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Conference Tackles Energy, Climate Change

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Sub-Atomic Physics Marks 100th Birthday at April Meeting

Located in Anaheim, California from April 30 through May 3, this year's APS April Meeting will bring together over 1,000 physicists to share the latest research in particle physics, nuclear physics, astrophysics and plasma physics research, featuring 170 sessions, 225 invited speakers and three poster sessions.

Commemorating the discovery of the atomic nucleus, the theme of the meeting is "100 years of Sub-Atomic Physics". As the official kickoff to the meeting, the Kavli Foundation is sponsoring a keynote session starting with a retrospective look at the last century of work probing the fundamental particles of the universe. During session A1 on Saturday morning, Steven Weinberg from the University of Texas at Austin, will highlight the history of particle physics from Rutherford's gold foil experiment to the startup of the LHC. Picking up from there, Maria Spiropulu of CERN will discuss the latest results from the LHC, while Dan Hooper of Fermilab will bring an update on the hunt for the theorized WIMPS that make up dark matter.

Plenary Sessions: Two other plenary sessions promise to enlighten audiences on a range of topics. The Monday morning plenary ses-

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Trial Program Puts Selected Meeting Presentations on the Web

APS is launching a trial program at its April Meeting to allow researchers, especially those based outside the United States, access to some of the meeting's presentations. Using INDICO, a scientific collaboration service developed by CERN, select speakers will upload their presentation materials directly to the web, before, during or after the meeting. This trial will provide access to presentations from eleven of the regular invited sessions, as well as the three plenary sessions.

"Our aim is to facilitate the dissemination of fresh new scientific results," said Karsten Heeger, chair of APS's Committee on International Scientific Affairs (CISA). "From our experience people are always eager to share their talks and share their results."

Though the use of INDICO is a one-time trial, organizers hope to garner information about who is interested in remote access to the presentations, and how best to market it. Responses from the membership, speakers and meeting attendees will be useful to the APS Headquarters IT (HQIT) staff as they enhance the APS Online Bulletin system to include the ability for speakers to upload their presentation materials. This feature is currently under development.

"The trial should help us learn how the speakers and membership may use online access to slide presentations," said Amy Flatten, APS Director of International Affairs. "It's part of a larger effort to make our meetings more accessible to our members outside the United States."

About 25 percent of APS's non-student membership resides outside of the United States. For the test program, both members and non-members will be able to access the presentations.

"What we want to do is provide a level of service to our international members that doesn't currently exist and a level of access to our meetings that doesn't currently exist," Flatten said.

"We would like to showcase the

TRIAL continued on page 6

Local Congressman Decries Brookhaven Cuts

By Michael Lucibella

Speaking at a press conference on February 28 at the APS editorial offices in Ridge, NY, Congressman Tim Bishop (D–NY) condemned possible funding cuts to Brookhaven National Laboratory for the rest of the fiscal year. Bishop said that the proposed cuts were "destructive" and would have long-lasting effects on the lab and local community.

As of February 28, no federal budget had been passed for fiscal year 2011, and the government had been running at fiscal year 2010 funding levels. On February 19, the House of Representatives passed a bill, H.R.1, that would fund the government, but cut the budget for the rest of the fiscal year by $61 billion. The Department of Energy's Office of Science, which runs the national laboratories, would lose $1.1 billion of its $5.1 billion budget in the remaining seven months of the fiscal year. The effects of this 22 percent cut would be especially acute because the entirety of it would be enacted only on the second half of the fiscal year, meaning that the labs would be facing nearly a 40 percent cut during that time.

Photo by Michael Lucibella

No, APS Director of Public Affairs Michael Lubell is not interrupting the press conference to take a phone call. He is pointing out to the audience the many ways in which fundamental physics research contributed to the smart phone, and how damaging cutting back on physics research could be to the economy. Congressman Tim Bishop, the main speaker at the press conference, looks on at left. In the background, museum-quality bound volumes of the *Physical Review* grace the shelves at the APS editorial offices in Ridge, NY.

As *APS News* goes to press, the budget has not yet been finalized. The Republican-controlled House passed its version, but the Democratic-controlled Senate has so far rejected many of the proposed cuts. The House version does not specify how much each individual lab would stand to lose, but estimates by Brookhaven look at the impact of the cuts were they spread out evenly among all the national labs.

"I think all of us should hope that this budget does not get passed. But if it does, I think it sends a terribly, terribly, depressing message about the commitment that this nation has to remaining on the cutting edge in terms of scientific research," Bishop said. "Scientists

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Workshop to Help Scientists Engage in Public Service

The third in a series of campaign education workshops will take place in Washington at the headquarters of the American Association for the Advancement of Science. As *APS News* goes to press, the workshop is scheduled for Saturday, May 7, but the date may be subject to change. Like its predecessors, the workshop is designed for scientists and engineers who recognize the importance of public service and who are contemplating either running for public office, helping in a campaign, or serving in government in an administrative capacity. The one-day workshop will cover all levels of government, from local school boards and town councils to the US Congress. Experienced campaign professionals will be on hand to give participants an overview of what's involved in a political campaign, and how to mount a successful one.

APS is one of the sponsors of the workshop, and a limited number of registration fee rebates will be available to APS members who attend. These will be allocated on a first-come first-served basis, so it's important for those interested to register early. The workshop is being held under the auspices of Scientists and Engineers for America (SEA), and more information, including how to register, is available at www.seaworkshop.com. The first twelve APS members who register will be eligible to have half their registration refunded. Those applying for the rebate should send an email confirming their registration to sea@aps.org.

APS President Sends Condolences to Japan

In the wake of the combined disasters of the Japanese earthquake and tsunami on March 11, followed by the crisis at the Fukushima Daiichi nuclear complex, APS President Barry Barish sent letters to representatives of the Japanese Society of Applied Physics and the Physical Society of Japan. The letter to the Japanese Society of Applied Physics, dated March 14, follows:

"On behalf of the American Physical Society (APS), I would like to convey our deepest care and sympathy to the citizens of Japan and the Japan Society of Applied Physics for the tragedy that your country has suffered as a result of the earthquake and tsunami last week. We are saddened by the loss of lives and the extent of the devastation. Our thoughts are with everyone who has been affected by this tragic event.

Along with our condolences for the loss of life and property, we share your concerns over the impact on your scientific community and facilities. We hope that our fellow scientists and their families are safe.

We join our colleagues worldwide in extending our sympathies to the Japanese people and the Japanese scientific community. Please know that the members of the American Physical Society are with you during this difficult time.

Sincerely,
Barry Barish"

Kudos for APS Blog

The APS outreach blog, Physics Buzz, has been receiving lots of attention on the Internet recently. In October, it was named among the five best physics blogs by the Institute of Physics website physics.org. In March, Physics Buzz was at the top of LaboratoryTechnician.org's list of the 50 best physics blogs. Physics Buzz was launched four and a half years ago to get physics news out into the blogosphere and to excite the general public about the science. It has since become an integral part of Physics Central, APS' outreach website, and published its 1,000th post. It is prominently displayed at www.physicscentral.com. *-Mary Catherine Adams*

Members in the Media

Ed. Note: *We begin the "Members in the Media" column with several quotes from members about the nuclear disaster in Japan, as of March 15.*

"The administration believes we must rely on a diverse set of energy sources, including renewables like wind and solar, natural gas, clean coal and nuclear power…The administration is committed to learning from Japan's experience as we work to continue to strengthen America's nuclear industry."

Steven Chu*, U.S. Department of Energy,* The Los Angeles Times*, March 15, 2011.*

"They imply some kind of core problem."

Thomas B. Cochran*, the Natural Resources Defense Council, on the possible release of radioactive iodine and cesium from the Fukushima plant,* The New York Times*, March 12, 2011.*

"The thyroid is more sensitive to damage when the cells are dividing and the gland is growing."

Frank von Hippel*, Princeton, on the dangers of radiation to children,* The New York Times, *March 12, 2011.*

"As long as there's no meltdown of the fuel rods, you're in good shape."

Kirby Kemper*, Florida State University, on the crisis at Japan's Fukushima Daiichi nuclear power station,* The Wall Street Journal*, March 13, 2011.*

"Let's say we have an 8.0 earthquake–smaller than the one that hit Japan–right on the San Andreas Fault… According to the U.S. Geological Survey, the devastation would be catastrophic. Downtown L.A. flattened. Forty percent could withstand an 8.0 earthquake, but 15 percent of the tall buildings are at risk and could, in fact, collapse."

Michio Kaku*, City College of New York,* ABCNews.com*, March 14, 2011.*

"I was thinking, 'What's the scariest thing that I could make with nanotechnology?'"

Paul McEuen*, Cornell, on the inspiration for his sci-fi novel "Spiral,"* The Wall Street Journal*, March 18, 2011.*

"We are now working to accumulate trillions of positrons or more in a novel 'multicell' trap–an array of magnetic bottles akin to a hotel with many rooms, with each room containing tens of billions of antiparticles."

