consulting on a major Hollywood motion picture. He jokes frequently that even if he were to win three Nobel Prizes, the photo of him surrounded by action figures would be his legacy.

There is of course more to Kakalios than caped crusaders and comic books. In addition to teaching and directing undergraduate studies at the University of Minnesota, he is also a condensed matter experimentalist. His work in disordered systems extends from the properties of amorphous semiconductors to neurological systems and the avalanche dynamics of sand.

Kakalios's book *Physics of Superheroes* originated from an impulse and momentum problem he included on exams nearly fifteen years ago. He asked his students to calculate how much force Spiderman would need to save his girlfriend Gwen Stacey after the nefarious Green Goblin sent her plummeting off the Brooklyn Bridge.

"I was trying to come up with an exam problem related to impulse and momentum that hadn't been done a hundred times already," Kakalios said, "At the time I was just really thrilled to come up with something challenging, a freshman physics problem that hadn't been done before."

He found that students responded well to the question because it presented a real world physics problem cloaked in an approachable pop culture superhero getup. Though caped heroes in spandex wielding super powers may not necessarily seem like "the real world," Kakalios pointed out that most examples in physics books involving helicopters dropping bowling balls and such are so abstract that "those are fiction. There's really no difference."

Kakalios began incorporating more pop culture references in his physics lectures until in 2001 he started teaching a freshman seminar class title "Everything I Know About Science I Learned from Reading Comic Books." In the class every diagram and example Kakalios used was borrowed directly from the pages of comic books.

"It really is a class on the physics of everyday life with instruction in creative problem solving, and it's hidden in an superhero ice cream sundae," Kakalios said, "The point of the class was not the equations themselves… [it was] if you can quantitatively analyze a new situation. How to figure out something you wouldn't expect to be a physics problem and look at it from a physics point of view."

The class required students to break down complex problems into their constituent parts and creatively solve them. Instead of a final exam Kakalios had students pick a character from a comic book and do a scientific analysis of them. Students would come up with original approaches like calculating how many calories the Flash needed to run hundreds of miles an hour. One student used the curve of the Earth in a single panel to extrapolate the height of an airplane flown by a cartoon mouse.

Kakalios found that many of his students enrolled in the course weren't regular comic book readers, and most were from majors outside of the sciences, like history and journalism. They were people who had enjoyed physics in high school and had wanted to learn more but were intimidated by it.

When the Spiderman movie came out in 2002, Kakalios penned an editorial for the *Minneapolis Star Tribune* based on his original exam question about Spiderman's imperiled girlfriend. After his editorial ran, other publications began to take notice of his novel method of teaching physics. The timing

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McKinsey, where one may work on many projects for short periods of time, government consulting is different. "I work on client engagements that tend to be long-term, and will typically work from cradle to grave with program managers on programs which can last up to five years," says Knauss.

Yet there is flexibility in consulting careers, and Knauss acknowledges that at Booz Allen, "a person is not locked into" working on a project for its entire existence. "I joined Booz Allen because of the reputation of the firm…and I found that I could have long-term client engagements and also maintain a work-life balance," he says. "One can stay involved in the science but yet explore other areas in technology and business…The sky is the limit in terms of what you can do and you have the opportunity to pave your own way."

Similarly, at McKinsey, where career development is a company mantra, consultants can move around from project to project, and are assigned a mentor to assist them with professional development. Every employee, says Harrow, is treated as a potential Director (the highest position in the firm) and is given opportunities for skill improvement to achieve this objective.

Indeed, at McKinsey, Booz Allen, and other consulting firms, all consultants can influence the speed at which their careers progress. For many physicists, this flexibility and self-determination to run their own career path is a positive aspect of the industry. "The ability to make a difference," is another feature of consulting that Jubas finds attractive, he says. "The nice thing about a consulting career is our ability to pretty quickly make a substantial difference in a company's performance and an individual's life in that company. It's rare that you can measure success in weeks and months. Consulting tends to be a high intensity interaction–you tend to have quite amount of impact in a short period of time."

