APS NEWS

A PUBLICATION OF THE AMERICAN PHYSICAL SOCIETY • WWW.APS.ORG/PUBLICATIONS/APSNEWS

April 2009
Volume 18, No. 4
www.aps.org/publications/apsnews

Stacks and Stacks of Letters
Pages 4-5

400 Years of Telescopes, and More, at APS April Meeting

This year's April Meeting, May 2nd–5th in Denver, Colorado, promises to feature the best in cutting-edge research in particle, nuclear and astrophysics, and related areas. In addition, the meeting will take place jointly with the Sherwood Conference on Fusion Theory. In honor of the 400th anniversary of Galileo's first observations of the heavens with more than just the naked eye, the overall theme of the meeting is "New Eyes on the Universe: 400 Years of Telescopes."

Keynote speaker **Richard Ellis** from Caltech expands on the theme for his Sunday night talk "The Quest for Giant Telescopes: Four Centuries of Challenge and Scientific Discovery."

Two town meetings are planned for evening sessions. On Saturday, **Neil Gehrels** of NASA's Goddard Space Flight Center, and others, will speak and answer questions about the DOE/NASA Joint Dark Energy Mission. On Monday, members of the National Research Council Astronomy and Astrophysics Decadal Survey Committee, chaired by **Roger Blandford**, will present their plans, with discussion to follow.

The annual APS Prizes and Awards ceremony will be held on Sunday, honoring the significant contributions of 16 individuals.

The nine scheduled Plenary Lectures will cover a wide range of topics. Among them: **Joan Centrella** of NASA/Goddard on merging black holes; **Alexander Zholent** of LBNL describing some of the next generation of microscopes; **Paris Sphicas** from the University of Athens, Greece, on the Large Hadron Collider; **Richard Muller** of the University of California, Berkeley, on evaluating the terrorist threat. The complete list of plenary speakers is available on the web.

A lecture for the public will be given by **Phil Plait**, author, blogger and self-described "Bad Astronomer." He will detail the different ways the universe might do in planet Earth once and for all, and what we might do about it. His talk "Death from the Skies," drawing from his book of the same name, depicts cataclysmic events ranging from meteorite impacts to nearby gamma ray bursts.

This year's meeting boasts over 75 invited sessions and 100 contributed sessions. Some of the highlights include:

Paul Stankus of Oak Ridge National Laboratory describing the latest experiments on the quark-gluon plasma; **Michael Watkins** of Caltech on ways to use gravity to map climate change; and, in conjunction with the simultaneous Sherwood Fusion Theory Conference, **Steven Cowley** of UKAEA Culham tracing the history of fusion research. The full program is on the web at www.aps.org/meetings/april/index.cfm .

Physics Is Flourishing

Readership has been growing for the online publication *Physics,* launched last fall by APS. The publication features articles summarizing the most interesting and important results in the *Physical Review* journals. The articles in *Physics* are aimed at a broad readership of physicists and scientists in related areas. *Physics* is freely available online at physics.aps.org.

About 16,000 people visited the site in the first week in February. The number of site visits has been increasing steadily since the publication was launched, growing at a rate of about 15% per month since last fall.

David Voss, editor of *Physics*, notes that another indicator of the growing popularity of *Physics* is that when one types "physics" into a Google search, the APS publication comes up among the first several results.

Photo by Ken Cole

David Voss

Physics publishes three types of articles: "Viewpoints," short pieces of about 1000-1500 words, focus on a specific paper in *PRL* or *PR A-E*., explaining and discussing the significance of the work. Longer pieces, called "Trends," highlight areas of current research, reviewing recent results and identifying questions and directions for more research, and "Synopses," which are short (150-200 word) items written by APS journal editors explaining recent papers of particular interest. Several "synopses" are published each week, along with one or two "viewpoints," while "trends" come out somewhat less frequently.

APS Video Contest Features Physics of Toys

The APS public outreach department is encouraging physics enthusiasts of all ages to "bounce, spin, jump and splash your way into physics history" by entering a new physics video contest. The "toy box physics" video contest challenges participants to create a short You-Tube video that demonstrates the physics behind toys such as slinky, dippy birds, yo-yos, and more.

Last year, the APS outreach department held its first video contest, the "nanobowl," in which entrants created videos explaining some aspect of the physics of football. Following the success of that effort, the outreach department is sponsoring another contest this year. "We realized there is a lot of physics in toys, and we thought that would be a good idea for our next video contest," said Becky Thompson-Flagg, head of public outreach at APS.

Contest entrants are encouraged to be imaginative. "We're excited to see what people come up with," said Thompson-Flagg. Fun, interesting videos that correctly explain the physics will impress the judges more than high production quality.

Last year's contest attracted 27 entries; the outreach department expects an even greater response this year. APS hopes to receive submissions from physicists and from students of all ages. Professors could encourage their students to enter, suggests Thompson-Flagg.

Last year the prize for the best entry in the "nanobowl" video contest was $1000 and a "nano-trophy," a silicon chip etched with a nanoscale football field and helmet, made by Harold Craighead's research lab at Cornell University. This year, in addition to $1000, the winner will receive a trophy made by the APS outreach staff out of physics related toys. Unlike last year's trophy, this year's will actually be visible to the naked eye.

The submitted videos will be posted on You Tube with the tag "toy box physics" and on the physicscentral.com website. Since the videos will be fun and educational, teachers could use them in their classes as teaching tools.

APS recommends videos be no more than two minutes long, but longer videos will be accepted. The contest deadline is May 26. Contest rules and instructions for submitting a video are online at physicscentral.com.

Subscription Revenue, Membership Numbers Hold Steady Despite Downturn

The recent financial meltdown that has affected broad sectors of the economy has thus far left the operations of APS largely unscathed. Though the Society's reserve fund has taken a hit from declining stock values, there has only been a muted effect on operations.

"Given the financial climate of the world we're not doing badly," said APS Treasurer/Publisher Joe Serene, adding that while "nobody's doing well," APS has been able to avoid much of the fallout from the chaos on Wall Street.

As of this writing in early March, the reserve fund has fallen from a peak of around $105 million at the beginning of 2008 to around $75 million, down by about 29 percent. Though significant, the loss is less acute than in many other sections of the economy. During the same period the Dow Jones Industrial Average, S&P 500 and NASDAQ each fell nearly 50 percent. The reserve fund is conservatively invested by Towneley Capital Management across 21 highly diversified mutual funds and a hedge fund.

As matters stand, the losses in the reserve fund should not affect the operations of APS in 2009. There are no expected reductions in personnel and no budget cuts for planned programs for the year.

In recent years, APS has used very little of its invested reserve fund to finance its operations. The majority of the organization's income comes from revenue generated by its journal publications. For the last 4 years, this net revenue has covered nearly all of the Society's operating expenses, allowing the profits from the reserve fund from the preceding surplus years to be reinvested.

REVENUE continued on page 7

Prize and Award Nominations Now Electronic

In the past, anyone submitting a nomination for an APS prize or award was instructed to mail 5 copies to the Chair of the relevant selection committee.

No more. Starting with this year's selection cycle, nominators who go to the web page of a particular prize or award will find themselves but a click away from the new online nomination system. Nominations submitted through the system are uploaded to a database that will be accessible to members of the selection committee once the nomination deadline has passed.

Because nominations are active for 3 cycles, there are a lot of paper nominations, as well as some in various electronic formats, still in the hands of selection committee chairs. These should be sent to APS Honors Program Administrator Shelly Johnston (johnston@aps.org, 301-209-3268) who will scan them in if necessary, and enter them into the system. Johnston is also the person to contact if any bugs are detected by nominators as they experience the system's maiden voyage.

Thirty-nine and Counting

Photo by Ken Cole

On February 28, APS held its annual Unit Convocation for officers of its Divisions, Topical Groups, Forums, and Sections. Eighty-three officers, representing all 39 units, attended the event at APS headquarters in College Park, MD. About 50 of them arrived a day early to participate in visits to Capitol Hill to lobby for science. In the picture, during one of the breakout sessions, APS Director of Membership Trish Lettieri (left) explains the intricacies of enhancing unit membership to (l to r): Noemie Koller, Chair-elect of the Forum on International Physics; Chris Fasano, Chair-elect of the new Prairie Section; and Terry Sheridan, Chair-elect of the Ohio-region Section.

Members in the Media

"I didn't imagine I would ever visit Riyadh. We will need more money, but $2.7 million by itself is really helpful. We now have a clear end in sight."

***Francis Everitt**, Stanford University, on getting a grant from Saudi Arabia for Gravity Probe B,* The New York Times*, February 17, 2009*

"It will provide advanced tools for discovery-class science in condensed matter and materials physics, chemistry, and biology –science that ultimately will enhance national and energy security and help drive abundant, safe, and clean energy technologies."

***Steven Dierker,** Brookhaven National Laboratory, on the planned National Synchrotron Light Source II,* Newsday*, February 12, 2009*

"We now have a very, very good chance that we will see hints of the Higgs before the LHC will." "It's a race. Whoever is first is first."

***Dmitri Denisov,** Fermilab,* BBC news.com *February 17, 2009*

"If they do find the Higgs, good luck to them. But I think it's unlikely they will find it before the LHC comes online. "

***Lyn Evans,** CERN,* BBC News.com, *February 17, 2009*

"The stereotype is boys are good at math, and you're not going to have a life if you do science. It's not true."

***Jennifer Doebbler,** Argonne National Laboratory, at an event encouraging girls to do science,* South Town Star *(Illinois), February 20, 2009*

"It was an important demonstration to make things this small and prove that we can do this. But whether it is feasible depends on many details."

