APS NEWS

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Campaign for Physics Celebrates Reaching $5 Million Funding Goal

The Campaign for Physics, the science education fundraising initiative of the APS and the American Association of Physics Teachers (AAPT) launched in the fall of 1995, attained its $5 million funding goal. A victory celebration was held November 22, 1997 in San Francisco, CA. The evening included remarks from key campaign leadership, endorsements from participants in Campaign programs and recognition of campaign volunteers. Funding from the Campaign has allowed APS and AAPT to launch and expand five important science education programs which are having a dramatic impact on improving the teaching of science in schools across the country.

According to Campaign Director Darlene Logan, the effort benefitted greatly from the financial and volunteer support of major industrial leaders, including William R. Hewlett, Co-founder of Hewlett-Packard Company, who led the Campaign's Executive Committee as honorary chair. Working with him were leading captains of industry who served as vice chairs of the Campaign Executive Committee. These included Robert Allen, AT&T; Paul Allaire, Xerox Corporation; Norman Augustine, Lockheed Martin Corporation; Livio DeSimone, 3M; Robert Galvin, Motorola, Inc.; Gordon Moore, Intel Corporation; Lewis Platt, Hewlett-Packard Company; George Soros, Soros Fund Management & Soros Foundation Network; and Alex Trotman, Ford Motor Company. Together with the support of 39 Nobel laureates serving on a Campaign Council of Nobel Laureates, the committee raised $3.5 million in corporate and foundation gifts including one seven-figure gift and 11 six-figure gifts.

"Through the Campaign, we have helped school districts implement systemic science education reform which will provide students with a science curriculum and learning environment that will nurture their interest in and appreciation for science," said Hewlett, who considered the Campaign an imperative. "We have created support structures for science teachers, particularly in urban settings, who are seeking ways in which to improve their teaching skills and techniques and developed a resource center for their use in obtaining information on the best in science teaching curricula and materials." He added that the Campaign funds are also being used to provide mentor and financial support to undergraduate minority students interested in pursuing careers in science, and to help establish mechanisms for the exchange of information among academia, industry and government on science education and industrial needs.

Nobel laureate Nicolaas Bloembergen, Harvard University and a past president of APS, chaired both the Campaign Council of Nobel Laureates and Campaign Administrative Group, the internal steering committee for the initiative. "The carefully developed science education programs of the Campaign for Physics will make a dramatic difference in elementary through graduate level science teaching, benefitting students, teachers, industry and our nation," he said of his involvement. "I am proud to have played a leadership role in support of such excellent initiatives."

In addition to the Corporate and Foundation Gifts Campaign, an effort to obtain the support of individuals was led by an Individual Gifts Committee. Chaired by John Armstrong (formerly of IBM Corporation), the committee included 40 outstanding members of the physics community, each of whom made a leadership gift to the Campaign and encouraged others to participate. The committee generated over $1.5 million in individual gifts including 23 gifts of $10,000 or more. "I am pleased that I was able to contribute to this key undertaking by APS and AAPT as it is important that we, as physicists, involve ourselves in helping assure that future generations are afforded a strong science education," said Ernest Henley (University of Washington), another former APS president, who served as a vice chair on this committee.

The Campaign for Physics initiatives have and will continue to make important strides in improving science education.

The Campaign consists of five interrelated initiatives designed to spark and keep alive the flame of scientific interest and learning in youngsters from kindergarten through graduate school. Campaign programs are designed to help teachers, engage students, involve scientists and build support structures among business, academia and government that will strengthen the country. The following summarizes program progress to date thanks to the generous support of Campaign donors.

Corporate representatives and campaign program participants joined in the celebration of the Campaign's victory. From far right (clockwise): Lewis Platt, Hewlett-Packard Company; D. Allan Bromley, 1997 APS president; Joan Platt, wife of Lewis Platt; Nicolaas Bloembergen, Campaign Administrative Group Chair; Jan Hustler, Bay Area Schools for Excellence in Education (benefiting from the Teacher-Scientist Alliance Institute); Ginn Huster, husband of Jan Hustler; Barbara Kaufmann, 3M Foundation director; Nancy Thomas, Hewlett-Packard Company contributions manager; Len Thomas, husband of Nancy Thomas; Deli Bloembergen, wife of Nicolaas Bloembergen.

The Teacher-Scientist-Alliance Institute

The Teacher-Scientist Alliance Institute (TSAI) is an education outreach effort designed to support a hands-on science education approach in the US. This systemic science education reform program was launched by the APS with funding from the Campaign. TSAI involves volunteer scientists who have committed to working with their local school district or districts to reform science education.

(Continued on page 3)

Nicolaas Bloembergen presents Lewis Platt, Chairman, President & Chief Executive Officer of Hewlett-Packard Company, with a plaque recognizing the contributions of Mr. Platt and Hewlett-Packard Company toward the Campaign's success.

Tutorial Sessions, Mini-Conferences, Plasma Science Expo Featured at the DPP Meeting

Physicists discussed the latest discoveries in the universe of plasmas when the APS Division of Plasma Physics (DPP) held its annual meeting on November 17-21, 1997 at the Lawrence Convention Center in Pittsburgh, Pennsylvania. More than 1500 papers were presented at the second largest APS meeting of the year, including four review papers, three APS prize recipient addresses, and 84 invited talks. Wednesday evening's banquet featured a keynote address by William Happer of Princeton University, as well as presentation of the 1997 APS Maxwell Prize, Award for Excellence in Plasma Physics, and Award for Outstanding Doctoral Dissertation in Plasma Physics by APS President, Andy Sessler.

A prominent new feature was the organization of five tutorial sessions, aimed at educating non-specialists with a graduate level understanding of important topics in plasma physics. Thirteen tutorial presentations were given, explaining the basic principles, accomplishments, issues and objectives of such topics as laser-induced fluorescence diagnostics in plasmas, magnetic reconnection, laser-driven plasma based accelerators, and controversies in quasilinear theory. The DPP hopes such sessions will be a valuable addition to the annual meeting, and contribute to the continued cross-fertilization of ideas in plasma physics. There were also four "mini-conferences" consisting of contributed presentations throughout the week in the areas of coherent radiation generation, plasma accelerators, nonlinear dynamics, and deep space plasmas.

Latest Fusion News

Magnetic Fusion - Scientists working on the Joint European Torus (JET), the world's largest fusion experiment, presented results of a recent run of experiments on their machine using high-power operation with a 50-50 mixture of deuterium and tritium fuel. The researchers announced a record 14 Megajoules of fusion energy, 16 megawatts of peak fusion power and a record fusion Q (the ratio of fusion power produced to the net input power) of 65%.

On Monday morning, Richard Hawryluk of Princeton Plasma Physics Laboratory gave a twenty-year retrospective on physics experiments of the Tokamak Fusion Test Reactor (TFTR), the experimental nuclear fusion facility in Princeton. Before it ended operations in 1995, TFTR held the previous world record of fusion power yeild and provided deep insights into the nature of fusion plasmas.

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Inside...

MEMBER IN THE *Spotlight*

Cherry Murray Pursues Excellence in Industrial Research

Juggling a demanding career in condensed matter research and industrial management with volunteer work and family obligations is just the latest in a lifetime of challenges for Cherry Murray, a condensed matter physicist who is currently director of the Physical Research Laboratory at Bell Laboratories/Lucent Technologies in Murray Hill, New Jersey. A fellow of both the APS and the American Association for the Advancment of Science, Murray has a broad background in experimental research in low temperature, surface, condensed matter, and complex fluid physics, with particular emphasis on light scattering and imaging.

Ironically, Murray had always expected to become an artist, thanks to the influence of her parents, both of whom earned degrees in fine arts and met at an artist's colony in Taos, NM. Her father also holds a degree in English literature, and was an English teacher and headmaster of a private school prior to embarking on a diplomatic career after a stint in the US Army during World War II. The family moved constantly around the world thereafter.

