APS NEWS

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

June 2007
Volume 16, No. 6
www.aps.org/publications/apsnews

APS physics

Our Siberian Correspondent
International News on page 4

Photo by Ken Cole

Alice Agogino of UC Berkeley addresses the opening session of the Gender Equity conference. (See story on the right.) There were 127 attendees at the conference, of whom 72 were male and 55 were female–closer to gender equality than in the larger physics community.

Gender Equity: No Silver Bullet but Lots of Ways to Help

Chairs of about 50 major research-oriented physics departments in the United States and managers of about 15 physics-related national laboratories met at the American Center for Physics May 6-8 for a conference entitled "Gender Equity: Strengthening the Physics Enterprise in Universities and National Laboratories."

The goal of the meeting, according to conference co-chair Nora Berrah of Western Michigan University, was to find ways to double the number of women in physics over the next 15 years. The gender equity conference was organized by APS with support from NSF and DOE.

Women now make up about 13% of physics faculty, but only 7.9% at top 50 research-oriented universities. Berrah pointed out that chemistry and astronomy have twice the percentage of women that physics has. "The gender gap is a serious concern. We should be talking advantage of the pool of talent," she said.

In the opening session, workshop co-chair Arthur Bienenstock of Stanford University said that given the current US demographics and increasing competition from other countries in science and technology, we need to increase the proportion of the US workforce engaged in science and technology. To do this, we must recruit more women to scientific careers. "If we fail to increase the participation of women we will see a steady decline in the fraction of the workforce in science and technology," he said.

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New Data Produce Radio Map of North Galactic Pole

Using combined data from the Arecibo telescope and the Dominion Radio Astrophysical Observatory, scientists have produced a new view of the universe above the north galactic pole.

The new map, which covers over 50 square degrees of sky, reveals several new features that haven't been seen before.

"You might have thought that the radio sky has been well imaged," said Philipp Kronberg, of Los Alamos National Lab, who led the research project. But in fact there are holes in our picture of the sky, he said.

The image, the researchers report, provides the first detailed view of foreground galactic and extragalactic features that might contribute to CMB backgrounds on scales to be imaged by the PLANCK cosmic microwave background explorer.

Kronberg and colleagues produced the image by combining data from Arecibo, the world's largest radio telescope, located in Puerto Rico, and the Dominion Radio Astrophysical Observatory in British Columbia, Canada. The DRAO is an array of 7 telescopes, each 9 meters across, in an east-west line. The telescopes shift along the line over twelve days in such a way that the combined data simulate a single 600 meter telescope.

The researchers chose the region of sky above the north galactic pole in order to be minimally affected by the Milky Way, said Kronberg. The new map's field of view is centered on the Coma cluster of galaxies.

They were looking for areas of faint, 0.4 GHz synchrotron emission at low surface brightness levels on angular scales from 3 minutes to 8 degrees. In producing the map, they subtracted out known point sources, cosmic microwave background radiation, and smooth Milky Way foreground.

They found several interesting features, which Kronberg reported at the April Meeting of APS.

For instance, they found no correlation between the faint radiation produced by particles accelerated in the magnetized plasma of space and the distribu-

NEW DATA continued on page 4

NSF's "Broader Impacts" Criterion Gets Mixed Reviews

Every scientist who submits a proposal to NSF must address both the intellectual merit and the "broader impacts" of the proposed research. The broader impacts requirement is supposed to promote education, outreach, and benefits to society, but some scientists view the criterion as confusing, burdensome, inappropriate, or counterproductive.

The broader impacts section of a proposal could include a description of how the researcher will promote teaching, training, and learning; broaden participation of underrepresented minorities; enhance infrastructure for research and education; disseminate results broadly; or benefit society.

Bob Eisenstein, Chair of APS's Panel on Public Affairs, was at NSF when the criterion was first put in place in the mid-1990s. He said that the criterion is meant to serve two purposes: first, it forces scientists to think more carefully about the ways in which their work impacts society, and second, it helps provide the public with more information about what scientists are doing.

Fred Cooper, a current NSF program director for theoretical physics, said his personal opinion is that this is a good thing for NSF to do. "I'm very happy to encourage people to think about these things," he said. He says it is in scientists' self-interest to do so.

However, some scientists ob-

NSF continued on page 6

Preliminary Results from Gravity Probe B Announced at April Meeting

The preliminary results from Gravity Probe B are in, providing further evidence in support of Einstein's theory of general relativity, according to Francis Everitt of Stanford University, the scientific overseer for the project. Everitt gave a broad overview of the space-based experiment during the first plenary lecture at the APS April Meeting in Jacksonville, Florida.

Gravity Probe B is an orbiting observatory dedicated to testing general relativity. Stanford officials call it "the most sophisticated orbiting laboratory ever created," but it is also possibly the longest-running, most expensive single experiment in history, experiencing numerous delays and a few unexpected complications in the data collection that made the subsequent analysis more difficult.

The measurement data indicate that general relativity correctly predicts the geodetic effect–how much the mass of Earth is warping local spacetime–to within around 1%. Once certain unanticipated torques on the gyroscopes are better understood, the GP-B scientists expect the precision of their geodetic measurement to improve to a level of 0.01%.

Still to come is the final analysis of the data on measuring the frame-dragging effect: whether or not, and by what degree, the Earth drags the fabric of spacetime with it as it rotates. However, Everitt, while cautious, is "optimistic" that they have caught "glimpses" of the frame-dragging effect.

That caution translates into another eight months of data analysis to account for the unexpected anomalies, but Everitt is confident that in the end, GP-B's results will mesh nicely with Einstein's prediction at the 1% level. (An earlier indirect measurement of frame-dragging by the LAGEOS satellite had a 10-15% uncertainty.)

There is little doubt about the confirmation of the geodetic effect, according to Everitt: "[It] is clearly seen even in the unprocessed sci-

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April Meeting Prize and Award Recipients

Photo by Ken McCray

Seated (l to r): Bruce Winstein, Amy Barger, Kathryn Miknaitis, Magdalena Djordjevic, Gabriela Gonzalez, Stuart J. Freedman. Standing (l to r): Ronald Drever, Stanley Brodsky, Matthew Bunn, Heinrich Wahl, Italo Mannelli, Joseph Polchinski, Juan Maldacena, David Kestenbaum.

Members in the Media

"The hype is bigger because the physics is richer."

Carlo Beenakker*, Leiden University, on graphene,* The New York Times*, April 10, 2007*

"I guess you could say we're now living on borrowed time. All we need to keep going is maybe $20,000, but nobody seems that interested in funding this project."

John Cramer*, University of Washington, on a time travel experiment for which he can't get funding,* Seattle Post Intelligencer*, April 8, 2007*

"What drives me is seeing below the surface, seeing what is happening in there."

Daniel Rugar*, IBM, on a new technique combining magnetic resonance imaging and atomic force microscopy,* USA Today*, April 29, 2007*

"I became the country's leading tennis technologist, mostly because I was the only one doing it."

Howard Brody*, University of Pennsylvania, on studying the science of tennis,* The Jewish Exponent*, May 3, 2007*

"It's really the worst. We are half the percentage for chemistry or even astronomy."

Nora Berrah*, Western Michigan University, on the low number of women in physics,* Marketplace*, May 4, 2007*

"It sounded pretty terrible."

Larry Slifkin*, University of North Carolina, on picking up the trumpet again after his days as an Army bugler in WWII,* The News & Observer*, May 7, 2007*

"It is inevitable I bring these issues to court because there is no other way. That is the American way."

Ruggero Santilli*, On lawsuits he has filed alleging that other scientists plagiarized his work,* St. Petersburg Times*, May 9, 2007*

"She asked me do I work here and what I do here. 'I'm a physicist,' I told her."

John Krizmanic*, NASA, on meeting Queen Elizabeth,* Washington Post *May 9, 2007*

"I'm just a physicist."

Martha Elizabeth Baylor*, University of Colorado, on being the first black woman to get a PhD in physics at Colorado,* Denver Post*, April 22, 2007*

"When I try to help my daughter, she complains, 'But the teacher doesn't do it that way.'"

William Christie*, Brookhaven National Lab, on trying to tutor his daughter in physics,* The New York Times*, May 6, 2007*

"They're thinking of a world without air ... but air resistance is a big deal for little things. It slows down leaves, it slows down raindrops and it slows down pennies."

Lou Bloomfield*, University of Virginia, on the myth that pennies thrown from the tops of buildings could kill pedestrians below, ABC News, May 3, 2007*

"It's an extremely efficient way to reduce air pollution."

Thomas Cahill*, UC Davis, on studies showing that redwood trees remove tailpipe exhaust particles from the air,* Sacramento Bee*, May 8, 2007*

"The trash compactors have a public outreach value. Something high-profile that's sustainable makes a statement."

David Tanenbaum*, Pomona College, on new solar-powered trash compactors in Palm Springs,* The Press-Enterprise*, May 6, 2007*

"God is the cosmological singularity. I am not being blasphemous. I'm just following in the ancient tradition in saying that science puts the tenets of religion up to the experimental test, and we find that god exists."

Frank Tipler*, Tulane University, CBS11 TV, May 9, 2007*

"There is a sense among many experimentalists that theorists are a bunch of irresponsible little spoiled brats who get to sit around all day, having all these fun ideas, drinking espresso and goofing off, with next to no accountability."

Nima Arkani-Hamed*, Harvard University,* The New Yorker*, May 14, 2007*

"When I asked them to apply their knowledge in a situation they had not seen before, they failed. You have to be able to tackle the new and unfamiliar, not just the familiar, in everything. We have to give the students the skills to solve such problems. That's the goal of education."

