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New DOE Security Guidelines Impose Restrictions on National Labs

By Pamela Zerbinos

New interim security guidelines outlined by the US Department of Energy (DOE) are causing upheavals in the way some national laboratories handle their identification and access procedures. The guidelines went into effect on April 4. The restrictive measures taken include tying laboratory identification and access cards to visa status, as well as rescinding the exemptions granted to seven national labs due to the unclassified nature of their work. Final regulations are expected to be approved later this year.

The seven labs directly affected by the new guidelines are Ames Laboratory, Fermi National Accelerator Laboratory, Lawrence Berkeley National Laboratory, the National Renewable Energy Laboratory, Princeton Plasma Physics Laboratory, Stanford Linear Accelerator Center, and the Thomas Jefferson National Accelerator Laboratory. These were exempt from much of the previous DOE directives concerning foreign visitors and assignments, because the work they perform is not classified. "Everyone expects a higher security standard when you're designing nuclear weapons," said John Womersley, co-spokesperson for Fermilab's DZero experiment. "What we were unprepared for is that this standard would be applied to us."

The prior exemption meant that the labs did not have to collect and report certain information on foreigners, including biographical and personal data; passport and visa information; the purpose of the visit; the actual areas and subjects to be visited, and the host and sponsoring organization of the visit. Under the new policy, this information is now to be collected and entered into DOE's Foreign Access Central Tracking System (FACTS). This translates into interviewing every foreign visitor to the seven labs to ensure that the DOE has their information on file. It also necessitates issuing new ID badges tied to their visas; when the visa expires, so does the ID badge. Scientists must go through the interviewing pro-

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March Meeting Prize and Award Recipients

Photo Credit: Eller's Photography 2003

Prize and Award recipients at the March meeting gather together for a group photo with sponsors of two of the awards. They are listed left to right, with an asterisk denoting the sponsors. Front row: Phaedon Avouris, Ivan Schuller, Jason Alicea, Giacinto Scoles, Arthur Ashkin, Andrew Lovinger, Dhiraj Sardar. Back row: Boris Altshuler, Ruud Tromp, Kennedy Reed, C. Paul Robinson, Kevin Lehmann, Steven White, Russell Donnelly (*), Pierre Hohenberg, George Flynn, Leon Radziemski (*).

Physics Hits the Road at Colorado Conference

By Pamela Zerbinos

In late February, all roads led to Fort Collins, Colorado, as around 5,000 members of the general public and 55 mobile physics program coordinators from 38 institutions descended on Colorado State University for the Little Shop of Physics open house and the first "Physics on the Road" conference.

The event began on February 22, with Colorado's 12th annual Little Shop of Physics open house. The Little Shop of Physics was started in 1992 by Brian Jones, who hits the road once a week or so with a troupe of undergraduate students and takes hands-on physics experiments to local communities, neighboring states, and even foreign countries.

"We don't do a show," Jones said. "We want to give folks a sense that science is something they can do."

Once a year, the program also hosts an open house. The first year, around 200 people came; this year, more than 5,000 students, children and parents strolled through two ballrooms and looked at 150 physics displays that had been set up by Jones and 20 CSU science majors.

See **COLORADO** *on page 4*

Photo Credit: Jessica Clark

Harvey Gould of Clark University (standing) offers some advice to William Jensen of UMass-Boston, who is preparing to write to his representatives in Congress using special software provided by the APS Office of Public Affairs. More than 2000 letters to Congress were written by attendees at the March meeting.

Co-Author Question Dominates Ethics Panel Discussion

Last year's high-profile cases of scientific fraud may have been resolved, but the aftershocks are still rippling through the physics community, as became apparent during a panel discussion on scientific ethics at the APS March Meeting in Austin, Texas. The panelists provided a broad overview of the various issues involved, but it was the question of the responsibility of co-authors in cases of fraud that dominated the audience concerns and subsequent discussion

Pierre Hohenberg (Yale University) distinguished between two types of ethical issues: those related to the applications or misuse of science, and those related to the process of scientific research (scientific misconduct). "Physicists have led the way in questioning the ethics of such scientific applications as nuclear weapons, for example," he said. But most of the speakers agreed that in the past, the physics community has felt overly secure in the fact that, because of its reliance on reproducibility of results, physics would remain largely unaffected by the type of blatant misconduct that plagued biomedicine in the 1980s and 1990s.

Then came allegations that Victor Ninov (Lawrence Berkeley National Laboratory) had fabricated data to support the discovery of Element 118. It was

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"Left-Handed" Materials Could Make Perfect Lenses

The controversy over whether left-handed materials (LHMs) can be realized appears to be resolved, thanks to new experimental results reported by speakers at the APS March Meeting in Austin, Texas. LHMs are defined as materials with a negative index of refraction. LHMs bend microwave and light beams the opposite way to ordinary lenses, and because they can, in principle, focus light without the need for curved surfaces, they have the potential of making the "perfect" lens and entirely new classes of electronic and optical devices.

In 1968 Victor Veselago of the Lebedev Physics Institute in Moscow argued that a material with both a negative electric permittivity and magnetic permeability would result in novel optical phenomena when light passed through it, including a reverse Doppler shift (wherein the light from a source coming toward you would be reddened and the light from a receding source would be blue-shifted), reverse Cerenkov radiation, and an inverse Snell's law—the index of refraction of the material is negative. Permittivity (epsilon) is a measure of a material's response to an applied electric field, while permeability (mu) is a measure of the material's response to an applied magnetic field.

It is rare for a material to have either negative permittivity or negative permeability, much less both, and until a few years ago, no such materials were known nor thought likely to exist. They certainly do not occur naturally. But in 1999, John Pendry of Imperial College showed how negative-epsilon materials could be built from rows of wires and negative-mu materials from arrays of tiny resonant rings. His material consisted of alternating layers of metal rods and "C" shaped rings lodged on a honeycomb array of printed circuit boards. Following his prescriptions, Sheldon Schultz and David Smith of the University of California, San Diego, succeeded in

See **LENSES** *on page 5*

Highlights

Members in the Media

"DNA has a water layer under practically any conditions. We have systematically changed the number of water layers and shown that the conductivity arises from water molecules, not the electrons on the DNA."
—George Gruner, UCLA, on whether DNA conducts electricity, New Scientist, March 29, 2003

✶✶✶

"Manned programs are exorbitantly expensive. If we are serious about doing science, we cannot spend as much on manned programs."
—Vernon Ehlers, US Congress (R-MI), on the space program, New Scientist, March 8, 2003

✶✶✶

"You've got regular stuff doing funky things."
—Andrew Houck, MIT, on the behavior of left-handed materials, Dallas Morning News, March 10, 2003

✶✶✶

"There are media people 'embedded' with the teams that are going to do the (weapons of mass destruction) inspection assessment. Any good police reporter knows how not to be fooled by faked evidence."
—Jay Davis, Livermore National Laboratory (retired), on how credible the evidence coming out of Iraq will be, San Francisco Chronicle, March 25, 2003

✶✶✶

"The fact that there appears to be an angular cutoff hints at a special distance scale in the universe."
—Gary Hinshaw, Goddard Space Flight Center, on whether the universe is shaped like a donut, New York Times, March 11, 2003

MEMBERS GET ESTATE PLANNING TIPS AT MARCH MEETING

Board-certified estate planning and probate attorneys Kathleen Ford Bay and Bethann Eccles of the Austin, Texas firm Hilgers & Watkins P.C. presented an informational session on estate planning at the APS March meeting. Topics covered included the importance of having a will, as well as proper planning to ensure the passing of assets to beneficiaries without severe taxation. Those who missed the meeting can get copies of the handout that was distributed by contacting Sarah Davis at *davis@aps.org*, or 301-209-3223.

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cess all over again to acquire a new ID badge.

"This creates a problem when you have people who go back and forth regularly and who arrive after hours," said Womersley, "particularly on large collaborations like DZero which have many Western European scientists visiting the lab for a few days at a time every few months." Scientists from countries such as Great Britain, France and Germany do not need visas in order to enter the US; they come with a visa waiver, good for only 90 days, and hence need a new waiver every time they come to the US This means reapplying for laboratory identification on every trip. Furthermore, "They arrive after-hours and on weekends because that's usually when they can get cheap flights," says Womersley. "But there's not going to be anyone here at those times to issue them ID cards."

At Fermilab, ID badges grant access not only to the site itself, but to many of the buildings and experiment halls. Fermilab is attempting to solve the problem of after-hours access by issuing a visitor's pass to all users who previously held a Fermilab ID card. If a user is a member of the CDF or DZero collaborations, he or she will be issued a pre-encoded card allowing access to those experiments. The passes will only be valid through the next working day, when a regular ID card will be issued.