Despite her enjoyment of lessons in piano, dance and art, Murray credits her brother, John, nine years her senior, with first piquing her interest in physics at the age of 6 when he decided to study physics during the height of the Sputnik Era. [He is now a research physicist at Lawrence Livermore National Laboratory.] A chemistry teacher at her high school in Alexandria, Virginia, encouraged her abilities in physical chemistry and physics, and when the family subsequently moved to Korea, she studied calculus and physics on her own because the US embassy school was so small. John also played a pivotal role in her decision to study physics at the Massachusetts Institute of Technology by insisting she would never survive the rigorous course of study. "So of course, I had to do it," says Murray, who earned her B.S. in physics from MIT in 1973 and won a scholarship to pursue graduate work there.

It was during her first year of graduate study that Murray was first exposed to physics in industry, when she elected to take a summer internship at Bell Laboratories, working on plasma physics. The experience "absolutely changed my view of what one could do as a career in physics," she says. "That's really why I'm at Bell Labs today." She considers the company to be one of the best places for doing cutting-edge research in condensed matter physics, while simultaneously having an impact on technology and business in general.

Murray received her PhD in physics from MIT in 1978, and promptly joined the technical staff at Bell Labs, becoming a distinguished member in 1985. She subsequently headed the Low Temperature and Solid State Research Department, the Condensed Matter Physics Research Department, and the Semiconductor Physics Department before assuming her present position in June 1997. The Physical Research Laboratory has approximately 100 researchers in fundamental physics, biophysics, chemistry and materials science, as well as thrusts in applied physics and materials, devices and circuits for high-speed optoelectronics, leading to inventions and innovations for future communications and microelectronics technologies of importance to Lucent Technologies.

Murray's own research program currently encompasses imaging of order-disorder transitions in colloidal crystals, self-assembly of optical materials, and Raman scattering from very small monodisperse silicon quantum dots. In 1989, she received the APS Maria Goeppert-Mayer Award for the experimental methods she used to discover "two stage" melting in two-dimensional arrays of colloidal polystyrene spheres, singled out particularly for her elucidation of the role that defects play in this phenomenon, as well as the connection between her discovery and recent theories of melting in two dimensions.

Although her own graduate experiences were highly positive, Murray cautions aspiring young women physicists to choose their school carefully, particularly if they wish to study with specific professors at smaller schools. "If you know exactly what you want to do, and who you want to work for, make sure that they're available and will be able to take you on as a student," she says. But the most important advice she would give is to find a good mentor, citing as an example the efforts of Mildred Dresselhaus, a professor of electrical engineering at MIT, who organizes seminar series for graduate students to give talks on their research topics.

Murray herself has volunteered as a mentor for several physics graduate students, in addition to participating in a hands-on science program at a local junior high school to encourage students to pursue careers in physics. Within the APS, she has held several positions in APS divisions, served on the executive committees of the Forums on Education and Industrial and Applied Physics, and on the Panel on Public Affairs, as well as various prize and fellowship committees. She is currently vice-chair of the APS Pake Prize Committee.

Despite her considerable professional commitments and volunteer work, Murray has still found time to marry and raise a family. She has a son, age 11, and a daughter, age 6, and credits the availability of an excellent child care center in New Jersey with making her dual role much easier. "It's usually child care arrangements that are the difficulty," she says. "I was very fortunate that the center had openings for both my children." She even occasionally finds time play the piano and take dance classes to keep physically active.

While she can envision one day obtaining a position as a university professor having an impact on the field by producing excellent students, she finds her current position far too challenging and enjoyable to consider changing career paths any time soon. "Someone described my new job as trying to drink from a fire hose, with things flying at you all the time, but I enjoy that kind of challenge," she says. "I definitely enjoy management and having an impact by working in industry, so I see myself doing this for a while."

APS Outreach Programs for Minorities and Women at a Glance

Colloquium Speakers Lists of Women and Minorities in Physics, available online and in hard copy, list the names and talk titles of women and minority physicists, indexed by field and state.

Travel Grants for Minority and Women Speakers Programs. The APS provides small grants to physics departments to fund visits by minority and women colloquium speakers. Funding is still available for the 1997-1998 academic year.

The Gazette is the official newsletter of the Committee on the Status of Women in Physics (CSWP), featuring updates on CSWP activities and programs, book reviews, statistical reports, and articles on programs designed to increase the participation of women and girls in science.

The Roster of Women and Minorities in Physics lists the names and qualifications of over 4000 women and minorities in physics. It serves as the mailing list for CSWP and the Committee on Minorities (COM) publications, and is also widely used by prospective employers to identify women and minority physicists for job openings.

Improving the Climate for Minority/Women in Physics Site Visits. Through this program, teams of minority/women physicists visit physics departments to assess the climate for minorities/women in the departments, and to make recommendations to improve the climate for minority/women undergraduates, graduate students and faculty.

WIPHYS (Women in Physics) Internet List. Over 750 subscribers from around the world network, exchange advice, and discuss issues of interest to women in physics on WIPHYS.

The Internet Archive of the Contributions of Women to Physics documents citations of women who have made original and important contributions to physics this century.

The Edward A. Bouchet Award. A lectureship/award meant to enhance the visibility and awareness of outstanding minority physicists to peers and minority students.

COM Symposia. At both the March and April meetings, COM organizes invited sessions during which minority physicists give technical talks.

CSWP/COM Receptions. COM and CSWP usually hold a joint networking reception at both the April and March APS meetings, during which they publicize their programs and projects.

For further information:

Minority programs contact: Arlene Modeste, APS Staff Liaison to the Committee on Minorities; 301-209-3232; modeste@aps.org; COM web site http://www.aps.org/educ/commiss.html

Women programs contact: Tara McLoughlin, APS Staff Liaison to the Committee on the Status of Women in Physics; 301-209-3231; tara@aps.org; CSWP web site http://www.aps.org/educ/cswp/cswp.htm

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Campaign for Physics Celebrates *(Continued from page 1)*

The Physics Teacher Resource Agent Program

The focus of the Physics Teacher Resource Agent (PTRA) program is to select, train and support experienced physics teachers who serve as mentors to less experienced physics teachers from their communities. It has become a highly recognized piece of infrastructure in the physics teaching community, offering a single point of contact for high school physics teachers across the country. The Campaign has provided funds to the PTRA program to support initiation of workshops in selected urban areas.

The Physical Science Resource Center

The American Association of Physics Teachers' Physical Science Resource Center provides on-line access as well as hard copies of teaching and learning materials in physics at the high school and undergraduate levels. The information center includes bibliographies on the best physical science teaching technologies, materials and procedures.

The Minority Scholarship Program

Established in 1980 by the APS, this highly successful program is able, as a result of Campaign funding, to increase the number of scholarships for undergraduate physics majors awarded annually to its highly qualified pool of applicants. This program consists of three support components: 1) a monetary grant to the students; 2) a faculty mentor for the student; 3) and a small monetary grant to the student's host physics department to promote a relationship between the department and the scholarship recipient. To date, a total of 374 new and renewal scholarships have been awarded and an impressive 20% have also gone on to earn their Ph.D. in physics.

The Academic-Industrial-Government Roundtables

The Roundtables are a one-day meeting of leading academic and industrial scientists with educators and government and community leaders. Through a plenary session of invited speakers and a series of workshops, participants examine how to address the economic and educational challenges facing their state and region. Roundtables are sponsored by the APS, the NSF, local universities and industries and are co-hosted by the region's Members of Congress. Three such roundtables have taken place to date in Virginia, California, and Washington states with the next one planned for Connecticut.

In-depth descriptions of the Campaign for Physics program goals can be found in the insert in the June 1997 issue of *APS News*, the January 1998 *APS News Education Outreach* insert, and through the APS home page [www.aps.org].

Andria Erzberger, a lead teacher in the Physics Teacher Resource Agent Program speaks to the important support that program is providing to physics teachers in the San Francisco area.

Charles Duke, Xerox Corporation and APS Council member (shown on the left) shares a celebratory moment with Nobel laureate Burton Richter and his wife Laurose and Harry Lustig (right), retired Treasurer of APS and leading force behind the Campaign's initiation.

