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Dresselhaus Wins Kavli Prize
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APS Members Weigh in on Strategic Plan

In early May, APS unveiled its five-year strategic plan in an email to its 50,000 members, inviting them to look at the document and express their views. The membership responded with dozens of emails and comments, highlighting the members' many concerns and suggestions for the Society. Responders held a wide variety of opinions, both positive and negative, ranging from concerns over the details of implementing the plan to the future role of science in the broader society.

The rollout to the membership followed closely on the APS Unit Convocation, held at APS headquarters in late April, when leaders of the APS Divisions, Forums, Topical Groups and Sections had a chance to give detailed consideration to the strategic plan.

"The plan itself has energized a lot of members. I saw this in the discussions with unit leaders and I see that in the comments," said APS Executive Officer Kate Kirby. "A number of people applauded the fact that APS had developed a strategic plan."

The plan highlights four different areas in which APS aims to make progress over the next few years. The goals of the plan are to better serve the members of APS, the physics community, and society at large, and to improve APS's own internal organizational structure. The plan stresses the need to enhance communication and engagement with the membership, to maintain the high quality of its meetings and peer-reviewed journals, and to build better support for physics and science amongst the public. It particularly highlights the goals of increasing diversity in the physics community, better serving industrial physicists and early-career physicists, and encouraging more international collaboration and public outreach, as well as continuing leadership in physics education.

Responses to the plan have been

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Back-to-back Conferences Confront the Health of Physics Education

By Bushraa Khatib

June 8 through 12 were a busy five days at the American Center for Physics as APS and the American Association of Physics Teachers (AAPT) jointly held back-to-back conferences– the Physics Department Chairs Conference and the Building a Thriving Undergraduate Physics Program Workshop–designed to bring physics department chairs and faculty up-to-date on trends in physics research and education, and address building thriving physics programs with sustainable, healthy physics enrollments.

"The biennial Physics Department Chairs Conference, co-sponsored by AAPT and APS, had over 120 people registered, making this one of the largest, if not the largest, Chairs Conference," said Bob Hilborn, AAPT Associate Executive Officer and a key organizer of both conferences.

The Chairs Conference began on June 8 with an optional Congressional Visitors Day, where attendees spent a day on Capitol Hill discussing issues with policy makers, and communicating the importance of science and education funding. Keynote speaker S. James Gates, a professor of physics at the University of Maryland and a member of the President's

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All-electric Cars Need Battery Breakthrough

By Fred Schlachter

Despite their many potential advantages, all-electric vehicles will not replace the standard American family car in the foreseeable future. This was the perhaps reluctant consensus at a recent symposium focused on battery research.

Hosted by Lawrence Berkeley National Lab, the conference, titled "Beyond Lithium Ion V: Symposium on Scalable Energy Storage," took place in Berkeley from June 5 to June 7. An estimated 300 scientists and engineers attended the symposium.

As the talks at the symposium emphasized, powering cars with electricity is a dream whose realization is drawing closer, if not yet close enough. A battery-electric car powered by a green grid would eliminate America's dependence on imported oil and reduce emissions of CO_2 into the atmosphere. However, the driving range of a battery-electric car is too limited for many Americans, and the cost is high, even though electricity is much less expensive than gasoline for a given driving range.

Photo by Roy Kaltschmidt/Berkeley Lab

Participants examine a Nissan Leaf on display at the conference.

Researchers agreed that the lithium-ion chemistry used in today's generation of batteries for electric cars–and laptops and cell phones–is reaching maturity, and

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Radio Telescope Boosts South Africa's Science Credentials

By Michael Lucibella

In the last week of May, the organizing body of the largest, most advanced radio telescope, the Square Kilometer Array (SKA), revealed its decision to divide construction between candidate sites in New Zealand, Australia and South Africa. Observers have called the split decision a political move, but it reflects how strong both proposals were (Australia and New Zealand submitted jointly as one single bid). South Africa, considered an underdog in the early 1990s when the project was first announced, has shown that it has become a scientific powerhouse on the African continent.

The SKA is so named because the total collecting area of all the dishes, antennas and aperture arrays will total about one square kilometer. South Africa will be home to the mid- and high-frequency antennas. The telescope will be spread out over a huge distance, with antennas as far away as 3,000 miles from its core cluster of dishes. Seen from afar, the telescope's layout resembles a spiral galaxy, with a dense five-kilometer diameter core of dishes and antennas at its center and long arms spiraling out across the continent.

Radio telescopes already dot the Northern Cape Province at the site where the heart of South Africa's SKA will be built. On the arid Karoo plains in the western part of the country, seven radio dishes,

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Winning PhysicsQuest Class Helps Outwit Maxwell's Demon

The winners of this year's PhysicsQuest competition for middle school students have been announced by the APS Outreach Department. The grand prize winner is Michelle Harrison's eighth grade class from the Holly Grove Christian School in Westover, Maryland.

"PhysicsQuest is a program where APS creates a kit with everything you need to do four physics experiments. They're themed. This year's theme was heat," said Becky Thompson, APS's Head of Public Outreach. The experiments in the kits are tied together through a comic book based on APS's original laser superhero, the middle-school-aged Spectra.

In her adventure this year Spectra had to save her friends from the clutches of a demon belonging to Tiffany Maxwell, the new mean girl in school. The four physics experiments in the kit included comparing the evaporation rates of water and alcohol using a drinking bird toy, examining the heat conductance of different metals by melting Hershey's Kisses, demonstrating an exothermic reaction by letting steel wool rust, and watching warm air rise and turn a pinwheel.

Harrison's class of 42 students correctly solved the four physics problems in the PhysicsQuest kit. The winners were chosen at random from the hundreds of correct submissions received. Her class received a $500 gift certificate to the teaching supply company Educational Innovations, who produced the APS-designed kits. In addition the students in her class each received an iPod Nano, a complete set of signed comic books, color changing pencils and a toy "drinking bird."

"[The students] were over the moon that they got something that cool," Harrison said. She added that she had been participating in PhysicsQuest for years and was a big fan of the kits. "It has given me easily done experiments, that are written well and that the kids can follow along with, and it gives me the resources to do them."

The second place winners were from Lynne Towers's class at Our Lady of Mount Carmel School in Bristol, Rhode Island. Her class received a $300 gift certificate to Educational Innovations, drinking birds, comics and pencils. Third place went to Kathy Peavey's middle school class at Wilbur Middle School in Wichita, Kansas. The class received a $100 gift certifi-

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Fellows by the Lake

Photo by Sarah Davis

On April 11, APS hosted a reception for Chicago-area Fellows at the Adler Planetarium on the shores of Lake Michigan. Attendees had time to mingle, and heard brief remarks from APS President-elect Michael Turner, who hosted the reception, as well as Executive Officer Kate Kirby, Treasurer/Publisher Joe Serene, and Director of Education and Diversity Ted Hodapp. In the photo, APS Fellows Laurie Brown, Murray Peshkin and Stanley Cohen enjoy the refreshments, the conversation, and the view.

Members in the Media

The point (of subsidies) is not to make energy more expensive… The point is to make renewable energy as inexpensive as possible."

***Steven Chu**, Department of Energy,* USA Today*, May 16, 2012.*

"It's a law that you wear your seatbelt. Now you may choose to break that law, and not wear your seatbelt, but there are laws that you cannot break, and those are the laws of physics. So if you choose to not wear your seatbelt, and you are unfortunate enough to be in an accident, then the laws of physics may break you in return."

***E. Dan Dahlberg**, University of Minnesota,* CBS Minnesota*, May 21, 2012.*

"We predicted and discovered dark energy… We have the biggest dark-energy community and the best ground game; we have been designing a space mission since 1998; and now the Europeans will fly it with our minor participation. Something is wrong with this picture."

***Michael Turner**, University of Chicago, on budget cuts limiting US participation in the Euclid satellite,* The New York Times*, May 21, 2012.*

"The danger, of course, is that we will watch the science (and scientists–and good students) move on to other countries and continents, where projects are being begun and completed."

***Saul Perlmutter**, University of California, Berkeley, on budget cuts limiting US participation in the Euclid satellite,* The New York Times*, May 21, 2012.*

"The NRC's failure to protect the public existed long before Gregory Jaczko became the NRC chairman…Congress should not be sidetracked into thinking he is the source of the problem or that his removal would be the solution."

