APS NEWS

FEBRUARY 1997 | THE AMERICAN PHYSICAL SOCIETY | VOLUME 6, NO 2

APS Council Proposes Constitutional Amendments

At its November 1996 meeting, the APS Council began the Constitutional process to change the way the variable "X" in the APS Constitution and Bylaws determines when a shrinking Division or Forum loses Council representation. These changes follow a report by the APS Committee on Constitution and Bylaws on how the X system has worked, and recommendations by the Committee on appropriate adjustments. Taking into account members' comments, which are hereby invited, a final decision on the bylaws and on the wording of the proposed Constitutional amendments will be made at the Council meeting in April. The proposed amendments will be submitted to the entire membership for a vote in the next general election mail ballot.

The parameter X% in the APS Constitution and Bylaws sets the percentage of APS members who must belong to a unit in order to entitle it to a representative on the APS Council: a voting Councillor for a Division or Forum and a non-voting Advisor for a Section. Topical Groups do not qualify for a Councillor. [For all the ways X is used, see the APS Constitution and Bylaws on pages xl-lv in the 1996-97 Membership Directory, or on the APS home page at http://www.aps.org/exec/bylaws/bylaws.html]

The value of X is stated in the Bylaws, and has been set at 3 since 1991, when the new Constitution and Bylaws were adopted. The Constitution specifies that X operates linearly, with the same X to acquire a first Councillor, or for large Divisions to get additional Councillors, and for the loss of a single Councillor when a Forum or Division decreases below X% in size. The Committee on Constitution and Bylaws reported that the X system and the value 3 have worked very well in orderly creation of new Divisions and Forums with Councillors and providing proportional representation of the large Divisions. These major objectives of the new Constitution were clearly met. The only exception was a potential problem concerning the loss of the last Councillor at the same value of X as is required to gain the first one. The Division of High Polymer Physics (DHPP), the sec-

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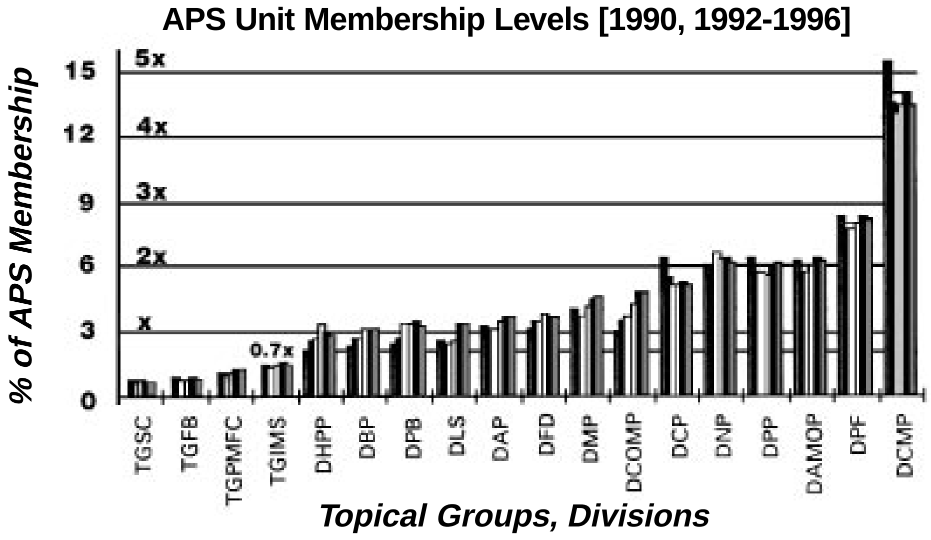
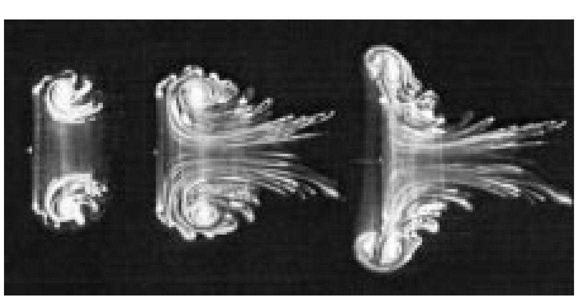
APS Unit Membership Levels [1990, 1992-1996]



Fluid Researchers Gathered in Syracuse for DFD Meeting



New work in simulation techniques, turbulence, and the fluid dynamics of physical oceanography were among the highlights of the 1996 fall meeting of the APS Division of Fluid Dynamics, held 24-26 November in Syracuse, New York. More than 800 contributed papers were presented, in addition to several invited lectures and a mini-symposium on low-temperature superfluids. The meeting also featured the 14th 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 1997 issue of *Physics of Fluids*.

Simulation Techniques

Over the last 10 years, direct numerical simulation (DNS) of turbulence has emerged as a powerful technique in this area of research. According to Parviz Moin of Stanford University and NASA-Ames, recipient of the 1996 Fluid Dynamics Prize, DNS is particularly viable for low-to-moderate Reynolds numbers because of the disparity in the range of scales. For complex turbulent flows with higher numbers, large eddy simulation (LES) is experiencing a breakthrough with the advent of the dynamic subgrid scale procedure in 1990, a new approach to turbulence modelling where one actually computes, rather than prescribes, the model coefficients. However, outstanding issues remain concerning the constitutive equations for large eddies and the effects of numerical and subgrid scale modeling errors on large-scale turbulence statistics.

Symbolic Coupling

The application of numerical simulations in fluid dynamics has become commonplace, but questions still remain about the relation of such simulations to physical phenomena, as well as to rigorous solutions of partial differential equations, according to Richard Peskin of Rutgers University. In a Monday afternoon session, he discussed the role of symbolic computation (such as computer algebra and related paradigms) as a preprocessing tool to aid in establishing the

(Continued on page 3)

ICF, Plasma Astrophysics and Education Outreach Highlight 1996 DPP Meeting

Undergraduate Poster Session at DPP Meeting. *Hampton University student Toni Burton (left) with her poster and Professors Alkesh Punjato and Halim Ali, Ms. Burton's mentor.*

Plasma scientists from around the world gathered in Denver, Colorado, to hear about the latest research in inertial confinement fusion (ICF), ITER physics, laser plasmas, astrophysics and plasma applications during the 1996 annual meeting of the APS Division of Plasma Physics (DPP), held 11-15 November. Over 1,400 papers were presented, including four review papers, one prize recipient address and 55 invited talks.

Several special symposia organized throughout the week featured such topics as fusion energy sciences restructuring, science education, plasma science career opportunities, and magnetic reconnection in the laboratory and space. The keynote speaker at Wednesday evening's banquet was James Randi, a conjuror, lecturer, author and amateur astronomer who received the APS Forum Award in 1989 for his success in exposing scientific fraud.

Inertial Confinement Fusion

Magnetically-driven z-pinch implosions have been used for more than 40 years to evaluate the effects of x-ray radiation on materials and electronics. Keith Matzen of Sandia National Laboratories reported on a new use for these implosions in a Monday morning review session, of special significance to the national stockpile stewardship program which requires that the safety and reliability of nuclear weapons be determined without underground tests. In a z-pinch implosion, electrical energy is coupled into the kinetic energy of a magnetically-driven plasma, formed from a gas puff, an annular array of wires, or a metal foil. On the Saturn and PBFA Z accelerators, a dramatic increase in x-ray energy and power from fast z-pinch implosions was obtained using an annular array of 100 to 200 thin wires in the shape of a cylindrical shell. When the confined plasma, produced by ionization of the wire material, "pinches" on axis, a large fraction of the energy is emitted as soft x rays. The improvement in x-ray power represents a new world laboratory record (by a factor of four).

In ICF, laser light irradiating a plasma at very high irradiances can induce nonlinear phenomena, such as parametric instabilities, and decay into various combinations of waves of different frequencies. Recent

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Meeting Deadlines

March Meeting Kansas City, MO	**17-21 March 1997**
Hotel Registration and Preregistration	14 February 1997
Joint April APS/AAPT Meeting, CAM '97 with DAMOP Washington, DC	**18-21 April 1997**
Hotel Registration	17 March 1997
Preregistration	21 March 1997

Bromley Emphasizes Communication, Cooperation in Science

Improving communication and cooperation at both the local and global level is the key to resolving many of the issues currently facing the APS and the physics community as a whole, according to incoming APS President D. Allan Bromley. The Sterling Professor of the Sciences and Dean of Engineering and Technology at Yale University and former science advisor to President Bush, Bromley assumed office on January 1.

