# APS NEWS

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**Highlights**



## Serene to Succeed McIlrath As APS Treasurer

This fall Joseph Serene will become the new APS Treasurer, succeeding Thomas McIlrath, who is retiring.

McIlrath has served as APS Treasurer since September 30, 1996. Serene will take over the position on or about September 30, 2006.

The APS Treasurer, one of the Society's three operating officers, is responsible for the Society's fiscal management and publications marketing activities.

Serene is currently a professor of physics at Georgetown University. He has served as chair of the physics department and as dean of the Graduate School of Arts and Sciences. He is currently the Interim Director of Music and Dance.

Serene earned his PhD in physics from Cornell University in 1974. He spent a year as a postdoctoral fellow at Stanford University, followed by a year as a NORDITA Guest Professor at the Helsinki University of Technology. He has held faculty positions at Yale University and the State University of New York at Stony Brook. From 1984 to 1987

*Serene to Succeed continued on page 7*

## March Meeting Prize and Award Recipients

*Photo credit: Robert Stockfield*

*Front row (l to r): Robert Meyer (standing); Ludwik Leibler; James Chelikowski; Kenji Urayama; Mark Johnson; Alfred Redfield. Middle row (l to r): Noel Clark; Charles Su; Rainer Grobe; Frances Hellman; Hui Cao; Roberto Merlin. Back row (l to r): Charles Duke; Hongjie Dai; Alex Zettl; David Vanderbilt; Matthew Paoletti; Murray Batchelor (on behalf of Rodney Baxter).*

## APS Honors Its First President

*Photo credit: Robert Stockfield*

*As part of the APS historic sites initiative, at the March Meeting a plaque was presented to Johns Hopkins University to commemorate the work of Henry A. Rowland, Professor of Physics at Johns Hopkins from 1875 to his death in 1901, and inventor of the diffraction grating that bears his name. He was also the founding president of the American Physical Society in 1899. Presenting the plaque on behalf of APS was past-President Marvin Cohen (left). The plaque was accepted by Adam Falk (center), the James B. Knapp Dean, Krieger School of Arts and Sciences at Johns Hopkins. Watching at right is John Rigden of Washington University, St. Louis, the Chair of the APS Historic Sites Committee.*

## March Meeting Physicists Drop In on Congress

Over two days in March, some 110 physicists and physics students took time off from the APS March Meeting in Baltimore, Maryland, to discuss the importance of science research funding with their individual Congressional representatives.

"Carrying the message to individual offices remains one of the best means of influencing a Member of Congress," says Kimberly Regan, science policy fellow with the APS Washington Office, of the incentive behind organizing the event. "The advantageous location of this year's meeting provided an exciting opportunity to have attendees from as many districts and states as possible travel to Washington, DC, to educate Congress on the importance of science funding."

Following a briefing in Baltimore, participants were bused to Capitol Hill. They met with staffers–and in some cases the members themselves–in 153 Congressional offices from 31 states. The emphasis was primarily on encouraging Congress to fully fund the Bush administration's FY07 budget request as outlined in the American Competitiveness Initiative. This includes an 8% increase for NSF, a 14% increase for the DOE Office of Science and an 18% increase for NIST. Participants also urged Congressional

*Congress continued on page 6*

## Graphene's Unique Properties Offer Much Potential

A two-dimensional sheet of carbon, called graphene, has many of the same interesting properties as one-dimensional carbon nanotubes (CNTs), according to several papers presented at the APS March Meeting in Baltimore. Electrons can move at high speeds through the material–so fast that their behavior is governed by relativity rather than classical physics. They also suffer little energy loss, making graphene an ideal candidate for future electronics applications, especially at the nanoscale.

To date, much attention has focused on CNTs as holding the most promise for nanoelectronics because they conduct electricity with virtually no resistance. But there are some serious obstacles to scaling up CNT-based devices to high-throughput manufacturing. For example, scientists have yet to find a way to produce nanotubes of consistent sizes and electronic properties, which is key to achieving sufficient control for device applications. It is also difficult to integrate CNT into electronic devices using processes suitable for high-volume production. And there is high electrical resistance that produces heating and energy loss at junctions between CNTs and the metal wires connecting them.

Their use in next-wave microchips is among the most promising short-term applications for graphene. When rolled into CNTs or formed into ribbons or patterned planes, graphene is a terrific platform for electronics. Electrons move quickly and suffer very little energy dissipation even at room temperature. In fact, they act almost like massless particles. Making smooth interconnections between separated devices on a chip might be easier with graphene, and scientists hope to be able to further exploit the material's unusual quantum effects.

"Nanotubes are simply graphene than has been rolled into a cylindrical shape," says Georgia Tech's Walt de Heer. "Using narrow ribbons of graphene, we can get all the properties of nanotubes because those properties are due to the graphene and the confinement of the electrons, not the nanotube structure." The width of the ribbon controls the material's band-gap. Other structures, such as sensing molecules, could be attached to the edges of the ribbons, which are normally passivated by hydrogen atoms. The ribbon width confines the electrons in a quantum effect similar to that seen in CNTs.

According to de Heer, graphene will provide a more controllable platform for integrated electronics than is possible with CNTs since graphene structures can be fabricated as large wafers using

*Graphene continued on page 3*

## New APS Education Award Calls for Nominations

The APS Excellence in Education Award, approved by Council in November 2003, has achieved its fundraising goal of $100,000 and will be awarded for the first time next year. The selection process is underway, and a call for nominations has been issued. The deadline for nominations for the first award is July 1, 2006.

The award, which consists of $5000 and a certificate citing the achievements of the recipients, is distinctive in that it is intended to recognize groups, rather than individuals. Its defining characteristics are set forth in the language that was adopted by Council:

The Excellence in Physics Education Award will recognize and honor a team or group of individuals (such as a collaboration), or exceptionally a single individual, who have exhibited a sustained commitment to excellence in physics education. Such a commitment may be evidenced by, but not restricted to, such accomplishments as:

–outreach programs

–a specific program or project that has had a major ongoing influence on physics education at the national level

–outstanding teacher enhancement or teacher preparation programs over a number of years

–long-lasting professional service related to physics education that has had a demonstrated positive impact.

Nominations should be submitted to the chair of the selection committee, Wolfgang Christian, at the following address:

PO Box 6926, Davidson College, Davidson NC 28035-6926 [email: wochristian@davidson.edu].

*Nominations continued on page 7*

## Members in the Media

"At first, we were disbelieving. We repeated the experiment many times to make sure we had a true result and not an 'Ooops'!"

*– Chris Deeney, Sandia National Lab, on achieving a temperature of 2 billion kelvins in Sandia's Z machine, Associated Press, March 9, 2006*

"Several things about it are not really understood – the durability, for one thing, is really not known how to predict."

*–Edward Garboczi, NIST, on concrete, Baltimore Sun, March 24, 2006*

"It's been very hard to come to a consensus. But it looks like it could be years or decades or millennia before any serious degradation takes place."

*–Raymond Jeanloz, UC Berkeley, on the useful lifespan of plutonium for weapons, San Francisco Chronicle, March 21, 2006*

"It never ceases to amaze me that it is possible to tell what is going on in the first moment of the universe."

*–Charles Bennett, Johns Hopkins University, on the latest results from WMAP, USA Today, March 16, 2006*

"What works? Science works. Geocentrism doesn't. End of story. I've learned over time that it's hard to convince people who believe otherwise, independent of evidence."

*–Lawrence Krauss, Case Western Reserve University, on geocentrism, the Sun Herald (South Mississippi), March 28, 2006*

"Redefining science? Who are you? Where do you come from? The arrogance is just unbelievable."

*–Hume Feldman, University of Kansas, on the Kansas State Board of Education's changes to the definition of science in thepublic school science standards, Lawrence Journal-World, March 17, 2006*

"It's amazing we are so uncertain about the most abundant substance on Earth. I have a feeling that, with water, there will be more surprises."

*–Anders Nilsson, Stanford University, on the structure of water, The Wall Street Journal, March 10, 2006*

"There are no bacteria known to be resistant to silver or silver oxide."

*–Dan Storey, Nexxion, on new silver oxide coating for medical devices to prevent infections, Baltimore Sun, March 17, 2006*

"It shows that planet formation is really ubiquitous in the universe. It's a very robust process and can happen in all sorts of unexpected environments."

*–Deepto Chakrabarty, MIT, on finding a dusty disk around a dead star, Associated Press, April 5, 2006*

"This was the most successful of the 42."

*–Jay Pasachoff, Williams College, on the many eclipses during which he has collected data, The New York Times, March 30, 2006*

"It's still up in the air how readily H5N1 can become human-to-human, but almost certainly there will be another pandemic at some point."

