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Physicist in the Soup
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The Physicists are Coming! The Physicists are Coming!

The March Meeting of the American Physical Society is coming to the Boston Convention Center in Boston Massachusetts from February 27 through March 2. The annual meeting is the largest yearly physics meeting in the United States and will feature more than 100 invited sessions, 550 contributed sessions and a total of more than 8,500 papers presented, about a thousand more than last year. Organizers are expecting close to 9,000 people to attend. The meeting highlights the latest research from the APS divisions of Atomic, Molecular and Optical Physics; Biological Physics; Chemical Physics; Computational Physics; Condensed Matter Physics; Fluid Dynamics; Materials Physics; Physics of Beams; and Polymer Physics, as well as the topical groups on Statistical and Nonlinear Physics, Magnetism and its Applications, and Quantum Information.

On the Saturday before the start of the meeting, DPOLY will host a short course on the applications of polymers in industry. The NSF-sponsored Professional Skills Development Workshop, a day-long seminar for women physicists to better develop communication and negotiation skills, will be held on Sunday. Also on Sunday, pre-meeting tutorials will take place

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Kavli Symposium Addresses Physics at the Mesoscale

A special feature of the March Meeting will be a symposium on "Emergent Physics at the Mesoscale" sponsored by the Kavli Foundation, taking place on Wednesday afternoon, February 29. The symposium aims to initiate a dialogue to define scientific opportunities at the Mesoscale for the next decade. Among the speakers will be two Nobel laureates, Robert Laughlin and William Phillips.

Special Session Looks at Sexual and Gender Diversity Issues

In addition to the scientific sessions, the 2012 March Meeting will feature for the first time an entire session devoted to addressing issues of sexual orientation and gender identity issues in physics. Historically LGBT physicists and educators have had few resources for information on the representation of gender minorities in their fields. Organizers of the session hope to draw attention to this lack of resources and highlight other issues important to the LGBT community.

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International Conference of Graduate Students Invades Nation's Capital

Graduate students from across North America converged on Washington DC for a three-day conference highlighting their research in physics, as well as possible career paths outside of research. The Canadian-American-Mexican Graduate Student Physics Conference (CAM) brought together 103 students and 21 additional invited speakers from the three North American countries from Thursday, September 29 through Saturday, October 1.

"CAM is a conference that is organized by, and is for, graduate students in the US, Canada and Mexico," said Michele Irwin, APS's international programs administrator. "It's an opportunity for the graduate students to come together in a smaller setting… and present their research to an audience of their peers."

"It's a unique conference where students get to see their fellow students from Mexico and Canada," said Abhishek Kumar, a graduate student at the University of Massachusetts, Lowell and chair of the conference's organizing committee. "CAM is organized by the students, for the students, with help from APS, CAP, and SMF," referring, in addition to APS, to the Canadian Association of Physicists and the Sociedad Mexicana de Física.

The CAM conference is held every other year and is hosted in the United States, Canada and Mexico on a rotating basis. The last CAM conference was held in 2009 in Acapulco, Mexico. The United States last hosted in 2005, when it was held in San Diego. The scientific sessions feature research done by graduate students across the physics disciplines.

"It was a really great conference," Irwin said. "The students did really well, and everyone had a good time."

Because the meeting this year was held in Washington DC, the organizers placed an extra emphasis on the intersection of science and public policy. The meeting featured discussions on careers in shaping science policy, and on the role in foreign policy that scientific collaborations play. The last full day of the meeting concluded with a banquet at the House Rayburn Office Building on Capitol Hill.

CAM continued on page 6

Electronic Coalition May Save Some Texas Programs

By Michael Lucibella

As reported in the October *APS News*, the Texas Higher Education Coordinating Board (THECB) informed seven universities that their physics programs would be terminated because they have not graduated enough physics majors over the last five years. However, in a new development, several of the schools are working with the state to keep their programs running in some capacity by participating in a consortium that broadcasts physics lectures.

In February, the THECB, which oversees Texas public universities, alerted all the schools in its system that undergraduate programs graduating fewer than an average of five students per year for the last five years were in danger of being shut down. All told, 545 degree programs, including twelve in physics, across 24 Texas public universities missed the required minimum. Some were placed on two-year probation, others were consolidated with other degrees, while some schools requested a temporary exemption to try to increase their enrollment. Seven physics programs put in for an exemption and were denied.

On October 27, the presidents of many of the schools with programs slated for closure presented their final appeal to the full THECB. However the board opted to shut down six of the physics programs. The seventh, at University of Texas Brownsville, opted to combine its physics major with the school's engineering physics degree.

The move to shut down programs has been controversial. APS president Barry Barish released a letter to the THECB on behalf of the Society, criticizing the closures' potential impact on the training of high school physics teachers in the state.

"Texas recently began requiring four full years of science and mathematics including a year of

COALITION continued on page 5

APS Calls for Outreach Grant Proposals

For the second year in a row, APS is calling for members interested in outreach to submit proposals to get the public excited about physics. Successful applicants will receive mini-grants up to $10,000 to start a program aimed at bringing the fun of science to the general public.

"We are soliciting proposals from people interested in starting their own outreach program," said Rebecca Thompson, APS's head of public outreach.

The department is looking to fund original and creative programs for all ages, including adults. The idea is to get people involved in fun activities that highlight the importance of science and physics. Many outreach programs have traditionally focused on activities for kids between kindergarten and 12th grade, but the grant administrators say that they're also looking to broaden the scope of audiences. They are especially looking for proposals that use grants as seed money, to get a program started that can continue on after the grant expires. Likewise, proposals that would potentially have a particularly high impact, for example by involving radio, TV, print or other media, will also receive careful consideration.

"We're making it intentionally open-ended because we don't want to squash creativity," Thompson said. She added that they were particularly looking for ideas with a way to reach a wide audience. "Things using popular media, things that will get a lot of publicity, things that will make a big splash."

The deadline for submissions is January 6, 2012, for programs that would run sometime in the 18 months following May 1, 2012. Since the grant program is for members of APS, the primary contact listed on the proposal has to be a member. To find out more information about the program including application procedures, visit www.aps.org/programs/outreach.

Jochim, Radicevic Receive Apker Awards

Photo by Jay Pasachoff

Photo by Shelly Johnston

APS annually chooses two undergraduates as recipients of the LeRoy Apker Award for outstanding achievement in physics research. Typically, one of the recipients comes from a research university, and the other from a four-year college. This year, the selection committee, which was chaired by former APS President Cherry Murray of Harvard, recommended Bethany Jochim of Augustana College and Djordje Radicevic of Princeton for the Award, and these choices were approved by the APS Executive Board in late September. Jochim will be presented with her award at next spring's DAMOP meeting in Anaheim; Radicevic will receive his award at the APS April meeting in Atlanta. They each will receive an award stipend of $5000, and their departments will receive an additional $5000 each to support undergraduate research.

Jochim did her research under the supervision of Eric Wells at Augustana College in Sioux Falls, South Dakota. She performed experimental work at Kansas State University, using ultra-fast laser pulses to study the dissociation dynamics of the molecule NO^{2+}. She is a co-author on five peer-reviewed papers, and is currently pursuing graduate work at Kansas State.

Working under the supervision of Herman Verlinde at Princeton, Radicevic did his senior thesis on "Holography from Renormalization Group Flows", an important step in deriving aspects of the AdS/CFT correspondence without making use of string theory. He is now doing graduate work at Stanford University.

Members in the Media

"The problem of the stars is larger than most people realize."

***James Benford**, Microwave Sciences, on the challenges of interstellar travel,* The New York Times*, October 17, 2011*

"In the last few days we have started to send a different time structure of the beam to Gran Sasso. This will allow Opera to repeat the measurement, removing some of the possible systematics."

***Sergio Bertolucci**, CERN, on efforts to recheck OPERA's results that indicated faster-than-light neutrinos,* BBCNews.com*, October 28, 2011.*

"In science we like surprises. We like big surprises. This one is too big to be true… We really like things that rock the boat and turn us in a new direction, but this one turns the boat upside down and fills it with water."

***Michael Turner,** University of Chicago, on faster than light neutrinos,* The Washington Post*, November 14, 2011.*

"It would mean that the underlying assumptions of Einstein's theory are not precise, they're just approximate."

***Lisa Randall**, Harvard, on the implications of faster than light neutrinos,* The Washington Post*, November 14, 2011.*

"I would expect consumption in the future gets larger, but we also learn how to do things more efficiently… so the raw material consumption may well go down."