***Jeremy Levy,** University of Pittsburgh, on a new transistor he designed that is only 2 nm wide,* Pittsburgh Post-Gazette*, February* 20, 2009

"This is a miracle, I think. It is redressing this terrible problem where the success rate for excellent proposals was very low."

***A. J. Stewart Smith**, Princeton University, on research funding in the economic stimulus bill,* The New York Times*, February 24, 2009*

"Everything you can think of that is a renewable–or somewhat more renewable–energy option has roadblocks to it, and it needs a science solution."

***George Crabtree**, Argonne National Laboratory,* Los Angeles Times*, February 23, 2009*

"It is a disservice to society to say that only people who are devoted 24 hours a day to their careers can be scientists. Other people can make important contributions."

***Rachel Wortis,** Trent University,* Forbes.com*, March 6, 2009*

"We have a plan going forward where we can reduce what could have been years down to months, and we feel very strongly that this thing will work."

***Steven Chu**, Secretary of Energy, announcing his plan to speed up the integration of green technology outlined in the stimulus package,* Atlantic Monthly*, February 24, 2009*

"We really need to be careful about our openness to the world."

***John H. Marburger III,** former science advisor to the Bush administration, explaining how it should be easier for students to gain access to United States universities,* The New York Times*, March 3, 2009.*

"The more pieces of debris up there, the more chance you'll have another collision. Near Earth, space is really very crowded."

***Geoffrey Forden,** MIT, describing how Earth's orbit is full of space junk,* The Wall Street Journal*, February 26, 2009.*

"We just don't know … I think people should be worried."

***David Albright,** Institute for Science and International Security, speculating on what Iran's intent might be for enriching uranium.* Newsweek*, February 28, 2009.*

"Options theory is kind of deep in some way. It was very elegant; it had the quality of physics,"

***Emanuel Derman**, explaining why he left the world of research physics to pursue finance,* The New York Times*, March 10, 2009*

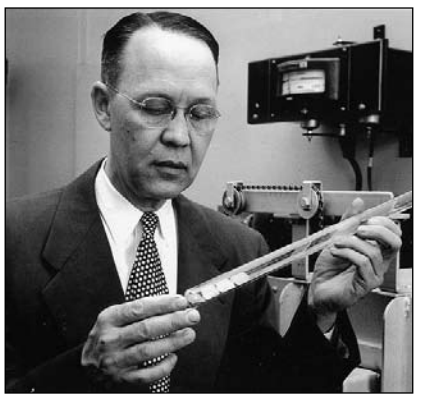
This Month in Physics History

April 25, 1954: Bell Labs demonstrates the first practical silicon solar cell

Solar cells, which convert sunlight into electrical current, had their beginnings more than a hundred years ago, though early solar cells were too inefficient to be of much use. In April, 1954, researchers at Bell Laboratories demonstrated the first practical silicon solar cell.

The story of solar cells goes back to an early observation of the photovoltaic effect in 1839. French physicist Alexandre-Edmond Becquerel, son of physicist Antoine Cesar Becquerel and father of physicist Henri Becquerel, was working with metal electrodes in an electrolyte solution when he noticed that small electric currents were produced when the metals were exposed to light, but he couldn't explain the effect.

Several decades later, in 1873, Willoughby Smith, an English engineer, discovered the photoconductivity of selenium while testing materials for underwater telegraph cables. In 1883, American inventor Charles Fritts made the first solar cells from selenium. Though Fritts had hoped his solar cells might compete with Edison's coal-fired power plants, they were less than one percent efficient at converting sunlight to electricity and thus not very practical. Some research on selenium photovoltaics continued for the next several decades, and a few applications were found, but they were not put to widespread use.



Calvin S. Fuller at work diffusing boron into silicon to create the world's first solar cell

The next major advance in solar cell technology was made in 1940 by Russell Shoemaker Ohl, a semiconductor researcher at Bell Labs. He had been investigating some silicon samples, one of which had a crack in the middle. He noticed that in this particular sample, current flowed through this sample when it was exposed to light. This crack, which had probably formed when the sample was made, actually marked the boundary between regions containing different levels of impurities, so one side was positively doped and the other side negatively doped. Ohl had inadvertently made a p-n junction, the basis of a solar cell. Excess positive charge builds up on one side of the p-n barrier, and excess negative charge builds up on the other side of the barrier, creating an electric field. When the cell is hooked up in a circuit, an incoming photon that hits the cell can then give an electron a kick and start current flowing. Ohl patented his solar cell, which was about one percent efficient.

The first practical silicon solar cell was created thirteen years later by a team of scientists working together at Bell Labs.

In 1953, engineer Daryl Chapin, who had previously been working on magnetic materials at Bell Labs, was trying to develop a source of power for telephone systems in remote humid locations, where dry cell batteries degraded too quickly. Chapin investigated several alternative energy sources, and settled on solar power as one of the most promising. He tried selenium solar cells, but found them too inefficient.

Meanwhile, Calvin Fuller, a chemist, and Gerald Pearson, a physicist, were working on controlling the properties of semiconductors by introducing impurities. Fuller gave Pearson a piece of silicon containing gallium impurities. Pearson dipped it in lithium, creating a p-n junction. Pearson then hooked up an ammeter to the piece of silicon and shined a light on it. The ammeter jumped significantly, to their surprise.

Pearson, who was aware of Chapin's work, went and told his friend not to waste any more time on selenium solar cells, and Chapin immediately switched to silicon.

The three then worked for several months on improving the properties of their silicon solar cells. One problem was the difficulty in making good electrical contacts with the silicon cells. Another problem was that at room temperature, lithium migrated through the silicon over time, moving the p-n junction farther away from the incoming sunlight. To solve that problem, they tried different impurities, and eventually settled on arsenic and boron, which created a p-n junction that stayed near the surface. They also found they were able to make good electrical contacts with the boron-arsenic silicon sells. After making some other improvements to the design, they linked together several solar cells to create what they called a "solar battery."

Bell Labs announced the invention on April 25, 1954 in Murray Hill, New Jersey. They demonstrated their solar panel by using it to power a small toy Ferris wheel and a solar powered radio transmitter.

Those first silicon solar cells were about 6 percent efficient at converting the energy in sunlight into electricity, a huge improvement over any previous solar cells.

The New York Times wrote that the silicon solar cell "may mark the beginning of a new era, leading eventually to the realization of one of mankind's most cherished dreams–the harnessing of the almost limitless energy of the sun for the uses of civilization."

The first silicon solar cells were expensive to produce, and early efforts at commercialization were not initially a huge success. But within a few years solar cells were commonly used to power satellites, and other applications followed.

Chapin soon simplified the process of making silicon solar cells and even developed a solar cell science experiment for high school students. Chapin, Fuller, and Pearson were inducted into the National Inventors Hall of Fame in 2008.

Solar cells today are used in all sorts of devices, from handheld calculators to rooftop solar panels. Improved designs and advanced materials have made it possible to build solar cells that reach over 40 percent efficiency, and research and development continues with the goal of bringing the cost down and raising the efficiency to make solar power more competitive with fossil fuels.

APS NEWS

Series II, Vol. 18, No. 4
April 2009

Coden: ANWSEN ISSN: 1058-8132

Editor . . . . . **Alan Chodos**
Art Director and Special Publications Manager. . . . . . **Kerry G. Johnson**
Design and Production. . . . . . **Nancy Bennett-Karasik**
Proofreader. . . . . . **Edward Lee**
Staff Science Writer . . . . . **Michael Lucibella**

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

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

Subscriptions: APS News is an on-membership publication delivered by Periodical Mail. Members residing abroad may receive airfreight delivery for a fee of $15. Nonmembers: Subscription rates are available at http://librarians.aps.org/institutional.html.

Subscription orders, renewals and address changes should be addressed as follows: For APS Members–Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, membership@aps.org.

For Nonmembers–Circulation and Fulfillment Division, American Institute of Physics, Suite 1NO1, 2 Huntington Quadrangle, Melville, NY 11747-4502. Allow at least 6 weeks advance notice. For address changes, please send both the old and new addresses, and, if possible, include a mailing label from a recent issue. Requests from subscribers for missing issues will be honored without charge only if received within 6 months of the issue's actual date of publication. Periodical Postage Paid at College Park, MD and at additional mailing offices. Postmaster: Send address changes to APS News, Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844.

Helping Patients Leads to Satisfying Biotech Career

By Alaina G. Levine

One of the world's largest biotechnology companies is a physics fan. Amgen, headquartered in Thousand Oaks, CA, develops medicines that treat various ailments such as kidney disease and congestive heart failure based on advances in recombinant DNA and molecular biology. Life scientists flock to Amgen for the chance to work in an intellectually rigorous organization that values both science and patients. But there is also a cadre of physicists and mathematicians who serve the firm as well, performing on-call assignments as needed throughout the corporation. This group exists to solve literally any math problem that Amgen faces, be it related to drug discovery or supply chain management.

Steve Johnson, who has degrees in physics, math and computer science, works for this mathematics consulting group where he and his eight other colleagues use advanced mathematical and physics techniques to analyze, model, optimize and solve significant technical and business problems that face the company. He gets to apply his physics knowledge every day, and he loves it.

Johnson, 52, has been employed by Amgen since 2003 in a variety of capacities. Today he is the Senior Manager in Amgen's Research and Development Systems Informatics group, part of the larger Information Systems organization. His projects involve not only solving mathematical problems, but also translating and converting innovative mathematical approaches into viable business solutions for Amgen. His work with clinical, operations and medical affairs leaders is part of the group's focus on problems relating to drug structure, drug metabolism, manufacturing processes, and logistics. He also travels a lot, especially to Europe, where he has addressed various regulatory and compliance issues pertaining to Amgen's products from a mathematical point of view.

