APS NEWS

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February 2014 • Vol. 23, No. 2

Profiles in Versatility: Olympics Special Edition

See Page 3

APS Membership Boosted by Student Sign-ups

The American Physical Society hit a new membership record in 2013 with students making up the bulk of the growth. After completing its annual count, the APS membership department announced that the Society had reached 50,578 members, an increase of 925 over last year, following a general five-year trend. "When we were able to get up over 50,000 again, that was good news. That keeps us moving in the right direction," said Trish Lettieri, the director of APS Membership.

Students were one reason: The total number of student members increased by 1,075 over last year. Lettieri credited much of that growth to enrollment stemming from the annual Conferences for Undergraduate Women in Physics. Undergraduate students who attended the conferences could sign up for a free year of student membership in the Society.

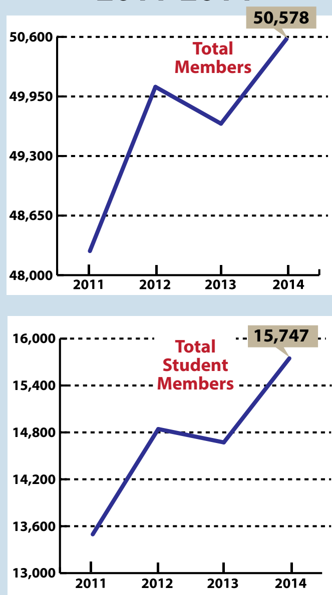
In addition, the Society added nearly 100 new early-career members after a change in policy that extended membership discounts for early-career members from three to five years. "The change to five-year eligibility in the early career category definitely helped." Lettieri said. "That's where a lot of our focus is going to be now, with students and early-career members."

"That's where a lot of our focus is going to be now, with students and early-career members."

At the same time, the regular membership declined by 273 members, dropping from 23,138 in the beginning of 2013 to 22,865 this

MEMBERSHIP continued on page 6

APS Membership 2011-2014



Graphs are on different scales and show totals from January 2014

Physics Newsmakers of 2013

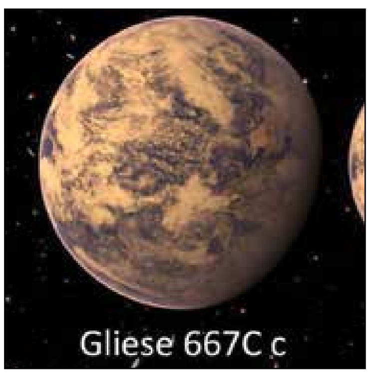
The Envelope Please . . .

By Michael Lucibella

Each year, *APS News* looks back at the headlines around the world to see which physics news stories grabbed the most attention. They're stories that the wider public paid attention to and news that made a big splash. In roughly chronological order, the Top Ten Physics Newsmakers of 2013 are:

Exoplanets

2013 was another banner year for the search for another Earth. In **February** astronomers announced the discovery of Kepler-37b: With a diameter just slightly larger than Earth's moon, it's the smallest exoplanet discovered yet. Two months later, astronomers discovered the twin worlds of Kepler-62e and



Courtesy of PHL@UPR Arecibo, NASA

"Habitable world?"

ENVELOPE continued on page 6

Bouchet Award Winner Followed a Parental Path to Science

Luz Martinez-Miranda, this year's recipient of the Edward A. Bouchet Award, always knew she wanted to go into science. She was born in Maryland, moved to Puerto Rico when she was five, and is now a professor of materials science at the University of Maryland.

The APS Bouchet Award recognizes a distinguished minority physicist who has made significant contributions to physics research. Martinez-Miranda will receive a stipend and travel support to present a lecture at the APS March Meeting.

Growing up, she assumed she would follow in her parent's footsteps. "I got interested in physics because I was originally interested in chemistry," Martinez-Miranda said. "My parents were chemists."

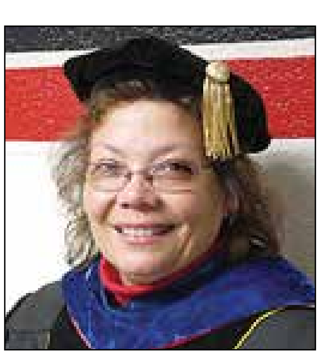


Photo courtesy of University of Maryland

Luz Martinez-Miranda

She also credits her grandmother with inspiring her career in science. Her grandmother's formal education stopped at the third grade, but she always insisted Martinez-Miranda's mother go to college. "This is something that I consider very important," Martinez-Miranda said. "It's because of that my mother went and studied chemistry."

Her high school teacher's somewhat unorthodox way of teaching physics first got her thinking about physics as a career. Instead of focusing on inclined planes or free-falling balls, he delved into the refraction and reflection of light.

"He actually went into the optics part of physics," Martinez-Miranda said. "I think that…optics, which is more visual and more associated with physical phenomena…made it more attractive to me."

When she went to college she combined her parents' love of chemistry with her own love of physics. At the University of Puerto Rico she majored in physics and minored in chemistry, which turned out to be a prescient decision. By her sophomore year she knew she wanted to explore the experimental side of physics.

In addition, Martinez-Miranda always had an eye for the artistic, or rather an ear. As an undergraduate, she also studied piano and graduated with a bachelor's of music from the Conservatorio de Música in Puerto Rico.

Once she finished her master's in physics, also at the University of Puerto Rico, she left for the Massachusetts Institute of Technology for her PhD. Upon arriving, she found a number of researchers there working with liquid crystals. Again, her artistic side came out: she was taken by the intricate beauty of liquid crystals she saw under a microscope.

"Liquid crystals are very inter-

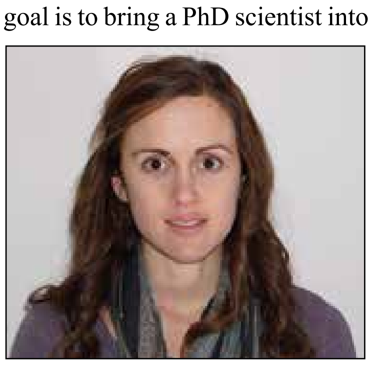
BOUCHET continued on page 7

New APS Education Fellow Goes to Washington

The American Physical Society has selected its first fellow to send to the Department of Education as part of the new Science, Technology, Engineering, and Math (STEM) Education Policy Fellowship. Julia Mundy, who recently defended her PhD thesis in applied physics, will go to the Department of Education to work on science and math education policies.

