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Mini-grant Deadline Looms

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APS Honors Los Alamos as a Historic Site

Photo by Richard Robinson

On July 22, APS President Michael Turner (right) presented a plaque to Los Alamos National Laboratory Director Charles McMillan, to recognize the many scientific achievements of the Laboratory since its founding in the midst of World War II. Presented as part of the APS Historic Sites Initiative, the plaque reads: "Created in response to an international crisis, Los Alamos successfully developed the atomic bomb under the leadership of J. Robert Oppenheimer. Its scientists and engineers have made numerous contributions, including discovery of the neutrino by Clyde Cowan and Frederick Reines, development of high-performance computing, large scale numerical simulations, study of material under extreme conditions, integration of physical, earth and life sciences, stewardship of the national nuclear stockpile, and leadership in the science and technology of global security and non-proliferation."

Open Access Mandate will Include Raw Data

By Michael Lucibella

Scientists receiving federal funds will soon have to include plans for the public access of much of their raw data. This requirement was spelled out in February, in the same memo from the executive branch's Office of Science and Technology Policy (OSTP) that dealt with the open availability of journal papers derived from federally funded research.

Though there has been no official statement on the issue, scientists applying for federal grants will likely start seeing requirements for a data management plan in the coming months. Michael Lubell, APS Director of Public Affairs, said that after meetings with representatives from various funding agencies, including the NSF and the DOE, it's clear that the beginning of a framework is just starting to take shape.

Many of the details of how and where this data will be stored are still unclear, and the timeframe is still uncertain. The enormous amount and huge diversity of different kinds of data across all disciplines of science poses a huge challenge to anyone trying to put together a single centralized database of research data. It's also possible that individual agencies, or even publishers, might be the stewards of the raw data files. Who will store the data will have to be worked out on a field by field or even discipline by discipline basis.

"What they're looking for is not something that would be burdensome but something that will enable readers to assess how important that result is in terms of their own work," Lubell said.

Generally speaking the data that would have to be included are the individual data points used in preparation of a published paper. Data points that have been expunged from the final analysis will likely have to be included, the idea being that scientists can evaluate why those points were eliminated.

However, the policy would not extend to objects or lab notebooks. It would likely not extend also to computer codes, though talks are continuing over this point.

Victoria Stodden, a statistician at Columbia University and an expert on open data, expressed con-

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US Physics Enrollments Continue to Set Records

More US students graduated with physics degrees in 2012 than ever before, according to a recently released study. The statistics center at the American Institute of Physics (AIP) reported that 6,776 students received a bachelor's degree in physics in the 2011-2012 academic year, and 1,762 students earned a PhD, a record in both categories.

Bachelor's degrees are up eight percent over last year's numbers and PhDs increased by four percent. The number of physics degrees awarded has been climbing since enrollments bottomed out about a decade and a half ago. The number of physics degrees awarded represents an 86 percent increase from 1999 when enrollment was at its lowest in recent years. PhDs similarly hit a their lowest point in 2004, and have risen 62 percent since then.

Patrick Mulvey, of AIP's statistical research center, said that there was no single cause driving the increase in enrollment. He said that physics departments have been devoting more resources and effort to developing better undergraduate programs, which opens the pipeline for more graduate degrees as well.

"Ten years ago there was an important report, 'Strategic Programs for Innovations in Undergraduate Physics: Project Report,' that described the characteristics of a successful and inviting physics

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2013 Blewett Fellows Integrate Family and Physics Careers

By Michael Lucibella

Established by APS in 2004 by a bequest from the estate of M. Hildred Blewett, the Blewett Fellowship enables women to return to physics research careers after having had to interrupt those careers. This year APS awarded two new fellowships, and renewed the award to one of last year's fellows. The fellowship consists of a one-year award of up to $45,000.

Amy Daradich

Leslie Kerby

It was her high school teacher's passion for physics that first drew **Amy Daradich** to the subject.

"It was genuinely exciting," she said. "When people have enthusiasm for what they do, it's really infectious."

The experience sparked a deep interest in her to understand how things work, and to get to the root of problems. She decided physics was the path for her.

Daradich hails from Toronto and enrolled at the University of Toronto after graduating from high school. For her undergraduate degree she dabbled in several fields, but ended up focusing on biophysics. However, once she started taking the required fundamental courses for her master's, she found herself drawn more towards geophysics and studying the long-term evolution of terrestrial planets.

"There are so many interesting things to work on," she said.

She met her husband while at the University and they were married while attending school together. However, in early 2007 he landed a job in Edmonton, Alberta, about 2,000 miles away.

Also in early 2007 Daradich discovered she was pregnant, and would be due shortly after defending her PhD thesis. She graduated in September of 2007, then immediately moved to Edmonton to be with her husband. Her son was born in November, but there was a complication. He had a congenital heart defect and needed several surgeries early

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Profiles In Versatility

Part 1 of two-part Interview: Entrepreneur Elon Musk Talks About his Background in Physics

Elon Musk, the founder or co-founder of companies such as PayPal, SpaceX and Tesla Motors, studied physics and economics at the University of Pennsylvania. In part one of an exclusive two-part interview with Alaina G. Levine, Musk discusses how he bases his thought processes on first principles, the benefits he gets from having studied physics and why he's proud to call himself a nerd.

This interview has been edited for space and clarity.

L: *You had stated in an interview recently that one of your pieces of advice for people looking to innovate is to "study physics and learn how to reason from first principles rather than reason by analogy." Can you expand on what you meant by that?*

Elon Musk

M: Of necessity, physics had to develop a framework of thinking that would allow understanding counter-intuitive elements of reality. Something like quantum physics is not very intuitive, and in order to make progress, physics essentially evolved a framework of thinking that was very effective for coming to correct answers that are not obvious. And in order to do this, it requires quite a lot of mental exertion. One cannot conduct one's everyday life reasoning from first principles; it would just require too much mental energy. So I think you have to operate most of your life with reasoning by analogy or essentially copying other people with minor variations. But if you are trying to break new ground and be really innovative, that's where you have

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Members in the Media

"What we were trying to understand better is how actions, in terms of routing humans, could affect the spread of disease."

***Ruben Juanes**, MIT, on how the freedom to travel affects the speed a contagion spreads,* FoxNews.com*, August 1, 2013.*

"The voters, the citizens, deserve a campaign that helps them think about their future and shows them the choice they have…I don't think a campaign where one candidate is coronated before the race even begins helps that."

***Rush Holt**, House of Representatives, on his ultimately unsuccessful campaign for Senate in New Jersey,* The New York Times*, August 8 2013.*

"It points to something missing in our understanding of gravity."

***Joseph Polchinski**, the Kavli Institute for Theoretical Physics in Santa Barbara, California, on whether there exists a "firewall paradox" at the edge of a black hole,* The New York Times*, August 12, 2013.*

"Quantum field theory is how the world works."

***Edward Witten**, Institute for Advanced Study,* The New York Times*, August 12, 2013.*

"It's a very curious time in high-energy physics…The problem is going to be convincing the US government that they can find a pot of money in order to support this Japanese initiative."

***Michael Peskin**, SLAC, on the International Linear Accelerator,* National Public Radio*, August 12, 2013.*

"Everything is perfect."

***Krzysztof Rykaczewski**, Oak Ridge National Laboratory, on the confirmation of element 115,* The New York Times*, August 27, 2013.*

"The universe is this great, big, amazing place and we really only understand about five percent of it. In my day-to-day life, the questions I ask myself have to deal with car payments or airport security or traffic. These are boring questions. Then I talk to my 3-year-old nephew and that's when I remember–because he walks around and asks 'why' all the time…That's why I believe particle physics is important…because my nephew asks me, 'Why?' and I want to be able to answer."

***Hugh Lippincott**, Fermilab,* The Chicago Tribune*, August 27, 2013.*

"It's the first spacecraft to reach interstellar space…Think of that. It's really something that's mind-boggling."

***Ed Stone**, Caltech, on the whereabouts of Voyager 1,* The Los Angeles Times*, September 12, 2013.*

"It's almost a pure tone. Like middle C. But slightly varying, like your piano is not quite tuned right."

***Donald Gurnett**, University of Iowa, on what space "sounds like" to the Voyager I spacecraft,* The Washington Post*, September 12, 2013.*

"We know they're producing steam, but we don't know if this is a test or if the reactor is up and running…they said they've kept it operationally on standby. They have staff. They maintain it."

***David Albright**, the Institute for Science and International Security, on suspicious steam rising out of North Korea's Yongbyon nuclear reactor,* The Chicago Tribune*, September 12, 2013.*

"Physics and chemistry as we know them would become very different, and certainly no living creature would survive."

