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21st Century Campaign Nears Goal and Needs Your Support!
(See insert)

Energy Efficiency Crucial to Achieving Energy Security and Reducing Global Warming, States APS Report

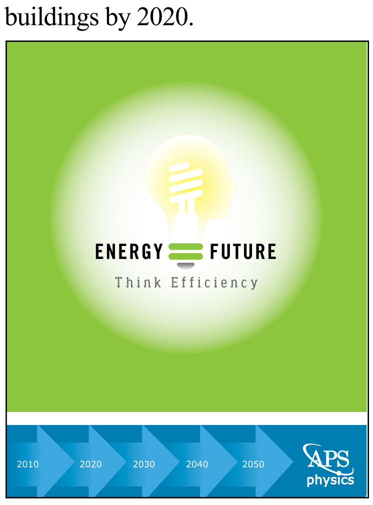
Tapping wasted energy from inefficient automobiles, homes and businesses is equivalent to discovering a hidden energy reserve that will help the United States improve its energy security and reduce global warming, an APS study panel has concluded.

Their report, *Energy Future: Think Efficiency*, states that the key to unlocking the efficiency potential is developing policies that will put technology into the marketplace and developing new technologies through applied and basic research in the public and private sectors.

The study panel concluded that increased energy efficiency, particularly in the transportation and building sectors, will help eliminate US reliance on foreign oil and reduce greenhouse gas emissions that contribute to global warming.

Most recommendations addressing high fuel costs focus on either increasing the supply of oil or finding a substitute fuel, but the APS report offers a practical roadmap with short-term and longer-term solutions for reducing demand through cost-effective efficiencies that find public and political acceptance.

The report provides a path to 50 miles per gallon mileage for cars and other light-duty vehicles by 2030 and the elimination of energy from fossil fuels in new residential buildings by 2020.



It also states that the federal government should broaden its research, development and demonstration programs, particularly in the areas of batteries for conventional hybrid vehicles, plug-in hybrids and battery electric vehicles. The report credits automakers for devoting resources to the development of hydrogen fuel cell and plug-in hybrid vehicles, but concludes that they are not a solution to the nation's short-term energy needs because they require significant scientific and engineering breakthroughs in several critical areas.

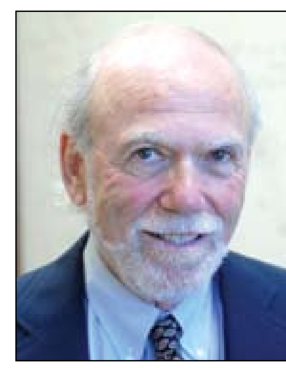
The study also calls on Congress and the White House to increase spending on research and development of next-generation building technologies, training scientists who work on building technologies and supporting associated national laboratory, university and private-sector research programs. Additionally, it recommends that lawmakers develop policies that address a wide-array of market barriers that discourage consumers from adopting investment in energy-efficient technologies, especially in the highly fragmented building sector.

The American people need leadership from the Congress and the next president on this issue, said Nobel Laureate Burton Richter, chair of the study committee and director emeritus of the Stanford Linear Accelerator Center. Both Senators McCain and Obama have outlined plans for improving energy efficiency and defining the important role new technologies will play in our energy future. The next

REPORT continued on page 5

Members Elect Barry Barish as next APS Vice-President

APS members have elected Barry Barish, Linde Professor of Physics Emeritus at Caltech, as the Society's next vice president. Barish will assume the office in January 2009. At the same time, Curtis Callan of Princeton University will become president-elect, and Cherry Murray of Lawrence Livermore National Laboratory will serve as APS president for 2009, succeeding 2008 APS president Arthur Bienenstock of Stanford University. Barish will be president-elect in 2010, and will serve as APS president in 2011.



Barry Barish

In other election results, Kate Kirby of the Harvard-Smithsonian Center for Astrophysics was selected as the new chair-elect of the APS Nominating Committee, which has the responsibility of selecting a slate of candidates each year to run for APS office. Nergis Mavalvala, a professor of physics at MIT, and Jorge Pullin, Horace Hearne Chair in Theoretical Physics at the Louisiana State University, were elected as general councilors.

Barish earned his PhD in 1963 in physics from the University of California, Berkeley. He joined the faculty at Caltech in 1963. Among his noteworthy experiments were those performed at Fermilab using high-energy neutrino collisions to reveal the quark substructure of the nucleon. In the 1980s, Barish initiated an international effort to build a sophisticated underground detector (MACRO) in Italy in the emerging field of particle astrophysics. 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. He is currently the Director of the Global Design Effort for the International Linear Collider (ILC). In October 2002, Barish was nominated to the National Science Board, which oversees the National Science Foundation (NSF) and advises the President and the Congress on policy issues related to science, engineering, and education.

ELECTIONS continued on page 7

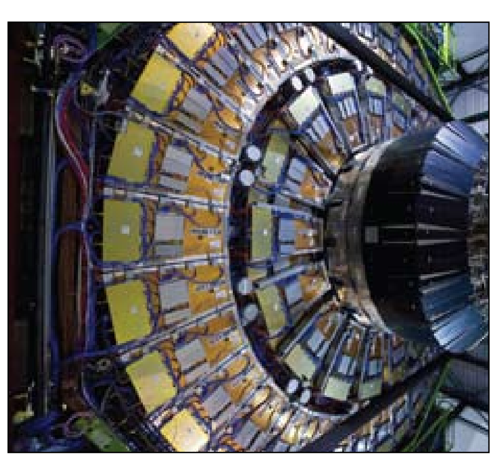
LHC Start Up was a Long Time Coming

By Kate McAlpine

Kate McAlpine is a science writer with the ATLAS collaboration at CERN and a former science writing intern at APS. She has recently received a lot of attention for her video, "Large Hadron Rap" (Check it out on YouTube). Here she gives her impressions of the startup of the LHC and the months leading up to it.

After more than two decades of planning, over a decade of digging and building, the Large Hadron Collider and its detectors are finally complete. The first beam of protons ran through the accelerator ring on September 10th, and collisions are expected before the year is out.

If you think of the project as a marathon, I've been running alongside for the last mile. Work on the LHC started in the early 1980s, and official planning began in 1984–five years before its predecessor in the tunnel, the Large Electron-Positron collider, had even started up. But from late October last year, I



Courtesy of CERN

Lowering of the final element (YE-1) of the Compact Muon Solenoid (CMS) detector into its underground experimental cavern

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Three Women Receive Blewett Scholarships in 2008

By Nadia Ramlagan

Ya Li

Three women have been selected by the APS Committee on the Status of Women in Physics as the recipients of this year's M. Hildred Blewett Scholarship: Ya Li of Hampton University, Firouzeh Sabri of the University of Memphis, and Janice Guikema of Johns Hopkins University. The Blewett scholarship is a one year award of up to $45,000 that is intended to enable women scientists to return to physics research after having to interrupt their careers for family reasons. Recipients can use the funds for expenses related to child care, salary, and travel, equipment, and tuition fees.

Born in Wenzhou, China, Ya Li received her undergraduate degree in physics and masters degree in condensed matter physics from Tongji University in Shanghai. She then came to the United States and received another masters degree from the University of Houston.

"I have always been good at mathematics and physics, and I love reading all kinds of scientific articles. Being a scientist has always been my dream, ever since I was a child," Li says.

In 2003 she moved to Jefferson Lab in Virginia to work on her dissertation, studying duality in meson electroproduction. "The most exciting thing about Jefferson Lab is that they have a high luminosity electron beam, which is great for studying the structure of matter on the nucleon scale," Li explains. After stopping her career for a few years, she is currently resuming her graduate studies at the nearby Hampton

BLEWETT continued on page 6

Four APS Members Receive National Medal of Science

Four APS members are among the recipients of the 2007 National Medal of Science, and one APS member is among the recipients of the 2007 National Medal of Technology. The awards honor the nation's top scientists and innovators.

President Bush presented the medals in a ceremony at the White House on September 29.

APS members Mostafa El-Sayed of Georgia Institute of Technology, Fay Ajzenberg-Selove of the University of Pennsylvania, Charles Slichter of the University of Illinois, Urbana-Champaign, and David Wineland of the National Institute of Standards and Technology received the 2007 National Medal of Science.

El-Sayed was cited "for his contributions to our understanding of the electronic and catalytic properties of nanostructures and nanomaterials."

Ajzenberg-Selove was cited "for her contributions in nuclear physics that have advanced research into applications including energy generation from fusion, dating of artifacts, and nuclear medicine."

Slichter was cited "for establishing nuclear magnetic resonance as a powerful tool to reveal the fundamental properties of molecules, liquids and solids, enabling the development of numerous modern technologies."