Clifford Surko*, University of California, San Diego, describing his work to build the world's largest antimatter trap,* MSNBC.com*, February 18, 2011.*

"The magnitude of the whole thing was overwhelming as it detonated, sitting there in the desert in the early morning."

Robert Carter*, describing witnessing his work come to fruition while at the Manhattan Project,* FoxNews.com*, February 19, 2011.*

"You put energy into it, and some of that energy gets converted into that beautiful coherent light beam."

Doug Stone*, Yale, on developing an "anti-laser,"* The New York Times*, February 21, 2011.*

"I am saying that all predictions concerning climate [change] are highly uncertain. On the other hand, the remedies proposed by the experts are enormously costly and damaging."

Freeman Dyson*, Institute for Advanced Study,* The Independent*, February 25, 2011.*

"I wonder if Watson wasn't having a low-voltage night, because I certainly didn't expect to score higher than the computer."

Rush Holt *(D-N.J.) U.S. House of Representatives, after learning he beat the computer Watson in an online Jeopardy game,* The Associated Press*, March 2, 2011.*

"I am pretty sure that once you admit exotic matter of some suitable kind, you can mathematically construct a star with a wormhole inside."

Dieter Brill*, University of Maryland, on a hypothesized "phantom matter" that could prop open a wormhole,* United Press International*, March 4, 2011.*

"To me the problem of a notion

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This Month in Physics History

April 16, 1901: Death of Henry Rowland

Isaac Newton's experiments with splitting light using a prism in the 17th century inspired a scientist named James Gregory to look more closely at bird feathers, and outline some basic principles for what would become the modern diffraction grating. By 1785, Philadelphia inventor David Rittenhouse had figured out how to build the first diffraction grating by stringing hairs between two threaded screws. In 1821, a German physicist named Joseph von Fraunhofer built a very similar device.

However, these early attempts at building diffraction gratings were rough, and the patterns of parallel lines too imprecise, which limited their usefulness in spectroscopy–an important tool in physics, chemistry, and astronomy. The smaller the distance between those parallel lines, the higher the resolution of the gratings. The man who did the most to improve the precision of diffraction gratings, thereby revolutionizing the field of spectroscopy, was the 19th century American physicist Henry Rowland.

Born in Honesdale, Pennsylvania in 1848, Rowland came from a long line of Protestant theologians, and his family expected him to become a minister. But young Henry rejected the classics and had a passion from the start for science, particularly electrical and chemical experiments that he devised himself. When he was 17, his family relented and sent him to Rensselaer Technological Institute, where he earned a degree in civil engineering in 1870. He briefly worked for the Western New York railway after graduation, and then taught science at the University of Wooster in Ohio. By 1876, he had returned to RPI as an instructor in natural philosophy.

Alas, the professional respect of his peers was not immediately forthcoming. Rowland struggled to have his early scientific papers published in US journals. Frustrated, he sent a paper on his work in magnetic permeability to the eminent British physicist James Clerk Maxwell, who published it in London's *Philosophical Magazine*. His US colleagues did not seem to notice.

Rowland was first and foremost a researcher. Years later, at a AAAS meeting in 1883, Rowland declared, "I here assert that all can find time for scientific research if they desire it. But here, again, that curse of our country, mediocrity, is upon us. Our colleges and universities seldom call for first-class men of reputation, and I have even heard the trustee of a well-known college assert that no professor should engage in research because of the time wasted."

In 1875, Rowland's luck turned. A man named Daniel Colt Gilman began asking for recommendations for faculty members to join the newly established Johns Hopkins University in Baltimore, Maryland, the first true research institution in the US. One name kept popping up among European scientists: Henry Rowland. Gilman offered Rowland a position at the fledgling university as a physics professor, which Rowland was happy to accept.

Once on board, Rowland embarked upon a tour of European laboratories to glean ideas and purchase any necessary equipment to reproduce similar world-class laboratories back in Baltimore. Among the labs he visited was that of Hermann von Helmholtz in Berlin, where he had a chance to work with the great physicist firsthand and conduct an experiment on the magnetic effect of a charged rotating disc–something he'd never had the means to attempt before. The experiment was a smashing success: Rowland demonstrated unequivocally that a charged body in motion produces a magnetic field.

After getting settled in at Hopkins, Rowland attacked his scientific pursuits with renewed vigor. He avoided teaching and administrative duties as much as possible, in favor of research, and when he did teach, his students were often devastated by his forbidding presence and withering critiques.

For example, he undertook a series of experiments to re-calibrate the value for the ohm, coming up with a much smaller number than the original. (Rowland's conclusion was accepted as correct.) He also supervised several experiments that led one of his graduate students, Edwin Hall, to discover the eponymous Hall effect.

In other work, he set about re-creating James Joule's seminal paddlewheel experiment for measuring the mechanical equivalent of heat. Rowland greatly improved upon the original apparatus: his version was larger, and his experiments were conducted over a wider temperature range, resulting in a much higher number than that obtained by Joule. He also noted that the specific heat of water varied as a function of temperature; Joule had assumed the specific heat would be constant.

Then Rowland became intrigued by diffraction gratings, and decided to try to improve their precision. He invented a "ruling engine": a machine that employed one main screw to shift the diamond tip used to etch the grating a very small distance between each line during the etching process, done on a concave surface. He went on to use his diffraction gratings in spectrometers to study the solar spectrum, producing an impressive photographic map of that spectrum in 1888. His gratings were orders of magnitude better than others available at the time, and much in demand. He sold hundreds to scientists all over the world. Ultimately, Rowland's name became so strongly associated with diffraction gratings that one is featured in his official 1897 portrait by artist Thomas Eakins.

There is an apocryphal story that Rowland–while under oath in court as part of a lawsuit he was involved with–once declared himself to be the world's greatest physicist. In reality, he said he was "the highest known authority in this country upon the subject of the laws and principles of electricity."

The man who struggled for recognition from his peers ended up being awarded the Henry Draper Medal in 1890 by the National Academy of Sciences, for his contributions to astrophysics. When the American Physical Society was founded in 1899, Rowland became its very first president. Alas, Rowland's health failed at a relatively young age: he was diagnosed with diabetes shortly after marrying in 1890, and thereafter focused on inventing and patenting various improvements in telegraphy so that he would not leave his family destitute. He died in 1901 of complications from the disease.

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Washington Dispatch

A bimonthly update from the APS Office of Public Affairs

ISSUE: Budget and Authorization Environment

Fiscal Year 2011 Update

In the last edition of the Dispatch, we reported that Congress had passed a Continuing Resolution (CR) for Fiscal Year (FY) 2011 spending, which extended funding for federal programs through March 4th 2011 at FY 2010 levels with virtually no waivers. On February 11th, the House Republicans released their proposed FY11 funding bill (H.R. 1), which included a total of $61 billion worth of cuts to the Federal budget and significant cuts to DOE Office of Science, NIST, and NSF. The cuts would have to be absorbed in the seven months that remain in FY11. The effective reductions, from FY10 levels, would be 9.9% for NSF; 32.7% for DOE Office of Science; and 36% for NIST Core Programs.

The House-passed bill was a non-starter for the Democrat-controlled Senate chamber. With a government shutdown looming, the House and Senate agreed on March 1st to a two week extension of the FY11 CR, accompanied by $4 billion in reductions that mirrored cuts the White House had requested in FY12. On March 9th, the Senate rejected two bills that would have extended the CR for the balance of the fiscal year: a Republican proposal to cut an additional $57 billion in accordance with H.R. 1 and a Democratic proposal that would have cut $4.7 billion.

As of the deadline for the Dispatch, House GOP leaders have begun behind-the-scenes negotiations on another short-term stopgap spending measure to keep the government operating beyond March 18th. A Senate aide close to the House GOP leadership said the measure would likely keep the government running for another 3 weeks, with accompanying reductions of $2 billion per week ($6 billion total).

Senate Democrats appear willing to agree to the plan but worry that by accepting a series of short-term government funding measures they will eventually provide the House Republicans with the $61 billion in cuts the GOP is seeking. “I don’t like this death by a thousand cuts but I also don’t want a government shutdown,” Senator Mikulski (D-MD) said last week. The White House has also sent signals that it is ready to accept many, if not most, of the Republican reductions if that will keep the government open.

Fiscal Year 2012 Budget Request

On February 14th, President Obama released his annual Budget Request for Fiscal Year 2012 (FY12). In light of fiscal and political realities, the request is fairly good for science.

The following summarizes the presidential request for the key science agencies:

National Science Foundation (NSF): Up 13% from FY10 enacted levels to $8.9 billion in FY12. The request keeps the Foundation on its ten-year doubling, as authorized by the America COMPETES Act (Public Law 110-69).

National Institute of Standards and Technology (NIST) Core: Up 15% from FY10 enacted levels to $763.5 million in FY12. The NIST Core budget comprises the Scientific & Technical Research and Services (STRS) and Construction of Research Facilities (CRF). The STRS request is $678.9 million, an increase of 32% from 2010; the CRF request is $84.6 million, a decrease of 42% from 2010.

