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APS T-Shirt Contest
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Physics Caucus in Action

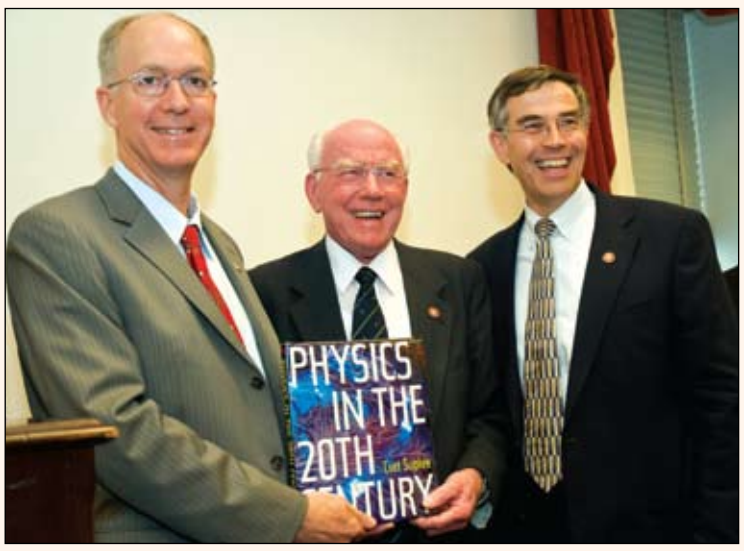


Photo by Ken Cole

On July 16 APS hosted a reception on Capitol Hill welcoming newly elected physicist Bill Foster (D-IL) to Congress. At the reception he was presented with a copy of the APS-produced volume "Physics in the 20th Century" by APS President Arthur Bienenstock. In the picture, the three physicists in Congress, all APS Fellows, proudly display the souvenir volume. They are, left to right, Foster, Vernon Ehlers (R-MI), and Rush Holt (D-NJ). The reception was co-hosted by the National Society of Black Physicists and the National Society of Hispanic Physicists, and was attended by Congressional staff, representatives of the funding agencies, lobbyists, and members of the sponsoring societies.

Physics is for Physicists (and others)

APS has launched a new online publication called, simply, *Physics*, which provides commentary on important journal articles and trends in physics.

Physics spotlights noteworthy papers in the APS journals *Physical Review A-E* and *Physical Review Letters*. Editors of those journals help select papers that report on a significant advance; *Physics* editor David Voss and assistant editor Jessica Thomas then commission an independent expert in the field to write a commentary on each selected paper.

The new journal "fills a niche that has been in need of filling for some time," says Voss.

The *Physical Review* journals publish high quality peer-reviewed research papers, but these are typically read only by specialists in a narrow area of physics. APS also publishes *Physical Review Focus*, an online publication that describes results in *PRL* and *Physical Review* for an audience of physicists, students, and others. Other publications explain developments in physics to other audiences, such as journalists and the general public. *Physics* will complement these. Articles in *Physics* are written by physicists, for physicists and aim to be understandable to a broad cross-section of physicists and scientists in related areas. Graduate students and advanced undergrad-

***PHYSICS* continued on page 3**

US Team Wins Five Medals at Hanoi Competition

By Nadia Ramlagan

Tucker Chan, Edward Gan, Joshua Oreman, and Danny Zhu brought home four gold medals and Rui Hu won a silver medal (he was just 0.2 points away from a gold), at this year's International Physics Olympiad held July 20-29 in Hanoi, Vietnam.

The medals were awarded at the competition's closing ceremony on July 28th. Among the festivities were a banquet, several speeches, and lively music and dance performances. The US placed second alongside South Korea and India, while China and Taiwan tied for first place. Both the coaches and team are extremely proud of their high ranking among stiff competition–a reflection of their talent and hard work.

The exam period is two days long, comprising a theoretical and experimental examination, each lasting about 5 hours. The theoretical exam covered mechanics, hydromechanics, thermodynamics and molecular physics, oscillations and waves, electric charge and electric field, current and magnetic field, electromagnetic waves, quantum physics, relativity, and condensed matter.

The theoretical exam provided the basis for all problems in the experimental exam. Participants

MEDALS continued on page 7

Franz to Step Down as APS Executive Officer; Search Committee Seeks her Successor

Judy R. Franz has been the Executive Officer of APS since 1994. In April of 2009 she will have completed her third 5-year term, and she has announced her intention to step down at that time.

According to the APS constitution, the Executive Officer serves as the principal administrator of the Society, and has primary responsibility for the Society's meetings. During Franz's tenure, among many other accomplishments, APS membership and meeting attendance have grown, programs in education and informing the public have been established, and the APS presence in Washington has been greatly enhanced. Under her leadership APS celebrated its centennial in 1999, and the World Year of Physics in 2005. In addition, as one of the 3 operating officers, she has worked with the Treasurer, who oversees the Society's finances and acts as publisher, and with the Editor-in-Chief, who runs the Society's journals, to manage the day-to-day operation of the Society.

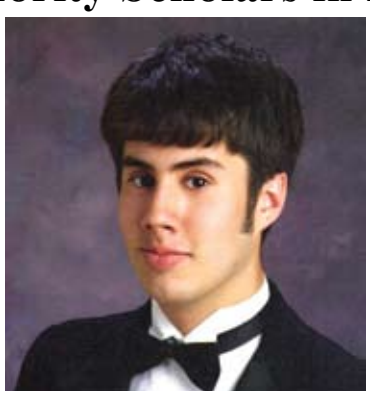
APS President Arthur Bienenstock has appointed a search committee to evaluate nominations and applications for Franz's replacement. Kate Kirby of the Harvard-Smithsonian Center for Astrophysics will serve as Chair. Joining her on the committee will be Curt Callan of Princeton, Jerry Friedman of MIT, Allen Goldman of the University of Minnesota, Anthony Johnson of the University of Maryland (Baltimore County), George Trilling of Berkeley, and Stefan Zollner of Freescale Semiconductor. Friedman and Trilling are past APS Presidents; Callan is the current APS vice-President.

The search committee begins its work in August, with the goal of forwarding a list of candidates to the APS Executive Board in early 2009. According to Kirby, the committee encourages suggestions from both the membership as well as the staff of APS as to highly qualified individuals whom they should consider for this position. Suggestions can be sent to Kirby at kkirby@cfa.harvard.edu, but all application materials should be submitted to execsearch@aps.org.

APS Funds 27 Minority Scholars in 2008-2009

The APS Committee on Minorities has selected 27 students to receive its Scholarship for Minority Undergraduate Physics Majors for 2008-2009. The recipients include 16 new scholars and 11 renewal scholars.

Each new scholarship consists of $2,000, which may be renewed once, for $3,000. The scholarship may be used for tuition, room and board, and educational materials. In addition, minority scholars are paired with two mentors, one at their university and one from the Committee on Minorities. Physics departments that host a minority scholar each receive $500 for programs to encourage minority students.



Minority Scholar John Bardeen

The program, formerly known as the Corporate-Sponsored Scholarship for Minority Undergraduate Students Who Major in Physics, began in 1980. Since then, hundreds of students have received the scholarship, many of whom have gone on to receive PhDs in physics and are now working as physics faculty members in universities, as well as at corporations and national labs. Some past scholars have also become high school physics teachers.

New minority scholar Jessica Starr, who will be a freshman at the University of Denver this fall, traces her interest in physics to her experience volunteering at the Space Odyssey exhibit of the Denver Museum of Nature and Science. She isn't sure yet what she wants to do with her degree in physics, but is considering a career in research. Starr is also an artist who has exhibited her work in galleries.

SCHOLARS continued on page 7

Astrowatch Keeps LIGO's Eyes on the Sky

By Calla Cofield

When LIGO announced last September that the upgrade to Enhanced LIGO would take its two largest interferometers offline from October 2007 until early 2009, a handful of physicists winced, and recalled a similar situation in 1987. That year, all available bar detectors went offline simultaneously and missed the 1987a supernova. Concerns were raised that LIGO might miss the gravitational wave signals from a gamma ray burst or supernova like 1987a—which it might have been able to detect—and have to wait who-knows-how-long for another one. Meanwhile, LIGO's smallest interferometer—the 2-kilometer-long H2 located at the Hanford, Washington facility—would be unable to operate during the daytime hours because of the significant seismic activity created by the construction. Plus, the operators would be occupied with the upgrade, and there wasn't funding to pay a new team.

It was looking like LIGO would be sitting out until 2009, when Keith Riles of the University of Michigan and Fred Raab of the LIGO Hanford observatory persuaded graduate student Evan Goetz to take up the reins. Willing to work odd hours for no pay, graduate students seemed like the perfect candidates–maybe the only candidates–to keep LIGO running. Now, Goetz is heading

LIGO continued on page 5

Photo by Evan Goetz

Left to right: Matthew West, Evan Goetz, Philip Roberts and Pinkesh Patel.

Members in the Media

"This is a new step for science. For the first time we have a chance to really objectively follow certain aspects of human behavior."