Campaign Council of Nobel Laureates

Chair:	Jerome Friedman	Willis Lamb, Jr.	Abdus Salam *(dec.)*
Nicolaas Bloembergen	Kenichi Fukui	Leon Lederman	Arthur Schawlow
	Ivar Giaever	Yuan Lee	Robert Schrieffer
Members:	Donald Glaser	William Lipscomb	Melvin Schwartz
Leon Cooper	Sheldon Glashow	Rudolph Marcus	Glenn Seaborg
Allan Cormack	Herbert Hauptman	Linus Pauling *(dec.)*	Richard Taylor
James Cronin	Dudley Herschbach	Arno Penzias	Charles Townes
Pierre de Gennes	Gerhard Herzberg	Edward Purcell *(dec.)*	Steven Weinberg
Richard Ernst	Roald Hoffmann	Norman Ramsey	Robert Wilson
Leo Esaki	Jerome Karle	Burton Richter	Chen Ning Yang
William Fowler *(dec.)*	Henry Kendall		

Individual Gifts Campaign Committee

Chair:	John McTague	**Members:**	Harry Lustig
John Armstrong	George Pake	Reuben Alley	Thomas McIlrath
	Nicholas Samios	Nicolaas Bloembergen	Sokrates Pantelides
Vice Chairs:	David Saxon	Arthur Bienenstock	C. Kumar N. Patel
Lewis Branscomb	Robert Schrieffer	Martin Blume	John Peoples
D. Allan Bromley	Ray Serway	Judy Franz	Burton Richter
Bunny Clark	Andrew Sessler	Simon Foner	Brian Schwartz
Robert Frosch	James Stith	Maurice Goldhaber	Frederick Seitz
Theodore Geballe	Alvin Trivelpiece	Charles Hebel	Charles Shank
Hermann Grunder		Bernard Khoury	H. Eugene Stanley
Ernest Henley		Daniel Kleppner	Paul Vanden Bout
Paul Hewitt		Donald Langenberg	Howard Voss

IN BRIEF

Committee on Careers and Professional Development

At its November meeting, the APS Council voted to approve a proposed amendment to the APS Bylaws that would change the name of the Committee on Applications of Physics (CAP) to that of the Committee on Careers and Professional Development (CCPD), and revise its charge. The change was suggested by the APS Committee on Committees, and approved by the Committee on Constitution & Bylaws before being submitted to Council. The rationale behind the change is that, with the initiation of the Forum on Industrial and Applied Physics (FIAP), much of the work that CAP used to do — such as organizing sessions at meetings — was taken on by FIAP. It was also felt that the APS needs an advisory body and a clearing house for its career activities. The recent Task Force on Careers and Professional Development recommended that an APS committee be charged with these responsibilities. The revised charge in the APS Bylaws will read as follows:

"The membership of the Committee on Careers and Professional Development shall consist of nine members appointed by the President to staggered three-year terms. The President shall appoint the Chairperson from among the members. The Committee shall be responsible for coordinating affairs within the Society concerned with career and professional development in physics and advising the Society on courses of action. The Committee shall also facilitate the participation of physicists from all career paths in the Society and its functions and publications." Comments from the membership on the proposed revision should be submitted to Amy Halsted at APS headquarters [halsted@aps.org] by March 31st. APS Council will take the required second vote for a Bylaw change in April.

Doubling Non-Defense R&D

On December 4, 1997, two Republican and two Democratic senators wrote to President Clinton urging him to use the FY 1999 budget to establish a bipartisan national consensus on doubling non-defense federal R&D over the next ten years. Clinton sends his FY 1999 budget request to Congress this month. At the Office of Management and Budget, officials are confronting some tough numbers. Under the balanced budget agreement, total discretionary spending can increase by only 1%, or about $5 billion, over this year. As expected, there are many conflicting recommendations on what the nation's priorities should be in FY 1999. The letter from Senators Phil Gramm (R-Texas), Joseph Lieberman (D-Connecticut), Pete Domenici (R-New Mexico), and Jeff Bingaman (D-New Mexico), all cosponsors of S. 1305 (see *APS News*, January 1998), urges Clinton to "take the lead on this important issue and include significant increases in R&D investment" in the FY 1999 budget request, especially for the 12 federal agencies specified in the bill. The letter coincided with an electronic alert to APS members by APS Past President D. Allan Bromley (Yale University) to add their support by writing to Clinton as well.

Task Force on APS Prizes and Awards

The APS Executive Board has appointed a new Task Force on APS Prizes and Awards, chaired by Mildred Dresselhaus (Massachusetts Institute of Technology), with a primary charge to consider the full range, breadth, and number of APS prizes and awards to see if they are appropriate and if all areas of the physics community are covered in an equitable manner. In particular, the Board is interested in advice on under what conditions the APS should accept funding for additional prizes and awards if offered, and whether some of the criteria for existing prizes and awards should be broadened to encourage more nominations. Additional topics include whether there should be a minimum monetary amount for the major APS prizes and whether the APS should change the current policy on multiple recipients for a prize or award. A preliminary report will be presented at the Executive Board's February 21 meeting. The other members of the task force are Ronald C. Davidson, Princeton Univesity; Katharine B. Gebbie, National Institute of Standards and Technology; Wick C. Haxton, University of Washington; Rolf W. Landauer, IBM T J Watson Research Center; John M. Rowell, John Rowell Inc; and Frank J. Sciulli, Columbia University.

National Medal and Presidential Early Career Winners

Recipients of this year's National Medal of Science, announced in December by President Clinton, included three Fellows of the American Physical Society: Darlene Hoffman, a professor of chemistry at Berkeley, for her work on transuranium elements; Harold Johnston, emeritus chemistry professor at Berkeley, for contributions to atmospheric chemistry; and Marshall Rosenbluth, a plasma theorist at UCSD, for fusion research. The medal was awarded posthumously to Martin Schwarzchild of Princeton for fathering stellar evolution.

Last November, President Clinton presented 60 young researchers with the second annual Presidential Early Career Awards for Scientists and Engineers (PECASE). APS member David S. Citrin, a professor in the Department of Physics at Washington State University, was among those honored for developing a comprehensive theory of exciton-polaritons in semiconductor nanostructures. Those selected receive up to $500,000 over a five-year period to further their research and advance science for government missions.

New Funding Initiatives

President Clinton announced two new research and development partnerships that will leverage roughly $200 million in government and industry funds. Federal government funding is $96 million, already appropriated for the current fiscal year, with the remainder coming from industry. First, the Defense Department and the semiconductor industry will fund long-term R&D at leading universities intended to eventually allow US companies to manufacture a supercomputer on a chip. This initiative is being funded by the Defense Department's $14 million Government-Industry Co-sponsored University Research program. Second, the Commerce Department's Advanced Technology Program (ATP) will provide $82 million in cost-shared funds for eight new competitions to support R&D with broad-based benefits to the US economy. More than half of all ATP grants have gone to small companies or joint ventures led by small companies.

APS VIEWS

APS Junior Member Survey: Perceptions of the Job Market

by Sherrie Preische, APS Executive Office

There is presently a rumor among some physicists that the job crunch for recent physics PhD recipients, so much discussed in the first half of the'90s, is now a distant memory. It is said that there are now plenty of easily obtained jobs for physicists — the crisis is over. What support is there for this story and what do young physicists think of it?

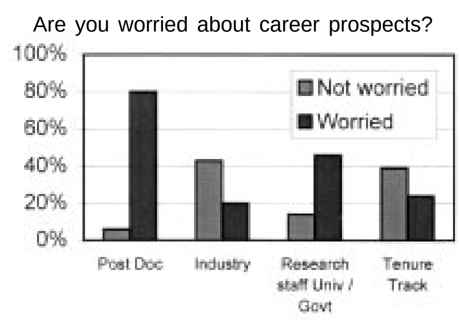
To help us get some understanding of the present job climate and the mood of recent degree recipients, the APS, under the auspices of CAP/Committee on Careers and Professional Development (see In Brief article on page 3), did an email survey of 'junior members' in October 1997. Upon graduation, student members may become junior members (full membership, but half the regular dues rate) for three years. This is a group of young physicists starting their careers. There was a strong response to this survey — 43%. This includes 592 replies from recent PhD recipients.

