APS NEWS

A PUBLICATION OF THE AMERICAN PHYSICAL SOCIETY • WWW.APS.ORG/PUBLICATIONS/APSNEWS

December 2009
Volume 18, No. 11
www.aps.org/publications/apsnews

Saving American Industry
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March Meeting to Convene in Oregon

The 2010 APS March meeting will take place from March 15th to the 19th at the Oregon Convention Center in Portland, Oregon. The yearly meeting is the largest annual conference of professional physicists in the United States, and will feature 100 invited sessions and 550 contributed sessions totaling over 7,000 presented papers. The meeting will include the latest research from the APS divisions of Atomic, Molecular and Optical Physics; Biological Physics; Chemical Physics; Computational Physics; Condensed Matter Physics; Fluid Dynamics; Laser Science; Materials Physics; Physics of Beams; and Polymer Physics.

In addition to the scientific sessions the meeting will include a

number of fun, exciting and fascinating events. Tuesday night's Nobel Prize session will feature 2009 laureate George E. Smith describing the invention and early history of charge-coupled devices. The Committee on the Status of Women in Physics will be having a joint breakfast reception with the Forum on Industrial and Applied Physics on Tuesday morning. The APS Washington office will be operating its "Contact Congress" computer bank so APS members can voice their concerns over issues of science to their senator or member of congress. To help everyone relax after days of intense presentations, the ever-popular physics sing-along will be returning as well.

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Greenberg, Zhuang Share 2009 Apker Award

Each year after a rigorous selection process, APS presents two undergraduates with the LeRoy Apker Award for outstanding research accomplishments. This year the award broke new ground, in that both the recipients hailed from women's colleges.


Bilin Zhuang


Kathryn Greenberg

Bilin Zhuang graduated this spring from Wellesley College, where her research supervisor was Courtney Lannert. She was recognized for her work on the thermodynamics of frustrated Ising systems.

Kathryn Greenberg graduated from Mount Holyoke College, having worked under the supervision of Janice Hudgings on thermal coupling and lensing in arrays of vertical cavity surface emitting lasers.

Zhuang is currently employed by the Agency for Science, Technology and Research (Singapore) and works on theories related to MRAM devices. She intends to pursue PhD studies in theoretical physics or chemistry starting in Fall 2010.

Greenberg is studying for her Master's degree at Cambridge University on a Gates Scholarship, working in Professor Sir Richard Friend's group. Next year she will pursue her PhD in Applied Physics at Harvard.

Council Keeps Current Climate Change Statement

In May, Council tabled a motion by Robert Austin that would have replaced the current APS statement on climate change with a new one much more skeptical of the evidence for, and consequences of, anthropogenic global warming. At its November 8 meeting, Council took it off the table and brought it to a vote.

The result: the motion was soundly defeated, with no one voting in favor and only one abstention. Even Austin voted against it.

In the interim, Councilors had faced an email barrage from APS members, expressing their opinions on the current statement and the proposed alternative (see accompanying story). In addition, APS President Cherry Murray had appointed an ad hoc committee, chaired by MIT Professor Daniel Kleppner, to advise her on appropriate action. The report of the committee was presented by Kleppner himself both to the Executive Board and Council.

The Kleppner committee made two main recommendations: first, that the current statement be retained; and second, that the statement be returned to the APS Panel of Public Affairs (POPA) to address "issues of clarity and tone." Council voted to adopt the second recommendation as well, with 27 in favor, 5 opposed and no abstentions.

The other members of the ad hoc committee were Robert K. Adair, David M. Ceperley, Alexander L. Fetter, Helen R. Quinn, and Ellen D. Williams.

The full text of the Kleppner committee report is available to APS members at http://www.aps.org/policy/reports/climate/.

The APS statement on climate change was printed in the October *APS News*, and can also be found on the web at http://www.aps.org/policy/statements/07_1.cfm. After POPA has done its review, the statement and any clarifications will be posted for member comment and input in advance of the report back from POPA to Council at the April, 2010 Council meeting.

Members Bombard Councilors with Messages on Climate Change

By Michael Lucibella

In the weeks leading up to the November 8 Council meeting, APS Councilors were inundated with emails from the membership about proposed changes to the current climate change statement. The responses were prompted by an article in the October edition of *APS News* and an independent mass email sent to a large portion of the membership soliciting input. It has been the largest response to an action of the Council in recent memory.

In November of 2007, the Council adopted a national policy statement calling for action to curb greenhouse gases and prevent global climate change. At the Council meeting in May of 2009 Councilor Robert Austin proposed an alternate statement that said that current models were not reliable enough to support climate change predictions.

This sparked a debate within the Council and the general membership about the statement. *APS News* ran an article in October describing the controversy, and told

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New APS Blog Tackles Science and Public Policy

APS's Washington DC office has launched a blog, designed to engage APS members, dealing with areas where science and public policy overlap. The Physics Frontline blog features news, articles and commentary written by the members of APS's public affairs team.

Though only in its infancy, the blog has touched on some of the current hot-button issues facing the world of science. These range from the importance of climate change legislation and science education in schools, to the many ways that particle accelerators benefit society.

As Physics Frontline continues to expand, the public affairs team plans to continue to delve into all of the major issues the Washington office focuses on, including energy planning, innovative technology, climate change, basic research funding, and nuclear policy. However the team does not want the flow of information to be a one-way street, and hopes to receive input and opinions from the members themselves.

"The blog allows for conversation, that's one of the main things we want to do," said Washington Office press secretary Tawanda Johnson, "We get feedback from our members right away through the blog."

Though designed to appeal to all members of APS, the team is making a special effort to reach out to physicists in industry. Johnson said that historically their office has had a harder time engaging these physicists on some of the issues. Reaching people who aren't APS members is a goal for the team as well, especially individuals working on science issues on Capitol Hill and in the general public.

The blog first went live on October 12th, and has already seen over a thousand unique visits to the site. Everyone at the Washington Office is contributing, with new content posted several times a week.

Getting the government to

BLOG continued on page 3

Superhero is Fellows' Surprise Guest

Photo courtesy of Charles Clark

On November 10, APS hosted a reception at its headquarters in College Park for Fellows residing in the DC region. In addition to refreshments and plenty of opportunity to mingle, Fellows were treated to a short program featuring presentations by APS President Cherry Murray, Executive Officer Kate Kirby, Editor-in-Chief Gene Sprouse, and Director of Public Affairs Michael Lubell. At the end of the program, in honor of the LaserFest celebration that will take place in 2010, a surprise appearance was made by Laser Superhero Spectra, who is featured in this year's PhysicsQuest program for middle school students, and is the star of an accompanying comic book. More information about Spectra and PhysicsQuest is available on the web at www.physicscentral.com/experiment/physicsquest/index.cfm, and more information about LaserFest is at www.laserfest.org .

In the photo, APS Fellow Charles Clark of NIST (left) tells Spectra of his plans to send copies of the comic book to his middle-school niece and nephew.

Members in the Media

"The advantage of using an accelerator is that if something goes wrong, we can switch it off,"

***Rajendran Raja**, Fermilab, on the benefits of a theorized accelerator-driven subcritical system to turn nuclear waste into fuel,* The New York Times*, October 19, 2009.*

"It is a tool that will allow us to see what was previously unseen,"

***Persis Drell**, SLAC, on the Linac Coherent Light Source,* The New York Times*, October 17, 2009.*

"Without the stimulus money, we would have sat on the sidelines,"

***Wim Pieter Leemans**, Berkeley National Lab, on the infusion of funds for the Berkeley Lab Laser Accelerator,* The New York Times, *October 17, 2009.*

"Nationally, this is the first effort to have physical scientists work together in close proximity with oncologists. This has never been done before,"

***Jan Liphardt**, UC Berkeley, describing how University of California at Berkeley is part of a new national effort to combat cancer by scientists from a variety of backgrounds,* CBS5.com, *October 28, 2009.*

"The FBI action is stupid and foolish and misguided and utterly wrong,"

***Hugh DeWitt**, Lawrence Livermore National Labs, after the FBI raided the home of former colleague P. Leonardo Mascheroni on the suspicion he was spying for Venezuela,* The Associated Press*, October 27, 2009.*

"We are interested in getting these ideas working in a real engineering system…We are looking for applications we can put into real devices, not just a paper,"

***Chuan-Hua Chen**, Duke University, after creating a material with a surface that mimics the water repellence of a lotus leaf,* Minnesota Post*, October 26, 2009.*

"He knows that in the past great things have come out of MIT, and I think what he is doing is called upon people who know the challenges, who know the possibilities,"

***Cyril Opeil**, Boston College, on the President's speech at MIT calling for more research into clean energy,* The Boston Globe*, October 23, 2009.*

"I take it as a confirmation that Einstein is still right,"

***Peter Michelson,** Stanford, on a recent experiment that showed both high and low energy photons arriving at almost precisely the same moment after travelling 7.3 billion light years,* The New York Times*, October 23, 2009.*

"The petascale supercomputer gives us the capacity to look for similarities across whole populations of acute patients."