In the meantime, representatives of the international working groups at CDF and DZero have sent a letter of protest to Raymond Orbach, director of the DOE Office of Science, outlining the practical difficulties the new policies will cause for many collaborators and the repercussions they may cause throughout the international scientific community. Asserting that "the new access regulations introduce discrimination and instability," the letter asked Orbach to "do your utmost to maintain the excellent working conditions we have enjoyed at Fermilab, and to respect the international standards for access to pure research laboratories." According to Womersley, Orbach has acknowledged receipt of the letter and attempted to address these concerns, but his degree of success is not known.

"We're mostly concerned about the precedent this sets, and the message it sends regarding longer-term policy," said Womersley. Because the guidelines are only in effect until final regulations are approved, he hopes the final draft will include the exemptions rescinded by the interim guidelines. Interested parties can access the interim guidelines online at http://www.ig.doe.gov/pdf/ig-0579.pdf.

This Month in Physics History

May 1888: Tesla Patents "Electric Transmission of Power"

Electric power is an aspect of modern life that most of us take for granted. And while the general public associates Thomas Edison with its invention and the development of transmission processes, the methods used today are largely due to the efforts of Nikola Tesla.

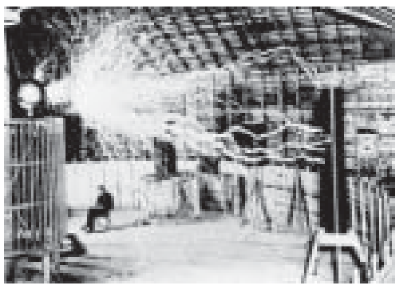
Tesla was born in July 1856 in Smiljan, Lika, a region of Croatia, the son of a Serbian Orthodox priest. He studied at the Polytechnic Institute in Graaz, Austria, and the University of Prague, initially intending to specialize in physics and mathematics, against his family's desire that he follow his father in an ecclesiastical career. But he soon became fascinated with electricity, and began his career as an electrical engineer with a Hungarian telephone company in 1881, which is where he first devised the concept of the induction motor.

In February 1882 he discovered the effects of a rotating magnetic field, which has found widespread application in electrical devices that use alternating current.

He spent some time with the Continental Edison Company in Paris designing dynamos, and in 1883 he built a prototype of the induction motor and ran it successfully.

He came to the US the following year and took a job in Thomas Edison's lab, but the two men quickly found themselves at odds over direct current (DC) versus alternating current (AC). Edison espoused DC, which flows continuously in one direction, whereas AC typically changes direction 50 or 60 times per second. With a transformer, the AC voltage can be stepped up, and the current correspondingly stepped down, to minimize resistive heating losses in the transmission lines over long distances. In a DC system, line losses required additional power stations at two-mile intervals.

Tesla developed polyphase alternating current systems of generators, motors and transformers, eventually holding 40 basic US patents. These were bought by George Westinghouse, who was determined to supply America with the Tesla system, which eventually won out as the superior technology and became the standard power in the 20th century.



After receiving a patent on the electric transmission of power in May of 1888, Tesla subsequently demonstrated alternating current electricity at the World Columbian Exposition in Chicago in 1893. He then designed the first hydroelectric powerplant in Niagara Falls in 1895, culminating his lifelong dream.

In 1899 he built an experimental station in Colorado Springs to experiment with high-voltage, high frequency electricity and other phenomena, where he generated and sent out wireless waves without wires for miles. This is also where he made what he regarded as his most important discovery: *terrestrial stationary waves*. He proved that the Earth could be used as a conductor and would be as responsive as a tuning fork to electrical vibrations of a certain frequency.

Tesla invented the Tesla coil in 1891, which is widely used today in radio and television sets and other electronic equipment. Financially supported by J. Pierpont Morgan, he built the Wardenclyffe laboratory and its famous transmitting tower in Shoreham, Long Island between 1901 and 1905, 187 feet high and capped by a 68-foot dome. It was intended to be the first broadcast system, transmitting both signals and power without wires to any point on the globe. The magnifying transmitter—the largest Tesla coil ever built—was capable of generating 300,000 watts of power and reportedly could produce a bolt of lightning 130 feet long. But Tesla fell out with Morgan before the tower was completed, and the unfinished structure was demolished in 1917.

Among Tesla's other discoveries were the fluorescent light, the bladeless turbine, wireless communications, wireless transmission of electrical energy, and remote control. Yet even today, most history books credit Guglielmo Marconi with invention of the radio, and many electric utilities are still referred to as the "Edison Company", even though they use the Tesla-Westinghouse alternating current system—omissions that have caused some Tesla advocates to dub him the "forgotten father of technology." Tesla himself said of the skeptics of his day, "The present is theirs. The future, for which I really worked, is mine."

For all his (sung and unsung) accomplishments, Tesla was a bona fide eccentric, and his odd habits became more apparent as he aged. He always wore white gloves and rarely shook hands because of progressive germ phobia. He never stayed in a hotel room or floor whose number was divisible by three, feared pearl earrings worn by women, and insisted on large numbers of napkins at meals, which he used to meticulously polish his silverware. At the end of his life he made strange claims about death rays that could make entire armies vanish in seconds and communication with other planets.

He died virtually penniless on January 7, 1943, in the Hotel New Yorker where he lived for the last ten years of his life. Nine months after his death, the US Supreme Patent Court determined that Tesla, not Marconi, should be considered the father of wireless transmission and radio, a somewhat belated` victory for the deceased inventor.

Further Reading:

Margaret Cheney, ed. *Tesla: Man Out of Time*. (Touchstone Books, NY 2001).

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Editor .... Alan Chodos
Associate Editor .... Jennifer Ouellette
Special Publications Manager .... Elizabeth Buchan-Higgins
Design and Production .... Stephanie Jankowski
Forefronts Editor .... Neville Connell
Proofreader .... Edward Lee

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Number Four

Atomic Force Microscope

(G. Binnig, C. Quate, and Ch. Gerber, Phys. Rev. Lett. 56 (1986), 930), 3469 citations

This is the seventh in a series of articles by James Riordon. The first article appeared in the November 2002 issue. The articles are archived under "Special Features" on the APS News online web site.

Nineteen eighty-six was a busy year for Gerd Binnig: the Zurich-based IBM physicist was blessed with birth of a son, jointly won Nobel Prize in physics with Heinrich Rohrer for the invention of the scanning tunneling microscope (the prize was also was shared with Ernst Ruska for his work on electron optics), and published a highly cited PRL succinctly entitled *Atomic Force Microscope*. "Surprising, isn't it," is Binnig's understated reply when asked to reflect on the events that surrounded the development of one of the most versatile analytical tools to appear on the research scene in a century. "It was a very exciting year for me working in this wonderful group in Stanford."

Binnig clearly recalls the moment that the inspiration for the AFM came to him. "After the STM was working I was torturing my brain for many years how to get atomic resolution also on insulators." (STMs are limited to imaging conducting samples.) "I tried so many ideas, none of them was promising. One day I was lying on the couch and suddenly saw a drawing in the statistically structured ceiling. It was the drawing of an AFM with a tip mounted on a cantilever," says Binnig, "I talked with Cal [Quate] and Christoph [Gerber] about it… It appeared that nobody had asked the question before whether one could measure the force between two single atoms. What should the instrument look like; how should it function? Christoph then built the first AFM at IBM. He was mainly working at IBM, I mainly in Stanford."

The AFM that Binnig envisioned is a conceptually simple device; a sharp probe of silicon, carbon, or some other material is mounted on a cantilever spring and dragged across the surface of a sample. In one of its most common operating modes, a feedback system adjusts the distance between the sample and the probe tip to maintain a constant deflection of the cantilever as it traverses the sample, and the structure of the surface contour is deduced by monitoring signals in the feedback loop. The interaction between the probe and sample may be mediated by various forces—electric, magnetic, van Der Waals—depending on the sample material and the specific scanning mode selected. Unlike the STM, which monitors fluctuations in currents flowing between the probe tip and a conductive sample, the AFM can provide images of a broad spectrum of both conducting and insulating materials.

"Basically," says Cal Quate, leader of the group at Stanford where Binnig began developing the AFM during his sabbatical from IBM, "it's a phonograph that's scaled down to look at atoms." In fact, Christoph Gerber scavenged a portion of the first AFM from a commercially-produced phonograph. "The first cantilever spring was a gold foil with a glued-on tip," explains Gerber, "and that was a diamond from an old record player needle, which I went down to Palo Alto and bought." Gerber crushed the diamond, and selected one of the sharpest fragments to serve as the their first probe tip.

Although the AFM is now widely recognized as an atomic resolution microscope, it was not immediately clear that the AFM would be capable of detecting the detail that Binnig, Gerber and Quate first proposed. "The fact that 'atomic' was in the title implied that we would see atoms," says Quate.

