APS NEWS

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1 Month to Go

aps centennial

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

Survey Looks at "Two-Body" Problem Among Physicists

Physicists are increasingly faced with the "two-body problem": the difficulty of finding two professional jobs (possibly two physics jobs) in the same geographic location. This problem has a particularly acute impact on women, in part because 45% of married female physicists are married to other physicists, whereas only 6% of married male physicists have a physicist spouse.

The two-body problem also poses a challenge for institutions that hire physicists, as it is increasingly likely that the top candidate in a search will have a spouse who is also seeking professional employment. Lack of suitable employment for the spouse can lead a candidate to reject a job offer, or to leave a job after a few years if the spouse can find a better situation elsewhere. The frustration of unemployment and underemployment can also cause some to leave physics altogether, representing a net loss to the profession. As these employment problems are more acute for women, lack of attention to dual-career issues can hamper efforts to increase the representation of qualified women in physics.

In order to assess the extent of the dual-career couple problem, to examine its effects on the scientific community and to learn about possible solutions that have proven successful, Laurie McNeil, University of North Carolina, and Marc Sher, College of William and Mary, conducted a Web-based survey in 1998. This was done under the auspices and funding of the APS Committee on the Status of Women in Physics. Laurie McNeil was chair of CSWP in 1997. Because the primary goal was to obtain information about approaches that institutions might take to the problem, they did not attempt to use rigorous statistical sampling techniques or sophisticated quantitative analysis of the responses.

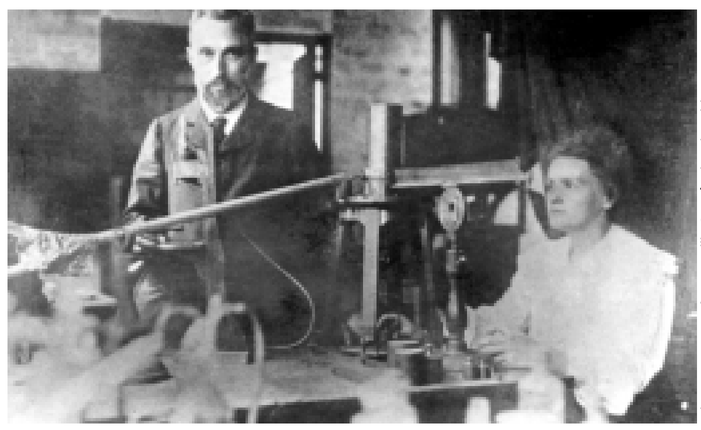

Photo courtesy of AIP Emilio Segrè Visual Archives

Typical dual-career couple: Marie and Pierre Curie.

The survey requested responses from couples in which one member was a physicist and the other was also a scientist (often another physicist). The core of the survey was a set of open-ended questions asking about the dual-career problems that respondents had faced, institutional responses to these problems, and possible solutions. A total of 620 responses were received, many with very detailed answers to some of the questions.

From these replies were called a collection of ways in which institutions respond to the dual-career situation faced by physicists whom they wish to hire. These responses fell into two categories: those that made the situation worse, or at least did nothing to improve it; and those that helped to make the situation better.

One very common form of problematic response was to give reduced consideration to candidates who are in a dual-career situation, perhaps with the justification that a candidate free of such encumbrances would be more likely to accept a potential offer. Another was to ignore the situation entirely. Many of the respondents to the survey replies reported that when they asked the institution that had offered them a job for assistance in finding employment for their spouse, the requests were met with astonishment, as if the possibility that a candidate might have a partner who was seeking a professional position were an entirely novel notion.

Continued on page 2

Hawking Confirmed as Centennial Speaker

Stephen Hawking, University of Cambridge, England — and a highly popular author and lecturer on general relativity, particularly the physics of black holes — has been confirmed as a featured speaker at the upcoming APS Centennial Meeting in Atlanta, Georgia.

This year's recipient of the Julius Edgar Lilienfeld Prize, Hawking will give the Lilienfeld address on Wednesday, March 24 in Atlanta.

He was cited, "For boldness and creativity in gravitational physics, best illustrated by the prediction that black holes should emit black body radiation and evaporate, and for the special gift of making abstract ideas accessible and exciting to experts, generalists, and the public alike."

Hawking is the author of two bestselling books: *A Brief History of Time* (1988) and *Black Holes and Baby Universes and Other Essays* (1997).

Inside...

APS Workshop Targets Tribulations of New Managers

When asked by the APS what professional development courses most interested them, members of the APS Forum on Industrial and Applied Physics (FIAP) overwhelmingly ranked the problems of being a manager as number one. That choice reflects the concerns of industrial physicists working in or contemplating managerial jobs, and their awareness of the need to acquire new skills and better understanding of leadership.

During its Centennial meeting, the APS will host a workshop entitled "Management Problems of the Technical Person in a Leadership Role," a wide-ranging program designed to increase the successful transition of technical specialists into the ranks of management. Other career-related events include a series of special symposia, a tutorial on career choices, and a networking breakfast for women industrial physicists.

Physicists moving into management positions confront several challenges along their new career paths. "The skills and capabilities that help them do their jobs as technical specialists are dramatically different from what it takes to lead people," says Vicki Cherry, an electrical and biomedical engineer with management experience in the food-processing industry who will lead the workshop, which was developed by Fred Pryor Seminars.

The five-hour session on Sunday, March 21, will be followed by a two-hour optional question and answer period. Cherry will address such issues as how to delegate work; dealing effectively with corporate politics and power structures; channeling one's strengths as a technical specialist into strong leadership skills; and ways to develop productive, motivated employees. "It takes more people skills than technical skills to do the job of a technical manager," Cherry says.

Technical experts tend to look for perfect solutions to specific problems, but as managers, they must find less-than-perfect — yet acceptable — answers to many different situations. High standards remain necessary for any manager, but excessive expectations can cripple his or her effectiveness. Today's managers need to skillfully practice "situation leadership" — to get their team involved in the planning and decision-making process and to recognize that on any given project, someone else might have better skills than they do to head the effort.

*Adapted from an article by Patrick Young appearing in **The Industrial Physicist**, February 1999. To request a free subscription, visit the website www.aip.org/tip, or send inquiries to tip@aip.org.*

For more information or to register early to ensure a place at the "Management Problems of the Technical Person in a Leadership Role" workshop, contact Arlene Modeste, modeste@aps.org, 301-209-3232.

CRITICAL CENTENNIAL MEETING DEADLINES

Late Mail/Fax Registrations	**2/20/99**	**Post Deadline Abstracts** *(Posters only)*	**2/19/99**
Late On-Line Registrations	**3/08/99**	**Housing and Tours Deadline**	**2/20/99**

See Enclosed *APS Meeting Announcements* for additional Centennial Registration Information

Career Corner

An Alternate View: Is Industry Really a "Nontraditional" Career?

by Jeffrey Hunt, Boeing Corporation

It seems there is still a good deal of discussion and confusion regarding the sort of employment physicists can and should aspire to when seeking jobs in the nontraditional (or "industrial") sector. Are graduate students to be directed towards areas where skilled technicians are needed? Should we be encouraging universities to de-establish exotic technical areas in favor of those where jobs are plentiful? What are the special qualities that a physics background can bring to a company?

I'd like to begin with another question: when, exactly, did industrial laboratories become non-traditional? If you look back to the applied journals in the 1940s and 1950s (and even the 1960s), most of the exciting new developments were not coming from universities of national laboratories. They were coming from companies. This included not only Bell Labs and IBM, but also Xerox, General Electric, Hughes and Varian, among others. All had R&D development within their companies, and several had separate divisions altogether.