***Tanmoy Bhattacharya**, on using the world's fastest supercomputer to create a comprehensive model of HIV's evolutionary history,* UPI, *October 29, 2009.*

"This panorama image shows stars 1,000 times fainter than the human eye can see, as well as hundreds of galaxies, star clusters and nebulae,"

***Axel Mellinger**, Central Michigan University, who created a detailed map of the Milky Way using over 3,000 photos he took around the world,* MSNBC.com*, October 30, 2009.*

"In the future we can take video of the launch environment, and the software can automatically … conclude what were the sources and the makeup of the debris."

***Philip Metzger**, NASA, on a proposed camera that can track potential threats to a rocket during launch,* U.S. News and World Report*, November 3, 2009.*

"The galactic center is the Hell's Kitchen of astrophysical forces,"

***Eliott Bloom**, Stanford,* The New York Times*, October 30, 2009.*

"[T]he evolution of life is a fact, whereas the theory explaining the evolution of life is Darwin's theory of evolution by natural selection. Unfortunately, Darwin's theory of natural selection is often called the theory of evolution, leading to unnecessary confusion with the fact of the evolution of life."

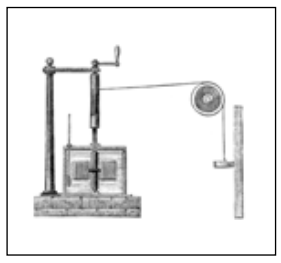
***Lawrence Woolf**, General Atomics, describing how evolution can be described as both a fact and theory simultaneously,*The New York Times "*Paper Cuts* Blog," October 23, 2009.

This Month in Physics History

December 1840: Joule's abstract on converting mechanical power into heat

Scientists in the early 19th century adhered to caloric theory, first proposed by Antoine Lavoisier in 1783 and further bolstered by the work of Sadi Carnot in 1824. The work of a brewer and amateur scientist on the nature of heat and its relationship to mechanical work would give rise to the first law of thermodynamics.

Born in 1818, James Prescott Joule came from a long line of brewers, so chemistry was in his blood – as was scientific experimentation. Described as "delicate" in contemporary accounts, he and his brother experimented with electricity by giving each other electric shocks, as well as experimenting on the servants. The two boys were tutored at home until 1834, when their father sent them to study under John Dalton, one of the leading chemists of that time, at the Manchester Literary and Philosophical Society. Two years later, Dalton suffered a stroke and was forced to retire from teaching. The Joule brothers' education was entrusted to John Davies.



Calorimeter used by Joule in his 1876 determination of the mechanical equivalent of heat.

Eventually Joule took over as manager of the family brewery, but science remained an active hobby. Fascinated by the emerging field of thermodynamics, Joule jerry-rigged his own equipment at home–using salvaged materials–to conduct scientific experiments–initially to test the feasibility of replacing the brewery's steam engines with the newfangled electric motor that had just been invented. He found that burning a pound of coal in a steam engine produced five times as much work (then known as "duty") as a pound of zinc consumed in an early electric battery. His brewery was better off with the steam engines. His standard of "economical duty" was the ability to raise one pound by one foot (the "foot-pound").

His first experiments focused on electromagnetism and he quickly showed a gift for experimental apparatus; he built his first electromagnetic engine at 19, as well as improved galvanometers for measuring electrical current. Thanks to Dalton's influence, Joule was a rare subscriber to atomic theory, and sought to explain electricity and magnetism in terms of atoms wrapped by a "calorific ether in a state of vibration."

This did not match his experimental results, however, and in December 1840, Joule published a short abstract in the *Proceedings of the Royal Society* suggesting that the heat generated in a wire conveying an electrical current results from the heat generated by the chemical reactions in a voltaic cell. In other words, heat is generated, not merely transferred from some other source in an electromagnetic engine. Based on this work, he formulated "Joule's Law," which states that the heat produced in a wire by an electric current is proportional to the product of the resistance of the wire and the square of the current.

When Joule presented these findings in a paper read before the British Association meeting in Cambridge, he concluded, "[T]he mechanical power exerted in turning a magneto-electric machine is converted into the heat evolved by the passage of the currents of induction through its coils; and, on the other hand, that the motive power of the electro-magnetic engine is obtained at the expense of the heat due to the chemical reactions of the battery by which it is worked."

In subsequent papers presented in 1841 and 1842, he quantified this heating effect, demonstrating that the total amount of heat produced in a circuit during "voltaic action" was proportional to the chemical reactions taking place inside the voltaic pile. By January 1843, he had concluded that his magneto-electric machine enabled him to convert mechanical power into heat. All of this led Joule to ultimately reject the caloric theory of heat. He also established that the various forms of energy are basically the same and can be changed from one into another, a discovery that formed the basis of the law of conservation of energy, the first law of thermodynamics.

In his most famous experiment. Joule attached some weights to strings and pulleys and connected them to a paddle wheel inside an insulated container of water. Then he raised the weights to an appropriate height and slowly dropped them. As they fell, the paddle wheel began to turn, stirring up the water. This friction generated heat, and the temperature of the water began to increase.

It was the very precision of his measurements that caused some scientists to balk at accepting Joule's findings. He claimed to be able to measure temperatures to within 1/200 of a degree Fahrenheit, which would have been astonishing to a 19th century scientist. Some historians have speculated that Joule's experience in the art of brewing may have given him skills with experimental apparatus that his colleagues lacked. He also worked with John Benjamin Dancer, England's finest instrument maker, to build highly accurate thermometers. Among those inclined to accept Joule's work were Michael Faraday and William Thomson (Lord Kelvin), although they remained skeptical.

Thomson and Joule eventually became good friends and scientific collaborators. Thomson recalled in his memoir meeting Joule and his new wife, Amelia, during a tour of Mont Blanc in 1847. Joule was carrying a thermometer and claimed he would attempt to measure the thermal effects of fluid motion in local waterfalls. Thomson joined him a few days later at the Cascade de Sallanches, but they "found it much too broken into spray" to make a useful measurement. For several years, Joule conducted experiments and sent his results in letters to Thomson, who analyzed them from a theoretical standpoint and suggested further experiments Joule might try. Among the fruits of this partnership was the Joule-Thomson effect, in which an expanding gas, under certain conditions, is cooled by the expansion.

Joule lost his wife and daughter in 1854, and lived a fairly secluded life from then on. He died on October 11, 1889, and his gravestone is inscribed with the number 772.55–his most accurate 1878 measurement of the mechanical equivalent of heat. His work did not go unrecognized: the Queen of England granted him a pension in 1878 in recognition of his scientific achievements. The value of the mechanical equivalent of heat is represented by the letter J in his honor, and the standard unit of work is the joule.

APS NEWS

Series II, Vol. 18, No. 11
December 2009

Coden: ANWSEN ISSN: 1058-8132

Editor . . . . . **Alan Chodos**
Art Director and Special Publications Manager. . . . . . **Kerry G. Johnson**
Design and Production. . . . . . **Nancy Bennett-Karasik**
Proofreader. . . . . . **Edward Lee**
Staff Science Writer . . . . . **Michael Lucibella**

APS News (ISSN: 1058-8132) is published 11X yearly, monthly, except the August/September issue, by the American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, (301) 209-3200. It contains news of the Society and of its Divisions, Topical Groups, Sections, and Forums; advance information on meetings of the Society; and reports to the Society by its committees and task forces, as well as opinions.

Letters to the editor are welcomed from the membership. Letters must be signed and should include an address and daytime telephone number. The APS reserves the right to select and to edit for length or clarity. All correspondence regarding *APS News* should be directed to: Editor, APS News, One Physics Ellipse, College Park, MD 20740-3844, E-mail: letters@aps.org.

Subscriptions: APS News is an on-membership publication delivered by Periodical Mail. Members residing abroad may receive airfreight delivery for a fee of $15. Nonmembers: Subscription rates are available at http://librarians.aps.org/institutional.html.

Subscription orders, renewals and address changes should be addressed as follows: For APS Members–Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, membership@aps.org.
For Nonmembers–Circulation and Fulfillment Division, American Institute of Physics, Suite 1NO1, 2 Huntington Quadrangle, Melville, NY 11747-4502. Allow at least 6 weeks advance notice. For address changes, please send both the old and new addresses, and, if possible, include a mailing label from a recent issue. Requests from subscribers for missing issues will be honored without charge only if received within 6 months of the issue's actual date of publication. Periodical Postage Paid at College Park, MD and at additional mailing offices. Postmaster: Send address changes to APS News, Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844.