Initially, however, the *PRL* reviewers dwelt on the lower resolution scans reported in the letter, and were doubtful of the ultimate performance that the authors predicted for AFMs. "We argued with the reviewers," laughs Quate, "it took us a long time to convince them that it should be published."

Of course, the reviewers eventually conceded the point, but in retrospect their skepticism was at least partly justified by challenges the authors faced in the years following publication of their notable *PRL*. Early AFM images of atomic-scale structure, it turned out, proved to be deceptive. "I was always wondering why the surfaces investigated by AFM looked atomically very ordered, but very disordered when studied by STM," recalls Binnig. "The explanation is that many tip atoms of the AFM image the atomic structure of the surface. The result is an overlay of many atomic images and defects average out, but the periodicity remains… it took seven years to get [true] atomic resolution. Today this is under control."

For the most part, the authors note, AFMs are rarely pushed to their ultimate resolution. Much of their popularity as analytical tools, and therefore many of the letter's citations, result from the incredible versatility of the microscope in a wide variety of fields. "It is obvious that investigating all kinds of materials on the atomic scale, or close to that, makes a big difference," says Binnig, "Seeing is believing. Understanding the structure of matter on that scale, and being able to manipulate it by the AFM or other means in a controlled, 'seeing' way opens a new world. That was clear, and the STM already worked, being the biggest step in this direction. The AFM, however, broadened this in several ways. A large community can operate the AFM on a wide range of samples with the option, besides measuring tunnel currents and doing tunneling spectroscopy, or doing force spectroscopy."

"We developed the AFM solely to get atomic resolution on non-conductive surfaces," adds Gerber, "That was the idea, and that took many years [following publication of the letter]. In the meantime many researchers picked up the simplicity of the device and developed the AFM into this versatile instrument that we have today. It's incredible what you can do with it." In recent years, AFMs have been improved and modified to the point that they can probe soft, biological samples as well as the rugged crystals that were the focus of early studies. Other versions detect chemical properties, respond to magnetic fields, or measure frictional forces on a minute scale, to name a few of the seemingly endless AFM variations.

"When you look at instrumentation," Gerber adds, "it's stuff like deep space, like the Hubble and all that, which contribute to the understanding of our universe. What we've done with the STM and AFM helped to open up the

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ETHICS PANEL *from page 1*

followed closely by similar allegations of data falsification against Henrik Schön, a materials scientist at Lucent/Bell Labs. Two separate investigative committees were formed to determine whether fraud had been committed.

Fortunately for the committee members, there were federal guidelines already in place to assist them in their deliberations. Formally issued in December 2000 by the White House Office of Science and Technology Policy (OSTP), the guidelines focus on fabrication, falsification and plagiarism. The alleged misconduct must have been done "intentionally, knowingly or recklessly," and be supported by a preponderance of the evidence.

Although the APS adopted guidelines for professional conduct as early as 1991, relatively little attention was paid to the matter in the physics community until recently. As a result of the Ninov and Schön cases, the Society revised its guidelines (See *APS News*, January 2003) and called for universal adoption of the OSTP guidelines. Arthur Bienenstock (Stanford University), who was instrumental in the development of those OSTP guidelines during his tenure as its associate director for science, believes the APS action was necessary, since a few federal agencies—most notably Health and Human Services and the DOE—have not yet published implementation plans called for in the guidelines. Also, there are rare institutions that don't receive federal funding and may not have policies in place for research misconduct.

LBL's George Trilling—a former APS president who was a member of the Ninov investigative committee—gave an overview of the facts surrounding the case, and speculated on possible motivating factors for the misconduct, including the presence of a highly competitive situation, with several labs vying to be the first to announce the discovery.

Malcolm Beasley (Stanford University), who chaired the Lucent investigative committee, reported that his committee found the guidelines particularly well-designed and useful. But the central issue that sparked the most heated debate during the subsequent discussion was the responsibilities of co-author. In both the Berkeley and Lucent cases, there were experienced, respected co-authors who nevertheless failed to detect the fabrications.

"Given the importance of the result, it was incredible that, prior to publication, no one had looked at the raw data for the particular events claimed to make sure that there had been no errors " said Trilling of the Element 118 case. "Extraordinary results demand extra ordinary supporting evidence, and the burden of proof for an unexpected or major discovery is much greater than for a routine measurement." He added that journal referees "could and should" help enforce this principle.

Yet determining co-author responsibility is a complex issue, due in large part to the different cultures of the various subfields of physics. For example, high energy and nuclear physics are typically characterized by massive projects with hundreds of collaborators. A typical paper may have as many as 500 co-author, each of whom has made a significant contribution to a small part of the overall project.

"We have to feel responsible and be held accountable," said Beasley. "But I don't think there's an easy checklist; the guidelines should not be overly prescriptive. We must leave room for discretion, because we can't define the issue in such a way that would apply to all individual cases." This is one reason why the Berkeley committee ruffled feathers with its sharp rebuke of Ninov's co-authors, while the Lucent committee received criticism from a few individuals for not chastising Schön's senior co-authors more directly.

Because of these differences, there was general agreement among the speakers that the OSTP guidelines should not be amended to address the co-author issue. It is an issue more appropriately left to the scientific community to resolve, and professional societies like the APS have a vital role to play by fostering further discussion and setting their own internal policies to address potential fraud.

"The federal policy represents the law and it carries with it legal repercussions for research misconduct," says Bienenstock. "Ethics go beyond the law. You don't want to limit things so much that you hinder good science from being performed."

However, despite the community's best efforts to guard against misconduct, "With a sufficiently motivated and capable hacker, fraud is always a possibility," said Trilling. He insisted that the independent confirmation of scientific results is still the best guarantee against misconduct, and independent confirmation within a collaboration provides the best guarantee that a fraudulent result is not published—"something that could have been done by the Element 118 collaboration, but was not." The same considerations apply not only to fraud but also to sloppy work or to errors in data analysis.

While the speakers agreed that, in the end, the scientific system worked, several emphasized that many younger colleagues of the perpetrators of the fraud were hurt by the misconduct. In the Schön case, for example, there were a good number of young condensed matter physicists who were establishing their careers by building on what they thought were favorable results, and they received a very rude jolt when it turned out to be a house of cards.

"For the most part, the system served science well, but there has been long-standing criticism of the process by which we conduct the business of science," said Beasley. "It's important to understand how much science has changed, and how those changes are demanding a re-examination of professional ethics. We have not become less ethical, but the circumstances under which we work have changed. We need to adapt accordingly."

LETTERS

Is It Legal to Attend a Conference in Cuba?

In a Back Page article [*APS News*, August/September 2002] entitled "Engaging Cuban Physicists Through APS/CPS Partnership", Irving Lerch writes of a meeting of APS officers with representatives of the Cuban Physical Society (CPS), at which "an agreement was made to organize joint meetings in Cuba," one of which appears to be the VIII Inter-American Conference on Physics Education, to be held in Havana on July 7-11, 2003.

I cannot tell from the article whether American scientists may lawfully travel to Cuba to participate. I am a physicist at the University of Wisconsin who is active in the "Wonders of Physics" outreach program, and have a professional interest in attending this conference.

Can I lawfully go?

Could my wife lawfully go?

Jim Reardon
Madison, Wisconsin

Editor's Note: *APS Director of International Affairs Irving Lerch [lerch@aps.org]replies:*

Every American resident or citizen has the right to travel to Cuba. However, because of the US Embargo, you may not spend money there unless granted permission to do so by the Office of Foreign Assets Control of the Department of Treasury.

Upon obtaining such permission, you may make appropriate travel arrangements through a licensed agent who is permitted to charter flights from the US to Cuba via Miami, LAX or JFK in New York.

The Education meeting you refer to is sponsored, in part, by IUPAP and therefore every bona fide scholar qualifies for travel to Cuba to attend this meeting under the provisions of a General License granted to all US participants in meetings sponsored by international organizations of which the US is a member but which is not headquartered in the US.

Thus, all members of APS may attend the meeting and we will assist in making the arrangements. We have engaged the services of a licensed agent.

We can even make arrangements for spouses who wish to participate in a cultural exchange coincident with the meeting. We will make the necessary arrangements and provide all the details you will need to make the trip.

Female Student Deserves Credit

While I was quite pleased to see in the *"Physics News in 2002"* section a report on the discovery of "A Young Evolving Planetary System", I was also a bit dismayed at the credit given for the work. While it was noted that the discovery was accomplished by "William Herbst and his colleagues", I believe this statement does not give the proper picture of credit.

It is my understanding that the majority of the work in this discovery is due to Catrina Hamilton, who is currently finishing her PhD at Wesleyan with Dr. Herbst as her advisor.

In fact, the work on KH15D forms the bulk of her thesis. As such I would hope that Ms. Hamilton would receive proper credit for her efforts. My interest in this is due to the fact that Ms. Hamilton, while pursuing her PhD, has also served as a Senior Lecturer in our department at Connecticut College for many years. We have encouraged her in her graduate work, and are also very proud of her accomplishments.

