APS NEWS

AUGUST/SEPTEMBER 1998 THE AMERICAN PHYSICAL SOCIETY VOLUME 7, NO 8

Try the enhanced APS News-online: [http://www.aps.org/apsnews]

7/6
Months to Go

aps centennial

March 20-26, 1999
www.aps.org/centennial

PROLA

Physical Review Online Archive

Covering all of *Physical Review* from 1985-1996

The *Physical Review OnLine Archive* (*PROLA*), covering all of *Physical Review* from 1985 to 1996, became available and will be **free for the remainder of the year**. In 1999, *PROLA* will be available at a modest cost of $300 for institutional subscribers to any of the *Physical Review* journals or *Physical Review Letters*, as well as to individual members for $100. Also, subscribers to a single journal who subscribe to *PROLA* get access to everything in *PROLA*, not just the particular journal to which they subscribe. An existing protoype system has been in use at Los Alamos National Laboratory [http://www.lanl.gov/external/] and other select pilot sites since late 1996. Although the new server has been completely redesigned, the new *PROLA* will have nearly 100,000 articles.

According to APS Editor-in-Chief Martin Blume, work is progressing on carrying the archive further back in time, with the expectation that *PROLA* will become the repository for all new journal issues, such that a library subscriber will have access to prior year volumes through *PROLA*. "We have the capability to go back as far as 1975 without much travail," said Blume. "Ultimately we would like to go back to 1893, including the entire contents of the journal since its inception in the online archive."

The availability of an online archive offers to dramatically improve the usability of previously published material by creating a powerful new research tool for both the science historian and the working physicist. Specifically, *PROLA* gives users the ability to navigate quickly from a table of contents, or a search result, to a good screen viewable image version of each article. Other features include the ability to print high-quality versions of the article at the user's desktop; and planned hypertext links to articles containing references to, or that are referenced by, the current document, as well as any errata referring to the current document.

PROLA will be a very valuable asset for the scientific community. Greatly enhanced access to earlier issues of *Physical Review* together with useful search and linking capabilities will be brought to the scientist's desktop," said Blume of this most recent APS online effort, "We believe that this wide desktop availability of early issues of *Physical Review* will change the way reference materials are used."

PROLA may be accessed through the APS Homepage, under the Reseach Journal button, or directly at: http://prola.aps.org.

Plenary Speakers Selected for APS Centennial

The APS Centennial Meeting to be held in Atlanta, Georgia, next March will feature, plenary sessions with world-renowned scientists addressing a wide range of topics of general interest. They are listed below.

- **Steven Weinberg**, University of Texas, Austin, "Physics of the Very Large and Very Small"
- **Harold Varmus**, National Institute of Health, "Impact of Physics on Biology and Medicine"
- **Joel Birnbaum**, Hewlett-Packard, "Physics and the information Revolution"
- **Mary Good**, Venture Capital, "Physics and Technology"
- **Richard Smalley**, Rice University, "Physics and Materials"
- **Martin Klein**, Yale University, "20th Century Physics and its Cultural Impact"

Up-to-date Centennial events and meeting information will be posted on the Centennial Web page from now through 1999. It can be accessed from the APS homepage [www.aps.org] or directly at [www.aps.org/centennial.]

Inside...

NEWS

Antonia Herzog is 1998-99 APS Congressional Fellow 2

APS Sponsors Mass Media Fellows 2
Two young physicists are spending this summer as journalist interns at Business Week and CNN.

Coulomb Interactions, "Transistor-less Computing" Highlight 1998 DAMOP Meeting 3
Recent studies on Coulomb interactions of hydrogen atoms, and using arrays of quantum dots for computing were among the highlights of the 1998 DAMOP meeting.

A Century of Physics 3
1945-1955: The Post-War Boom

100 Years: The International Dimension ... 3

DAMOP Thesis Award 5
DAMOP selected Christopher Wood as its latest thesis award recipient at its meeting in May.

Outstanding Undergraduate AMO Researchers 5

Commission on Women in Science 5
The APS Executive Board voted to endorse a proposal before Congress to establish a Commission on the Advancement of Women in Science, Engineering and Technology.

Zero Gravity 5
Brain Teaser Limerick Contest

APS Statement on Federal R&D Presented to Senate Committee 6
The APS Executive Board approved a statement on federal investment in R&D that was presented at an April Senate hearing.

APS Task Force Suggests "Physics Today" Changes 6
"Physics Today" continues to receive high marks from APS members, although there is room for improvement, an APS task force concluded.

Acrivos Dissertation Award Established ... 6
DFD has established a new dissertation award for fluid dynamics.

OPINION

APS Views 4
Roman Czujko of AIP's Employment and Education Statistics Division gives a status report on trends, opportunities and threats for physics.

Letters 4

Announcements 7

The Back Page: 8
Senator Bill Frist discusses the importance of science and technology.

INSIDE THE BELTWAY

How to Use a Surplus: Squeeze and Double

by Michael S. Lubell, APS Director of Public Affairs

It seems only yesterday that the federal budget was drowning in a sea of red ink. Less than two years ago the White House projected that the annual deficit would run $200 billion or more as far into the future as analysts could peer. As little as a year ago, forecasts of break-even for the current fiscal year seemed to be little more than wishful thinking. And last December, then Budget Director Raines vehemently denied rumors that his office was projecting a surplus for this year.

Yet within two months, the Office of Management and Budget reversed its public stance, and by the time President Clinton delivered his State of the Union Address, OMB was forecasting a small surplus — if you call $13 billion a small number. By April, the figure had grown to $39 billion, and as the sultry summer days enveloped the nation's capital, OMB once again moved its estimate upward, this time to $63 billion. Some analysts believe that by the close of the fiscal year on September 30, the surplus could reach $75 billion, driven by an incredibly vibrant economy that is fueled by technology.

With all this cash piling up in the Treasury, you might wonder why Congress is embroiled in appropriations arguments that seemingly could be solved by adding less than $10 billion to the current spending plans. The answer is simple: It's 25 percent ideology and 75 percent politics — as most things are in Washington. Here's the inside dope.

First the ideology. Conservatives, including a large majority of Republicans, and a band of about 20 Blue Dog Democrats, want to shrink the federal government in order to adhere to their populist credo. They regard the federal government, at worst, as the enemy of the people and, at best, as a well-meaning but inept legion of bureaucrats. For them, keeping the lid on the budget is the most effective way of downsizing government. That was House Budget Committee Chairman Kasich's (R-OH) contentious rationale for reducing five-year federal expenditures by $100 billion below the balanced budget caps agreed to just last year.

Now the politics. This is an election year in which the swing of 11 seats could return control of the House of Representatives to the Democrats. This simple fact, well-known to every Beltway denizen, establishes the backdrop for almost all current decision-making in Washington. To position the Democratic party for the November shoot-out, the White House last January decided to try to deprive the GOP of its ammunition of choice — tax cuts. In his State of the Union Address, the President fenced off any budget surplus until the Social Security "crisis" is solved. Whether there is a crisis, of course, is still a matter of debate.

(continues on page 7)

1998 Fall Meeting Madness

Ten APS units — four divisions and six geographical sections — are holding their fall meetings in October and November, making it one of the busiest times of the year for the Society. The APS is also sponsoring the 51st Annual Gaseous Electronics Conference, October 19-22 in Maui, Hawaii.

October:		
October 3-4	New York Section	Troy, NY
October 4-9	Division of Laser Science	Baltimore, MD
October 15-17	Texas Section	El Paso, TX
October 16-17	Four Corners Section	Provo, UT
October 16-17	Ohio Section	Akron, OH
October 19-22	Gaseous Electronics	Maui, HI
October 23-24	New England Section	Durham, NH
October 28-31	Division of Nuclear Physics	Santa Fe, NM
November:		
November 12-14	Southeastern Section	Miami, FL
November 16-20	Division of Plasma Physics	New Orleans, LA
November 22-24	Division of Fluid Dynamics	Philadelphia, PA

Antonia Herzog is 1998-99 APS Congressional Fellow

The American Physical Society selected the 1998-99 Congressional Fellow at its annual spring meeting in Columbus, OH in April. Antonia Herzog, currently a consultant with the American Association for the Advancement of Science (AAAS), will serve one year as a special legislative assistant in a congressional office of her choice, following an intensive, ten-day orientation period and interview process.