Department of Energy Office of Science (DOE SC): Up 9.2% from FY10 enacted levels to $5.4 billion in FY12.

The proposed FY2012 budget does eliminate funding for the TEVATRON at Fermi as well as the Holifield Radioactive Ion Beam Facility. The DOE Office of Science budget proposal explains that continued upgrades to the Continuous Electron Beam Accelerator Facility (CEBAF) and construction of the Facility for Rare Isotope Beams (FRIB) necessitated these cuts. However, while the closure of the TEVATRON was expected, the Holifield closure was not. Hearings on the proposed FY2012 budget are underway, but it is unclear when voting will take place.

Department of Energy Advanced Research Projects Agency-Energy (ARPA-E): $550 million; ARPA-E did not receive appropriations in the FY10 budget because it received funding through the Stimulus bill.

Be sure to check the APS Washington Office’s Blog, Physics Frontline (http://physicsfrontline.aps.org/), for the latest news on the FY11 and FY12 Budgets.

ISSUE: POPA Reports

The Energy Critical Elements (ECEs) Study Group publicly released its report, which examines the scarcity of critical elements for new energy technologies, on February 18th at a press conference held at the AAAS Annual Meeting in Washington, DC. The report has received extensive coverage in the media, and is the subject of the Back Page in this issue of *APS News*. The report includes policy recommendations on: the coordination of departmental efforts where ECEs are concerned; the gathering and analysis of information on ECEs; research, development, and workforce issues; efficiency and recycling efforts; and possible market interventions. On February 17th, Senator Udall (D-CO) introduced a bill that implements nearly all of the recommendations. Briefings have been scheduled for or have already been provided to the Department of Energy, the Department of Defense, the Office of Science & Technology Policy, the U.S. Geological Survey, and the Department of the Interior.

As of the writing of this dispatch, the Direct Air Capture Report still remains under review.

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INTERNATIONAL News

...from the APS Office of International Affairs

The Jasmine Revolution

By Mourad Telmini

Photo by Mourad Telmini

What happened in Tunisia on January 14th 2011 is no doubt a major event in the history of a century that started with another milestone, the tragedy of September 11th 2001. After a decade under the sign of terror and war, the flavor of Jasmine is bringing to the world a breeze of freshness and optimism.

By its purpose, dynamics, first results and ongoing consequences, it makes sense to compare the Jasmine revolution to the fall of the Berlin wall. Indeed, while these lines are being written, the news on the Internet reports on Chinese opposition leaders who are taking the Jasmine revolution as an example for bringing about democracy in China, inspired by the role that new technologies and social networks played in Tunisia. Obviously, the perfume of Jasmine, this beautiful and delicate white flower typical of Tunisia, is diffusing across the world.

When looking to the repercussions of the Jasmine revolution, first in the neighboring countries of the Middle East region, where the Egyptian people succeeded to drive out Hosni Mubarak, and where dramatic events are currently underway in Libya, Algeria, Yemen and Bahrain, any physicist can find in this dynamics a striking illustration of the famous “butterfly effect.” Indeed, the whole story started with a rather banal incident: on December 17th 2010, a policewoman slapped Mohamed Bouazizi, a young jobless man who was trying hard to sell some fruit and vegetables in the market of a poor city in the center of Tunisia called Sidi Bouzid.

For Mohamed, valiant heir of a people whose 3000 years of history include such icons as Hannibal, who crossed the Alps using elephants, Saint Augustine, Ibn Khaldoun and other geniuses, this humiliation was too much. Mohamed Bouazizi immolated himself in front of the official representatives of the government. By this act, he became the first martyr and the symbol of the revolution and freedom. His message was received one hundred percent by the people of Sidi Bouzid : No dignity means no life. A spontaneous, popular demonstration started to rise up, but immediately faced the oppression of the regime. Indeed, like many other governments in the region, the Tunisian dictatorial regime took advantage of the atmosphere post September 11, with the tacit benediction of the main western democracies, to oppress any protest, even peaceful and civil, branding the protesters as dangerous terrorists.

Actually, all the ingredients for a revolution aiming toward a transition to democracy and the free world were there for many years. The Tunisian people are among the most advanced in North Africa. This small country was the first to abolish slavery (1846), to promulgate a constitution (1861), to introduce modern science in education (1875), to prohibit polygamy (1957), etc. The Tunisian youth are extremely open-minded and in touch with the most advanced communication technologies (more than 25% of the 10 million Tunisians have a Facebook account). A very widely shared feeling is that the Tunisian people deserve to join the free world and become a genuine democracy, and the president, in office for 23 years, became the major obstacle to that legitimate aspiration.

The echo of the Sidi Bouzid events was instantaneously broadcast through the social networks and the protest increased with demonstrations in the other cities of Tunisia (Regueb, Kasserine, Thala, …) where the dictatorial government commanded snipers to kill the peaceful protesters. The videos recorded by the people of Kasserine with their mobile phones and uploaded on the net shocked the nation, whereas the official media continued to deny or minimize these events, or present them as terrorism acts perpetrated by foreign agents.

Despite the speeches of Zine El Abidine Ben Ali, aggressive and pathetic, an implicit, but strong consensus was growing up among the people: The dictator has to go. On Friday January 14th 2011, many tens of thousands demonstrated in Tunis, transforming Habib Bourguiba avenue, named after the first president of Tunisia, to a civilian *place de combat* against despotism. The few hours of this civilian demonstration were clear enough to force the dictator to leave. I was there and I can testify how impressive this demonstration was, not only by the number of people, but also and mainly by their civility and the very high quality of their behavior and their demands. We were undertaking the first revolution of the 21th century and the conscience of this exceptional event was so great, that a very strange and unique phenomenon happened. A kind of collective effect linked all the demonstrators together, making them take care of each other, support each other and feel that it is a leitmotiv and a national duty to be exemplary.

Moreover, it is interesting that many notices were written in English, with slogans like “Game over”, “Yes we can,” etc (see picture). This is absolutely new because the preceding generation was tightly linked to France and French culture and language. It is no longer the case. Tunisian youth is open to the entire world. It will be great if this message is well taken and well understood by our friends from all over the world.

Afterwards, if one has to take a lesson from the Jasmine revolution, I think that it would be to never despair of humankind, whatever their present status, and wherever they live. For many years, people around the world, including scientists, were convinced that the only way to bring Arab countries to democracy, if any, is the Iraqi example, and it doesn’t matter if the price for that can be tens of thousands of civilians killed. The Tunisian revolution demonstrates with the most striking clarity how much this Machiavellian view is wrong. Tunisians and Arabs are humans on the same footing as others. They are able to emancipate themselves and contribute to the stability and the progress of humankind. All that we need is to be more known and accepted as we are, without any stereotypes or clichés.. Contrary to a widely shared but false idea, democracy in the Arab world is the best guarantee for peace and stability in the Middle East. The transition towards democracy should be strongly supported by the US and other main democracies. We need to learn from your experiences. We want to rely on your friendship, to show you our luminous face, not that dark one portrayed in the media and from which we have all suffered so much. Together, we can go forward through mutual collaboration. Personally, I have the enormous good fortune to have many friends in US and I had the opportunity to visit this fantastic country. But, many of my colleagues, despite the fact that they are conducting very good science, and even those who are retired now, have never had the possibility to collaborate with US scientists, nor to visit America. We deserve more interest, and this is beneficial both for you and for us.

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Letters

Others Contributed More than Van de Graaff to Electrostatic Accelerators

The column "This Month in Physics History" in the February *APS News*, which comments on the 1935 patent granted for the Van de Graaff generator, is a better example of the power of an eponym than it is of physics history. While the importance of Van de Graaff's development of his method of generating high voltages by carrying charge to a terminal through charge sprayed on a continuous canvas belt is properly acknowledged, Van de Graaff's early machines produced high voltages–and great pictures of lighting discharge and publicity–but not high energy beams. Hence those machines were not "accelerators" and were not useful in nuclear physics research.

The earliest application of the Van de Graaff potential generation mechanism to produce an accelerator was centered at the Department of Terrestrial Magnetism Laboratories in Washington where Tuve, Hafstad, and Dahl, Phys. Rev. 48, 315-337 (1935), describe their development of "electrostatic generators… used for the production of high energy protons and deuterons." In that paper they reported that late in 1933 they succeeded in accelerating 20 microamp beams of protons to energies of over one MeV. In later papers they report using their electrostatic generator in important experiments bearing on the structure of protons and light nuclei.

Merle Tuve grew up in Canton, North Dakota, across the street from his best friend, Ernest Lawrence, both from Norwegian immigrant families (the name Lawrence was anglicized from Lavrens). Odd Dahl, physicist and arctic explorer, was Norwegian and returned to Norway a few years after the 1935 paper was published. Tuve was elected to the National Academy of Sciences in 1946.

