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APS physics

Election Preview
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2008 US Physics Team Training Camp: Sights Set on Vietnam

By Nadia Ramlagan

Richard Berg of the University of Maryland is standing on top of a desk, one arm outstretched and grasping a slinky. The bottom end isn't touching the ground. What happens to the bottom end if the upper end is released? An eager group of hands shoots up in the air. Welcome to the 2008 US Physics Team training camp. The students were responding to Berg's question during his physics IQ test lecture, one of the many entertaining but challenging events the team will experience during its 10-day stay at the campus in College Park.

The 24 students attending camp were selected through a highly competitive elimination process, and they represent the brightest, most disciplined high school physics students in the United States. Five of these students will be chosen to represent the US at the 67th International Physics Olympiad July 20-29 in Hanoi, Vietnam.

The daily routine is intensive, studying physics from 8:00 a.m. to 9:30 p.m. "I wish we could sleep in at least one day," says Tucker Chan, a senior from Princeton High School in Princeton, NJ. The week consists of 5 mystery labs, 7 exams, and daily lectures on oscillations, waves, relativity, and thermodynamics.

Scattered throughout the week were games, including frisbee most nights, and a trip to Congress in Washington DC, where the students toured the city and met former Democratic presidential nominee John Kerry. Students also presented a physics-related toy to their own Senators and Representatives.

"Only special kids get to this level of math and physics, they have to push themselves. This means doing extra problems on their own time. The most rewarding aspects of this experience are interacting with the kids, and pushing them further intellectually. Many times they push you," says coach David Jones, an instructor at Florida International University and high school teacher of 20 years.

The students, ranging from freshmen to seniors and coming from a variety of backgrounds, are enthusiastic about camp, ready to absorb as much information as

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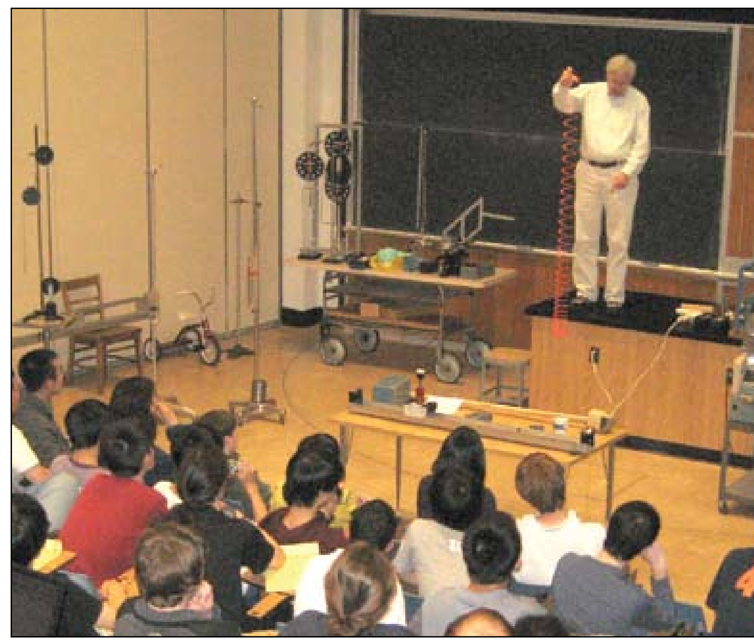

Photo by Nadia Ramlagan

Richard Berg challenges the members of the US Physics Olympiad team to predict what will happen when he drops the slinky.

PhysicsCentral Takes on a New Look and Feel

When PhysicsCentral, the APS website for the public, was launched in late 2000, the web was a very different place. The original PhysicsCentral (below, left) was all text and pictures, with an occasional animated gif to liven things up. But now the web is filled with podcasts and vodcasts, blogs and RSS feeds, words that didn't even exist back then.

Clearly PhysicsCentral needed an upgrade if it wanted to maintain its core audience of members of the public with an interest in science, especially students at all levels from middle school through university. Rather than do it piecemeal, it was decided last year to undertake a complete redesign.

The new PhysicsCentral was launched in May, and as can be seen by comparing the two pictures, the look is very different. Underneath the design is a dynamic architecture that accesses the content more efficiently and brings more of it to the home page. The site now features its own blog, Physics Buzz, and APS Head of Public Outreach Jessica Clark, who runs PhysicsCentral, is busy collecting a series of podcasts and vodcasts that will augment the text and pictures format of the earlier material.

Before

After

"A lot of work went into the redesign," says Clark. "The new site is interactive with tons of fun new features which will engage all levels of users, from K to grey."

Finalists Vie for APS Industrial Physics Prize

Five finalists are competing for the first APS Prize for Industrial Applications of Physics, launched this year. As reported in the January *APS News*, the prize, sponsored by General Motors and presented biennially, is intended to recognize cutting-edge technologies, and is especially targeted at physicists working in smaller companies.

To encourage nominations, the selection process has two stages: first, preliminary nominations are submitted by the deadline of April 1. The selection committee picks a small number of finalists, who then submit more complete nomination packages by July 1, from among which the committee will recommend the recipient to the APS Executive Board.

This year 16 preliminary nominations were received. "I was delighted that there were so many nominations of high quality," said Greg Meisner, the selection committee chair. "But it made choosing the finalists very difficult."

The finalists selected by the committee are:

Jason Ensher and Susan Hunter

Jason Ensher and Susan Hunter applied tunable External Cavity Laser Diodes (ECLDs) to holographic data storage. Holography holds great potential for storing information because holograms can be multiplexed in three dimensions, rather than being limited to the surface of the storage medium. InPhase Technologies spun off from Bell Labs in 2000 to commercialize a unique chemistry for the storage media and the architecture for a holographic drive, with a storage lifetime of 50 years and density and cost comparable to magnetic tape. However, the most daunting remaining challenge was finding a light source for the drive. Commercial holography requires a laser with spectroscopic quality, in a small robust package that costs a small fraction of the total $18,000 drive.

ECLDs have been used since the early 1990s to apply semiconductor laser diodes to high-resolution spectroscopy, but while the performance specifications met InPhase's needs, the cost to scale up efficiently to manufacturing volumes was too high: Ensher and Hunter aimed for a cost 10 times lower than ECLDs of comparable performance. The usual approach is to make the ECLD continuously tunable in a single mode using an expensive cavity and very precise tuning mechanism. Ensher and Hunter realized it would be much cheaper to design a cavity that minimizes laser mode-hops that can also detect when the laser mode is degrading thanks to the incorporation of a mode sensor combined with a digital control algorithm.

Ensher and Hunter's ECLD automatically senses the laser mode and feeds back this information to correct the laser cavity length–they

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DAMOP Holds Annual Meeting in State College, PA

Recent progress towards achieving quantum storage in solid state devices, manipulating single-electron spins in quantum dots, and laser cooling of mechanical oscillators were among the highlights of the 2008 meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP), held 27-31 May in State College, Pennsylvania.

Quantum Memory. Quantum memories are likely to be critical components in any future long-range communications network, and several talks at the DAMOP meeting focused on various methods and approaches to achieving a viable quantum memory. Matthew Sellars of the University of Otago described a method for storing light that operates by controlling the local group velocity of light in a crystal, using an applied electric field. He maintains that unlike other proposals for quantum memories, his method requires no optical control pulses, thereby simplifying the operation of the memory and improving its signal to noise.

Hugues de Riedmatten of the University of Geneva is developing atomic ensembles to realize a quantum storage device for single photons in a solid state environment. His ensembles employ rare-earth ions–a "frozen gas of atoms"–doped into dielectric crystals, which can in principle store single photos and recall them with high efficiency using a modified photon echo approach. Different wavelengths of absorption can be achieved depending on the choice of rare-earth ions employed. De Riedmatten finds that erbium-doped solids are an especially attractive candidate for a quantum memory at telecommunication wavelengths.

The "holy grail" of research into

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VOTE in the APS News Caption Contest!!

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Members in the Media

"Most every problem you can imagine has been solved by nature. Nature got there first. All that is left is to rationalize nature's designs, many of which are remarkably subtle."
John Bush*, MIT,* Boston Globe*, May 19, 2008*

"Nature has simple ways of making structures and materials that are still unobtainable with our million-dollar instruments and engineering strategies."
Michael Bartl*, University of Utah, on a beetle whose scales are photonic crystals,* The Salt Lake Tribune*, May 23, 2008*

"He really changed our concept of how space and time are put together."
William H. Wing*, University of Arizona, in an obituary for Willis Lamb,* Washington Post*, May 19, 2008*

"The discovery of dark energy has greatly changed how we think about the laws of nature."
Edward Witten*, Institute for Advanced Study,* The New York Times*, June 3, 2008*

"We caught the whole thing on tape, so to speak. I truly won the astronomy lottery. A star in the galaxy exploded right in front of my eyes."
Alicia Soderberg*, Princeton University, on discovering a supernova as it was beginning to explode,* The New York Times*, May 22, 2008*

"If you're wearing gold jewelry, it came from a supernova explosion."
Robert Kirshner*, Harvard University,* The New York Times*, May 22, 2008*

"Because we see this extra effect, we can either blame it on the left-hand side of the equation and say we don't understand gravity, or we can blame it on the right-hand side and say there's this extra stuff."
Adam Riess*, Johns Hopkins University, on dark energy,* National Geographic News*, May 16, 2008*

"We're motivated by the physics questions we're trying to answer, and we're willing to move heaven and Earth to get the experiment built to answer these fundamental questions about the universe."
Paul Padley*, Rice University, on the LHC,* The Houston Chronicle*, May 25, 2008*

"Still, it's incredibly hard for Americans to be effective on a European experiment."
David Toback*, Texas A&M University, on the LHC,* The Houston Chronicle*, May 25, 2008*

"Congress had to have some symbol of fiscal restraint, and we were it,"
Roy Schwitters*, University of Texas, on the cancellation of the SSC,* The Houston Chronicle*, May 25, 2008*

"The specific experience you get doing that stuff doesn't have applications outside that narrow world. It's not obvious that I will be able to be fully employed."
Ken Sale*, a nuclear weapons expert who was recently laid off from Lawrence Livermore Lab,* The Associated Press*, June 3, 2008*

"These results strongly imply that no more than 4 percent of the pulsar's energy loss is due to gravitational radiation."
Michael Landry*, LIGO, on new data from the Crab Pulsar,* Tri City Herald*, June 3, 2008*

"Looking out of the Milky Way, we can see some supernova explosions with optical telescopes across half of the Universe, but when they're in this murk, we can miss them in our own cosmic backyard."
Stephen Reynolds*, North Carolina State University, on the discovery of the youngest supernova in the Milky Way,* Reuters*, May 14, 2008*

This Month in Physics History

July 1820: Oersted and electromagnetism

By the end of the 18th century, scientists had noticed many electrical phenomena and many magnetic phenomena, but most believed that these were distinct forces. Then in July 1820, Danish natural philosopher Hans Christian Oersted published a pamphlet that showed clearly that they were in fact closely related.

