APS NEWS

July 2002
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# Physics Bachelors on the Rise After 10-Year Decline

A new study issued by the American Institute of Physics (AIP) reports that, for the first time in nearly a decade, the production of physics bachelor's degrees in on the rise. The graduating class of 2000 produced a total of 3,849 bachelor's degrees in physics, an increase of 7% over the class of 1999, and that number is expected to continue to rise at least for the next two years. The report also found that there has been a slight increase in recent years in the proportion of new degree recipients entering directly into physics graduate study.

According to Patrick Mulvey in AIP's Statistical Research Center, the data in the report are based on responses from 2,721 physics seniors from 763 degree-granting US physics departments, who were surveyed during their final year of undergraduate physics study. The center has been collecting data on senior-level physics and astronomy majors from both students and departments for more than 30 years.

For every 1000 bachelor's degrees awarded in the U.S., only about 3.3 are awarded in physics, and during the 1990s, physics bachelor's degree production declined sharply by 27%. "In a sense, physics lost some of its market share," says Mulvey. Especially hard hit were the larger departments that included graduate as well as undergraduate programs, and it is these departments which are now largely responsible for the recovery in degree production.

The report found that the likelihood of an individual receiving a physics bachelor's degree is much higher if he or she has taken a high school physics course; 92% of physics bachelor's said they had take at least one physics class in high school. Based on this finding, "With the increasing student enrollments seen in high school physics in recent years, one can be optimistic in thinking that more students may choose to continue with physics at the undergraduate level in the future," says Mulvey. Most respondents said they chose to major in physics because they were intrigued by the subject matter, followed closely by the influence of the high school teacher or college professor who taught their first physics course. Ironically, very few students cited long-term employment goals as their primary influencing factor in choose to major in physics.

Once students have declared a major, the study found that 76% of physics majors said they had worked on an undergraduate research project, which Mulvey says "gives undergraduates a feel for research through practical hands-on experience, solving real problems, not just those in curriculum-based labs." Such participation could also be an indicator of whether they will

See BACHELORS on page 3

## Boston Area Fellows Meet


Photo by Darlene Logan

*APS hosted a reception for Fellows in the Boston area on May 1 at the Harvard Faculty Club. Shown here are (left to right) Frans Spaepen, David Litster, and Denis McWhan. APS President Bill Brinkman served as master of ceremonies. Venkatesh Narayanamurti, Dean, Division of Engineering & Applied Sciences at Harvard was the local host. The program focused on APS education programs and Dan Kleppner, (MIT) also gave a short presentation on the APS-sponsored study of boost-phase missile defense that he is co-chairing.*

# Panel Probes Possibilities in Particle Physics

"The Future of U.S. High-Energy Physics" is a big topic that was addressed from different points of view by participants in a special session at the meeting of the Division of Particles and Fields (DPF) in Williamsburg, VA in late May.

Photo by Jessica Clark

*Left to right: Stanley Wojcicki, Raymond Orbach, Joseph Dehmer, William Brinkman.*

Participating were APS President William F. Brinkman, Director of NSF's Physics Division Joseph L. Dehmer, Director of the Department of Energy's Office of Science Raymond L. Orbach, and DPF Chair Stanley G. Wojcicki. The panel was chaired by APS Past President George Trilling.

Orbach talked about some areas of research in high-energy physics that he felt were exciting and deserving of a high level of support from his office. One was the Large Hadron Collider, now under construction at the CERN laboratory in Geneva with significant help from US scientists. The LHC will be operational in about five years, and the particle physics community is already looking ahead to the next big accelerator, which will probably be an electron-positron linear collider. Orbach stressed that this must be an international effort from the start, regardless of where the machine is built, and expressed concern that "we don't have a mechanism to bring governments together to work towards this end."

Second on Orbach's list was the

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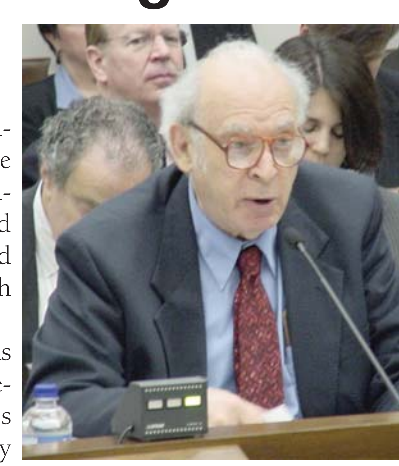
# Friedman Testifies in Washington on NSF Doubling Bill



Former APS President Jerome Friedman, a Nobel laureate and professor of physics at the Massachusetts Institute of Technology, testified before the House Science Subcommittee in early May in support of proposed legislation authorizing 15% increases in the budget of the National Science Foundation in each of the next three years.

H.R. 4664, currently known as the "Investing in American's Future Act", was authored by subcommittee chairman Nick Smith (R-MI), who said that part of the rationale behind the legislation was the subcommittee's concern that the NSF may be rejecting too many grant applications because of financial constraints. Increasing the NSF budget would allow it to increase the number, size and duration of research grants, and reduce the backlog of research facilities' upgrades, says Smith.

Friedman devoted much of his testimony to the issue of major research equipment and facilities construction. "The NSF currently does not provide the scientific community or Congress with a prioritized list of approved projects," he said, commenting on NSF's decision-making process for construction and operation of major facilities. "The lack of transparency has prevented orderly planning by the research community. As a result, science has suffered and international research partners have been left dangling." he cited the lack of an NSF funding request for the Rare Symmetry

See FRIEDMAN on page 4

## 2002 APS General Election Preview

The APS announces its second annual Society-wide electronic election. Members for whom the APS has valid e-mail addresses will be notified via e-mail regarding election procedures and all members are encouraged to use the web-based voting process developed by Survey and Ballot Systems, Inc. of Eden Prairie, Minnesota.

The election website will be open from **June 15 until September 3**. Paper ballots will be provided upon request or for those for whom the APS does not have a valid e-mail address.

Those who are elected will begin their terms on 1 January 2003. A brief biographical summary for each candidate is on page 6. Complete biographical information and candidates' statements can be found on the APS Website: http://www.aps.org/exec/election2002/

## Highlights



*APS News Interview*

# Ethnic Profiling, Other Issues Still Surround Wen Ho Lee Case

*By James Riordon*

The bad guys used to wear black hats in grainy old cowboy movies, and the good guys wore white. Cinematic profiling was a handy way to let audiences know whom to cheer and whom to jeer during the inevitable, climactic shoot out. In real life, of course, villains are not always so obliging - and when it comes to espionage, they're often downright contrary. In an August 2001 CNN list of twenty-two recent espionage suspects, twenty-one US traitors since 1984 not only shunned black hats, but as a rule preferred to wear the uniforms of our own country's soldiers and law enforcement agents. Based on that list, a turncoat spy is likely to be a white, middle-aged male employed as a guardian of US national security. Robert Hanssen (FBI), Aldrich Ames (CIA), and George Trofimoff (US Army Reserves) are among the high profile spies who betrayed the country while working in counter-espionage. But one spy suspect on the CNN list stands out: Wen Ho Lee is an Asian-American, a former Los Alamos National Laboratory

See WEN HO LEE on page 2

## Members in the Media

"It seems by the time they left the class, they were looking at the world with a more critical and more scientific eye."
*—Jim Kakalios, University of Minnesota, on using comic books to teach physics, AP, May 9 2002*

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"Anywhere you find waves you find solitons."
*—Randall Hulet, Rice University, on creating solitons in Bose-Einstein condensates, Dallas Morning News, May 20, 2002*

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"It would be quite foolish to rest the future of civilization (at least of countless lives) on the feeble assurance of small odds. It is a matter not of whether a serious collision will happen, but of when."
*—Marcelo Gleiser, Dartmouth College, on the possibility of Earth being struck by a large asteroid, LA Times, May 27, 2002*

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"We expect it will be a long struggle to perfect the instrument. Hundreds of things need to be just right to get the sensitivity we need."
*—Fred Raab, LIGO Hanford Observatory, on the difficulties of detecting gravitational waves, Seattle Post-Intelligencer, May 28, 2002*

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"The ability to manipulate molecules with tailored laser pulses opens up the ability to understand and possibly eventually alter the pathways of chemical or biological processes."
*— Herschel Rabitz, Princeton University, on using lasers to control photosynthesis, UPI, May 29, 2002*

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"Although they have a weird name, Wimpzillas are among the most reasonable of current speculative ideas in the field."
*—Angela Olinto, University of Chicago, on a possible dark matter candidate, New Scientist, June 3, 2002*

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And finally, some quotes having to do with alleged misconduct by scientists at Bell Labs:

"We found the results to be extremely intriguing and potentially revolutionary. We had a significant team focusing on this work and trying to reproduce the published results. So far, we have not been able to reproduce the results."
*—Thomas N. Theis, IBM Watson Research Center, NY Times, May 23, 2002*

"There were funny things about the data that just shouldn't have occurred."
*—Lydia Sohn, Princeton University, Financial Times, May 23, 2002*

"It looks very unusual, and I felt it was my ethical responsibility to inform the people involved."
*—Paul McEuen, Cornell University, AP, May 23, 2002*

"I am not convinced it will all turn out to be fraudulent, and in fact I'd be surprised if the ultimate story is as simple as that."
*—David Goldhaber-Gordon, Stanford University, AP, May 22, 2002*

"We will report back to Lucent on our findings whether we believe there has been scientific misconduct or not."
*—Malcolm Beasley, Stanford University, NY Times, May 21, 2002*

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## WEN HO LEE, *from page 1*

(LANL) hydrodynamics expert, and, it now seems, probably innocent.