Eric Mazur*, Harvard University, on why he switched from giving lectures to having students work in small groups in introductory physics classes,* The New York Times*, May 10, 2007*

This Month in Physics History

June 1876: Edward Bouchet becomes the first African American PhD in physics

In 1876 Edward Alexander Bouchet made history by becoming the first African American PhD physicist, and the sixth person of any race to receive a PhD in physics from an American university. Bouchet went on to educate and inspire others as a science teacher at a school for black students.

Edward Bouchet was born in September 1852, in New Haven, Connecticut. His father, a freed slave, worked as an unskilled laborer, like many black men in the town. His mother was a housewife, and he had three older sisters. The Bouchet family was active with their local church and the local abolitionist movement, and encouraged all the children to get an education.

The local public schools were segregated, so in elementary school Edward Bouchet attended the Artisan Street Colored School, which had 30 students of all grade levels, and one teacher. In 1868 he gained admittance to Hopkins Grammar School, a prestigious private preparatory school that sent its graduates to Yale College. At Hopkins Grammar School he received a classical education, studying Latin and Greek as well as geometry, algebra and history. Bouchet graduated first in his class in 1870.

He entered Yale in the fall of that year. Bouchet was not the first black student to enter Yale, but he was the first to graduate. He lived at home during his time at Yale, and was clearly devoted to his studies. In June 1874, he graduated sixth in a class of 124 students. He was the first black person to be nominated to Phi Beta Kappa.

As a talented young black man interested in science, Bouchet had come to the attention of Alfred Cope, a philanthropist in Philadelphia who was on the board of managers for the Institute for Colored Youth. The ICY was one of the few places in the city where black students could get an academic high school education. Cope wanted to build up the science program there, and hoped to bring Bouchet onto the staff.

But before recruiting him as a teacher, Cope encouraged Bouchet to continue his studies, and paid for his graduate education at Yale. Edward Bouchet spent two more years there, completing further studies in chemistry, mineralogy, and physics. His primary professor was Arthur Wright, who in 1861 had become the first person to earn a doctorate in physics from an American university. Bouchet's original research focused on geometrical optics, and he wrote a dissertation entitled "On Measuring Refractive Indices." Just two years after completing undergraduate studies, Bouchet became the first black person to earn a PhD in physics.

A white person with Bouchet's credentials would have been able to obtain a university position, but even with his impressive accomplishments, not many career options were open to him as an African American. So in the fall of 1876 Bouchet went to teach at the Institute for Colored Youth, as Cope had wanted.

At ICY, Bouchet headed the school's new science program. In addition to physics and chemistry, Bouchet taught classes in astronomy, physical geography, and physiology. An advocate for improving science education, Bouchet repeatedly asked the school's board of managers to provide laboratory space for students to perform individual experiments. In addition to his regular teaching, Bouchet gave lectures on various scientific topics for students and staff, and even reached out to the wider community by giving public lectures on science.

Bouchet taught at the ICY for 26 years. However, by around 1900, many black young people were being pushed into vocational and technical training, rather than academic education. Even black leaders, including Booker T. Washington, advocated for this approach, arguing that this type of education was what suited black people best. Bouchet's accomplishments clearly showed that black people were capable of academic and scientific pursuits, but in 1902 the ICY managers decided that the school would give up academic subjects and shift its focus to industrial education. Bouchet lost his job.

Bouchet spent the next several years in several different teaching positions around the country. In 1916, Bouchet returned home to New Haven in poor health, and died in 1918 at age 66. He was survived by his mother, who died two years later at age 102.

As a black man in a segregated society, Bouchet surely faced many challenges, but he didn't leave behind many letters or notebooks, so we know little today about his thoughts on his career or his daily life. A friend of his wrote in an obituary that Bouchet was "a man of keen sensibilities and unusual refinement. He was a prolific reader and was greatly interested in the history of his own people and of his native town."

Bouchet never married or had children. He was a member of the Franklin Institute and the American Academy of Political and Social Science and was active in the NAACP.

Over his career in teaching, Bouchet had educated many black youth in science, but black people were still excluded from most scientific education and careers for many years. It was not until 1918, the year Bouchet died, and 42 years after he received his PhD, that Elmer Imes became the second African American to receive a PhD in physics.

Further reading: Ronald E. Mickens, ed., Edward Bouchet, The First African-American Doctorate*, World Scientific Publishing Company (2002).*

APS NEWS

Series II, Vol. 16, No.6
June 2007

Coden: ANWSEN ISSN: 1058-8132

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

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

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

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

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Washington Dispatch

A bimonthly update from the APS Office of Public Affairs

ISSUE: Science Research Budgets

Congress has begun consideration of the President's Budget Request for Fiscal Year 2008, which begins October 1. While no appropriations bills have been marked up as of press time, the House and Senate have sent positive signals for science research funding through their respective Budget Resolutions.

The Budget Resolution, which sets non-binding spending goals and contains a cap for federal discretionary spending, provided funding for the $1.2 billion in increases requested by the President for the Department of Energy Office of Science, the National Science Foundation, and the National Institute of Standards and Technology. It provided an additional $450 million for scientific research and education. The "Sense of the House" section of the Resolution states that the "resolution will put us on the path toward doubling funding for the National Science Foundation, basic research in the physical sciences across all agencies, and collaborative research partnerships; and toward achieving energy independence through the development of clean and sustainable alternative energy technologies."

In its original form, the Senate Budget Resolution did not provide sufficient funding for the President's requested increases for DOE Science, NSF, and the NIST Labs. Senators Bingaman (D-NM) and Alexander (R-TN) offered an amendment to provide an addition $1 billion for the requested increases and other science and math education and research measures. The amendment passed overwhelmingly by a 97-1 vote. Conferees are reconciling the differences between the House and Senate resolutions.

The House began marking up its appropriations bills in May; the Senate will do so in June. See http://www.aaas.org/spp/rd/fy08.htm to track the progress.

ISSUE: Nuclear Forensics Study

The APS Panel on Public Affairs and the AAAS have established a study group on nuclear forensics technology and techniques. The chair is Michael May, Emeritus Director of Lawrence Livermore National Lab and Professor Emeritus at Stanford University. Other members of the group include Al Carnesale, Phil Coyle, Jay Davis, Bill Dorland, Bill Dunlop, Steve Fetter, Alex Glaser, Ian Hutcheon, Don Kerr, Francis Slakey, & Benn Tannenbaum. The first panel meeting will be held this summer, with the report scheduled to be completed early next year.

ISSUE: Nuclear Workforce Study

The APS Panel on Public Affairs has established a study group to examine the status of the United States Nuclear Workforce. Sekazi Mtingwa, from MIT, will chair the study. Other members of the group include Ruth Howes, William Magwood, Darlene Hoffman, Andrew Klein, Lynne Fairobent, Allen Sessoms, Marc Ross, and Carol Berrigan. The first panel meeting is scheduled to be held this summer, with site visits planned for August and September. A report is slated to be completed early next year.

ISSUE: Science Education and School Boards

Congressional and Executive Branch Science Fellows will have the opportunity to attend a workshop on how to get involved with school boards, July 16th at the AAAS. The workshop will provide materials on how school boards function, how members are elected or selected, and how scientists can become effective participants. Those interested in attending the workshop should contact Francis Slakey at slakey@aps.org.

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

APS and Yale Honor J. Willard Gibbs

Photo by Michael Marsland/Yale University Office of Public Affairs

J. Willard Gibbs served as Professor of Mathematical Physics at Yale from 1871 until his death in 1903, during which time he made fundamental contributions to thermodynamics and statistical mechanics. To honor Gibbs, Yale was among the original set of physics historic sites chosen by the APS Historic Sites Committee in 2005. For scheduling reasons, however, the plaque presentation ceremony was not held until this year. On April 20, members of the Yale Physics department and guests gathered in Sloane Physics Laboratory to celebrate the occasion. Standing, left to right, are Yale Physics Chair R. Shankar, APS Editor-in-Chief Gene Sprouse, and Yale Provost Andrew D. Hamilton, who is explaining the impact that Gibbs had on Yale and on science. Listening intently are the Chair of the APS Historic Sites Committee, John Rigden (seated at left) and J. Willard Gibbs himself (perched on the easel). After the ceremony, the audience was treated to a lecture on Gibbs by Yale historian of science emeritus Martin J. Klein, the first recipient of the APS Pais Prize for history of physics.

Efficiency is Key to Resolution of Energy Crisis

While many energy discussions focus on finding new sources of energy, a lot can be done to use the energy we have more efficiently, said speakers in an April Meeting session. In many cases, more efficient technology is already available and cost-effective.

Amory Lovins, an energy expert and founder of the Rocky Mountain Institute, described several existing efficient technologies. We could save billions of dollars per year by investing in these technologies, he said. In fact, it would cost less to use efficient technology to save energy than to produce and deliver energy, he said.

Vehicles use 70% of US oil, said Lovins. New advanced ultralight materials such as carbon fiber thermoplastic composites that are already available could lead to significantly more efficient automobiles. If manufacturers built cars out of such materials, said Lovins, you could have an ultra-light hybrid SUV that gets 67 miles per gallon. The car would be as big, comfortable, and safe as today's SUVs. Such a car would not cost much more to produce, and would pay for itself in saved oil in less than two years, he said. "Think of this as finding a Saudi Arabia under Detroit," said Lovins in a press conference at the April Meeting.