I also found it very ironic that in the same issue "The Back Page" article by professor Meg Urry comments on the continuing gender discrimination in physics, while a female physicist does not get due recognition for her work on a previous page of *APS News.*

Michael Monce,
New London, Connecticut

Article Disgraceful, Gratuitous, and Unnecessary

Who is the political activist that wrote the article: "President Signs NSF Authorization Bill; White House Suppresses the Evidence—Searching for an elusive photo of Bush with former APS President Bill Brinkman"?

Is it your opinion that the statements made reflect the opinion of the majority of APS members? Here is one APS member that believes the statements made are insulting to all responsible and clear thinking Americans. Is that article somehow supposed to help the APS? Please keep your personal politics out of our paper. Either represent us accurately or step down. That was a disgrace.

Elgin A. Anderson
Logan, Utah

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In the March 2003 *APS News*, I find the remarks about the President "(Bush, that is)" in the article on the NSF Authorization Bill gratuitous and unnecessary. Let's keep *APS News* a newsletter about physics and not a political satire magazine. (This is not a liberal-conservative issue. A comment about Clinton and Monica Lewinsky would be equally inappropriate.)

Joe Palmieri
Oberlin, Ohio

Editor's Note: APS News *is not a politically partisan publication. We would have been delighted to print a picture of President Bush and APS President Brinkman on our front page. We continue to be puzzled as to why that picture was not made available.*

Visa Problem Simply Solved

The Visa problem [front page, *APS News*, March 2003] is indeed a serious one.

Might I suggest a simple solution. First let the APS loudly disavow the Big Bang theory. Follow this with a plea to our colleagues in biology to abandon evolution for creationism. And finally, let us assure the President that nuclear warfare is appropriate for dealing with evil empires.

Leonard Yarmus
Oakland Gardens, NY

Omission Produces Perplexity

In the "Physics News in 2002" section in *APS News*, February 2003, the item: "Ballistic magnetoresistance (BMR)" in the section "Condensed Matter/Materials Physics" describes an experiment conducted by researchers at Buffalo that finds a remarkably large resistance change in nickel nanocontacts at room temperature. The publication given as reference is a paper from that group in *Phys. Rev.* B 66, 020403 (R)(2002).

We wish to manifest our perplexity that the news about BMR is given based on the above quoted experiment and publication, since this phenomenon was discovered in Madrid, Spain, in 1999, by the team lead by N. Garcia, who coined this term. From then (*Phys. Rev. Lett.* 82,2923 (1999)) until 2002, they have published at least five papers on increases of this BMR and obtained several patents. This is acknowledged by the Buffalo group in their publications, and in particular in their aforementioned paper where they give six references to the Madrid work out of a total of fourteen referenced publications.

In both "Physics News", and in *Physics Today*, August 2002, page 9, the BMR progress is presented as due to the Buffalo team only, overlooking the work of the Madrid group, which has never been mentioned in either publication.

Manuel Nieto-Vesperinas,
Manuel Torres Hernaz
Madrid, Spain

Editor's Note: *We thank the authors for pointing out this omission.*

Don't Forget Sandia

Harold Agnew's letter in the March, 2003 issue regarding the current uproar over the University of California's management contract for Los Alamos National Laboratory contain two items that require comment.

First, there are three weapons laboratories that have "the responsibility for maintaining the integrity of our nation's nuclear deterrent", not two as Director Agnew implies. He omits Sandia National Laboratories (SNL), which along with LANL and Lawrence Livermore National Laboratory (LLNL) have this obligation. LANL and LLNL are responsible for the "physics package" portion of our weapons, but SNL is responsible for just about everything else, from arming, firing & fusing systems, neutron generators and parachutes to providing training courses for the military personnel who would ultimately be responsible for their use.

Whereas LANL and LLNL competed for the physics packages of each new system that came along, SNL worked with both of them to provide deployable weapons. And since SNL was a GOCO operated by AT&T until the early nineties, and Lockheed Martin now, clearly having a different contract manager did not cause our nuclear deterrent to "suffer a very serious setback". I spent my entire career before retiring at Sandia and during that time, I worked with both LANL and LLNL personnel, and the fact that we had different organizations as contract managers never even came up and certainly did nothing to impede our work.

Personally, I take no position on whether or not the University of California should continue to manage LANL, but my second point is that over fifty years of experience have shown that SNL could work seamlessly with the two other labs, so having different managers at LANL and LLNL shouldn't be a problem, if that's what the politicos decide.

James A. Borders
Albuquerque, NM

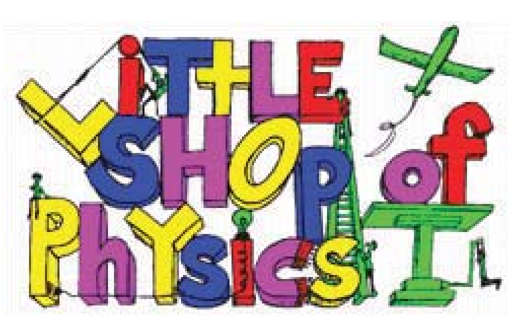
COLARADO *from page 1*

The 2003 Physics on the Road conference was the first real chance for Jones to interact with others who have similar programs.

"This is something we've talked about doing for three years," said Fredrick Stein, director of the APS Education and Outreach office. "But everyone was so busy with other things that we didn't get the chance. This year, finally, we had the time to do it. It went wonderfully."

"The conference provided a chance to build a network of people interested in taking physics into the community," said David Harris, APS media liaison. "Previously, most of these people were working in isolation with few resources and little moral support from their universities or departments."

"It was nice to be able to talk shop with people," Jones said. Although he does have the support of CSU, he often works alone. "I came away with a lot of great ideas. It really invigorated me."



"There were panels, problem-solving sessions, posters, networking, everything a conference should have," said Stein.

The sessions were devoted to demonstrating the many different approaches to traveling physics experiments using interactive exhibits and mobile demonstration shows. Issues covered ranged from the mundane (what type of boxes to use) and practical (how to best get exhibits from point A to point B), to the more philosophical question of why the participants do mobile physics shows. There was a sharing session where participants did their favorite demonstration, and a keynote address by Stanford's Doug Osheroff, who discussed how his early experience with a traveling physics show was a defining moment in his career.

"Everyone wants to do it again next year," said Harris. "APS has set up an e-mail listserver to allow participants to keep in contact over e-mail, and they're very excited about being able to continue to talk to one another about their programs."

Physics Golden Oldies

I enjoyed seeing in the "Zero Gravity" section of the latest *APS News* the partial text of the "Placement" song by Arthur Roberts. Actually that song is part of a collection of songs by Roberts and collaborators written over the period 1939 to 1947. They were first recorded in December 1947. The titles of the other songs are "The Cyclotronist's Nightmare", "It Ain't the Money", "Take Away Your Billion Dollars", "Conant, Compton, and Baruch", and "How Nice To Be a Physicist".

These songs are a reflection of the sudden emergence of physics into the big time after WW II, and resonated with young graduate students like me who had thought they'd chosen an obscure and unremunerative profession. I still have a set of the original 78 RPM recordings of these songs.

Stephen Tamor
La Jolla, CA

Editor's Note: *We regret that in the "Zero Gravity" article, we incorrectly dated the song as 1974 instead of 1947.*

ERRATUM

In a page 1 story in the April issue, headlined "APS Units, Members Get More Political", reference was made to Congressional Fellows working in the APS Washington office. This is incorrect. They should have been called Senior Policy Fellows. APS Congressional Fellows work on Capitol Hill and do not engage in lobbying.

Focus on Committees

Committee Works on Improving Education


Robert Clark

Education and outreach are among the Society's most important areas of activity. A central role is played by the Committee on Education, which advises the APS Department of Education and Outreach, provides a source of new ideas to improve physics education in America.

The COE works not only in all areas of graduate and undergraduate physics education, but also tries to increase cooperation between the education and physics communities. One of their key initiatives in this area is the support and development of the Physics Teachers Education Coalition (PhysTEC), which aims to bring physics and education faculty together to improve the science education of future K-12 teachers.

This initiative, spearheaded by the APS under the leadership of Director of Education Fred Stein, is a joint effort with the American Institute of Physics and the American Association of Physics Teachers, and is funded by both the National Science Foundation and the US Department of Education (see *APS News*, October 2002, http://www.aps.org/apsnews/1002/100204.html).

"Another important role of the COE," said committee chair Robert Beck Clark, a physics professor at Brigham Young University and Texas A&M, "has been the preparation of statements on educational matters for consideration of the APS council to represent the official APS position on these issues."

Their most recent statement was created to help physics students explain to others what they're doing, and why.