Amgen encourages its scientists to move throughout the company and pursue different positions. This is a perk for Johnson who says that "every three or four years I get antsy and want to move to do something else." His previous assignment before Systems Informatics was in commercial operations in support of the Amgen nephrology business unit. It was a marketing-related assignment, although he still solved math problems. In this case, he collected, managed, and reported on data for all the dialysis patients in the United States in an effort to gain insights into that patient population. This medical-marketing job involved partnering with Amgen's business units, such as Strategy and Operations, Legal and Compliance, and National Accounts, and applying his results to new brands and market segments throughout the world.

In the biotech industry and at Amgen in particular, Johnson says, physicists, mathematicians and engineers have significant opportunities. In addition to his research position he also serves as a technical recruiter for the Information Systems organization and "we specifically look for people with engineering and science backgrounds, not just computer science or programming," he says. "We look for and actively recruit people with physics backgrounds."

Johnson holds a BS in physics and mathematics from DePaul University and a MS in Computer and Information Science from Ohio State University (OSU). His thesis for his master's focused on building a hybrid computer system for a hexapod vehicle in a biomedical engineering lab at OSU.

He describes his entrée into biotech as a "random walk", although "there were some things I knew I wanted to do and some things I knew I enjoyed," he says. His early academic focus on instrumentation led to a job in telecommunications at Bell Labs in Columbus, OH. But after six months he found himself "bored out of my skull," he confesses, and he soon departed. Reminiscing, he realizes that the highlight of his time there was having conversa-

tions with physicists Robert Wilson and Arno Penzias who shared the Nobel Prize in 1978 for the discovery of cosmic microwave background radiation, adding to the evidence for the Big Bang.

It was Johnson's interactions with his roommate while at Bell Labs that led him to have his own "Big Bang" moment and rapidly propelled him toward a career in biotechnology. The roommate worked for the Anesthesia Department at the OSU medical school and was doing systems design for medical devices. "As I was coming home more and more disillusioned, he was coming home more and more enthusiastic and cheerful and engaged with what he was doing," Johnson recalls.

Johnson applied for and secured a job in the Anesthesia Department as well, where he helped develop an intra-operative anesthesia monitoring system. Johnson's team applied their knowledge of hardware and software design to construct a uniform user interface for the machines used by anesthesiologists during surgery. Prior to this, anesthesiologists had a significant problem: every operating room in which they worked had different machines used to monitor life signs and other vital information. These devices were often from different manufacturers and did not communicate information the same way. So every time the anesthesiologist went into a different operating room, it would take a few moments to acclimate to the new machines. That time wasted could be the difference between life and death for a patient. The innovative intra-operative anesthesia monitoring system Johnson helped create could be applied to any machine used during anesthesia to ensure that important patient information (such as heart rate) was organized and displayed in a consistent manner that was useful for the anesthesiologist.

Johnson's three years at the hospital solidified his interest in working in the life sciences. "I had a wonderful time," he says. "It was extremely engaging and I could immediately see the benefits to patients." Furthermore, Johnson realized "that there was an incredible amount of leverage that scientists and technologists could have in the medical field," and he was certain that he could contribute. He easily transitioned into industry, where, prior to Amgen, he held positions at Siemens Medical Systems, SPX Corporation, and Pfizer, Inc. His work involved bioinformatics, embedded systems, sales, project management, and intellectual property coordination, among many other tasks.

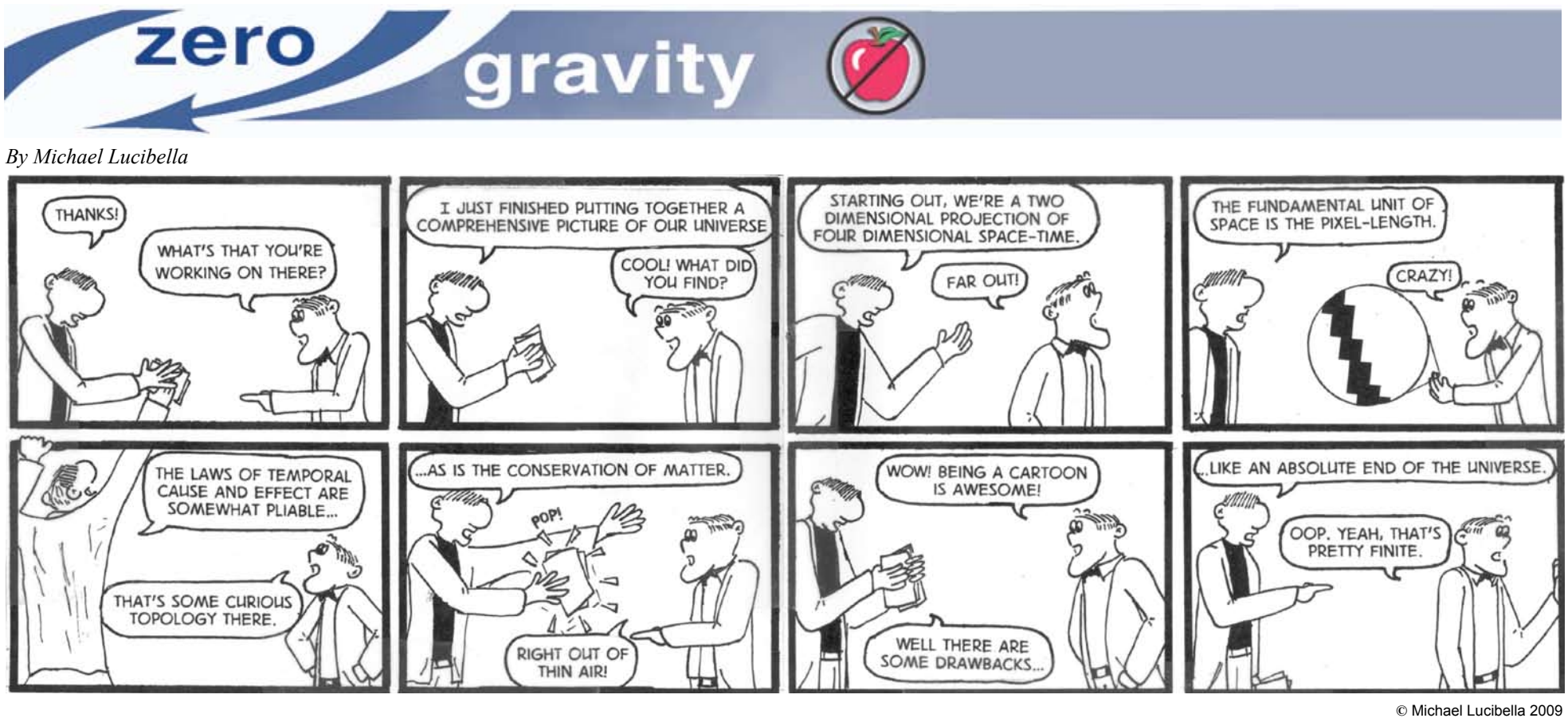
Johnson considered a career in academia, but only for "half a second," he jokes. In industry, "there is the ability to see things with a tangible result within a reasonably short timeframe," he explains. "A product development lifecycle is something that fits comfortably with my mindset." Furthermore, "I like the idea of building something that people will use and will benefit [from],"he continues. "Knowing that something I design is valued by patients is very satisfying to me."

At Amgen, the Systems Informatics group employs various mathematical techniques to complete assignments, such as category theory, set theory, Petri Nets, ODEs and PDEs, computational fluid dynamics, and signal processing. In addition to his technical skills, Johnson also relies heavily on other talents he mastered from studying physics as well. He stresses that the act of preparing his thesis groomed him for success in public speaking, dealing with bureaucracy, the art of persuasion, and "the intensity of work and writing that is absolutely necessary" in his industry.

For those interested in employment in biotechnology, Johnson reveals his secret tip for finding a job. Networking helps, he says, but if you have a particular area of interest, such as medical devices, do a patent search and find the names of the people and companies that are associated with the intellectual property. Those are the professionals you should contact first, he advises.

Johnson is not sure where his "random walk" will take him next, but for now he is certain Amgen is the company for him. He appreciates his job because of the global view it gives him of the drug development enterprise. "I have a perspective of what goes on at Amgen that is fairly broad and fairly deep because the problems [we solve] are very significant," he explains. "It's really fun to have this holistic vision of this huge business and know there is the potential benefit of helping patients."

Alaina can be contacted through her website at www.alainalevine.com.



Letters

Back and Forth on Faith and Physics

What was *APS News* thinking in preparing its February issue? Almost an entire page is boldly devoted to "Faith and Physics" by Alaina Levine, highlighting particular religious views of physicists Rabbi Kopelman and Reverend Heller. Why should their views on faith trump news of other things physical, as in American Physical Society News?

One could expect to read views like these in religious-tract magazines and perhaps even in many Sunday newspapers, but they do not belong in *APS News* unless there are plans to replace the "P" in APS with an "F."

Harry A. Schafft
Silver Spring, MD

I read with interest the article on *Finding Sanctuary in Faith and Physics*, by Alaina Levine. Chief among the points made in the article is that there is no conflict between science and religion, as shown by Kopelman and Heller active engagement in both, and that there is no contradiction between them, in fact they can be considered as two sides of the same coin. I agree with the author on the conflict issue. There can be no intellectual conflict between two very different things, one giving limited but certain knowledge, shared by all human beings, the other providing opinions and moral rules, changing in time, changing for different ethnic groups, and all based on faith. I understand that religion and spiritual beliefs can motivate some scientists in their search to explore the beauty of the universe. At the individual level religion can be a strong, and sometime positive, force to motivate a human being, as can be other philosophical beliefs. Epicurus encouraged his followers to study natural philosophy to escape superstition and live with peace of mind. However at the social level–and we should not forget that all that we do has a social dimension–science and religion are very different. In our societies religions are powerful and rich organizations, and their representatives have different motivations in their actions from those of scientists. At the social level religion and science are often in conflict, as shown through past and very recent history. Compare the power and social impact of churches of any denomination with that of the American Physical Society. The bloodiest war in Europe, in terms of devastation and percentage of people killed, was the war of religions between Protestants and Catholics in the 17th century. Which is exactly why I am very happy to be a member of APS, while I am not a member of any church. Near the end of the paper Ms. Levine gives a quote from a 1940 Einstein paper: " ... science without religion is lame, religion without science is blind." But in a letter to Eric Gutkind in 1945 Einstein wrote: "... The word God is for me nothing more than the expression and product of human weaknesses, the Bible a collection of honorable, but still primitive legends which are nevertheless pretty childish. No interpretation no matter how subtle can (for me) change this."