Survey responses reinforce a supposition that our junior members remain more closely aligned with physics than the general population of recent physics PhD graduates. Assuming this is the case, these survey responses are given by people who are doing "better" (by the terms of what a physics career is typically expected to be) than the overall population of recent graduates. The major employment sectors for our PhD respondents are post-docs 53%, industry 17%, tenure-track 11%, and university or government research staff 9%.

Junior members are worried about their own future careers. The strength of this feeling varies by the type of job people hold. Post-docs are most concerned while those in industry or tenure-track positions feel more secure about their future. When asked,

Are you worried about career prospects for the future, such as finding a permanent job with opportunity for advancement?

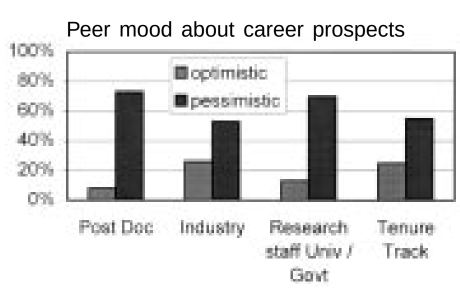
Post docs are very concerned about career prospects for the future: 80% worried, 6% not worried.



To try to learn something about all recent PhD graduates, we asked the question:

In terms of career prospects, what do you think is the present mood of most physicists in your peer group (0 - 4 years after degree)?

70% of PhD respondents say the mood of their peer group is pessimistic with regard to career prospects.



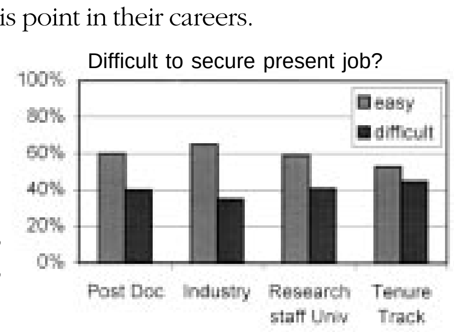
When asked *"Do you expect to remain in your present type of career path over the next 5 years or do you expect to make a major career change?"*, 60% of PhD respondents lean toward expecting to stay in their present career path over the next 5 years. 40% don't know or think they may have to make a major career change. Again, post-docs are slightly less secure, with 48% not sure that they can stay in their present type of career path over the next 5 years.

Why are people considering a major career change? The overwhelmingly highest reason given is "lack of opportunities for me in my present career path". This is the first or only reason for 40% of respondents and mentioned as a reason by 54%. The next highest reason is "family or other personal considerations", mentioned by 31% of respondents. These are followed by "developed new interests" and "job security".

With this degree of insecurity and pessimism about their career future, it seems that recent PhDs do not think that the job problem is over. But, do they *really* have cause for concern?

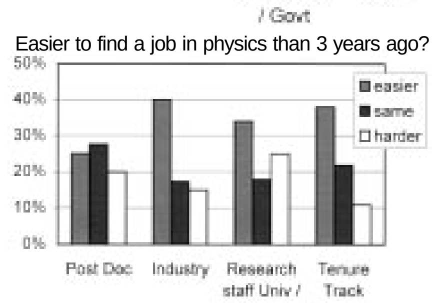
- Few (less than 1%) are unemployed.
- Only 11% of PhD respondents say they found it very difficult to secure their present job.
- Only 7% of PhD respondents do not find their job professionally challenging.
- When asked how their present job compares to their expectations when they started graduate school, few (6%) say their job is very different from what they expected and unfavorable; 21% say their job is very different from what they expected, but favorable; and 40% are doing what they thought they would be doing at this point in their careers.

A majority found it somewhat easy to secure their present job, with graduates in 1997 showing slightly more of a tendency to say it was easy to secure their job compared to previous classes.



When asked, Compared to 3 years ago, do you think it is easier or more difficult to find a job in physics?

30% think that it is easier (included in this are 3% who think that it is much easier), 24% think that it is the same, and 20% think that it is more difficult. On a scale of 1 to 5, where 1 is much easier, 3 is the same, and 5 is much harder, the average response is 2.9.



While there is a slight tendency among recent PhDs to think that that job market is somewhat better than it was a few years ago, this feeling is not overwhelming.

Recent AIP statistics show that very recent graduates are less likely to take a postdoctoral position than in previous years and are more likely to take a job outside of physics for their first job (AIP Pub. R-282.20, to bp). Does this mean that recent PhDs are giving up on physics? Is this tendency to leave the field immediately relieving pressure on the system and making it slightly easier to find a job these days?

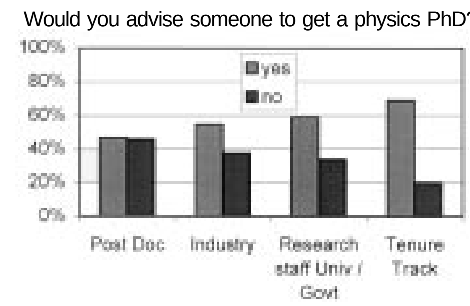
The response to the survey shows that physicists starting their careers think it has been relatively easy to find their first (usually temporary) job and yet they are still very concerned about their future career prospects. Based on this response and on the many comments received with the survey:

It may be easier to find a first job, but there is great concern about finding a long-term or permanent job.

Perhaps even more troubling is the depth of the pessimism of young PhDs shown in their response to the following question.

Do you agree with the following statement: If I was asked to advise someone who was considering pursuing a PhD in physics, I would advise them to do it.

40% of respondents would not advise someone to pursue a PhD in physics.



Another surprise is that those who hold a PhD in physics from the12 "most distinguished" physics departments (as defined by the NRC 1995 ratings) do not feel any more secure about their own career prospects than other respondents to the survey. These respondents also have the same distribution by employment sector as other respondents to the survey. **People with degrees from these prestigious departments are no more likely to be in tenure-track positions than other APS junior members.** They are also equally likely to advise or not advise someone to pursue a PhD as other respondents.

Distribution of APS membership (from 1996 membership survey)

14%	Students
5%	Junior members
19%	US resident physicists working in academia
19%	US resident physicist working in industry or government
14%	US resident non-physicists (self described)
9%	US residents retired
20%	Foreign residents

Neither is there a significant difference in responses to the survey by people who hold a PhD in a field other than physics.

The results of this survey confirm the fact that the APS junior membership is very diverse, as is the general membership. Only 71% of junior member respondents hold a PhD in physics from a US university. The 1996 APS Membership Survey also showed that the APS membership is a diverse group. (For details, see *APS News*, October 1997 and survey results through the APS home page (www.aps.org) under the Membership button).

Students and physicists in the early stages of their careers represent a significant fraction of APS membership - a similar fraction to that of our members who are physicists working in academia or in industry. Do these physicists starting their careers think that the physics job crisis is over? This survey shows that they think it may be relatively easy to find a first job, but they are very concerned about their ability to establish long-term or permanent careers.

Contributions to this survey by Jim Egan, Judy Franz, and Barrie Ripin of the APS and Roman Czujko, Raymond Chu and Kristi Jentoft-Nilsen of the AIP are gratefully acknowledged.

Who are the survey respondents?

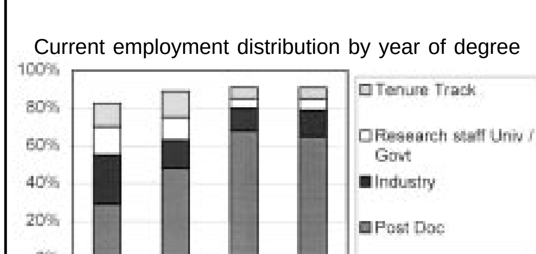
Post-doctoral	53%
Other temp research	4%
Industry	17%
Research staff (univ / govt)	9%
Non-tenure track teaching	2%
Tenure track	11%
Other non-research	3%

PhD year	
1997	14%
1996	30%
1995	31%
1994	14%

Residency status	
US Citizen	70%
Permanent US visa	11%
Temporary US visa	18%
Non-US resident	1%

Field of degree	
Physics	71%
Engineering	10%
Chemistry	6%
Astronomy	2%
Materials Science	1%
Applied Math	1%
Degree from non-US univ	8%

There are 2,150 APS junior members. The survey was sent to 1449 US resident junior members with valid email addresses and 622 replies were received, 592 of these from junior members with PhDs. These replies include about 10% of all physics PhD recipients from US universities in the classes of 1995 and 1996. Because very few responses were received from members whose highest degree is a masters or bachelors degree, the results given here are based only on responses from PhD holders.