Things changed in the 1970s when companies stopped hiring, due to less than optimum economic conditions. At that time, many graduating PhDs had to abandon their dreams of working in exciting research areas, and were forced to take low-paying jobs as professors. There, they spent many years toiling away in poorly equipped labs with untrained students, forced to watch the company-sponsored research labs from the sidelines. [Don't laugh — you'd be surprised how many 50-something physics professors have told me this privately.] Thus, being a professor was the fallback position in a weak economy. But times change, and nowadays, only failed academics are supposed to go into industry, or so some grad students and professors have informed me.

Regardless, there are some things which every grad student should know, but most professors will not tell you. I offer the following "Seven Undeniable Facts":

Physicists cannot do...

- electrical engineering as well as electrical engineers.
- chemical engineering as well as chemical engineers.
- software engineering as well as software engineers.
- mechanical engineering as well as mechanical engineers.
- optical engineering as well as optical engineers.
- aeronautical engineering as well as aeronautical engineers.
- mathematics as well as mathematicians.

Given these facts, why the hell would anyone want to hire a physicist? The answer: Physicists can do 80% as well as the experts on all these tasks, whereas each of the experts' abilities goes quickly to zero once outside their disciplines. Even in my company, there are engineers of many types on many tasks, but the guys at the top are disproportionately physics PhDs. [Okay, there are a couple of engineers and maybe even a chemist.] Why? Because they are the ones who can comprehend the big picture and make sure that all the subdisciplines are exchanging the right information with each other.

So, am I in favor of directing the workforce away from, for example, optoelectronics and microelectronics and toward rf and microwaves? Of course I'm not. I'm against physicists being directed to any one area of specialization. From the time you leave high school to the time you receive your doctorate will be at least a decade. Today's practical growing industry is tomorrow's out-of-date technical assembly line.

What I do favor is making graduate school what it is supposed to be: an apprenticeship at working independently. Too many students these days do experiments with equipment that is all commercially manufactured. They never learn electrical control and design; they never learn machining. These are indispensable skills in an industrial environment. If you're being paid the big bucks that industrial physicists make, you're not getting them because you only know how to work with things that already exist commercially. You're being paid to come up with new ideas and adaptations on a daily basis. This is the sort of thing you learn to do if you have a "homemade" project as a PhD dissertation. Even though your experiment may look primitive by industrial standards, the skills you learn are the same. Only the complexity changes. Put another way, the sophistication and expense of the things that don't work increases.

While in school I performed a measurement in which I (1) designed the optical system, (2) machined most of the set-up, (3) designed and built the electronics, (4) integrated the system, and (5) programmed the (simple) computer controls. And oh yeah, I conducted a neat experiment, too.

Jeffrey Hunt

The truth is, in most cases, no one will give a damn about your thesis six months after you leave school. But the abilities you learn stay with you. Who cares if you have no rf or microwave experience after leaving school? A "good" PhD should be able to hit the library, read up and be able to start making contributions within a few weeks, if he knows what he is doing. Since your schooling should be concerned with making you a generalist, you should be able to come into a scenario that you don't understand at all, get the background under your belt and be able to start to contribute quickly.

That is what a PhD in physics is about. It is not about whether you're an expert within some given area of specialization. This is the message that we really should be sending to faculty who are training students. The students have to do things on their own. Even if things are available commercially, they should still go out and do as much as they can from scratch. It's the thing that makes you useful and, dare I say, employable down the line.

[From the Fall 1998 FIAP Newsletter.]

Career Survey, *continued from page 1*

In locations where there are few employers of physicists, a job candidate may inquire about the possibility of a position for the partner at the same institution. Institutions often reject such possibilities on the basis of nepotism rules (which may no longer be in force or may be of questionable legal standing) or a general resistance to allocating two slots to one couple. Or, the institution may choose to hire the partner but into a position that is below her or his qualifications. Finally, many of the survey respondents reported outrageous remarks made by potential employers, including suggestions that the couple solve the dual-career problem by divorcing, or statements that the woman "should not be working anyway."

As a counterbalance to these problematic responses, McNeil and Sher also received information about solutions that had been successful at various institutions. The first of these is the shared or split position, in which two scientists occupy a single (or possibly 1.5) position. This can be attractive to couples with small children. In other cases, institutions have been able to find other sorts of positions for the spouse, such as soft-money research positions, adjunct or part-time teaching positions, or employment in other technical areas such as computer systems management. Some large institutions have established Spousal Hiring Programs which are charged with aiding partners of new hires in finding suitable professional employment either within the institution or somewhere else in the area. Other institutions provide such assistance informally, by maintaining contact lists and setting up interviews with local companies that hire physicists.

From these negative and positive ways of addressing the dual-career situation, McNeil and Sher have formulated several recommendations to institutions. The first is to recognize the existence of the dual-career situation and choose to deal with it. This is obviously the key step, but many institutions have yet to take it. It must be taken before the institution is faced with a potential new hire with a spouse in need of employment; at that stage, there is not enough time to formulate an adequate response. In particular, institutions need to investigate and establish policies regarding nepotism, shared or split positions, and the like. They also need to investigate other hiring opportunities in the area, whether by establishing a formal Spousal Hiring office or by informal means. Once an offer has been made for which the acceptance by the candidate may depend on employment opportunities for the partner, it is too late to begin formulating policies and developing contacts.

In an effort to aid institutions in taking such action in a timely manner, the CSWP is establishing a Web site where information gathered on shared or split position policies, spousal hiring programs, and other successful approaches to the dual-career problem will be posted. The hope is that this will encourage institutions to face the issue and take positive action, which will benefit not only the job-seeker and the institution, but also the physics profession as a whole.

The full report on the survey can be found online at <http://www.physics.wm.edu/dualcareer.html>. McNeil will be speaking on the survey results at the upcoming APS Centennial meeting, Session JB21.03, Tuesday, March 23, 10:30 a.m.

Survey Stats

- 89% had partners who were scientists, half of which were dual-career physics couples.
- 57% of the respondents were women.
- Average age female respondents was 37.2; the male respondents had an average age of 40.1.
- When last searching for a job, 20% were searching for a postdoc, 64% for a faculty job, 25% for an industrial job and 20% for a government laboratory job; 15% answered "other".
- 60% siad that they or their partner had to take a lower-level position in science or a nonscience or no job due to dual-career issues.

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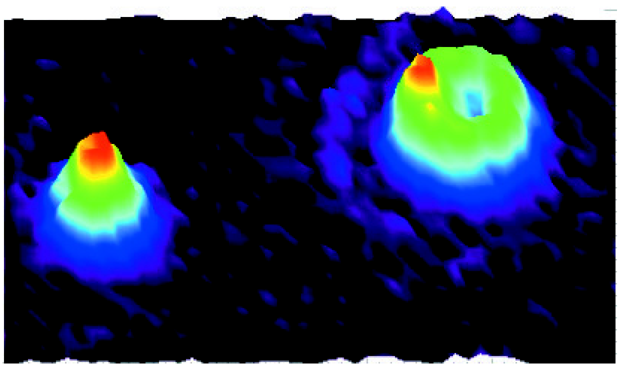
Physical Review Focus

http://publish.aps.org/FOCUS/

PR Focus is a FREE APS electronic journal featuring selections from *Physical Review Letters* explained at a level accessible to all physicists. The editor is David Ehrenstein [see page 1, April 1998 *APS News*]. *PR Focus* is available at the web address: **http://publish.aps.org/FOCUS/**. *APS News* is printing samplings from *PR Focus* to introduce the membership to this new journal. To receive one-paragraph introductions (such as the ones below) each week by e-mail, send the the message "subscribe focus" to majordomo@aps.org, leaving the subject line blank.

Orienting Single Molecules

Although physicists have developed many methods for observing the average properties of large collections of molecules, researchers have only recently managed to detect individual molecules. For example, attaching a highly fluorescent dye to a large protein molecule allows biophysicists to learn about details of the conformational changes that occur when the protein carries out its biological function. Now a team reports in the 14 December *PRL* a method for distinguishing the orientation of such a fluorescent molecule in a direct way. The technique may also be useful in understanding the structures of polymer matrices and other materials. (R. M. Dickson *et al.*, Phys. Rev. Lett. **81**, 5322; see complete *PR Focus* story posted online 15 December 1998.)