***Klaus Lackner**, Columbia University,* National Public Radio*, November 1, 2011.*

"Many people say it's a religious question, but I've been trying to say it's a scientific one."

***Lawrence Krauss**, Arizona State University, on discussions about whether the universe came from nothing,* BBCNews.com*, November 7, 2011.*

"Don't say there's nothing there to a physicist. Space has a seething quantum structure to it. I like to think of it as a pot of water on the stove with bubbles coming out. Space is like that. It's always bubbling. We could see it if we had a powerful enough microscope."

***S. James Gates**, University of Maryland,* The Washington Post*, November 8, 2011.*

"[W]hen they are working on a concept and somebody says, 'Yeah, but it's going to cost too much for the customer in the end,' that's sort of like a non-issue for a government researcher… I really think that venture capital might just come in at this point and pick the best fruits off the tree and run with them."

***Richard Siemon**, formerly at Los Alamos, on private fusion experiments,* National Public Radio*, November 9, 2011.*

"When we started getting results that showed that it was not slowing ... [that] in fact it wasn't slowing at all–it was speeding up–it was a pretty big shock…At the time, when you first get those results, it doesn't worry you too much...because you know you haven't finished doing the calibration. The more we did the calibration, the more the results didn't go away."

***Saul Perlmutter**, Lawrence Berkeley National Laboratory, on discovering that the expansion of the universe is accelerating,* National Public Radio*, November 14, 2011.*

"Over the course of Solyndra's loan guarantee, I did not make any decision based on political considerations… My decision to guarantee a loan to Solyndra was based on the analysis of experienced professionals and on the strength of the information they had available to them at the time."

***Steven Chu**, Department of Energy, testifying before Congress,* CNN.com*, November 17, 2011.*

"So it seems like there is probably chemistry going on that we don't know about yet."

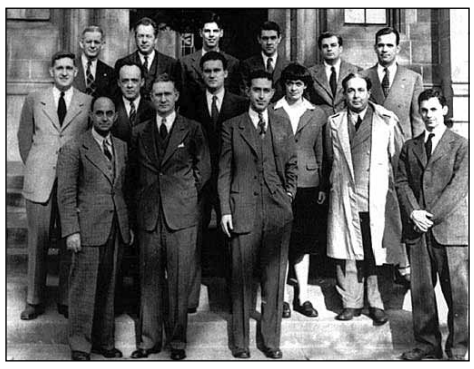
***David Graves**, University of California Berkeley, on finding that ionized plasma could be used to sterilize water and turn it into an antimicrobial solution,* MSNBC.com*, November 17, 2011.*

This Month in Physics History

December 2, 1942: First self-sustained nuclear chain reaction

Despite the onset of the Great Depression, the 1930s was a heady, dramatic decade for physics. Against a backdrop of growing global political unrest, a series of revolutionary breakthroughs in nuclear physics set the stage for a high-stakes race to build the first atomic bomb and put an end to World War II. Caught in the thick of that race was an Italian physicist whose name would one day adorn one of the foremost laboratories in the world: Enrico Fermi.

Fermi was born in Rome, Italy, in 1901 to a railroad official, Alberto, and his wife Ida, a schoolteacher. He and his older brother Giulio shared a fascination for taking apart engines and other mechanical things, but Giulio died suddenly in 1915 due to a throat abscess. The grief-stricken Enrico threw himself into scientific study to cope, confessing many years later in his memoirs that he used to walk past the hospital where his brother died every single day until the grief finally abated.



Members of the Chicago Pile team gathered on December 2, 1946, to mark the 4th anniversary of the first self-sustained chain reaction. Fermi is at left in the front row; Leo Szilard is the third from the right.

Science turned out to be an excellent fit for the gifted young man, particularly physics. Fermi discovered physics by accident, after stumbling upon a 900-page Jesuit treatise on elementary mathematical physics while browsing in the local market one day. He also found a friend to share his enthusiasm for science: a fellow student named Enrico Persico. The two of them built gyroscopes and performed their own experiments to measure Earth's magnetic fields, among other projects.

Fermi's first important scientific contribution was a 1922 paper in an Italian journal where he first introduced the concept of "Fermi coordinates" –coincidentally the same year he graduated from Scuola Normale Superiore. He went on to study at the University of Gottingen and the University of Florence before becoming a professor at the University of Italy at the tender age of 24.

The year before, Fermi had been writing an appendix for the Italian translation of A. Kopff's *The Mathematical Theory of Relativity*. He realized that Albert Einstein's most famous equation ($E=mc^2$) implied a very large amount of potential nuclear energy that might conceivably be made available under the right experimental conditions. He pursued that avenue of research enthusiastically while in Rome with a small group of colleagues that included Emilio Segre. They earned the moniker "the Via Panisperna boys" after the street on which the labs were located. Among their many seminal contributions was the discovery of so-called slow neutrons and their effect on various elements.

Ultimately, Fermi won the 1938 Nobel Prize in Physics for his "demonstrations of the existence of new radioactive elements produced by neutron irradiation, and for his related discovery of nuclear reactions brought about by slow neutrons." Fermi took advantage of the award ceremony in Stockholm to emigrate to the United States, concerned about the safety of his Jewish wife, Laura, under Mussolini's Fascist regime–specifically the newly instituted Manifesto of Race. He wound up at Columbia University.

Reports of experimental evidence for nuclear fission began circulating early in 1939, in a manuscript by German chemists claiming they had detected barium after bombarding uranium with neutrons. Among those who heard the news was Lise Meitner, who realized, with her nephew, Otto Frisch, that this could be nuclear fission. The news quickly spread across the pond to American physicists, including Fermi.

On January 25, 1939, Fermi and his Columbia colleagues conducted the first US nuclear fission experiment. Later that year, Leo Szilard–who first hypothesized the chain reaction in 1933–and Einstein signed the now-famous letter to President Franklin D. Roosevelt warning that Nazi Germany was likely trying to build an atomic bomb. Roosevelt responded with funding for further experiments. And the seeds for the Manhattan Project were sown.

Fermi transferred to the University of Chicago to supervise the design and assembly of the first nuclear reactor, although originally it was known as an "atomic pile." It was built in the squash court under Stagg Field, the University of Chicago's football stadium. Fermi himself described is as "a crude pile of black bricks and wooden timbers."

Uranium pellets made up the neutron-producing core, separated by graphite blocks, and the critical reaction was controlled by a series of cadmium-coated control rods that absorbed the neutrons emitted by the core. One by one, those cadmium rods were removed, increasing the neutron activity in the pile until a self-sustaining nuclear chain reaction occurred. Conspicuously absent from the pile was any kind of radiation shielding or cooling system.

On December 2, 1942, a young physicist named George Weil removed the final control rod from the pile under Fermi's supervision, which reached criticality at 3:25 PM. Fermi shut down the reaction 28 minutes later by re-inserting the cadmium rods. It was a landmark achievement, reported in a coded conversation between Arthur Compton and James Conant, chairman of the National Defense Committee:

Compton: The Italian navigator [Fermi] has landed in the New World. *Conant:* How were the natives? *Compton:* Everyone landed safe and happy.

Chicago Pile-1 ceased operation in February 1943 and was moved to the site of the future Argonne National laboratory, where it was rebuilt with the original materials–this time with a radiation shield–and renamed Chicago Pile-2. One can still view a few of the original graphite blocks on display in various spots around the country.

The original site at the University of Chicago was designated a national historic landmark on October 15, 1966, and a city landmark in 1971. The plaque inscription reads, "On December 2, 1942, man achieved here the first self-sustaining chain reaction and thereby initiated the controlled release of nuclear energy."

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Education Corner

A column on educational programs and publications

Minority Scholarship Application Process Begins
The American Physical Society is once again pleased to announce the APS Scholarships for Minority Undergraduate Physics Majors. African American, Hispanic American, and Native American students who are college freshmen or sophomore physics majors, and who are US citizens or permanent residents, are invited to apply. The online application deadline is February 3, 2012. Awards are $2000 and $3000 per academic year. More information can be found at http://www.aps.org/programs/minorities/honors/scholarship/.