***Albert-László Barabási**, Northeastern University, on his study tracking people's movement through cell phone data,* Associated Press*, June 5, 2008*

"Every time you break an egg or spill a glass of water you're learning about the Big Bang,"

***Sean Carroll**, Caltech,* BBC News Online*, June 6, 2008*

"We're covering an energy range that almost hasn't been explored. We say we're working on the extremes of the universe. Gamma rays are the extreme."

***David J. Thompson**, NASA, on NASA's GLAST telescope,* Baltimore Sun*, June 9, 2008*

"We've done the calculation. By midcentury, I think, we'll have a functioning majority."

***Rush Holt**, on the growing number of physicists in Congress,* The New York Times*, June 10, 2008*

"They say, 'I am glad you are there, but I think you are crazy.' "

***Vern Ehlers**, on fellow scientists' reaction to his being in Congress,* The New York Times*, June 10, 2008*

"The result is certainly funny, but the process seems reasonable. I don't know of any previous attempts to make diamonds from drinks."

***Rudolf Pfeiffer**, University of Vienna, on a process for making diamond thin films from tequila,* New Scientist*, June 20, 2008*

"It's a trick that nobody has ever used and nobody has ever come up with because the belief was this would never work."

***Andrea Damascelli**, University of British Columbia, on a way to control and study electrons on the surface of superconductors,* Vancouver Sun*, June 24, 2008*

"Fortune 500 companies are cutting greenhouse gas emissions and increasing energy efficiency all over the world."

***Amory Lovins**, Rocky Mountain Institute,* Northwest Arkansas Times*, June 24, 2008*

"Lots of theories are going to pop up–it's like a crime scene, and everyone wants to have a hand in solving the mystery. It's fun to speculate."

***Mark Boslough**, Sandia National Laboratories, on the mysterious Tunguska explosion in Siberia in 1908,* Space.com*, July 4, 2008*

"Obviously, the world will not end when the LHC switches on."

***Lyn Evans**, CERN, on fears that the LHC will produce black holes that will swallow Earth,* Associated Press*, June 28, 2008*

"Tremendous progress has been made, much higher technical performance, for much lower cost."

***John Deutch**, MIT, on solar power,* The Boston Globe*, July 11, 2008*

"People cannot believe it. They think that we must have pasted a picture inside the end of the telescope."

***Bassem Sabra**, Notre Dame University, on a public astronomy event,* The Daily Star *(Lebanon) July 15, 2008*

"It's kind of like finding your friend's name in some ancient hieroglyphics."

***Peter Meyers**, Princeton University, on a mysterious coded letter sent to Fermilab that appears to refer to physicist Frank Shoemaker, the* Chicago Tribune*, July 10, 2008*

"The question since then has been, 'Where does the solar wind stop? Where is this termination shock?' What we've learned is, it certainly goes a lot farther out than anyone thought and it behaves differently than almost anyone believed."

***Stamatios Krimigis**, Johns Hopkins University,* Baltimore Sun*, July 17, 2008*

"SLAC's record is pretty distinguished, and with the university's offer of a license to use the Stanford name, what more do they need? I'm really bewildered."

***Burt Richter,** SLAC, on the Department of Energy's plan to rename SLAC and trademark the new name,* San Francisco Chronicle*, July 28, 2008*

"We desperately need it, and I personally think it's not there yet. You have to look at starts with a grain of salt, especially starts where they say, 'It's around the corner, and by the way, can you pay half the bill?' "

***Steven Chu**, Lawrence Berkeley National Laboratory, on plans for converting garbage to fuel,* The New York Times *July 24, 2008*

"There are more theories of the glass transition than there are theorists who propose them. It just can get so controversial and so many loud arguments, and I don't want to get involved with that myself."

***David Weitz**, Harvard University,* The New York Times*, July 29, 2008*

This Month in Physics History

Maria Goeppert Mayer and the Nuclear Shell Model

Maria Goeppert Mayer, who made important discoveries about nuclear structure, is one of only two women to have won the Nobel Prize in physics. But during her early career, she was forced to spend many years in unpaid positions before she was able to obtain a professorship in physics. Nonetheless, she persevered in her research. In August 1948, Goeppert Mayer published her first paper detailing the evidence for the nuclear shell model, which accounts for many properties of atomic nuclei.

Maria Goeppert was born in 1906 in Kattowitz, which was part of Germany at the time. When she was four years old, her family moved to Göttingen, where her father was a professor of pediatrics. In fact, he was the sixth generation university professor in the family, and Maria was later proud of being the seventh generation academic. Her father always encouraged her to grow up to be more than a housewife. It was assumed that Maria would get an education, and she did, even though it was difficult for women at the time.

Maria Goeppert Mayer

After attending public school and a college preparatory academy for girls, in 1924 she entered the University of Göttingen, where at first intending to study mathematics. But after attending Max Born's quantum mechanics seminar, she switched her focus to physics.

She completed her PhD in 1930, with a thesis on double photon reactions. While at Göttingen, she met her husband, physical chemist Joseph Mayer. After she completed her PhD, the couple moved to the US, where he got a job at Johns Hopkins University in Baltimore. Nepotism rules prevented the university from hiring her as a professor, so she worked as a volunteer, continuing her own research, most of which involved applying quantum mechanics to chemical problems. She encountered a similar situation in 1939 when her husband got a job at Columbia University. Maria Goeppert Mayer was given office space, but no salary. At first she worked on calculations of properties of transuranic elements; later she worked with Harold Urey on a photochemical method for isotope separation (the method was abandoned as impractical).

In 1946, Maria Goeppert Mayer and her husband moved to Chicago, where she was employed half time at the University of Chicago's Institute for Nuclear Studies and half time at Argonne National Laboratory. Here she began working with Edward Teller on a project to determine the origin of the elements.

The work involved creating a list of isotope abundances. While making this list, it became clear to Goeppert Mayer that nuclei with 2, 8, 20, 28, 50, 82, or 126 protons or neutrons were especially stable. (These numbers became known as "magic numbers," a term thought to have been coined by Eugene Wigner, who was somewhat skeptical about the shell model.) This observation led her to suggest a shell structure for nuclei, analogous to electron shell structure in atoms.

In the nuclear shell model, each nucleon moves in a central potential well created by other nucleons, just as the electrons orbit a potential well created by the nucleus in the atomic shell model. The orbits form a series of shells of increasing energy. Nuclei with completely filled outer shells are most stable.

The fact that nuclei with certain numbers of nucleons were especially stable had in fact been noticed before, but physicists were so certain that a shell model could not be correct, in part because an alternative model, the liquid drop model, which treats the nucleus as a homogeneous blob, had been quite successful in explaining fission. In addition, physicists assumed that the interactions between nucleons would be too strong for the nucleus to be accurately described by a shell model, which treats nucleons as independent particles. Goeppert Mayer, who had less formal training in nuclear physics, was less biased by evidence for the liquid drop model.

Goeppert Mayer then considered other nuclear properties, and found they all pointed to more support for magic numbers. In August 1948, her first paper summarizing the evidence for a shell model of the nucleus was published in *Physical Review*.

Although Goeppert Mayer had collected evidence for the nuclear shell model, at first she couldn't explain the specific sequence of magic numbers. Standard quantum mechanics and a simple central potential couldn't account for the magic numbers higher than 20.

The key insight came to Goeppert Mayer when Enrico Fermi happened to ask her if there was any evidence of spin-orbit coupling. She immediately realized this was the answer. Goeppert Mayer was now able to calculate energy levels and magic numbers.

As she was sending her paper off to the *Physical Review* for publication, she became aware of a paper by Hans Jensen and colleagues, who had independently come up with the same result. She asked that her paper be delayed to be published in the same issue as theirs, though hers ended up being published in the issue after theirs, in June 1949.

Goeppert Mayer had not met Jensen at the time, but later the two did meet. They became friends and collaborators, and wrote a book together on the nuclear shell model. Jensen and Goeppert Mayer won the Nobel Prize in 1963 for their work on the shell model. They shared the prize with Eugene Wigner, for unrelated work.

Maria Goeppert Mayer was appointed to a full professorship at the University of California, San Diego in 1960, but suffered a stroke soon after. She never fully recovered, and died in 1972.

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Team Overcomes Politics to Broadcast Eclipse

On August 1, a total solar eclipse traversed Greenland, the Arctic Ocean, Russia, Mongolia, and China. Totality only lasted for about two minutes, but preparations took more than a year for an Exploratorium team that traveled to the edge of the Gobi Desert to webcast the event. In order to broadcast out of a remote location in China, they had to get past a number of difficulties. "There's technical challenges and also political challenges that we've had to work through," said APS member Rob Semper, Executive Associate Director of the Exploratorium, a science museum in San Francisco.

The location they picked, in the town of Yiwu, in the Xinjiang Uygur Autonomous Region in northwestern China, had the lowest average cloud cover along the eclipse path, and thus offered the best chance of seeing the eclipse. "We've put a lot of energy into making the arrangements, but it's a sensitive time, of course," said Semper. The Chinese government always requires permission for any live broadcast, but has been especially careful around the time of the Olympics.

"We've been working on the issue of securing permission because there haven't been any live video broadcasts out of this part of China. In fact, there are rarely broadcasts out of China, even for a closed circuit project like this one," said Semper before the trip.

