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spring 2005 Prizes & Awards
See Pullout Insert Inside

2005 March Meeting Gears Up for Showtime in the City of Angels

The latest research results on the spin Hall effect, new chemistry with superatoms, and several sessions celebrating all things Einstein are among the expected highlights at the 2005 APS March meeting, to be held later this month in Los Angeles, California. The conference is the largest physics meeting of the year, featuring some 6500 talks covering a wide variety of research topics—many of which directly impact technologies that help to define the nature of modern culture.

Photo Credit: Courtesy of the Los Angeles Convention Center

Examples of cutting-edge work to be discussed at the meeting that might convert basic knowledge into useful devices include biological computing, magnetic resonance force microscopy, fuel cells and other uses for hydrogen fuel, superconducting diamond, condensates of utlracold Fermi atoms, gene chips, amorphous steel, solid-state qubits, and circuit QED. A special plenary session will focus on ways in which changing attitudes can recrystallize an entire field, often called a "paradigm shift." Topics to be covered include the advent of single-molecule biology; the discovery of a black hole at the center of the Milky Way, and strongly-correlated electron systems, including the quantum Hall effect.

However, physics research doesn't exist in a vacuum, but is linked in many ways to social issues. Several sessions will focus on such nontechnical issues as the status of women in physics research, human rights of scientists in China and Iran, paper citations in *Physical Review Letters*, journal refereeing, scientific collaborations between developed and developing countries, and alternative careers for physicists.

Celebrating All Things Einstein. This year marks the centenary of Albert Einstein's famous year of physics breakthroughs, when he published papers on the photoelectric effect, Brownian motion, and special relativity. Appropriately, 2005 has been recognized as the World Year of Physics (http://www.physics2005.org), and there are numerous sessions at the meeting devoted to Einstein's ideas and activities. For instance, these sessions showcase Einstein's many fruitful collaborations with other scientists. These include such well-known figures as Millikan, Lorentz, Bohr, Born, Planck, Boltzmann, and Ehrenfest, but also Emmy Noether, one of the rare women physicists of that era, who proved two deep theorems on the connection between symmetries and conservation laws—an achievement that greatly impressed Einstein.

Einstein's discoveries aren't simply relegated to the dusty annals of physics history: his ideas are still having an impact on cutting-edge research in condensed matter physics today, according to speakers at a special Wednesday evening session. For instance, Alex Zettle of the University of California, Berkeley, will discuss how Einstein's doctoral thesis work in 1905 concerned the size, geometry and interactions of nanoparticles, which are in turn of fundamental relevance to the design and creation of next-generation nano-electro-mechanical systems (NEMS). Moses Chan (Pennsylvania State University) will talk about evidence of Bose-Einstein condensation in solid helium, while Stanford University's Zhixun Shen will discuss how photoemission spectroscopy has emerged as a leading tool to push the frontier of condensed matter physics—a full 100 years since Einstein first explained the photoelectric effect at the heart of the technology.

Another session focuses on Einstein's activities in the social sphere, including his involvement with such ticklish issues as racism, pacifism, Zionism, and the dropping of the atom bomb during World War II. There will also be papers presented on Einstein in China, Einstein and diversity in physics, and a special World Year of Physics public lecture by 1996 Nobel Laureate Douglas Osheroff (Stanford University).

Spins in the Hall. Physicists at

See 2005 MARCH *on page 6*

Reborn Nicholson Medal Stresses Mentorship

Photo from Iowa University Relations.

Dwight R. Nicholson.

Established in memory of Dwight R. Nicholson of the University of Iowa, who died tragically in 1991, and first given in 1994, the APS Nicholson Medal has been reborn this year as an award for human outreach. According to the information contained on the Medal's web site (http://www.aps.org/praw/nicholso/index.cfm), the Nicholson Medal for Human Outreach shall be awarded to a physicist who either through teaching, research, or science-related activities,

1. has demonstrated a particularly giving and caring relationship as a mentor to students or colleagues, or has succeeded in motivating interest in physics through inspiring educational works; or

2. has created special opportunities that inspire the scientific development of students or junior colleagues, or has developed programs for students at any level that facilitated positive career choices in physics; or

3. has successfully stimulated the interest and involvement of the general public in the progress of physics.

In redesigning the purpose of the Medal, the APS Executive Board wanted to emphasize the importance of mentorship in maintaining the health and diversity of the physics profession. Nominations are now being sought for the first presentation of the medal under its new set of criteria. Nominations should be sent to the chair of the selection committee, William Gelbart of UCLA. Further details of the nomination process are available on the Medal's web site.

Einstein@Home, Grassroots Astrophysics Project, Goes Live

A new grassroots computing project dubbed Einstein@Home, which will let anyone with a personal computer contribute to cutting-edge astrophysics research, was officially announced at the annual meeting of the American Association for the Advancement of Science in Washington, DC, on February 19th. LIGO Laboratory Director Barry Barish of Caltech and Einstein@Home Principal Investigator Bruce Allen (University of Wisconsin-Milwaukee) made the

See EINSTEIN@HOME *on page 5*

Nominations Sought for New Sakharov Prize

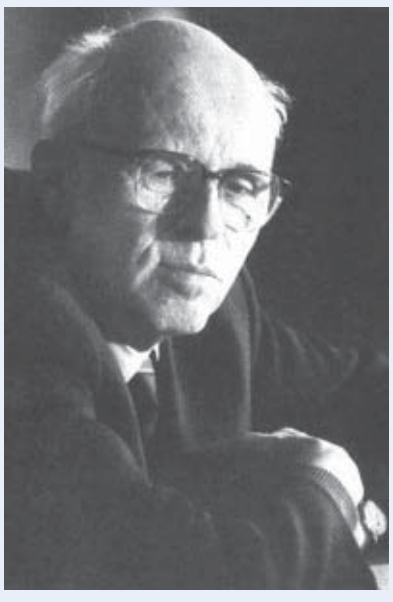

Photo Credit: nuclearweaponarchive.org

A new prize of the APS will recognize outstanding achievements of scientists in upholding human rights. Named in honor of the late Russian physicist Andrei Sakharov, the prize will consist of a certificate and $10,000. Nominations are now being sought for the first presentation of the prize. They should be sent to the Chair of the selection committee, John Gillespie of CUNY. Further details regarding eligibility and nomination procedures are available at the Sakharov Prize web site, http://www.aps.org/praw/sakharov/index.cfm

Board Blames Bush's Budget For Not Saving Hubble

By Ernie Tretkoff

In reaction to President Bush's proposed FY06 budget, the APS Executive Board has passed a resolution stating that servicing the Hubble Space Telescope should be one of NASA's highest priorities.

President Bush's budget, released on February 7, does not include funding for a mission to service the telescope. The resolution states that the Board "disagrees with the omission of funding for such a mission from the President's budget."

Under the President's proposal, NASA's total budget would increase by 2.4% to $16.46 billion, but no funds would be devoted to a repair mission for Hubble. NASA is shifting its priorities in order to carry out President Bush's vision for manned space exploration. The proposed budget includes money for returning the space shuttle to flight and operating the International Space Station.

The resolution states "the Board believes that Hubble's scientific potential is as promising as the remarkable past record it has achieved. It further believes that this potential provides a compelling, persuasive reason for adding money to the NASA science program to carry out the necessary servicing mission."

"Hubble is NASA's most successful scientific venture and one of the most successful scientific achievements in recorded history," said John Bahcall, APS President Elect.