A similar revolution is going on in electricity generation, he said. Clean, small, "micropower" plants were already generating a sixth of the world's electricity in 2005, and are set to provide an even greater proportion of our electricity supply. "The revolution already happened, sorry if you missed it," said Lovins. These small, low-carbon decentralized generating plants involve less financial risk than large central thermal power stations, and can be financed mainly by private investment.

Another speaker in the session, Leon Glicksman of MIT, said that more efficient buildings could save significant amounts of energy. Buildings use almost 40% of the country's energy, and about two-thirds of the electricity. In fact, given how much energy is used indoors, buildings probably have more of an impact than transportation, said Glicksman.

Many discussions about energy issues focus on the supply side, but we need to have a more balanced approach, devoting more effort to saving energy and using it efficiently, he said.

Glicksman has worked on ways to design buildings that are more efficient. Buildings usually last a long time and are difficult to retrofit, so it's important to build them efficiently, he said.

Design techniques already exist to save a lot of energy, he said. For instance, buildings with natural ventilation use about half as much energy. Houses can be designed so that they don't need central heating systems, even in cold climates. And scientists have developed a design that collects sunlight and transmits it farther into a room, lighting up areas that would otherwise be dark without electric lights, resulting in significant electricity savings, Glicksman said.

From an economic standpoint, it makes sense to build efficient buildings, he said. But builders don't have an incentive to do so because they don't pay the energy bills, and consumers don't know enough about energy efficiency.

Glicksman said that architects have to be trained to design more efficient structures. To help them, he and colleagues have developed a computer program that simulates the heating, lighting, and cooling requirements for a given building design.

In addition to building new structures that are more energy efficient, sometimes simple fixes can save a lot of energy in existing buildings, said Glicksman. For instance, they found that at MIT about half of the fume hoods in the chemistry building were being left open at night, which wasted a lot of energy.

Energy efficient buildings and other ways of saving energy are available, Glicksman said. "It's really a question of getting people to use these things."

JLab Experiment Pins Down π^0 Lifetime

A new measurement of the lifetime of the neutral pion is twice as precise as previous measurements, researchers from the PrimEx collaboration reported at the APS April Meeting.

The result agrees with previous measurements and confirms our understanding of fundamental symmetry breaking, said PrimEx collaboration spokesman Ashot Gasparian of North Carolina A&T State University.

The new result is the most precise measurement of the neutral pion lifetime to date. The experiment was carried out at the Thomas Jefferson National Accelerator Facility by the PrimEx collaboration, a group of over 70 researchers from 21 institutions.

The new mean lifetime value, about 82 attoseconds, is more than twice as precise as previous measurements, Gasparian said.

The neutral pion, the lightest quark-anti-quark meson, is made up of a superposition an up, anti-up pair and a down, anti-down pair.

The lifetime of the chargeless pion is one of the few quantities that can be calculated directly from QCD, said PrimEx collaboration member Liping Gan of the University of North Carolina, Wilmington.

Lawrence Cardman, Jefferson Lab's Associate Director for Experimental Nuclear Physics commented that the neutral pion is a simple system that provides a good test of fundamental theory. He called the system the "positronium of QCD."

The JLab experiment produces pions using the Primakoff effect. In this effect, a beam of photons is aimed at a target nucleus. The nucleus generates a cloud of virtual photons, one of which interacts with a photon from the beam to produce a neutral pion.

The pion then quickly decays back into two photons. Using a sensitive calorimeter, the researchers detected the energy and position of both of these decay photons. They used these measurements to calculate the pion's lifetime.

The PrimEx collaboration came up with a mean value of (8.2 ±0.24) x 10^{-17} s. The Particle Data Group's Particle Physics Booklet's value, based on the average of several previous experiments, is (8.4 ±0.6) x10^{-17}s.

The PrimEx group was able to obtain a more precise measurement than previous Primakoff experiments because the photon beam is tagged so that the number and energy of photons aimed at the target nucleus can be tracked, and the decay photons are measured by an advanced hybrid calorimeter.

More data from the PrimEx experiment remains to be analyzed, and the collaboration expects to announce an even more precise value for the neutral pion lifetime after completing that analysis.

Letters

Can Simulations Really Teach Physics?

I want to comment on the letter "Simulations Teach Real Physics" in the April 07 *APS News* by Henderson Cole, and the Viewpoint by Alan Chodos in the February 07 *APS News*. The former states that "events in a real laboratory happen too fast to observe the physics," so it is better to learn by using a physics simulation software package, and watch it in slow motion. He specifically mentioned measuring the gravitational acceleration constant g.

About 55 years ago, my high school physics teacher devised an experiment to measure g using a ball bearing slowly rolling down an improvised inclined plane (a 16-foot section of half-round rain gutter dusted with flour to show the oscillating trajectory). Measurements gave a value of g that was about 30% too low. More precise measurements confirmed this low value. My teacher and I decided that perhaps the "inertia" of the rolling ball bearing slowed it down. I found a college calculus book in the school library, and after about a week of intense study, learned enough math to understand and calculate the rotational inertia of the ball bearing, and get the accepted value of g. The enjoyment was in the quest for the answer, not learning it in a simulation. How can one appreciate a lab on electricity without recalling the acrid smell of an overheated Allen-Bradley resistor, or the sweet aroma of ozone from sparks.

Doing physics lab experiments using canned software simulations is about as exciting as picking up a crossword puzzle, only to find that the answers have already been penciled in. The virtue of using virtual experiments as a teaching tool in high schools should be limited to comparing the measured results to the expected results, not as a substitute for real physics. Teaching the fundamental laws of physics in high schools requires observation and measurement before simulation. Watching a current-carrying wire move in a magnetic field is more instructive than just plugging the current and field values into a simulation of the Lorentz Force Law. Can a force really be perpendicular to both the current and the magnetic field? Seeing it is better than reading about it. Doing it is even better. I recently gave small battery-powered DC electric motor kits to every student in the AP physics class at my former high school. I can understand why students who learn (memorize?) physics using virtual physics experiments might perform better on AP physics tests. And I can understand the inherent danger in exposing some students to electricity in the lab (These are often the same ones who never learn AAA (Always Add Acid) in the chemistry lab). But the original basis for physics was to explain real world phenomena using tools such as mathematics and reasoning. Viewing virtual experiments on a computer is no substitute for doing the real thing, even if the equipment has to be improvised.

Robert Shafer
Los Alamos, NM

First Morehouse Physics Prize Goes to Byron Freelon

APS member Byron Freelon has been awarded the first Morehouse Physics Prize, which recognizes graduates of historically black colleges and universities who have shown considerable promise as physics researchers and teachers. The prize includes a cash award and a travel grant to give a colloquium at Morehouse College.

The National Society of Black Physicists established the Morehouse Physics Prize through a financial gift by Walter and Shirley Massey. Walter Massey is the president of Morehouse College.

Freelon accepted the award at Morehouse College on April 5 and gave a talk entitled "Probing High-Temperature Superconductors with Layers and Light."

Freelon attended Prairie View A&M University in Texas, and received a PhD in physics from the University of Minnesota in 2001. He worked as a postdoc at Lawrence Berkeley National Laboratory, where he developed a beam-line-based molecular beam epitaxy system at the Advanced Light Source. Freelon is now a research scientist at the University of California Berkeley in the group of UC Berkeley Chancellor Robert Birgeneau. Freelon is interested in various synchrotron techniques to study high-temperature superconductors and soft-matter systems. In addition to synchrotron techniques, he is working on inelastic neutron scattering. Freelon is also leading an international collaboration to develop a pulsed-laser deposition facility at the Advanced Light Source synchrotron. He is a member of the APS committee on careers.

"I attempt to dedicate every day to doing physics and thinking about the status of blacks who do physics. It is deeply meaningful to be honored by an organization dedicated to these same concerns," said Freelon.

Correction

The institutional affiliation of Geraldo A. Barbosa, the author of the International News column in the April *APS News*, was listed incorrectly. His correct title is Adjunct Professor in the Department of Electrical Engineering and Computer Science at Northwestern University. We thank David E. Taylor for bringing this to our attention.

INTERNATIONAL News

...from the APS Office of International Affairs

A Report from Siberia

By Kyler Kuehn

Editor's Note: *While many senior US scientists have cultivated a variety of international contacts, younger scientists may not have yet had the opportunity to integrate such experiences into their professional or personal lives. There follows the account of one early-career scientist, detailing his observations as a researcher in a location far removed from the experience of most physics students.*

In December of 1998, upon completing my Bachelor's Degree in Physics, I began a 3-month volunteer research position at the Hydrodynamics Institute of the Siberian Branch of the Russian Academy of Sciences in Akademgorodok, Russia. My research collaborators and I performed calculations designed to predict the effects of shock waves from stellar explosions on the star formation rate in spiral galaxies. This research culminated in a presentation of our findings at an international astronomy conference the following year.

While these are the basic facts of my professional accomplishments during my time in Russia, there was so much more that I learned beyond simply the results of a single research project. In particular, the relationships I forged with the people there have been of much greater significance to me as I continue on in my scientific career and in my everyday life.

Of the many opportunities that I had to learn from interactions with my friends and colleagues there, the myriad cultural differences between Russia and the US were often the most striking experiences for me. For example, many scientists in the US take for granted the ability to communicate their research findings to their peers, and to be able to understand the communication of others. That was not necessarily the case with all of the researchers in Siberia. While every one of them had some formal training in English, I was the only native speaker in the research group–perhaps in the entire Institute. One of the most valuable ways that I was able to contribute to the Institute's work was simply by assisting in the translation and editing of papers to be submitted to English-language scientific journals, so that they would have a much quicker review process and a greater chance of being accepted for publication.