*–Timothy Germann, Los Alamos National Laboratory, on how bird flu would spread, National Geographic News, April 3, 2006*

"Many students have a fear of science, but if they come at it from a different angle, they sometimes find out they're interested in the subject and take more classes."

*–Michael Dennin, UC Irvine, on using comic book heroes to teach physics, Los Angeles Times, March 25, 2006*

"The drop rides along on the vapor like a boat on a river. The vapor is generated between the droplet and the ratchet's surface in a narrow gap, about the width of a human hair."

*–Heiner Linke, University of Oregon, on a way of making water droplets run uphill, FOX news.com, March 30, 2006*

"Most people don't report their sightings. They're afraid of ridicule, but in reality the world is interested. It's ready."

*–Stanton Friedman, on flying saucers, KOAA TV news, March 23, 2006*

## This Month in Physics History

**May, 1911: Rutherford and the discovery of the atomic nucleus**

In 1909, Ernest Rutherford's student reported some unexpected results from an experiment Rutherford had assigned him. Rutherford called this news the most incredible event of his life.

In the now well-known experiment, alpha particles were observed to scatter backwards from a gold foil. Rutherford's explanation, which he published in May 1911, was that the scattering was caused by a hard, dense core at the center of the atom–the nucleus.

Ernest Rutherford was born in New Zealand, in 1871, one of 12 children. Growing up, he often helped out on the family farm, but he was a good student, and received a scholarship to attend the University of New Zealand. After college he won a scholarship in 1894 to become a research student at Cambridge. Upon receiving the news of this scholarship, Rutherford is reported to have said, "That's the last potato I'll ever dig."

At Cambridge, the young Rutherford worked in the Cavendish lab with J.J. Thomson, discoverer of the electron. Rutherford's talent was quickly recognized, and in 1898 he took a professorship at McGill University in Montreal. There, he identified alpha and beta radiation as two separate types of radiation, and studied some of their properties, though he didn't know that alphas were helium nuclei. In 1901 Rutherford and chemist Frederick Soddy found that one radioactive element can decay into another. The discovery earned Rutherford the 1908 Nobel Prize in Chemistry, which irritated him somewhat because he considered himself a physicist, not a chemist. (Rutherford is widely quoted as having said, "All science is either physics or stamp collecting")

In 1907 Rutherford returned to England, to the University of Manchester. In 1909, he and his colleague Hans Geiger were looking for a research project for a student, Ernest Marsden. Rutherford had already been studying the scattering of alpha particles off a gold target, carefully measuring the small forward angles through which most of the particles scattered. Rutherford, who didn't want to neglect any angle of an experiment, no matter how unpromising, suggested Marsden look to see if any alpha particles actually scattered backwards.

*Ernest Rutherford*

Marsden was not expected to find anything, but nonetheless he dutifully and carefully carried out the experiment. He later wrote that he felt it was a sort of test of his experimental skills. The experiment involved firing alpha particles from a radioactive source at a thin gold foil. Any scattered particles would hit a screen coated with zinc sulfide, which scintillates when hit with charged particles. Marsden was to sit in the darkened room, wait for his eyes to adjust to the darkness, and then patiently stare at the screen, expecting to see nothing at all.

Instead, Marsden saw lots of tiny, fleeting flashes of yellowish light, on average more than one blip per second.

He could hardly believe what he saw. He tested and retested every aspect of the experiment, but when he couldn't find anything wrong, he reported the results to Rutherford.

Rutherford too was astonished. As he was fond of saying, "It was as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you."

About one in every few thousand of the alpha particles fired at the gold target had scattered at an angle greater than 90 degrees. This didn't fit with the prevailing model of the atom, the so-called plum pudding model developed by J.J. Thomson. In this model electrons were believed to be stuck throughout a blob of positively charged matter, like raisins in a pudding. But this sort of arrangement would only cause small angle scattering, nothing like what Marsden had observed.

After thinking about the problem for over a year, Rutherford came up with an answer. The only explanation, Rutherford suggested in 1911, was that the alpha particles were being scattered by a large amount of positive charge concentrated in a very small space at the center of the gold atom. The electrons in the atom must be orbiting around this central core, like planets around the sun, Rutherford proposed.

Rutherford carried out a fairly simple calculation to find the size of the nucleus, and found it to be only about 1/100,000 the size of the atom. The atom was mostly empty space.

In March 1911, Rutherford announced his surprising finding at a meeting of the Manchester Literary and Philosophical Society, and in May 1911, he published a paper on the results in the *Philosophical Magazine*.

Later Rutherford and Marsden tried the experiment with other elements as the target, and measured their nuclei as well.

The solar system model was not immediately accepted. One obvious problem was that according to Maxwell's equations, electrons traveling in a circular orbit should radiate energy, and therefore slow down and fall into the nucleus. A solar system atom wouldn't last long.

Fortunately, Niels Bohr was soon able to save the solar system model by applying new ideas from quantum mechanics. He showed that the atom could stay intact if electrons were only allowed to occupy certain discrete orbitals.

Though Rutherford still didn't know what was in this nucleus he had discovered (protons and neutrons would be identified later), his insight in 1911, which overturned the prevailing plum pudding model of the atom, had opened the way for modern nuclear physics.

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### GRAPHENE CONTINUED FROM PAGE 1

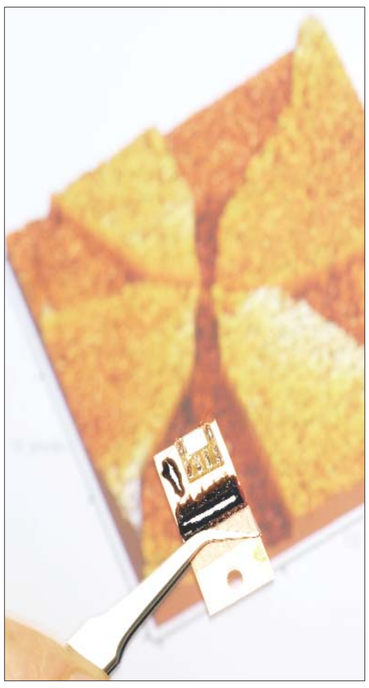
existing lithographic techniques. Continuous graphene circuitry can be produced using standard microelectronic processing techniques, which gives scientists a road map for high-volume graphene electronics manufacturing. "There is a huge advantage to making a system out of one continuous material, compared to having different materials with different interfaces–and large resistances to cause heating at the contacts," he said.

Single sheets of graphene were only isolated in 2004 by a group of researchers led by Andre Geim of the University of Manchester, sparking a wave of related investigation into the material. De Heer's team starts with a wafer of silicon carbide, and then heats the wafer in a high vacuum to drive silicon atoms from the surface. What's left is a thin continuous later of graphene. Next, they spin-coat onto the surface a photoresist material and pattern the surface using optical lithography or electron-beam lithography, followed by conventional etching processes to remove unwanted graphene.

De Heer's team has managed to create feature sizes as small as 80 nm–well on the way towards their goal of 10 nm–using electron beam lithography. Electrons move with very little scattering through the resulting graphene circuitry. The researchers have also shown electronic coherence at near room temperature, as well as evidence of quantum interference effects. They expect to see ballistic transport when they make structures small enough.

From a fundamental research perspective, graphene is equally rich in potential. For instance, it exhibits effects previously thought to occur only in the plasmas surrounding very dense neutron stars. Also, in graphene, electron velocity is independent of energy, so the electrons move as if they were light waves–they act like massless particles, even though the material contains particles known as massive chiral fermions, and particle theory has previously maintained that any particle with chirality must have mass.

This extraordinary property was explored further in November 2005 experiments making use of the quantum Hall effect (QHE), in which electrons, confined to a plane and subjected to high magnetic fields, execute only prescribed quantum trajectories. The experiments were conducted by Geim's group, and by a team at Columbia University led by Philip Kim.



*Graphene holds lots of promise for future nanoscale electronics.*

The QHE studies also revealed that when an electron completes a full circular trajectory in the imposed magnetic field, the phase of its wave function is shifted by 180 degrees. This is a modification known as "Berry's phase," and it serves to reduce electron energy loss. In a new twist to the story, Geim reported that he's observed a new version of QHE while studying the effect in graphene bilayers, resulting in a doubled Berry's phase of 360 degrees. This translates into even less energy loss than previously reported.

Geim compared his results to certain cosmologies in which multiple universes can co-exist, each with its own set of physical constants; in graphene, he said, where electrons move in a light-like way, with a fast speed (yet still somewhat less than the speed of light in a vacuum), the parameter which sets the scale of the electromagnetic force–that is, the fine structure constant–has a higher value of 2.0 rather than the customary 1/137.

The next step is to learn more about the fundamental physics of graphene, rather than focusing on potential applications. For example, de Heer reported that a plot of resistance versus an applied magnetic field had a fractal shape. He admitted that he can't yet explain this unusual finding.