Herzog received a BA in physics from Vassar College in 1987 and a BE in general engineering from Dartmouth College the following year. After completing her MS in applied physics at Columbia University in 1989, where she studied the stresses and strains in doped silicon membranes using Raman spectroscopy, she went on to earn a PhD in physics from the University of California, San Diego. There she studied the transport properties of disordered metallic and superconducting one-dimensional wires. Herzog also gained industrial experience through a summer internship at Xerox Corporation in Webster, New York, in 1988, working in the Business Products & Supplies/Material Technology and Control Group.

Before joining the AAAS, Herzog explored other research options, working as a postdoctoral research associate at The Salk Institute for Biological Studies, studying the organization of neuronal circuits for visual information processing. Specifically, she used intracellular electrophysiological recordings in brain slices to elucidate the functional connectivity of cortical neurons in the visual cortex. "There is an expanding interaction between biology and physics, especially in the computational modeling of neurobiological systems," she said, adding that while the two fields are very different, "The techniques that I used in my neurobiology lab were related to experimental techniques that I used in my physics lab."

"I felt that to really understand how things are accomplished, you have to know how Congress works."

While positive, the experience convinced her that her true interests lay elsewhere, and in 1997 she moved to Washington, DC, to pursue a career in science policy. At AAAS, she has been exploring various issues related to the ethical, legal and policy implications of science and technology. Past community service includes working with the San Diego chapter of the Sierra Club to preserve the remaining coastal wetlands in San Diego County through lobbying efforts and public education. "It made me realize that this is a very complex process and you need to know what you're doing if you want to get anything accomplished," she said of the experience. She also participated in Habitat for Humanity, a non-profit group that provides housing for low-income families at reduced costs.

Applying for the APS Congressional Fellowship was a logical next step for Herzog's budding career in science policy. "I felt that to really understand how things are accomplished, you have to know how Congress works," she said, "I felt this would be an incredible first-hand experience that would make me more effective in the future regarding whatever issues concerned me." While she has yet to decide where she will spend her fellowship year, Herzog is leaning towards working on the personal staff of a member of Congress: "Congress is all about the home state and constituency concerns and if you don't understand that, you've missed the boat." She is specifically interested in working on issues regarding energy use and conservation, global climate change, and other environmental concerns, and ultimately sees herself working for a nonprofit science policy organization.


Antonia Herzog

The APS Congressional Fellowship program is intended to provide a public service by making available individuals with scientific knowledge and skills to members of Congress, few of whom have a technical background. In turn, the program enables scientists to broaden their experience through direct involvement with the legislative and political processes. "Fellows gain a perspective which, ideally, will enhance not only their own careers but also the physics community's ability to more effectively communicate with its representatives in Congress," said APS Associate Executive Officer Barrett Ripin.

APS Sponsors Mass Media Fellows

The APS has selected two young physicists as the Society's newest Mass Media Fellows. Nellie Andreeva, a graduate student in physics at the University of Maine in Orono, will spend this summer at *Business Week* magazine in New York. Zohra Aziza Baccouche of Hampton University will begin her fellowship at CNN this fall.

Andreeva received MS degrees in both physics and TV and radio journalism from Sofia University in Bulgaria in 1993, and began her graduate studies at the University of Maine last year. She has long been interested in combining her interest in physics with journalism. She spent six years as a producer, writer and director of TV shows for Bulgarian National Television, creating what became the number one comedy show in Bulgaria and winning two prestigious national awards for her efforts. She has had two prior internships: one at the BBC in London, England, and another at WCAU-TV in Philadelphia, organized by the University of Delaware.

Andreeva views her participation in the APS Mass Media Fellowship program as a unique opportunity to work with other physicists who share her interest in communicating science to the public. "The problem is clear: We have a society exquisitely dependent on science and technology, in which the average person understands hardly anything about science and technology," she says. "For good or evil, the media has an enormous influence on the average person. Therefore, scientists and engineers must use it and work together, both with and as journalists." She is currently engaged in a thesis entitled "Learning Physics Through Movies," designed to pique the interest of high school and college students in physics through blockbuster films.

After receiving a BS degree in physics from the College of William and Mary in 1995, Baccouche went on to earn an MS degree last year from Hampton University. She is currently pursuing her PhD in physics at the University of Maryland, College Park, working on a numerical calculation of the energy spectrum, wave functions and decay widths of heavy B and D mesons using a non-relativistic quark model. She hopes to pursue a career in science communication after completing her PhD because of what she perceives as a "growing need" for better communication between scientists, the media, and the general public. "As scientists, we are conjuring up research that has and will continue to have defining implications on people's lives around the world," she says. "It's important that people are aware of these implications."


Aziza Baccouche

Baccouche has held several prior media-related internships. She worked at Voice of America and WETA-TV in Washington, DC; and became involved in editing and producing science documentaries for NASA through its Langley Video Production Company in Hampton, VA. She currently writes for *Jefferson On Target* magazine, a publication the Thomas Jefferson National Accelerator Facility (formerly CEBAF).

APS News

Coden: ANWSEN ISSN: 1058-8132
Series II, Vol. 7, No.8 August/September 1998

Editor: Barrett H. Ripin
Newswriter: Jennifer Ouellette
Production: Elizabeth Buchan-Higgins
Alicia Y. Chang
Kim Parsons
Coordinator: Amy Halsted

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

Letters to the editor are welcomed from the membership. Letters must be signed and should include an address and daytime telephone number. The APS reserves the right to select and to edit for length or clarity. All correspondence regarding *APS News* should be directed to: Editor, *APS News*, One Physics Ellipse, College Park, MD 20749-3844, E-mail: letters@aps.org.

Subscriptions: *APS News* is an on-membership publication delivered by Periodical Mail. Members residing abroad may receive airfreight delivery for a fee of $20. **Nonmembers:** Subscription rates are: domestic $160; Canada, Mexico, Central and South America, and Caribbean $180; Air Freight Europe, Asia, Africa and Oceania $210.

Subscription orders, renewals and address changes should be addressed as follows: **For APS Members**—Membership Department, The American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, membership@aps.org. **For Nonmembers**—Circulation and Fulfillment Division, American Institute of Physics, 500 Sunnyside Blvd., Woodbury, NY 11797. Allow at least 6 weeks advance notice. For address changes, please send both the old and new addresses, and, if possible, include a mailing label from a recent issue. Requests from subscribers for missing issues will be honored without charge only if received within 6 months of the issue's actual date of publication.

Periodical Postage Paid at College Park, MD and at additional mailing offices. Postmaster: Send address changes to *APS News*, Membership Department, The American Physical Society, One Physics Ellipse, College Park, MD 20740-3844.

Coulomb Interactions, "Transistor-Less Computing" Highlight 1998 DAMOP Meeting

Recent studies on Coulomb interactions of hydrogen atoms and the relative masses of protons and antiprotons, as well as the possibility of transistor-less computing using arrays of quantum dots, were among the highlights of the 29th annual meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP). Held jointly with the AMO division of the Canadian Association of Physicists, the conference took place from 27-30 May 1998 in Santa Fe, New Mexico.

Wednesday's opening plenary session featured lectures from this year's recipients of the Davisson-Germer, Earle K. Plyler and Will Allis Prizes, while two of the winners of the 1997 Nobel Prize in Physics — Steven Chu (Stanford University) and William Phillips (NIST) — were featured at Saturday's closing plenary session. There was also a special session featuring papers presented by finalists for the DAMOP Thesis Award and for undergraduate research (see stories, page 5).

Protons and Antiprotons Have Same Mass. Protons and antiprotons have the same mass to within one part in 10 billion, according to Harvard physicists Gerald Gabrielse and Anton Khabbaz. Along with their Bonn collaborators, they are able to make this comparison by loading a single antiproton and a single proton (saddled with two electrons, in order to make the proton into a negatively charged object) and letting them orbit simultaneously around an ion trap under the influence of a strong magnetic field. This stringent new measurement constitutes the best test yet (by a factor of 10) of the CPT theorem, which says that physics should not discriminate between particles, and antiparticles moving backwards in time.

Record Low Temperatures for Elementary Particles. In a separate ion trap experiment, Gabrielse and his Harvard colleagues chilled electrons down to only 70° mK, making this the first time elementary particles had ever been stored at temperatures below 4° K; previously only atoms, which are much heavier composite structures, had been cooled so low.

Coulomb Interactions of Hydrogen Ions. How three hydrogen ions share their energy and how they position themselves with respect to each other has been experimentally measured for the first time, shedding light on the infamous "three-body problem" in the realm of electrically charged particles.