APS/IBM Research Internship for Undergraduate Women
APS and IBM co-sponsor a research internship program for undergraduate women, to encourage female students to pursue graduate studies in science and engineering. The deadline for the Summer 2012 internship is February 1, 2012. Internship information and the application can be found at http://www.aps.org/programs/women/scholarships/ibm/index.cfm

2012 PhysTEC and AAPT Winter Conferences–February 3-4 in Ontario, California
The 2012 PhysTEC Conference will occur in conjunction with AAPT's annual winter meeting in Ontario, California from February 3-4, 2012. The conference is the nation's largest meeting dedicated to physics teacher education. It features workshops, panel discussions, and presentations by national leaders, as well as excellent networking opportunities. The registration and housing reservation deadline is January 16, 2012. More information can be found at http://www.ptec.org/conferences/2012/logistics.cfm

Physics InSight has undergone a facelift.
The slideshow still presents information on physics careers, interesting topics, and salary and employment, but in a new eye-catching format. APS hopes these slide shows will be shown in venues frequented by potential physics majors, such as university science buildings. Download the slide shows at http://www.aps.org/careers/insight/

AIP Statistical Research Center Publishes New Reports
The American Institute of Physics Statistical Research Center recently published new reports on the initial employment of physics PhD recipients, girls taking physics in US high schools, and graduate physics degree data. To read the reports and find additional data on education and employment in physics, see www.aip.org/statistics/.

Two Plaques Recognize Physics Milestones

This fall, as part of its historic sites initiative, APS recognized both Brookhaven National Laboratory on Long Island and the former campus of the National Bureau of Standards in Washington, DC as historic physics sites.

Photo courtesy Brookhaven National Lab

Brookhaven was recognized not for one achievement, but for many. The citation on the plaque that was presented reads "At this laboratory, over many years, scientists and engineers have made numerous fundamental discoveries in the fields of nuclear and high-energy physics, the physics and chemistry of materials, energy and environment, biology and medicine. Among many landmark experiments are establishing the spin direction (helicity) of the electron neutrino, first observation of solar neutrinos, proof of more than one species of neutrinos, first observation of a lack of symmetry between matter and antimatter, and the principle of strong focusing that led to more compact and powerful accelerators." Not mentioned on the plaque, but also a landmark in physics, was the discovery of the omega-minus particle in a bubble chamber experiment in 1964, confirming the predictions of the quark model. In the photo at top, APS President Barry Barish (right) presents the plaque to Brookhaven Laboratory Director Samuel Aronson. The presentation took place on September 23 during a special symposium at Brookhaven to mark the historic site designation.

Photo Credit: Alan Etter/UDC

In the autumn of 1956, the National Bureau of Standards campus in northwest Washington DC was the site of an experiment showing that nature did not respect the symmetry interchanging left and right. The idea that weak interactions might violate this symmetry was suggested by T.D. Lee and C.N. Yang, and the experimental proof was carried out by C.S. Wu of Columbia and four NBS scientists, working at the low temperature laboratory on the NBS campus. The citation on the plaque reads "At this location in 1956, C.S. Wu, E. Ambler, R.W. Hayward, D. D. Hoppes, and R.P. Hudson measured the asymmetry of the angular distribution of electrons emitted by polarized ^{60}Co nuclei demonstrating that weak interactions are not symmetric under a change of parity. This work led to the recognition that the weak and electromagnetic forces are aspects of a single force."

In the 1960s, the NBS moved from Washington to Gaithersburg, MD, and later changed its name to the National Institute of Standards and Technology (NIST). The former campus is today mostly occupied by the University of the District of Columbia (UDC). As shown in the photo, on November 9, APS Executive Officer Kate Kirby (right) presented the plaque recognizing the parity experiment to UDC President Allen Sessoms, himself a physicist and APS Fellow. Also participating in the ceremony was Katharine Gebbie (left), Director of the Physical Measurement Laboratory at NIST.

APS Starts New Recognition Program for Women

Beginning in January, the APS's Committee on the Status of Women in Physics (CSWP) will begin a program to highlight exceptional female physicists. The CSWP Woman Physicist of the Month award will recognize female physicists who have positively impacted other individuals' lives and careers. The committee is calling for the first nominations to get the program underway.

"It is still often true that few women receive APS awards," said Deanna Ratnikova, APS women and education programs administrator. "This is a way to address the situation."

Each CSWP Woman Physicist of the Month will be featured on the Women in Physics website, announced in the *Gazette*, and recognized at a reception at an APS national meeting. CSWP will also work to identify other outlets through which awardees can be recognized for their efforts and contributions.

The award was the idea of the 2011 chair of the CSWP, Kawtar Hafidi. She found that after she won the Association for Women in Science Chicago's scientist of the month award, it opened up a lot of professional doors and opportunities for her.

"She thought that something similar to that would be very beneficial to women in physics," Ratnikova said.

The Woman Physicist of the Month award is not restricted to just research physicists, but open to students, teachers or any woman doing physics-related work. The organizers intentionally kept the criteria for nominees nonspecific in order to encourage a diverse group of nominees.

To nominate someone, the name, institution/facility/company, and email of both the nominee and nominator should be emailed to women@aps.org. The nominee's CV and a nomination statement up to three paragraphs should also be included in the email as attachments. The nominee does not need to be an APS member.

Nominations are being accepted on a rolling basis. The committee will start to consider the nominees in December and will announce the first award winner in January. To nominate a woman physicist, visit www.WomenInPhysics.com.

Science gets Budget Boost, but Congress Slams OSTP

By Michael Lucibella

In the first portion of the FY 2012 budget passed by Congress, support for scientific research is mostly preserved despite cumulative budget cuts across different agencies. The budget covers a fraction of government spending, and only a portion of scientific research funding as well, but many advocates for science find the move encouraging.

Congress passed a "minibus" bill on November 17 made up of three appropriations bills, for Agriculture, Transportation-HUD, and Commerce-Justice-Science, which includes the budgets for NASA, the National Institute of Standards and Technology (NIST), the National Science Foundation (NSF) and the White House's Office of Science and Technology Policy (OSTP). The minibus all told cut about 1 percent of funding from the agencies it covers, but scientific programs within many of those agencies were largely spared such cuts. Overall funding for the agencies in these bills is 7 percent less than what was requested by the Obama administration, which included significant increases to many scientific programs.

"Some people complained because it's not what the president requested," said Patrick Clemins, former director of the R&D Budget and Policy Program at the American Association for the Advancement of Science. "If you look, there's a couple of numbers that are bigger than the House or Senate requested in the first place. So if you look at it from that perspective, science did pretty well."

The budget passed covers some, but not all, government-supported research. It is unclear if these increases indicate strong congressional support of scientific research during a time of budget cuts, or if these programs are exceptions.

"It's too early to tell, we only have one piece of it…that represents the National Science Foundation, NIST and NASA," said Michael Lubell, APS director of public affairs. "Of the big pieces, we're still missing Energy and NIH and at this point we don't know what's going to happen with those."

The National Science Foundation got a surprising $173 million, or 2.5 percent boost to its budget bringing its total to $7.03 billion. Earlier versions of the bill in the House kept the budget the same as 2011, while a Senate version cut $161 million. The research account of the NSF benefits the most, getting a nearly 3 percent bump to $5.7 billion, while its education directorate would shrink 4 percent to $829 million. The increase is largely to try to make up for the expiration of the stimulus package passed in 2009. The stimulus added $3 billion to the NSF which was awarded as grants, and rather than have half completed experiments run out of funding, Congress opted to increase the budget to partially cover continuing research. NIST also got a big increase, about 12 percent or $33 million, bringing the total for the agency to $751 million.

NASA is getting a bit of a haircut with its budget trimmed about $650 million, about 3.5 percent, to $17.8 billion, $924 million less than the President's request. However, the agency's science budget is getting a $155 million boost to $5.1 billion. Significantly, the budget includes funding for the James Webb Space Telescope, which had its funding zeroed out in an earlier draft of the House budget. In August, the APS Executive Board released a statement urging Congress to reinstate funds for the JWST.

All together about $530 million is designated for the telescope in 2012, $374M more than the president requested. However the budget imposes an $8 billion cap on total spending for it, $800 million less than NASA now estimates the project to cost. Legislators explained in an accompanying summary of the full appropriations bill that the telescope would be funded by making cuts to other programs and setting up new cost oversight measures. It is unclear which scientific programs might be the targets of cuts.

The increase in the science budget is offset by a $1.3 billion cut to space operations bringing it to $4.2 billion, stemming largely from the end of the space shuttle program and cuts to the development of commercial space taxis.