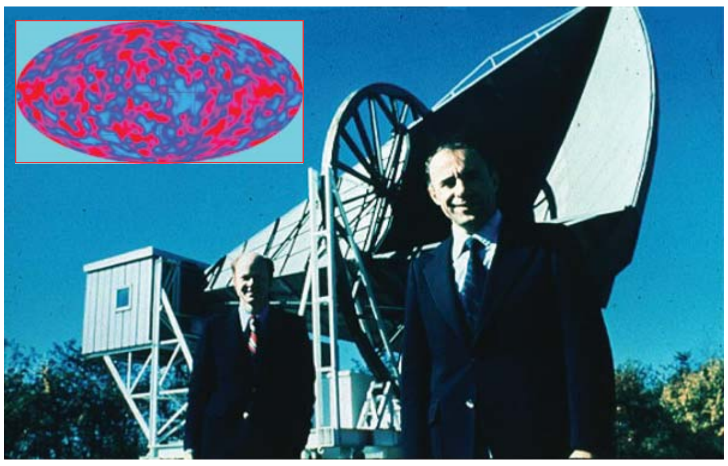
A full explanation of the events that led to Lee's ill-fated prosecution may never be revealed. Too much information is buried in classified documents. This past May, a judge dismissed a civil lawsuit brought against Lee by Notra Trulock, the Energy Department's former security chief who was instrumental in identifying Lee as a likely spy, after government attorneys warned that national security could be compromised if the classified documents vital to Lee's defense were introduced into evidence. (Trulock's suit alleged that Lee and government investigators had damaged his reputation by claiming that he singled out Lee because of his ethnicity.) Based on declassified documents, including the 1999 Cox congressional report on security concerns relating to the People's Republic of China, the DOE suspected that design details for the W-88 thermonuclear warhead were leaked to China in the mid-1980s. Convoluted logic eventually convinced investigators to focus on Lee despite the countervailing precedents set by Ames, Hanssen, and most of the other convicted members of the US spy fraternity.

Ultimately, Lee did not escape prosecution entirely unscathed. Round-the-clock surveillance of Lee and his family, a multi-million

*See* **WEN HO LEE** *on page 7*

# This Month in Physics History

### *June 1963: Discovery of the Cosmic Microwave Background*



Sometimes the most stunning scientific discoveries are the least expected, and occur more by serendipity than by intent. Take the case of Bell Labs physicists Arno Penzias and Robert Wilson, who set out to map radio signals from the Milky Way and wound up being the first to measure the cosmic background radiation (CMB). Their momentous discovery made it possible to obtain information about cosmic processes that took place about 16 million years ago, and forever changed the science of cosmology, transforming it from a specialty of a select few astronomers to a "respectable" branch of physics almost overnight.

In the 1950s there were essentially two theories about the origin of the universe. One was the Steady State Theory, which held that the universe was homogenous in space and time and would remain so forever . The more controversial theory sought to incorporate Edwin Hubble's discovery in 1929 that galaxies are moving away from one another at remarkable speeds. A handful of physicists led by George Gamow argued that the separation between galaxies must have been smaller in the past, which meant that at some point the universe had once been infinitely dense. Everything in the universe had emerged from this incredibly dense and hot state in a cataclysmic explosion called "the Big Bang."

Bell Labs had built a giant, 20-foot horn-shaped antenna in Holmdel, NJ in 1960 as part of a very early satellite transmission system called Echo, but the launch of the Teslar satellite a few years later made the Echo system obsolete for its intended commercial application. Penzias and Wilson seized the opportunity to use the antenna as a radio telescope to amplify and measure radio signals from the spaces between galaxies. To do so, they had to eliminate all recognizable interference from their receiver, removing the effects of radar and radio broadcasting and suppressing interference from the heart of the receiver itself by cooling it with liquid helium.

However, when Penzias and Wilson reduced their data, they found an annoying background "noise", like static in a radio, that interfered with their observations. The noise was a uniform signal in the microwave range (with a wavelength of 7.35 centimeters), and seemed to come from all directions. Penzias and Wilson checked everything they could think of to rule out the source of the excess radiation. They pointed the antenna at New York City and found it wasn't due to urban interference. Nor was it radiation from our galaxy or extraterrestrial radio sources.

Finally , they decided the problem might be due to the droppings from pigeons roosting in the horn-shaped antenna, contrived a pigeon trap to oust the birds, and spent hours removing pigeon dung from the contraption. [Ivan Kaminow, a colleague of Penzias during the latter's early days at Bell Labs, once joked that Penzias and Wilson "looked for dung but found gold, which is just opposite of the experience of most of us."] Yet still the background radiation remained.

So Penzias and Wilson began looking for theoretical explanations. Around the same time, Princeton University physicist Robert Dicke theorized that if the universe was created according to the Big Bang theory, a low-level background radiation at around 3 degrees Kelvin would exist throughout the universe. Dicke had begun looking for evidence to support his theory when Penzias and Wilson got in touch with his laboratory. He visited Bell Labs and confirmed that the mysterious radio signal was indeed the cosmic background radiation — proof of the Big Bang. Dicke shared his theoretical work with the Bell Labs researchers, even as he resignedly admitted to his Princeton colleagues, "We've been scooped."

The two groups published their results at the same time in *Astrophysical Journal Letters*. Penzias and Wilson received the Nobel prize in physics in 1978 for their serendipitous discovery of the CMB. More than three decades later, NASA sent the Cosmic Microwave Background Explorer (COBE) satellite into orbit to investigate the CMB in great detail, producing the first detailed map analyzing the small irregularities, or "ripples", in the microwave background.

The giant radio antenna at Holmdel was designated a National Historic Landmark in 1990. Even the lowly pigeon trap has found its way into posterity. It is now one of the key artifacts on permanent display in Washington, DC, part of a new exhibit at the Smithsonian Institute's National Air & Space Museum that debuted in September 2001, entitled, "Exploring the Universe." And Penzias and Wilson went down in scientific history for a momentous discovery that opened a window into the early universe, enabling astronomers and physicists to see the initial conditions from which the beauty of the present-day cosmos emerged.

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# Focus on Committees

## APS Committees Acting Globally

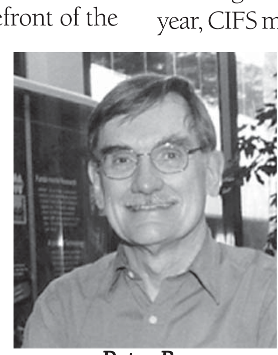
One in five APS members currently lives and works outside of the US; international collaborations are vital for large research efforts; and few things stimulate scientific progress more than the free flow of information across borders and cultures. These are just a few of the many reasons that the APS has interests in events and conditions in the world beyond American shores. In fact, two of the standing APS committees are specifically dedicated to monitoring and influencing international affairs.

The Committee on the International Freedom of Scientists (CIFS) began as a subcommittee under the APS Panel On Public Affairs (POPA) in the 1970s, and blossomed into a full-fledged APS committee in the 1980s. The Committee on International Scientific Affairs (CISA) followed a similar progression in the 1980s and early 1990s. The cold war era that set the stage for the creation of the committees in the first place is rapidly fading into history. Nevertheless, the injustices that motivate CIFS and the issues that trouble CISA remain as serious today as they were a quarter century ago.

### CIFS: Working for Freedom

Even in the era of enlightened globalization, free speech is still a crime in many countries. Peaceful assembly and other fundamental liberties are restricted in some corners, and unheard of in others. Because scientists are often at the forefront of the struggle for basic rights, they are disproportionally represented among those imprisoned for crimes of conscience. In addition, scientists are crucial to technological military projects, and the simple access to sensitive information is sometimes enough to draw fire from overzealous spy hunters, even in countries as enlightened as the US.

*Noemie Koller*



*Peter Barnes*

CIFS is the APS committee responsible for monitoring concerns regarding human rights of scientists throughout the world. In addition to informing the APS president, Executive Board, and Council about rights violations, the committee writes letters on behalf of imprisoned or persecuted scientists. Recently, CIFS added its name to a list of sponsors on a petition to authorities of the People's Republic of China requesting fair treatment for eight prisoners, two of whom are physicists.

"The most important role of CIFS," explains committee chair Noemie Koller, "is to help people who have not been lucky enough to live under free conditions. And part of the motivation is, of course, that science is wonderful, and we want everybody to be able carry it on freely — to follow their imaginations and creativity. It's a universal concept, independent of where in the world it's done."