Among its many accomplishments, he said, "It has revealed the formation of solar systems and the evolution of structure in the universe, helped to uncover what is driving the universe to expand, and it has given us awesome and beau-

See SAVE HUBBLE *on page 3*

Highlights

Members in the Media

"I see no problem with letting the darn stuff fall down the drain. Why are people so afraid of the singularity?"
—Ted Jacobson, University of Maryland, on the possibility that information is lost in a black hole, New Scientist, January 22, 2005

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"Most string theorists are very arrogant. If there is something [beyond string theory], we will call it string theory."
—Nathan Seiberg, Institute for Advanced Study, The Guardian, January 20, 2005

✶✶✶

"People assume that because it is familiar it is understood. But if you really probe, there are mysteries."
—Lakshminarayanan Mahadevan, Harvard University, on studying how venus fly traps snap shut, Boston Globe, January 27, 2005

✶✶✶

"In their back yards people find bones and panic, thinking it's human. Police send them for analysis, and it can take months to say it's just a dog. We could tell immediately."
—Madhavi Martin, Oak Ridge National Laboratory, on a technique called laser-induced breakdown spectroscopy that can be used for chemical analysis at crime scenes, Baltimore Sun, February 4, 2005

✶✶✶

"You may look at something every day, but you may never see it until someone says, 'There's something surprising going on here.' "
—Wendy Zhang, University of Chicago, on her experiments on air bubbles in pancake syrup, Chicago Sun-Times, February 2, 2005

✶✶✶

"The gas from the outer layers can't fall in at once. It spirals around like water going down the drain, forming a "squashy doughnut shape."
—Stan Woosley, UCSC, describing the collapse of some massive stars, Santa Cruz Sentinel, January 25, 2005

✶✶✶

"These things do almost nothing. The reason that they can go all the way from Chicago to Soudan is that almost nothing happens."
—Marvin Marshak, University of Minnesota, on neutrinos, Associated Press, February 11, 2005

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"Modern biology is built around evolutionary theory. You can't ignore it, but you can downplay it. You can't not teach it, but you can teach it badly."
—Mano Singham, Case Western Reserve University, The (Cleveland) Plain Dealer, February 10, 2005

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And, finally, a compendium of comments on Einstein, his theories, and the World Year of Physics:

"He definitely has a persona that captures your attention. I am impressed by his total independence. He came up with these incredible theories and was not part of the academic world at the time. That takes raw brain power and imagination. He could consider what most people thought of as impossible, as real."
—Robert Bluhm, Colby College, on Einstein, the Morning Sentinel (Maine), February 7, 2005

✶✶✶

"It's very complex. It took him a decade to work it out, and he got it wrong about four times along the way."
—Grant Mathews, University of Notre Dame, on general relativity, South Bend Tribune, February 4, 2005

✶✶✶

"This is one of the hardest parts of his theory to prove because the waves we hope to see are just so incredibly weak. It's a tiny effect."
—Peter Shawhan, California Institute of Technology, on gravitational waves, ABC News.com, January 24, 2005

✶✶✶

"It's like twirling a spoon in a jar of honey. You see the honey dragging along with the spoon. It's analogous to what happens in space."
—Michael Salamon, NASA, explaining frame dragging, ABC news.com, January 24, 2005

✶✶✶

"We have a conception of space and time built into us. He for the first time made space and time a part of physics and not of metaphysics."
—Steven Weinberg, University of Texas at Austin, on Einstein, Christian Science Monitor, January 20, 2005

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"If ever physics had a golden age, a case could be made that it is now."
—Stephen Benka, American Institute of Physics, Christian Science Monitor, January 20, 2005

✶✶✶

"There's a typhoon headed our way."
— Gerald Holton, Harvard University, on the World Year of Physics, The New York Times, January 25, 2005

This Month in Physics History

Einstein and Special Relativity

As a young boy, Albert Einstein had read a book by Aaron Bernstein, entitled *The People's Book on Natural Science*. In one section, Bernstein asked the reader to imagine riding alongside a current of electricity as it raced down a telegraph wire. This image stuck in young Albert's mind, and when he was 16, he began to wonder what a light beam would look like if he could catch up to it. As a child, he thought that a light beam would appear frozen, like a motionless wave, if one were racing alongside it. But no one had ever observed frozen light, and he began to wonder why this might be.

Ever since the days of Galileo and Isaac Newton, physicists had observed that laboratory measurements of mechanical processes could never show any difference between an apparatus at rest and one moving at constant speed in a straight line. Objects behaved the same way on a uniformly moving ship as on a ship docked in the harbor. They called this the *principle of relativity*. But they didn't believe this principle should apply to light.

At the end of the 19th century, light was assumed to be a wave. To scientists, this meant it had to travel in some sort of medium, just like sound or water waves. They decided there must a special substance called the ether permeating the world, and this would explain why light could travel through seemingly empty space. But if this were true, then the speed of light should not be constant, as predicted in Maxwell's equations; it should show the effects of motion. Experiment after experiment failed to turn up any supporting evidence for the assumption.

The most well-known of these experiments was done in Cleveland, Ohio, by Albert Michelson and Edward Morley in 1887. Their experimental apparatus was a massive stone block with mirrors and criss-crossing light beams, giving an accurate measurement of any change in the velocity of light. Michelson and Morley expected to see their light beams shifted by the swift motion of the earth in space. To their surprise, they could not detect any change. It is debatable whether Einstein paid heed to this particular experiment, but his work provided an explanation of the unexpected result through a new analysis of space and time.

In the wake of Michelson and Morley's results, (or lack thereof), Einstein decided to dispense with the notion of the ether altogether for his theory of special relativity. He began with two fundamental assumptions.

First, any observer moving at a constant speed would have the same laws of physics. Second, the speed of light *c* is always constant, no matter how fast or in what direction the light source was moving. If both of those assumptions held, then our notion of time must be incorrect: specifically, two events that are simultaneous in one frame of reference would not be simultaneous in another. Time was not absolute, but relative.

Since length measurement involves determining the front and back positions of an object at the same time, this same relative principle must apply to length as well. It also applies to the quantities of matter and energy. So time beats at different rates depending on how fast an object (or person) is moving; the faster you move, the slower time progresses. And the faster an object moves, the more distances contract, and the heavier an object becomes. In fact, in the limit that the speed of a massive object approaches *c*, time slows down to a stop, distances contract to nothing, and the object's energy becomes infinite.

Einstein wasn't the only scientist or philosopher to question the absoluteness of time. He developed his ideas in an era that was obsessed with the issue of synchronizing time frames through space. For one thing, it was critical to coordinating the schedules of railway companies. By the time Einstein was employed in the Swiss patent office in Bern, developing networks of clocks running in sync was a major precision industry, according to Peter Galison, author of *Einstein's Clocks, Poincare's Maps*. There were a large number of patents submitted dealing with clocks linked by signals.

And by the 1890s it was routine for astronomers and engineers to figure in the time an electrical signal took to travel from one place to another in their calculations. Some engineers even sent their time signals on round trips to compensate for the inevitable errors.

Photo: courtesy Yerkes Observatory, University of Chicago

Henri Poincare

At the Bureau of Longitude in Paris, Henri Poincare was among those worried about this "time of transmission." In January 1898, he wrote a famous philosophical article, "The Measure of Time," in which he discussed the possibility that simultaneity is little more than the exchange of signals between two clocks, taking into account the time of transfer between them at the speed of an electrical signal, or of light. Poincare didn't apply his ideas to physics until 1900, when he was invited to speak at a gathering to honor H.A. Lorentz, who was a major figure in the electrodynamics of moving bodies. Poincare realized he could reinterpret Lorentz's purely mathematical ideal of time as a physical coordination procedure.

Yet Poincare couldn't bring himself to discard the fundamental distinction between true time (in the frame of the ether) and "apparent time," as measured in any other frame of reference, nor could he discard the notion of the ether. Einstein did away with both, and the result was truly revolutionary.

Next Month: Einstein's Most Famous Formula

See the special exhibit on Albert Einstein's life and work by the American Institute of Physics: http://www.aip.org/history/einstein/

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ComPADRE Brings Digital Resources to Physics and Astronomy Education

By Ernie Tretkoff

ComPADRE (Communities for Physics and Astronomy Digital Resources in Education), a digital library of physics and astronomy education resources, has been running for over two years, and is continuing to expand.

"In general, there is a lot of material out there, from simple lesson plans, to simulations, to problem-based learning experiences, to reference material," said comPADRE principle investigator Bruce Mason of the University of Oklahoma. ComPADRE makes all these materials accessible from one website (www.compadre.org).

ComPADRE, an effort in which APS is collaborating with several other societies, currently comprises six collections of online resources on astronomy and physics. The collections each include links to and descriptions of resources such as online simulations, lesson plans, student activities, reference material, tutorials, and education research.

The six collections under the ComPADRE umbrella are:

1. PSRC (Physical Science Resource Center), the original collection, which contains all types of physical science resources;

2. The Nucleus, a collection by and for the AIP/Society of Physics Students that provides physics and astronomy resources for undergraduates;

3. Physics to Go, a library of informal science websites for the general public, produced by APS;

4. Quantum Exchange, a repository of resources for teachers of quantum physics;

5. Astronomy Center, a repository of resources compiled to assist in the teaching of a college-level introductory astronomy course;

6. The Physics Front, a digital library for all secondary school physics teachers.

For several years, the American Association of Physics Teachers (AAPT) had been collecting online resources in the PSRC, a general collection that includes resources on all physics subjects. In 2002, AAPT joined with the American Astronomical Society (AAS), the American Institute of Physics (AIP) and APS to expand the digital library and create the collections that now make up comPADRE, said Mason. The project is funded by the National Science Foundation and is part of the National Science Digital Library.