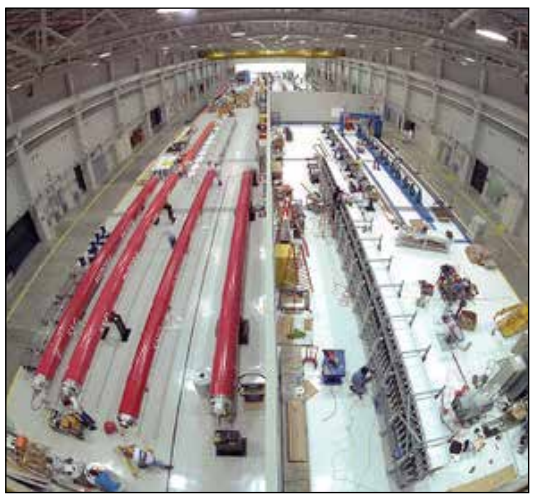
***Sean Carroll**, Caltech, on what the universe would be like if the quantum vacuum becomes unstable,* NBCNews.com*, September 13, 2013.*

This Month in Physics History

October 1993: Congress Cancels Funding for the SSC

In July 2012, physicists around the world thrilled to the news that the last piece of the Standard Model of Particle Physics–the Higgs boson–had likely been discovered by CERN's Large Hadron Collider. It was the culmination of decades of research by theorists and experimentalists alike, but the achievement was bittersweet for the American contingent. They couldn't help thinking of an earlier accelerator, the Superconducting Supercollider (SSC), which never made it to completion.

The roots of the SSC arose from a cancelled project at Brookhaven National Laboratory called ISABELLE, during the Reagan administration. By 1984, the under-construction ISABELLE was beset with problems, notably superconducting magnets that didn't work. Even worse, its primary purpose had been to discover the W and Z bosons –and those particles were found the prior year by CERN's rival accelerator in Switzerland. Leaders in the high-energy physics community decided the best course of action would be to cancel ISABELLE and redirect the funds to the design and construction of an even bigger accelerator, initially nicknamed the "desertron", possibly because it would be so large, it would have to be built in a remote low-population area where land came cheap.



The old interior of the Magnet Development Laboratory where technicians coiled superconducting niobium wires to make powerful magnets.

What the same space looks like today.

In 1986, physicists unveiled the SSC's design, which featured a ring 53 miles in circumference, filled with 8600 superconducting magnets. The 20 TeV proton beam would pass through a four-centimeter bore in each magnet as it made its way around the ring. The following year, the Department of Energy presented the SSC plans to President Reagan and his cabinet, estimating the total cost at around $4.4 billion (later raised to $5.3 billion to include the cost of detectors). The project appealed to Reagan, who recalled advice he'd once received from a star quarterback: "Throw deep." Told that he would make a lot of physicists ecstatic with his decision to approve the SSC, Reagan purportedly replied. "That's probably fair, because I made two physics teachers in high school very miserable."

That sense of victorious elation did not last long; the project experienced difficulties from the start. Still, construction began in 1991 in Waxahachie, Texas, and within two years, workers had bored through enough sandstone and limestone to create 30 kilometers of tunnels. A 1991 effort to cancel the SSC, brought on by concerns about cost overruns, failed in the House of Representatives, 165 to 251. But it proved to be a temporary reprieve.

The rising price tag in the face of economic recession as President Bill Clinton took office in the early 1990s certainly figured prominently in the collider's falling fortunes. By then the estimated cost had ballooned to more than $10 billion, and the DOE's 1993 Baseline Validation Report called for increased safety and contingency margins, resulting in another 15% increase to the budget, to $11.5 billion. National priorities had shifted, and slashing the federal budget topped the list. The SSC was not the only major science project with a hefty budget; it was competing with the International Space Station, which held greater appeal for the new Congress than the more esoteric objectives of the SSC; nor were Clinton's science advisor, or his Energy Secretary, particularly passionate about the SSC.

One of the most frequent criticisms leveled was poor management, particularly when it came to implementing the required bureaucratic procedures. A 1994 follow-up Congressional report listed several examples, spanning a lack of mandatory internal reviews and communication breakdowns, to consistently underestimating costs on the project. The physicists may have been brilliant at science, but they were less enthusiastic about red tape. One senior physicist grumbled undiplomatically, "Our time and energy are being sapped by bureaucrats and politicians."

There was considerable tension even within the physics community itself, with physicists in other subfields resenting the high-energy physicists for garnering what they perceived to be the lion's share of funding and public attention. They perceived it as a zero sum game: the more government money funneled into building the SSC, the less was available for other projects. Among the most vocal detractors was Nobel Laureate Philip Anderson, a condensed matter physicist who bemoaned "the almost complete irrelevance of the results of particle physics not only to real life but to the rest of science."

In the end, the House of Representatives voted

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Diversity Corner

APS Bridge Program Places Students in Graduate Programs

The APS Bridge Program was able to facilitate the placement of at least 14 students into physics bridge programs or directly into graduate programs. Seven students were named Bridge Fellows at the newly selected APS Bridge sites University of South Florida and the Ohio State University. Each site was also able to admit one student directly into its graduate program. Students that applied to APS-BP were considered by other graduate programs, with sixteen offers of admission made to ten students. Five of these students accepted offers, and at press time, five students have offers pending, leaving the potential of APS assisting possibly up to 19 students into graduate programs in physics during the first year of the bridge program.

More information is available at www.apsbridgeprogram.org.

APS Diversity Working Group Formed

The APS executive office recently formed a Diversity Working Group (APS-DWG) to look broadly at diversity issues that concern the organization, including membership and staff. The APS-DWG is composed of 10 APS staff members who work with different areas of operation, including publishing, membership, meetings, prizes and awards, public affairs, education, diversity, and human resources, among others. The charge to the group includes gathering statistics on diversity, assessing climate among staff, and making recommendations to the executive officers. The APS-DWG will work in collaboration with the Committee on the Status of Women in Physics and the Committee on Minorities.

2014 Professional Skills Development Workshops for Women

The American Physical Society, with support from NSF, will host two Professional Skills Development Workshops in 2014 for female physicists. Applicants affiliated with a US institution/facility are eligible to be considered for travel and lodging funding. Those needing funding assistance are encouraged to apply early. The deadlines for the workshops and a link to the online application can be found at: www.aps.org/programs/women/workshops/skills/

APS Scholarships for Minority Undergraduate Physics Majors

The APS Scholarships for Minority Undergraduate Physics Majors is a merit-based scholarship with the goal of increasing the number of underrepresented minority students obtaining physics bachelor's degrees. Any high school senior, college freshman or sophomore who is an African American, Hispanic American or Native American US citizen or permanent legal resident, is eligible to apply. The online application opens on November 1 and the deadline for applying is February 7.

APS Bridge Program Request for Proposals

The 2013 APS Bridge Program (APS-BP) Request for Proposals (RFP) for new *Bridge Sites* is now available at http://www.apsbridgeprogram.org/institutions/bridge/rfp.cfm. The primary goal of the APS-BP is to increase the number of underrepresented minorities who are awarded PhDs in physics. The deadline for submitting an initial proposal is October 4, 2013. In the 2012-2013 RFP solicitation, we received and reviewed twenty-four initial proposals, and of these, seven advanced to the full proposal submission process. Two of these were selected to become *Bridge Sites*.

A webinar on the APS Bridge Program RFP will be held on September 20 at 12:00 pm ET. To participate, please register for the webinar at https://www3.gotomeeting.com/register/636404230.

Texas College Consortium Gains Approval

An electronic consortium of small colleges across Texas recently won permission to offer a joint physics degree. Together, the eight participating schools, whose physics programs were facing shutdown because of low enrollment two years ago, will now make up the second biggest physics program in the state.

As *APS News* previously reported, in 2011 the Texas Higher Education College Board decided to shut down programs at public colleges that graduated fewer than five students a year on average. Several of the schools with physics programs that didn't meet the requirements joined a small network of universities that together taught classes through online streaming.

After a lengthy application process, the THECB officially signed off on the expanded Texas Physics Consortium in July, authorizing it to start awarding bachelor's degrees.

"We have plenty of schools," said Dan Marble, a professor at Tarleton State University who helped set up the online consortium. "That pretty much killed the issue of [the THECB] ever coming back on us."

Students attending seven schools across the state will receive a degree from the consortium, rather than their individual schools. An eighth member of the network, Texas A&M University-Commerce, will also share teaching responsibilities, but it was never in danger of losing its degree program.

