APS NEWS

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(Try the enhanced APS News-online: http://www.aps.org/apsnews)

IN THIS ISSUE: Physics News in 1999

APS 100 years — celebrate a century of physics

APS April Meeting Drops Anchor in Long Beach, CA

Since the spring of 1999, when the *New York Times* first reported an allegation of a Chinese spy at Los Alamos National Laboratory, the attention of the national media, scientific community, and federal government alike has focused powerfully — and sometimes with heated disagreement — on the possible threat to national security of foreign-born scientists employed at the national weapons laboratories. On the afternoon of Saturday, April 30, at the APS April Meeting in Long Beach, California, a distinguished panel of scientists will discuss various aspects of the issue and suggest possible guidelines for setting US policy that protect both national security and open scientific exchange. LANL's Jerry Wilhelmy will address his alarm at what he perceives as a "growing sense of xenophobia," and will present a white paper on foreign national involvement at LANL (see www.fellows.lanl.gov) that recognizes "the vital role that foreign scientists have played and continue to play in making LANL a forefront scientific institution."

Cheuk-Yin Wong, who chairs the Overseas Chinese Physics Association in addition to his work as a research scientist at Oak Ridge National Laboratory, will review the history of the Chinese-American science community and its contributions to the advancement of science and national defense in the US. Nor is China alone under the cloud of suspicion. Following the nuclear tests in 1998 by India and Pakistan, the Department of Energy banned collaborative efforts with scientists from those countries, despite a long history of collaboration dating back to the 1980s. The ban has only recently been rescinded. Rajendran Raja, an Indian-born scientist at Fermilab, will review recent developments and assess the implications of such restrictions on scientific freedom. This session will take place in Ballroom A of the Hyatt Regency Hotel.

The April meeting runs from April 29 to May 2 and will feature the latest research results in nuclear, particle, astrophysics and accelerator physics. Four plenary sessions will be offered with lectures on extrasolar planets, biological microfabrication, the accelerating universe, future neutron scattering and synchrotron radiation facilities, new superheavy element results, and elementary science standards, among others.

Other sessions of unusual interest include the following, all held in the Long Beach Convention Center.

Real World Physicists in Science Fiction

Camille Minichino, formerly a researcher with Lawrence Livermore National Laboratory, and Gregory Benford, a professor of physics at the University of

Continued on page 3

Courtesy of Long Beach Area Convention & Visitors Bureau

Scenes from Long Beach, CA, site of the 2000 APS April Meeting. Clockwise from left: the Queen Mary; the interior of the Convention Center; and two views of the waterfront.

Inside...

DOE Travel Cuts Impact Lab Meeting Attendance

When Congress approved legislation last fall lowering the FY2000 cap on travel allocations for the DOE national laboratories, its intent was to discourage abuse of the allocations, not to impede the progress of scientific research already being conducted at those labs. Nevertheless, some laboratory directors say the cuts are doing just that. And as they struggle to re-prioritize travel under the new conditions, conference attendance is the first thing to go.

According to Robert Woods, senior program officer for DOE's High Energy and Nuclear Physics Division, the problem dates back about 5 years ago, when a report by the Inspector General auditing travel by DOE contractors found instances of gross misuse. As a result, travel allocations have come under close scrutiny and funds have been steadily declining. But the FY2000 travel allocation was particularly draconian: an overall cut of about 35% to $500 million for agency travel as a whole. Initially, the DOE parceled out a one-third cut across the board for all laboratories, although it was ultimately able to restore the travel budgets for Fermilab and SLAC at their FY1999 levels.

Other labs were less fortunate. James Siegriest, who heads the physics division at Lawrence Berkeley National Laboratory (LBL), reports that because the facility lacks an onsite accelerator, scientists must travel elsewhere to conduct experiments, such as those at the newly operational BaBar particle

Continued on page 6

Langer Petitions Reno on Behalf of Wen Ho Lee

APS President James Langer has written to US Attorney General Janet Reno on behalf of imprisoned physicist Wen Ho Lee, formerly a researcher at Los Alamos National Laboratory, objecting to his pretrial treatment. Lee was indicted last year and charged with violations of the Atomic Energy and Espionage Acts, and is presently being held without bail in a penitentiary near Santa Fe.

Lee has been imprisoned since December 10, 1999, on the government's contention that he is both a danger to this nation and a flight risk. The indictment alleges that in 1993 and 1994, Lee knowingly downloaded 19 collections of computer files containing secret and confidential restricted data relating to atomic weapon research, design, construction, and testing onto an unsecured computer system. Lee has not been charged with communicating classified information to a foreign power, but the government has said that it views his "mishandling of classified information" as seriously damaging to national interests. On February 29, the Court of Appeals rejected Lee's challenge of the denial of bail. The text of Langer's letter, which was communicated to the Attorney General in February, follows.

Dear Attorney General Reno:

As President of the American Physical Society, I am writing to express our concern about the pretrial treatment of Dr. Wen Ho Lee, accused of mishandling classified information at the Los Alamos National Laboratory.

We recognize the great importance of the proper handling of classified information to our national security, and we make no judgment about Lee's guilt or innocence. That will be decided in a court of law. However, we are deeply disturbed by the inhumane treatment that he has received in his pretrial incarceration. The extraordinarily harsh conditions under which he is detained suggest to the outside world that he is presumed guilty, and is being punished, before his trial has even begun. This perception has been reinforced by the statement of CIA Director George Tenet that Lee's actions were taken "with intent to harm the United States." It seems to us that basic principles of American justice are being violated in this case.

I would like to bring another important issue to your attention. One of the principal missions of the American Physical Society is to maintain the strength and vitality of the scientific enterprise in this country. The perception in the physics community that Dr. Lee is not being treated justly has caused great consternation, especially among the large number of scientists in the United States who have come here from abroad. As a result, it is becoming difficult to attract and retain the very best scientists at our weapons laboratories and other facilities. We are deeply concerned, therefore, that our scientific capabilities and national security are being compromised by our government's actions in the case of Wen Ho Lee.

I respectfully urge you to look into this matter.

Sincerely yours,
James S. Langer
APS President

Editor's Note: *More details on the Wen Ho Lee case can be found on the Back Page.*

To Advance & Diffuse the Knowledge of Physics

100 Years of the American Physical Society

Excerpts from an exhibit displayed at the APS Centennial Meeting.

Curator: Sara Schechner, *Gnomon Research*
Exhibit Director: Barrett Ripin
With contributions by Harry Lustig, R. Mark Wilson, and others.