Jubas also likes how problems in consulting are defined, which, he recognizes, differs from that in physics and can be a source of surprise and "frustration" for some physicists entering the industry. "When we solve a problem," Jubas explains, "what we mean is we've helped a client make the best possible decision on an issue in a certain context. While our approach is fact-based and analytical, we cannot apply the same level of rigor and proof that you would do to get published in *Physical Review Letters*……If you are the kind of person looking for the perfect answer [to a problem] you may find this career a little frustrating, so one needs to get accustomed to answering a problem in business because it is different than answering a problem in science," he says.

Choosing a consulting career doesn't preclude you from certain types of publishing, however. In July 2009, Farese co-authored a report entitled *Unlocking Energy Efficiency in the US Economy,* which, while co-sponsored by several companies, is an analysis of the energy efficiency potential throughout the nation and the barriers that prevent capturing the potential. It is available on McKinsey's website.

Certainly there are a number of nuances that physicists must learn to happily adjust to the consulting environment. "For me the hardest adjustment was teamwork," says Jubas.

For those physicists interested in consulting careers, sources recommend exploring the different types of consulting firms and the clients they serve. The good news is that there are jobs out there right now–"even during this economic downturn we are looking for people and hiring," says Knauss.

"If you're looking for an opportunity to be involved in helping to guide the direction of science and technology outside the laboratory environment, then [technology and government] consulting can be a very rewarding place do to that," affirms Knauss. "You really can get involved in work that can change the world."

And if one is interested in management consulting, Farese advises "know what you're getting into…You are not going to be coming here and doing physics research anymore per se. You're not going to be researching physical laws, [performing] theoretical calculations, building apparatus, testing samples," he warns. "However the spirit of what you were doing [in physics research] is very much retained, and even accentuated. The idea of having interesting problems to address, getting to use your mind creatively, constructively, [and] being challenged very much still applies."

"What we do is very scientific," Farese adds, and, with a laugh, states the obvious: "Once a physicist, always a physicist."

Alaina G. Levine is a science writer and President of Quantum Success Solutions, a leadership and professional development consulting enterprise. She can be contacted through www.alainalevine.com.

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coincided with a slew of new feature films based on comic books, so news started to travel fast. The Associated Press profiled him which carried his story around the world. Other news outlets started to contact Kakalios as well, including CNN Headline News and the BBC.

Soon after, Gotham Books approached Kakalios to write a book based on his seminar course. In 2005 *The Physics of Superheroes* hit store shelves with *Discover Magazine* naming it one of the top science books of the year. Now in its eleventh printing, the book has been translated into German, Italian and Spanish, with Greek and Korean versions in the works.

The book takes its readers on a superhero guided tour of physics; starting with fundamental forces and motion then working up through thermodynamics, electricity, general relativity, and finally some fundamental quantum mechanics. To make it as accessible as possible, Kakalios intersperses humor with the hard science and opted to focus on the numerous instances where comic books get their physics correct rather than the many times they don't.

"I explained all of physics using only superhero illustrations," Kakalios said, "If you explain it using Spiderman or Superman, their shields aren't up and people will stay engaged."

The book's popularity attracted the attention of Hollywood. In 2007 Ann Merchant, the deputy executive director of communications at the National Academies, asked Kakalios to act as the science advisor for the big-screen adaption of the popular "Watchmen" graphic novel. Kakalios advised the production company on ways to help create a believable fantasy in the film. Actor Billy Crudup, who played the physicist turned superhero Dr. Manhattan, said that talking science with Kakalios helped him get into character. The studio also helped Kakalios produce a series of "The Science of Watchmen" video clips. To date these videos have been downloaded from YouTube over 1.5 million times.

Kakalios is currently putting the finishing touches on an updated edition of his book, due out this month. The new version expands the original book to include the fluid dynamics of Aquaman, the angular momentum of the Human Top, and the material science of the members of the Justice League of America. "I did all the calculations and now the jokes are 12.7 percent funnier," Kakalios said.