Wineland was cited "for his outstanding leadership in the science of laser cooling and manipulation of ions, that have had mul-

MEDAL continued on page 7

Members in the Media

"It's not a stable black hole that could swallow the universe. It's unstable, so it explodes right away."

***Yongsheng Gao**, California State University, Fresno, on the possibility of the LHC producing black holes,* The Fresno Bee, *August 5, 2008*

"We don't want this to be another Lee Harvey Oswald case where the public says it is never solved to their satisfaction."

***Rush Holt**, on the anthrax investigation,* Los Angeles Times, *August 8, 2008*

"I sent them because I thought everything was quiet over there, life was nice."

***Vasily Dzhordzhadze**, Brookhaven National Laboratory, on sending his children to visit Georgia this summer,* Newsday, *August 20, 2008*

"We're a group of people from all over the world–many religions and attitudes. It is essential for scientists to participate in this and try to help the Catholic Church, advise them on their policies. ."

***Charles Townes**, University of California, Berkeley, on the Pontifical Academy of Sciences,* Discover, *August 18, 2008*

"The bottom line is it's a wonderful experiment, but it needs to be approached carefully, or you go out of business."

***Fred Dylla**, American Institute of Physics, on open access journals,* The Boston Globe, *August 21, 2008*

"Amazingly, there are no tricks involved. What you have here is one of the most efficient human movements ever conceived."

***Michael Feld**, MIT, on breaking boards with karate chops,* Discover, *August 2008*

"We like to think that we are rewriting our children's science textbooks. In the same way that Galileo revolutionized our thinking about our place in the universe, we hope our discoveries will give us new insight into mankind's place in the universe."

***Michael Barnett**, Lawrence Berkeley National Laboratory,* The Newshour with Jim Lehrer online, *August 8, 2008*

"The Higgs is an important component if it's there. It's not going to create world peace or solve the energy crisis, but it will help us understand the world we live in."

***Robert Roser**, Fermilab,* Kane County Chronicle, *August 9, 2008*

"If all the molecules of air in the room where you're sitting would suddenly cross to one side, you would not have any air to breathe. This probability is not zero. It is in the 10 to the minus-25 range."

***Greg Landsberg**, Brown University,* The New York Times, *August 23, 2008*

"If I had, I would have never got tenure."

***Ronald Mallett**, University of Connecticut, on why he didn't initially tell his colleagues he wanted to build a time machine,* East Hartford Gazette, *August 22, 2008*

"Besides the scientific implications, this kind of search has repercussions in the way humanity perceives its place in the cosmos."

***Paolo Gondolo**, University of Utah, on the Sloan Digital Sky Survey,* Salt Lake Tribune, *August 27, 2008*

"This was just a hobby that got out of control."

***Robert Grober**, Yale University, on a golf gadget he invented,* the Hartford Courant, *September 2, 2008*

"Consider if you would have a great model to predict the quirks of the world's economy–would you go and publish it?"

Sabine Hossenfelder, *Perimeter Institute, on open science,* Live Science, *September 2, 2008*

"I know personally a number of people who've received the award. To be part of that list of which they are members is a thrill."

***Charles Slichter**, University of Illinois, on winning the National Medal of Science,* News Gazette, *August 27, 2008*

"We have no problem with that process."

***Susan Coppersmith**, University of Wisconsin, Madison, on the physics department undergoing a Title IX review*, The Capital Times, *September 3, 2008*

"Improv has got to be more difficult than doing physics. You have to think in milliseconds."

***Robert Stanek**, Argonne National Laboratory, on an improv comedy workshop at CERN,* The Wall Street Journal, *September 4, 2008*

This Month in Physics History

October 1958: Physicist Invents First Video Game

In October 1958, Physicist William Higinbotham created what is thought to be the first video game. It was a very simple tennis game, similar to the classic 1970s video game Pong, and it was quite a hit at a Brookhaven National Laboratory open house.

Higinbotham was born on October 25, 1910 in Bridgeport, CT and grew up in Caledonia, NY.

He graduated from Williams College in 1932, and then went to graduate school in physics at Cornell University. At Cornell as a graduate student he worked as an electronics technician. In 1941, he joined the MIT Radiation Lab, where he worked on cathode ray tube displays for radar systems. In 1943 he moved to Los Alamos to work on electronics for a timing system for the atomic bomb.

In 1948 he joined Brookhaven National Laboratory's instrumentation group. He served as head of that group from 1951 to 1968.

During that time, in October Brookhaven held annual visitors' days, during which thousands of people would come tour the lab. Higinbotham was responsible for creating an exhibit to show off the instrumentation division's work.

Most of the existing exhibits were rather dull. Higinbotham thought he could better capture visitors' interest by creating an interactive demonstration. He later recalled in a magazine interview that he had thought "it might liven up the place to have a game that people could play, and which would convey the message that our scientific endeavors have relevance for society."

The instrumentation group had a small analog computer that could display various curves, including the path of a bouncing ball, on an oscilloscope. It took Higinbotham only a couple of hours to conceive the idea of a tennis game, and only a few days to put together the basic pieces. Having worked on displays for radar systems and many other electronic devices, Higinbotham had no trouble designing the simple game display.

Higinbotham made some drawings, and blueprints were drawn up. Technician Robert Dvorak spent about two weeks building the device. After a little debugging, the first video game was ready for its debut. They called the game Tennis for Two.

Players could turn a knob to adjust the angle of the ball, and push a button to hit the ball towards the other player. As long as they pressed the button when the ball was in their court, players couldn't actually miss the ball, but if they hit it at the wrong time or hit it at the wrong angle, the ball wouldn't make it over the net. Balls that hit the ground would bounce like a real tennis ball. When the ball went off the court or into the net, players hit a reset button to start the next round.

Tennis for Two had none of the fancy graphics video games use today. The cathode ray tube display simply showed a side view of a tennis court represented by just two lines, one representing the ground and a one representing the net. The ball was just a dot that bounced back and forth. Players also had to keep score for themselves.

The game circuitry was fairly simple, using mostly resistors, capacitors and relays, though it did use transistors for the fast switching needed when the ball was in play.

Visitors loved it. It quickly became the most popular exhibit, with people standing in long lines to get a chance to play.

The first version, used in the 1958 visitor's day, had an oscilloscope with a tiny display, only five inches in diameter. The next year, Higinbotham improved it with a larger display screen. He also added another feature: the game could now simulate stronger or weaker gravity, so visitors could play tennis on the moon, Earth or Jupiter.

After two years, Tennis for Two was retired. The oscilloscope and computer were taken for other uses, and Higinbotham designed a new visitor's day display that showed cosmic rays passing through a spark chamber.

Higinbotham, who had already patented 20 inventions, didn't think his tennis game was particularly innovative. Although he saw that the Brookhaven visitors liked the game, he had no idea how popular video games would later become. Even had he had the foresight to patent the game, since he worked at a government lab, the federal government would have owned the patent, so he wouldn't have made any money from it. "It never occurred to me that I was doing anything very exciting. The long line of people I though was not because this was so great but because all the rest of the things were so dull," he once said.

Tennis for Two was more or less forgotten for some time. In 1964 Sanders Associates received the first patent for a video game. Magnavox bought the patent and produced video game systems beginning in the early 1970s. Competitors wanting to break the Magnavox patent found out about Higinbotham's earlier video game and he was called to testify, but the case was settled out of court. Higinbotham only became well known as the inventor of the video game after an article appeared in *Creative Computing* magazine in 1982.

Higinbotham's main interest throughout most of his career was not video games, but nuclear arms control. He helped found the Federation of American Scientists and served as its first chairman and executive secretary. Higinbotham died in November 1994, more famous for his video game than his work on nonproliferation.

Further reading: http://www.bnl.gov/bnlweb/history/higinbotham.asp

Flatow, Ira. *They All Laughed... from light bulbs to lasers: the fascinating stories behind the great inventions that have changed our lives.* HarperCollins, 1993.

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Washington Dispatch

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

ISSUE: Science Research Budgets

As of September 12, the APS News filing deadline, neither the House nor the Senate had moved any Fiscal Year 2009 appropriations bills to the respective floors. With Congress scheduled to recess on September 26, leaders in both chambers were preparing to put the federal government on a Continuing Resolution (CR) that would keep almost all agencies funded at FY 2008 levels. The Democratic House leadership indicated, moreover, that it was loath to schedule a post-election lame-duck session at this time. Should Congress not return for any further business in November or December, the FY 2009 CR would extend until February or March. What action the new 111th Congress would take on FY 2009 appropriations remains murky and will almost certainly depend on the outcome of the November elections. As a result, Federal agencies have been making plans for budgets that would remain level for at least the first 6 months of the new fiscal year.