Hans Christian Oersted was born in August 1777, in Rudkobing, Denmark. He was educated mainly at home, and showed some interest in science as a child. At age 13 he apprenticed himself to his father, a pharmacist. In 1794, he entered the University of Copenhagen, where he studied physics, philosophy and pharmacy, and earned a PhD in philosophy.

He completed his PhD in 1801, and, as was customary, he began traveling around Europe, visiting Germany and France and meeting other scientists. One person he met, and may have been inspired by, was Johann Ritter, one of the few scientists at the time who believed there was a connection between electricity and magnetism.


Hans Christian Oersted

Returning to Copenhagen in 1803, Oersted sought a university position teaching physics, but didn't immediately get one. Instead he began giving lectures privately, charging admission. Soon his lectures became popular, and he was given an appointment in 1806 at the University of Copenhagen, where he expanded the physics and chemistry program and established new laboratories. He also continued his own research in physics and other areas of science. His first scientific paper was on electrical and chemical forces. He investigated a variety of problems in physics, including the compressibility of water and the use of electric currents to explode mines.

Oersted made the discovery for which he is famous in 1820. At the time, although most scientists thought electricity and magnetism were not related, there were some reasons to think there might be a connection. For instance, it had long been known that a compass, when struck by lightning, could reverse polarity. Oersted had previously noted a similarity between thermal radiation and light, though he did not determine that both are electromagnetic waves. He seems to have believed that electricity and magnetism were forces radiated by all substances, and these forces might somehow interfere with each other.

During a lecture demonstration, on April 21, 1820, while setting up his apparatus, Oersted noticed that when he turned on an electric current by connecting the wire to both ends of the battery, a compass needle held nearby deflected away from magnetic north, where it normally pointed. The compass needle moved only slightly, so slightly that the audience didn't even notice. But it was clear to Oersted that something significant was happening.

Some people have suggested that this was a totally accidental discovery, but accounts differ on whether the demonstration was designed to look for a connection between electricity and magnetism, or was intended to demonstrate something else entirely. Certainly Oersted was well prepared to observe such an effect, with the compass needle and the battery (or "galvanic apparatus," as he called it) on hand.

Whether completely accidental or at least somewhat expected, Oersted was intrigued by his observation. He didn't immediately find a mathematical explanation, but he thought it over for the next three months, and then continued to experiment, until he was quite certain that an electric current could produce a magnetic field (which he called an "electric conflict").

On July 21, 1820, Oersted published his results in a pamphlet, which was circulated privately to physicists and scientific societies. His results were mainly qualitative, but the effect was clear–an electric current generates a magnetic force.

His battery, a voltaic pile using 20 copper rectangles, probably produced an emf of about 15-20 volts. He tried various types of wires, and still found the compass needle deflected. When he reversed the current, he found the needle deflected in the opposite direction. He experimented with various orientations of the needle and wire. He also noticed that the effect couldn't be shielded by placing wood or glass between the compass and the electric current.

The publication caused an immediate sensation, and raised Oersted's status as a scientist. Others began investigating the newly found connection between electricity and magnetism. French physicist André Ampère developed a mathematical law to describe the magnetic forces between current carrying wires. Starting about a decade after Oersted's discovery, Michael Faraday demonstrated essentially the opposite of what Oersted had found–that a changing magnetic field induces an electric current. Following Faraday's work, James Clerk Maxwell developed Maxwell's equations, formally unifying electricity and magnetism.

Oersted continued working in physics. He started the Society for Dissemination of Natural Science, which was dedicated to making science accessible to the public, something he thought was very important. In 1829 he established the Polytechnical Institute in Copenhagen. He was also a published writer and poet, and contributed to other fields of science, such as chemistry–for instance, in 1825 he produced aluminum for the first time. Oersted died in 1851. His 1820 discovery marked the beginning of a revolution in the understanding of electromagnetism, providing the first connection between what had been thought to be two very different physical phenomena.

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Washington Dispatch

A bi-monthly update from the APS Office of Public Affairs

ISSUE: Science Research Budgets

As of June 2nd, the *APS News* filing deadline, the House and Senate had passed separate bills for Fiscal Year 2008 supplemental appropriations, intended principally to fund the ongoing Iraq and Afghanistan wars. Science lobbyists had hoped that an intensive five-month effort would pay off with the inclusion of several hundred million dollars of emergency research funding to address the serious shortfalls in last December's Omnibus funding bill. But the House was unable to muster enough votes even to pass the Iraq and Afghanistan provision. And ultimately it sent a stripped-down bill to the Senate that contained money for the support of veterans' education, an extension of unemployment benefits, international food and disaster assistance, and strengthening of the New Orleans levees. In spite of House Speaker Nancy Pelosi's expressed intention to include science, it was conspicuously absent from the list.

By contrast, the Senate delivered on its promise to provide additional funding for science research and education. Its supplemental bill, which passed by a veto-proof margin of 75 to 22, contained $1.2 billion allocated to four key agencies:

- NSF–$150 million for Research and Related Activities (much of it for graduate traineeships) and $50 million for science and math education programs (teacher training and graduate fellowships);
- DOE–$100 million for the Office of Science and $300 million for Environmental Management (nuclear waste clean-up, targeted for Hanford, WA);
- NASA–$200 million for a new account related to the Space Shuttle return to flight; and
- NIH–$400M.

The Senate bill represents a major step forward, but it leaves unaddressed the inability of the DOE national laboratories to continue their operations under the FY 2008 Omnibus appropriations bill, without eliminating thousands of jobs and seriously reducing the availability of its users facilities. The House-Senate conference that is needed to resolve the differences between the two versions of the Supplemental Bill could provide an opportunity for Congress to remedy the flaws in the DOE allocation.

Although final passage of the Supplemental Bill could occur in mid-June, there is a strong possibility that President Bush will veto it. Should he choose to do so, and should Congress fail to override the veto, a compromise will have to be worked out. That could provide an opening for lawmakers and the President to deliver on their expressed desire to keep the American science enterprise healthy and competitive.

To track the progress of the appropriations bills and the emergency supplemental bill, visit http://www.aaas.org/spp/rd/approp08.htm or go to http://www.aps.org/policy/issues/research-funding/index.cfm.

ISSUE: Nuclear Forensics

As reported in the May Washington Dispatch, the APS Panel on Public Affairs, in cooperation with the American Association for the Advancement of Science (AAAS) Center for Science Technology and Security Policy, issued an unclassified report that reviews the US nuclear forensics program. The report provides a summary of the techniques and capabilities and identifies five areas for improvement. The report can be downloaded from the APS website: http://www.aps.org/policy/reports/popa-reports/index.cfm.

Since then, both the House of Representatives and the Senate implemented the report's recommendations in their Defense Authorization Bills. The Senate bill calls for $25 million for forensics-related research and fellowships, while the House bill also incorporates the policy recommendations of the APS/AAAS report, including the establishment of a federal Nuclear Forensics Advisory Panel and the development of an international forensics database. Rep. Bill Foster (D-IL), a physicist who won a special House election in March, had previously proposed the policy language in H.R. 5929, which the House adopted as an amendment to the Defense authorization bill on May 23rd.

ISSUE: Campaign Education Project

The American Physical Society, in cooperation with 10 science and engineering organizations, hosted a "Campaign School" on May 10th in Washington DC. The purpose of the event was to educate members of the participating organizations on how to run for state and local elected office. The workshop was highly successful and received coverage not only in *APS News*, but also in *USA Today* and *Physics Today*, among other media outlets.

For more information, please contact Francis Slakey at slakeyf@georgetown.edu.

ISSUE: Washington Office Media Update

The Courier-Journal in Kentucky published an op-ed on April 28 by University of Kentucky President Lee T. Todd Jr. regarding the importance of including critical science funding in the FY '08 supplemental spending bill.

Physics World magazine ran a story on April 15 about a group of 20 American Nobel Laureates in the physics field who wrote to President Bush, urging him to include crucial science funding in the supplemental legislation. Michael Mandel, a journalist who covers hot economic issues for *BusinessWeek* magazine, published the APS news release regarding the Nobelists' letter on his blog, "Economics Unbound." Mandel commented on May 7, "I just got this press release from the American Physical Society. This is the sort of thing which depresses me. If we can't find the money to spend on science and innovation, then my optimism index goes way down."

Log on to the APS Web site (http://www.aps.org/public_affairs) for more information.

Committee Holds New York Meeting

Photo by Rob Steiner

In May the APS Committee on Informing the Public, together with visitors and APS staff, met at the American Museum of Natural History in New York. Front row (l to r): James Riordon (APS), Laura Greene (U. of Illinois), Bo Hammer, Chair (Franklin Institute), Alan Chodos (APS), Jessica Clark (APS), Gianfranco Vidali (Syracuse U.), Sean Carroll (Caltech), Dan Dahlberg (U. of Minnesota), Larry Gladney (U. of Pennsylvania), Ivan Schuller (UCSD), Becky Thompson-Flagg (APS), Paul Chaikin (NYU), Brian Schwartz (CUNY). Back row (l to r): Tyrannosaurus Rex, Apatosaurus.