A native Canadian, Bromley received his Ph.D. in physics from the University of Rochester in 1952 and remained on the Rochester faculty until 1955, when he returned to Canada and the Chalk River Laboratories. In 1960 he joined Yale University's physics department, which he chaired from 1970 to 1977. On leave from Yale from 1989 to 1993, he served as Assistant to the President for Science and Technology in the Bush Administration, the first science advisor to hold this rank.

A past president of the American Association for the Advancement of Science and of the International Union of Pure and Applied Physics, Bromley is also a founding member of the APS Division of Nuclear Physics, serving as its first divisional councillor. He has also served on the APS Publications Oversight Committee, the Physics Planning Committee and the APS Committee on Education.

In addition to his activities while in the White House, Bromley has extensive experience in international science and technology, including service on a number of international commissions on science. He has published widely in nuclear physics, on accelerator-related instrumentation, and on science and technology policy, serving as a member of the High Energy Physics Advisory Panel, the National Science Board, and many other boards and committees in government and private sectors. He was awarded the U.S. National Medal of Science by then-President Ronald Reagan.

Bromley identified three key issues he considers priorities for his tenure as APS president: (1) improved communication and cooperation between scientific societies in the U.S.; (2) the advent of electronic publishing; and (3) improved communication and cooperation with the international scientific community. He will draw on his experiences as IUPAP president, and as George Bush's science advisor. The upcoming APS Centenary, scheduled for March 1999 in Atlanta, Georgia, is also a major focus. "Our centennial celebration has the potential of being a major focus for scientific activity in the U.S. and for bringing together the world physics community," he said.

Bromley also gave high praise to the current APS officers with whom he will be working, including APS Executive Officer Judy Franz and two new appointees, Treasurer Tom McIlrath and Editor-in-Chief Martin Blume, who replaced Harry Lustig and Benjamin Bederson respectively. "I consider myself extremely fortunate to have so accomplished a set of officers in place," he said. "This is a remarkably able trio, and I am very much looking forward to working with them."

***Q** Improving communication and cooperation with other scientific societies is one of your goals for the coming year. What can be gained by accomplishing this?*

A Federal funding in support of science and technology during the next five years is going to be dwindling. Therefore, it is more important than ever for us to make a more effective case to Congress that investment in support of science and technology is truly an investment in the future of our nation. I am convinced that we can do this much more effectively if we do it on behalf of science generally, rather than as representatives of a particular field, such as physics, chemistry, biology or engineering. I would like to make sure that as many scientific societies as we can recruit come together and jointly present the case for maintaining the support of scientific research and development in this country to Congress and to the Administration. We are fortunate to have Michael Lubell as a member of our senior staff working in these areas.

***Q** How can the APS best respond to the clear shift from traditional paper publication to electronic publishing?*

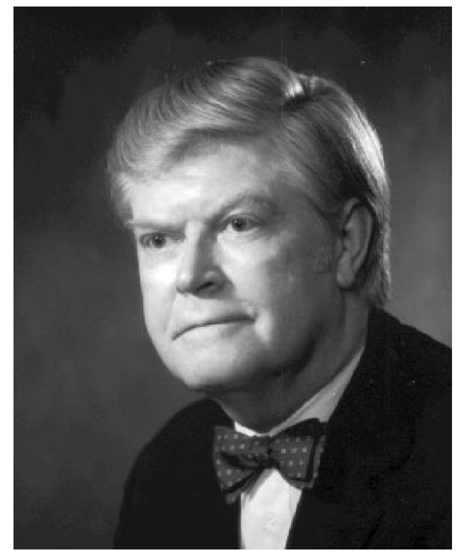
A Again, we can make major progress by joining forces and cooperating with the other societies. It is vitally important that we each not try to reinvent the wheel. The APS derives a very substantial fraction of its income from its publication activities. It is not clear yet how we can make the transition to electronic publication while retaining the kind of income that will be required to provide many of the other services that our members have come to expect. It is also not clear how we will maintain the quality and archival aspects of electronic publishing. Change is inevitable, but it is essential that we do it in an effective, coherent way, to achieve minimum upheaval and maximum benefit to the scientific community.

***Q** Does this emphasis on improved communication also apply to the international activities of the Society?*

A Just as there is tremendous advantage in cooperation across the scientific frontier within the U.S., there are also many potential advantages to improving our communication and cooperation with the international scientific community. The logical place to start is with the other physical societies worldwide. I'm very enthusiastic about a meeting that we are planning for October 1997 that will bring a substantial fraction of the major physical societies together in Washington to discuss some of the issues we all face. These include such topics as education, support for research, electronic publishing, and general cooperation and communication, particularly as it relates to the use and availability of major facilities. Irving Lerch, our senior officer in charge of international affairs, is already doing outstanding work with the international community.

***Q** Physics and science in general have become very fragmented, but there now seems to be a trend towards pulling those various disciplines together, with much more emphasis on interdisciplinary research. Is this likely to continue?*

A Yes. In a very large fraction of cases, the most interesting research and the important discoveries are going to come in the interfaces between the traditional disciplines. The historical traditions of academic departments and of federal agencies have made communication and cooperation more difficult than necessary across departmental boundaries. For example, try to get someone actively involved in interdisciplinary research a tenured position at a university. The general attitude encountered is that, if the individual was 'really' a physicist or chemist, he would have worked full time at it rather than fooling around with other departments. This is a totally outmoded approach, and the APS can play a



leading role in changing it.

It's also true that coming out of the War years physicists played a substantial leadership role in the overall scientific community. That's no longer true. For example, on the Bush Council of Advisors on Science and Technology (PCAST), we had a very wide array of disciplines, and that is as it should be. It is very important for us to be talking to the biologists, chemists, geologists, astronomers, and all the other folk who are going to be playing much more important roles in the future in leading the scientific community of this country.

***Q** In your candidate's statement you spoke of an erosion of the public trust in science since the Vietnam era, whereas in the decades immediately following World War II scientists were seen as saviors who helped us win the war. Is there a specific reason why the image of science seems to have suffered so badly?*

A The problem is that much of our citizenry find it difficult to distinguish between science and technology. Technology acquired a bad name during the Vietnam period, and always is seen by much of the public with a mushroom cloud in the background. Sometimes science gets a bit of the backlash. Fundamentally, however, we can trace most of the difficulties back to the unwillingness of scientists to pay enough attention to the importance of explaining to the public what they were doing, how they were doing it, and what its consequences would be. After all, we work for the taxpayers and we have a responsibility to account to them in ways they can understand. Nevertheless, it is important to recognize that in poll after poll taken within the past few years, over 80 percent of the American public has responded positively to the kind of question that asks, "Would you support fundamental research even if there was no obvious utility for that research apparent?"

***Q** Is this lack of understanding also indicative of the poor state of science education in the U.S.?*

A We are in a very paradoxical situation. Our graduate education is the best in the world, as evidenced by the large number of foreign students who come to this country for graduate education. Students vote with their feet. In 1990 the number of foreign doctorates in engineering awarded by U.S. universities was over 50 percent. In 1994, the number of

(Continued on page 3)

Corrections

In the article on the 1996 Nobel Prize Winners in Physics and Chemistry (December 1996 *APS News*), we incorrectly identified Dr. Robert F. Curl as "Richard". Our apologies to Dr. Curl for the error. In addition, we note that all three chemistry Nobel recipients [Carl, Kroto, and Smalley] won the 1992 APS New Materials Prize.

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Bromley (continued from page 2)

doctorates in mathematics and computer science to foreign candidates was over 50 percent, and the number of foreign graduate students in agriculture is presently approaching 50 percent. However, our problem has not been too many foreign students, but too few American students.