The history of electrostatic accelerators continued with work by Ray Herb, elected to the National Academy of Sciences in 1955. Beginning in the late 1930s at Wisconsin, Herb's machines produced highly controlled nearly mono-energetic proton beams up to energies of 4.5 MeV. The two generators which played an important role at Los Alamos during WWII were Herb's machines brought from Wisconsin. As a graduate student and then junior faculty member at Wisconsin circa 1950 who worked with "the long tank", a generator returned from Los Alamos, I recall, with amusement, that we always called the machine "the electrostatic generator", never–bite-your-tongue–the Van de Graaff. And it was Ray Herb who developed in the 1960s the pelletron generators of which several hundred are in use today. The Pelletron potential generation mechanism is a kind of grandchild of Van de Graaff's design where the high voltage is generated through the transfer of charge carried by belts of metal pellets connected with insulating nylon links.

So honor Van de Graaff! But honor Tuve, Herb, and others who contributed more to the development of the electrostatic generators that have played a central role in our understanding of the nucleus.

Robert K. Adair
Hamden, CT

It Pays to Keep Track of Units

The Back Page in the February *APS News* makes a hypothetical comparison as to which of two job candidates one would hire: what appears to be an American high school graduate at $17/hr and a more qualified foreign candidate eager to work for $1.50/hr. The comparison has little merit because the respective costs of living in the two candidates' countries is not considered. Having only half the data makes the author's conclusion suspect. The cost of living relative to the wage paid is an important consideration.

What the authors of the article, *Rising Above the Gathering Storm, Revisited*, are doing is to use only one coordinate system for comparison. There are two coordinate systems with different scales on their respective axes, one for the American candidate and one for the foreign candidate. When engineers do what the authors have done it causes space probes to crash into the planets upon which they were supposed to land softly. One cannot put the foreign candidate data on the American candidate's coordinate system without scaling the numbers accordingly, and vice versa. Dimensional analysis used to be taught before we moved on to the "modern stuff". Knowing what unit system one is working in has always had value until h = c = whatever = 1 came along.

Tom J. Gray
Corpus Christi, TX

Open Letter to APS President Barry Barish

In the January, 2011 issue of *APS News*, you responded to a question from the reporter as to what you considered the most pressing issue facing the physics community right now with the statement, "Research Funding".

You and I have known each other for over fifty years, dating back to when we were both at the Lawrence Berkeley Laboratory conducting experimental research in elementary particle physics. I don't believe that either of us would have given that response then and I still do not believe that your response would be appropriate today. It is one that I have heard repeatedly over the years, particularly by scientists who have moved into advisory and administrative responsibilities as they have aged. It misses the mark.

What would my response have been? Mine would have been, "Excellence of Ideas".

As you know, just about 25 years after the establishment of the NSF, I spent eight years of my career there, between 1972 and 1980, as Program Director for Elementary Particle Physics. One of the very first things I learned was from the charter, which placed prime importance on the need for excellence when funding science. I adopted that belief early in my tenure and have held it ever since.

At the time, NSF was almost inconsequential in the funding of particle physics, and aside from supporting the operation of the 12 GeV electron synchrotron, the program was rather non-descript and only a tiny fraction the size of the Atomic Energy Commission's.

The scientific community had a great deal of difficulty in accepting a meaningful role for the NSF in its support of outstanding science and not infrequently acted imprudently in judging the value of NSF proposals to achieving understanding in the field. Probably the most notable example of that attitude was the review, conducted by the Future Facilities Panel at Woods Hole, Massachusetts in 1974, of the Cornell CESR proposal to convert the synchrotron to an electron-positron collider.

I believe you were one of the panelists, and I am sure that you recall the Panel's decision to recommend not funding that proposal under any funding scenario. Later, the Panel introduced a fourth scenario, labeled "Blue Skies" under which it supported the proposal.

The rationale for not supporting what was widely viewed by the panelists as an excellent proposal was that there wasn't enough money to support two electron-positron colliders, (the other being PEP, the SLAC 15 GeV x 15 GeV collider). This was a phony argument; the real rationale was political.

The bottom line is that the NSF did provide support for CESR, which turned out to be the nation's premier facility for a 30-year period when it essentially dominated publications on the properties of b quark states.

At that time, the NSF funded another proposal, from the University of Utah, called the Fly's Eye, which relied upon observing fluorescence caused by high-energy cosmic rays interacting with nitrogen atoms of the earth's atmosphere. That experiment evolved into Hi-Res and became a world-class effort of high renown.

These efforts did not require an infusion of lots of new money and were achieved at least in part via a redirection of program funds. When I informed a Nobel Prize winner that funding for his proposed program was scheduled to be reduced, I was told I was the worst program officer that he had ever encountered in all of his dealings with federal agencies. Others accused me of not being truthful in stating the proposal's funding.

In closing, I would like to take issue with one of your other statements, "Probably the most urgent issue is for constituent scientists to make contact with the new members of Congress to talk to them about how valuable basic science is to the future of the country". I feel this approach is being naive and further tends to promote the use of "pork" to get financial support in the form of "earmarks." All too often, I have found those approaches to be counterproductive to getting the best research supported and to end up being wasteful and poorly designed and planned.

I think a debate on the funding of science may be long overdue. If you feel such an initiative might be appropriate, I would be willing to participate.

Sincerely yours,

Alexander Abashian
Ruckersville, VA

Barry Barish Responds:

I welcome Al Abashian's reaction to my question and answer interview published in the January 2011 *APS News*, but do not agree with a couple of his major points.

In particular, Abashian took issue with my calling "research funding" the most pressing issue facing the physics community, and he gives several examples (in hindsight) where more judicious choices could have been made, presumably replacing our need for increased funding. Of course, it goes without saying that we can always improve our priority setting. The peer review process we use serves us very well, but it is far from perfect. Nevertheless, even in Abashian's own field of particle physics, the lack of U.S. research investment is resulting in the premier new facilities moving abroad, the LHC at CERN in Europe, two new B-factories in Japan and Italy, and the Tevatron at Fermilab being shut down despite significant discovery opportunities. In Astrophysics, despite dramatic discoveries of recent years and the highly regarded ASTRO2010 report, the highest priority future dark energy mission cannot be funded in the near future by NASA and DoE. We certainly don't lack for good ideas, excellent projects or priority setting in the U.S. We do lack research support!

Abashian also disagrees with my plea that constituent scientists make contact with their new members of Congress. My point is a very simple one and has nothing to do with "pork" or "earmarks." Our Congress has few scientists in its ranks, yet they make many decisions involving science and technology. Scientists must discuss these issues with them, if we are to have an informed Congress.

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If you have suggestions for a POPA study, please send in your ideas electronically. http://www.aps.org/policy/reports/popa-reports/suggestions/index.cfm.

ISSUE: Media Update

The Energy Critical Elements report received considerable media coverage after it was launched Feb. 18th during a press conference at the AAAS meeting in Washington, D.C. Among the numerous publications that published stories: *The Washington Post*, *The New York Times*, *Time*, *Nature* and *Agence France-Presse*.

Coverage of the damaging effects to science proposed in H.R. 1 has also been robust. *Roll Call, USA Today, Science, Newsday, The Associated Press, Wall Street Journal* and *Long Island Business News* published stories about scientific program cuts and layoffs that would occur if the bill were to become law.

The APS petition to the Nuclear Regulatory Commission calling for a non-proliferation assessment of smaller, efficient technologies generated stories in the *Global Newswire* and *The Hill* and *Huffington Post* blogs.

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

Designing Games in Sin City Pays Off

By Alaina G. Levine

Lady Luck doesn't always smile on physicists, but for Olaf Vancura, she not only grinned, she handed him the jackpot.

In the early 1990s, Vancura, whose PhD in physics is from Johns Hopkins University, was minding his own business probing the dawn of matter and time as a scientist at the Harvard-Smithsonian Center for Astrophysics (CfA). He enjoyed his cosmic endeavors, but was also titillated by casino games, brought on by a lifelong interest in cards and card counting. While still employed at CfA, he created and began teaching a course at Tufts University on the mathematics of gambling. It became one of the most popular classes offered as part of Tufts' "Experimental College" and inspired him to write a textbook, *Smart Casino Gambling*, in part because "I couldn't find [a textbook] without junk," he says. "I didn't want to expose my students to the nonsense" that existed in current tomes about card counting.

Vancura invited the casino director of Foxwoods, a major casino complex in Connecticut, to address his pupils. As fate would have it, he soon began consulting for the industry and found himself spending more time thinking about the mathematical problems associated with gambling than about G stars and gamma rays. In 1997, he left astrophysics and joined Mikohn Gaming, a game manufacturing firm, full-time. He advanced through the ranks, earning the title of Vice President of Game Development, and from 2004 to 2006, he served as Chief Creative Officer at Progressive Gaming International.