DAMOP continued from page 1

quantum memory is a system that would allow high-fidelity storage and retrieval of an arbitrary optical state. Alexander Lvovsky of the University of Calgary reported on the potential for storage of squeezed light to serve as a step towards a universal quantum memory. He presented results from a functioning testbed for such a system, bringing together the quantum state, the memory cell, and full characterization of both the input and the retrieved state in a single apparatus.

Quantum Dots. David Awschalom of the University of California, Santa Barbara's Center for Spintronics and Quantum Computation reported that his research group has demonstrated the non-destructive detection of a single electron spin in a quantum dot. The ability to sequentially initialize, manipulate and read out the state of a qubit, such as an electron spin in a quantum dot, is necessary for virtually any scheme for quantum information processing. The dot in this case is formed by interface fluctuations of a gallium arsenide quantum well, and embedded in a diode structure, positioned within a vertical optical cavity to enhance the small single spin signal. Awschalom's group has also recently developed a scheme for high-speed all-optical manipulation of the spin state that enables multiple operations.

Cool Runnings. Laser cooling of macroscopic mechanical oscillators has applications in high-precision measurements, gravitational wave detectors, and exploration of the classical-quantum transition, according to MIT's Nergis Mavalvaya. She described a series of cooling experiments–inspired by gravitational wave detectors–to trap and cool gram-scale mirror oscillators. To achieve this, her team had to use a variety of cooling techniques that employ frictionless forces. Such forces are created from either radiation pressure in a detuned optical resonator, or from electronic feedback forces in an active servo. They predict that as the experiments approach the quantum regime, an assortment of non-classical behavior and effects become evident, such as quantum radiation pressure noise, and squeezing and entanglement of the light and mirror states. With upgrades to their current apparatus, Mavalvaya hopes to observe these effects in the near future.

Runaway Electrons. In 2005, the Reuven Ramaty High Energy Solar Spectroscopic Imager recorded gamma-ray flashes of atmospheric origin, thereby revealing the presence of relativistic electrons in Earth's mesosphere, with energies up to 40 MeV. E.E. Kunhardt of Polytechnic University in New York examined the origin of these bursts in runaway electrons, which are not, on average, in dynamical equilibrium with the background gas, and move progressively towards higher energies. A collisional avalanche mechanism seems likely, but would have to overcome the fact that the peak ambient electric fields in the mesosphere are too low, even during thunderstorms, for electrons to overcome collisional losses and accelerate to such high energies.

Magnetic Sensing. Paola Cappellaro of the Harvard-Smithsonian Center for Astrophysics reported on development of a novel magnetic sensor that can operate at room temperature ambient conditions and could provide an "unprecedented combination of ultra-high sensitivity and spatial resolution." Among other applications, the new sensor could enable sensing of nanotesla magnetic fields with resolution below 50 nm–allowing for the detection of a single nuclear spin's precession within one second. Cappellaro's team took advantage of recently developed techniques for coherent control of solid-state electronic spin quantum bits, specifically, the use of spins associated with nitrogen-vacancy centers in diamond.

Biomolecule Precursors in Space. It is a topic of intense debate to what extent biomolecule precursors have been synthesized on planetary surfaces or in the interstellar medium. Advanced biomolecules such as amino acids are unlikely to survive the strong YV field present under disc and planetary formation, but precursor molecules like nitriles are present abundantly in the interstellar medium, and could possibly be delivered to planets by comets or meteorites, according to Wolf Geppert of Stockholm University. He presented recent measurements on the rate constants and branching ratios of several protonated nitriles gleaned from a storage ring experiment. In planetary atmospheres, nitriles can polymerize to tholines, which can form amino acids and nucleobases. Furthermore, the Cassini-Huygens mission revealed that protonated nitriles are abundant in Titan's atmosphere, which may resemble that of early Earth.

Living on the Air in Saint Louis

Photo by Brian Mosley

It had been a long day. As reported in last month's *APS News*, Nancy Ellen Abrams and Joel Primack (left) delivered a successful APS-sponsored public lecture at the Saint Louis Science Center, based on their book *The View from the Center of the Universe*. But after a late dinner, Abrams and Primack had more work to do–an appearance on late-night radio at KMOX, chatting with host Jon Grayson (right). Who knows how many of their listeners drifted off to sleep dreaming of galaxies far, far away? Fortunately for Abrams and Primack, once the interview was over, their hotel was close, close by across the street.

Letters

Teaching is an Independent Skill

In response to the letter in the May *APS News* from Kashyap Vasavada titled "Education Courses Don't Help": I agree that the balance between hours of education classes and classes in one's target subject required for a teaching certification needs adjustment. However, in my opinion, education classes do help. Even someone who understands the subject material can't necessarily teach it effectively. To teach well requires a commitment to the process of enabling learning and development in others, and this trait is not correlated with proficiency in one's field. However, understanding the principles of effective teaching doesn't mean you can teach a subject well when you don't understand the material. For me, the balance needs to be addressed because subject matter familiarity is required to teach effectively, but it is not sufficient. Therefore, education classes do (or at least should) help.

Dr. Vasavada was surprised by my statement that "...in most schools, too few students take physics to justify full-time physics teachers." The reason for this situation is that, although large percentages of students take 1 year of physics (100%?), those same students take 2-4 years of English, history/social sciences, and math. For this reason, the physics teachers often teach one or more of the other sciences the students take. So the issue isn't the percentage of students who take physics at some point in high school but rather that most students only take physics for one year in high school. I acknowledge that my "not enough students take physics" was a misleading way to express this point, and I am sorry for any confusion this may have caused.

One of my outside pursuits for the past 12 years has been coaching youth soccer. I am rather too fond of saying that I encounter nothing in my profession as a university researcher, graduate student and postdoctoral advisor, and K-12 science education outreach presenter, that I don't see on the soccer field in the interactions of 10-15 players, their parents, and the coaching and refereeing staffs. Of relevance to this discussion, we frequently have coaches who have played soccer at much higher levels than I ever played (collegiate and even professional) who wish to coach. These players often are frustrated by the certification requirements–they believe that since they play the game arguably better than the instructors, that they have nothing to learn in the coaching clinics. Many can and do go on to coach well, but many do not–the control parameter in my view being the style and effectiveness of the player's own coaches. Just as we tend to emulate our parents (for better and worse) when rearing our own children, we often tend also to emulate our teachers when teaching–which is why effective mentoring is so important, and can have such a big impact.

In any field of human activity, mastery of the skills of the activity does not necessarily imply mastery–or even competence–in teaching those very skills to others. I have been teaching some subject continuously since I was 17, when I was first certified by the Red Cross to teach first aid and CPR. Whether it's first aid, music, scuba diving, soccer, Sunday school, or even physics, my experiences tell me that this is a universal truth. I hope that the physics community will remember this "truth" when working to improve the training of physics teachers.

Rick Moyer
San Diego, CA

Make Physics More User-friendly

In response to K. Vasavada's letter about few students taking high school physics: If high school physics is a voluntary course, the reason few students take it is because the high school mathematically-based physics course is not user-friendly. Besides bad teaching, the texts are generally badly written. Most high school students have to do problems which they cannot readily solve since there is no example. In reality most average and better high school students can solve even difficult physics problems if given an example in the text. Under the erroneous idea that if a student struggles with a problem, he/she is "thinking," many good and diligent students have been turned off high school and college physics. Unnecessary struggling with a problem is really a waste of time. It is only successful problem-solving that turns novice students positively onto physics. Principles of educational psychology are not being used in either the teaching of high school or college physics, resulting in low enrollments from high school to college. The students are voting about physics with their feet–not taking physics when it can easily be made more user-friendly.

Stewart E Brekke
Downers Grove, Il

"Mixed Reality" Might Influence Real Life

Alfred Hubler's "Mixed Reality" state, as described in the May *APS News*, couples a real physical system, through sensors and actuators, to a running model of the system in a high speed computer. When the two finally get correlated, it leads to some interesting speculations: Digital computing is as good as analog coupling. Such correlation really validates the model, making its stand-alone use more trustworthy. One can study the effects of extending the physical system without having to build it.

But one wonders if the physical system itself is affected in any way. As a thought experiment, if we could couple real weather measurements and actuators (a thought, remember) to a running model of the weather, could we be able to influence the weather through this "Mixed Reality"? Or more specifically, in his coupled pendulum case, is there anything different about the first real pendulum, or its coupling to another "virtual" pendulum?

When it comes to human behavior as part of the feedback, perhaps being coupled to the stock market while it was coupled to a running model, will it really affect outcomes? Or when making one's life decisions when coupled to one's image in the model, Second Life? Could such intense "Mixed Reality" be any different from learning by being coupled physically to a superb running model with feedback, as in a flight simulator? Or are we talking about creating the "holodeck" on the Enterprise?

Henderson Cole
Danbury, CT

Proposed Constitutional Amendments Regarding Updating APS Treasurer Position to Treasurer/Publisher

Over the years, APS journal production and dissemination has become much more complex. With the introduction of online publications, tier pricing, consortium agreements, and the need for an international marketing effort, the position of Treasurer has broadened and assumed the usual responsibilities of Publisher. For the last six year the Treasurer has in fact given two reports to the Council: the Treasurer's report and the Publisher's report. The proposed Constitution and Bylaws amendments below are an effort to reflect the current operating procedures and clarify this in the statutes of the Society.

APS CONSTITUTION

ARTICLE IV-COUNCIL

2. **Duties**. The functions of the Council shall include the following:
b. Elect the Operating Officers, which are the Executive Officer, the Treasurer/Publisher, and the Editor in Chief.

3. **Composition**. The Council shall consist of the President, the President Elect, the Vice President, the most recent Past President, the Chairperson of the Nominating Committee, the Chairperson of the Panel on Public Affairs, who is elected by Council according to procedures specified in the Bylaws, the Operating Officers (Executive Officer, Treasurer/Publisher, Editor in Chief), and Councilors: eight General Councilors, one International Councilor, whose primary residence is outside the United States, and Councilors representing the Divisions, Forums and Sections. The value of the percentage X which appears in other Articles and affects the composition of Council, shall be determined by Council and specified in the Bylaws. There may sit with the Council as advisors such persons as Council deems desirable.