***Lisbeth Gronlund**, the Union of Concerned Scientists, on the resignation of the chairman of the Nuclear Regulatory Commission,* The Christian Science Monitor*, May 21, 2012.*

"I'm an outlier in the naiveté quotient as well as IQ, I buy that… There were, of course, warning signs that most people would have viewed with great suspicion, and this diagnosis as a defense explains the foolishness…But I certainly had no idea there were illegal drugs and certainly had no idea of smuggling drugs to make money,"

***Paul Frampton**, University of North Carolina at Chapel Hill, on being arrested in Argentina for possessing drugs, which he claims he was tricked into carrying for someone else,* The Charlotte Observer*, June 14, 2012.*

"This story seems rather suspicious… None of the news reports give any details of the calculation. None of the people who hailed Shouryya Ray as a genius are scientists, and none of them give the impression that they have seen the calculation in question. It is impossible to gauge the scientific merit of the calculation until it is made public."

***Richard Fitzpatrick**, University of Texas at Austin, on news reports that a 16-year-old reportedly solved a missing piece of Newtonian mechanics,* MSNBC.com*, May 28, 2012.*

"This year, 2012, is going to be a very significant year because we get to turn the ... detector on and know very soon whether we have actually found dark matter or not."

***Richard Gaitskell**, Brown University, on the Large Underground Xenon Experiment,* The Associated Press*, May 30, 2012.*

"When we're in college, we think about our future as a direct line from now to then, from here to there. You might get an internship at a financial services firm, then become an assistant, and gradually move up until someday you're the boss. That's a fine life's path. But if you look at the careers of many successful people, you'll find that their route is often far more sinuous. And if you look at happy people, you'll find even fewer who traveled a straight line."

***Leonard Mlodinow**, Caltech,* The New York Times*, June 2, 2012.*

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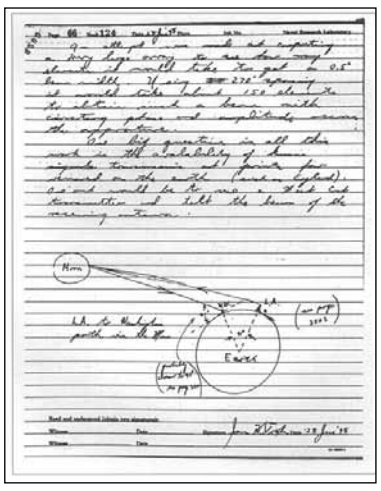
This Month in Physics History

July 24, 1954: Operation Moon Bounce

We think nothing today about the proliferation of artificial telecommunications satellites orbiting Earth. But before that system was in place, there was the U.S. Navy's Communication Moon Relay Project, intended to serve as a secure and reliable means of wireless communication, using the moon as a natural satellite.

Proposals for using the moon as a radio wave reflector date back to 1928, and the U.S. Army's Project Diana successfully detected radar waves bouncing off the moon in 1946. That experiment piqued the interest of Donald Menzel of the Harvard College Observatory, a former Navy Reserve commander. He thought the moon showed promise as a secure communications satellite.

Wireless transmission was commonplace by the post-World War II era, but long-distance high-frequency transmissions relied upon refractions of the radio waves by Earth's ionosphere. Solar flares or geomagnetic storms seriously disrupted those transmissions, and were difficult to predict. The ability to bounce radio waves off a sitting target like the moon–or, later, an artificial satellite–would make it possible to maintain wireless communications even during solar flares or geomagnetic storms. There was also interest in using such a system to track radio signals from the Soviet Union and Eastern Europe, at a time when diplomatic relations with the US were becoming rather frosty. The Navy's powerful radar receivers had already been picking up stray radio signals from Europe and Japan during World War II–a phenomenon referred to as "anomalous propagation."



An entry in James Trexler's notebook regarding moon bounce communications

It was a Naval Research Laboratory engineer named James Trexler who put the two ideas together and suggested using the moon for both communications and radio intercept systems. Trexler studied electrical engineering at Southern Methodist University, where his father was a professor of political science. But he wasn't especially academically inclined, much to his family's disappointment. Still, he had a knack for hands-on experiments and was an accomplished amateur radio technician, skills that enabled him to support himself as an undergraduate, and also to land a job with NRL.

While still at SMU, Trexler had studied the impact of the ionized atmosphere on radio wave propagation, particularly how high-frequency radio waves reflected off the ionization trails left by meteors. Upon joining NRL's new electronic countermeasures unit, he shifted focus to using high-frequency radio waves to probe the upper atmosphere.

According to a 1948 entry in his scientific notebook, Trexler was intrigued by the possibility that the moon had an ionosphere, which would mean certain radio frequencies could reflect off that ionosphere with much greater efficiency than from the actual surface of the moon. He devised a means of testing such a system using "a beamed antenna having a sharp East-West pattern and a broad North-South shape." He added "The intensity of the signal would be noted continuously and an attempt would be made to correlate it with the position of the moon." While such equipment would be expensive to construct, he thought it would be worth the cost.

At its Blue Plains field station in 1948, the NRL set up several German Würzburg antenna arrays salvaged from the war, and began carrying out regular observations of the moon by August 1949 as part of a classified military espionage program called Passive Moon Relay (PAMOR). Code-named "Joe," the system proved sufficiently promising to warrant further funding for development.

A new antenna was constructed in Stump Neck, Maryland, shaped like a parabola with an elliptical opening 220 by 263 feet. The first test run occurred on October 21, 1951, when the 750-watt transmitter sent out a few short 198-megahertz pulses, and received an echo of much higher fidelity than expected. This pushed the program into high gear, since the intelligence potential for the technology was even greater than anticipated.

In fact, the fidelity of the return signal was so high, the NRL commissioned a spinoff project called Communication Moon Relay, a.k.a. "Operation Moon Bounce." By 1954, Trexler was confident that "the fidelity of the moon circuit is much better than predicted, resulting in the possible use of many types of circuits such as high-speed teletype, facsimile, and voice." He proposed using the moon as a passive reflector "to broadcast to half the world at any one time," at very high frequencies. Such a system would also be ideal for two-way communications between ships, submarines or large aircraft.

By then, the original PAMOR project had stalled, since the antenna at Stump Neck proved too small to collect weaker Soviet radar signals. But it was still ideal for Operation Moon Bounce, which required only a simple antenna to receive signals. On July 24, 1954, Trexler spoke into a microphone in the Stump Neck Laboratory, and his words returned to him two and half seconds later, after a 500,000 mile journey. It was first time a human voice had been transmitted beyond the ionosphere and returned to Earth.

The following year, Navy scientists successfully completed the first transcontinental test of

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Washington Dispatch

A bimonthly update from the APS Office of Public Affairs

ISSUE: Budget and Authorization Environment

Fiscal Year 2013 Appropriations

The Fiscal Year 2013 (FY13) appropriations bills are moving through both chambers. But the legislative process is expected to come to a halt once the Senate and House bills are ready for conferences to resolve the differences. The most likely outcome is a continuing resolution that will fund the government until after elections, perhaps into February or March of 2013. The funding debate centers on the House's funding levels that are below the mandates of last year's Budget Control Act (BCA) agreement. The president has pledged to veto any individual appropriations bill until all twelve bills are ready for his signature. The Administration is concerned that the House will hold hostage the Labor-Health & Human Services bill that contains funding for health care reform.

It is highly doubtful that the post-election, 20-day lame duck congressional session will be able to achieve very much, since the fiscal issues requiring resolution are exceedingly large. On the table will be $600 billion associated with BCA "sequestrations," expiration of the Bush era tax cuts, the payroll tax holiday, the Medicare "doc fix" and a host of smaller issues. The 112th Congress will probably opt to let the 113th Congress deal with most of the problems when it convenes next January.

The House and Senate appropriations subcommittees have already completed much of their work, including passage of the Energy & Water and Commerce, Justice & Science funding bills, which also cleared the House floor after extensive debate. All told, the House has passed six of the twelve bills, while the Senate has yet to take up any of them. In floor action, the House adopted a number of amendments related to science funding, including the elimination of NSF's Climate Change Education Program and its political science research programs. The House Defense appropriations markup requests a decrease in funding for Department of Defense applied research and maintains flat funding for basic research. The House also slashed funding for ARPA-E and Energy Efficiency & Renewable Energy in DOE's budget, modestly reduced appropriations for the Office of Science (SC) and reallocated SC's spending by restoring proposed presidential cuts to the domestic fusion program, fully funding ITER, adding a small amount of money for neutrino work at Fermilab, adjusting Nuclear Physics upward from the presidential request and cutting the presidential spending levels for Biological and Environmental Research, Basic Energy Sciences and Advanced Scientific Computing Research. The White House has threatened to veto the House Energy & Water bill.

STEM education has been an important part of appropriations discussions. NSF's Education and Human Resources budget is slated to receive increases from both the House and the Senate. During the Senate Labor-HHS markup funding was restored for Math-Science partnerships, which had originally been slated to be cut by a third. The House Defense appropriations subcommittee tasked the Department of Defense "to support the development of STEM skill sets" with funds appropriated for Operations and Maintenance.