Today he is the Vice President of Game Development at American Gaming Systems, a leading designer, manufacturer and operator of gaming machines for casinos. Based in Las Vegas, Vancura oversees all product development for the company, including game development, operating systems, software and hardware advancement, platform progression and integration with third-party content providers. He directs a 40 to 50 person team and is involved in all elements of new game creation. The company's portfolio includes both table and slot machine games.

Vancura gets his greatest satisfaction from helping to design and develop a particular game, a process which he views as a marriage of art and science. He refers to the original specifications for the game as a recipe, which comprise the mathematics that will be used to determine how the game will be played. "You must understand the game mathematically," he explains, "but then you have to step back and ask how would an average guy play? What are the emotional issues I will guide them through? That's where the art comes in."

Depending upon the type of game he is designing, the math involved could be as simple as basic algebra and calculus, to more complex optimization, probability and statistics, and of course, game theory.

After Vancura and his team determine the recipe that will serve as the technical bones of the game, the next step, called asset creation, is where the sound engineering, artwork, and animation are designed and planned. Implementation, the subsequent phase, involves programming the

Olaf Vancura

actual game onto the platform with which the player will interact. His engineers usually program in C++ or a variant, such as Flash Action Script. Testing, and quality and assurance (Q and A) follows. The final step in the process is partnering with the regulators, to ensure that the game meets all of the required standards for the casino. The lifecycle of a game, from concept to Q and A is anywhere from six toeighteen months, but one of Vancura's goals as Vice President is to streamline the process and cut it down to less than six months.

The most difficult aspect of his job is "as an inventor, part of the problem of creating something is thinking in mind who the audience is, which might not be you," he explains. "So you should never fall in love with your inventions until the market proves you right."

Understanding the power of the market is especially important for scientists and mathematicians interested in moving into the gaming profession. Although he doesn't know of other physicists in the industry, he declares that there is a "non-trivial" number of mathematicians shaping the future of slots and other casino games. Even so, "mathematicians might come across as nerdy people and don't understand what motivates everyday people," he says. "If you are so highly trained in math and physics, you might lose sight of how Joe the Plumber might think on a regular basis. You have to create stuff that has mass appeal."

The key, he adds, is to design games that are fun for the players and keeps them playing, even when they are losing. "As an inventor I have to be humble," he says. "I am not designing for [someone with] a PhD in physics, but rather a guy who wants something entertaining and exciting," and who will find it interesting enough to keep coming back.

In an industry that generates 10 times the revenue of the film industry, according to Vancura, this astrophysicist has found great success at bridging the art and science. "I have a gift," he admits, "I am good at creating and inventing (table and slot) games." One of his particular strengths is translating the concepts behind established board games, such as Yahtzee and Battleship, into table or slot games. He holds 65 patents, one of which is for a Pachinko–type mechanical game he calls Boogie Ball, and another for a trivia-based slot machine game framed around the Ripley's Believe It or Not brand.

Vancura frequently refers to himself as an inventor, and argues that the best thing about manufacturing casino games is the creativity involved. "When I was a researcher, that's what I was missing," he says. "[Training as a] physicist taught me how to solve problems, obliquely, but that creative aspect was missing. Astrophysics was a discovery process rather than an inventorship."

But in gaming, there is much to invent and the feedback he gets is immediate–he can see it on the players' faces as they enjoy a game he helped execute. There is plenty of scientific rigor, he adds, such as in the card counting system he created for his book *Knock Out Blackjack*. And in the end, he stands by his decision to pursue physics.

"The greatest value in getting a physics degree," says Vancura, "is that it teaches you to think and synthesize knowledge. It gives you an exceptional viewpoint of the landscape of the world, because it's a high-minded field that wants to understand everything."

Alaina G. Levine is a science writer and President of Quantum Success Solutions, a leadership and professional development consulting enterprise. She can be contacted through www.alainalevine.com. Copyright, 2011, Alaina G. Levine.

Physicist Takes a Look at TIMSS

By Gabriel Popkin

The Trends in International Mathematics and Science Study (TIMSS) has given rise to considerable hand-wringing among US educators and policy makers due to US students' poor performance. At the annual meeting of the American Association for the Advancement of Science (AAAS) in February in Washington, DC, physicist Chad Orzel said that TIMSS physics questions were generally aligned with standard US high school physics curricula, but he also suggested ways to improve the next round of the test.

TIMSS is a major international math and science assessment designed by the International Association for the Evaluation of Educational Achievement. Although portions of TIMSS are conducted every four years, the high school portion that includes physics has only been given twice, in 1995 and 2008. In 1995, US high school seniors taking the test scored poorly, underperforming their peers in every other country tested. In 2008, the US did not participate, in part due to insufficient funding at the Department of Education's National Center for Education Statistics (NCES), which manages US participation in various international assessments. NCES officials also questioned whether students graduating from secondary school around the world form a comparable cohort.

Orzel, who is a professor of physics at Union College in Schenectady, New York, said that he approached the topic by asking the question, "Would this make our [physics professors'] job easier?" He concluded, "If my incoming students could answer the TIMSS physics questions, it would make my job considerably easier."

Orzel's analysis covered 39 physics questions that were released from TIMSS 2008, which was given to students graduating from high school in nine countries. While Orzel did not seek to explain US students' prior poor performance, he noted that two of the major topic areas covered by TIMSS—heat and temperature, and atomic and nuclear physics—re-

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of a theory of everything is that it implies we will eventually know everything there is to know...For me physics is a work in progress."

***Marcelo Gleiser**, Dartmouth College,* MSNBC.com*, March 8, 2011.*

"One of the attractive things about this approach to time travel is that it avoids all the big paradoxes…Because time travel is limited to these special particles, it is not possible for a man to travel back in time and murder one of his parents before he himself is born, for example. However, if scientists could control the production of Higgs singlets, they might be able to send messages to the past or future."

***Tom Weiler**, Vanderbilt University, on his theory that the LHC could be used to create particles that can travel through time,* FoxNews.com*, March 16, 2011.*

Conferees Grapple with Climate Change, Sustainable Energy

By Michael Lucibella

Researchers and technical experts speaking at the second Physics of Sustainable Energy conference emphasized the urgent need to change how the planet generates and uses energy. The conference, sponsored by the APS Forum on Physics and Society (FPS) and held at the University of California, Berkeley, in early March, highlighted new research and technology aimed at better understanding and combating climate change.

Talks on the first day of the two-day meeting included discussions on energy policy, the environmental effect of fossil fuels and ways to clean up transportation, while the second day was devoted to ways to make buildings more efficient and to sources of renewable energy.

Though much of the conference was devoted to looking for energy solutions, speakers at the beginning of the program offered a defense against critics of anthropogenic global climate change.

"Natural causes alone cannot –I repeat cannot–explain the… changes we've actually seen," said Ben Santer, a climatologist at Lawrence Livermore National Lab. He pointed to his research showing that different layers of Earth's atmosphere have been warming at different rates, rather than evenly, as they would if the sun were changing. "'The sun explains everything' does not fit the available data," Santer said.

The tone of many of the presentations indicated that there is no silver bullet or panacea to solve climate change and completely fulfill the looming energy needs of the planet. Speakers pointed to an inexorably warming planet with limited resources, a growing population and a global demographic shift towards urbanization and higher energy use per capita. These challenges are daunting and will take a concerted effort from wide swaths of society including researchers developing the latest green technologies, policy mak-

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We've got an app for you!

The April Meeting app contains the scientific program of abstracts. You can sort the talks by session or unit. You'll be able to read the abstracts, view the speaker index, get information on exhibitors, and see maps of Hyatt Hotel Orange County, Garden Grove, California.

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interesting and broad science that is represented at the April meeting at the plenary sessions and talks," Heeger said. "We selected the plenary sessions and then a cross section of invited and contributed talks, from the fields of nuclear, particle and astrophysics."

The sessions picked to be posted online include the three plenary sessions as well as several of the scientific and forum sessions. The scientific sessions include "T1: The future of Particle Physics," "J1: The Essence of Neutrinos," "Q3: Direct Detection of Dark Matter," and "J3: New Results from the Cosmos." The forums on Physics in Society and International Physics are sponsoring four sessions. They also include "E5: Nuclear Weapons at 65," "J6: The Digital Divide in 2010," "Y5: Science Diplomacy," and "R5: The Status of Arms Control."

The sessions were chosen in part because research in particle physics, astrophysics and nuclear physics is often part of large international collaborations. With the capability to self-upload presentation materials, scientists can instantly share their latest results with the world.

While the INDICO trial grew out of CISA's desire to bring meetings content to our international members, the trial results will help shape the APS HQIT plans for expansion of the Online Bulletin to offer upload capability to all meeting speakers. The Committee on Meetings (COM) will determine the final feature set of the Speaker Slide Upload module, but the IT team is currently designing the system to support .ppt, .pdf, audio files and others. It will also include a Copyright Permission signoff, granting APS the right to post the slides, and confirming that the speaker has obtained permissions for any copyrighted material contained in the slides.