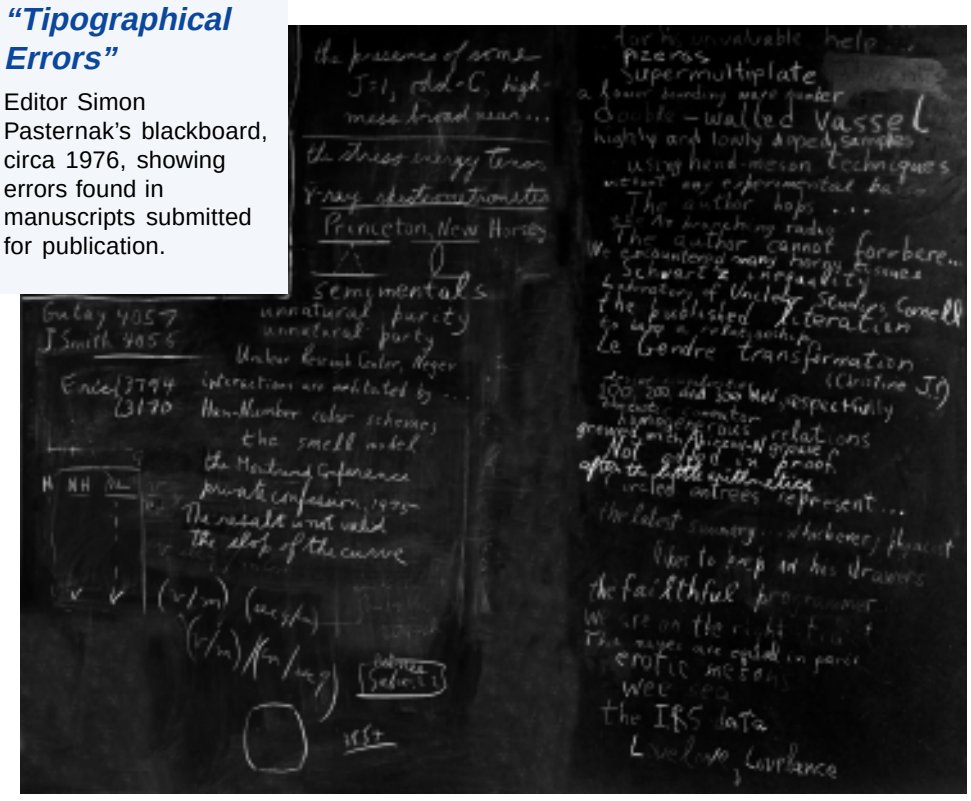
Mechanics of Publishing

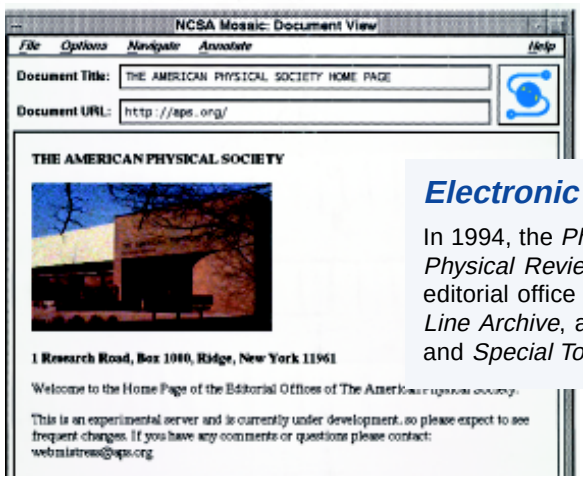
Editors of the *Physical Review* have always been on the lookout for innovations that would improve communication. In 1957, Samuel Goudsmit saw that use of typewriter composition and offset printing instead of hot metal and letterpress would speed up the production of *Physical Review Letters*. He later introduced computer composition.

Typists had to attach special "harp" keys whenever they needed to insert scientific notation into the article.

"Tipographical Errors"

Editor Simon Pasternak's blackboard, circa 1976, showing errors found in manuscripts submitted for publication.





Electronic Age

In 1994, the *Physical Review* set up their first website. Since then, all *Physical Review* publications have been placed on-line. The editorial office also inaugurated *PROLA*, the *Physical Review On-Line Archive*, and two electronic journals, *Physical Review Focus* and *Special Topics—Accelerators and Beams* (*STAB*).

Next Month, Final Installment: APS Today

APS News

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INSIDE THE BELTWAY

A Washington Analysis

Science on the Threshold of Political Success

By Michael S. Lubell, APS Director of Public Affairs

A presidential election is a Washington pundit's worst nightmare. It doesn't muzzle a true talking head: nothing will. But the quadrennial political saber dance, the essence of American democracy, sucks the wind out of the sails of the best of them.

In the off-years, when the spotlight is on Washington, pundits pontificate profusely. And inside the corridors of power, politicians pay homage. But ratchet up presidential campaigns, and it's what happens outside the Beltway that counts. In the crudest terms, the most savvy Washington analyst is reduced to bystander status.

Still, for science, the rhetoric inside the Beltway always counts big time, election-year or no. And as 2000 began, science burst onto the Washington scene with unexpected fanfare.

After seven years of hand-wringing over budget cuts, deficits and caps, the Clinton Administration rolled out a Fiscal Year 2001 budget request that puts science plus-ups center stage. Prosperity and surpluses do wonders for resolve, especially when the likes of Federal Reserve Chairman Alan Greenspan, White House Chief of Staff John Podesta and Office of Management and Budget Director Jacob Lew become staunch advocates.

Before he even delivered up his budget, President Clinton was on the road at Cal Tech beating the science drum. And he continued to thump the theme in his State of the Union Address.

When the budget books reached Capitol Hill, Republicans predictably reacted by stamping them, "Dead on Arrival!" That was part politics and part reality-check.

But the science portfolio, for obvious reasons, drew an additional chorus of GOP shouts: "We were there first!" Everyone likes a winner, and this year, science can be just that.

The Clinton Administration used February's additional leap-year day to run a meeting in the Roosevelt Room. That in itself is not unusual. White House honchos often convene there to plot strategy and debate issues of great moment.

But science was the only item on the agenda of the hour-long meeting. And the conveners were White House heavy weights: Chief of Staff Podesta, Presidential Science Advisor Neal Lane, Vice Presidential Chief Domestic Policy Advisor David Beier, National Economic Council Special Presidential Assistant Thomas Kalil and Deputy Assistant to the President for Legislative Affairs Charles Brain.

The freewheeling discussion, involving about twenty-five representatives of science, engineering and industrial organizations, focused on four recurrent themes – the economic impact of science and technology, the interdependence of the sciences, the need for a balanced federal research portfolio and the importance of a sustained program of investment. These, you may recall, have been the mantra of the science community for the last three years.

For now, optimism abounds, but the road to the final budget, as Washington insiders know, is fraught with hazards. The Senate and House Budget Committees have barely begun their work on the Budget Resolution, and warning signs are already up.

Reliable sources report that Senate Budget Committee Chairman Pete V. Domenici's (R-NM) preliminary mark-up falls below the presidential level, although White House analysts believe that the two sides will be able to bridge the gap. But real trouble lies in the House, where retiring Budget Committee Chairman John Kasich (R-OH) has vowed that he will make an extraordinarily tight-fisted spending line his parting shot.

So large is the reported difference between the House and Senate resolutions, that many observers believe that the two chambers, once again, will fail to come to a mutually acceptable agreement. That would set the stage for another last-minute round of appropriations bargaining in early fall.

But Republican leaders pledge that they will not give President Clinton yet one more opportunity to beat them up in omnibus budget talks, as he has done for two years running. They also swear that they will close up shop by October 1. If they really stick to that schedule, budget work must begin early and move with unusual speed.

This election year, as members of Congress struggle to find bipartisan themes that demonstrate a can-do ethic, science has the potential to become a rallying point. But only if the science community reacts swiftly. Former House Speaker Newt Gingrich laid out the challenge last December, when he wrote in *The Boston Globe*, "The fate of our country may well depend on whether or not scientists recognize that they have responsibilities as citizens. The fact is no one else is as qualified to make the case for increased funding in science research and reform of science education."

Editor's Note: The complete text of Gingrich's article was reprinted in the March 2000 APS News.

Coalition Efforts Spell Good News for Science

When the White House unveiled its proposed budget for FY2001 in February, the news was mostly good for science. Although the Presidential budget is up a mere 1.5%, basic science research is up by 7% overall, with significantly higher percentages for selected programs. For example, the National Science Foundation budget request is up 17.3% to $4.6 billion, with research funding up 19.7%, thanks to major initiatives in information technology, nanotechnology, and biocomplexity. The Department of Energy's basic science programs are up 13%, including funding for the Spallation Neutron Source. NASA's budget is up 6% overall, with space science up 9.4%.

That 7% increase is not an arbitrary happenstance. It is largely due to the culmination of a three-year effort by a joint coalition of scientific societies, including the APS, and the participation of APS members in letter-writing campaigns and Congressional visits through the Physics and Government Network (PGNet). Spearheaded by then-APS President Allan Bromley and the APS Washington Office, the coalition was founded in 1997 in response to predictions of a potential 5% cut in funding levels for many science and technology programs in FY1998. The result was a joint statement to Congress signed by over 100 scientific societies calling for a doubling of the federal budget for research by 2009 — roughly 7% each year, inspiring the catch phrase "the Seven Percent Solution." [see *APS News*, January 1998, p. 6] When the dust had settled, Congress had approved substantial increases in FY1998 for most science and technology programs of between 5% and 8%, instead of the expected 5% cut.

Encouraged by this success, the coalition has since grown to more than 150 member organizations, and its joint lobbying efforts on behalf of science clearly continue to yield positive concrete results on the Hill. The message is clear, says Michael Lubell, APS director of public affairs: When scientists speak out with a unified voice, Congress listens. Yet despite these gains, he insists, the voices of scientists are needed more than ever as Congress gears up for the final budget appropriations battle this fall.