"We rather often have parents call up and say that their child wants to be a physicist, but they don't have any idea what that means," said APS staff liaison Sue Otwell.

The statement, "Why Study Physics?" is designed to help everyone answer that question.

Other APS policy statements sponsored by the COE include the APS Statement on Research in Physics Education and Policy Statement on Student Assessment and Accountability. They are currently working on a new statement, "Physics for Everyone," with the APS Panel on Public Affairs.

"The COE also actively monitors educational developments of interest to the physics community," said Clark. Examples include the state of federal funding for science and mathematics education; the recent National Research Council (NRC) report on the role of advanced placement physics programs; and the current national initiative to encourage the study of physics earlier in secondary education.

"The traditional sequence has been biology, chemistry and then physics," said Otwell, "but that's starting to change."

The committee usually has nine members, six of whom are appointed by the President-Elect to staggered three-year terms. The other three slots are filled by the Chair, Past-Chair and Chair-Elect from the Forum on Education, which works closely with the Committee.

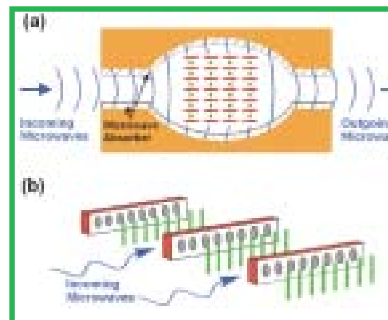
The COE has supported the APS Department of Education and Outreach in its efforts to undertake innovative activities and initiatives. One such is the 2003 Conference on "Physics on the Road", which took place in February in Fort Collins, Colorado.

"This conference," said Clark, "brought together the leaders of a variety of successful traveling physics programs conducted by university physics departments that share the excitement of physics with children in their geographical regions."

Future COE plans include continuing to work on a proposed future APS education award to reward excellence in educators, as well as considering the thorny issues of program accreditation and review.

—Pamela Zerbinos

LENSES from page 1



UC San Diego Physicists have devised a composite material in which the effective electrical permittivity, and the magnetic permeability are both negative. This leads to bizarre optical properties. a) A top view of the experimental setup. Microwaves enter a cavity from the left. They fall on the composite material, consisting of alternating rows of rods and thin copper patterned disks (1 cm in diameter). b) A sideview of the microwaves hitting the composite material.

in constructing such a material at microwave frequencies, using copper wires and rings.

But then a group at the University of Texas, Austin, contended that the earlier studies of negative refraction failed to account for both the group and phase characteristics of electromagnetic waves, while another group at the Consejo Superior de Investigaciones Cientificas in Madrid believed that reports of perfect lensing made false assumptions about the behavior of radiation in LHMs. In response, Pendry insisted that both the Spanish and US studies were "seriously in error."

Now scientists at several labs have reported the experiments that have verified Pendry's original finding, effectively putting to rest at least that aspect of the ongoing work on LHMs. At the March meeting, two labs reported devising LHMs of their own and demonstrating a negative-index behavior when microwaves were sent into a wedge-shaped LHM "prism." A group from MIT, represented at the meeting by Andrew Houck, said that microwaves entering an LHM sample were, sure enough, refracted according to Snell's law, but with a negative sign.

The MIT experiment also provides evidence that light from a point source can be focused with a flat rectangular slab of LHM material.

Patanjali Parimi (Northeastern University) also reported at the meeting that his team of scientists had observed negative-index propagation on microwaves through a LHM sample. [For background and some simple movies, See http://sagar.physics.neu.edu/].

Two theorists present at the meeting, Clifford Krowne (Naval Research Laboratory) and Alexandre Pokrovski (University of Utah), affirmed that the experimental results had indeed established the existence of working left handed meta-materials but that an earlier criterion thought necessary for LHM behavior—namely that the material's permittivity and its permeability both had to be negative—was not strictly required.

Potential applications in the cell-phone industry alone are many: LHM devices would be handy for filtering, steering, and focusing microwaves.

Presidents Three


Photo Credit: Lalena Lancaster

Three of the four women to serve in the APS Presidential line got together at the American Center for Physics in College Park, MD, in March to attend the meeting of the governing board of the American Institute of Physics (see story on page 6). Myriam Sarachik (left) is the current APS President. Mildred Dresselhaus (center) was President in 1984, and Helen Quinn (right), as the current President-elect, will become President in 2004. The fourth woman APS President was the late Chien-Shiung Wu, who served in 1975.

INSIDE THE BELTWAY:
A Washington Analysis

Energy's Office of Science an Early War Casualty

by Michael S. Lubell, APS Director of Public Affairs

Call it collateral damage or an unintended consequence of war. As American tanks began to roll across the Middle Eastern sands in March, House budgeteers slashed the Department of Energy's Fiscal Year 2004 Office of Science by a startling 22 percent. That reduction accompanied House approval of the President's $726 billion tax cut and was driven, paradoxically, by concern that the federal deficit could balloon to half a trillion dollars next year as the Iraq costs mount up.

The House Budget Resolution, or H. Con. Res. 95 if you look for it on the congressional web-site, **thomas.loc.gov**, provides $22.8 billion dollars for Function 250. In budget jargon, that's the account that covers the National Science Foundation, most of NASA, the DOE Office of Science and the new Department of Homeland Security's science and technology portfolio.

The House Budget Committee set aside $5.5 billion for NSF and $14.5 billion for NASA, leaving $2.8 billion for DOE and DHS combined. In his February Fiscal Year 2004 budget request, President Bush called for $273 million for the DHS science and technology programs. And you can bet that Congress intends to allocate at least that much. Which leaves DOE Science with a little more than $2.5 billion for FY 2004, compared to about $3.3 billion in FY 2003.

The Senate Budget Committee, which passed its own Budget Resolution, H. Sen. Res. 23, a week after the House acted, provides $800 million more for Function 250. It wouldn't give the Office of Science the needed infusion that the President's Council of Advisors on Science and Technology (PCAST) implicitly called for last fall, but, at least, it wouldn't gut the federal government's support of the physical sciences. More often than not, however, the House and Senate split their differences in conference, which would leave DOE Science with an 11% or $400 million hole to plug.

It's possible that the Department could handle such a shortfall by closing one or more of its national laboratories. Eight years ago, Robert Galvin, former Motorola CEO and chairman of the Task Force on Alternative Futures for the DOE National Laboratories, floated the idea during congressional testimony. But it never made it out of the hearing room. And there's no reason to believe it will now. So unless appropriators reverse the course chartered by the Budget Committee, the entire physics community can expect to share the pain.

Despite its rhetorical support for science, the Administration has been noticeably silent about the draconian congressional budget plan. Word from the Hill is that OMB is not at all dissatisfied with the House Budget Resolution.

The reason is simple: defense, homeland security, war and tax cuts are the White House priorities, and they're expensive. With the size of the deficit beginning to scare even the most ardent supply-siders, the civilian discretionary budget simply has to be squeezed for every nickel.

The recent report from the Congressional Budget Office, now in the hands of dynamic scorers, offered little comfort. They are the folks who argue that forecasts of federal revenues must take into account the impact of tax cuts on the economy. They believe that conventional CBO projections based on static scoring have consistently underestimated the flow of money into the federal coffers.

They got a chance to prove their mettle this year, when Congress chose Douglas Holtz-Eakin to head the CBO. The Princeton-trained former chief economist for the White House Council of Economic Advisors is a staunch advocate of dynamic scoring and one of the architects of the Bush tax cut plan.

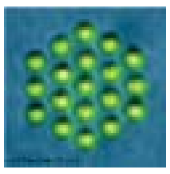
But tax cutters and dynamic scorers got a shock. Of the seven scenarios Holtz-Eakins' CBO used to project federal revenues, none produced a rosy picture. In fact, two gave a more pessimistic result than the statically scored baseline.

So for now, the Hill is taking the red ink seriously. And the entire civilian discretionary budget could be on the chopping block, science included.

Holographic Optical Tweezers, Stretchers Advance Microfluidics

Several key advances in the field of microfluidics were presented at the APS March Meeting in Austin, Texas. Microfluidics is best described as a traffic control system for sampling, sorting, and mixing mesoscopic objects, often biological, such as cells, proteins and chromosomes in a solvent. Fabricated with many of the lithographical tools used to make electronic integrated circuits, microfluid "labs on a chip" manipulate tiny bits of fluids around networks of channels using volts, heat or even peristaltic pressure, where they are combined and probed with diagnostic lasers.

Carl Hansen of CalTech has devised the most complex microfluidic testbed to date, boasting thousands of micromechanical valves and hundreds of addressable chambers. His device has the largest degree of integration yet achieved: a chip with 1000 250-picoliter chambers with attendant valves for controlling flow and mixing. This makes it ideal for large-batch processing of protein crystal growth and other biomolecule studies.