Semper made several visits to the site in advance, making connections at the local, provincial, and national levels. Everything seemed to be on track, but as the date approached, the Chinese government began applying extra scrutiny, and additional negotiations were necessary. "This heightened concern has made things more difficult for us," said Semper.

The Chinese government wasn't objecting to the eclipse project per se, said Semper. In fact, it was planned as a collaborative project with the Chinese science television channel, which intended to use the Exploratorium's imagery for educational purposes within the country. "So there's a lot of excitement about our project, actually," said Semper.

As a backup, the Exploratorium planned to send a secondary crew to broadcast the eclipse from Mongolia. The site, in the mountains of southwestern Mongolia, about 400 miles from the Chinese location, was even more difficult to travel to, and, with slightly greater cloud cover, offered a somewhat reduced probability of seeing the eclipse.

In addition to the political difficulties, traveling to the site itself with a film crew of twelve people and tons of special equipment was a challenge. "We do a large, broadcast quality television production, which is three cameras and really high quality telescopes connected to high quality video outputs," said Semper. "Another challenge is this is a place without much in terms of support facilities or accommodations," he said. To get there, the crew flew to Urumqi, the capital of Xinjiang region, then traveled by bus for more than 10 hours, with a police escort, to get to the remote village of Yiwu. The village set up a tent camp for the tens of thousands of people who descended on the area for the eclipse, coming from all over China and the world.

The Exploratorium's mission was not cheap: though some of the equipment was donated, Semper estimates the total cost of the expedition and broadcast was on the order of $100,000.

Fortunately, the permission for the Chinese site did come through in time, and the broadcast went smoothly. A passing cloud briefly threatened to block views of the eclipse a few minutes before totality, but it passed in time, and the telescopes caught beautiful images. Semper, along with Exploratorium scientist Paul Doherty and NASA physicist Erik Christian, showed imagery of the sun and described the features visible during the eclipse.

The eclipse is certainly dramatic, but why would the Exploratorium team go through all of that trouble to get to a remote location for an event that lasts only a couple minutes? Because the broadcast attracts millions of viewers, and it's a great chance to talk about science, says Semper. "People are just always intrigued by this event, and most people don't get the chance to travel to see it," he says.

The Exploratorium has broadcast the past five eclipses, and they have all been very popular. Hundreds of thousands of people watch the broadcast live on the web, and millions more view the archived version later. NASA TV also carries the broadcast, reaching millions of more viewers. The imagery is also used on television news programs. "So it's actually a very large audience for this two minute event," said Semper.

The eclipse webcast is online at: http://www.exploratorium.edu/eclipse/2008/.

Workshop Bridges the Worlds of Academia, Science Museums

Collaborations between universities and science museums were the focus of a recent workshop at the Franklin Institute in Philadelphia. Organized by Bo Hammer of the Franklin Institute, the workshop was funded by APS, under the leadership of past president and co-organizer Leo Kadanoff. Spanning May 31 and June 1, the workshop attracted about 45 participants from around the US, as well as a group from Israel.

Many APS members are funded to do outreach as part of their research grants, and seek out their local science center as a potential partner, yet forging a successful collaboration is tricky, according to Hammer. The workshop helped participants identify ways of improving these collaborations.

"The workshop was very successful," said Hammer. "The participants benefited from the networking and the opportunity to share their expertise and experiences with colleagues."

To follow up, a series of best practices and recommendations will be compiled so that both sides can better understand the needs of the other. Findings from the workshop will be put on a new APS website as an outreach resource guide. The organizers are also planning a session at the annual meeting of the Association of Science and Technology Centers (ASTC) this October in Philadelphia, and they plan to propose a session on University/Science Center Collaboration for the 2009 APS March Meeting.

REU Experience Can Change People's Lives

Leaders of Research Experience for Undergraduates (REU) programs gathered in June for a workshop facilitated by the APS Education and Diversity Department. At the meeting, held June 11-13 at the American Center for Physics in College Park, Maryland, about 40 participants discussed ways to improve these summer undergraduate research programs, assess the impact of their programs on the undergraduates, and recruit a diverse group of participants.

The National Science Foundation has funded a number of these summer research programs for undergraduate physics students for about 20 years, but in the past 15 years the leaders of programs at different sites haven't gotten together to discuss what works. One goal of the recent meeting was to produce a report collecting best practices, said APS education consultant Cathy Mader, a co-organizer of the workshop.

Most undergraduate physics majors engage in some sort of research experience. Many do so at their home institution, while 23% participate in an REU, which provides them an organized summer research experience away from their home university.

One of the workshop steering committee members, Sherry Yennello of Texas A&M University, emphasized the value of these programs. "What you guys are doing is critically important," she told the participants.

Larry Josbeno of Corning Community College said that students return from their summer research experience excited about physics research. "These programs have changed people's lives," he said. "I've never had a student that had a bad experience in an REU program."

The workshop included informal, seminar-like conversation as well as presentations and panel discussions. Participants and panelists discussed administrative models, focusing on sharing the responsibilities across multiple facilities. Ideas proposed included wiki-forums, blogs, and other web forums to foster better communication among REU Principle Investigators. They also discussed management schemes, central coordination of REU programs, and better communications and management methods for Principal Investigators.

One session focused on increasing minority participation. Proposed ideas included putting a gold sticker on minority applicant's files, and having a common application date for all REU programs. Other methods some REU leaders have found useful were making connections with historically black colleges and universities (HBCUs) and minority serving institutions, and advertising the REU programs at the NSBP/NSHP (National Society of Black Physicists/ National Society of Hispanic Physicists) meetings.

Participants said they found the workshop useful "It was helpful to hear how other site directors run their programs; every site seems to have its own unique qualities. I believe the REU program is very important, and was especially impressed by the efforts to reach out to minorities and women," said Kristan Corwin of Kansas State University.

zero gravity

The Lighter Side of Science

Physical Theories Made Magical

Steinn Sigurdsson

A personification of major theories in physics, based on the characters of J.K. Rowling's *Harry Potter* series.

0. **Newtonian gravity** is Ron Weasley. Solid, dependable, good long heritage. It has its limits, but is surprisingly powerful.

1. **Electromagnetism** is Severus Snape. You must master E&M, but so many have irrational fear or hatred of it. It leads to deep unification and glimpses of fundamental symmetries, and is strangely beautiful yet powerful.

2. **Special Relativity** is Ginny Weasley. Transcends classical mechanics, but in touch with its heritage. Practical, explosive, generally high energy. Underappreciated.

3. **Quantum Mechanics** is Albus Dumbledore. No one really understands QM, though many think they do. QM has its roots in classical mechanics but goes a step beyond convention to deal with levels not imagined classically. Steeped in contradiction and contains the seed of its destruction. Quantum electrodynamics is both the end of QM and the beginning of what comes next.

4. **General Relativity** is Harry Potter. The culmination of classical physics, enormously powerful, providing deep insights but also intractable and limited in application. Rooted in special relativity. Apparently orthogonal to EM, yet incomplete without it, GR provides a direction for the future and a deep insight that must be reconciled. Where GR and QM meet is the paradox that must ultimately be resolved.

5. **Quantum Field Theory** is Draco Malfoy. The heritage is classical, and is the powerful but hideous mess you get when EM is forced to be reconciled with QM. QFT looks indomitable at times, but fails just when it is needed most, leaving the field open to new solutions and better approaches. Still there at the end, doing its thing within the limits of its applicability, in eternal opposition with GR yet always avoiding direct conflict.

6. **Quantum Gravity** is Neville Longbottom. It is whacky, full of missteps, but brings surprising insight when least expected and possesses hidden power. And, deep down, you always have to think that maybe really QG is the ultimate answer.

7. **Cosmology** is Luna Lovegood. Ignored and mocked for so long, comes into its own as the other fields have matured. Interesting, although it is a magnet for whacky ideas of all kind, but, hey you never know if maybe some of these crazy notions are really the way things are...

8. **String Theory** is Hermione Granger. Beautiful, powerful, the signpost for future directions. Tries to encompass all classical and quantum phenomena, and to develop master all the most powerful techniques. May contain all the other fields within it. But, curiously directionless without classical direction, needs external input to be prodded into applying itself to real world issues.

9. **Voldemort** is Aryan physics ("a nationalist movement in the German physics community in the 1930s against the work of Albert Einstein"–Wikipedia). Claims classical heritage, and the power and applicability of QM while rejecting GR. Never really gets QM, although EM is classically contained within it. QM could have put him right, but failed and a generation was lost. Totally wrong about Relativity, misses the key insight and never gets the ultimate power.

Steinn Sigurdsson is Professor Lupin, when he's not being an astrophysicist at Penn State University. This article first appeared on his blog, Dynamics of Cats.

***PHYSICS* continued from page 1**

uates should also be able to comprehend many *Physics* articles. "We're trying to enhance what APS does best," says Voss.

Physics publishes three types of articles. "Viewpoints," short pieces of about 1000-1500 words, focus on a specific paper in *PRL* or *PR A-E*., explaining and discussing the significance of the work. Initially about two such pieces will appear each week. These articles will be somewhat similar to "Perspectives" in *Science*, or "News and Views" in *Nature*.