April Meeting Preview, *continued from page 1*

Irvine, both moonlight as authors of mystery and science fiction novels. On Sunday afternoon, they will explain why such formats offer a prime opportunity to offset negative stereotypes and introduce the general reader to real-world physicists: "ones who don't want to take over the world, don't leave the house with two different socks on, and aren't social misfits." The session will be followed by a reception to meet the authors and a book signing. (Session K12)

The Language of the People

Finding ways to effectively communicate science outside the classroom is also the focus of a Monday morning session featuring David Goodstein, who will summarize lessons learned from his involvement in "The Mechanical Universe," a 52-part television series. Designed to teach introductory physics at the university level. David Crippens of KCET-TV Education Enterprises in Los Angeles, will provide examples of work the public television station has done to increase and enhance science literacy. (Session P13)

Addressing similar themes, Jeremiah Sullivan, a professor of physics at the University of Illinois, Urbana-Champaign, will draw upon his personal involvement in public policy debates to illustrate what he believes are essential requirements for the effective presentation of technical information and analysis to the general public. He will be joined by Peter Zimmerman of the US Department of State, who will give an entertaining account of his lively—and sometimes costly—public battles against "pseudoscience." (Session J12)

Green With Energy

Today's cars and trucks are the largest source of air pollution in most urban areas in the US, accounting for 25% of the nation's carbon emissions — more than most countries emit from all sources combined. But James Mark of the Union of Concerned Scientists believes that a host of emerging technical improvements could help take vehicles out of the pollution picture. His fellow speakers include Princeton University's Joan Ogden, who will report on the potential for the development of a zero-emission transportation system using fuel cells powered by hydrogen. Offering an alternative is Dan Cohn of MIT, who believes plasmatron electric discharge technology can enable onboard hydrogen production to improve the environmental quality of automobiles (see *APS News*, January 2000, page 5).

Richard Post, a researcher at Lawrence Livermore National Laboratory, will report on the development of new types of magnetic ball bearings that should enable the construction a new magnetically levitated (maglev) train system. Thomas Surek of the National Renewable Energy Laboratory will round out the session with a status report on photovoltaics, a semiconductor-based technology that directly converts sunlight into electricity. (Session P12)

Missile Defense?

Arms control issues have reached a critical turning point, particularly with regard to ballistic missiles, according to speakers at a Monday afternoon session on the subject. John Cornwall of the University of California, Los Angeles, will speak on the proposed national missile defense (NMD) program, intended to counter accidental Russian or Chinese launches of intercontinental nuclear-armed missiles, or similar launches by rogue nations. Cornwall will be joined by Roy Pettis of the US Department of State, who will report on progress and status of the 1998 Presidential Initiative on Shared Early Warning to reduce the risk of ballistic missile launches. (Session Q12)

Reaching for the Stars

For more than a century women have played a key role in astronomy, making major discoveries that have advanced the field — a tradition which continues today. A Tuesday morning session sponsored by the APS Committee on the Status of Women in Physics seeks to highlight some of these stellar woman astronomers. They include Wiliamina Fleming, Antonia Maury and Annie J. Cannon, who helped classify more than 11,000 stars in the latter part of the 19th century; Cecelia Payne, whose analysis of stellar spectra in the Harvard collection in the 1920s yielded a fundamentally new understanding of the composition of the universe; and Beatrice Tinsley, who contributed enormously to establishing the formalisms for studying the chemical evolution of galactic systems. (Session V8)

SPECIAL EVENTS

For detailed information, please check on-line at http://www.aps.org/meet/APR00/

COM/CSWP Lecture and Reception
Saturday, April 29, 5:30 - 7:30 PM
Shoreline A, Hyatt Regency

Student Reception
Sunday, April 30, 5:30 - 7:00 PM
Beacon Rotunda, Hyatt Regency

Career Workshop
Sunday, April 30, 6:30 - 9:30 PM
Regency Ballroom F, Hyatt Regency

Retiring Presidential Address
Monday, May 1, 4:30 PM
Ballroom II, Long Beach Convention Center

Awards Banquet
Monday, May 1, 7:30 - 9:30 PM
Beacon Ballroom, Hyatt Regency

Networking Breakfast for Women in Physics
Monday, May 1, 7:00 - 9:00 AM
Shoreline A, Hyatt Regency

Special Symposium on Funding for High Energy Physics
Saturday, April 29, 5:30 - 6:30 PM
Ballroom DEF, Hyatt Regency

OPINION

LETTERS

There We Go Again!

Your headline on Albert Einstein (*APS News*, February 2000) is truly an amazing example of political incorrectness, as well as insensitivity to gender issues in a context where it could be called simple impoliteness. As you state at the beginning of the article, *Time* called Einstein "Person of the Century", but you called him "Man of the Century" in your headline. The one thing in your favor: It's not clear who should feel slighted, women who are left out, or Einstein because there might have been an even better Woman of the Century!

Alfred Scharff Goldhaber
C.N. Yang Institute for Theoretical Physics; State University of New York

Weighty Issues

In the column "Zero Gravity" (*APS News*, February 2000) the CAUTION: the mass of this product contains the energy equivalent of 85 million tons of TNT per net ounce of weight. Thanks to relativity and the equivalence of inertial and gravitational masses the statement is correct, assuming the TNT and product are at the same place. Mass might be a better choice so that the caution would apply even if the product were on the moon and the TNT in outer space.

Martin L. Sage
Department of Chemistry; Syracuse University

Congress Should Recreate OTA

Newt Gingrich's "Scientists Must Speak Out; We Depend On It" in OPINION of the March 2000 issue clashes with his leadership in destroying Congress's Office of Technology Assessment, in which scientists and technologists worked effectively to inform Congress of technical opportunities and limits in studies assigned to the Office. I served on several advisory committees to the late OTA, with others of contrasting views. Mr. Gingrich should lead an initiative to recreate OTA.

Richard L. Garwin
Thomas J. Watson Research Center

More Top Ten Physicists

I disagree in a few minor ways with the list of top ten physicists. Here is my own list (which includes 11 names):

1. Newton
2. Einstein
3. Maxwell
4. Galileo

5-7 (tie). Heisenberg, Schrödinger, Dirac

8. Faraday
9. Rutherford

10-11 (tie) Bohr, Fermi

I put Newton ahead of Einstein because he not only was a great theorist but he invented the mathematics (calculus) that he needed. Furthermore, he was also a good experimentalist, especially in optics. Galileo's position is improved because Newton built on Galileo's initial achievements.

I cannot decide who was the best among Heisenberg, Schrodinger, and Dirac. Not only did Schrodinger formulate wave mechanics but showed it was equivalent to Heisenberg's matrix mechanics. He also first wrote down the relativistic wave equation known as the Klein-Gordon equation. Dirac's relativistic theory of the electron not only explained the electron's spin and (to a very good approximation) its magnetic moment, but it predicted the existence of antiparticles.

Faraday was surely the best experimental physicist of the 19th century if not of all time. Bohr was a great physicist, but his work had a very provisional character, being the best theory of the H atom for only a few years, so I downgraded him.

I had to include Fermi because he was a great experimentalist as well as a great theorist—the only renaissance physicist of the 20th century. I was sorry to omit Feynman, but I also omitted a large number of other great physicists.

Don Lichtenberg
Indiana University

Test Your Knowledge of Physics Trivia

The February 2000 issue of *APS News* featured a list of the top ten physicists and physics discoveries, as selected by *Physics World*, and invited the APS membership to respond with their own top ten lists. This month we have devised a completely different means of scoring those same "Top Ten," sampled below:

Newton	0
Maxwell	1
Einstein	2
Feynman	3

... and so on.

Can you figure out the scoring system and use it to score the remaining six physicists on the Top Ten list? We'll give you two hints: the scoring system is not subjective, and there will be many "tie" scores.