A survey showed that there was a need for collections designed with more specific audiences in mind, so the newer collections are aimed at groups such as students and secondary school teachers, or focused on more specific subjects, such as quantum physics or astronomy, said Mason.

ComPADRE is more than just a collection of links. Users can easily find what they are looking for because the database can be searched or browsed by topic, resource type, and intended audience. Every resource listed on comPADRE has been reviewed by a team of editors, and comPADRE allows users to post comments on resources.

Thad Lurie of AAPT, technical lead for comPADRE, says he often gets asked why comPADRE is any better than Google. The answer, he says, is that, "If you search for, say, optics, on Google, you get sixteen million results. You have no idea where they come from; you have no idea if they're any good." ComPADRE might give many fewer results, said Lurie, but they are all of high quality. "With comPADRE, you know they have been reviewed by an editorial staff."

Registered users of comPADRE can also recommend new resources, so comPADRE is not only a good way to find educational tools, but a good way to share them as well, said Mason.

One comPADRE collection, the Nucleus, designed for undergraduate students, has an especially active community of users, who communicate with each other through discussion boards. The Nucleus also contains a list of summer research opportunities for undergraduates. Employers and researchers can submit positions to the list, and students have said they especially liked this component of the site.

Over 20,000 unique users visit comPADRE each month, said Lurie. So far, feedback has been very positive. Mason said he has heard from many teachers who have told him that comPADRE enabled them to find exactly what they need.

Resources are constantly being added to the existing collections, and several new comPADRE collections are being planned, including one devoted to physics education research, said Lurie. Mason said he would like to add comPADRE collections devoted to all of the standard courses in the physics curriculum. Ted Hodapp, APS director of Education and Outreach, is working on developing a comPADRE collection devoted to teacher preparation.

As the site expands, the comPADRE team is trying to promote the site to attract more users. "We're now at the stage where we've got a really good tool, and we're looking for more people to start using it," said Mason.

SAVE HUBBLE *from page 1*

tiful pictures of stars in the process of forming."

"Its greatest achievements can lie in the future, if it is properly serviced," said Bahcall. Without a service mission Hubble would probably cease operations sometime in 2007, due to failing batteries and gyroscopes.

The President's budget allocates $93 million for the Hubble Space Telescope, but $75 million of that amount would go towards developing a robot to steer the telescope safely out of its orbit at the end of its lifetime, and the remaining $18 million would be devoted to trying to squeeze more observing time out of the telescope.

The Board resolution expresses agreement with the recommendation made last year by the National Research Council, which proposed a shuttle mission to repair the telescope, since a robotic mission to repair Hubble would be unlikely to succeed. The American Astronomical Society has also called for a manned service mission to Hubble.

A shuttle mission to Hubble would probably cost over $1 billion. The President's budget does include space shuttle flights to the International Space Station.

The Executive Board resolution also reiterates the Board's position on President Bush's Moon-Mars Initiative, which is funded in his FY06 budget. The resolution states that "The technical hurdles facing the Moon-Mars initiative are formidable, and the program's overall costs are still unknown. Further, the rapid pace currently envisioned for this program may require a wide redistribution of the science and technology budgets that could significantly alter the broad scientific priorities carefully defined for NASA and the other federal agencies. Launching such a massive program without broad consultation and a clear idea of its scope and budget may hurt rather than enhance, as intended, the scientific standing of the US and the training of its scientists and engineers."

Bahcall urged APS members to write to their members of Congress. Congress could restore funding to repair the Hubble, said Bahcall. "I think that can happen if members of APS let their congressional representatives know what they think. There's a good chance it will be reversed." He mentioned that the situation was similar in 1973, when the Hubble Space Telescope (then called the Large Space Telescope) was cut out of President Nixon's proposed budget, but aggressive lobbying pushed Congress to fund the telescope.

INSIDE THE BELTWAY:
Washington Analysis and Opinion

Bad Dreams? No, Reality Check!

By Michael S. Lubell, APS Director of Public Affairs

My mouse pad, courtesy of Edvard Munch, carries the image of the "Scream." It pretty well summed up my emotions on February 7. That was the day the President released his budget request for Fiscal Year 2006.

The forecast had been bleak. The reality was worse. But it's really not surprising. Science took it on the chin.

During the first term, it is said, a president worries about getting elected for a second term. In the second term, conventional wisdom holds, he worries about his legacy.

Having delivered on his promise of tax cuts in his first year in office, but getting pummeled by Democrats for short-changing homeland security in the aftermath of 9/11 and seeing 80 billion images of George Washington flutter down over Baghdad for each of the last three years, President Bush woke up.

I can hear Josh Bolton, Director of the Office of Management and Budget, giving him the bad news.

"Mr. President, the budget is a mess. True, as a percentage of the GDP, the federal deficit is not as bad as it was in 1983, but you're not missing the mark by much. Then it was 6%. The last two years it was only hovering around 5%."

"But, the current account deficit, by which, sir, I mean the trade imbalance, is now running at a staggering $60 billion a month. It wasn't even as large as that for an entire year back then."


Michael S. Lubell

"And the Chinese are buying up the federal debt so fast, —about 90% of it in the last couple of years— that soon they'll practically own us. They'll be able to take over Taiwan without firing a shot."

"And as for the Medicare drug benefit, we've got new figures that boost the ten-year cost to $1.2 trillion, instead of the $400 billion we told Congress two years ago when we co-opted the issue from the Democrats."

"Sir, you've got to get spending under control. The only other choice is to raise..."

"Josh, don't go there, it cost my father his second term, and it will cost us control of Congress in '06, just like it did Clinton in '94."

Turning to Karl Rove, the President continues, "Karl, you got me elected to the White House twice, and now I made you Deputy Chief of Staff to take care of my legacy. What's the game plan?"

"Mr. President, it's simple, we're going to cut the deficit in half by the end of your second term. We'll boost spending for defense and homeland security and cut all those social welfare programs that our conservative base hates."

"Karl, you know a lot of people don't give me credit for being smart enough to understand numbers, but my MBA taught me a hell of a lot. So I'm not nitpicking when I tell you that I don't see how the dollars add up."

"Sir, it's pretty simple, we call war spending, making the tax cuts permanent and instituting Social Security reforms 'off budget items.' Then in four years, we've got spending under control."

"For the rest of your legacy, you'll have democracy in Iraq, peace between Israel and the Palestinians, "No Child Left Behind," the "Ownership Society," building the hydrogen economy and, of course, sending men to the Moon and Mars. No other president in the last half century could claim to have achieved so much, not even Reagan."

"O.K., Karl. Josh, let's start cutting so we can hit the ball out of the park on this legacy thing."

"Sir, I'm way ahead of you. I've got the whole plan on a disk."

And that's how it happened that NSF science education got slammed, RHIC running time got slashed by 61% and JLab by 29%, BTev got cancelled, Hubble got decommissioned and DOD basic and applied research got cut by about 15%.

Of course, Congress gets to have the final say, so as Yogi Berra said, "It ain't over until it's over!"

LETTERS

Lubell Too Ready to Compromise

Michael Lubell in his January 2005 Inside the Beltway column would have us get over the results of the last election. He says we need to build bridges to the White House and to Middle America.

Oh really? We have a my-way-or-the-highway White House that is interested only if scientists support its ideological positions. Such bridges will be built on ethical quicksand. And, just how do we build bridges to a Middle America captured by the Administration's polarizing talk of "moral values"? I guess we can start by saying: Hey, intentional creationism may have some merit after all. Lubell seems to say: To get along, you gotta go along.

What is needed from the scientific community is not capitulation but more people to speak up and fight against the control and censoring of information flow from scientists to the public. We need more people like James E. Hansen, head of the NASA Goddard Institute for Space Studies in New York, who has denounced the Bush administration's policy on climate change (see p. A17 of the *Washington Post*, 1/19/05). We need to give ourselves a better chance to inform the public and government officials about the results and implications of our work and have that discussed in open debate.

Free and open channels of communication are fundamental to a democracy; they are vital in making decisions for effective funding and evaluations of scientific efforts.

Harry A. Schafft
Silver Spring, MD

Cardboard Cutout Misrepresents Relativity

Ed Note: *The "error" referred to in this letter is contained in the caption to a photo, where we explained the thinness of a cardboard cutout of Einstein as being "Lorentz contracted." We believe most readers took this with the intended grain of salt.*

There is a physics error on page 1 of the January 2005 issue of *APS News*. It is an especially interesting error, since we now celebrate the 100th anniversary of Einstein's development of the special theory of relativity.