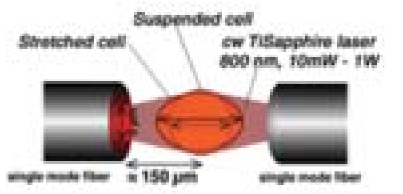


Dynamic Holographic Optical Tweezers

Another device in the Caltech lab of Hansen's colleague, Stephen Quake, allows the careful metering of reagents in order to facilitate protein crystallization under a variety of conditions, such as pH, viscosity, surface tension, or various different solvents. The device is capable of producing 144 parallel reactions, which can take place using only 10nl of precious protein samples —100 times less than with usual methods. In this way, many proteins have been transformed into crystals, often in the space of hours rather than days, and some species were crystallized for the first time. The crystals can then be bombarded with x-rays in order to determine molecular structure.

The University of Chicago's David Grier has created multiple optical tweezers using holography, in which a beam of laser light, sent into a hologram, is divided into a myriad of sub-beams, which can independently suspend and manipulate numerous tiny objects for possible transportation, mixing or reacting. Grier showed movies of ensembles of microspheres moved into patterns and set to spinning by the holographically sculpted light fields.

Applied to fluid samples of biomolecules, the holographic multiplexing produces what Grier calls "optical fractionation," an optical equivalent of gel electro-



phoresis, in which electric fields are used differentially to drive and separate macromolecules. In the more flexible Chicago approach, there is no viscous gel, and a deft change in the computer generated hologram or the laser wavelength can quickly bring about sorting of objects ranging from the 100-nm size (the scale size of viruses, for example) up to the 100-micron size scale.

Jochen Guck of the University of Leipzig in Germany has invented an "optical stretcher," a device in which cells moving through fluid channels are sorted and studied by squeezing the cells. Since sick cells are softer (by a factor of 2 to 10) than healthy cells, the process can differentiate between healthy and sick cells, at a rate of hundreds of cells per hour, compared to typical rates of 10 cells per day using other elastisizing methods, thus reducing the need for biopsies requiring larger tissue samples. The device might even be able to differentiate between ordinary cancer cells and mestasizing cancer cells, which are even softer. Guck subjects fluid-borne cells to a pair of laser beams which stretch the cells and probe their elasticity.

New Prototype Magnetic Refrigerators Hold Commercial Promise

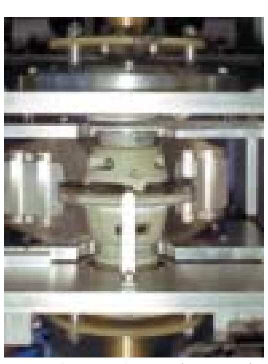
The concept of magnetic refrigerators is not new, but to date, significant progress has been hampered by the need for extremely strong magnetic fields. Over the last few years, scientists at two separate companies have made significant improvements to the magnetocaloric materials being used and are incorporating them into working prototypes suitable for everyday use, according to speakers at the APS March Meeting in Austin, Texas.

Conventional refrigerators work by compressing and expanding a gas as it flows around the cooling unit, but this process is not especially efficient. Refrigeration currently accounts for 25% of residential and 15% of commercial power consumption in the US In the past it has also used gases harmful to the environment.

In contrast, magnetic refrigeration devices have high efficiency even at a small scale, enabling the development of portable, battery-powered products. In fact, Stephen Russek of Aeronautics Corporation, estimates that when magnetic refrigerators are fully developed, they could reduce energy usage by approximately $10 billion per year, along with significant reductions in carbon dioxide emissions. In addition, magnetic refrigeration doesn't use ozone-depleting or global warming gases.

The enabling technology is based upon the magnetocaloric effect, first observed in 1881: an efficient magnetocaloric material warms when placed in a magnetic field and reversibly cools back down when it is removed from the magnetic field.

The first magnetic refrigerator was demonstrated in 1933, and magnetic refrigeration has been used in many laboratories to cool within a thousandth of a degree above absolute zero. Ames Laboratory became involved in 1991, according to senior metallurgist Karl Gschneider, Jr., when Aeronautics asked his group to design less expensive magnetic refrigerants for the liquefaction of hydrogen. They produced materials that were 10% to 30% more efficient than those then in use, and based on this work, Aeronautics demonstrated a prototype unit in November 1996.



Rotating ring (center), roughly the diameter of a compact disk, cycles powdered magnetic material in and out of a gap in the powerful magnet at rear.

A second breakthrough occurred in 1997, when Ames Lab scientists discovered that the giant magnetocaloric effect in gadolinium-silicon-germanium alloys was two to 10 times larger than in existing prototype refrigerants. These alloys improve the efficiency of large-scale magnetic refrigerators, but also open the door to new small-scale applications, such as home and automotive air conditioning.

However, initially the process used more expensive high-purity gadolinium and resulted in small quantities of less than 50 grams of the Gd-Si-Ge alloys. Gschneider and his cohorts developed a new process for producing kilogram quantities of the alloy using inexpensive commercial-grade gadolinium, achieving nearly the same magnetocaloric effect as the original discovery. Meanwhile, other Ames Lab researchers have designed a permanent magnet configuration capable of producing a stronger magnetic field, an important advance since the output and efficiency of the device is proportional to the strength of the magnetic field.

Building on its previous demonstration of a room temperature, superconducting-magnet based device, Aeronautics Corporation has now demonstrated the first room temperature, permanent-magnet based rotary magnetic refrigerator. The rotary design consists of a wheel containing gadolinium and a strong permanent magnet. The wheel passes through a gap in the magnet where the magnetic field is concentrated, and the gadolinium heats up. While still in the field, water is circulated to draw the heat out of the material and reject the heat through the hot heat exchanger. As the material leaves the magnetic field, it cools further. While the material is out of the field, a stream of water is cooled by the material and circulated through the refrigerator's cold heat exchanger, removing heat from the object to be cooled.

Aeronautics is not the only company committed to the development of magnetic refrigeration. Scientists at Japan's Chubu Electric, in cooperation with Toshiba Corporation, have also succeeded in developing a rotating magnetic refrigerator with permanent magnets.

The design schematic is similar to that of the Aeronautics, with an increase in cooling capacity by a factor of 1.5 and a 1/3 decrease in driving power. Chubu's device is also about a twentieth the size of earlier prototype refrigerators employing superconducting magnets. Potential commercial applications of such refrigerators include air conditioning, food preservation, air dehumidification, and beverage dispensing.

However, Russek says that the most likely early applications will be industrial in nature: chilling of process fluids for food, chemicals, industrial gases and pharmaceutical production, as well as refrigerated transport and cooling of electronics. "We firmly believe this could be a great new global business," he says.

Dresselhaus To Chair AIP Governing Board

Former APS President Mildred Dresselhaus, professor of physics at MIT, has been selected as the first woman to chair the Governing Board of the American Institute of Physics (AIP). She was only the second woman to serve as APS president, and will succeed John A. Armstrong, who is stepping down as AIP chair after five years.

Dresselhaus received her PhD from the University of Chicago in 1958, and her physics research has produced key breakthroughs in understanding carbon nanotubes. In addition to 35 years of teaching and mentoring both male and female students, Dresselhaus has extensive experience as a leader of scientific societies. In addition to her term as APS President in 1984, she also served as treasurer of the National Academy of Sciences and president of the American Association for the Advancement of Science. She was director of the DOE Office of Science, and is a recipient of the National Medal of Science.

"AIP is important to me and to all physicists. I am very much looking forward to this new opportunity to serve the physics community," said Dresselhaus of her selection. "As I get into the job I hopefully can find areas where I can have special impact. My experiences all give me some perspective that should help me in this new position."

From the PhysTEC Conference:

Photos Credit: Edward Lee

As part of the Physics Teachers' Education Coalition (PhysTEC) annual conference, held this year in Tucson, participants took part in a workshop on Powerful Ideas in Physical Science, *an inquiry-based curriculum created by the American Association of Physics Teachers (AAPT).*

The top photo shows physics department chair Kathleen McCloud and Teacher-in-Residence David Johnson, both of Xavier University of Louisiana, investigating fundamental concepts in optics.

In the bottom photo, Gay Stewart, physics professor at the University of Arkansas (left), and Ellen Momsen, Teacher-in-Residence in the physics department of Oregon State University, exchange ideas at the poster session of the PhysTEC Conference.

PRL *from page 3*

nanoworld for visualization. Those are the two great things, in my opinion, to have happened with regard to instrumentation in the last twenty years."

All three researchers remain active in AFM research and development. Although he is now retired from IBM, Gerber continues to explore biological AFM applications at the university of Basel. Quate, who holds the Leland T. Edwards chair in the Stanford department of engineering, is working on AFM arrays with carbon nanotube tips. Binnig, like Quate, spends some of his time working on AFM arrays, including a massively parallel array of thousands of probes known as project Millipede. In addition, Binnig, currently ponders complexity informatics and leads a Munich research group attempting to model human perception.