All together, the program will likely average about 20 to 25 physics graduates a year, more than any single university in the state other than the University of Texas at Austin. Marble said also it's likely that the consortium will expand again in a year or two to incorporate the University of Texas at San Antonio.

The last step is to get the Southern Association of Colleges and Schools, the accrediting agency of the state, to sign off. Marble has sent in the application, and expects them to approve the program.

"It feels great," Marble said. He added that for him the next step is to start coordinating with the registrars at the different universities to get the program up and running. "Now comes all the hard work."

APS President Visits Vietnam for Physics Event

APS President Michael Turner traveled to Vietnam in August and met with the head of the Vietnam Physical Society. They agreed that there are many ways for the two Societies, and the two countries, to work together on future scientific initiatives.

Phan Hong Khoi, president of the VPS, said that he hoped to see the two Societies work together to train young scientists, establish future workshops and conferences and generally improve the scientific dialogue between the two countries.

Turner said he also saw many areas for cooperation between the APS and the VPS. "It's stunning that there are so few Vietnamese physicists that are part of the APS."

While the VPS has a membership of more than 1000, there are currently only three APS members who reside in Vietnam. After their meeting Turner said that he would like to boost that number to 30 APS members.

"Asia is one of the fastest growing regions in terms of physics," Turner said. "I think Vietnam will be right in there."

In recent years, the economy of the country has been growing rapidly, and its leaders have been talking about increasing their investment in scientific research.

Turner was in Vietnam to represent APS at the opening of the new International Center for Interdisciplinary Science and Engineering (ICISE) in Quy Nhon. Its inaugural meeting, "Windows on the Universe," was organized by renowned physicist Trần Thanh Vân.

Photo Credit: I. Cossin

The photo shows part of the group of speakers and participants in the inaugural conference Rencontres du Vietnam: Windows on the Universe 2013, held August 11-17 at the International Center for Interdisciplinary Science and Engineering in Quy Nhon. Speakers included APS President Michael Turner (left circle) and 2011 APS President Barry Barish (right circle). Gracing the front row (l to r) are conference organizer Jean Trần Thanh Vân (sixth from left end) and Nobel Laureates David Gross, Sheldon Glashow and Jack Steinberger.

"The purpose of the meeting was to dedicate this new center that Trần Thanh Vân had started," Turner said. "Now that Vietnam is really starting to take off, he convinced the regional government to provide the land and the money for the meeting."

The meeting on particle physics, astrophysics and cosmology attracted hundreds of physicists from around the world, including former APS President Barry Barish, CERN Director General Rolf Heuer, and five Nobel laureates.

"I do hope that this conference and new conferences and training courses organized by the ICISE have an important contribution to reinforce the attraction and inspiration of young people in science and physics research and education in Vietnam, to reinforce the linking [of] young scientists from developing countries and territories to international great intellectual centers and promoting science and physics research and education in Vietnam, " Khoi said.

Panel Contemplates Choices on Snowmass Menu

By Michael Lucibella

The federal government's recent High Energy Physics Advisory Panel meeting offered insight into the future of federally sponsored physics projects. Neutrino detection and the search for dark matter will dominate much of the foreseeable future of high-energy experiments in the US, while physicists work to develop designs and technology for the next generation of particle accelerators.

The September HEPAP meeting was largely an overview of discussions at the Community Summer Study 2013, held in Minneapolis in late July, popularly known as "Snowmass on the Mississippi." Snowmass laid the groundwork for the DOE's recently formed strategic planning panel. By early next year, the Particle Physics Projects Planning Panel, usually referred to as P5, is charged with delivering its roadmap for the next 20 years of high-energy physics.

Researchers participating in Snowmass created a list of major scientific questions facing the high energy physics community and possible experiments to answer them. This list includes questions on the nature of the Higgs boson, neutrinos, dark matter and dark energy, whether there are more undiscovered fundamental forces in the universe, if there are extra dimensions, and what is the origin of the matter-antimatter asymmetry. The P5 panel will use that as a resource to prioritize those questions and provide guidance for the Department of Energy and the National Science Foundation as they develop plans to fund a range of experiments.

"Snowmass is providing the menu," said Jonathan Feng, of the University of California Irvine. "Someone has to go through and actually pick the meal. That would be P5."

Future budget constraints are a concern for the planners, and their final report will reflect that. Years of flat federal budgets have reduced the scope, or caused the outright cancelation, of many physics projects. The P5 will produce three recommendations, one based on essentially a flat budget for the next ten years, one with slight increases over the same time period and an unconstrained, "pie in the sky" budget to prioritize all possible projects.

"Uncertain budget scenarios makes planning more difficult," said Jim Siegrist, the Associate Director of the DOE's Office of High Energy Physics. "It makes it hard for the labs especially, but also the university groups."

The organizers of P5 emphasized that they wanted input from the physics community while they worked. They will soon have a website set up to disseminate news and solicit input.

For some years, the Department of Energy has divided high energy physics into three categories, or "frontiers." Generally speaking, the "Energy Frontier" looks for new discoveries hidden in the powerful collisions inside of particle accelerators. Experiments aimed at the "Cosmic Frontier" look for exotic particles and signals coming from space. The "Intensity Frontier" is more broadly defined, focusing on sifting through massive amounts of data searching for extremely rare events and particle decays using very intense sources and sensitive detectors.

Several panel members and presenters at the HEPAP meeting said that there was a growing concern in the community that dividing the field into such categories would result in "stovepiping." They feared it would be difficult to fund research that didn't fit neatly into one of the three categories, and scientists might interact less across the different boundaries. However, there is no indication at present that the DOE will change these categorizations.

Since the last predicted particle in the standard model, the Higgs Boson, was discovered last year, the energy frontier lacks a single clear and obvious objective to work towards. Physicists plan to continue to study the Higgs in great detail, but as a whole, the field has moved into an area not well defined by theory.

"Confirming the Standard Model is no longer a goal… Now we're exploring," said Chip Brock from Michigan State University, "We're on a road now to figure out what particle physics means now that we've discovered the Higgs particle."

Scientists are also trying to figure out what the US will contribute to the field in the upcoming years. Likely it will play a sup-

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Letters

Readers interested in submitting a letter to APS News ***should email letters@aps.org***

AAPT Plays Lead Role for Physics Olympiad Team

I was delighted to read the article in the August/September *APS News* regarding the US Physics Olympiad Team. The Team had an outstanding performance this year in the International Competition. I appreciate APS highlighting the Team's success to its members. I also appreciate the support that APS provides every year (along with AIP, the other AIP member societies, and University of Maryland's Physics Department).

There was, however, a substantive omission in this article. The American Association of Physics Teachers (AAPT) is responsible for recruiting, selecting, and training teams each year to compete in the International Physics Olympiad. We oversee the Team's training program and make sure that the Team has the opportunity to learn physics and integrate into the physics community. Finally, with the financial support of the Team's sponsors we are able to cover the expenses of the Team members and coaches as they represent the United States and the physics community in the International Competition.

Beth A. Cunningham,
College Park, MD

The writer is Executive Officer of the American Association of Physics Teachers.

Cultural Bias Can Make Teaching Seem Less Attractive

In addition to the attitude toward and role modeling of physics teaching demonstrated by college and university physics faculty ("The Role of Physics Departments in High School teacher Education" *APS News* Back Page, Aug/Sep 2013), the ethos of one's institution cannot be overlooked. In my nearly 40 years of full-time undergraduate physics teaching I regularly featured a career in secondary school physics teaching as an option for my students. We had a well-respected School of Education on our campus with a vigorous and well-supervised student teaching experience. Yet in all those years, only one physics major actively sought secondary teaching credentials and subsequently became a high school physics teacher. My institution's ethos was strongly biased by a predisposition toward health care. A show of hands in a class of 50 General Physics students might yield five or six who were NOT intending on a career in medicine, dentistry, etc.

Over the years a number of my physics majors expressed interest in teaching, often after doing a stint as a General Physics lab TA. But invariably teaching as a career was put in second or third place, as a bailout position if something better didn't work out. This attitude was initially inculcated at home and within their social groups, but strongly supported by the campus ethos within which they subsequently matriculated. I readily agree with Meltzer, Plisch, and Vokos that college and university physics faculty must see themselves as the first line of defense against the decline of competent high school physics teachers. But they may find that their success heavily depends upon their institutional setting and the culture of the student body it attracts.