Claudio Pellegrini
Los Angeles, CA

With all due respect to Reverend Heller and Rabbi Kopelman (*APS News*, February 2009), it's a waste of time (mine, other readers), and space (yours), to try one more time to rationalize science and religion. It's really very simple logically: if "A" is contained within a circular boundary, then "NOT A" is outside of it! There is physics, and NOT physics, i.e. metaphysics. The former is independent of language, culture, religion–and usually politics! (The Bible falls with the same acceleration as anything else if released in the gravitational field.) The latter clearly is not. Anything contrived by man's primal imagination and fear, those metaphysical "things" outside of the circle, are all logically equivalent: if you accept at all, anything to do with those anthropomorphic male characters up there somewhere, then you might as well accept witches, demons, trolls, fairies (the one for the teeth comes to mind), etc. not to mention Santa Claus among other "things" (the list is endless as I'm sure you can appreciate). And as for the gobbledygook about "how" vs. "why," well–mathematics satisfies the first, again it's just pure logic, and the conservation laws answer the second. PLEASE, no more holy rationalizations, just "shut up and calculate" (so to speak).

Peter Hansen
Torrance, CA

Profiles in Versatility, Finding Sanctuary in Faith and Physics by Alaina G. Levine was very interesting. But I am surprised that neither Rabbi Kopelman nor Reverend Heller touched upon some of the bridges between physics and religion which add strength to their convictions. For instance, if one was to assume that the theory of the Big Bang is correct, then one only has to look at the typical answer that physicists give to the question: "What caused the Big Bang?" The standard answer is that a physicist cannot answer that question. As it is the nature of physics to study only what can be measured and since one cannot measure what caused the Big Bang, that is out of the realm of physics. Hence we have come to a bridge between physics and religion or between physics and philosophy if you will. In this case one completes the other. Religion can go where science cannot dwell and the picture is complete.

Joseph R. Tatarczuk
Poestenkill, NY

Very glad to read the article "Finding Sanctuary in Faith and Physics" by Alaina Levine in the February *APS News*.

The rational views of both Rabbi-Physicist Kopelman and Priest-Physicist Heller are similar and can be summarized as "they do NOT see a conflict between religion and physics."

As an atheist since my first day of Sunday school at age 6, my conclusion is similar. For a long time, there have been conflicts between religion and science. But I do not see them as necessary. Science and religion can remain true to their own separate domains without conflict.

The essence of religion is to establish a code for human behavior. Examples are the Ten Commandments and philosophical phrases such "Do unto others as you would have them do unto you." This is essentially philosophy which does not have to be based upon anything but acceptance, belief or faith. No data or evidence is necessary. Dinosaurs are not relevant. Flat vs round Earth is not relevant. The motion of the Solar System is not relevant. Religious philosophy should be based on faith and belief, independent of extraneous factors.

The essence of science is to compile data about natural phenomena and try to describe them systematically and self-consistently. The ultimate goal is the universal description of all phenomena in this fashion, but that lofty goal is a long way off.

Any data and/or theory is under constant scrutiny and reassessment to be altered, changed, expanded, discarded or replaced in response to new and better input or insight.

There are no absolute truths in science, only an approach constantly seeking more accurate truths.

The two disciplines are in totally separate domains which do not overlap. Conflicts should be avoided by each discipline by remaining confined to its own separate domain. The World would be a much better place.

Chuck Gallo
Lake Elmo, MN

Katrina Disaster at Least Partly Manmade

In the December edition of *APS News*, H. Eugene Stanley wrote an insightful article analyzing our present "financial fluctuation." Overall I enjoyed the article. But I must object to his description of Hurricane Katrina as a "completely natural" disaster. It is clear to those of us who lived through Katrina that a century of misguided, politically driven Army Corps of Engineers policies led to manmade protection systems that, even when they held, produced unintended consequences. One of these consequences was higher flood levels in unplanned places, such as the North Shore along Lake Pontchartrain and the South Coast of Mississippi and even Alabama.

I must also remind him that Katrina was not a direct hit to New Orleans, but only a glancing blow on the mild side of the storm. Further, as a resident of coastal Mississippi, I know of no citizen down here who does not prepare for the "unlikely event of a direct hit", because we all know that it will happen several times a century. Everyone along the Gulf and Atlantic coasts will suffer from a hurricane eventually.

Improved flood models are required to assist our disaster planning. I know I speak for more than myself when I say that we welcome anyone with expertise in this area who is willing to do forensic studies on Katrina to determine which portion was natural and how much was manmade.

A. Louise Perkins
Long Beach, MS

Achievement not so New After All

One of the "Top Ten Physics News Stories of 2008" reported in the February *APS News* was the fascinating achievement of light passage through opaque matter. With my colleague Wayne Strange, I accomplished this feat over ten years ago through the use of polarization-selective optical phase modulation and synchronous detection. By scanning a helium-neon laser beam across the front surface of a cuvette containing a liquid of the opacity of whole milk under ambient illumination, we were able to map out the topographic features of various kinds of objects entirely hidden from view in the milky suspension [*Optics Communications* **144**, 7 (1997)]. A detailed account of the experiment is given in my book *Waves and Grains: Reflections on Light and Learning* (Princeton University Press, 1998).

The same experimental technique enabled me and my colleague Jacques Badoz to detect and quantitatively measure for the first time the minute difference between the reflection of a left-and right-circularly polarized light beam by a naturally chiral medium [*Optics Letters* **17**, 886(1992)] A personal account of this experiment is also included in *Waves and Grains*.

Mark P Silverman
Hartford, CT

Crucial to Help Pakistan with Science Education

The recent "Back Page" article by Wasif Syed called attention to the important challenge for Pakistan to expand and improve its science and engineering education and research programs. In an age when technology has come to dominate many important aspects of society, it is imperative for all nations and especially those in the developing world to place greater emphasis on advanced science and engineering education. For starters, there is an urgent need to develop homegrown solutions for critical problems in areas such as energy, agriculture, public health, and telecommunications. Unfortunately, there is often no infrastructure in these countries equal to the task. Perhaps partnerships with educational institutions in the developed world, together with funding from those countries, can jump start the growth of homegrown capacity. We are now participating in such an effort in Pakistan. Led by a group of young engineers, scientists, and entrepreneurs, the highly regarded Lahore University of Management Sciences (LUMS) has launched a new School of Science and Engineering (SSE). The SSE adds undergraduate, and eventually graduate, programs in basic science and engineering to existing programs in business, management, humanities, mathematics, and computer science at LUMS. The aim is nothing short of creating a world class research university with a rigorous science-based education program enhanced by an interdisciplinary research agenda. Dedicated to inclusiveness, the SSE maintains need-blind admissions and substantial financial aid, and is open to all, independent of gender, religion, or social status. The first class of 150 undergraduates entered in the fall of 2008, selected from a pool of about 7000 applicants. Clearly there is a deep hunger for high quality technical and scientific training, and the talent is certainly abundant. We, and about a dozen of our colleagues from U.S., European, and Asian universities and businesses, serve on an external Advisory Board for the SSE. It may be constructive for US agencies and Pakistan ministries to consider support for projects like this in Pakistan for higher education in general and science and engineering in particular.

Robert Jaffe
Cambridge MA

Alvin L. Kwiram
Seattle WA

Letters (continued)

Kirshner's Account of Cosmic Acceleration History Challenged

As one of the five people who participated in the January 8, 1998 AAS press release session described by Robert Kirshner in his letter that appeared in the February 2009 *APS News*, I must disagree with the notion that cosmic acceleration was not suggested during that session. My press release for that session states "Astrophysicists announced today new predictions of the ultimate fate of the universe obtained by calculating the characteristic or maximum size of very distant radio galaxies. Reports being presented by Dr. Ruth A. Daly, and Dr. Erick Guerra, both of Princeton University, in Princeton, New Jersey, to the American Astronomical Society meeting in Washington, DC, suggest that the expanding universe will continue to expand forever, and will expand more and more rapidly as time goes by." The press release goes on to say "The apparent size, or distance from hotspot to hotspot, of a high redshift radio galaxy is a clue to which of the competing models of the nature of the universe is most likely. A relatively small size at great distance from Earth would suggest a universe that will halt its current expansion and recollapse; a larger size suggests a universe that will continue to expand forever, but at an ever decreasing rate; an even larger size suggests the universe will continue to expand, and will expand at a faster and faster rate. The current work finds that at high redshift the galaxies are very large, with widely separated radio hotspots. Thus, the universe will continue to expand forever and will expand at a faster and faster rate as time goes by." Clearly, the acceleration of the rate of expansion of the universe was indeed suggested at the January 8, 1998 AAS meeting press release session.

The press release is available at http://www.princeton.edu/pr/news/98/index1.html under "The Ultimate Fate of the Universe" (1/8/1998) and at http://www.bk.psu.edu/faculty/daly.