The first three correct answers received will receive a prize. Send submissions to Editor, *APS News*, One Physics Ellipse, College Park, MD 20740, letters@aps.org.

zero gravity

The Physics Department "Cosmo Quiz"

Editor's Note: *This quiz was prepared as a public service by some of the members of the Task Force on Undergraduate Physics (see story on page 6). Readers are warned that it has no proven diagnostic value whatsoever.*

Many popular magazines such as *Cosmopolitan* and *Mademoiselle* feature quizzes that help you evaluate major issues in your life such as whether you are in love or just experiencing a physical attraction (no pun intended). Here is a similar lighthearted quiz to help you judge the health of your undergraduate physics program. Choose the answer to each question that best describes your program, add the points up, and check the bottom of the page to see what we think your score means!

1. In the last five years, how many departments have dropped the requirement that their majors take your introductory course?

(20 pts) None—our course is so wonderful, other departments have added it to their requirements.
(15 pts) Only one.
(10 pts) Only one—but it was the School of Engineering.
(5 pts) Two or more.
(0 pts) Nobody requires our introductory course anymore except us.

2. How many graduates (B.S./B.A.) per year have you averaged over the past five years?

(20 pts) More than 25
(15 pts) 10 - 25
(10 pts) 5 - 10
(5 pts) Fewer than 5
(0 pts) We haven't had any since Joe retired

3. How many graduates (B.S./B.A.) per year *per faculty member* have you averaged in the last five years?

(20 pts) More than 2
(15 pts) 1 - 2
(10 pts) Fewer than 1
(5 pts) Fewer than 0.50
(0 pts) Fewer than 0.05

4. What fraction of your undergraduates participate in research?

(20 pts) Nearly all of them do a senior project.
(15 pts) About 50% of them do a research project.
(10 pts) All of them know where the research labs are.
(5 pts) All of them know theoretically what research is although they don't actually do it.
(0 pts) All of them can spell research correctly.

5. What was the change in the number of faculty slots in your department in the last five years?

(0 pts) We lost three or more
(5 pts) We lost one or two
(10 pts) No change
(15 pts) We gained one or two
(20 pts) We gained three or more

6. When was the last major revision of the labs for your introductory course?

(0 pts) Nobody around here remembers, but we think it was before Joe retired
(5 pts) About ten years ago
(10 pts) Five years ago or more
(15 pts) Between two and five years ago
(20 pts) It was done within the last two years

7. What fraction of your undergraduate majors are females?

(20 pts) More than 30%, and we are a coed school
(15 pts) 15-30%, which beats the national average
(10 pts) 5-15%
(5 pts) < 5%
(0 pts) We saw a woman in the hall once, but we think she was looking for the Math Dept.

8. What fraction of your undergraduate majors are underrepresented minorities (African-American, Hispanic, Native American)?

(0 pts) All of our majors are white, despite the fact that we are an HBCU
(5 pts) < 5%
(10 pts) 5-15%
(15 pts) > 15%
(20 pts) Underrepresented minorities are overrepresented among our majors compared to the student body at our institution.

9. How long has your SPS chapter been defunct?

(0 pts) What's SPS?
(5 pts) Nobody around here remembers, but we think it folded when Joe retired
(10 pts) Less than five years
(15 pts) It's in existence now, but with only a few students
(20 pts) It's much more active than any of the organizations the faculty belong to

10. What fraction of your faculty are making serious efforts to improve the quality of the undergraduate courses they teach (reading the physics education literature and trying to apply it, restructuring a course to incorporate recent scientific and technological developments, developing a new course to interest different audiences, etc.)?

(20 pts) All of them (or so they claim)
(15 pts) The ones with tenure
(10 pts) The ones without tenure
(5 pts) Hardly any of them, now that Joe is retired
(0 pts) None of them, since they know it won't make any difference in their salary or promotion

SCORE

150-200 points — Congratulations! You have a thriving program that could serve as a model for other departments. Please contact the National Task Force on Undergraduate Physics (ntfup@aapt.org). (See story on page 6)

100-150 points — Your department is doing OK for the moment, but it would be a good idea to look at improvements other departments are making to strengthen their programs.

50-100 points — This is serious. Call the Dean for help in starting to revitalize your department.

0-50 points — If the Dean calls, don't answer the phone.

APS News is now being posted on the web two to three weeks in advance of the appearance of the paper version. APS members who wish to read it on the web can go to the APS homepage, click on aps news online, and then click on "Advance Issue." This feature is password protected for APS members only.

PHYSICS AND TECHNOLOGY FOREFRONTS

Physics and Medicine: A Beginning to the Next Wave

By Henry D. I. Abarbanel and Allen I. Selverston

Physics and medicine have a rich joint history. Ben Franklin wore spectacles to correct his short sightedness. No doubt today he would have had laser surgery to reshape his cornea. And can you imagine a doctor diagnosing your injured ankle, knee, or shoulder without x-rays and MRI or treating your problem without arthroscopy? You expect rods and screws, made from space-age materials, to be implanted in your broken bone to ensure its rapid and strong recovery. And soon you will have a remotely powered micro-electromechanical strain gauge implanted to provide a real-time measure of the healing process and to permit your physician to prescribe an optimum course of physical therapy. Cancer is still an enormous problem, but you can expect a cancerous tumor to be successfully treated by carefully focused radiation, monitored in real time by a large area amorphous silicon imaging system to ensure that you receive the correct dosage.

As innovative and important as these contributions are, they do not help in the treatment of problems within the nervous systems. Many people are paralyzed for life by injuries to their spinal cords. Just recently, President Clinton in his State of the Union address challenged scientists, engineers, and physicians to develop a chip that when implanted would relay the severed signal to the isolated limbs and restore their function. And many sufferers of Alzheimer's disease might benefit from bio-circuits that serve as brain pacemakers.

Not surprisingly, American research universities are attracted by the intellectual challenges of the problem. Stanford's Bio-x Program (http://biochem.stanford.edu/biox/) and the University of Chicago's Institute for Biophysical Dynamics (http://bmb.bsd.uchicago.edu/IBDHome.html) are two prominent examples. Stanford has raised $350 million to support Bio-x with significant leadership from physicist Steven Chu and an individual donation of $150 million from Netscape founder Jim Clark. Other equally staggering amounts have been raised elsewhere. Such ambitious R&D projects will certainly lead to major new directions and understanding in each of the basic sciences involved but should also lead to the next wave of physical science in medical practice.

Neuroscience is now in a state where the maturity of the biological experimental base proves fecund for the skills of a physicist monitoring the activity of individual neurons as they participate in the functioning of a network. We have studied the properties of a biological neural network comprised of fourteen neurons, which act as a control system in the California spiny lobster. The network directs muscles surrounding the so-called pyloric chamber to contract and dilate in a complex pattern that moves shredded food from the stomach to the digestive tract of the lobster. When the physics/biology interaction was initiated through a casual conversation, the biologists knew the interconnections among the component neurons but were seeking ways to understand the functioning of the network. The physicists, working in nonlinear dynamics, saw an opportunity to model a functioning network of nonlinear oscillators and learn something of the biology in the process.

After analyzing the cross membrane voltage of many of the component neurons in the pyloric circuit when they were isolated from the rest of the circuit, we discovered that the degrees of freedom expressed in the voltage activity was typically only three or four. As the voltage activity is the signaling method for communication among neurons and responsible for the functioning of the network, we can simulate and even replicate the entire network in simple electrical circuitry. In fact, we realized that we could purposely damage the network by selectively removing key neurons, and then restore the damaged activity to good health by electrical circuitry.

After an intense period of modeling, we created an electronic neuron in the spring of 1999 and inserted it in place of a deliberately damaged neuron in the lobster's neurological circuit. By themselves, the remaining intact biological neurons oscillated quite irregularly producing electrical signals that could not be interpreted by the muscles but the mutual interaction of the electronic neuron with the biological neurons restored the natural activity of the circuit. Figure 1 shows a sample of the experimental data.

Small neural networks like these are found in humans and other animals where they have the functional task of driving rhythmic activity of muscles. While the circuitry is not as well mapped as that of the lobster and developing a successful surgical procedure is a major challenge, we believe we are seeing the earliest stages of a new neural therapy.

Not all areas of biological sciences are ready for the mathematical, analytic, and modeling skills and inclinations of physicists, but many clearly are. With the sequencing of the human genome imminent, predictive models of the proteins expressed by genes take on an immediacy and provide an arena in which the skills of physicists will be immediately productive. Other areas ready for interaction with the quantitative methods of the physical sciences include the dynamics of folding proteins, "bio-inspired nanomaterials," signaling between cells, and similar questions.