However, at the undergraduate level, we're the only developed nation that doesn't have standards for what constitutes a college education. Thus, we have some institutions that provide education far beyond world standards in quality, and a very large number that provide an inferior education. We used to think that on the average we were competitive with the rest of the world. However, in March 1996 the National Association of Scholars looked at 50 of our leading universities and found some very sobering statistics suggesting that we can't become complacent about the quality of college education in this country.

The precollege level is enormously important for the sciences, mathematics and engineering, because people in these areas make their career decisions typically in the middle grades, and if we've lost them at that point, we've lost them permanently. This poses a particularly serious problem in the case of women and minority group members. That is why I think that the education summit in 1989 was so important in alerting the nation to the real crisis that exists in precollege education, and why the APS education programs are critically important. There is no problem facing the U.S. that is more serious than bringing our overall educational system back to excellence. Money is not the problem — we spend around $700 billion a year on education — it's how we spend it.

***Q** Is the influx of foreign graduate students likely to continue into the next century?*

A We're going to have to recognize and cope with the fact that the number of foreign students is going to decrease substantially in the future. One reason is that their home countries are increasingly recognizing that the U.S. is benefitting from a brain drain; we are picking off some of their brightest young people, to our advantage. That's not going to be allowed to continue. These countries are realizing that they have to develop infrastructure at home that results in attractive career opportunities for these bright young people. Secondly, last summer the U.S. Immigration and Naturalization Service substantially tightened the restrictions on admission of foreign scholars and students, I regret to say in part because of pressure from Americans who didn't want the increased competition.

***Q** Is it true that it's not so much that there are no job opportunities, but there are not the same traditional opportunities available for Ph.D. physicists, and they are increasingly required to be interdisciplinary and inventive in their career choices?*

A To a significant extent, the problem has been that faculty members like myself have allowed the career horizons of our students to narrow substantially, such that students have the impression that if they don't clone their professors' laboratory lifestyles and careers, they are really second-class citizens. This lack of understanding of the opportunities, challenges and rewards of career trajectories completely outside of academia is something that we must combat.

Far too many faculty members also feel that their responsibility to students ends at commencement. That is clearly unacceptable. Having a senior faculty member work to assist a student in finding an attractive position can make a difference of between five to ten years in their career pattern. We must educate our faculty about the importance of their responsibilities after graduation, as well as giving an honest evaluation of the career situation at the very beginning of their relationship with students.

MEMBERS IN THE Spotlight

- Mildred Dresselhaus, an Institute Professor of electrical engineering at MIT and former APS president, assumed the presidency of the American Association for the Advancement of Science in January. She identified three major areas on which she intends to focus her efforts as AAAS president: (1) interesting young people in science and improving scientific literacy; (2) encouraging young physicists in today's tight job market; and (3) further educating the scientific community about the federal budget process. She is a recipient of the National Medal of Honor, and also founded the highly successful MIT's Women's Forum in 1970 to support the careers of women in science and engineering at the Institute.

- Diola Bagayoko, a physics professor at Southern University in Baton Rouge, Louisiana, and APS member, was one of 10 individuals awarded the first annual Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring in September 1996. He was recognized for his contributions to encouraging minorities to earn degrees in these fields. The White House established the awards as a strategy to achieve the goal of developing a pool of highly trained scientists and engineers that reflect the nation's diverse population. Bagayoko's belief in the effectiveness of mentoring has influenced his approach as director of the university's Timbuktu Academy, an undergraduate research program that has been nationally recognized for its outstanding achievements in mathematics, science and engineering education.

- Dean Zollman, a professor of physics at Kansas State University (KSU), was named 1996 Professor of the Year at a research and doctoral university by the Carnegie Foundation for the Advancement of Teaching. The national award includes a $5,000 cash prize and certificate of recognition. Zollman received his Ph.D. in physics from the University of Maryland, College Park, in 1970, and promptly joined the faculty of KSU. He was recognized for his contributions to teaching physics using a variety of new methods — including film, interactive videotapes, and CD-ROMs — to provide students with hands-on experience to help them understand how physics plays a role in everyday life.

- In December, President Clinton named 60 young, independent researchers — nine of them APS members — to receive the first annual Presidential Early Career Awards for Scientists and Engineers (PECASE). The APS members honored are Eric Cornell of NIST; Andrea Bertozzi, Duke University; Peter Sercel, University of Oregon; Shenda Baker, Harvey Mudd College; John Hill, Brookhaven National Laboratory; Michael Smith, Oak Ridge National Laboratory; Juan de Pablo, University of Wisconsin, Madison; Marilyn Gunner, City College of CUNY; and Charles Marcus, Stanford University. Created last spring, the awards recognize demonstrated excellence and promise of future success in scientific or engineering research, as well as the potential for eventual leadership in their respective fields. Candidates are nominated by agencies across the federal government and recipients receive up to $500,000 over a five-year period to further their research. "From the ranks of these outstanding young researchers will come tomorrow's leaders in science and technology, our university faculties, and our Nobel laureates," said John Gibbons, Assistant to the President for Science and Technology. "The talents of these young professionals will create the world of the 21st century."

1996 DFD Meeting (continued from page 1)

correctness and completeness of numerical solutions, as well as comprehending numerical results, using the example of the dynamics of a two-dimensional cylindrical wake flow.

Computational Aeroacoustics

Computational aeroacoustics (CAA) involves the numerical simulation of the generation and radiation of sound by unsteady flows. Noise predictions prior to the advent of high performance computers were based on acoustic analogies, which are not readily applicable to problems with complex geometries. Initially the CAA technique was applied to the development of algorithms for discretization and boundary treatments. More recently, scientists at Penn State University have attempted to apply CAA methodologies to more practical problems, necessitating the use of parallel computers to adequately produce the three-dimensional unsteady simulations.

Purely Elastic Instabilities

Purely elastic instabilities in viscometric flows are instabilities that are present in the absence of fluid inertia, because they occur solely as a result of the elasticity of the flowing fluid. Research activity in this area has burgeoned over the last decade because these flow instabilities have practical implications for rheometry. Scientists at Stanford University have demonstrated that such work also has application in understanding new instabilities in nonviscometric flows as well, using local linear stability analysis to theoretically suggest that flow is inelastically unstable for all eccentricities. The Stanford team then conducted flow visualization experiments of the viscoelastic flow between eccentric cylinders, using a solution of high molecular weight polybutene dissolved in a viscous solvent. A related study examined the occurrence of the phenomenon in recirculation flows.

Flow-Induced Microstructures

Researchers at Cornell University have concluded that flow-induced microstructure has a strong influence on the rheology of suspensions of non-Brownian fibers and thermal, electrical and mechanical properties of injection-molded composite materials. Donald Koch and his colleagues applied slender-body theories and simulations to describe the hydrodynamic interactions among the fibers, as well as to predict their properties. They then investigated the dynamic evolution of the microstructure during flow, finding that at modest concentrations, fibers change their orientation due to hydrodynamic interactions mediated by the fluid. At higher concentrations, direct mechanical contacts among the fibers control both the microstructure and the thermal and rheological properties of the material.

Paths to Transition in Open Flow Systems

With minor exceptions, transition to turbulence in open flow shear layers is forced by external disturbances which enter the system across the inflow and lateral boundaries, according to Eli Reshotko of Case Western Reserve University. In turn, the shear layers respond by converting these environmental disturbances into internal disturbances by a receptivity process which filters forcing motions. Reshotko found that the phenomenon of transient growth is also subject to such a process, leading to numerous transition scenarios dependent on the nature and intensity of external disturbances penetrating the system.

On Tuesday afternoon, Robert Kerr of the National Center for Atmospheric Research in Boulder, Colorado presented numerical evidence consistent with analytic bounds on singular behavior in the three-dimensional incompressible Euler equations, extending the finding to viscous, turbulent dynamics. According to Kerr, in viscous flows the properties of the antiparallel vortex interaction calculations which show singular behavior can be used to identify the three steps by which full-developed turbulence might form from smooth initial conditions. While admitting that taken alone, none of the flows he cited as examples approach the Reynolds numbers needed for convincing evidence, he noted that in each case he observed (1) formation of vortex sheets and suppression of singular behavior, followed by (2) a strong increase in peak vorticity, and finally (3) a peak in enstrophy.