Highlights from 1997 DPP Meeting

(Continued from page 1)

ICF - There were many talks on inertial confinement fusion (ICF), especially on topics related to the 192-beam, 2 Megajoule National Ignition Facility (NIF) under construction at LLNL. Not surprisingly, the focus of ICF research revolves around refining the understanding of the underlying physics of interaction of intense light with plasma, capsule implosions, and firming up the designs for ignition. Other ICF highlights presented include talks on the "fast ignition" scheme for ICF, in which an ultra-intense short-laser pulse could supply the ignition spark of a compressed ICF pellet, and impressive increases of x-ray yields from Sandia's Z-pinch.

Plasma Applications

Medical physics - At a Thursday morning session, Richard London of LLNL described how models developed for laser fision are now being applied to laser medicine. Laser fusion and medicine may be described by similar physics relations which, for example, describe how heat energy from the laser is transported through materials. By simulating the interactions between lasers and human tissue, the model can offer insights into how to optimize laser surgery. It is being applied to animal trials of a laser system for breaking up blood clots in the cerebral vessels which cause strokes.

Accelerator for materials processing - At the same session, Kurt Schoenberg of LANL described the possible application of coaxial plasma accelerators as environmentally sound and economic means for materials processing and advanced manufacturing. Originally developed to provide energetic plasmas for fusion energy experiments, the device uses the Lorentz force to accelerate plasmas to high velocity. Commercial applications are already online.

Plasma Thrusters for Deep Space Transport - Though titles such as "variable specific impulse magnetoplasma rocket" (Jared P. Squire, ASPL/JSC/NASA), "lithium-fed Lorentz force accelerator propulsion" (Nat Fisch, Princeton Univ), or "antiproton-catalyzed microfission/fusion propulsion system" (Gerald A. Smith, Penn State Univ.) sound like the stuff of science fiction, this is indeed not the case. A "mini-conference" held within the DPP annual meeting, drew engineers and researchers from around the world to discuss the latest advances in the theory and designs of plasma-based propulsion systems for deep space travel. A major limiting factor on deep space missions has been the relatively limited exhaust velocities of chemical rockets, which necessitates large initial fuel mass. Plasma thrusters yield high exhaust velocities and energy efficiency.

Plasma applications sessions were interspersed throughout the meeting touching on such varied topics as: klystrons; uses of ion beams; plasma processing of materials, such as for the semiconductor industry; compact accelerators; plasma display panels; environmental cleanup; and plasma 'mirrors' and 'windows.'

Dusty Plasmas

Roughly 99% of all matter in the universe exists in the form of a plasma which coexists with dust grains. In this "dusty plasma," the grains exert significant influences on plasma behavior. A one-micron dust grain weighs a trillion times more than a hydrogen ion in the plasma, and can accumulate thousands of electrons with ease. Creating artificial dusty plasmas in their laboratory, Bob Merlino, Nick D'Angelo and their students at the University of Iowa have observed extremely low-frequency waves that propagate through dusty plasmas. According to Merlino, who spoke at a Monday afternoon tutorial, these "dust-acoustic waves" are analogous to sound waves.

Simulating Supernova 1987 A with the NOVA Laser

To better understand Supernova 1987 A (SN1987A), the bright exploding star first observed a decade ago, plasma physicists are creating miniature laboratory versions of the explosion. Right before it explodes, the supernova is believed to be layered like an onion, with a metal core surrounded by helium and hydrogen layers. Observers of SN1987A soon realized that metal atoms were quickly poking through the hydrogen layer. In experiments at LLNL's NOVA laser, copper plasma (representing the supernova's metal core) is accelerated into a less dense plastic plasma (representing the less dense hydrogen and helium layers). According to Jave Kane of the University of Arizona, this produces features similar to those observed in the supernova.

Laboratory Simulations of Solar Prominences

Solar prominences, huge luminous arches extending outwards from the surface of the sun, are often twisted, forming striking helical patterns. Scientists believe these patterns result from plasmas tracing out the shape of complex twisted magnetic fields emanating from the solar surface. When prominences erupt from the sun's surface, they can indirectly cause magnetic disturbances on Earth, damaging satellites or even causing power outages. Paul Bellan and colleagues at Caltech in a laboratory experiment which produces controlled, reproducible simulations of erupting prominences, observe twisted, unstable arch-shaped structures very similar to the solar prominences seen by observatories and spacecraft.

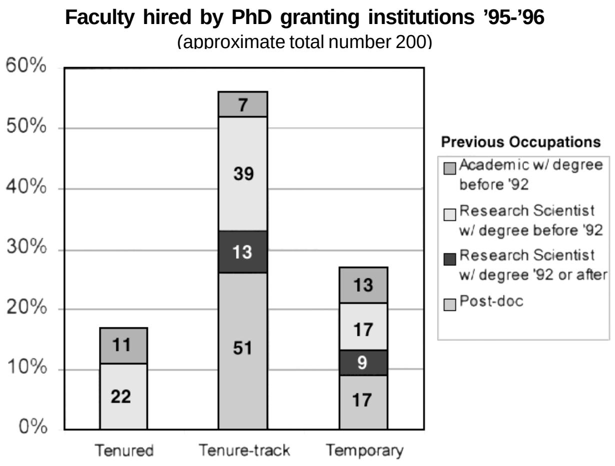
Ionospheric Mapping

In a Monday afternoon session, P.A. Bernhardt of NRL described how he is mapping the plasma density in the earth's upper atmosphere using Computerized Ionospheric Tomography (CIT), a recently developed technique that uses and computer reconstructions to determine both electron and ion densities. New ionospheric imaging instruments are scheduled for launch on numerous spacecraft.

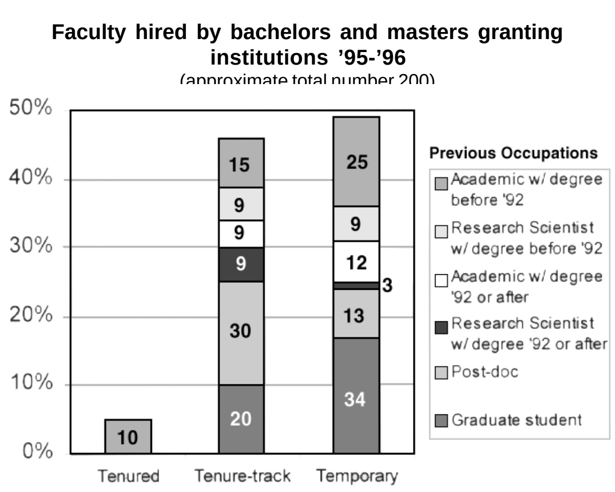
Special thanks to Philip Schewe and Benjamin Stein of AIP's Public Information Division and Bruce Remington, DPP's Public Information Coordinator, for contributing to the coverage of technical sessions in this article.

At what rate are physics departments hiring early career physicists?

In 1995-96, 1,438 PhDs were granted by US physics departments.



Shown are the previous occupations of new faculty hired by PhD granting physics departments in 1995-96. In some cases it is indicated whether these new hires received their PhD anytime before 1992 or between 1992 and 1995. These new faculty were hired into tenured, tenure-track, or temporary positions. **The numbers shown within each bar are the approximate total number of hires in that category.** Temporary positions are those such as sabbatical leave replacement, research staff, adjunct or visiting professor, or lecturer. Previous occupation of "Academic" includes all ranks from professor to temporary lecturer. Previous occupation of "Research Scientist" includes industry, government labs, and some university positions. 19% of all these new hires received their degree from a foreign institution.