Previous experiments with two electrons and a positive ion can be easily approximated as a two-body problem because the ion remains relatively stationary. Lisa Wiese of the University of Nebraska described smashing a molecular ion H_3^+ against a helium target to produce three ions: H^+, H^-, and H^+. The target, the physicists deduced that the H^- tended to reside in between the two H^+ ions, from near the "Coulomb saddle point" (where the forces from the other hydrogen ions balance out) to the near vicinity of an H^+ ion. Interestingly, the H^- was never found at the saddle point itself.

Transistor-Less Computing. Quantum dot cellular automata (QCA) might make possible a new type of transistor-less computing. A quantum dot is essentially a zero-dimensional artificial atom, isolated on (or in) a semiconductor substrate. Using a pair of electrons within a cell of four closely spaced dots — the electrons can tunnel from dot to dot — creates a binary bit: the configuration of the electrons establishes either a 1 or a 0. Put many of these cells together and you have a programmable cellular automata network. Wolfgang Porod at Notre Dame reported on the modeling and operation of a QCA array, including a demonstration of the manipulation of a single electron by another nearby single electron.

Momentum Microscope. A momentum microscope for viewing single-molecule collisions has been demonstrated, allowing physicists to determine how the alignment of a molecule can affect the final outcome of a collision. Michael Prior of Lawrence Berkeley Lab described how he and his colleagues combined the imaging of molecular fragments with a new application of the technique called COLTRIMS, short for "cold target recoil ion momentum spectroscopy." COLTRIMS collects the products of a collision in a weak electric field and projects them onto position-sensitive detectors. Measuring the particles' positions and the times it takes them to fly to the detector, one can determine the particles' momentum values and thereby reconstruct the collision itself.

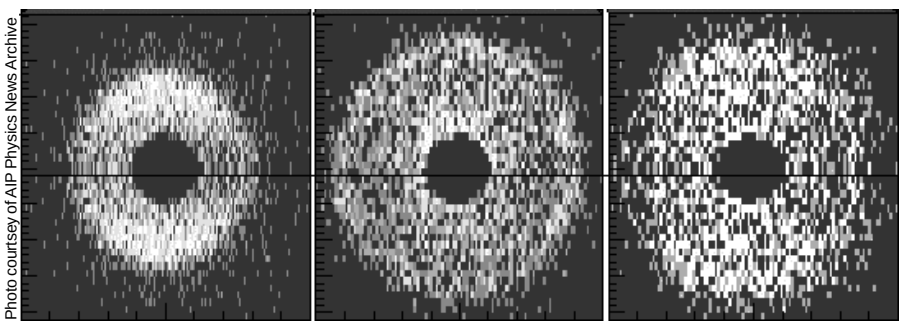


Photo courtsey of AIP Physics News Archive

The doughnut-shaped images above, provide information on the alignment of a helium hydride ion (HeH^+) as it collides with a target of helium atoms, captures an electron, and becomes a neutral HeH molecule. Three cases are shown: collisions producing HeH in its lowest energy state (left), in an excited state (center), and a higher-energy excited state (right).

Optical Force Clamps for Molecular Motors. Scientists at Princeton University have developed a novel optical trapping microscope, or force clamp, to better enable the study of single molecules of kinesin, a motor protein. According to Koen Visscher, the optical force clamp specifically permits investigation of the long-standing question of how mechanical motion is coupled to the biochemical engine cycle. "The combination of new optical trapping and statistical analysis techniques opens new and powerful ways of studying protein dynamics at the single molecule level in a wide variety of systems," said Visscher.

Spin-Polarized Noble Gases. The ability to polarize large quantities of noble gases such as He^3 and Xe^{129} is emerging as a powerful tool for probing the spin structure of the neutron in particle and nuclear physics, according to Princeton's Gordon Cates, who reviewed recent progress in spin-exchange optical pumping to create large nuclear spin polarizations in dense samples of noble gases, as well as some potential applications. Such large spin-polarization greatly enhances the NMR detection sensitivity of these gases. Genevieve Tastevin of the Ecole Normale Superieure in France recently obtained high resolution 3-D images of ventilatory lung spaces in humans by nuclear magnetic resonance using inhaled hyperpolarized He^3 gas.

A century of physics

1945-1954: The Post War Boom

by Hans Christian von Baeyer

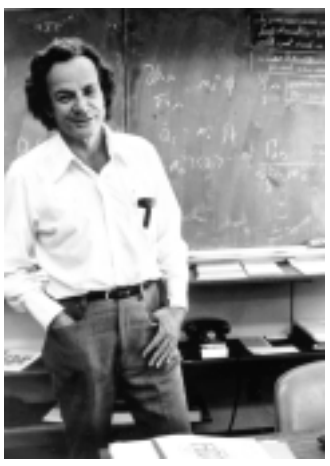


Photo courtsey of AIP Niels Bohr Library

Richard Feynman

In the United States the successful conclusion of World War II inspired a heady sense of optimism and self-confidence which was further bolstered by the end of the Great Depression. Renewed prosperity, in turn, allowed America to contribute generously to the reconstruction of the world's shattered nations. Neither the emerging Cold War, nor the sudden eruption of the Korean conflict in 1951, could dampen the good spirits. Physics, too, blossomed as young scientists returned to their universities and industrial labs, full of new ideas picked up in the course of their war work, and eager to get on with their careers. Far from closing down, weapons laboratories developed into permanent national institutions devoted to both military and civilian research. For the first time, the federal government undertook the systematic support of basic science.

One of the theoreticians who came down from Oppenheimer's mountaintop in New Mexico was Richard Feynman (right), a native New Yorker just three years past his Ph.D. Brilliant, irreverent, and ambitious, he distrusted authority and insisted on figuring things out in his own way. His particular strength was his visual imagination. For example, he developed an elegant code for representing complex equations by simple diagrams that allowed him to let his physical intuition guide his mathematical calculations toward quick, accurate solutions.

Feynman brought this unorthodox technique to bear on what was at the time the principal problem of theoretical physics: the quantum mechanics of light. Photons had been around for half a century, but a detailed description of how they are emitted and absorbed by electrons was lacking. Together with American colleagues and Japanese physicists who had worked along similar lines while they were out of touch with the West during the war, Feynman solved the problem by creating Quantum Electrodynamics (QED). QED proved to be of such unprecedented precision and scope that it set a standard of excellence against which all future fundamental theories of elementary particles would come to be measured.

In contrast to QED, which applies to the outer shell of the atom where the electrons reside, theoretical descriptions of the atomic nucleus remained rudimentary. Even as the list of so-called elementary particles produced at accelerators grew into the hundreds, theories proliferated, but none were mathematically satisfactory. Neither the aging giants, such as Werner Heisenberg, nor the young geniuses, such as Feynman, knew which way to turn. The tantalizing success of QED only added to their frustration.

Editor's Note: A CENTURY OF PHYSICS, a dramatic illustrated timeline wallchart of over a hundred entries on eleven large posters is intended for high schools and colleges. Each poster covers about a decade and is introduced by a thumbnail essay to provide a glimpse of the historical and scientific context of the time.

In the October issue, APS News will feature the seventh introductory essay: ***1955-1965: Connections****.*

100 years: The International Dimension

The 23rd General Assembly of the International Union of Pure and Applied Physics will convene in Atlanta, Georgia (March 17-21, 1999), just one week before the beginning of the APS Centennial Meeting. Thus, at the outset, there will be a substantial international physics presence in Atlanta, with more than 150 leaders of the academic and industrial research communities meeting to chart the future course of the Union. The new Union President, former APS President Burton Richter, will assume the IUPAP Presidency at the conclusion of the General Assembly. In addition, from 50 to 60 physical societies have indicated that they will send delegates to represent their organizations.

The Nobel luncheon and opening of the Nobel Exhibit on Saturday, March 20, will be held in honor of laureates from all over the world. It will be a fitting start to the 100 year celebration of physics as a global cultural, social and economic adventure—one that has transformed the 20th century and promises even greater contributions to our quality of life and understanding of nature in the new millennium.

In acknowledgment of the importance of the international dimensions of the physics enterprise, the opening plenary on March 20 is entitled, "International Cooperation in Physics," and will feature presentations by Cylon Concalves de Silva (Brazil), Jan S. Nilsson (Sweden and IUPAP), Predaman K. Kaw (India), Tadahiro Sekimoto (Japan) and Luciano Maiani (Italy and CERN). The session will be chaired by Jerry Friedman, incoming President of APS. After the conclusion of the plenary, a reception and dinner will be hosted by APS in honor of our sister societies around the world.