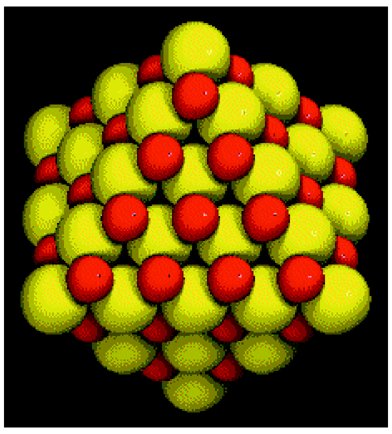


Robert M. Dickson/Georgia Institute of Technology

Orientations made easy. Based on their fluorescence patterns, researchers can distinguish single molecules that are primarily *xy*-aligned (left) from those primarily *z*-aligned (right).

Nuclei Affect Bounce of H_2

A molecule's atomic nuclei don't usually have much effect on its interactions with other atoms and molecules. Chemical reactions, for example, involve only the external electrons. But the alignment of the nuclear spins can affect the rotation of a diatomic molecule like H_2. Now a report in the 21 December *PRL* shows that this alignment strongly affects even a simple scattering experiment, where hydrogen molecules bounce off the surface of a crystal. The experiment may also provide a new method for probing the electric field structures of surfaces. (M. F. Bertino *et al.*, Phys. Rev. Lett. **81**, 5608; see complete *PR Focus* story posted online 22 December 1998.)



Joseph Lauher/SUNY Stony Brook

Crystalline bouncer. Hydrogen molecules with different nuclear spin alignments rebound differently from the surface of a lithium fluoride crystal. The results can reveal details of the surface electric field.

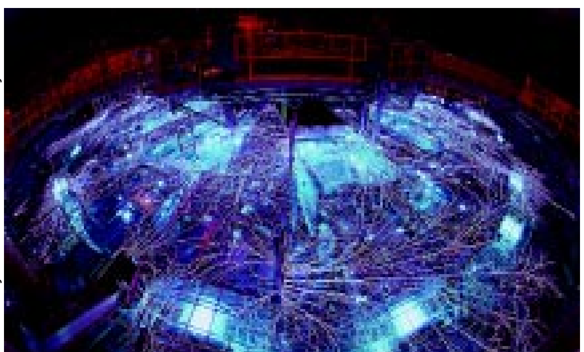


Photo courtesy of Sandia National Laboratory

Time-exposure photograph of a nuclear fusion experiment.

A century of physics

1995: Prospect

by Hans Christian von Baeyer, College of William and Mary

A look back over a century of physics reveals an era of vigorous growth, not only in depth and scope, but also in sheer volume. The membership of the American Physical Society, for example, increased four hundred-fold from about a hundred in 1900 to over forty thousand in 1997. In part this growth reflects ballooning university enrollments, but it is also a symptom of the evolution of the scientific enterprise from a genteel academic pursuit into a robust component of the world's economy.

Bernard Khoury, AAPT

American competitors in the 1998 Physics Olympiad in Iceland.

The story of the transistor illustrates the transformation. Life without computers is now as unthinkable as a computer without miniaturized transistors. Those, in turn, are products of a vast applied research effort at university and industrial laboratories that was rooted in pure, basic research. The lineage of today's laptop leads straight back to Werner Heisenberg's discovery of quantum mechanics in 1925.

Turning to the coming century, and trying to anticipate the future directions of science, it helps to remember that the great discoveries are rarely the outcomes of deliberate searches for universal answers, but more often the unanticipated dividends of careful research focused on modest, specific questions. Nearly four hundred years ago, for example, the German astronomer Johannes Kepler struggled for four years to remove a minute discrepancy in the calculated orbit of Mars — and discovered the laws that govern the motions of all the planets in the universe. In this century, Ernest Rutherford was investigating the details of the passage of charged particles through matter, when he hit upon the atomic nucleus. In the 21st century the passionate pursuit of particular problems will likewise yield wonderfully unexpected universal insights.

And what are the profound insights physicists could hope for? We may soon know what dark matter is, and whether the universe will continue to expand forever, but how did time begin? General Relativity teaches us what gravity is, but where does mass — which measures inertia even in the absence of gravity — come from? How should we describe turbulence, the chaotic swirl of liquids and gases that has defied mathematical physicists for a century? If we knew, would we be able to predict weather patterns and heart attacks? Can consciousness be explained in terms of electrical currents in neural networks, and possibly quantum mechanics, or is there more to it? For that matter, do we have to accept the strange laws of quantum mechanics without question, or will someone discover the clue that makes the quantum obvious, as Albert Einstein never stopped hoping? How did life begin? Are we alone in the universe? Until we can answer such questions with confidence, we cannot claim to have understood the world.

Looking back we realize that we have learned much in this century, but of mysteries there is no end. The most impenetrable of them all is to predict what the next discovery will be.

Editor's Note: A CENTURY OF PHYSICS, a dramatic illustrated timeline wallchart of several hundred entries on eleven large posters is being given to all US high schools and colleges. Each poster covers about a decade and is introduced by a thumbnail essay to provide a glimpse of the historical and scientific context of the time. A CENTURY OF PHYSICS will be on display at the Atlanta Centennial Meeting in March.

Additional Exhibits to Appear at the Centennial Meeting

Dozens of exhibits developed by the APS and its Units, funding agencies such as NSF and DOE, laboratories, and commercial vendors will be on display at the Centennial. In addition to those noted previously in *APS News*, are the following:

Nobel Discoveries Exhibit: Exploring Nature, Saving Lives, Driving Technology — An interactive traveling museum exhibit that illustrates how Nobel Prize discoveries in physics and related fields impact our lives makes its debut at the Centennial.

APS Historical Entryway Exhibit — A museum style exhibit showing the origins and historical development of the APS will be shown in the entrance lobby of the Georgia World Congress Center. The display will include APS research journals, outreach programs, as well a number of interesting incidents that helped shape the character of the Society.

Division of Atomic and Molecular Physics — Recent advances in the physics of high-Z ions will be illustrated with electron beam ion sources and traps, including a demonstration allowing visitors to dial up highly-charged ions of their own choosing. Applications of atomic, molecular, and optical physics will be represented by new work on biomedical imaging using spin-polarized xenon.

National Society of Hispanic Physicists — This exhibit captures through action pictures the contributions Hispanic physicists have made to US physics over the course of the century, as well as the richness and variety of backgrounds they bring to science.

LETTERS

Duct Tape, Not

I found Max Sherman's article, "How Duct Tape Sealed My Place in History," (December 1998) to be both entertaining and useful practically. For years my basement has been filling up with clothes-dryer lint, and I have wondered why. I have advanced theories and even formulated experiments to choose among the theories. But after reading Professor Sherman's article, I looked at the flexible ducting that leads from my dryer down to the basement, across the basement ceiling, and out a vent at the opposite wall. I observed that where two long sections of ducting were coupled together with duct tape, they had separated ("failed catastrophically" in Sherman's words). I now intend to recouple the sections, using another sealant as Sherman recommends. I will keep you informed.

Larry Turner
South Riding, Virginia

Go for the Big Bang

Charles Duke of Xerox [The Back Page, *APS News*, December 1998] tells young physicists going into industry, "For those who are or wish to be 'players' in industrial R&D, you might consider three actions. First, the big bang value system is inappropriate in your new life; discard it."

Some people never learn. Xerox exists because of one big bang, the xerographic copier. Another could have made it a world leader in computers. It happened at Xerox Palo Alto Research Center, only to be discarded by Xerox management. Now it is called the Macintosh.