Any good news regarding science related appropriations must still be tempered by the sequestrations mandated in January of 2013 by the Budget Control Act. Taking into account sequestrations, most all science accounts would see a relative decrease in FY13.

Be sure to follow the APS Washington Office's Blog, Physics Frontline (http://physicsfrontline.aps.org/), or Twitter feed (@APSPhysicsDC) for the latest news on the FY13 Budget.

ISSUE: POPA

At its June meeting, POPA approved a proposal for a study of the technical issues that surround the extension of nuclear reactor licenses from 60 to 80 years.

A study for the Department of Homeland Security's Domestic Nuclear Detection Office (DNDO) regarding trends in nuclear and radiological detection, sponsored jointly by APS and the Institute of Electrical and Electronics Engineers (IEEE), is underway and will be completed within the year. The group's first briefings were held in late May; they are due to convene again in late July.

A non-proliferation workshop will be held, in conjunction with the Center for Strategic & International Studies (CSIS), in early 2013.

POPA approved a template for all future study proposals at their February 2012 meeting. The template can be found online, along with a suggestion box for future POPA studies, by visiting:

http://www.aps.org/policy/reports/popa-reports/suggestions/index.cfm.

ISSUE: Media Update

Michael S. Lubell, APS Director of Public Affairs, in his recurring *Roll Call* column, wrote a piece on May 31 titled "Science Funding and the Ideological Divide."

APS Member Carol Hirschmugl, physics professor at the University of Wisconsin-Milwaukee, authored an op-ed in the *Milwaukee Journal-Sentinel* titled "Investing in Science Boosts Economy."

APS vice-President Malcolm Beasley, emeritus professor of Applied Physics at Stanford, wrote an op-ed in the *San Jose Mercury News* titled "Proposal in Congress threatens peer review to validate research."

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

Top High School Students Prepare for International Physics Competition in Estonia

By Brian Jacobsmeyer

Photo by Matthew Payne

Olympiad finalists gather at a well-known Washington landmark on the grounds of the National Academies

The long hallways in the University of Maryland's (UMD) physics department can feel eerily empty during June. Most of the undergraduates have left for the summer, but a new group of twenty promising high school students has filled the building's lecture halls and laboratories. It's time for physics boot camp.

These new recruits are training for the 2012 International Physics Olympiad–a weeklong competition among physics students representing over 85 countries. From July 15 to 24, national teams of five students each will converge on the country of Estonia on the Baltic Sea for the 43rd annual event.

Every year, the American Association of Physics Teachers (AAPT) selects 20 US team members from an initial pool of thousands of students. During the training camp at the University of Maryland, the 20 finalists will be further evaluated, and the traveling team of five students will be chosen from among them. Although only five students will attend the Olympiad, all 20 students are considered finalists.

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INTERNATIONAL News

...from the APS Office of International Affairs

The Bologna Process: a voluntary harmonization of the European higher education system

Luisa Cifarelli and Elena Sassi

In 1998 France, Germany, UK and Italy signed the Sorbonne Declaration, aimed at promoting both mobility of students and teachers, within EHEA (European Higher Education Area, http://www.ehea.info/), and improving their qualifications. In 1999 the Bologna Process (BP) was signed by 29 countries. It is a crucial voluntary harmonization process, not a binding contract. Initially, BP aimed at strengthening competitiveness/attractiveness of higher education, creating connecting tools, improving transparency amongst higher education systems, facilitating recognition of degrees/qualifications, fostering student and teacher mobility and employability, and improving quality assurance, while acknowledging the richness of the diverse national educational systems. A comparable 3-cycle degree system: Bachelor, Master and PhD, has been agreed upon, including qualification frameworks and emphasis on learning outcomes.

In 2011 EHEA had 47 member nations (see http://www.ehea.info/members.aspx). Consultative members are: Council of Europe, European Commission, Representatives of European universities (EUA), professional higher education institutions (EURASHE), students (ESU), quality assurance agencies (ENQA), the UN Educational, Scientific and Cultural Organisation-European Centre for Higher Education (UNESCO-CEPES), Education International (EI), and Business Europe. Biannual Ministerial Conferences check on progress and plan the future. BP and EHEA are now being consolidated despite diverse reactions to the implementation process.

An important instrument to describe an educational program is ECTS (European Credit Transfer and Accumulation System) or colloquially "credits" system, introduced in 1989: a student-centred system based on the student workload (lectures, lab-work, dissertation, etc.) needed to achieve the program objectives defined as competences and learning outcomes. Sixty credits measure the workload of a full-time student during one academic year (on the average 36/40 weeks/year, one credit standing for 25-30 working hours). A first cycle degree lasting officially 3-4 years is expressed as 180-240 credits.

EPS, the European Physical Society (http://www.eps.org/), a not-for-profit representative organization created in 1968 to promote physics and physicists in Europe, now has 41 national member societies. It supports the Bologna Process and also has provided European Specifications for University Level Physics Programs, for Bachelor, Master and Doctorate (www.eps.org/?page=studies_reports). For instance, Bachelor graduates should know how to: formulate/solve problems; plan/perform experiments; analyze/evaluate data and uncertainties; relate results. The types of general competences should be: problem-solving (also non-standard problems), analytical (also handling of intricate ideas/reasoning), personal (individual and teamwork), communication (clear, concise, in different registers), ICT (to exploit information and communication technologies methods and instruments), language (multilingualism also to contribute to personal development, social cohesion and economic growth). EPS has also proposed a European Benchmark for a Physics Bachelor Degree with at least 140 out of 180 ECTS credits in Physics and Mathematics.

Begun in 2007, a 3-year EPS project, funded by the European Commission, studied the implementation of Bachelor/Master degrees in Physics in Europe (https://eps.site-ym.com/?page=bologna_process). The International Centre for Higher Education Research at Kassel University, Germany, has analyzed the curricula and administered the survey. Data have been collected from 27 countries, 382 Universities (about 40% of the total number), with 154 curricula submitted. The conclusions can be summarised as follows:

• The implementation of Bachelor programs in some countries (e.g., Belgium, Switzerland, Netherlands) is completed, in others it goes on (e.g., Spain), in others it lags behind (e.g., Ukraine, Belarus, Greece). UK has basically kept its Bachelor degree (three years in England/Wales, four years in Scotland) and a Master degree after an additional year (3 + 1 structure). European Credit Transfer and Accumulation System or a compatible national system of credits are used across Europe, even if the ideas about modularization of studies, student workload and assessment are heterogeneously interpreted and applied. It takes time to endorse new approaches.

• Most of the Bachelor programs in physics tend to have some international and interdisciplinary dimensions. Studies

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Letters

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

More Planning Needed to Prepare for Underground Physics Program

In the Letters section of the April, 2011 issue of *APS News*, I wrote in an open letter to then APS President Barry Barish expressing my contention that excellence of ideas was a more important factor than research funding levels in addressing the most pressing problems facing the physics community at this time.

In his response to my letter, Barish implied that the examples that I had cited as supporting my point of view were chosen in hindsight. He further stated that the lack of US research funding was resulting in American scientists becoming dependent on conducting their research at premier facilities located abroad.

The November, 2011 issue of *APS News* and the December, 2011 issue of *Physics Today* contained a number of articles related to these issues, including the redirection of the Fermilab research program from one that was Tevatron based to one based upon a study of neutrino properties utilizing accelerator facilities. In other related articles, the outlook and prospects for future US federal support for basic research in the related fields of astrophysics and elementary particle physics were discussed.

The proposed US programs are based upon the studies of neutrinos produced at accelerator facilities such as Fermilab. The history of US efforts in this area during the past 25 years has been disappointing. They have yielded inconclusive or negative results and have done essentially little in advancing scientific understanding. Those programs have been costly and entailed the primary efforts of hundreds of physicists from dozens of institutions.

In assessing the future prospects for the proposed underground laboratory program, it is my opinion that serious problems and limitations for the Soudan and proposed Homestake laboratories remain. Despite the fact that major expenditures will be required to overcome these problems, the experiments will still retain only a limited scientific capability. I do not feel that I am alone in this assessment and that these factors have been the basis for a decision by the National Science Board to withdraw a commitment for financial support for the DUSEL project. That decision has now been followed by an action by the DOE to reduce its commitment to that project and to ask for a reconsideration of the scope of the program. A two-day scientific review at Fermilab in late April of this year recommended substituting a plan that would rely upon surface-based detectors instead. It was widely recognized that this new plan would require a seriously reduced scientific capability.