Education Corner

A column on educational programs and publications

2010 PTEC Conference

The 2010 Physics Teacher Education Coalition (PTEC) Anuual Conference will be held on February 12 and 13 in Washington, DC, in conjunction with the APS "April" Meeting, the AAPT Winter Meeting, and the National Society of Black Physicists/National Society of Hispanic Physicists Joint Annual Meeting. The theme of the conference will be "Diversity in Physics Education: Preparing Teachers for the 21st Century." National leaders in physics teacher education will lead workshops focusing on:

- Diversity in teacher recruitment
- Preparing teachers for urban schools
- Closing the achievement gap
- Funding teacher education programs
- Collaborating across the sciences
- Teaching pedagogical knowledge

The conference will also feature the first release of findings from the joint APS/AAPT/AIP Task Force on Teacher Education in Physics, in addition to several plenary talks, a contributed poster session, and time for informal collaboration and networking. For more information and to register, please see www.PTEC.org/conferences/2010

Upcoming Events

High School Physics Teachers Days

The APS Education and Diversity Department will run its annual High School Physics Teachers Days at the upcoming joint APS "April" Meeting/AAPT Winter Meeting in Washington, DC and the APS March Meeting in Portland, OR. Teachers Days offer presentations on physics research, hands-on workshops on teaching, and lunch with physicists–all at no cost to teachers. By bringing teachers and physicists together, APS hopes to encourage collaborations between these two groups. Physicists in the Washington or Portland areas are invited to attend the Teachers Day lunch at their respective local meeting. To sign up, please send an email to Ed Lee at lee@aps.org

High School Laser Activity

The April Meeting Teachers Day, which is co-sponsored by AAPT, will feature the debut of a unit of laser activities for high school physics students, which was developed by APS staff as part of LaserFest. Working with laser pointers, participants will investigate the properties of laser light, explore a few of its applications, and work through the PhET laser simulation developed at the University of Colorado at Boulder. Participating teachers will receive kits of workshop materials. The workshop will also be offered at the March Meeting Teachers Day and other APS meetings next year.

Future Physicist Days

APS, the Society of Physics Students (SPS), and the Council of Undergraduate Research (CUR) jointly run Future Physicist Days for undergraduates who attend the APS March and April Meetings. The program includes a welcome lunch featuring presentations on physics careers; sessions of undergraduate oral and poster research presentations; and an awards reception featuring SPS's Physics Jeopardy!™ Undergraduate registration at both these meetings is free, and travel supplements of $200 are available for undergraduates who present at the meetings. For more information, go to www.aps.org and search on "future physicist days".

Minority Scholarship Program

APS is proud to offer once again its Scholarship for Minority Undergraduate Physics Majors, which provides both funding and significant mentoring to selected under-represented minority students. Any African-American, Hispanic-American, or Native American US citizen or permanent legal resident who is majoring or plans to major in physics and who is a high school senior, college freshman, or college sophomore is eligible to apply. The application for 2010-2011 scholars can be found at www.aps.org/programs/minorities/honors/scholarship/ and is due February 5, 2010. APS encourages faculty members and high school teachers to alert their eligible students to this opportunity.

The Red and the Black

Photo by Ken Cole

The November Council meeting was the last one that past-President Arthur Bienenstock (left) attended as a member of the Presidential Line. To commemorate his four years of service, APS Executive Officer Kate Kirby presented Bienenstock with what she described as "bedtime reading": a bound volume of the minutes of the five Executive Board and two Council meetings that he chaired during his Presidency in 2008.

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members to contact their Councilors if they wanted to weigh in on the issue.

The article said, "Members who wish to provide their input on these issues prior to the Council meeting on November 8 can do so by contacting an appropriate member of Council."

Council members said they soon started receiving a few emails following the publication of the article.

"There was a trickle for a while; then the floodgates opened," Council member James Brasseur said. "It's been overwhelming."

On the morning of Monday November second, APS Fellow Harold (Hal) Lewis sent an email to a large number of APS members. The message contained the original statement the Council adopted in 2007, a link to the petition with the new statement, and the email addresses of 30 Council members.

"We urge you to let the Councilors know if you believe the Statement is a fair representation of the scientific position through an e-mail to any or all of them," the message read, "Since the addressees of this note represent only a sample of the membership, we would also urge you to pass this on."

Members of the Council were soon inundated with emails. Councilors Brasseur and Gay Stewart estimated that they each received around two hundred emails from members. Austin, whose name appeared on the original inciting email, figured he may have received as many as twice that.

Brasseur organized and categorized the first 180 messages he received to gauge the overall sentiments of the membership that responded. He found that 63 percent of respondents supported the existing statement with little or no change, while 37 percent said they opposed the current statement and wanted either no statement or the alternate statement adopted. Stewart and Austin said that while they had not crunched the numbers as precisely, they felt they had received a similar proportion of pro and anti statements.

"The number in support of the current statement is far larger than those against," Stewart said, "At least two to one for."

The message had the signatures of Hal Lewis, APS Fellow Roger Cohen, and Councilor Robert Austin at its bottom. The email was not an official APS-sanctioned action, and it is unclear where the senders got the email addresses of the membership. Austin said that he had nothing to do with the message's circulation.

"It was really Hal and Roger that did it," Austin said, "It [my name] probably shouldn't have been on it I suppose."

The controversy prompted debate among the Council about how national policy statements are adopted, and what role the general membership should play. Austin said that he thought it was positive that the membership took an active role in the debate over the statement, and that he hoped to see this level of participation continue.

"I think it's very beneficial," Austin said, "I think the Council needs to be aware of what the membership feels about the statements."

He added that he hoped that the controversy over the statement would prompt the Council to amend the constitution to include a way to involve the membership before adopting an official statement. He said that overall he wanted to see more openness about the process and to let the membership weigh in on statements before they're adopted.

Other Council members are concerned about too much general involvement. Brasseur said that while he supported better informing the membership on actions of the Council, he was uncomfortable with the idea of a membership-wide referendum on statements. He said that he was concerned that having a membership wide vote on controversial issues could lead to the adoption of scientifically unsound statements.

"Should [the process] be a democratic one or a science-based one?" Brasseur said, "I'm totally against the idea of a democratic poll of the membership."

The Council asked the Constitution and Bylaws Committee to deliberate possible changes to the process of deciding official APS statements. Their recommendations are expected at the next Council meeting in April.

BLOG continued from page 1

properly address concerns about the future of energy and the environment is a major focus of APS's advocacy team, and is likewise a prominent topic on their blog.

"As the Senate kicks off debate on climate change legislation, one holdover from the House discussions remains: Does the bill include adequate R&D funding for new energy technologies?"

Jodi Lieberman, senior government relations specialist, wrote in an early post, "If the U.S. is going to achieve emissions targets… then we absolutely must continue to develop advanced energy technologies to accomplish the goal."

In addition to blogging about issues facing science, the blog also features perspectives on what it's like to advocate for science. Brian Mosley, the office's legislative correspondent, has been writing an ongoing series debunking popular myths about public advocacy.

"Scientists are often taken aback after I explain that being polite is the best way to have a productive meeting with elected officials," Mosley wrote in a recent post "It's important to remember that as a constituent (AKA: a voter), you are the representative's boss. Representatives and staffers know this and are going to be as helpful as possible."

The blog can be accessed at http://physicsfrontline.aps.org/.

Letters

Teacher Incompetence Plays a Role

Although I share Joseph Ganem's concern and experiences [*APS News* Back Page, October 2009], with both teaching undergraduates and helping my own children with high-school mathematics, his conclusion does not follow from his observations. Yes one must teach age-appropriate concepts, but he offers no evidence to support the popular theory he espouses that the cause of inappropriate teaching is an "adult obsession with testing."

My own view is that, in mathematics particularly, the main cause of inappropriate teaching is incompetent teachers. It seems hopeless to me to expect students to learn concepts of trigonometry, calculus, or linear algebra from teachers who don't themselves understand them. What appears to happen (by my observations) is that the teachers don't teach or explain them. They tell the students to read the textbook and set them exercises. (The interesting personal examples Ganem relates support this view more than his own.) In today's internet and mass-media culture, this approach is even less likely to succeed than ever.

It has been established by "new math" experiment and study over many years that children in their mid teens are able to master mathematical concepts that to their parents seem very advanced, when properly taught. If the problem really is testing, then one would expect students in countries in Europe, or, for example, China, where testing is even more emphasized than the US, to produce students weak in mathematics. The opposite appears to be true. While I can't say whether the school mathematics curriculum in Maryland is appropriately sequenced, or should be adjusted, I will say that attacking the idea that mathematical competence can and should be measured hardly seems likely to enhance the understanding and accomplishment of our young people in mathematics.

Ian Hutchinson
Cambridge, MA

Joseph Ganem responds:

I would not disagree with the assertion that the quality of math teachers could be improved at the high school level. However, the stories I told about the teachers were not meant to disparage them, or their abilities. My intent was to illustrate that the curriculum had become so advanced that the math problems in it challenged me. I do not expect a high school teacher to have the depth of understanding of math that I have. Maybe a competent high school math teacher should know math at the level of a professional physicist. But, I don't think my level of understanding is necessary for a high school teacher using an age-appropriate curriculum. Without an age-appropriate curriculum, it is difficult to judge the competence of the teachers.