James Kakalios

In addition, Kakalios is writing a new book on the importance of quantum mechanics in everyday devices like CD players and cell phones. Even if his new book is as popular as "The Physics of Superheroes," Kakalios still plans to attend comic conventions across the country.

"Comic book fans ask the best questions," Kakalios said, "They're people who enjoy the science and keep up with what's new."

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done far exceeds what I imagined would have been possible back in February. That's happened thanks to the unprecedented level of support that CERN is receiving from other labs, notably Fermilab, in preparing the LHC for a restart later this year. And that in turn is due to the long-standing partnerships the world's particle physics laboratories enjoy.

The LHC work is a very obvious and immediate benefit to CERN, but what I have in mind goes further than simply helping out in time of need. It was recently my privilege to chair the peer review committee on the Canadian TRIUMF Laboratory's new five-year plan. I found the experience most rewarding, and a valuable learning opportunity. TRIUMF's plan sees the lab building through partnership on what it has already achieved. Modern laboratories thrive on partnerships, both around the world and across sectors. We at CERN know all about TRIUMF's commitment to international partnership through the LHC. What the five-year review has allowed me to learn is how the same approach can bear fruit in other areas of our laboratories' work, exploiting the undoubted synergies that exist between our unique, yet complementary facilities. CERN's ISOLDE and many of the facilities at TRIUMF are world-class in their own right, but together they're even stronger.

Globalization is nothing new for particle physics. My field has always worked globally. When CERN was established in the 1950s, the Brookhaven laboratory was CERN's natural American partner and competitor. Competition was fierce, though not in the traditional sense of the word. Then as now, our objectives were shared and although each lab wanted to be first, the overriding goal was generating knowledge and innovation for the common good. Back then, when Brookhaven scientists developed a new beam-focusing technique, their instinct was to share it with CERN. The result was that our 10 GeV proton synchrotron (PS) became a 25 GeV machine. When the PS started up 50 years ago, Hildred Blewett from Brookhaven even came to CERN to help us commission it. In return, her European experience traveled back with her to Brookhaven, which was just about to commission its own proton synchrotron, the AGS. After the PS and the AGS came a series of competing, yet complementary facilities on both sides of the Atlantic. By the time we reached the end of the 80s and CERN's LEP machine was running, the size of the collaborations had grown to the extent that one young CERN scientist was inspired to invent a new communication tool: the World Wide Web. And it's no accident that the first American web site was put up by CERN's stiffest US competitor at the time, the Stanford Linear Accelerator Center. So yes we're in competition, but it's a healthy competition that benefits us all–regardless of where the discoveries and technological advances are made.

There has always been a healthy exchange of particle physicists between the Americas, Asia, and Europe. Particle physicists from around the world have always been welcome at any laboratory with the infrastructure needed for their research. With the LHC, however, this exchange has reached a new level. Just as before, CERN maintains an open door policy and we have over 100 nationalities in our user community. Although originally a European project, the LHC is becoming the global focus for particle physics, and it is safe to assume that future projects of a similar scale will be conceived as global from the start, wherever they end up being built.

To prepare for this future, the CERN Council has established a working group on the geographical and scientific enlargement of CERN. This is, in my opinion, a necessary step for Europe to redefine its role on the global stage. The group will pave the way for CERN to play the role it was created for–coordinating fundamental particle physics research in Europe, and representing Europe on the world stage. In another development, the world's funding bodies for particle physics have been holding regular meetings for several years now.

It is processes like these that will allow our field to remain healthy on all levels. And what is true for particle physics is, I believe, true for science as a whole. The future of science will be healthiest if there are strong national, regional and global projects, all coordinated on a global scale. Today, globalization is a fact of life, and the scientific community can set an example showing the benefit of working together.

Rolf-Dieter Heuer is the Director-General of CERN, a post he assumed in January, 2009. He had previously been Research Director for particle and astroparticle physics at the DESY laboratory in Hamburg.