Lubell said that he thought these increases are likely not part of a bigger trend. Many of the programs that got budget increases are agencies that have historically had strong backing from appropriation subcommittee chairs in the House and Senate.

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Letters

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

Once a Physicist...

Contrary to the characterization by Brian T. Schwartz of Rush Holt as a "physicist-turned-Congressman" (letter, November *APS News*), Holt is a physicist elected to Congress. And lucky we are.

Michael D. Rosenthal
Washington, DC

Consumers' rights to catastrophe

In his letter in the November *APS News*, Brian T. Schwartz opposes legislation to limit the sale of incandescent lamps because it would "violate consumers' rights to choose." Did he oppose or would he have opposed (on the same grounds) the legislation that limited the use of chlorofluorocarbon compounds, legislation that has been at least partly successful in limiting the damage to the ozone layer? Did he oppose or would he have opposed the legislation that limited emissions of sulfur dioxide, which had the effect of reducing acid rain? Does he oppose the legislation that limits hunting, even if such laws are instrumental in protecting many species from extinction?

Schwartz writes: "Businesses in relatively free markets innovate just fine", and this is true, but unregulated businesses do a very poor job of avoiding future catastrophes. Moreover, the evidence suggests that consumers, acting individually, do not do a good job of making choices that lead to a secure future, but that they are happy to accept legislation that leads them, collectively, to make choices that help avoid catastrophes, in this case catastrophic climate change.

Alwyn Eades
Bethlehem, PA

Kelvin No Hero to Geologists

George R. Bart (letters, October *APS News*) is correct that history should give full credit to Lord Kelvin's enormous accomplishment. It is also obliged to record of some of his less than stellar contributions. He stubbornly insisted on assigning to the Earth a much too short age, based on his simple but inadequate model for thermal cooling. What were some of the consequences? : (a) Without the prestige his conviction carried, "the theory of continental drift might have been accepted decades earlier"[1]; (b) Because of his rigid stance "geologists and biologists no longer felt that they had to justify their conclusions to physicists"[2] !

1. P.C. England et al, *American Scientist* 95 , 342 (2007)

2. B.C. Shipley, *Geol. Soc Lond.* Special Publications 190 , 91 (2001)

Hellmut J. Juretschke
Mount Desert, ME

There is no game to change

The Back Page in the October *APS News* by Kate Marvel and Michael May implies that there is a nuclear energy game to change. In the United States there is not. Many of us were hoping that there would be a revival of nuclear power in the US in the 21st century, but nuclear energy in the US and Europe has priced itself out of the market. I quote Wigner who in 1973 said that if nuclear energy is not cheaper than alternatives it will not be used. Nuclear power was cheaper in 1972-4 when a nuclear power plant took 3 years to build from planning to operation including all licensing and permits.[1] If one is lucky enough to own a power plant with the mortgage costs paid (as they all now are) it is still cheaper to operate than alternatives. In 2007 I was optimistic that the cost of new nuclear plants would still be within reach at $1,000-$1,500 per kwe installed. But when new orders came in since then, the price was $4,000 per kwe installed. The capital cost, including paying off the mortgage, is now about 20 times what it was in 1974, much more than inflation.

Of course there have been safety improvements. But these have mostly arisen from improved analysis. The increased time for approval and construction has of course increased costs. It is well known that to build something cheaply it must be done fast. Robert R. (Bob) Wilson in building Fermilab knew this. It is likely that Steve Jobs did too. Parkinson[2] stated it well in his first law "work expands to meet the time available for its completion." In the 1970s Ralph Nader explicitly encouraged nuclear power opponents to use a tactic of delay. But several careful studies suggest that there must be something more: I tentatively have suggested that the quality, dedication and enthusiasm of the scientists and engineers in the 1960s made the difference.

After World War II society looked to physicists in particular for guidance. This declined after 1970. The scientific issues of global warming were already visible on the horizon, and it was clear that nuclear power could aid in addressing this. Glen Seaborg made a public appeal as President of AAAS for grass roots support but very few physicists responded. When they do speak up they tend to point out, as Marvel and May do, that the "industry" should act to ensure that there are no accidents. They are of course right. But all too many scientists have a knee jerk response and ask for immediate abandonment of all old nuclear reactors–before asking for a new replacement and ignoring the fact that all existing coal fired plants are worse. Much more important is for physicists to bring to the table the rigorous thinking they employ in the laboratory.

Many scientists are unaware that radiation does not cause unique cancers but increases the probability of a cancer that might happen without exposure. All too often it is said that we do not know the effects of low exposures to radiation. True. But we do know what they are not and physicists in particular know how to discuss an upper limit on such effects. Although I have never had Seaborg's authority I have often repeated his appeal to fellow physicists. Make the effort to understand the effects of radiation. Make the effort to understand the implications to public health of TMI, Chernobyl and now Fukushima. For example NO ONE in Fukushima got acute radiation sickness leading to death within a month. The calculated increase in cancer rate for the first year of continuous exposure in the open in the worst location is about 3%. [3] Scientists should be explaining this to the public in all fora; then perhaps we could get a game change. In about 1988 I was asked to explain to a meeting of the Center for Environmental Information what nuclear power could do to avert global warming.[4] I said unequivocally that unless physicists stood up, the "nay sayers" would carry the day. ln 2002, I was optimistic that the tide had changed and new nuclear plants were discussed at $1,000 to $1,500 per Kwe and so described the reasons for the optimism at the World Federation of Scientists in Erice, Sicily [5] and later in reference 1. By 2008 my optimism had been destroyed as the new estimates were over 4 times greater![6] In December 2008 an ad-hoc group of scientists presented to each incoming Congressman (and Congresswoman) a list of the extensive "road blocks"[7] put in place since 1974 which delay construction and help to make it expensive. If physicists do not act, the only nuclear power will be in China, India and smaller countries who are far less likely to do it safely than the US. The world will have all the disadvantages of nuclear power but few of the advantages.

Richard Wilson
Cambridge, MA

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"NIST and NSF are favorites of [Representative Frank] Wolf and NASA is one of [Senator Barbara] Mikulski's favorites," Lubell said. He added that when the Department of Energy and the National Institutes of Health budgets come up for a vote, he does'nt think that the support for scientific research will necessarily be as strong; however it is unclear when this might happen.

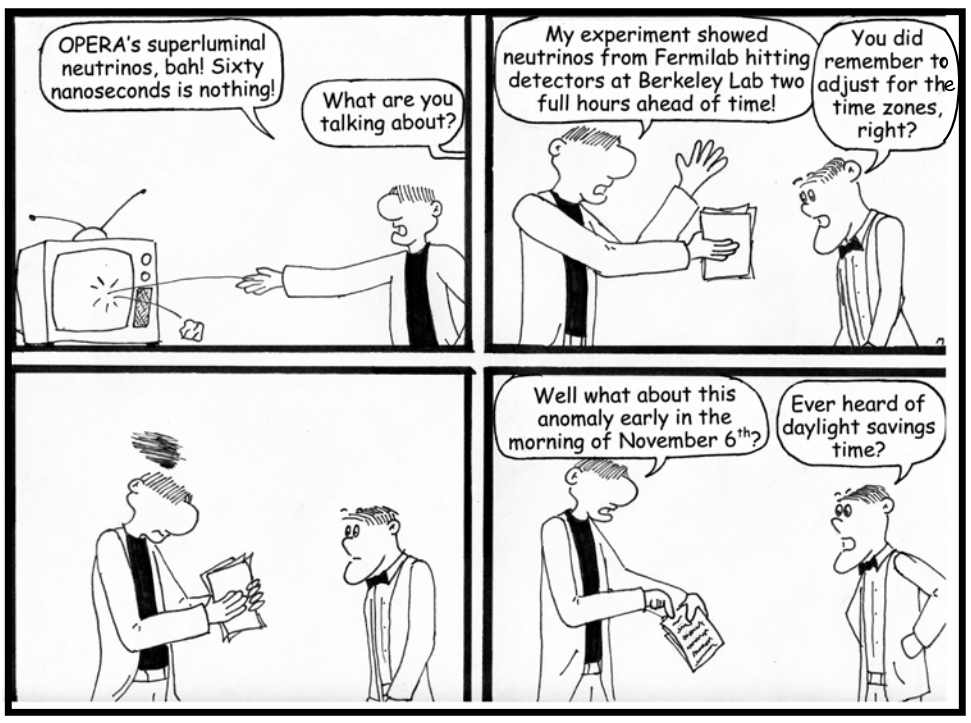
Politics were also a big factor in OSTP's taking a big hit. The Office is getting its budget slashed 32 percent from $6.6 million to $4.5 million. The earlier draft of the budget passed by the House had a much bigger, 55 percent cut, while the earlier Senate version had only a 9 percent cut. The two houses of Congress opted to split the difference at their budget conference. It is unclear if the cuts will result in any layoffs at the office, as many of its staff are on loan from other agencies and institutions, but officials say it will force the office to reprioritize its activities.