It was also not my intent to suggest that math achievement not be tested and assessed. I believe that we should test for student math achievement. I am attacking an educational mindset, in which test scores are not measures of learning outcomes; the test scores are the outcomes. While that distinction might be subtle, it has real effects on how classes are taught and in the messages we communicate to students about the goals of an education. Tests are measurement tools; they should not be the reasons that students come to class.

Bad Schools Lead to Math Paradox

As a member of the physics faculty at UCSD and father of two daughters, I share the experiences that Joseph Ganem describes [Back Page, October *APS News*]. Nevertheless, I think his extrapolation is incomplete. My daughters are lucky. They have attended some of the best public schools in San Diego county. As a result, they have been exposed to math at every step of the way that was challenging for them, and fun for me.

However, that's not the education that the vast majority of incoming students have received when they enter UCSD.

A few years back, I volunteered to participate in the interviews for hiring new math and science teachers at a startup Charter School.

This gave me a thoroughly different perspective on the San Diego school district, as I got to interview teachers with shockingly different backgrounds and daily routines. Quite honestly, it scared the living daylights out of me.

Maybe the reason for the math paradox Ganem describes is simply that 49% of the incoming students at colleges in Maryland have not had the privilege of attending decent public schools. Maybe the reason for the problems we see among the incoming classes at our Universities is that there is too little standardization in high school. When I think back to my own high school experience in Germany, there was no need for an SAT, no need for a math entrance exam at Heidelberg University. My peers and I knew where we stood in math. All we needed to look at was our math and physics grades in the high school exit exam.

Frank Wuerthwein
San Diego, CA

Math Misery Loves Company

Kudos to Joseph Ganem on the wonderful article on the Back Page of the October 2009 *APS News*. I'm glad to know I'm not the only one having a hard time with math! I got all the way through college algebra in high school and was placed into remedial math in college, only three months after graduating high school! I'll graduate this year (B.S. Physics) on the five year track, thanks to the first "no math no physics" year of my college career.

John Metcalf
Huntsville, UT

INSIDE THE BELTWAY

Sustainability or Not

by Michael S. Lubell, APS Director of Public Affairs

Performing without a safety net became the trademark of the Flying Wallendas, who debuted their unplanned "netless" high-wire act in Madison Square Garden in front of an awestruck New York audience in 1928. Now, 81 years later and 204 miles further south, the Obama White House is trying to edge its way across another yawning void, and its audience is the entire world.

With the House of Representatives having cleared healthcare legislation and the Senate pursuing its predictably erratic and isolated course, the President is finally beginning to focus on sustainability. It isn't climate change –as important as it may be–that has captured his attention. It's the fiscal balancing act he must perform, if our nation and the world are to avoid a devastating fall.

A few quick numbers tell the story. The national debt shortly will surpass $12 trillion, just about equal to the gross domestic product. And unless we mend our ways, we will soon exceed the peak debt to GDP ratio of 121 percent that was part of our World War Two legacy.

Equally alarming today, foreign nations own more than a quarter of our national debt. China alone holds $800 billion of Treasury obligations, and Japan carries $750 billion on its books.

Having China as a primary creditor has its consequences, not all of them benign. In October, the Dalai Lama, Tibet's spiritual leader, visited Washington but didn't find the White House welcome mat put out for him. It was the first time in twenty years that an American president refused to meet with the Tibetan Nobel Peace Laureate, since he began making pilgrimages to the banks of the Potomac.

Administration representatives admitted that the snub was intended to curry favor with China, which has been increasingly at odds with Tibet. The lesson is clear: Don't cross your principal creditor if you're not prepared to declare bankruptcy.

I know no economists who believe that our current path will lead to any promised land, spiritual or otherwise. From the far right to the far left they all say that we must radically reduce deficit spending as soon as our economy has recovered.

William Galston, a senior fellow at the Brookings Institution, a former domestic policy advisor to President Bill Clinton and an unabashed liberal, testified before the

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zero gravity

The 2009 Ig Nobel Prizes

The 2009 Ig Nobel Prizes honoring "research that makes people laugh then think" were awarded to the pinnacle of unusual, outlandish and downright wacky research over the last year. Before a sold-out crowd at the Sanders Theater in Harvard University, Nobel Laureates Wolfgang Ketterle, Paul Krugman, and Orhan Pamuk presented the Ig Nobel winners their awards.

The ceremony was organized by the humor magazine *Annals of Improbable Research* and co-sponsored by the Harvard-Radcliffe Society of Physics Students, the Harvard-Radcliffe Science Fiction Association, and the Harvard Computer Society. A complete report of the ceremony, including photos, videos, and links to the winners' research is available on the *Annals of Improbable Research's* website, www.improbable.com.

The 2009 winners are…

PHYSICS PRIZE

Katherine K. Whitcome of the University of Cincinnati, USA, Daniel E. Lieberman of Harvard University, USA, and Liza J. Shapiro of the University of Texas, USA, for analytically determining why pregnant women don't tip over.

VETERINARY MEDICINE PRIZE

Catherine Douglas and Peter Rowlinson of Newcastle University, Newcastle-Upon-Tyne, UK, for showing that cows who have names give more milk than cows that are nameless.

PEACE PRIZE

Stephan Bolliger, Steffen Ross, Lars Oesterhelweg, Michael Thali and Beat Kneubuehl of the University of Bern, Switzerland, for determining–by experiment–whether it is better to be smashed over the head with a full bottle of beer or with an empty bottle.

ECONOMICS PRIZE

The directors, executives, and auditors of four Icelandic banks –Kaupthing Bank, Landsbanki, Glitnir Bank, and Central Bank of Iceland–for demonstrating that tiny banks can be rapidly transformed into huge banks, and vice versa–and for demonstrating that similar things can be done to an entire national economy.

CHEMISTRY PRIZE

Javier Morales, Miguel Apátiga, and Victor M. Castaño of Universidad Nacional Autónoma de México, for creating diamonds from liquid–specifically from tequila.

MEDICINE PRIZE

Donald L. Unger, of Thousand Oaks, California, USA, for investigating a possible cause of arthritis of the fingers, by diligently cracking the knuckles of his left hand–but never cracking the knuckles of his right hand–every day for more than sixty (60) years.

LITERATURE PRIZE

Ireland's police service (An Garda Siochana), for writing and presenting more than fifty traffic tickets to the most frequent driving offender in the country–Prawo Jazdy–whose name in Polish means "Driving License."

PUBLIC HEALTH PRIZE

Elena N. Bodnar, Raphael C. Lee, and Sandra Marijan of Chicago, Illinois, USA, for inventing a brassiere that, in an emergency, can be quickly converted into a pair of protective face masks, one for the brassiere wearer and one to be given to some needy bystander.

BIOLOGY PRIZE

Fumiaki Taguchi, Song Guofu, and Zhang Guanglei of Kitasato University Graduate School of Medical Sciences in Sagamihara, Japan, for demonstrating that kitchen refuse can be reduced more than 90% in mass by using bacteria extracted from the feces of giant pandas.

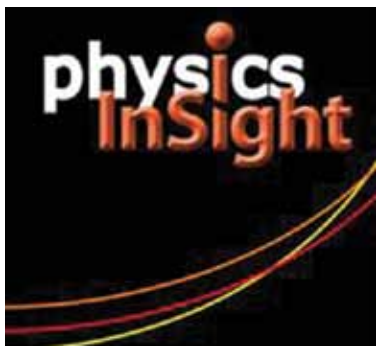
APS Launches Slide Shows for Undergrads

By Gabriel Popkin

Physics InSight is a new APS multimedia project that will inform and excite undergraduates about careers and opportunities in physics. It involves a series of slide shows designed to be shown in venues frequented by potential physics majors, such as hallway displays in university science buildings.

One of InSight's main purposes is to expose students to a range of exciting contemporary physics research areas. The October 2009 edition features research on "relic neutrinos" from the Big Bang, the acoustical properties of the violin, and laser-based techniques to develop new treatments for injuries. Along with images of research projects, InSight includes photos of and information about prominent research scientists. Links for more information are provided on each slide.

InSight also profiles so-called "hidden physicists," who have jobs outside academia. For example, the most recent edition highlights a medical facility manager, a wind energy engineer, and an astronaut, all of whom have degrees in physics. "Physics professors are very knowledgeable about academic career paths, but are often less aware of the other jobs out there that are also available to physics degree recipients," says Crystal Bailey,



Education and Careers Program Manager at APS, who manages the InSight project. "InSight is designed to inform students about physics careers that are possible at all stages of the degree path."

In addition, InSight provides information about opportunities for undergraduates, including Future Physicist Days at APS meetings, summer internships with the Society of Physics Students, and APS Minority Scholarships.

"One of the things we did to make the InSight shows more useful is make them open-source," says Bailey. "We encourage faculty to add their own slides and highlight their department's research activities and programs."

Kevin Giovanetti, a faculty member at James Madison University in Harrisonburg, VA, is an early adopter of the slide show. He says, "We have InSight on display in our building's entry way, and I enjoy seeing it as I enter each morning. It receives a lot of traffic and is a great way of advertising physics. We merge the APS show with some local news."