There are alternative possibilities that retain scientific potential at lower costs, but they have not been addressed by the scientific community. I have sent a letter to William Brinkman, the DOE's Director of the Office of Science, in which I criticize the decision reached at the Fermilab workshop to abandon research at underground laboratories. I further point out that there are underground facilities which already exist and which could be optimally modified at low cost. This was something that the workshop attendees were advised not to consider in deciding upon a new course of action.

I call for a change in direction and focus. It is time to return to extended studies such as those conducted at Woods Hole in the 1970s and the month-long Snowmass workshops of the 1970's and 1980's. Hopefully, these studies will act to stimulate thinking and to provide new ideas and insights into a broad range of subjects including accelerator design, detector design, laboratory design, and speculative physics and astrophysics ideas which together can culminate in a long range program lasting many years. In the long run, such an approach will be the most productive and least costly to carry out. Scientists in these areas need now to exhibit the imagination and ingenuity that at one time had been theirs and now has been lost, and to begin to exhibit the attributes of the internet community where a few people with outstanding ideas initiate revolutions which transform the society.

Alexander Abashian
Ruckersville, VA

Ed. Note: *The APS Division of Particles and Fields has initiated a long-term planning assessment of High Energy Physics, which will include a Community Summer Study taking place in Snowmass, June 2-22, 2013.*

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each 12 meters across, started listening to the skies in 2009. The array, known as KAT-7, is the precursor to another, even bigger array known as MeerKAT. Already under construction, the telescope will ultimately be made up of 64 dishes total, each 13.5 meters across. Ultimately MeerKAT will become part of the larger SKA as construction on the international project goes forward. As it stands, the South African government is planning to have MeerKAT ready to start collecting data by 2016.

"MeerKAT is a done deal. The South African government has committed two billion rands [about $240 million] to build it," said Nithaya Chetty, a professor at the University of Pretoria and former president of the South African Institute of Physics.

KAT-7 is not the first radio telescope in the country. In 1961 the United States built a 26 meter radio dish outside Johannesburg as part of NASA's Deep Space Network used to track its space missions. In 1974, after the end of the manned lunar program, NASA relinquished control of the dish to South Africa and it became the Hartebeesthoek Radio Astronomy Observatory. A test dish for MeerKAT was built at the site.

As part of its bid for the Square Kilometer Array, South Africa has partnered with several other countries across the continent, including Ghana, Kenya, Namibia, Botswana, Mozambique, Mauritius and Madagascar. As part of the collaboration, South Africa has been helping either to build new radio telescopes in these countries, or to convert existing radio dishes into stellar observatories.

With its unique position in the Southern Hemisphere, South Africa has had a long history of stargazing, one of the reasons it has been selected for the Square Kilometer Array.

"Astronomy is very big in South Africa, we have an almost 200 year history of astronomy," Chetty said. In 1820 the first observatory was built in Cape Town. Over the next hundred years, European colonists continued to build observatories across South Africa to take advantage of the dry air and dark skies.

Today the South African Astronomical Observatory is the overarching organization that operates seven optical and infrared telescopes across the country, under the management of the National Research Foundation.

"The real jewel is, of course, the Southern African Large Telescope," Chetty said. The SALT, as it is more popularly known, is a 9.2 meter diameter reflecting telescope on the Karoo plains, the largest optical telescope in the Southern Hemisphere. It opened its bay doors to the heavens in 2005, and since then has become one of the premier telescopes south of the equator.

Also in 2005, the South African Institute of Physics released the report "Shaping the Future of Physics in South Africa." The study provided an assessment of the current state of physics in the country, and a roadmap of where to go and the big issues that needed to be addressed.

"What the nation has to do is to invest in the human capital," said S. James Gates of the University of Maryland, one of the authors of the report. The lingering effects of apartheid are still being felt, and there is still a huge disparity in education between black and white citizens. "The system had to find a way to involve the majority of South Africans."

The study offered a number of suggestions on ways to increase the profile of physics in the country, and encourage more students to pursue physics and science degrees. These included better elementary and secondary school education, a concerted effort to integrate historically white universities and historically black universities, a national campaign showing that physics degrees are sought after by employers, and an improved broadband internet infrastructure.

"We also suggested that there were some flagship initiatives that would be useful to providing overarching paradigms for the community," Gates said.

The SKA is one such initiative, as is the African Laser Center. Between the 1960s and 1980s, the apartheid government developed a small nuclear arsenal before dismantling their stockpile and discontinuing the program in 1989. The equipment used to manufacture and design the nuclear weapons was then repurposed for other scientific research. At the time, the South African government was at the forefront of experimenting with lasers to enrich uranium. Much of the advanced laser equipment was used to develop the National Laser Center in Johannesburg in 2000. The center expanded its mission in 2003, and helped to found the African Laser Center, an international collaboration of laser labs across Africa.

"Now laser scientists all over the continent are working together, they know what they're doing," said Sekazi Mtingwa, a professor at MIT who helped found the African Laser Center. "We were able to make the connection and transform the entire culture of laser science in South Africa."

Another initiative is a proposed South African synchrotron light source. Although this is still in the preliminary design phase, the scientific community has been working to build up its expertise. There already exist a number of smaller accelerators throughout the country organized through the nations iThemba LABS; Mtingwa and his colleagues, however, have been calling for a larger, third-generation synchrotron light source.

Students have been traveling to light sources around the world to ready a future generation of researchers and technicians. In addition, the Department of Science and Technology has been working to make South Africa an associate scientific member of the European Synchrotron Radiation Facility located in Grenoble, France. The plan is next to build a beamline at the ESRF owned entirely by South Africa, before construction of a full facility in the country.

"I think one of the biggest benefits of a synchrotron light source is that graduate students can do frontier work there without traveling abroad," said Herman Winick, a research professor at SLAC who has been a vocal international advocate for a South African synchrotron.

In December, the country hosted a conference on synchrotron science to help promote the construction of such a light source. The proposal is just starting to gain traction. The South African government recently asked for a white paper describing the necessary steps to build a light source in the country. The biggest potential obstacle is likely to be the cost of such a facility, as much as $1 billion by some estimates. The construction and operation of the Square Kilometer Array will be a big part of South Africa's science budget in the coming years, and promoters of a synchrotron worry that the government won't opt to pay for the two.

"I can imagine it would be difficult. It would be wonderful if they did both," said Mtingwa, who has also been a strong advocate for bringing a synchrotron to South Africa. "I would have to be optimistic regardless of what happens with the SKA… In ten to twenty years I think they will get one."

Despite an uncertain future, scientists from the country have continued to prepare for the day the light source is ready.

"Where we are at currently, I think we're still in the process of building up our capacity," Chetty said. He added that the plan for a synchrotron has been slowly building momentum for a decade, but the cost of the SKA would likely postpone its construction. "Not likely in the near future, but that's not to mean it's off the agenda… When the time is more opportune I think it will be built up."

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"The story captured the public imagination, and has given people the opportunity to see the scientific method in action–an unexpected result was put up for scrutiny, thoroughly investigated and resolved in part thanks to collaboration between normally competing experiments… That's how science moves forward."

Sergio Bertolucci*, CERN, announcing that neutrinos do not in fact travel faster than the speed of light,* MSNBC.com*, June 6, 2012.*

"Just as a violin or guitar string will emit harmonics of its fundamental sound tone when plucked strongly, an atom can also emit harmonics of light when plucked violently by a laser pulse… The laser pulse first plucks electrons from the atoms, before driving them back again where they can collide with atoms from which they came. Any excess energy is emitted as high-energy ultraviolet photons."

Margaret Murnane*, University of Colorado-Boulder, on the world's first table-top X-ray laser,* The Los Angeles Times*, June 7, 2012.*

"I did get a sweatshirt from Marvel and a bottle of wine from Ridley Scott."

Sean Carroll*, Caltech, on compensation he's gotten from movie studios for being a science consultant on motion picture,* The Washington Post*, June 8, 2012.*

"It's a very exciting mission… It opens up a new window on the universe."

Roger Blandford*, Stanford University, about the launch of the satellite NuSTAR which will hunt for black holes,* The Los Angeles Times*, June 13, 2012.*

Dresselhaus Wins Kavli Nanoscience Prize

The Kavli Foundation named Mildred Dresselhaus, professor emeritus at MIT, as this year's winner of the Kavli Prize in Nanoscience. The award cited her "for her pioneering contributions to the study of phonons, electron-phonon interactions, and thermal transport in nanostructures."

The Kavli prize in Nanoscience is awarded to researchers who have made significant contributions to the science and application of the atomic, molecular, chemical and biological properties of structures at the nanometer scale. Over her fifty-year career, Dresselhaus has studied how and why nanoscale materials often display different properties than they do at macro scales. Her pioneering work on carbon fibers and the properties of layers of graphite laid the groundwork for later Nobel-Prize-winning research into buckyballs, carbon nanotubes and graphene.