ARTICLE V – OFFICERS

1. **Officers**: The statutory Officers of the Society are the President, the President Elect, the Vice President, the Executive Officer, the Treasurer/Publisher, and the Editor in Chief. The President, the President Elect, and the Vice President shall assume office as hereinafter provided. The Executive Officer, the Treasurer/Publisher, and the Editor in Chief are the Operating Officers. They shall be elected by the Council as specified in the Bylaws.

6. **Duties of the Treasurer/Publisher**: The Treasurer/Publisher shall be responsible for the conduct of the financial affairs of the Society and shall oversee the financial affairs of the Divisions, Topical Groups, Forums, and Sections. The Treasurer/Publisher shall have direct responsibility for the financial aspects of the Society's publishing operations, such as contracts with outside vendors, marketing, subscriptions and consortia agreements, and pricing, and shall share with the Editor in Chief responsibility for non-editorial matters that have strong financial implications, such as copyright and policies for electronic access. The Treasurer/Publisher shall supervise the staff and operations of the office of the Treasurer/Publisher. Each year, the Treasurer/Publisher shall prepare a budget of income and expenses and a report on the financial condition of the Society and its units for review by the Executive Board and the Council. The Treasurer/Publisher shall receive, disburse, and invest funds as authorized by the Council or the Executive Board. The Treasurer/Publisher shall provide regular reports to the Executive Board and Council on the financial status of the Society. The Treasurer/Publisher shall perform such other duties as specified in the Constitution and Bylaws and as the Council or the Executive Board may assign.

7. **Duties of the Editor in Chief**: The Editor in Chief shall have editorial and operational responsibility for the research journals published by the Society and shall share with the Treasurer/Publisher responsibility for non-editorial matters

AMENDMENT continued on page 7

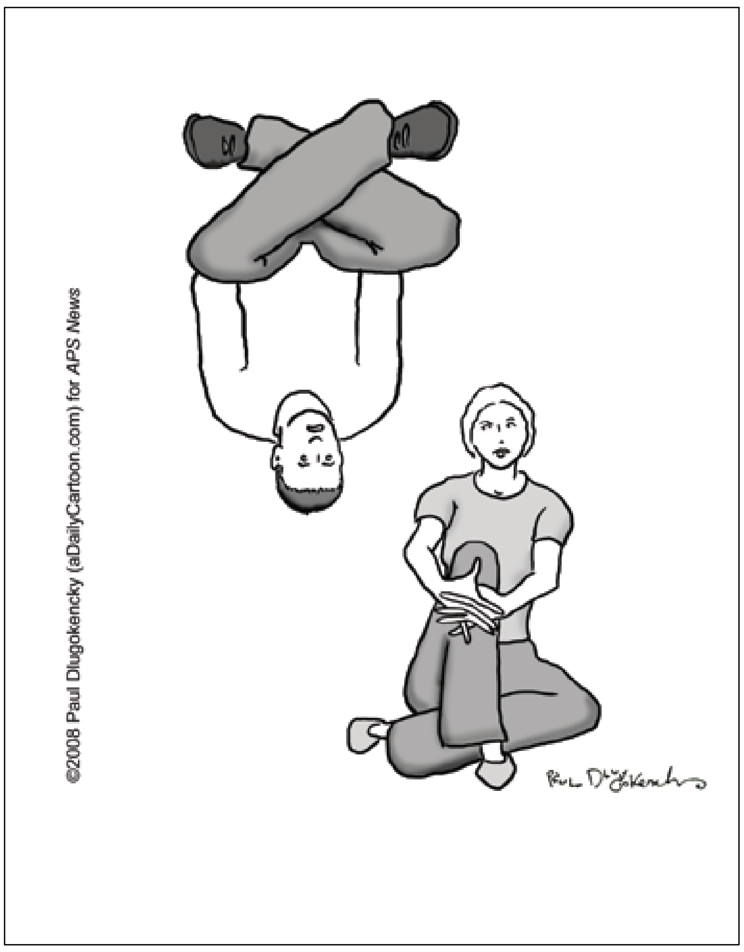
zero gravity

The Lighter Side of Science

Vote in the APS News Caption Contest

OK, we lied. In the April *APS News*, we said we'd post the best 3 captions for our readers to vote on. We thought we might get a dozen entries. Little did we suspect that the total would be 137. It's true that two very prolific caption writers broke the rules and submitted way more than one entry per person, but we're happy that 48 different people submitted entries, ranging from the sublime to the ridiculous. And of course the more ridiculous the better.

The range of opinion on what's funny extended not only to those submitting captions, but to those judging them. It has proved extraordinarily difficult to narrow the selection to five, much less three, but after an epic struggle we have decided on five captions as the finalists in our contest. Here they are:



Partway through their argument, Mary realizes that Albert does not understand the gravity of the situation.
–***Robert Collyer***, *Baton Rouge, LA*

"I think you lost a minus sign."
–***David Kaz***, *Somerville, MA*

Only in his 3rd year of teaching did the physics department become aware that Professor Wilberforce was actually a helium-filled balloon.
–***Roger Johnston***, *Argonne, IL*

"On our next date, can we please sit *next* to each other in the centrifuge?"
–***Elissa Dunn***, *New Haven, CT*

"When I said you have potential as a physicist, I didn't mean mgh."
–***Loren Booda***, *Arlington, VA*

It's easy for readers to vote. Just go to www.aps.org/publications/apsnews/poll/ and click on your favorite caption. One vote per person. Voting ends as of August 31. The winner will be announced in the October *APS News*.

PRIZE continued from page 1

call this Automatic Mode Control (AMC)–thereby enabling the ECLD to produce holograms for hours at a time, over a wide temperature range. The entire laser fits into a small package measuring 5 cm x 14 cm x 3 cm. Manufacturing of the first prototypes began in May 2008. The first customers for holographic storage are likely to be TV networks and major media companies. Further in the future, holography might be the basis for the next generation of consumer optical storage devices, selling millions of units per year.

As a graduate student in the mid 1990s, Ensher worked with Eric Cornell and Carl Wieman at the University of Colorado on laser cooling and trapping of atoms, which led to the creation of the first Bose-Einstein condensate of dilute alkali gases. After a postdoctoral position at the University of Connecticut, Ensher worked with laser diodes for ILX Lightwave, and then worked on tunable lasers for Precision Photonics Corp. He joined InPhase Technologies in 2006.

Hunter began working on 3D optical data storage and specialized lasers as a graduate student at the University of California, San Diego. She continued that work over an 11-year career at Hewlett-Packard (later Agilent Technologies). She joined InPhase Technologies in 2005.

Andrew McDowell

Andrew McDowell developed the first hand-held detector capable of nuclear magnetic resonance (NMR) spectroscopy of hydrogen. NMR techniques are popular because of their broad applicability to the study of chemical, physical and spatial properties of samples, without damaging or destroying those samples. Modern NMR instruments, while sophisticated, are large, expensive, must be installed in special rooms, and require periodic maintenance. This makes it difficult to bring NMR techniques out of the lab into applied industrial settings on the "factory floor."

McDowell set out to reduce the size and cost of NMR instrumentation by combining nanoliter volume "microcoil" detectors with small permanent magnets, which can generate magnetic fields of between 1 and 2 Tesla. While this is weak compared to superconducting NMR magnets, it is strong enough for portable NMR applications. To allow the operation of the tiny coils in the weak field, he added a counterintuitive "auxiliary inductor" to the traditional tuning circuit.

One of the most critical application areas for handheld NMR is the detection of pathogenic bacteria in biological samples, such as blood. Contaminated blood can lead to sepsis and death if not diagnosed and treated quickly. Over 200,000 people in the US die each year from sepsis. Combined with immuno-magnetic labeling of target entities, McDowell's technology results in unprecedented sensitivity and speed of detection. The technology allows for detection and identification of bacteria in blood samples within minutes, compared to 12 to 24 hours for conventional blood cultures. A start-up company based in Albuquerque, New Mexico, called nanoMR, has been formed to commercialize this technology.

McDowell earned his PhD in physics from Cornell University and was a postdoctoral fellow at Washington University in St. Louis before joining the faculty of Knox College. He worked as a scientist for New Mexico Resonance prior to co-founding ABQMR in 2005.

Roy Rand

As the vice president for research and development of a small start-up company, Imatron, Inc., Roy Rand played a key role in the development of an innovative cardiac CT scanner. The scanner Imatron developed had much shorter scan time than conventional CT scanners at the time, making possible clear images of a rapidly moving heart.

Conventional CT scanners use an x-ray tube that is swept mechanically; the Imatron scanner works with no moving parts–the x-ray beam is swept electronically, and therefore can be swept much faster. To do this, x-rays are generated using an electron beam that traverses a stationary tungsten X-ray target. For this application, an electron beam with high power (up to 140 kW) and a small beam spot (much less than 1 mm) was needed. These parameters hadn't been thought achievable, due to space charge repulsion.

Rand began a theoretical study, and realized that the necessary conditions could be achieved by neutralizing the space-charge of the electron beam and using "gas focusing." Rand's study resulted in a beam-optics system utilizing neutralization of the beam by means of its own beam-generated plasma. Ions were extracted from selected sectors of the beam by clearing electrodes while the pressure of the background chamber gas was controlled automatically. In this system most of the focusing was due to beam self-forces, while the focus adjustment and shaping of the beam spot were achieved by means of solenoid and quadrupole coils.

Rand's work resulted in 25 patents and a publication in the *Journal of Applied Physics*. Electron Beam Computed Tomography, as the technology is called, is used to detect calcification of coronary arteries, which is a heath risk factor that cannot be quantitatively measured with as much accuracy by any other device. Competing technologies expose the patient to a much greater radiation dose.