Edwin A. Karlow
Walla Walla, WA

Bold Solutions Help with Children on Campus

In her letter in the July *APS News*, Keri Haruza mentioned several accommodations for working mothers that seem to be missing on university campuses, such as changing tables in bathrooms and play areas for small children. As a female who earned tenure while concurrently raising a toddler, I thought I might suggest a few ways to view a college campus from a small child's eyes. I brought my son with me everywhere, but in some meetings he had to be silent. To accomplish this, I brought quiet toys for the meeting, and then let him pick his favorite green space on campus; after the meeting we went directly to his choice of green space for some un-hurried play time. I never left until he said he was done playing. We would string ropes up stairwells, and climb 'K2', every time we came on campus. Once I had to bring him to a graduation ceremony because I had a PhD candidate to hood. I tucked him under my robes, pretending we were in 'The Princess Bride' under the holocaust coat, and after we marched in, I sat him on my lap. The people next to me kindly watched him when I had to leave to hood the candidate. The provost noticed, and when he mentioned it to me, I told him that innovation was the hallmark of a good scientist. He and I laughed about my 'innovative solutions' for a few years! I agree with and appreciate Keri Haruza's comments, but I thought presenting the workarounds that I fashioned for my child might help others. Be bold enough to fashion your own innovative solutions–after all that's why we enjoy this field so much.

Louise Perkins
Hattiesburg, MS

Get Volunteers to Help Educate Science Teachers

The Back Page article in the August-September *APS News* talks about the need for colleges to foster people that are interested in going into teaching. Good. That is a piece of the solution, and of course there are lots of pieces.

Many years ago I taught high school physics myself in NY state. Why did I leave high school science and physics teaching? One of the problems is that I had nothing in common with the other teachers. Aside from physics, I wanted to be able to talk to my work mates about where I could buy brakes for my car or why it is difficult to fly an airplane using solar cells. The majority of high school teachers were more interested in their social life.

Next difficulty was the administration. All but one of my physics students passed the NY state regents exam. Administrators were very happy about that, but reminded me that I needed to take the required education courses to continue teaching. Sorry, I was not interested in learning that I had to place all the window shades at the same level.

The scarcity of good physics teachers in high school is a big problem, I agree. There was a time, about 20 years ago, when APS had a program to help educate K-12 teachers of science in Montgomery County, MD. The NSF funding ended, the APS leader went away, and all of the scientist volunteers were left cold. We were willing to go on helping Montgomery County teachers but as far as I knew, the program fell apart. I am willing to volunteer again and try to help educate the local teachers, even way down to the K level. I suspect that many of the other scientists in the area would also. I would rather work with the physics teachers but I know there is value working with all levels. Any chance APS can organize helping local public schools?

Victor J. Sank
Rockville, MD

Ed. Note: *The Back Page in this issue of* APS News *describes a program in Santa Fe, NM that is similar to what the writer is advocating.*

FUNDING continued from page 2

to cancel the SSC on October 27, 1993, by a vote of 283 to 143, cutting its losses on the $2 billion already spent. The decision did not lead to increased funding for other areas of physics. In fact, the biggest beneficiary was the LHC, as the US particle physics community successfully lobbied for a greater role in the international collaboration. That investment paid off handsomely with the discovery of the Higgs boson. An International Linear Collider is planned for the next generation, but whether it will actually be built is still uncertain.

As for the SSC, its empty, abandoned tunnels are still there, under the plains of central Texas. The equipment was sold off long ago, and a multimillionaire named Johnnie Bryan Hunt finally bought the site in 2006, intending to build a large and secure data storage facility there. Alas, six months later, Hunt slipped on a patch of ice and hit his head on the pavement; the fall killed him, and his Collider Data Center project died with him. A chemical manufacturer bought the site in 2012.

Perhaps the SSC's most lasting contribution has been to fiction: it inspired two novels: a comic novel by Herman Wouk called *A Hole in Texas*, and John G. Cramer's *Einstein's Bridge*. The latter envisions an alternate history in which the collider was actually built and begins trial runs, with earth-shattering ramifications involving exotic particles, wormholes, aliens, and time travel. It seems a fitting paean to the accelerator that might have been.

Recommended Reading:

Carroll, Sean M. *The Particle at the End of the Universe*. New York: Dutton, 2013.

Cramer, John G. *Einstein's Bridge*. New York: Avon, 1997. (fiction)

Cramer, John G. "The Decline and Fall of the SSC," The Alternate View, *Analog Science Fiction and Fact*, May 1997.

Riordan, Michael. (2001) "A Tale of Two Cultures: Building the Superconducting Super Collider, 1988–1993," *Historical Studies in the Physical and Biological Sciences* 32(1): 125–144

Zero Gravity

the lighter side of science

The Haunting of the Snark: An Anxiety in 13 Bits

(With apologies to Lewis Carroll)

By Jerome Malenfant

"Just the place for a Snark!" the Chairman said,
To encourage the crew about.
"While my works on this subject are mostly unread,
Of this there can be no doubt!"

"We have sailed from the East, we have sailed from the West,
Our one goal sublimely stark;
And that is to put our theories to test
By hunting the shadowy Snark."

"The machines and the crew are ready at last,"
(As he polished his Nobel Prizes).
"The principle task, if one needs to ask,
Is to penetrate the Snark's disguises."

"It will hide in the desert, it will hide in the sea;
It will pretend to be a tourist from Rome.
It will act as a long-lost friend from Paree
At the same time it asks for a loan."

"It will take all your stocks, your cash, and your socks,
With an outcome that's generally tragic.
It will vex with conundrums and paradoxes
and all sorts of problems mathematic."

"The Snark, in addition, does not lack for ambition
And will cheat at chess and croquet.
And upon your encounter with its apparition
You may possibly vanish away."

With this last bit of news we altered our views
On the wisdom of hunting the Snark.

(As an added precaution, we sent out for more booze,
In light of the Chairman's remark.)

But we pursued it with hope from obscure publications
By a Mathematician from Maine
Who therein had proven, through algebraic relations,
That our Chairman was mostly insane.

We sought it with logic, we sought it with glue;
We hunted with cunning and malice.
We threatened its fate with red tape and blue;
We searched with ATLAS and ALICE.

We sought it with truth, we sought it with charm;
We pursued it with Belle, book, and candle.
We searched in city and searched under farm;
We googled in Orff and in Handel.

We sought it with paper, we sought it with string;
We looked for it under the stairs.
We thought of the press that its capture would bring,
Found either as one or in pairs.

We sought it in circles, we sought it in lines,
In symbols, in graphs, and in primes.
We searched for arcane metaphysical signs
Of its passage through other space-times.

Then finally, at last, we encountered the prey
In the depths of the LHC,
Where we softly and suddenly vanished away–
For the Snark WAS a Black Hole, you see.

Ig Nobels Honor Off-Beat Science

By Michael Lucibella

The annual Ig Nobel awards, presented in mid-September, honored the year's best and wackiest science. Awards went to researchers who ate a shrew for science, played opera for mice and stuck small hats on the heads of dung beetles.

The winners of the Physics Prize discovered that a human would be able to run across a pool of water on the Moon. Alberto Minetti from the University of Milan and his team used a harness to suspend volunteers wearing plastic fins on their feet over a wading pool.

"We could vary their load so we could simulate different planets," Minetti said. "We found that in gravity lower than 20 percent of Earth's gravity you can stay afloat. Only for a few seconds."

Photo by Michael Lucibella

Nobel laureate Frank Wilczek (right) presents Alberto Minetti (left) and Yuri Ivanenko with the Ig Nobel Physics Prize for their research on how humans could run across a pool of water on the Moon.

The test subjects ran in place trying to use the water's surface tension to stay afloat. It's a trick used on Earth by water-skimming insects and even small lizards, and maybe someday astronauts living on the Moon.

"The study helps us also understand what is happening on Earth for those species that are able to run on water," Minetti said.

The Ig Nobel Prizes were

IG NOBELS continued on page 7

INSIDE THE Beltway

Why Healthcare Should Matter to Scientists

by Michael S. Lubell, APS Director of Public Affairs

The House of Representatives has already voted to abolish the Affordable Care Act 41 times. And if there were enough legislative days remaining before the end of the 2013 session, the anti-Obamacare zealots would probably do it 41 more times.

But masked by the partisan attacks on the president's signature program is an uncomfortable truth that most Americans don't want to hear: unless healthcare costs stop rising faster than inflation, wages will continue to stagnate and discretionary federal spending will be squeezed into a thimble.

Frank Wolf (R-VA), chairman of the House Commerce Justice and Science Appropriations Subcommittee, is a staunch supporter of the National Science Foundation and the National Institute of Standards and Technology, both of which fall under his subcommittee's jurisdiction. But he has warned repeatedly that unless mandatory spending is held in check, his subcommittee's ability to fund science will be increasingly constrained.