Fluid Dynamics in Physical Oceanography

On Monday afternoon, Jack Whitehood of the Woods Hole Oceanographic Institute reviewed current research in the fluid dynamics of physical oceanography. "The ocean is the most massive fluid body in contact with human kind, and understandably its behavior covers an immense range of length and time scales," he said, adding that the largest and longest time scales are linked to ideas about the ocean's evolution. While research indicates that scales governing temperature and salinity and heat transfer laws may play a role in climate issues, more work needs to be done in this area, as well as in research on eddy flux mechanisms, which are only partly understood.

According to Whitehead, much is known about the ocean's general circulation. Vorticity conservation laws govern a rotating spherical shell of water, and these are also manifest in today's oceans. Large boundary layer currents are found the western sides of basins and at the equator, and wind and driving have been observed to result in circulation patterns, ventilated regions, and constant potential vorticity gyres. At shorter length and time scales, fronts, jets and mesoscale eddies are numerous, balanced between rotational and inertial effects, as well as the possibility of friction, dissipation and mixing.

OPINION

APS VIEWS

Physics Anniversaries at Spring APS Meetings

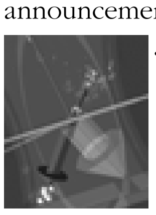
by Michael Scanlan, Manager, APS Meetings Department

Meetings Manager Michael Scanlan wallowing in about 5,000 March Meeting abstracts.

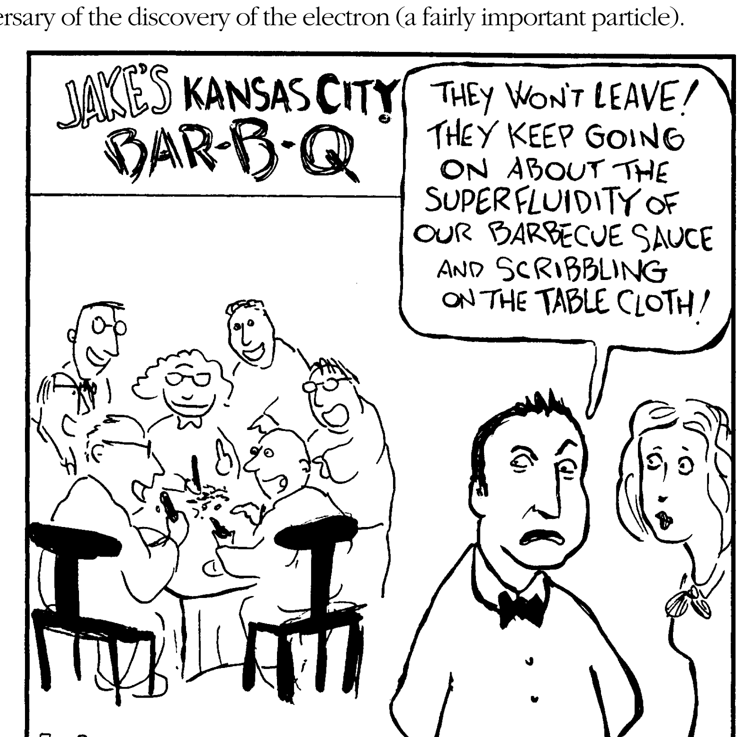
Within a month of each other the presentations at the two General APS Meetings will have touched on virtually every discipline currently in the lexicon of physics. There will be almost 6,000 talks covering everything from defects in silicon to accelerator design, from the 100 year anniversary of the discovery of the electron to the 50 year anniversary of the invention of the transistor, from new top quark results to galactic motion, from environmental physics to the possibility of life on Mars. And there will be physicists. Lots and lots and lots of them. Progress in research across the country may be seriously impaired during these events. But only briefly.

It has been observed that the growth of physics has made it impossible to keep current in the whole field. Indeed, it may not be possible to be familiar with even a large fraction of it. If one were to sit through each of these meetings, attending a talk whenever one was available, one would still only see two percent of the programs. This, of course, would leave no time to renew old acquaintances, make new ones, discuss what you've heard, get lunch, call the office, or even present your own talk.

Nobel Prize Winners to Speak at 1997 March Meeting — The March APS Meeting is, in all probability, the largest physics meeting in the world, with an anticipated attendance of 5,000. This year it will be held 17-21 March in the Kansas City Convention Center. Among those scheduled to speak at the meeting are Nobel Prize in Physics winners Robert C. Richardson, Douglas Osheroff, and David Lee, who received the prize in 1996 for their discovery of superfluidity in He^3. At this writing, it appears that two (Robert F. Curl, and Richard E. Smalley) of the three winners (Harold W. Kroto being the third) of the 1996 Nobel Prize in Chemistry will also be speaking. They were awarded the Nobel for their discovery of fullerenes (C^{60}). The APS had previously awarded the International Prize for New Materials to the trio in 1992, cleverly anticipating the Nobel committee. There will also be a special session on the 50th anniversary of the transistor. The complete program of the 1997 March Meeting is now available on the APS Home Page **(http://www.aps.org)**, under "Meetings". As usual, tutorials and short courses in a variety of subjects are offered just prior to the meeting. The housing and preregistration forms can be downloaded from the home page in a pdf format. The registration deadline is 14 February. The final announcement is in this month's issue of *APS Meeting News*.



Joint April APS/AAPT Meeting & CAM'97 with DAMOP in DC — The Joint APS/AAPT April Meeting will be truly enhanced this year as the Canadian Association of Physics (CAP), the Sociedad Mexicana de Física (SMF), and the APS Division of Atomic, Molecular, and Optical Physics (DAMOP) will join the traditional participants as the meeting returns to its former home in the District of Columbia. The meeting had successful road trip to Indianapolis in 1996, and we are looking forward to continued success with its return to Washington in 1997 with an especially unique program. The complete program should be available on the APS Home Page**(http://www.aps.org)** by 14 February. There will be an increased emphasis on programming from our neighbors both to the north and south. An international reception for all meeting attendees will be held at the Smithsonian Institution Saturday evening. DAMOP will be holding its annual meeting in conjunction with the Joint Meeting, so we anticipate a record turnout. The program represents a broad spectrum of physics disciplines and an opportunity to hear physics outside of one's specialty, including nuclear physics, particles and fields, astrophysics, chemical physics, instrument and measurement science, few body systems, computational physics, plasmas, beams, fundamental constants, gravitation, and applied physics. There will be a special Tri-Divisional Colloquia on the apparent fossil evidence of life on Mars. The APS Forums will also be providing programing in the areas of physics and society, education, international physics, and, especially the history of physics, this year being the 100th anniversary of the discovery of the electron (a fairly important particle).



LETTERS

Horgan's Arguments Require Closer Examination

I would like to argue emphatically against the point of view advocated by John Horgan in his BACK PAGE article, "Is Science a Victim of its Own Success?" (*APS News*, December 1996). In fact, it is a myth that string theories or ideas formulated at the Planck scale cannot be tested.

We do not have to be able to do an experiment directly at some small distance scale or high energy scale, or be there when something happened, to test a theory in normal scientific ways. We can test the big bang theory of the universe by quantitative study of its predictions that the universe is expanding, that certain abundances of nuclei should be observed throughout the universe, that the microwave background radiation left over as the universe cooled should have a certain temperature and power spectrum, and so on, even though we do not recreate the conditions of the big bang in the laboratory. We can test hypotheses about how dinosaurs became extinct 60 million years ago even though we were not there. Similarly, we can test the existence of forces that only act over Planck scale distances because they might induce decays forbidden by the Standard Model of particle physics, such as proton decay or decays that violate conservation laws. It is also a test of such theories if they explain previously unexplained results, such as quark or lepton masses, or CP violation. Many more examples could be given if there were more space; however, as it happens, an article by me will be published in the February 1997 *Physics Today* that contains further examples.

It is important to examine Horgan's arguments a little further. He discloses his intentions early in the article by the use of the word "narrative," and then "modern myth" to describe the results of science. The results of science are not narratives or myths, because they require systematic testing before they are accepted.