"They definitely will be limited in terms of what kind of advice they can provide to the administration in terms of reports," Clemins said. "They're optimistic that they can work with that, and can still provide advice to the President"

The impetus for the steep cut apparently stems from a dispute between the Office and Congressional Republicans, particularly Wolf. The 2011 budget resolution passed last year contained language prohibiting NASA and the OSTP from collaborating with China over concerns that the Chinese would steal sensitive technology or information. John Holdren, Director of the OSTP, held meetings with Chinese officials in the spring, after the ban was in place. Wolf was reportedly furious at the action and moved to slash the office's budget.

The 2012 budget also contains language prohibiting similar meetings, but it does allow for some collaborations if the White House can confirm that there is no chance that sensitive technology or information will be transferred, and the Office gives Congress a two-week notification of the meeting.

By Michael Lucibella



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physics for all high school students–an exciting policy development we hope other states will adopt–there is an even greater need for qualified high school physics teachers," the letter read. "Ironically, just as this legislation is coming into effect, the actions of the THECB to close physics programs will cripple the state's ability to effectively prepare sufficient numbers of highly qualified physics instructors to meet the new requirements."

The Texas Section of APS released a similar letter calling on the Board to reassess its plan to shut down programs. The letter went on to say that the Board's decision would have a particularly adverse impact on several schools that have seen high rates of underrepresented minority student enrollment.

"The purpose is not so much about saving money, it's about conserving resources and the quality of the program," said Macgregor Stephenson, assistant commissioner for academic programs and research on the THECB.

Physics programs at Texas Southern University, Prairie View A&M University, Texas A&M University Kingsville, West Texas A&M University, Tarleton State University and Midwestern State University all fell short of the THECB's requirement, and are slated to be phased out. However, the board did hold out the possibility that the schools may be able to still graduate physics majors by joining a consortium of universities pooling their physics programs.

"I think the Coordinating Board has a point: you're not contributing a lot to the economy by producing one student a year… They understand the bottom line," said Heather Galloway, director of the University Honors program at Texas State University San Marcos and a former member of the APS Executive Board. "They did seem to recognize that there is something to be said for physics. They took it upon themselves to start a coalition."

In fact, the Texas Electronic Coalition for Physics was started in 2004 and is currently made up of five schools across the state. The consortium spreads teaching physics courses throughout the system by having a professor at one of the schools deliver a lecture, which is then broadcast live to the other schools in the system. Participating in the program are some of the smaller, more rural schools, often ones that also have higher enrollment rates of women and underrepresented minorities.

Stemming from the Board's decision, two more schools have joined the coalition, Texas Southern and Texas A&M Commerce, which is on a two-year probation. Midwestern and Prairie View have also been invited to join.

"I guess it ended up not as bad as I thought it would be," said Daniel Marble, an assistant professor at Tarleton State University, one of the coalition members. "[Members of the THECB] say they're going to work with us and make it happen."

The question of how to confer degrees to students in the consortium has been tricky. Students who earn a physics degree while participating in the consortium receive it from their home university. As a result, classes would be filled well beyond state minimum requirements, but on paper, each university would only have a small number of graduates. Members of the consortium and the THECB are working on a plan to evaluate the program based on the cumulative number of students in the program, rather than the number of students at each individual school.

"What they're letting us do, in essence, is do what we thought we were doing already, which is to try to sum the graduates," Marble said. "I don't care what they call it; they could call it the degree from Mars, I only care about teaching my kids."

The exact form that such a degree would take is not yet clear. Consortium administrators and members of the THECB held their first meeting on November 18 to start formulating a plan to put together a joint degree. Administrators have said that they hope to get a plan figured out soon so schools can know if they have a physics degree to offer students enrolling for fall of 2012.

There may still be another round of program shutdowns in the future. At the October meeting, several board members, including chair Fred Heldenfels, brought up the possibility of upping the minimum number of students required to graduate per year from five to eight.

"It's certainly been on the mind of our board members," Stephenson said. "Of states that have a statewide standard, we're definitely at the most permissive end in terms of the number that we require." He added that Louisiana's requirement is a minimum of eight students graduating per year, Georgia's minimum is ten, and Kentucky's is twelve.

Fellows Convene in Santa Fe

Photo by Darlene Logan/APS

On November 10, APS hosted a reception for New Mexico Fellows at the La Fonda Hotel in downtown Santa Fe. More than 100 attendees heard short presentations by APS President Barry Barish, Executive Officer Kate Kirby, Treasurer/Publisher Joe Serene, and Director of Education Ted Hodapp, and had a chance to mingle and enjoy some Southwest food and drink. In the photo, Scott Crooker of Los Alamos National Laboratory (left) looks on while Albert Migliori, also of Los Alamos, offers to share his refreshments with the starving photographer.

Plasma Meeting Features Research on High Pressures, Fusion Reactors, and Etching

The APS Division of Plasma Physics held its annual meeting in Salt Lake City, Utah from November 14 through 18, and drew over 1,500 scientists and engineers who met to share the latest cutting-edge plasma physics research. The Gaseous Electronics Conference was held in conjuction with this meeting.

Coming from the National Ignition Facility at Lawrence Livermore National Laboratory is news that a team compressed a diamond sample to 50 megabars of pressure, a new record. Raymond Smith of LLNL described his team's experiment using a pulsed 750 kilojoule laser to gradually compress a small diamond sample to 50 million times Earth's atmospheric pressure. Studying the behavior of diamond at such high pressure is a relatively new field. Traditional quasi-static compression methods peaked at only about three megabars, while this relatively new "ramp-compression" technique can achieve much higher pressures. This kind of crushing pressure is thought to be found in the cores of some "super-earths" discovered orbiting distant stars,

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Mmm, Mmm, Physics! The Man with the Plan for Cans

By Alaina G. Levine

Alexander Skutlartz did not expect to work in the soup business. He did not plan to make his mark with mushrooms or to develop an x-ray innovation for metal cans. But when Campbell Soup Company offered him a job, he couldn't say no.

With a PhD in atomic collision physics from Kansas State University and experience at Argonne National Laboratory and the University of Frankfurt in his native Germany, by 1988, Skutlartz had settled into an academic career at East Carolina University. His wife, whose expertise is in grain science, found a job at Campbell's, and for a few years, the couple commuted back and forth between North Carolina and New Jersey, where the company's headquarters is based.

In 1992, when the couple had had enough of the two body problem, a fortuitous meeting with Campbell's Vice President of Process R & D and Process Safety allowed Skutlartz to chart a new career course. Following a chat about his research, the executive asked the physicist to do some consulting for the corporation. One week of consulting over spring break turned into another week over winter recess, and so on, until "I hinted that I wanted a permanent position," he says. Campbell Soup agreed. When the semester ended, Skutlartz segued from protons to potatoes.

Although his initial assignments focused on optical sorting, "mainly physics but how it is applied to the food industry," he explains, it wasn't a completely smooth transition. "The vice president who hired me took a fairly large risk. There were people who were dead set against hiring me. They were used to chemical engineers working as process engineers, but not physicists." Furthermore, as Skutlartz later found out, a PhD "can be the kiss of death in the food industry," he says, and it is even rarer to find a leader in the industry with a PhD in physics.

But Skutlartz prevailed at the firm. "I did what the company couldn't do," he admits. "If they needed a crazy idea they would come to me. I wasn't working in the food industry for a long time and therefore could look at the problem from outside the box."

Alexander Skutlartz

One of the first "crazy ideas" that struck Skutlartz at Campbell's involved the use of optical sensors to sort mushrooms. Optical sorting was in its infancy at the time, he explains, and the company, in its quest to make white mushroom soup, needed a way to quickly examine, identify, and remove any mushrooms that were dirty from the growing process. Together with an outside company, Skutlartz developed an optical sorting system (using simple color cameras) and the software needed to run them to spot any imperfections on the 'shrooms from a 360 degree angle. This was revolutionary for the business–the sorters processed several tons of the fungi every hour, saving the company precious time and millions of dollars of lost income from unsatisfactory product.