Without question, Wolf's admonition is correct, but by pointing his finger at the three big budget busters (Social Security, Medicare and Medicaid) he is giving a pass to the real culprit: the extraordinary cost of American medicine.

Social Security, it turns out, is not too difficult to fix, at least in principle. The 2012 Social Security Trustees Report provides a number of possible scenarios, including one I find particularly appealing: raising the inflation-adjusted wage base, currently $113,700, to capture a greater share of America's rapidly growing income disparity.

You may find other approaches more acceptable, including President Obama's proposal to use the "chained Consumer Price Index" to adjust benefits for inflation. But in the end, we should all reach the same conclusion: Social Security does not have to be a budget buster.

Healthcare is another matter. Constraining Medicare and Medicaid spending at a time when our population is aging rapidly is a herculean task. In fact, without a clampdown on the costs of medicine, not even Harry Houdini would be able to escape the inevitable bind.

It's time for every American to begin to ponder why we spend almost twice as much per capita on healthcare as France–rated No. 1 in the world by the World Health Organization–and see poorer outcomes. And, absent transformations of the American landscape, it's time for physicists to ponder whether the next generation of scientists will be better off seeking employment in Europe or Asia, where healthcare costs are not choking off research spending and where future jobs may be more plentiful.

Scientists must take Frank Wolf's admonition seriously that federal research support will erode in the face of increasing federal commitments to Medicare and Medicaid. But they must also take seriously the impact of Medicaid spending at the state level.

Begun as part of Lyndon Johnson's "Great Society" initiative in 1965, Medicaid has been encroaching for more than four decades on public support of higher education across the country. The Kaiser Family Foundation's 2011 report, "Update: State Budgets in Recession and Recovery," highlights the impact.

In 2009, according to Kaiser, Medicaid consumed an average of more than 15 cents of every state dollar allocated to general fund expenditures. And in 23 states Medicaid disbursements surpassed spending on higher education.

The higher education budget vise has had dramatic impacts, and as you may imagine, none of them good. The cost of college tuition has increased dramatically, student debt has soared and a four-year bachelor's degree program has often become an eight-year slog.

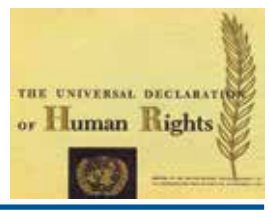
Today, public universities are under pressure from Washington and state capitals to limit tuition increases, enhance student enrollment, promote student retention, reduce time to graduation and boost faculty instructional productivity. It's hard to argue with the lofty goals, but achieving them may come at a number of costs, especially to science.

Less institutional support for research infrastructure, fewer credit requirements for graduation, higher teaching loads, closure of undersubscribed programs and potentially lower academic standards may be on the horizon. And they are all inimical to sustaining high-quality research and STEM education in public universities.

For more than half a century, America's colleges and universities have been the envy of the world, especially in science. Paring back the public component under the inexorable pressure of rising costs of medicine is coming now just as the rest of the world has caught up.

In a highly competitive and mobile global scientific enterprise, it is imperative that American policy makers face up to a reality: to keep America at the cutting edge of research will require making America competitive in healthcare costs. Obamacare may deliver insurance for the uninsured, but if it doesn't lower the costs of medical treatment and drugs, it will fail to provide a viable path for continued excellence of American science.

APS Committee on International Freedom of Scientists



CIFS Briefs: Highlighting the Connection Between Human Rights and Science for the Physics Community

Since its creation in 1980, the APS Committee on International Freedom of Scientists (CIFS) has advocated for and defended the rights of scientists around the globe. In this column, CIFS describes some of the issues that the Committee is monitoring as well as the Society's other human rights activities.

Kemal Gürüz

Kemal Gürüz is a retired professor of chemical engineering and the former rector of Karadeniz Technical University in Trabzon, Turkey. In June 2012, he was arrested and imprisoned on charges of conspiracy to overthrow or incapacitate the government in connection with the 1997 political transition in Turkey. Gürüz has denied the charges. Given no clear evidence for his pre-trial detention, CIFS wrote to Turkish President Abdullah Gül this summer to urge him to ensure that this case proceeded in a manner consistent with Turkey's obligations under domestic and international law. Given that Gürüz attempted suicide in June, CIFS asked President Gül to consider dropping charges against Gürüz or permit his release on bail on humanitarian or medical grounds. In August, Gürüz and several other academics were convicted of terrorism-related charges and of seeking to destabilize the government. Gürüz was sentenced to 13 years and 11 months. However, CIFS is happy to report that on September 5, Professor Gürüz was released from detention and permitted to go home, pending appeal of his sentence. While he still faces charges in a second trial, CIFS is pleased that he is no longer in prison.

Academic Boycotts

CIFS recently reiterated its opposition to academic boycotts and stated its support for open scientific dialogue among scientists. The statement notes, in part, that "CIFS respects the rights of individual scientists to express their opinion of a government's specific policies or actions." However, the Committee also "strongly believes that excluding scientists, because of their nationality, from participating in the scientific enterprise or discouraging others from engaging them, is wrong."

The full statement can be read on CIFS's website at: http://www.aps.org/about/governance/committees/cifs/index.cfm

Lev Ponomaryov

CIFS expresses its concern over the beating of physicist and human rights activist Lev Ponomaryov, 71, on the night of June 22, 2013. The assault occurred as Ponomaryov was evicted from the building in Moscow where his organization, For Human Rights, was based. It is our understanding that this assault was conducted by men in civilian clothing while a group of Russian police officers observed, but did not try to intervene in the beating. This represents a major affront in Russia to human rights work and to civil society more generally. What is particularly alarming is the openness with which the act was conducted, which indicates a brazen increase of anti-human rights activity in Russia.

CIFS encourages the physics community to take note of the incident, and to assist and defend its colleagues, both domestically and abroad.

AAAS Science and Human Rights Coalition

In July, APS participated in the AAAS Science and Human Rights Coalition meeting. The theme of the meeting was Article 15 of the International Covenant on Economic, Social and Cultural Rights (ICESCR), which states that everyone has the right "to enjoy the benefits of scientific progress and its applications." To ensure this right, Article 15 requires that governments "respect the freedom indispensable for scientific research" and "recognize the benefits of international…cooperation in the scientific field." One plenary session explored the associations among human rights, national security, and the scientific freedoms guaranteed by Article 15. The session included talks by two APS members, E. William Colglazier and Herman Winick. Colglazier, who is the Science and Technology Adviser to the U.S. Secretary of State, stressed the importance of science to global economic progress and diplomacy. Winick, Professor Emeritus at Stanford University, emphasized the benefits of international collaborations in science. He used the Synchrotron-Light for Experimental Science and Applications in the Middle East (SESAME) project in Amman, Jordan as an example of how science can aid in fostering dialogue, cooperation and trust among people from countries that are in conflict.

Vikram Singh Prasher of the Executive Committee of the Forum on Graduate Student Affairs is now serving as the APS student representative in the Coalition. He will work to bring the voices of physics graduate students to the Coalition's efforts and educate that community about the connection between science and human rights.

BLEWETT continued from page 1

in life. Daradich planned to take some time away from research to care for him while he was undergoing these procedures.

She had originally thought she would be able to take only a year off from work to care for him, and had placed his name on numerous wait lists for childcare facilities. However when that year was up, no slots had opened up for her son, so she continued to stay home with him. In the fall of 2009, while she was still waiting for childcare, her husband's startup relocated to Québec City.

Unfortunately, at about the same time, her father's Parkinson's disease took a turn for the worse and she spent much of 2010 traveling between Québec City and Toronto to care for him. Her father passed away in October of 2010.

"After not working for four years and having that gap on my résumé, I was like 'I've got to work,'" Daradich said.

In early 2011, she finally located a childcare service that would watch her son four days a week. She was able to find work at a biophotonics lab, through a friend she knew from graduate school. Although glad to be back doing research, she really wanted to return to studying the evolution of planets.

"I really missed it, but I didn't realize how much until I got back to work," she said. "Research is really something you think about all the time, even when you're not right there."

Transitioning back to doing research has not been easy.

"I think it's a big problem in academia right now," Daradich said. "All fellowship opportunities really dry up within about three years of finishing your PhD."

She added that the Blewett fellowship was a welcome exception. She plans to use the award to travel to Cambridge, Massachusetts for a year and collaborate with researchers at MIT and Harvard.

"I think having this award will do a lot for getting me back in the game," she said. "I wouldn't have had this opportunity if not for the fellowship."

Leslie Kerby has returned to academia after nearly fifteen years away from research.