Dresselhaus has been an active member of APS for many years. In 1984 she was elected APS President, and after the end of her term served as Chair of the APS Committee on the Status of Women in Physics. In 1999 she was awarded APS's Dwight Nicholson Medal for Human Outreach for her mentorship of young scientists and promotion of international ties in science. In 2008 she received the APS's Oliver Buckley Prize, one of the most prestigious awards in condensed matter physics.

Mildred Dresselhaus

Dresselhaus was a 1990 recipient of the National Medal of Science, and she was a co-recipient of the 2012 Enrico Fermi Award with Burton Richter. In 2000-2001, she served as Director of the DOE's Office of Science.

The Kavli awards are presented every other year, in the fields of nanoscience, astrophysics and neuroscience. The Kavli Foundation was founded in 2000 by Norwegian-born physicist and philanthropist Fred Kavli to support scientific research. The Kavli prize is offered in conjunction with the Norwegian Academy of Science and Letters and the Norwegian Ministry of Education and Research. Recipients receive $1 million, a gold medal and a scroll recognizing their work. This year's astrophysics prize was awarded to David Jewitt of UCLA, Jane Luu of MIT, and Michael Brown of Caltech for their work studying the solar system's Kuiper Belt. The neuroscience prize was presented to Cornelia Isabella Bargmann of Rockefeller University, Winfried Denk of the Max Planck Institute for Medical Research, and Ann Graybiel of MIT for work on understanding how the brain processes perception and decision.

zero gravity

By Michael Lucibella

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the system, bouncing a signal off the surface of the moon that was detected by a receiving station at the U.S. Navy Electronics Laboratory in San Diego. On November 29th, at 11:51 p.m. Pacific Standard Time, NRL's associate director of research, Robert Morris Page, sent a teletype message to Frank Kurie, the technical director of the Navy Electronics Laboratory. It urged him to "lift up your eyes and behold a new horizon."

Ultimately, the transmissions were extended to Wahiawa, Hawaii, after tweaking the system to reduce signal loss. In 1956, the National Academy of Science's Advisory Committee on Undersea Warfare recommended using moon-reflection path signaling for submarine ship-to-shore communications. And the system also proved useful to astronomers, since they could use it to study the moon when the body was in the wrong position for effective radio transmission.

The completed Communication Moon Relay System was inaugurated publicly in January 1960, and was used to beam images of the USS Hancock aircraft carrier from Honolulu to Washington, DC. Despite its success, the moon relay system was soon eclipsed by the Navy's artificial satellite communication system, although the knowledge gleaned from the former made the new system possible.

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shared with the Executive Board and Presidential Line, and will be available to relevant taskforces as they form.

"It's important for people to know that these comments are really being read and considered," Kirby said.

One recurring issue was the lack of an explicit implementation strategy for the strategic plan. Several members commented that they approved of the plan's goals, but worried little might come of it without clear steps for implementation or metrics to measure its progress.

"There may not have been the full recognition that the plan lays out a set of goals and objectives, with implementation to take place over the next five years," Kirby said. She added that specific implementation plans would be developed by task forces of APS members in specific areas.

A task force for examining the relationship between APS and the American Institute of Physics (AIP) has been working since December of last year, and a taskforce devoted to development issues is being formed, led by APS vice-President Malcolm Beasley. Another focusing on serving the needs of early-career physicists is slated to start this summer. Others that should begin within the next year or two will deal with international engagement, meetings, and communications.

The unit leaders provided written reports with many suggestions for implementation of the strategic plan. These included fostering closer ties between APS Sections and industrial physicists, collecting better data on the achievements and APS service of women and under-represented minorities, and establishing a best-practices wiki to help improve unit organization and activities. Another idea was to strongly encourage units to have elected student representatives on their Executive Committees.

One area of comment by the membership had to do with APS meetings. Responders approved of APS's recent experiment of posting PowerPoint presentations free online from sessions at the April 2011 meeting, and pointed out that this was a huge benefit for those for whom travel costs as well as time away from job responsibilities prohibited their participation in APS meetings .

Respondents were also divided over the issue of advocacy, and the Society's role in influencing public policy. Some supported the current APS role in Washington, advocating for science funding and issuing reports on physics-related policy matters, and called for an increased role for APS in the policy arena. Others said the Society ought only to advocate for science funding, while still others said to stick strictly to disseminating scientific knowledge and let individual scientists promote their own policy positions.

"There are some people who don't think we should have any advocacy role. I think that this is very much a minority view," Kirby said. "In general our advocacy is highly valued by the different physics communities within APS, and we are constantly looking for ways to be more effective."

Kirby added that there was a careful balance for the Society to maintain when advocating for science. "It's very important for the Society to try to keep science as a bipartisan issue," she said.

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that only incremental improvements can be expected in energy density, which needs to be higher, and cost, which needs to be lower, for widespread use in battery-electric vehicles (BEV)–cars which are powered only by electricity from the electric grid and stored onboard. Lithium-ion batteries are adequate for hybrid electric vehicles (HEV) like the Prius, and marginally adequate for plug-in-hybrid vehicles (PHEV) like the Chevy Volt. However, the range of a fully electric vehicle such as the Nissan LEAF–powered only by electricity stored on board and without a gasoline "range extender"–is too low for many drivers, who may use a BEV as a second car for urban trips while maintaining a gasoline-powered or hybrid car for trips exceeding the electric range of a BEV.

The issue of range limitation and range anxiety–fear of running out of charge far from a charging station–is related to the almost complete absence of infrastructure for charging electric cars. Eventually such infrastructure will likely be built, but perhaps not soon enough to recharge the present generation of electric cars.

The need for research on a new chemistry to develop high-density batteries was a theme of the symposium. Paul Alivisatos, Director of LBNL, and a Fellow of APS, summarized research needs: "It remains true today, as in the past, that we need a fundamental understanding of the physics of how energy-conversion processes take place, at a much deeper level, in order to achieve a truly sustainable energy future."

Research is presently focused on two different chemistries: lithium/oxygen (lithium/air) and lithium/sulfur. Both theoretically offer much higher energy density than is possible even at the limit of lithium-ion-battery development. However, the technical difficulties in making a practical battery with good recharging capability, using either of these chemistries are enormous. There are major research issues concerning the cathode, the anode, and the electrolyte. Many approaches are being followed, including studies using nanotubes, nanowires, nanospheres, and many other nanomaterials. There were reports on large-scale computation modeling projects, and essentially every talk was accompanied by high-quality scanning-electron-microscope images, including in-situ movies. However, none of the researchers reported on progress to the point where a practical battery using one of these chemistries could be envisioned.

Texas Physics Consortium Moves Ahead Slowly

Last December, *APS News* reported that, in an effort to save physics programs at several universities in Texas, schools were banding together to participate in an electronic consortium of physics classes. Since then, the consortium has been beset by delays, but is still on track to reach its goal of preventing the termination of physics degree programs across the Lone Star State.

The Texas Higher Education Coordinating Board (THECB) last year did an assessment of the state's 24 public universities and started to eliminate programs that graduated fewer than an average of five students per year. Six schools lost their physics programs, but three of them moved to join the Texas Electronic Coalition for Physics, a consortium with the capability of teaching physics classes remotely. The organizers hoped that by pooling several schools into a single degree program they could surpass the five graduates a year minimum. That way, students could continue to attend physics classes at their local universities, even if individually the school fails to meet minimum graduating requirements. How the institution or institutions will be listed on the diploma awarded is currently being worked out.

The program is still moving forward, but has hit several bumps in the road. Such a program has never been tried before in Texas, so confusion over paperwork has slowed the process. Because Tarleton State University, the school hosting the program, was one of the schools that lost its physics degree, the consortium had to start the application process from scratch, as if they were applying for a completely new degree program. Physics professors seeking to join the coalition, now dubbed the Texas Physics Consortium, say they are continuing to move forward with the applications, but the lengthy paperwork application had to be restarted, and the Board of Regents at each of the three schools has to approve it before it can go to the THECB for final approval, now expected sometime in the fall.

Dan Marble, a professor at Tarleton State who has been working to set up the consortium, said that they've been "mired in bureaucratic paperwork," but added "I think we're almost through all of that."

The delays shouldn't affect students currently enrolled in classes at any of the schools in the coalition.

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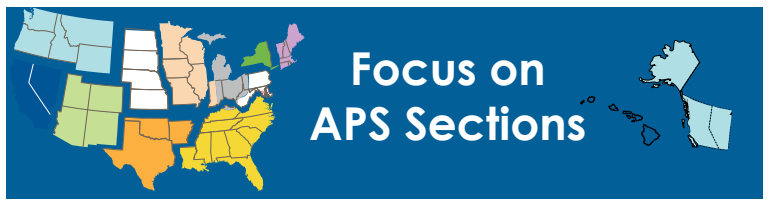
cate, as well as the drinking birds, comics and pencils.