Although the CR will keep most federal activities operating at FY 2008 levels, the White House has signaled that it might look favorably on a limited number of exceptions. Science could fall into that category, since it has strong bipartisan support. Several prominent congressional Democrats have said that they believe that an additional fiscal stimulus is necessary to keep the nation's economy afloat. It is unclear whether the Administration and Congress will be able to strike a deal that includes waivers in the FY 2009 CR, and if so, what those waivers would be.

ISSUE: Nuclear Weapons Policy

The APS Panel on Public Affairs (POPA), in cooperation with the American Association for the Advancement of Science (AAAS) and Center for Strategic and International Studies (CSIS), is issuing an unclassified report titled Nuclear Weapons in 21st Century US National Security. The project is based on four workshops covering four areas: Technical, International, Military, and Integration. Each workshop has had strong participation of physicists working in the relevant issue areas. The report can be downloaded from the APS website: http://www.aps.org/policy/reports/popa-reports/index.cfm.

ISSUE: POPA Activities

At the October meeting of the APS Panel on Public Affairs, the committee will be going over the following agenda items:

- Review of first items sent in via the new POPA Report Suggestion box (see below),
- A proposed future POPA Report from the Energy and Environment subcommittee,
- Draft statements on diversity and civic engagement of scientists.

The POPA Report Suggestion Box is where APS members are encouraged to suggest potential future POPA studies. Submitted suggestions will be directed to the relevant POPA subcommittee for discussion. Please note, while POPA welcomes member input, it may not be able to pursue, or respond to, every suggestion. The Suggestion Box can be found at: http://www.aps.org/policy/reports/popa-reports/suggestions.

ISSUE: Washington Office Media Update

The Cincinnati Enquirer published an editorial on August 31 regarding maintaining the country's competitive edge by investing in basic research and retaining high-tech jobs. The editorial was the result of efforts of the Task Force on the Future of American Innovation and the Semiconductor Industry Association.

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

INTERNATIONAL News

...from the APS Office of International Affairs

UK Faces Science Funding Challenges

By John Womersley

During the past six months, I've seen something I never thought I would: stories about science on the front pages and op-ed pages of major British newspapers, and scientists interviewed on prime time BBC current affairs programmes. The only problem is that these stories have all been about funding shortfalls, cuts to grants and potential cessation of support for prominent projects. And this is happening despite a government which claims to strongly support science. What is going on?

Most scientific research in the UK is funded through research councils, which receive their money from government on a three-year cycle. Particle and nuclear physics, astronomy, space, and large facilities for the physical and life sciences like synchrotrons and neutron sources, are all funded through the Science and Technology Facilities Council (STFC). STFC was created in 2007 by merging two former councils, one responsible for particle physics and astronomy and the other for national laboratories and facilities. In autumn 2007, the government announced its funding for STFC for 2008-2011. Once various mandatory commitments have been taken out (increased support for university researchers, depreciation costs on fixed assets, and so on) the budget is roughly flat cash ("flat-flat" in US terms) for the next three years. By STFC's calculation, this leaves it £80M short of what it needs for its "core" activities and £120M short of what would be needed to have enough headroom to start new projects. In a total three-year budget of £1.9 billion, such shortfalls might seem manageable, but STFC carries large commitments to international subscriptions (CERN, ESO, ESA and so on) and to projects that can't be renegotiated easily.

STFC's Council (its governing body) therefore made some strategic decisions to withdraw or limit involvement in projects. One of the most visible of these decisions was to cease to participate in the International Linear Collider (though in fact we are maintaining support for generic electron collider work at a reduced level). We initiated a programmatic review of all of our ongoing projects and facilities in order to potentially reprioritise them within a more tightly constrained budget. This review was carried out by our science advisory panels, who did an excellent job in very difficult circumstances. As may be imagined, the research community was not at all pleased with the overall situation and in particular felt that decisions were being made without sufficient community input, so a subsequent phase was added in which an open consultation was conducted and ad hoc panels of researchers were convened in each subject area to make suggestions on alternative ways to prioritise projects. This process has concluded and the results have been

FUNDING continued on page 7

Agreement Lets APS Members Provide Expertise to Industry

One company is looking for innovative technologies to reduce the moisture content of coal. Another company seeks better rust removal chemicals. Still other companies need technologies for polymer optical devices, platinum-free catalysts for fuel cells, and construction materials and technologies that enhance energy efficiency and safety.

Rather than develop these technologies in house, these companies can turn to TekScout, an online network that brings together scientists and engineers to solve R&D challenges posted by corporations that seek outside expertise.

APS members may have the expertise to find solutions to some of these challenges. APS has recently signed an agreement with TekScout that allows APS members to sign up as experts at a 50% discount. Registered TekScout experts will be notified of industrial challenges in physics and applied physics. A list of current challenges is on the TekScout web page (www.tekscout.com); more details on the challenges are available to registered experts. Experts who believe they can provide the needed expertise can send in a response, and those selected to work on the posted challenges receive payment for their work. Each company offers experts a fee and sets a timeline for completion. As of October 1, 2008, the registration fee for APS members is $50. TekScout is a service of UTEK, an innovation services company.

Through this open innovation process, TekScout can help companies develop products faster and less expensively than they could do using only internal resources.

"Our alliance with APS brings TekScout clients additional expert resources in the disciplines of physics and applied physics and further expands our base of TekExperts," stated Edward Weisberg, Vice President of UTEK and General Manager of TekScout in a press release.

"Part of APS's mission is to encourage the advancement of science and science education. We believe that the opportunity for our members to solve challenges on TekScout will provide an additional forum for our members to carry out this effort," stated APS Executive Officer Judy Franz.

As reported in the October, 2006 *APS News*, APS also has an agreement with Fortnight Solutions, another company that matches experts with companies needing outside assistance. (www.fortnightsolutions.com)

Physicist Tilts at Diploma Mills

In early July, a woman named Dixie Randock was sentenced to three years in prison for her role in operating a notorious diploma mill. The sentencing was the culmination of a six-year crusade begun by particle physicist George Gollin, a professor at the University of Illinois, Urbana-Champaign. Randock's operation sold fake degrees online, many of which were issued under the name St. Regis University.

Gollin's quest began innocently enough, with his irritation at the massive amounts of SPAM from various diploma mills that began clogging the computers in his lab and instructional classrooms in 2002. He called the number, "mostly because I wanted to yell at someone, because it was really intensely annoying." The person who returned his call offered to sell him a bachelor's, master's, and PhD degree for the bargain price of $4400, with an additional $900 price reduction if he paid for them there and then.

Gollin admits that at first, he found the concept amusing, a classic example of *caveat emptor* ("let the buyer beware"). But then he began looking into the various operations more closely, and was alarmed to find that the degrees being bought and sold included those certifying clinical expertise, such as forensic psychology, oncology, plastic surgery, even orthopaedic surgery. Furthermore, some foreign individuals were using the diploma mills to acquire fake credentials for H-1B visa applications, making it an issue of national security. Far from merely being an entertaining diversion, the fake degrees were potentially harmful.

"Having knowledge sometimes carries with it an ethical obligation, and that's how I felt about this," says Gollin about his decision to begin tracking and collecting material about diploma mills onto a central website hosted by his university. He is very careful to emphasize that this is not a "hobby": it is a professional activity that fulfills UI's requirement for faculty public service.

There is good reason for this caution: he has paid a price for his dedication to the cause, exposing himself to attacks by the very same diploma mill operators he was working to shut down. Threatening correspondence was sent to UI, which initially asked Gollin to take down the material, before reversing its decision a year later. The same group also attacked Gollin personally, spreading vicious rumors about his own academic credentials and personal morality, even attempting to smear his wife and daughter with the same tarred brush.

Fed up and angry–"I've never had people come after me like that before," he says–Gollin went on the warpath, writing an 80-page analysis and sending it to the Federal Trade Commission, hoping it would become the basis of a civil suit for fraud, and ultimately shut down St. Regis University and another diploma mill called American Coastline University. That didn't happen, but the attorney general in Washington state began a criminal investigation when Gollin informed her that St. Regis operated out of Randock's real estate office in Spokane. Randock and seven others–including her husband and daughter–were indicted in 2005. Sentencing should be complete for all the defendants by the end of September.

One other good thing emerged from Gollin's dedicated pursuit of diploma mills: the "Higher Education Opportunity Act" bill currently being developed by the House and Senate contains 15 pages of legislation related to controlling the spread of diploma mills. For instance, it seeks stricter rules on which schools can be considered accredited by requiring their accreditors to be recognized by the U.S. Department of Education and/or the Council for Higher Education Accreditation.