Ruth A. Daly
Reading, PA

Your January column "This Month in Physics History" gave what I thought a fair and balanced account of the discovery of the accelerating universe, including the contributions of both research groups, so I was surprised at Robert Kirshner's letter responding to it in the February issue. Having reviewed his fine book, *The Extravagant Universe*, in the *New York Times Book Review* and edited a *SLAC Beam Line* article on the research written by Gerson Goldhaber of Lawrence Berkeley Laboratory, I feel in a good position to comment further.

The column might indeed have delved more deeply into the experimental techniques involved—and Kirshner cited a few of the specific contributions of his High-Z Supernova Search team. Omitted from both accounts, however, was the central role of Saul Perlmutter of the LBL Supernova Cosmology Project in pioneering the core technique used by the two groups. This method involves taking successive photographs with a CCD camera of the same patches of night sky about four weeks apart during the new moon; by comparing individual pixels in this wide field of view, researchers can identify candidate supernovae for further observation during the next few months on dedicated telescopes. By following a supernova's light output over this period, they can obtain the correction factor Kirshner mentions and thereby establish the supernova as a valid "standard candle."

The LBL team, composed mostly of experimental particle physicists familiar with manipulating vast quantities of data, felt equal to this daunting task. But many astronomers and astrophysicists figured that the technique would never work. Thus the High-Z group found itself playing catch-up in the mid-1990s after the LBL team showed that it *did* work.

I vividly recall sitting in the front row at a UC Santa Cruz physics colloquium on 8 December 1997, when Perlmutter gave the first public (beyond Berkeley) presentation of the results that attracted so much attention a month later. Having just edited Goldhaber's article and been primed on the significance of this research by my UCSC colleague Joel Primack, I was sitting on the edge of my seat, waiting for the numbers, which came only in the last few minutes of the talk. Based on 38 Type Ia supernovae analyzed until then, Perlmutter said, they could conclude that the universe was open: it had only about 30 percent of the critical mass density needed to slow the Hubble expansion to zero. I don't recall him making any further conclusions, but Primack was not so reluctant. In the ensuing discussion period, he stood up and pointed out that these results implied the previously unthinkable: the need for a cosmological constant.

To be fair to Kirshner and the High-Z team, these preliminary LBL data could not yet rule out dimming of the supernovae light due to absorption by intervening dust—which his group could eliminate by making observations at three different wavelengths. But in early 1998, when these astonishing results began to surface in press accounts, the High-Z team had a statistically weak sample of only about 10 supernovae, while the LBL group by then had accumulated over 40. Nobody—at least not in the particle physics community—would have accepted the momentous conclusion of an accelerating universe as valid based on such a single small sample had there not been another, independent result with significantly better statistics. In the final historical analysis, it was the joint results of *both* teams, each covering weaknesses in the other's analysis, that convinced the wider scientific community so rapidly about such an unexpected, revolutionary result.

Historians of science find these priority disputes rather tiresome, but then we don't have any Nobel prizes at stake! The current dispute about the discovery of the accelerating universe reminds me of my favorite adage: "One of the most difficult things to divide is success."

Michael Riordan
Santa Cruz, CA

APS Copyright Policy Still No Good

When I saw that a new APS copyright policy was announced, I was happy for a moment ... until I discovered the "new" policy continues to be that APS takes your copyright and keeps it (although now giving back some limited rights.)

The commercial publishers in the world–by which I mean the ones that actually pay their authors–do not take an author's copyright. It is odd that the APS, which doesn't pay, demands transfer of copyright on the grounds that "we must have this to continue to provide quality publications." Must? Commercial publishers do not require transfer of copyright, but APS does?

And I'm left the same question: Since APS inherently can't defend the intellectual property rights of physicists in this case, because of their conflict of interest: who will?

Geoffrey A. Landis
Cleveland OH

Science Journalism Faces Perilous Times

By Michael Lucibella

APS devotes significant resources to "media relations," aimed mainly at promoting the coverage of the latest physics research in the general media.

But the targets of this effort, science journalists, are an endangered breed. Newspapers have been shutting down their science bureaus while networks have been cutting airtime for science stories. This disquieting trend comes at a time when science and technology play a greater role in people's lives than ever before. The tumultuous and uncertain state of science journalism today could jeopardize public science literacy in the coming years.

In late December CNN eliminated its general science desk, opting to focus exclusively on environmental issues. Two reporters, Miles O'Brien and Peter Dykstra, along with five producers, were laid off during the reorganization, touching off a flurry of controversy. The Council for the Advancement of Science Writing, in conjunction with the National Associations of Science Writers, issued an open letter to the presidents of CNN and CNN International criticizing the cuts. They wrote that "The wholesale dismantling of the science unit calls into question CNN's commitment to bringing the most informative science news to the general public, including the science-minded younger audience."

CNN may be the most prominent major news source to announce cutbacks in its science reporting, but it is not the only one. *The Boston Globe* announced in

JOURNALISM continued on page 7

Washington Dispatch

A bimonthly update from the APS Office of Public Affairs

ISSUE: Science Research Budgets

After delaying consideration of the Fiscal Year 2009 (FY09) Appropriations Bill until half the year had passed, and after extending the FY09 Continuing Resolution for five additional days until March 11th, Congress finally put last year's budgetary business to rest. For science, the numbers are impressive. As readers will recall, the Stimulus Bill (or the American Recovery and Reinvestment Act of 2009), added $1.6 billion to DOE's Office of Science, $0.4 billion to the new ARPA-E program and $16.8 billion to the DOE Office of Energy Efficiency and Renewable Energy (EERE); $3 billion to NSF ($2.5 billion of which is allocated to Research and Related Activities); and $600 million to the NIST Core Program. Adding on to the success of the Stimulus, the FY09 "Omnibus" Appropriations Bill is consistent with a planned doubling of the physical science research funding as authorized by the America Competes Act. The Omnibus Bill contains the following allocations:

- **National Science Foundation (NSF):** "$6.5 billion, $363 million above 2008, for the most promising scientific research at America's colleges and universities, and supporting scientists with cutting edge labs and equipment."
- **Department of Energy:** "$4.8 billion, $755 million above 2008, for basic scientific research critical to addressing long-term energy needs. This provides for 2,600 more research personnel, producing highly educated American scientists and engineers whose innovations will drive economic growth."
- **National Institute of Standards & Technology (NIST):** "$819 million, $63.1 million above 2008, to promote American innovation and economic competitiveness by improving scientific measurements, standards, and technology."

In mid-February, President Obama released his budget blueprint for the 2010 fiscal year. A full budget proposal is expected to be released in early April, but the early signs are very positive for the physical sciences.

Be sure to check the APS Washington Office's webpage (http://www.aps.org/public_affairs/index.cfm) for the latest news on the FY09 Omnibus and FY10 Budget.

ISSUE: POPA Activities

At the February 6th meeting, POPA approved a study, proposed by the Energy & Environment Subcommittee, to examine the means to increase the amount of renewable energy that could be delivered by the grid to high-demand centers. The study will build on previous POPA report findings published in 2007 (*Challenges of Electricity Storage Technologies*) and the 2008 APS Energy Efficiency Study (*Think Efficiency*). Funding from POPA is slated for late 2009. The Study Chair, George Crabtree, anticipates also raising outside funds. A list of possible Study Committee participants is being finalized and a timetable for completion of a report is being discussed.

The National Security Subcommittee also received approval for a study on verification technology for reducing nuclear arsenals. A Study Committee has been assembled and the first Workshop has been scheduled for April 21st-22nd in Washington, DC Guest speakers and the agenda for both days are being finalized. Jay Davis has agreed to participate as Study Chair.

The study on non-biological CO_2 capture, which was approved at the October 3rd, 2008 meeting, is in full swing. Additional outside funding was raised by the Chair and Co-Chair of the Study Committee, Dr. William Brinkman and Dr. Robert Socolow. The first meeting of the Study Committee will be held at Princeton March 23rd-24th.

If you have suggestions for a POPA study, please visit http://www.aps.org/policy/reports/popa-reports/suggestions/index.cfm and send in your ideas.

ISSUE: Washington Office Media Update

News stories in the *New York Times* (February 6th and 10th) stressed the scientific community's disappointment with the initial direction of funding in the American Recovery & Reinvestment Act, which contributed to securing a win for science in the final legislation: $5.2 billion overall for DOE-SC, NSF and NIST.

Similarly, Congressman Rush Holt (D-NJ) and Congresswoman Anna Eshoo (D-CA) jointly authored an op-ed on February 11th in *The Hill* newspaper detailing how funds for science would create jobs in the short run and lay the foundation for economic growth in the long run.

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

Focus on APS Topical Groups

Few Body Systems

By Michael Lucibella

A notable moment for the APS Topical Group on Few Body Systems (GFB) came at the 1989 APS meeting in Baltimore, where the group sponsored a now famous symposium on cold fusion. The subject was all over the media after Martin Fleischmann and Stanley Pons controversially claimed to have produced fusion in their lab. At the high profile meeting, eight of the nine speakers refuted the Fleischmann-Pons claims, roundly rejecting the recent cold fusion assertions.

This year marks the 25th anniversary of GFB. The Group's main purpose has always been to bring together a broad range of scientists who work on atomic and subatomic systems involving three or more particles. By taking this interdisciplinary approach to research, GFB may be the most scientifically diverse of all topical groups.

Few body systems can yield some of the most fiendishly complex problems to work with. Single and two body systems involve only a small number of variables while much larger systems can be simplified by studying their overall dynamics statistically. That middle range is where the number of variables quickly becomes overwhelming and has often stymied attempts to precisely model atomic and nuclear behavior. But results in this area have led to advances in fusion research and an overall better picture of the universe. Few body interactions between hydrogen and helium atoms play an important role throughout the observable cosmos.