Such lofty goals require patience and persistence. "We are dealing with closed regimes, with regimes where laws change as you go along: as soon as you get past one hurdle, laws change and you start all over again," Koller explains. "It takes a long time for each individual before we get them out of jail or out of trouble. We've achieved some success in several cases, but it has been slow."

Ironically, one of the difficulties that CIFS has faced in recent years resulted from the fall of the Soviet Union. During the cold war, imperilled Soviet dissidents included physicists Andrei Sakharov and Natan Sharansky, and biologist Yuri Orlov. While countless lesser-known dissidents suffered as well, the big three achieved enough notoriety that a group of activists in the US joined the struggle against Soviet repression under the moniker "Scientists for Sakharov, Orlov, and Sharansky," or SOS for short. It's likely that few people these days recognize the names Yury Bandazhevsky, Tong Shidong, or Valentin Danilov — three physicists included on the CIFS list of current cases. Raising awareness for comparatively anonymous individuals is a significant challenge.

In light of the events of the past year, CIFS must adjust again. "We are entering new territory," says Koller, "September 11 changed the parameters." Sessions at APS meetings, which once served as the primary vehicles for disseminating CIFS information, are drawing fewer participants. The committee is considering using newsletters to take up the slack in communication. Another issue of increasing importance is communication with scientists in Islamic communities. Koller points out that CIFS has well developed relations with countries such as Russia, China, and Belarus, but little experience with the Near East. "We have to increase our awareness of the scientific climate and opportunities in Near Eastern countries and open channels of communication."

Koller is not entirely certain what vehicles CIFS will employ in their future efforts, considering the volatility of the moment, but her vision of the committee's ultimate purpose is clear. "Our major goal," asserts Koller, "is to monitor and uphold the human rights of scientists throughout the world."

### CISA: Advancing Physics Education, Research, and Community

CISA's role, as defined in the APS bylaws, consists of "encouraging the society's efforts to strengthen interaction among researchers and institutions in different regions of the world and to further extend worldwide access of physicists to scientific information and its exchange." To these ends, CISA promotes the free flow of information and scientific personnel across borders, and strives to bolster science programs and funding in underdeveloped countries.

Current CISA chair Peter Barnes feels that physics education and research, in both developing and established countries, are among the committee's primary concerns. Coordinating interactions that cement the physics community worldwide is also an important committee function. A recent focus, which is somewhat nebulous at the moment, involves helping find solutions to technically sophisticated applied physics problems that plague underprivileged nations.

"Under the category of education," says Barnes, "we promote physics in underdeveloped countries. Getting copies of the *Physical Review*, for example, into libraries or physics departments in Africa or Latin America is one educational avenue that we pursue."

Barnes breaks down the research effort into two categories. One thrust involves helping physicists involved in research in developed countries. "We have an important segment of the APS that works in research labs such as CERN and DESY, and labs in Japan, to name a few." Another CISA effort concentrates on promoting sophisticated research programs in less developed regions. "For example, we were recently discussing the established plans for construction of a light source (SESAME) in Jordan."

CISA is also instrumental in promoting development of the physics community as a whole. "That means orchestrating physics conferences between the American Physical Society and, say Canadian and Mexican societies," Barnes explains, "This is useful both from the point of view of discussing physics research as well as tying the communities together."

Finally, the committee is contemplating a request to become involved in a rather different issue. There is a need for expertise to help find ways to detect and clear land mines in countries such as Croatia, where the request for help originated, as well as Southeast Asia and many other regions. "It's going to be a problem in Afghanistan," says Barnes. "This is a well known applied physics problem of international proportions, which requires development of sophisticated and highly reliable technical solution." Barnes speculates that APS role, if it has one in this case, is to motivate the investment of US technical expertise in this very difficult area. [See the BackPage in this issue.]

### Facing a World in Flux

Koller and Barnes both express some concern over the roles of their committees in coming years. After

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**BACHELORS,** *from page 1*

continue on to graduate studies. Ninety percent of those students intending to go to graduate school in physics had participated in a research project, compared to 65% of those planning graduate studies in other fields and 68% of students planning to enter directly into the workforce. Unfortunately, barely half of those hoping to become high school teachers participated in such projects—a group that could greatly benefit from such an experience since "They are the ones who will be imparting a feel for such practices to others in the future."

An overwhelming majority (84%) expressed satisfaction with their choice of major and said they would choose the subject again if given the opportunity to repeat the experience. Those who said they would change their major cited developing interests in another subject as their reason, not dissatisfaction with physics. Respondents also expressed optimism about their career prospects as physics majors, with 81% agreeing that their physics degree would provide them with a solid background for any career they ultimately chose to pursue. In terms of long-term goals, the report found a slight shift in postbaccalaureate plans, with slightly more than one-third planning to continue with graduate studies in physics, and another one-fifth planning to pursue graduate studies in other subjects. The top career goal for physics bachelor's recipients (31%) is to work at a college or university doing teaching and/or research, although the majority of new degree recipients said they planned to go directly into the workforce upon graduation.

**Editor's note:** *The full report covering the survey can he found online at http://www.aip.org/statistics/trends/undtrends/htm.*

## New Mexico Yields New Senior Editors for PRC and PRE

Following a year long search process, committees for Physical Review C and Physical Review E have found new editors. Benjamin Gibson of Los Alamos National Laboratory will take the senior position at PRC and Gary Grest of Sandia National Laboratory will be PRE's senior editor.

Gibson has been involved off and on (mostly on!) on the PRC Editorial Board or as a PRC Associate Editor since 1978. His long association with the Division of Nuclear Physics is another of his assets. Gibson will replace Sam Austin, who has been at PRC's helm since 1988.

Grest is a recent Divisional Associate Editor for PRL and has been a very active author and referee for PRE.

His broad background in condensed matter, soft matter, computational physics, polymers and complex fluids made him a strong candidate.

*Benjamin Gibson*

*Gary Grest*

Grest takes over from Irwin Oppenheim, PRE's original senior editor.

Peter Bond (BNL) chaired the PRC search committee and Herman Cummins (City College) lead the PRE committee.

The community responded strongly to the call for nominations and candidates, which appeared in a number of domestic and international publications. Each committee had over 40 names to consider. Electronic communication (not to mention the high percentage of international authors and subscribers) allowed the search committees to consider international candidates, and several of these reached the short lists.

**PANEL PROBES,** *from page 1*

general area of astro-particle physics and the problem of dark energy. "The public at large is interested in these philosophical concepts" Orbach stated, and added that their study is "important philosophically, almost religiously." He particularly mentioned the SNAP (SuperNova/Acceleration Probe) experiment proposed by scientists at Berkeley's Lawrence Radiation Laboratory to measure the acceleration of the universe, using distant supernovae, much more accurately than has been possible to date. "In putting together the 2004 budget we have made a significant commitment to SNAP," Orbach said.

Orbach also called for a major effort to improve US computing capabilities. He pointed out that the Japanese have built a computer, the Earth Simulator, that studies the weather and is roughly 50 times faster than anything that exists in the US. "To find ourselves second on an international scale is a national disaster," he said.

The study of quantum chromodynamics (the theory of strong interactions) on a lattice is an excellent way to develop leading-edge

*See* PANEL PROBES *on page 4*

# LETTERS

## Top Quark Discovery Was a Joint Effort

We are very pleased to see that in the April 2002 issue of *APS News*, "This Month in Physics History" (on page 2) describes one of the recent successes of particle physics, the discovery of the top quark. The article contains a very fair description of how the discovery unfolded.

Unfortunately, in searching for a snappy title for this piece, your healine writer erred. "April 1994: Discovery of the top quark at Fermilab" is not correct, and the article itself makes this clear. In 1994, the first evidence for top started to come in, and the actual discovery was made in 1995. This is important because the 1995 results were the independent work of two groups and were statistically very solid. The 1994 publication was from one group, and wasn't close to meeting the normal criteria for a discovery in particle physics (a five standard deviation effect).

This may seem like a tempest in a tea-cup, but hundreds of people, including many graduate students, worked hard to put the data concerning the top quark on a rigorous and statistically firm basis. By 1995, when this had been done, discovery could be, and was, announced. Without them, the discovery wouldn't have happened. They are naturally very sensitive to any perceived attempt to "backdate" the discovery to this earlier paper. This would imply that all their hard work was unneeded.

**Harry Weerts**
**John Womersley**
***Fermilab***

## Report Omitted "Wigner and Symmetries" Talk

I just received the *APS News*, April 2002, Volume 11, No.4 on page 3 there is a note on "Remembering Wigner". The writer probably was not present at the Centennial Symposium in honor of Eugene Wigner. He speaks of George Marx who gave a lively talk on Wigner' s life, John Wheeler, whose subject was interesting but unfortunately his health was poor, and Alvin Weinberg, who very properly mentioned Wigner as the first nuclear engineer.