In addition to the crucial role that effective communication plays in the success of the scientific enterprise, another important value I experienced was the sense of camaraderie among the researchers. They were even willing to incorporate a young, foreign man barely out of college into the life of their community. Upon the completion of a successful run of our computer simulation, the researchers with whom I worked would invariably pause to celebrate, and invite everyone nearby to join them for a tea break. Throughout my stay there, I was likewise treated as a colleague even by researchers outside our group and outside our particular Institute. I was able to learn first-hand about the numerous other experiments being performed there, and to tour a significant number of laboratory facilities. "Rank" or "prestige" did not seem to be of paramount importance; we were all simply scientists working together to expand our knowledge. One of my favorite experiences in Akademgorodok was being given a tour of the particle accelerator at the Nuclear Physics Institute by one of the senior scientists at the facility (I later learned that what had previously seemed to be a random and unexplained dimming of lights throughout the town was caused by the particle accelerator being turned on).

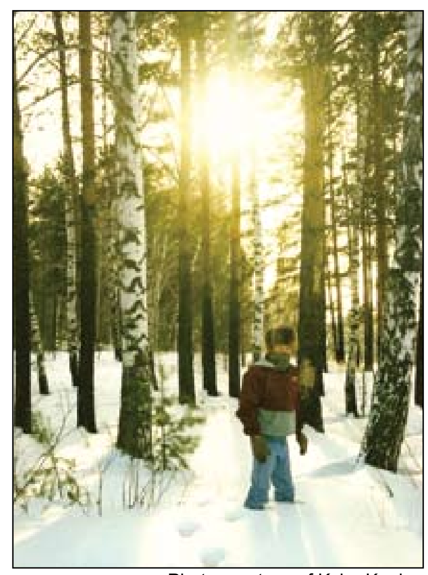

Photo courtesy of Kyler Kuehn

Pictured here in wintry Siberia, Kyler Kuehn is now a PhD candidate at the University of California, Irvine. He also serves as the International Student Affairs Officer for the APS Forum on Graduate Student Affairs.

Outside of the Institute, I also experienced the welcoming spirit of the entire community of Akademgorodok. Families opened their homes to me, inviting me to participate in various festivities, including various birthdays, New Year's Day, and Christmas–which is celebrated not on December 25th, as in the west, but on January 7th, in keeping with the Eastern Orthodox calendar. The cultural center of Akademgorodok was known as "The House of Scientists", where I was able to attend symphony orchestra performances and engage in other aspects of the social life of the town. In particular, I was quite popular with the "English Club" that met at the House of Scientists, whose members were anxious to practice their English with me and to learn as much as they could about life in the US. Furthermore, I distinctly remember the selfless work of the members of some of the local churches, where I also assisted in the efforts to teach English language courses and to provide humanitarian aid to hospitals, schools, and prisons throughout the region.

The results of the research that I performed in Russia have been superseded in the intervening years, and the focus of my scientific career has changed significantly, but the experiences I had in Akademgorodok have stayed with me ever since I returned in February of 1999. I have not forgotten the quite beautiful daily walks through knee-deep snow in -40 degree weather (where the Fahrenheit and Celsius scales coincide) to reach the offices of the Institute. I remember the occasional signs of significant economic hardship in the region, such as when the local grocery store ran out of the vast majority of its products and was unable to restock. Even more so I remember how patient and adaptable the community was in the face of such hardship. I recall with amazement the accomplishments of my research group, despite the fact that we all relied upon a single 286 computer that almost certainly would have been discarded as obsolete in the US. But mostly I remember the opportunities afforded to me to learn important new skills, to gain exposure to some of the diverse members of the international scientific community, and to learn about the goals, ideals, and lives of fellow scientists in a part of the world that so few people from the US are able to see.

NEW DATA continued from page 1

tion of bright stars and galaxies.

"We see signals all over this piece of sky," said Kronberg in a press conference at the April Meeting. There are some patches of what is probably Milky Way foreground throughout much of the mapped area, though the new view identifies some areas that are relatively foreground-free. The Planck CMB explorer, which will be launched later this year, might want to concentrate on those spots, suggested Kronberg.

The new map revealed a large (about 9 million light years across) region of magnetized plasma near the Coma cluster, probably at the distance of the Great Wall of galaxies. The magnetic field is about 0.3 micro gauss, about 1/10th the strength of the Milky Way's magnetic field. How that field is generated and maintained is not known, he said. This is the first known large diffuse patch that's not associated with any galaxy, said Kronberg.

They found another large diffuse source. This feature, which has never been seen before, could be a giant radio galaxy that had not previously been observed because it was obscured by other nearby sources of radio waves, said Kronberg.

A Leading Lederman in Industry

By Alaina G. Levine

***Editor's Note:** This is the second in a series of articles profiling people trained in physics who have gone on to make their mark in a variety of careers. The first article appeared in the April* APS News.

Looking back on a successful and intellectually-stimulating career in research management and technology development spanning more than 30 years, Frank Lederman, former chief technology officer and vice president of Alcoa, doesn't question his decision to choose industry over academia. "After all," he chortles, "another Lederman won the Nobel Prize in my field." He and famed Fermilab physicist Leon Lederman are not related and have never met. But the non-collision of Leon and Frank never deterred the latter Lederman from pursuing his great love of physics.

Yet, when he graduated with his PhD in both theoretical and experimental solid state physics (he had two thesis advisors) from the University of Illinois at Urbana-Champaign in 1975, the future did not look so rosy.

"There were only four or five jobs in industry for physicists," says Frank. "I assumed I would end up in academia, but I was lucky enough to get the chance to interview with industry as well."

Although he liked both, Frank became more intrigued with industry. "The environment I saw was fast-paced and exciting," he recalls. "Many of my interview discussions were interrupted with colleagues bringing new results or theories. They were working on real-world, practical problems, but with plenty of hard science."

He had applied to General Electric, and they wrote to him that there were no positions available. Some time later, they invited him back for an interview and again told him at the start of the visit that there was no job for him. "But they must have liked what they saw," says Frank, "because they called a week later with an offer. My new boss, also a physicist, said that he found room for me, thanks to his losing a government contract."

Frank started at GE as a physicist where he conducted research in different subjects, including ultrasonic imaging. In fact, he was one of the designers of GE's first medical ultrasonic systems. He found his work fascinating, with great physics content to it, and within a year, Frank was given the opportunity to coordinate a large study for the group vice president, who at the time was Jack Welch. The chance to play such a role so fresh out of school was "very unusual," recalls Frank. Management must have seen something in him.

As an outcome of the study, a multi-million dollar project was formed, and Frank took a leadership role. It was his "character to be in the center of the project," he says. Essentially, Frank was systems engineer for the project. "It was my job to make sure the whole thing was successful, with all the pieces working together."

This melding of physics and management suited him well. "I had to play the role of the honeybee going from flower to flower cross-pollinating ideas," Frank recalls. "I like working at the interfaces where things come together, so it is natural for me to gravitate to this kind of work."

Like any good physicist, Frank excelled in observation, data collection, decision-making, and problem-solving. And so it was that in observing a colleague's frustrated attempts to lead, Frank decided that a managerial career was right for him. "I went into management, partly because I didn't want this guy to control my destiny; I wanted to do that myself," he says.

He was eventually promoted, and Frank's interests and skills made him an excellent leader at GE. He had a passion for pursuing the best solution for a problem. "It means change, often when others are most resistant to it," he says. "But that's what leaders do; they make changes. I remember one thesis advisor telling me that you can't change the course of a river by paddling downstream."

"Change" certainly describes Frank's career. GE gave him lots of opportunities, and he had eight different jobs for the 12 years of his tenure. The longer he remained in industry, the more he realized this was where he wanted to stay. But he was still occasionally tempted by the sirens of academic physics. In one example, while working on the ultrasound projects, he was offered the opportunity to collaborate with a certain medical doctor and write a review article on the science of ultrasound technology. His alternative choice was to be promoted to a higher position at the company. He chose the latter, even though it took him away from ultrasound, which is now a billion dollar business for GE.

In 1988, Frank left GE for Canada-based Noranda, where he was Senior Vice President of Technology, and then for Alcoa, the world's leading producer of aluminum and its products, where he served as the Vice President and Chief Technical Officer for six years.

Frank asserts his physics PhD was always an asset and never a liability. When you head a research group, he says, "a PhD gives you credibility with recruiting, with directing research, and with government and universities, especially when getting funding."

And as a manager in industry, expertise in physics is almost a strategic necessity. "A physics background gives you experience in taking big complex problems and breaking them down into bite-size pieces. And you have to recognize what you have done already," Frank says. "You need to look at the toughest parts of a project first, to see if it can be done. Physics is outstanding for that. It is systems thinking."

As CTO, Frank was accountable for the "technical health" of the company. He was responsible for research, development, and engineering at the corporate laboratories and at the business units, which oversaw product lines. His job was to ensure that the technological strategy and the technology of the company's products and processes were all running smoothly.

For a physicist, the job was a blast. "Physicists deal with a broad range of technologies, including biotechnology, nanotechnology, metallurgy, etc., so physics is the perfect platform for designing and leading a company's technological strategy," says Frank.

As a member of Alcoa's executive team, Frank participated in the business decisions of the company. Again, his physics came in handy, as it taught him what questions to ask in order to identify the underlying problem driving a particular situation.