Kerby received her bachelor's degree in physics when she was 22 years old. She was first drawn to physics because of the mathematics that underlies so much of the field.

"I love mathematics but I'm not a pure mathematician. I wanted to apply it to something," Kerby said. "I kind of sit on the fence in my work between physics and engineering."

However, after she received her bachelor's degree, she put her career on hold in order to raise her children. She had married her husband at a fairly young age and had children young as well. In keeping with her religious family background, it was up to her to raise the children.

While she was raising her kids, she occasionally tutored and taught physics as an adjunct at the local physics department. She also is an accomplished classical collaborative pianist and briefly considered pursuing it as a career.

"I love music but I also love science," she said, adding that she didn't think that she would be able to support her five children as a musician.

After her divorce three years ago, Kerby decided to return to research. She enrolled at the University of Iowa and started working towards her master's and PhD. As an undergraduate, she had always been drawn to quantum mechanics, so she started looking around for ways that she could mix quantum mechanics with applied research.

"That was my favorite field," Kerby said. "[It] probably stems from my love of mathematics as well."

Her advisor, Akira Tokuhiro, recommended that she study nuclear engineering, in particular the computational quantum mechanics of it.

"This is a field that I would both enjoy and be pretty good at," Kerby said.

While in graduate school, she got an offer to work on nuclear physics at Los Alamos National Laboratory in New Mexico. There, she's been working to upgrade the code that's commonly used by physicists calculating nuclear reactions.

"I've been working on upgrading it so it includes the emission of light, high-energy fragments in nuclear collisions," Kerby said.

She finished her master's degree last spring and is on track to earn her PhD in about two years. Working as a full-time student has not been easy for Kerby. She has full custody of her five children, ranging in age from 15 down to two. In addition, because of budget cuts and a divisional reorganization, the amount of funding she is set to receive from Los Alamos in the coming months is less than she had budgeted for.

She said the Blewett scholarship will go a long way to pay tuition costs at the University of Iowa, while still leaving money left over to care for her children.

"It's a great honor," Kerby said. "The future is bright and promising."

This is the second year of Blewett fellowship funding for **Sujatha Sampath.**

Her career stalled somewhat after finishing her postdoc research in 2003. She followed her husband, who was working as an engineer in Milwaukee, but she had trouble finding a permanent research position there. Since then, she's worked a series of short-term and part time research positions in order to maintain her visa status.

In 2010 she got a temporary appointment at the University of Milwaukee, where she has been continuing work she started years earlier. In 2005, she joined a team of researchers from Arizona State University. They were studying the molecular structure of spider silk using synchrotron X-rays at Argonne National Laboratory. She also currently holds another temporary appointment at the University of Wisconsin.

"The fellowship has really helped me diversify the areas in which I'm doing research, within the scope of the project," Sampath said.

Over the last year she started using infrared tomography and electron microscopy to investigate the structure of silk.

"These are sort of independent techniques but they will give very complementary information," she said. She added that the infrared tomography will help her understand more about the chemistry of silk, while the electron microscope offers a better physical picture of the strands.

"The idea is to understand the structure from different angles."

She also started working with another team of polymer researchers who have been working to develop a synthetic spider silk. Spider silk is a remarkable material, stronger than steel, yet more flexible than Kevlar or nylon. Researchers have been trying to reproduce the natural substance for years, and Sampath is seeing how close researchers are getting.

"What we are trying to look at is the structure of the synthetic silks," she said. "That will allow us to compare them to the natural silks."

In addition, over the last year she's published two research papers based on data taken years before, and is currently working on submitting a third. She said that over the next year she hopes to work with other kinds of biopolymers and to find a permanent position.

MUSK continued from page 1

to apply first-principle thinking and try to identify the most fundamental truths in any particular arena and you reason up from there. This requires quite a bit of mental exertion and I can give you some examples of how this helps one in the rocket business.

L: *Please.*

M: Any given rocket technology should be evaluated by to what degree does it improve the cost of space transport. Historically, [if you look at] how much rockets cost, you'd see that the trend line has been pretty flat and in the United States, it's actually gotten worse over time. If you just reason by analogy, you'd say that's just the way things are. But it's not. The first-principle approach would be to ask what materials is a rocket made of and how much do those materials cost. When we look at that we say wow–in terms of raw materials cost, it's a few percent of what the price of a rocket is. So there must be something wrong here and people are being pretty silly. If we can be clever, we can make a much lower cost rocket.

L: *How do you go through your day? Are you constantly trying to think from first principles but in a certain respect you have to stop yourself because it does take so much mental exertion?*

M: I'd love to say that I spend most of my days thinking from first principles, but unfortunately I have too many separate things to do, so I have to reserve mental energy only for the things that are very important, like trying to come up with some technological breakthrough that is quite pressing, or sometimes the business is in a bit of a jam and I have to come up with some creative solution. Sometimes it happens without me trying all too hard, in that I'll wake up in the morning and have some sort of epiphany in the shower (laughs). It's a cliché but it happens quite a lot. I guess subconsciously my mind's been thinking about it and several hours later after waking up it kind of pops into the conscious mind.

L: *Why did you choose to study physics?*

M: I was really curious to understand how the universe works. And that's really what physics is about–trying to understand how the universe really works at a fundamental level. At one point, I was thinking about a career in physics and trying to work on physics problems, but as I looked ahead, I thought I might get stuck in some bureaucracy at a collider and then that collider could get canceled like the Super Conducting Supercollider and then that would suck (laughs). That would really be very frustrating.

L: *So you were already thinking ahead: you loved physics, you wanted to study it so you could understand the universe, but you were thinking you were not going to be a physicist.*

M: For a while, I did think that I wanted to be that. I had an existential crisis when I was 12 or 13, and [was] trying to figure out what does it all mean, why are we here, is it all meaningless, that sort of thing. I came to the conclusion that the best thing we can do is try to improve the scope and scale of consciousness and gain greater enlightenment which will in turn allow us to ask better and better questions, because obviously the universe is the answer, so what is the question? All questions, I suppose.

L: *It's interesting to me that you chose to study physics so you could understand the universe but yet at the same time I understand that you were also taking business classes, so perhaps you were thinking about enlightenment from perhaps an entrepreneurial point of view early on?*

M: I was trying to figure out what I would do and I was concerned that if I didn't study business, I would be forced to work for someone who did study business, (laughs) and they would know some special things that I didn't know. That didn't sound good, so I wanted to make sure that I knew those things too. (Laughs) I can't say I had a particular affinity for the business students quite frankly. I liked hanging out with my physics cohorts. I liked the arts and sciences people more. I don't know if you should print that. (Laughs). I wasn't the biggest fan of my business classmates. I preferred the arts and sciences.

L: *Would you consider yourself a nerd?*

M: I certainly was a nerd and probably am still a nerd in large part. If you had a list of all the things that nerds would do, man, I've done 'em all. I played many hours of Dungeon and Dragons with paper and dice.

L: *Did you dress up?*

M: (Laughs) I did actually dress up on a couple of occasions, but not at home. There were these Dungeon and Dragons tournaments…

L: *Yes of course. I know them well.*

M: ...it was awesome. I love those things. They were so great. I grew up in South Africa and it really was a little community so I had quite limited outlet for [these types of activities]…I didn't know any other kids who wrote software. I had to coerce my friends into playing Dungeons and Dragons. Some of them liked it but I had to wheedle a lot of them into it, because we needed four people in our d and d group to go into the tournaments. So I played video games, wrote computer software, and I had pants with a draw string. (Laughs) It was pretty bad actually. It was tough to get a date. And I did a lot of other stuff: built a radio, created handmade rockets. In South Africa we didn't have any of these rockets, so I had to figure out the ingredients for rocket propellant and then mix it with a mortar and pestle, put it in a tube and create rockets–with mixed results.

L: *I think you got it–you can check off everything for a nerd.*

M: (Laughs) Nerd Master 3000.

In the next issue of *APS News*, read Part 2 of the interview and learn why Musk thinks MBAs can be a mistake, what it will cost to cruise to Mars, and how his Tesla Model S is making history.

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ENROLLMENT continued from page 1

department," Mulvey said. "I think many departments took to heart the sentiment of that report and proceeded to change the culture of their undergraduate programs."

AIP contacted the nation's 751 degree-granting physics departments and 79 astronomy departments nationwide to compile their enrollment numbers. There was a 94 percent response rate in physics, and 89 percent in astronomy. The reports include data from the responding departments and estimates from those that did not respond.

The reports are available online at http://www.aip.org/statistics/catalog.html .