The notion that one sees an object severely contracted, if that object travels at velocity near that of light is not correct. The trap lies in the method of measurement used when "one sees." Einstein's prescription for the measurement of a rapidly moving body of unknown length *l* is a defining "thought" experiement Observers at rest in our system observe the ends of the moving object at points x_1 and x_2, simultaneously. The length of the object, as measured in our system, is then $x_2 - x_1$. In this prescription for measurement, the Lorentz contraction results.

Hovever, the experiment is difficult. Since the length is not known at the outset, one does not know where to position the two observers. Of course a continuum of observers or some other trick could be used, but an infinite number of observers is hard to come by.

When one observer looks at a rapidly moving object, the result for the length is quite different. The problem stems from the fact that the light signal from the front end of the object reaches the single observer after having traveled a different distance than the light signal from the rear. Stated another way, the light seem by the observer at any one time left the front and rear of the object at two different times.

For the case of a nearby rapidly moving object, as shown in your page 1 article, the object appears greatly *elongated* as it approaches, and is seen foreshortened by a much greater factor than the Lorentz factor, as it retreats.

Most writers, prior to the late 1950s, made the same error as is made in your article, *i.e.*, they assumed that *one* would *see* the Lorentz contraction. Circa 1959, two cases were treated correctly. One dealt with very close distances of approach, as in your article, and reached the conclusions described above. The other dealt with very large distances of closest approach. In that case also, *one* does *not see* the Lorentz contraction. Instead one sees the object as undistorted except for a rotation.

These conclusions do not reflect on the brilliance nor on the correctness of special relativity. Rather they indicate a certain experimental naivety of many who apply relativity to laboratory situtations.

Roy Weinstein
Houston, TX

Article Misstates Order

The December *APS News* article on the 2004 Nobel Prize states that the discovery of asymptotic freedom by Gross et al. led to QCD, the theory of the strong interaction. This is definitely wrong.

The theory was discussed about one year before that by Gell-Mann and myself. Gross, Wilczek and Politzer agree with us about this, as does the Nobel Foundation, which declared that the prize was solely given to asymptotic freedom, and another prize might be given to the proponents of the theory in the future.

H. Fritzsch
Munich, Germany

Viewpoints...

Balance Needed in Counterterrorism Research

By Martin Bridge

The National Institutes of Health, the biggest sponsor of biomedical research in this country, recently saw its budget double over a period of roughly five years. During the same period, the National Science Foundation and the Office of Science of the Department of Energy budgets remained relatively flat, continuing a trend of stagnant or declining budgets that extends back for decades.

This has led to the argument, coming from both physical scientists and some biological scientists as well, that the Federal research portfolio has gone out of balance, favoring the life sciences while the physical sciences have fallen behind. Advocates for more funding for the NSF and the Office of Science point out that many medical advances depend on underlying research in physics and related sciences.

Meanwhile, in the wake of 9/11, the federal government has established the Department of Homeland Security, and boosted antiterrorism funding across the board. We have all experienced the results at airports, and in the much stricter visa processes that have impeded foreign students and researchers alike from entering the country. But as the nation continues to work hard to improve its security, one of the components of the war on terror is a substantial budget for research, and both universities and government labs are being offered a variety of opportunities to participate in the effort.

One might expect that the research program would be structured in a way that matches the perceived threats. A whole spectrum of potential dangers must be combated, but these should be weighted by what is known about terrorist activities and capabilities. There is essentially no evidence that any terrorist organization is engaged in developing biological weapons, and yet the lion's share of American anti-terrorism research money is going to bio-defense.

Photo Credit: Pacific National Labatory

It's as if the funding is tracking the pre-existing research establishment, instead of the job that actually needs to be done. It reminds one of the old story about the man looking for his keys under the lamppost because the light was better there, even though he lost them somewhere else.

According to data published by Ari Schuler last fall in Vol. 2, no. 2, of *Biosecurity and Bioterrorism*, since 9/11, $14 billion has been spent on bio-defense, of which more than $4 billion was for research. In FY05, more than $2 billion will be spent on research. Most of the research funding, $1.7 billion, goes to NIH, with a lesser amount, $363 million, to DHS. The amount DHS spends on bio-defense research exceeds its expenditures in any other research area by a wide margin.

In December, David Kestenbaum of NPR did a piece examining whether all that money is being well spent. One of his guests was Milton Leitenberg of the University of Maryland, author of the book *The Problem of Biological Weapons*, who emphasized the lack of meaningful threat assessment, which he defined as "establish[ing] for such and such a group, what does it have, who does it have, what can they do?". He called the level of funding "very out of whack," and said that instead of genuine threat assessment, there has been "fear mongering" that "gets to the point of hucksterism."

Another guest on the program, Jonathan Tucker of the Center for Nonproliferation Studies, pointed out that certain kinds of research on biological weapons can actually be counterproductive. In the October issue of *Arms Control Today* he writes: "… the novel pathogens and related know-how generated by threat-assessment work could be stolen or diverted for malicious purposes, exacerbating the threat of bioterrorism."

In fact, the leading explanation for the anthrax mailings that killed five people in the fall of 2001 is that they were carried out by someone who had inside knowledge of the US biological weapons program.

Defending the need for bio-defense research at DHS was Parney Albright, Assistant Secretary for plans, programs and budget. "Imagine if we got an attack of aerosolized anthrax on a major city," he said, "or somebody came out with smallpox and our response was 'Well, we just didn't want to work on it.' That, I think, is an answer the American public would not accept."

True enough. But if, as seems much more probable, America were to be attacked by some kind of explosive, whether it be a car bomb, a suicide bomber, an airplane used as a guided missile, or a dirty radioactive bomb [see the Back Page, *APS News* March 2004], the public may be equally outraged to find out that we were spending our resources so disproportionately. No one is saying we should discontinue research on bio-defense. But the imbalance that afflicts the overall research portfolio is even more severe in the realm of counter-terrorism. The welfare not only of the scientific community, but that of the entire nation, depends on setting it right.

Martin Bridge is a frequent contributor to APS News.

ANNOUNCEMENTS

EDITOR, REVIEWS OF MODERN PHYSICS

http://rmp.aps.org/

The American Physical Society is conducting an international search for a successor to the current Editor of RMP, who is retiring at the end of 2005. The Editor is responsible for editorial standards, policies, and direction of the journal, and leadership of a board of remote Associate Editors, composed of distinguished physicists who solicit review articles in all fields of physics. The Editor reports to the Editor-in-Chief and is supported by an in-house Assistant Editor.

It is expected that the Editor will maintain his/her present appointment and location and devote approximately 20% of his/her time to the position.

A candidate should possess the following qualifications:

- *recognized stature as a research physicist;*
- *broad knowledge and interest in physics and its frontiers;*
- *experience with the editing/refereeing process in physics publication.*

In addition, the Editor needs good interpersonal skills to promote the journal's aim of publishing critical reviews that serve a wide physics readership.

The initial appointment is for three years with renewal possible after review. Salary is negotiable. To ensure a smooth transition, the new Editor is expected to become involved in the fall of 2005, while the current Editor is still active. The APS is an equal opportunity employer.

Inquiries, nominations, and applications (including CV, publications, and letter of intent) are requested by 1 May 2005 and may be directed to: Robert Siemann, Chair, RMP Search Committee, c/o American Physical Society, 1 Research Road, Box 9000, Ridge, NY 11961-9000; or electronically to edsearch@aps.org.

APS April Meeting Job Fair

Come to the Job Fair at the APS April Meeting

Come to the 2005 APS April Meeting Job Fair to meet with employers and job seekers from the fields of Nuclear Physics, Particles and Fields, Astrophysics, Beams, Plasma Physics and Computational physics. The Job fair will provide an excellent opportunity for job seekers to explore new career options, practice one's interviewing skills or conduct research into the job market. For employers, the Job Fair will provide an informal setting to discuss employment opportunities in their organizations.

For More Information
Contact Alix Brice at
301-209-3187 or at abrice@aip.org

CSWP Responds to Harvard University President's Comments

By Ernie Tretkoff

The APS Committee on the Status of Women in Physics has written a letter to the editor of *The New York Times* in response to Harvard University President Lawrence Summers' recent remarks suggesting that genetic differences may partly explain the low numbers of women in science.

Speaking at a January 14 meeting of the National Bureau of Economic Research, Summers reportedly suggested that the shortage of women scientists may stem in part from "innate" differences between men and women. He also mentioned other possible causes of the low numbers of women in science, including women's unwillingness or inability to work 80-hour weeks, and discrimination against women. Summers' statement that genetic differences might explain the underrepresentation of women was widely reported and sparked a controversy and a lot of criticism.

CSWP chair Aihua Xie said, "Basically we are outraged with Summers' statement. There is no scientific support for that statement. He is the leader of a top university, so people pay attention to what he said. He should do some research if he wants to make such statements."