His greatest moment of satisfaction as CTO came when he convinced the CEO and key business managers that they had to play a bigger role in deciding which technologies get pursued and how they are managed. The technologies ranged from the design of alloys for an airplane wing to "enabling technologies" such as the physical chemistry behind production processes.

"We formed a 'virtual technology organization'" Frank recalls, "I gave up a lot of direct control over people, and I think I was respected for putting the company first, with a structure that is more global for a global company."

Although he is retired, Frank Lederman still stays involved in technology management as a member of the Board of Directors of Cray Inc. (a global supercomputer leader), and as an emeritus member of the Industrial Research Institute, which consists of past and present CTOs. He also volunteers his time on several university advisory boards.

For students and colleagues interested in a career in technology management, the physicist suggests "getting exposure to a lot of different things, and developing a vision for using your unique abilities to follow your passion." And the quintessential academic subject upon which to build a triumphant technology management career? There's no question, Frank says. "Physics is the right science. I wouldn't pick another."

MiniBooNE Results Inconsistent with Existence of "Sterile" Neutrino

One neutrino anomaly has been resolved while another has sprung up, according to results from the MiniBooNE experiment at Fermilab. The results were officially announced the week before the APS April Meeting in Jacksonville, Florida, and there were several papers on the topic presented at the conference.

MiniBooNE is short for Mini Booster Neutrino Experiment, an international collaboration involving 77 physicists from 17 different institutions in the US and the United Kingdom. Its much-anticipated findings indicate that only three low-mass neutrino species exist: electron, muon and tau neutrinos. This in turn seems to rule out two-way neutrino oscillations involving a hypothetical fourth species of low-mass neutrino.

Several experiments had previously shown that neutrinos regularly transform from one species to another. Oscillating neutrinos are comprised of three different waves that combine in different ways as they travel through space. Small physical differences in mass lead to telltale interference effects. If, indeed, neutrinos oscillate–as seems to be the case per experimental results from Japan's Super-Kamiokande collaboration announced in 1998–then they are not the massless particles assumed by the Standard Model.

About 10 years ago, the Liquid Scintillator Neutrino Detector (LSND) experiment at Los Alamos National Laboratory threw an unexpected wrinkle into the mix: the possibility of a fourth "sterile" neutrino that would only interact through gravity. The level of observed oscillations suggested very different values for neutrino masses than those inferred from prior studies of solar neutrinos and other accelerator-based experiments. MiniBooNE was conceived to test the results of the LSND experiment.

For the experiment, protons from Fermilab's booster accelerator smashed into a fixed target, creating a swarm of mesons, which very quickly decayed into secondary particles, including many muon neutrinos. The MiniBooNE detector was placed 500 meters away. Although muon neutrinos might oscillate into electron neutrinos, over the short run from the fixed target to the detector, the scientists expected very few oscillations to occur.

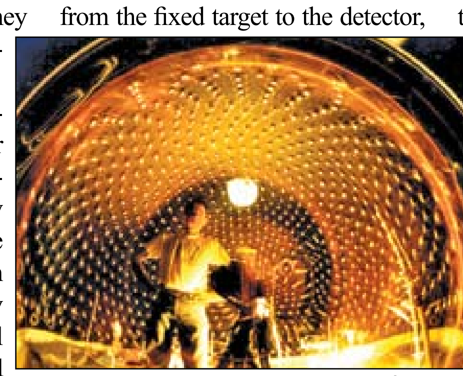

Image courtesy of Fermilab

Photodetector array

The LSND and Fermilab detector both looked for electron neutrinos. Fermilab tried to approximate the same ratio of source-detector distance to neutrino energy, thereby setting the amount of likely oscillation. LSND used 30 MeV neutrinos observed after a 30-meter distance, while the earlier Fermilab experiment used 500 MeV neutrinos detected after a distance of 500 meters.

The trick is to discriminate between the few rare events in which an electron neutrino strikes a neutron in a huge bath of mineral oil, thereby creating a telltale signature–an electron plus a slow-moving proton–and the much more common event in which a muon neutrino strikes a proton to make a muon and a proton. LSND saw a small but statistically significant (the team argued) number of electron neutrino events.

According to Heather Ray of Los Alamos, when analyzing MiniBooNE's data, they took a "blind box" approach, meaning that as they were collecting the neutrino data, they didn't even look at any of the data in the region of interest: the region where they would expect to see the same signature of oscillations as LSND. They didn't "unblind" the data and open the box until three weeks before the official announcement.

Upon doing so, they found no telltale oscillation signature, contradicting the LSND findings from 1995. So MiniBooNE's results rule out a fourth sterile neutrino, thereby verifying the current Standard Model with its three low-mass neutrino species.

However, a new anomaly presented itself. There were some electron neutrino events detected at low neutrino energies, and this tiny subset of data remains a mystery. More experiments are planned to explore this anomaly, this time using a beam of anti-neutrinos.

Project spokesperson Janet Conrad (Columbia University) said that the MiniBooNE data are robust and that, while some new physical effect cannot be ruled out, the low energy data do not undo the new assertion that the earlier LSND results cannot be explained by the existence of a fourth neutrino type.

My Heart Belongs to Gravity

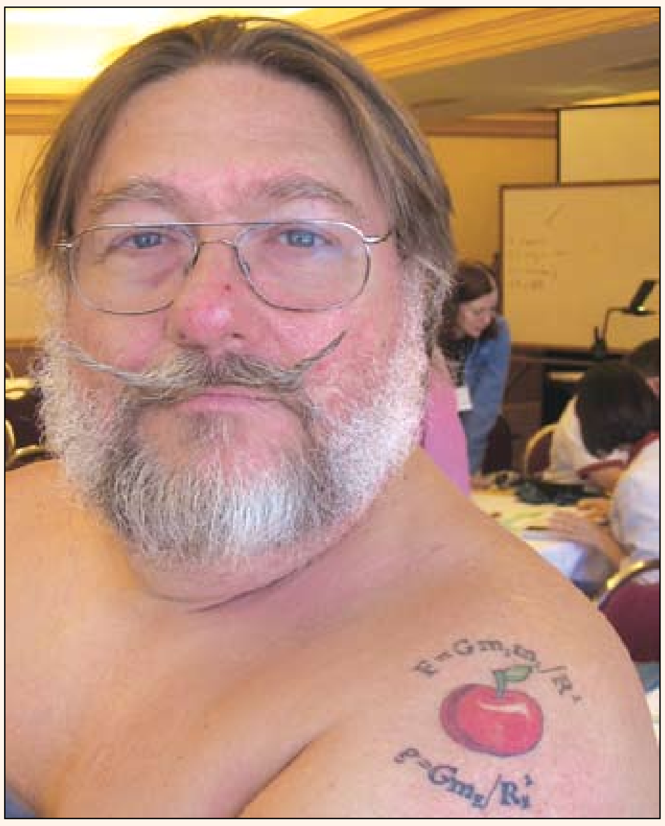

Photo by Ed Lee

If Todo Todorsky ever falls off a tall building, he has only to glance at his left shoulder to remind himself of the gravity of the situation. As a high-school physics teacher in Jacksonville, Florida, Todorsky finds the tattoo a perfect vehicle for show and tell. He was photographed during the Teachers' Day that took place during the APS April Meeting in Jacksonville.

New Fermilab Data Favor Light Higgs

Experiments at Fermilab have placed new constraints on the mass of the Higgs particle that suggest that it might be within reach of the Tevatron. Tevatron scientists have also detected rare processes and tightened constraints on some exotic particles. These are among the many results from the Tevatron presented at the April Meeting.

The Tevatron smashes together protons and antiprotons with combined energies near 1.96 TeV. Kevin Lannon of Ohio State University said in a press conference that the Tevatron is now generating data at its highest rate ever. The key to success is sophisticated data analysis, he said.

Among the recent results Lannon described is a new measurement of the top quark mass. The Tevatron scientists report a top quark mass of 170.9 GeV, with 1% uncertainty. This measurement gives indirect information on the mass of the Higgs particle, said Lannon.

Lannon also discussed evidence for the extremely rare production of single top quarks via a weak-force process. Top quarks are usually produced in top-antitop pairs by a strong force process. The DZero collaboration at Fermilab identified about 60 single top events out of billions of collisions.

The rate of single top production places constraints on the parameter V_tb, which is related to the probability of a top quark decaying into a bottom quark. The Tevatron single-top data limit V_tb to lie between about .68 and 1. This provides strong evidence that only the six known types of quarks exist, said Lannon. Continued data analysis will constrain V_tb further. "This is not the end of the story for single tops. It's just the beginning," said Lannon.

Another April Meeting speaker, Gerald Blazey of Northern Illinois University, said that the latest measurement of the W mass and the top mass favor a light Higgs. The new W mass (80.4 GeV), along with the new top quark mass, constrains the Higgs mass to be less than 144 GeV, with 95 percent confidence, Blazey said. This value, slightly lower than previous limits, puts the Higgs potentially within reach of the Tevatron. The Higgs boson is the only particle predicted by the standard model that has not yet been detected.

Ulrich Heintz of Boston University described Tevatron searches for some exotic particles and new physics beyond the standard model. No such particles have been observed, but the Tevatron research has put some limits on several possibilities. They have excluded squarks and gluinos below about 300 to 400 GeV, and placed limits on neutralinos and non-standard Higgs particles, said Heintz. Tevatron searches have also placed mass limits on other exotic particles, including leptoquarks, excited gravitons, massive non-standard W and Z bosons, and excited electrons, said Heintz. However, new physics might be soon found at energy scales of around a few TeV, he suggested.