ANNOUNCEMENTS

MANDATE continued from page 1

cern at the prospect that computer code might not be included in the requirements. She said that computers have dramatically changed the way that scientists process their data, and knowing how is as important as knowing the raw data points.

"Now things have changed, computation adds this extra level of complexity," Stodden said, adding that without codes, "results are not replicate-able."

The February memorandum from OSTP called for a road map to make all scientific journal articles based on federally funded research freely available for everyone to see after a year. The memo also stipulated that "scientific data resulting from unclassified research supported wholly or in part by Federal funding should be stored and publicly accessible to search, retrieve, and analyze."

The memo set an August 22 deadline for when the funding agencies needed to submit a plan for their data management. Several agencies have received extensions and no plans have been publicly released.

When reached for comment, OSTP spokesperson Rick Weiss said that "[The] OSTP will be working with the agencies to get the various submitted plans finalized."

In June, APS announced that along with 75 other publishers and organizations, they will participate in the Clearinghouse for the Open Research of the United States, or CHORUS, which would be an online platform that links to open access journal articles stored on publishers' servers. However, the service focuses solely on research articles.

"The concept of CHORUS is to maximize existing infrastructure, standards and processes," said Andi Sporkin, spokesperson for CHORUS. "The maintenance of raw data requires a new infrastructure."

Though policies and guidelines are still forthcoming, Lubell encouraged researchers to start thinking ahead about raw data management.

"Everyone needs to start thinking about 'How am I going to manage my data?'…'What is the plan, and how do I ensure a long life for this so it doesn't get destroyed?'" Lubell said. "That is what the community will have to start thinking about right now."

PANEL continued from page 3

porting role in the Energy Frontier for the foreseeable future. CERN's Large Hadron Collider is the undisputed leader for high energy particle collisions, and many US laboratories and scientists are part of the international collaborations that use it. The biggest accelerator on US soil, Fermilab's Tevatron, was shuttered two years ago.

One suggestion from Snowmass is that DOE scientists develop next-generation detector and accelerator technologies and work on designing the successor to the LHC.

During his presentation, Nick Hadley of the University of Maryland highlighted a list of recommendations from Snowmass that included "Develop technologies for the long-term future to build multi-TeV lepton colliders and 100 TeV hadron colliders."

Researchers in the Cosmic Frontier seem to have a clearer path forward. The big questions facing the community largely circle around the nature of dark matter, dark energy and cosmic neutrinos, for all of which there are already an array of experiments in progress and in development.

Researchers in the field have expressed the view that the next ten years will be the "decade of dark matter detection". Jonathan Feng highlighted how complementary direct and indirect detection experiments seem to be on the verge of finding the elusive particles. Currently-running programs like the CDMS-II dark matter detector, Fermi-LAT gamma ray space telescope and IceCube's Deep Core neutrino detectors already have planned successors like SuperCDMS, HESS and PINGU respectively.

Dark energy is a thornier problem, but also one with a self-evident roadmap for the near future.

"Right now there is no compelling theoretical idea," Feng said. He added that while physicists continue to lack an explanation as to why the universe's expansion is accelerating, they are in good shape to use new astronomical observations to pin down exactly how fast it's speeding up. In the next ten years, researchers should be able to determine the rate of expansion down to a few percent.

The intensity frontier is full of many medium-sized experiments and detectors spread across the globe looking for a variety of new physics. Many are based in the United States, and those that aren't often have US funding and researchers.

Many of the same questions facing researchers at the intensity frontier linger from the previous P5 report in 2008. In the time since then, the mixing angles of neutrinos have been measured; however, questions persist about neutrinos' mass, whether they are Majorana particles and if there are more flavors.

"We have a clear path forward for precision tests of the three flavor paradigm, and exploration of anomalies building off these successes," said Harry Weerts of Argonne National Labs.

The biggest project to address these questions is the Long Baseline Neutrino Experiment with detectors in South Dakota on the receiving end of a neutrino beam originating at Fermilab's Project X. Its backers have described the project as the most important neutrino experiment in the works, but budget constraints may prevent its detectors from being located deep underground, shielding them from cosmic rays. Planners are still hoping to find ways to make up the $150 million shortfall needed to locate the experiment deep in the mine.

Smaller and midsized projects are also planned. These include searches for axions at ADMX, rare kaon decays at ORKA, and proton decays at Super-K and the planned Hyper-K detectors, among other experiments.

The final, 350-page report from "Snowmass on the Mississippi" is due out in early October. The P5 recommendations will be sent to HEPAP by March of next year, which will review and sign off on the plan by May.

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started twenty-three years ago by Marc Abrahams, then at *Science Magazine*, to highlight science that "Makes you laugh, then makes you think." The idea is to recognize science that might seem silly or frivolous at first, but is properly carried out and relevant.

The Probability Prize given to Bert Tolkamp and his team is an example. They won for their work analyzing the time and frequency that cows stand up and sit down.

"We looked at animal behavior and changes in animal behavior because we're very interested in early detection of health and welfare problems in cows," Tolkamp said. He added that as large farms are becoming more automated, farmers can use this research to design sensors and algorithms to better track the health of cows.

Brian Crandall, formerly at Binghamton University, who now runs the Mad Science educational company, received the Archeology Prize for his work. His had a lab assistant eat a small, parboiled rodent, and studied the effects of the human digestive system on its bones.

"We convinced someone to eat a shrew. We let them digest it, and we collected what came out the other end, filtered out the bones, and analyzed them," Crandall said.

Crandall called it "experimental archeology." Piles of small mammal bones have been unearthed in archeological sites around the world, and researchers have puzzled over whether or not our ancestors ate them. Based on the way bones were digested, it seems that small mice, rats, and voles were very much a part of the human diet in ancient times.

Other winners this year included:

- The first joint Prize in Biology and Astronomy for research that used tiny hats to show that dung beetles use the Milky Way to navigate at night when there's no moon.
- The Chemistry Prize for discovering the chemical process that makes a person cry while cutting onions.
- The Psychology Prize for experiments showing that people who think they are drunk also think they are attractive.
- The Medicine Prize for the discovery that mice recover faster from heart transplants when they listen to opera.

The Peace Prize went to Alexander Lukashenko, president of Belarus, for banning applauding in public, and the Belarus State Police for arresting a one-armed man for violating that ban. No representatives from Belarus attended the ceremony to receive their prize.

The Back Page

K-14 Math and Science Education: A Physicist Meets Reality

By Robert A. Eisenstein

No one reading this page needs to be reminded of the crisis facing the United States in K-14 education, especially in math and science. Since the high point for STEM education that characterized the Sputnik era, the slope has been steadily downhill. For over 30 years, one prominent committee after another (1) has issued dire warnings about what this state of affairs portends for our national future. Action needs to be taken, but what can be done? And by whom? The answers are: "a lot," and "by all of us."

In this article I want to describe my evolution from a completely focused R1-level university professor and science administrator to a committed partner in K-14 STEM education. After a cursory view of the issues we face I'll describe the Santa Fe Alliance for Science (www.sfafs.org), an organization I co-founded in 2005 with Susan McIntosh, a local elementary-school science teacher. The purpose of SFAFS is to help improve K-14 STEM in the Santa Fe area and to boost the perception of science held in our community. It is almost entirely a volunteer effort.

For those of us concerned about the nation's future in STEM fields, it's very troubling that for large swaths of the country, education–particularly STEM education–just doesn't seem to matter very much. I think though that this is an area where our science and engineering communities can play a very positive role, as indeed many STEM professional societies already are.

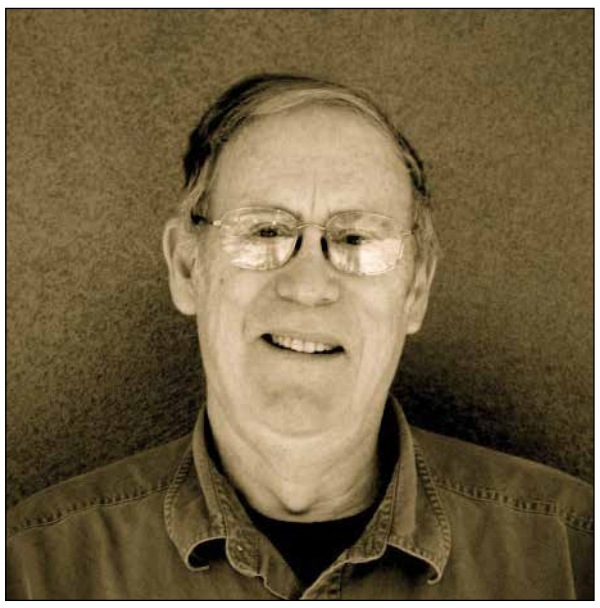
Our educational systems are accurate mirrors of what has become educationally acceptable locally and in the country as a whole. In fact, education is so deeply embedded in the social fabric that our remedial efforts must occur in a society-wide context. There is no single magic elixir that will make things right. Two outstanding publications that view our K-12 educational systems in this comprehensive way are the "Quality Counts" (2) and "Kids Count" (3) annual national and state surveys. Both make clear the essential roles of factors such as high-quality teaching, parenting, family income, poverty, pre-school and kindergarten enrollment, development of early literacy and numeracy, and so on.