The Society will also host round-tables on a variety of international topics the following day, Sunday, March 21, prior to the opening of technical and scientific sessions. It will constitute the beginning of a global dialog on physics in the 21st century.

OPINION

APS VIEWS

Status Report on Physics: Trends, Opportunities and Threats

by Roman Czujko, AIP Employment and Education Statistics Division

Over the last few years, the US economy has been very strong. Much of that strength has been driven by technological innovation, and the career opportunities for individuals with physics training have improved markedly.

The following report is an overview of some of the trends and issues facing the physics community. There are both positive and negative aspects to each stage of both the education and employment systems.

Precollege Physics Education. Over the past decade, the proportion of high school graduates who took a physics course rose from 20% to 27%. This is doubly encouraging, since the total number of high school graduates also increased over that time. In short, about 812,000 students took high school physics during academic year 1996-1997, compared to only 624,000 in 1986-1987.

Both the proportion and the number of women taking high school physics has also improved markedly over the last decade. The percentage of female high school physics students climbed from 38% to 47% from 1987 to 1997. During academic year 1996-1997, about 380,000 girls took physics in US high schools.

The Third International Mathematics and Science Study (TIMSS), however, casts doubt on the effectiveness of physics education specifically, and the precollege science curriculum in general. US students came in last from among 15 countries that participated in the high school physics portion of the TIMSS studies. This finding is especially troubling in light of the efforts of the NSF and other groups to improve high school physics and provide in-service training to teachers.

Two-Year College Physics. Two-year colleges play an important role in physics education. The AIP Statistics Division finds that 10-12% of physics bachelor's degree recipients report that they started their college education in two-year institutions. We will publish the first nationwide study of physics in two-year colleges in September 1998. This study finds that about 120,000 students take physics each year in two-year institutions, that physics is offered at about 1,100 different campuses, and that physics is taught by approximately 1,800 full-time and 900 part-time faculty. We published a Directory of Physics and Faculty Programs in Two-Year Colleges last fall.

Undergraduate Physics Education in Four-Year Institutions. Enrollment in introductory physics courses remain strong at about 375,000 students per year. About 40% of these students take the calculus-based course, 37% the algebra-based course, and 23% take an introductory physics course that requires no college math. The majority of the students taking the calculus-based course are engineering majors. Thus, the relationship between physics and engineering departments is of considerable concern. There is talk about some engineering departments taking over physics teaching. At those institutions that pursue this strategy, the impact on the physics department will, in many cases, be severe, because many departments are evaluated, in part, on the total number of undergraduate credit hours taught.

The number of bachelor's degrees awarded in physics has been declining steadily since 1991. During the late 1980s, bachelor production hovered around 4900-5000 per year. The physics class of 1997 fell to about 3,850. Based on junior enrollments, we anticipate that the class of 1998 will be smaller still. There are approximately 760 physics degree-granting departments, 500 of which offer the bachelors as their highest physics degree. Over three-quarters of physics bachelor-granting departments award five or fewer degrees per year. Increasingly, smaller departments are having to justify their degree-granting status.

Physics Graduate Education. The number of students admitted into physics graduate programs has been declining since 1992. First-year graduate student enrollments for 1996-1997 were 27% lower than in 1992. U.S. citizens have been declining faster than foreign citizens. During the late 1980s, foreign citizens made up about 42% of first year students; they now account for 48%. In addition, the countries of origin have changed. There are now fewer Chinese students entering physics; they are being replaced by students from the former Soviet Union.

Recently, attention has focused on master's programs in physics as a means of making students more marketable in the industrial work force. However, surprisingly few physics master's programs offer such curriculum options as co-ops, internships, or interdisciplinary degrees.

PhD production is starting to show signs of the impending decline that is inevitable given the drop in first-year graduate student enrollments. In 1993-1994, about 1,480 physics PhDs were conferred. The class of 1997 was down to about 1,345. We anticipate that the total will drop below 1,100 new physics PhDs by 2002, and for the first time, the majority of those PhDs will be earned by foreign citizens.

Initial Employment. About half of all physics bachelors enter the work force, 30% study physics at the graduate level, and the remaining 20% go on to advanced education in a broad variety of fields. Of the physics bachelors who enter the work force, about 60% are employed in the private sector. The average starting salary for the physics bachelors class of 1996 in industry was $31,000. We expect that the physics graduates of 1997 and 1998 entering industrial employment will earn significantly higher salaries than those of the class of 1996.

Over the last few years, there have been significant changes in the initial employment that new physics PhDs accepted. During the late 1980s and early 1990s, about 60% of new physics PhDs took a postdoctoral appointment. This trend changed for the classes of 1995 and 1996, dropping to about 40%. Preliminary analysis of the employment of the class of 1997 indicates that this trend has bounced back up somewhat, and about half of physics PhDs took a postdoctoral position. Part of this bounce may have to do with salaries. Preliminary results indicate that postdoc salaries for physicists in universities have increased to about $33,500 for the class of 1997. For the PhD classes of 1996 and 1997, there is also a major shift towards industrial employment outside the field of physics. The dominant employment areas in the latter case are engineering, software development, and modeling within finance and business.

Career Issues. One of the strengths and weaknesses of physics is that people with a physics education work throughout the economy in a broad range of common careers. On the positive side, this reflects the value of a physics education as a foundation for responding to changes in the demand for technically trained workers. However, during recessions and difficult job markets, physics degree recipients are often at a disadvantage, in part because so few jobs are specifically labeled as physicist.

The retirement patterns of physics faculty is an important but not well understood issue. The change in the law has certainly added to the complexity of this phenomenon. Up until 1990, it was possible to project academic retirements with considerable accuracy. However, this is no longer true, given the increase in deferred retirements, early retirements, and concern about whether institutions will allow physics departments to replace retired faculty. The age structure of physics faculty in research departments has become increasingly distorted and there are now more faculty who are over the age of 60 than under the age of 40. Within the next six months, the AIP Statistics Division will publish a report describing the complexities and parameters of academic retirement.

Based on a study of a sample of Sigma Pi Sigma members carried out in 1994, it is clear that the majority of physics graduates at all degree levels believe that their physics training was a solid foundation for their current careers, regardless of whether those positions were primarily in physics or in other fields. With support from the NSF, the AIP Statistics Division has recently initiated a new study entitled *Bachelors Plus Five*, which will develop detailed data on the subsequent educational and employment experiences of the physics bachelors classes of 1991, 1992 and 1993. It will provide students with information about the rich diversity of careers commonly pursued by physics alumni, and will provide faculty with information that they can use to assess the effectiveness of their undergraduate curriculum.

Postdocs continue to be an area of concern for physicists. We estimate that there are about 1700-1800 physicists holding postdocs in PhD-granting departments and university-affiliated research institutes. More than one quarter of them earned their PhDs abroad. We estimate that there are another 900 postdocs in other sectors, mostly at 30 Federally Funded Research & Development Centers. Two questions that are asked frequently about postdocs are (1) What proportion of postdocs eventually get faculty positions in research universities, and (2) Of postdocs who do not (the majority), where do they get jobs and was their postdoc experience valuable to them in their subsequent careers?

Unfortunately, we do not know the precise answers to these questions. What is more, the system is presently so volatile that whatever may have been true two years ago need not be two years hence. The Statistics Division will develop a grant proposal to look at the early careers of PhD physicists during the 1990s, both those who began in postdocs and those who entered permanent positions.

Then there are the so-called "hidden physicists." Only about one in seven physics bachelors go on to earn a PhD in physics, and only about 55% of those report that their primary field of employment is physics. The question is, what can and should the APS

(continues on page 5)

LETTERS

A Question About Tenure...

I have a question about the tenure system. It is generally held that the creative period of a physicist's career ends at a very young age (Alan Lightman, for example, has mentioned the age of 35 as a point where he in particular felt "past his prime"). Yet most physicists do not get tenure until their mid-thirties, at least.

Why, then, do we have a tenure system which supports the creative work of people whose period of creativity has ended? Wouldn't it be better to put our resources into supporting the research of more young physicists, who are in the prime of their careers, and cannot get academic jobs in the current economic climate?