ANNOUNCEMENTS

Call for Nominations for 2004 APS Prizes and Awards

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 in the March 2003 *APS News Prizes and Awards* insert, along with the addresses of the selection committee chairs to whom nominations should be sent. Please visit the Prizes and Awards page on the APS web site at http://www.aps.org/praw/ under the Prizes and Awards button for complete information regarding rules and eligibility requirements for individual prizes and awards.

PRIZES

Will Allis Prize for the Sudy of Ionized Gases
Hans A. Bethe Prize
Biological Physics Prize
Tom W. Bonner Prize in Nuclear Physics
Oliver E. Buckley Condensed Matter Physics Prize
Davisson-Germer Prize in Atomic or Surface Physics
Dannie Heineman Prize for Mathematical Physics
Polymer Physics Prize
Frank Isakson Prize for Optical Effects in Solids
James C. McGroddy Prize for New Materials
Lars Onsager Prize
W.K.H. Panofsky Prize in Experimental Particle Physics
Earle K. Plyler Prize for Molecular Spectroscopy
Aneesur Rahman Prize for Computational Physics
J. J. Sakurai Prize for Theoretical Particle Physics
Arthur L. Schawlow Prize in Laser Science
Prize to a Faculty Member for Research in an Undergraduate Institution
George E. Valley Jr. Prize
Robert R. Wilson Prize

AWARDS

LeRoy Apker Award *(June 13, 2003 Deadline)*
Joseph A. Burton Forum Award
Maria Goeppert-Mayer Award
Joseph F. Keithley Award for Advances in Measurement Science
Leo Szilard Lectureship Award

MEDALS AND LECTURESHIPS

David Adler Lectureship Award
Edward A. Bouchet Award
John H. Dillon Medal
Nicholson Medal

DISSERTATION AWARDS

Mitsuyoshi Tanaka Dissertation Award *(June 30)*
Nicholas Metropolis Award *(Sept. 15)*
Dissertation Award in Nuclear Physics

NOMINATION DEADLINE IS JULY 1, 2003, UNLESS OTHERWISE INDICATED.

Nicholson Medal
Nomination Deadline Extended

The nomination deadline for the Nicholson Medal for Humanitarian Service has been extended from April 1 to July 1, 2003. Please send nominations to the Chair of the selection committee:

Antonia Herzog
Natural Resources Defense Council
1200 New York Ave., NW
Suite 400
Washington, DC 20005

Nominators who sent material to a previous address should communicate with Dr. Herzog by e-mail at **aherzog@earthlink.net**, or by phone at 202-289-2428 to make sure that the material was properly received. Further information about the Nicholson Medal is available on the web at **http://www.aps.org/praw/nicholso/index.html**.

Introductory Physics Taught Using Comic Book Heroes

By Susan Ginsberg

Each year physics professors ask themselves the same question: *How can I make introductory physics more exciting for my students?*

As he told a rapt audience at the March APS meeting in Austin, James Kakalios—a professor of physics and the director of graduate studies at the University of Minnesota—chooses to capture his students' attention by using comic book heroes to explicate the basic principles of physics and astronomy.

"Students find it much more interesting to determine Spider-Man's centripetal acceleration as he swings on his webbing, and to talk about the tensile strength of a real spider's web, than to describe a weight on the end of a twirling string," said Kakalios.

He uses comic books from as far back as 1938 and clips from recent films such as *Spider-Man* (2002) and *The X-Men* (2000). His classes attract a wide variety of students, including many who are not comic book fans, but enjoyed physics in high school and sought an enjoyable way to continue their physics education.

Kakalios developed his unique way of teaching introductory physics when he used a story concerning the death of Spider-Man's girlfriend as an exam problem in a freshman physics class. Knocked from the top of a bridge tower by the Green Goblin, she fell to her apparent doom until stopped suddenly by Spider-Man's webbing, yet was revealed to have died nonetheless. Kakalios' students used the principle of conservation of momentum to find that the force the webbing exerted on her was over 10g's, and thus her death was physically plausible.

Kakalios spoke as part of the Thursday evening session in Austin on "The Physics of Comics, Baseball and Hollywood" along with Robert Adair and Lawrence Krauss. During Kakalios' talk he described how, using basic force equations, his students calculate the force Superman needs in order to leap a tall building in a single bound.

Turning next to Newton's law of gravitation and astrophysical phenomena, he argued that if the source of Superman's strength was the larger gravity on his home planet Krypton, then one could build a planet with such a large gravity, but it would be difficult to keep an explosion from occurring. "The comic book authors got the science right, but only by accident," said Kakalios

Kakalios is clearly a fount of information about comic book heroes, especially to those who haven't followed the history of the art. On Thursday night at the March meeting, he pointed out that in the first years of Superman comics, the writers gave voice to the revenge fantasies of their Depression era readers. "Superman's early foes were not bank robbers or world conquerors, but rather slumlords, sweatshop owners, crooked politicians and Washington lobbyists."

Dan Dahlberg, also a professor of physics at the University of Minnesota, attended Kakalios' talk in Austin. Even though they work in the same department, this is the first time Dahlberg saw Kakalios' examples laid out in detail. He plans to adopt some of Kakalios' methods. "I'm really excited to try it out in class," he said.

Anne Catlla, a graduate student at Northwestern University, was struck by Kakalios' obvious enthusiasm for both comics and teaching. "He caught all of us up in the stories and the science behind them. Everyone wanted to know where the comics were right and wrong, but we also wanted to see how the physics fit into the context of the comic book story…I can see why his students would be caught up by his interest, too."

Folding Patterns Offer Clues to RNA's Family Tree

The search for a hypothetical ancestor of some or all of the types of RNA now known might be possible using a technique pioneered by scientists at MIT's Whitehead Institute, according to speakers at the APS March Meeting.

Just as DNA samples can be used to study the spread of humans to different parts of the world, as well as to study connections among various lineages among living organisms, so too there might be ways of studying the origins of RNA.

RNA is increasingly considered by scientists to be the most likely candidate for the origin of life. It starts out single-stranded, but can at many places along its length double over on itself to arrive at complicated, twisted shapes. Like DNA, it is found in abundance in living cells, but it has the advantage of being a two-pronged biomolecule. Not only can it carry genetic information, it can also fold into protein-like molecules that can catalyze important biochemical reactions.

At the APS meeting, numerous researchers discussed how the folding patterns of RNA molecules support the notion that RNA is connected to the origin of life, and may even explain why nature chose four letters for the genetic code. Also, RNA folding has supplied insights into other questions on how proteins fold into their final shapes.

MIT-Whitehead's Erik Schultes reported on an experiment in which a particular sequence of RNA bases could, by altering one base at a time, quickly take on the identity of either of two very different ribozymes (RNA molecules that can catalyze reactions).

Schultes compared this to transforming the word "cat" into the word "dog" through a sequence of single-letter mutations, each one of which resulted in a legitimate word: cat-cot-cog-dog.

Ranjan Mukhopadhyay reported that he and his colleagues at NEC Laboratories in New Jersey have found that a typical RNA sequence with its 4-base chemical code folds more predictably and stably than would hypothetical RNA sequences based on a two-base or six-base "alphabet."

In other theoretical work, Ralf Bundschuh of Ohio State University and Terence Hwa of University of California, San Diego, have shown that RNA could exhibit several different "phases," just as water can exist in the solid, gaseous or liquid forms.

From the March Meeting Teachers' Day

Photos Credit: Edward Lee

Teachers Marisa Carillo and Doug Muckelroy (top left photo) are building a mousetrap car as part of a hands-on workshop at the March Meeting High School Physics Teachers' Day.

In the top right photo, Donald Kolle and Jeanette DeHart are performing a kinematics experiment with a calculator-based ranger and graphing calculator. Reflected ultrasonic pulses provide the distance from the ranger to the ball, and the calculator produces graphs of distance, speed, and acceleration vs. *time.*

The program also included two research talks, one on Granular Material by George Crabtree and Igor Aronson of Argonne National Lab, and the other on Quasicrystals by Renee Diehl of Penn State. Physicists from the meeting joined the teachers for lunch.

The Back Page

Can Title IX Do for Women In Science and Engineering What It Has Done for Women In Sports?

Debra R. Rolison

What does Title IX have to do with women in science? Many Americans singularly associate the Education Amendments of 1972, commonly called Title IX, with the spectacular increase in opportunities for female athletes in schools and colleges, but the law as originally written never mentioned sports.

It stated, "*No person in the United States shall, on the basis of sex, be... denied the benefits of... any education program or activity receiving Federal financial assistance.*"

I would argue that being a professor of science in a federally funded university is an educational activity and therefore subject to Title IX considerations.