He forgot the fact that I, Wigner' s student in 1946-1949 with whom I got a Ph.D., had the task of talking on "Eugene Wigner and Symmetries in Physics" where I tried in 40 minutes to present the main achievements of Wigner on applications of group theory from atomic to relativistic physics.

As I have spent my life working at the Universidad Nacional Autonoma de Mexico my name was probably unknown to the author of the report, but at least he must have read the abstract of my talk that appeared in the Bulletin of the April Conference.

**Marcos Moshinsky**
***Mexico City***

## A Scientist looks at the Corporate Universe

In the hectic corporate world, one should understand the underlying physics. When Einstein studied the physical universe, he concluded that as one goes faster and faster, time slows down. This is good! However, in the corporate universe, analysis has shown that as one goes faster and faster, time accelerates. The time you have to do the next job is always less than the time available for the current job.

A corollary of this theorem is captured in the well known folk saying, "The more faster you go, the more behinder you get."

**Sheldon Kavesh**
***Whippany, New Jersey***

## More on Kelvin's Degree

In a letter in the March issue of *APS News*, B.S. Chandrasekhar 'corrects' Arne Reitan on the issue of whether the plural of kelvin is kelvin or kelvins. Without taking sides on who is right, I advance the following explanation for the confusion.

We used to say the temperature was, *e.g*,. N degrees Celsius or K degrees Kelvin. Note that degrees is plural. Now the word degrees has been dropped (along with the capital letter) and we get K kelvin (without the s). In other words kelvin is a short-hand for degrees kelvin.

**W. J. Metzger**
***Nijmegen,***
***The Netherlands***

## Bridge Goes Too Far

I must take issue with your decision to publish the Zero Gravity article written by Martin Bridge (May 2002). Are the pieces in *APS News* not refereed or is it that you seek to promote sexist and elitist ideas? This article was not funny. I don't know much about so-called table-top fusion, so I can't comment on whether or not this author and you have any justification for such ridicule of that experiment, but I must comment on the depiction of women and community college teachers.

I quote. "'You'd think we'd found the Higgs Boson or something,' said Emily McTavish, who has been having her hair done at Gladys's every other Wednesday." What is the intended sentiment in this quip found in Bridge's article? It seems obvious to me: Women in beauty parlors should clearly know nothing about the Higgs Boson. It reminds me of a talk given by a colleague a few years ago, where he kept stating that "even my mother could understand this." I asked him after the fourth or fifth repetition if his mother wasn't a physicist. He was not amused. As a female member of the audience, neither was I. Another physicist whom I admire thought I shouldn't take offense if none was intended. Perhaps Mr. Bridge meant no offense either, but one can easily see his attitude towards women and APS editors should be sensitive to how it could make female members of their society feel.

Likewise, how should physics teachers at community colleges feel about this "lighter side of science?" Another supposedly funny part of the article goes on, "Rodney Colquist, a physics teacher at Swampscott Community College, was the one who discovered what was going on when his wife, Samantha, came home after her appointment at Gladys's in a frenzy of excitement and disbelief." Clearly,one should have no respect for the intellect of a physics teacher at a mere community college, it seems. And if not, then how about high school teachers — the ones we're supposed to be desperately, actively recruiting? I thought APS wanted to do something about attracting more women to physics also, but I guess was wrong about that.

This makes me want to quit being a member of your society, but you're the only game in town, so I guess I have to renew my membership, though it has a bitter taste.

**Monica Halka**
***Portland, Oregon***

## 2002 Physics Olympiad Team Announced

## Country's Brightest Students Head to Physics 'Boot' Camp

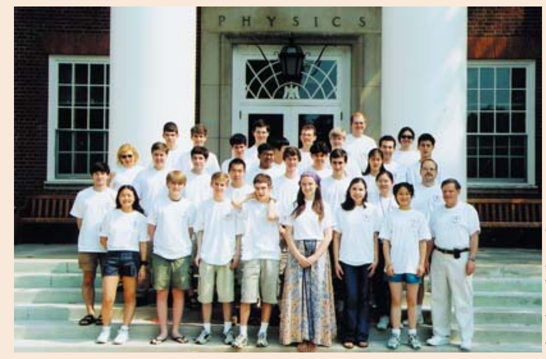

*Photo by Malcolm Tarlton*

Twenty-four students from 15 states have been selected as some of the brightest physics and math students in the country. On May 31st, the students will arrive at the University of Maryland as members of the 2002 Physics Olympiad Team. First nominated by their high school physics teachers in January the students began taking extremely challenging physics exams, eventually scoring higher than 1100 other students to earn a spot on the prestigious team.

The team is about more than just academics however, says Dr. Bernard Khoury, Executive Officer of The American Association of Physics Teachers (AAPT), which co-sponsors the U.S. Olympiad Team with the American Institute of Physics (AIP). "These students are great role models, learning what it means to be the leaders driving the technological advances of tomorrow," he says.

The Physics Team will spend a week at the physics 'boot' camp, conducting lab experiments, taking exams, and hearing presentations from prominent scientists. They will also be competing. The top five students from the camp will be awarded medals and college scholarships at a tribute ceremony at NASA headquarters in Washington D.C. on June 7th. At the ceremony the students will hear from NASA Astronaut Dr. John Grunsfeld, a veteran of four space flights, including the most recent shuttle mission to service the Hubble Space Telescope. "Dr. Grunsfeld is an excellent example of where physics training can take you," says James Stith, Vice President of Physics Resources at AIP.

The U.S. Physics Olympiad Program was started in 1986 to promote and demonstrate academic excellence and prepare students to compete in the International Physics Olympiad. Due to concerns about the safety of international travel, this year's winners will not be traveling to the international competition being held in Indonesia.

*— Inside Science News Service*

## FRIEDMAN, *from page 1*

Violating Process project as an example, and recommended that NSF adopt a process similar to that outlined in the legislation. Friedman also described the large decline in students enrolled in physics since the 1960s, noted the corresponding reduction in physics research funding, and said that many students "felt they had no future" in physics.

Among other witnesses at the hearing was the dean of Tufts University's engineering department, Ionnis Miaoulis, who expressed concern that the nation's unbalanced R&D portfolio, with underfunding for the physical and engineering sciences in favor of the life sciences, "will in the long run have a detrimental effect on the life sciences," later declaring, "The nation's creative minds should spend more time focusing on their research and less time trying to get funding."

University of Maryland President C.D. Mote described the financial constraints facing principal investigators in need of hiring students to perform research, but expressed even greater concern over looming scientific manpower shortages. "[This] authorization bill will send a strong signal to the appropriators, the rest of the Congress, and the Administration, that support for the NSF is strong, it is bipartisan, and it is grounded in sound arguments," he said.

At the conclusion of the hearing, subcommittee members approved the bill and sent it to the full House Science Committee, which reviewed it the following week. However, the legislation has a long way to go. Smith predicted that "competition for money is going to become much more aggressive" in the wake of the

*See* FRIEDMAN *on page 7*

## Panel Probes, *from page 3*

computers, Orbach maintained. "QCD simulation leads the way," he said, calling it "as fundamental an exercise as experiment and theory."

Dehmer said that despite current problems with funding, "the public enjoy and are impressed by new developments in science." He noted that although the FY2002 NSF budget was up 4.4%, the level of funding for individual investigators in physics was actually down about 10% because of the necessity to support facilities, new initiatives like Physics Frontier Centers, and other NSF-wide commitments. He added that the overall FY2003 request was down by 1-2% but expected nevertheless that the situation would improve for the individual investigators.

"Broad support for physical science has been strong and coherent" on Capitol Hill, Dehmer said, and predicted that the effects of that support would be evident when the Congressional appropriations were passed in the fall.

Not being a particle physicist himself, Brinkman took a broader view and addressed the question of whether physics as a discipline was in some kind of malaise. He cited a variety of reasons for this perception, and pointed out that in many cases the reality was quite different.

Although there has been declining enrollment in physics, and PhD production now stands at about 1200/year, Brinkman noted that when production reaches 1500 unemployment can result, and as long as it stays above about 1000 there tends to be an adequate supply of new physicists. He concluded that "this is not a major aspect" of any possible malaise.

He did agree that the number of Americans going into physics has gone way down, and suggested that this could be ameliorated if the funding agencies would significantly increase the stipends that they offered to students, for example with NSF Fellowships.

Another factor Brinkman cited was the perception that there is an increasing emphasis on biology at the expense of physics. But he noted that "some physicists" had invented a way to do very rapid decoding of DNA, which stimulated great advances in biology. He said there were "opportunities in biology for physicists that we shouldn't ignore", and remarked that "if you can't fight 'em, join 'em."

"Physics has become irrelevant to our quality of life" was another complaint that Brinkman felt was highly overstated. He said that not only was the Web invented by physicists, but the entire internet is based on improved optical communication, and cited the optical amplifier as "one of the enabling things invented by physicists."