The opportunities for physicists in many fields of biology, neuroscience in particular, are open to those with physics undergraduate degrees. There are now a few programs where physicists can receive the training in wet lab neurophysiology utilized in our example, and biologists can be trained in the skills of the physicist. Starting in such a program one may be part of a remarkable next wave of physical science and medicine, and the beginning of a creative career that ultimately benefits the whole of society.

Henry D. I. Abarbanel is a professor of physics and research physicist, Marine Physical Laboratory, Scripps Institution of Oceanography. He is a member of the Panel on Public Affairs of the APS. Allen I. Selverston is a research professor of biology. Both are at the University of California, San Diego.

Editor's Note: Additional information on the electronic neuron accompanies the online version of this article.

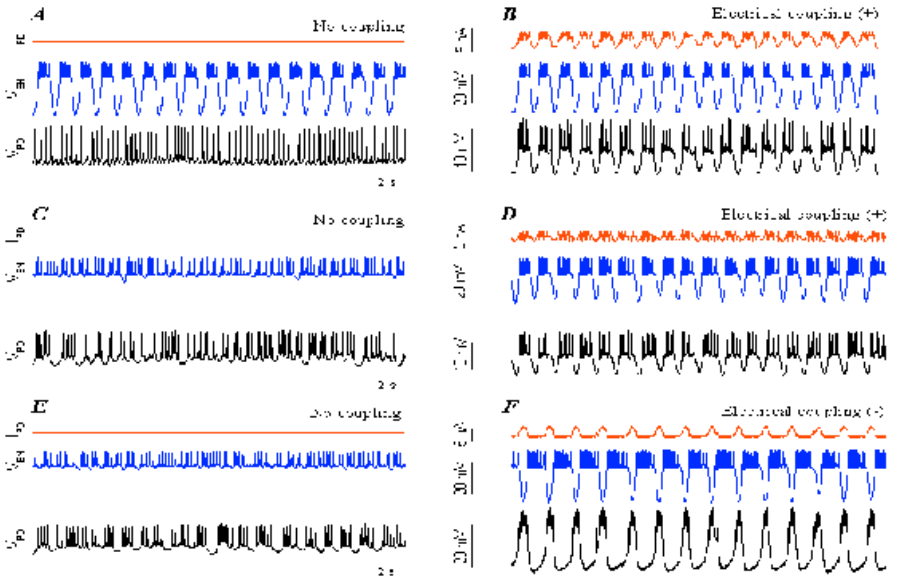

Figure 1: The blue trace is for the electrical neuron, the red trace is the current flowing between the neurons, and the black trace is the membrane voltage activity of the biological neuron.

Shapley

This Month in Physics History

April 26, 1920: The Shapley-Curtis Debate

Curtis

In April 1920, the Natural History Museum in Washington, DC, played host to an historic interchange on competing theories about the scale of the universe. At the center of the controversy were Harlow Shapley, a young ambitious rising star in astronomy who specialized in the properties of stars in binary systems of globular clusters, and Heber D. Curtis, a well-respected established authority on the properties of spiral nebulae known for his conservative approach and frequent skepticism of new theories. Their confrontation at the 1920 meeting of the National Academy of Science in Washington is widely held to be at the crux of a major shift of humanity's view of its place in the universe.

Ironically, given its historical significance to astronomers, the actual debate was neither well publicized nor well-attended at the time it occurred during the 1920 meeting of the National Academy of Sciences — nor was it a truly formal "debate" in the modern sense of the word. Shapley and Curtis each gave a 40-minute presentation and were allowed one opportunity to rebut the other's remarks, followed by commentary from the floor. Curtis argued that the universe is composed of many galaxies similar to our own, identified by astronomers of that period as "spiral nebulae." In contrast, Shapley believed that the spiral nebulae were merely nearby gas clouds, and that the universe was composed of a single large galaxy. In Shapley's model, the sun is far from the center of the galaxy, while Curtis located the sun near its center.

Astronomers still disagree about which man technically "won" the debate, but history ultimately has the final say, and it appears to be draw. A partial resolution to the standoff occurred in the mid-1920s, when Edwin Hubble identified Cepheid variable stars in the Andromeda Galaxy, which enabled him to demonstrate that the distance to Andromeda was even greater than Shapley proposed. In the 1930s, the further discovery of interstellar absorption, combined with an increased understanding of the distances and distribution of globular clusters, led to general acceptance that the Milky Way was much larger than previously estimated, and that the Sun was not near its center.

Thus, Shapley proved to be correct about the size of our galaxy and the sun's location in it, while Curtis correctly predicted that the universe is composed of many galaxies, among them the spiral nebulae which are very similar to our own galaxy — a point Shapley readily conceded when the new evidence came to light. Shapley was also correct about the usefulness of Cepheid variables as distance indicators, which continue to be cornerstones of our knowledge of distance to further objects today. Ironically, both men were mistaken regarding a point on which they were in agreement: the interstellar absorption of starlight, which they agreed was not important in determining the size of the galaxy.

According to the astronomer F. Shu, the Shapley-Curtis debate stands to this day as a fascinating "glimpse into the reasoning processes of eminent scientists engaged in a great controversy for which the evidence on both sides is fragmentary and partly faulty," and as an historical illustration of the difficulty of navigating through "the treacherous ground that characterizes research at the frontiers of science."

For more information on the Shapley-Curtis debate, see http://antwrp.gsfc.nasa.gov/diamond_jubilee/debate_1920.html.

Birthdays for April:

12 Igor Tamm (1895)
22 J. Robert Oppenheimer (1904)
23 Max Planck (1858)
29 Henri Poincaré (1854)
30 Karl Friedrich Gauss (1777)

A Strike: The Hardest Way To Learn Physics

Editor's Note: *This article was written for* APS News *by Javier Crúz Mena, science editor of the Mexican newspaper* Reforma, *and a member of UNAM's Engineering faculty.*

When Physics 101 is finally in session at the School of Science of UNAM, Mexico's National University, some unexpected analogies will be available to help understand a few bizarre concepts of modern physics.

Take the case of Schrödinger's cat. If told that a system may, at any given time, exist in two mutually exclusive states, these students will not be quite as puzzled by the notion as they would have otherwise been, had they not lived through the perplexing nine months of a student strike triggered, back in April of 1999, by the Administration's attempt to raise tuition from US$0.02 to about US$140 a year.

The amount might seem low, but opposers argued that it was improper to charge even that much when the general income in Mexico has dropped steadily for two decades, as has the Government's contribution to higher education. To complicate matters further, the wording of the country's Constitution –"All education provided by the State shall be free of charge"—lends itself to controversy as to whether public colleges should be included.

During those 9 months, the University led the kind of uncertain day-to-day existence typical of split personality conditions—much like quantum cats, indeed. This being a student strike, all teaching stopped as schools were closed from day one. But research continued to get done, somehow, throughout UNAM's main campus in Mexico City. It was not business as usual, though. Long walks in the open had to be endured on those days when the strike's steering committee decided—rather haphazardly—to ban automobile access to campus facilities.

While research institutes were allowed to keep their doors open for most of the strike, teaching centers, such as the Schools of Science—home to Physics, Mathematics and Biology undergraduate studies, Chemistry, Medicine and Engineering—were not. Consequently, all experimental work there came to a halt.

But theoretical research wasn't spared either. "Getting new work done was much more difficult, because I had no access to the things I am used to—books, notes and article references," said Rodolfo Martínez, full time Professor at the School of Science, who works on high energy physics. "Three papers which are being refereed right now would have already been published had it not been for the strike."

Life was relatively easier at the Institute of Physics, a research center with close academic ties to the School of Science, although working days were shortened for security reasons, affecting such things as all-night runs at the institute's particle accelerators.

Nevertheless, the months of irregular life and high tension did leave a negative mark. According to Manuel Torres, Secretary of Academic Affairs at the institute, they used to have close to 100 graduate students and 150 undergrads. By the end of the strike, he estimates those numbers to have been reduced by 20% and 40% respectively.