As far as the topics covered in his article are concerned, he is simply incorrect that string theory or questions about the origins of the universe are not testable. We don't yet know what the outcome will be, or whether physics can explain such questions, but the tests are there.

The book by Horgan presents his views as the consequences of interviews with distinguished, often older and famous, physicists. Only one of them actually does research in string theory, and he certainly believes it is testable, but probably did not have such arguments at his fingertips. Perhaps it is not surprising that Horgan formed his views, particularly since some distinguished physicists have stated such views. But it is sad that he did not turn his narrative into something closer to science and to the truth by talking with more people who could explain why he was wrong. Particle physics and cosmology may end because the questions do get answered and tested, but they will not end because possible answers cannot be tested.

Gordon Kane
University of Michigan, Ann Arbor

In John Horgan's article, "Is Science a Victim of Its Own Success," he quotes Richard Feynman as saying, "The age in which we live is the age in which we are discovering the fundamental laws of nature, and that day will never come again." However, in Feynman's provocative essay, "The 7 Percent Solution," he says, "Since then I never pay any attention to anything by 'experts.' I calculate everything myself." In the first quotation, Feynman is speaking as an "expert," whereas in the second, he is speaking as a practicing scientist, par excellence. The moral for practicing scientists is that they should not pay any attention to that first quotation, but pay close heed to the second quotation. A fortiori, they should not pay any attention to what John Horgan is saying, either.

F.R. Tangherlim
San Diego, California

Mr. Horgan seems to believe that much of the research being done in particle physics today, and particularly in string theory, can never be given a firm experimental standing. His thesis rests on the fact that physicists may never be able to do experiments at the Planckian energies needed to observe elementary string quanta.

While it is true that elementary strings are probably out of reach, there are low-energy predictions of superstring theory that physicists hope to verify in the next generation of particle accelerators. Foremost among these is supersymmetry, the search for which is one of the primary goals of accelerators in the U.S. and abroad. The discovery of any of the supersymmetric partners of the known particles would be a great hint in the direction of superstrings and would provide a unique framework for studying Planck-scale physics with Fermi-scale experiments.

Besides the search for low-energy supersymmetry, there is an active program to search for proton decay as predicted by superstring theory. The strong overlap with cosmology has led to a great deal of excitement in the particle physics community over the plethora of data that is coming now, and in the near future, on cosmic microwave background anisotropies. Theoretical work in superstring theory has shown promise in providing an explanation of fermion masses, and can even address the solar neutrino problem. And the list of experimental issues addressed by string theory goes on from there.

Mr. Horgan believes that questions such as "Why is there something rather than nothing?" will never be answered by physics.

History and common sense are not on the side of those who expect, or require, a single definitive experiment which once and for all verifies or rules out superstring theory. Few of the major advances in science (including special and general relativity, quantum mechanics, and the Standard Model) were accepted as the result of any one experiment; instead the evidence in their favor emerged slowly from a patchwork of indirect tests which, when taken together, formed a complete picture. Such is the experimental program for testing superstring theory.

I share the belief held by many physicists today that we are standing at a new threshold in our understanding of the

(Continued on page 5)

OPINION

Recognizing the Importance of Undergraduate Science Education

by Robert C. Hilborn

In any discussion of undergraduate physics education, it is important to emphasize its connections with other levels of science education, as well as other aspects of the fourfold scientific enterprise encompassing science, mathematics, engineering and technology. In my thinking about the subject, there are four numbers that I believe dominate all considerations: 24 percent, 3 percent, 15 percent and 40 percent. Let me explain what these percentages represent.

Only 24 percent of high school students currently take some form of high school physics, compared to about 54 percent who take chemistry, and 93 percent who take biology. Even with the most optimistic estimates, this means that fewer than half of the students entering college have any background in physics. The implications for all college science courses are ominous. Many of the students will be innocent of basic physical principles such as conservation of energy and momentum. They will lack the sharp problem solving and math skills that are often honed by physics courses, and their knowledge of electricity, magnetism and simple circuits will be close to zero.

Only 3 percent of the students who take calculus-based introductory physics in college go on to take another physics class. If we include those taking algebra-based physics, the number is even smaller. This illustrates the dilemma of how to balance the need to prepare potential majors with the need of students who will have careers in other fields.

The final two percentages apply to the Ph.D. end of the physics educational pipeline, but have direct relevance for undergraduate physics education. Less than 15 percent of the Ph.D.s in physics in the United States go to women and minorities. That deeply troubles me as a physicist, a physics teacher and as a human being. Physics, as well as society as a whole, cannot afford to continue to let that much of the nation's talent fail to see physics as a viable career path, or to find themselves unwelcome in physics.

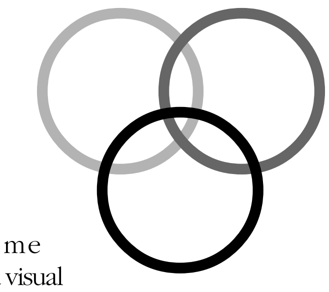
Forty percent is the fraction of Ph.D. physicists who take career positions in academia or conduct basic research in industry and the national laboratories; 60 percent go elsewhere for employment. Yet most undergraduate programs and nearly all the Ph.D. programs focus solely on preparing for a career in basic research with almost no attention paid to what in fact most physics Ph.D.s actually do for careers. To exacerbate matters, public recognition and prestige focus on graduate education and basic research to the detriment of teaching and to careers outside academia and basic research.

I don't wish to downplay the importance of research, both as an intrinsic good and as an equal partner with classroom teaching in both the graduate and undergraduate physics enterprise. But I do wish to point out a widespread and ultimately unhealthy bias against what myopic academic physicists have called "non- traditional careers."

Now let me turn to the question of fostering and implementing science education reform. The American educational system is not a monolith. That is both a strength and a weakness, but it is a fact. It requires programs to encourage both small-scale innovations that may later grow into major national reforms, and also broad initiatives, like the calculus reform movement, that can directly effect systemic changes. Programs like NSF's Instructional Laboratory Improvement program, although modest in scale, have acted as crucial catalysts for curriculum development and improvement at the local level.

Another fact: the financial and educational needs of public colleges and universities can be quite different from those of private institutions. Those public institutions with only bachelor's or master's degree programs are under particularly acute stress. Generally their financial resources are more constrained than those of research universities or private institutions, but their ambitions are just as high. All of us will need to be creative in finding a diversity of programs to match the diversity of American higher education.

A final point: education does not end with the awarding of a degree. Science educators and scientists in general need to be concerned with continued outreach to the general public. Investments in everything from traveling demonstrations for schools, to science and technology museums and TV shows will all pay enormous dividends in the public's awareness and appreciation of science.



Let me close with a visual demonstration that illustrates the underlying theme of many of my remarks (see figure). The three interlocking loops are in a configuration called the Borromean Rings, named after the Borromeo family of northern Italy in whose coat of arms they appear. One ring represents undergraduate science education, which is closely linked to the second ring, representing pre-college science education, as well as the third ring, which represents graduate education and research. They are closely intertwined, with considerable overlap. But there is an unusual feature to the Borromean ring configuration, which is shared by the enterprise of science education: If any one of the rings breaks, the entire complex falls apart. It is a vivid warning to anyone who believes that we as a nation do not need to pay serious attention to undergraduate science education.

Robert C. Hilborn is the Lisa and Amanda Cross Professor of Physics at Amherst College in Massachusetts and past-president of the American Association of Physics Teachers. This article first appeared in the Spring 1996 issue of the APS Forum on Education newsletter.

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fundamental laws of Nature. And while there may be some eventual limit in our ability to probe and understand Nature, I see no reason to believe that we have already arrived at that final stop in our journey. Rather, I believe that all of the available evidence points to a renewed era of discovery in the coming decades. It would be a shame if articles such as Mr. Horgan's, promulgated by our very own professional society, discouraged the next generation of physicists from participating in those advances.