"I think it's a great opportunity," Mundy said. "There hasn't been a strong presence of scientists in the Department of Education so I'm really excited for the opportunity."

The APS and AIP jointly announced the formation of the new fellowship in September 2013. The goal is to bring a PhD scientist into



Julia Mundy

the Department of Education for two years to consult on STEM policies.

"It's exciting," said Tyler Glembo, the APS government relations specialist who helped set up the new program. "The Department of Education is really the place to make important systemic changes."

Mundy will work with the department's STEM lead, Camsie McAdams. Though specific plans are still being finalized, she'll likely be working on new STEM initiatives at the department including the STEM Innovation Network, STEM Innovation Hubs, the STEM Teachers Pathway Initiative, and

FELLOW continued on page 7

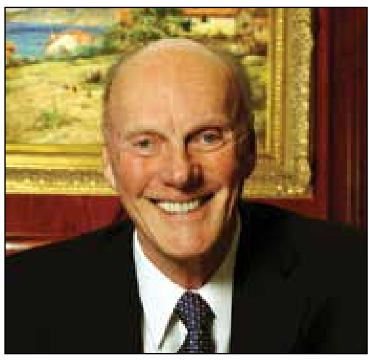
In Memoriam: Fred Kavli (1927–2013)

By Alaina G. Levine

The story goes that Fred Kavli, industrialist, philanthropist and physicist, would look up at the night in his native Norway as a child and gaze at the stars that salted the skies. Being so far north, he had unique visual access to the universe, with long, dark nights that included the Northern Lights, which significantly influenced his decision to both study and support science.

"Physics meant everything to Fred," says Robert W. Conn, President and CEO of the Kavli Foundation and an APS Fellow. "It was his love growing up. It was the underpinning for everything he did."

On November 21, 2013, science, and more specifically physics, lost a great champion, when Kavli passed away due to complications from cancer. He was 86 years old.



Fred Kavli

Kavli was probably already hooked on innovation and entrepreneurship when as boy, he and his brother started selling wood briquettes as car fuel. This was before oil was discovered off the coast of Norway and the country became rich with petrol. But his real passion, says his colleagues, was science and support of discovery. "He said 'if I ever get wealthy, I want to leave it all to science to help produce a better future for mankind,'" recalls Conn.

And that's just what he did. After receiving a degree in applied physics from the Norwegian Institute of Technology, Kavli emigrated first to Canada and, after a year, to the United States. Three years later, in 1958, he launched Kavlico Corporation, which designed and sold sensors for myriad industries including the automobile, aerospace, and home appliance sectors.

KAVLI continued on page 6

Members in the Media

"My wife Naomi and I enjoy spending as much time as possible in the mountains, hiking and fly fishing, so hanging out with Interior Secretary Sally Jewell, an avid outdoors person, in the national parks, national forests and wilderness areas would be outstanding."

***Ernest Moniz**, the Department of Energy,* The Washington Post, *December 17, 2013.*

"We know that it cannot be the final word because it cannot even describe why a universe of matter survived if the Big Bang produced essentially equal amounts of antimatter and matter that should then have annihilated as the universe cooled."

***Gerald Gabrielse**, Harvard University, on his recent experiment that measured the spherical nature of the electron,* The Boston Globe, *December 19, 2013.*

"That reflects the zeitgeist.… Everyone knows there is something big happening, and they're trying find out what it is."

***Terry Sejnowski**, the Salk Institute, on the popularity of courses teaching biologically inspired algorithms,* The New York Times, *December 29, 2013.*

"I had this huge to-do list with over a thousand things on it, and I found I wasn't looking at it very often because whenever I did, I just got this depressing feeling of being overwhelmed by my failure to accomplish stuff.…I learned that if I want Max to do something in December, I should think about December Max as a different person."

***Max Tegmark**, the Massachusetts Institute of Technology, on prioritizing his new year's resolutions,* The Wall Street Journal, *January 1, 2014.*

"Quantum computers are extremely delicate, so if you don't protect them from their environment, then the computation will be useless."

***Daniel Lidar**, University of Southern California,* The Washington Post, *January 2, 2014.*

"To be clear, there was essentially zero reason to believe that they were going to find any evidence for time travelers, but since it didn't exactly cost a lot of money to perform the study I'm all in favor of it."

***Sean Carroll**, Caltech, on the online search for time travellers,* CNN.com, *January 3, 2014.*

"This wasn't a major research push.…This was typing things into search engines. Billions of dollars are spent on time travel movies and books and stuff like that. This probably costs less than a dollar to check on it."

***Robert Nemiroff**, Michigan Tech University, on his online search for any evidence of time travellers,* The Associated Press, *January 6, 2014.*

"There are not many things in our daily lives that we know to 1% accuracy. I now know the size of the universe better than I know the size of my house. Twenty years ago astronomers were arguing about estimates that differed by up to 50%. Five years ago, we'd refined that uncertainty to 5%; a year ago it was 2%. One percent accuracy will be the standard for a long time to come."

***David Schlegel**, Lawrence Berkeley National Laboratory, on recent measurements of the distances between galaxies,* BBC-News.com, *January 9, 2014.*

"It's like there are 1,000 different particles emerging from all the wormholes, but in fact they're all the same particle you sent in the beginning.…You just have all these temporary copies emerging from and going back into these wormholes."

***Mark Wilde**, Louisiana State University, on how a theoretical time machine could also clone objects,* FoxNews.com, *January 13, 2014.*

MEMBERS continued on page 7

This Month in Physics History

February 1932: James Chadwick's Letter to *Nature* on the Neutron

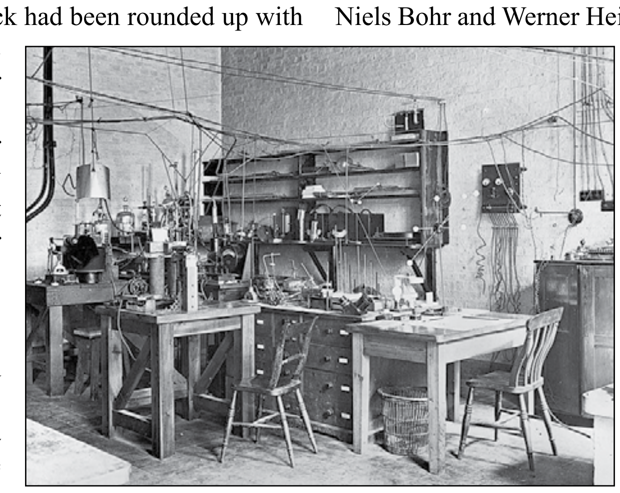
Among the many scientists who witnessed the famous Trinity test on July 16, 1945, was a modest British physicist named James Chadwick. While many physicists contributed to this remarkable achievement, it was Chadwick's discovery of the neutron in 1932 that made atom-splitting–and the nuclear bomb–a very real prospect in the first place.