Charles W. McCutchen
Princeton, New Jersey

Discounted Auto Insurance Added to Member Benefits

The APS has entered into an agreement with GEICO, a leading auto insurer, to provide members with a preferred rate. With a current or new GEICO Preferred auto insurance policy, mention your APS membership number (listed on the first line of your *APS News* mailing label) and, in most states, GEICO will give you an extra 8% discount.* The savings to you will cover the cost of annual APS dues in most cases. In addition to savings, GEICO offers convenient 24-hour service with a professional representative for rate quotes, filing a claim, or to answer questions. When you qualify, you'll get coverage tailored to your personal needs and a choice of payment plans.

All it takes is a quick call to GEICO Preferred at: 1-800-368-2734 or visit their web site at: www.geico.com.

**Discount is 10% in CA, DC, and IL; 3% in NY; not available in all states. Discount is not available in GEICO Indemnity Company or GEICO Casualty Company. One group discount applicable per policy. Government Employees Insurance Co. GEICO General Insurance Co. GEICO Indemnity Co. GEICO Casualty Co. These shareholder-owned companies are not affiliated with the U.S. Government. GEICO Auto Insurance is not available in MA , NJ or outside the U.S.*

Centennial Special: Take $100 Off a New Life APS Membership

In celebration of the Centennial, the APS Committee on Membership has initiated a $100 discount off new life memberships between March 1, 1999 and February 29, 2000. A life membership, which ordinarily costs 15 times the regular current annual dues rate, includes a free life membership in one dues-requiring unit.

To take advantage of this special offer, look for details in your next invoice renewal packet. The offer is not valid on an existing or previously purchased Life membership. Questions may be directed to the APS Membership Department at 301-209-3280 or membership@aps.org.

AMERICAN PHYSICAL SOCIETY

100 TAKE $100 OFF A NEW

100 APS LIFE MEMBERSHIP TODAY!

zero gravity

Love Boson Discovered on Valentine's Day

By Lynda Williams

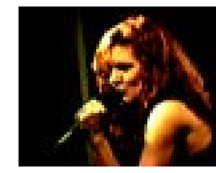
Romantic geeks and their loved ones can listen to Lynda Williams (a.k.a. The Physics Chanteuse) sing the *The Love Boson* through her website: www.entersci.com.

BOSONS force carriers spin = 0, 1, 2,...

Unified Electroweak spin = 1	Mass GeV/c²	Electric charge
γ photon	0	0
W⁻	80.22	–1
W⁺	80.22	+1
Z⁰	91.187	0

Strong or color spin = 1	Mass GeV/c²	Electric charge
g gluon	0	0
Love	Mass	Range
♥ lovon	0	∞

Photo courtesy of Lynda Williams



Lynda Williams will be performing live at the Centennial Meeting in Atlanta, Georgia. She has a Masters degree in Physics.

The Standard Model of Physics
has four forces in it:
the Strong, the Weak, Gravity
and the Electromagnetic.
But I've discovered a new force
that rules from high above.
Let me propose to you
a Unified Theory of Love!

Gluons are Strong!
They make a quantum-chromo glue
binding quarks into atoms
like I am bound to you.

Z's and W's are Weak!
They make particles decay
and atoms radioactive
that's how I feel when you're away.

Photons mediate E&M -
both particle and wave - they're so
yin-yang!

Gravitons attract
both mass and energy
they make the world go round and round
that's what you do to me.

And so I'm searching for the boson
that mediates the force of Love!
But you can't measure it!
You can only feel it!

Pulling on the superstrings of your heart!
We should add it to the Standard Model Chart
the force that rules from high above
in a Unified Field Theory of Love!

© 1998 Lynda Williams

Centennial Meeting Tutorials

The APS is hosting five tutorials during the APS Centennial Meeting, to be held on Sunday, March 21, from 9:00 am to 1:00 p.m. Arranged by MIT's Lawrence Rubin, the topics to be featured are listed below. Further information can be found in the APS Meeting Announcements booklet, December 1998 (mailed as an insert to *APS News*), or online at http://www.aps.org.

- Applications of Magnetic Force Microscopy in Magnetic Imaging of Materials.
- Cellular Automata Simulations with Mathematica.
- Physics of Cold Atoms at Millikelvin, Microkelvin and Nanokelvin Temperatures.
- Perspectives on Career Choices in Industrial and Applied Physics.
- Development of Key Concepts in Surface Science.

Corrections

- The article on the winners of the 1998 Nobel Prize in Physics in the December 1998 *APS News* failed to mention that the fundamental experiment for which Horst Stormer and Daniel Tsui were honored took place while they were visiting scientists at MIT's Francis Bitter National Magnet Laboratory. Our apologies to the laboratory for the oversight.
- In the sidebar by P. Schewe describing fractional-charge effects in quantum Hall experiments on page 6 of the December Issue of *APS News*, please note also the work of Goldman and Su, *Science*, 17 February 1995.
- Max Sherman, author of the article on duct tape published in the December 1998 *APS News* (page 5), was incorrectly identified as a professor of physics at the University of California, Berkeley. He is a scientist at the Lawrence Berkeley National Laboratory.

Fusion Pellets, Most Powerful Laser Highlight DPP Meeting

The latest discoveries in the universe of plasmas were presented during the annual meeting of the APS Division of Plasma Physics (DPP), held November 16-20, 1998 in New Orleans, Louisiana. Over 1,500 attended and presented approximately 1500 papers were presented at the meeting, which is one of the largest physics meetings in the world held each year.

Nuclear Fusion Research

A major pursuit of many plasma physicists is to develop nuclear fusion into an abundant source of energy for the world in the 21st century and beyond. In the last year, scientists at the Joint European Torus (JET) in England produced 21 Megawatts of power—a new world record for nuclear fusion. Like all fusion demonstrations to date, the recent JET experiment did not generate as much power as had been poured into the reactor to start the fusion process. Still, the ratio of output power to input power was a record 65%, more than double previous records. There were also dramatic advances in a promising approach for achieving fusion known as "Z-pinch."

Physics with the Petawatt

The Petawatt is currently the world's most powerful laser, located at Lawrence Livermore National Laboratory. It can produce pulses of 1.3 quadrillion (peta) watts for half a trillionth of a second, more than 1300 times the entire electrical generating capacity of the U.S. LLNL's Stephen P. Hatchett described how the laser can produce highly improved, submillimeter resolution images of objects through 145 mm of lead. Shining the laser on a gold target, other researchers have ejected electrons with as much as 100 MeV energy, a new record for electrons coming from a solid. When these electrons were made to decelerate rapidly and release high-energy photons as a result, the researchers observed the photons to induce nuclear fission of uranium-238. In addition to shedding insights on the fundamental interplay between light and solids, studying such electrons may help physicists develop models for understanding the generation of gamma ray bursts and other phenomena in high-energy astrophysics.

Photon-Induced Nuclear Fission and Positron Emission

Some of the high-energy electrons created at LLNL's Petawatt laser pass straight through the solid material in which they are created; as they penetrate, they are significantly slowed down, producing high-energy photons. Researchers have observed these photons to induce nuclear fission of uranium-238 and create positron-electron pairs. According to LLNL's Thomas E. Cowan, this result is striking because the process of nuclear fission is usually initiated by a massive particle such as a neutron. Although photon-induced nuclear fission and positron production have been seen before, the advantages of the Petawatt laser light may allow researchers to obtain newly detailed information on thermonuclear processes.

Less Expensive Road to Ultrashort, Powerful Lasers?

Producing ultrashort, ultrapowerful laser pulses typically requires equipment with prohibitive costs. In new theoretical work, researchers proposed a tabletop scheme for producing such pulses by colliding a short laser pulse with a long laser pulse inside a plasma. Theoretical simulations of this process show that the short pulse would remain short while being amplified by orders of magnitude. This method of ultra-short [less than 10 femtoseconds] pulse amplification may provide an alternative to the widely used chirped-pulse amplification technique, which requires large and expensive gratings. First experiments on this technique are slated to begin this month at the Max-Planck Institute for Quantum Optics in Garching, Germany.