MEMBERS continued from page 2

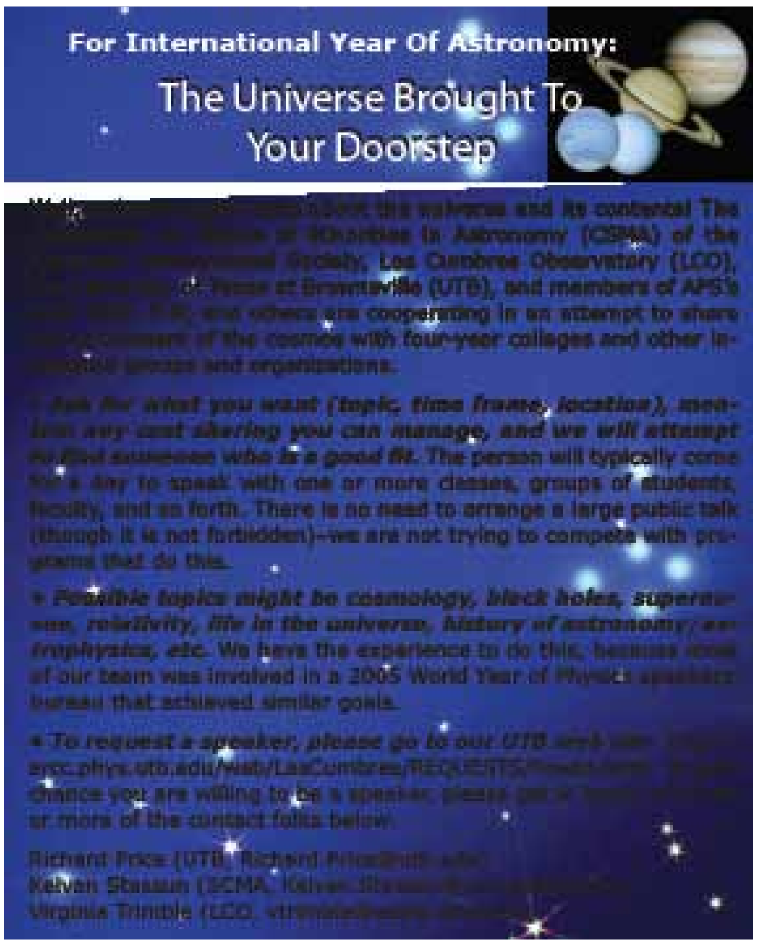
community of faculty, students, staff, and alumni that define the college,"

Adam Falk, *Williams College, on being named the next president of Williams College,* The Boston Globe, *September 29, 2009.*

"There's nothing you can get at the LHC that can do any damage to anybody, except a hammer,"

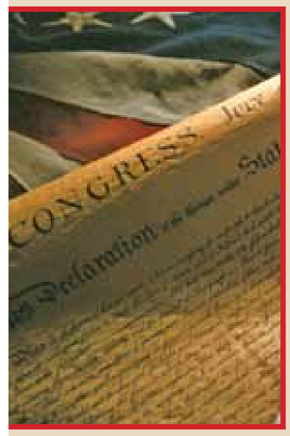
Sheldon Stone, *Syracuse University, on the potential threat posed by a data analyst at CERN accused of having links to Al Qaeda,* Christian Science Monitor, *October 13, 2009.*

ANNOUNCEMENTS



APS Congressional Science Fellowship 2010-2011

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



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

TERM OF APPOINTMENT is one year, beginning in September of 2010 with participation in a two-week orientation sponsored by AAAS. Fellows have considerable choice in congressional assignments.

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

APPLICATION should consist of a letter of intent of no more than two-pages, a two-page resume: with one additional page for publications, and three letters of reference. Please see the APS website (http://www.aps.org/policy/fellowships/congressional.cfm) for detailed information on materials required for applying and other information on the program.

ALL APPLICATION MATERIALS MUST BE SUBMITTED ONLINE BY JANUARY 15, 2010.

childcare grants available!

small grants of up to $400

who is eligible

Parents/caregivers who plan to attend the APS March or April (February) meeting with their small children or who incur extra costs to bring them along or leave them at home. Preference is given to early career applicants.

deadline

Apply by Dec 15 (for February) or January 15 (for March)

March Meeting details at
http://www.aps.org/meetings/march/services/index.cfm

April Meeting (February) details at
http://www.aps.org/meetings/april/services/index.cfm

These grants are made possible by funds from the Elsevier Foundation and the American Physical Society.