Born in Cheshire, England to a family of modest means, Chadwick relied on scholarships to pursue physics at Victoria University in Manchester, walking the four miles to campus every day. He graduated with top honors, co-authoring his first paper with Ernest B. Rutherford. Chadwick earned his master's degree in 1912, and then won a scholarship to study beta radiation in Berlin under Hans Geiger.

James Chadwick

When World War I broke out, Geiger reported for active duty, and warned Chadwick to return to England as soon as possible. Chadwick tried, but by then international travel had become too difficult. He was briefly arrested and spent ten days in jail, falsely accused of having uttered treasonous statements. The laboratory orchestrated his release and he returned to work in Berlin–a decision he would soon regret.

As the war progressed, all British citizens were sent to a prison camp called Ruhleben, including Chadwick. It was a former racing track, and the prisoners were housed in the stables, six men to a cell, sleeping on mattresses on the floor. Food was scarce, and the first winter in the camp was especially brutal: Chadwick had been rounded up with just the clothes on his back, not sufficient for the harsh German winters. "I can remember the agony when my feet began to thaw out about 11 AM," he later recalled.



Sir Ernest Rutherford's laboratory, early 20th century

There were a handful of other scientists, like Chadwick, and they were given permission to set up a crude laboratory in one of the abandoned barracks in the camp. They traded for chemicals and built their own equipment from whatever materials were at hand. Chadwick once fashioned a makeshift magnet, coiling the salvaged copper wire by hand one sweltering summer evening. He found that toothpaste with thorium powder was mildly radioactive, and also explored the photochemical reaction of carbon monoxide and chlorine.

After the war ended in November 1918, Chadwick returned to Manchester to recuperate at his parents' house. He was physically weak, and the severe conditions of his internment meant that for years afterward, he had difficulty digesting fats. He was also broke. Rutherford found a part-time teaching position for him, and when Rutherford succeeded J. J. Thomson as head of Cambridge's famed Cavendish Laboratory, Chadwick opted to follow his mentor, working on experiments on artificial nuclear disintegration to earn his PhD in 1921.

Two years earlier, Rutherford had discovered the proton, but in his subsequent experiments, the atomic number consistently was less than the atomic mass. This couldn't be due to the number of electrons, so Rutherford hypothesized that there was another type of particle in the atomic nucleus–one with mass but no charge. By 1925, physicists had proposed nuclear spin to explain the Zeeman effect (shifts in atomic energy levels in a magnetic field), but it didn't seem to fit the prevailing model for the atomic nucleus, believed to contain just protons and electrons.

Chadwick replicated a German experiment in which polonium struck a beryllium target, and the unusual form of radiation produced provided evidence of a new kind of chargeless particle. Encouraged, Chadwick devoted all his energy to further experiments, often working through the night, and his efforts paid off within weeks.

In February 1932, he submitted a letter to *Nature* detailing his experimental results as evidence for the existence of a neutron. He followed with a second paper in May, providing more of the technical details. The discovery was quickly championed by Niels Bohr and Werner Heisenberg, and Chadwick worked with Maurice Goldhaber to measure the mass of the neutron, and concluded the neutron is a nuclear particle rather than a proton-electron pair.

The ongoing economic depression meant tight funds for scientific research, even at the Cavendish lab. Chadwick wanted to build a cyclotron so the lab could keep pace with the cutting-edge nuclear physics now being done in the US, but Rutherford was old school, and didn't want to invest in one, believing bulky, expensive equipment wasn't necessary to do good science. Frustrated, Chadwick left in 1935 for the far less prestigious University of Liverpool to take over an old laboratory so out-of-date it still used direct current. He won the Nobel Prize that same year, and used part of the prize money to finance a cyclotron, relying on grants and donated materials to make up the difference. By

CHADWICK continued on page 3

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Diversity Corner

APS Bridge Program student applications now being accepted (Deadline: March 21, 2014)
The APS Bridge Program provides 1-2 years of research experience, coursework, mentoring, and application coaching to students interested in pursuing a PhD in physics. African American, Hispanic and Native American students are strongly encouraged to apply. Students must be US citizens or permanent residents, and have received a bachelor's degree in physics (or a related discipline) by summer 2014 to be eligible. http://apsbridgeprogram.org/about/students.cfm

Women in Physics (WIPHYS) Email Group
The Committee on the Status of Women in Physics (CSWP) welcomes you to join WIPHYS, its electronic mailing list. WIPHYS is sent weekly and includes funding, job, and professional development opportunities for women. WIPHYS was "officially" started in January 1993, and now has over 900 subscribers. Join here: http://www.aps.org/programs/women/email-lists/wiphys.cfm

Bridge Summer Meeting set for June 25-27, 2014, in College Park, MD
The APS Bridge Program Summer Meeting will bring together experts to discuss efforts to increase the number of underrepresented minorities who receive PhDs in physics. This year's meeting will focus on exploring and understanding the role of the MS degree in promoting underrepresented minorities in physics. Workshops, panel discussions and presentations will address topics including

- establishing MS/PhD institutional relationships
- role of master's degrees for underrepresented minority students
- barriers to student advancement to the PhD
- mentoring
- non-cognitive admissions measures

Who should attend: faculty, students, and administrators interested in increasing the number of underrepresented students pursuing PhDs in physics. For more information, see apsbridgeprogram.org/conferences/summer14/index.cfm

Stay on top of the Conferences for Undergraduate Women in Physics
A new email list was created to share news, announcements, and deadlines related to the Conferences for Undergraduate Women in Physics. To join the list, email women@aps.org with the subject "Subscription to CUWiP email list".

2014 Katherine Weimer Award: Deadline is April 1
The Weimer award is open to any female plasma scientist who received her PhD within the ten-year period prior to April 1, 2014. Nominations are active for one selection cycle (three years). The award, established by the APS Division of Plasma Physics, consists of $2,000 and funds for travel to the annual meeting where the award is to be presented. The recipient will be invited to give a talk at the Division's annual meeting. More details are available at: http://www.aps.org/programs/women/scholarships/katherineweimer.cfm

Network with other physicists on LinkedIn
Join the LinkedIn groups for Minorities in Physics (http://go.aps.org/minoritiesinphysics) and Women in Physics (http://go.aps.org/womeninphysics) and start networking today!