PROBE continued from page 1

entific data." Einstein predicted that geodetic warping around Earth would cause the spin axes of each gyroscope to shift by 6.606 arc-seconds per year, or 0.0018 degrees.

But frame-dragging is a much tinier effect; the prediction is that the twisting of Earth's local spacetime would cause the spin axis to shift by 0.039 arc-seconds per year, or 0.000011 degrees. It is much harder to measure accurately–particularly since the "signal" indicating relativistic effects of gravity around Earth must be extracted from a bunch of background noise. This is where the biggest delays have occurred in terms of analyzing the data.

First, the initial in-flight verification phase of the project took twice as long as expected. Then, as the experiment was running, computer reboots in response to random radiation strikes meant there were interruptions in the data streams.

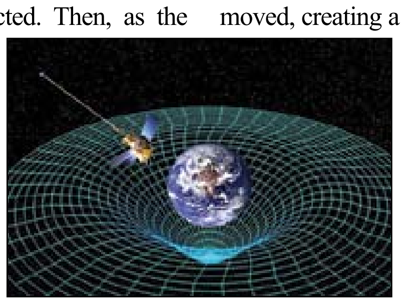

Image courtesy of NASA/Stanford

The GP-B scientists also overlooked a tiny electrostatic "patch" effect in the gyroscopes. These patches can cause the gyroscope to "wobble" a bit as it spins, much like a football that isn't thrown in a perfect spiral. The scientists were able to model and predict that wobble. What they didn't expect was that the pattern would subtly shift over time. They accounted for electrostatic patches on the rotor, said Everitt, but forgot about the housing.

Those same electrostatic patches also caused small torques in the gyroscopes' spin axes, and the resulting slight changes in orientation could be mistaken for the relativity "signal" that GP-B is designed to measure.

Gravity Probe B was first conceived in 1959 by two scientists named George Pugh and Leonard Schiff to precisely measure the displacement angles of the spin axes of four different gyroscopes in space over the course of a year and then compare that data with Einstein's predictions. But the instrumentation and associated technologies didn't exist at the time.

It has taken several decades for science to advance sufficiently to make GP-B feasible. For instance, they needed wobble-free gyroscopes; one way to measure the geodetic effect is through the perturbative influence of massive bodies on nearby gyroscopes. This was achieved by creating the world's smoothest, most perfect spheres, only surpassed in their perfect roundness by very dense neutron stars.

The four GP-B gyroscopes are electrostatically held in a small case, spun up to speeds of 4000 rpm by puffs of gas. The gas is then removed, creating a vacuum. Covered with niobium and reposing at a temperature of just a few Kelvin, the balls are rotating superconductors, and as such they develop a tiny magnetic signature which can be read out to fix the sphere's instantaneous orientation.

GP-B scientists also needed very sensitive and precise sensors capable of measuring an effect on a par with observing an object roughly the width of a human hair from about a mile away. The distortion of space caused by Earth's rotation around its axis should only deflect the spinning axis of the gyroscope by the tiniest of angles–so small that it would take more than a million years for the gyroscope to turn in a full circle. The invention and subsequent development of Superconducting-Quantum Interference-Device-(SQUID)-based sensors made it possible to measure those tiny magnetic variations.

Other necessary advancements included the Global Positioning System and a suspension system capable of keeping the gyroscopes' spinning rotors from making contact with the walls.

NSF continued from page 1

ject to research funding being coupled to education or outreach efforts. Mildred Dresselhaus of MIT says she has heard from many scientists who are unhappy with the broader impacts requirements, and who feel they should be funded based on the quality of their research, not for outreach. Many physicists feel they don't have the expertise to do outreach activities, she adds. She thinks education and outreach should be encouraged, but shouldn't be a requirement for research funding.

Some scientists, especially those applying for their first grants, find the broader impacts requirement confusing and burdensome. Given the low success rate for scientists applying for their first grant, Dresselhaus says that these beginning professors are overstretched trying to survive. They feel they have to do everything possible to get a grant, and they think that they must devote significant time and energy to addressing the broader impacts criterion. Dresselhaus describes this situation as "punitive."

Broader impacts doesn't have to be burdensome, said Eisenstein. There are a variety of things one can do, and NSF does not expect individual researchers to move mountains. "I think you can make a good faith effort to do reasonable things without a tremendous effort," he said.

Cooper also didn't think the requirements were onerous. He said that almost every scientist should be able to participate to some extent in outreach activities.

But some researchers do have trouble with the criterion. Ann Orel of UC Davis gave an example of a woman she knew who was applying for her first NSF grant. This woman, said Orel, was contributing to diversity simply by being a woman in physics, but the broader impacts criterion had her so confused and distressed because she didn't know what she had to do. "She's already doing outreach by existing," said Orel. By making it harder for this woman to apply for a research grant, NSF was actually being counterproductive.

Some scientists may be confused because the guidelines don't specify what activities a researcher has to do or how much effort is expected. Furthermore, the criterion may not be applied consistently by different reviewers, said Orel.

Greg Miller of UC Davis, who applied for NSF funding recently, also said that the criterion is too vague. "I think it's too open- ended. I don't know how to craft a good answer," he said. He felt the criterion was encouraging scientists to do things that would actually slow down the research, such as having undergraduates work in a lab.

The requirements are deliberately nonspecific in order to encourage creativity, explained Eisenstein.

Orel said that better mentoring might help young scientists understand what's expected. Also, Orel said she has been part of a panel that reviews NSF proposals. Researchers beginning their careers could learn a lot by sitting on these panels, she said.

Cooper suggests that one way to make it easier for scientists to fulfill the broader impacts requirement would be to have established education or outreach programs that individual scientists could join. This way, scientists would not have to develop their own outreach project, which might or might not be effective. For example, Cooper has started a program called TheoryNet, which brings theoretical physicists to talk with high school classes. Scientists could participate in such programs to do their broader impacts.

NSF grants that support large research centers often provide for extensive outreach projects. For instance, the Center for Nanoscale Systems at Cornell University, which is supported by NSF, devotes about 10% of its budget to broader impacts activities, according to Monica Plisch, Director of Education Programs for the center. These programs include workshops for high school teachers that include lab tours, talks by scientists about their current research, and hands-on activities that relate to the high school curriculum. The center also has developed nanoscience classes for undergraduates and mentoring and career advice programs for graduate students. Plisch says that most scientists at the center are supportive of the education efforts. Those scientists who want to participate can do so, and they are happy to work within a well-run established program, says Plisch. Those few scientists who don't want to participate in education and outreach aren't forced to do so, she said. "I want people who are excited about being part of this." Plisch has conducted surveys that show that the Center's education programs are effective. "Everyone gets something out of it," said Plisch.

Large research centers have the resources to set up these kinds of programs, but individual scientists with smaller research grants may not be skilled at planning and carrying out an effective educational activity. Orel said she thinks that educational activities are best left to large organizations that have the resources to do educational projects.

Individual scientists should be able to focus on pure research, and NSF is the only funding agency dedicated to funding pure research, said Orel.

Others, including Eisenstein, argue that broader impacts activities are something most scientists can and should do, and that it's appropriate that an education or outreach effort be related to the research project.

Cooper says that being a responsible citizen is part of the duty of being a scientist. "If scientists don't do outreach, there won't be a next generation," he said. "This country is going to have a real crisis."

ANNOUNCEMENTS

The following two amendments are to be voted on by APS members in the upcoming Society election. In each case, we present the language as it now exists, the motion that has established current practice, and the proposed amendment that is intended to update the Constitution to reflect current practice.

CONSTITUTIONAL AMENDMENT I
Regarding Appointees to Unit Nominating Committees

The APS Committee on the Constitution and Bylaws has discussed and recommended the following amendment to update the Constitution to reflect current practice. This amendment relates to a task assigned by the Constitution to the Council that was delegated to the Executive Officer in 1995 by voice resolution.

AMENDMENT I: Council Appointees to Unit Nominating Committees
The current Constitution contains language requiring the Council to appoint one member to the nominating committee for each APS unit:

ARTICLE VIII-Divisions, Topical Groups, and Forums
3. *Nominating Committee*. The Division, Topical Group, or Forum Nominating Committee shall include one member of the Division, Topical Group, or Forum appointed by the Council.

ARTICLE IX - Sections
2 .*Nominating Committee*. The Section Nominating Committee shall include one member of the Division, Topical Group, or Forum appointed by the Council.

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The following resolution was made and passed in 1995 to delegate this task to the Executive Officer and is still currently being practiced.

April, 23 1995
Motion: That the Council delegates to the Executive Officer the responsibility to appoint a member of the Nominating Committee of each of the APS Units
Action: Passed unanimously

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PROPOSED CONSTITUTIONAL AMENDMENT:

ARTICLE VIII - Divisions, Topical Groups, and Forums
3. *Nominating Committee.* The Division, Topical Group, or Forum Nominating Committee shall include one member of the Division, Topical Group, or Forum appointed by the Executive Officer.

ARTICLE IX - Sections
2. *Nominating Committee*. The Section Nominating Committee shall include one member appointed by the Executive Officer.

A complete copy of the APS Constitution can be found on the "About APS" section of the APS website at: www.aps.org/about/governance/constitution.cfm

CONSTITUTIONAL AMENDMENT II
Regarding Approval of Unit Meeting Time and Place

The APS Committee on the Constitution and Bylaws has discussed and recommended the following amendment to update the Constitution to reflect current practice. This amendment relates to a task assigned by the Constitution to the Executive Board that was delegated to the Executive Officer in 1999 by voice resolution.