"Physics InSight is part of APS's efforts to double the number of undergraduate physics majors," says Theodore Hodapp, Director of Education and Diversity at APS. "By providing information on career opportunities and programs directly to undergraduates, we are hoping to bring in students who in the past might not have given much thought to studying physics."

To download the most recent version of InSight, visit www.aps.org/careers/insight.

Accelerators Are Ubiquitous but Unsung

In late October, dozens of the country's top particle accelerator physicists assembled in Washington, DC to discuss issues facing their field. The three-day "Accelerators for America" symposium, sponsored by the Department of Energy's Office of High Energy Physics, served as an open forum for physicists to confer about matters ranging from improving the public perception of science, to sharing new uses for particle accelerators in industry, medicine and national security.

The opening day's speakers set the tone by emphasizing how accelerators are integral to many of the United States' scientific advancements, but much of the American public is unaware of their importance. Norman Augustine, the retired chairman and CEO of Lockheed Martin, said that high energy physics serves the public both directly and by driving innovation, but it was sometimes hard for the public to see that tie.

"The connection between the work and the research and the connection to the public, to the taxpayers, is probably less apparent than in the biological sciences," said Augustine. "Science is at the very root of innovation in this country and anywhere else in the world…I can think of no field more exciting, more brain-stretching and more demanding than particle physics."

Several of the speakers referred to a recent meeting of the House Science and Technology subcommittee on energy and the environment where Chairman Brian Baird (D-Wash.) questioned the value of funding for big accelerators such as the US share in the Large Hadron Collider and the long defunct Superconducting Supercollider.

"We've got thousands of other problems and the money we spend on the big gizmos you folks [accelerator physicists] work with, is money we can't spend on other things that might actually have more immediate and more direct benefit to the society and the economy that are in trouble."

Dennis Kovar, associate director of the Department of Energy's Office of High Energy Physics, responded to the congressman's question by saying that the general public benefits from the numerous applications of accelerator beams, and that the scientific community needed to do a better job of conveying those benefits. In the opening talk of the symposium, Kovar said that "Particle accelerators serve the nation today in many ways."

H. Frederick Dylla, Executive Director and CEO of the American Institute of Physics, echoed this sentiment and also referenced the chairman's question during his talk to the symposium. He said that one of the major goals of the symposium was to help people show how and why particle accelerators are important to the public.

"Our community needs to do a better job of communicating the value of these machines," said Dylla, who, before joining AIP, was Chief Technology Officer and Associate Director for the Free-Electron Laser program at Thomas Jefferson National Accelerator Facility.

Speakers spent much of the rest of the day highlighting the importance of particle accelerators to society. A major point that several speakers tried to get across was the large but often overlooked role of particle accelerators in medicine. Cancerous tumors were first treated with accelerated particle beams in 1961, and medical accelerators were first installed at top hospitals in 1990. Jurgen Debus from the University of Heidelberg said that the proton irradiation therapy for ocular melanoma developed at the Harvard Cyclotron has a nearly 95 percent success rate. He pointed also to ongoing research into carbon ion and helium ion beams that can penetrate deeper with better focus than current proton beams.

"Accelerators have saved more lives than any other biomedical device," said Tom Katsouleas, Dean of the Pratt School of Engineering at Duke University.

Speakers pointed out the importance of particle accelerators in industry as well. Particle beams are used to strengthen carbon fibers, sterilize food products, and even make the next generation of efficient solar cells. Indirectly, accelerator development has led to countless new offshoot technologies and enhancements, such as new materials and detectors.

"Almost all of the electronic devices we use have an accelerator somewhere in the background," said Bill Barletta of MIT, "Many of these applications are derived from our basic interest in the fundamental nature of matter."

Focus on APS Topical Groups

New Group Focuses on Energy Research

By Lauren Schenkman

The Topical Group on Energy Research and Applications is only a few months old, but its members are already working hard to connect the many types of physicists investigating how to generate, store, use, and transmit energy in a world with diminishing resources.

"Energy now is one of the major national or international issues that interest a broad range of scientists and engineers. It's important to our society and the environment," said GERA interim secretary and treasurer Joseph Poon of the University of Virginia. "APS has this topical group to have physicists engage [with] this problem and contribute to solving it."

GERA was conceived in December of 2008, when Judy Franz, then executive officer of the APS, raised the possibility of forming an energy topical group in an email to division members.

"A couple of years ago I noticed there was a tremendous interest among young physicists in energy and the role they could play," she said. In 2007 and 2008 Franz initiated workshops on energy research for graduate students and post-doctorates at the March Meeting, and in both years it attracted many more attendees than could be accommodated. "This led to me to think there was probably an interest in the physics community as a whole, and one way to focus that would be a topical group."

Over a thousand members responded in favor of creating a topical group on energy research. "It was clear that this was something people wanted APS to do," Franz said.

Since becoming an official topical group in May, GERA has grown to about 140 members from across the spectrum of physics.

Energy research involves different disciplines and different length scales so we have to think about it very broadly," "Poon said. "The topical group will help to stimulate discussions among physicists who do all kinds of things."

That's just what GERA has set out to do this year, said interim chair Robert McGrath, who recently retired as provost of Stony Brook University. The group has planned an exciting program of energy-related activities for the 2010 April and March Meetings.

"That's when we're really going to launch things," McGrath said.

At the "April" Meeting in February in Washington, DC, GERA is sponsoring an invited session of broad overview talks on sustainability, nuclear energy, and the importance of alternative energy to national security. A second session co-sponsored with the Division of Physics of Beams explores energy applications of beams and particle accelerators. Attendees interested in energy issues can also look forward to a plenary talk on climate change and the possibility of talks by senior government officials that touch on energy research subjects, McGrath said.

At the March Meeting, GERA is sponsoring an invited session of talks on a broad range of topics on energy research and applications ranging from the role of basic science on our energy future to energy materials design and discovery, and to materials tolerance under extreme conditions. A second invited session co-sponsored with the Division of Materials Physics focuses on the current status and future of materials for solar to electricity conversion. GERA rounds out the program with four focus sessions co-sponsored with the Division of Materials Physics, Division of Polymer Physics, and Forum on Industrial and Applied Physics on hot topics in energy research.

The two-year tradition of a March Meeting energy workshop for graduate students and post-doctorates will continue this year under GERA's auspices. The workshop will feature a panel of speakers from industry, the national laboratories, and academia, exploring the status and prospects of a wide variety of budding renewable energy technologies.

"Mostly it's going to focus… on how does one enter the field of energy research, what are the prerequisites, and the funding outlook," said Julia Hsu of Sandia National Laboratory. "The committee chooses…people we know will give a good introductory talk and who are energetic speakers… young physicists will be interested." Hsu, who helped organize the first two workshops, urged interested graduate students and postdoctoral researchers to apply as soon as possible since seats are limited.

McGrath said GERA is currently preparing for fall elections and planning to publish an electronic newsletter via the web to make it easy for physicists to stay abreast of recent developments across disciplines.

McGrath said he hopes that coming years will see GERA expanding on their current activities and growing as a group.

Poon said that GERA, besides linking diverse fields, helps recognize the importance of basic energy research. "We cannot depend on just existing materials and systems alone," he said. "We need to continue to discover new things and have breakthroughs, so basic research is a very important component."

Hallowe'en Treat

Photo by Ken Cole

Sorters for the APS "April" Meeting met early this time around, because the meeting will, in fact, take place in mid-February. Just before Hallowe'en, over 20 sorters met at the American Center for Physics in College Park, Maryland. Here Patricia McBride of Fermilab (right), and Kara Hoffman of the University of Maryland contemplate a few of the more than 1,100 abstracts that were submitted.

Viewpoint...

A Math Makeover: Closing the Gap Between High School and College Math

By Tao Pang

In his Back Page article in the October *APS News*, Joseph Ganem has correctly identified the widening gap between high school and college math. Here I want to focus on the poor outcomes of college math classes and suggest a few strategies that can be adopted to improve the situation.

Over nearly two decades, I have witnessed a steady decline of math readiness of college students in my general physics classes. How bad is it? A couple of years ago, I started conducting a math background survey in my general physics classes. The survey questions included all necessary math elements for the course and the results indicated that nearly half of these students could not carry out simple arithmetic operations.

According to a recent report from the Brown Center on Education Policy at the Brookings Institution, researchers have found that the misplaced math student in eighth-grade algebra class is at the level of third grade if not worse. My math survey result is consistent with the findings of the Brown Center; half of the college students have not learned more math since third grade.

There is also a sharp contrast found between the students well-prepared in math and the others. For example, the students who had 50% or more correct answers in my math survey showed a strong correlation between knowing more math and learning more physics. Thus students better prepared in math do better in college classes and will more likely finish their degrees.