A few APS units currently post selected presentations online, but the manual process introduces a time delay that will be eliminated by giving speakers a self-upload function. This trial is the next step toward a comprehensive approach to putting meeting sessions on the web. More information on how to access the presentations from this year's meeting can be found on the April meeting web page on the APS website.

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sion will feature John Johnson of Caltech with the latest update on the hunt for exoplanets, followed by Carl Wieman of the White House Office of Science and Technology Policy discussing how federal policies could be used to help spur university research, and Yang Shao-Horn of MIT with the latest battery developments. Tuesday morning's plenary likewise has offerings of broad interest, including William Marciano of Brookhaven National Lab explaining the tricky business of pinning down the proton radius, Stuart Henderson from the Spallation Neutron Source showing how particle accelerators have contributed to society and Nergis Mavalvala of MIT discussing the connection between quantum mechanics and gravitational waves.

Superconductivity: 2011 also marks the 100th anniversary of the discovery of superconductivity. To mark this important milestone Session J2 on Sunday afternoon will be devoted to exploring the history and future promise of this unusual effect of nature. Peter Pesic of St. John's College will reflect on the history and controversy of its discovery by Heike Kamerlingh Onnes and his collaborators. David Larbalestier of Florida State University will look at the range of materials used in today's superconductors, and offer insight into what future materials hold promise. Taking the implications even farther, Tony Zee from the University of California, Santa Barbara will delve into the implications of superconductivity for theoretical particle physics and quantum field theory.

Physics in Hollywood: On Saturday night, well-known science writer Jennifer Ouellette will moderate a special VIP panel about the uses and misuses of science and physics in Hollywood films and shows. Included on the panel will be Bill Prady, co-creator of CBS's "The Big Bang Theory," Jaime Paglia and Bruce Miller, co-creators for the Syfy original series "Eureka" and actor John de Lancie, who played Q in "Star Trek: The Next Generation."

Deepwater Drilling: In light of last summer's Gulf oil spill, Monday morning's session "Q5: Physics and Engineering of Deep Water Drilling" will begin with a talk by Brian Clark of the Schlumberger Company on how physics techniques have aided in the search for oil deposits around the world. From there Kenneth Gray from the University of Texas at Austin will offer a brief primer on deep water drilling. Jonathan Katz from Washington University in St. Louis will describe what caused the infamous "top-kill" attempt to fail to stop the spill, and what could possibly have been done to make it work.

Stellar, Galactic and Intergalactic Flares: Flares of all kinds are invaluable to astrophysicists, and are the subject of the session "L3: Astrophysical Flares." Hugh Hudson from the University of California, Berkeley will talk about data from NASA's Solar Dynamics Observatory, giving a fresh look at how solar flares behave and what role the Sun's chromosphere plays in their formation. At the center of the galaxy resides a super-massive black hole known as Sagittarius A. Though usually not luminous, it is prone to flares of radio, millimeter, infrared and X-ray radiation. Farhad Yusef-Zadeh of Northwestern University has looked at the infrared radiation of some of these flare-ups, and will discuss how they might be caused by a blob of synchrotron plasma orbiting the black hole. Wystan Benbow, Harvard-Smithsonian Center for Astrophysics, has been studying intense gamma ray bursts with the latest generation of detectors, and will present his latest research.

Cosmic Rays and Particles: New technologies to hunt for some of the exotic particles of the universe will be explored in session "C11: Cosmic Ray Measurements, Anisotropies and Propagation." The balloon lofted Cosmic Ray Energetics And Mass (CREAM) experiment, which looks for high energy cosmic rays, recently completed its third run in Antarctica. Young Soo Yoon from the University of Maryland will present its findings on proton and helium fluxes. Also in Antarctica is the kilometer-sized IceCube neutrino detector, which has been recently completed. A team of physicists from the University of Wisconsin will show how the detector can be used to detect the direction of solar and stellar cosmic rays as well.

Digital Divide: Access to the internet is critical for a country and its population to integrate into the evolving global economy, and bridging the "digital divide" is the subject of session "J6: The Digital Divide in 2010." Hamadoun Tourè, Secretary-General of the International Telecommunications Union, will start out with an overview of how mobile phones have made tremendous inroads in the developing world, and how to replicate that success for broadband internet. Michael Stanton from the Brazilian National Research and Education Network will highlight how the RedCLARA network that reaches throughout Latin America has made collaborations of all kinds possible. Roger Cottrell from Stanford University takes a closer look at internet penetration in Africa, and despite challenges, there's much room for improvement.

For students, a free career panel and networking reception will be held on Friday night, complete with refreshments. For graduate students, Sunday's "Lunch with the Experts" is a great opportunity to meet some of the leading researchers in the fields of astrophysics, nuclear physics, gravitation and particle and fields in an informal setting.

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from all over the world come here, they come to our lab, and we're saying 'you know what, stay away,' we're saying, 'stay in Switzerland, go to France,' that's what we're saying and I think that's a terrible message to put out there. It's also a terrible message to send to the college senior who's a physics major, who maybe contemplating a PhD program, and we're going to say 'you know what, we don't have places where you can go to pursue your research'."

Bishop spent much of his time calling attention to the local impact that the possible budget cuts would have on the town of Brookhaven, whose economy relies heavily on the lab. According to budget estimates by the lab, about 950 workers employed at the lab would be laid off. On top of that the National Synchrotron Light Source and the Relativistic Heavy Ion Collider would have to be shuttered and work halted on the NSLS-2 due to lack of funding, affecting thousands more visiting scientists and construction workers.

"[T]he RHIC and the NSLS right now play host to approximately 3,300 visiting scientists," Bishop said. "That's 3,300 visiting scientists who–leave aside the value of the work they're doing, which is considerable–that's 3,300 visiting scientists who will not be staying in our hotels, who will not be renting cars from local dealerships, who will not be eating in local restaurants, who will not be buying their coffee from local delis."

The impact on scientific research would not be limited to Brookhaven, but would have a similarly deleterious effect at almost all federally funded research centers.

"What is happening, or would happen, at Brookhaven will happen across the country," said Mike Lubell, the APS director of public affairs. "H.R. 1 would affect 26,000 scientists and engineers nationwide. It would cause the loss of jobs at each laboratory. As the congressman pointed out, at Brookhaven there are roughly 1,000 people on staff. The same thing would be replicated of course at each national laboratory; Oakridge National laboratory, Argonne National Laboratory and Femilab in Illinois, the California labs, SLAC and Berkeley."

It is unclear how long science programs like the NSLS and RHIC might be shuttered. The President's proposed budget for 2012 includes increases to federal research. However, researchers at the lab say that even a temporary shutdown would have lasting effects on the labs.

"Essentially our research stops," said Tony Lanzirotti, a researcher from the University of Chicago whose research uses the National Synchrotron Light Source, "[The researchers] are all very highly skilled people, they're going to go out and they're going to find other opportunities, and getting them to come back to Long Island, back to Brookhaven if they have to leave, is not something that's going to be easy to do."

Speakers at the press conference highlighted also how basic research contributes to new technology and industries. At one point Lubell held up his iPhone, saying that without federally supported research, the technology needed to build the device wouldn't exist.

"This isn't just a sand box, this isn't somebody's pork barrel, this is the future of the country, and you can see it," said Peter Stephens, a professor in the physics and astronomy department at Stony Brook University.

APS has been actively involved in communicating the importance of the national labs throughout the budget process. APS has sponsored meetings on Capitol Hill with legislators, sent out alerts to all its members who reside in the US, helped organize a taskforce on American innovation, written numerous op-ed articles, and contributed to other media campaigns.

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ceive what he termed "extremely variable" coverage in US state standards. Speaking about his faculty colleagues, Orzel said, "We tend to assume that first-year college students have seen nothing but mechanics and very basic E&M."

Orzel also observed that the released TIMSS questions tend to emphasize computational skill, rather than conceptual understanding of physics. Many physics education research studies have shown that students can often solve seemingly complex physics problems without understanding the concepts underlying the problems.

Orzel did not discuss typical physics curricula in other countries, but Alka Arora of the International Study Center, the Massachusetts-based center that administers TIMSS, discussed the different physics experiences offered to students in participating countries. In the nine countries that participated in the TIMSS 2008 physics assessment, students taking the test had received physics instruction in at least two, and as many as five, years before graduating from secondary school. In comparison, most US students who take physics at all take it for only one year, according to data from the American Institute of Physics.

APS and other professional physics societies have long been concerned about US students' dismal performance on international assessments. "TIMSS results since 1995 do not give us any reason to believe US physics education has improved since then," says Monica Plisch, Assistant Director of Education at APS. "A major factor is the broken system for preparing physics teachers, as documented by the Task Force on Teacher Education in Physics."

TIMSS Advanced will be given again in 2015. If the US participates, educators and policy makers may gain another look into how our students stack up against their international peers.