Perhaps not surprisingly, these surveys show the same few states at the top, and the same few at the bottom, year after year after year. My home state (New Mexico) is in the latter category. Since statehood (1912), the creation of a robust educational system has been a continuing challenge here. This is due to many factors: a rather small, multicultural minority-majority population (~ 2.1 million, 36th in US, 2010) dispersed over a large land area (5th); a largely rural, agrarian (non-industrial based) economy; and low per capita income ($23K, 45th, 2010).

A dramatic example of our problem is the situation facing the Santa Fe Public Schools. Poverty affects as many as half of our school families, and out of about 13,500 students in the SFPS district, almost 1,000 are homeless ("homeless" is defined as a student with no fixed address). This means that for a substantial fraction of our kids, school is probably not the most important thing they are thinking about that day. Since parents are often working more than one job, they are often not available to give their children the kind of help they need (e.g., nutritional meals, help with homework, or attending school functions).

In terms of academic performance the situation is rather bleak. While in recent years student scores on the National Assessment of Educational Progress (NAEP) have shown modest upward progress, it's still true that New Mexico students lag far behind the national average on the 4th, 8th and 12th grade literacy and math tests. In our elementary schools students are reading well behind grade level, while in math our average student enters middle school math (think pre-algebra and possibly algebra) very poorly prepared in fundamental math skills. It's common to find students who cannot add a column of numbers, who do not know the multiplication tables, and are completely at sea with ideas like fractions, ratios and proportion. This poor state of affairs has a significant impact on New Mexico's future, because a major outcome is that we are not producing a workforce that has a strong enough technical component. This hinders the state's ability to attract new business.

However, the technical staffs at our national labs (LANL, Sandia, White Sands) and at Intel are potentially an important resource for New Mexico in STEM education, since we have one of the highest per capita ratios of STEM professionals of any state. Building on this resource, from 1990 to 1995 Sandia established a program of science advisors (SCIAD) in the Albuquerque Public Schools in which staff members spent about one morning per week in a science or math classroom.



At its peak, the program was active in ~150 schools in the Albuquerque area.

Other areas in New Mexico are also replete with STEM talent: Los Alamos, Las Cruces (New Mexico State University and White Sands) and Santa Fe (near LANL). Each has seen the establishment of programs making use of this resource. In terms of purely volunteer effort, the Science Education Alliance in Las Cruces was active from ~1991 until ~2011, and in Santa Fe, SFAFS began in 2005.

SFAFS is an organization of well more than 100 volunteers who work with students and teachers to help improve K-14 math and science education. Many are retired STEM professionals, but we recruit anyone who can contribute meaningfully. There are many ways to do that. This broader approach helps imbed SFAFS more completely into the community.

SFAFS offers high school and community college tutoring and mentoring in all science and math subjects, provides advisors and judges for science fairs, and offers an evening "Santa Fe Science Café for Young Thinkers" series for middle and high school students. More recently established are programs for "Professional Enrichment for Middle and High School Math and Science Teachers," and a "Math Blitz" effort aimed at improving the math skills of middle school students.

Our goal is to raise the profile of math and science in a community that heretofore has had little regard for these subjects. We want to illustrate to students (and parents) that engineering, math and science are interesting subjects that are valuable parts of their basic education and are accessible as career prospects. Here's how our programs have developed over the last eight years:

SFAFS joined forces with the SFPS science fair program in 2007-2008. Since then SFAFS has provided almost all of the judges for that program as well as some advising about the nature of inquiry-based science fair projects. That year, nine SFPS elementary and middle schools (out of 25) participated and ~614 projects were judged. SFAFS also participated in the creation of the annual district-wide "Science Expo," a fair featuring the ~200 best projects from the local schools. In 2012-2013, nineteen schools participated and ~3311 projects were submitted. Since ~10% of these had more than one contributor, we can say that at least 3500 SFPS students participated in a science fair project, a huge increase since 2007-2008 (SFAFS also provides judging at some non-district schools; this boosts these numbers by about 8%). Science fairs have thus become much-anticipated and enjoyed (by both students and judges) annual events and a real contributor to science learning.

In November, 2006, SFAFS began the "Santa Fe Science Cafés for Young Thinkers" series. Averaging six Cafés per academic year, 45 will have been presented by the end of 2013. Topics covered come from all aspects of science and technology. Average attendance is ~65. Videos of the Cafés are posted on our website and almost all of the presenters have been interviewed on the KSFR Public Radio Café. Several Cafés have been the subject of extensive newspaper coverage.

The SFAFS tutoring program began in 2007-2008. We offer tutoring at SF High School and SF Community College in all math and science subjects. The SFHS program operates two afternoons/week; the one at SFCC is part of a diverse college-wide program that operates all day every weekday. We also provide smaller-scale tutoring activities at two other SFPS high schools. In our peak year (2011-2012) SFAFS interacted with over 2400 students, about two-thirds of whom attended SFCC. Tutors are offered $15/contact hour for their efforts; about half accept it.

SFAFS began a "Professional Enrichment Program for Middle-and High School Math and Science Teachers" in Fall, 2010. Each event is a three-hour session on a Saturday morning and teachers are paid to attend. Topics are selected from forefront areas in math/science that are of general interest and that also can be of use in planning classroom lessons. Last year's series of four events on "Energy and the Environment" was very popular (average attendance ~25). Teachers registered strong enthusiasm for these events as they have for all of the 14 sessions held so far.

The "Math Blitz" program began in Fall, 2010 as an attempt to begin elevating the poor math skills of many of our middle school students. Two out of the six SFPS middle schools are involved so far. "Blitzing" in a classroom involves volunteers engaging in a number of activities to entice student interest: competition and games about math, novel ways to learn math facts, discussion of advanced (but accessible) math topics, or providing math help to students who need it. Student attitudes toward math are assessed at the beginning and end of each semester, and we find that most students emerge at semester's end more enthusiastic about math and their likelihood for success in it.

With the Santa Fe Institute, SFAFS annually awards a "Prize for Scientific Excellence" to the leading math or science student at each of Santa Fe's 13 graduating high schools, and to a leading math or science teacher.

The Alliance is led by a Board of Directors. Day-to-day operations are overseen by a director and four board members who manage the major program segments. Operating funds mostly come from an NSF award, but nearly 25% comes from local private foundations and individuals. Annual operating expenses in 2012-2013 were ~ $35,000.

Of course the heart and soul of the SFAFS program is its large, enthusiastic corps of volunteers. At present, we have about 100 people on our active rolls, but since inception the number is much larger. Their loyalty and commitment has been an inspiration and is the main reason for whatever success the Alliance has enjoyed. Finding volunteers in a small community like Santa Fe is not so easy, yet year after year we are able to do it.

A main purpose in writing this article is to open a discussion about whether programs similar to SFAFS would be a reasonable thing for the APS to sponsor. Their thrust would be quite different than the existing APS educational efforts since they would emphasize direct, immediate contact with students in a variety of venues. APS members can also provide important career advice and can serve usefully as knowledgeable voices of reason on issues like evolution, climate change and relativity.

An APS program like this would make excellent use of its natural advantage, for APS is nothing if not 50,000 math and science "content experts." When student interactions are done well, and they can be much more often than not, they have a powerful, immediate and positive impact on all concerned. And it's great for students to see that scientists are engaging, sympathetic, real people–just like they are.

Eight years in, we believe that SFAFS has been a significant, very cost-effective success. It has substantially helped to rejuvenate K-14 math and science education in Santa Fe. Based on what's happened here we believe that similar successes could be had elsewhere, and that APS, with its already outstanding programs in education, could play a leading role. I hope that proves to be possible.

References

1. Dozens of reports have been issued since the Kerner Commission Report (*A Nation At Risk,* 1983).
2. *Quality Counts*: http://www.edweek.org/ew/qc/index.html
3. *Kids Count*: http://datacenter.kidscount.org/

Bob Eisenstein is retired in Santa Fe, NM after a rewarding career in university-based nuclear and particle physics and as a science administrator at the National Science Foundation.

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