APS sends 13,000 kits out to more than 3,500 teachers. This year kits were sent to every state in the United States. The kits are open to any group who signs up for them, which included neighborhood science clubs, Boy Scout and Girl Scout troops and church youth groups.

The Physics Quest kits were first introduced in 2005 to coincide with the World Year of Physics, celebrating the 100th anniversary of Albert Einstein's "miracle year." The 2009 kit was the first to feature a comic, which told the story of Nicola Tesla and the electrification of the 1893 Chicago World's Fair. Spectra made her debut in the 2010 kits about lasers and optics, to correspond with LaserFest, the 50th anniversary of the invention of the laser.

"Next year's kit will focus on fluid dynamics. It will look at non-Newtonian fluids, turbulent flow and granular materials," Thompson said. She added that the villain will be a nefarious swim coach named Henri Toueaux (pronounced "two-oh").

Michelle Harrison surrounded by students from the winning PhysicsQuest class at Holly Grove Christian School



Prairie Section Primed for Expansion

By Brian Jacobsmeyer

Editor's Note: *This is the fifth in an occasional series of columns highlighting the history and achievement of APS Sections. The first column appeared in October 2010. There are currently nine geographical sections, covering most of the United States and parts of Canada, with a tenth, in the mid-Atlantic region, in formation.*

Formed only four years ago, the Prairie Section remains the smallest–albeit fastest growing–APS section. Despite the section's short existence, its geographical area has long been a hotbed for physics research and education, encompassing Fermilab, Argonne National Laboratory, and numerous universities ranging from top research schools to teaching-focused liberal arts colleges.

Between 2009 and 2011, section membership rose over 50 percent, and student membership more than doubled, rising from 133 to 315 members over the two year period. But the section's leaders still see room for improvement.

Five full states formally belong to the section, namely Illinois, Wisconsin, Minnesota, Iowa and Missouri. They are joined by parts of Indiana. Four neighboring states–North and South Dakota, Kansas, and Nebraska–don't belong to any APS section, however, and Prairie Section leaders will submit a proposal soon to add these states, said Cheng Chin, the Prairie Section Chair from the University of Chicago. If all goes according to plan, the section will nearly double its geographic reach after including these new member states.

APS members from these neighboring states have already played an active role in the blossoming Prairie Section. In fact, the section meeting this year will be held at the University of Kansas, home to the section's Vice Chair, Stephen Sanders.

In addition to increasing membership and engagement, Chin and other leaders also plan to extend the section's community impact. They hope to collaborate with science institutions throughout the area to increase public outreach efforts and educational opportunities, such as public tours of national labs.

"There's a sense we should be doing more," said Russell Betts, former section chair and current dean of the College of Science and Letters at Illinois Institute of Technology. "One of the things we have been looking at is what defines the Prairie Section."

Part of what defines any APS section are the regular meetings, which give researchers and students a chance to showcase their science among local peers. When the University of Northern Iowa (UNI) hosted the annual section meeting last year amidst talks of shutting down the physics department, Department Head Cliff Chancy saw it as an opportunity to highlight the program's strengths.

Although there's a strong research community at UNI, the physics department prides itself on its dedication to undergraduate education. Consequently, Chancy made sure to emphasize UNI's undergraduate mentoring while simplifying the meeting registration process for younger students.

"It's about showing local variety and local strengths, and that's what we did," said Chancy.

Simple actions like waiving the pre-registration fee for undergraduates helped stimulate undergraduate participation at the meeting. In the future, section leaders want to distribute more travel fellowships for students and postdoctoral researchers and foster an environment that rewards outstanding student achievement. As membership increases, there will be even more opportunities to award prizes for student research at the annual meeting, said Chin.

Joint meetings with members of the American Association of Physics Teachers (AAPT) over the past few years have further reflected the section's dedication to physics education. During the section's first meetings, attendance was a concern, so teaming with AAPT helped popularize the annual meeting.

But meeting attendance has grown rapidly over just a few years. While the first meetings had between 30 and 40 attendees, last year's meeting tripled these numbers to exceed 100 participants, said Chin.

At this early stage in the section's history, increasing membership and engagement begets much more participation, and Chin remains optimistic about the section's future.

"We're growing, and we have a pretty ambitious plan to improve membership," he said.

This year's section meeting has been tentatively slated for early November.

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abroad (mainly as ERASMUS courses) are possible in most of the programs but are rarely compulsory.

• The emphasis on the final examination is reduced, in favor of a more continuous assessment. In more than half of the Bachelor programs, the written thesis plus defense is the typical final examination.

• To facilitate the students' employability after a Bachelor degree and a smooth transition into the labor-market some key skills are required, as foreign language, communication, project management and work.

• Access into Master and Doctorate programs is more regulated/selective. Some countries require longer preparatory courses, mostly mathematics (e.g., some universities in Croatia, Switzerland, Germany, and Italy).

• Most students continue to study at the Master's level (exceptions are British, Irish and French universities).

• New quality assurance procedures have been established, also by (more or less) independent accreditation. Globally the general structures of European Bachelor physics programs will converge more and more, with an increased level of diversity.

The progress so far in the Bologna Process and the key political future objectives have been presented and discussed at the 2012 EHEA Ministerial Conference and Policy Forum, April 26-27, Bucharest, Romania (http://www.ehea.info/news-details.aspx?ArticleId=266). The main priorities have been set for actions by 2015:

1) At the national level: widen overall access to higher education; increase completion rates and participation of underrepresented groups; foster student-centered learning, innovative teaching methods and supportive/inspiring working/learning environment; ensure qualifications frameworks and ECTS implementation-based on learning outcomes; implement the "Mobility for better learning" initiative and full portability of national grants/loans across the EHEA.

2) At the European level: promote quality, transparency, employability and mobility in the third cycle; examine national legislation/practices relating to joint programs and degrees as a way to dismantle obstacles to cooperation and mobility embedded in national contexts; evaluate the implementation of the "EHEA in a global setting" strategy.

The next EHEA Ministerial Conference will take place in Yerevan, Armenia in 2015, where the progress on the priorities set above will be reviewed.

The diversity in national academic cultures and teaching/learning styles remains, being viewed, however, as an expression of European richness and an added value. The Bologna Process has been evolving through the years all over Europe, with variable degrees of success as far as its actual implementation is concerned, and it has still a long way to go. But it has been fostering mobility, links and exchanges among students of distant and different countries. Its continued progress represents a social and cultural challenge for the next generations.

Luisa Cifarelli, a professor of physics at the University of Bologna, is EPS President. Elena Sassi is a professor at the Napoli Physics Education Research Group, and a Board Member of the EPS Physics Education Division.

Acknowledgement: The authors are specially indebted to Hendrik Ferdinande, Member of EPS Executive Committee and Board Member of EPS Physics Education Division, for useful discussion and information.

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Council of Advisors On Science and Technology led off the conference with a presentation on the *Engage to Excel Report: Producing One Million Additional College Graduates with Degrees in STEM*. The conference was built around four major topics including: physics curriculum in the 21st century, preparing students for careers in an increasingly global R&D environment, connecting with local and regional industry, and meeting the "die or thrive" challenge.

Stefan Zollner of New Mexico State University gave a plenary talk on preparing students for careers in an increasingly global R&D environment. He urged chairs to keep in touch with alumni, encourage students to attend APS March and April meetings, and inform students about industrial and government careers. Zollner also said that students should be encouraged to engage in more outreach and internship activities instead of taking additional courses in other fields. "The skills that make you successful as a department chair or as a researcher in business and industry were not taught in courses," he said.

The conference also featured parallel small group sessions on topics such as undergraduate recruitment and retention, research funding, guidelines for undergraduate programs, and business/industry connections. In the session on undergraduate recruitment and retention, participants shared recent efforts that have improved recruitment, such as study abroad programs at CERN, "Freshman Experience" courses with alumni panels for first-year students possibly interested in physics, and encouraging freshman to retake calculus even if they come in with AP credit in order to improve math skills, a top reason for poor retention rates. The small group sessions presented participants with a casual atmosphere to share ideas and methods that work well or not at all at different universities.

Photo by Peter Muhoro

Attendees at the Workshop on Building a Thriving Undergraduate Physics Program pay close attention.

As the Chairs Conference wound down to a close on Sunday, the workshop on Building a Thriving Undergraduate Physics Program, which focused entirely on the "die or thrive" challenge, was just beginning. Representatives from fifty-five institutions attended the sold-out workshop, which was sponsored by APS, AAPT, the Physics Teachers Education Coalition (PhysTEC), and the National Science Foundation (NSF). Thirty-one of the 106 workshop participants were department chairs who stayed on from the previous conference. Participants came from a good mix of Bachelor's-, Master's-, and PhD-granting institutions.