Longer pieces, called "Trends," appearing approximately once a month, highlight areas of current research, reviewing recent results and identifying questions and directions for more research.

In addition, *Physics* publishes "Synopses," which are short (150-200 word) items written by APS journal editors explaining recent papers of particular interest.

As for the choice of title for the new journal, "The idea was to be bold about it," says Voss.

A preliminary version of the journal launched on July 14. The web address is physics.aps.org.

Letters

Copyright Decision A Matter of Principle

William Unruh has raised an important issue, and APS has responded. Clearly, all physicists have interests on both sides of this argument, and the eventual policy will be controlled by a majority of the membership. Some changes in APS copyright language are certainly appropriate, but which ones?

Science benefits from protection of the archival nature of journals. Revenue from all sources–page charges, subscription fee to both physical and digital copies, and subsidies from the parent organization–must cover all publication costs. Copyright plays a clear role in protecting that revenue stream.

But science requires a more immediate and free dissemination of the content than archival journals provide.

The key question for scientists must then be: on what principle should we divide the interest in the journal article between the individual authors and the community of interested scientists? Once a consistent principle is adopted by the membership, then APS, through its committees and officers, can see that the copyright implements that.

It seems to me that the best principle would be one based on the contributions of the two: the ideas and data clearly should belong to the authors, and the reviewed, edited, laid out, and delivered copy should belong to the community through the journal.

Michael H. Frese
Albuquerque, NM

Copyright Causes Conflict of Interest

Congratulations to Professor Unruh for challenging the APS copyright policy in the June 2008 *APS News*. The APS policy of requiring authors to copyright their work in the name of APS is at best unnecessary: there is no legal requirement for the APS to take copyright in order to publish an author's material. In the commercial publishing industry it is unheard-of for authors to sign away copyright. It is odd that in the part of the publishing industry that actually PAYS authors for their work, they do not take copyright; but in the physics field, where authors give away their work with no payment, they are expected to give away their copyright as well.

The issue points out a curious conflict of interest. Normally, one would expect that the APS, the organization that usually would be defending the rights of physicists, ought to be outspoken in organizing physicists to keep their rights. But in this case, the organization that in other situations defends the rights of physicists is the very organization that is taking the copyright!

Geoffrey A. Landis
Cleveland, OH

Fair Use Protects Authors' Rights

W. G. Unruh in his Back Page article "Physicists and Copyright" [June 2008, *APS News*] has found a non-existent monster–and the APS response could have been rather more to the point in slaying it.

The US copyright law (Section 107 http://www.copyright.gov/title17/92chap1.html#107) explicitly defines the *fair use* limitations on the exclusive rights conferred by the law. In particular,

the fair use of a copyrighted work, including such use by reproduction in copies or phonorecords or by any other means specified by that section, for purposes such as criticism, comment, news reporting, ***teaching (including multiple copies for classroom use), scholarship, or research****, is not an infringement of copyright. [emphasis added].*

The formulation in the APS response was at best a clearly strained attempt to specify the rights retained by an author (or any other scholar, for that matter). Avoiding simply stating the unambiguous lawful exception to the APS copyright assignment agreement might have been an attempt (inadvertent, I hope) to retain for APS publications certain rights to which they are not entitled.

Of course, "fair use" itself has exceptions, but for the purpose of rebutting Unruh's creed, I believe it would have been quite sufficient.

Robert A. Myers
New York, NY

Unruh responds:

Unfortunately Myers did not quote all of the "fair use" section. "Fair use" is limited in its application. Condition 3 from the Copyright law lists, as one of the tests a court is to apply regarding "fair use", "the amount and substantiality of the portion used in relation to the copyrighted work as a whole."

Courts have found, for example, that use of even a few pages from a book can be sufficient to negate "fair use," which is primarily intended to allow very limited quoting from another's article, not for substantial use. Thus, if you photocopy a textbook in its entirety, or even a chapter, for use in your class, "fair use" for teaching purposes will not protect you. If you copy an entire article, fair use will not protect you. If you rewrite your article for a conference proceeding, reusing substantial portions in the process, I do not believe that "fair use" will protect you.

Note also that "use for research" does not mean the same thing as "publish in a commercial journal." If you copy parts of someone's article from a journal in order to study it, it may be considered "fair use." If you then use large parts of that article in your own article which you publish, it would almost certainly not be.

"Fair use" is a defense available to anyone. Surely the author of a work should have the right to make more use of his or her own work than some person off the street has. "Fair use" treats everyone the same. I believe all the examples quoted in my article go far beyond "fair use."

Pat on Back is Premature

While I am pleased that *APS News* (June 2008) chose to publish Bill Unruh's critique of current copyright practice, I am dismayed by the editors' lengthy published response on the same page. The editors extensively rebut criticisms which do not appear to have been leveled at the APS, while completely ignoring the single paragraph which was. Perhaps it is indeed time to publicly discuss the reasonableness of the conditions the APS still imposes, rather than patting ourselves on the back for those which have been removed.

Tevian Dray
Corvallis, OR

Outreach, Outreach and Outreach

Michael Lubell's column "Science! Who Needs It?" in the June *APS News* provides a coherent and relevant picture illustrating the problems inherent with a scientifically illiterate public, and in general is absolutely correct that policy decisions made by the government of the United States are suffering as a result. However, I must disagree that responsibility for remedying the problem lies with "state and local governments, and teacher's organizations"-in short, everyone except us scientists. We must take it upon ourselves to educate the general populace any way we can. Personally, I perform a "science day"activity at my children's elementary school. The specifics of my demonstrations are less relevant than simply showing that science and scientific reasoning apply to a lot of things the kids encounter in their lives-cooking is a great example. What is more important than demanding the public know (for example) Newton's laws is that we demonstrate to the public that (1) performing scientific reasoning does not require a PhD, and (2) using a scientific approach to problem solving is the only way to generate reliable and repeatable knowledge.

The only ways the American public will become more scientifically literate are outreach, outreach, and outreach.

Andy Resnick
Cleveland, OH

Plug-ins are a Panacea

If Michael Lubell had done his homework for his Inside the Beltway piece "Science! Who Needs It?" (*APS News* June 2008), he wouldn't have criticized Senator Obama for advocating plug-in hybrid vehicles to solve our energy problems. Plug-ins are indeed a panacea. Despite extensive propaganda to the contrary, batteries are not an obstacle; General Motors produced the EV-1 in the 90's with a battery that went 50-75 miles on a charge, and the people who drove EV-1's were so in love with them that some considered going to jail to prevent GM from recalling and shredding them. See the video "Who Killed the Electric Car?" by Chris Paine. If an all-electric "family use" car could get 50-75 miles on a charge, a similar battery could be dropped into a Prius for the same purpose. As a matter of fact, several small companies are today converting hybrids to plug-in capability.

Lubell's comments sound like those of the cynical observer who thinks there's no use throwing the rascals out because the new rascals will be just as bad. And just exactly who are the rascals he doesn't want to throw out? Nor is this the first time Lubell has been an advocate for the current administration-after the 2004 election, he encouraged "building bridges" to them, Inside the Beltway, *APS News*, January 2005 (Time for Building Bridges).

Robert A. Levy
El Paso, TX

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Michael Lubell replies: *The APS has undertaken a major study on energy efficiency, chaired by Nobel Laureate Burton Richter of Stanford University. Robert Levy would have done well to hold his fire until he had read the report, which will be available this summer. As for the current administration, had he quoted from many of my other columns, he would not be able to justify his assertion that I am an apologist for the Bush Administration.*

Newton Estimated Earth's Density

The article "This month in physics history" in the June *APS News* says that Newton "hadn't made any attempt to determine the constant G or the mass of Earth."

He did make an estimate (in the *Principia*, Book III, Proposition X, Andrew Motte's translation), based on observed densities, of "five or six times" the density of water. Compared with the modern number of 5.52, this is a good estimate. Although an accomplished experimentalist, Newton did not try to measure G directly.

Knowing the value of G is necessary when comparing forces of different kinds–Newton's work on planetary motions was mainly concerned with gravitational forces–and indeed that is the context in which Newton made his estimate. He wanted to calculate the effect of air resistance on the motions of the planets, so he needed the masses. He also estimated the density of air at 200 miles altitude to be 1.3×10^{-14} atmospheres, and calculated that air of that density would slow Jupiter's speed by less than one part in a million over a million years.

Kenneth W. McFarlane
Yorktown, VA

Diversity in Higher Ed–What happens at the end of the pipeline?

I have been a physics faculty member of a large urban public university system for nearly 25 years. Physics is among the most under-represented fields by black and Hispanic students in academia. An often-stated goal of federal agencies and university administrators is to increase the number of minority faculty at our universities in order to better reflect the student population and provide role models for these students. In fact, some federally funded initiatives such as the National Science Foundation's AGEP (Alliance for Graduate Education and the Professoriate) program attempt to provide a framework for a smooth transition between graduate school and employment in academia. However limited our experiences in these relatively young programs are, it is clear that the trends so far are not all that encouraging. Although my personal experience is anecdotal, my university setting is not much different from other public institutions, and given the urban backdrop of my institution, one could argue that the difficulties with minority faculty hiring are probably considerably worse elsewhere.