New Experimental Information on ICF

In inertial confinement fusion (ICF), a laser or other energy source implodes a capsule containing nuclear fuel, and heats its contents to the high temperatures and densities necessary for nuclear fusion to occur. For the first time, researchers have made experimental measurements of the energy spectrum of the charged particles produced in capsule implosions. Obtained at the Omega laser facility at the University of Rochester, these measurements provide new insights into the physical conditions in the imploding capsules.

Energy Transfer Between Crossed Beams in Flowing Plasmas

In ICF experiments planned at the National Ignition Facility (NIF) being built at Livermore, a set of 192 powerful laser beams will converge not on a fuel pellet directly, but rather inside a gold cylinder called a "holhraum" (a German word meaning "cavity").

In this scheme, the laser light, turns gas, inside the hohlraum, into a hot plasma (which then, will tend, to flow out of the laser entrance holes in the hohlraum) and the hohlraum's hot gold walls generate x-rays which symmetrically heat and compress a fusion fuel pellet at the center.

But researchers have discovered a new phenomenon which could compromise this process: When two laser beams with the same color cross paths in a plasma, energy can be transferred from one beam to the other when the velocity at which the plasma flows equals the speed of sound in the plasma. This phenomenon may cause unwanted energy transfer between the NIF beams, preventing a target from being heated uniformly. This "resonant energy transfer" has been observed and measured at the Nova laser at Livermore and at the laser facility at LULI in France. Several researchers at the meeting proposed possible solutions to the problem.

3-D Laboratory Simulations of Solar Eruptions

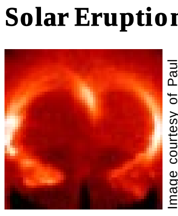


Image courtesy of Paul Bellan, Caltech.

Laboratory simulation of solar prominences.

Researchers are creating plasmas which simulate astrophysical phenomena such as exploding stars and galaxy formation. In the past year, Caltech researchers have produced improved laboratory versions of solar prominences, huge luminous arches extending outwards from the surface of the sun. Using a newly designed plasma gun and a two-camera system, they have obtained 3-D photographs that provide useful insights into how prominences evolve.

Reducing Energy and Particle Loss in Magnetic Fusion Reactors

In magnetic fusion, magnetic fields trap a hot plasma and allow it to reach the conditions necessary for nuclear fusion. The most widely used device for achieving these fusion conditions is a tokamak, which produces multilayered magnetic fields to trap the plasma and allow it to reach high temperatures and densities. However, large-scale and small-scale turbulence in the plasma hinders the process somewhat by causing particles and heat to leak out of the tokamak. Researchers have recently found ways to reduce this leakage by causing the plasma to flow around the system parallel to the walls of the chamber, but with different speeds at different points in the multilayered field structure. This flow is produced by making an electric field in the plasma which changes with position.

It produces shear forces that reduce small-scale turbulence and the loss of particles and heat.

Reaching Out for Plasma Science

In addition to the usual technical program, a number of science education and outreach activities were featured during the DPP meeting in New Orleans. For example, the DPP Concerns of Young Scientists Committee sponsored a workshop on career opportunities on Tuesday, and two invited talks on science education were featured at a special Wednesday afternoon session.

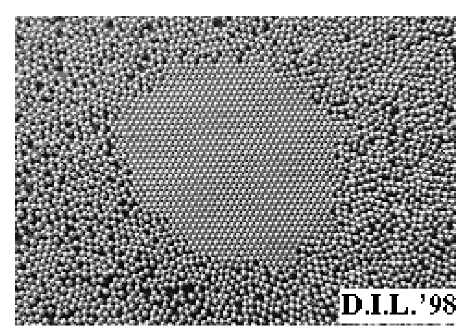
Also featured was the 11th annual Science Teachers' Day, including workshops with area educators, followed by the poster session of undergraduate research and education outreach projects all day Tuesday. This year, the program focused on the science and technology of plasmas and plasma applications, with a special emphasis on fusion energy, and was organized by MIT with support from various universities, laboratories and industry.

The 5th annual Plasma Science Expo was held all day Thursday, intended as a means for the DPP scientific community to share some of the exciting challenges of plasma science with the local community. A variety of industrial exhibitors, laboratories and universities sponsored displays for the event, many of which were interactive hands-on exhibits. On display throughout the DPP meeting was a large, poster display — created for the upcoming APS Centennial Meeting in March 1999 — to acquaint APS unit members and the general public with the importance and applicability of plasma physics.

MEETING BRIEFS

Mini-Symposia, Granular Materials Featured at 1998 DFD Fall Meeting

The APS Division of Fluid Dynamics held its 51st annual meeting, 22-24 November in Philadelphia, Pennsylvania, jointly hosted by Rutgers University, Princeton University, the New Jersey Institute of Technology, and the University of Pennsylvania. Approximately 900 contributed papers were presented, in addition to several invited lectures. In addition, the 1998 receipients of the APS Fluid Dynamics Prize and Otto LaPorte Award spoke at a special awards program on Sunday afternoon (see *APS News*, November 1998). The meeting also featured the 16th 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 1999 issue of Physics of Fluids.



Jeffrey Olafsen and Jeffrey Urbach, Georgetown University

Condensation of steel balls on a shaken table.

The meeting featured three mini-symposia in addition to the usual invited and contributed sessions. The first featured talks on new research into gas fluidized beds. The second offered faculty perspectives on graduate student contributions, opportunities and changes in fluid dynamics research, while the third focused on convection in nematic liquid crystals. Other sessions of interest included lectures on the application of fluid mechanics to the study of blood flow and the vascular system, fiber flocculation in papermaking, and complex fluids and materials processing, as well as new evolution equations for turbulent boundary layers and vortex dynamics of accelrtated inhomogenous flows.

Another highlight of the meeting was the presentation of new experimental research on clustering and collapse in granular materials such as salt, sand, sugar, and seeds, which share some properties with solids, liquids, and ideal gases, but also have peculiar properties of their own. For example,the thermal energy of a grain is a trillion times less than the energy it takes to lift one grain on top of another. Besides wanting to apply knowledge about granular materials in such industrial settings as foodstuffs, paint mixing, pharmaceuticals, agriculture, researchers hope to find more relations among the many things in the universe that clump and condense, such as atoms, bacteria, and galaxies.

Annual GEC Incorporated into DAMOP

The annual Gaseous Electronics Conference (GEC), an endorsed conference of the APS for over a decade, has been officially incorporated into the APS meetings structure as a divisional meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP). According to Gordon Dunn, DAMOP divisional councilor, of the approximately 300 to 500 people that attend GEC each year, about half are APS members.

DPF Holds 1999 Winter Meeting

The APS Division of Particles and Fields (DPF) held its annual meeting January 6-9, 1999, at the University of California, Los Angeles. Featured topics of the invited plenary sessions held on Friday and Saturday included electroweak physics, B factories, high energy astrophysics, heavy flavor physics, rare decays and CP violation, neutrino physics, particle physics and the early universe, and perspectives on future accelerators. The program also featured a town meeting with Martha Krebs, director of the Department of Energy on Thursday evening, and a Wednesday evening session co-sponsored by the DPF and the APS Committee on the Status of Women in Physics, on the problems faced by dual-career couples when seeking scientific employment (see story, page 1).

1999 OPERATING AND BYLAWS COMMITTEES

COMMITTEE ON CAREERS AND PROFESSIONAL DEVELOPMENT: Allen Goland (Chair), Peter Abbamonte, Frederico Capasso, Gordon Cates, David Elmore, Arthur Hebard, Diandra Leslie-Pelecki, Anthony Nero.