What can we do to improve the situation? First is how to improve the preparatory math education. Certain basic concepts, such as the order of arithmetic operations, fractions, percents, and square roots, taught at elementary school or middle school, should be reinforced over the course of the math education in high school and beginning college classes. Geometry is a fundamental subject that needs to be reinforced in beginning college mathematics before trigonometry is taught.

A two-tier precalculus course can help both well-prepared and lost students. A placement test can be used to admit students into fast-track one-semester precalculus. Others should take a one-year course that will give them more time to catch up without delaying them from taking the course. Adequate resources should be directed to math education by hiring more competent teaching assistants for the classes. Assign the best instructors to teach these courses and award them with merit, reduced teaching or service load, or teaching assistance. Mandate recitation for the slow-paced course. The goal of recitation is to help students one by one to catch up in arithmetic, prealgebra, or whatever is needed to move them to a better level in math. For some, this may just mean that they will learn how to add and multiply, and that's it. For others, this can be an opportunity for them finally to learn how to solve an equation.

How can we improve the learning of the students in a typical physics class given their weak math background and time constraint? A quick overview of the basic skills in mathematics at the beginning of the course is a good starting point. A small number of well selected exercises can be helpful, too. A similar review, with calculus included, can also be devised for students taking a calculus-based physics course. A handout that summarizes the math needed is another effective tool. A set of well compiled web links suits this generation of students even better.

In my general physics class, I usually take a three-step approach to a subject. I start with some cartoons and sketches to illustrate a new concept. Then I try to describe the concept as accurately as possible in words. The final step is to introduce the concept with the

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Gallagher Confirmed as NIST Director

Patrick Gallagher was confirmed as the 14th Director of the National Institute of Standards and Technology by the U.S. Senate on November 5th. Gallagher will oversee all operations at both the Gaithersburg, Maryland and the Boulder, Colorado facilities. He had already assumed most of the administrative responsibilities when named its Deputy Director in September 2008. Gallagher said that he was "humbled and honored" to be named Director of the Institute.

"NIST is at an important juncture in its history," Gallagher said, "We have a world-class workforce, state-of-the-art research facilities, and the opportunity to make a real difference helping find practical, innovative solutions to some of the nation's toughest technical challenges."

With a budget of $1.6 billion and 2,900 employees, NIST's mission is to help strengthen the U.S. economy by advancing science and technology. With a PhD in physics from the University of Pittsburgh, Gallagher first came to NIST's Center for Neutron Research in 1993 to further develop neutron and X-ray instrumentation as well as to study the properties of soft condensed matter in polymers, liquids and gels. In 2000 he became the agency's representative at the National Science and Technology Council, and later was named chair of the Interagency Working Group on neutron and light source facilities under the President's Office of Science and Technology Policy.

Laser Science Meeting Features Beetles and Fast X-Rays

APS's Division of Laser Science held its annual meeting in conjunction with the Optical Society of America's Frontiers in Optics in San Jose from October 11th through the 15th. The meeting featured presentations on the latest research in optics and photonics.

Green Scarab Beetles: Invited speaker Mohan Srinivasarao from Georgia Tech presented his research showing how the iridescent scarab beetle *Chrysina gloriosa* selectively reflects circularly polarized light. Tiny spiral etchings in the beetle's exoskeleton about ten nanometers in diameter cause only left-handedly polarized light to reflect, giving the beetle a shimmering green metallic luster. Biologists still aren't entirely sure what the scarab beetle has to gain from its polarizing shell, or even if it is able itself to distinguish the difference between different handed polarizations of light.

Femtosecond X-Ray Pulses: Ultra-fast beams of X-rays can reveal details about a material's molecular structure that optical observations can't. Harry Ihee from KAIST in South Korea described how femtosecond pulses can show with unprecedented accuracy how the molecular bonds form and evolve over time. Steven L. Johnson from the Paul Scherrer Institut in Switzerland showed how observations of an emerging crystalline structure using these femtosecond laser pulses can yield surprising results. SLAC's David Fritz updated attendees on the construction of the X-ray Pump Probe Instrument, due to be completed at the Linac Coherent Light Source in the fall of 2010.

Detecting Gravitational Waves: Nergis Mavalvala of MIT has been helping to develop instruments that can detect gravitational waves at the Laser Interferometer Gravitational Wave Observatory. Predicted by Einstein's theory of relativity, gravitational waves cause an object to expand and contract as they propagate through space-time. These effects are so minuscule they usually get lost among an object's noisy thermal vibrations. Mavalvala described how lasers can optically trap and cool large macro-sized objects to dampen out nearly all thermal vibrations to make detecting gravitational waves and also delicate quantum effects possible.

Imaging Gene Transcription: Christopher Fecko from the University of North Carolina at Chapel Hill has been able to resolve a DNA strand transcribing its genetic sequence into a corresponding RNA strand. Using multiphoton microscopy, a process where light penetrates deep into living tissue, Fecko explored movement of proteins inside the living cells of a fruit fly. The major research focus for him and his team at Chapel Hill has been to develop new and better techniques to image the inner workings of biological systems.

DNP Holds Third Joint Meeting with Japan

This year, APS's Division of Nuclear Physics held its third joint meeting with the Physical Society of Japan, on Hawaii's Big Island from October 13th to the 17th. Over 900 scientists attended ninety-three sessions (plus one luau) presenting the latest research in all areas of nuclear physics including nuclear astrophysics, hadronic physics, and quantum chromodynamics.

Wednesday morning's plenary sessions gave participants an inside look at where nuclear physics has been and where it is headed in the future. Stuart Freedman from UC Berkeley gave a brief history of neutrinos and suggested a roadmap for future developments. Duke University's Berndt Mueller showed how Brookhaven's Relativistic Heavy Ion Collider (RHIC) has revolutionized the field of Quantum Chromodynamics, and speculated about possible discoveries still in store. Similarly, Tomofumi Nagae from Kyoto University briefed attendees as to how Japan's recently completed Proton Accelerator Research Complex (J-PARC) is poised to take its place as a leader in the field for investigating nuclear strangeness.

International collaborations are becoming more and more prominent throughout nuclear physics as particle accelerators grow in size and expense. Individual governments can scarcely afford to fund big science projects without support from other nations. Nowhere is this more evident than with CERN's Large Hadron Collider, which straddles the border between Switzerland and France. At a cost of over $6 billion to build and with a diameter of over five miles, twenty member nations and six observer nations have joined together to bring the world's largest science experiment to fruition.

Ken Oyama from the University of Heidelberg highlighted how over 1000 physicists from 105 separate institutions have come together to study the nuclear collisions at the LHC's ALICE experiment. He said that the experiment has huge potential to shed new light on the persisting mysteries of quantum chromodynamics once proton collisions start up in mid-December and ion collisions commence sometime next year. When the collider is running, Hisayuki Torii from Hiroshima University said that the advanced photon detectors within ALICE will be able to measure the thermal photons of a heavy ion collision with unprecedented accuracy, continuing work started at RHIC.

Since the meeting was joint with the Physical Society of Japan, speakers emphasized the collaboration between the two nations. A brief history of these partnerships was described by Akito Arima, chairman of the Japan Science Foundation. He showed how the early collaborations between UC Berkeley and the Institute for Nuclear Study at the University of Japan led to the first rare isotope beam experiments, ultimately laying the groundwork for RHIC. David Dean of Oak Ridge described how today, the Japan-United States Institute for Theoretical Physics with Exotic Nuclei (JUSTIPEN) at RIKEN works to bring together theoretical physicists from both sides of the Pacific.

A neutrino's minuscule mass allows these peculiar particles to travel through vast amounts of solid matter without interacting

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For International Year Of Astronomy:

The Universe Brought To Your Doorstep

Well, at least expert talks about the universe and its contents! The Committee on Status of Minorities in Astronomy (CSMA) of the American Astronomical Society, Las Cumbres Observatory (LCO), the University of Texas at Brownsville (UTB), and members of APS's DAP, GGR, FHP, and others are cooperating in an attempt to share the excitement of the cosmos with four-year colleges and other interested groups and organizations.

• ***Ask for what you want (topic, time frame, location), mention any cost sharing you can manage, and we will attempt to find someone who is a good fit.*** The person will typically come for a day to speak with one or more classes, groups of students, faculty, and so forth. There is no need to arrange a large public talk (though it is not forbidden)–we are not trying to compete with programs that do this.

• ***Possible topics might be cosmology, black holes, supernovae, relativity, life in the universe, history of astronomy/astrophysics, etc.*** We have the experience to do this, because most of our team was involved in a 2005 World Year of Physics speakers' bureau that achieved similar goals.

• ***To request a speaker, please go to our UTB web site:*** http://arcc.phys.utb.edu/web/LasCumbres/REQUESTS/howto.html. If perchance you are willing to be a speaker, please get in touch with one or more of the contact folks below.