"We were very impressed by the participation rate and the high level of interest we had in the workshop," said Peter Muhoro, APS Bridge Program Manager and one of the conference organizers. "Many physics departments are threatened with extinction and we are glad to have APS and AAPT facilitate discussions on building thriving physics programs."

Physics Nobel Prize Winner Carl Wieman gave a "big picture" plenary talk on the National Perspective on education research applied to improving physics learning.

A series of inspiring case studies illustrated how physics departments were able to turn their programs into thriving ones. The physics department at University of Wisconsin–La Crosse was on the brink of extinction until sweeping curricular reforms, aggressive recruitment, new academic programs, and flexible advising, among other efforts, turned it into a nationally recognized program. James Madison University and Florida International University offered similar success stories that were useful to many departments hoping to do the same.

David Garrison, Associate Professor and Chair of Physics at the University of Houston-Clear Lake attended both conferences. "I found this a very valuable experience which occurred at just the right time for our program. We recently started an undergraduate physics program and are in the process of adding lower level courses to our university so the advice gained on how to better design introductory courses was very useful," he said.

Key parts of the workshop were four planning sessions in which small teams of institutions met with consultants who offered their expertise and advice as institutions developed action plans to strengthen their own physics programs.

Naresh Sen of the University of Toledo cited these small group work sessions as the best part of the workshop. "The planning sessions were very valuable, since they sharply focused ideas with guidance from consultants and other people in the sessions," he said. "Progressively focusing in on what to do to implement changes in our department–this is something concrete we can take home with us."

The workshop had a notable turnout of minority serving institutions (MSIs). A total of twenty MSIs including Historically Black Colleges and Universities, Hispanic-Serving Institutions, and Predominantly Black Institutions attended. "The issues that most physics departments are facing are usually magnified at minority serving institutions," said Theodore Hodapp, APS Director of Education and Diversity, and a conference co-organizer "We're happy to see the high level of interest by physics departments, and hope faculty members will see APS and AAPT as significant resources as they work toward further improving their programs."

ANNOUNCEMENTS

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"It's a group of twenty incredibly unique individuals with widely varying backgrounds and an insatiable love of doing problems," said Paul Stanley, the team's head coach who teaches physics at Beloit College in Wisconsin. Stanley added that this year's group was among the best he's seen in his ten years of coaching the Olympiad.

On their first day of camp, the students were already tackling complex topics like special relativity and Lorentz transformations. After only one lecture, Stanley's charisma and enthusiasm for physics had already rubbed off on some of the students.

"His lecture was really memorable," said Vicki Ye, a finalist from Beckman High School in Irvine, California.

In addition to attending lectures by the team's coaches, the students will take exams and perform laboratory experiments during their time at UMD. This thorough training will prepare the students for the rigorous theoretical and laboratory tests they'll face in Estonia.

During the days of testing in Estonia, the students will have little contact with their coaches. In fact, the students and coaches will be in two different cities for this core part of the competition. The five traveling members will have to exhibit not only a strong understanding of physics but also the necessary composure to perform under pressure.

After Estonian judges and team coaches tabulate the scores, they'll award gold, silver and bronze medals to all of the individuals who perform above certain percentiles. Although the Chinese contingent has consistently outperformed other teams at the Olympiad, Stanley thinks this year's US team will be tough to beat.

But physics training camp is about much more than preparing for a single competition. Many of the students have never been around so many other high-achieving physics students, and team members tend to forge lasting bonds.

"It gave me a connection with a lot of really talented and special peers," said Jason LaRue, an assistant coach and alumnus of the 2007 Olympiad team.

In the past, students have also formed friendships with their international peers at the Olympiad. Although there are some friendly rivalries between countries, the Olympiad atmosphere is usually collaborative and harmonious rather than adversarial.

LaRue vividly remembers connecting with students from other countries during his participation in the 2007 Olympiad in Iran. Despite the ongoing tension between the US and Iran, the students representing the two countries overcame language and cultural differences while finding common ground through the universal language of mathematics.

During their downtime, some of the teams would inscribe clay tiles with their team names to commemorate their time in Iran. When LaRue asked an Iranian student about a specific Farsi character for his tile, the Iranian student quickly knew how to explain it: the character looked just like a ket, a symbol familiar from quantum mechanics' bracket notation.

Stanley has consistently seen such examples in the past ten years as his students begin to appreciate the true value of the trip.

"They realize 'I am with an international group of 400 people my age who think like I do, who have aspirations like I do, and we can get along, so let's do so,'" he said.

The route to the Olympiad involves a thorough and lengthy application and evaluation process. In January of this year, thousands of students from across the country took the "F=ma" multiple choice exam. After grading this exam, AAPT invited between 400 and 600 students to take a more difficult free response test to determine the 20 finalists.

The final leg of the selection process–physics boot camp– came to an end on June 13 when the five traveling team members were announced. The following five students will depart for Estonia in mid-July: Jeffrey Cai from Ridge High School in Basking Ridge, NJ; Allan Sadun from Liberal Arts & Science Academy High School in Austin, TX; Eric Schneider from High Technology High School in Lincroft, NJ; Jeffrey Yan from Palo Alto High School in Palo Alto, CA; and Kevin Zhou from High Technology High School in Lincroft, NJ.

These students hope to continue the team's tradition of excellence that began when AAPT formed the first US team in 1986. Since then, AAPT, the University of Maryland, and member societies of the American Institute of Physics, including APS, have supported the program.

As the traveling team prepared for their departure to Europe, Stanley gave them some words of encouragement.

"I have faith in their ability to represent all twenty, I have faith in their ability to do the best that they can to represent the United States," Stanley said.

And the coach's final allusion to the team's friendly rivalry was met with room-filling laughter: "And hopefully beat the Chinese team as best we can."

The Back Page

A Cold-War Folly?

By Nina Byers

Nina Byers

I have been teaching an undergraduate seminar at UCLA called NUCLEAR POWER: Power Plants and Weapons of War. The students are not physics majors but come from other departments including social science and engineering. It is a stimulating and rewarding experience–very different from teaching a physics class. In an undergraduate physics class generally the subject matter taught allows no time for critical discussion. The time for useful critical discussion of such subjects was in the nineteenth century and before. In my class the first few weeks I spend on teaching physics–some basic physics that the students need to know to learn to be able to speak quantitatively about energy and power and how they differ, and about power production from uranium and plutonium fission as well as other more conventional fuels. For nuclear fission as power source, the basic physics of that is the same for power plants and nuclear bombs. Of course the engineering of generating useful power is worlds apart for slow controlled releases and explosive releases. In the class we do not discuss how these are engineered other than in very primitive outline. Instead the class is challenged to engage in thoughtful discussion of controversial topics that may be of current interest to the students, such as the current status of nuclear weapons stockpiles globally, arms control, and lessons learned from the Fukushima-Dai-ichi, Chernobyl, and Three Mile Island disasters.

Students choose from a small list of topics for class discussion and then individual students pick a subtopic for a five minute report to deliver to the class that each will prepare with my guidance. The reports are required to consist of factual data with references and conclude with an expression of his/her opinion based on those data. I feel this experiment in education has worked out very well. What makes this format possible is that the enrollment is limited to twenty students.

As I am an emeritus professor teaching only this course, I have spent quite a bit of time preparing background material for the students. I teach them elementary atomic and nuclear physics leading up to and including properties of the isotopes of uranium and plutonium and the fission of ^{235}U and ^{239}Pu. I summarize briefly the history of the making of the atomic bomb, recommend they read more in Richard Rhodes' book, *The Making of the Atomic Bomb*, and show some of the classic photos of Hiroshima and Nagasaki days after the bombing.[1] The only one of these the students had seen were those of the mushroom cloud. When students with family connections to survivors of the bombings were in the class, only they knew some details about their effects. To the others they were ancient history.

Recently Norris and Kristensen[2] published estimates of global nuclear weapons inventories at the end of each year from 1945 to 2010. For presentation to my class I graphed these data.