ANNOUNCEMENTS

Distinguished Traveling Lecturer Program in LASER SCIENCE

The Division of Laser Sciences (DLS) of the American Physical Society announces its lecture program in Laser Science, and invites applications from schools to host a lecturer in 2011/2012. Lecturers will visit selected academic institutions for two days, during which time they will give a public lecture open to the entire academic community and meet informally with students and faculty. They may also give guest lectures in classes related to Laser Science. The purpose of the program is to bring distinguished scientists to colleges and universities in order to convey the excitement of Laser Science to undergraduate students.

The DLS will cover the travel expenses and honorarium of the lecturer. The host institution will be responsible only for the local expenses of the lecturer and for advertising the public lecture. Awards to host institutions will be made by the selection committee after consulting with the lecturers. Priority will be given to those predominantly undergraduate institutions that do not have extensive resources for similar programs.

Applications should be sent to the DTL committee Chair Rainer Grobe (grobe@ilstu.edu) and to the DLS Secretary-Treasurer Anne Myers Kelley (amkelley@ucmerced.edu). The deadline for application for visits in Fall 2011 is May 30.

Detailed information about the program and the application procedure is available on the DLS-DTL home page: http://physics.sdsu.edu/~anderson/DTL/

Lecturers for 2011/2012:

- Laurie Butler, University of Chicago.
- Hui Cao, Yale University.
- Eric Cornell, University of Colorado.
- Jim Kafka, Spectra Physics.
- Fleming Krim, University of Wisconsin.
- Christopher Monroe, University of Maryland.
- Luis A. Orozco, University of Maryland.
- Carlos Stroud, University of Rochester.
- Ron Walsworth, Harvard University.
- Linda Young, Argonne National Lab.

2011 PhysTEC Annual Conference

May 23-24, 2011
Austin, TX

Plenary Speaker: Carl Wieman
Associate Director of Science,
Office of Science and Technology Policy;
Nobel Prize in Physics, 2001

The 2011 **Physics Teacher Education Coalition 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 2011 conference will be held jointly with the UTeach-NMSI Institute Annual Conference.

www.ptec.org/conferences/2011

Physics Teacher Education Coalition

THE UTEACH INSTITUTE

Reviews of Modern Physics

Recently Posted Reviews and Colloquia

Intermittent search strategies
O. Bénichou, C. Loverdo, M. Moreau, and R. Voituriez

At the macroscopic scale, many foraging animals search for food by moving slowly and scanning an area intently, and then moving rapidly to a new area for a new slow scan. At the microscopic scale, vesicles inside cells sometimes move diffusively, and sometimes move ballistically along rigid biopolymers. DNA binding proteins also have periods of slow diffusion motion and fast motion along the DNA. These disparate processes can be described using the mathematics of intermittent search strategies. In this review, the theoretical framework for such search strategies is described, paying particular question to their efficiency.

http://rmp.aps.org

American Association of Physics Teachers
Call for Award Nominations

The AAPT Awards Committee is seeking nominations for:

- the Oersted Medal
- the Richtmyer Memorial Lecture Award
- the Melba Newell Phillips Medal
- the J. D. Jackson Award for Excellence in Graduate Physics Teaching, and
- the AAPT Distinguished Service Citation.

All AAPT members are urged to review the descriptions of these awards on the AAPT website **(http://www.aapt.org/Programs/awards/)** and then, following instructions available at a link on that website, to nominate individuals deemed worthy of consideration for any of these awards.

AAPT PHYSICS EDUCATION

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After the Arab countries, the next region in the world that will make its revolution will be Sub-Saharan Africa. To save time, and for the benefit of humankind, we have to avoid the same reefs and help them in taking their future in their own hands. This will be the best testament to the Jasmine revolution.

Mourad Telmini is Professor of Physics, Faculty of Science, University of Tunis El Manar. He is also Director General of the National Centre for Nuclear Science and Technology, and vice-President of the Tunisian Physical Society.

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ers making tough decisions and a public willing to change its behavior.

Scientists estimate that the biggest single source of greenhouse gases is transport, especially cars. Sonya Yeh, a researcher at the University of California, Davis said that emerging alternative fuels for cars, including electric batteries, hydrogen fuel cells and biofuels each had their own advantages and disadvantages

"We don't know what [fuel] will win out, but we'll probably need them all," Yeh said. She added also that in order for the switch to sustainable fuels to take root, the government would likely have to step in and help make the adjustment. "Infrastructure is probably the number one challenge we're facing when trying to get to a sustainable future."

Tim Lipman, co-director of the University of California's Transportation Sustainability Research Center, showed a brief history of fuel technologies and weighed in on their possible futures. Battery capacity has improved dramatically in the last 20 years, to the point where plug-in electric and hybrid cars are able to compete commercially. Hydrogen fuel cells have similarly made significant strides, but still generally have limited ranges and are not quite ready for the market.

"It's a lot easier to concentrate emissions at power plants and clean them up than it is to clean up millions of tailpipes," Lipman said. "Cars are only as clean as the electricity and hydrogen used to fuel them."

Converting the United States to clean sources of electricity provides its own sets of problems. The Department of Energy recently deemed doubling the United States' reliance on renewable energy, from 10 percent to 20 percent by 2035, as an "aggressive but achievable" goal. However, in order for clean sources of energy to become adopted more widely, the cost of renewable fuel sources like solar and wind would have to come down significantly to be competitive with fossil fuels like coal and oil. K. John Holmes from the National Academy of Sciences examined whether it was likely to see the costs of renewable energy come down in price.

"Renewable electricity is generally more costly (except for hydro, wind and traditional geothermal) to produce than fossil fuels… So we need those policy incentives to drive increases," Holmes said. "Just having adequate technology capable of efficiency and reliably producing electricity is not sufficient to have non-hydro renewable energy make a significant contribution to the US energy market."

Nuclear energy received a strong defense from Robert Budnitz of the Lawrence Berkeley National Lab. He pointed to the fact that nuclear power can deliver electricity at rates that can compete with fossil fuels without the greenhouse gas emissions. Historically nuclear power has had a mixed safety record and lax oversight culminating in the 1979 Three Mile Island accident. Budnitz said that since then the industry has doubled down and focused on safety and reliability. He pointed to a bevy of statistics showing that the number of "significant incidents" at each plant has fallen from an average of 4 per year in 1979 to .01 today.

"What all this is telling us is the systems are reliable and the people are reliable," Budnitz said.

As important as the generation of power is its transfer to consumers. George Crabtree, from Argonne National Lab and co-chair of the APS study Integrating Renewable Electricity on the Grid, said that the United States has huge potential solar and wind resources, but they're generally far from where people live. He highlighted also how the grid would need to be able to smooth out disruptions in supply of solar and wind energy on cloudy and calm days respectively.

"Renewables require a nationally coherent electricity grid, and that's clearly something that we're very far from at the moment," Crabtree said. Crabtree coauthored a Back Page based on the APS study in the December, 2010 issue of *APS News*.

Other talks highlighted improvements in solar photovoltaics, systems to gauge the energy consumption of buildings, successes of policies in the state of California, as well as nationally, to improve energy efficiency and future energy consumption in the developing world.

Though the problems described sometimes seemed intractable, most speakers remained optimistic that new technology and governmental policies could dramatically change how the country conserves energy. During his talk, Arthur Rosenfeld, who recently retired from the California Energy Commission, described how refrigerators kept getting bigger and cheaper after federal regulation of their energy efficiency. He said that with the proper political backing, these kinds of energy savings could be spread to many products.

"This is the second golden age of energy efficiency," Rosenfeld said.

FPS had also helped to sponsor the first Physics of Sustainable Energy conference in 2008, often referred to as "The Woodstock of energy sustainability" by its participants. This year's conference had talks on many of the same topics, but featured all-new speakers.

Organizer of the conference, David Hafemeister from the California Polytechnic State University, said that he was pleased with the turnout and he hoped that physicists and students attending the conference might consider focusing in renewable energy research.

"Physics is the best discipline for understanding these things," Hafemeister said.

The Back Page

Energy Critical Elements

Robert Jaffe, Jonathan Price, Murray Hitzman, Francis Slakey

A number of chemical elements that were once laboratory curiosities now figure prominently in new technologies like wind turbines, solar energy collectors, and electric cars. If widely deployed, such inventions have the capacity to transform the way we produce, transmit, store, or conserve energy. To meet US energy needs and reduce dependence on fossil fuels, novel energy systems must be scaled from laboratory, to demonstration, to widespread deployment.

Energy-related systems are typically materials intensive. If widely deployed, the elements required by these technologies will be needed in significant quantities. However, many of these unfamiliar elements are not presently mined, refined, or traded in large quantities, and as a result their availability may be constrained by many complex factors. A shortage of these "energy-critical elements" (ECEs) could significantly inhibit the adoption of otherwise game-changing energy technologies. This in turn would limit the competitiveness of US industries and the domestic scientific enterprise.