Brinkman echoed Orbach and Dehmer in asserting that "concepts in astrophysics, cosmology and particle physics have greatly piqued the

*See* PANEL PROBES *on page 7*

# Viewpoint...

## Professional Master's Degree Programs: A Case Study in Identifying Challenges and Orchestrating Successes

*By Alaina G. Levine*

There's been a lot of talk recently about professional master's degree programs (PMDPs) in applied physics. We've heard the rationale for and benefits of these initiatives: students who graduate from these programs have more career options and unique skills ranging from the highly technical to business acumen in communications, teamwork, and project management. Industry benefits because they get students who are specifically educated for industry and are ready and fully capable of contributing to the success and bottom-line of companies and organizations. Of course, physics departments benefit because PMDPs can foster new or reinforce existing partnerships with industry, cultivate connections with alumni, and invigorate departments by attracting a new crop of talented physics students who otherwise might not have considered graduate school.

So the word is out: PMDPs can do a lot of good for physics departments and the constituents they serve. But just because a PMDP is appropriate for one department, does this mean that every department should or even is able to jump on the PMDP bandwagon?

It is obvious that every physics department is unique and has its own individual needs and goals which must be adequately scrutinized before solidifying the decision to institute a PMDP. Since every situation is different, it would be impossible to provide a singular model program which other physics departments can emulate. However, one can examine a case study of a successful program, in which the sponsoring department, in initiating and administering the PMDP identified the desire and need for the creation, the challenges it faced and still faces, and keys which led to the program's ultimate fruition and success.

**The Case:**
The University of Arizona's Professional Master's Degree Program in Applied and Industrial Physics

*Alaina G. Levine*

**Background:**
The University of Arizona (UA) launched its professional master's degree program in 2000, sponsored by the Sloan Foundation's nationwide initiative. The program was created "in response to the often-repeated complaint that physics professors typically train Ph.D.s to be carbon copies of themselves," said Daniel L. Stein, Head of the UA Physics Department.

"Meanwhile, there's a real and increasing demand in industry for people who bring the unique skills and perspectives of physics to bear on solving problems that arise in the development and manufacture of various goods and services. So, in the spirit of 'adapt or die', we explored ways in which we could take the initiative and provide a service to both students and industry while of course benefiting ourselves at the same time," Stein said.

The UA's program was organized around a series of learning outcomes designed to give students proficiency in teamwork, change management, computational techniques, communication, and basic business and legal issues associated with scientific projects. The components of the program consist of a core curriculum in graduate-level physics, specialty electives in any related subfield, two courses in business foundations and project management, a colloquium series with speakers from industry ranging from CEOs to intellectual property attorneys to lab directors, an internship, and a final project or thesis. The final project, which takes into account the learning outcomes and unites the physics with the industrial aspects of the degree, often is a culmination of research conducted or applied problems solved in the internship.

**Challenges and Keys to Success:**
The challenges of orchestrating a PMDP at the UA seem simple and straightforward, but many of them still exist. One issue the department realized early on is that it cannot assume that potential students will fully understand the uniqueness and more importantly the value of the PMDP in their career plans. Similarly, target companies for internships or permanent positions also did not comprehend the benefit of hiring students from the PMDP. The department realized that these problems could be solved through public relations efforts and a lot of one-on-one discussions with students and industry partners. However, it is a slow process, and since the PMDP is such a new concept, the department regularly seeks advice from other PMDPs on how to effectively recruit students and industry partners, most notably with other Sloan-funded schools, such as Michigan State University and Rice University.

One of the main reasons the department has had success in its program is because it continually reevaluates the program and its goals, fine-tuning any aspect that has deviated from the ultimate mission of the PMDP. Self-assessment, and constant and thorough consultation with industry, faculty, and students are certainly keys to success as the program continues to grow and prosper. In addition, great pains have been taken to ensure that the actual physics has not been compromised for the sake of the "professional" aspect of the degree. Yet, the program is flexible, allowing students to specialize in any subdiscipline of physics or related area (such as optics or satellite circuit design). Students constantly interact with industry leaders and have the opportunity to attend special industry-related conferences, tradeshows, seminars, and skill-building workshops.

By building the PMDP around not only the research strengths of the department and other units at the UA, but also the industrial strengths of the region, and by instilling in the program an inherent and perpetual alliance with industry, this PMDP has been able to effectively serve and benefit all of its constituents. Physics students receive excellent educational experiences uniquely preparing them for industrial careers, particularly geared towards regional enterprise. Industry benefits from a new workforce with strong technical skills, knowledge of business fundamentals, and consequentially, the connection between science and business in industry.

*Alaina G. Levine is Directory of Special Projects, College of Science, University of Arizona. She currently oversees the University of Arizona's Professional Master's Degree Program in Applied and Industrial Physics, Mathematical Sciences, and Applied Biosciences, as well as public, media, and industrial relations for the UA College of Science and its 14 departments. She can be contacted at alaina@u.arizona.edu or 520-621-3374. More information on the UA PMDP can be obtained at http://cos.arizona.edu/sloan.*

# zero gravity

**The Lighter Side of Science**

## SCIENTIST SPLITS ATOM, FINDS TOY PRIZE INSIDE

### Promise of Hidden Surprises Has Propelled Fission Research for Decades

*Princeton, N.J. (SatireWire.com)* — A Princeton physicist recently split an atom of hydrogen and found a toy prize inside, the journal *Science* reported in its June issue.

"It was just a cheap plastic clicker you use to make cricket sounds, and it broke, like, the second time I used it, but it was the surprise I found most satisfying,"said Prof. Harold Lumiere of the Princeton Plasma Physics Laboratory.

*Science* noted that it was the first prize found inside an atom since Allison Wyatt of Cambridge University discovered a magic puzzle toy in a lithium atom in February.

For Lumiere, it was the first time in his 15-year, atom-splitting career that he has come across anything more than the normal protons, gluons, and quarks. "I know that over at MIT, Hendricks has amassed an entire collection of little *gewgaws* – spinning tops, decoder rings, stickers," he said. "He is so lucky. I hate him."

And well he should. Atomic prizes are so rare as to drive scientists into the field of physics, and then, quite often, drive them mad.

Legendary theoretical physicist Richard Feynman, in fact, first became interested in nuclear fission after watching a professor at Cal Tech discover a mystery motion fun card inside an iodine atom. Feynman himself, however, never knew that joy. This deficiency caused him to declare, on his death, that despite his Nobel, he had failed to win the only real prize in physics.

Even Enrico Fermi, a pioneer of fission, had to wait nearly 10 years before discovering a plastic whistle inside a newly split nucleus of uranium. "He was so happy, he just cried and cried," wrote colleague Edward Teller in his 1952 book, *The Physicists Guide to Isotopal Isolation and Collectible Atomic Prizes*. "For days after, Enrico kept running around the lab, his fingers to his lips, trying to play that whistle," Teller recalled. "Of course, we couldn't hear it, but he said he could. He was such a goof."

More than half a century later, perceptibility remains an issue with physicists. "You can't do much with (the toys) because they're infinitesimally small," said Lumiere. "You can only play with them under an electron microscope, and if you have to sneeze, kiss it goodbye."

Some winners, meanwhile, have been forced to part with their prizes without so much as exhaling.

In his book, *Bohr, Baubles, and the Bomb: Why the Nazis Lost the Nuclear Race*, historian Everson White recounts how Hitler's quest to build the ultimate weapon was thwarted by his own policies that claimed atomic prizes were the property of the Third Reich.

Danish physicist Niels Bohr, a fission pioneer, fled occupied Denmark after learning of the policy, while German colleague Werner Heisenberg stayed behind but sabotaged the program after Goering confiscated a "Hi Score" pinball game Heisenberg found in a phosphorous atom.

Ironically, while the lure of tiny tokens has shaped history and led scientists to unravel much of the riddle of the atom, the existence of the prizes themselves is perhaps the greatest mystery facing physics today. Who, they still wonder, put the prizes there?

Many have proposed theories. Einstein thought it was aliens. Niels Bohr suspected it was Einstein. Ernest Rutherford conjectured that the prizes were natural formations. But most physicists today accept the argument espoused by Nobel laureate Ernest Walton, who along with John Cockcroft split the atom in 1932.

In early 1946, Walton was thrilled to discover a decoder ring and secret message inside a carbon atom. After four days of painstaking work, he finally deciphered the message: "Sorry," it read, "you're not a winner. Try again." "That's gotta be God," Walton reportedly said.