There is also language tightening the accreditation requirements on schools whose degrees can be used by government employees for employment and promotion. The bill also calls for the establishment of a federal task force to make recommendations on how to more seriously address the problem of diploma mills. Gollin admits there is no way to predict how much of this will survive in the final version of the bill. But it's a start.

Letters

Overselling Science Causes Problems

I appreciated Ron Hira's thoughtful Back Page in the August/September 2008 edition of *APS News*. It does seem to accurately capture my experiences and those of my colleagues, and it quantifies the issues regarding STEM supply and demand.

His comment "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" was very apt. I recall a very similar statement made in 1990 by an MIT/University of Illinois PhD physicist. By the way, this friend left science and engineering in his 40s and never returned, as far as I know.

In my opinion, the overselling of the sciences as a profession over the past 4 decades has been the primary problem for science in this country. When the best and brightest go into science and then fail professionally, it leaves a huge impression on family, friends, and the larger community. When this happens repeatedly over 4 decades, it can create an anti-science cultural bias that is difficult to erase. I know talented recent PhD's in the physical sciences in their 30s and 40s who are either vastly underemployed or unemployed in 2008, so the issue still remains.

I have been grateful for my limited success in science and engineering, and for the opportunity to contribute to the human endeavor in a unique and positive way through scientific discovery and innovation for 25 years. However, at age 49 I definitely question whether the sacrifices were worth it, and wonder how much longer I will survive (or should survive) in science and technology.

Rich Holmes
Cannon Park, CA

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saw many of the last pieces set into place in the experimental halls. I visited the detector caverns, guiding journalists around CERN, and listened in on conversations about the progress of construction as well as the discoveries that physicists hope to find in the data to come.

Although the years of preparation might make it seem like teams were taking their time, it quickly becomes apparent that most of the physicists are putting in long hours. I came to work, having realized too late that it was a CERN holiday, the day after LHC start-up. To my surprise, it seemed that at least a third of the usual population was also at work.

Pawel de Barbaro, a Polish physicist in CMS (one of the major LHC detectors) employed by the University of Rochester, pointed out, "From the construction point of view, I think it only makes sense to build the detector right. We're building a very complex detector, and we're building it for first time, so unpredictable problems are bound to appear."

Lyn Evans, LHC Project Leader, often remarks that the accelerator "is its own prototype."

In one of my favorite posts from US LHC blogger Monica Dunford, a post-doc at the University of Chicago, she compares working on ATLAS (another major LHC detector) to a training exercise, in which she had to negotiate a difficult trail–running as fast as she could with a teammate pursuing her. Looking back could result in a stumble, and she would lose more time. The four main detectors all needed to be ready before the LHC, or at the very least, before the other three detectors. It's not really possible to look back and see how close the others are to completion, so everyone works as hard and fast as they can to avoid coming in last.

I followed the race by watching pieces of hardware entering the caverns. The most impressive "lowering" that I saw was the last slice of CMS, a 1430 ton disk of iron and particle detectors, 52 feet tall. Starting shortly after 6:00 a.m., the equipment didn't complete its 300-foot journey until about 5:30 that evening.

That day, I guided a film crew working on an artistic documentary. The director, Peter Mettler, was surprised that the descent was so slow–barely noticeable as we looked on. Looking toward the Alps that night, reflecting on the day, he compared the descent to the speed at which the moon seems to rise.

While cavern security required an access card, helmet, and closed-toed shoes during that January lowering, I was receiving sideways looks for not wearing safety boots by the time I finished as a guide in April, even on the well-traced visitor pathways. By the end of May, they had activated the retina scanners, glowing blue in the access gates.

One of my favorite analogies for building the LHC came from Michael Schmitt, of the University of Illinois Urbana-Champaign. He thought of it as a car, "built in pieces by amateurs around the world." Having brought all the pieces to one place and assembled the machine, "we'll turn the key and see if it starts."

Luckily, it has. At 10:26 on the morning of September 10th, the LHC beam physicists breathed their sighs of relief or shouted their cheers as the first bunch of protons went full-circle in the 27-kilometer ring. The detectors received what seemed, after the months of relatively infrequent cosmic rays, a blast of data from the single beam hitting what little particle debris remains in the vacuum of the beam pipe. With a couple of months to refine calibrations on the detectors and the accelerator itself, everyone at CERN is looking forward to the collisions to follow.

Mission Relevance Enhances Army Research Impact

In his July 2008 Back Page article, Leo Kadanoff makes a compelling case regarding the decline in the nation's basic research capacity, and he recommends a corrective response that emphasizes education as well as enhanced research support. He argues this decline has cut across both the private and public sectors, and cites as an example of the decline of government support the 50th Anniversary Symposium of the Army Research Office (ARO), held in June 2001, from which Kadanoff understood that ARO would no longer support basic research. As the Director of ARO, I can state categorically that is not the case.

Throughout its 57-year history ARO has consistently championed basic research, producing many scientific advances that profoundly impacted technical innovations for the Army in particular, and the nation in general. If anything, ARO is now even more vigilant than ever in maintaining its focus on highly innovative basic research, to a large extent for the reasons stated by Kadanoff–there has been a significant erosion of the overall national support of long-term, high-risk basic research–so ARO's contribution to this national imperative is even more critical.

ARO's mission has always been to identify, create, fund, and manage fundamental basic research programs that lead to key technological advances needed to make our soldiers safer and more effective. ARO receives very strong support in this mission from all levels within the Army and DoD, ranging from its parent organization, the Army Research Laboratory, to the highest levels within the Pentagon. In fact, thanks to recent efforts by DoD Secretary Gates and his Office of Defense Research and Engineering, and with the support of the Army and other services, the President has submitted a budget to Congress that includes a very significant increase in the DoD basic research funding for FY09. It is also worth noting that the Office of the Deputy Assistant Secretary of the Army for Research and Technology is supporting a large number of STEM education initiatives to help educate the future high-tech workforce for the Army and the nation at large.

ARO's purview includes essentially all of the physical, engineering, life, and computer science disciplines. It should be understood that ARO doesn't support all sub-disciplines within a given discipline because of our Army mission. For example, ARO doesn't currently fund any projects in elementary particle physics because the probable Army impact is low compared to other possible investments. This focus on mission relevant research does not mean the ARO programs are not truly basic in nature. For example, ARO Physics programs currently include research on quantum information science, meta-materials and transformation optics, ultracold quantum degenerate gases, the physics of strongly correlated matter, novel quantum phases and quantum phase transitions, and behavior at interfaces. Another indication of ARO's ongoing commitment to basic research is that, so far this decade, nine individuals have won Nobel Prizes involving research ARO supported prior to their getting the awards.

Scientific advances produced by ARO-funded research, often supported in concert with other agencies, will result in revolutionary advances in Army capabilities ranging from fundamentally new types of sensors, to ultra-secure communications, to very lightweight, strong and multifunctional materials. The impact on civilian technology is also very significant. Although ARO's investments in basic research programs are constrained by Army mission relevance, it is precisely this relevance that accounts for these programs' extraordinary impact on the nation's economy and our quality of life.

David Skatrud
Research Triangle Park, NC

The Whole 8.23 Meters

In his stimulating Back Page article "APS, Physics: Aspirations and Goals" {*APS News*, July 2008], Leo Kadanoff discusses some various proposals to arrest the decline in American science, such as given in the report, *Rising Above the Gathering Storm*. However, nowhere in the list of the report's suggestions is there any mention of the need for the United States to convert to the metric system. At present this nation is joined with Liberia and Myanmar as being the only nations left on the planet not on the metric system! The support in the "Gathering Storm" for "more immigration of high tech workers," fails to mention that these workers would come from countries that are all on the metric system, which has consequently given those workers a better scientific "head start" than our own, thereby resulting in a shortage. In any case, to help arouse the American people, and eventually Congress to the need for such a conversion, for some years I have been advocating that our high schools, colleges, and universities convert their football fields from one hundred yards to one hundred meters. Having done this, one would no longer have the absurd situation that presently prevails in which students on the track team run distances in meters, while students on the football team run distances in yards. Or, as a mother recently informed me, her son's length was measured in inches, but the circumference of his head was measured in centimeters! Although we have come a long way from the scientific accomplishments of the St. Louis Exposition of 1904, we still have a long way to go. Nearly 10 meters in fact.

Frank R. Tangherlini
San Diego, CA

zero gravity
The Lighter Side of Science

Collyer Captures Caption Contest

In the April *APS News*, we invited readers to submit a physics-related caption for this cartoon drawn by *APS News* cartoonist Paul Dlugokencky. We then narrowed the field down to five finalists, and asked readers to vote for their favorite. Now the votes are in.

Hundreds of people voted. The winner is Robert Collyer of Baton Rouge, LA, who submitted the caption, "Partway through their argument, Mary realizes that Albert does not understand the gravity of the situation."