Some 100,000 striking students of Mexico's National University and supporters march May 21 in defense of free public education. AP/José Luis Magaña

Image from: http://www.internationalist.org/mexunamleaflet0699.html

"Some 30 research projects were slowed down," said Torres. Then there was the matter of personal and institutional relations. At least two meetings already scheduled had to be held elsewhere, and several visits by foreign scientists were cancelled.

All in all, though, Torres finds reasons to feel rather fortunate "thanks to the positive attitude of our faculty." Research on campus, limited indeed, showed signs of life during the strike. Thus, somehow, the University did look very much like Schrödinger's cat—both dead and alive all at once.

At least until just before dawn on February 6th, when a recently created military police unit showed up on campus –to the strikers' surprise— and took nearly one thousand prisoners, mostly students, with and without orders of arrest. For all practical purposes, that was the end of the full-scale student strike.

One might argue that the police action was tantamount to the human measurement of the quantum puma—the university's feline mascot—ending the indeterminacy of its state. Classes are being resumed, most strikers —but not all—have been released, and the puma seems to have been alive after all.

Or was it? The core of the strike's steering committee is still in jail –accused of "social dangerousness," an obscure offense just recently added to the Criminal Code, and held on US$5,000 to US$10,000 bonds—but there is considerable support for their release. The longer their imprisonment, the stronger the student protests seem to be getting. Already the School of Science is under threat of being closed again.

"The strike has proven highly destructive of all academic activity," said Martínez, "regardless of which facilities were closed. Whether the University will recover is not at all clear."

APS, AIP, and AAPT Launch Task Force on Undergrad Physics

The APS, the American Institute of Physics (AIP), and the American Association of Physics Teachers (AAPT) have announced the formation of a National Task Force on Undergraduate Physics. The eleven-member Task Force will be chaired by Robert C. Hilborn, Amanda and Lisa Cross Professor of Physics at Amherst College and former President of AAPT.

"There have been dramatic changes in the environment for undergraduate physics in colleges and universities across the nation," says Hilborn. "The field itself has changed dramatically in the past thirty years with many new sub-disciplines not represented in today's undergraduate physics curriculum." He points out that the number of undergraduate physics majors is now at a forty year low, and the accrediting criteria for engineering programs (ABET 2000) no longer require a year of undergraduate physics. "The Task Force's job is to provide advice to the physics organizations and to the physics community at large about constructive and creative responses to those changes," says Hilborn.

The Task Force will coordinate a number of efforts aimed at advancing undergraduate physics programs. The emphasis is on the undergraduate program as a whole: introductory and advanced courses for all students, preparation of K-12 teachers, undergraduate research opportunities, and the recruitment and mentoring of students for diverse careers. Among the current APS/AAPT/AIP projects which exemplify the objectives of the Task Force are the NSF-funded New Physics Faculty Workshops, designed to help new physics faculty become familiar with innovative pedagogy, and a series of Physics Department Chairs meetings to encourage physics departments to act collectively to improve undergraduate physics programs.

During the next few months, Task Force members will visit several physics departments to learn how departments are planning for and implementing innovations in their undergraduate programs. The goal is to put together a catalog of case studies with analysis of departments that have developed thriving undergraduate programs. The Task Force will also work with similar education groups in other disciplines and with various funding agencies to coordinate efforts to improve undergraduate science, mathematics, and engineering education.

The other Task Force members are J. D. Garcia (University of Arizona), Ruth H. Howes (Ball State University), Karen Johnston (North Carolina State University), Kenneth S. Krane (Oregon State University), Laurie McNeil (University of North Carolina-Chapel Hill), Jose P. Mestre (University of Massachusetts-Amherst), Thomas L. O'Kuma (Lee College), Douglas D. Osheroff (Stanford University), Carl Wieman (University of Colorado), and David T. Wilkinson (Princeton University). The ExxonMobil Education Foundation has provided a Planning Grant to assist the Task Force in its first year of activities and to supplement the support from AIP, APS, and AAPT.

APS Members Receive National Medal of Science

Four APS members were among the 12 recipients of the 1999 National Medal of Science selected in January by President Clinton. To date, 374 medals have been bestowed on leading US scientists and engineers since Congress established the award in 1959. Administered by the National Science Foundation, the National Medal of Science is intended to honor the discoveries and lifetime achievements of the nation's top scientists The new medalists, the last to be named in the 20th century, received their medals on March 14 at the White House in Washington, DC, along with five recipients of the National Medal of Technology.

Among the recipients is James Cronin of the University of Chicago, who shared the 1980 Nobel Prize in Physics with former APS president Val Fitch for discovering CP violation, one of the essential ingredients in explaining the predominance of matter over antimatter in the universe. He is being honored for "fundamental contributions to the fields of elementary particle physics and astrophysics, and as a leader in creating an international effort to determine the unknown origins of very high-energy cosmic rays." Another University of Chicago scientist, Leo Kadanoff, was honored for his contributions to fundamental theoretical research in statistical, solid state and nonlinear physics, "which has led to numerous and important applications in engineering, urban planning, computer science, hydrodynamics, biology, applied mathematics, and geophysics."

In addition, chemical physicist Stuart Rice, also of the University of Chicago, was honored for "changing the very nature of modern physical chemistry through his research, teaching and writing, and for using imaginative approaches to both experiment and theory that have inspired a new generation of scientists." In addition to the trio of Chicagoans, John Ross, professor of chemistry at Stanford University, was honored "for his enormous impact in physical chemistry, especially in molecular studies, statistical mechanics, nonlinear kinetics, and for opening up new fields in chemical science."

Travel Cuts, *continued from page 1*

detector at SLAC's B-meson facility. LBL is also committed to collaborative construction projects at other facilities, most notably upgrades to the CDF and D0 detectors at Fermilab. Los Alamos National Laboratory (LANL) also conducts much of its high energy and nuclear physics experimental work offsite, according to John McClelland, LANL's deputy division director of physics, including taking shifts at the Sudbury Neutrino Observatory. It is also heavily involved in construction of the BOONE neutrino experiment at Fermilab, and installation of two detectors as part of the PHOENIX project at the Relativistic Heavy Ion Collider.

The result, says Woods, is to place experimental travel in direct competition with travel to meetings — and the meetings nearly always lose out. Both Siegrist and McClelland report that they are giving top travel priority to meeting existing commitments in new construction and ongoing experimental work, with any residual allocations going toward conference attendance. However, says Siegrist, "We're already operating under stringent [travel] conditions, so the only way to absorb additional cuts is to reduce trips." That means being more selective about which conferences would prove the most useful in terms of professional interaction.

The impact has certainly been felt at the upcoming APS April meeting. APS Meetings Manager Donna Baudrau reports that the number of abstracts submitted is down from about 1000 in 1998 to 800 this year. While attendance at the April meeting has been declining for several years, this is the sharpest drop since 1992, and McClelland, for one, believes it is a direct result of decreased travel from the national laboratories.

Some relief has been forthcoming. Additional funds have been allocated to enable post-doctoral and other early-career physicists to attend scientific conferences. And LBL's management has come through with some additional allocations for the Physics Department. Still, "At these new lower [travel] levels, we can barely meet our existing commitments and there's nothing left over for conference attendance, or meeting offsite with collaborators, — the kinds of things that keep us visible and active participants in the scientific community," says McClelland.

Announcements

APS UNDERGRADUATE PHYSICS STUDENT COMPETITION

2000 APKER AWARDS

For Outstanding Undergraduate Student Research in Physics

Endowed by Jean Dickey Apker, in memory of LeRoy Apker

DESCRIPTION

Two awards are normally made each year: One to a student attending an institution offering a Physics PhD and one to a student attending an institution not offering a Physics PhD

- Recipients receive a $5,000 award; finalists $2,000. They also receive an allowance for travel to the Award presentation.
- Recipients' and finalists' home institutions receive $5,000 and $1,000, respectively, to support undergraduate research.
- Recipients, finalists and their home physics departments will be presented with plaques or certificates of achievement. The student's home institution is prominently featured on all awards and news stories of the competition.
- Each nominee will be granted a free APS Student Membership for one year upon receipt of their completed application.

QUALIFICATIONS

- Students who have been enrolled as undergraduates at colleges and universities in the United States at least one quarter/semester during the year preceding the 16 June 2000 deadline.
- Students who have an excellent academic record and have demonstrated exceptional potential for scientific research through an original contribution to physics.
- Only one candidate may be nominated per department.