Richard Price (UTB, Richard.Price@utb.edu)
Keivan Stassun (SCMA, Keivan.Stassun@vanderbilt.edu)
Virginia Trimble (LCO, vtrimble@astro.umd.edu)

childcare grants available!

small grants of up to $400

who is eligible

Parents/caregivers who plan to attend the APS March or April (February) meeting with their small children or who incur extra costs to bring them along or leave them at home. Preference is given to early career applicants.

deadline

Apply by Dec 15 (for February) or January 15 (for March)

March Meeting details at
http://www.aps.org/meetings/march/services/index.cfm

April Meeting (February) details at
http://www.aps.org/meetings/april/services/index.cfm

These grants are made possible by funds from the Elsevier Foundation and the American Physical Society.

ANNOUNCEMENTS

Now Appearing in RMP: Recently Posted Reviews and Colloquia

You will find the following in the online edition of *Reviews of Modern Physics* at http://rmp.aps.org

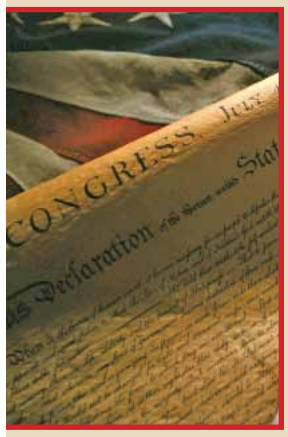
The physics of heavy *Z* gauge bosons

Paul Langacker

Extensions of the standard model allow for the existence of heavy neutral gauge bosons *Z* with different masses and couplings. This article focuses on the theory and phenomenology of the *Z*. Present limits from electroweak and collider experiments are presented, as are prospects for discovery at future colliders. Implications of existence of various *Z* particles on the extended Higgs sector, supersymmetry, and flavor changing neutral currents are discussed as well as the interplay with neutrino physics, implications for baryogenesis, and cold dark matter. With the start up of the LHC, this article serves as a reference for the theoretical underpinning of the searches for heavy neutral gauge bosons.

APS Congressional Science Fellowship 2010-2011

THE AMERICAN PHYSICAL SOCIETY is currently accepting applications for the Congressional Science Fellowship Program. Fellows serve one year on the staff of a senator, representative, or congressional committee. They are afforded an opportunity to learn the legislative process and explore science policy issues from the lawmakers' perspective. In turn, Fellows have the opportunity to lend scientific and technical expertise to public policy issues.



QUALIFICATIONS include a PhD or equivalent in physics or a closely related field, a strong interest in science and technology policy, and, ideally, some experience in applying scientific knowledge toward the solution of societal problems. Fellows are required to be US citizens and members of the APS.

TERM OF APPOINTMENT is one year, beginning in September of 2010 with participation in a two-week orientation sponsored by AAAS. Fellows have considerable choice in congressional assignments.

A STIPEND is offered in addition to allowances for relocation, in-service travel, and health insurance premiums.

APPLICATION should consist of a letter of intent of no more than two-pages, a two-page resume, with one additional page for publications, and three letters of reference. Please see the APS website (http://www.aps.org/policy/fellowships/congressional.cfm) for detailed information on materials required for applying and other information on the program.

ALL APPLICATION MATERIALS MUST BE SUBMITTED ONLINE BY JANUARY 15, 2010.

MEETING continued from page 1

The division of polymer physics will be organizing a series of pre-meeting courses, on the 13th and 14th, about the uses of polymers for energy generation and storage, ranging from basic battery operation and electrical transport to polymer electrodes and electrolytes.

Other workshops include the Professional Skills Development Workshop for women post-docs and junior tenure-track women physicists held on the 14th. Also on the 14th, there will be an Energy Research Opportunities Workshop for graduates and post-docs interested in pursuing clean energy research, as well as the APS Forum on Education for anyone interested in teaching physics courses. Eight other stand-alone tutorials will also be held on the 14th on topics from graphene and spintronics to careers in industry and government.

Anyone planning on attending the workshops will need to sign up beforehand, as there is no on-site registration for any of the pre-meeting workshops and tutorials. Registration for the various workshops and courses can be found by following the links on the main March Meeting webpage.

Childcare grants up to $400 are available to meeting attendees with young children. Grant applications are available on the website and need be completed by January 15th. Quiet rooms will be available at the meeting,

SUSTAINABILITY continued from page 4

Senate Budget Committee in early November. He put it this way:

"Regardless of party, ideology, or branch of government, almost no one in possession of the facts believes that our current fiscal course is sustainable. The level of deficits, debt, and borrowing from abroad projected for the next decade threatens not only our economic prosperity but also our currency, our global leadership, and our national independence. As soon as our economy emerges from recession and the job market improves, we must adopt a new fiscal strategy, and the planning needed to craft and implement it should begin without delay."

Galston has been around Washington long enough to know that the political deck is stacked against long-term rationality, especially when it comes to reducing spending and increasing taxes, both of which will have to be part of the fiscal solution. Democrats cringe at the former, and Republicans reflexively reject the latter.

That's why Galston and several moderates in the House and Senate are urging the formation of a bipartisan commission to provide a path forward. Without it, they say, politics will trump policy, and no compromise will be found And that, they submit, is a prescription for disaster.

Even Keynesians, who promoted the stimulus bill as a key to forestalling an economic collapse earlier this year, accept the need for a debt remedy. They acknowledge that $1 trillion of annual federal spending will have little impact on long-term economic growth. The discretionary federal budget is simply too small to play a major role on the national economic stage. Although federal spending cannot contribute substantially to economic growth, out-of-control deficits, they note, can cripple it.

President Obama's economic advisors have long counseled that once the banking system and the economy regain their equilibrium, the White House must rein in spending. For now, White House counselors say publicly that the President remains committed to his ten-year plan to double the physical science budgets. But privately, they caution that their high-wire act is a tough one, at least as dangerous as the one featuring the Flying Wallendas.

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with it. Physicists have theorized since the 1930s that a neutrino might be its own antiparticle, but no one has yet observed evidence for this. Boris Kayser of Fermilab underscored what he described as "the profound implications" of this seemingly outlandish concept. He said that the observation of neutrinoless beta decay would imply physics outside the currently accepted standard model, and provide evidence for the leptogenesis theory explaining the universe's matter-antimatter asymmetry.

Teams around the world are working to first observe neutrinoless double-beta decay. Sei Yoshida of Tohoku University reported that the KamLAND detector located deep in the Kamioka mine outside of Toyama Japan is being upgraded to pick up low energy solar neutrinos from beta decays in the sun. Likewise, Yury Kolomensky from Lawrence Berkeley National Lab gave an update on the construction of the Cryogenic Underground Observatory for Rare Events (CUORE) at the Gran Sasso National Laboratory in Italy which measures the slight temperature variations caused by a neutrino reacting with the detector's tellurium oxide crystals. The recently opened Enriched Xenon Observatory, located near Carlsbad, New Mexico, uses over 200 kilograms of liquid xenon-136 to detect the tiny amounts of light emitted when an energetic electron reacts with it. Giorgio Gratta at Stanford described how the project is partnering with scientists from nations including Canada, Russia, and Switzerland to complete testing with the 200 kg prototype and move to build the full-fledged experiment using at least a ton of liquid xenon.

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necessary mathematics combined with examples. About half of my students can follow immediately in this third step after the preparation of the first two steps. The other half will need extra help, which usually is not readily available or may cost students financially. Each college should concentrate on this problem by creating individual tutoring programs for the students.

If we help students make up the math that they should have learned, we will close the gap between high school and college math. Knowing that the enemy of higher education in physics is the lack of math, we can win the war for student retention by strengthening math education on all fronts.

Tao Pang is Chair and Professor at Department of Physics and Astronomy, University of Nevada, Las Vegas and author of the book: An Introduction to Computational Physics*, published by Cambridge University Press.*

The Back Page

The critical need for closer ties between physics and industry

By Philip J. Wyatt

The Golden Age for America's industrial physicists was surely the period from the end of World War II to about 1980. Within a year of Einstein's famous 1939 letter to President Roosevelt, in which he warned of the imminent dangers of German interest in nuclear fission, our country began its crash program to develop an atomic bomb and the concomitant ability to produce nuclear power. This massive program, code-named the Manhattan Project, immediately recruited every physicist that could help. Within a brief three-and-a-half years, the nation not only had its nuclear weapons, but a growing capability to produce power using nuclear reactors.

With the onset of the cold war, and then Sputnik in 1957, physics opportunities in the country began to explode. The huge availability of government funds spawned the creation of new companies and industries *by physicists*. Among the many notable successful entrepreneurs were Simon Ramo, Gabriel Maria Giannini, Keeve M. (Kip) Siegel, J. Robert Beyster, Arnold Beckman, Russell Varian, and Chester Carlson.

Literally dozens of other physicists started and managed their own firms during these remarkable years. Many universities expanded their physics faculties to begin granting higher degrees and the larger departments grew rapidly. Physics graduates with PhD degrees had no problem getting jobs in the many industrial labs that sought them. Through the unique skills and efforts of physicists, the nation's technological base grew rapidly as did its productivity and standard of living.