Upon hearing a news report on Summers' comments, CSWP member Marc Sher alerted the rest of the committee. The CSWP then wrote a letter to the editor of *The New York Times*, which can be seen at the CSWP website: http://www.aps.org/educ/cswp/

In the letter, CSWP wrote that, "Leaders in academia wondering aloud if women may be genetically inferior in math/science skills perpetuate a self-fulfilling prophecy." The letter also stated that research is at odds with a genetic explanation for the underrepresentation of women in science, and that, "We expect leaders of elite academic institutions to do their research before lending their voices to such unsubstantiated prejudices."

The underrepresentation of women in physics can be attributed to factors such as social pressures and the lack of role models, said Xie. The situation is improving, she said. "More and more women get into physics now. This trend will continue, far from reaching a stable state. Therefore, it is inadequate to use genetics to explain the current gender differences in physics and other sciences. "

There is still discrimination against women, said Xie. "People don't give women the same opportunities and training that they give men," she said. In addition, many talented women lack the confidence in their abilities, and these women need more support, she said.

CSWP member Marc Sher pointed out that another reason for the shortage of women in physics is the "two-body problem." Many women scientists are married to men who are also scientists, often in the same or a closely related field, and it is difficult to find two academic jobs in the same field in the same geographic location at the same time, and many universities are reluctant to hire both spouses. In these cases, it is often the woman's career that suffers.

Sher said he has been gratified by the response to Summers' remarks. "To some degree it's a learning experience. There is a huge amount of data that shows he's wrong." The uproar over Summers' statements has brought that data to people's attention, said Sher.

In response to the criticism, Summers' has apologized several times, and has set up two task forces charged with making recommendations for improving the status of women faculty and women in science and engineering.

CSWP works to improve the status of women in physics through a variety of programs, including workshops for women held at the APS March and April meetings, and site visits to universities to evaluate their climate for women and help them improve it. "I would like to say that in physics there are lots of situations that can improve for women to succeed. Our committee works hard to improve the climate for women in physics," said Xie.

Excuse me, Mr. President...

Photo credit: Bob Kelly

APS President Marvin Cohen (right) briefed APS staff at Ridge, NY prior to a meeting of the Executive Board there in February. Ridge, near Brookhaven National Laboratory on Long Island, is the site of the APS editorial offices where the Physical Review, Physical Review Letters, and Reviews of Modern Physics come into being under the watchful eye of Editor-in-Chief Martin Blume.

EINSTEIN@HOME *from page 1*

announcement. Einstein@Home is a flagship program of the World Year of Physics 2005 celebration of the centennial of Albert Einstein's miraculous year. The program searches for gravitational waves in data collected by US and European gravitational wave detectors, including LIGO and the British/German GEO-600 gravitational wave observatory.

The data is collected from signals coming from very dense, rapidly rotating quark and neutron stars. General relativity predicts that if these compact stars are not perfectly spherical, they could continuously emit gravitational waves. LIGO and GEO-600 are now sufficiently sensitive that they might detect these signals if the stars are close enough to Earth.

Finding such signals requires an enormous amount of computing power. In fact, estimates indicate that searching gravitational data with the maximum possible sensitivity would require many times the computing capacity of even the most powerful supercomputer. So researchers are enlisting the aid of an army of home computer users to analyze the data. Much like the popular SETI@Home project that searches radio telescope data for signs of extraterrestrial life, Einstein@Home will involve hundreds of thousands of people who will dedicate a portion of their personal computers' computation time to the project.

The Einstein@Home program is available for PCs running Windows, Linux and Mac operating systems. When the computer is not in use, it downloads LIGO and GEO-600 data from a central server and searches it for gravitational wave signals. While running, it displays a screensaver that depicts the celestial sphere, with the major constellations outlined. A moving marker indicates the portion of the sky currently being searched on the computer.

For more information, see http://einstein.phys.uwm.edu.

zero gravity
The Lighter Side of Science

The Crackpot Index

By John Baez

This is a simple method for rating potentially revolutionary contributions to physics. Begin with a –5 point starting credit, then make the following additions as appropriate:

1. 1 point for every statement that is widely agreed on to be false.
2. 2 points for every statement that is clearly vacuous.
3. 3 points for every statement that is logically inconsistent.
4. 5 points for each such statement that is adhered to despite careful correction.
5. 5 points for using a thought experiment that contradicts the results of a widely accepted real experiment.
6. 5 points for each word in all capital letters (except for those with defective keyboards).
7. 5 points for each mention of "Einstien", "Hawkins" or "Feynmann".
8. 10 points for each claim that quantum mechanics is fundamentally misguided (without good evidence).
9. 10 points for pointing out that you have gone to school, as if this were evidence of sanity.
10. 10 points for beginning the description of your theory by saying how long you have been working on it.
11. 10 points for mailing your theory to someone you don't know personally and asking them not to tell anyone else about it, for fear that your ideas will be stolen.
12. 10 points for offering prize money to anyone who proves and/or finds any flaws in your theory.
13. 10 points for each new term you invent and use without properly defining it.
14. 10 points for each statement along the lines of "I'm not good at math, but my theory is conceptually right, so all I need is for someone to express it in terms of equations".
15. 10 points for arguing that a current well-established theory is "only a theory", as if this were somehow a point against it.
16. 10 points for arguing that while a current well-established theory predicts phenomena correctly, it doesn't explain "why" they occur, or fails to provide a "mechanism".
17. 10 points for each favorable comparison of yourself to Einstein, or claim that special or general relativity are fundamentally misguided (without good evidence).
18. 10 points for claiming that your work is on the cutting edge of a "paradigm shift".
19. 20 points for emailing me and complaining about the crackpot index, *e.g.* saying that it "suppresses original thinkers" or saying that I misspelled "Einstein" in item 7.
20. 20 points for suggesting that you deserve a Nobel prize.
21. 20 points for each favorable comparison of yourself to Newton or claim that classical mechanics is fundamentally misguided (without good evidence).
22. 20 points for every use of science fiction works or myths as if they were fact.
23. 20 points for defending yourself by bringing up (real or imagined) ridicule accorded to your past theories.
24. 20 points for each use of the phrase "hidebound reactionary".
25. 20 points for each use of the phrase "self-appointed defender of the orthodoxy".
26. 30 points for suggesting that a famous figure secretly disbelieved in a theory which he or she publicly supported. (*e.g.*, that Feynman was a closet opponent of special relativity, as deduced by reading between the lines in his freshman physics textbooks.)
27. 30 points for suggesting that Einstein, in his later years, was groping his way towards the ideas you now advocate.
28. 30 points for claiming that your theories were developed by an extraterrestrial civilization (without good evidence).
29. 30 points for allusions to a delay in your work while you spent time in an asylum, or references to the psychiatrist who tried to talk you out of your theory.
30. 40 points for comparing those who argue against your ideas to Nazis, stormtroopers, or brownshirts.
31. 40 points for claiming that the "scientific establishment" is engaged in a "conspiracy" to prevent your work from gaining its well-deserved fame, or suchlike.
32. 40 points for comparing yourself to Galileo, suggesting that a modern-day inquisition is hard at work on your case.
33. 40 points for claiming that when your theory is finally appreciated, present-day science will be seen for the sham it truly is. (30 more points for fantasizing about show trials in which scientists who mocked your theories will be forced to recant.)
34. 50 points for claiming you have a revolutionary theory but giving no concrete testable predictions.

Young Astrophysicist/Beauty Queen Defies Stereotypes

Allison Porter breaks down many stereotypes. The 24-year-old Miss Washington 2004 graduated from Harvard in 2002 with a degree in astrophysics. She also boxes, plays the violin, speaks Spanish, does biomedical research, and plans to become a doctor for the medically underserved.

Many people ask her what, if anything, ties her diverse interests together. She says everything is connected, either closely or loosely, with her goal of being a better doctor. So for instance, she learned Spanish in part because so many people in need of medical care don't speak English. Boxing is a way of keeping physically fit, something Porter believes is important, especially with the growing obesity problem in this country.

Porter also spent lots of time volunteering— she's worked in rural Mexico, educating people about disease and building stoves to reduce smoke inhalation, in Calcutta at an orphanage for disabled children, and in Ecuador with a mobile surgery unit. In Ecuador, she contracted malaria and had to go home early, but even that experience, while she admits it wasn't exactly fun, helped her to understand what it's like to be a patient, a valuable lesson for someone who wants to become a doctor.