Professional Skills Development for Women Physicists

Improve your negotiation skills and learn to communicate your great ideas to your colleagues.

When
Friday, February 12, 2010, Washington, DC
Sunday, March 14, 2010, Portland, Oregon

Who may apply
Women postdoctoral associates and women faculty in physics. Each workshop will have one session aimed at postdocs and one session aimed at women faculty.

Deadlines to apply
November 9, 2009 (for February 12)
December 7, 2009 (for March 14)

First consideration will be given to applications received by the deadlines. Workshops will be limited in size for optimal benefit. Women of color are warmly encouraged to apply.

Participants are eligible to receive a stipend to help cover the cost of travel and up to two nights lodging.

Details at http://www.aps.org/programs/women/workshops/skills/index.cfm

These workshops are funded by a grant from the National Science Foundation.

Now Appearing in RMP: Recently Posted Reviews and Colloquia

You will find the following in the online edition of *Reviews of Modern Physics* at http://rmp.aps.org

The security of practical quantum key distribution

Valerio Scarani, Helle Bechmann-Pasquinucci, Nicolas J. Cerf, Miroslav Dušek, Norbert Lütkenhaus and Momtchil Peev

Quantum mechanics offers us a new way for secure communication. Photons prepared in certain quantum states can be used to distribute a key–a random string of bits–between two partners, which can be used to encode secret messages. Any eavesdropper who tries to obtain the key will distort the quantum states, something which can be detected. In practical applications, the noise induced by the environment will be indistinguishable from that coming from a potential eavesdropper, something which may compromise the security of the transmission. This paper reviews different methods to assess the security of most practical key distribution protocols in the presence of any kind of noise.

MEETING continued from page 1

throughout the year will include traveling shows, public exhibitions, videos, and educational materials for schools across the country. On Monday February 15th, Nobel laureate Theodor Hänsch, director of the Max-Planck-Institut für Quantenoptik in Germany, will deliver a public lecture at the meeting entitled "From edible lasers to the search for earth-like planets –five decades of laser spectroscopy."

Other meeting events will include a joint APS and AAPT job fair with dozens of potential employers registered to attend. There will also be a special Graduate Student Career Panel and Networking Reception with guidance for students looking to start their careers in the physical sciences. AAPT will be holding a series of workshops aimed at educators which APS meeting participants can also attend. Topics range from improving physics fundamentals for physics teachers, to teaching nuclear forensics and how the Nintendo Wii can be used in a classroom. Costs for these courses range from $35 to $115.

Although the deadline for submitting an abstract was October 23rd, post-deadline abstracts received before December 18th will be assigned space for a poster presentation, dependent on availability. Early registration ends December 11th. Stay tuned to the APS website (www.aps.org) for more details and timely updates.

"April" Meeting Plenaries Highlight Exciting Research

This year's three plenary sessions promise to highlight some of the best and most exciting physics research in the country.

At press time, APS is awaiting the invited speakers' confirmation for the first plenary session. It will be held on **Saturday February 13 from 4 to 6 pm**.

The second session, scheduled for **Monday the 15th from 8:30 to 10:30 am**, will feature a talk by the retired Chairman and CEO of Lockheed Martin, Norman R. Augustine. In addition, Judith Lean from the Naval Research Laboratory will talk on "Surface Temperature Responses to Natural and Anthropogenic Influences: Past, Present and Future" and Naomi Makins of the University of Illinois will speak on "The Nucleon Spin Puzzle."

At the final session, scheduled for **Tuesday the 16th from 8:30 to 10:30 am**, William Borucki of NASA's Ames Research Center will present "Early Results from the Kepler Mission," John Carlstrom from the University of Chicago will speak on "Cosmology with the Cosmic Microwave Background," and Rob Roser of Fermilab will talk on "The Search for the Higgs Bosons, and More, at the Tevatron Collider."