Bringing together a wide variety of scientific disciplines to the group has allowed the sharing of techniques that work across many fields. Though the forces acting between different particles may differ, the tools and methods for calculating their properties are often the same. This allows disciplines ranging from atomic physics to physical chemistry to come together and share their knowledge.

The group can trace its origins back to several older organizations. Starting in 1965, the International Few Body Conferences, typically occurring every two years, served as the major gathering for physicists working on various few body problems and research. Nuclear physicists made up the audience of the first two meetings, before other fields began to filter in by 1974.

A few years later in 1977 theoretical chemist Don Kouri and nuclear theorist Yeong Kim submitted a proposal to the Gordon Research Foundation to create a parallel series of interdisciplinary conferences on few body physics. These conferences laid the groundwork for the later GFB by enthusiastically reaching out to different fields. One of the core principles of these Gordon Conferences was to keep the presentations on a reasonably technical level so that the chemists could fully understand the physicists' presentations and vice-versa.

In 1982, however, the International Union of Pure and Applied Physics (IUPAP), acting under the recommendation of the APS Division of Nuclear Physics, refused to sponsor the tenth Conference on the Few Body Problem. The IUPAP said that there had been too many such conferences and demanded a three-year hiatus. To combat this unwelcome intrusion, participants at the 1984 Gordon Conference circulated a petition asking APS to dedicate one of its newly announced Topical Groups to Few Body Physics.

Frank Levin, Founding Chairman of the GFB, remembers the petition well, "The response of the attendees at the 1984 Gordon Conference was overwhelmingly positive–I think everyone signed the petition urging the formation of the GFB–and of course the rest is history."

Since its inception twenty-five years ago, GFB has stayed true to its interdisciplinary approach to few body problems. Today the group is made up mostly of nuclear and atomic physicists, but also incorporates members in molecular physics, physical chemistry, particle physics, and even some specialists in condensed matter research.

"The group's main focus was and I believe still is to be an umbrella organization that brings together researchers in different disciplines… who work on few-body problems and multiparticle dynamics," Levin said.

While the group's focus may not have changed over the years, the technology and methodology certainly has. An infusion of better computing power and more accurate measurements has brought a previously unheard of level of precision to the complex field.

"When we started, two and three body problems were the limit of what we could do," said Wayne Polyzou of the University of Iowa, current Chair of the Group, adding that computers now can calculate the interactions of up to ten bodies, "This has transformed nuclear physics from twenty-five years ago from a qualitative type of science to something more quantitative."

One of the major issues facing the Few Body Group has been low membership rates in recent years. The group grew initially from its start of around 100 members, but then began to plateau. Today, at 310 members, it is the smallest topical group, just passing the minimum of 300 required members. The Gordon Conferences have been discontinued because of low attendance.

"I am quite hopeful that we can bring it back up," said Ravi Rau, Chair Elect, "We used to be a bit larger. We've always been small."

The Group is always tirelessly recruiting. At the upcoming April Meeting, clipboards will be circulated at workshops that would be

FEW BODY continued on page 7

INTERNATIONAL News
...from the APS Office of International Affairs

Construction of the European X-ray Free-Electron Laser Facility starts in Hamburg

By Massimo Altarelli

Ever since their discovery at the end of the 19th century, x-rays have contributed immensely to our understanding of the structure of matter at the atomic level, from the discovery of diffraction by crystals to the unveiling of the double-helix structure of DNA. In the last few decades, novel perspectives have been open to the application of x-rays in physics, chemistry, materials science and biology by synchrotron radiation sources. The key figure of merit of many x-ray experiments is the brilliance (or spectral brightness), which is enhanced by up to nine or ten orders of magnitude when comparing a modern large circular accelerator with a conventional laboratory source. A new kind of accelerator-based x-ray source is about to become available to the scientific community, which promises a similarly huge jump in brilliance.

Aerial view of the European X-Ray Laser Facility

A number of projects worldwide are pursuing the realization of a source of extremely brilliant (peak brilliance ~ 10^{33} photons/s /mm^2/mrad^2/0.1%BW), ultra-short (~ 100 fs) pulses of spatially coherent x-rays with wavelengths down to 0.1 nm, and to exploit them for revolutionary scientific experiments in a variety of disciplines. In particular, the short duration of the pulses, and their high intensity, should enable researchers to obtain structural information with atomic resolution on the time scale of relevance for vibrational relaxation, molecular rearrangement during chemical reactions, and so on; it is also envisaged to use coherent diffraction on single objects (e.g. cells, viruses, or even large macromolecules) to obtain structural information without the need for crystallization; the high intensity delivered by the beam to a target will also be exploited to create states of matter, characterized by a high energy-density, which are not easily obtained on earth.

These facilities are based on linear electron accelerators, and use the "SASE" (for Self-Amplified Spontaneous Emission) process for the generation of coherent radiation. In the US, the Linac Coherent Light Source (LCLS) at SLAC, Stanford, is due to produce its first beam later this year; in Japan, the SCSS (Spring-8 Compact SASE Source) is scheduled to come into operation in 2011. These two projects are being developed based on room-temperature linear accelerators (linacs); in the case of LCLS it is the SLAC linac, or, more precisely, the final one-third of the linac's length. The facility uses the superconducting linear accelerator technology developed at DESY within the TESLA collaboration, and successfully applied to produce laser-like radiation down to 6.5 nm wavelength at the FLASH facility at DESY (the first

FACILITY continued on page 7

Solar Energy, Energy Storage Highlight AAAS Symposium

By Gabriel Popkin

A great and urgent need exists for major advances in energy efficiency and alternative energy technologies. This was the consensus of speakers at a symposium featuring several APS members that was held at this year's American Association for the Advancement of Science (AAAS) Annual Meeting in Chicago.

Leaders in fields as varied as solar fuel generation, lithium-ion battery development, and superconductor research were unanimous in their calls for major increases in research programs to develop large-scale, cost-effective technologies that will provide energy security for the US and other countries, and reduce the levels of greenhouse gases in the atmosphere.

APS Fellow and Lawrence Berkeley Laboratory (LBL) Interim Director Paul Alivisatos spoke on "Nanoscale Materials for Solar Fuel Generation". He said that the current state-of-the-art solar cells and those that will be developed in the near future are made of multiple materials with different band gaps, which allow them to optimally extract energy from incident light of different wavelengths. These cells can extract around 3 eV of energy from each incident photon and convert solar power to electricity at up to 50% efficiency. But the materials currently used to make them—crystalline silicon, and thin-film cadmium telluride or copper indium gallium selenide—are too rare and expensive to be scaled up to cover the US's energy demands, much less the rest of the world's. "The physics is there, but not the cost," Alivisatos said. "The cost needs to come down by a factor of five."

One way Alivisatos hopes to bring those costs down is by developing a new generation of photovoltaics based on nanocrystals. Because these nanocrystals can be smaller than typical electron wavelengths in the parent material, quantum tunneling of electrons between them could enable solar cells to provide more efficient charge separation and conduction using inexpensive materials such as iron pyrite or lead selenide. Nanocrystals themselves are also much cheaper to grow than the larger silicon crystals in current use, just as small diamonds are much more common, and thus cheaper, than large, defect-free diamonds.

But Alivisatos made no bones about the scale of the challenge. In order to generate the approximately 3.2 terawatts of power the US currently consumes, he estimates we would need to cover around 60 million acres (roughly a square 300 miles on a side) with solar panels converting power at 8% efficiency—not a likely scenario—and this demand is growing rapidly. Thus, Alivisatos said, "we are in a hurry" to develop cheap, efficient solar generating technology. He sees national research labs such as LBL serving as "anchor points" that can work with university and industry research groups to "re-connect basic and applied research in a 'science-to-solutions' approach" to this unprecedented energy challenge.

Another theme of the symposium was the need for advances in energy storage, where Alivisatos estimated we are a factor of two away from where we need them to be in parameters such as cost and energy density. One of the leading researchers working to change this is Yet-Ming Chiang, an APS member and professor of materials science and engineering at MIT. Chiang gave a talk on his work developing lithium iron phosphate as a replacement cathode material for lithium cobalt oxide, which is currently used in most lithium-ion batteries that power laptops and cell phones. Because iron is abundant and non-toxic, and iron phosphate is a safer and more stable structure than cobalt oxide, Chiang sees it as a promising material for the batteries in plug-in hybrid-electric and fully electric cars. But in Chiang's vision, these batteries will do more than allow drivers to go 200 miles on a charge. He also believes that lithium-ion batteries,

ENERGY continued on page 7

JOURNALISM continued from page 5

February that it would discontinue its separate Health & Science section. *The Los Angeles Times* and the *Columbus Dispatch* have likewise curtailed much of their science coverage. Even specialized publications have felt the pinch. *Aviation Week & Space Technology* closed its Cape Canaveral bureau, laying off three reporters, each with over 25 years of experience.

These cuts in science staffs reflect the dire financial state of newspapers as a whole. More and more readers have been getting news articles free online, rather than purchasing the physical paper itself. With fewer readers buying the papers, their greatest source of revenue, advertising, has sharply declined. Websites like Craig's List have also been eating into the once-lucrative classifieds ads.

All of this has left nearly the whole newspaper industry strapped for cash. *The Rocky Mountain News* recently shuttered its doors for good while the *Christian Science Monitor* cut back to only a single weekly printed edition.

"The situation is grave," says science journalist Tom Siegfried. "In the general media, science is at the bottom of the priority list."

Siegfried had been the science editor for *The Dallas Morning News* since 1985. In 2004, bowing to financial pressures, the newspaper dismantled the science department. After being laid off, Siegfried went on to become the editor in chief at the bi-weekly *Science News* magazine.