CHADWICK continued from page 2

July 1939, the machine was up and running.

Chadwick's discovery made it possible to create elements heavier than uranium in the laboratory via capture of slow neutrons and beta decay–a critical breakthrough for the eventual development of the nuclear bomb. The neutron proved to be an ideal "bullet" for penetrating nuclei, thanks to its lack of charge. When World War II broke out, Chadwick was vacationing with his family in Sweden. This time, he returned to England immediately and lent his scientific expertise to determining the nuclear cross-section of uranium-235. After the war ended, he returned to his old life in England in 1946.

In 1948, Chadwick opted to become master of Gonville and Caius College, a position he held until his retirement in 1958. He died peacefully in his sleep in 1974–a fitting end to the quiet man's long, rich life.

References:

Chadwick, J. (1932) "Possible Existence of a Neutron," *Nature* 129 (3252): 312.

Chadwick, J. (1932) "The Existence of a Neutron," *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences* 136(830): 692.

AIP Oral History transcript: http://www.aip.org/history/ohilist/3974_1.html

Editor's note: The January 2014 "This Month in Physics History" column in *APS News* recounted how Alan Turing was convicted of criminal behavior in 1952 after admitting his homosexuality. Two years later he committed suicide. On 24 December 2013, Turing was granted a royal pardon by Queen Elizabeth II.

Goeppert-Mayer Awardee Loved High-School Physics

By Michael Lucibella

This year, APS presented its Maria Goeppert-Mayer Award to Ana Maria Rey of the University of Colorado. The award recognizes outstanding achievement by a woman physicist in the early years of her career. The award is named after German-American physicist Maria Goeppert-Mayer, the second woman to win a Nobel prize in physics (after Marie Curie).

In addition to a certificate honoring her achievement, Rey will receive a $2,500 stipend plus $4,000 in travel allowances to be used towards speaking at up to four US universities and at an APS meeting.

Rey is an atomic, molecular, and optical physicist working at JILA and the University of Colorado. Her research focuses on optically trapping alkaline atoms and polar molecules. This work could serve as the basis for future atomic clocks, as well as quantum simulators, which are possible steppingstones to quantum computers.

She was born in Bogota, Colombia and has enjoyed physics since she was young. "I love to be able to write an equation, and nature behaves as I predicted," Rey said. She liked solving these kinds of equations so much that in her teen years, she found herself needing more from her physics class.

"I was in high school, I loved physics and I asked the high school teacher to give me more problems," Rey said. "He borrowed a physics book for me that I used to do more problems besides the ones assigned from the class."

She attended the Universidad de los Andes in Bogota where she majored in physics. It was there also she met her husband, Juan. After finishing, she decided to travel abroad to continue her education. "I wanted to come to the United States to learn more," Rey said. "At that time there was no graduate program in Colombia."

Ana Maria Rey

She set her sights on the University of Maryland and as luck would have it both she and her husband were accepted into the school. The two moved to the US in 1999. However, at that time, the university had limited options for the field she wanted to go into. "When I graduated the formal program started in atomic, molecular and optical physics." Rey said.

To compensate, Rey took a job at NIST in nearby Gaithersburg, Maryland to get experience in this field. There she worked on the theory of optical lattices and ultracold atoms. She received her PhD in 2004.

She did her postdoc work at the Harvard-Smithsonian Center for Astrophysics. After three years there, she left for Colorado and is now a fellow at JILA and an associate professor in the University of Colorado's physics department. Rey was named a MacArthur Fellow in 2013.

As a theorist, she is noted for her willingness to work closely with the experimentalists. "The groups are downstairs so you can just go into the basement and talk to them," Rey said. "This collaboration has been stronger in the last couple of years." In addition to her work, she also spends time raising her four-year-old son Nicholas.

Rey said that she was honored by the recognition of her work, and was looking forward to using the Maria Goeppert-Mayer Award to help advance her research. "There are collaborators around the world, in Europe especially, that are doing experiments with alkaline atoms and collaborating more closely with them could be very interesting," Rey said.

Profiles In Versatility

Physicists in Sports Deserve a Gold Medal

By Alaina Levine

With the Olympics starting this month in Russia, one can't help but think of the significant role physics plays in orchestrating this enormous affair. From equipment design, to ticketing and scoring algorithms, to the science behind the movements of the athletes themselves, the Olympics presents a great teaching moment. But while some may be keeping their eye on the physics of the games, others are more excited about the physicists who contribute to the Games and beyond.

Ida Bernstein is simultaneously working on her PhD in theoretical physics at Delaware State University, and training for a spot on the US National Team in rugby. An optical scientist with a NASA Fellowship, she specializes in the mathematics behind the use of different frequencies of light to combat viruses. She chose her research field so she could continue working on it while on the road in training and at competitions. As an algorithm designer, "I can do my physics anywhere in the world," she says.

Bernstein has been a sports fan and an athlete for much of her life. She ran 5km races in middle school and as an undergraduate at Syracuse, she played varsity soccer and track. In recent years Bernstein focused on rugby and bobsled, with the objective of joining the US Olympic Team. "I trained for bobsled for two years and had the potential to be a pusher," she explains, "I could have done more with bobsledding, but rugby had a hold on me." In the fall of 2013, she made the choice to concentrate on training for the 2016 Olympics, during which women's rugby will make its debut. But her immediate goal is to make the US team that will compete in the Women's Rugby World Cup this summer.

Photo courtesy of Louis Poirier

The need for speed. Physicists contribute their skills and passion to go faster, higher, stronger.

Another bobsledding/physics fanatic, Louis Poirier, not only competed on behalf of his native Canada, but he also represented bobsledders on national boards and conducted research on ice friction as it relates to bobsledding. "I'm a typical scrawny physicist," he jokes. Yet while on Canada's national bobsledding team, Poirier medaled at the America's Cup, among other events. And in 2006, he was part of two Canadian teams that trained for the Olympics, although he didn't compete.

Poirier received his bachelors in physics from the Université de Moncton in 2003, and as he transitioned into graduate school at the University of Calgary, he was looking for an avenue to combine his two eclectic passions. "I knew I was uniquely qualified to study ice friction as it relates to bobsledding," he says.