Although they are essential to our culture and economy, the availability of traditional mineral materials is rarely an issue because they come from many sources and are the focus of well-established, relatively stable markets. Recently there have been several efforts (1,2,3,4) to identify critical minerals that are both essential to our economy and subject to supply restrictions.

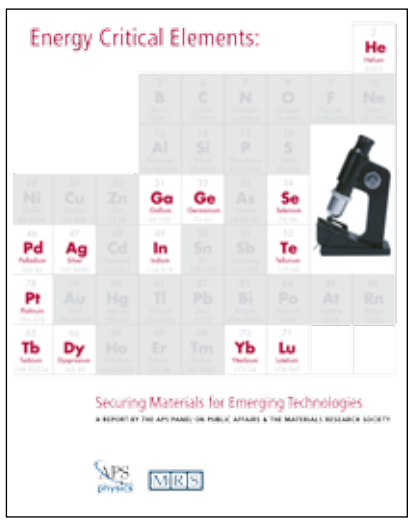
A newly released report by the American Physical Society and the Materials Research Society (5) focuses specifically on ECEs and on the challenges posed by rapidly increasing demand. It recommends a coordinated set of government actions to facilitate smooth and rapid deployment of desirable technologies. The APS/MRS report focuses on identifying commonalities and addressing potential constraints on ECEs rather than on constructing a definitive list of ECEs, which will doubtless change with time as technologies, supply lines, and risk factors change. Although today's list of ECEs would likely include most of the rare earth elements (REEs) along with gallium, germanium, helium, indium, platinum, rhenium, selenium, tellurium, and perhaps cobalt, lithium and silver, a definitive list of ECEs would require extensive study based on information about occurrences, reserves, extraction, processing, utilization, and recycling, much of which is not yet available.

An element may be "energy-critical" for a variety of reasons. It may be intrinsically rare in Earth's crust, or poorly concentrated by natural processes, or currently unavailable in the US Some potential ECEs, such as tellurium and rhenium, are genuinely rare in Earth's crust (6). Others like indium are unevenly distributed, making the US highly reliant on imports. Still other ECEs, like germanium, are seldom found in concentrations that allow for economic extraction.

Geopolitical issues may arise when a critical element is produced in a small number of countries or in a location subject to political instability. The present concentration of REE production in China is a particularly pertinent example. Although the US led the world in both production and expertise into the 1990s, over 95% of these important elements are now produced in China, which is rapidly becoming the center for REE extraction and processing expertise, putting the US and other REE importers at a further disadvantage.

Many potential ECEs are not found in concentrations high enough to warrant extraction as a primary product given today's prices. Instead, they are obtained primarily as byproducts during the extraction of other primary ores. For example, tellurium and indium are currently obtained as by-products of the electrolytic processing of copper and zinc ores, respectively. By-production and co-production present special economic issues. For example, it is unlikely that the mining of copper (production value ~$80 billion in 2009) would be driven by an increased demand for tellurium (production value ~$30 million in 2009).

Several additional factors complicate the availability of ECEs. Some are toxic; others are now obtained in ways that produce environmental damage unacceptable in most countries. Discovery of new mineral deposits typically takes several years and the time between discovery and start-up of a new mine averages five to ten years (7). For some elements, large-scale production may require development of new processing technologies, another time-consuming activity. As a result, the lag time between increased demand and the availability of new supplies may be extensive. Recycling, and the existence of secondary markets, is quite variable. For example, recycling is highly developed for platinum, but almost non-existent for most other ECEs. Sometimes one element can be substituted for another in a technology, but more often than not, substitution requires significant redesign, reengineering, and recertification with attendant delays. The APS/MRS study stresses, however, that with the exception of helium, there does not appear to be any fundamental limit on the availability of any element for energy technologies in the foreseeable future. The problems lie in short-term interruptions or constraints on supplies.



To deal with the multifaceted issue of ECE availability the APS/MRS report makes the following recommendations for US federal action.

Information Collection and Analysis

Collecting and evaluating data required to track the availability and uses of chemical elements is a complex undertaking. While some data are already collected by a number of federal agencies, there is no central entity for tracking minerals and processed materials over their life-cycle. The Report recommends that the government should gather, analyze, and disseminate information on ECEs across the life-cycle supply chain including discovered and potential resources, production, use, trade, disposal, and recycling. The entity undertaking this task should be a "Principal Statistical Agency", a designation that would enable it to require compliance with requests for information.

In addition the Report urges the federal government to regularly survey emerging energy technologies and the supply chain for elements throughout the periodic table, with the aim of identifying critical applications as well as potential shortfalls.

Research and Development

A focused federal research and development program would enable the US to expand the availability of and reduce its dependence on energy critical elements. R&D to expand the availability of energy critical elements should include the geology and geochemistry of mineral deposits as well as metallurgy and minerals processing technologies. Research on substitutional chemistry and material science and the technology of recycling can also help reduce the dependence on ECEs. Substitutions for ECEs may involve several other materials or sweeping redesign, reengineering, and recertification. General Electric's 2006 redesign of high performance turbine alloys in anticipation of a projected shortage of rhenium (8) provides a pertinent example. Few companies have resources to undertake a project of this scope; thus research of this type would be greatly aided by federal funding.

R&D on recycling could also reduce dependence on ECEs. Since most products that use ECEs currently have little recycling capability, significant quantities of ECEs are permanently discarded every year. Research on product designs that are more suited to recycling could help ensure that scarce elements are more easily recovered from discarded products. Research in chemical, metallurgical, and environmental science and engineering, and industrial design methods, can create high-value reusable ECE materials.

The APS/MRS report recommends that the federal government establish a research and development effort focused on ECEs and possible substitutes that can enhance vital aspects of the supply chain including: geological deposit modeling, mineral extraction and processing, material characterization and substitution, utilization, manufacturing, recycling, and lifecycle analysis. Such a research program would have the added advantage of enhancing the training of undergraduate, graduate, and postdoctoral students in disciplines essential to maintaining US expertise in ECEs.

Success in this kind of research requires collaboration among scientists, engineers, and manufacturers across a range of fields. Within the US this breadth of expertise exists only at some national laboratories and major research universities. Consortia built around such institutions could bring the depth of knowledge and continuity of focus required. Such centers should engage and assist efforts by smaller groups in academia and industry.

Efficient Use of Materials

The APS/MRS report urges greater attention to material efficiency with the aim of producing necessary goods from as little primary material as possible. Recycling is a major, but not the sole, component of efficient material use. Other aspects include improved extraction technology, reduced concentration in applications, replacement in non-critical applications, development of substitutes in critical applications, and life-style adaptations. Several of these approaches fall under the R&D heading discussed earlier.

In addition, the APS/MRS report urges that the federal government establish a consumer-oriented "Critical Materials" designation for ECE-related products. The certification requirements should include the choice of materials that minimize concerns related to scarcity and toxicity, the ease of disassembly, the availability of appropriate recycling technology, and the potential for functional as opposed to non-functional recycling. Also steps should be taken to improve rates of post-consumer collection of industrial and consumer products containing ECEs, beginning with an examination of the numerous methods being explored and implemented in various states and countries.

Market Interventions

With the exception of helium, the APS/MRS report does not advocate government interventions in markets beyond those implicit in their other recommendations concerning research and development, information gathering and analysis, and recycling. In particular, the report does not recommend non-defense-related economic stockpiles. Industrial users of ECEs are best able to evaluate the supply risks they face and purchase their own "insurance" against supply disruptions caused by either physical unavailability or price fluctuations. Non-defense government stockpiles of critical minerals have had unintended, disruptive effects on markets (2,9).

The single exception noted by the APS/MRS report concerns helium, which is unique even among energy-critical elements because it is permanently lost to the atmosphere if not captured during natural gas extraction. Helium has unique properties: it remains liquid at 0K; it cannot be made radioactive; it has the highest specific heat capacity of any gas except hydrogen. Helium is critical for current energy R&D and it is anticipated that it will be increasingly in demand in the future for technologies not yet developed. The Report recommends that measures should be adopted to conserve and enhance the nation's helium reserves.

Federal Coordination

ECE availability is a complex topic that straddles the domains of a number of federal agencies including the Departments of Commerce, Defense, Energy, Homeland Security, Interior, State, and Transportation, the Environmental Protection Agency, the National Science Foundation, and the Office of the US Trade Representative. The capacity to orchestrate a productive collaboration between these agencies and coordinate their efforts with the Office of Management and Budget lies in the Executive Office of Science and Technology Policy (OSTP).

The Report recommends that OSTP create a subcommittee within the National Science and Technology Council to examine the production and use of ECEs within the US and to coordinate federal actions.

The authors of this article all served on the committee that drafted the Energy-Critical Elements Report*. Robert Jaffe, chair of the committee, is at MIT; Jonathan Price, co-chair, is at the University of Nevada, Reno; Murray Hitzman is at the Colorado School of Mines; and Francis Slakey is APS Associate Director of Public Affairs and an adjunct professor at Georgetown University.*

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