AUDIT COMMITTEE: Howard Birnbaum (Chair), Robert Callendar, John Schiffer.

COMMITTEE ON COMMITTEES: Guenter Ahlers (Chair), David Aspnes, Dan Auerbach, Virginia Brown, Zachary Fisk, Will Happer, Eric Heller, Dan Kleppner, Andrew Lovinger, Virginia Trimble.

COMMITTEE ON CONSTITUTION AND BYLAWS: Steve Baker (Chair), Robert Adair, Gordon Dunn, Lynn Knutson, Mark McDermott, Ray Orbach.

COMMITTEE ON EDUCATION: Meigan Aronson (Chair), Don Burland, Ken Hass, Theodore Hodapp, Don Madison, Andrea Palounek, Richard Saenz, Jim Wynne, Paul Zitzewitz.

EXECUTIVE BOARD: Jerome Friedman (Chair), David Aspnes, Martin Blume, Zachary Fisk, Judy Franz, Jim Gates, Don Hamann, Eric Heller, James Langer, Thomas McIlrath, Paul Peercy, Susan Seestrom, Andrew Sessler, George Trilling, Virginia Trimble.

FELLOWSHIP COMMITTEE: George Trilling (Chair), Anthony Johnson, Pat Mooney, Chris Quigg.

COMMITTEE ON INTERNATIONAL FREEDOM OF SCIENTISTS: (Chair TBA),Dan Auerbach, Aurel Bulgac, Hugh De Witt, William Dorland, Rudolph Hwa, Anne Kernan, Theodore Lavine, Joel Lebowitz, Dmitri Maslov, Vladimir Zelevinsky.

COMMITTEE ON INTERNATIONAL SCIENTIFIC AFFAIRS: Lynn Boatner(Chair), Joe Birman, Bernd Crasemann, Karl Erb, David Ernst, Tom Ferbel, Herman Grunder, Kennedy Reed, Shang Fen Ren, Myriam Sarachik.

INVESTMENT COMMITTEE: Thomas McIlrath (Chair), Judy Franz, George Trilling, Richard Newrock, Mel Schwartz, Charlie Duke.

COMMITTEE ON MEETINGS: Susan Seestrom (Chair), David Cassel, Tom Cohen, Judy Franz, Alan Kleinsasser, Thomas McIlrath, Paul Peercy, Mary Ann Sweeney.

COMMITTEE ON MEMBERSHIP: Peter Reynolds (Chair), James Crichton, Judy Franz, Daniel Grischkowsky, James Maher, Bernie Meyerson, Tom O'Neill, Matthew Richter, Erich Vogt, TBA.

COMMITTEE ON MINORITIES: Sergio Ulloa (Chair), Kevin Aylesworth, Clayton Bates, Bunny Clark, Carlos Gutierrez, Cynthia Keppel, Cynthia McIntyre, Lawrence Norris, TBA.

NOMINATING COMMITTEE: Dan Kleppner (Chair), Francis Chen, Bunny Clark, Melissa Franklin, Wick Haxton, Barbara Jones, Miles Klein, Andrew Sessler, Cliff Surko, Michael Turner.

PANEL ON PUBLIC AFFAIRS: Denis McWhan (Chair), Henry Abarbanel, John Ahearne, Howard Birnbaum,G.A. Neville Connell, John G. Cramer, John Doyle, William Frazer, Elsa Garmire, Ruth Howes, Barry Klein, Louis Lanzarotti, Marsha Lester, Thomas Moss, Robert Richardson, Michael Riordan, Roberta Saxon, Marc Sher, Lawrence Schwartz, George Trilling, James Tsang, Robert M. White.

PHYSICS POLICY COMMITTEE: Robert Richardson (Chair), John Armstrong, Praveen Chaudhari, Ronald Davidson, Millie Dresselhaus, Gerald Garvey, Katharine Gebbie, Hermann Grunder, Beverly Hartline, Gerald Iafrate, Jim Langer, Venkatesh Narayanamurti, Burton Richter, Lee Riedinger, Alvin Trivelpiece.

PUBLICATIONS OVERSIGHT COMMITTEE: Alan Chodos (Chair), Phil Allen, Martin Blume, R. Stephen Berry, Judy Franz, Allan Goldman, Thomas McIlrath, Chris Quigg, Mark Riley, Katepalli Sreenivasan,Virginia Trimble.

COMMITTEE ON THE STATUS OF WOMEN IN PHYSICS: Marjorie Olmstead (Chair), Neil Abraham, Elizabeth Beise, Beverly Berger, Shu Chang, Sally Dawson, Elsa Garmire, Linda Vahala, Barbara Whitten, David Wolfe, TBA.

New Topical Group on Plasma Astrophysics Formed

The APS Council approved the establishment of a new topical group on plasma astrophysics at its November 1998 meeting. Its stated principal objective is "the advancement and diffusion of plasma astrophysics — an inter-disciplinary body of knowledge that seeks common ground between plasma physics and astrophysics, and involves the application of fundamental concepts of plasma physics to the solution of outstanding problems in astrophysics."

According to Amitava Bhattacharjee of the University of Iowa, who helped spearhead the effort, the new unit has its roots in the Plasma Astrophysics Working Group of the APS Division of Plasma Physics (DPP). The working group has grown steadily in size since it was established, and has sponsored several popular evening symposia on plasma astrophysics at DPP meetings in recent years, featuring well-known plasma and astro-physicists seeking common ground by sharing their knowledge of observations, theory and simulation. Bhattacharjee and his colleagues hope that the formation of the topical group will lead to the genuine sharing of knowledge based in fundamental plasma physics and make it easier for plasma astrophysics to become an integral and visible presence at APS meetings.

IN BRIEF

Burton Richter to Retire

After 14 years as head of the Stanford Linear Accelerator, former APS president Burton Richter will end his stint on August 31, 1999 about the same time as his latest accomplishment, the Asymmetric B Factory, begins operating. Richter received his PhD in particle physics in 1956 from MIT and accepted a postdoctoral appointment at Stanford University. He joined the staff of SLAC in 1963, becoming its director in 1984. His research in experimental particle physics has included pioneering work in colliding beam technology, and he shared the 1976 Nobel Prize with Sam Ting for discovery of the J-Psi particle. In addition to the APS presidency in 1994, Richter has served as a Councilor for the Division of Particles and Fields, and on the APS Publications Committee, as well as on the advisory committees of numerous national and European laboratories.

Shirley Jackson to Become President of RPI

Shirley Ann Jackson, a fellow of the APS, has been named the 18th president of Rensselaer Polytechnic Institute, effective July 1, 1999. She becomes the first African-American woman to lead one of the nation's top technological universities. Jackson is currently chairman of the U.S. Nuclear Regulatory Commission (NRC). A native of Washington, DC, she earned her PhD in theoretical elementary particle physics from MIT in 1973 — the first African-American woman to receive a doctorate from MIT in any subject. Following postdoctoral research at Fermilab and SLAC, among others, Jackson conducted research in theoretical physics, solid-state and quantum physics, and optical physics at AT&T Bell Laboratories until 1991. That year she joined the faculty of Rutgers University, serving concurrently as a consultant in semiconductor theory to Bell Labs until assuming the chairmanship of the NRC. An APS Fellow, Jackson was inducted into the National Women's Hall of Fame in 1998.

Two APS Members Receive National Medal of Science

In December, President Clinton named two APS members among the nine 1998 recipients of the National Medal of Science, the nation's highest science honor. John N. Bahcall, a professor of natural sciences at Princeton's Institute for Advanced Study and APS Fellow, was recognized for his pioneering efforts in neutrino astrophysics and his contributions to the development and planning of the Hubble Space Telescope. APS member George M. Whitesides, a professor of chemistry at Harvard University, was recognized for his innovative and far-ranging research in chemistry, biology, biochemistry and materials science that has resulted in breakthroughs to transition metal chemistry, heterogeneous reactions, organic surface chemistry, and enzyme-mediated synthesis.