His thesis dealt with a problem in bobsledding as it relates to the safety of new tracks–"you really don't know how fast the athletes are going to go once they're on it," he explains. So Poirier set out to analyze the aerodynamic dragging and ice friction coefficients and discovered that the coefficients were lower than anything published. "This was revolutionary data we detected," he says. "Previously published reports suggested the coefficient of friction was always higher than 0.01 and we found it was half of that." This suggests that the sleds go faster down the tracks than previously thought. He shared his investigations with the International Bobsled and Skeleton Federation, and his work will be featured in the track designs for the 2018 Olympics.

MEDAL continued on page 4

Letters

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

Remembering the Bomb

Jeremy Bernstein closes his November 2013 Back Page article "Learning to Love the Bomb" with the sentence, "Perhaps there should be one more explosion in the desert of Nevada to remind us." This reminded me that the late Harold Agnew, former director of Los Alamos, made a similar suggestion. He suggested, I believe, that when the Limited Test Ban banning nuclear tests in the atmosphere and elsewhere went into effect, an H-bomb should be detonated every year over the Pacific and all the world's heads of governments should be invited to watch it, for the same reason Bernstein gives, "to remind us."

Michael May
Stanford, California

Controversy Continues Over Picking Nobel Winners

The naming of Nobel Prize winners always raises the specter of those who may have also contributed but who were not included in the award. This year's physics prize is no exception (*APS News*, November 2013, page 1).

This year's winners, François Englert and Peter Higgs, developed the theoretical mechanism for the origin of mass of subatomic particles. Others that proposed what is now known as the Higgs field were the late Robert Brout, Carl Hagen, Gerald Guralnik, and Tom Kibble.

The prize is not awarded posthumously and may not be shared among more than three people. These criteria may explain why Brout, longtime collaborator of Englert, was not included and thus why only two were awarded the Prize.

The recent passing of Kenneth Wilson (*Physics Today*, November 2013, page 65) reminds us of a similar case regarding the 1982 Noble Prize in Physics awarded to Wilson for the development of the renormalization group as applied to critical points and phase transitions. The names of Michael Fisher, Leo Kadanoff, and Benjamin Widom come to mind as possible contributors. Surely, the three-person criterion may have been used in this case.

No doubt, there are many more cases of contention. However, a case that stands out is that of Raymond Vahan Damadian, an American medical practitioner and inventor of the first magnetic resonance scanning machine. Damadian was the first to perform a full body scan of a human being in 1977 to diagnose cancer. Damadian has received a multitude of awards for his discoveries. In 2003, the Nobel Prize in Physiology or Medicine was awarded jointly to Paul C. Lauterbur and Peter Mansfield for their discoveries concerning magnetic resonance imaging. Surely, there was room here for a third winner.

Moorad Alexanian
Wilmington, North Carolina

Women and the Nobel Prize

I read with great interest the article in *APS News*, December 2013, about women and Noble Prizes. One person who should have been mentioned is Isabella Karle, a chemist at the Naval Research Laboratory. I have spent a career at NRL, although in a very different field, and had one or two interactions with her. She was a very impressive individual. Her husband, Jerome, also at NRL did win the Nobel Prize for his development of the "direct method" of analyzing X-ray diffraction to determine molecular structure. His work was theoretical, but Isabella was the principal experimentalist that made it all real. There is a web story about her on the following link: http://narrative.ly/the-nonagenarians/isabella-karles-curious-crystal-method/

Wallace Manheimer
Allendale, New Jersey

Digital versus Analog

In "Doing Science 'Online' (Letters, *APS News*, November 2013) David Lide credits the telegraph with the first "digital" communication. Unfortunately, the only thing digital about the telegraph is that it is operated by the fingers (digits) as defined by the *Oxford Dictionary*:

Digital (adjective): 1. (of signals or data) expressed as series of the digits 0 and 1, typically represented by values of a physical quantity such as voltage or magnetic polarization. Often contrasted with analog. Relating to, using, or storing data or information in the form of digital signals: digital TV. A digital recording involving or relating to the use of computer technology: the digital revolution. 2. (of a clock or watch) showing the time by means of displayed digits rather than hands or a pointer. 3. of or relating to a finger or fingers.

The telegraph is a form of analogue communication as defined by Oxford and other dictionaries. Lord Rayleigh may have communicated and collaborated using the telegraph, but he did not live to see the "Digital Age" in which we are now embedded. Even the ciphers, such as Morse Code, are analogue communications. As defined in the *Oxford Dictionary*:

Analogue (adjective): relating to or using signals or information represented by a continuously variable physical quantity such as spatial position, voltage, etc.: analogue signals the information on a gramophone record is analogue. Often contrasted with digital (sense 1). (of a clock or watch) showing the time by means of hands or a pointer rather than displayed digits.

If the telegraph were true digital communication, I seriously doubt that Rayleigh would have been the first to use it as such.

My doctoral research advisor frequently resorted to the Oxford and other dictionaries for clarification. Spelling and grammar checks often do not spot such word misuse. This is another differentiation that is basic to understanding the physical world today.

Victor S. Alpher
Austin, Texas

MEDAL continued from page 3

When Poirier finished his PhD in 2011, he found a position at the National Research Council of Canada–Oceans, Coastal, and River Engineering, where he applies his knowledge to the study of sea ice. Although he retired from bobsledding in 2008, he still watches the races and keeps up with the stats.

Having a career in sports with a physics degree is not limited to athletes. Adam Karnish, who received his BA in physics from Ithaca College, has been playing golf since he was six years old. "It's always been a passion of mine," he notes. He was on a championship team while in high school. Today he is a Handicap Research and Analysis Coordinator, where most of his work draws on his scientific problem-solving abilities. He travels the country teaching methods for rating the difficulty of the courses and helps implement a handicap system for that specific location. Currently, he is working on how to improve the pace of play and fix "traffic jams" on the course by taking a page from innovations in factory engineering. "The way a player moves through a course is the same way a car moves through a plant," he notes.

Many of Karnish's principal tasks are related to handicapping, which allows players to compete on an equitable basis. He serves on the USGA's own handicap research team, which involves "lots of calculus, statistics and stochastic process" analyses, he says. Additionally, "the USGA saw my strength in physics and mathematics and created a position for me to develop a global handicapping system," he explains. "We are developing a standardized procedure so a handicap is portable from one course to the next."

And then there's Timothy Gay, a professor of physics and astronomy at the University of Nebraska-Lincoln (UNL), whose research expertise lies in polarized electron physics. But he also wears another hat–a football enthusiast. He wrote the book *Football Physics: The Science of The Game* and produced a series of edutainment videos about the subject which played during UNL games and were eventually picked up and distributed by NFL Films.