As for the applications, he said that on an all-graphene chip, linking components with the usual metallic interconnects (which tends to disrupt quantum relations) would not be necessary. So the wave nature of electrons could be more fully exploited for quantum-information purposes. Thus far de Heer's group has attempted to build circuitry in this way, and has even made a few rudimentary graphene structures, including a graphene planar field-effect transistor. They have also built a working quantum interference device, which would be useful in manipulating electronic waves.

Meanwhile, research in CNTs marches on. A March 23 paper in *Science* by IBM researchers reported that they have succeeded in fashioning an electronic circuit around a single CNT molecule, obtaining switching frequencies of 52 MHz, roughly equivalent to Intel's old 486 microprocessor chips. The approach could be used to simplify the manufacture of molecular electronic circuits.

# INTERNATIONAL News

***...from the APS Office of International Affairs***

## International Efforts in Homeland Security R&D

**Penrose Albright**

At the creation of the Department of Homeland Security (DHS), one of the key rationales cited by the President and Congress was the need to provide a focal point for enlisting the national science and technology enterprise. Science and technology were–and are–seen as clear asymmetric advantages held by the developed world in dealing with the threat of terrorism. Moreover, it was clear from the outset that the effort to counter this threat needed to be international in scope. As a physicist, I understood that international cooperation in S&T must underpin any US counter-terrorism strategy.

Obviously, other nations had been thinking about and dealing with the terrorist threat for a long time; the UK, Israel, Russia, Australia all come to mind. The threats they have tended to face, however, have not been as technology-enabled and apocalyptically driven as those we fear today–for example, the IRA typically called ahead of time to warn of a bombing. Furthermore, it is clearly advantageous to the US if sophisticated counter-terrorism technology that deters, dissuades, and prevents attacks is deployed across the developed world–the usual target of terrorists. It should be just as difficult for a terrorist to cross the border into the EU as it is to cross into the US; it should be just as difficult to attack the public with a pathogen in London as it is in Chicago.

However, while the technical infrastructure for conducting R&D aimed at domestic security lies primarily in the developed world, the needed talent (and understanding of the threat) exists in the broader international community. Although the developed world is naturally concerned about its status as a preferred target, terrorism is a global phenomenon and so is the desire by governments to protect against it. The market for technical capabilities is worldwide, and the talents and insights needed to combat it is truly international in character.

Perhaps the greatest issue surrounding contemporary counterterrorism is the potential for truly catastrophic terrorism–biological, nuclear, and chemical. Terrorist organizations have made clear their desire to acquire such weapons, and with the possible exception of the nuclear threat,

*International News continued on page 6*

## Meeting Attendees Contact Congress

*Photo credit: Brian Mosley*

*During the APS March meeting, over 1100 attendees were able to use terminals with special software to write to their members of Congress about key budget issues. Shown here are (bottom to top): Vinobalan Durairaj,Gang Cao, Boyd Edwards,and John Colton.*

## Washington Dispatch

***A bimonthly update from the APS Office of Public Affairs***

**ISSUE: SCIENCE RESEARCH BUDGETS**

Congress is currently holding hearings to consider the President's Budget Request for Fiscal Year 2007, which begins on October 1. As noted in the previous Dispatch, the president has proposed significant increases for the National Science Foundation, the Department of Energy Office of Science, and the NIST laboratories as part of his American Competitiveness Initiative (ACI). The Appropriations Committees has yet to mark up any of the spending bills, but the Budget Committees have moved ahead with their work on the Budget Resolution. The Budget Committee's actions influence overall funding levels for the federal budget and the individual spending bills, rather than the budget of specific line items. The Senate Budget Committee, chaired by Senator Judd Gregg (R-NH), signaled strong support for ACI basic research budget requests in the Committee's draft of the Budget Resolution. It included levels to fully fund the President's ACI basic research increases and also provided a reserve fund. On the House side, the Budget Committee, chaired by Representative Jim Nussle (R-IA), in its committee draft reduced the ACI basic research components by more than $300 million. Reflecting the difficulties that the House Republican Leadership is having in achieving a consensus on spending levels, the Budget Resolution failed to gain a majority in early April. Final spending levels may not be worked out until the appropriators mark up their bills. For details of the FY07 budget process, go to http://www.aaas.org/spp/rd/.

To express your views to Congress on the President's ACI requests, go to http://www.congressweb.com /cweb4/ index.cfm?orgcode=apspa&hotissue=58.

***

The bipartisan Senate competitiveness bills discussed in the previous Dispatch continue to gain co-sponsors. Senate committees are currently holding hearings on the bills and are expected to hold votes soon. In the House, competitiveness bills addressing science have been stalled by lack of action by the House Leadership. House Democrats have submitted bills that mimic the bipartisan Senate counterparts. Although the House Republicans introduced a "competitiveness" bill in March, it did not address basic research.

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**ISSUE: RELIABLE REPLACEMENT WARHEAD (RRW)**

The Panel on Public Affairs (POPA) is participating informally in the establishment of a Nuclear Weapons Complex Assessment Committee (NWCAC). The committee, chaired by Bruce Tarter of Lawrence Livermore National Lab, has 13 other members, of whom 8 are APS members and 5 are APS Fellows. The first act of the committee will be to review and comment on the proposed Reliable Replacement Warhead (RRW).

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**ISSUE: GLOBAL NUCLEAR ENERGY PARTNERSHIP (GNEP)**

The Department of Energy (DOE) recently proposed a plan for a Global Nuclear Energy Partnership (GNEP: http://www.gnep.energy.gov). The plan contains some elements that were proposed by the POPA Nuclear Energy Study Group (NESG). Roger Hagengruber of the University of New Mexico, chair of the study group, plans to reconvene the committee to review and comment on GNEP. For information on the membership of the Nuclear Energy Study Group, please visit the website at http://www.aps.org/public_affairs/proliferation-resistance.

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

# Letters

### Theory of Everything a Grand Illusion

The anthropic principle and multiple universes continue to be trotted out in the columns of *The New York Times*, *Nature*, and physics journals. There must be other physicists like me who regard these as constituting bad philosophy and bad physics, but who have found their protesting letters simply ignored.

These ideas, supposedly cute and holding popular appeal, actually demonstrate a failure to absorb the lessons of Newton and Copernicus. Almost as important as his laws of motion and of gravity was Newton's emphasis that we have laws of physics and we have initial conditions. When contemporaries scoffed that he had not accounted for the planets' particular orbits or their lying in the same plane, his response was that it was sufficient for him to have accounted for what he had, rightly leaving these specifics as due to initial conditions.

A later, more embracing theory may explain them. Indeed, condensation of a swirling gaseous cloud leads to planets in one plane, but that picture will have its own initial conditions. Newton's genius that set the course for the development of our subject lay in narrowing the focus on what we set out to establish. This route to progress has been forgotten by those who seek a "theory of everything". The very search for everything explained in a grand closed whole seems unscientific.

Among the initial conditions are the constants that seem to characterize our Universe such as the fine structure constant alpha whose inverse is, approximately, 137. Either it is a given, or a more complete development will give a formula that yields the observed value. Anthropic arguments that, except for a narrow band of values, the Universe would look very different and be incapable of housing sentient beings to ask these questions, cut off prematurely any future quest to "derive" the number, while also failing on their own premise to "explain" the value. It is unimpressive that their band lies around the observed value because, however narrow, even just between 137 and 137.1, an infinity of real numbers lie in any band.

The question still remains of why the particular one to many decimal figures that our experiments measure. The same is true of the cosmological constant Lambda, no matter

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# Viewpoint...

## Scientists Can Bring Truth to the Public Arena

Leo Kadanoff

All over the world, this is a particularly difficult time for physics. In many places, there is a sharp decline in funding for research and teaching in physics. Some nations have a very serious shortage of home-grown students of physics. In others, the international exchange essential for the conduct of science has been seriously curtailed. Some places show some support for very applied work, but little interest in the basics. Some governments and groups are actively hostile to the patterns and traditions of independent intellectual activity which surrounds good scientific work. Others would reject the best scientific knowledge in such matters as the construction of school curricula, or the development of health policies, or in the implementation of environmental policy. In some places, government labs are pressed into being mouthpieces of partisan policy or politics. Everywhere, industrial labs doing physics have mostly faded away, or work on problems with a very short time-horizon. Unfortunately, in the United States we see elements of all of these difficulties. Why is this happening?