The main problem? The faculty. Yes, this intellectually elite fraternity that often claims to espouse the most liberal views is in fact rather conservative when confronted with the real prospect of diversity hiring into its own ranks. The "excuses" for not considering particular candidates have remained remarkably constant over the last 20 or so years, for example, "he/she's not in the specific field (fill in your choice of narrow topics) that we're interested in building up in our department." Let's do a simple statistical exercise. Take the total number of African American or Hispanic physics PhD recipients in the US in a given recent year (about 10–20). Now restrict your search to, say, experimental nanoscience, with emphasis on femtosecond optical spectroscopy and spintronics. How

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Briefing Explains how Accelerator Can Boost Industry

By Nadia Ramlagan

What can the International Linear Collider (ILC) provide to US industry? This question was addressed at a recent Capitol Hill meeting of the Linear Collider Forum of America (LCFOA), a non-profit organization founded in 2005 to facilitate partnership between US industry and government in the design, component manufacturing, and location of the ILC. After opening comments from LCFOA president Ken Olsen, ILC Program Director Robert Kephart of Fermilab spoke about the importance of the ILC to physical science research, especially high energy physics.

"Discoveries at the ILC are expected to revolutionize our understanding of the fundamental nature of the universe in which we live. Previous high-energy physics projects have also produced far-reaching practical applications and technologies," said Kephart.

Kephart emphasized that fundamental questions in particle physics remain on the energy, cosmic, and intensity frontiers. The future electron-positron collider could help solve the puzzle of how particles acquire mass, the nature of dark energy, or the properties of neutrinos, to name a few. The proposed ILC design features two opposing linear particle accelerators, each 12 kilometers long.

The discussion quickly shifted to economic and technological benefits deriving from the ILC, with presentations by the Director of the ILC Americas Regional Team Mike Harrison, and also by Paul Grannis of Stony Brook University. The speakers focused on innovative ILC particle accelerator technology, particularly Superconducting Radio Frequency (SCRF)-based systems such as cavities and cryomodules.

Cavities are used to accelerate charged particles to high energies by applying a radiofrequency electromagnetic field to the particle beam. SCRF cavities are made from pure niobium chilled to near absolute zero temperatures. Unlike traditionally used copper cavities, SCRF cavities conduct electric current with almost no loss of energy, ensuring that the majority of electrical energy goes into accelerating the beam, rather than into heating up the accelerating structures themselves.

In the past decade, physicists, engineers, and technicians continue to work on the challenging task of creating the ultra-smooth and polished niobium surfaces needed to retain superconductivity in the presence of large radiofrequency magnetic fields. SCRF research and development programs in the US include the Operational Spallation Neutron Source (SNS) at Oak Ridge in Tennessee, and the Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab in Virginia.

While development occurs at laboratories, there is an ongoing effort to shift production and pro-

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APS Fellows Get High in Santa Fe

Photo by Darlene Logan

In conjunction with its Board meeting in June, APS hosted a reception for Santa Fe-area Fellows. Well over 100 attended, and they were entertained and enlightened by remarks from APS President Arthur Bienenstock. They also were able to experience the enhanced effects of alcohol at 7000 feet, as well as various other refreshments. Enjoying the reception are (l to r) APS Fellows Robert Eisenstein, Hywel White and Virginia Brown.

LIGO continued from page 1

up Astrowatch–an effort to keep H2 staffed and running until the upgrade is complete.

The Astrowatch program is a tough one. Since the program started in February 2008, graduate students have arrived from as far away as Germany and Spain to stay at LIGO for at least three months. Ideally, six to eight of them will share the evening and nighttime shifts, with two students per shift. Then there's work and maintenance to be done during the day, and the students have to keep up with their own research as well. Training on these very complicated machines takes at least a month. Those who stay for over six months will receive free housing from LIGO, but otherwise they all go unpaid; living off of their usual stipend from their home universities. Goetz admits that it takes "a certain caliber of student" to handle the tough hours and complex skill set.

Goetz has been working on his PhD thesis at the Hanford, Washington facility for two years. Talking with him, he hardly seems like he was coerced into running Astrowatch. In fact, he's enthusiastic about what he sees as a once-in-a-lifetime opportunity.

During normal science operations, LIGO allows only its highly trained operators to run the instruments, in order to keep data collection at a maximum. Short windows of downtime are the only opportunities that students have to interact with the interferometers. With Astrowatch, students can run experiments and tests on all of the H2 systems. They're in charge of doing everything from data collection to weekly maintenance tasks. "I think it's an incredible skill for anybody who's going into academia with relations to the LIGO project: to really understand where the data is coming from," says Goetz.

To confirm a gravitational wave detection, LIGO is operating in coincidence with the GEO600 interferometer in Germany. A similar comparison is usually made between the two larger LIGO detectors. While the odds of a supernova occurring in our neighborhood in the next year may be only a few percent, it should still come as a relief that someone will be watching. As Goetz says, even if they don't detect anything, the project will have been extremely beneficial to those who participated. Of course, there is still hope for glory, and the chance to make a great discovery; the possibility that a group of graduate students could successfully collect gravitational wave signals, some late night in Washington.

LETTERS continued from page 4

many years will it then take you to find an African American with this particular training if you have only about ten per year spread among the 100 or so narrow subfields in physics?

If the status quo is acceptable, then no special measures are required, i.e. business as usual. However, if diversity in the science/engineering professoriate is really desired, then we have to change the way we do business. The statistics of minority PhD production and minority faculty hires in the physical sciences suggest that all but very few department faculties are sufficiently enlightened to conduct searches with honest and aggressive affirmative action goals.

For the rest, what can the university administrators and the federal government do to provide incentives to hire minority faculty? Despite various recent successful legal challenges to affirmative action which have introduced significant tortuousness into the path between recruitment, vetting, and hiring minorities, the fact is that if the campus wishes to hire a person of color, they can. Such "slots" can be created (often under the title "target of opportunity") and even partially financed by federal funding agencies. Nevertheless, no faculty would ever accept a recommendation from the administration for hiring anyone (of any color!), as this would be interpreted as a violation of one of the basic tenets of academic freedom. So the process must begin with the individual department's admission that if diversity in the professoriate is a good thing, then the old methods simply don't work. Next the university administration needs to express willingness to provide extra lines to those departments that wish to diversify, otherwise the departments will always come up with the same tired excuses (she's not in the right field, etc).

Now the hard part. The departments must be willing to be a little flexible about the field of expertise of the candidate. I'm not suggesting that if they seek a laser spectroscopist they should hire a string theorist instead–but there should be some leeway within fields. It is also vitally important that candidates who may lack the wherewithal to flourish in an academic setting, for example as evidenced by their previous record of publications, are not pushed into one just to satisfy diversity goals. Nothing feeds the anti-affirmative action frenzy more deliciously than a candidate who fails. If the department then believes that the candidate has the capacity to succeed and eventually gain tenure, they should be willing to take certain steps to ensure that success, for example by providing one or more senior faculty mentors to work closely with the new hire on all aspects of professional development. By the way, senior mentoring is also not a bad thing to do for new faculty members who happen to be white males. Finally, many opponents of affirmative action in higher education voice the fear that "special treatment" for minorities will take jobs and positions away from white male students. If you look at the actual number of minority physics PhDs as the tiny percentage (about 1%– 2%) that it is, however, this argument is absolutely ludicrous.

Steve Greenbaum
New York, NY

Making Energy While the Sun Shines

Solar energy has the potential to contribute significantly to our increasing energy needs, if lawmakers provide support for research and tax incentives, according to speakers at a July 11 briefing on Capitol Hill hosted by the Optical Society of America and the Environmental and Energy Study Institute, in conjunction with the US House Renewable Energy and Energy Efficiency Caucus.

"This topic is extremely timely," said Carol Werner of EESI, introducing the briefing. "Energy is dominating headlines."

Sunlight is clean and abundant, but currently solar power contributes only one-eighth of 1% of electricity in the US. Doug Hall, director of photovoltaic glass technologies for Corning, described existing photovoltaic technologies and those in development. Existing photovoltaics, including wafered silicon (which has most of the market share now), and newer thin film photovoltaics (currently 5% of the market but expected to grow) are currently used for rooftops and small scale applications. More research is needed to improve the efficiency and bring down the cost of these technologies. In addition to technologies already on the market, a new generation of photovoltaics, using new classes of materials, is still in development.

Research and development are not anywhere near over; the technological challenges are many and interdisciplinary, Hall said. Growth of solar is just beginning to take off now, said Hall. The current market for photovoltiacs is about 4 GW; he predicted it would grow to 15-30 GW by 2020. Government legislation is needed to clear the way for growth, Hall said.

Chuck Kutscher of the National Renewable Energy Laboratory described another technology to use the sun's energy: Concentrating Solar Power (CSP). There are several types of concentrators, each with advantages and disadvantages, but all of them basically work by using lenses or mirrors to concentrate sunlight in order to heat water in a steam generator to generate electricity. Large farms of concentrating solar power can be used for electric generating systems, and the cost of CSP is becoming comparable with the cost of natural gas, he said.