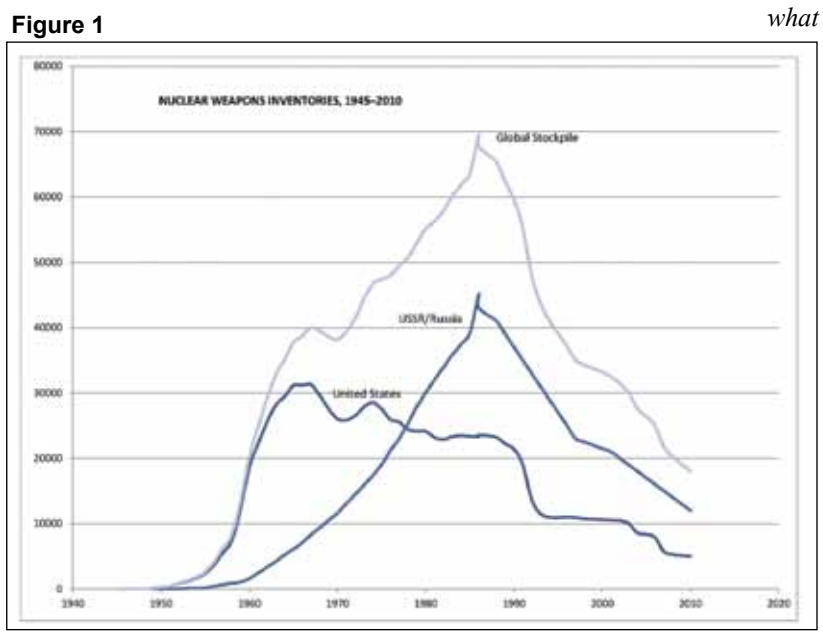
Seeing the curves astounded the students and me. Three of them are shown in Figure 1. The sizes of the 2010 inventories range in order of magnitude from ten thousand to 10. The inventories of Russia and the United States together make up 95% of the total. A table of Norris and Kristensen data is shown also.

Many of my students did not know much if anything about the cold war between the US and the USSR. As can be seen in Figure 1, it began to close down around 1991. This was before many of our college students were born.

The downward trend of the curves in the early 1960's followed the atmospheric test ban treaty, officially known as the Partial Nuclear Test Ban Treaty ratified in 1963. The ratification followed upon considerable public pressure from the scientific community and others, particularly following the 1961 publication of Louise Reiss's study[3] of baby teeth. She led a study which tested thousands of baby teeth of boys born in St. Louis around 1960. The study measured concentration of ^{90}Sr, an isotope of strontium with a half life of 28.79 years generally made in nuclear explosions. Its chemistry is similar to calcium. When ingested by living things it is deposited in bones and teeth. Her study found the children in St. Louis had 50 times as much ^{90}Sr in their teeth as children born in 1950 before most of the atmospheric nuclear bomb tests.

Reacting to the sense that many young people have that somehow physicists are synonymous with bomb builders, I felt obliged to tell them that there were many physicists, among them Niels Bohr, Leo Szilard, and Albert Einstein who endeavored to prevent our use of atomic bombs as weapons in World War II once the defeat of Germany was in sight. In 1944 it was clear that neither Germany nor Japan could or would manufacture such weapons.

Figure 1



Niels Bohr came to the U.S. in 1944 and traveled to Los Alamos to express his concern that when the feasibility of nuclear weapons became known, it would initiate a nuclear arms race. He said this was why he had come to Los Alamos. He didn't think his physics knowledge was needed there because he knew there were enough good physicists there already.[4]

In his effort to try to head off a postwar nuclear arms race, Bohr spoke with President Roosevelt and suggested that the international community in due course be informed of the technological achievements at Los Alamos. FDR was sympathetic but asked him to "see what Winston had to say about this." Bohr traveled to London and had an unsuccessful meeting with Churchill. Subsequently, in September 1944 at Hyde Park, Roosevelt and Churchill signed their official Aide-Memoire[5] saying in part, "the suggestion that the world be informed regarding Tube Alloys [The Manhattan Project], with a view towards international agreement regarding its control and use, is not accepted."

In December 1944 Einstein wrote to Bohr[6],

When the war is over, then there will be in all countries a pursuit of secret war preparations with technological means which will lead inevitably to preventive wars and to destruction even more terrible than the present destruction of life. The politicians do not appreciate the possibilities and consequently do not know the extent of the menace. I share your view of the situation…

It seemed to us that there is one possibility, however slight it may be. There are principal countries scientists who are really influential and who know how to get a hearing with political leaders. There is you yourself with your international connection, Compton in the USA, Lindeman in England, Kapitza and Joffe in Russia, etc. The idea is that these men should bring combined pressure on the political leaders in their countries in order to bring about internationalization of military power–a method that has been rejected for too long as being too adventurous. But this radical step with all its far-reaching political assumptions regarding extra-national government seems the only alternative to a secret technical arms race.

Bohr deeply believed, along with Einstein, in internationalism; i.e., that international agreements foregoing some aspects of nationalism among the nations of the world were essential to the peace.

Nielson recalls Bohr saying,[3]

We must be internationalists, and in science we succeed fairly well. All peoples and races are essentially alike; the differences are in their traditions and backgrounds… Every valuable human being must be a radical and a rebel, for what he must aim at is to make things better than they are…

In the war and post-War II period other prominent and distinguished physicists disagreed with this idea. One was Nobel Laureate Arthur H. Compton who in 1941 was Chairman of the National Academy of Sciences Committee to Evaluate Use of Atomic Energy in War. His investigations, carried out in cooperation with Enrico Fermi, Leo Szilard, Eugene P. Wigner and others had led to the establishment of the first controlled uranium fission reactors, and ultimately, to the large plutonium-producing reactors which produced the plutonium for the Nagasaki bomb. Arthur Compton's political philosophy was very different from Bohr and Einstein. In 1946 he suggested how to keep the peace in an essay entitled, "The Moral Meaning of the Atomic Bomb," published in the collection, *Christianity Takes a Stand*. He wrote,

It is now possible to equip a world police with weapons by which war can be prevented and peace assured. An adequate air force equipped with atomic bombs, well dispersed over the earth, should suffice… we must work quickly. Our monopoly of atomic bombs and control of the world's peace is short-lived. It is our duty to do our utmost to effect the establishment of an adequate world police… This is the obligation that goes with the power God has seen fit to give us.

Despite the arguments against wartime use of the atomic bomb put forward by Leo Szilard, James Franck and other Chicago scientists reported in the June 1945 Franck Committee Report[7], President Truman's Scientific Panel composed of Robert Oppenheimer, Enrico Fermi, Arthur H. Compton, and Ernest O. Lawrence found on June 16, 1945 "no acceptable alternative to direct military use."[5]

Commenting on his collaborations with Enrico Fermi on neutron induced fission of uranium, Szilard recollected,

Fermi is a scientist pure and simple. This position is unassailable because it is all of one piece. I doubt he understood some people live in two worlds like I do. A world, and science is a part of this one, in which we have to predict what is going to happen, and another world in which we try to forget these predictions in order to be able to fight for what we would want to happen.

In the seminar I've been teaching it has been important to me to acquaint the students with the variously different positions physicists in America took from 1944 onward both rejecting and supporting an ideological framework of governments in which national interests prevail.

Furthermore I believe it important to recognize the folly that was the nuclear arms race of the cold war, particularly now as we are seeing nuclear arms races emerging among various nations of the world.

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Status of World Nuclear Forces 2011*

Country	Operational Strategic	Operational Nonstrategic	Reserve	Military Stockpile	Total Inventory
Russia	2,430[a]	0[b]	5,500[c]	8,000	11,000[d]
United States	1,950[e]	200[f]	2,850[g]	5,000	8,500[h]
France	290	n.a.	?[i]	~300	~300
China	0[j]	?[i]	~180	240	240[j]
United Kingdom	160[k]	n.a.	65	225	225[k]
Israel	0	n.a.	80	80	80[l]
Pakistan	0	n.a.	90-110	90-110	90-110[m]
India	0	n.a.	80-100	80-100	80-100[n]
North Korea	0	n.a.	<10	<10	<10[o]
Total:[p]	**~4,830**	**~200**	**~8,650**	**~14,000**	**~20,500**

* All numbers are estimates and further described in the Nuclear Notebook in the *Bulletin of the Atomic Scientists*, and the nuclear appendix in the SIPRI Yearbook. Additional reports are published on the FAS Strategic Security Blog. Unlike those publications, this table is updated continuously as new information becomes available. Current update: **June 7, 2011**.

1. http://www.gensuikin.org/english/photo.html
2. Norris and Kristensen, *Bull At Sci* {see reference in previous manuscript}
3. L.Z. Reiss, *Science*, 134, 1669, Nov. 24, 1961; see also her obituary in *New York Times* / January 15, 2011.
4. J. Rud Nielson, "Memories of Niels Bohr," *Physics Today*, October 1963.
5. *The Manhattan Project: A Documentary Introduction to the Atomic Age*, Michael B. Stoff, Jonathan F. Fatnon, Hal Williams, McGraw-Hill Inc., 1991.
6. Einstein Archives 8-095
7. http://www.dannen.com/szilard.html

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