Three Fellows Receive E.O. Lawrence Awards

Three APS Fellows were among six recipients of DOE's E.O. Lawrence Awards in January by Secretary of Energy Bill Richardson. Each recipient will receive a gold medal, a citation and $15,000. The award is given for outstanding contributions in the field of atomic energy, which today has influenced many fields of science such as environmental research, materials science and nuclear medicine that were in their infancy in 1960 when the first Lawrence Award was given.

Laura Greene (University of Illinois, Urbana-Champaign) was honored in the materials research category for her pioneering experiments that clarify the behavior of electrons at the surfaces of low and high-temperature superconductors.

Steven Koonin (Caltech) was honored in the physics category for his broad impact on nuclear and many-body physics. Particularly noteworthy are Koonin's new supercomputer calculations that greatly extend our ability to predict the properties of atomic nuclei on Earth and in the stars.

Ahmed Zewail (CalTech) was honored in the chemistry category for discovering new ways to view molecular reactions using extremely short pulses of laser light.

Announcements

APS UNDERGRADUATE PHYSICS STUDENT COMPETITION

1999 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 1999 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 1999** 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 1999** 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

1999 APS Fellowship Nomination Deadlines

Fellowship nominations may be submitted at any time, but must be received by the deadlines listed below for 1999 review. Nomination forms and submission information may be found through the APS Home Page [www.aps.org] under the Fellowship button.

All nominations should be sent to: Executive Officer, The American Physical Society; One Physics Ellipse, College Park. MD 20750; ATTN: Fellowship Program

UNIT	DEADLINE (1999)
DIVISIONS	
Astrophysics	05/01
Biological Physics	06/01
Chemical Physics	02/15
Computational Physics	02/15
Atomic, Molecular, Optical	02/15
Condensed Matter	Past
Fluid Dynamics	02/15
High Polymer Physics	Past
Laser Science	04/01
Materials Physics	02/15
Nuclear Physics	04/01
Particles & Fields	04/01
Physics of Beams	03/15
Plasma Physics	04/01

UNIT	DEADLINE (1999)
FORUMS	
Physics & Society	04/01
History of Physics	04/01
International Physics	04/01
Industrial & Applied Physics	03/01
Education	Past
TOPICAL GROUPS	
Few Body	04/01
Fundamental Constants	04/01
Precision Instrs. & Meas.	04/01
Shock Compression	04/01
Gravitation	04/01
Magnetism & Its Appli.	05/06
APS GENERAL NOMINATIONS	**06/01**

CAUGHT IN THE WEB

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

Centennial
- Centennial Meeting Program
- Centennial Programs updated
- Centennial Projects updated
- Centennial Events updated

Units
- DPB, DPF, DBP and DMP pages updated
- FIAP Fall 1998 Newsletter

Committees
- Four Corners Executive Committee updated

General
- New Minority Scholarships Forms posted
- Physics Internet Resources updated

APS Job Openings

Director of APS Education and Outreach Programs

The American Physical Society (APS) is seeking applications and nominations for the position of Director of Education and Outreach Programs. The person selected will play the leadership role in all APS education programs and work closely with the Committee on Education and the Forum on Education. In addition, he or she will work with the Committee on the Status of Women in Physics and the Committee on Minorities in Physics in efforts to increase the number of women and minorities with careers in physics. An excellent staff is available to help with these programs and efforts to seek external funding to enhance the programs will be strongly supported.

Qualifications for the position include a PhD in physics or a related field, extensive familiarity with the physics research and education communities, and excellent interpersonal and communication skills.

The selection process will begin on April 5 and continue until the position is filled. For consideration, send a cover letter, resume, and professional references to: American Physical Society; Judy Franz, Executive Officer; One Physics Ellipse; College Park, MD 20740-3844

APS Journal Positions Open

Editor for PR A and E — A scientist (preferably a PhD) with a broad interest in physics is sought for an editorial position involving work for both journals. Responsibilities will include participation in all phases of the selection of manuscripts for publication, playing a leadership role within the editorial staff in the development of a more electronic review process, and assisting in the management of editorial operations. The person would work both independently and in coordination with remote editors on manuscripts, and might if appropriate have some subject area(s) for which he or she served as the primary editor. Excellent written and verbal communication skills are essential, as is a basic understanding of the working scientist's expectations of the editorial process. Applicants should possess decision-making ability, self-motivation, flexibility, and good organizational skills. Administrative or managerial background would be helpful, as would some knowledge of electronic publishing or experience with Internet and World Wide Web applications.

Editor for PR B — Physical Review B has an opening for a Ph.D. scientist (preferably in condensed matter physics). We will train someone with an interest in journal publication willing to make the commitment necessary to develop editorial skills. Responsibilities will involve assisting in all phases of the peer review process. We are looking for a broad interest in physics and familiarity with the working scientist's expectations for a scientific publication. Excellent written and verbal communication skills are essential.

Programmer Analysts — Responsibilities include implementing user interface for the web and Internet based applications, coding, implementing and testing software, and evaluating prospective software. UNIX experience, proficiency in C language and a scripting language such as perl required.

APS editorial office positions, located in Ridge, [Long Island] New York, offer competitive salaries, career stability and outstanding benefits packages. For immediate consideration send a cover letter and resume including names of references, current salary and requirements via fax, email, or conventional mail to: Joseph Ignacio, Personnel Manager, The American Physical Society, 1 Research Road, Box 9000, Ridge, NY 11961; Email: edresumes@aps.org; fax: (516) 591-4155

RFP for Preparing Future Physics Faculty

The Council of Graduate Schools (CGS) and the American Association of Colleges and Universities (AAC&U) have received a grant from NSF entitled "Shaping the Preparation of Future Science and Mathematics Faculty." The project builds on and extends the Preparing Future Faculty program led by AAC&U and CGS since 1993. The goal is to create model graduate programs to prepare future faculty for emerging and evolving roles in five academic disciplines: chemistry, computer science, mathematics, microbiology, and physics. The American Association of Physics Teachers (AAPT) will be participating as a subcontractor to this grant along with the American Chemical Society, the American Society of Microbiology, the American Mathematical Society, the Mathematical Association of America, and the Special Interest Group on Computer Science Education of the Association of Computing Machinery.

Each of the five participating disciplines will select four doctoral institutions to participate in the project. The departments will receive up to $10,000 for the 1999-2000 and 2000-2001 academic years that can used to offset the costs of participating in the project. Each department is expected to provide matching funds equivalent to funds received from NSF through the academic discipline. Each of the selected departments will receive additional travel support to attend Preparing Future Faculty events.

Your department is encouraged to submit a proposal to participate in the Preparing Future Physics Faculty (PFPF) program. An application form, including guidelines is also available at the AAPT web site: www.aapt.org/programs/pfpf.html.

Proposals are due by March 15, 1999. The successful awardees will be notified by April 15, 1999. Inquiries should be directed to Warren Hein (whein@aapt.org)

COMPLETED APPLICATION PACKETS SHOULD BE CLEARLY MARKED PFPF AND MAILED TO: Attn.: Warren W. Hein; American Association of Physics Teachers; One Physics Ellipse; College Park, MD 20740-3845

THE BACK PAGE

The Future of Graduate Education: The Next 25 Years

by Dr. Eamon Kelly

Dr. Eamon Kelly

We are all aware that the current state of graduate education, and the National Science Foundation (NSF), results in great measure from the conscious national policy put into place at the end of World War II. Without revisiting one more time the Vannevar Bush initiative and the positive aspects of this very successful policy, it is obvious that some problems have emerged since the establishment of the Federal/university partnership.