*Leo Kadanoff*

Partly the problem is a confusion about the role of science. We need to articulate to ourselves and to the general public the true meaning and value of our scientific work. Our work is particularly valuable not for the wealth or power it produces–in the present-day world there are quicker roads to wealth and power–but because it is a method for generating and discerning true things. If we carry out our professional responsibilities correctly and carefully, we might have the opportunity to say things about nature that are and will remain true: a certain pollutant will diffuse at a certain rate through a given medium, in the ordinary course of things information never moves faster than the speed of light, photons tend to clump in the same state, etc. These true statements can provide the hard facts upon which others may build the reliable instruments of our polity, or our economy, or our view of the world. More important, by using good judgment, we serve as examples showing how others might perform their own roles. That is our true value to the community–scientists can produce objectivity and a good approximation to something true.

To meet this purpose, we have to keep our work up to the highest standards of morality and correctness. Thus, the data fabrication scandals at Bell Labs and Lawrence Berkeley have proven destructive, particularly so because of the centrality of these labs to our world of physics. Almost equally destructive are media circuses about "breakthroughs" which in the end never quite work out, or the promulgation of exaggerated statements about the economic or military value of our work. In asserting the value of our profession each of us has the responsibility to see that all the work that we do is honestly carried out, and reported accurately and fully, without undue puffery. In doing this we may have to resist pressures from our employers, journals, and even from the apparent needs of our own careers.

Insofar as we do meet high standards, and mostly we do that reasonably well, we serve our society. We serve it in the classroom by teaching methods for finding and reporting facts about nature. We serve it in the laboratory by finding new things and reporting them with a reliable accuracy. In both lab and class we develop and maintain standards of logic and evidence that should be applied in many other walks of life, particularly in public life. We further serve the society in the public arena by helping to bring our government and leaders into better contact with the limitations and possibilities of physical reality. And most of all we serve our society by providing a

*Viewpoint continued on page 7*

# ... And the Physicists Sang Along

*Photo credit: Ernie Tretkoff*

*Laura Greene and Walter Smith wow the crowd with a duet performance of "Fabricate!"*

Richard Feynman would have been there in a heartbeat. So would James Clerk Maxwell and J.J. Thomson. They were certainly present in spirit at the first ever APS Singalong, held in conjunction with the March Meeting in Baltimore, where over 50 attendees sang physics-centric lyrics to familiar tunes while being accompanied by a guitar and a bongo.

Singing songs about physics is a long, time-honored tradition that originated in England, according to singalong organizer Walter Smith. Smith is a physics professor at Haverford College who runs what he describes as the premiere online collection of physics songs in the world. [See http://www.haverford.edu/physics-astro/songs.]

James Clerk Maxwell may have been the first physics songwriter. Maxwell composed alternate lyrics to the then-familiar folk song "Comin' Through the Rye," substituting the meeting of two young lovers with a rumination on the physics of collisions. By the early 20th century, Cambridge University's Cavendish Laboratory had made singalongs a tradition of their winter holiday parties, with participants like J.J. Thomson standing on chairs and singing parodies at the top of their lungs.

There's even a US precedent for physics singalongs. Before he achieved national fame for his satirical ditties, Tom Lehrer was a physics grad student at Harvard, where he penned an entire musical show called *The Physical Revue.*

Thanks to his six-year involvement in collecting physics songs, last year Smith inherited some valuable historical documents: a bundle of ancient mimeographs of some of the songs sung at the Cavendish Laboratory in the early 1900s, carefully preserved by Arthur Quinton. "I was absolutely overwhelmed," said Smith. "My hands were shaking as I looked through the old pages, revealing delights that might otherwise have been lost forever."

The find inspired him to organize the Baltimore singalong. "I felt we needed more socializing activities," he explained. "After all, one of the most important purposes of any conference is to spark new collaborations, which often grow from social encounters."

Smith himself penned most of the songs featured at Wednesday's singalong, including "The Love Song of the Electric Field" (sung to the tune of "Loch Lomond"), and the opening number, "L, Me Say L" (to the "Banana Boat Song"). "I thought it would take awhile to cajole folks into actually singing along," he said. "But they started singing right away." They were accompanied by guitarist Jamie Diorio, a UMD grad student in mechanical engineering, and UMD physics professor Victor Yakovenko, who provided the percussive beat with bongos and maracas.

James Riordon, head of the Society's Media Relations, obliged with an original tune about evolution. Physics professor Laura Greene of the University of Illinois performed a song she wrote called "Fabricate" (*see Zero Gravity, at right*), sung to the tune of "Cabaret." It satirizes former Bell Labs physicist Jan Hendrik Schoen, who was found to have engaged in scientific misconduct.

## zero gravity
### The Lighter Side of Science

## Fabricate!

These song lyrics concern the fate of Jan Hendrik Schön, who was considered a rising star in physics until it emerged that he had fabricated much of his data. The following should be sung to the tune of *Cabaret*!

*What good is working alone in your lab*
*Don't leave results to fate*
*Come and just Fabricate, young Schön*
*Come and just Fabricate*

*No use permitting truth dictate your doom*
*Or wipe all your fame away*
*Come and just Fabricate, young Schön*
*Come and just Fabricate.*

*I knew a Prof with honesty and stature*
*Worked day and night but never got in Nature*
*She wasn't what you'd call a CV power*
*With no Science pubs, her salary soon went sour.*
*When she lost her grants the big-shots came to snicker*
*"Well, compared to Schön, the NSF won't pick her"*
*But when we heard of young Schön's evil deeds?*
*She was the happiest Prof, you'd ever seen*

*Put down the flanges, the scopes and the probes*
*Don't make the journals wait*
*Come and just Fabricate, young Schön*
*Come and just Fabricate*

*Come fudge the lines*
*Draw points by hand*
*Get Nature pubs, start celebrating*
*Right this way, your Nobel's waiting*

*And as for me, and as for me,*
*I made my mind up, with Science and Nature*
*To publish there, does not raise stature*
*Start by admitting inventing the points*
*Isn't worth accolades*
*You lose when you Fabricate, young Schön*
*You lose when you Fabricate, young Schön*
*And we all lose, when you Fabricate!*

**Lyrics by Laura Greene. Printed with the author's permission.**

# Nanopores Have a Zillion Uses, Researchers Say

Nanopores, the tiny holes formed by proteins, could be used for a variety of applications, including sequencing DNA and detecting anthrax. Researchers reported the latest developments on natural and artificial nanopores and their applications at the March Meeting in a number of sessions devoted to the topic.

Nanopores are nanometer scale holes formed naturally by proteins or cells, for instance to allow ions to pass between nerve cells. Single nanopores form the basis for nerve activity. Similarly sized holes can also be made artificially.

Sean Ling of Brown University is one of many researchers working on DNA sequencing using nanopores. The basic idea was first proposed 10 years ago as an alternative to the standard method of DNA sequencing, which requires making many copies of a strand of DNA, chopping it up into small pieces for sequencing and then reconstructing the genome. This method is slow and expensive, costing about $10 million to sequence the $10^9$ bases in the entire human genome. Ling hopes nanopore sequencing could reduce that to about $1,000 per genome, and allow genomes to be sequenced in days.

Nanopore sequencing would work by looking at changes in ion flow as a single strand of DNA in a solution flows through a nanopore. Each nucleotide would affect the current in a characteristic way. One problem with this approach is that bases in a strand of DNA are too close together and move too quickly through the nanopore, making it difficult to identify individual nucleotides. Ling gets around this problem by attaching known probes, six or eight bases long, to single stranded strings of DNA, making it possible to read the strand in chunks of six or eight letters instead of one letter at a time. Also, by attaching a magnetic particle to one end of the DNA strand, he can slow down the rate at which the DNA traverses the pore, allowing for better resolution. In addition to the work with single nanopores, Ling also reported on developments of addressable nanopore arrays.

There are still some problems with nanopore DNA sequencing, said Ling, but as silicon nanopore technology becomes more reliable and affordable, fast DNA sequencing using nanopores will become a reality. There are challenges, but no show stoppers, Ling said.

Meanwhile, John Kasianowicz of NIST, who was one of the first to suggest that nanopores could be used for rapid DNA sequencing, is also working on other applications of nanopores. At the March Meeting, he described his recent work on a method for using nanopores for quickly detecting anthrax infections.

The anthrax bacterium secretes a protein, called "protective antigen," that naturally forms into nanopores, which then penetrate cell walls, creating a hole. When a voltage is applied across the cell membrane, ions can flow through the pore. Anthrax also secretes other proteins, called "lethal factor" and "edema factor," which can bind to the nanopore and prevent the flow of ions through the channel.

Kasianowicz can detect the presence of these toxic proteins in a sample of blood by measuring current flow through the nanopores. He has been able to measure these proteins in blood from guinea pigs, even at very low concentrations.

Previous methods of detecting active anthrax proteins relied on injecting live animals or cell cultures with samples for analysis, and required several days to work. This new method can reliably detect these anthrax proteins in about an hour.

In addition, the method could be used for screening potential therapeutic agents which would work by interfering with the binding of lethal factor and edema factor to the nanopore, Kasianowicz said.