Brett Bochner
Massachusetts Institute of Technology

Some Style Points for Writing

I have some additional specific points to add to the article, "Some Simple Rules for Writing (*APS News*, June 1998), since Barbara Levi covered the generalities. Please publish a retraction of (1) split infinitives to better see, to consistently follow; (2) implied split infinitives to...drastically rephrase, to...completely drop; (3) awhile; (4) number mismatches we...emulate the style of our favorite author, each of us has to hone our own understanding. Dr. Levi's article was good on the literary aspects. APS has lots of guidelines on the technical aspects. Unfortunately all warnings against student mistakes have disappeared from grammar school.

Fred Ordway
Bethesda, Maryland

Barbara Levi replies:

It was bound to happen! In my preaching about "Some Simple Rules of Writing," I have committed a few sins. I readily confess to transgressions 3 and 4 on Ordways list, but I have to defend some of my split infinitives (items 1 and 2). I cite The Elements of Style, which states (on page 78) that some infinitives improve on being split. A good guideline, I feel, is to split an infinitive if doing so results in a more felicitous voice or a clearer meaning. Accordingly, in two of the cases Ordway spotted (item 1), I would have done better not to have allowed the split.

I thank Mr. Ordway for his vigilence. I'm glad to know there are people like him who really care about the proper use of grammar.

Christopher Wood Received 1998 DAMOP Thesis Award


Christopher Wood

At the recent meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP) in Santa Fe (see story, page 3), Christopher Wood, currently a postdoctoral fellow at the National Institute for Standards and Technology in Boulder, Colorado, was selected as the 1998 recipient of the DAMOP Thesis Award. Wood was chosen from among five finalists who presented their papers at a special Thursday morning session.

Born and raised in Wyoming, Wood attended the University of Wyoming in Laramie from 1985 to 1989 for his undergraduate studies. During that time, he worked as an undergraduate on balloon-based measurements of the ozone hole in Antarctica. He also participated in the Summer Science Undergraduate program at the Stanford Linear Accelerator Center. He opted to attend the University of Colorado /JILA for graduate study, where he worked on the cesium parity non-conservation (PNC) measurement with Carl Wieman, for which work the DAMOP thesis award was given. He is presently engaged in 1-, 2-, and 3-ion experiments (using Be+ ions) for quantum logic and quantum optics at NIST.

"Historically, atomic PNC measurements have bridged the gap between high energy and low energy physics," said Wood of his thesis work with Wieman. "Our recently completed 0.35% measurement of PNC in cesium has gone a step further and created a bridge between atomic physics and nuclear physics." He also made a 14% measurement of the parity violating nuclear anapole moment, a seven-fold improvement over previous measurements.

The DAMOP Thesis Award recognizes doctoral thesis research of outstanding quality and achievement in atomic, molecular or optical physics, and encourages effective written and oral presentation of research results. The other four finalists, and their thesis topics, were Orly Alter (Stanford University), "Impossibility of Determining the Quantum Wavefunction of a Single System and Fundamental Limit to External Force Detection"; W.R. Anderson (University of Virginia, Charlottesville), "Resonant Dipole-Dipole Collisions of Rydberg Atoms in a Magneto-Optical Trap"; Robert J. Dodd (Oxford University), "Bose-Einstein Condensation in Atomic Alkali Gases"; and Chandra S. Raman (Massachusetts Institute of Technology), "Rydberg Wave Packets and Half-Cycle Electromagnetic Pulses."

Executive Board Endorses Proposed Commission on Women in Science

In June, the APS Executive Board voted to endorse a statement expressing support of H.R. 3007, The Commission on the Advancement of Women in Science, Engineering and Technology Act. If adopted, this act will establish a special commission to determine why women continue to be underrepresented in the science and engineering workforce, and examine practices that have been successful in recruiting women.

The bill was introduced into the House of Representatives by Rep. Connie Morella (R-MD), who noted that while women represent 50% of all workers, they compose roughly 22% of the science and engineering workforce. The House Science Subcommittee on Technology approved the bill by voice vote on March 26, 1998. [Testimony from the Congressional hearings held in March can be found online at http://www.house.gov/science] H.R. 3007 has also been endorsed by the American Association of Engineering Societies, the American Chemical Society, and the Institute of Electrical and Electronic Engineers.

The APS statement was drafted by an ad-hoc subcommittee of the APS Panel on Public Affairs (POPA), which included Caroline Herzenberg, Henry Abarbanel, Marc Sher, and Lou Lanzerotti. Text of the statement follows.

Statement on the Advancement of Women in Science, Engineering and Technology

Professional organizations, universities, private industry, and government research laboratories have made modest progress in attracting women to careers in science and engineering. Yet, the numbers remain disturbingly low. In physics, for example, women account for only 6.5% of the labor force and only 13 percent of new PhDs.

For a number of years, The American Physical Society has championed programs that encourage more women to enter the science and engineering fields. In accordance with past policies, the Executive Board of The American Physical Society endorses the establishment of a Commission on the Advancement of Women in Science, Engineering and Technology proposed in the bill H.R. 3007, which will seek to identify barriers that might deter women from entering these fields.

Outstanding Atomic, Molecular and Optical Undergraduate Researchers

DAMOP has held an annual competition to select the best undergraduate AMO research being performed for the last four years. All DAMOP advisors are asked to encourage their outstanding undergraduates to apply. Candidates submit an abstract of their work and a brief description of their involvement and contribution to the research project. An international committee selects the best of these to present an invited talk and be recognized at a ceremony at the annual DAMOP meeting. Undergraduate recipients have all expenses paid to the meeting. Don Madison, University of Missouri-Rolla organized the competition. This year, five students were selected to present talks at the Santa Fe meeting. The talks covered a wide variety of topics. Dan Chitwood from the University of Missouri-Rolla discussed quantum mechanical interference effects occurring in atomic ionization when the ionized electron energy coincides with the energy of an atomic autoionizing state. David Griggs from Georgia Southern University talked about the dynamical behavior of cold-atom Bose-Einstein condensates driven by an oscillating magnetic trap. Brooks Hitt from the University of Nebraska presented a novel method for creating polarized electrons through collisions with optically pumped rubidium. Robert Komara from Youngstown State University discussed ion-core parameters for argon by analyzing transitions between high-L Rydberg states. Finally, Chris Maloney from the University of Missouri-Rolla presented theoretical calculations for electrons colliding with argon atoms in a metastable state.


DAMOP outstanding undergraduate researchers. From left to right: David Griggs, Chris Maloney, Dan Chitwood, Brooks Hitt and Robert Komara.

APS Views *(continued from page 4)*

do for the vast majority of physics bachelors degree recipients, i.e., those who use significant portions of their physics knowledge and training in their careers, but are not specifically employed as physicists. Among the areas that are projected to have continued strong demand are management within a technical environment, computer software and hardware, semiconductor technology, and computer simulations and modeling.

Women and Minorities. Women continue to slowly increase their representation among recent physics degree recipients, 19% of the bachelors and 12% at the PhD level. It should be noted, however, that compared to all other sciences, physics continues to have the lowest representation of women; only engineering has proportionately fewer women. In 1994, women were hired as assistant professors at the same rate as their availability among recent PhDs (12%). Women also represent 12% of all physics postdocs.

The representation of African Americans is low among all the physical sciences, and physics is no exception. We estimate that fewer than 200 African Americans earned physics PhDs between 1973 and 1996, representing less than 1% of the total pool of physics PhDs conferred over that time. About 4% of new physics bachelors degrees are earned by African Americans. This is up slightly over the past decade. However, about 60% of African Americans who earn physics bachelors degrees come from the 30 Historically Black Colleges and Universities that have physics degree-granting departments. It is estimated that about 60 African Americans earn bachelors degrees each year from the 730 majority institutions with physics departments. Hispanic Americans account for only 2% of physics bachelors, and physics PhD recipients.

More detailed information on employment and education in physics can be found on-line at http://www.aip.org/statistics.

zero gravity

BRAIN TEASER LIMERICKS

Editor's Note: *Given the past popularity of physics limericks, APS News announces a new contest: brain teaser puzzles, presented in limerick form. Some examples, using rudimentary mathematical concepts, are below. We are looking for original brain teaser limericks on more advanced physical and mathematical concepts, as a challenge to readers and would-be limerickists alike. Winning entries will receive the usual fabulous prizes, plus publication in a future issue of APS News. The deadline for receipt of submissions is* ***November 30, 1998****.*

1. Kindly old Grandfather Lunn
   Is twice as old as his son
   Twenty-five years ago
   Their age ratio
   Strange enough was three to one
   When does Grandfather celebrate his centenary?