Christopher Kolda
Institute for Advanced Study
Princeton, New Jersey

Critical Thinking & Science Literacy are not the Same Thing

I was pleased to see the article "An Alien Ate my Laundry: The Decline of Reason in the Age of Science" by James C. Garland ("The Back Page," November 1996). It was a very interesting and thought provoking article. One thing I thought it lacked was a clear distinction between critical thinking and scientific literacy.

For example, the article implied that if the woman whose laundry was "eaten" was scientifically literate she would not have come to that conclusion. I don't think scientific illiteracy is entirely to blame for the widespread belief in paranormal phenomena. In this case, it isn't necessary for the woman to know Newton's laws or any other science facts. What she needs to know is how to come to a conclusion based on evidence. Square holes in sheets are not evidence for the existence of extraterrestrials. This is critical thinking, not scientific literacy.

Since critical thinking can be taught in any class, the popularity of paranormal beliefs is a failure of all parts of the education system, not just science education. However, we physicists have a special role to play in educating the public since many paranormal claims directly contradict established laws of physics. It is up to us to teach not only the steps one follows to solve a problem but also the critical thinking skills students need to apply physics facts to their daily lives.

The article gave the impression that there is little we can do to fix the problem and that we are doing our part. It said, "The problem will not be solved if it is only the educators and scientists who wave their arms in despair." Is that what we're doing? Can we do more? I think we can. First we need to educate ourselves about the common paranormal beliefs. I strongly recommend both the Skeptical Inquirer and Skeptic magazines. Then we need to explain why these beliefs are wrong. Professors can include these subjects in their lectures or even start a new class (Physics and the Paranormal 101, perhaps). The rest of us can influence friends and relatives, write to TV stations and newspapers who encourage these beliefs, or teach classes for the local community education program. If we scientists don't encourage "reason in the age of science" who will?

Bruce Behrens
Ithaca, New York

Two-Year Colleges and the APS

A recent letter here [M. Sawicki, *APS News*, November 1996] complains that two-year-college (TYC) physics teachers are looked down upon by APS members; that TYC faculty are prevented from applying for DOE and NSF research grants; and that these conditions make TYC physics teachers drop out of the APS. The letter proposes that the APS form a topical group for TYC physics teachers.

I have taught at a two-year college for 26 years, and have been a member of the APS all that time; my last *Physical Review* publication was in 1991. My experience has been the opposite to Sawicki's in every way. University researchers have always been friendly and hospitable. Three different DOE-funded facilities have generously supported summer visits. The NSF funded a summer Research Opportunity Award and is currently evaluating a research proposal of my own.

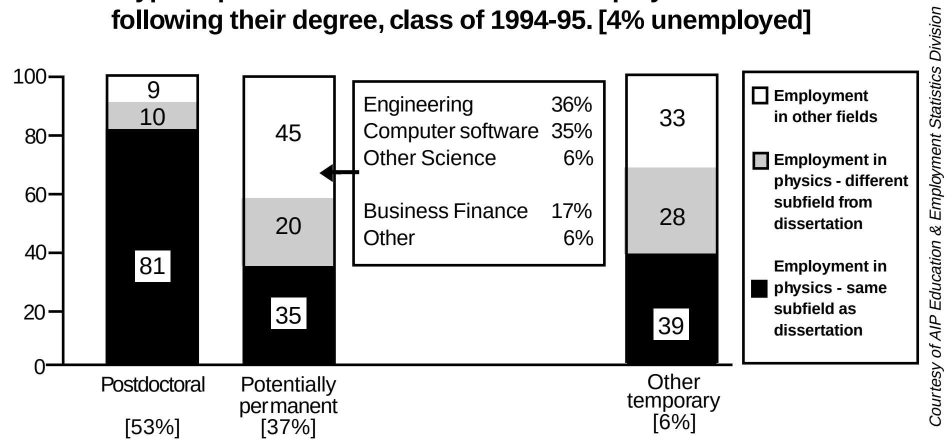
At least in the research area, people and organizations have always seemed to make an extra effort to help people from two-year colleges. Also, the TYC teachers I know who dropped APS membership had simply lost interest in research. A support group for TYC physics teachers called "TYC21" has recently been founded by the American Association of Physics Teachers (AAPT) [http://www.aapt.org/programs/tyc.html]. TYC21 intends to alleviate the isolation expressed by Sawicki.

Young physicists may encounter a culture shock on first arriving at a TYC. If they stay, they may find that compared to teaching 18-to-22 year-olds, it is a great pleasure to teach young adults living in the real world. TYC teachers can keep up research if they really want to. Theory is easiest, but a biology colleague of mine studies whales.

John H. Connell
Springfield, Massachusetts

FACTOID

Ph.D.'s type of position secured and field of employment in the winter following their degree, class of 1994-95. [4% unemployed]



Courtesy of AIP Education & Employment Statistics Division

Constitutional Amendments *(continued from page 1)*

ond oldest division in the APS, is about to be the first unit to cross that threshold downward. DHPP is a small but exceedingly active APS group for its size.

A 1992 Council motion called for periodic review of the value of X, and accordingly the issue was raised at the May 1996 Council meeting. DHPP Councillor Andrew Lovinger spoke on behalf of lowering the downward threshold so that his division and several others hovering near the same threshold, such as the Division of Biological Physics [see graph], would retain divisional status and Council representation. Following discussion, Council voted to ask the Committee on Constitution and Bylaws to consider the issue, and the committee outlined its solution in a report at the November 1996 Council meeting.

The Committee recommended amendments to the APS Constitution lowering the threshold for relegation. After some discussion, the Council agreed that the threshold for loss of a single Councillor or Council representative should be lowered to 0.7X%.

Council was concerned that having the threshold for relegation the same as for acquiring the first Councillor could lead to instabilities, as a group oscillated between one and zero councillors. A lower threshold for relegation would avoid this. Therefore, the Council voted to propose to the membership a group of Constitutional amendments that would change the threshold for loss of a single councillor or Council Representative, to 0.7X % of the APS membership. "Council liked the idea of damping the instability caused by having the up and down thresholds the same," said Miriam Forman, Chair of the Committee on Constitution and Bylaws. The Committee supports the amendments as proposed by Council, viewing them as a simple and conservative long-term solution which leaves intact all the excellent features of the X system of representation on the APS Council created by the Constitution of 1991.

Comments on the proposed amendments to the Constitution and Bylaws, as outlined in the accompanying box, should be sent to Amy Halsted, APS, One Physics Ellipse, College Park, MD 20912-3844; email: halsted@aps.org; comments must be received before the 19 April 1997 Council meeting.

TEXT OF PROPOSED AMENDMENTS

Language proposed for deletion appears in ~~strikeout~~; new language appears in **bold**.

CONSTITUTION:

Article VIII - Establishment of a Division, Topical Group, or Forum

1. Organization. -…If the membership of a Topical Group exceeds X percent of the total membership of the Society for two consecutive calendar years, it shall become a Division following application to and approval by Council. If the membership of a Division falls below ~~this size~~ **.7X%** for four consecutive years, it shall revert to the status of a Topical Group…If the membership of a Forum falls below ~~this size~~ **.7X%** for four consecutive years, it shall lose its Councillor…

Article IX - Establishment of a Section

1. Organization. - …If the membership of a Section exceeds X percent of the total membership of the Society for two consecutive calendar years, it shall qualify to have one nonvoting advisor on Council. If the membership of a Section falls below ~~the size specified in the Bylaws~~* **.7X%** for four consecutive years, it shall lose its Council advisor…

*In fact, no such size is presently specified in the Bylaws.

BYLAWS:

Article I - Composition of Council

…When the ratio of a Division membership to the total APS membership falls below *NX***%** (with *N* greater than 1) on 31 December, the Division shall lose the Councillor(s) whose term(s) next expires, when that term ends. When a Division or Forum membership ratio drops below ~~X~~ **.7X%** for four consecutive years, the Division or Forum shall lose its remaining Councillor(s) on 31 December of the fourth year.

Highlights from 1996 DPP Meeting *(continued from page 1)*

experiments at Los Alamos National Laboratory indicate that ion-driven parametric instabilities, which affect the propagation of the laser through plasmas, are prevalent in many ICF plasmas.