*Reprinted with permission from SatireWire.com, who also have authored the new book "Economy of Errors: SatireWire gives Business the Business."*

# 2002 APS General Election Preview — Members to Elect New Officers, Councillors from 2002 Slate of Candidates

Election notices and invitations to vote electronically were sent to APS members with valid e-mail addresses in June. Members without e-mail or invalid e-mail addresses were sent paper ballots. Web votes and paper ballots must be received by Survey and Ballot Systems by noon CDT, **September 1, 2002** to be counted. Paper ballots can also be requested by calling 301-209-3288 or e-mailing governance@aps.org ***Editors Note:*** Complete biographical information and candidate statements can be found at: http://www.aps.org/exec/election2002/

## FOR VICE-PRESIDENT

**MARVIN L. COHEN**
*University of California, Berkeley*

Born in Montreal, Cohen was an undergraduate at Berkeley and completed graduate studies at the University of Chicago in 1963 (PhD 1964). After a one year postdoctoral position with the Theory Group at Bell Laboratories (1963-64), he joined the Berkeley Physics Faculty, becoming University Professor in 1995. He has also been a Senior Faculty Scientist at the Lawrence Berkeley National Laboratory since 1995. Cohen's current and past research work covers a broad spectrum of subjects in theoretical condensed matter physics. He is best known for his work with pseudopotentials with applications to electronic, optical, and structural properties of materials, superconductivity, semiconductor physics, and nanoscience. Cohen is the recipient of the APS Oliver E. Buckley Prize for Solid State Physics and the APS Julius Edgar Lilienfeld Prize. In 2002 Cohen will receive the National Medal of Science.

He has served as a member and then chair of the Executive Council of the Division of Condensed Matter Physics of the APS, as the US representative on the IUPAP Semiconductor Commission, and as a member of the National Academy of Sciences Government-University Industry Research Roundtable. Cohen served on a variety of national and international boards and committees as an advisor and advocate for science education. He was Vice Chair of the NAS-GUIR Working Group on Science and Engineering Talent emphasizing the recruitment of women and minorities. He was a featured speaker for the Electron Birthday Project (televised to US high schools) and is currently active in lecturing to lay groups, K-12 students, and industrial groups.

## FOR VICE-PRESIDENT

**NEAL LANE**
*Rice University*

Lane was born in Oklahoma City, Oklahoma, and obtained his B.S., M.S. and PhD degrees from the University of Oklahoma. From 1993 to 2001, Neal served in the Clinton Administration, first as Director of the NSF, from 1993-98, and later as Presidential Science Advisor and Director of the White House Office of Science and Technology Policy, from 1998-2001. At the NSF, Neal emphasized the integrity of peer review; balance of funding among fields; NSF-wide support of all large construction projects, such as LIGO; quality science and math education for all; staff morale; electronic proposal processing; good relations with the White House and Congress; and other matters. While at the White House, he stressed the importance of research funding for the physical sciences, a point emphasized by President Clinton in his FY2001 budget request, which included the new National Nanotechnology Initiative.

Prior to going to Washington, Lane enjoyed a successful academic career in teaching, research, and administration. He was Provost of Rice University from 1986-93, and Professor of Physics, from 1972, serving one term as chair. He also has served as Chancellor of the University of Colorado at Colorado Springs (1984-86), and Director of the NSF Division of Physics (1979-80).

His field of research is AMO physics, specializing in electronic and atomic collision theory. He serves on several boards and advisory committees and has received a number of fellowships, honorary degrees, and awards, including the AAS/AMS/APS Public Service Award. He has served at various times on APS Council and Executive Board, POPA (chair 1983), and other APS committees. He currently serves on the APS Physics Policy Committee.

## FOR CHAIR-ELECT, NOMINATING COMMITTEE

**JOHN PEOPLES**
*Fermilab*

Peoples is a senior scientist in the Fermilab Experimental Astrophysics Group and Director of the Sloan Digital Sky Survey (SDSS). He received his Ph.D. in Physics in 1966 from Columbia University. He was an Assistant Professor in Physics at Columbia from 1966 to 1969 and at Cornell University from1969 to 1972. He joined Fermilab in 1972 and during the next sixteen years he was engaged in the construction and management of experimental facilities and accelerators for high-energy physics. He served Fermilab as Deputy Director in 1988 and Director from 1989 to 1999. He was appointed Director Emeritus in 1999. He was the chair of the Division of Particles and Fields in 1984 and the chair of the Division of Physics of Beams in 1999, and is currently a member of the APS Committee of International Scientific Affairs. He was a member of the High Energy Physics Advisory Panel from 1976 until 1980 and again from 1984 through 1985.

## FOR CHAIR-ELECT, NOMINATING COMMITTEE

**SUNIL SINHA**
*University of California, San Diego*

Sinha obtained his Ph.D. in physics from Cambridge University in 1964. He has held positions at universities (Iowa State University, 1965-1975), industrial research laboratories (Exxon Corporate Research Laboratories, 1983-1995), and government research laboratories (Argonne National Laboratory, 1975-1983 and 1995-2001). He is currently professor of physics at the University of California San Diego. His research involves the study of the structure and dynamics of Condensed Matter using neutron and X-ray scattering techniques. He has spent several periods as a visiting fellow and visiting scientist in Japan, France, Germany, Denmark and India. He has served on the Executive Committees of the APS Division of Condensed Matter Physics and the APS International Physics Group, and on numerous advisory and review committees of several materials science and physics departments and neutron and synchrotron radiation facilities around the world.

## FOR GENERAL COUNCILLOR

**JANET M. CONRAD**
*Columbia University*

Conrad received her Ph.D. from Harvard University in 1993. Since that time, she has been associated with Columbia University and is presently an Associate Professor. At present, Conrad's research focuses on using neutrinos as tools to search for beyond-the-standard-model physics signatures. She was given the Marie Goeppert-Meyer Award from APS in 2001 for her leadership in the search for neutral heavy leptons at the NuTeV deep inelastic neutrino scattering experiment at Fermilab. Conrad has been active in the APS since she was a graduate student, and is a member of FPS, DPF, DPB and DNP. She has been a member of the DPF Executive Committee since 2000. She has served on the Tanaka Prize Committee and is presently on the Selection Committee for the Maria Goeppert Meyer Award. She has been active in outreach and mentoring, giving public lectures, describing neutrino physics on NPR's Earth & Sky, and serving on a number of panels focused on outreach to educators and the larger community.

**STEVEN G. LOUIE**
*University of California, Berkeley*

Louie received his Ph.D. in physics in 1976, both from the University of California at Berkeley. He was a postdoctoral fellow at the IBM Watson Research Center, a visiting member of the technical staff at AT&T Bell Laboratories, and Assistant Professor of Physics at the University of Pennsylvania before returning to UCB in 1980. He is concurrently a Senior Faculty Scientist in the Materials Sciences Division of the Lawrence Berkeley National Laboratory. His research interests are in theoretical condensed matter physics and nanoscience. He was awarded the APS Aneesur Rahman Prize for Computational Physics in 1996, and the APS Davisson-Germer Prize in 1999. Within the APS, he has served on the Aneesur Rahman Prize Selection Committee, the Davisson-Germer Prize Selection Committee, the Nicholas Metropolis Award Selection Committee, and the Nominating Committee, Fellowship Committee, and Executive Committee of the Division of Computational Physics.

## FOR GENERAL COUNCILLOR

**LAURA SMOLIAR**
*Lighwave Electronics*

Born in New York City, Smoliar earned her Ph.D. from the University of California, Berkeley in 1995. As a graduate student, she spent seven months in Taiwan at the Institute of Atomic and Molecular Sciences (IAMS), an institute of the Academia Sinica founded by Professor Lee and spent an additional year as a postdoc working at IAMS and the Synchrotron Radiation Research Center (SRRC). Smoliar has worked in Silicon Valley since September, 1996. Initially she worked in the data storage industry at Seagate Technology, and in 1998 co-founded a start-up working on three-dimensional laser-based displays. She was then recruited by Lightwave Electronics, a small privately-held photonics company in Silicon Valley, to lead a development program aimed at the display industry. At Lightwave, she manages a multi-disciplinary group of engineers and physicists, working very closely with development partners in Asia and Europe. She has been very active in the APS Forum on Industrial and Applied Physics, serving on the Executive Committee and as Chair in 2001-02.

**KATEPALLI SREENIVASAN**
*Institute for Physical Science & Technology, University of Maryland*

Sreenivasan was educated in India, Australia and Johns Hopkins and was a faculty mamber at Yale University from 1979 until this year. He is currently the Distinguished University Professor and Director of the Institute for Physical Science and Technology at the University of Maryland. His research is devoted to experimental and theoretical studies of wide-ranging problems in fluid dynamics, with a major focus on the turbulent state. Within the APS, Sreenivasan has served as the Chairman of the Division of Fluid Dynamics, Chairman of the Topical Group on Statistical and Nonlinear Physics which he helped create, Associate Editor of Physical Review E (1994-97), and Divisional Associate Editor of Physical Review Letters. He is also a member of the APS Publications Oversight Committee. Sreenivasan was awarded a Guggenheim Fellowship in 1989 and the APS Otto Laporte Award in 1995.

# ANNOUNCEMENTS

## Are you active in or supportive of undergraduate research?

The Council on Undergraduate Research (CUR) and its affiliated colleges, universities, and individuals share a focus on enhancing research opportunities for faculty and undergraduate students. CUR provides support for faculty development, works with agencies and foundations to develop research opportunities for faculty and students, and assists administrators and faculty members in improving and assessing the research environment as it relates to undergraduate education at their institutions. We are the national voice for undergraduate research and for primarily undergraduate institutions.