2. Said a certain young lady named Gwen
   Of her tally of smitten young men
   "one less and three more
   Divided by four
   Together give one more than ten"
   How many boyfriends had she?

3. There was a young fellow named Clive
   Whose bees number ten power five
   The daughters to each son
   Were as nineteen to one,
   A truly remarkable hive.
   How many sons (drones) were in the hive?

4. A team's opening batter named Nero
   Squared his number of hits, the big hero!
   After subtracting his score
   He took off ten and two more
   And the final result was a "zero".
   How many hits did Nero make:

5. Some freshman from Trinity Hall
   Played hockey with a wonderful ball;
   Two times its weight
   Plus weight squared, minus eight,
   Gave "nothing" in ounces at all.
   What was the weight of the ball?

(Answers on page 6)

APS Centurions

We would like to identify the oldest living APS member, those born in 1899 (Centennial centurions), and members belonging to the APS the longest. Let us know if you can help.

APS Statement on Federal R&D Presented to Senate Committee

At its April meeting, the APS Executive Board approved a statement regarding federal investments in research and development, presented at an April 28 hearing of the Senate Committee on Commerce, Science and Transportation's Subcommittee on Science, Technology and Space by APS President Andrew Sessler. The action was a continuation of recent APS efforts on behalf of science funding, including a prior statement approved by the Board last fall in support of the bipartisan National Research Investment Act (S.1305) (see *APS News*, January 1998). The text of the statement as read before the Senate Committee follows.

Our support for a comprehensive increase in federal research investments is based upon the following key points:

• Federal investment in research increases economic growth and keeps the nation on the path to a balanced budget. Economic analyses show that since the end of World War II, technology has accounted for more than half of all economic growth in the U.S. Today, increased productivity, driven by technological innovation, receives much of the credit for sustaining the current expansion, which is characterized by low inflation and low unemployment. Federal investments in research increase economic growth and keep the nation on the balanced budget path.

• Federal investment in research sustains technological innovation. Almost 75 percent of the citations listed in U.S. industrial patent applications reference publicly supported research. The cause is clear: American industry has been forced to shorten its research time horizons and to adopt risk-adverse R&D strategies. The result is that the federal government has become the steward for almost all long-term, high-risk research, which is now performed by universities and national laboratories.

• Science is the underpinning of technological progress. Indeed, basic research, according to economists such as Stanford's Michael Boskin and the late Edwin Madsfield of the University of Pennsylvania, provide extraordinary social returns on the federal investment. Estimates run between 20% and 60%.

• Tomorrow's technology is based upon today's research. Although some efficiencies in research have shortened the time to market, many time horizons still run one, two or more decades from research proposal to marketable product. Much of the extraordinary technological growth we have witnessed during the last ten years is based upon research ideas first explored 20 or 30 years ago.

• The federal investment in research has been declining by most relevant measures. For FY1997, only 1.9% of the federal budget was allocated to non-defense R&D, compared to more than 5.7% about 30 years ago. As a fraction of the GDP, the federal investment in research is less than half of what it was 30 years ago.

• Scientific disciplines have become thoroughly intertwined and completely interdependent. Progress in one area invariably requires supporting work from other areas. Examples abound: HIV protease inhibitors were synthesized by pharmaceutical companies based on the structure of HIV protease determined by biologists, using physicists' x-ray diffraction techniques; neural network computing algorithms find their origin in brain studies performed by neurobiologists; and MRI, the least invasive and most precise medical imaging diagnostic tool, comes from research carried out by physicists, chemists and mathematicians.

• Revolutionary scientific discovery often originates from research that is neither driven by strategic mission nor closely coupled to planned strategic outcomes. The laser, which traces its genesis to the arcane study of optical pumping, is a prime example. Today's corporate climate would make such research almost impossible. It could not be justified to stockholders and it would be inconsistent with the ruthlessness of global competition.

APS Task Force Suggests *Physics Today* Changes

Physics Today magazine continues to receive high marks from APS members, who rate the publication the most valued of the Society's membership benefits, an APS task force concluded in its final report, which was accepted by the APS Executive Board in June. However, there is room for improvement, most notably in expanding the breadth of technical coverage and shortening many non-science articles. The monthly magazine, which recently celebrated its 50th anniversary, is published by the American Institute of Physics (AIP) and distributed to APS members, as well as to members of other AIP societies.

Chaired by APS Past President Burton Richter (Stanford Linear Accelerator Center), the task force was charged with evaluating the content and style of *Physics Today* and suggesting ways in which it could better serve the diverse interests and needs of APS members. "The special role of *Physics Today* as a unifying force in physics is widely appreciated within the APS," the report stated in its introduction. "However, as the physics community grows ever larger and more diverse in personnel and practice, the [magazine's] special role becomes both increasingly important and challenging to meet."

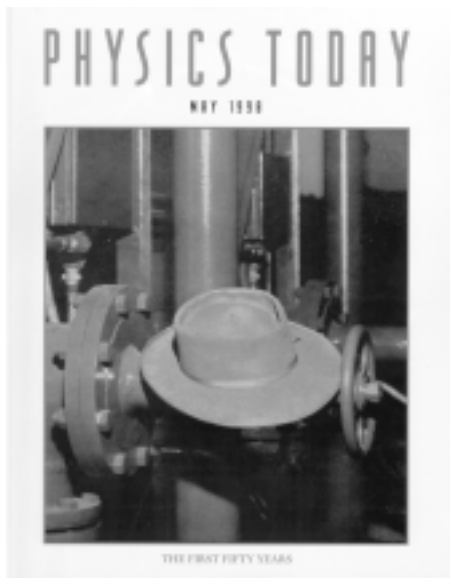
Readership surveys continue to reveal a high level of satisfaction with the magazine, among APS members. Based on data collected from AIP surveys of member societies in recent years, the majority of APS members (65%) view the magazine as their most important member benefit and feel they would "lose out" if they didn't receive it compared to 36% of members from other AIP societies.

The main concern in terms of improving service to APS members is that a larger fraction of editorial effort needs to be focused on the scientific coverage. Specifically, more science articles should be published per issue, with more of an effort to cover all of physics over the course of a multi-year cycle. The 1995 *Physics Today* readership survey indicated that the magazine's readers consider science coverage to be the most important part of *Physics Today*. *Physics Today* editors plan to increase the number of technical articles per issue from three to four. Some articles will continue to focus on the history of physics and science policy.

The task force also felt that until recently, some articles had become too technical for readers lacking first-hand acquaintance with the subject area being reviewed. The recent addition of the "Physics News Update" section makes a good complement to the "Search and Discovery" section. Many articles in the latter were considered too long, and a lack of some subjects, such as biophysics, was noted. The task force suggested recruiting "stringers" or contributing editors to help broaden the range of expertise. The "Reference Frame" column received high marks from the task force members. Among the non-science features, the task force deemed the "Washington Reports", "Physics Community" and "Letters" sections most valuable to the magazine's readers.

Because editorial effort is the primary limiting factor in terms of broader coverage, the task force felt that the focus of existing staff should be shifted from sections of lower priority coverage, such as book reviews and obituarites, which the task force deemed overlong. One recommendation was that the APS consider funding a Science Writing Fellowship to increase the *Physics Today* staff available to work on the science portion of the magazine.

The task force also briefly examined the relationship of *Physics Today* with its sister publication, *The Industrial Physicist* (*TIP*), and concluded that the two publications successfully satisfy complementary needs for the physics community. Surprisingly, a large portion of *TIP's* 50,000 readers are not members of AIP societies, making the publication a useful vehicle to attract new members to AIP organizations. To that end, the task force recommended establishing a cut-rate introductory membership offer for AIP societies to *TIP* subscribers.



Overall, despite the need for improvements in organization and efficiency, "*Physics Today* is doing a good job of serving the interests of the APS," the task force concluded in its report, noting that the magazine's Advisory Committee is in agreement with its findings and plans are underway to address the areas of concern.

Interestingly, the last paragraph of the task force report reads "In the long run, it would be best for the APS to take full responsibility for *Physics Today*, including its deficit. This is not likely to happen soon, but it is a possiblity that should remain in our minds."

The other members of the APS task force to evaluate *Physics Today* were Julia Philips, Sandia National Laboratory; Ray Baughman, Allied Signal Inc.; John Pribram, Bates College; Ron Walsworth, Harvard-Smithsonian Center for Astrophysics; and John Wilkins, Ohio State University.