"We know this technology works; we have a lot of experience with it," he said. Power companies have recently shown renewed interest in the technology. There are 4000 MW of concentrating solar power projects planned in the US, and over 7000 MW are planned worldwide, he said. However, an investment tax credit for these is scheduled to expire, making companies uncertain about making further investments in the technology, said Kutscher.

In the 1970s there was a jump in funding for solar energy R&D, but funding then declined and leveled off, Fred Sissine of the Congressional Research Service pointed out. Historically solar energy has been given much less funding than nuclear and fossil fuel technologies.

Rhone Resch, President of the Solar Energy Industries Association, called solar "the next great high tech growth industry." There is incredible demand for solar power, he said. Germany and Spain have led the market recently. Germany has actively put in place policies to encourage the use of solar power. Although Germany gets the same average sunlight as Anchorage, Alaska, it accounts for 46 percent of global photovoltaic demand. The United States, which gets much more sunlight, accounts for only 8 percent of the global photovoltaic market. In the US, tax credits for solar power are about to expire, and it is uncertain whether they will be renewed. Market demand for solar power is strong, said Resch, but such policy uncertainty can affect investor willingness to invest in large scale installations.

"We want a level playing field" with other technologies, Resch said. In order to expand the US solar market, Resch said we need a long term commitment to R&D, long term state incentives, long-term meaningful federal incentives, and public education.

Happy Birthday, PRL!

Photos by David Ellis

On June 27, APS hosted an afternoon symposium, a gala reception and dinner, all because a new journal called *Physical Review Letters* had been founded 50 years before. The celebration took place at the Charles B. Wang Center of Stony Brook University. In the photo at far left, the symposium speakers gather around a portrait of Sam Goudsmit, the founding editor of *PRL*. They are (l to r): Lawrence M. Krauss (Case Western Reserve University), Martin Blume (Brookhaven Laboratory and APS Editor-in-Chief emeritus), and Barbara V. Jacak (Stony Brook University). The other photo shows *PRL's* birthday cake on its way to demolition by the evening's attendees.

INSIDE THE BELTWAY
WASHINGTON ANALYSIS AND OPINION

Oil Shock 2008

by Michael S. Lubell, APS Director of Public Affairs

When oil magnate and corporate raider T. Boone Pickens begins tilting at windmills, you know something must be in the air.

Four years ago, Pickens, who has made billions in the Texas oil fields, siphoned off some of his extraordinary petro wealth to fund the "Swift Boaters," those Vietnam vets who helped sink John Kerry's 2004 presidential campaign ship. But that was then, when oil men were ruling high in Washington, gas was selling for $2.00 a gallon, Iraq had yet to develop the foul stench of a quagmire and disbelievers in global warming were still roaming the halls of the Capitol.

Today, T. Boone is spending millions of dollars a week just to advertise his plan for weaning America off foreign oil. He admits he's not an Al Gore global warming groupie, but his plan to have wind displace natural gas for electricity generation and natural gas displace gasoline for powering cars resonates well with many environmentalists.

Even Democrats, who were ready to send out a lynch mob to get Pickens four years ago, seem somewhat conciliatory. As one member of the House Democratic leadership put it recently, "Look, if he is serious about it, we're happy to have him join us in cutting our dependence on oil."

So, is Pickens serious about replacing oil with wind? Is Washington serious about doing anything at all about energy? And do any of the myriad proposals on the table make scientific or political sense?

First about Pickens: give him credit for amassing extraordinary wealth by making wise business decisions and taking calculated risks. But is his wind plan a sound long-term energy strategy or just a scheme to make his already very deep pockets even deeper?

Pickens swears he has no interest in getting any richer. He says that at eighty, he has more money than he can possibly spend in his remaining years and that he will bequeath all of his formidable estate to charity when he dies.

And, as for a personal commitment to his advertised wind plan, he argues that he has already placed a $2 billion order for wind turbines with G.E. For truth in marketing, he gets an A.

How does Washington match up? On histrionics, posturing and oratory, Congress and the White House score high. But, they have little to show for substance. And if history is any guide, whatever policies finally make it through the political sausage mill might not have much of a shelf life.

Still, the oil shock of 2008 may be different from the tremors of 1973, 1979 and 1991. Back then, China and India were economic basket cases and demanded little from the world's energy resources. Today, their economic engines are whirring, and they are guzzling oil as fast as OPEC pumps it.

Twenty years ago, global warming was still a matter of debate in some scientific quarters. Today, only a few scientists believe that anthropogenic climate change is not real.

Members of Congress are also under much more public pressure to do something about energy than ever before.

A House member from Maine, for example, notes that in his state, homeowners, many earning little more than $30,000 a year, will likely have to spend between $2,500 and $4,000 on heating oil next winter. "They'll either freeze or starve, and I don't yet have an answer for them," he says.

A North Carolina representative is even more blunt. "My constituents are irate with Congress for not doing something to help them with gas prices," he says, "and if we don't have anything to show, there'll be a lot of surprises for both parties next November."

Congress may have little tangible to show for its efforts on energy so far, but that doesn't mean there aren't good ideas around. The 2005 Energy Policy Act and the 2007 America COMPETES Act, for instance, contained many worthy R&D goals, but funding hasn't followed. The new 35-mile-per-gallon CAFE standard Congress and the White House adopted last year for 2020 was long overdue, but it isn't aggressive enough, given known automotive technologies.

Effective energy strategies based on good science are fairly easy to envision. But getting them over the political hurdles is much more difficult.

Science looks long term. Politics focuses on the next term. And that mismatch makes it hard to find the right answers to the energy crisis. We'll see whether Washington can kick the instant gratification habit this time around: the response to the upcoming APS Energy Efficiency Report could be a leading indicator.

Oh, and for Pickens' windmills to be fruitful and multiply, science needs to find better ways to store electricity when the wind doesn't blow.

Towson PhysTEC Project Targets Elementary Science Teaching

By Gabriel Popkin

Towson University professors Laura Lising and Cody Sandifer know that for too many elementary students, a science lesson means listening to the teacher read from a book, or quietly filling out a worksheet. To address this problem, the two professors and several dedicated elementary teachers have spent the last four years reforming the course Teaching Science in the Elementary School, which gives Towson's elementary education majors a chance to focus on practicing science teaching. Lising and Sandifer wanted Towson graduates to be able to expose their young students to the excitement of scientific investigation and discovery. A multi-year grant awarded in 2004 by the APS-led Physics Teacher Education Coalition (PhysTEC) project provided the funding for Lising and Sandifer to take on this ambitious effort.

Four years later, each future elementary teacher at Towson now gets the opportunity to spend a semester delivering weekly science lessons to a group of four to six elementary students, and reflecting on his or her experiences through writing assignments, discussions, and audio recordings of their lessons. The course instructors help the future teachers develop the concept of inquiry as a guiding principle for their teaching—an approach that encourages learning through active investigation and deep thinking, rather than by passively absorbing information. Lising and Sandifer, along with their Teachers-in-Residence (TIRs), lead workshops for the course instructors and mentor teachers at the beginning of each semester, to ensure that all project participants have a strong understanding of the course goals and the importance of inquiry teaching.

Lising and Sandifer have gathered evidence that Towson's elementary teachers can now teach science with confidence and enthusiasm, and incorporate a significant amount of inquiry into their practice. They report that "it is possible, given the proper course structure, support, and feedback, for interns to experience a radical change in attitude toward science and science teaching after only a single semester." As one intern noted in an end-of-semester reflection, "I never thought I would say this, but I truly loved teaching science. My fear of teaching science is completely gone." Although research indicates that actual classroom practice is much harder to impact than attitudes–especially when the goal is facilitation of inquiry–systematic observations of the interns' actual practice in the classroom also show dramatic improvements toward aligning with nationally recognized standards in science education.

The project has proven so successful in improving elementary teachers' attitudes toward and practice of science teaching that Towson's Fisher College of Science and Mathematics has secured resources to sustain the project beyond the external funding provided by PhysTEC, which ends this year. Towson will pay for workshops and stipends for the mentoring teachers and course instructors who participate in the project, and also support the TIR position that PhysTEC has funded in the past. The TIR will continue to coordinate classroom placements for future teachers, administer and analyze assessments, develop and help disseminate resources for others who wish to make similar reforms in their courses, and do many other activities to support the science education of future elementary teachers.

Photo by Ted Hodapp

Towson University physics professor and PhysTEC project leader Cody Sandifer works with a future elementary teacher.

Towson's project is unique among those sponsored by PhysTEC in that it focuses on elementary–as opposed to secondary–teacher education. Lising and Sandifer are also in a unique position as science education researchers within Towson's Department of Physics, Astronomy, and Geosciences, which enables them to apply the department's resources to problems not traditionally considered to belong to physics research. Because Towson graduates over 200 elementary teachers a year–the most of any institution in Maryland–this project has the potential to foster independent scientific thinking and encourage an early love for science in many thousands of future elementary students. In addition, the project team has developed a set of resources, available on CD or online at http://pages.towson.edu/csandife/phystec/Elem_Internship_Resources.zip, that allow course instructors at other institutions to use the activities they have developed.