His next task was equally interesting, although clandestine. "I can't talk about it," he says with a chuckle, but in all seriousness, "it saved the company lots of money and involved a vacuum chamber."

Skutlartz found similarities between laboring in the food arena and in physics, especially when it comes to the length of time it takes for projects to come to fruition. One of his most significant innovations took ten years to complete: high-speed x-ray imaging systems for evaluating product after it had been sealed in cans. This groundbreaking invention was important for many reasons. Prior to Skutlartz's solution, there was no way to know for certain if foreign material was present in a can of soup after it was sealed. The x-ray systems also allowed plant operators to know the exact weight and level of the soup in the container, which "was very critical for safety processes and sterilization," he explains. For example, if a can of potato soup has twice as

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New Faculty Gather in College Park

Photo by Michael Lucibella

On a sunny autumn day in late November, more than 50 new physics and astronomy faculty members gathered for a photo opportunity at the American Center for Physics in College Park, MD, as part of the latest in an ongoing series of workshops. These semi-annual 3-day conferences are designed to give new faculty an update on the latest in teaching techniques, as well as to provide some guidance for navigating the often treacherous waters of academe. APS is a co-sponsor of these conferences, whose other sponsors include the American Association of Physics Teachers (AAPT), the American Astronomical Society (AAS) and the National Science Foundation (NSF). Additional support is provided by the Research Corporation for Science Advancement. The workshop chair is Robert Hilborn of AAPT.

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all day on subjects ranging from topological insulators and spintronics to graphene and the physics of cancer.

At Monday afternoon's Ceremonial Session, the APS President will present prizes and awards recognizing the achievements of physicists who have made important contributions to their field. The award session segues into the meeting's welcome reception where attendees can mingle and enjoy refreshments.

The DCMP/DMP/DCOMP/DCP New Fellows and Award Winners Reception will be held on Tuesday night at the Westin Boston Waterfront Hotel. There, APS's newest Fellows will be honored, and award recipients recognized by the divisions of Chemical Physics, Computational Physics, Condensed Matter Physics and Materials Physics.

APS is joining forces with the Society of Physics Students for Future of Physics Days on Monday and Tuesday. The days include a graduate school fair, special research sessions just for undergraduates, awards, and panels about careers and graduate schools in physics. Registration for the March Meeting is free for undergraduate students. Travel grants of up to $1,000 are available to students presenting contributed papers at the meeting.

For graduate students interested in getting to know a subject straight from an expert, Wednesday's Lunch with the Experts can be a good opportunity to connect with professors and other authorities. Students can enjoy a boxed lunch while having an informal, freewheeling discussion with an expert on a subject of interest.

Nearly 130 organizations and companies have registered for this year's exhibit hall, including the American Association for the Advancement of Science, Los Alamos National Labs and Wolfram Research. The hall will be open from 10 a.m. to 5 p.m. on Monday and Tuesday, and from 10 a.m. to 4 p.m. on Wednesday. Special wine and cheese receptions will be held in the exhibit hall on Monday and Tuesday at 4 p.m.

As always, at APS's Contact Congress booth, attendees are invited at any time to send a letter to their members of Congress about the importance of federal research funding.

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Currently there is no committee in APS devoted to LGBT-related issues, so the APS committees on minorities and the status of women in physics both contributed time to make Tuesday's special session happen. According to the session's organizers, issues to be addressed include employment protections against discrimination, further research on the subject, and advocacy of gender minorities in physics. Previous meetings have had smaller forums on the subject, usually held as informal evening discussions organized by Elena Long of Kent State University.

Speakers at the session include Sue Rankin from Penn State University, who is co-author of the 2010 survey "State of Higher Education for LGBT People"; Michael Ramsey-Musolf of the University of Wisconsin; Janice Hicks of NSF, who helped found the American Chemical Society's Gay and Transgender Chemists and Allies professional subdivision; and doctoral student Elena Long who also founded the website LGBT+ Physicists.

The session will conclude with an open panel discussion on empowering gender minority people in physics and research. Ted Hodapp, APS's director of education and diversity, will join in the discussion. Later in the meeting there will be a networking reception for people interested in the issues.

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Friday afternoon's plenary session on science and foreign policy explored current and historical examples of scientists putting aside national and ethnic differences to advance science and understanding. The modern example the panel cited is the ongoing SESAME project that brings together scientists from nine countries in the Middle East, including from nations unfriendly each other, to build a synchrotron light source in Jordan. Historically, they pointed to times during the Cold War when US and Soviet scientists continued to communicate and collaborate, even during times of strained government relations.

"It was an example of how scientists and scientific societies can help in diplomacy and add to foreign policy," Kumar said

Photo by Ken Cole/APS

Blessing Iserhienrhien, University of Saskatchewan, explains her research during the poster session of the CAM meeting.

Graduate students learning about organizing a conference is as much a part of CAM as are the sessions. The students that made up the organizing committees gained firsthand knowledge of budgeting, logistics and moderating a science conference.

"It was a unique experience for me, because I got to do something we don't usually have the opportunity to do during grad school," Kumar said.

INSIDE THE BELTWAY

Wall Street's Loss May Be the Nation's Gain

by Michael S. Lubell, APS Director of Public Affairs

Washington may hold the levers of power, but it's Wall Street that makes them move. And these days, that nexus isn't sitting too well with the American public. It's not just the "Occupy Wall Street" movement–which has now spread nationwide–but also the drumbeat emanating from Main Street for hiking taxes on millionaires and billionaires that is dulling the gloss on the canyon walls of lower Manhattan.

And if the Street loses some of its lure for the brightest graduates of the Ivies, it may not be such a bad thing. Just before the banking sector imploded in 2008, Harvard was sending almost 6 out of 10 of its newly minted bachelors degree job seekers to financial services firms, with Goldman Sachs the commencement trophy of choice.

Today, Goldman no longer sports the gold medal, having agreed last year to pay a $550 million Securities and Exchange penalty for misleading investors on subprime mortgages, and announcing this past October that it had lost $393 million in the third quarter of 2011. It's true that bonuses on Wall Street have nearly reached their pre-recession peak, but New York financial firms have shed nearly 22,000 jobs since then, and they predict they will eliminate 10,000 more in the next two years.

These days, if you're a smart cookie, you might not want to bet your smarts on the financial Svengalis. You might just want to consider a career that creates something of worth beyond a pile of chips in a Wall Street casino. You might just want to try your skills at discovery, innovation and entrepreneurship. You might just want to help grow the economy and create jobs. You might just want to consider a career that uses your science and engineering abilities to build a better America.

It wasn't too long ago that the American Physical Society was featuring Wall Street as an avenue for alternative careers in science. I recall attending the 2000 APS March Meeting in Minneapolis. It had been an usually warm winter, and by the time 5,000 physicists had descended on the City of Lakes, the snow had melted and the buzz of discovery was in the air.

A few weeks before the meeting convened, *APS News* had featured several sessions in its front-page article, "APS Gears Up For Minneapolis March Meeting Madness." One item had caught my eye. Session P5, scheduled for Wednesday afternoon, carried the enticing title, "Bullish on Wall Street," and I had marked it on my calendar as a must attend.

The *APS News* article had observed, "Over the last decade, the number of PhD physicists employed in the financial community has increased dramatically. Once considered something of an anomaly, physicists have become a critical element to successful investment strategies." The item concluded with a summary of the session: "[A] broad range of recent research centered on econophysics: critical phenomena in economics, the growth of complex organizations, the application of random matrix theory to economics, and elements for developing a theory of financial risk." With hindsight and the financial collapse still evident in a rear view mirror, the final words carry with them more than a tinge of irony.

As usual, I was running late that Wednesday afternoon. But I had assumed that "Bullish on Wall Street" would be no match for the hard science sessions with which it was competing, and that I would have no trouble finding a seat. That proved to be an immense miscalculation.

By the time I had arrived, a few minutes before the session was scheduled to begin, the hall was filled well beyond its capacity. There was so little space between people, it was hard to estimate how large the crowd actually was, but I came up with a figure well in excess of 500, most of them very young.

A decade ago, physicists fresh out of graduate school, many of them with exceptional credentials and capabilities, viewed Wall Street as an exciting and very lucrative career opportunity. The American Institute of Physics estimates that at least 1,000 of them are still employed in the financial services industry today–although no hard figures are available–and I am sure they are well compensated for their work.