PRIZE continued from page 1

transfer a signal a few tens of meters, but with Kao's research, cables were soon made to transmit signals over 100 kilometers. He found that transmitting light pulses through the center of an extremely pure glass fiber, rather than along its surface, dramatically reduced signal degradation, allowing for data transfer over much greater distances. Kao shared APS's James C. McGroddy Prize for New Materials in 1989 for his work developing modern fiber optics.

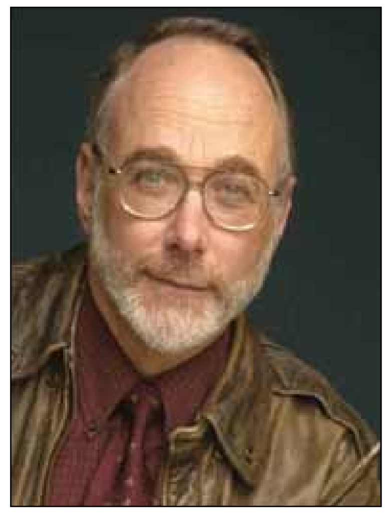
Boyle and Smith worked at Bell Labs in 1969, originally attempting to design a new memory system that used the photoelectric effect to convert photons into electronic memory. The technology worked poorly to store information, but expanding on their original work, the two researchers soon created "charged-coupled devices" which could easily capture digital images. Within six years of their paper, the two created a video camera with a high enough resolution to be used for TV broadcasts. Today most digital cameras, ranging from small cell phone cameras to the Hubble Space Telescope's wide field camera, use CCDs to capture images. Boyle is a fellow of the American Physical Society.

"We extend our sincere congratulations to all three Physics Nobel Laureates," said APS president Cherry Murray, "We are particularly pleased that we can count Boyle among our distinguished APS Fellows, and that the APS had the foresight twenty years ago to honor Kao for his pioneering work on optical fibers. If it weren't for the contributions of all three of these outstanding physicists, the revolutionary advances in information technology we've witnessed in recent decades could never have been possible."

The Back Page

Why We're Celebrating LaserFest

By Thomas M. Baer



On May 16, 1960, working at Hughes Research Laboratories in Malibu, California, Theodore Maiman and his co-workers C. K. Asawa and I. J. D'Haenens switched on a makeshift device that they had assembled, and hoped for the best. The device was revolutionary, yet deceptively simple and elegant–its essence was a powerful coiled flash lamp surrounding a synthetic, single-crystal ruby rod. The brilliant pulsed lamp excited chromium ions in the ruby, which then emitted a bright fluorescent pulse of red light. But the experimenters looked more closely and saw what they were hoping for, something much more unusual: a telltale burst of coherent radiation superimposed on the normal fluorescence. This team had just created the first working example of a laser.

Forty-three years earlier, Einstein had predicted the phenomenon of stimulated emission, whereby a photon interacts with an excited molecule or atom and causes the emission of a second photon having the same frequency, phase, polarization and direction. In the early fifties, Charles Townes and collaborators at Columbia, and Basov and Prokhorov in the USSR, invented the maser, which stands for Microwave Amplification by Stimulated Emission of Radiation. Masers were the first devices to use stimulated emission to amplify photons, in this case microwaves. These first masers, four-energy-level gaseous systems, using ammonia as the active medium, could continuously sustain a population inversion and oscillation.

In the late fifties, Townes turned his attention to the challenge of using stimulated emission to amplify shorter wavelength visible photons. He and Arthur Schawlow wrote a lengthy theoretical paper in *Physical Review* in 1958 describing in great detail the principles of the laser, which Townes dubbed the optical maser, and submitted a patent application that same year. The Townes and Schawlow paper generated considerable scientific interest, especially with experimentalists who raced to build the first laser.

Maiman's group won the race and subsequently wrote a short paper describing the first laser, which was submitted to and rejected by a prominent physics journal. However, soon thereafter a shorter version was accepted and published in the August 6, 1960 edition of *Nature*. Maiman's success initially passed almost unnoticed among the general public, and failed to get much recognition even within the scientific community.