The American education and training of its physicists is the best in the world. In the past 21 years, of the 53 Nobel Prizes in Physics awarded, 32 have been to Americans. Not bad for a nation whose quality of math and science education was ranked 43rd by the World Economic Forum Executive Opinion Survey 2006-2007! Physicists historically have led the nation in providing the direction and many of the innovations needed to build great industries and defense capabilities. In non-government funded areas alone, their achievements have produced many of the key elements of modern electronics, lasers and communications, the genetic code, energy conversion from natural and nuclear sources, etc. The basic training of physicists focuses on the interplay between all elements of the problems they address, and encourages the investigation of and participation in scientific disciplines often well outside of their fields of specialty. Unfortunately, their place in American industry has been increasingly marginalized in recent years.

During the past two decades, the country's manufacturing base has eroded significantly due to massive outsourcing, financial restructuring, unfortunate accidents, thefts of trade secrets, and increased foreign innovation and competition, with a corresponding deterioration of the nation's standard of living. Since 2001 the US has run a trade deficit in advanced technology products, a US Census Bureau category that includes new or leading-edge technologies such as biotechnology, life science, optoelectronics, information and communications, electronics, aerospace, and nuclear technology. The US annually imports $53B more in *advanced technology products* than it exports. We shall never regain our world economic dominance unless we are able to stop and reverse this accelerating trend.

It has been argued that the outsourcing of R&D, now a popular idea, will continue to benefit us by providing these new discoveries more rapidly and at far lower cost. Typical of this concept is a recent article from the *New York Times* that states: "American innovators–with their world-class strengths in product design, marketing and finance–may have a historic opportunity to convert the scientific know-how from abroad into market gains and profits…." Unfortunately, the article and many like it miss the most important point: without an expanding manufacturing base with increasing productivity that provides expanding job opportunities for its citizens, our nation's living standards will continue to deteriorate when such developments are made offshore.

Gregory Tassey of NIST wrote recently: "…When technological advances take place in the foreign industry, manufacturing is frequently located in that country to be near the source of the R&D.The issue of co-location of R&D and manufacturing is especially important because it means the value added from both R&D and manufacturing will accrue to the innovating economy, at least when the technology is in its formative stages. This phenomenon occurs because much of the knowledge produced in the early phases of a technology's life cycle is tacit in nature and such knowledge transfers most efficiently through personal contact. Intel's major R&D program in Israel is an example. Collaborative research developed a new architecture for the company's 64–bit microprocessor, which was followed by Intel's investment in a $4 billion manufacturing plant near the R&D facility. Thus, an economy that initially controls both R&D and manufacturing can lose the value

added first from manufacturing and then R&D in the current technology life cycle–and then first R&D followed by manufacturing in the subsequent technology life cycle. This is the economics of decline…."

Our nuclear power industry and the associated development of new reactor designs, for example, were lost many years ago. Indeed, there is no extant manufacturing facility in the country capable of building a containment vessel, let alone a commercial reactor. So many other products with their associated manufacturing infrastructure and employment that began in this country have been lost. These include TV sets, mobile phones, liquid crystal displays, portable consumer electronics, advanced rechargeable batteries for the automotive sector, hard disk drives, advanced composite materials for consumer products, and compact fluorescent lighting to name but a few. And many more of our current innovative industries are at risk, such as solid state lighting using LEDs, thin film solar cells, optical communication components, carbon composites for aerospace and wind energy applications, flash memory chips, *etc*.

The number of physicists in our country is quite small, perhaps only about 50,000, but many of these are spending their time in dead-end "Waiting-for-Godot" postdoctoral positions when they might better be directing their efforts to the nation's critical industrial needs. The latest data from AIP show that of those graduating with a PhD degree, almost 70% are engaged in such non-permanent postdoctoral positions, of which 75% are academic with little hope of achieving a permanent academic appointment. As for the total PhDs graduating, their number, though rising, has yet to equal the numbers graduated in the 1970s. In addition, only 40% of the graduating physics PhDs are US citizens. This fact means that the number of Americans pursuing a PhD education in physics has fallen precipitously from the levels of the 1960s. While our manufacturing industries are collapsing for lack of the technological innovation these few physicists might provide, we continue to train ever increasing numbers of foreign physicists who have the skills to help their native countries expand and grow through their future efforts. With current government restrictions on their domestic employment, many have no choice but to return to their countries of origin. We must redirect, somehow, our physics resources to the refinement and expansion of the nation's manufacturing infrastructure.

Unfortunately, a major disconnect exists between physicists and the industrial arena. No major manufacturing firms in the US have a physicist on their board of directors; nor do such firms have physicists in the top echelons of management. Surprisingly, this is also true for large firms manufacturing highly technical products. Many of these companies have no PhD level directors in any discipline despite the need to be fully aware of all technical developments that may affect their very survival. There is also an insidious element that is apparent in many firms regarding the hiring of physicists per se. Many technical managers seem to have a fear or distrust of physicists working for them. They consider physicists a little too smart and, therefore, potential competitors for their own status in the company. This unspoken attitude affects the industrial opportunities for physicists to some degree. I spoke recently with a colleague who has an important management position at a major pharmaceutical firm. I asked him if he had any physicists in his group. After some hesitation, he began to explain why such hires would not be appropriate as he and his colleagues considered physicists distant, aloof, nerd-like, and, therefore, not the type of scientist that would "fit in!" This seems to characterize the great change in the public's impression of our profession since its golden days almost 50 years ago. It is an impression that must be changed, not only for the well-being of physicists in general, but for the nation as a whole.

If we are to increase our physics enrollments and encourage both pure and applied research, a new source of funding must be found. I believe that this must eventually fall on private industry to pitch in each year and fund physics with no strings attached. It will take some time before this occurs, but the various taxing authorities, unable to provide the funds promised to support science, must at the very least provide some form of tax incentives to industrial firms contributing to such endeavors.

Physics departments and other departments staffed by physicists should encourage some of their faculty members to take a two or three year sabbatical leave and join companies wishing to use their skills to strengthen or rebuild their industrial bases. Physicists in academia already spend far too much of their time writing proposals to compete for government grants. They should help the nation by joining one of the many companies who could use their skills to refine their products and introduce the innovations so characteristic of their physics training. The successes of these industrially focused physicists would encourage further enrollments in physics and all related sciences. Meanwhile the nation's manufacturing base would be strengthened and rebuilt.

APS must become more active in encouraging greater interactions with industry. The APS Forum on Industrial and Applied Physics (FIAP) was established to encourage industrial applications of physics. It has become instead a forum for academicians who believe that applied physics is different from other physics. In the 1959 March Meeting, there were 25 invited papers from academia, 14 from industry, and 5 from National Labs. By 2009 these numbers were 695, 71, and 79! Thus the academic-to-industrial ratio increased from about double to 10-fold. Of the 12 newly-elected FIAP Fellows in 2009, only one was an industrial physicist. APS should encourage immediately the establishment of a *Division of Industrial Physics*, or redirect the focus of FIAP from *Industrial & Applied Physics* to *Industrial Applications of Physics*. Under this new focus, such division or forum should undertake to:

1. Encourage and expand the application of physics to the nation's industrial and, especially, its manufacturing base.

2. Encourage greater interactions between industry and academic physics providing thereby additional opportunities for funding from industrial sources, and faculty sabbatical opportunities in industry.

3. Increase the awareness of graduate students of the employment and career opportunities in industry.

4. Encourage greater enrollments in undergraduate physics and engineering physics curricula.

5. Encourage physicists, especially in academia, to invent and learn how to reduce their inventions to patents.

6. Interact more with the Forums on Education (FEd), Physics and Society (FPS), and Graduate Student Affairs (FGSA).

7. Increase the awareness of industrial physics opportunities by the Executive Committees, and, thereby, the membership, of other APS divisions with strong applications for Industrial Physics.

8. Support an AIP publication to be called Industrial Physics.

9. Encourage industrial firms to offer postdoctoral positions to new PhD's that would be developed within their firms.

I recall vividly a meeting I attended many years ago after I had just joined a new company whose physics group was headed up by Bernie Lippman (a great industrial physicist of Lippman-Schwinger scattering theory fame, among others). My own thesis director Alex Green (one of the great nuclear physicists of that era) had taken off a few years from academia to head up a position similar to Lippman's at Convair in San Diego. Green asked Lippman how he could make such large salary offers to the same young physicists he was trying to hire. Bernie leaned back against a wall with a great big smile on his face as he said "I am just trying to restore the dignity to our profession!" Yes, the salaries and life expectations of physicists should be among the highest in a nation whose standard of living should also be the highest. Let's try to achieve that.

Philip Wyatt is the 2009 recipient of the APS Prize for Industrial Applications of Physics and the founder and CEO of an industrial developer and manufacturer of analytical instruments sold in over 50 countries. Of the 70 plus total members of its staff, there are 8 physicists of whom 6 have PhDs.

***Editor's Note:** A longer version of this article, containing more information about the history of physicists in industry is available online at www.aps.org/publications/apsnews.*

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