While some scientists are using natural nanopores for these and other applications, other researchers at the meeting reported on developing artificial nanopores as important tools for biophysical studies. For instance, Cees Dekker of Delft University of Technology described advances in solid state nanopores, made from silicon oxide. Artificial nanopores are flexible, stable and adjustable, and can be used for a variety of studies, said Dekker. For instance, longer DNA strands take longer to travel through the pore, so one can use nanopores to measure the length of the strand.

In addition, DNA can go through a pore in either a folded or stretched state, making nanopores a potential tool for studying DNA or RNA folding and unfolding, or DNA-protein binding. Many other uses for nanopores are also being developed, said Dekker. "There's like a zillion ways you can use it."

# States with Unmatched Spins Lead to Novel Superfluids

A strange new form of superfluid with unequal numbers of spin up and spin down atoms has been created in a lab by two independent research groups. Though theorists have speculated for years about what would happen in states with unmatched spins, this is the first experimental observation of such a state. At the APS March Meeting, two research groups described their observations of cold gases of lithium atoms with unequal numbers of spin up and spin down atoms.

Normally in a superconductor, each spin up electron pairs with a spin down electron, and the pairs can flow with no resistance. Similarly, in a superfluid, atoms pair up and can flow with zero viscosity.

States with unequal numbers of spin up and down atoms do not fit the conventional model of superfluidity. There have been attempts to observe such phases, but until recently nothing definitive had been seen. The two experimental groups, one from Harvard and one from Rice, have now measured the effects of unmatched spins.

Both groups chill a cloud of lithium-6 atoms, which are fermions, in a laser trap to within billionths of a degree of absolute zero. The spin up atoms form pairs with spin down atoms. The researchers have been able to tune the pair interaction strength by adjusting a magnetic field. At one extreme, the atoms pair up into tightly bound molecules and condense into a molecular BEC. At the other extreme, the atoms form loosely coupled Cooper pairs, as in a BCS superconductor. This BEC-BCS crossover region has been explored by a number of research groups in the past several years.

Those studies involved gases with an equal number of spin up and down atoms. More recently, researchers have found they can use radio waves to control the number of spin up and spin down atoms.

"The beauty of these experiments is that the essential physics can be revealed in a very controllable, clear way," said Randy Hulet of Rice in a press conference at the March Meeting.

Above a critical mismatch of spin up and spin down atoms, Hulet observed a phase separation, in which the excess unpaired atoms were expelled from the superfluid gas in the center and collected at the edges of the traps, while the gas in the center remained paired.

Below the critical mismatch, the system behaved in an unexpected way–it incorporated the extra unmatched spins as if there were no mismatch. There was no phase separation. Although his group did not directly measure superfluidity, based on previous experiments, Hulet believes the gas was a superfluid. This behavior suggests some new form of exotic pairing is going on, said Hulet. "This is completely unexpected."

Martin Zwierlein, a graduate student in Wolfgang Ketterle's group at MIT, described his group's experiments on a gas of lithium-6 atoms with unequal numbers of spin up and spin down atoms. By rotating the condensate, they observed the formation of vortices that only occur in rotating superfluids, and found that in these experiments, some superfluidity persists even up to a 70 percent mismatch in some cases. The critical mismatch depends on the pair interaction strength.

Theorist Eugene Demler of Harvard commented that these experiments are intriguing, and even though we don't fully understand what's going on in these strange new states, we are in a new era of cold atom research.

Scientists believe these studies could provide insights into the extremely dense quark matter in the cores of neutron stars, where there may be unpaired quarks. The cold atom studies could also help explain the peculiar heavy-fermion materials that exhibit both magnetism and superconductivity. In addition, they could shed light on high temperature superconductivity.

# The Ides of March

Photo credit: Ken Cole

Photo credit: Charles Clark

*On the 2049th anniversary of the assassination of Julius Caesar in Rome, APS hosted a reception on Capitol Hill in Washington. The event, which attracted physicists, members of the administration, Congressional staffers, and members of Congress, was titled "Physics Today for a Brighter Tomorrow". The goal was to inform attendees about the ways in which fundamental physics research positively impacts their daily lives and how it can help them face tomorrow's challenges. To this end, attendees could, for example, witness cryogenic demonstrations by Nobel laureate Bill Phillips, hear about the physics of superheroes from Jim Kakalios, and find out about superconductivity from Paul Chu.*

*In the top picture, APS Fellow and member of Congress Rush Holt (D-NJ) addresses the crowd while APS Fellow and member of Congress Vernon Ehlers (R-MI) looks on, together with event organizers Charles Clark of NIST and Susan Coppersmith of the University of Wisconsin. In the lower picture, Ehlers (3rd from left) chats with Sidney Nagel of the University of Chicago, former APS President Myriam Sarachik of CCNY, and current APS President-elect Leo Kadanoff of the University of Chicago.*

# Meeting Attendee Has Identity Stolen

When Greg Grason, a postdoc at UCLA, arrived at the Baltimore Convention Center first thing on the Monday morning of the March Meeting, he made his way to the registration booth, and asked to pick up his badge. But the badge had already been checked out.

Assuming it had been some minor mix-up, registration staff made him another badge, and Grason was not concerned at the time.

Not until Thursday did he discover that he'd been the victim of a sort of identity theft–someone had posed as Grason, gotten a badge with Grason's name on it, and used it to scam meeting attendees out of money.

On Thursday night, several of Grason's colleagues told him they had seen a man on the street wearing a badge with Grason's name on it, introducing himself as Grason, and asking to borrow money for a taxi.

He thought this was odd, and reported it to meeting registration staff on Friday morning. The meetings staff took note of the problem, but at that point there wasn't anything they could do about the matter.

Shortly after the end of the meeting, Grason received several emails from other meeting attendees who had met the impostor. Two had lent money to the person, believing him to be Grason, and were now requesting him to repay the $20. Grason responded to these emails explaining that he had not, in fact, been the person asking for money. Another email came from a physicist who had given money to the impostor, but now realized it wasn't Grason, and simply wanted to alert him to the scam. One correspondent told Grason he had tried to report the incident to the police, but after waiting for hours at the police station without receiving much attention, he gave up.

Grason believes that the perpetrator may have met dozens, or even hundreds, of meeting attendees, Grason's current and potential future colleagues. Grason therefore wants to make sure it is known that this individual wearing his badge and asking for money wasn't him.

Nothing like this has happened at an APS meeting before, says Donna Baudrau, APS Director of Meetings.

It seems that the impostor went to the registration desk, claimed to be Greg Grason, and was given the badge. It isn't clear why this individual chose to impersonate Grason, or how he knew that Grason was pre-registered for the meeting, Baudrau said. Possibly the impostor looked at the meeting program, picked Grason at random, approached the registration desk, asked for Grason's badge, and was simply lucky that

**Meeting Scam continued on page 7**

## Committee on Minorities Meets

Photo credit: Ernie Tretkoff

*The APS Committee on Minorities met at APS headquarters in College Park, MD on April 7. In the photo are (left to right): Juana Rudati, Eric Lin, Lawrence Norris (National Society of Black Physicists liaison), Calvin Howell (COM Chair), Edward Thomas (bottom), Jay Dickerson (top), APS Director of Education Ted Hodapp, APS Outreach Programs Administrator Arlene Modeste Knowles, and Pete Markowitz.*

## Intel Science Talent Search Selects 2006 Winners

In March, Intel Corporation awarded a $100,000 scholarship to Utah high school science student Shannon Babb for her six-month-long study to identify water quality problems in the Spanish Fork River.

Yi Sun of San Jose, California, received second place honors (a $75,000 scholarship) for discovering new geometric properties of random walks, while Yuan Zhang of Rockville, Maryland, placed third (a $50,000 scholarship) with a study of the molecular genetic mechanisms behind heart disease. Rounding out the top ten were projects on the quantum tunneling effect, a computational study on new krypton- and argon-bonded molecules, and the effects of age on near-IR spectral features of brown dwarf stars, among others.

The remaining 30 finalists received $5000 scholarships and an Intel Centrino notebook computer. Some 1558 students from 486 high schools in 44 states entered the competition this year, from which 300 semifinalists were chosen. The top 40 finalists were judged according to research ability, scientific originality and creative thinking.

"The talent represented at Intel STS is a dramatic illustration that investing in science and math education will pay great dividends for the future of American innovation," said Intel Chairman Craig Barrett–a long-time advocate–in a prepared statement at the black-tie awards gala in Washington, DC. "The seed of the next big scientific discovery could very well be planted in this room tonight."

Sponsored by Intel since 1998, the STS is the country's oldest and most prestigious high school science competition. Past winners have included six Nobel Laureates, three winners of the National Medal of Science, ten MacArthur Foundation Fellows, and two Fields Medalists.