A decade ago, I was far less concerned with America's ability to innovate and compete globally than I am now. I was less concerned with an economy that was becoming increasingly focused on services, especially financial services and health care, and much less on manufacturing. In 2000, the job market was robust, and the federal government was running such large surpluses that Alan Greenspan, then chairman of the Federal Reserve, worried that the elimination of the nation's debt could lead to instabilities in the bond market.

The world is much changed. Today, manufacturing accounts for about 12 percent of U.S. GDP, about half of what it did four decades ago, and its share continues to shrink. And the financial services sector, which today garners an 8 percent slice of GDP, has seen its contribution double over the same period, and its share is still rising. Many economists believe the trends hold warning signs for America's future.

So Wall Street's loss of gloss could be Main Street's gain, if the brightest college graduates begin to pursue high-paying careers that lead to greater prosperity for all Americans rather than simply outsized gains in their own personal wealth.

ANNOUNCEMENTS

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many potatoes as it is supposed to have, then during the sterilization process, it won't heat up enough to properly prepare the soup for safe consumption. The x-ray system furthermore detected if any leakage was present.

Skutlartz initially collaborated with a vendor in Italy that utilized x-ray systems for checking tires used in race cars to design and build the system for Campbell's that would not only be efficient, but would also not take up too much floor space. "It took five years [just] to develop a good system," he says. One of the problems in food manufacture is that plants are very crowded with myriad machinery, he continues, and the x-ray systems that existed a decade ago were very large–they had a 50 to100 square foot footprint, which was difficult to incorporate into a plant where space is at a premium.

In addition to researching and fashioning the technology, Skutlartz was also responsible for coordinating the integration of the technology into the plant's overall operating structure, and writing manufacturing procedures for using the invention. The innovation specs were impressive: It was the first system that simultaneously detected foreign materials and checked weight in metal cans, it had a smaller footprint and was a considerably cheaper device than anything used before, and it could process 1300 containers/minute. Its value was considerably nontrivial: The foreign material detection program resulted in a huge cost avoidance (due to the prevention of product recalls), and the "checkweighing" element resulted in substantial line efficiency increases compared to mechanical checkweighers, he says. On the first day it was installed in a German plant, two dozen bones were found in sealed cans. Needless to say, the plant quality manager was ecstatic, recalls Skutlartz.

Skutlartz went one step further with the x-ray innovation. He launched a research program at the company to make common plastic materials (a portion of foreign material normally not detectable and often resulting in consumer complaints) detectable by x-ray imaging. The program resulted in a first for the food industry: a changeover from common plastic materials to FDA approved x-ray detectable plastics. "The program already resulted in a noticeable reduction of consumer complaints and product-on-hold for plastic contamination," he says.

Because Skutlartz was the go-to guy for all sorts of problem solving, he regularly traveled upwards of 100,000 miles every year to different manufacturing facilities to meet with operators. "One of my jobs in the plants was to look for bottlenecks," he adds. "The operators in the plants would always call me if they had a problem."

His greatest joy at Campbell Soup Company was "getting up every morning and not knowing what new questions would be thrown at me," he jokes. "It was a constant challenge. Some of the challenges I created." After noticing that a need existed to have a precise way to measure liquids in very small amounts while containers moved quickly on a manufacturing line (around 1200 cans/minute), he created and implemented a system to drop precise doses of liquids into moving cans. "The biggest problem was not to hit the cans with the drops, but to design nozzles that prevented the drops from recombining into a stream of liquid, which would have resulted in the loss of dose definition," says Skutlartz. He collaborated with a vendor that worked for a pharmaceutical company to orchestrate a fully automatic digital beverage blending system with up to 130 gallon/min production capability. It resulted in substantial increases in ingredient yield and line efficiency, and rapid (4 to 15 minute) product change-over capability.

During his 18 years with the firm, Skutlartz rose through the ranks and eventually became a Senior Research Manager/Senior Scientist, Global Process Research & Development. He was essentially a technical fellow, and besides his day-to-day responsibilities, he had the freedom to pursue his own research projects. He often partnered with university consortia to develop new technology.

Although he is no longer with Campbell Soup Company, he considers his time there to have been intellectually exciting and he is glad to have had the opportunity to apply his physics skills to the food industry. "No matter what industry one works in," notes Skutlartz, "as physicists we are well trained to be analytical problem solvers. And with the right amount of intellectual curiosity and imagination, it really can become a fun ride to shape the future of something as simple as a bowl of soup."

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and the researchers said that this technique can offer clues to their formation and inner structure.

The effort to build a viable fusion energy source continues as scientists work to improve tokomak reactors. Physicists from General Atomics presented at several sessions different new experimental techniques to prevent rare but potentially dangerous "beams of very energetic 'runaway' electrons" when a major fault happens inside a reactor. Another team, led by Rajesh Maingi of Oak Ridge National Laboratory, found that lining the walls of a fusion reactor increases its efficiency and is more effective at containing hot ionized plasma. Sometimes when the heated plasma inside the reactor interacts with the reactor walls, it knocks off impurities as a kind of "ash" into the plasma stream, reducing its efficiency. Physicists at MIT are using a laser to introduce impurities into one of their reactor's plasma stream so they can chart their effects and model how they behave.

Plasmas also play a role in building cutting-edge microchips. Richard Gottscho from Lam Research described his team's latest work improving methods to fabricate transistors and other micro-electronic devices using plasma etching. For years plasmas have been used to "fill in" imperfections in micro-wires left over from the lithographic fabrication process. Gottscho and his team are working to develop a process to etch off a single layer of atoms from the nanowires to better shape them.

The Back Page

The Economics of Education: Closing Undergraduate Physics Programs

By Theodore Hodapp

The Crisis

- 49% of all public institutions
- 58% of all institutions
- 100% of all public Historically Black Colleges and Universities (HBCUs) (and all but two of the private HBCUs)

These are the percentages[1] of undergraduate physics programs that would be closed if the recently enacted standards in Texas are applied throughout the country. One might write this off as Texas politics, but similar measures are already in progress or being considered in California, Florida, Idaho, Louisiana, Maine, Mississippi, Missouri, and Tennessee–and there are undoubtedly others we have not heard from. Physics programs around the country are under attack.

What was the criterion used? For an undergraduate program to survive, it must graduate 5 majors per year averaged over the past five years. The reality is that universities have been hit hard with budget cuts and state officials are looking for ways to slice off whole programs in a draconian attempt to either save money or at least be seen as saving money.

Why 5? In some cases the number has been even larger, and there is no indication from places like Texas that 5 is the ultimate goal. The real answer is that no one seems to know, but for now 5 is a commonly used number, although 10 or even 15 graduates per year may be where things are heading.

It is also nothing new to consider closing (or opening) smaller programs. The American Institute of Physics (AIP) Statistical Research Center reports that on average three programs close in any given year, and about the same number open. Over the past decade the number of baccalaureate physics programs has been relatively constant at around 760. What is disconcerting in this new calculus of survival is that, according to data from the National Center for Educational Statistics, 58% of all physics programs fail to meet the 5/year mark. At 10/year the number rises to 94% of all programs, eliminating 71% of all physics bachelor's. Astronomy is even worse off, with 70% of the 82 departments in the US educating fewer than 5 majors per year, and only two of the remaining departments educating more than 10 annually.

These recent decisions in a number of states indicate that the era, if it ever existed, of a program existing because it is unthinkable not to offer physics is over. Dominating the current academic landscape are huge numbers of business, psychology, communications, and life-sciences majors. Physics undergraduate degrees accounted for 0.88%[2] of all majors in 1966. Now they account for 0.32%. Figure 1 shows how physics has fared compared to the aggregate STEM (Science, Technology, Engineering and Mathematics) fields. The total number of physics graduates is roughly the same as it was in the late 60's at around 6,000, but as a fraction of the undergraduate degrees it has fallen by almost a factor of three from its former standing. Further, if you normalize the data to the US population, which increases at roughly 1% per year, the data indicate that other majors have successfully lured away students who previously would have majored in physics. As a colleague recently said to me, "Who is better equipped to deal with the challenging problems that currently face our society–physics or psychology majors?" Psychology graduates increased from roughly 17,000 to 100,000 in those same four and half decades.