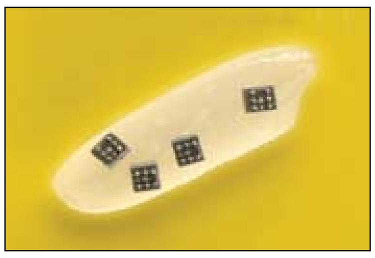
Rand earned his B.Sc. and Ph.D. from University College London. From 1960 to 1981, Rand was employed at various times at University College London, Daresbury Nuclear Physics Laboratory in England, Stanford University in California, and the University of Western Australia. He worked in high energy physics, nuclear physics, and accelerator physics. In 1981 he was asked by a former colleague, Douglas Boyd, to join him in founding Imatron as Vice President of Research and Development. Imatron manufactured and sold about 200 cardiac CT scanners throughout the world. The company was eventually bought out by General Electric in 2001, and Rand retired shortly after. Since then he has consulted for various companies on electron beam technology and is currently involved in designing an electron beam baggage scanner and explosives detector.

Richard Ruby, John Larson and Paul Bradley

Sleek thin cell phones packed with features are possible thanks to work by Richard Ruby, John Larson, and Paul Bradley of Avago Technologies. They developed filters and duplexers using FBAR (free standing bulk acoustic resonator) technology. The FBAR resonator consists of a piezoelectric layer sandwiched between two electrodes. The device resonates in the GHz frequency range, and because it is a mechanical resonator, the Q (quality factor) is exceptionally high.

In the early 1980s FBAR technology looked promising, but by the end of the decade researchers had lost interest in the technology due to several issues: the piezoelectric used, ZnO, was difficult to process; the gold electrodes used also had processing problems and poor Q; and it was difficult to make free- standing membranes. In addition, a simpler competing technology, surface acoustic wave (SAW) filters, already existed.

Ruby began working on the FBAR technology in 1993. He developed it into a practical device by using a different piezoelectric material, aluminum nitride, different electrodes, and a surface micro-machined process to create the free standing membrane.



Four FBAR filters in an all-silicon package (WLP) placed on a single grain of rice

Larson joined the project in 1996, working on modeling the device and on controlling the frequency across a whole wafer of filters. Paul Bradley, who joined the group in 1997, worked on modeling and designing filters using the FBAR resonator as the "engine." He measured and modeled the package as well as the device and began designing a PCS duplexer, which would become critical for cell phones.

Cell phones shrank dramatically with the first duplexers using FBAR technology. Duplexers, which separate transmitted signals from received signals, were previously made from ceramic, and were much larger. The FBAR filters are typically the size of a grain of sand. The first FBAR duplexers were sold in 2000, and now over a billion FBAR filters have been sold.

Rich Ruby obtained his PhD from the University of California, Berkeley, in 1984. Ruby then joined HP Labs. In 1993, he began researching FBAR technology as a means to making high-Q, ultra-miniature filters for rf applications. In 1999, Ruby became part of Agilent (a spin-off of HP) and moved to the Wireless Semiconductor Division of Agilent. This division became part of a new spin-off to a company called Avago Technologies.

John Larson earned his Ph.D. from Stanford University in 1971, then joined H-P Laboratories in 1972. Larson began working with Ruby in 1996 and began modeling, giving valuable insight as to the acoustics of the device. Later, he found a low-cost manufacturable method to "tune" all the filters on a silicon wafer to one frequency, and invented many new tools to improve the manufacture of FBAR.

Paul Bradley received a PhD in physics from UC Berkeley in 1988. From 1989-1997 he worked at Hypres, a low temperature superconductivity fabrication and design company in Elmsford, N.Y. He joined the HP Labs/Agilent Labs/Avago team in 1997 and became the key designer of the early filters and most important, the PCS duplexer (a particularly demanding filter-pair used in many cell phones today).

Philip Wyatt

Wyatt pioneered the commercialization of laser light scattering (LLS), a method with much practical benefit for both the chemical and pharmaceutical industries. Wyatt first became interested in the practical applications of the classical inverse scattering problem in 1967, suspecting it might prove to be a useful tool for identifying bacteria and spores, especially those that might be deployed in biological warfare. He modified a traditional light scattering photometer by replacing the usual Hg arc lamp with the then-newly- available HeNe laser source, and used his prototype to demonstrate its ability to differentiate between some species in liquid, to measure physical properties of a bacterial cell, and to detect the effects of antimicrobials within a few minutes.

He founded a company to commercialize these laser-based instruments, which closed after 12 years, and founded the Wyatt Technology Company (WTC) in 1982 with funding from the Department of Defense. Over the next 20 years, WTC's multi-angle light scattering photometer moved from use by manufacturers of synthetic polymers to the pharmaceutical industry, which recognized the potential of such instruments in the development of new biologicals, including vaccines and protein-based products. By the turn of the century, the product line had expanded to include differential refractometers and devices to fractionate liquid dispersed samples.

CAMP continued from page 1

they can, make new friends, and share their passion for physics with others.

Edward Gan, a junior from Montgomery Blair High School in Maryland, discusses the exposure to university-level work and equipment the camp provides. "Camp gives you direction. They give you all the materials and everything you need to do labs, things you don't have at home, like lasers. The best part is, if you do it right you might actually get a right answer, whereas at home you wouldn't."

Despite the fact that students are competing against each other for a spot on the traveling team, the atmosphere is jovial. Students and coaches crack jokes and laugh constantly at dinner, playing around with optical illusion toys and glowing balls in between bites of spaghetti and meatballs.

"You would expect it to be really competitive, but there is a real collaborative spirit, everyone is helping each other out," notes Kiranmayi Bhattaram, a junior from San Jose, California. Many students are just happy to be in the company of others who share similar interests.

With a talent for mentorship, coaches are largely responsible for the student's enjoyment, and they work hard to ensure campers are prepared for the difficulties of international competition. "The coaches here aren't like regular teachers. They put life into their teaching, and they're really fun to hang around," says Alesia Dechkovskaia, a junior from Durham, North Carolina. "I hadn't really thought about majoring in physics in college, it's always been a hobby of mine. But the lab experience I've gotten from camp has made me want to do more," she says.

The feeling seems to be reciprocal. Head coach Robert Shultz says, "I enjoy the challenge in working with high school students. I get a lot of questions I have to think about, and it is rewarding to see the student's hard work pay off." Shultz has been coaching the US team for the past 8 years.

After a careful selection process (based mainly on exam and mystery lab scores), the five finalists selected to comprise the traveling team were announced the last day of camp before a final dinner reception. The 2008 competitors are Tucker Chan; Edward Gan; Rui Hu, a senior from the Charter School of Wilmington in Delaware; Joshua Oreman, a junior from Harvard Westlake School in California; and Danny Zhu, a junior from Stuyvesant High School in New York.

More information about the traveling team, and the rest of the US participants, can be found on the web at http://www.aapt.org/olympiad2008/.

The traveling team will head to the west coast, meeting for 3 days of rigorous preparation at California State Polytechnic University before flying to Hanoi. Last year's team traveled to Isfahan, Iran where they won two gold and three silver medals.

The event is sponsored by the American Association of Physics Teachers, which also selects the participants and organizes the training camp at the University of Maryland. Additional funding comes from the American Institute of Physics and its member societies, including APS.

Created in 1967 by Eastern European nations, the first Physics Olympiad was held in Warsaw, Poland. Western countries began to participate throughout 1980's, with the US entering in 1986 as the program expanded. Since then, the US has continually ranked near the top 10 of all participants. Today, high school students from over 60 countries take part in the nine-day competition. The Vietnamese Physical Society and Ministry of Education and Training organized this year's Olympiad.

2008 GENERAL ELECTION PREVIEW

It's that time of year again, when APS members have the opportunity to elect next year's leadership from a slate of candidates selected by the APS Nominating Committee. Brief biographical descriptions for each candidate can be found below. Those elected will begin their terms on January 1, 2009. Members will elect a Vice President, Chair-Elect of the Nominating Committee, and two General Councillors. All votes must be entered by Noon, Central Daylight Time, September 1, 2008. Full biographical information and candidates' statements can be found at http://www.aps.org/about/governance/election/index.cfm.

VICE PRESIDENT

Barry C. Barish
California Institute of Technology

Dr. Barish earned his B.A. in 1957 and PhD in 1963 in physics from the University of California, Berkeley. He came to Caltech in 1963 as part of a new experimental effort in particle physics using frontier particle accelerators at the national laboratories. Among Dr. Barish's noteworthy experiments were those performed at Fermilab using high-energy neutrino collisions to reveal the quark substructure of the nucleon. These experiments were among the first to observe the weak neutral current, a linchpin of the electroweak unification theories of Glashow, Salam, and Weinberg.

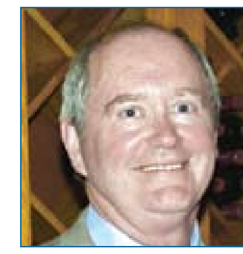
In the 1980s, Barish initiated an ambitious international effort to build a sophisticated underground detector (MACRO) in Italy in the promising and emerging field of particle astrophysics. Results from MACRO provided the best limits on the density of Grand Unified magnetic monopoles in the universe, ruling it out as a major contributor to the dark matter. The experiment also provided key evidence for atmospheric neutrino oscillations, helping to establish that neutrinos have mass.

Barish became Principal Investigator of the Laser Interferometer Gravitational-wave Observatory (LIGO) project in 1994 and served as Director of the LIGO Laboratory from 1997 to 2005. LIGO has recently completed a one year long data run at design sensitivity and is presently in the midst of analyzing that data for gravitational wave signals. The experiment has already set the best limits on most candidate sources at levels that are becoming astrophysically interesting. The interferometry technique works very well and a major upgrade is now underway to improve the sensitivity by more than an order of magnitude.