Gay also consults for the industry. He has worked with major sports equipment manufacturers to help them improve padding in helmets, and has briefed the media on the physics of concussions. When one football helmet manufacturer was sued by another over potential patent infringement of a helmet design, Gay analyzed the evidence for the defendants. He discovered that previous comparisons of the two helmet designs were shoddy. "Physicists have a particular way of quantifying measurements," he explains. "The [plaintiffs] had done crude measurements that I was able to demonstrate were not reproducible." Gay conducted his own experiments related to the two helmets in question and "we were able to show they just made minor cosmetic changes to the helmet but didn't violate the design patent."

Gay has additionally contributed to videos for UNL on the physics of gymnastics and the physics of track and field. Despite his passion for sports, he doubts that knowledge of science necessarily improves the game playing. "It's rare that my physics insight helps a player do better," he says. "My chief intellectual interest is explaining [how things work], and figuring out how to explain it to a lay audience."

Some physicist-athletes disagree and are steadfast that their prowess is directly influenced by their physics familiarity. "I have instincts from physics," says Bernstein. "If I do something clever on the field, such as getting the other player to use their own velocity against them, it's directly from being a physicist." Karnish agreed: "Physics has made me a better golf player," because it enables him to carefully scrutinize issues of trajectory, force and lift with every swing of his club. "During practice, I consciously think about these things."

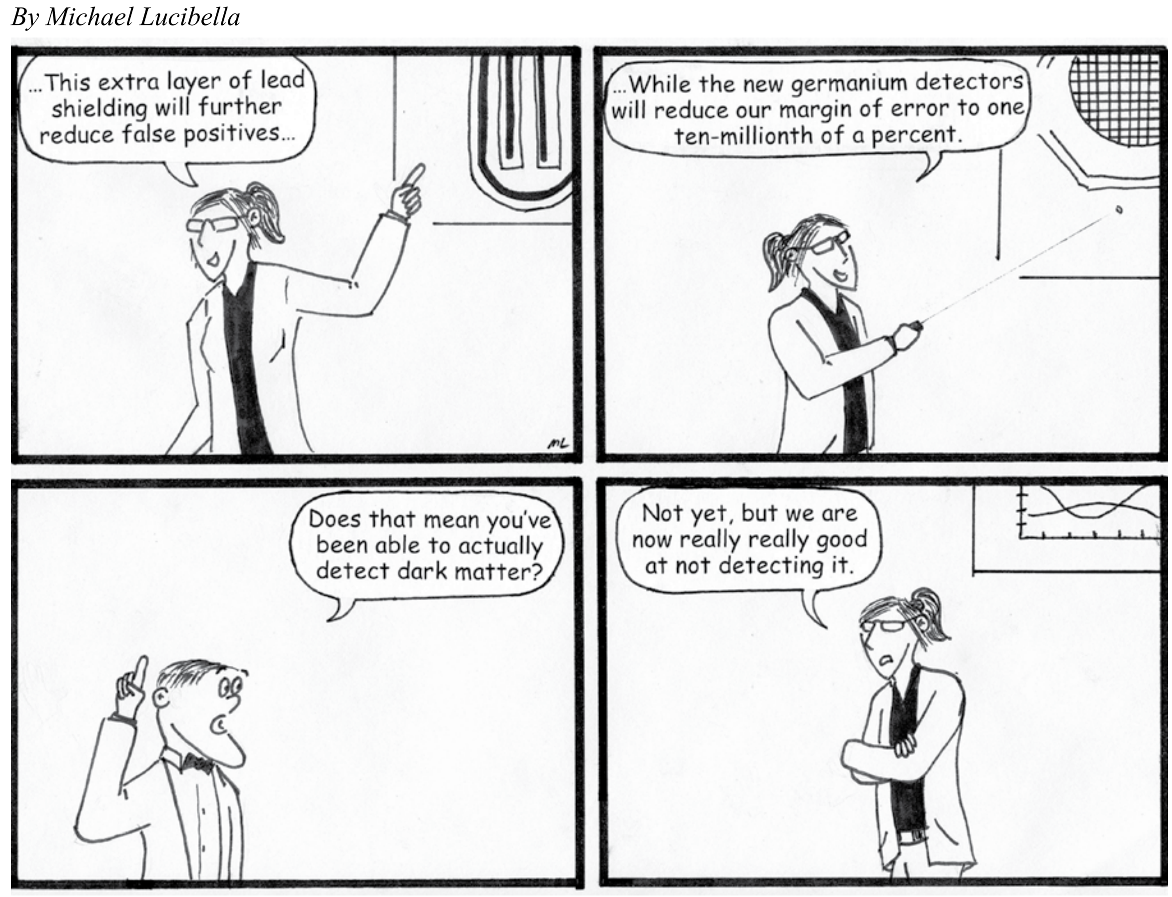
As for the future, the champion physicists all want to keep incorporating sports in their careers. "I love the game of golf, and I love the idea of improving it," says Karnish. "The game has changed in the last 15 years and I like being where I am to have a real-time effect in getting more people involved in the game."

Alaina G. Levine is the author of Networking for Nerds *(Wiley, 2014) and President of Quantum Success Solutions, a science career and professional development consulting enterprise. She can be contacted through www.alainalevine.com, or followed on twitter @AlainaGLevine*

Zero Gravity

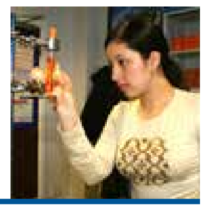
the lighter side of science

By Michael Lucibella



Education Corner

APS educational programs and publications



Save the date: 2014 PhysTEC Conference

The 2014 PhysTEC Conference will be held in Austin, Texas on May 19-20 in conjunction with the UTeach Conference. The PhysTEC Conference is the nation's largest meeting dedicated to physics teacher education.

This year's Conference theme is "Building Leadership" and the Conference features workshops, panel discussions, presentations by national leaders, and a contributed poster session. There will be a PhysTEC-UTeach joint plenary session by Arthur Levine (Woodrow Wilson Foundation). Other plenary speakers include Nicole Gillespie (Knowles Science Teaching Foundation); David E. Meltzer (Arizona State University); and Susan Singer (National Science Foundation).