Ever since she was a teenager, Porter has dreamed of becoming a doctor, in part inspired by her aunt's struggle with ovarian cancer. But she was also interested in other sciences. In her high school physics class, she worked with a computer program that allowed users to create a model solar system by specifying masses and velocities for several objects. Porter was especially intrigued by this activity, and she remembered it when choosing her major at Harvard at the end of her freshman year. Though she planned to go to medical school, she wanted her undergraduate years to be a chance to branch out. Porter was attracted to astrophysics because she loved the subject matter. "I think a lot of it is from just a philosophical standpoint, studying things that are much larger than we can really comprehend," she says. "I was very interested in big bang cosmology, the origins of the universe."

She also liked the astronomy and astrophysics department, which, with many professors and relatively few students, offered lots of individual attention and access to great resources. For instance, in one of her classes, Porter went to a telescope, took real data and analyzed it. "I would just show up at this telescope on a Wednesday afternoon,

and my professor would show me all the buttons to press, and she'd pretty much say, 'see you later, have fun.' So I was in control of this enormous, beautiful radio telescope, and was able to collect my own data and stay as long as I wanted. That was a really special experience, and something I couldn't have done if I'd been in another major."

While in college, she started boxing as a way to keep fit during the off-season for soccer. Contrary to what many people initially think, Porter, the 2004 Tacoma Golden Gloves champion, is not a violent person at all. That stereotype is based on professional boxing, she says. Amateur boxing is safer, and more about technique than about inflicting pain. For instance, the scoring system often rewards a light tap with as many points as a heavy punch. Amateur boxers also wear headgear and more heavily padded gloves, and the referees will stop a match if it becomes dangerous.

Porter currently works as a technician in a research lab at the Fred Hutchinson Cancer Center in Seattle. Her research group studies a common phenomenon called microchimerism. During pregnancy, a small number of cells may pass from the mother to the fetus, and from the fetus to the mother. These cells, called microchimeric cells, can remain in the bodies of both mother and child for years, even decades, but researchers don't really know what effect these cells have. Porter's group, led by Lee Nelson, has proposed that these cells may be related to some autoimmune diseases, so they have been measuring levels of microchimeric cells in both healthy people and those with autoimmune disease. In addition to a better understanding of the immune system and autoimmune diseases, the research may lead to improvements in cancer treatment, says Porter, since some therapies for autoimmune disease are sometimes effective on cancer.

Last spring she entered the Miss Washington Pageant, after having investigated the Miss America program for two years. Unlike many pageants, Miss America places more emphasis on the interview and talent than on the swimsuit and evening gown events, says Porter. That doesn't mean that there isn't any truth to the stereotype. "I found that once I got to the Miss America pageant, there were of course many beautiful women there, who were there because they loved the glitz and the glamour and the makeup and the gowns and all of that," says Porter. "But there were, I think, four Rhodes scholar finalists there as well, and many women are pursuing medical school and law school, who were there to help pay their way through grad school."

The Miss America program appealed to Porter and many women like her because it encourages well-roundedness. "I was interested in it because I'm a person that has walked around never being the best at anything, but always succeeding relatively well in just about anything. And this type of competition really caters to that type of person because of the different weighting of the different phases of competition."

Porter will enter medical school next fall. In the meantime, she'll continue working at the Fred Hutchinson Cancer Center, and making appearances related to her Miss Washington platform: "Going Three Rounds in the Fight Against Cancer: *Prevention, Treatment, and Funding*."

— Courtesy of PhysicsCentral.com

2005 MARCH *from page 1*

the meeting will be buzzing over a newly observed phenomenon, the spin Hall effect, whose origin is still being hotly debated. It has the potential of leading to extremely low-power memory chips and computer processors. The classical Hall effect is created by the deflection of electric current as it traverses a conductor in a magnetic field. In contrast, the spin Hall effect is the deflection of an electron in a semiconductor in a direction that depends on the electron's spin. Speakers at two separate sessions will discuss the experiment and theory underlying this effect, including two research groups that recently demonstrated it. Originally proposed in 1971, theoretical interest in the phenomenon languished until quite recently, but has since revived: over 60 theoretical papers have been published in the past two years.

Superatom Chemistry. Researchers have discovered that clusters of aluminum atoms can behave as "superatoms" that mimic the chemical properties of different elements depending upon the size of the cluster. Starting with iodine-based compounds called polyiodides, a team of scientists from Penn State and Virginia Commonwealth University removed a single iodine atom and replaced it with an aluminum cluster made of either 13 or 14 atoms. As a result, the clusters exhibited chemistry similar to halogen atoms, such as iodine, and alkaline earth elements such as magnesium. But there were some differences, too, leading in one case to the creation of an entirely new class of polyiodide structures. These results provide further evidence of an underlying "periodic table" of cluster elements. The work may also lead to novel materials such as aluminum-based compounds that wouldn't rust.

Antifreeze Proteins. More than 35 years ago, scientists discovered special proteins in the bloodstream of certain fish that prevented them from freezing. These antifreeze proteins (AFPs) have also been found in insects, plants, fungi, bacteria, and even vertebrates. They either keep the organism from freezing or, if crystallization has occurred, help to mitigate structural damage, caused by large ice grains growing at the expense of small grains, irrevocably breaking some tissue structures. Scientists think that AFPS are able to work by binding to (and limiting further growth of) ice crystals. The first direct observations of AFP on newly-formed ice crystals will be reported at the meeting.

Integrating Strained Silicon. The silicon chip industry is turning to strained silicon as a means to make faster, low-power computer chips with conventional technology. Physicists have long known that strained silicon contains electrons that travel up to twice the maximum speed of electrons in ordinary silicon. While the original motivation for strained silicon was to make chips with speedier electrons, researchers now realize that using reduced-strength electric fields to turn on and off transistors could get electrons moving at conventional speeds, while dissipating lower levels of power as they travel through dense networks of transistors. Strained silicon technology has already begun to appear in the product lines of major chip manufacturers such as AMD, Intel, Texas Instruments, and IBM. Several speakers from industry and academia will be on hand to discuss some of the latest discoveries and challenges of implementing this promising new technology.

How Frogs Get Perfect Pitch. Clawed frogs in South Africa depend for dinner on their ability to sense the floundering of insects on the surface of the pond they inhabit. They must not only detect, but discriminate: the frog can discern between water waves at, for example, a frequency of 14 Hz and 14.5 Hz, respectively. J. Leo van Hammen and colleagues at the Technical University of Munich study what happens at the synapse level to allow the frog to accomplish this. The frog can "hear" with its skin and detect motions in the pond as slow as 0.1 mm/sec through an underlying "lateral-line" system. Human touch sensors simply aren't sensitive enough to "hear" with their skin. Van Hemmen will report on how the frog develops effective "wetware" (neuronal software and hardware) for catching prey by resolution.

Terahertz Technology. The terahertz portion of the electromagnetic spectrum (300 GHz to 10 THz) spans the region between microwaves and light. THz radiation is non-ionizing and can penetrate many materials, leading to several new inventions in areas ranging from medicine to homeland security. At the March meeting, Michael Kemp of TeraView Ltd. will discuss the use of THz radiation in medical imaging to detect cancer, while David Zimdars of Picometrix will present a THz scanning system that has been deployed to scan space shuttle fuel tanks for defects. NIST's Erich Grossman will round out the session by describing the design of an imager for concealed weapons detection.

Looking Deeper with 3D Imaging. Ordinary x-ray crystallography yields the structure of a biomolecule like a protein simply by providing averaged information from scattering from a large number of identical unit cells. In contrast, UCLA physicist John Miao forms high-resolution images of non-crystalline samples. He and his colleagues use the SPring-8 synchrotron in Japan—the most powerful continuous x-ray source in the world—to reveal layered images with spatial resolution as good as 7 nm. These layers are then stacked up to provide the best 3D images yet obtained for targets such as *E. coli* and yeast. Microscopic methods with similar spatial resolution, like scanned probe microscopes or electron microscopes, can't form 3D images.

Artificial Sight. Age-related macular degeneration (AMD) and retinitis pigmentosa (RP) are the leading causes of blindness around the world. Although the neural "wiring" from eye to brain is intact, these patients lack photoreceptor activity. Scientists now realize that electrical stimulation of the retina can produce visual percepts in blind patients suffering from these diseases, and are developing retinal implants to do just that. Thus far, such implants have had only a few electrodes; several thousand pixels would be required to restore meaningful sight. Speakers will discuss their work on various elements of the next generation of retinal prosthetic devices. Closing out the session will be Oak Ridge National Labora-tory's Elias Greenbaum, who is developing a method for inserting purified spinach protein reaction centers and other photoreactive agents into retinal cells to restore photoreceptor function.