"I honestly entered on a lark," Collyer said upon hearing he had won. "I thought it was funny."

Collyer will receive a print of the cartoon signed by the artist, as well as a copy of the book *Physics in the 20th Century* and an APS tee shirt.

He's havin' a ball at Ball

By Alaina G. Levine

Carl Gelderloos never stops smiling. Is this Boulder-based PhD physicist in the middle of a perpetual Rocky Mountain high? Or perhaps he's so cheery because he has the privilege of doing exactly what he loves to do everyday as a business development leader at Ball Aerospace & Technologies Corporation. His work has led directly to the design, development, and launch of spacecraft and space-based experiments, so one thing is clear: Carl Gelderloos is having a ball working for Ball.

To the outside observer, Carl's job may seem simple: as Deputy Director of Ball's Advanced Systems group, Civil & Operational Space Division, he is tasked with responding to NASA requests for proposals for various space missions. He is a project manager, so he diagnoses what NASA's requirements are for a particular mission, identifies what resources Ball has and needs to solve the problem, aligns those resources with the goal, calculates the costs of the project, and crafts the proposal to articulate Ball's unique value proposition for the mission.

Being a business development pro requires experience in complex problem-solving and project management analysis, a distinct creative eye, and an intense mathematical approach that quite possibly only a physicist could obtain, hone, and love to employ. His role "involves bridging the gap between what is scientifically interesting and what is technically possible," Carl explains. He has to determine the project's scientific needs and then set everything up in advance to ensure Ball can satisfy them. This may involve working with academic and industrial researchers outside of the company, or setting up research and development centers that will solve the scientific problems needed to launch and run the mission.

On the other hand, he also has to identify, analyze, and solve all the business problems associated with the mission. This involves cost analysis, supply chain identification and management, human resource allocation and training, and various other business-related issues. For each project, he directly oversees 10-15 people, but he is indirectly working with hundreds, both internal and external to Ball, and often juggles many projects and teams at once.

As an example of his work, Carl cites the recent win by Ball to build a sensor to be used on NASA's Orion spacecraft. Orion is the spacecraft that is slated to replace the Space Shuttle as NASA's vehicle for transporting astronauts to low Earth orbit and beyond. The sensor, a flash LIDAR (Light Detection and Ranging), will be the primary instrument used to guide the spacecraft to autonomous rendezvous and docking, to both the International Space Station and future lunar spacecraft.

"We've been developing the technologies internally for several years, but this was the first opportunity we had to propose it for a NASA mission," says Carl. His team merged state-of-the-art focal plane, laser optic, and electronics capabilities into a compact system that met the low mass and power requirements of the mission. What resulted was a 3-D imaging system that output data at video rates, and the algorithms to compute the spacecraft's bearing and relative position.

"By combining capabilities uniquely and creatively, we've leapfrogged existing sensors and created a system that enables new capabilities and missions for NASA. Being able to harness our team's creativity, developing a plan for producing and proving it out, and ultimately creating an affordable product that enables autonomous rendezvous and docking in space is incredibly rewarding and exciting," states Carl. Now the next stage is to find other ways of using and applying the technology.

Carl's work is on the "front end," as he interacts directly with the customer, so while he helps launch Ball's participation in a mission, he often does not play a detailed role later on as the project unfolds. But what he loves most about his work is his ability and opportunity to express his creativity and bring simplification to any project, a talent and a passion he realized when he was first drawn to physics.

Carl, who is now 41, originally became entranced by physics after "seeing how simply and elegantly a huge variety of natural phenomena could be interpreted using just a few simple equations and simple mathematical relationships," he recalls. "The simplicity and the elegance of it was what really drew me in."

He received his bachelor's degree in physics from Hope College in Holland, MI in 1989, and his PhD in nuclear physics from University at Stony Brook in 1994. After a postdoctoral appointment at the University of Colorado at Boulder, he worked for Hughes Space & Communications, and joined Ball Aerospace in 2001.

His assignments at Ball reflect a veritable rainbow of space-related projects. He participated in the design of a mission to Jupiter to explore its moons, developed an earth science project that involved remote sensing in the atmosphere, and designed avionics innovations that control launch vehicles.

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president of the United States will have an opportunity to be the first in history to lay the necessary groundwork to reduce energy use among Americans.

Among its other key findings and recommendations based on the 12-month study are:

Transportation

•The federal government should adopt new standards for light-duty vehicles that average 50 miles per gallon or more by 2030.

•Vehicle weight can be significantly reduced through design and new materials without compromising safety. Vehicle weight reductions of 20 percent, for example, achieved by greater use of high-strength steel, aluminum and composite materials, would improve fuel economy by approximately 14 percent while reducing traffic injuries and fatalities.

•Plug-in hybrids require more efficient and more durable batteries, able to withstand deep discharges that are not yet in commercial large-scale production. Given the technical difficulties, plug-in hybrids will not replace the standard American family car in the near term.

•Improvements in the US electric grid must be made in order to handle charging of electric vehicles if daytime charging is to occur on a large scale or when the market penetration of electric vehicles becomes significant.

•Hydrogen fuel cell vehicles (FCVs) are not a short-term solution to our oil needs, but rather a long-term option requiring fundamental science and engineering breakthroughs in several areas.

Buildings

•To achieve the 2030 zero energy building goal for commercial buildings, the federal government should create a research, development and demonstration program that makes integrated design and operation of buildings standard practice.

•Green building rating systems should give energy efficiency the highest priority and require reporting of energy consumption data.

•The federal government should establish a comprehensive program of efficiency standards and labeling for appliances that are cost-effective and technologically feasible. A streamlined procedure is needed to avoid delays in releasing the standards.

•States should be encouraged to create demand-side, utility management programs.

•Energy standards for buildings should be implemented nationwide.

•Longer-term applied research opportunities include advanced ventilation, advanced windows, thermodynamic cycles and ultra-thin insulators.

Government Action: Legislative

•Congress should appropriate and the White House should approve for the U.S. Department of Energy's (DOE) Office of Science funds that are consistent with the spending profiles specified in the 2005 Energy Policy Act and the 2007 America COMPETES Act.

•Congressional oversight committees should ensure that DOE fulfills its obligation. Historically, coordination among basic and applied research programs within the Department of Energy has been far from ideal. Congress should periodically review the Energy Frontiers Research Centers program to ensure that basic research related to energy efficiency receives adequate attention.

•Estimating the long-term effects of transportation infrastructure on transportation demand should become a required component of the transportation planning process, and to that end, a better understanding of social science is needed.

Government Action: Executive

•DOE should fully comply with the 2005 Energy Policy Act mandate to improve the coordination between its basic and applied research activities.

•Long-term applied research, whether it is general or strategic in nature, often is the orphan child of science and technology programming. DOE must take steps now to fold long-term applied research into its scientific programming in a more serious way than it currently does.

•Smart growth policies in planning urban and transportation infrastructure can contribute to energy efficiency by reducing vehicle miles traveled (VMT) by 10 to 30 percent by 2030 compared to business as usual.

For a full copy of the APS report *Energy Future: Think Efficiency* and related materials, including video and photographs, go to http://www.aps.org/energyefficiencyreport/.

This Time It's For Real

Photo by Brian Mosley

Former APS President and Nobel Laureate Burton Richter tells the assembled media that this time the energy crisis is for real, and that dealing with it involves a serious commitment to energy efficiency. He spoke at the National Press Club on September 16 at the unveiling of the APS Energy Efficiency Report (see accompanying story), for which he served as Chair of the Study Group. Also addressing the media on this occasion were Study Group vice-Chair David Goldston (left), and APS Director of Public Affairs Michael Lubell (center).

Focus on APS Topical Groups

Topical Group on Magnetism and its Applications

By Nadia Ramlagan

Perhaps tantamount to the attention, growth, and interest the APS Topical Group on Magnetism and its Applications (GMAG) has experienced over the past decade, last year's 2007 Nobel Prize in Physics went to Albert Fert of France and Peter Grunberg of Germany, for their (independent) discovery of giant magnetoresistance (GMR). "The March meeting was a lot of fun, we sponsored a special reception and lecture to honor the Nobel Laureates and had a huge audience. Both Grunberg and Fert were able to attend. They gave a successful lecture to GMAG people," says GMAG chair William Butler.

Giant magnetoresistance is the change in the electrical resistance of a metallic magnetic multilayer that occurs when an external magnetic field aligns the moments in different layers. The discovery has radically transformed methods of retrieving data from hard disks, improved magnetic sensors, and spawned the development of a whole new field of electronics called "spintronics."