CUR welcomes faculty and administrators from all academic institutions as we continue to promote undergraduate research and the integration of research and undergraduate learning. Our membership is organized into eight divisions: biology, chemistry, geosciences, mathematics and computer science, physics and astronomy, psychology, social sciences, and an at-large division serving administrators and other disciplines. For additional information about our programs, meetings, publications, and members, please visit our website at http://www.cur.org.

We hope you will join us. If you are interested in joining, please go to http://www.cur.org/membership.html or contact us at cur@cur.org or (202)783-4810.

## Science's Next Wave

www.nextwave.org, is the weekly online publication that focuses on the careers of scientists—from undergraduates to faculty. Next Wave is published by the American Association for the Advancement of Science (AAAS) and *Science* magazine.

This global site includes weekly news, alternative career profiles, discussion forums, career advice and funding information.

To stay on top of the latest articles from Next Wave, you can subscribe to our weekly e-mail alerts at http://mailman.aaas.org/mailman/listinfo/snwreader

APS has a society-wide subscription to Next Wave. As an APS member, you can access our site for FREE through the APS website at **http://www.aps.org/memb/students.html**

What we offer: **Monthly Features . For Faculty. For Postdocs. For Graduate Students. For Undergraduates. Minority Scientists Network (MiSciNet).**

Check out YOUR Next Wave's Forums!
These forums are by YOU and for YOU, the reader.

## 2002-2003 Women's International Science Collaboration

AAAS announces the second round of applications for the 2002-2003 Women's International Science Collaboration (WISC) Program.

Supported by the U.S. National Science Foundation (NSF), this program aims to increase the participation of women in international scientific research through travel awards to locations around the world.

Applicants must be female, have a female co-principal investigator, or propose a partnership with a female researcher in another country. Applicants must have a Ph.D. or equivalent research experience. Graduate students (Ph.D. candidates) are also eligible, if they will be conducting research in an established Ph.D. program in the U.S.

For further information please visit the NSF website at http://www.nsf.gov. **The next application deadline is July 15, 2002.**

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**WEN HO LEE,** *from page 4*

dollar government investigation, and Lee's nine months of solitary confinement culminated when Lee pled guilty to one of the prosecution's fifty-nine original charges. On September 13, 2000, US District Judge James Parker apologized to Lee for the government's abuses during the investigation and prosecution, and subsequently sentenced Lee to time served for mishandling sensitive material.

Repercussions stemming from the Lee espionage case continue to shake up federal law enforcement agencies and the National Laboratories. A Government Accounting Office report requested by House Representatives David Wu (D-OR) and Eddie Bernice Johnson (D-TX) in response to Lee's case was released in April. The report, entitled "Actions Needed to Strengthen Equal Employment Opportunity Oversight," revealed a pattern of discriminatory employment practices toward women and minorities at three national weapons labs, including LANL. Also in April, Ray Juzaitis' bid for the top position at Lawrence Livermore National Laboratory was derailed in part because of his comparatively remote supervisory connection to Lee as head of nuclear weapons research at LANL during the Lee fiasco. And the pathological investigation of Lee's case is frequently cited along with intelligence failures prior to the September 11 attacks as evidence of the breakdown in our national security infrastructure.

Although Lee recently released a biographical account of his harrowing experiences (*My Country Versus Me, Hyperion*, 2001), and has become the poster child for groups monitoring investigative abuses and racial discrimination, he is a difficult man to reach these days. Lee is insulated by phalanx of friends and relatives eager to protect what is left of his private life. In addition, his lawyers are loath to permit him to comment on anything that relates to his current civil suit alleging that the government violated Lee's privacy by leaking his name to reporters during the espionage investigation. Nevertheless, APS News recently managed to pass the following questions to Lee through a trusted intermediary.

**APS News:** A number of scientists have publicly stated that the government's actions against you, after its discovery that you had mishandled sensitive information, were unjustified. In particular, detaining you without bail and placing you in solitary confinement seemed excessive. On the other hand, in your book you concede that copying certain files constituted security violations. Do you think the government's discovery of those security violations warranted some action against you, and if so what sorts of actions would have been appropriate?

**WHL:** The purpose for downloading my files was to protect my work. I used the best technique that I knew to protect my files. I know others who have performed similar downloading, but nobody was ever put into solitary confinement like me. The worst punishment I have heard for someone who performed similar downloadings was relocation from a secured area to an unsecured area.

**APS News:** During your February appearance at New York University to promote your book, you said, "I hope when you read [My Country Versus Me] you will see what a huge mistake the government has made and will learn something from my experience." What specifically do you think we can learn from your experience?

**WHL:** As a scientist, we always try to do a good job on our research work. Now, I know that we also have to pay attention to the politics.

**APS News:** The response of the US scientific community, including the American Physical Society, to the news of your arrest and denial of bail consisted primarily of well publicized letters to Janet Reno and other governmental officials demanding you be released on bail pending trial. Do you feel this response was sufficient?

**WHL:** I feel that the American Physical Society and the rest of the US scientific community have done the best they could. I really appreciate everyone's help!

**APS News:** Based on your experience, would you advise foreign and naturalized scientists working in the US not to accept employment requiring a security clearance? How about employment, at Los Alamos and other National Laboratories, if a security clearance is not required?

**WHL:** I feel that racial profiling may be a very complicated and longstanding problem. It will take a long time even to make tiny progress. Therefore, the risk of unequal treatment may still be unnecessarily high for a foreign and naturalized scientist working in a US Company that requires security clearance. For employment in the open area at Los Alamos or other National Laboratories, the work environment is much better than in the secured area.

**APS News:** Finally, do you think you will be content to spend the remainder of your life in retirement? If you think you might want to get back to work, what sort of employment do you envision? Has your trial and conviction hampered your efforts to secure such employment?

**WHL:** I have tried to get a job in both the university and industry setting. But, so far, I have not been able to locate a job. I am currently doing my own research on semiconductor design. I hope that someday I can make a contribution to the electronics industry.

Wen Ho Lee and his wife Sylvia still live in New Mexico. He works in his garden, and frequents secret fishing spots where he can bag trout twenty-seven inches long. Lee's son Chung is a medical student, and his daughter Alberta is a vocal activist for her father's cause. Further information on Lee's case and a petition drive for his presidential pardon is available on the web site "www.WenHoLee.com."

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**PANEL PROBES,** *from page 4*

interest of the general public." He denied that it looks like physics is in trouble because one cannot go on building bigger machines, pointing to the exciting results from the neutrino observatories, and expressing confidence in physicists' abilities to find "new directions, new ways of doing things."

Summing up, Brinkman urged his audience to "think of yourselves as physicists—you are one end of a spectrum from the curiosity driven to the very applied. You are part of a very large community that does all kinds of physics."

Wojcicki agreed with Orbach's contention that the next accelerator had to be international from the start. "The next major accelerator facility, a TeV scale linear collider, has to be an international effort," he said, but added that "construction of a multi-billion dollar scientific facility as an international enterprise will not be a piece of cake. In addition, our political system with its separate Executive and Legislative branches and our funding system, with its year to year appropriations, do not make the situation any easier."

He also remarked on internal problems within high-energy physics, especially as they affect younger people. "What does a graduate student do in a 500 member collaboration? How does she manage not be lost? How does he manage to have his work recognized?" he asked, adding that "the experimental timescale today exceeds the natural time scales of a graduate career, postdoc tenure, or appointment length of an Assistant Professor. The senior people in the field…must address [this] issue and search for solutions which will overcome these inherent difficulties that are of such paramount importance to our younger colleagues."

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**FOCUS,** *from page 3*

all, the world's current political and social volatility presents at least as much challenge to CISA and CIFS as did the precarious balances of the cold war era. However they approach their respective tasks, the chairs are both hopeful that the committees will continue to effectively reflect the growing international flavor of the APS. Ironically, one of the positive outcomes of these troubled times is likely to be increased contact, and potentially improved relations, with Islamic nations that have long been under-represented in the global physics community.

*–James Riordon*

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**FRIEDMAN,** *from page 4*

September 11th terrorist attacks, and performance and results will therefore become more important in scientific research. Rep. Gil Gutknecht (R-MN) said that Congress is facing difficult fiscal challenges, and that Congress reflects the will of the American people, whose priorities lean more towards national security, prescription drug coverage, and lower taxes. After passing the Research Subcommittee unanimously, and gaining the approval of the Science Committee, H.R. 4664 was passed by the full House of Representatives on June 5.

# THE BACK PAGE

## LAND MINES: An Explosive Issue Requiring Physicists' Help

*By Richard Craig*

I have to confess that I am not an expert on land mines. This issue marks my third anniversary of working in this area. What I've learned has been connected with research on how to deal with them. The mines I've met have had the detonators removed—and I'm just as happy to keep it that way. Land mines, however, present an issue that won't go away on its own and provide opportunities for physicists to apply their peculiar skills to help address this life-and-death issue.