AMENDMENT II: Executive Board approval for time and place of unit meetings The current Constitution contains language requiring the Executive Board to approve the time and place of APS unit meetings:

ARTICLE VIII-Divisions, Topical Groups, and Forums
3. *Meetings*. The times and places of the Meetings of a Division, Topical Group, or Forum require approval of the Executive Board.

ARTICLE IX - Sections
2. *Meetings*. The times and places of Section Meetings require approval of the Executive Board.

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This task was delegated to the Executive Officer by a voice vote of the Executive Board.

May 20, 1999:
Motion: To delegate to the Executive Officer the ability to approve the time and place of unit meetings and report back to the Executive board what has been done.
Action: Passed unanimously

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PROPOSED CONSTITUTIONAL AMENDMENT:

ARTICLE VIII-Divisions, Topical Groups, and Forums
4. *Meetings*. The times and places of the Meetings of a Division, Topical Group, or Forum require approval of the Executive Officer.

ARTICLE IX - Sections
3. *Meetings*. The times and places of Section Meetings require the approval of the Executive Officer.

A complete copy of the APS Constitution can be found on the "About APS" section of the APS website at: www.aps.org/about/governance/constitution.cfm .

Last Call for Nominations

Nicholson Medal for Human Outreach
***Deadline:* July 1, 2007**

Details at www.aps.org/programs/honors/awards/nicholson.cfm

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LeRoy Apker Award for Undergraduate Research
***Deadline:* June 20, 2007**

Details at www.aps.org/programs/honors/awards/apker.cfm

Now Appearing in RMP: Recently Posted Reviews and Colloquia

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

Dissipation-induced instabilities in finite dimensions
R. Krechetnikov and J. E. Marsden

Dissipation is usually thought of as a stabilizing effect. However, there are circumstances in which exactly the opposite happens: dissipation leads to destabilization. This article analyzes how andwhen this happens, bringing together various disparate threads in theliterature. It presents many illustrative examples and identifies open problems requiring further study.

EQUITY continued from page 1

Workshop attendees participated in an interactive theater performance by the University of Michigan Center for Research on Learning and Teaching (CRLT) players. The sketch, "faculty meeting" showed some of the subtle biases and often unnoticed behaviors that make it difficult for women to succeed.

After listening to presentations and participating in break-out groups, workshop participants came up with recommendations for increasing the number of women in physics. Department chairs were asked to take at least two recommendations back to their departments and implement them. A website will be set up for them to report their progress.

Throughout the meeting, speakers and participants addressed the causes for the low numbers of women in physics and made recommendations for improving the situation. Many of the recommendations were aimed at creating a more welcoming climate for all physics students and young professors, including women.

Virginia Valian of Hunter College attributed the slow progress of women to the many subtle biases against them. We all hold mental schemas (essentially stereotypes) of men as capable, independent, and decisive, while we view women as caring, nurturing, and emotional. We also hold schemas about the qualities of a good scientist, she said. These schemas influence the way people evaluate male and female job candidates, Valian said. She cited several recent studies showing this to be the case.

There is no silver bullet to fixing these problems, she said. Gender schemas are ubiquitous, persistent, and resist change, so we have to be constantly working to counter them, she said.

Several speakers focused on the biases against care-giving that tends to harm women's careers. Mary Ann Mason of the University of California, Berkeley and Robert Drago of Penn State University both presented evidence showing that bias against care-giving in the academic workplace slows women's career progress. Furthermore, more women than men report having missed important events in their children's lives or limited the number of children they have in order to achieve success in their careers. Women often fear they won't be taken seriously as scientists if they take time off for family reasons, Drago pointed out.

To address this problem, better family leave policies are needed, and they must apply to men as well as women, speakers said. Women will be more willing to take advantage of family leave benefits if they see men also taking time off for family.

Workshop participants also discussed ways to recruit, hire, and retain more women faculty. These included broadening the search, making sure the search committee isn't overlooking good women or minority candidates, and encouraging women to apply.

Particular attention needs to be paid to the dual career couple problem, said several speakers. Female scientists are likely to be married to male scientists, and both members of the couple need to be able to find suitable employment. To attract female faculty members, universities need to have a plan to for handling these situations. Often these arrangements benefit the university and the couple, so the dual career problem can be turned into a "dual career opportunity," said Sherry Yennello of Texas A&M University. Many universities are already developing policies for hiring couples.

Physics departments also need to increase the number of female undergraduate physics majors. Barbara Whitten of Colorado College said that the undergraduate level is where the biggest leak in the pipeline comes in, and the undergraduate level is usually the last chance to recruit new students to physics. Whitten suggested that to recruit more majors, including more women, departments should focus on introductory courses and create an attractive curriculum that includes contemporary topics. Departments can also be friendlier towards undergraduates by creating student lounges, encouraging cooperative group work, hosting social events, and making departmental seminars accessible to undergraduates, she said.

Funding agencies are also concerned about the low numbers of women in physics. Patricia Dehmer, Associate Director of Science for Basic Energy Sciences and acting Deputy for Programs in the DOE Office of Science, said that the career path of an academic scientist is unattractive to today's workforce, in which both men and women work, and people want to have both a career and a family. "We're advertising jobs that are, frankly, antiquated," she said. We shouldn't be encouraging people to trade family and children for careers in science and technology, she said.

From a federal perspective, a science and technology workforce is essential to the economy, Dehmer said. The S&T workforce must represent the whole population, not alienate large portions of the population, she said.

Judith Sunley, Executive Officer of NSF's Directorate for Mathematical and Physical Science, also said that the funding agencies can play an important role. She pointed out that there have been successful programs such as NSF's ADVANCE, which provides grants for programs to increase the participation of women in academic science and engineering careers.

Several workshop participants expressed the concern that the difficulty of applying for funding is deterring young people from scientific careers, as they see young assistant professors having to spend a lot of their time applying for funding.

Working in break-out groups, participants made several recommendations for funding agencies. These recommendations included finding ways to fund child care so scientists with children can travel to conferences, finding ways to reduce the pressure on assistant professors applying for funding, encouraging young professors to meet program officers, and encouraging the use of no-cost extensions to grants or other existing policies to allow scientists to take time off for family reasons.

APS Executive Officer Judy Franz mentioned several successful programs of the APS Committee on the Status of Women in Physics, such as site visits to departments to help them assess and improve the climate for women, lists of best practices, and professional skills development workshops for women. Franz asked the department chairs to go back to their departments and speak up about these issues that affect women. "If you can create an atmosphere where everyone is valued and treated with dignity, you will have a female-friendly department," she said.

In concluding remarks, Bienenstock said we've seen enormous change in the situation of women in physics over the past 50 years. He urged participants to continue working towards more improvement.

The Back Page

The Strange Tale of the Hafnium Bomb: A Personal Narrative

By Peter D. Zimmerman

There is that odd sinking feeling when you realize you've let an investigative journalist into your life. You can say what you want to her, but whatever anybody else says about you is out of your control. Sharon Weinberger entered my life almost by accident. While I was working for the Senate Foreign Relations Committee I attended a talk by Steve Younger, then the director of the Defense Threat Reduction Agency, on the future of US nuclear weapons. And I asked Steve what he thought about the DARPA "hafnium bomb" project.

He brushed past the question, but Sharon came up to me afterwards to ask "what's a hafnium bomb?" As she tells the story in her book *Imaginary Weapons*, I was fairly mischievous and just said "call me." The next day we had coffee in one of the Senate's many coffee shops, and I began the story.

More than eight years on it's a little hard to remember just exactly how the peculiar properties of the hafnium-178m2 isomeric state, and plans to exploit it, came to my attention. I seem to remember a discussion in the fall of 1998 in my office at the Institute for Defense Analyses with people from Sandia National Laboratories. But perhaps not. In any event, the 25 January, 1999 issue of *Physical Review Letters* was what really triggered things. (Pun intended.) In that article, University of Texas at Dallas (UTD) physicist Carl Collins reported that he had stimulated decays of the isomer via bombardment with X-rays from a second-hand dental X-ray machine.

Bohdan Balko (also at IDA) and I considered whether we should write a "comment" in rebuttal, pointing out the obvious failings in the Collins paper's theory and data analysis. We decided against the idea, and I mostly forgot about hafnium. In any event, I had not been able to discern any actual decay rate enhancement in Collins's report. There were almost as many lines "suppressed" by the X-ray beam as "enhanced." The difference spectrum looked mostly like noise.

I was in my last few weeks of waiting for White House security clearance to start a new job as chief scientific advisor of the Arms Control and Disarmament Agency (ACDA) when I received an offer to be briefed by an official of the Defense Intelligence Agency (DIA) on hafnium research. Because I had not yet started my new job, protocol declared that the briefing be on DIA's turf, and not ACDA's, and so I crossed the Potomac.

What I heard was extraordinary: DARPA had gone to work on isomers in a big way, despite the fact that there was a six or seven order of magnitude gap between real nuclear theory and the claimed experimental results. The Russians had shown "interest" in isomers, and, most serious of all, they were likely to be far ahead of the US. There was, you see, a mysterious "enigma site" in Russia, the purpose of which we did not know, but intelligence indicated it was both big and expensive. And if the Russians were spending hidden research funds, *and* were interested in isomers, then the enigma site was probably their isomer R&D facility.

(In retrospect, that part of the briefing was of a piece with some more recently declassified British military intelligence papers. Commenting on the sad state of UK research on carrier pigeons after World War II, the War Office Intelligence Section warned "Pigeon research will not stand still. If we do not experiment, other powers will. "

Among the more interesting weaponizations of pigeons was a plan to have kamikaze anti-anti-aircraft pigeons carry explosives. These birds would crash into searchlights, destroying them to protect bombers overhead.)