Towson is now planning to become a major player in secondary physics teacher preparation as well. The physics department is hiring a tenure-track faculty member to improve the secondary physics teacher preparation program and recruit more undergraduates to teaching. In addition, Sandifer has started a Learning Assistant program, adapted from the program developed at the University of Colorado, that enables talented undergraduates–and potential future teachers–to help their peers master math and science. Towson appears to be in an ideal position to lead the University System of Maryland's effort to triple its science teacher production in three years–a goal set by the system Chancellor Britt Kirwan. The PhysTEC project is excited to continue working with Towson to improve physics and physical science teacher education at all levels.

ANNOUNCEMENTS

Now Appearing in RMP: Recently Posted Reviews and Colloquia
You will find the following in the online edition of
Reviews of Modern Physics
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Hadron structure at low Q^2

Dieter Drechsel and Thomas Walcher

Hadrons have a size of about 1 fm and are strongly interacting many-body systems of quarks and gluons. Although the latter cannot be resolved in scattering experiments at relatively low momentum transfer Q in the GeV region, their presence becomes manifestly evident in bound many-body systems like pions, nucleons, and their resonances. This review describes the interaction of electrons and photons with hadrons, presents results on the most significant experimental observables, and compares them with results from phenomenological and theoretical approaches to quantum chromodynamics in the nonperturbative regime.

Job Fair

APS Division of Plasma Physics

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Looking for a job?
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Register today at: http://www.aps.org/meetings/unit/dpp/conf2008/jobfair/index.cfm

For more information contact Alix Brice at 301-209-3187 or at abrice@aip.org

Tired of the same old t-shirt designs at the APS Store?

Have an idea for a slogan you would like to see worn by your friends and colleagues?

Submit your original slogan by **Friday, November 14th**. If your submission is selected and used on APS merchandise, you will receive a $50 voucher for the APS Store and be eligible for the grand prize random drawing for one year free APS membership!

All APS members are invited to participate. All submissions should include your name and contact information and be sent to:

American Physical Society
Attn: Jennifer Pirnat
One Physics Ellipse
College Park, MD 20740
pirnat@aps.org
301-209-0867 (fax)

SCHOLARS continued from page 1

New minority scholar Dana Lewis has long known that she wants to be a medical physicist. Among her many accomplishments are being prom queen and salutatorian of her high school class. She also worked on a project to educate the public about stem cell research. "There's a laundry list of things I've done," she says. She found her high school physics class difficult at first, but she enjoys the subject. "Physics was the first real challenge that I had in my life," she says. Lewis will be a freshman this fall at Louisiana State University, and is especially excited about a research position in medical physics she has lined up.

New scholar Bernadette Cogswell has loved physics since age five, when she visited the Smithsonian Air and Space Musuem. Her mother worked in international development, so she traveled a lot as a child, living in many countries. After high school, Cogswell attended the United States Air Force Academy with the hope of becoming an astronaut, but found that military life wasn't for her, so she transferred to another school. Unfortunately, when a professor told her she wouldn't come up with any new ideas in physics, she became discouraged and dropped out. But she always loved physics, and now, after receiving degrees in English and psychology, she has returned to physics. She will graduate next year from Florida State University with a major in physics, and aims to get a PhD in nuclear physics. She hopes to work in the private sector. Physics isn't her only interest: she loves drawing, languages, travel, and writing. This summer, she's in Hawaii, working on her first novel–a historical fiction novel set in Florida.

Renewal scholar Maximo Menchaca, who is beginning his sophomore year at the University of Illinois, Urbana-Champaign, describes himself as a "huge environmentalist" and plans to eventually combine his physics education with environmental stewardship. This summer, he's doing research in magnetohydrodynamics, with a project titled "Numerically Approximating the Propagation of Particles in Dynamical Plasmas Near Black Holes." Describing how he became interested in physics, he says, "Physics is the spice of life. It can do just about anything you want it to. It's just such a powerful and versatile tool. Science and the way things work have always intrigued me, so physics was a natural choice."

Any African-American, Hispanic American, or Native American US citizen or permanent resident who is majoring or planning to major in physics, and who is a high school senior, college freshman, or sophomore is eligible to apply for the scholarship. The selection committee especially encourages applications from students enrolled in institutions that historically serve African American, Hispanic, or Native American populations.

Information about the scholarship can be found at http://www.aps.org/programs/minorities/honors/scholarship/.This website also contains bios and photos of the minority scholars.

New scholars:

John Bardeen
Peter Boyce
Alex Burger
Bernadette Cogswell
Maia Eubanks
Jose Gutierrez
Christine Jones
Sara Kostiniski
Luis Leal
Dana Lewis
Jorge Medina
Saliou Ndao
Jasmine Oliver
Shaun Pacheo
Jessica Starr
Judith Vasquez

Renewals:

Ana Brown
Iara Cury
Maria Garzon
Elizabeth Henderson
Maximo Menchaca
Maxwell Murialdo
Franklin Orndorff-Plunkett
Laura Salguero
Irene Toro Martinez
Jaime Varela
Erik Verlage

Science Societies Quiz Congressional Candidates

What do your candidates for Congress think about important issues related to science? Scientists and Engineers for America (SEA) is asking them.

In cooperation with a number of scientific organizations including APS, SEA has developed a list of seven questions on science policy topics, and has sent messages to all current candidates for Congress asking them for answers. The questions deal with innovation, climate change, energy, education, water, research funding, and health.

"These are issues that every candidate should care about," says Lesley Stone, Executive Director of SEA.

At the website, innovation2008.org, people can enter their zip code to find their congressional candidates and see the candidates' answers to the questions, or if they have not answered, send them email urging them to do so.

As of late July, more than thirty candidates have submitted answers to the questions. Others are expected to do so soon.

The more letters candidates get urging them to answer, the more likely they are to do so, SEA believes. "Candidates are much more likely to answer questions from their constituents," says Stone.

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cessing of cavities and other critical ILC components to American industry. There is much industry concern, as only one small US business is currently certified to manufacture SCRF cavities. The Department of Energy (DOE) laboratories use SCRF cavities manufactured by European companies.

There is also impetus to house the ILC on US soil. The Department of Energy's Office of Science has supported the ILC as a scientific priority and has stated that Fermilab is the US candidate site for the Collider. After an overview of the ILC research and development plan by the Project Manager of the Americas Regional Team, Marc Ross, the meeting closed with statements by LCFOA board of director companies.

MEDALS continued from page 1

US Physics Team at the Closing Ceremony. Back Row: (left to right) Paul Stanley, Warren Turner, Bob Shurtz; Front Row: (left to right) Rui Hu, Ed Gan, Tucker Chan, Josh Oreman, Danny Zhu

were expected to use basic laboratory instruments like voltmeters, diodes, transistors, along with more sophisticated equipment such as dual trace oscilloscopes and generators.

Their trip certainly wasn't devoid of play; much time was spent sightseeing and traveling around Hanoi. The team rode junks, or Vietnamese sailing vessels, along Halong Bay and explored Thien Cung ("heavenly palace") cave, a beautiful grotto of fused stalactites that form odd, drip-like shapes. Visits to Buddhist temples and pagodas, munching on authentic Vietnamese cuisine, and soaking up the hot sun made for a fun vacation.

Formed in May, the five-member team was selected based on exam scores from a national contest and a semifinal ten-day training camp at the University of Maryland, College Park. Tucker Chan recently graduated from Princeton High School in Princeton, NJ; Danny Zhu recently graduated from Stuyvesant High School in New York, NY; Edward Gan is a senior at Montgomery Blair High School in Silver Spring, MD; Joshua Oreman is a senior at Harvard Westlake School in North Hollywood, CA; and Rui Hu recently graduated from The Charter School of Wilmington, DE.

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 the1980'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.

The Back Page

STEM Workforce Discussion Needs More Data, Analysis

By Ron Hira

It is broadly accepted that the scientific and technical workforce plays a critical role in increasing our standard of living, ensuring national security, and solving some of society's most pressing problems–whether it is global warming, terrorism, or national economic competitiveness. Even though Science, Technology, Engineering and Mathematics (STEM) represents only about 5% of the nation's workforce, there is a widespread belief among policy makers and academic and business leaders that it has a disproportionately high impact on the nation. As a result, policies are often targeted specifically at changing the size and characteristics of the STEM workforce.

Concern about inadequacies of the state of the US STEM workforce is a recurring and bipartisan theme in the public policy discussion. In response to growing unease about America's ability to compete with India and China, last year Congress passed, and the President signed into law, the America COMPETES Act, which included a number of provisions directed at improving the STEM workforce. In the words of its sponsors in both the House and Senate, this will ensure that the United States retains its "brainpower advantage so our good jobs don't go overseas to places like India and China."