DFD Establishes New Acrivos Dissertation Award


Photo courtsey of City College of New York website

Andreas Acrivos

In April, the APS Council approved the establishment of a new dissertation award to honor the many outstanding contributions to fluid mechanics of Andreas Acrivos, particularly his years of distinguished editorship of *Physics of Fluids*. It is supported by donations from members and friends of the APS Division of Fluid Dynamics. The division expects to make the first award in 2000.

Consisting of $1,000 and a certificate citing the accomplishments of the recipient, the award is intended to provide recognition to exceptional young scientists who have performed original doctoral thesis work of outstanding scientific quality and achievement in the area of fluid dynamics. As with most APS prizes and awards, up to $500 is available for travel to enable the recipient to attend the annual meeting of the Division of Fluid Dynamics at which the award will be presented. Any doctoral student studying at a college or university in the U.S., or in an education abroad program of a college or university in the U.S., is eligible to apply. The work to be considered must have been accomplished as part of the requirements for a doctoral degree.

Born in Athens, Greece, Acrivos earned his PhD in 1954 from the University of Minnesota, and promptly joined the faculty of the University of California, Berkeley's Department of Chemical Engineering. He moved to Stanford University in 1962, where he has been professor emeritus since 1988. He is presently the Albert Einstein Professor of Science and Engineering at the City College of New York, as well as director of the Benjamin Levich Institute for Physiochemical Hydrodynamics. His research interests include fundamental problems in fluid mechanics, the effective properties of two-phase materials, suspension rheology, and sedimentation. A two-time Guggenheim Fellow and long-standing editor of *Physics of Fluids*, Acrivos received the 1991 APS Fluid Dynamics Prize for his work in fluid mechanics.

Answers to Zero Gravity Brain Teasers from page 5:

1. This year. He is 100; his son is 50.

2. Gwen had forty-two boyfriends. 42-1=41. 41+3=44. 44/4=11. 11-1=10.

3. Five Thousand. Ten power five = 100,000. Divide that out (it was a 19:1 ratio) and you get a ratio of 95,000:5,000 (daughters:sons).

4. Four. If you square it, you get 16. Subtract his number of hits and you get 12. Subtract 10 and then 2 more and you get 0.

5. Two ounces. (Beach ball, or ping-pong ball?) $2x2=4$. $4+2^2=8$. $8-8=0$.

Announcements

NOMINATIONS FOR PRIZES AND AWARDS

The following prizes and awards will be bestowed at the Fluid Dynamics Division Meeting in 1999. A brief description of each prize and award is given below, along with the addresses of the selection committee chairs to whom nominations should be sent. Please refer to the new 1998-1999 Centennial APS Membership Directory, pages A19-A37, or select the Prize and Award button on the APS homepage [www.aps.org] for complete information regarding rules and eligibility requirements for individual prizes and awards.

1999 FLUID DYNAMICS PRIZE

Sponsored by friends of the Division of Fluid Dynamics and the American Institute of Physics journal Physics of Fluids.

Purpose: To recognize and encourage outstanding achievement in fluid dynamics research.

Nature: The prize consists of $5,000, a certificate citing the contributions made by the recipient, and a travel allowance to the meeting at which the prize is bestowed.

Send name of proposed candidate and supporting information **before January 18, 1999** to: Elaine S Oran (Chair), 3516Duff Dr., Falls Church, VA 22041; Phone (202) 767-2960; Fax (202) 767-4798; Email ORAN@LCP.NRL.NAVY.MIL

1999 OTTO LAPORTE AWARD

Sponsored by the friends of Otto LaPorte and the APS Division of Fluid Dynamics.

Purpose: To recognize outstanding research accomplishments pertaining to the physics of fluids.

Nature: The award consists of $2,000, and a certificate citing the contributions made by the recipient.

Send name of proposed candidate and supporting information **before January 18, 1999** to: Israel J Wygnanski (Chair), School of Engineering, University of Tel Aviv, Tel Aviv 69978, ISRAEL; Fax 972-36429540; Email wygy@genius.tau.ac.il

Physical Review Focus

PR Focus, the fully electronic journal featuring physics highlights, is available FREE through the APS Home Page [www.aps.org], under the research journal button, or directly at [publish.aps.org/FOCUS]. To receive one-paragraph introductions to *Focus* stories each week by e-mail send the following message to majordomo@aps.org: subscribe focus [Leave the subject line blank].

New Physics Teacher Newsletter Begins

The *Physics Alliances Newsletter* is a new online publication promoting alliances between high-school and college physics teachers. The aim is to help bring regional college and university personnel together with high school teachers for: meetings, visits, and sharing ideas, programs and possibly equipment. Sponsored by the APS Forum on Education, the newsletter is the reincarnation of the "CHIC Newsletter." Editor Peter Lindenfeld of Rutgers University says *PAN* will feature interactive discussions on education issues, such as recent articles on: computer simulations in the lab and "Is the lecture dead?"

To access the *Physics Alliances Newsletter*, click the Education and Outreach button on the APS homepage [www.aps.org].

Free APS Membership Offered to Society of Physics Students

Starting in September, with the 1998-99 academic year, all undergraduate members of the Society of Physics Students (SPS) will be offered a free membership in the APS or one of the other nine AIP Member Societies. This offer is meant to expose undergraduates to the benefits of professional society involvement. Promotional information will be sent to all SPS chapters in August.

If you would like more information, contact your local SPS chapter or visit the SPS web site at www.aip.org/education/sps/sps.htm. New SPS members will be able to join online starting this Fall.

All APS Student/SPS undergraduate members, **with a renewal date after September 1, 1998**, will be able to join SPS directly and choose APS at no charge. Questions about current APS Student/SPS memberships should be directed to the APS Membership Department at (301) 209-3280 or membership@aps.org.

APS News June Issue Corrections:

We neglected to identify Anupam Garg of Northwestern University as a key source for the article on quantum computing; the final quote attributed to Peter Zoller should have been attributed to Dr. Garg. We also correct the name and acronym of the National Spherical Torus Experiment (NSTX) at Princeton University.

CAUGHT IN THE WEB

Notable additions to the APS Web Server. The APS Web Server can be found at http://www.aps.org

APS News Online latest edition

APS Committees and Governance
- APS Governance page updated
- APS Bylaws updated
- APS Constitution updated

Membership
- Home page update
- Recently Deceased Members List updated

Education
- *Physics Alliances Newsletter* for high school and college physics teachers

Prize & Awards
- The Andreas Acrivos Award in Fluid Dynamics

Careers
- Additional Job Listings updated on APS Careers in Physics

Meetings
- Division of Fluid Dynamics Meeting Announcement
- Texas Section Fall Meeting Announcement
- Ohio Section Fall Meeting Announcement

Physics Internet Resources updated

Related Scientific Societies updated

centennial webpage
www.aps.org/centennial

Be sure to visit the CSWP-sponsored women physicists archive at http://www.physics.ucla.edu/~cwp

Inside the Beltway *(continued from page 1)*

But the President's call resonated well with deficit hawks, such as Senate Budget Committee Chairman Domenici (R-NM), who note that without the current surplus in Social Security revenues, the rest of the federal budget would actually still be in the red, even if a year-end $75 billion surplus number for the total budget turns out to be true. Unlike the anti-Washington ideologists, the deficit hawks do not want to cut taxes until the deficit excluding Social Security balances totally disappears. They simply want to hold the line on spending.

So for now, the budget squeeze remains. Given the constraints, it's amazing how well science did in Round 1 of the appropriations process. Sen. Domenici (R-NM) and Rep. Lewis (R-CA), chairmen of key appropiations committees, did remarkable work in securing increases for science. Senate and House spending bills exiting the appropriations committees would generally boost the federal investment in scientific research by five to nine percent. Having both the President and the Speaker of the House on our side didn't hurt.

Regular readers of this column already know that President Clinton delivered a blockbuster of a science budget in his request to Congress in February and that privately House Speaker Gingrich (R-GA) was advocating major increases, as well. In three June commencement speeches, the Speaker took his message public, calling for doubling funds for science over eight years. In a June 18 *Washington Post* interview, he said, "Investing in our future ought to be our second highest priority after winning the war on drugs, and we should shape our appropriations bills accordingly."

Even House Appropriations Committee Chairman Livingston (R-LA), who always protects his right flank, was cautiously optimistic. "[A]n emphasis on science, at the request of the Speaker, means that science is going up," he said.