Barry C. Barish is presently the Director of the Global Design Effort for the International Linear Collider (ILC) and Linde Professor of Physics, Emeritus at the California Institute of Technology. The ILC is the highest priority future project for particle physics worldwide, as it promises to complement the Large Hadron Collider at CERN in exploring the TeV energy scale. This ambitious effort is being uniquely coordinated worldwide, representing a major step in international collaborations going from conception to design to implementation for large scale projects in physics.

In October 2002, Dr. Barish was nominated to the National Science Board; the 24-member board that oversees the National Science Foundation (NSF) and advises the President and the Congress on policy issues related to science, engineering, and education. He is a fellow of the American Physical Society and has received the Klopsteg Award from the American Association of Physics Teachers. Barish is an elected member of the American Academy of Arts and Sciences and the National Academy of Sciences. He has received honorary doctorates from the University of Bologna and the University of Florida.

Chris Quigg
Fermi National Accelerator Laboratory



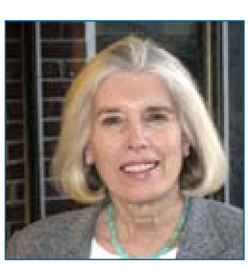
Chris Quigg graduated in physics from Yale in 1966 and received his PhD at Berkeley in 1970 with J. D. Jackson. After four years in the Institute for Theoretical Physics at Stony Brook, he moved to Fermilab, which has been his scientific home ever since. He was for ten years Head of Fermilab's Theoretical Physics Department, and held a joint appointment at the University of Chicago from 1974 to 1991. In 1987 he returned to Berkeley to serve for two years as Deputy Director of the Superconducting Super Collider Central Design Group. He has held visiting professorships at École Normale Supérieure in Paris, Cornell, and Princeton, was Erwin Schrödinger Professor at the University of Vienna, and is a regular visitor to CERN. He has lectured at summer schools around the world, and is much in demand as a keynote and summary speaker.

Chris Quigg is a Fellow of the American Physical Society and of the American Association for the Advancement of Science, and held a Sloan Fellowship. He has just received an Alexander von Humboldt Senior Scientist Award. Quigg has been Divisional Associate Editor of *Physical Review Letters* (1980-1983), Associate Editor of *Reviews of Modern Physics* (1981-1993), and Editor of the *Annual Review of Nuclear and Particle Science* (1994-2004). As Chair of the APS Division of Particles and Fields, he led the organization of Snowmass 2001: a Summer Study on the Future of Particle Physics. He has served the Society in numerous capacities, most recently as chair of the task force on the future of the April Meeting. His work for the physics community includes membership on experimental advisory committees, visiting committees, and government advisory committees in the US and abroad.

Quigg was a charter member of Saturday Morning Physics, Fermilab's enrichment program for high school students, and served as Trustee of the Illinois Mathematics & Science Academy. He has lectured and written frequently for the general public, and was featured in The Ultimate Particle, a road movie of particle physics broadcast in France and Germany.

CHAIR ELECT, NOMINATING COMMITTEE

Kate Kirby
Harvard-Smithsonian Center for Astrophysics



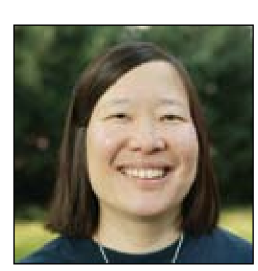
Kate Kirby received her B.A. in Chemistry and Physics from Harvard/Radcliffe College in 1967 and her PhD from the University of Chicago in 1972. After a postdoctoral fellowship at the Harvard College Observatory (1972-73), she was appointed as research physicist at the Smithsonian Astrophysical Observatory and Lecturer in the Harvard University Department of Astronomy (1973-86, and 2003-present). From 1988 to 2001 she served as an Associate Director at the Harvard-Smithsonian Center for Astrophysics, heading the Atomic and Molecular Physics Division. In 2001 she was appointed Director of the NSF-funded Institute for Theoretical Atomic, Molecular and Optical Physics (ITAMP) at Harvard and Smithsonian.

Kirby's research interests lie in the area of theoretical atomic and molecular physics, particularly focusing on the calculation of atomic and molecular processes important in astrophysics and atmospheric physics. Recent work has included studies of collision-broadened alkali atom resonance lines (seen in the atmospheres of brown dwarf stars), electron impact excitation of highly-charged ions (to understand astrophysical x-ray spectra), molecular line opacities in cool stellar atmospheres, and formation and destruction of small molecules in astrophysical environments. In addition she is working on processes for forming ultracold polar molecules via laser-induced photoassociation and using such systems as a platform for robust quantum computation. In 1990 she was elected to Fellowship in the APS.

Kirby has both chaired and served on numerous committees of the American Physical Society, including the Fellowship Committee (1993-95), the Nominating Committee (1994-96), the APS Ethics Task Force (2002-2003), the Committee on Prizes and Awards (2005-2006), and the Search Committee for APS Leadership Positions (Editor-in-Chief and Treasurer, 2005-06). She was elected APS Councilor-at-Large (1991-93) and Divisional Councilor for DAMOP (2003-07) and elected to the Executive Board of APS (2005-06). In addition she has served as Vice-Chair, Chair-Elect, and Chair of DAMOP (1995-98).

Other activities include membership on the Basic Energy Sciences Advisory Committee (2003-2008) and co-chair of the BESAC Subcommittee on Theory and Computation, member of the NAS/NRC Decadal Assessment Committee for Atomic, Molecular and Optical Science (AMO2010), Chair of the International Conference on Photonic, Electronic, and Atomic Collisions (2001-2003), and member of the Editorial Board of *Reports on Progress in Physics* (2007-present).

Clare Yu
University of California, Irvine



Clare Yu is currently a professor of Physics and Astronomy at the University of California, Irvine. She received her B.A. and PhD in physics from Princeton University. She was a postdoc at the University of Illinois, Urbana-Champaign and Los Alamos National Laboratory before joining the faculty at UC Irvine.

Her present research interests include biological physics and condensed matter physics. In biological physics she is working on intracellular transport and developmental biology. Her condensed matter physics interests include glassy and disordered systems, noise, and superconducting Josephson junction qubits. She has also contributed to problems in strongly correlated electrons, quantum magnetism, superconducting vortices, phase transitions, and quantum solids.

She was an Alfred P. Sloan Fellow and is a Fellow of the American Physical Society. She has served as a member-at-large of the executive committee of the APS Division of Condensed Matter Physics (DCMP), and as a member of the nominating committee of the APS DCMP. She was a co-organizer of the 2006 Workshop on Opportunities in Biological Physics sponsored by the APS Division of Biological Physics. She was co-leader of a Campus-Laboratory Collaboration (involving 5 campuses and Los Alamos) on Superconducting Vortices and Related Phenomena. She is currently a member of the University of California Academic Council Special Committee on (National) Lab Issues.

GENERAL COUNCILLOR

Nergis Mavalvala
Massachusetts Institute of Technology

Nergis Mavalvala is an associate professor of Physics at the Massachusetts Institute of Technology. She works on experimental gravitational wave detection and precision measurement at the quantum limit. She received her B.A. in Physics and Astronomy from Wellesley College in 1990, and completed her PhD in 1997, under the supervision of Rai Weiss at MIT. Her thesis work involved developing and testing the alignment sensing and control systems for the LIGO (Laser Interferometer Gravitational-Wave Observatory) interferometers. As a postdoctoral researcher at the California Institute of Technology, she was heavily involved in all aspects of the design and commissioning of the LIGO detectors. Since 2002 she has been on the Physics faculty at MIT, where she has continued her involvement with LIGO, but has also branched out into experimental quantum optics and quantum measurement in macroscopic mechanical systems. Nergis has been a Sloan fellow and enjoys teaching and interacting with students as much as she does her research.

Nergis's research interests span two related fields– experimental gravitational wave (GW) interferometry, and the quantum limits of precision measurement. She has been involved in experimental activities within the LIGO Laboratory over the past fifteen years, including design and implementation of interferometric sensing and control systems, commissioning of the initial LIGO detectors, study of quantum effects in future GW detectors, use of squeezed quantum states of light to enhance GW detector performance, and measurement of quantum behavior of macroscopic objects.

ANNOUNCEMENTS

Shekhar Mishra

Fermi National Accelerator Laboratory

Shekhar Mishra is Deputy International Linear Collider Program Director at Fermilab and adjunct professor of physics at University of Delhi, India. He received his B.S. in Physics at Patna University, India in 1980, his M.S. in Physics in 1983 and Ph.D. in Nuclear Physics in 1987 at the University of South Carolina. He conducted his M.S. and PhD thesis work in part at the Los Alamos Meson Physics Facility (LAMPF) and the Swiss Institute of Nuclear Research. From 1987-1989, Mishra was a Research Associate in the Physics Division, Los Alamos National Laboratory. As a young research associate Mishra was also co-spokesperson of three nuclear physics experiments at LAMPF. He was visiting scientist at Brookhaven National Laboratory and Fermilab. In 1989, Mishra joined the Fermilab staff as a Research Associate and played a leading role in design, construction, running, and analysis of a B Meson experiment. In 1991, he became a staff scientist in the Fermilab Accelerator Division as a member of Main Injector design team.

Mishra's research interests are in a broad range of accelerator physics, design, construction, and operation, as well as in experimental high energy physics. In the Accelerator Division, he has held positions of Head of Main Injector Commissioning (1998-1999) and Head of the Main Injector Department (1999-2003). He played a central role in the design, construction, and commissioning of two new accelerators, the Main Injector and Recycler at Fermilab. While a member of the Main Injector Design team, he continued his HEP interest by pursuing B-Physics at Fermilab's DZero detector and its upgrade (1990-2004).

In 2003, Mishra returned to accelerator design, this time to work on the design of the proposed International Linear Collider. He was initially involved in the design of the ILC Main Linac with the key issue of beam emittance preservation to maximize the luminosity. He played a central role in the ILC Main Linac technology selection by the International Technology Recommendation Panel. Since the selection of Superconducting Radio Frequency technology, he is leading the Fermilab R&D on superconducting cavities and cryomodules for future accelerators.