The Pentagon had seemingly estimated that a five pound hand grenade powered by a hafnium explosive could deliver a two kiloton kick. Neither the briefer, Fred Ambrose, nor his colleague, Dr. Eliot Lehman, could explain just how the laws of physics were to be violated quite so grossly.

Other things they didn't explain included how a soldier was supposed to hold a hafnium grenade, given that it would be fiercely radioactive, at least thousands of curies, or how anybody was supposed to be able to throw a five pound ball far enough to survive a two kiloton blast. Later others were to scale that back to two tons, but I still don't know how the grenadier was going to come out alive, even if his throwing arm weren't roasted.

Only a month after I started at ACDA it was folded into the State Department. Ambassador Avis T. Bohlen became assistant secretary of state for arms control, and I became her science adviser. I also had the job of running the research budget for the three State Department bureaus which housed most of the people from ACDA.

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Stanford Hooper may be the most important two-star admiral you've never heard of. He is the father of electronics in the US Navy. He won the Navy Cross in the First World War as well, and in the late 1930s headed the U.S. Navy's Technical Division.

But if Hooper's name rings any bells at all with modern physicists, it is because of a brief and largely fruitless meeting with Enrico Fermi in 1939. Fermi had turned to the Navy to fund research in making explosives using the newly discovered process of uranium fission. Hooper is remembered for dismissing Fermi, allegedly with a racist slur.

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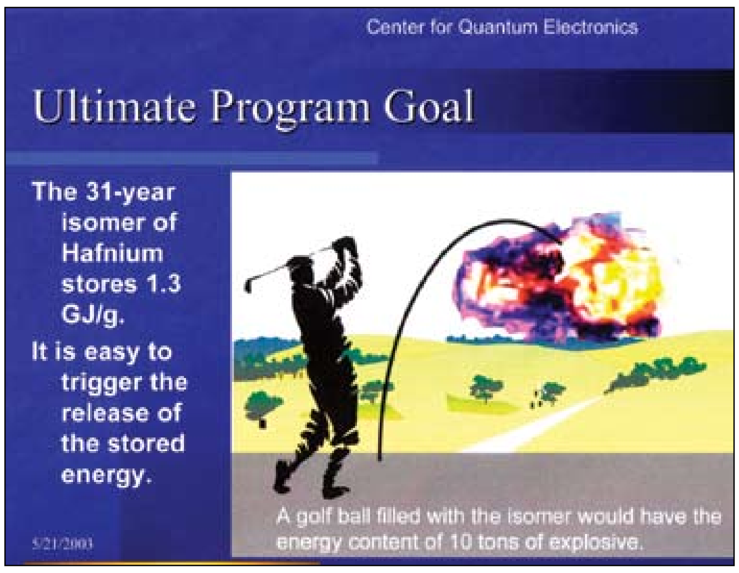
I had no ambition to become the Stanford Hooper of hafnium.

I wanted to know that if I opposed funding for hafnium, my instinct that it was a quantitative impossibility was correct. To get the best possible physics analysis I turned to the JASON consulting group, a self-perpetuating "club" of some of the top US scientists who work largely for the Department of Defense on very tough, and very important scientific questions. The State Department research budget had neither the size nor the elasticity of the DOD budget, but we were able to provide a token payment, and JASON agreed to do the work.



A slide used to promote the Hafnium bomb

Washington bureaucracy works in strange ways. I was immediately asked what stake the arms control groups at State had in a fight over whether or not DARPA was to be allowed to waste $40 million on what my instincts said was very bad science. But we did have a reason to get involved: the proponents of isomer weapons suggested that–although the energy release derived from excited states of nuclei–because the mechanism did not involve either fission or fusion, an isomer bomb *would not be a nuclear weapon.* That would mean it could be tested even under the terms of the Comprehensive Test Ban Treaty, and could even be tested in the atmosphere, despite the 1963 Limited Test Ban Treaty.

Our lawyers, of course, said that was nonsense. But it appeared that the only way State could enter the fray was to alert the rest of the government that the ^{178m2}Hf isomer could not be used in any kind of weapon because the physics prevented it. I was allowed to contract with JASON, and asked some pointed questions which included:

- What is the proposed physical mechanism by which Collins claims the decay rate is enhanced?
- Is this mechanism in accord with the known principles of nuclear and atomic physics?
- Have Collins and his co-workers actually demonstrated an enhanced decay rate of ^{178}Hf?
- Is it likely that ^{178}Hf isomeric nuclei can be produced in useful quantities within the next 20 years? By what mechanism?
- Is it likely that mechanisms to cause the near-simultaneous de-excitation of large numbers of ^{178}Hf isomers will become practical in the next 20 years?

The answer to all of my questions was "no." Collins's experiment was unequivocally dismissed. The question of an explosive was pretty thoroughly undermined by pointing out that the enormous background of photons from the normal decay of the isomer was great enough to ensure a preinitiation fizzle and so the inevitable maximum yield would approach zero, but would scatter thousands of curies of isomer. And there was no known mechanism for producing an exponentiating reaction except the vague hope that one of the photons released in the stimulated decay of the isomer would be exactly the right energy to stimulate another decay. One of the pro-isomer scientists suggested that he could mix the hafnium with another (unknown) element which would provide the necessary photons.

Rather naively for somebody who had worked in Washington for 16 years, I thought the JASON report would end the program. I didn't even bother to collect any of the "I Believe in Isomers" campaign buttons some of the Sandia National Labs people were handing out, because I didn't believe.

In 2001, with a new president and secretary of defense, less interested in taking scientific advice if it conflicted with a desired outcome, DARPA stepped in with two large programs, SIER, or Stimulated Isomer Energy Release, and HIPP, the Hafnium Isomer Production Panel. Heading the effort was an early believer in isomers, C. Martin Stickley, along with Ehsan Khan of Energy, who always seemed to pop up whenever any strange forms of New Energy were reported. Fortunately, they had recruited William Herrmannsfeldt of SLAC to the HIPP. Bill sought to do from the inside of the isomeric world what I had tried to do from the outside: Find out if it made sense, and if it did not, kill it.

Sharon tells the story of Bill's efforts, and the help I tried to give him, in her book. At about this time in the story, she walked into my life. Because I wanted to stop the waste of money, and also the assault on arms control treaties, I agreed to talk. Why not? I wasn't talking about anything that was classified. A rather misguided State Department had been snookered into putting isomer weapons on the arms export control list (arguing that while they were presently impossible, it had taken less than seven years to go from the discovery of nuclear fission to Hiroshima, so just as with pigeon research, we must stay ahead of Other Powers), but I knew that wouldn't pass the giggle test.

When you tell a reporter a story, you become a "source." But reporters need several sources, and so I knew that Sharon would find others. She would certainly talk to people like Stickley and the Sandia group who probably weren't happy with what I had done. They would be "sources" too, and only Sharon Weinberger would get to sort out what she thought was the truth, writing only what she chose. Hence the sinking feeling.

Hafnium became the subject of the cover article of a *Washington Post Sunday Magazine* few months later, complete with a cover photo of Collins, and a screen shot of the isomer hand grenade. That got the House and Senate appropriators in the game, and within months the law forbade DOD to spend its money on isomers. I thought we had killed the hafnium bomb with laughter. Victory for the good guys? Well, not exactly. DOE supported the work with Stickley apparently getting funds that way. A TRiggered Isomer Proof experiment, TRIP, was scheduled and apparently was conducted at the synchrotron light source at Brookhaven although all reviewers recommended against the experiment. Many of the critics were invited to critique the experimental plans on the condition that if Pat McDaniel's TRIP showed triggering and our suggestions were followed, we would agree that triggering was real; my contribution was to suggest some target-out/target-in procedures and taking data from ordinary hafnium, all under the usual computer controls so that the experimenters were effectively blindfolded and couldn't tune their instruments to maximize any signal from the isomer. All my suggestions were rejected.

Did "TRIP" become "Stumble-Fall?" Did McDaniel ever show that isomer triggering occurred? I have no idea, because the results have never been published. Perhaps they have been trapped in the government's highest level of classification: TS/E, Top Secret/Embarrassing. Surely they showed no prospects for a weapon, because even Carl Collins conceded that he needed 11 keV photons to trigger the isomer, and that only one photon in 600 would interact leaving a net energy deficit of several MeV per trigger.

But this is Washington. Last summer Ehsan Khan circulated a strange letter to the remains of the HIPP warning them not to talk to Sharon and to inform him if she contacted them. Khan wrote "[T]his is really important." And he added that TRIP had been so successful that an Independent Evaluation Board had recommended further "exploratory research," which he defined as "high risk/high payoff" with only the "most seasoned and outstanding individuals" selected by DOE/DOD allowed to be engaged. No such category as "exploratory research" appears in DOD's budget documents. We'll never know about TRIP if they don't publish, and if the research has been classified TS/E there will never be a paper.

So it almost worked out. I let an investigative reporter have a crack at me, and wound up being featured in a news magazine and a book. However much money is wasted on "hafnium bombs," former presidential science adviser Jack Gibbons, whom I admire greatly, called me a hero in his review of *Imaginary Weapons* in *Physics Today*. That's good enough.

Peter D. Zimmerman is Chair of Science and Security and Director of the Centre for Science & Security Studies at King's College London. He was the last chief scientist of the US Arms Control and Disarmament Agency, science adviser for arms control in the State Department, and chief scientist of the Senate Foreign Relations Committee.