## Coloring Book Features Famous Physicists

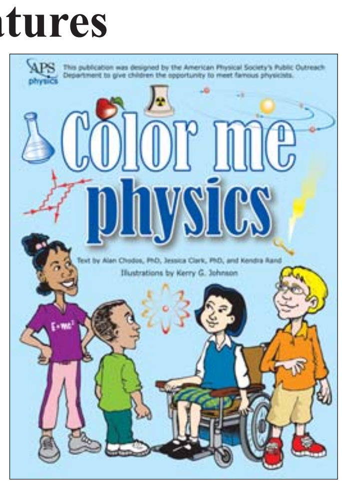


Illustration by: Kerry G. Johnson

The APS Public Outreach department has produced *Color Me Physics*, a coloring book that highlights ten famous physicists. Each page features a drawing of the physicist, suitable for coloring, together with a verse giving a brief description of what the physicist did. For example, the verse about Galileo reads:

*Galileo was no dope*
*Looking through his telescope.*
*He would have to be much stupider*
*Not to see the moons of Jupiter.*

and the verse about Marie Curie is:

*Men said women can't do science*
*Marie Curie showed defiance.*
*She was not afraidy 'um*
*She discovered radium.*

In addition to these, the book contains pages devoted to Copernicus, Newton, Franklin, Bouchet, Einstein, Fermi, Goeppert-Mayer, and Feynman. The inside front cover gives additional biographical information on each physicist.

The book will be distributed to teachers and others who can use it as a fun way to give younger children a first impression of physics and physicists. It is also online, in a format suitable for downloading, at www.physicscentral.com/coloringbook. The website contains additional source material on the featured physicists. Further information can be obtained by emailing outreach@aps.org .

**CONGRESS CONTINUED FROM PAGE 1**

members to increase NASA's science budget by at lease 3%, in line with the current rate of inflation for research.

Another focus of the visits was to encourage Congressional members to sign "Dear Colleague" letters circulating in the House and Senate, calling for support of NSF and DOE. There were 164 signatories on the House NSF letter, and, at press time, 136 on the House DOE letter, and 66 signatories on the Senate DOE letter. Many were first-time signers, which Regan credits to the efforts of APS members during the visits.

The visits coincided not only with the APS March Meeting, but also the start of Congressional considerations of the appropriations for the next fiscal year. However, the event also had more long-term objectives, namely demonstrating to APS members the importance of informing their elected officials about what physicists do, and encouraging them to become more active in this regard.

Marie Mapes of the University of Wisconsin met with staffers from five offices of members of Congress from her state, and emphasized that the US is lagging behind other areas of the world in terms of both R&D funding and producing science PhDs. Mapes decided to participate in the Congressional visits "because I wanted to let my representatives know how best to represent me," she said. "Now that I know it is relatively easy to access our members of Congress, I'm much more likely to approach them again about issues that are important to me."

Cris Ugolini of Kansas State University visited five Congressional offices. He participated in the event because he believes strongly that there is a great need for increased scientific funding. "We as scientists often discuss amongst ourselves the need for more funding to perform basic research," he said. "But we rarely act out to inform our respective government officials of the desired funding."

He attributes this in part to the fact that "many feel their voice cannot make a significant change." One of the senators whose office he visited signed the DOE "Dear Colleague" letter the very next day, which convinced Ugolini that "our government officials listen to their constituents, and the voice of one person can still have an impact."

While describing the outcome as "a terrific start" to the appropriations process, Regan emphasized, "We view these visits as part of our members developing a relationship with an office rather than a one-time event." The hope is that members will follow up in the future, make visits to home offices, and perhaps even invite staff members of Congressional representatives to visit their laboratories. In turn, Congressional offices might find APS members to be a valuable resource on science and technology policy issues.

The Washington office also set up a "Contact Congress" booth at the Baltimore Convention Center, encouraging more than 1100 attendees to sign letters to their representatives on the Hill. Those letters were hand-delivered to Congressional offices later in the week (see picture on page 3).

## Nevada APS Members Visit Their Congresswoman

*Six APS members from Nevada visited with Congresswoman Shelley Berkley (D-NV) during the Congressional visits organized by APS. From left to right are Philippe Weck, Zachary Quine, Eunja Kim, Congresswoman Shelley Berkley, Michael Pravica, Edward Romano, and Brian Yulga.*

**INTERNATIONAL NEWS CONTINUED FROM PAGE 3**

the technological infrastructure and expertise needed for their production is not a significant barrier.

Furthermore, the critical ability to produce fissile material is no longer in the hands of a few countries–it is spreading. A large-scale biological attack, or the explosion of a nuclear weapon on domestic soil would be epochal in its effect. The attacks of September 11$^{th}$ killed an order of magnitude more people than the previous largest terrorist attack, and its perpetrators had the *intention* to kill far more. The subsequent anthrax attacks reminded policymakers that use of that agent in an aerosolized release, as opposed to mailing it in letters, could kill 10 to 100 times more people beyond that. The scale of this threat and the softness of the targets require new ways of thinking.

Nevertheless, international cooperation can be impeded by differences between the US and foreign governments with regard to perceptions of the threat. For example, most nations regard the nuclear threat as much less of a concern than does the US. Therefore, prerequisites for successful international S&T cooperation include a coordinated risk assessment between governments and then, for those areas of commonality, a strategic approach to the S&T requirements.

Another potential impediment to international S&T cooperation is that organizationally, no other country has anything like a "Department of Homeland Security." Most nations provide equivalent scope through offices at the Prime Ministerial level, equivalent in most ways to the old Office of Homeland Security in the White House that preceded creation of the Department of Homeland Security in the US. In particular, most nations deal with the more apocalyptic threats of biological, nuclear, and chemical terrorism through their military establishments, with public health and environmental agencies playing a supporting role.

This military nexus can impede collaboration on homeland security technology development for both technical and programmatic reasons. Although the S&T base generated by military programs is invaluable, defense technology cannot easily be transferred to the civilian community. For example, militaries must train and equip themselves for deployed and episodic operations, and hence assume an extensive and constant supply chain, depot and spares infrastructure, along with a cadre of specialists trained to service the equipment.

The civil community, on the other hand, cannot support that same infrastructure or a dedicated trained workforce. Likewise, many of the protection requirements for military technology are predicated on its use by and for soldiers of a certain age, degree of health, and acceptance of personal risk. The civilian population that must be protected includes people of all age groups, in varying degrees of health, who also enjoy a strong legal framework to minimize risk to the individual. For sensors, as an example, the detection, false alarm, and throughput requirements that must be met in a civil setting are profoundly different from those associated with military deployments.

*Penrose Albright, now with the Civitas Group, served in the White House Office of Homeland Security as Senior Director for Research and Development and headed the Transition Planning Office that designed the future Department of Homeland Security's Science and Technology Directorate. When that Directorate was established, he became its first Assistant Secretary for Science and Technology.*

# Scientists Explore Intricacies of Evolution

Though the theory of evolution is well established, there are aspects scientists don't fully understand. Biologists and physicists are trying to fill in some of the gaps in our knowledge, by creating more quantitative models and approaching evolution from new perspectives. In a well-attended session at the APS March Meeting, several scientists discussed various aspects of the foundations of evolution.

Michael Deem of Rice University talked about how "life has evolved to evolve." That is, evolvability itself is a selectable trait, especially when the environment changes rapidly. The findings have implications for drug resistance, and could be used to help hospitals develop strategies to get the most use out of a collection of antibiotics before bacteria become resistant to all of them.

Daniel Fisher of Harvard discussed what is known and what is not well understood about evolution, and described a quantitative model he has developed to help answer some of the open questions. For instance, it is well known that mutation leads to heritable variation and selection, but we don't have a good grasp of what can evolve on what time scales, he said. At short time scales, we can watch evolution happen in the lab, such as when bacteria evolve antibiotic resistance. But at longer time scales, we don't know the details of what can evolve, said Fisher. He described his quantitative model of how fast populations can evolve under various conditions.

We could also benefit from a new view of DNA and genomics, said biologist Jim Shapiro of the University of Chicago. Viewing the cell as a sort of computer provides a useful perspective, said Shapiro, who discussed what he called a "21st century view of genomes and evolution."

Life has evolved sophisticated information processing tools that we can learn a lot from, he said. Genomes function in complicated ways, and genomics cannot be viewed as a simple one gene-one trait system, he pointed out. DNA acts as a data storage medium, and is always in communication with the rest of the cell. DNA doesn't do things by itself, he emphasized.

Furthermore, mutations are not always just undirected random changes. Cells are filled with mechanisms for formatting, restructuring and repairing DNA. The immune system is one example. As another example, Shapiro described how the DNA of *E. coli* is formatted so that it can execute an algorithm to discriminate between lactose and glucose and decide how to process them, depending on whether one or both are present in the cell.