Registration will open in mid-February; the registration rate for attendees from PhysTEC member institutions is $150 and rate for the non-member attendees is $295. Faculty from minority-serving institutions are eligible to apply for travel grants. Additional Conference information can be found at: http://www.phystec.org/conferences/2014

ALPhA's 2014 Laboratory Immersions Program

During the summer of 2014, the Advanced Laboratory Physics Association (ALPhA) will be offering a record number of sites for its popular "Laboratory Immersions". The Immersions offer an opportunity for faculty and teaching staff to spend two to three full days, with expert colleagues on hand, learning the details of a single experiment well enough to teach it with confidence. This year there are 14 sites offering a total of 28 different experiments, including new sites at Vanderbilt, Harvard, Sewanee, and the Princeton Plasma Physics Lab. For details, including topics and registration, please visit www.advlab.org.

Interested in hosting a future Conference for Undergraduate Women in Physics? Apply by February 15 to host a site

Applications for future host institutions open in January 2014 for Conferences for Undergraduate Women in Physics to be hosted over the Martin Luther King Jr. holiday weekend in mid-January of 2015. If you are interested in applying to host a conference, please visit http://www.aps.org/programs/women/workshops/cuwip-host.cfm

New K-12 Statement Passed

The American Physical Society calls upon local, state and federal policy makers, educators and schools to:

- provide every student access to high-quality science instruction including physics and physical science concepts at all grade levels; and
- provide the opportunity for all students to take at least one year of high-quality high school physics.

Read more at http://www.aps.org/policy/statements/index.cfm

Nuclear Physics Prize Reaches Fundraising Goal

APS's newest prize reached its fundraising goal in late October and has selected its first recipient. The new Herman Feshbach Prize is awarded to physicists who have made important theoretical contributions to the field of nuclear physics.

The Prize's selection committee picked John Negele of the Massachusetts Institute of Technology for his work on many-body theory and the study of nucleons. Negele will receive the prize and the $10,000 award stipend at the 2014 April Meeting in Savannah, Georgia.

"I feel honored and humbled," Negele said. "Although it is gratifying to have my research contributions appreciated by the nuclear physics community, what makes this award especially meaningful to me is the fact that it was founded in memory of Herman Feshbach. He was a towering figure in our field and was a colleague and friend at MIT where we shared our passion for nuclear physics for 30 years."

More than 100 individuals and organizations contributed to the fundraising effort. The Division of Nuclear Physics raised over $200,000 to endow the prize.

"The response was very enthusiastic," said Gerald Miller of the University of Washington, the Prize's fundraising committee chair. "I anticipated a three-year fundraising period, but it took only two years."

Herman Feshbach worked at MIT's physics department for more than fifty years, serving as its chair for ten and directed its Center for Theoretical Physics from 1967 through 1973. He contributed greatly to the understanding of nuclear reactions and the structure of nuclei, and was an outspoken advocate for scientific freedom around the world.

More information about the Feshbach Prize can be found on its web page at http://www.aps.org/programs/honors/prizes/feshbach.cfm

Historic Site: IBM Thomas J. Watson Research Center

Photo by Charles Treppeda (IBM)

On December 5, 2013 APS President-Elect Sam Aronson (right) presented a plaque to David McQueeney, IBM Research vice president of Technical Strategy and Worldwide Operations, to recognize the IBM Thomas J. Watson Research Center as an APS Historic Site. The wording on the plaque reads as follows: "The IBM Thomas J. Watson Research Center has been home to numerous physicists who have produced seminal advances in many disciplines and fields of study. Innovations discovered and developed here include dynamic random access memory (DRAM), field-effect transistor scaling laws, semiconductor superlattice structures, specialized lasers and thin-film magnetic recording heads, as well as advances in optical communications and electron microscopy."

INSIDE THE Beltway

The American Dream Unwound! and Restored?

by Michael S. Lubell, APS Director of Public Affairs

There's nothing like six to nine inches of snow piling up on the Connecticut hills, with 40 mile per hour winds and temperatures of five below, to take the starch out of you–unless you live in Minneapolis, in which case it's like a day at a balmy winter spa.

So, faced with the prospect of venturing outside and chilling my body to the bone, I decided to catch up on some books I've had on my reading list for a while. Curled up in an armchair, what I encountered was just as chilling. But evident in these gloomy snapshots of today were rays of hope for the future, especially for science.

I started with Joe Scarborough's beautifully written new book, *The Right Path: From Ike to Reagan, How Republicans Once Mastered Politics–And Can Again.* I'm a "Morning Joe" junky and rarely miss the MSNBC show that Scarborough, a former conservative Republican House member, hosts on weekdays along with Mika Brzezinski, who provides a Democratic counterpoint.

Scarborough's message simply distilled is that Republicans have lost their way. The party of Abraham Lincoln, Teddy Roosevelt, Dwight Eisenhower and Ronald Reagan has strayed from purposeful pragmatism to ideological intransigence, so much so that it is marginalizing its national appeal and prospects. That party once had a tent large enough to attract moderates like Nelson Rockefeller and conservatives like Robert Taft, but Scarborough asserts it has now become so intolerant of moderation that it is ceding the future of the nation to liberalism embodied by an ascendant Democratic left.

A one-party polity, which he sees as a serious possibility absent Republican redirection, poses an existential threat to American democracy in his view. And in a not-so-veiled warning to Tea Partisans, Scarborough exhorts the GOP leadership to push back against the inflammatory rhetoric of the far right and embrace pragmatic conservative accommodation. And if Republican poobahs take his advice, I believe science–historically a bipartisan venture–could provide them with an ideal opening gambit.

Saving an ailing Republican Party is a serious matter. But saving an ailing nation is even more crucial. And that is what Thomas Friedman and Michael Mandelbaum have attempted in their 2011 book, *That Used to Be Us: How America Fell Behind in the World It Invented and How We Can Come Back.*

It's hard to summarize 356 pages in just a few sentences, but here is the essence of their analysis and prescription for national recovery. American exceptionalism–a term that finds its roots in Alexis de Toqueville's 19th century two-volume treatise, *Democracy in America* –is not immutable, Friedman and Mandelbaum assert. And without addressing four major challenges–globalization, the IT revolution, deficits and debt, and energy and the environment–they say the United States is in the process of ceding its unique status in the world–a bad outcome for all nations, in their view.

To recapture its exceptional position, they argue, America will have to draw on its historical capacity that de Toqueville termed exceptional and sharply focus policies and spending on three categories: education, infrastructure, and research and development. They could not have connected American science to American success more vividly.