Shown are the previous occupations of new faculty hired by bachelors and masters granting physics departments in 1995-96. Almost all of these new hires received their PhD from a US university.

All of these numbers are *estimates* based on responses from institutions describing approximately 2/3 of the new hires.

PhD physicists are also hired into faculty positions in university departments other than physics departments. Hires by other departments increase the total number of hires of PhD physicists by about 25%.

Thanks to Roman Czujko and Christine Cassagnau for providing these statistics based on AIP 1995-96 Academic Workforce report, AIP Pub. No. R-392.2

Early Electronic Publication of Physical Review D Articles

In recent years, the physics community, particularly in the fields covered by *Physical Review D*, has become increasingly accustomed to accessing the current literature electronically. In keeping with this trend, *Physical Review D* is changing its production process so that all articles will be first published electronically, with the printed version appearing at a subsequent date. As at present, the printed and online versions will be visually identical. This new process begins with the articles of Volume 57 (the January-June 1998 print issues) and includes all articles currently being accepted.

"In making this change, we are moving from a batch mode that focussed on the production of an entire printed issue to one that allows each article to be published as soon as it is ready," said *PRD* Editor Erick Weinberg (Columbia University). "For well-prepared manuscripts, our goal is to send page proofs to the author about two weeks after the article has been accepted for publication." He added that a few days after approval of the proofs has been received, the article will be posted as part of the electronic journal, with the date of posting being listed as the publication date of the article. At monthly intervals these articles will be collected together to make up the printed issues that will appear, according to the same division by subject area as at present, on the 1st and 15th of each month.

In a six-month transitional phase, full citation information (volume and page number) will only be available when all of the articles corresponding to a given print issue have been posted. Beginning with the first issue of Volume 58 (print date 1 July 1998), the journal will change to a citation scheme based on volume and article number, with the article number being assigned at the time that the article is published electronically. Articles will then be fully citable as soon as they appear in the online journal. In the printed journal, articles will be ordered by increasing article number; the algorithm for assigning these numbers has been designed so that articles will be ordered by topic within each printed issue, as is currently done.

According to Weinberg, authors should be aware of two important implications of this change. First, because articles will be published electronically as soon as they are ready, authors can reduce the time from acceptance to publication by carefully preparing and proofreading their manuscript, submitting it electronically, and responding promptly after receiving the page proofs. (If the proofs require only a few minor corrections, or none at all, an email response is sufficient.) Second, because the online version will be considered the final published version, with the subsequent printed version simply a reproduction of the online version, authors will not be able to make any corrections to the article after the page proofs have been returned; instead, any further corrections must be made by submitting an erratum.

APS members may access the electronic version of *Physical Review D* at http://publish.aps.org/PRDO/prdohome.html

Free *JETP Letters Online*

In an effort to promote the online version of the *Journal of Experimental and Theoretical Physics Letters (JETP Letters Online)*, the American Institute of Physics (AIP) is offering free access to current subscribers of *Physical Review Letters-online* from October 15, 1997, through December 31, 1998. One of the most important physics journals published in Russia, *JETP Letters Online* presents timely and topical short papers, emphasizing fundamental theoretical and experimental research in all fields of physics — from solid state to elementary particles. Its first-hand reports of the current state of research in the former Soviet Union place it among the most consulted journals serving physics, chemistry and engineering departments and laboratories around the world.

The online edition provides access to *JETP Letters Online* articles beginning with January 1996 issues, and includes the following features: reference linking to connect to a referenced article's abstract; new download options to enable users to print full-text PostScript or PDF files for each published article; and "See also" links providing access to such related information as errata, multi-part papers, reader comments and author responses to comments. Subscribers to *PRL-o* may gain immediate access to *JETP Letters Online* at http://www.aip.org/jetplo, using their current username and password. They may also link from one letters journal to the other without re-validation. There is no need to complete another subscriber agreement for access. For technical questions, contact AIP at 516-576-2262, or via e-mail: ojshelp@aip.org.

Fluid Dynamics Researchers Meet in San Francisco

New research results in turbulence control, sonoluminescence, and biofluid dynamics were among the highlights of the 1997 fall meeting of the APS Division of Fluid Dynamics, held 23-25 November in San Francisco. Nearly 900 contributed papers were presented in addition to several invited lectures. In addition, the 1997 recipients of the APS Fluid Dynamics Prize and Otto LaPorte Award spoke at a special awards program on Sunday afternoon. The meeting also featured the 15th Annual Gallery of Fluid Motion, an exhibit of contributed photographs and videos of experimental fluid dynamics. Outstanding entries, selected for originality and their ability to convey and exchange information, will appear in the September 1998 issue of *Physics of Fluids*.

MEMs and Turbulence Control

Recent experiments and simulations have demonstrated the feasibility of active boundary layer control, according to Sudeep Kumar and William Reynolds of Stanford University, who spoke at a Tuesday afternoon session. They have developed actuator arrays using a combination of micromachining technologies along with mesoscale assembly. An array consists of eight piezoceramic-silicon cantilevers with integrated cavities and unequal side gaps, with typical spring constants ranging between 100-500 N/m. In addition, the actuator has millisecond rise times with power consumption in the milliwatt range.

At the same session, Steve Tung of CalTech described how his team has designed and fabricated multiple arrays of micromachined micro shear-stress sensors, intended to temporally and spatially resolve the small stream-wise streaks in the near-wall region of a turbulent boundary layer. Using these sensors, the turbulent surface shear-stress distribution has been measured, and the high shear-stress streaks have been identified and analyzed. Based on the temporal data, Tung's group found that a high correlation exists between the peak shear stress level and the leading edge shear-stress gradient of a high shear-stress streak. This information is currently being applied to the design of a real-time flow control logic, which is part of a MEMS-based neuronet system for active turbulent shear-stress control.

Synthetic Jet Actuators

Ari Glezer of the Georgia Institute of Technology described his novel approach to the manipulation and control of shear flows using fluidic technology based on synthetic jets. These jets are zero-mass-flux and are synthesized from the working fluid in the flow system in which they are embedded. Although there is no net mass injection, the jets provide for momentum transfer into the flow system to be controlled. In addition, near the surface from which it is generated, interaction of a synthetic jet with an embedding flow results in formation of closed recirculation regimes, with an apparent modification of the surface shape.

These attributes enable synthetic-jet control systems to effect significant global modification of embedding flows on scales one to two orders of magnitude larger than the characteristic length scale of the jets. Futhermore, while conventional excitation methods have been limited to frequency bands tailored to the linear receptivity mechanisms of a given flow, fluidic actuation facilitates exploitation of nonlinear mechanisms for amplification of disturbances in a very broad frequency band. Potential applications of fluidic technology based on synthetic jets include jet mixing and thrust management, and modification of aerodynamic surfaces.

Sonoluminescence

When an acoustic wave of moderate pressure converges in an aqueous liquid, light emissions can be observed, a conversion of mechanical energy into electromagnetic energy that represents an energy amplification per molecule of over eleven orders of magnitude. On Monday afternoon, Lawrence Crum of the University of Washington's Applied Physics Laboratory, described his recent discovery that a single, stable gas bubble, acoustically levitated in a liquid, can emit optical emissions each cycle for an unlimited period of time. "We have no current explanation for how this mechanical system sustains itself," Crum admitted. "Presumably, the oscillations of the bubble cause the gas in the interior to be heated to incandescent temperatures during the compression portion of the cycle."

Furthermore, recent experimental evidence suggests that the lifetime of the optical pulse is less than 12 picoseconds, and that the temperature in the interior of the bubble can exceed 40,000 K. While Crum finds the recent suggestion that sonoluminescence may be due to quantum vacuum radiation, he theorizes that a shock wave is created in the gas, which is then elevated to high temperatures by inertial confinement. "If shock waves are the mechanism for sonoluminescent emission, the optimization of the process could lead to extraordinary physics, including the remote but intriguing possibility of thermonuclear fusion," he said.