Fast Cancer Detection. Many cancer-detection devices still use staining and fluorescence techniques. Researchers at Sandia National Laboratories have developed a newer approach, using single cells as waveguides within special optical cavities. The way in which the laser light in the cavity is scattered or absorbed depends on the internal state of the cell, especially the structure of the cell's mitochondria, which in turn depends on malignant conditions. According to Sandia scientist Paul Gourley, the new laser method is fast (with picosecond sampling times) and less prone to misinterpretation. It is well suited to cell types with lots of mitochondria, such as brain, muscle and liver cells.

Scratching the Surface. What, exactly, is happening when you scratch your skin with a needle? It triggers a physiological response, sending substances that create vasodilation in order to repair the scratch. But we still don't understand completely what mechanical processes are behind this response. Now, researchers have devised a method that obtains the contraction state of smooth and very small muscles situated around blood vessels, which they have used to describe the entire mechanical response to skin irritation, They will report on their findings at the meeting.

— James Riordon, Ben Stein and Phil Schewe contributed to this article.

Nomination Announcements

Call for Nominations for 2006 APS Prizes and Awards

The following prizes and awards will be bestowed by the Society in 2005. Members are invited to nominate candidates to the respective committees charged with recommending the recipients. A brief description of each prize and award is given below, along with the addresses of the selection committee chairs to whom nominations should be sent. For complete information regarding rules and eligibility requirements for individual prizes and awards, please refer to the Prizes and Awards page on the APS web site at http://www.aps.org/praw/index.cfm/.

NOMINATION DEADLINE IS JULY 1, 2005, UNLESS OTHERWISE INDICATED.

PRIZES

WILL ALLIS PRIZE

Send name of proposed candidate and supporting information to: Rainer Johnsen; University of Pittsburgh; Department of Physics & Astronomy, Pittsburgh, PA 15260; Phone (412) 624-9285, Email: rj@vms.cis.pitt.edu

HANS A. BETHE PRIZE

Send name of proposed candidate and supporting information to: Arthur Champagne; University of North Carolina; Department of Physics & Astronomy; CB3255 Phillips Hall; Chapel Hill, NC 27599-3255, Phone (919) 962-7205; Fax (919) 962-0480; Email: AEC@tunl.duke.edu

BIOLOGICAL PHYSICS PRIZE

Send name of proposed candidate and supporting information to: Paul Champion; Northeastern University; Department of Physics 106 Dana; 360 Huntington Ave; Boston, MA 02115; Phone (617) 373-2918; Fax (617) 373-2943; Email: p.champion@neu.edu

TOM W. BONNER PRIZE

Send name of proposed candidate and supporting information to: Henry Weller; Duke University; TUNL; PO Box 90308; Durham, NC 27708-0308; Phone (919) 660-2633; Fax (919) 660-2525; Email: weller@tunl.duke.edu

OLIVER E. BUCKLEY CONDENSED MATTER PHYSICS PRIZE

Send name of proposed candidate and supporting information to: Barbara Jones; IBM Almaden Research Center; K13/D01; 650 Harry Road; San Jose, CA 95120-6099; Phone (408) 927-2494; Fax (408) 927-2100; Email: bajones@almaden.ibm.com

DAVISSON-GERMER PRIZE

Send name of proposed candidate and supporting information to: Ron Phaneuf; University of Nevada; Department of Physics; Reno, NV 89557-0058; Phone (775) 784-6818; Fax (775) 784-1398; Email: phaneuf@physics.nvr.edu

FLUID DYNAMICS PRIZE

Send name of proposed candidate and supporting information to: Marvin Goldstein; Chief Scientist; NASA/Lewis Research Center; 21000 Brookpark Road; MS 3-17; Cleveland, OH 44135; Phone (440) 433-5825; Fax (440) 433-5531; Email: marvin.e.Goldstein@lerc.nasa.gov

DANNIE HEINEMAN PRIZE

Send name of proposed candidate and supporting information to: Carl Bender; Dept of Physics;Washington University; St Louis, MO 63130; Phone (314) 935-6216; Fax (314) 935-6219; Email cmb@howdy.wustl.edu

FRANK ISAKSON PRIZE

Send name of proposed candidate and supporting information to: Alex Zunger; National Renewable Energy Lab; 1617 Cole Blvd; Golden; CO 80401; Phone (303) 384-6672; Fax (303) 384-6432; Email: azunger@nrel.gov

JULIUS EDGAR LILIENFELD PRIZE

Send name of proposed candidate and supporting information to: Margaret Murnane; JILA; University of Colorado; Boulder; Boulder, CO 80309-0440; Phone (303) 492-7839; Fax (303) 492-5235; Email: murnane@jila.colorado.edu

JAMES CLERK MAXWELL PRIZE

Deadline: April 1, 2005

Send name of proposed candidate and supporting information to: Barbara Lasinski; LLNL; 7000 East Avenue; Livermore, CA 94550-9234; Phone (925) 422-5443; Fax (925) 423-9200; Email: lasinski@uiuc.edu

JAMES C. MCGRODDY PRIZE FOR NEW MATERIALS

Send name of proposed candidate and supporting information to: Myron B. Salamon; University of Illinois; Department of Physics; 1110 West Green Street; Urbana, IL 61801-3080; Phone (217) 333-6186; Fax (217) 244-8544; Email: salamon@uiuc.edu

LARS ONSAGER PRIZE

Send name of proposed candidate and supporting information to: Tom C. Lubensky; University of Pennsylvania; Department of Physics; 209 S 33rd Street; Philadelphia, PA 19104; Phone (215) 898-7002; Fax (215) 898-2010; Email: tom@physics.upenn.edu

GEORGE E. PAKE PRIZE

Send name of proposed candidate and supporting information to: Kenneth Hass; Ford Motor Company; Manager, Physical & Environmental Sciences Department; SRL MD-3083; Dearborn, MI 48121-2053; Phone (313) 322-0098; Fax (313) 322-7044; Email: khass1@ford.com

W.K.H. PANOFSKY PRIZE

Send name of proposed candidate and supporting information to: Ian Shipsey; Purdue University; Physics Department; West Lafayette, IN 47907; Phone (765) 494-4600; Email: shipsey@physics.purdue.edu

EARLE K. PLYLER PRIZE FOR MOLECULAR SPECTROSCOPY

Send name of proposed candidate and supporting information to: Kenneth Janda; University of California, Irvine; Department of Chemistry; 317 Rowland Hall; Irvine, CA 92697-2025; Phone (949) 824-5526; Fax (949) 824-3168; Email: kejanda@uci.edu

POLYMER PHYSICS PRIZE

Send name of proposed candidate and supporting information to: Murugappan Muthukumar; University of Massachusetts; Department of Polymer Science & Engineering; Conte Polymer Research Building; 120 Governors Drive; Cambridge, MA 01003-9263; Phone (413) 577-1212; Email: muthu@polysci.umass.edu

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JOHN H. DILLON MEDAL

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ABRAHAM PAIS AWARD FOR HISTORY OF PHYSICS

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Deadline: May 1, 2005

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MITSUYOSHI TANAKA DISSERTATION AWARD IN EXPERIMENTAL PARTICLE PHYSICS

Deadline: June 30, 2005

Send name of proposed candidate and supporting information to: John Hobbs; Graduate Physics Building; D140 Physics Department; SUNY—Stony Brook; Stony Brook, NY 11794; Phone: (631) 632-8107/8095; Fax: (631) 632-8101; Email: hobbs@sbhep.physics.sunysb.edu

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The Back Page

Why Johnny Can't Vote

Barbara Simons

In the 2004 US election about 30% of the electorate voted on paperless computerized voting machines. The lack of an audit trail for these machines combined with discrepancies between exit polls and tabulated results raised questions in some people's minds about the accuracy of the tabulated results. Because there is no way to conduct a meaningful recount for paperless voting machines, it is impossible to verify that the reported results are correct. This is not a healthy situation for a democracy.

As a result of Florida 2000, some people concluded that paper ballots simply couldn't be counted, even though businesses, banks, racetracks, lottery systems, and other entities in our society count and deal with paper all the time. Instead, paperless computerized voting systems (Direct Recording Electronic, or DREs) were touted as the solution to "the Florida problem." Replacing hanging chads with 21st century technology, proponents claimed, would result in accurate election counts and machines that would be impossible to rig. Furthermore, computerized voting systems could report results shortly after the polls close.

Election officials loved the idea, believing the new machines would be cheaper and more reliable than the old systems. The lack of recounts meant that election workers could go home early on Election Day. Vendor enthusiasm was enhanced by the almost $4 billion of US government money that was promised in the Help America Vote Act, passed in 2002. Yet now, voter verified paper trails are being demanded by numerous public interest groups, computing professionals, and members of Congress.Where did things go wrong?