However, most particle-in-cell (PIC) algorithms are either incapable of simulating the actual physics behind the phenomenon, or computationally inefficient. So an LANL team of scientists have developed a 3-D hybrid PIC code written for the massively parallel CRAY-T3D platform. "We believe HERCULES is the first PIC computational tool capable of simulating low-frequency ion- driven parametric instabilities in a large, 3-D plasma volume, and offers a unique opportunity for examining issues that are potentially vital to ICF," said LANL's H.X. Vu of the new code.

ICF Laser Imprinting

In direct-drive ICF, in which laser light impinges directly on the ICF pellet containing the fusionable material, nonuniformities in laser illumination seed ripples at the ablation front in a process known as "imprinting." These nonuniformities grow during the capsule implosion and can penetrate the capsule shell, impede ignition, or degrade burn. Scientists at Lawrence Livermore National Laboratory have developed a novel technique for studying the imprint of a direct-drive laser beam on a thin foil, using an x-ray laser as a backlighter. This technique allows the LLNL team to measure small variations in the foil thickness, and in turn to measure modulations due to imprint.

Researchers at the Imperial College in London, England, have developed a novel direct-drive smoothing scheme called foam buffered direct drive which substantially reduces initial non-uniform imprinting. The foam plasma helps to smooth out any laser drive structure.

ITER Physics

The International Thermonuclear Experimental Reactor/Engineering Design Activity (ITER/EDA) is a joint project of the European Union, Japan, the Russian Federation and the U.S. to carry out the engineering design of a reactor-scale tokamak capable of producing 1 to 1.5 GW of fusion power. According to John Wesley of the ITER Joint Central Team, it is expected to be the principal facility for fusion research for the period 2010-2030. It is being designed to be capable of conducting comprehensive physics studies of reactor-regime plasmas, and to reliably produce the fusion power level and burn duration needed for testing of reactor components at appreciable neutron fluence.

Many key issues concerning ITER's design still require work. Understanding the scaling and effect of plasma turbulence on ITER's performance is being vigorously pursued. Physicists must also find a method for producing plasma conditions with acceptably low peak heat loads.

Laser Plasma Astrophysics

Recent radio and x-ray observations of supernova SN1987A provide evidence for the shock interaction with an ionized region created in the dense plasma wind from a previous evolutionary phase, according to Roger Chevalier of the University of Virginia. The supernova's proximity "gives us an unprecedented opportunity to observe the development of the supernova shock wave as it interacts with mass lost prior to the explosion," he said, adding that the ionizing radiation from the progenitor star probably played an important role in shaping the supernova environment. In the case of another nearby supernova, SN1993J, dense gas was present close to the explosion, giving rise to a cooling shock wave and radiative phenomena at an early phase. Experiments simulating astrophysical shock conditions are being performed in high intensity laser plasma experiments at NRL and LLNL.

Magnetic Reconnection

The MRX magnetic reconnection experiment at Princeton Plasma Physics Laboratory was constructed to investigate the fundamental physics of magnetic reconnection. PPPL's Masaaki Yamada reported on some of the results on Thursday evening. The initial experiment measured a two-dimensional profile of the neutral current sheet layer in which reconnection occurs and the relationship between the reconnection rate and plasma conditions, such as the merging angle and plasma conductivity.

Cold Antimatter

Recent successes in confining antimatter in the form of positrons and antiprotons have created new scientific and technological opportunities, according to C.M. Surko of the University of California, San Diego, who described work by recent groups on trapping antimatter plasmas. Surko's group is studying the physics of electron-positron plasmas, considered relevant to astrophysical processes, as well as the interaction of an electron beam with a trapped positron plasma, and the interaction of cold positrons with atoms and molecules. In addition, scientists at CERN have succeeded in accumulating and cooling large numbers of antiprotons.

According to Surko, the ability to produce and trap cold antihydrogen atoms will enable precise comparisons of the properties of matter and antimatter, including tests of CPT invariance and the measurement of gravitational masses. Other scientific and technological uses of cold antiparticles include the transportation of antimatter plasmas in portable traps; the possible reflection of positronium or antihydrogen atoms from material surfaces at low temperatures; and potential medical uses of antiprotons.

Plasma Applications

Inductively coupled plasmas (ICPs) have been re-discovered by the multi-billion-dollar semiconductor industry as an important class of high-density, low-pressure plasma sources suitable for the manufacture of next-generation integrated circuits. However, according to M. Tuszewski of Los Alamos National Laboratory, the approach is still prohibitively expensive for upcoming 300-mm diameter wafers. There is an urgent need for basic ICP plasma research, such as experimental characterization and predictive numerical modeling. "Inductive radio frequency (rf) power absorption is fundamental to the ICP electron heating and resulting plasma transport, but remains poorly understood," said Tuszewski by way of example.

Photocathode-driven free electron lasers (FELs) are proving extremely attractive for material processing applications, according to Alan Todd of Northrop Grumman. These include broad-band tunability across the infrared and ultraviolet spectra; high peak and average radiated power for economic processing in quantity; and high brightness. The most promising areas for application are in polymer, metal and electronic material processing, micromachining and defense applications. Unfortunately, although the usefulness of the process has been proven, the power levels and costs of lamps and lasers do not yet scale to production margins, Todd reported.

Education and Outreach

The third annual Science Museum Open House was also a highlight of the DPP meeting, intended as a means of reaching out to the community to share the exciting challenges of plasma science and fusion. In addition to Thursday evening lectures on plasma science, several industrial exhibitors, laboratories and universities set up displays for the general public, primarily hands-on and interactive. In addition, the conference featured a special Science Teacher's Day focusing on the science and technology of plasmas and plasma applications, with an emphasis on fusion energy, co-sponsored by the DPP, APS, and General Atomics.

NEW NSF/DOE PARTNERSHIP IN BASIC PLASMA SCIENCE AND ENGINEERING

This is a joint funding initiative supported by:

NATIONAL SCIENCE FOUNDATION - Directorates for: Engineering, Geosciences, Mathematical and Physical Sciences, and the Office of Polar Programs

DEPARTMENT OF ENERGY - Office of Energy Research.

The focus of this initiative (NSF 97-39) is to address fundamental issues in plasma science and engineering which can have impact in other areas or disciplines in which improved basic understanding of the plasma state is needed. The full announcement is accessible electronically through the NSF web page at: http://www.nsf.gov/nsf/nsfpubs/nsf9739.htm

DEADLINES: *Abstract:* February 28, 1997 — *Proposal:* March 21, 1997.

ANNOUNCEMENTS

APS UNDERGRADUATE PHYSICS STUDENT COMPETITION

1997 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 $3,000 award; finalists $1,000. They also receive an allowance for travel to the Award presentation.
- Recipients' and finalists' home institutions also receive $1,500 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 13 June 1997 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 **13 June 1997** 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 **13 June 1997** to:
Administrator, Apker Award Selection Committee
The American Physical Society
One Physics Ellipse
College Park, MD 20740-3844
Telephone: (301) 209-3221/email: ripin@aps.org

CAUGHT IN THE WEB

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

MEETINGS

- APS announces our New Abstract Tester
- Joint Spring Meeting of the Texas Section of the APS, AAPT, and the SPS
- 1997 Topical Conference on Shock Compression of Condensed Matter
- PC '97: International Conference on Computational Physics:

PRIZES AND AWARDS

- List of New Prize and Award Nomination Deadlines and Selection Committee Chairs

UNITS

- DMP Newsletter

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 nominees 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://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	**Passed**
• Chemical Physics • Computational Physics • Fluid Dynamics • Materials Physics • Forum on Industrial & Applied Physics	**02/15/97**
• Forum on History of Physics	**03/01/97**
• Physics of Beams • DAMOP (Atomic, Molecular, Optical) • Plasma Physics	**03/15/97**

UNIT	DEADLINE
• 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	**04/01/97**
• Astrophysics	**05/01/97**
• Biological Physics	**06/01/97**

APS E-Print Server

Authors, try out the new APS E-Print Server. The server is open for postings of articles in any and all fields of physics and physics education. Applied, industrial as well as basic topics are welcomed. Posting is free and accessible by colleagues world-wide through the web. Instructions for submittal or use can be found under the E-Print Server button on the APS home page [http://www.aps.org] or directly at [http://publish.aps.org/eprint/].