"There are lots of people who realize how important science is, but there is little attention paid to how important science journalism is," Siegfried said, "Not having a flow of good information about what science is doing is bad."

Siegfried's situation is characteristic of the changes happening throughout the general media. Reporters once at science desks for major publications have frequently either been reassigned to general news beats, or left for more specialized science periodicals.

James Riordon, APS Head of Media Relations and current vice president of the D.C. Science Writers Association, says that while the recent cutbacks in the media are worrying, science journalism won't completely disappear.

"There's an added value that makes science journalism less vulnerable," Riordon said, "As a specialty part of any periodical, it's going away. But experts like science journalists will likely have to suffer less than other people."

What the future may hold for the profession is anyone's guess. The fast paced change brought about by the internet has reshaped the entire news industry in just a few years. The web has allowed for much easier and more direct access to original reports and published papers. Websites are able to "scoop" not only daily newspapers, but even sometimes hourly television news networks. Additionally the spread of online blogs has given individuals who normally wouldn't be heard a public voice.

Blogger Phil Plait began running his website "Bad Astronomy" in 1993, long before the term "blog" had entered the public lexicon. He has received numerous online awards and "Bad Astronomy" was recently named one of the 25 most influential blogs by *Time Magazine*. He will also be the featured public speaker at the upcoming APS April Meeting. Plait has been an enthusiastic supporter of the internet's universal accessibility.

"Scientists have a voice now," Plait said, "You're getting the information directly from the source. That's not a bad thing."

Riordon, however, cautions that "Like most things, it's a mixed bag." He says "I really like the fact you get a lot more voices," but notes that sometimes this chorus of information can be either overwhelming or just plain inaccurate. "They're fulfilling a demand for science but we don't yet know if it's very nutritious."

The move towards predominantly online science news has prompted a great deal of debate over who qualifies as a journalist, and whether blogging counts as journalism. Provided they are accurate and reporting new information, Plait says absolutely blogs count. Siegfried however thinks that though blogs may be popular, journalism needs dedicated professionals to provide the best accuracy and clarity.

"If you call blogs journalism, you'd have to invent a new word describing what journalism used to be," Siegfried said, adding also that it was uncertain whether an exclusively online news medium was capable of supporting itself.

"The future of science journalism is tied up with the future of journalism in general, which will be electronic," Siegfried said, "There is certainly a market for science journalism. The question is if there's an economic way of providing that information to the people who want it."

One of the great questions surrounding the new online media is whether the economics of the web can allow full-time professional science writers to thrive. Advertising slots on websites bring in much less revenue than traditional print ads, even if they are seen by the same number of people. Plait was only able to devote himself full time to his blog after *Discover Magazine* hired him for their website.

"If I were just blogging it would not be enough for me to live on," Plait said, "I wouldn't recommend this as a career path unless you want to live on the street."

What shape the science media will take in the coming decades is anyone's guess. With so much upheaval at the traditional news outlets and the uncertain economics of the web, predicting the future can seem like a fool's errand. More content will move online, but whether its quality will be any better or worse than what we have today is not yet clear.

ANNOUNCEMENTS

M. Hildred Blewett Scholarship for Women Physicists

This scholarship has been established to enable women to return to physics research careers after having had to interrupt those careers for family reasons. The scholarship consists of an award of up to $45,000. The applicant must currently be a legal resident of the US or Canada. She must be currently in Canada or the US and must have an affiliation with a research-active educational institution or national lab. She must have completed work toward a PhD.

Applications are due June 1, 2009. Announcement of the award is expected to be made by August 1, 2009.

Details and on-line application can be found at http://www.aps.org/programs/women/scholarships/blewett/index.cfm

Contact: Sue Otwell in the APS office at blewett@aps.org

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

Artificial Brownian motors: Controlling transport on the nanoscale

Peter Hänggi and Fabio Marchesoni

Brownian motion in systems with spatial or dynamic symmetry breaking, combined with external deterministic or random input signals, may assist directed motion of particles at submicrometer scales. For this phenomenon the term "Brownian motors" has been coined. There is a rich variety of possible Brownian motor scenarios and working principles in nature. The present review focuses on nonbiological, i.e., artificial, mostly solid state based Brownian motors and provides a comprehensive overview of the field, including newest developments in theoretical descriptions as well as most compelling experimental demonstrations and first successful technical applications.

REVENUE continued from page 1

"We always budget to be at an operating loss," Serene said, "But we've actually been making money on operations the last few years."

The budget for 2009 as passed by Council has no major cuts, but what effect the economic downturn may have for 2010 is yet to be seen. Many colleges and universities have been hit hard. Those whose operating budgets rely more heavily on invested assets are staring at steep cuts in their endowments for next year. The major concern for APS is that this, among other factors, could lead to a drop off in subscription revenue.

"The bottom line is no one is panicked, but we're prudently worried." Serene said.

Though details have not yet been finalized, it seems likely that there might be an adjustment somewhere to the society's revenue stream. In the upcoming year the prices of meeting registration, membership dues or journal subscriptions may have to be adjusted in order to keep funding at sustainable levels. For 2009, the Society dropped prices for smaller institutions while raising the prices slightly for the largest ones.

Membership in the society has been increasing since 2001. Trish Lettieri, Director of Membership, said that initial projections look as if the trend is likely to continue.

"The Membership Department is closely monitoring what effect the current economy will have on membership numbers," Lettieri said, "There was an increase in the total number of members this past year and as of right now, both recruitment and retention statistics are holding close to what we saw a year ago."

FACILITY continued from page 6

short-wavelength free-electron laser to operate for users). The most important advantage of the superconducting technology is the possibility to fill each RF pulse with a large number of electron bunches: in the European X-Ray Free Electron Laser (XFEL), up to 3,000 in each of the 10 RF pulses per second; there are 50 in each of 60 RF pulses for the Japanese project and one or a few for the LCLS, with 120 RF pulses. The European Facility will therefore produce up to 30,000 x-ray pulses per second, instead of the 3,000 or 120 foreseen in the Japanese and American projects, respectively.

In the European facility, electron bunches, accelerated to 17.5 GeV in a ~ 1.7 km long Linac, will pass through long (up to 200 m) undulators. Commissioning with first beam of the facility is expected to take place in 2014. An initial contingent of 3 photon beamlines with 6 experimental stations (later to be upgraded to 5 photon beamlines and 10 experimental stations) is planned, where experiments exploiting the high intensity, the coherence and the time structure of the new source are going to be performed.

In early January, construction work started simultaneously at three distinct sites: inside the DESY campus, where the injector building is going to be located; about 1.5 km northwest of there, where the linac ends and a "switching station" will be placed, to deliver the electron bunches to one or the other of the three initially foreseen undulators; and finally some 3.4 km from the injector, where the experimental hall is going to be located, not far from the village of Schenefeld.

The construction and operation of the facility is going to be entrusted to a non-profit limited-liability company, European XFEL GmbH, along with research institutions of 13 European countries (Denmark, France, Germany, Greece, Hungary, Italy, Poland, Russia, Slovakia, Spain, Sweden, Switzerland, and UK) plus China, as shareholders. This is the well-tested organizational model of the ESRF (European Synchrotron Radiation Facility) in Grenoble and other internationally funded research institutions in Europe. The involved countries agreed, with a Memorandum of Understanding, to proceed to the preparation of the official foundation of the company, which is expected for later this year, after signature of an inter-governmental convention by the representatives of the 14 participating countries.

In the meantime, a project team has been assembled, and civil engineering work started, thanks to financial support mostly from Germany, but also from the European Union and by the Swedish, Slovakian and Spanish partners. When the company reaches its full personnel complement, it will employ over 230 people; most tasks related to linear accelerator construction and operation are going to be contracted to a consortium of laboratories coordinated by DESY.

Massimo Altarelli is the Project Team Leader for the European XFEL.

ENERGY continued from page 6

when scaled up, will be able to "hybridize the electric grid" by storing electrical energy and delivering it to the grid at times of high demand.

Chiang echoed Alivisatos in advocating for large increases in basic and applied research funding for energy storage technology, and argued that the battery industry's current market share does not reflect its important for the future. "Right now, if the automobile and electric industries are the size of wheels, the battery industry is a lug nut," Chiang said.

Other talks were given by Nathan Lewis of the California Institute of Technology, APS Fellow John Sarrao of the Los Alamos National Laboratory, Vallampadugai Arunachalam of the Center for Study of Science, Technology, and Policy in Bangalore, India, and APS Fellow George Crabtree of Argonne National Laboratory. APS Fellow James Misewich of the Brookhaven National Laboratory co-organized and moderated the session.

FEW BODY continued from page 6

interesting to potential members of GFB. In addition, members of the group plan on vigorously appealing to students, since they are allowed to be members of up to two APS units free of charge.

Members of the group are always pushing the limits of precision. "When you deal with small systems, you can do complete calculations and measurements" Polyzou said, "You really can do realistic physics."

The Back Page

Putting US Nuclear Complex Under Pentagon Oversight Is a Bad Idea

By Raymond Jeanloz

The Obama Administration is considering transferring the US nuclear weapons complex from the Department of Energy's National Nuclear Security Administration (DOE/NNSA) to the Department of Defense (DoD), according to recent news reports.[1] It is good to see an open-minded evaluation of this topic early in a new administration, especially as the issues at stake have far greater significance than might be apparent from the limited amount of public discourse to date.

This is a matter on which we, the scientific community, have special expertise; though the decision is ultimately political, some of the key factors are technical. We can therefore bring unique insight to the discussion, and have at least as much legitimacy if not obligation as any other community–budget analysts, legal scholars, military specialists, among others–in explaining why such a move would be a bad idea.