"Cells have powerful information-processing networks," said Shapiro. Cells control hundreds of millions of biochemical and biomechanical events per cell cycle. When replicating its DNA, *E.coli* copies 1000 nucleotides per second, with very few mistakes. "Biological systems are unbelievably efficient," he said. "If we could mimic that, we'd be on to something."

Juan Keymer of Princeton University described how he has constructed a sort of cellular automaton based on how bacteria adapt to conditions in different tiny microhabitats. He used microfabrication techniques to build a landscape of habitat patches, each about 100 micrometers on a side, linked by microchannels through which the bacteria can move. In each of the tiny square pens, colonies of *E. coli* grow and reproduce.

Keymer can control the conditions in each microhabitat, for instance by altering the amount of food available to organisms in that pen, or by shining ultraviolet light on it. He then studies how the bacteria move from one microenvironment to the next, and develop mutations to adapt to local conditions. Because the bacteria reproduce and mutate in a predictable manner, they could form a living cellular automaton, with 0s and 1s represented by the presence or absence of bacteria in each cell.

# Division of Biological Physics Workshop Presents Research Opportunities

Physicists can make a substantial contribution to many rapidly advancing areas of biology, according to information presented at a workshop held Sunday before the March Meeting in Baltimore.

The workshop was aimed at physicists, especially graduate students and postdocs, who were curious about how a background in physics can provide a unique perspective on biological systems.

The program consisted of eight talks, which focused on the exciting research at the interface between physics and biology, and how physicists can work in those areas. Speakers covered a range of biophysics topics, including physical tools for biology research, molecular motors, computation in biophysics, and physics and brain research.

The speakers were William Bialek (Princeton), Robijn Bruinsma (UCLA), Hans Frauenfelder (Los Alamos), Klaus Lehnertz (Bonn), Yale Goldman (Penn), Charles Stevens (Salk Institute), Zuzanna Siwy (Irvine), and Sunney Xie (Harvard).

The workshop was inspired by two previous standalone conferences on opportunities in biology for physicists that were sponsored by the APS. The first was held in Boston, in September 2002, and the second in San Diego in January 2004. This year the Division of Biological Physics decided to hold the workshop with the March Meeting, to draw on the large pool of March Meeting attendees, attracting physicists who might not otherwise have attended the biological physics workshop.

Some of the approximately 200 people who attended the workshop already work in biophysics or closely related fields, while others work in other areas of physics but were interested in the topics. The attendees were a mix of graduate students, postdocs, and more senior physicists.

Participant response to the workshop was generally quite positive, said Claire Yu, one the workshop organizers. Attendees said they enjoyed the talks, though many commented that they would have appreciated more time for networking, and/or the inclusion of some informal or panel discussion in the program. DBP will try to incorporate those suggestions in next year's workshop, which will be held with the 2007 March Meeting.

**LETTERS CONTINUED FROM PAGE 4**

how it is jazzed up with umpteen negative powers of ten and accompanying dazzling words of "fine tuning" or that "our existence plays an important role."

As a number, there is nothing special about any value, including zero, and these constants have to have some value. It is a false mysticism to attribute special significance to zero. "Being at rest" was given special status before them, but Galileo and Newton made us appreciate that in physics it is on a par with any other constant velocity.

Multiple universes are also meaningless as physics so long as they have no influence on our own. Physics is an experimental subject aimed at understanding the (emphasis on this word) world around us. It is hubris for the physicists of our day, no matter how eminent, to think that in their lifespan of a hundred years on one planet of an insignificant star, the quest for physical understanding will end.

They should reflect on the lesson of the Copernican Principle, that they have no special status.

**A. R. P. Rau**
*Baton Rouge, LA*

**VIEWPOINT CONTINUED FROM PAGE 4**

much needed example of the possibility of creating value by disseminating truth. By doing this we can further enhance the public's great respect for scientists.

The APS can play an important role in all of this. The Physical Society is one of the primary mechanisms for us to formulate and express our view of ourselves and of the broad issues relevant to us. The APS then brings this view to the attention of people, industry, and government.

*Leo Kadanoff is the John D. and Catherine T. MacArthur Distinguished Service Professor of Physics and Mathematics at the University of Chicago, and the President-elect of the APS.*

**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**

**Onsager and the theory of hydrodynamic turbulence**
*Gregory L. Eyink and Katepalli R. Sreenivasan*

Besides Osager's well-known contributions to physics and chemistry, he had a lifelong interest and made ground-breaking discoveries in the subject of hydrodynamic turbulence. His 1949 paper stimulated considerable later work, but it is in his private letters and unpublished notes that some of the most original ideas appeared. In at least four cases, the theories were developed and published only decades later by others.

**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 or resident alien 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, 2006. Announcement of the award is expected to be made by August 1, 2006.

Details and online application can be found at http://www.aps.org/educ/cswp/blewett/index.cfm

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

## Call for Nominations:

# Lilienfeld Prize Honors Both Research and Communication

*Lilienfeld*

Most APS prizes are for research in a specific area, but a few cut across all disciplines. One of the most prestigious of these is the Julius Edgar Lilienfeld Prize, which recognizes both outstanding research and the ability to communicate to a broader audience.

Nominations are currently being sought for the 2007 prize. The deadline for receipt of nominations is July 1, 2006. The Prize, which is awarded annually, consists of $10,000, a certificate citing the contributions made by the recipient, plus expenses for three lectures by the recipient given at an APS meeting, a research university, and a predominantly undergraduate institution.

Nominations are active for three Prize cycles. Further information about the Prize, and a list of past recipients, can be obtained on the web at http://www.aps.org/praw/lilienfe/index.cfm.

**SERENE TO SUCCEED CONTINUED FROM PAGE 1**

he was a Program Director and Section Head of the Division of Materials Research of the National Science Foundation. Before joining the faculty at Georgetown University in 1993, Serene spent six years as a research scientist at the Naval Research Laboratory.

His research has been in condensed matter physics, especially theories of strongly correlated Fermi systems and unconventional superfluids and superconductors.

Serene is an APS Fellow and currently serves as Secretary-Treasurer of the Division of Condensed Matter Physics.

**NOMINATIONS CONTINUED FROM PAGE 1**

The fundraising effort was topped off by a gift from the Richard Lounsbery Foundation. Other major donors included Vernier Software, WebAssign, and Physics Academic Software. In addition, there were 19 contributions of over $1000, and 85 contributions up to $1000 in support of the Award. Further information may be obtained on the APS web site at http://www.aps.org/units/fed/award.cfm.

**MEETING SCAM CONTINUED FROM PAGE 5**

Grason was pre-registered and had not already picked up his badge.

Baudrau also wonders why anyone would give money to a stranger on the street, even someone who appeared to be a fellow physicist.

Meeting registration staff members do not ask registrants for identification, since asking 7000 participants for ID would slow the already long lines. Since there have been no previous incidents, there seems to be no reason to change the procedure, says Baudrau.

Grason also acknowledges that checking IDs of all meeting attendees would be impractical, though he hopes someone will try to come up with a way to avoid this sort of problem in the future, while keeping meeting registration efficient and convenient.

Grason says he still finds the incident strange, and while he can think of several ways that it could have happened, it all seems a bit implausible. He figures the scam artist could have been a physicist who was familiar with the meeting and registration procedures, or someone who hangs out around the Baltimore convention center and runs this sort of scam at other meetings as well. "Every scenario seems a bit silly," Grason says.

# The Back Page

## Welcome to the Blogosphere

**By Sean Carroll**

I know what you're thinking. You've heard of these things called "blogs," some sort of web journals feverishly updated by pajama-wearing authors convinced that the world is in desperate need of access to their innermost thoughts. Who has time to pay attention to such frivolities? Fortunately, as serious physicists we need not worry that our lives will be affected by this latest example of overhyped cyber-enthusiasm. Just like our lives were unaffected by the advent of email and electronic preprints.

When I'm asked what blogs are all about, I start by saying they are like magazines–collections of serially presented articles (called "posts" in the blog context), published on the internet instead of in bound paper editions. Blogs are a technology for conveying information. Like magazines, blogs can be about anything. The purposes to which we choose to put this technology are nearly infinitely flexible.

Two major differences distinguish blogs from magazines: accessibility and interactivity. By "accessibility" I mean not the ease of access to the reader, although there is that–almost all blogs are absolutely free and available instantly to anyone with a web browser. Rather, the first miracle of blogs is their accessibility to authors. It's not easy to get published in a magazine, but anyone can start their own blog in a matter of minutes, without knowing anything about web publishing, and without spending any money. Sites like Blogspot (www.blogger.com) provide not only free blogging software, but free web hosting as well. My first blog, Preposterous Universe (www.preposterousuniverse.blogspot.com), was literally set up in a couple of hours on a Sunday afternoon, with almost all of that time devoted to tweaking the look and feel to satisfy my stylistic predilections.