"Things seem to be coming along every few years", notes Butler. In 1995 there was the discovery of about 10% tunneling magnetoresistance (TMR) at room temperature by Terunobu Miyazaki at Tokyo University and Jagadeesh Moodera at MIT. The following year in 1996, John Slonczewski and Luc Berger independently predicted the phenomena of spin torque, a sort of converse to GMR. "In GMR the relative orientation of the magnetic moment in two layers will influence the current that goes through it. In spin torque, the spin-polarized current can influence the relative orientation of the moment, and you can actually apply a current that will cause the orientation of the moments to switch," explains Butler.

In 2001, very high TMR was predicted for magnesium oxide and cobalt iron. This was observed experimentally in 2004, and researchers were able to demonstrate about 1,000% TMR, a huge advancement from the 10% in 1995. Even more recently, there has been a huge investment in these new materials to make spin torque-switched magnetic random access memory. "The largest application of spintronics so far has been to the read sensor for hard drives. There was a lot of publicity talk about GMR and the IPod connected with the 2007 Nobel Prize because the first important application of GMR was for read sensors in hard drives. Nowadays hard drive read sensors use TMR, (tunneling magnetoresistance), using these new materials and most IPODS actually use flash memory," says Butler.

Currently, magnetic oxide research has been receiving a lot of attention. "In fact, the largest number of papers we get at APS are on magnetic oxides," Butler notes. Magnetic oxides (and to a lesser extent sulfides) generate lots of exciting phenomena. "It's interesting for the theorists because they are ionic materials, so the atoms all know where they want to be (in contrast to metals where you can have almost amorphous or fine microcrystalline samples). In the oxides you have the positive and negative atoms wanting to arrange themselves in a particular structure, and that makes things a little simpler to think about from a geometric point of view," says Butler.

Magnetic oxide materials allow researchers to generate what is called a spin filter effect, in which tunneling occurs through two magnetic layers that are insulators. The relative orientation of these layers can have a huge effect on the tunneling current. "These materials are also of extreme interest because they are very difficult to understand. The ordinary tools of band structure that we use are not always reliable when you apply them to these materials, because of the strong electron correlation", Butler says.

GMAG continues to play an important role at the APS March Meeting. This year, magnetism-related papers accounted for 14% (839 papers) of the March Meeting total, similar to the previous year. The group also sponsors student dissertation awards, a $500 prize and an invited talk at the March Meeting. "We also give awards for outreach. This year we funded a graduate student who has developed a program that's been going out and engaging students at local middle schools and high schools in science and magnetism activities," says Butler. As part of its public outreach effort, GMAG partially funds an Outreach Program (MINT-SOUP), which purchases kits for magnetism demos designed for high school and middle school students.

GMAG was founded in 1997 by David Jiles, the first chair. "David was really active in working to get the group recognized. All of the past chairs have done a good job, and this has been reflected in our growing membership," says Butler.

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University and working on a new experiment for her dissertation.

"In the past four years our family has grown rapidly. Three new babies came into our lives. It was wonderful. My first child is Jacob, who is 3. My second child is Owen, who is 2. And we have a little girl, Yealiya who is 3 months old," Li says.

Her husband Tim is the co-chief of operations at Jefferson Lab. His job requires him to take unregulated rotational shifts needed to keep the lab's accelerator running 24 hours a day 7 days a week. With no family in the area, it is difficult to arrange child care for their three young children.

"I was really overwhelmed by this situation and so I look 2 years leave from research, I didn't finish my PhD thesis work. But I really wanted to go back to physics; I didn't want to take too long of a leave to keep me from coming back," she says.

Li received plenty of support from Hampton professors to return to physics. Her current PhD advisor, Cynthia Keppel, told her about the Blewett scholarship and encouraged her to apply.

Li remarks, "There are a lot of women working in the lab and studying science. Women are very active in physics. But from my own situation I can see obstacles for women to focus on research or teaching, especially when they have children."

Firouzeh Sabri was born in Tehran, Iran. She received her undergraduate degree in physics from Swansea University, Wales and her PhD from the Cavendish laboratory at University of Cambridge, UK, where she worked on gallium arsenide metal insulator semiconductor transistors.

Firouzeh Sabri

"I've always enjoyed physics; originally I wanted to be an astronaut. That dream had to sort of go on the backburner, although all the way into the end of my undergraduate degree I still had great hopes for it," she says.

Currently, Sabri's research is focused on materials science at the University of Memphis, Tennessee. Her work funded by the Blewett scholarship will involve studying the UV degradation of two types of materials. She plans to determine the extent of damage and how the mechanical strength and stability of the materials are compromised by UV radiation.

"What is interesting is that the amount of UV radiation damage on these materials is pretty strong, and the process of this damage remains poorly understood," she explains.

Sabri was previously a postdoc at the University of Florida, Gainesville when her research was halted after her husband was offered a position near Memphis, Tennessee. Shortly afterward, she relocated to Memphis with her young son Kian. There she accepted a teaching position in the department of physics at the University of Memphis, where she is pursuing a research career.

In this day and age, early-career women scientists are experiencing less discrimination as societal norms and expectations shift, and as more women choose to enter scientific fields. "I have to say that I've never been discriminated against during my education. As a young single woman, I never felt anyone hold me back. No one pushed me through either, but I've never felt any discrimination. I've been treated as an equal, which is fantastic," says Sabri.

However, she points out that, "I did definitely sense a noticeable change in people after I had a child. It seems like when employers or colleagues find out you have a young child, they automatically prepare themselves for you to not be productive."

"I think that people, potential employers, whoever they are, they have to try and eliminate those things and judge you based on your capabilities and knowledge, not your family life. Because if you are someone who wants to get the job done, you will," she says.

Born in New Jersey, Janice Guikema received her undergraduate degree in physics from Cornell University and her PhD from Stanford University, where she used a scanning magnetic microscope to study vortices in high-temperature superconductors. She is currently a postdoc in the experimental condensed matter physics group at Johns Hopkins University.

Her research during the scholarship year will focus on the properties and applications of graphene, a single sheet of carbon atoms that flakes off of graphite. Since it was discovered a few years ago, graphene has been at the forefront of experimental physics research, mainly because of its novel electronic, optical and mechanical properties. The material is also free of defects (hardly ever missing a carbon atom), which makes designing very small, stable, graphene structures at room temperatures feasible.

She plans to fabricate a Hall probe sensor out of graphene, to determine if the material is sensitive enough to rival materials currently used to make Hall probes. In addition, she will also use scanning probe microscopy to study the local behavior of the charge carriers in graphene.

"My goal is to add to new knowledge about graphene and to exploit its properties for some useful devices," Guikema explains.

Along with her husband Seth, Guikema held a postdoc at Cornell University. They moved to Texas A&M University in 2005 when her husband got a faculty job there. Their son David was born in 2006. Since teaching appeared like a good option for balancing career and family, she accepted a half time lecturer position in physics at Texas A&M. "I enjoyed teaching, but I missed research even more. I found that after my teaching duties and caring for my baby I had little time for fruitful research," she says.

Guikema cites her PhD advisor Kathryn Moler as a prime mentor, inspiration, and influence. "I was actually her first graduate student, so she definitely was a great example for me, being a woman in physics and very successful, and while I was there she had twins. I think it was really good for me to see someone at a place like Stanford having kids and doing it all, having a successful career and lab," she reflects.

Janice Guikema

In January of 2008, her husband received a faculty position at Johns Hopkins University. There, Guikema negotiated a half-time research position with Hopkins faculty. She applied for the Blewett scholarship seeking more freedom to follow her research interests. The scholarship will enable her to work more hours and hire one or two undergraduates.

"I'm realizing now that in terms of your whole life and career, having a baby is a short time period. That's partly why I stepped back, because I don't want to miss out on my kid. It's better not to be overwhelmed and feel pulled in all directions. It's better to have a balance, even if that means not publishing as many papers, as long as you're still moving forward. And that's what I am trying to do," she says.

M. Hildred Blewett was a particle accelerator physicist whose dedication to physics prompted to her to leave almost all of her money to APS after her death in 2004, at age 93. Her intent was to help women overcome some of the many obstacles they face in the field by providing financial assistance in the form of scholarships. Born in Canada, Blewett began her career at General Electric (GE) in Schenectady, New York in the 1940s, a time when women physicists were scarce. While at GE, Blewett developed a method of controlling smoke pollution from factory chimneys. In 1947 she moved to Brookhaven National Laboratory, where she and her then husband John Blewett were among the original team members. Blewett later worked at Argonne National Laboratory, and then at CERN in Switzerland. She retired from CERN in 1977 and relocated to Vancouver.