But not everybody agrees with the President and the Speaker. As the appropriations process moves through Round 2 on the floors of the Senate and the House, advocates for other federal priorities will try to strip away funds from the science accounts.

The first such assault took place in the Senate when the Energy and Water Resources Appropriations Bill hit the floor in the middle of June. Dissatisfied with the allocation for solar and renewable technologies, Senators Jeffords (R-VT) and Roth (R-DE) offered an amendment to boost the funding for those programs by almost $60 million. To help offset the allocation, they cut the DOE science account by about 1.6 percent, perhaps unaware that by so doing they would cut some of the very science upon which the solar and renewable technologies rely. Their Senate colleagues responded by approving the amendment on a voice vote, reflecting the popularity of environmental programs with American voters.

But the real dirty work on the appropriations bills will take place in Round 3 behind closed doors when Senate and House conferees meet to iron out their differences. It is not unusual for the bills that finally emerge to be quite different from the ones that entered. During the August recess, members of Congress will listen closely to the voices of their constituents. And the budgets that emerge in September will mirror what they heard.

Fortunately, science has the potential of remaining on the legislative agenda throughout the summer, thanks to a new bill, the "Federal Research Investment Act." It was submitted on June 25 by Senators Frist (R-TN) and Rockefeller (D-WV), together with Senators Gramm (R-TX) Lieberman (D-CT), Domenici, and Bingaman (D-NM), the original co-sponsors of its S.1305 predecessor, and Senators Burns (R-MT) and Breaux (D-LA) (see Back Page article by Senator Bill Frist). The bill, S.2217, beefs up the call for doubling research by providing strong policy justifications, as well as recommendations for implementing the Government Performance and Results Act.

Although it stretches the time line out to 12 years, S.2217 has one big advantage over S.1305. It can move through committee, since Frist is the chairman of the Senate Commerce Subcommittee on Science, Transportation and Space, and Rockefeller is its Ranking Member. Of course as the senators noted in a packed Hill press conference at the end of June, their task will be made much easier if the science community pitches in. And friends, if you don't who that is, it's you!

THE BACK PAGE

The Importance of Science and Technology to America's Future

by Senator Bill Frist, M.D.

As a physician and surgeon, I've had the opportunity to witness everyday the remarkable difference that medical science and technology make in people's lives. In just the relatively short time I've been practicing medicine, less than 20 years, I've seen how the products of medical research and development — lasers, mechanical cardiac assist devices, mechanical valves, automatic internal defibrillators — have not only saved lives, but have vastly improved the quality of hundreds of thousands of lives every year.

Science and technology have shaped our world in many ways...Yet, technology also surrounds us in millions of little ways we no longer even notice.

As a physician, I can envision a future in which science and technology will expand the current frontier of medical knowledge. Armed with this new knowledge, we will identify the causes, and eliminate most of the effects of the diseases that now plague mankind. As a Senator, I can envision the difference that science and technology will make in the life and health of our citizens.

Science and technology have shaped our world in many ways. We've put men into space and looked into the farthest corners of the known universe. We've broken the code of the human genome and begun to dismantle previously incurable disease. We've created a virtual world and a whole new realm called cyberspace. Yet, technology also surrounds us in millions of little ways we no longer even notice. From computers and cellular phones, to stop lights, grocery store checkouts, and microwaves: in a million ways technology makes our lives run smoother and faster.

Today's world runs on technology, and through its investment in research and development (R&D), the federal government has played a significant role in its expansion. In fact, more than 56 percent of all basic research is produced with federal funds.

Much of our economy runs on technology as well. Half of all U.S. economic growth is the result of our technical progress. Technology helps provide new goods and services, new jobs and new capital — even whole new industries.

Without a doubt, technology is the principal driving force behind our long-term economic growth and our rising standard of living. In fact, according to the Office of Science and Technology Policy (OSTP), technology is the single most important factor in sustained economic growth. The performance of U.S. business and its contribution to economic growth is directly linked to the use of technology. As cited in a study conducted by the Department of Commerce, manufacturing businesses that used eight or more advanced technologies grew 14.4 percent more than plants that used none. Production wages were more than 14 percent higher.

Clearly, America's investment in science and technology must continue. The two central questions Congress must answer are: 1) will science and technology continue to be as great a congressional priority in the future as it has been in the past; and 2) will the kind of financial investment necessary to sustain future progress be possible in light of our other growing financial commitments?

In 1965, mandatory federal spending on entitlements and interest on the debt accounted for 30 percent of the federal budget. Fully 70 percent went toward discretionary programs — research, education, roads, bridges, national parks, and national defense.

Today, just 30 years later, that ratio has been almost completely reversed: Sixty-seven percent of the budget is spent on mandatory programs and interest on the debt; leaving only 33 percent for everything else, including research. In fact, total R&D spending today as a percentage of GDP is just 0.75 percent — as compared to 2.2 percent in the mid-1960s when superpower rivalry and the race to space fueled a national commitment to science and technology. As the baby boom generation begins to retire and the discretionary portion of the budget shrinks even further, this situation will only grow worse.

Thus, we have both the long-term problem of addressing the ever-increasing level of mandatory spending and the near-term challenge of apportioning the ever-dwindling amount of discretionary funding.

This increased dependency on technology and decreased fiscal flexibility has created a problem too obvious to ignore. Not all deserving programs can be funded, and not all authorized programs can be fully implemented. In other words, the luxury of fully funding science and technology programs across the board has long since passed. We must set priorities.

I believe that Congress must reaffirm our national commitment to science and technology and redouble its efforts to ensure that funding is not only maintained, but increased. I also believe that funding levels alone are not the answer. What we really need is a strategy for the future — a vision that not only provides adequate levels of funding, but ensures that funding is both responsible and sustainable over the long term.

We can do that by establishing a set of guiding principles that will enable Congress to consistently ask the right questions about each competing technology program; focus on that program's effectiveness and appropriateness for federal funding; and most importantly, make the hard choices about which programs deserve to be funded and which do not. What are these guiding principles?

First, federal R&D programs must be good science. They must be focused, not duplicative, and peer-reviewed. Because there is strength in diversity, they must support both knowledge-driven science and mission-driven science requirements. Second, programs must be fiscally accountable. Third, they should achieve their aims with measurable results. Finally, federal policy must be applied consistently across the entire spectrum of federal research agencies. High quality, productive research programs must be encouraged regardless of where they are located.

Senator Bill Frist, M.D.

I believe it is time to get America refocused on the importance of science.

Accompanying the four first principles, are four corollaries: 1) government must create a flow of technology from research through commercialization, so that promising technology is not lost in a bureaucratic maze; 2) it must foster a close relationship between research and education and find ways to extend the excellence of our university system to primary and secondary institutions; 3) we must encourage the revolutionary innovation taking place at the overlap by providing opportunities for interdisciplinary projects and fostering collaboration across fields of research; and 4) we must facilitate the creation of partnerships, in effect creating a whole that is greater than the sum of its parts.

These first principles and their four corollaries provide a framework that will guide the creation of new, federally funded research and development programs, and validate existing ones. Taken together, they will create a powerful method for elevating the debate by increasing Congress' ability to focus on the important issues, decreasing the likelihood that it will get sidetracked on politically-charged technicalities, and ensuring that federal R&D programs are consistent and effective. They will also help us establish a consistent set of national goals and a vision for the future.

On June 25th, Senator Rockefeller and I introduced the Federal Research Investment Act, a bipartisan bill which sets us on the path to accomplishing all of these goals.

The act elevates Congress' commitment to federally-funded research and development by doubling the aggregate amount of civilian R&D spending over a 12-year period. It establishes the set of guiding principles outlined above. It requires the president to submit, as part of his annual budget, a detailed report on how the administration will meet congressional funding goals.

It also lays a solid foundation for evaluating both current and future programs by directing the Office of Science and Technology Policy to commission the National Academy of Sciences to develop methods for evaluating federally-funded research.

As a physician, a scientist and a Senator, I believe it is time to get America refocused on the importance of science. As a Congress and as a nation, we must reaffirm our national commitment to science and technology and double our efforts to increase funding as America moves into the next century. The economic future of our Nation and our leadership position in the world depend on it.

Bill Frist is serving his first term as a Republican Senator from Tennessee. He is chairman of the Science, Technology and Space Subcommittee.

The Back Page is intended as a forum to foster discussion on topics of interest to the scientific community. Opinions expressed are not necessarily those of the APS, its elected officers, or staff. 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.*