Some refer to land mines as the perfect soldiers. They are inexpensive—a few 10s of dollars each to buy and deploy. They don't eat; they don't fall asleep on duty; they don't require maintenance. Land mines are selective in the sense that they don't, generally, detonate spontaneously or when encountered by something less than their target. By design, land mines aren't shock-sensitive so they're difficult and expensive to defeat.

Most field soldiers with whom I've spoken don't like them at all. They view land mines as an evil component of warfare. To them, land mines are undiscriminating weapons that kill and maim friends and foe alike.

Yet another perspective is that of civilian inhabitants of former war zones. For these people, land mines are a part of their everyday life. Land mines render their living and working areas dangerous. This is especially true in the case of civil wars for which the purpose of the land mines is, often, genocidal. Bosnia/Herzegovina and Croatia are one such example: Land mines, laid as part of ethnic cleansing activities, continue to contaminate the traditional living and farming areas of noncombatant populations.

### Low tech, High numbers

The numbers are overwhelming. The United Nations estimates that more than 110 million mines contaminate greater than 20 million square miles in 64 countries. (See Table 1.) It estimates more than 800 civilian deaths per month. Because antipersonnel mines are designed to maim rather than kill many others are crippled.

There are various estimates for the rates of humanitarian land-mine removal but, until very recently, the rate of mine placement exceeded that of removal manyfold. The cost of land-mine removal is 2 to 3 orders of magnitude greater than that of placement.

The ORDATA II database lists 800 varieties of land mine; this includes metal, plastic, wood, and ceramic mines. There are anti-tank mines, bounding mines—antipersonnel mines that pop out of the ground and then explode, for increased effective radius—and "toe poppers" with just a few grams of explosive. For most modern mines the casing is plastic and little to no metal is used in construction. Consequently, induction-based metal detectors, which worked so successfully on WWII metal mines are of very limited application. Sappers—those who remove mines—are loath to depend on low-detection probability techniques because false negatives are the source of about half of all land mine injuries.

The people who presently remove land mines mostly do so by hand. They use a probe to search the ground, inch-by-inch.

Except for the mechanical probe, there may be no single technology capable of finding land mines under all conditions. And a different mechanical probe is required for differing conditions.

A continuing issue for all technologies is "clutter"—objects that have signals similar to the target but that are false positives. When real-time imaging is possible, this provides the operator with the basis for interpreting away much clutter.

### High-tech options

The scientific community already has invested considerable R&D to find, remove, and dispose of land mines. Various approaches are being developed, each with advantages and disadvantages either from a technical aspect, feasibility angle for implementation, or cost issue. Each is significant in its own way. Because of the variety of environments in which these must operate, the international community is moving towards an integrated suite of technologies as the most reliable and comprehensive method of detecting land mines, instead of relying on a single device.

In terms of finding land mines, the best single technology is still a dog or similar animal. The difficulty with the use of animals is that the training cost and required infrastructure often outweigh the advantages. The U.S. DoD has a "Synthetic Dog's Nose" program to replace the biological sensor with something electronic; mass balance sensors with selective coatings are the heart of this program but others are looking at ion-mobility devices. The limitation here is that most high explosives have vanishingly small vapor pressures; the technology depends on the vapors (primarily nitrobenzenes) released by trace contaminants and degradation products. Because vapor transport through soil is slow, the dog—and its synthetic analog—work best shortly after a rainfall.

Most research into mine detection involves a physical probe other than a mechanical probe. Ground-penetrating radar (GPR), is attractive because it provides the potential for imaging the subsurface when phase information is retained. The particular difficulty with GPR is that the impedance mismatch between the air and soil is so great that a large surface reflection results.

Nuclear quadrupole resonance (NQR) depends on the contrast in nitrogen concentration between the explosive and the soil. But the NQR return pulse is very weak and subject to interference, so fieldable NQR devices require substantial power sources.

Land mines have different thermal conductivity and heat capacity than the surrounding earth. As a result, at certain times of day, a land mine presents a warmer or cooler area than its surroundings. This is the physical basis of infrared techniques for mine detection. When IR detection works, it can work very well—antitank mines can show up very clearly from an airborne platform. The issue with IR is that it may not work at all. This is not a confidence-building characteristic for a demining technology.


Photo by NEED A NAME

Richard Craig

| Table 1. | MOST HEAVILY MINED COUNTRIES | |
|---|---|---|
| Country | Number of land-mines per square mile | Estimated total number of land-mines |
| Bosnia and Herzegovina | 152 | 3,000,000 |
| Cambodia | 143 | 10,000,000 |
| Croatia | 137 | 3,000,000 |
| Egypt | 60 | 23,000,000 |
| Iraq | 59 | 10,000,000 |
| Afghanistan | 40 | 10,000,000 |
| Angola | 31 | 15,000,000 |
| Iran | 25 | 16,000,000 |
| Rwanda | 25 | 250,000 |

**Note:** There is too little information about some countries to include them in the estimates. **Source:** UNICEF website http://www.unicef.org/sowc96pk/hidekill.htm.

Acoustic-detection techniques are also being explored. For these the principal hurdles is the large attenuation in soils and the very large impedance difference between air and soil. The latter essentially restricts the technology to in-ground transducers.

A number of groups around the world are using neutron scattering as a means of land-mine detection. One "gotcha" with neutron scattering is that some mines classified as plastic are, in fact, glass-fiber composite; apparently there is sufficient boron in the glass fiber to capture a large fraction of thermal and epithermal neutrons.

For all the nuclear techniques, the principal hurdle is the antipathy towards things radioactive. The sources used can be small enough as not to project any significant risk to the user—especially when considered in the context of working in a possible mine field—but public perception still regards things nuclear in a negative light. Just as NMR imaging was changed to MRI for public relations purposes, for the same reasons, developers of NQR are silently dropping the "N" to QR.

Current thinking in the land-mine detection community is multiprobe instruments, either to provide complementary strengths for differing soil conditions, or to provide on-board confirmation. Generally, the confirmatory instruments are integrated into autonomous remote or heavily hardened vehicles.

Once the issue of finding a land mine has been solved, the first step in the removal process is uncovering it. The present approach is to brush the covering soil off—very carefully to take into account the possibility of booby trapping. An "air shovel" has been developed—basically a vacuum cleaner operated in reverse—to carefully remove the soil around a found mine.

Uncovered, the mine can be destroyed in-place, although this usually requires a fairly substantial explosive charge because land mines are designed to be shock-insensitive. Moreover, exploding in place is unpopular because of the essential lack of control. Several groups are working on means to destroy, nonexplosively, mines in place. One such method is to use, in effect, a torch to cut through the mine casing and ignite the high explosive. In most instances, the high explosive will burn rather than explode.

### The Future: our challenge

The land-mine problem isn't going to go away. Some of the approaches presently being studied may help to reduce the problem but, even if each is able to provide a contribution under its most promising physical conditions, there will still be conditions under which none, yet addressed, are effective. Consequently, the world will not be clear of mines by 2010 or 2110 for that matter.

Where can physics help? The opportunities in detection are several-fold: First, identifying a physical probe or suite of probes that is superior to those under consideration; second, finding a way to improve the performance of the existing probes, and third, engineering that high-tech probe into a low-tech instrument that is patently acceptable to a community that is comfortable with mechanical probes. The powers-that-be in the demining community have a dream date: Mine detection at a distance with a minimum standoff of 10 meters. Others are specifying aircraft standoff. Most of the present probes are limited by applicable physics to much shorter distances.

The demining community will accept higher-cost devices; it will not accept a device that is perceived to reduce the reliability, compared to a mechanical probe, regardless of speed or other advantages. Perhaps the low-field magnetic resonance spectroscopy work coming out of Berkeley recently can provide a basis for low-power, low-field resonance chemical probing akin to NQR. The need for helium cooling would restrict the application only slightly. Another variation on the dielectric probe theme, (not yet considered for land-mine detection, to my knowledge, although it has been successful in examining storage tanks for leaks), is electrical-resistance tomography; this would require that the soil have some reasonable conductivity. Neutron-scattering land-mine detection could be improved substantially if a small, truly inexpensive neutron generator became available. This would also provide a source that might be "turned off", improving public perceptions, as well.

Finally, there is an interesting socioeconomic issue for humanitarian demining in developing countries. Presently, mine clearance there is often a closed shop. Those doing the work are among the best-paid workers in their countries. They are loath to see outsiders come in to replace them or allow others to do so. Any technology to be used in these areas must be engineered to be adaptable to the existing infrastructure.

As a community, how can physicists help? The physics community has repeatedly demonstrated the talent, creativity and attitude needed in the pursuit of feasible, reliable solutions to real-world challenges, including those of land-mine detection. The bottom line is that this problem isn't solved and it is more than just a technical challenge. We can develop technologies that will be used to save lives the lives of women and children often recruited to clear mine fields.

*Richard Craig is a physicist at Pacific Northwest National Laboratory in Richland, WA. He received last year's Christopher Columbus Foundation Award for his development of a timed neutron detector of plastic land mines*

**Editor's Note:** A longer version of this article can be found on line at www. aps.org/apsnews/.