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Debunking Some Myths of Physics Departments, Students and Employment

by Brian Schwartz

Physics has been one of the most exciting sciences of the 20th century. Many of the revolutions in science, technology, and modes of thought have been led and influenced by developments in physics: relativity, quantum mechanics, the Big Bang theory of the universe, and quarks, the new building blocks of matter, just to name a few. Physicists have paved the way for the invention of transistors, lasers, nuclear power, electro-optical communications, magnetic resonance imaging, and much more. Since the end of World War II, after the success of American scientists in aiding the defense of the nation with the atomic bomb, the government and industry have placed a high value on physics and generously supported basic and applied research.

In the 1990s, with the end of the Cold War and fierce global competition in all aspects of high technology, the nation finds itself developing new modes and justification for science funding. It is clear that the knowledge provided by physics is in great demand and that research challenges are backed with a substantial base of government and industrial support. However, employment patterns for Ph.D. scientists and engineers are changing. There are fewer opportunities for academic positions due to budget limitations, but there are documented growing needs for flexible and broadly trained physicists in many aspects of the world of high technology and business.

There has been much written about the changing paradigms in science funding. My focus is on some of the myths surrounding physics departments, physics majors and the employment of physicists.

> ***Myth #1:** The fact that there are very few undergraduate physics majors — relative to many other undergraduate disciplines — at most universities is a clear indication that physics department faculties are too large.*

The American Institute of Physics (AIP) has collected data indicating that there are approximately 800 colleges and universities offering undergraduate degrees in physics, with about 5,000 baccalaureate degrees awarded annually — an average of six per institution. Thus, most physics departments across the nation have few physics majors. To within ± 15% this has been the situation for over 30 years. While it would be worthwhile for physics departments to make their undergraduate curricula more attractive and broadly based, it seems unlikely that, on a national level, the numbers of physics majors could be increased significantly. Even a factor increase of two would still leave physics with a small number of majors.

A much fairer yardstick for the size of the physics department faculty and necessary support should include a weighted matrix of the following factors:

1. The enrollment in introductory non-science major courses. Considerable faculty support can be generated by first-rate physics courses in astronomy, contemporary physics topics, or such specialized topics as the physics of music, physics of sports, or the physics of how things work.
2. The physics service courses for engineering, math, and computer science majors, as well as the pre-med, pre-dental and nursing majors.
3. The number of graduate students and yearly Ph.D. production.
4. The amount of externally funded grants and support it provides for undergraduate and graduate education, and the resulting quality of the research on campus.
5. The efforts of the department in education reform, research and outreach to local teachers and schools, as well as efforts to nurture and increase the numbers of physics majors who are women and minorities.
6. The involvement of the department in cooperative industrial research and the impact it has on local, as well as national, economic development.
7. The level of national recognition of the quality of the program and faculty.
8. The number of physics majors.

If such a matrix were to be applied, most physics departments would fare quite well, in spite of the relatively low number of physics majors. However, it would be important for department leaders and the faculty to develop strategies to improve their standing in each of the eight categories listed above. Each department should develop a strategic plan, in cooperation with the local administration, focusing on a matrix approach to determine appropriate size and the degree of support needed.

> ***Myth #2:** Physics majors at all levels have poorer employment opportunities than those majoring in other sciences, math, engineering or computer science.*

This myth is a partial result of the excellent and continuous data collection, interpretation and wide dissemination by AIP's Educational Employment Statistics Division. As a result, potential physics majors, as well as students in general, are aware of up-to-date and accurate information on employment prospects for physicists. Unfortunately, similar information, especially the dissemination of "hard data," is not equalled for many of the other scientifically based professions. Thus, many students have gotten the impression that the difficult employment situation for physicists is unique. This is not the case. A more accurate statement would be that demand for science and engineering talent in all fields remains tight, inasmuch as it relates to basic research in industry, government and academia.

In comparing median annual earning of bachelor degree graduates between the ages of 35 and 44 by major field of study, the December 1995 Monthly Labor Review found that among 29 professions, physics was rated fifth (the highest among all the physical and natural sciences), and was one of only five fields of study showing mean earnings over $50,000. Other degree majors from the arts or social sciences have average salaries 20 to 30% below that of physics majors. This is solid evidence that employers place a high value and premium on the physics degree.

> ***Myth #3:** There is little demand (or salary) for graduate students in physics, and thus physics graduates do not get good jobs that make use of their physics degree or advanced training.*

The oft-declared oversupply of Ph.D. physicists does not truly describe the situation. More accurately, there is an initial mismatch between the expectations of recent physics Ph.D.s for traditional jobs and the strong marketplace demands for their talents. While quality data disseminated by the physics community indicates it is more difficult to get traditional faculty or basic research industrial jobs, there is a vast marketplace for Ph.D.s in the general area of high technology, engineering, computers, business and finance. Employers are willing to pay premium salaries to gain the problem-solving skills physicists are able to apply to their companies' needs.

In past decades, there was a relative balance between the number of Ph.D. physicists produced and the traditional jobs for them in such sectors as academia, basic research laboratories, and government and national laboratories. Currently, employment opportunities for Ph.D. physicists (as well as all of science and engineering) in all three above sectors has tightened and decreased. Thus more physics students than in the past must consider — and be prepared for — nontraditional careers. It is true that some Ph.D.s who would have liked jobs in academia may have to adjust their plans, as Ph.D.s in the arts, humanities and social science have done for decades. However, with the right mindset and job search skills, Ph.D. physicists are getting excellent offers at salary levels and positions of responsibility well beyond their colleagues entering the more traditional employment sectors.

According to data collected by AIP, 96% of physics Ph.D.s are employed within six months after receiving their degree, with 53% in postdoctoral positions to further their training in research and education and 37% in potentially permanent positions. However, a detailed analysis of the types of positions secured reveals that 91% of the postdocs are employed in physics positions, compared to only 55% of those in potentially permanent positions. Further details can be found on page 5.

If one were to present the data for mean salaries of professionals with Ph.D. degrees, the market premium for physics would be similar to that of the undergraduate physics majors discussed above. During the past few years, the world of business, finance and management consulting have discovered the talents of Ph.D. physicists, and as a result many firms are specifically recruiting them to make use of their problem-solving skills, their work ethic, their ability to stick with a complex problems, and their analytical and computer skills. Unlike many other Ph.D. fields of study,

when a physicist is "forced" to take a job in business or finance, for example, instead of traditional academia, the starting salary approaches $100,000 per year and involves no typing. [See *Physics Today*, January 1997, pg. 42-46]

> ***Myth #4:** Most public universities have a relatively large number of foreign graduate students, who don't speak English well, don't get good job offers, don't remain employed in the region or nation, and return in large numbers to their native countries.*

There is presently a strong xenophobic undercurrent in the U.S. There has not been such a large influx of ethnic minorities in physics since before World War II, when many scientifically capable Jewish and European refugees fled Hitler and came to the U.S., with many making important contributions to such major projects as radar and the atomic bomb. Currently the U.S. is benefitting from the large numbers of the best students from China, India, the former Soviet Union and other nations around the world studying and contributing to science and engineering research and development. Data indicates that foreign physics students admitted score high on the TOEFL exam for English proficiency and score very well on the GRE physics exam. The data on post-Ph.D. employment indicates that foreign graduate students get good jobs at attractive salaries in both traditional and non- traditional employment sectors, and that few of them return to their country of origin.

Each of the myths discussed above has some slight "ring" of substance, but not of truth. They are not presented in context, nor are they informed with data to determine their reality. Yet these myths continue to be propagated and believed by administrators, and in some cases, are having a deleterious effect on faculty morale and on-campus support for physics. At many universities, the situation for maintaining the quality of physics programs is quite fragile. It would be worthwhile if all relevant parties would become informed and work with physics program leadership to develop a realistic strategic plan to maintain the excellence of physics departments nationwide.

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