Mishra has served on many review committees, including the US Department of Energy, Spallation Neutron Source project review team. He chaired the Committee for the Joint University-Fermilab Doctoral Program in Accelerator Physics (1997-2000) and served as a committee chair for two PhD theses in high energy physics from the University of Delhi. He enjoys working with students and research associates.

Mishra is actively involved in promoting international participation in accelerator research and most importantly collaboration on a future lepton collider. Since 2002 he has been actively involved in the development of collaboration of US and Indian laboratories on accelerator development. The collaboration is working on R&D for future colliders and on each nation's domestic accelerator program. He is the US laboratories' liaison for this Accelerator R&D collaboration.

Jorge Pullin

Louisiana State University

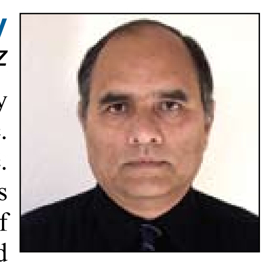
Jorge Pullin is the Horace Hearne Chair in Theoretical Physics at the Louisiana State University. His research interests center in theoretical gravitational physics, both in its classical and quantum aspects, including the application of numerical techniques.

He recently served as the chair of the Topical Group in Gravitation of the American Physical Society. His administrative experience also includes serving as associate director of Penn State's Center for Gravitational Physics and Geometry and as co-director of the Horace Hearne Jr. Institute for Theoretical Physics at Louisiana State. He is a managing editor of *International Journal of Modern Physics D,* serves on the editorial board of *Living Reviews in Relativity* and the *New Journal of Physics,* and served on the board of *Classical and Quantum Gravity*. He is one of the US representatives at the International Committee for General Relativity and Gravitation.

He has received several distinctions, including Alfred P. Sloan, John S. Guggenheim and Fulbright fellowships, a Career Award from the National Science Foundation and the Edward Bouchet Award of the American Physical Society. He is also a corresponding member of the National Academies of Science of Argentina and Mexico and of the Latin American Academy of Sciences. He is a fellow of APS, of the Institute of Physics (UK) and the American Association for the Advancement of Science. He got his doctorate in physics from the Balseiro Institute in Argentina in 1989.

Sriram Shastry

University of California, Santa Cruz



Sriram Shastry is a professor in the University of California at Santa Cruz. He received his B.Sc. in Physics from Nagpur University; his M.Sc. from the Indian Institute of Technology Madras in 1970 and his PhD from the Tata Institute of Fundamental Research, Bombay in 1976. He did postdoctoral work at the Imperial College London 1979-1980, and at the University of Utah 1980-1982. He was a faculty member at the Tata Institute 1982-1987, visiting faculty at Princeton University 1987-1988 and a Member of Technical Staff at AT&T Bell Laboratories in Murray Hill 1988-1994. He was a professor at the Indian Institute of Science, Bangalore 1994-2003 and has been at Santa Cruz since 2003.

Shastry is a theoretical condensed matter physicist who has worked in a wide variety of problems, from exactly integrable and exactly solvable models of quantum spins, to problems involving phenomenological modeling of experiments such as NMR relaxation rates, the Hall constant, and Raman Scattering in high T_c systems. He is the co-inventor of some popular models of quantum magnetism in low dimensional systems, where quantum fluctuations are dominant. He is mainly concerned, these days, with transport problems in strongly interacting electronic systems.

He is a Fellow of the American Physical Society, a Fellow of the Indian National Academy of Sciences, a Fellow of the Indian Academy of Sciences, and a Fellow of the TWAS (Academy of Sciences for the Developing World, Trieste, Italy). He received the 1998 TWAS award in physics for his work on interacting quantum many body physics.

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Many-body physics with ultracold gases

Immanuel Bloch, Jean Dalibard and Wilhelm Zwerger

Ultracold gases have had a surprising impact on condensed matter physics: they allow for an experimental realization of simple models for many-body physics, such as the Hubbard model. This review explains how the flexibility of trapped atomic gases can be used to observe important phenomena, such as the superfluid to Mott-insulator and Kosterlitz-Thouless transition, the exactly integrable Lieb-Liniger gas, and the BCS-BEC crossover by means of optical lattices and Feshbach resonances.

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with strong financial implications, such as copyright and policies for electronic access. The Editor-in-Chief shall supervise the staff and operations of the Society's research journals. The Editor-in-Chief shall implement policies relating to editorial policy and publications operations as approved by the Council or the Executive Board. The Editor-in-Chief shall submit periodic reports regarding the status of the Society's publications to the Council and the Executive Board and shall perform such other duties as specified in the Constitution and Bylaws and as the Council or Executive Board may assign.

ARTICLE VI - EXECUTIVE BOARD AND COMMITTEES

1. **Executive Board**. There shall be an Executive Board consisting of the President, the President Elect, the Vice President, the most recent Past President, the three Operating Officers (Executive Officer, Treasurer/Publisher, Editor in Chief), and eight additional Council members to be elected by Council as follows:

The functions of the Executive Board shall include the following:

c. Review the budget recommended by the Treasurer/Publisher before adoption by the Council, and authorize expenditures for current operations.

APS BYLAWS

ARTICLE III - STANDING COMMITTEES

A. OPERATING COMMITTEES

2. **Publications Oversight Committee**.-The membership of the Publications Oversight Committee shall consist of the Editor-in-Chief, the Executive Officer, the Treasurer/Publisher, four members elected by Council to staggered four-year terms and four members appointed by the President-Elect to staggered four year terms. The President-Elect shall appoint a Chairperson from among these eight members. The Committee shall propose guidelines for the operating philosophy of publications and shall oversee general editorial policy. It shall meet at least twice each year and shall make recommendations to Council regarding the research publications of the Society.

4. **Investment Committee**.-The membership of the Investment Committee shall consist of the Treasurer/Publisher, the Executive Officer, the Vice-President, and three other members appointed by the President-Elect to staggered three-year terms. The Treasurer shall serve as Chairperson. The Committee shall meet at least twice each year to review the financial and investment policies of the Society and shall make recommendations to the Executive Board and to the Council concerning these policies.

8. **Committee on Meetings**.-The membership of the Committee on Meetings shall consist of the Executive Officer, the Treasurer/Publisher, and six members appointed by the President-Elect to staggered three-year terms. The President-Elect shall appoint the Chairperson from among these six members. The Committee shall propose guidelines and rules for the organization and operation of all meetings of the Society and its units and shall provide oversight for meetings-related publications, including the Bulletin of the American Physical Society. The Committee shall recommend procedures for Society sponsorship of other meetings.

11. **Budget Committee**: The membership of the Budget Committee shall consist of the President-Elect and four members of the Council appointed by the President to staggered two-year terms. The President-Elect shall serve as Chairperson. The Committee shall meet with the Operating Officers during the initial budget planning process to establish overall goals and objectives for the next fiscal year and again as the budget is in the final stages of preparation. The Committee shall provide the Treasurer/Publisher with strategic guidance and with critical consideration of fundamental budget assumptions.

ARTICLE V - FINANCES

3. **Bonding**.-The Executive Officer and the Treasurer/Publisher shall give the Society bond in the amount required by the Council, at the expense of the Society, for the faithful performance of the duties of their office and for delivery, upon demand by the Council, of all records, money, and other property belonging to the Society that have been in their custody.

ARTICLE VI - POLICY ON TENURE OF OFFICERS

1. **Appointment and Tenure of Officers**.-The Executive Officer, the Treasurer/Publisher, and the Editor-in-Chief shall be elected by the Council to renewable five-year terms. A review of an incumbent Executive Officer, Treasurer/Publisher, or Editor-in-Chief shall be carried out by the Review Committee within the penultimate year of the term of office or sooner if so desired by Council. Council shall retain the power to replace an incumbent officer at any time following a review.

2. **Review Committee**.-The Review Committee shall consist of the members of the Executive Board except the Executive Officer, the Treasurer/Publisher, and the Editor-in-Chief. The most recent Past-President shall be the Chairperson of the Review Committee. The Review Committee shall be responsible for reviewing the performance of the Executive Officer, the Treasurer/Publisher, and the Editor-in-Chief, and it shall report its findings to the Council.

ARTICLE VII – NOMINATIONS AND ELECTIONS

6. **Nominations for Executive Officer, Treasurer/Publisher, or Editor-in-Chief**.-Nomination to fill a vacancy in the offices of Executive Officer, Treasurer/Publisher, or Editor-in-Chief shall be solicited from the entire membership of the Society by announcements in publications of the Society and the American Institute of Physics. The Review Committee, defined in Article VI, Section 2 of these Bylaws, shall select one or more candidates and shall present their names to Council for election according to Article IV, Section 2b of the Constitution.

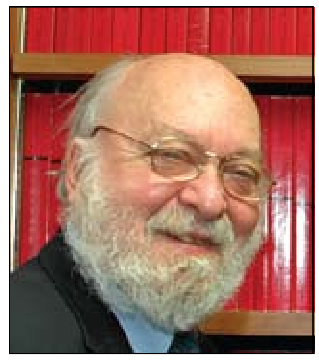
ARTICLE VIII - DIVISION, TOPICAL GROUP, FORUM, AND SECTION CONCERNS

1. **Division, Topical Group, Forum and Section Finances**.-Funds collected by the Society for Division, Topical Group, Forum, and Section membership dues, funds appropriated by the Council in lieu of dues, and funds collected by the Divisions, Topical Groups, Forums, and Sections shall be kept by the Society in internal accounts in the name of each such unit. The Society shall deduct from the accounts the itemized expenses incurred by the Society for services requested by these units and for services rendered them as approved by Council. The Secretary-Treasurer or a designate of a Division, Topical Group, Forum, or Section may authorize the disbursement of funds by the Treasurer/Publisher of the Society for expenses consistent with the general policies of that unit. Financial records shall be kept on an annual basis consistent with the fiscal policies of the Society. Statements of receipts and disbursements for a Division, Topical Group, Forum, and Section shall be submitted at least quarterly by the Treasurer/Publisher of the Society to the appropriate Secretary-Treasurers. Divisions, Topical Groups, Forums, and Sections may generate income from and incur expenses for activities, such as meetings, that are consistent with the Constitution and Bylaws and the fiscal policies of the Society. Petty cash accounts may be maintained by the Secretary-Treasurers of Divisions, Topical Groups, Forums, and Sections with the authorization of the Treasurer/Publisher of the Society.