APPLICATION PROCEDURE

The complete nomination package is due on or before **16 June 2000** and should include:

1. A letter of nomination from the head of the student's academic department
2. An official copy of the student's academic transcript
3. A description of the original contribution, written by the student such as a manuscript or reprint of a research publication or senior thesis (unbound)
4. A 1000-word summary, written by the student, describing his or her research
5. Two letters of recommendation from physicists who know the candidate's individual contribution to the work submitted
6. The nominee's address and telephone number during the summer.

FURTHER INFORMATION (See **http://www.aps.org/praw/apker/descrip.html**)

DEADLINE

Send name of proposed candidate and supporting information by **16 June 2000** to:

Dr. Alan Chodos, Administrator, Apker Award Selection Committee
The American Physical Society, One Physics Ellipse, College Park, MD 20740
Telephone: (301) 209-3268, Fax: (301) 209-3652, email: chodos@aps.org

Now Appearing in RMP...

The articles in the April 2000 issue of *Reviews of Modern Physics* are listed below. For brief descriptions of each article, consult the *RMP* website at <http://www.phys.washington.edu/~rmp/contents.current.html>. *George Bertsch, Editor.*

Nobel lectures in physics, 1999 — *Gerardus 't Hooft and Martinus J. G. Veltman*

CODATA recommended values of the fundamental physical constants: 1998 — *Peter J. Mohr and Barry N. Taylor*

Theory of two-electron atoms: from the ground state to complete fragmentation — *Gregor Tanner, Klaus Richter, and Jan-Michael Rost*

Intense few-cycle laser fields: frontiers of nonlinear optics — *Thomas Brabec and Ferenc Krausz*

Energetics of Si (001) — *H. J. W. Zandvliet*

The onset of shear flow turbulence (colloquium) — Siegfried Grossmann

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NAGPS Seeks Grad Student Responses to Online Survey

The National Association of Graduate-Professional Students (NAGPS) is conducting an online survey of doctoral students regarding their experiences in graduate school. Funded by a grant from the Alfred P. Sloan Foundation, the survey will cover issues in a number of areas, including information for prospective students, breadth and flexibility of the curriculum, career guidance and placement services, faculty mentoring, time to degree, departmental climate, professionalism, and overall satisfaction.

"For this survey to be useful, it is vital that we reach many current and recent doctoral students," says Adam Fagen of Harvard Univesity, chair of the NAGPS's Ad Hoc Committee on Faculty-Student Relations. "We are hoping to encourage a significant percentage of students to respond so that the results will represent a broad range of experiences and a realistic picture of department and institutional practices."

Anyone who has been enrolled in graduate school for at least one semester in the last five years is eligible for the study. The survey will run from January through May 1, 2000, and the results will be made available publicly on the Web in September. Interested graduate students may submit their responses at http://survey.nagps.org **no later than May 1, 2000.**

Corrections

In the February issue, the name of Lawrence Krauss was misspelled in the listing of members of the Panel on Public Affairs that appeared in the Announcements section. Also, the date of the Limited Test Ban Treaty, given in R.L. Garwin's Back Page article as "1973" is really "1963."

APS News regrets these errors.

APS Grants Online Journal Access to Troubled Russian Institutes

Physicists in the politically and economically troubled former Soviet Union have struggled in recent years to maintain subscriptions to the premier scientific journals, including those published by the APS. The situation became critical earlier this year when the Open Society Institute discontinued subsidies to Russian institutions for journal subscriptions. To help alleviate the pressure and ensure continued access to international research results for Russian scientists, at its February meeting the APS Executive Board approved a plan for short-term emergency online access to the Society's journals.

Under the proposed scheme, Russian academic and government institutions may petition the Society directly for free subscriptions to the online versions of *Physical Review* (all sections), *Physical Review Letters*, *Physical Review Online Archives* (PROLA), *Reviews of Modern Physics*, and *Physical Review Special Topics: Accelerators and Beams*, APS President James Langer believes this will ensure that such online access is provided only to those institutions where access is both desired and necessary. It also protects existing paid subscriptions from industrial laboratories in the region.

In future years, journal access will be gained through annual application to the APS by each institution, and the Society expects to begin charging for all online journal access beginning in 2001. The size of the charge will depend on the amount of supplementary support provided by other agencies, such as the Russian Foundation for Basic Research (RFBR), and by the effect of the subsidized online subscriptions on the existing subscriptions within Russia. The RFBR is a self-governing state-funded organization whose primary goal is to support the most promising research initiatives in all fields of fundamental science without departmental restrictions. It is currently the only such organization providing funds for subscriptions to foreign print and electronic journals in Russia.

Also under discussion is a cost-effective scheme for providing access to the APS journals to researchers in countries with little or no access to the Internet. APS Editor-in-Chief Martin Blume devised a plan while visiting the International Center for Theoretical Physics In Trieste, Italy, in which the Society would provide CDs of the most recent year's issues of APS journals, which ICTP would then distribute to a list of 75 institutions, subject to APS approval. The APS Committee on International Scientific Affairs will discuss the proposed program, to be jointly sponsored by the APS and ICTP, at its upcoming meeting, with plans to present the plan to the APS Executive Board and Council this spring.

Institutions requesting emergency online journal access can do so via FAX: (301) 209-0844 or email (hicks@aps.org). Online agreements are available on the APS web site: http://publish.aps.org/LEGAL/nonmember.html.

Krauss and Lane Win AAAS Awards

APS Fellows Lawrence Krauss and Neal Lane received awards at the American Association for the Advancement of Science's February meeting in Washington, D.C. Krauss, an astrophysicist, is the chair and Ambrose Swasey Professor of Physics at Case Western Reserve University.

Lawrence Krauss

Neal Lane

Lane is the Assistant to the President for Science and Technology, and Director of the White House Office of Science and Technology Policy.

Krauss, author of the best-selling book, *The Physics of Star Trek*, received the 1999-2000 AAAS Public Understanding of Science and Technology Award. Established in 1987, the award honors those who improve communication between the scientific community and the public.

In addition to *The Physics of Star Trek*, Krauss is the author of *The Fifth Essence, The Search for Dark Matter in the Universe, Fear of Physics*, and *Beyond Star Trek*. He has a book under way called *Genesis: The Lives of an Atom*, which will be a companion to a five-part PBS series. Krauss says his quest is to remove "the nonsense and non-science" from the public science debate. Since 1996, he has given more than 300 lectures and media interviews, and is a frequent contributor to the op-ed pages of the *New York Times*. In October he made public appearances in Kansas in an effort to counter the creationism movement in the state's public school system. He said he believes it is important for scientists to talk to the public about these issues.

Lane, who served as Director of the National Science Foundation before becoming Presidential science advisor, received the AAAS Philip Hauge Abelson Prize, "for his performance as an exceptional public servant, a distinguished scientist and educator, and for his unstinting service to the scientific community."

THE BACK PAGE

The Imprisonment of Dr. Wen Ho Lee

By Edward Gerjuoy

Editor's Note: *What follows is an abridged version of Edward Gerjuoy's article. The full text is available in the April Online edition at http://www.aps.org/apsnews/ (accessible to APS members only until May 1, 2000)*

As many readers of *APS News* are aware, Dr. Wen Ho Lee—who until last year was employed by the Los Alamos National Laboratory (LANL)—presently is being held without bail in a penitentiary near Santa Fe, charged with violations of the Atomic Energy and Espionage Acts. This article describes the circumstances of Dr. Lee's arrest, incarceration and detention hearings, in rather greater detail than has heretofore been revealed in the media. Unless otherwise stated, this article is based solely on the transcripts of Dr. Lee's bail hearings in federal district court and on the briefs in Lee's appeal of his bail denial.

Dr. Lee is 60 years old and a native of Taiwan. He received his mechanical engineering Ph.D. from Texas A&M in 1969, after coming to this country on a student visa in 1964. In 1970 he became a naturalized US citizen.

"The conditions of Lee's incarceration have been...disturbingly inhumane."