While the America COMPETES legislation is designed to deepen the future talent pool capable of entering STEM occupations, technology employers have focused much of their lobbying efforts on immediately expanding the talent pool on hand. They claim that demand persistently outstrips domestic supply. So the government should supplement the domestic supply with more foreign workers by liberalizing immigration policies. Microsoft's Bill Gates summed up this viewpoint in a *Washington Post* op-ed, saying, "Demand for specialized technical skills has long exceeded the supply of native-born workers with advanced degrees, and scientists and engineers from other countries fill this gap. This issue has reached a crisis point." In fact, Gates has stated that immigration policy liberalization is the number one issue for Microsoft's lobbying efforts.

Some university leaders use equally dire language when describing the future US STEM workforce. In 2003, Rensselaer Polytechnic Institute's President Shirley Ann Jackson described the coming "crisis" of a growing shortage of domestic STEM talent as a threat to "both national security and [America's] economic status in a global economy."

While their diagnoses may be slightly different, Gates and Jackson represent the consensus view of industry and university leaders–the STEM workforce crisis is due to an inadequate supply of domestic talent. And most of the 2008 Presidential candidates, from both parties, agreed with this diagnosis, lamenting the STEM supply shortfall in public statements and on their campaign websites. They offered a variety of proposals to expand the current and future STEM workforce.

Inadequate supply may be how the crisis is defined by business, academic, and political leaders, but some STEM workers view the problem very differently. A recent entry in a popular blog by a technology worker offers this starkly different picture. He says:

"I am a former American tech worker, programmer and systems analyst who is now functionally unemployed at the age of 50. What happened? Why? What to do? Does anyone relate to this or give a darn? These are some questions I wake up to and live with each day, trying to turn 20+ years of work on large scale IBM business systems and databases into a salvageable work life. Since 2003, I've worked in real estate (not a "real" job in most places), substitute teacher, Home Depot Flooring associate, contract writer for a struggling home builder, and tech writer for a small tech business with a spotty business history. Why was I once employable, making a reasonable income, and now almost unemployable with the business and tech skills amassed over 20+ years? "

This blog entry cannot be dismissed as an anecdote, because it faithfully represents the experiences and concerns of a sizable share of STEM workers. I have heard and read thousands of similar stories over the past few years from workers in a variety of STEM fields. Many are unemployed or underemployed, while still others are very anxious about their job security. Not surprisingly these workers believe that the real STEM crisis is lack of demand.

It is obvious, based on the strong language used all around, that key stakeholders are highly dissatisfied with the current state and direction of the STEM labor market. But they offer seemingly conflicting assessments and policy prescriptions. So, which is it, a lack of supply or of demand? Or could both conditions exist simultaneously? Too often policy discussions and proposals are driven by a single variable presented in isolation, such as the number of degrees. Those discussions ignore other system variables key to diagnosing and predicting how the entire system would respond to particular policy changes. They also frequently treat the STEM labor market as homogeneous, when in fact it is better characterized as a multiplicity of labor markets, demarcated by occupation, level of degree, geographic location, industry-specific knowledge, and years of experience. The STEM Workforce Data Project conducted by the Commission on Professionals in Science and Technology (CPST) helps to fill the data gaps by bringing together many key variables, at a disaggregated level, in one set of reports (STEM Workforce Data Project). And it provides policy makers with a broad range of facts to help them evaluate these conflicting viewpoints to make more informed policy choices.

While the data supplied by the project is a necessary step, it isn't sufficient. We need to build better analytic frameworks to judge STEM workforce policies. Our conceptual models, whether implicit or explicit, are too limited. They do not account for the complexity of the STEM workforce system, with its multiple factors, feedback loops, interconnectedness, and adaptation. As a result, our ability to predict the full array of impacts of specific policy choices is poor, even when we have good data.

The STEM Workforce & New Competitiveness Debate

The STEM workforce is central to the new competitiveness debate. Competitiveness is the term du jour in Washington, being attached to a variety of policy issues from taxes to healthcare to infrastructure. And of course it's also attached to many, if not most, science and technology policy issues–and appropriately so. But the key to responding to the new competitiveness challenges will reside in how we shape the American STEM workforce system.

I use the term "new" to distinguish it from the old competitiveness debate. That debate, which began in the late 1970s, had much more to do with improving the productivity of American companies and the quality of their products. Think General Motors trying to adopt lean manufacturing techniques from Toyota. This time around, though, it is not about companies competing across borders but rather American workers who are now competing head-to-head with workers abroad who can afford to be paid less. And increasingly American workers are competing against their own corporation's workers in low-cost countries. Think IBM workers in Boston competing against its fast-growing workforce in Bangalore. In addition, many major technology corporations require their American workers to train foreign replacements as a condition of severance and unemployment insurance.

This implies competitiveness, at least with respect to this round of globalization, is really about ensuring that American workers can justify their salary premiums, often 5X premiums. They can justify those salary premiums either through better relative productivity (producing 5X more) or by crowding into non-tradable jobs. Or they will be forced to take significantly lower wages.

Princeton University's Alan Blinder estimates that a large share of STEM jobs is becoming more tradable and as a result they are increasingly vulnerable to being offshored. IBM already has more than 75,000 workers in India, up from a mere 6,000 in 2003. And Accenture has more workers in India, 35,000, than it has in any other country including the US. The scale and scope of the coming impacts of offshoring on the STEM labor market are likely to be significant.

Responses by employers, workers, educational institutions and government to the changes wrought by globalization will take place. The question is whether those responses are going to be based on data driven inquiry or simply the desires of special interest groups.

I think, to date, our policy discussion about the implications of globalization has relied too heavily on interests of companies and universities rather than being based on any data driven analysis. This is particularly troubling given that corporations and universities already wield so much political power. But issues surrounding competitiveness are not the only areas where there is little analysis. The void also characterizes many, if not most, of our policy discussions about the myriad other factors shaping the STEM workforce, from the talent pool, to skills mismatches, to the K-16 pipeline, to underemployment, to immigration.

Some Surprising Data

Now let me highlight some surprising results from CPST's STEM Workforce Data Project.

Most STEM workers are paid significantly higher than the average occupation. In 2005, the median STEM pay was $57,000 versus $34,000 for all occupations. But STEM salary growth has not outperformed other occupations. Between 1995 and 2005 STEM salaries grew approximately 6%–the same rate as all occupations. This finding seemingly contradicts the widespread belief among leaders that STEM workers are persistently in short supply. If they were, their wages would be bid up faster than other occupations. Instead, salary changes indicate relatively balanced supply and demand–at least at the aggregate level. How would doubling the number of STEM graduates, as prominent industry groups have argued for, affect this supply and demand balance, and salaries for incumbent STEM workers?

If we look at the data at a more disaggregated level we begin to see that there are multiple labor markets. Over the 1995-2005 period, some STEM occupations had higher than average salary growth rates, such as aerospace engineering, which grew by 9 percent, while other groups fared worse than average. Salaries for all engineering occupations grew only 3 percent, half the rate of all occupations, and biological and life-scientist salaries didn't even keep up with inflation, losing 1 percent. What do these outcomes tell us, if anything, about policy? Should we be crafting targeted policies for the individual labor markets to make them more responsive?

Salaries don't tell us all we need to know about STEM labor markets. There are many non-monetary rewards for STEM occupations. Missing from most analyses are measures of job and career satisfaction. Are incumbent workers happy with their work and their work environment? The upcoming generation of "millennials" are expected to place more weight on non-monetary rewards such as whether their work is socially meaningful, fulfilling, and has the appropriate work-life balance. Will STEM occupations satisfy these new workers? Surely, these measures should be included in any meaningful look at the STEM workforce.

Turning to employment growth, STEM employment levels have historically grown faster than the overall labor force. STEM employment grew 190% between 1983 and 2000, versus a 136% increase in overall employment. However, this trend reversed course from 2001 and 2006, when the STEM share of the overall workforce has actually been shrinking.

Of course STEM occupations grow or shrink at widely different rates. Much of the increased employment during the period 1983-2000 can be attributed to the boom in the information technology and telecommunications industries. Most other sectors of employment did not do as well. And a significant share of the IT and telecom growth, approximately 38 percent, was filled by foreign-born workers.

Improving Our Policy Dialogue

To improve our policy discussion I would suggest we do the following.

First, recognize that the STEM workforce is not monolithic. Instead it's a complex system, with many variables and multiple labor markets and a capability to adapt.

Second, we should use data-driven analysis to better understand how particular policy responses may affect system outcomes in the short- medium-and long-terms.

Lastly, we should acknowledge openly that the political and economic interests of the various stakeholders (employers, educators, workers and students) can be at odds, and the distributional impacts of particular policy responses can vary widely. Put bluntly, policy solutions good for employers are not automatically good for workers and vice versa.

The policy debate should embrace this political reality. By doing so, policy makers will better be able to seek solutions that resolve inherent conflicts and better vet policy solutions with respect to their distributional impacts.

Ron Hira is an Assistant Professor of Public Policy at Rochester Institute of Technology, where he specializes in engineering workforce issues, high-skill immigration, and innovation policy. He is co-author of the book Outsourcing America. *This article is a modified version of remarks given at the CPST conference, "Can We Compete? Trends in America's Scientific and Technical Workforce", November 1, 2007, Washington DC (www.cpst.org).*

APS News welcomes and encourages letters and submissions from its members responding to these and other issues. Responses may be sent to: letters@aps.org