Biofluid Dynamics

According to Charles Peskin of New York University, who spoke on Monday afternoon, the fluid dynamics of the heart involve the interaction of blood, a viscous incompressible fluid, with the flexible, elastic, fiber- reinforced heart valve leaflets that are immersed in that fluid. Neither the fluid motion nor the valve leaflet motion are known in advance; both must be computed simultaneously by solving their coupled equations of motion. Peskin has developed a means of accomplishing this simulation using his immersed boundary method, which can be extended to incorporate the contractile fiber architecture of the muscular heart walls, as well as the valve leaflets and the blood. The result is a three-dimensional model of the heart, which can be used as a test chamber for the design of prosthetic cardiac valves, and also to study the function of the heart in health and in disease.

Dogs and other scenting animals detect airborne odors with extraordinary sensitivity. According to G.W. Settles of Penn State University, who spoke on Tuesday afternoon, aerodynamic sampling plays a key role in this, although little information is available on the external aerodynamics thereof. To this end, he visualized the airflows generated by a scenting dog using the so-called "schlieren technique." He observed that a dog stops panting in order to scent, since panting produces a turbulent jet which disturbs scent-bearing air currents. Furthermore, inspiratory airflow enters the nostrils from straight ahead, while expiration is directed to the sides of the nose and downward. Thus, the musculature and geometry of a dog's nose modulates the airflow during scenting. The eventual practical application of his work is to achieve a sufficient level of understanding of the aerodynamics of canine olfaction to design a mimicking device.

Nonlinear Stability

On Tuesday afternoon, William Saric of Arizona State University described recent research in the three-dimensional boundary layer transition, focusing on the cross-flow instability that leads to nonlinear saturation and transition on swept wings with pressure gradients. In particular, he has shown that the introduction of micron sized roughness organizes the unstable modes in up to nine harmonics, and that it is possible to isolate single-mode growth in order to provide a data base for the computations. According to Saric, the measurements show a clear nonlinear distortion of the mean flow and saturation of the stationary structure. He has also shown that certain roughness spacings inhibit the growth of the most unstable modes, and that transition can be moved beyond the smooth case.

Historical Factal

Leo Szilard

Photo Courtesy of Science Service and the Niels Bohr Library

Leo Szilard (left) in conversation with Ernest Lawrence at the APS Meeting in Washington, DC, April 27, 1935

Photo Courtesy of Argonne National Laboratory and the Niels Bohr Library

Leo Szilard

Leo Szilard was born 100 years ago on February 11, 1898, in Budapest, Hungary, and emigrated to the US in 1938. Szilard left Germany in 1933 because of the worsening situation for its jewish citizens He initially planned to study electrical engineering, but switched to physics while studying at the Technische Hochschule in Berlin, Germany. At Columbia University, he repeated the Hahn/Strassman experiment demonstrating nuclear fission and helped compose the letter signed by Albert Einstein imploring Franklin Roosevelt to consider development of a fission bomb. Although known for his contributions to nuclear fission and development of the world's first atomic bomb as a member of the Manhattan Project, Szilard is most remembered for his later efforts to cease research on nuclear weapons and his timeless work toward promoting socially responsible use of science. Szilard was a founding member of the Federation of Atomic Scientists, which worked to keep control of atomic energy out of the hands of the military, as well as the Council for a Livable World in Washington, DC. He later turned to biophysics as a professor at the University of Chicago, developing the chemostat, an instrument that aids in the study of bacteria and viruses by regulating various growth factors. In addition to his scientific publications, he published a collection of science fiction short stories, in 1961.

A Leo Szilard Centennial Meeting will be held this month, February 9-10, 1998, in Budapest, Hungary. It is sponsored by the Hungarian Physical Society and Pugwash and endorsed by the APS. A Szilard Centennial session is also scheduled for at the spring APS Meeting in Columbus, Ohio.

More information about Leo Szilard may be found at [www.peak.org/~danneng/szilard.html].

Do you have interesting historic photographs of physicists or meetings? Please send them to: Editor, APS News, One Physics Ellipse, College Park, MD 20740. We will see that they get to the Emilio Segrè Visual Archives of the Center for History of Physics Niels Bohr Library.

Leo Szilard Award for Physics in the Public Interest

The APS Forum on Physics and Society established the APS Leo Szilard Award for Physics in the Public Interest in 1974 in recognition of Szilard's concern for the social consequences of science.

The Forum has recently launched an effort to establish a $60,000 endowment to convert the Szilard Award into a lectureship award in which the recipients would receive funds to speak about their work at two or more institutions. The objective of the lectureship format would be to provide exposure for outstanding physicists who have applied their science for the benefit of society and, hopefully, act as positive role models. Those interested in making a donation should send their contribution (payable to APS-Szilard Fund) to: Barbara Levi, 1616 La Vista del Oceano, Santa Barbara, CA 93109.

Announcements

Francis M. Pipkin Award is Established

At its November meeting, the APS Council approved establishment of the Francis M. Pipkin Award. It is intended to recognize exceptional research accomplishments by a young scientist in the interdisciplinary area of precision measurement and fundamental constants, and to encourage the wide dissemination of the results of that research. The Pipkin award will be presented biennially and consist of $2000 plus support of travel expences to attend the APS meeting at which the award will be conferred.

Funding to endow the Pipkin award was established by the Topical Group on Precision Measurement and Fundamental Constants a memorial to Francis M. Pipkin. Pipkin was a professor and chair in the Department of Physics at Harvard. He served as thesis advisor to more than 50 PhD students in a broad range of experimental physics topics including: atomic, molecular, optical, nuclear, and particle physics.

Chaired by Louis W. Anderson, University of Wisconsin, the first selection committee will also include Linda Young, Argonne National Laboratory, as vice-chair, as well as Eric Adelberger, University of Washington, Kay Kinoshita, Virginia Technology Institute, and Marvin Cage, National Institute of Standards and Technology. The first awarding of the Francis M. Pipkin Award will be at the APS Centennial Meeting in Atlanta, GA in March 1999.

APS Fellowship Nomination Deadlines

Each year, up to 1/2 of 1% of the APS membership may be elected to fellowship. Submission of a nomination involves the following: completion of a nomination form, submission of the nominees C.V. and publication list, and providing 2 - 3 letters of support from colleagues who are knowledgeable of the nominee's work. Nominations packages should be forwarded to APS Fellowship Program, One Physics Ellipse, College Park, MD 20740 prior to the deadline listed below for the unit that will be reviewing the nomination. More information on submitting a nomination for APS Fellowship can be obtained by browsing the Fellowship Page on the APS web site [http://www.aps.org], emailing the fellowship office at "fellowship@aps.org", or calling (301) 209-3268.

UNIT	DEADLINE
• DCMP (Condensed Matter) • High Polymer Physics • Forum on Education • Forum on Industrial & Applied Physics	Passed
• Chemical Physics • Computational Physics • Fluid Dynamics • Materials Physics	02/15/98
• Forum on History of Physics	03/01/98
• Physics of Beams • DAMOP (Atomic, Molecular, Optical) • Plasma Physics	03/15/98
• Laser Science • Nuclear Physics • Particles & Fields • Forum on International Physics • Forum on Physics & Society • Few Body Systems • Fundamental Constants • Gravitation • Instrument & Measurement Science • Shock Compression • Magnetism & Its Applications	04/01/98
• Astrophysics	05/01/98
• Biological Physics	06/01/98

APS UNDERGRADUATE PHYSICS STUDENT COMPETITION

1998 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 Ph.D. and one to a student attending an institution not offering a Physics Ph.D.

- Recipients receive a $5,000 award; finalists $1,000. They also receive an allowance for travel to the Award presentation.
- Recipients' and finalists' home institutions receive $5,000 and $500, 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 15 June 1998 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 **15 June 1998** 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 **15 June 1998** to:

Dr. Barrie Ripin, Administrator, Apker Award Selection Committee
The American Physical Society, One Physics Ellipse, College Park, MD 20740-3844; Telephone: (301) 209-3268, Fax: (301) 209-0865,
email: ripin@aps.org

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** NOTE: There is an APS Bylaw proposed to change CAP into the **Committee on Career and Professional Development.** See In Brief article on page 3.*

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THE BACK PAGE

Liquidating the Cold War: Progress of the HEU Deal

by Thomas L. Neff

Approximately 60 years ago, the world began a technological revolution that would transform the nature of war, alter the relationships between nations, and ultimately restructure the economies and governance of the US, Russia and other nations. The invention and deployment of nuclear weapons by the US and the Soviet Union led to a different, bipolar world in which regional struggles were often merely proxies for the main adversaries in the Cold War, where nuclear weapons arsenals were the measure of greatness, and where domestic economies and decision-making were often dominated by Cold War considerations. This was also a new world in which scientists, particularly physicists, actually seemed important to government and to the public.