Electronic voting machine software is proprietary, the certification testing process is both secret and inadequate, and the test results are secret. For years, prominent computer security experts have been warning that paperless DRE machines present major security problems, including buggy software and the risk of malicious code changing the outcome of an election. But these experts were largely ignored until Stanford professor David Dill created a petition calling for voter verified audit trails for voting systems. The core idea behind the Dill petition is that the voters should be able to verify that their ballots have been correctly recorded; also, it should be possible to conduct a meaningful recount.

Because of the secrecy surrounding almost every aspect of e-voting—along with a lack of public national incident reporting—independent computing technologists can provide only limited analyses of problems relating to hardware, software, testing, security, and human factors. Nonetheless, evidence of these problems is widespread and varied.

For example, voting machines deployed in Carteret County, North Carolina for the 2004 election had a storage capacity for only 3005 ballots. When these machines were used for early voting by a large number of people, 4438 votes were irretrievably lost. Because only 2287 votes separated the Republican and Democratic candidates for state Agricultural Commissioner, the State Board of Elections ruled that a revote for Agricultural Commissioner be held in Carteret County only. After the courts struck down that decision, the Board of Elections called for a statewide revote. That, too, was struck down, and the Board, which is bitterly divided, was ordered to resolve the election some other way. As of this writing, the election of Agricultural Commissioner has not been resolved.

A case study in incompetence

Diebold, which has been manufacturing ATMs for years and is one of the major DRE vendors, has become the poster child of all that is wrong with DREs. Diebold's involvement with voting machines received significant national press when the CEO of Diebold, Walden O'Dell, stated in an August 14, 2003 letter to Central Ohio Republicans that he was "committed to helping Ohio deliver its electoral votes to the President next year."

However, the PR problem triggered by O'Dell's statement pales in comparison to the security breach uncovered by Bev Harris, who announced in February, 2003 that she had discovered Diebold voting machine software on an open FTP website. Computer science professors Avi Rubin and Dan Wallach, and two of their students subsequently analyzed some of that software and published a security analysis in a paper that is sometimes referred to as the "Hopkins paper". One of the more shocking revelations was that Diebold used a single DES key (F2654hD4) to encrypt all of the data on a storage device. Consequently, an attacker with access to the source code would have the ability to modify voting and auditing records. Diebold had been warned in 1997 about their sloppy key management by Douglas Jones, a professor of computer science at the University of Iowa and a member of the Iowa Board of Examiners for Voting Machines and Electronic Voting Equipment.

Because of the security issues raised in the Hopkins paper, the State of Maryland, which had just committed to purchasing Diebold DREs, commissioned a study of Diebold machines by Science Applications International Corporation (SAIC). The SAIC report is a very fast read, since only about 1/3 of it was made public—the rest was redacted. But even the limited amount of information that was released in the report is quite damning. For example, the report states that the Diebold system is so complicated that even if all of the problems were fixed, there still could be security risks because of poorly trained election officials.

Barbara Simons

In November 2003, the Maryland Department of Legislative Services commissioned yet another study of Diebold machines by RABA Technologies. The *Trusted Agent* report, released in January 2004, revealed physical security problems such as the use of identical keys on security panels covering PCMCIA and other sockets on the machines.

Despite these concerns, on January 12, 2005, Ohio Secretary of State J. Kenneth Blackwell announced that precinct-based optical scan voting systems (defined below), manufactured by Diebold or ES&S, will be offered to county boards of elections as the state's primary voting system.

How did such flawed machines become certified?

The first FEC standard for electronic voting machines, issued in 1990, was replaced in 2002. Many voting systems in use today were certified to the 1990 standards. Voting machines are tested and certified by three private companies, referred to as Independent Testing Authorities (ITAs). The ITAs are certified by the National Association of State Election Directors, but are not subjected to any government oversight. Vendors pay for all testing.

States typically are provided with a one-page certificate saying that the software satisfied the FEC standards. By contrast, vendors are given detailed test results. Some states request the test results, but results have been provided only when the states or election officials sign non-disclosure agreements. Not only should test results all be made public, but there also should be a central data depository that collects all test results and problem incidents from voting machines—so that the government and election officials can check to make sure that all known problems have been rectified.

Rather than checking all software for security flaws and attacking the software to see if it can be compromised, the ITAs limit their tests to items required by the FEC standards. For example, the 2002 FEC standards call for "effective password management," but the phrase is not defined. We can infer from the Diebold results that no one is checking to see if encryption keys have been hardwired into the code.

An obvious approach for dealing with buggy or malicious code would be to require that all voting software be made public, thereby exposing it to more eyes and increasing the likelihood of bug detection. But there is still the risk that software running on the voting machines may not be identical to the software that is made public. Further, it is possible to write a compiler that will insert malicious code into object code.

Even open source code can be vulnerable. A recent attempt to insert a two-lines-of-code backdoor into Linux was caught by some observant programmers. But, the fact that this particular backdoor attempt was stymied is no guarantee that some equally subtle future attempt will also be detected.

E-Voting Technologies

Voting systems on the market today can be divided into those that use screens or monitors and those that do not. Because they contain computers, screen-based systems can be equipped with earphones and various devices, typically hand-held, that allow voters with vision impairments to vote independently. Computerized machines are programmed to prevent voters from selecting too many candidates (overvotes), alert voters when they have omitted votes (undervotes), and permit voters to review their ballots before submitting them (second chance voting). Screen-based systems can be subdivided into systems that produce voter verified paper ballots and those that do not. A voter verified paper ballot (VVPB) is a piece of paper containing all of the voter's selections. Because it' s impossible to know whether or not computerized voting machines currently on the market correctly store and count the ballots, the creation of a paper ballot allows the voter to confirm that his or her choices have been correctly recorded.

DREs. The major manufacturers of paperless DREs are Diebold, Sequoia, ES&S, and Hart InterCivic. Several of the DREs, most of which use touch screens as inputs, are being retrofitted by the manufacturers to produce VVPBs. But these retrofits can themselves introduce new problems. For example, Sequoia has added a printer that prints the ballots consecutively on a roll of paper, leading to concerns among many that voter privacy could be negatively impacted by tracking the order in which people vote on various machines.

Other DREs, namely those manufactured by AccuPoll and Avante, were initially designed to produce VVPBs. Avante also manufactures an optical scan model that prints optical scan ballots that sighted voters can mark, as well as an "accessible" optical voting system for vision-impaired voters.

Optical scan systems. Optical scan voting systems, which are less expensive and do not entail the same security risks as DREs, typically require the voter to mark his or her ballot, in much the same way that a student taking a standardized test uses a number two pencil to make computer-readable marks. Precinct-based optical scan systems require the voter to "test" his or her ballot by submitting it to the scanner and having the scanner notify the voter if the ballot contains overvotes or appears to be blank.

Hybrid models. Ballot marking systems are a cross between DREs and optical scan systems. The AutoMARK, manufactured by Vogue Election Systems and currently marketed by ES&S, offers a touch screen like a DRE. After inserting a blank optical scan ballot into the back of the machine, the voter enters his or her choices via the touchscreen. The machine then marks the optical scan ballot, thereby eliminating the problem of stray pencil marks that could otherwise confuse the scanner. Another system, produced by Populex, includes a screen with an attached stylus. The system prints out a completed ballot once the voter has finished voting.

Cryptographic voting systems. VoteHere and David Chaum have developed voting systems that provide an encrypted receipt that voters can use to verify that their ballots has been accurately counted. Chaum's system is not currently being manufactured. A problem common to both systems is that they offer no way to conduct a recount should it be determined that a ballot tabulation problem has occurred, although individual ballots can be corrected.

Conclusion

The issue of e-voting should have been primarily a technological issue—one involving computer security, human factors, reliability, and efficiency. Instead, because of the vast sums of money involved, e-voting has been heavily politicized.

Election officials were told that DREs in the long run would be cheaper than alternative voting systems. They were told that DREs had been extensively tested and that the certification process guaranteed that the machines were reliable and secure. No mention was made of the significant costs of testing and of secure storage of DREs; no mention was made of the inadequacy of the testing and certification processes, to say nothing of the difficulty of creating bug-free software.

Technologists are attempting to educate election officials, policy makers, and the public about the risks of paperless DREs. It is critical for the continued existence of democracy throughout the world that we succeed.

Barbara Simons is retired from IBM Research. She is a former President of the Association for Computing Machinery (ACM), founder and former Chair of the US Public Policy Committee of ACM (USACM), and current chair of USACM's Committee on Voting.

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.