In the early days, lasers were labeled as "a solution in search of a problem", because no one had demonstrated useful applications outside of scientific research. But as time went on, and new, more compact, reliable and efficient lasers were developed, applications proliferated. In 1974, supermarket barcode scanners improved customer checkout times and introduced the public to the first practical application of the laser. The laserdisc video player, launched in 1978, utilized a He-Ne gas laser first developed right after the ruby laser and was the first true consumer product to include a laser. More reliable and efficient diode lasers, available in 1982, made possible the compact audio CD player, the first widely accepted laser-equipped consumer device. Today multiple laser sources emitting from the deep blue to the mid-infrared are found in blue ray disk players, laser printers, and fiber optic modems in homes throughout the world.

Beyond these ubiquitous household devices, lasers now significantly impact many aspects of our lives–from communications to environmental monitoring, from manufacturing to medicine, from entertainment to scientific research. These many uses stem from the unique properties of the laser.

The unique temporal coherence properties of the laser beam make it perfect for telecommunications. First developed in the 1970s, laser-based fiber optic telecommunication systems have revolutionized the communications industry and played a major role in the advent of the internet and the information age. Because of its many advantages over purely electronic systems, the use of lasers and optical fiber have replaced copper-wire-based networks in long-haul communication systems throughout the developed world. Charles Kao shared the Nobel Prize in physics this year for his seminal contributions to this area.

The laser's spatial coherence gives it the ability to achieve high intensities when focused, making it ideal for slicing through thick plates of steel or as a precision surgical scalpel. Lasers are capable of generating large, controllable quantities of optical energy and delivering it at intensities sufficient to produce permanent changes in materials. This new form of industrial energy has led to a wide range of laser-based manufacturing processes, such as cutting, welding, surface treatment, bending, cleaning, rapid prototyping, direct casting, and so on. From automobiles to cell phones, computer memory chips to high definition TVs, designer clothing to shelled peanuts, it is challenging to find a consumer product that was not in some way touched by a laser.

The earliest use of a laser in medicine occurred in December 1961: Columbia-Presbyterian Hospital used a ruby laser on a human for the first time, destroying a retinal tumor. The use of lasers in medicine has grown steadily. Today lasers are commonly used by surgeons, providing a precise, sterile surgical tool, capable of delivering high energies via fiber optic cables, minimally invasively, to areas of the body that are difficult to reach by other means.

The vivid bright colors of lasers, which make them very valuable to the entertainment industry, where they are often used in dramatic light shows, also provide scientists with a research tool par excellence. The laser has led to innumerable breakthroughs in physics, chemistry, biology, geophysics, and astrophysics.

In 2010, fifty years after Maiman's team created the first man-made burst of laser light on Earth, we are commemorating that achievement in a celebration called LaserFest. Three of the leading professional societies in laser research, APS, the Optical Society (OSA), and SPIE, are spearheading the celebration. One goal of LaserFest is honoring the original laser pioneers, both scientists and entrepreneurs. A second goal is highlighting for the general public the laser as one of the best examples of innovation; basic scientific research translating into technology resulting in great economic benefit. Yet a third goal is inspiring young people to pursue careers in optical science and engineering.

The three societies are organizing many LaserFest activities. These include "LaserFest on the Road"; traveling outreach teams will design laser demonstrations and take them on the road to schools, theaters and other venues. The societies are producing downloadable, educational videos that will be posted on the LaserFest website (www.laserfest.org) which can be shown at appropriate events. Web-based educational modules are being designed that will allow teachers to integrate material involving lasers into their curricula. The Laser Days project will involve outreach activities by student chapters of the sponsoring societies which are located at a large number of colleges and universities.

LaserFest extends far beyond APS, OSA and SPIE, involving many organizations from the broader scientific and engineering communities. Already an impressive number of organizations have joined as participants. Many opportunities exist for individuals to become involved: public lectures, open houses in laser research labs, laser demos, writing articles for newspapers, newsletters and blogs–all will be crucial to LaserFest's success.