Both the Soviet and US governments and societies were reshaped by the imperatives of the Cold War. Ministries and departments with Cold War roles were ascendant. Close to the centers of power, advisors with Cold War portfolios (some of them physicists) commanded a level of attention they may never have again. Unfortunately, institutional rigidities and Cold War conditioning remain serious obstacles to liquidating the Cold War, potentially resulting in dangers greater than those faced previously.

It seems at this point that we do not need more fathers of the H-bomb or modern equivalents, but rather morticians of the Cold War. The fundamental challenge is to find ways to restructure and redirect both the US and Russia along lines that simultaneously liquidate the dangers of the Cold War and create practical ways to use the valuable talents of scientists and engineers. The Highly Enriched Uranium (HEU) Deal is but the first of many possible initiatives.

The HEU Deal

In September 1991, Presidents Bush and Gorbachev reached agreement on reduced deployments of nuclear weapons, setting the stage for the first major reduction in numbers of nuclear weapons. At the same time, it became clear that the Soviet Union was disintegrating. I soon began to worry about what would happen to surplus nuclear weapons, fissile materials, and to the weapons capabilities, including a large number of highly trained people. It was immediately apparent that a potential outcome was that the weapons and personnel could be transformed in short order from a well-controlled force to a major weapons proliferation threat to the world.

The basic problem was to find a way to motivate and finance post-Soviet control of nuclear weapons, fissile material and personnel in a country where central authorities might not have the power to do so. It occurred to me that the highly enriched uranium in surplus weapons has a high value when blended down to enrichment levels usable in civil power reactors. The destruction of weapons could be a self-financing process, without cost to the US taxpayer.

Ideally, much of the money should flow to the Russian enterprises and secret cities that had produced the weapons, as they would be essential to reversing the process. If the material in each nuclear weapon had commercial value on the order of a half million dollars, not only would it be watched carefully, but the destruction of it and the uranium fissile material would be expedited. The highly capable scientists and engineers would continue to be supported, reducing the likelihood that they would be forced to sell their talents to other national or subnational groups. Once begun, the enterprises involved in the destruction of weapons and the blending of HEU to civil fuel would demand weapons and weapons material to destroy. Weapons destruction would not be driven by Russian compliance with treaty requirements, but by powerful self-interested forces within Russia. Politically, these large enterprises would enlist regional support in the fragmented post-Soviet system, ultimately helping to shift national policy away from new military spending.

On February 18, 1993, the US and Russia signed a bilateral agreement for the US to undertake the purchase of 500 metric tons of HEU, the quantity contained in roughly 20,000 nuclear weapons. Russia and the US were to appoint commercial executive agents to carry out the deal. Russia chose Techsnabexport (Tenex), essentially a government export

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agency, and the US chose the enrichment arm of the Department of Energy, which is now a government corporation called the US Enrichment Corporation (USEC) on its way to privatization. By May of 1993, the DOE and Tenex officials had initiated a draft contract for the purchase of 500 tons of HEU over 20 years, with an expected value of $12 billion. Used for making fuel, a kilogram of HEU is worth about $24,000, twice the value of gold. The final contract was signed in January 1994.

Problems and Progress

While these developments appeared to be a major victory for arms reduction and non-proliferation, it turned out to be only the beginning of a very difficult process of implementation. For example, at least some Russian HEU contains small amounts of plutonium, most likely the result of hybrid weapons designs in which HEU came into metallic contact with plutonium. To meet commercial specifications, it has been necessary to purify the HEU by reprocessing.

Also, to alleviate concerns that Russia might simply enrich natural uranium to make HEU, rather than destroying weapons, the US has insisted on monitoring the destruction and blend down of HEU. Russia has understandably been sensitive about this issue. The solution was achieved in December 1996: US monitors are placing measurement devices at key points in the HEU destruction facilities, and Russia has a reciprocal right to monitor the use of LEU from HEU in the US to make sure it is not being used to produce new weapons material.

In addition, there have been trade-related problems. In November 1991, an antidumping action was brought against the Soviet Union for selling nuclear fuel products at too low a price. The antidumping action would have prevented the import into the US of fuel products made from Russian HEU, as well as conventional nuclear fuel products from successor states. It was thus necessary to negotiate a settlement. Finally, even though the USEC was a government corporation, there was little independent or effective oversight of control by US policy makers. This set the stage for possible conflicts between the commercial objectives of the new corporation and the national security objectives of the US government.

These difficulties initially led to some delay in the original schedule for desctruction of HEU. However, their resolution and beginning of cash flow to Russia is rapidly eliminating bottlenecks. As of today, reactor fuel equivalent to 21 tons of HEU has been delivered to the US, the equivalent of about 1,000 nuclear weapons. By the end of the five-year contract, a total of 150 tons of HEU, equivalent to about 6,000 nuclear weapons, will have been destroyed. Capacity limits on purification and blending are the only factors impeding more rapid destruction of the fissile material.

In 1997, Russia received about $450 million for the destruction of nuclear weapons, which will increase to more than $750 million per year by 1999. While the monies not spent on actual weapons destruction will ostensibly be used for improvements in reactor safety and other purposes, there is a potential danger that some of these funds will be used to enhance weapons design and production capabilities. However, the HEU deal was not primarily intended as a disarmament program, but rather as a non-proliferation action that Russia and the US could agree on. Moreover, the US is hardly stopping its design activities, nor destroying its ability to produce nuclear weapons. There is thus still an important role to be played by traditional arms negotiations. The agreement to ban testing of nuclear weapons is an important first step. With some luck, the HEU deal will foster a better climate for arms agreements.

Reflections

In hindsight, the HEU deal appears to be an obvious idea. In reality, a new idea is much like a child: conceiving one is nowhere near as hard or time-consuming as raising one. With a lot of work, the HEU deal has survived its childhood. Unfortunately, it may be entering adolescence, where outside influences may lead it astray. The large amounts of money involved are likely to tempt opportunists. The deal has already been challenged in Russia by conservative nationalists, and some in the Russian government have been tempted to defend the HEU by saying that it is financing the

weapons program. In the US, the privatization of USEC continues to raise the larger question about the relationships between domestic economic matters and international security imperatives.

In the case of plutonium, some new ideas are needed. For several years I have been quietly trying to encourage a relatively brief delay in civil reprocessing that would free up existing capacity in Europe to fabricate mixed uranium and plutonium fuel (MOX) from weapons plutonium. While the reprocessing industry has previously opposed such actions, their customers in Europe and Asia would welcome a slowdown in civil reprocessing and corresponding delay in return of nuclear waste. If the MOX industry can be convinced to take this course, the real challenge will be to convince the US and Russian governments to let their weapons plutonium be fabricated in Europe and potentially burned elsewhere.

In all of this, we need better agreements with Russia, as well as with other nations. As Leo Szilard wrote, the "problem is not to write an agreement that Russia will sign, but to write one which Russia will be eager to keep, not only for the next few years but ten years and twenty years hence." Impatient with traditional diplomacy, Szilard went on to argue that "to devise such an agreement requires imagination and resourcefulness," qualities he obviously found wanting in government.

I do not agree with Szilard on this point — there are many creative people in government — but do share the impatience. It seems better to make small timely efforts to direct the course of events than to respond more heavily to the crisis of events gone badly astray. The entropy of multiple actors and agendas in government may require the injection of large amounts of political energy to get anything done. The broader challenge is to build on the success of the HEU deal to redirect both political systems and technological capabilities toward more peaceful and more economically productive ends.

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