Start with the fact that gram-for-gram a nuclear explosive (e.g., the fission yield of uranium-235) releases more than a million times the energy of conventional high explosives, thus magnifying the range of destruction 100-fold in all directions. As population scales with area, distance squared, this means 100 times 100-fold the casualties: hundreds of thousands extending over miles, instead of dozens over yards. Put another way, the amount of TNT needed to produce the explosive yield of a single modern nuclear weapon would cover a full acre of land to a height overshadowing a 10-story building.

These technical facts lead to the understanding that nuclear weapons are instruments of policy, not of military operations. The Department of Defense is only one of many elements of the US Government concerned with policy, and policy is not its primary mission. Instead, DoD necessarily focuses on urgent matters of defense, especially while men and women in uniform are suffering casualties in places near or far around the world.

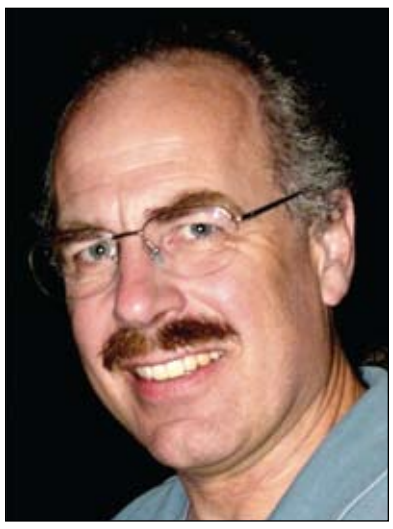
It is therefore no surprise that nuclear-weapons policy and practice have receded to less-immediate priority within the Defense Department; all the more so since the end of the Cold War, with its deterrence policy of "Mutually Assured Destruction."[2,3] Some have concluded that this diminished priority is the root cause for the US military's recent mishandling of nuclear weapons, such as the unintended deployment of 6 nuclear-tipped cruise missiles from Minot Air Force Base (North Dakota) to Barksdake Air Force Base (Louisiana) on August 29-30, 2007.

More than that, it is important that the role of nuclear weapons as limited to deterrence–that they are weapons of defensive last resort[4]–be clearly projected as a matter of policy. The US needs to show through actions as well as through words that the nuclear arsenal is not a part of our war-fighting planning. In this regard, maintaining a balance between civilian (Department of Energy) and military (Department of Defense) responsibility for nuclear weapons is all-important. Putting the complex into Defense sends exactly the wrong message, to ourselves and to others.

Nuclear Weapons Complex and Stockpile Stewardship

The US nuclear-weapons complex includes the national security laboratories, Los Alamos, Lawrence Livermore, and Sandia National Laboratories, as well as the production plants (Kansas City, Pantex, Savannah River and Y-12) and Nevada Test Site. The most pressing responsibility for this complex is to ensure that the enduring arsenal remains safe, secure and effective, so long as it is national policy to have a stockpile of nuclear weapons.

This has been accomplished through more than 50 years of stewardship, and most recently by way of the DOE's Stockpile Stewardship Program that was established after the US adopted a moratorium on nuclear-explosion testing.[5] This



program has successfully assessed the state of the stockpile for the past 15 years, annually certifying the arsenal as safe, secure and reliable. A key aspect of the evaluation is that it is conducted jointly by DOE and DoD, so there are important cross-checks on the analysis. Although most of the detailed information comes from the technical community in DOE, including the national laboratories and Pantex, it is the DoD "customer" that oversees the process each year. The result is a report to the President from both the Secretary of Energy and the Secretary of Defense assessing the state of the stockpile.

It would be difficult if not impossible to maintain this healthy tension–indispensable checks and balances–if the entire nuclear-weapons complex and arsenal were in one Department. As DoD's priorities are inevitably skewed toward maintaining effective military readiness, long-term safety and security cannot always be the highest priority in comparison with the reality of lives that are in harm's way on a daily basis. This is especially the case for a deterrent that does not contribute to immediate war-fighting capability.

It is also significant that stockpile stewardship has fundamentally relied on sophisticated technical work, which has been led by the laboratories and primarily conducted at those sites. Ranging from basic research on nuclear fusion or on the aging of plutonium, among many other topics, to the practicalities of "life-extension" programs that ensure the responsible maintenance of the existing warheads, science and engineering provides the foundation for effective stewardship.

The laboratories have established world-class capabilities in numerous fields, from astrophysics and materials science to lasers and nuclear engineering. These fields may be related to but can also range far beyond the laboratories' immediate mission, the main objective being to ensure enduring technical excellence. Academia and industry have benefitted extensively, through partnerships that have resulted in unique facilities (e.g., in high-performance computing) as well as in collaborations between top-level researchers inside and outside the laboratories. These collaborations have enhanced both the laboratories' and universities' contributions in basic scientific research, and the impact of science on problems of societal interest.

Nevertheless, the laboratories' research in areas of national and international security–including nuclear weapons–is ultimately a combination of basic and applied work that would not be possible in academia, because the essential openness of universities is incompatible with the study of technical details that are highly sensitive and therefore necessarily classified. Industry is likewise poorly suited due to the lack of economic incentives, and the military has difficulty supporting the long-term, basic research that is needed. These are not criticisms but a reflection of priorities.

Thus, immediate practicalities and strategic policy–the core role of technical research in effective stewardship, and the qualitative difference between conventional and nuclear weapons–both argue against transferring the complex from DOE to DoD.

This finding is not new, but underlies decisions reaching back to the Manhattan Project regarding the need for shared civilian–military oversight of US nuclear weapons High-level commissions have examined this question in past administrations, with reports issued in 1976, 1985 and 1999, and have repeatedly come to the same conclusion.[6] Most recently, the Defense Science Board has also advised against moving the nuclear-weapons complex to DoD.[2,7] Whether considered from technical, political or military perspectives, the prospect of moving the US nuclear-weapons complex to the Department of Defense has been found to be inadvisable.

Future Roles for the Laboratories

Ultimately, the highest-priority responsibility for the complex is to maintain the technical knowledge of nuclear-weapons design. Existing manufacturing facilities are useless without it, because the reliability of the work cannot be assured without this knowledge; and production capability can in principle be reconstituted with such expertise, should the nation ever need increased production of nuclear warheads. It is not just a matter of stewardship for an enduring arsenal, however.

Ironically, it is because the knowledge of nuclear weapons cannot be erased–they cannot be "uninvented," and the underlying concepts can be rediscovered by scientists and engineers worldwide–that it is essential to maintain expertise in designing warheads. Regardless of the future of the US arsenal, it is only through such knowledge that one can be aware of potential nuclear-weapons developments around the world.

Specifically, efforts at nuclear non-proliferation, disarmament and counter-terrorism can only succeed on the basis of a deep understanding of weapons designs. Indeed, it is members of the nuclear-weapons laboratories–from the US and other countries–that have helped train the international inspectors, or even participated in the inspection teams needed to monitor treaties and maintain international security. The laboratories have also participated in Cooperative Threat Reduction Programs for securing nuclear weapons, components and materials, and in developing nuclear forensics for tracking interdicted contraband that could fuel terrorists' detonation of a nuclear explosive.[8,9]

These are just a few examples of nuclear-weapons knowledge supporting arms control, non-proliferation and counter-terrorism. With appropriate procedures for protecting sensitive information, such efforts can be pursued cooperatively even between potentially rival nations, to the benefit of enhanced security and international stability.

These matters command attention because nuclear technology and materials are inevitably spreading around the world, as nations embrace nuclear power to supply their energy needs and to reduce the emission of greenhouse gases. Therefore, the potential for more nations becoming latent nuclear states–having the technical capability to develop nuclear weapons should they feel compelled to do so–increases relentlessly with time.

Such considerations show that the nuclear-weapons laboratories of the past will continue having a significant role in national and international security of the future, no matter how the nuclear arsenals evolve. These security laboratories have many contributions to make by applying their deep technical competencies to the expanding needs of homeland defense, intelligence and law enforcement, domains closely related to their traditional mission and in which they already have much experience. Once again, these are needs that cannot be met by academia or industry alone.

Rather than embedding the laboratories in the military as support for the nuclear arsenal, we are best served by having them address the world's growing needs for countering the 21st Century's emerging threats to security.

Raymond Jeanloz, a geophysicist at the University of California, Berkeley, is an advisor to government and academia in areas of national and international security, and chairs the US National Academy of Sciences Committee on International Security and Arms Control.

Ed. Note: *Links to many of the references are given in the online version of* APS News*, www.aps.org/publications/apsnews.*

[1] See, for example, J. Fleck "Military Control of Labs Studied" *Albuquerque Journal*, February 9, 2009

[2] *Nuclear Capabilities*, report of the Defense Science Board, December, 2006

[3] *Nuclear Deterrence Skills*, report of the Defense Science Board, September, 2008

[4] M. Bundy, W. J. Crowe, Jr. and S. D. Drell, *Reducing Nuclear Danger: The Road Away from the Brink*, Brookings Press, Washington, DC, 1993.

[5] R. Jeanloz, Comprehensive Nuclear-Test-Ban Treaty and US Security in *Reykjavik Revisited, Steps Toward a World Free of Nuclear Weapons* (G. P. Shultz, S. D. Drell and J. E. Goodby, eds.), Hoover Press, Stanford, CA, pp. 369-398 (2008).

[6] *Science at Its Best, Security at Its Worst*, report of the President's Foreign Intelligence Advisory Board, 1999.

[7] The news article (1) mistakenly states the opposite.

[8] *Global Security Engagement: A New Model for Cooperative Threat Reduction*, National Research Council, Washington, DC, 2009.

[9] *Nuclear Forensics*, Report of the AAAS and APS, Washington, DC, 2008.

APS News welcomes and encourages letters and submissions from its members responding to these and other issues. Responses may be sent to: letters@aps.org