The Back Page

APS, Physics: Aspirations and Goals

By Leo Kadanoff



In 2007, Bill Gates spoke to Congress about using science and technology to improve innovation and competitiveness in American industry: "In my view, our economic future is in peril unless we take three important steps: First, we must equip America's students and workers with the knowledge and skills they need to succeed in today's knowledge economy. Second, we need to reform our immigration policies for highly skilled workers so that we can be sure our workforce includes the world's most talented people. And third, we need to provide a foundation for future innovation by investing in new ideas and providing a framework for capturing their value." This statement is part of a movement by leaders in industry and science, including our own American Physical Society (APS), to invigorate US physical sciences.

Here, I'll talk about physics: its position at the top of the heap after World War II, its rapid decline during and after the Vietnam War, its efforts to rise again. At the moment, APS's attempts to boost physics are based upon lobbying for increased governmental funding of research. At the end of this talk, I'll suggest that APS increase its own effectiveness by making a substantially expanded parallel effort on improving education.

Looking Back; looking down

At a recent University cocktail party, a colleague asked me about how I felt about physics' decline in public prestige. This was to some extent a putdown. He is an economist. Then and now economists were to be found at the top of my university's status tree. They had replaced physical scientists in the perches on the topmost limbs.

Looking down from the top is jolly good fun. In 1960, I took up a postdoc in Copenhagen. That in itself was exciting. Nobody in my family had crossed the ocean in a civilian role since my mother's steerage passage in 1911. The Bolshoi Ballet came to town. As the highest cultural institution in the USSR they could only meet with ... us! So the often shy and awkward physicists came to dance with the ballerinas. Those graceful creatures moved under the watchful eyes of heavyset women who worked, no doubt, for the Soviet version of intelligence or security agencies. Promptly at 11:15 the watchers clapped their hands, the Bolshoi left. We were left behind, much impressed with our own social status.

Soon thereafter, as an assistant professor, I went to a scientific meeting in a very nice Italian town, Ravello, high above the Amalfi Drive. A movie company settled in our hotel. Like the Bolshoi the movie people thought that we could share their status at the top. They drew us into their circle, asking what we thought of the perpetual motion machine (first kind) that one of them (Ronald Colman) had invented. We were indeed pleased and flattered, most especially by their almost first-hand gossip about their social world, including things about the sex life of Bertrand Russell.

Quite a while later, I attended that cocktail party in which my colleague jabbed at me with the fact that physics had fallen off its pedestal. "How did I feel about our no longer being in intellectual 'high society'?" "Just fine," I said, "it gives me more time to work on the really worthwhile thing: physics" (I'm not quite sure I really said that. Memory is often flattering.)

A Golden (or maybe Silver) Age

Physics and physicists started the period after World War II with a great public reputation produced by the world-shattering work of Einstein, the inventors of quantum mechanics, and the developers of nuclear weapons. (Radar, codes, computers, and operations research counted too.) We helped invent new industries. We offered advice at the highest levels of government.

In this period, monetary support for physics and jobs for physicists came from a myriad of governmental labs and agencies, both civilian and military. Parallel support came from excellent industrial labs with major components of both basic and applied work. Widespread public enthusiasm for our work was kept going by the invention of the laser, maser, and transistor and later, in response to Sputnik.

But then things started falling apart.

Decline: Disaster after Disaster

Our mutually supportive arrangement with the military fell away when physicists did not fully support the Vietnam war. The river of military money became a trickle.

Scientific jobs in US industrial labs also started to disappear. Industrial labs often seem to have a roughly seven year lifetime of vibrant activity. They then shrink or close and are replaced by new labs. Only a few have a long life. This dynamic worked just fine in the US until, in recent years, the replacement labs in the physical sciences stopped coming. In parallel many firms moved facilities abroad or built them anew in places like Ireland or India or China. Why? Some firms perhaps were looking for a less expensive and better educated workforce. In addition, these facilities do serve as an advertisement for the firms in their growing markets. Overall, our industrial research showed a gradual decline over a long period, punctuated by the abrupt decline of Bell Labs, Xerox PARC, and Exxon's central research facility. With the decline and flight of industrial research, more than half the financial base for US physics disappeared.

Military sponsors also fell away. I recently attended an Army Research Office (ARO) conference intended to celebrate 50 years of ARO's accomplishments. They gloried in their past support for basic research, including the developments in atomic physics, by Dan Kleppner and others, which made possible the global positioning satellite system. They also pointed out that future accomplishments would be very different from past ones. No more basic research. Instead ARO wanted to support work on the immediate problems posed by the redesign of the army for much more intense firepower. They mentioned, for example, developing a better cloth for parachutes.

High energy physics was struck by its own very significant disaster: the closure of the Superconducting Super Collider (SSC) project in 1993. This Texas machine would have kept the center of particle physics in the US for a substantial time.

The world is flat; we are sliding off

That's ancient history. Let's jump to more recent events. After a long dry period for the physical sciences, about three years ago industrial leaders including Norman Augustine, former head of Lockheed, and Craig R. Barrett, the chairman of Intel, began to lobby intensively for better federal support for the physical sciences. As I see it, this effort was in large measure a response to the flight of high tech facilities abroad. The flight is a scary symptom of US decline.

Many industrial and scientific leaders felt it was imperative to arrest this decline. With staffing in part drawn from the APS Washington office, these leaders produced a series of reports and meetings with public officials. The most influential report, "Rising above the Gathering Storm" advocated (in its priority ordering)

1. better education in schools
2. financial support for useful research in physical sciences
3. support for higher education
4. more immigration of high tech workers
5. lower taxes on high tech in industry

2007: A good year foreseen

Last year, 2007, started out as a very good year for both the American Physical Society and American Physics. The previous year had brought broad support to the ideas of "Rising Above..." Early in 2007, authorization bills had been passed, which would, if converted into action, support both research and education as suggested in "Rising Above...".These bills got support from the White House, both Houses of Congress, and both Democrats and Republicans. All that was needed was an appropriation which would convert the plans into reality. APS continued to press for our own main goal: better support of research.

One might be able to see on the horizon, clouds, no larger than a man's hand, which could mar this potentially fine picture. First cloud: Congressional talk about the previous two appropriation bills had promised great leaps in physical science funding. In both cases the leaps disappeared at the last moment. Second cloud: the push toward new research funding was built upon the premise that business creativity would arise from a fertile research establishment. A buzzing of business opinion, for example in *The Economist* magazine, put forward the contrary premise that the important factor in corporate innovation was the creative push of business managers. Third cloud: although the support for increasing research and education was very broad, it was also very shallow. The same businesses which were now pushing federal support of research had previously rejected supporting US research within its own organizations. What would happen when push came to shove?

All through the year, APS' lobbyists kept pushing government on the numbers in the various bills that were intended to support research. In this way, APS worked to ensure that physics got the full dose, or more, of the moneys which had been quasi-promised in the authorization process. APS kept its eye on the research money, only on that money. Well, push did come to shoving between White House and Congress. Toward the end of the appropriations process there was a $20 billion difference between congressional bills and presidential statements. The president threatened a veto over that $20 billion. The people in Congress, our supporters, and our critics agreed to a final bill half way between the President's number and Congress'. In that compromise, almost all increases for physical sciences were eliminated.

Now we are in a tight spot. We were speaking out for doubling the research spending of three federal agencies: DOE, NSF, NIST. Much of the momentum of this process has been lost. In contrast, in the next months, the nation is planning to spend more than $400 billion over budget to make up for some errors of greedy moneylenders. As far as I can see, our more modest numbers have been drowned in that ocean of money.

Back to Basics

In my view, we have to go back to the beginning and make a new long-range plan. To do this we have to recognize that our industrial partners in "Rising above the Gathering Storm" and associated efforts are mostly concerned about workforce issues, and only secondarily worried by the relative decline in the US capacity for basic research. The workforce could be improved by better education. APS can improve the effectiveness of its advocacy and of its partnership with industry by making its goals equally education and research. If we argue and work for research, but not education, we will appear to be crass and selfish. The APS, its members, and physicists in general should, I believe, follow the mandate of the APS Council which tells us that

> *A strong educational program in Science and Mathematics is crucial for our national well-being. [...] Science literacy for all citizens is necessary to ensure full participation in the society of the future. (1983)*

I would thus urge APS lobbyists and policy makers to spend as much time on educational issues as upon research budgeting. APS concerns should include the entire spectrum of education: from pre-school programs to graduate training to science literacy for all. In particular, APS should take a much larger role in asking for better training of teachers.

Further, I would suggest that the richer of the physicists' institutions–Stanford, Princeton, Chicago, etc.–and the richer of the associations of scientists–AIP, APS, AAAS, etc.–should devote a small percentage (perhaps 2% per year) of their savings and endowment to the enhancement of pre-college education. They can accomplish this by freeing the time of concerned staff members to lead and participate in educational programs, both nationwide and local. In particular, they should take a much larger role in the training of teachers. A similar contribution might be expected from government labs and agencies containing scientists.

One success might be particularly close at hand. APS, AAPT, and AIP could contribute to high school physics teaching by using their resources to double the size of their very successful PhysTEC and PTEC teacher training programs.

I shall close with a comment by APS President Arthur Bienenstock. In his work in the (US) President's Office of Science and Technology he had a major interest in educational issues. He said that this interest paid off not only in the improvement of education but also enabled his involvement in alliances that made him more effective on other issues. I advocate for APS use of precisely that synergy.

Leo Kadanoff is the John D. and Catherine T. MacArthur Distinguished Service Professor Emeritus at the University of Chicago. He served as APS President in 2007. This article is adapted from his retiring Presidential address, delivered at the APS April Meeting in St. Louis.