Dr. Lee was hired by LANL in 1980, and worked at LANL until he was fired on March 8, 1999. About a year after being hired, and after receiving a Q clearance, he was assigned to LANL's X Division, which is responsible for LANL nuclear weapons research and design. On or about December 23, 1998 he was transferred to the LANL T Division, where he worked on unclassified tasks for the remainder of his tenure at LANL. Between March 8 and December 10, 1999, when he was arrested under an indictment whose terms are described below, Lee was unemployed; during this interval he resided at his home in White Rock, New Mexico, a small community in the Los Alamos area, under around-the-clock surveillance by the FBI, who followed both him and his wife wherever they went. He has been imprisoned since December 10, 1999, on the government's contention that he is both a danger to this nation and a flight risk.

The conditions of Dr. Lee's incarceration have been, and continue to be, disturbingly inhumane. Lee's briefs assert, without contradiction by the government in its briefs: that originally he was confined to his cell for 23 hours a day; that he was not permitted to make any telephone calls except to his attorneys; that he could be visited only by his attorneys and his immediate family; that his family's visits were limited to one hour a week in the presence of an FBI operative who listened in on everything that was said; that in order to ensure the FBI could understand everything said during these family visits, speaking Chinese was forbidden, i.e., all conversations had to be in English; that he had no access to TV or radio; and that when he moved within the prison he was shackled at the waist, wrists and ankles. Lee's counsel has informed me that originally: Lee also was denied access to any newspapers; that he was allowed to have books only if they were mailed directly to him from the bookseller, i.e., his family could not bring him any books; that he was not permitted to have any contacts with other prisoners; and that the one hour a day when he was released from his cell had to be spent indoors, i.e., he never was allowed to see the sky. Lee's counsel has further informed me that Lee's incarceration conditions recently have been eased somewhat, in that now (February 28, 2000, the date this article was submitted to *APS News*): he is allowed a daily newspaper; that speaking Chinese during his family's visits no longer is forbidden, because the attending FBI operative now is Chinese fluent; and that he now is allowed into an open area, from which he can see the sky, during his daily one hour release from his cell, but that he is not permitted to have any other prisoners share this open area with him.

On the day of Dr. Lee's arrest the government issued a press release which included the following summary of the contents of his indictment: "The indictment alleges that in 1993 and 1994, Lee knowingly assembled 19 collections of files, called tape archive (TAR) files, containing secret and confidential restricted data relating to atomic weapon research, design, construction, and testing. Lee is alleged to have gathered and collected this information from the secure, classified Los Alamos computer system, moved it to an unsecure, "open" computer, and then later downloaded 17 of the 19 classified TAR files to nine portable computer tapes. In addition, the indictment alleges that in 1997 Lee downloaded directly from the classified system to a tenth portable computer tape current nuclear weapons design codes, auxiliary libraries, and utility codes necessary to compare computer generated, calculated results with actual test data. Seven of the tapes Lee made remain unaccounted for as of the date of the indictment." The press release went on to quote the US Attorney in charge of the case as saying: "This case is being prosecuted because Wen Ho Lee has denied the United States its exclusive dominion and control over some of this nation's most sensitive nuclear secrets. Although Lee has not been charged with communicating classified information to a foreign power, the mishandling of classified information alleged in the indictment has, in the government's view, resulted in serious damage to important national interests."

The government's request that Lee be denied bail was the subject of a hearing before a US magistrate judge on December 13, 1999, three days after he was arrested. Immediately upon conclusion of the hearing the magistrate judge denied bail on a finding, without a supporting written opinion, that Lee was a danger to the community; there was no finding on the need to assure Lee's appearance at trial.

The magistrate judge's order was promptly challenged by Lee's attorneys, with the result that on December 27, 1999, a hearing on the government's request to hold Lee without bail was initiated before US District Court Judge James Parker. Judge Parker affirmed the magistrate judge's order, in a written opinion which held there was no combination of conditions of pretrial release "that will reasonably assure the appearance of Dr. Lee as required and the safety of…the nation." Judge Parker's holding has been appealed to the next higher court, the Tenth Circuit Court of Appeals, headquartered in Denver, whose only superior is the US Supreme Court.

The government's witnesses in the two detention hearings, in addition to two FBI Special Agents and a federal "Pretrial Services Officer," were: Dr. Stephen Younger, LANL associate director for nuclear weapons; Cheryl Wampler, LANL deputy group leader for computing services; Dr. Richard Krajcik, Deputy Division Director of the LANL X Division; John Romero, team leader for one of LANL's nuclear weapons design codes; and Dr. Paul Robinson, President of Sandia National Laboratories. The issue before the court in these hearings was whether Lee should be denied bail, not whether Lee was guilty of the charges in the indictment. Lee's only witnesses were Jean and Don Marshall, his married neighbors for 19 years. Although both Marshalls were Q-cleared X Division employees, they had not worked on the same projects as Lee and merely testified to Lee's good character and strong family ties. Dr. Lee himself did not testify, as is his Fifth Amendment right.

"'I have got to say that this Court, I believe, faces a you-bet-your-country decision.'"

Testimony by the government's witnesses included: (i) in answer to Judge Parker's question, "Do you have an opinion as to why Dr. Lee would wait until after he was arrested, more than five years after putting this information in an unclassified partition, to take actions to disclose it to unauthorized persons?" Dr. Krajcik replied, "Because he has information, due to his experience, that he can continue to pass on, just as a consultant continues to have value to customers on a continuing basis as problems come up. The consultant can answer the questions;" (ii) to essentially the same question from Judge Parker, FBI Special Agent Robert Messemer replied, "Because in my expertise in countering espionage threats against the United States, time and time again the issue of revenge is one of the single largest motivating factors. Today, his liberty has been denied him, today there's an additional factor for him. To want to take revenge against the United States for removing his liberty, this is a strong motivating factor for persons who commit espionage;" (iii) Agent Messemer also testified that one reason why confining Dr. Lee to his home and tapping his phone would not adequately ensure the national safety was the possibility Mrs. Lee or some other third party, deliberately or unwittingly, might pass on a message revealing the location of the missing tapes. During the course of this testimony of Agent Messemer's the government lawyers argued that if Dr. Lee were released on bail, foreign agents might fly to some location near his home and fly him out of the country; (iv) Dr. Younger testified, "An advanced country, that knew quite a bit about nuclear weapons, could use the information on the tapes...to uncover vulnerabilities in the American arsenal which could help them to defeat our weapons through antiballistic systems or other means;" (v) Dr. Robinson testified that "the tapes represent a portfolio of information that would allow one to develop a simple, easily manufacturable weapon such as a terrorist weapon all the way up to the very best that the United States is capable of designing;" (vi) Dr. Robinson also told Judge Parker, "I have got to say that this Court, I believe, faces a you-bet-your-country decision."

Image from http://204.202.137.117/sections/world/DailyNews/chinanuclear990709_leeprofile.html

Dr. Wen Ho Lee

Dr. Lee's appeal brief argues, as would be expected, that Judge Parker had erroneously held the government had met the evidentiary standards needed to conclude there was no combination of conditions of pretrial release "that will reasonably assure the appearance of Dr. Lee as required and the safety of...the nation." Lee's appeal brief also contends that Judge Parker's decision to deny bail had been based on considerations which infringed Lee's Fifth Amendment rights.

Lee's reply brief to the government's answering brief raises the new contention that if the downloaded files were as important to the nation's security as the government claims, they should have been classified "Top Secret Restricted Data, unauthorized disclosure of which reasonably could be expected to cause exceptionally grave damage to national security," rather than merely "Secret" or "Confidential."

On February 29, the Court of Appeals denied Lee's appeal to be granted bail.

Edward Gerjuoy is Professor of Physics Emeritus at the University of Pittsburgh and Of Counsel (in effect an attorney consultant) at a Pittsburgh law firm. In the past he has been Chair of two APS Standing Committees—the Panel on Public Affairs (POPA) and the Committee on International Freedom of Scientists (CIFS). This history, together with the fact that he is an attorney, motivated CIFS to request that he contact Dr. Lee's defense team concerning Lee's case. Dr. Gerjuoy has informed APS News, and wants the readers of this article to know, that the aforementioned contact has led to his active involvement in the preparation of Lee's defense.

APS News *welcomes and encourages letters and submissions from its members responding to these and other issues. Responses may be sent to: letters@aps.org.*