ANNOUNCEMENT

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Quarkonia and their transitions

Estia Eichten, Stephen Godfrey, Hanna Mahlke and Jonathan L. Rosner

Quarkonium spectroscopy has celebrated a great resurgence in the past few years. Transitions between quarkonium states (bound states of QQ, with the heavy quark Q=b or c) shed light on aspects of quantum chromodynamics, the theory of strong interactions, in both the perturbative and nonperturbative regimes. New information on such states and their transitions and theoretical implications are discussed.

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announced on our website (www.stfc.ac.uk). STFC has implemented a restructuring plan which will see significant reductions in its laboratory staff and tight squeezes on facility spending. Partly in response to the unhappiness caused by reduced funding, the government has instituted a review of physics which will look at such things as the sustainability of support for university physics departments. While some are hoping that this review will result in additional funding becoming available, we have been told publicly that this will not happen.

While tempers are still high and the consequences are still playing out, I think there are already a number of lessons to be drawn from all this. The first is that a research programme can be squeezed, but the process is very painful and damaging. Relationships were frayed over the past six months which may take years to repair. The second is that a science case is not a business case. STFC Council did not question the science case for the Linear Collider; they questioned the wisdom of investing in R&D towards it, given their assessment of its funding model, construction start, and indeed its overall likelihood of going ahead.

The third lesson is that even when the overall climate for science seems good, one cannot assume that everyone will gain. Governments do set priorities and sometimes these priorities reflect public policy considerations as well as science. In fact, one of the difficulties STFC has faced is that it must now make priority choices of its own–between support for light sources and for particle physics, for example–that used to be the domain of government when they were funded separately. The science community is not yet comfortable with such choices and often almost seems happier to see these decisions made by politicians, though this may change as familiarity grows.

The last and most important lesson is that when bad things happen to funding, there is a strong tendency to look for an immediate cause. It is assumed that one bad decision, or one person's poor performance, is responsible, and if that person were just to be replaced, all would be fine. I don't subscribe to this view–I believe that when bad things happen to funding it usually means that an underlying climate exists in which funding for that area of research is not seen as being as important as other ways the money could be spent. Changing this underlying climate is much harder work, and will take much longer, but unless it can be done the situation will not fundamentally shift, and the next funding settlement may be even less pleasant. The good news, at least in the UK, is that the media have demonstrated an interest in science and its support and a willingness to devote resources to the story. This is a great opportunity. To take advantage of it will require the research community and funding agencies to move past recent strong disagreements, and it will require talking about the science opportunities we are pursuing as well as the ones that we regretfully are not able to. If we can't do this, and do this together, we will all deserve whatever happens to us.

John Womersley is Director of Science Programmes for the Science and Technology Facilities Council.

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Carl playfully hints that "there are plenty of opportunities where you have to choose to either laugh or cry" in his profession, and true to his jovial nature, is more than happy to reveal an experience that epitomizes this mantra. While a post-doc, he was collaborating with a potential future employer and borrowed some of his lab equipment to do a measurement. The experiment was taking place inside a large electromagnet that was turned off.

"Somehow in the middle of the night, somebody threw a switch and the electromagnet came on," Carl describes, chuckling. "There was enough iron in the experiment to accelerate it A LOT and it smashed into little tiny pieces. That was the end of the experiment. I gathered the pieces together into a box, and showed up the next day for the informal job interview with the guy's experimental apparatus in shards."

"It was certainly a tough start to the interview," Carl jokes, and although it ended up not working out, "in retrospect it was pretty funny."

After his post-doc he considered a career in academia, but fortuitously had an opportunity to look at industry. "My realization was that I could study a lot of the same problems in industry (as in academia) with a different approach, but oftentimes with a much larger budget" he says. "It was an epiphany for me that the supposed confines of a career in industry were much less than I supposed."

Lately, however, he only occasionally does physics calculations. He quips that the length of time between doing integrals, which has increased over time, is inversely related to how much he categorizes himself as a physicist.

Yet, "physics has been a wonderful career choice for me. I began studying physics with no thought of what the employment picture was; it was from a perspective of pure enjoyment," he says. "I found it intellectually fascinating and that was sufficient in and of itself. Studying physics opened lots of doors…In industry I have been able to participate in projects and do things and play with very, very large toys to an extent I never dreamed possible. From my perspective I haven't found a downside (to studying physics) yet."

No wonder. Considering Ball is the 15th largest employer of physicists in the US (according to the American Institute of Physics), Carl has undoubtedly been able to reap the rewards of the company's philosophy that allows physicists to focus their skills in many different roles. Carl contributes by seeking out and hiring physicists at all levels.

In the end, Carl's attraction to physics and to his work at Ball is about simplicity, creativity, and fun. Carl himself is a simple guy. He likes space, he likes physics, and he likes how he can use his scientific training to simplify and solve business and technical problems for his customers. With goals that can be simply achieved with a physics platform, can you blame him for smiling all the time?

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tiple applications in modern physics."

In addition, APS member C. Grant Willson of the University of Texas at Austin was among the recipients of the 2007 National Medal of Technology. He created novel lithographic imaging materials and techniques that have enabled the manufacturing of smaller, faster and more efficient microelectronic components.

Image courtesy of the National Science Foundation

The National Science Foundation administers the National Medal of Science, which was established by Congress for the White House in 1959. The National Medal of Technology was established in 1980.

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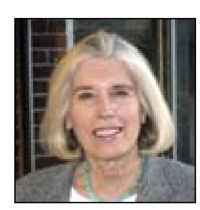
"I am very honored that my colleagues have chosen me to become the next vice president of the APS," said Barish. "I plan to work vigorously on the many challenges facing our field, including: improving funding for research in the physical sciences, broadening participation in our science and improving opportunities for international partnerships."

In his candidate's statement, Barish pointed to the "erosion of support for physics research" as one of the central issues facing APS. "We all understand the importance of a great country being at the forefront of basic science and the various ways our work impacts society," he said in his statement. "Many of us have been actively working over the past few years, epitomized by the "Gathering Storm" report, to make the case for increasing support for the physical sciences in the US. Just when we thought we had won that battle, we have suffered a major setback in the FY08 Omnibus Bill. As a result, we must redouble our efforts, in order to get us back on track to be able to push the frontiers of our science, develop new technologies, pursue international cooperation and train the next generation of scientists."

Barish has a special interest in international collaboration in physics. "Such collaborations are good for science and have proven to be a powerful way to bring nations together on a working level," he said in his candidate's statement. "It is crucial that we take into account cultural and political differences in establishing such collaborations and that we learn how we can make commitments that are firm and meaningful."

Kirby, a theoretical atomic and molecular physicist, received her PhD from the University of Chicago in 1972. She is currently a professor at the Harvard-Smithsonian Center for Astrophysics (CFA). In 2001 she was appointed Director of the Institute for Theoretical Atomic, Molecular and Optical Physics (ITAMP) at Harvard. Kirby's research interests focus on the calculation of atomic and molecular processes important in astrophysics and atmospheric physics. She has both served on and chaired numerous APS committees.



Kate Kirby

Nergis Mavalvala

Jorge Pullin

In her candidate's statement, she said that "the American Physical Society serves its membership in a number of important ways, including: organizing meetings for physicists, maintaining an outstanding series of journals for publication of physics research, educating and informing government and the public on issues involving physics, and cultivating a positive image regarding the study of physics and the importance of support to maintain a vital physics research enterprise." With the nominating committee, Kirby will work to recruit "an excellent and diverse slate of candidates" to serve in APS leadership positions and on its numerous committees.

Mavalvala received her PhD in 1997 from MIT. After a post-doc at Caltech, in 2002 she joined the faculty at MIT. She works on experimental gravitational wave detection and precision measurement at the quantum limit. 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.

In her candidate's statement she identified four important issues she wants to work on as an APS councilor: science funding–both for research and education; the role of physics and physicists in shaping our society; the dearth of women and under-represented minorities in physics; mentorship and recognition of physicists in the early stages of their careers.

Pullin's research interests center on theoretical gravitational physics, both in its classical and quantum aspects, including the application of numerical techniques. He received his doctorate in physics from the Balseiro Institute in Argentina in 1989. He is now the Horace Hearne Chair in Theoretical Physics at the Louisiana State University. He recently served as the chair of the APS Topical Group in Gravitation. He has also served 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.

"Physics is clearly in a golden age. More than ever we can make predictions that are experimentally verified over a wider and deeper range of physical phenomena from the subatomic to the cosmos. In spite of this intellectual bonanza, funding for the field, enthusiasm for it in the general public and attraction of young talent to physics continue to be three outstanding challenges that affect the work of all physicists," he said in his candidate's statement. As a councillor he plans to help APS deal with those challenges.