The problem of low numbers of physics majors is inextricably related to another significant issue–the profound shortage of highly qualified secondary physics teachers. Figure 2 shows that less than half of all high school physics classes are taught by a teacher with a degree in physics. While it is clear that knowing the content does not a great teacher make, it is an essential prerequisite. If we expect students coming into our physics departments to be excited about the opportunity to study physics, it is essential that they have the opportunity to take physics from a highly qualified teacher–something still unavailable to many students in the US.

Nor is this issue confined to the US. Director of Education and Science at the UK's Institute of Physics, Peter Main, reports[3] that the number of institutions that offered physics degrees fell by about 30% in only 10 years from 1994 to 2004. In roughly the same time period the number of students accepted into teacher training programs in physics fell by almost half.

Did you know that only about one in seven of all undergraduate physics majors will go on to receive a PhD in physics? Ask yourself: Is the physics major at my department appropriate for educating future high school physics teachers, or mostly for funneling students into graduate programs? Often the number of students who go on to graduate school is quoted among chairs who are extolling the strength of their department. Do you know how many of your majors go on to teach physics in high school? Shouldn't you be quoting this number too?

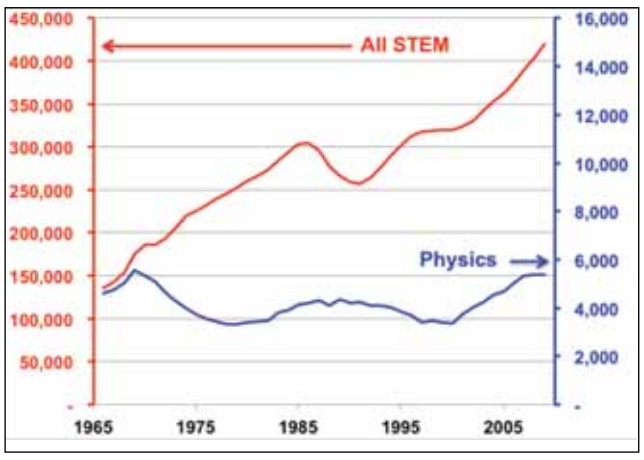

Figure 1. Annual graduates from all STEM fields, and Physics alone from US institutions. Data from the National Center for Education Statistics (NCES)

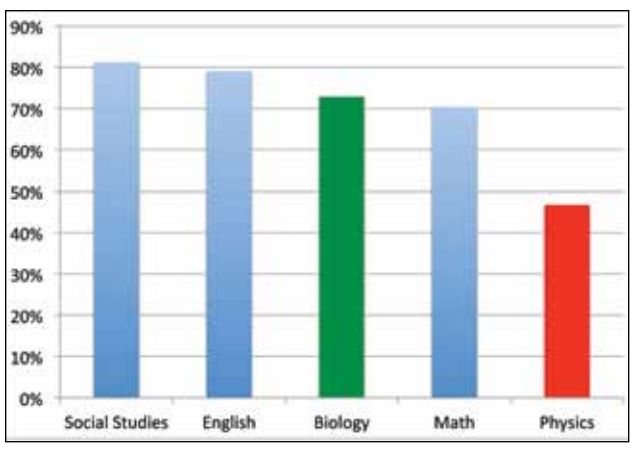

Figure 2. The percentage of high school classes taught by teachers with degrees in the field they teach. The annual demand for physics instructors is roughly three times the supply of teachers with undergraduate majors in physics. Data is from the NCES Schools and Staffing Survey (2007-08).

Ask your undergraduate majors why they decided to study physics in the first place. By far the most common answer I get when asking students in departments across the country is: I had a great high school physics teacher! What do you suppose physics would look like if everyone had that opportunity?

The Response

So what is to be done? One thing is certain: waiting until your dean, provost, or president (or state agency, as in many of the reports we are hearing now) gets involved probably means you are already too late. If your department is known to be addressing the issue, getting results, and being proactive, you have a better chance at convincing the powers-that-be that you are serious about understanding the concerns and taking significant steps to meet the challenge.

Fortunately, there are a number of success stories at a variety of types and sizes of institutions. The most comprehensive study, with recommendations on this issue, is the SPIN-UP report[4] (*Strategic Programs for Innovations in Undergraduate Physics*), the outcome of a multi-year study of physics departments that were increasing their number of graduates at a time when enrollments were declining. The report, a joint effort by APS, AIP, and the American Association of Physics Teachers, is worth reading in its entirety to understand the many details of how programs beat the downward trend. Among the findings, the report characterized common elements found in thriving departments:

- *A supportive, encouraging, and challenging environment for both faculty and students characterized by professional and personal interactions among faculty and students*
- *Energetic and sustained departmental leadership focused on a vision of an excellent undergraduate physics program*
- *A sense of constant experimentation with and evaluation of the undergraduate physics program to improve physics teaching, undergraduate research, student recruitment and advising*

Particular issues identified at thriving institutions included: improving the introductory course sequence; active recruiting, advising, and career mentoring; providing flexible major tracks; mentoring of new faculty, especially in teaching; and an active undergraduate research program. At successful institutions there was a confluence of effort rather than a single program that contributed to a vibrant community of students learning physics. Read this report!

Educating high school physics teachers, mentioned in SPIN-UP, is also a critical element of success for any department that recruits a substantial number of their majors from the surrounding area (this includes most departments). This is a long-term strategy, but, given the inspiration so many students have gotten from great teachers, it is a clear winner for attracting students to physics. The PhysTEC project[5] has more than a decade of experience in helping departments find ways to educate more teachers. Some steps to consider include:

- establish and advertise a separate physics major track in physics secondary education
- make sure all faculty who advise undergraduates are aware of guidelines and recommended courses for future teachers
- contact your education department to find out how to track recent grads who are now teaching, and contact them to hear their experience in becoming a teacher at your institution
- consider establishing a "learning assistants" program[6] to give students a taste of what it is like to teach
- attend the annual PhysTEC conference[7] to meet leaders in the field of high school physics teacher education
- know your local physics high school teachers, and make sure they know you: developing those relationships will pay big dividends

Another strategy that has proven extremely important is improving the introductory course. You can recruit students all you want, but if they get a bad taste in their mouth in your Physics 101 course, you will lose them–and all of your hard work in bringing them in the door. What is more, many students "find" their way to the discipline through this course. Putting your best foot forward is essential.

Consider implementing an active learning curriculum like SCALE-UP[8] or Tutorials in Introductory Physics[9]. These activity-based approaches to physics have demonstrated improved learning gains. SCALE-UP has also demonstrated a decrease in the drop/fail/withdrawal rate at a variety of institutions. An improved curriculum is not the only answer, but having research-tested materials, your best educators, and an opportunity for these instructors to learn how to use the materials effectively, will go a long way toward improving the situation.

Finally, and probably most importantly, undergraduate programs that do well, do so by paying attention to their students. Understanding their goals, and the challenges and context they bring to learning will help you understand how to provide appropriate advice and mentoring. Advising that is limited to "signing off" on their choice of courses will not allow you to intervene when needed, or let them know you care about their progress. That degree of empathy not only helps them, but it builds a stronger program, and more committed students.

The Challenge

Like many, I chose physics because it gave me a perspective that is empowering and powerful. I don't want everyone to become a physicist, but I do want everyone to have the opportunity to study the subject and learn why and how science, and physics in particular, provides that potent perspective.

If we do not take action, many of the programs that offer physics may be closed, and many students who do not choose physics initially, but instead happen upon it will never have the chance to enjoy the subject. Even more important, we will continue to fail to educate an adequate number of high school teachers who provide the first glimpse of the subject and its power to future generations.

The challenge is to be proactive in shaping a continually improving undergraduate program, building a cohesive student/faculty community, and actively recruiting promising students to that program.

If you graduate fewer than 10 majors each year, this means you!

Theodore Hodapp is Director of Education and Diversity for the American Physical Society. Prior to joining the APS, he was professor and chair of physics at Hamline University in St. Paul, MN. For more information, links, resources, and case studies of successful programs, visit www.aps.org/link/recruitingmajors

[1] Based on 2005-2009 graduation rates reported in the NCES Integrated Postsecondary Education Data System (IPEDS); [2] IPEDS data; [3] Personal communication; [4] The report is available at www.aps.org/link/spinup; [5] Physics Teacher Education Coalition (www.phystec.org); [6] laprogram.colorado.edu; [7] www.ptec.org/conferences; [8] www.ncsu.edu/PER/scaleup.html; [9] www.phys.washington.edu/groups/peg/tut.html