Ease of access is both a blessing and a curse. Recent estimates put the total number of blogs at over thirty million, the bulk of which prove Sturgeon's Revelation ("Ninety percent of everything is crap") to be wildly optimistic. But at the top end, blogs are beginning to be important players in the public discourse: large political blogs get hundreds of thousands of visits per day, comparable to the circulation of a major metropolitan newspaper. And the blogosphere is as yet sufficiently young and exuberant that hierarchies have not become completely entrenched; a talented new voice with something interesting to say can rapidly become recognized.

Interactivity, meanwhile, helps define the character of blogs as a publishing medium. On most blogs, each post is accompanied by a comment section to which anyone can contribute. These comment threads vary wildly in spirit and usefulness from blog to blog; some are little more than long strings of noisy insults, while others are thoughtful and nuanced conversations between parties who might not normally have the opportunity to interact.

But another kind of interactivity really separates blogs from traditional forms of publishing: hyperlinks. Blogs are the realization of the long-discussed prospect of the unique power of interconnected web publishing. I can include in my blog post a set of links to any relevant external web pages, including other blogs. More interestingly, through the device of "trackbacks" I can leave a link on the other blogs to which I am referring, so that readers of those other blogs know that the conversation is being continued over at mine. The ease and rapidity with which these connections are established creates a uniquely interactive medium, in which interlocked discussions proceed simultaneously in different locations among different audiences. And it helps newcomers jump into the fray; the very first day I started a blog, it received over a hundred visitors, even though I hadn't told anyone of its existence. Other bloggers had noticed that I linked to them, and threw traffic my way.

As scientists, should we care about this burgeoning new medium, or is it mostly a plaything of political junkies, gossip columnists, and self-professed technology geeks? Despite the pioneering role played by physicists in setting up the Web itself and popularizing electronic preprint distribution with arxiv.org, they have been relatively slow to take up blogging, especially in comparison with their colleagues in law and the social sciences.

One of the first physics blogs, dating back to 2002, was Jacques Distler's Musings (golem.ph.utexas.edu/~distler/blog). Distler has been exploring the possibility of blogging as a research tool, allowing physicists to engage in informal technical discussions about recent papers and speculative ideas–thoughts that might be insufficiently developed to warrant a full paper of their own, but are worth sharing with an extended audience. In fact, arxiv.org has recently instituted trackback capability, allowing bloggers to leave hyperlinks at the abstracts associated with individual research articles; this enables a distributed conversation (unobtrusive to those who are not interested) about the implications of each paper. And the Kavli Institute for Theoretical Physics at UC Santa Barbara has been experimenting with blogs attached to individual Institute programs (blog.kitp.ucsb.edu). We could be seeing the beginnings of a dramatic new mode of scientific communication.

To date, however, the majority of physics-oriented blogs have concentrated less on communication among different researchers and more on communication between researchers and the outside world. During the World Year of Physics in 2005, a project called Quantum Diaries (interactions.org/quantumdiaries) recruited a diverse collection of particle physicists to blog about whatever struck their fancy, from the progress of their experiments to life on the conference circuit. The explicit purpose of this project was to put a human face on a field that can appear intimidating and abstract to non-experts.

*Sean Carroll*

A similar spirit motivates Cosmic Variance (cosmicvariance.com), the group blog I started with collaborators JoAnne Hewett, Clifford Johnson, Mark Trodden, and Risa Wechsler last year. Our goal has been to explain and comment on science and its place in the wider world, aiming at the hypothetical interested person on the street. Along the way, we are happy to blog about anything that might move us at the moment, from arts and politics to gadgets and gardening. The resulting undisciplined sprawl is a feature, not a bug; it reflects the reality of our complicated interests as human beings as well as scientists. With about three thousand visits a day (and steadily growing), someone is evidently interested.

One of the most successful things we've been able to do is to provide insight on breaking science stories, frequently with direct input from the scientists involved themselves. A typical example concerned a study by Bradley Schaefer of LSU, using gamma-ray bursts to measure properties of the acceleration of the universe, including the surprising suggestion that the density of dark energy might be increasing with time. After the story appeared in a number of newspapers, we wrote a post about it that included links to more technical details. A lively discussion ensued, in which Schaefer himself participated, clarifying some questions raised by the newspaper articles. This pattern has repeated itself with other newsworthy findings, from quantum non-demolition experiments to cosmic microwave background observations; in each case scientists who were directly involved with the research chimed in as part of a multiway discussion.

This kind of forum, in which interested laypeople (not to mention students) can read informal descriptions of recent research by professional scientists and even ask questions of the researchers directly, would be impossible without blogs. Science blogging will not replace science journalism, but it lowers the barrier between general readers and professional researchers.

Our science posts are usually not ripped from the headlines. We have provided pedagogical articles on topics such as symmetry breaking, Lorentz invariance, string theory, modified gravity, and the promise of future particle accelerators. Beyond pedagogy, we have hosted lively discussions about the kind of issues that physicists talk about all the time, but don't always make it into published papers: the relative merits of different approaches to quantum gravity, the status of the anthropic principle as science or otherwise, naturalness in particle physics, differences in data analysis techniques between different subfields of physics. A wide variety of topics at the intersection of science and society provide food for blogging: funding priorities, women and minorities in science, the relationship between science and religion, the portrayal of scientists on movies and television, and advice on how to get into graduate school. We have had contests to determine the greatest physics paper of all time, celebrated successful thesis defenses and the weddings of colleagues, and mourned friends who have passed away. The blog has provided a public space in which people with common interests, widely separated in space and coming from dramatically different backgrounds, can share thoughts and impressions on an equal basis.

Cosmic Variance is less than a year old, and we are still feeling our way toward the best way to realize the potential of our blog. Meanwhile, physics bloggers of widely disparate backgrounds and perspectives are venturing forth in their own directions. Just to pick out a small sample, Chad Orzel at Uncertain Principles (scienceblogs.com/principles) mixes stories of experimental atomic physics with informed commentary on NCAA basketball. Phil Plait at Bad Astronomy (www.badastronomy.com/bablog) is kept busy debunking misuses of astronomy wherever they may appear, but still finds time to keep his readers updated on all the good astronomy that is going on at NASA and elsewhere. Biocurious (biocurious.com) is a blog by Andre Brown and Philip Johnson, graduate students in physics who are making a move into biology.

Some of the best science blogging is being done by interested non-scientists. Anna Gosline, Katie Law, and Anne Casselman are journalists living in London who are starting a new print-based science magazine, meanwhile providing links and commentary on science stories at their blog inkycircus (www.inkycircus.com). And *APS News's* own Jennifer Ouellette at Cocktail Party Physics (twisted-physics.typepad.com) spins intertwined tales of science and pop culture, with the occasional drink recipe for good measure. The low barrier to starting a blog helps to diminish the role of gatekeepers in the scientific discourse; everyone with something to say is welcome and able to contribute, regardless of their formal credentials. In a seminar or classroom this could be disastrous; but on the internet it's easy enough to ignore most of the noise, and the participation of new voices is an unambiguously good thing for physics. Blogging, I predict, will ultimately play a much greater role in getting the public excited about science than TV shows like Carl Sagan's *Cosmos* and books like Stephen Hawking's *A Brief History of Time* ever did.

How in the world does anyone have time to do this? The answer depends on who is writing and what their purpose might be. For me, blogging is a pleasant sidelight, consuming an average of maybe half an hour per day. But a key factor in a blog's popularity is how often its authors actually post something. Biologist PZ Myers at Pharyngula(scienceblogs.com/pharyngula), by a wide margin the most popular science blogger on the web, combines good humor and a fierce devotion to standing up for science with a seemingly inexhaustible energy that leads to several thoughtful posts every day. Most of us can't hope to match that kind of output, which is why ambitious but overcommitted bloggers often assemble into collectives. One of the benefits of a group blog is that individual contributors can disappear for periods of time without dissipating the blog's momentum entirely. Even intermittently-updated blogs can gain wide recognition, if the author is able to provide a unique source of information, a compelling perspective on events, or simply a compelling and original style.

Blogs are not a fad destined to quickly fade away. On the contrary, we are witnessing the very early stages of the phenomenon, in which the number of blogs and bloggers is growing explosively. A type of communication that didn't exist a few years ago will soon be as ubiquitous as the Internet itself. It's a great opportunity for physicists to exchange ideas more readily with each other, and to let the rest of the world share the thrill of the process by which science truly progresses. Whether as bloggers, commenters, or simply as readers, it's a big blogosphere out there, and all are welcome.

*Sean Carroll is Assistant Professor at the University of Chicago/Enrico Fermi Institute, and co-founder of the group blog Cosmic Variance.*

*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.