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Recruiting and Retaining Minorities into Your PhD Program

By David J. Ernst

What is the best way to recruit minority students into a PhD program and to maximize the number of such students who succeed at obtaining a PhD? The observations in this article are gained from many years of experience. They are not a result of any study; they are things learned through trial and error. Moreover, much that is put forward here is relevant to recruiting and retaining students in general. My personal experience is one that had a focus on domestic minorities as well as students from Latin America.

This article is also not directed toward the top few elite institutions, although many of the thoughts here could possibly be useful to them. The very elite institutions already receive an adequate number of applications from students who, on paper, look absolutely excellent. The question then is how to select the "best" when the evidence to distinguish between perfect applicants is very limited. Here, the interest is in a Research I institution that wants to increase the number of high-quality students applying, in how to identify the "best," and then in how to retain as many as possible all the way through to receiving a PhD.

Before starting the process of recruiting and admitting, one must define what one means by "best". Simply having the computer rank the students by grades, by general GRE's, by physics GRE scores, or a combination of these, does not yield my definition of best students, if the best students are defined as those who will complete the PhD degree and then be the most successful both in and outside of academia. Full weight must be given to success outside of academia where the majority of your students are headed; a student who gets rich in industry and donates money back to your department is indeed a great success. My experience tells me quite clearly that numbers are not a very reliable indicator of this long term view of success.

The students of interest here are not the students who have the very high numbers, are energetic, curious, hardworking, likable, and work well with others. Most departments admit students who are less than perfect in some aspect and nobody bats a thousand in only selecting students who do ultimately receive a PhD. The question is how do you determine, in the real world, who are the best to admit and how do you increase your efficiency by increasing your success rate? Given the need for US citizens by some industries and labs, and given the declining interest within the US in science and engineering, all should be interested in identifying and recruiting the "best" students from among a pool whose size is insufficient to meet our national needs.

You wish to recruit minority students into your program. What is the first thing you should do? You have to go out and meet the students. Minorities in the US are, on average, much more people oriented than the average American. They rely on personal contact, on knowing the people with whom they work. I learned quickly while living in Mexico that to do business with someone, you first sat down and had a coffee or a beer and learned about the person and their family. This holds true, to some extent, for the US Hispanic community and for the US African-American community. Personal relationships are very important to people in a community where you rely heavily on each other. Given this culture, it is most important that the recruiter go out, meet, and get to know the student. Sending out posters, e-mails, and other impersonal efforts are good but will prove insufficient.

In the US, it is possible to meet a large fraction of the minority students interested in a PhD in physics, astronomy, and related fields. First, the number of such students is unfortunately pretty small. The US is producing only tens of PhD's each year who are African-American or Hispanic. Second, there are two meetings each year where many of the likely students will be in attendance. These are the Annual Meeting of the Society for Chicanos and Native Americans in Science (SACNAS) and the Joint Annual Meeting of the National Society of Black Physicists (NSBP) and the National Society of Hispanic Physicists (NSHP). Both of these meetings are very student-oriented. However, NSHP is very active in the organization of the meetings so that physics students will find a full program of interest to them.

The NSBP/NSHP meeting is an interesting combination of a professional society, a research focused meeting, and a meeting for students with many student support activities. It has the advantage of being a physics meeting, with physics very broadly defined to include astronomy, geophysics, acoustics, optics, etc, in addition to the traditional physics subdisciplines. If you wish to meet minority students, attend these meetings, get a booth at these meetings.

Will that be sufficient? No. You need to meet and actively engage with the students at the meetings. Get involved, be a judge, organize a session, and definitely participate in all the mentoring activities that are organized at these meetings. Get involved in the organizations themselves, since the recruiter who is on the inside has an advantage over the recruiter from the outside. You also need to attend each year. Meeting them more than once can have a significant effect.

There are two APS meetings that now have special undergraduate student programs, the Nuclear Division meeting and the April Meeting. There are two section meetings, the meeting of the Southeastern Section of the American Physical Society (SESAPS) and the Texas Section of the American Physical Society (TSAPS) that have strong involvement of NSBP and NSHP in their organization. Any meeting with undergraduate participation is good for recruiting. Be sure to give recruiting some priority, be a judge, get involved. Don't give your "to be famous paper" and not take the time to search out students and let them know what your program has to offer. Don't wait for the students to come to you; do your best to seek out the students.

You must also recruit for the entire department. Far too often, faculty are looking only for the student who will work with them. If all faculty recruit for the entire department, the probability becomes large that a student with an interest in your work will be identified by someone and then you become the proactive, personal recruiter.

Now that you have met students and they have applied for your program, how do you decide whom to admit? I am not able to describe in a quantitative way those things that influence me to support a student for admission. Great work habits, curiosity, an ability to work in a group situation, and communication skills are some of the things to look for in addition to having the mental ability to work on complex problems. I, and my partners at Fisk and Vanderbilt, rely on intuition, on spotting a combination of traits in the students that convince us that the student can and will succeed. It is difficult to convince physicists of something that is so unscientific, but, having done the experiment over many years and many students, the results prove that a careful use of one's intuition can be quite reliable. The student needs to be one whose numbers might not indicate that the student will succeed. Those you find with great numbers don't really need any extra support. Fight to get this student admitted and when the student's performance far exceeds the expectation predicted by numbers, you have made the first significant step. Do tell the student that they are breaking new ground and that they are laying a path for others. Let the subsequent students know that they are maintaining a precedent and that their success is very important to you and the department. The challenge and the realization that they are a part of something larger is a great motivator.

Some students will enter the system and move on quite smoothly on their own. But you have identified students who did not look perfect on paper. This may translate into "they may not be the perfect student and may need some assistance to move through the system." Not all undergraduate degrees provide an adequate background to survive your program's course requirements. For these students, the program must be willing to allow the student to fill in background. Remember, the goal is the long term success of the student, not instant production of research for an advisor. If you recruited the student, it is your responsibility to make sure the student takes appropriate courses

Another common situation is simply that the student is not good at juggling the academic demands along with the demands of life in general. Some assistance in managing the everyday situation they face is sometimes needed. The students may require very hands-on proactive mentoring. This is not easy to provide. First, it takes time. Second, students, in general, are not comfortable telling faculty about their problems. Sometimes, the faculty must take the lead and poke their nose into the student's life in order to sniff out the existence of a problem. The missing skills may not be academic. The skills that teach them how to navigate the graduate program, are also those that will help them succeed afterwards. The students must be made aware that they too have entered into a contract. Their commitment is to work hard, to listen to advice, and to learn not only physics but to learn how better to succeed.

Can an individual have an impact and succeed in pursuing such a program? First, you should honestly examine the graduate program and the attitude and atmosphere at your institution. If your department runs a sink or swim graduate program and is happy with the present split between sinkers and swimmers, you probably should start with an effort to change the attitude within the department. Since the goal is to improve the quality and throughput of your graduate program, a cohort of like-minded faculty should be possible. Personally, this worked for me on the individual level for twenty-five years. The level of success was roughly a student per year. To work at this level, a vast majority of the students did not do their thesis with me. No rewards from the university were expected nor were they forthcoming. Being done at the one-on-one year-by-year level, I don't believe I would have been even able to articulate all that was involved.

About five years ago, the Fisk-Vanderbilt Masters to PhD Bridge Program was started (see http://www.vanderbilt.edu/gradschool/bridge). This program is based on the thoughts put forward above. It has the advantage that the students do not have to make the transition from their bachelor's program to the Research I graduate PhD program, but can start in the Master's program at Fisk University and then end up in the Vanderbilt PhD program. The transition is thus first to a small, friendly, personal Master's program and then to the Vanderbilt PhD program that is, in my opinion, more student-oriented than most, with an intense mentoring program to help along the way.

Having a formal program in place has many advantages. The recruiting is done by a group, the mentoring is done by a group. Having a program means we were able to get support–real money, tuition waivers, staff support from the universities involved. Originally, the program got extra money added to grants whose focus was research. Once in place and with a track record, the program can become the focus of a grant while continuing to be a positive addition to a number of other grants. Money is needed for a program, and money helps gain support from your fellow faculty and the administration. Having your university not only support the program but feature it and brag about it also helps the program succeed. The success of this program is due to its two present directors, Professor Keivan Stassun with a principal appointment at Vanderbilt University, and Professor Arnold Burger, with a principal appointment at Fisk University. The Fisk/Vanderbilt crew would gladly work with and help anyone who might be interested in a similar effort.

David Ernst is a Professor of Physics and Astronomy at Vanderbilt University; an Adjunct Professor at Fisk University; the President and a co-founder of the National Society of Hispanic Physicists; and a Co-Chair of the Division of Nuclear and Particle Physics of the National Society of Black Physicists. He is also the Chair-Elect, Southeastern Section of the APS, a member of the Council and the Executive Board of the APS, and a member of the Liaison Committee for Underrepresented Minorities of the American Institute of Physics.

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