OSA and APS are organizing several Capitol Hill events coinciding with the joint APS/AAPT meeting and the OSA Leadership Meeting in Washington next February. In addition, LaserFest will be a part of the DC Science Festival that is scheduled to take place in the fall of 2010. We encourage all members to use LaserFest as an opportunity to contact your representatives in Congress and speak with them about the importance of scientific research to the economy and security of the nation.

LaserFest celebrates not only the past 50 years of laser innovation but also the amazing developments occurring today. Today's lasers create the hottest temperatures on Earth, equal to temperatures in the inner core of the sun. Lasers also create the coldest temperatures on Earth, ten orders of magnitude colder than liquid nitrogen, opening up new areas of research including Bose Einstein Condensates. New laser instruments generate pulses that are short enough to take "flash pictures" of electron motion in atoms in molecules. Frequency stabilized lasers are now so accurate that they are being used to probe possible changes in fundamental physical constants as the universe expands. Lasers are clearly going where no laser has gone before.

Thomas M. Baer is the Executive Director of the Stanford Photonics Research Center. He is serving as OSA President in 2009.

Some Current and Future Laser Applications

I. Lasers Enhance Medicine and Biology

- ***Laser-based medical imaging:*** New medical imaging technology allows doctors to use laser light to probe microscopic structures deep within living tissues, and study in unprecedented detail breast cancer and retinal diseases.
- ***Lasers for earliest disease diagnosis:*** Lasers are being used to identify diseases at their earliest stages. Preliminary trials are starting for a laser-based technique that may allow Alzheimer's disease to be detected decades before neurological symptoms appear.
- ***Third generation gene sequencing instruments:*** Laser-based instruments will allow cost-effective sequencing of complete human genomes which may provide the basis for individually optimized preventive and therapeutic strategies.

II. Lasers Boost Energy Applications

- ***Laser fusion:*** The National Ignition Facility is conducting tests of the world's largest laser system, which, if successful, may open the door to laser fusion, and hopefully provide an almost limitless, carbon-free energy source.
- ***Lasers for transportation and emissions:*** Laser-based ignition can be used in internal combustion engines to increase fuel efficiency and reduce harmful emissions.
- ***Environmental sensing with lasers:*** Laser remote sensing techniques, can be used for global monitoring of environmental pollutants in the atmospheric and oceans,

III. Lasers Improve Commerce, Manufacturing and Production

- ***Lasers for manufacturing:*** High-power fiber and ceramic material lasers can cut through three inches of solid steel in mere seconds, expediting many manufacturing processes.
- ***Inspecting packages:*** Using laser-generated gamma rays or terahertz radiation we can peer inside dense objects, monitor cargo transport, and determine the presence of radioactive materials remotely.

IV. Lasers Transform Electronics, Computing, and Communications

- ***Completely secure networks:*** Lasers are enabling Quantum Encryption techniques with the potential to safeguard Internet communication through secure Quantum Key Distribution technology, essential for safe guarding online financial transactions.
- ***Smart Materials:*** Bridges, aircraft wings and other structures built with embedded fiber-optic strain sensors will allow detection of impending structural failure, well before disaster strikes.
- ***Laser free space communications:*** Wide bandwidth laser communication links will allow satellites to transfer information around the globe at gigahertz and possibly terahertz rates.

V. Potential for Basic Discovery

Entirely new research capabilities are being enabled by lasers that allow scientists to study physics processes that cannot be studied in other ways. For example:

- ***Gravitational Wave Detection:*** Instruments such as the Laser Interferometer Gravitational Observatory (LIGO) and the Laser Interferometer Satellite Antenna (LISA) will enable detection of gravity waves for the first time.
- ***Relativistic Collision Studies:*** The exceptionally high fields associated with intense short-pulse lasers may make possible studies of relativistic collisions of particles traveling near the speed of light using instruments several orders of magnitude smaller and cheaper than existing accelerators.
- ***Archeology: Fossils, ancient textiles, and medieval art objects*** can be probed noninvasively and analyzed using lasers to uncover hidden details. For example, laser diagnostic techniques make possible the identification of still intact dinosaur proteins.