These problems have created rising stresses in the enterprise since the end of the "Golden Age" of academic research and education, a little more than a quarter century ago. The "Golden Age" ended when the exponential growth in Federal support to research universities stopped, just as many new research universities had begun to participate in the system, particularly the large public university systems. More recently, with the end of the Cold War, the fierce competition for research dollars has been coupled with a decline in the public sense of urgency toward funding fundamental research, particularly Defense related research in the physical sciences and engineering.

The findings of studies sponsored by the National Academy of Sciences, the National Science Board (NSB), and other organizations reveal growing pressure on research and graduate education, due to the expanding demands on universities from diverse stakeholders, and the competitiveness of the research system. Demands and competitive pressures have been exacerbated by rising costs, budget constraints on traditional sources of funds, globalization of advanced education, and rising demands from the public for accountability for research dollars through demonstrated social benefits.

Simultaneously we hear a rising chorus of criticisms from employers of Ph.D. graduates, from students themselves, and from the public. These include the narrowness of the curriculum and the experience provided by Ph.D. programs, the unresponsiveness of universities to the needs of the workforce, the lengthening time to degree, the large number of foreign students in our graduate programs, as well as the low participation by women and some domestic minority groups in science and engineering degree programs and on our faculties. There are further complaints concerning the inaccessibility of research faculty to their students, and the lack of guidance to graduate students on realistic future careers. There is, finally, the suspicion that time to degree for some graduate and especially postdoctoral students is prolonged not to benefit their education but rather to provide a source of cheap labor for their faculty advisers.

On the other hand, the faculty-centered model for graduate education also places enormous stress on individual faculty members. Graduate education is essentially an apprenticeship, which can demand substantial faculty time and personal involvement. Frequently, it also involves responsibility for obtaining support for the student through the faculty member's research program as well as managing growing regulatory and administrative requirements of the Federal government, university administrations and the competitive grant system.

As we look to the next quarter century for graduate education in the university, there can be no doubt that it will continue to experience change and adaptation as a result of the remarkable transformations in computing and information systems, among other factors. These new tools promise to transform both science and education in general. But we need especially to acknowledge the central role that universities will continue to play in innovations based on the new capabilities.

The academic sector has a special role in innovations in information science and technology, both in research and in education. Academic institutions must grasp and adapt to broad-based innovations in the movement and relationships of producers and users of information. As a result of the partnership between the Federal government and universities in advanced scientific computing and communication, what is now happening is that information — the commodity on which knowledge, learning, and education depend — is moving between distributors and users in new ways that are not susceptible to the old rules and hierarchies. Relationships between owners, distributors, and users of information have become fluid. Boundaries are blurred. And low-cost, high performance computers enable people to access and apply information to contexts never thought possible before.

Just as this new fluidity in the distribution of information is affecting such diverse businesses as financial institutions and movie distributors, so universities must both grasp and capitalize on the implications of this new medium for the distribution of knowledge and the support of learning. Have we given enough thought yet to how information systems will alter not just the way we communicate, but what we communicate? Have we considered how it will alter the cultural and institutional context in which we conduct our mission in graduate education?

It seems to me that our greatest challenge is not as simple as mastering and extending the technology of information systems. It involves building a new culture for the academy. The revolution in information technology will continue to bring significant changes in how we perform our functions as teachers and scholars, and how students learn. Those changes create an imperative for new institutional structures and a new academic culture. It will offer new opportunities for cooperation across institutions-for example among researchers employed at research institutions and in primarily teaching institutions-and for collaborations across fields of science.

I believe that one of the most dramatic changes will take place in the way we teach. In a current lecture class, students sit passively, receiving information. The mode of learning is task-oriented, with students succeeding by demonstrating, through written examinations, each one's assimilation of certain knowledge. There are clear limits to the intellectual dimensions of this kind of learning. A student can "study to test," focusing on acquiring the information needed to succeed but never really connecting on an intellectual and analytical plane with the subject. With information technology it is possible to transform the task of learning into a complex, active, and intellectually challenging engagement with a subject. The communication of knowledge becomes more dynamic, encouraging analytic inquiry earlier in the educational career and the cultivation of diverse perspectives and new insights.

In the past, universities and schools have been charged with producing the concepts from which new tools are developed. The globalization of teaching and learning through information technology means that now the raw data and observations from which researchers draw their insights, and on which they build their theories, can flow more quickly into their laboratories.

What does this transformation of teaching and learning mean for graduate education? Some prognosticators say that the research university as we know it will vanish, replaced by a "virtual university" where degrees can be pursued electronically from the students' homes. Only a few faculty will be required to research and design new learning software, which will be used by thousands, if not millions, of students across the world. Campuses will disappear. However, this image of the lone student, able to learn and apply his or her skills to generate new knowledge in isolation with only his or her computer to stimulate and provide feedback, does not reflect the reality of scientific research today. And I feel certain this will not be a model for academic research and graduate education in the future.

My own prediction envisions greater interdependence rather than independence among cutting edge researchers. Teamwork and collaboration will become ever more important as research questions draw on the expertise of diverse fields of knowledge. Information technology will change the "chemistry" of what makes a given university or department appeal to its students, but I do not believe that it will overshadow the elements that currently define graduate education. In fact, I believe the faculty and the aggregation of scholars and research resources within a university context will become even more important to the students of the future than they are today.

Though the physical facilities of a campus will still be important, the residential component for graduate and professional students may change. Rather than spending several years on a single campus, I predict that graduate students are likely to come to campus for shorter periods of concentrated interaction with faculty and research collaborators. They may travel to several campuses in various parts of the world; and they are likely to be attracted to a university that offers a diversity of physical settings, with modules offered abroad or to other affiliated campuses. The introduction of electronic learning will make the faculty more essential to universities than ever before. A professor's ability to recognize and cultivate qualities in students that are uniquely human is beyond the capacity of any technology available on the market.

Today, faculties are important as repositories and transmitters of information — as pedagogues who shape students' intellectual growth and as creators and sustainers of distinctive academic programs. But the new electronic learning will cause the nature of the student-mentor relationship to develop in new directions. The faculty of the future will need to be adept at drawing out the individual intellectual and creative talents of each student in guiding him or her beyond the mastery of information to the use and extension of knowledge. The future faculty will have to be not only adept but also extremely facile and creative at using the tools of information technology in order to fulfill their roles.

I believe we are now entering a new Golden Age for research and education in the next century. This new age also will be supported by the Federal/university partnership, but will include greater participation by other stakeholders, both in the U.S, and in the international science and technology communities. We should build on the base of our experience, using the new tools past public investment has provided us to expand knowledge and innovation. But graduate education must continue to change, both to address the need for greater flexibility for students in career preparation, and in response to relevant concerns raised by our stakeholders in industry, the academy and the public.

To sustain the new Golden Age, we need to continue to be more agile in identifying and adequately supporting the most promising areas for research. We need to enable broader cross-disciplinary, cross-sector, and cross-institution collaborations among researchers and their students, even while providing strong support to traditional fields. We must remember that research supported in institutions of higher learning has an impact on our national science and technology capabilities for the future-both human and physical. We should be quick to seek opportunities to employ the latest in technology in research and learning in an environment of free and open inquiry. And we should be more creative and effective in identifying strategies for expanding participation of underrepresented groups in academic research and education.

We have a system that works, that is internationally admired as the finest science and engineering graduate education system in human history. We must continue to enhance this system and expand its benefits. It is our obligation to provide our future citizens with a healthy infrastructure of cutting edge scientific research and graduate education, not just for today, but to serve the next quarter century and beyond.

Dr. Eamon Kelly is chairman of the National Science Board, which recently published The Federal Role in Science and Engineering Graduate and Postdoctoral Education. The above text was adapted from remarks made to the Council of Scientific Society Presidents in Washington, D.C., December 7, 1998. Dr. Kelly's complete remarks, as well as the full report, can be found at http://www.nsf.gov/nsb/documents/start.htm

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