Title IX is a mechanism that can be used to stimulate change. In analogy with the legal strategy that extended Title IX to school sports and led to women comprising 42% of today's collegiate athletes, I argued in 2000 that it was time to apply Title IX as a strategy on behalf of women faculty in chemistry departments. Twenty percent of the PhDs in chemistry went to women in 1985 and that fraction has only increased, reaching 33% in 1999. Yet the fraction of women on the faculty of the top 50 research departments in chemistry in 2000 was only 10%, rising to 12% in 2002.

Should the American taxpayer support institutions that continue to hire white men preferentially? If universities cannot incorporate onto their faculty a representative fraction of the talented women awarded PhDs in science, then it is reasonable to withhold Federal funding from the departments seemingly satisfied with a gender status quo that would not be out of place in the 1950s.

As a further incentive, the research funds so freed could be directed to those universities who do attract to their science faculty the diversity of talent in the PhD pool.

Why propose such a drastic course of action? Because science, technology, engineering, and mathematics (STEM) departments need more women as faculty—and not only to show their undergraduate students (the majority of whom in some disciplines are now women) that a career in academia is a viable path.

The breathtaking inability of too many of our research universities to diversify their faculty is a national disgrace; these universities have recognized the importance of a diversified student body, but have not yet reflected that pool of talent onto their faculty.

Similar difficulties are apparent among the scientific staff of National and Federal laboratories. It matters who teaches and self-reform is not getting it done. The slow pace is especially frustrating in light of the historic opportunity to change the faculty demographics as scientists and engineers hired in the boom years of the 1960s retire.

The "pipeline" has increasingly allowed women with PhDs in STEM to flow into a well-populated candidate pool for faculty openings—albeit enriched in some disciplines, less so for others such as physics. Women earn more than 40% of the PhDs in the life sciences, more than 30% of the PhDs in chemistry, more than 20% of the PhDs in mathematics. Yet applications from women for advertised faculty positions in PhD-granting STEM departments rarely match the numbers of women who graduate from these departments with PhDs.

Science and our society can no longer tolerate the tired contention that "the statistics of small populations" is the operative reason for the slow advancement of women in science. Such language too often deflects action that would transform the academic culture to one that adapts to women.

If the observable is the absence of women from the applicant pool for science faculty, what is the mechanism?

In Cathy Trower's paraphrase of a 1990's political slogan: "It's the culture, stupid." Academic science still echoes the standards of David Noble's description of Western science: "*a world without women*" , one in which round-the-clock scholarship by men was historically sustained by an infrastructure first provided by monasteries and then by wives.

Most women in science do not have wives, and many men in science no longer have the traditional infrastructure either. The university, which should be the most flexible and advanced of workplaces, is unpleasantly out-of-phase with the modern world.

In the three years since I provocatively suggested applying Title IX to departments in the chemical sciences, I have heard from women and men across all the STEM disciplines saying that they, too, have the same problems we face in chemistry. It may be nice to have some company, but enough is enough. With nearly ten centuries of higher education, it is past time to diversify our university system beyond the operative one where the *de facto* hiring quota in science is 80-90% white men. Isn't a millennium of affirmative action for white men sufficient?

More to the point: Should scientists accept the male-dominant status quo of the modern university and laboratory? We have got to get out of our lily-white male universe if we want to stay at the forefront of science.

A leader, as opposed to a (minding-the-store) manager, would not stand still for less. Men, because they have been and predominantly still are the stewards and beneficiaries of the current system, have a moral responsibility to decide how to transform the institution and its culture.

But if sweet reason, historical perspective, and moral suasion were sufficient to alter the culture of science to one that fully incorporates the talent we train, I wouldn't be writing this article.

So, historically, how does one reform institutions that institutionalize injustice?

First option: complete demolition (see the French Revolution).

Second option: redirect the reward structure—do so and people change their behavior. The nominal demands for faculty success in STEM disciplines today require someone who must cover the CEO, COO, CFO, CTO, CIO, and human resources functions of a small company.

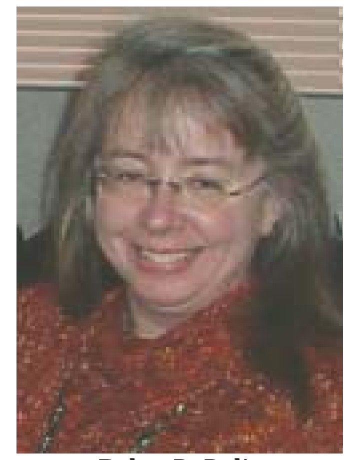
Our universities can never pay faculty commensurate with all those activities: it is past time to stop demanding so much of STEM faculty and return them to—and reward them for—the primary reason they are in academics: educating independent thinkers and critical scholars in pursuit of new knowledge.

Isn't a millennium of affirmative action for white men sufficient?

Third option: coercion. The possible loss of Federal R&D dollars as a consequence of Title IX assessments focuses the attention of the powers-that-be: administrators and those faculty most rewarded by the current system.

The environment in STEM departments is a multivariate problem; improving the environment will require more than one solution, even though Title IX is probably the biggest hammer we can take to it. But in the face of possible Title IX action, a wide range of transformational strategies immediately becomes more appealing.

If the case can be made that STEM departments merit application of Title IX, where does the fault lie? Not with the women, who did what was asked of them and stayed in the pipeline. Pumping more women with PhDs into the STEM professions was long thought to be the solution, but even a well-filled pipeline is only a necessary, not a sufficient condition for thriving careers.



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Because physics trails even mathematics with respect to the fraction of women achieving PhDs, we need to recognize that the problem lies with an environment and culture that do not appeal to women otherwise interested in science- and math-intensive studies, including how scientific arrogance and other solipsistic behaviors are over-rewarded by the existing culture.

The US Congress has noted with concern the increasing need for the US to import its scientific talent to satisfy the technological needs of our country and has tied that need to the inability of our educational system to attract the diverse American populace, including women, into scientific studies and careers.

The pre-9/11 findings of Phase III of the Hart-Rudman report on National Security/21st Century, which noted that it is a national imperative to maintain a high level of American expertise in science and technology, only amplified Congressional concerns on these matters after the 9/11 attacks.

In the October 2002 US Senate hearing on "Title IX and Science", Senator Ron Wyden (D-OR), then-chair of the Subcommittee on Science, Technology, and Space commented for the record: "It's time Congress quantified and qualified the realities facing women in the sciences. Only then can we find fully effective solutions." An outcome of this hearing was the addition of amendments to the bill authorizing appropriations for the National Science Foundation, which required the NSF to charge the National Academy of Sciences with examining gender differences on issues such as faculty hiring, promotion, tenure, and allocation of resources including laboratory space.

Such a study echoes the 1999 MIT report, which showed a pattern of gender discrimination among the faculty of the College of Science at MIT , and will provide the data to determine if comparable imbalances exist in our STEM departments—and Title IX permits the consideration of statistical evidence tending to show that imbalances exist. As a further outcome of this bill, the Academy will also examine gender differences in major Federal external grant programs.

In the meanwhile, activism that starts with the individual up to mechanisms to expand Title-IX-like actions (*e.g.*, withholding non-federally derived resources from poorly diversified departments) might rouse the stewards of the current STEM structures from their passivity.

As individuals, we can certainly start upending the myth of objectivity in evaluating merit. If women have to be more productive than men to be deemed comparably qualified, often at the expense of a far-greater expenditure of time and energy on family/home than a "comparable" man, all hiring, promotion, and award committees should reassess their standard perceptions of credentials/productivity in order to level the psychological playing field skewed by our gender schemas (culturally embedded unconscious biases and beliefs).

Let's "out" the toxic departments: create a guerilla web site that provides the statistics for the top tier of STEM graduate departments in order to get quantitative and qualitative information into the hands of the "consumer"— the undergraduate seniors and the faculty (primarily at four-year colleges) who advise them.

Undergraduates can then be encouraged to give diversified institutions their first attention when looking at graduate school.

Other practical goals to transform the culture and improve the environment for men and women include aggressively recruiting excellent female and under-represented minority candidates for faculty and staff openings, fairer evaluation of the contributions and productivity of candidates and faculty who are not white men, ensuring on-campus day care, career-long mentoring, and really rewarding the good teacher-scholars because of how they guide and challenge their students.

It is now time that women thrive, not just survive in their STEM career homes—especially in academia, our gateway to the future.

Debra R. Rolison is head of the Advanced Electrochemical Materials section at the Naval Research Laboratory in Washington, DC, and is also adjunct Professor of Chemistry at the University of Utah. The views herein are those of the author and do not represent official positions of the US Naval Research Laboratory or the US Department of Defense.

The author gave a talk on this topic at the APS March Meeting in a session sponsored by the Committee on the Status of Woman in Physics.

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.