Of course, to see that our nation and our political democracy are in trouble, you don't have to read Scarborough, or Friedman and Mandelbaum. You simply have to look around you. And that is what George Packer helps you do with a series of gripping narratives of contemporary American life in his recently published book, *The Unwinding.* It is eerily reminiscent in style and substance of John Dos Passos' Depression era trilogy, *U.S.A.*, which occupied a prominent place in my parents' extensive library, and which I remember reading when I was still in high school.

Packer, whom I first met several years ago and saw again recently, is an extraordinarily talented writer with progressive leanings. His book, as *New York Times* columnist David Brooks, a Republican, pointed out in a largely positive review, is really about three unwindings: "the stagnation of middle-class wages and widening inequality…the crushing recession that began in 2008…[and] the unraveling of the national fabric."

Although Packer doesn't say so explicitly, science and technology played a role in all three of those unwindings. Technology-enabled globalization and IT-driven workforce reductions helped produce the first. Complex mathematical algorithms known as derivatives helped bring Wall Street to its knees and led to Main Street's great recession. And the average person's inability to prosper in the modern technological world helped fray the traditional American fabric.

But if you think about it, as Friedman and Mandelbaum have done, investments in research, education and infrastructure–along with the 21st-century policies they require–can spawn a new era of American exceptionalism. The result won't be a complete rewinding, but in the end, it could provide a renascence of the American dream.

As the second session of the 113th Congress begins its work, I only hope that at least a few members took some time during their holiday break to reflect on the issues Scarborough, Friedman, Mandelbaum, and Packer have illuminated so poignantly.

All Sorted Out

Photo by Michael Lucibella

Physicists gather in mid-January to carry out the crucial task of sorting abstracts for the 2014 April Meeting. Back Row: Laura Blecha (University of Maryland), Tonia Venters (NASA Goddard), Brock Russell (University of Maryland), Liz Hays (NASA Goddard), Julie McEnery (NASA Goddard). Foreground: Sam Leitner (University of Maryland), Peter Polko, (University of Maryland).

ENVELOPE continued from page 1

Kepler-62f, planets about the size of Earth, covered in liquid water oceans, and orbiting safely within their sun's habitable zone. Then in **June** another surprise: Astronomers using Earth-based telescopes discovered that the three planets orbiting the star Gliese 667C were all within its habitable zone (largest number of such planets in the one solar system discovered so far). However, sad news came at the beginning of **June**. The prolific Kepler Telescope, which revolutionized the planet-hunting field, suffered a terminal malfunction, effectively ending its mission after only four years. In the **November** issue of the *Proceedings of the National Academy of Sciences*, scientists estimated that one in five sun-like stars in the galaxy have planets in their habitable zones, meaning statistically that there could be an inhabited planet within 12 light-years of Earth.

Planck Telescope

The European Space Agency released the final results from the Planck Space Telescope in **March**. The spacecraft took the most detailed picture yet of the cosmic microwave background, and there were still some surprises left. It turns out that the universe is a little bit older (13.82 billion years old as opposed to 13.7 billion) and made up of more dark matter than astronomers had previously thought. In **October**, the agency announced that after its successful mission, the observatory would shut down for good.

Higgs Boson

The Higgs boson continued to make headlines a year after its discovery. In **March**, CERN made an announcement that with more than twice as much data as in July 2012, the research team was even more convinced that the particle discovered was the Higgs boson. In **October**, Peter Higgs and François Englert jointly won the Nobel Prize for their fundamental contributions to the underlying theory.

Dark Matter

Apparently conflicting results dominated the ongoing search for dark matter this year. First in **April**, the Cryogenic Dark Matter Search reported that after analyzing data from their five-year run, they identified three signals that looked like dark-matter candidates. Though the team was unwilling to say the results amounted to a discovery, it seemed tantalizing evidence of a relatively light dark-matter particle. However, in **October**, scientists at the Large Underground Xenon experiment in South Dakota released the null results of their first run. It should have been able to spot the signals seen by CDMS, but the fact that it didn't has left physicists scratching their heads.

Omid Kokabee

Physicist and political prisoner Omid Kokabee released a letter in **April** from jail stating the reason the government of Iran has imprisoned him is because he has steadfastly refused to work on their weapons programs. Kokabee is an Iranian citizen who was studying at the University of Texas in Austin when he was arrested at the Tehran airport in January of 2011 while visiting his family. Eventually he was tried and sentenced to ten years for "cooperation with a hostile government." In his letter from prison, he said the Iranian government had asked him many times over the years to work for the military, but he refused, and that's the real reason for his incarceration.

Politics of Science

Science and politics is a volatile mixture, and this year was particularly contentious. In **April** a leaked draft of a Republican bill, the "High Quality Research Act," sparked outrage amongst scientists who saw its "national interest" clause as a ploy by Congress to interfere with the grant-making authority of the National Science Foundation. Though never introduced because of the outcry, elements of the bill resurfaced in November in the House's FIRST Act, which reauthorizes funding for the NSF. That legislation however has not been passed. In the midst of this controversy, scores of federal scientists had to walk away from their research when the federal government shut down for sixteen days in **October**.

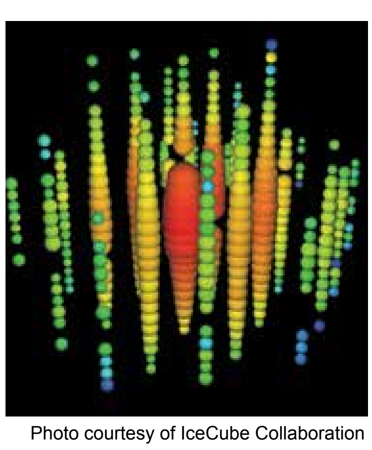


Photo courtesy of IceCube Collaboration

Space invaders: Data collected on neutrinos from space by the IceCube experiment.

Particles from Space

Earth is constantly pelted by a menagerie of particles, and this year scientists identified some of their interstellar sources. In **April**, the team running the Antarctic neutrino detector, IceCube, announced that they saw two neutrinos of such high energy, more than a petaelectronvolt, that it's almost impossible for them to have originated in the Milky Way Galaxy. In **August**, researchers using data from IceCube's surface detectors, IceTop, confirmed that, as scientists had long suspected, supernovae are among the main sources of the high-energy protons known as cosmic rays.

Ununpentium

A new element joined the periodic table in **August**. An international team of researchers created a few short-lived atoms of ununpentium (its temporary name) with atomic number 115 at the GSI Helmholtz Center for Heavy Ion Research in Germany by bombarding a film of americium with calcium ions. The element was first reported in 2003 by a group in Russia, however the International Union of Pure and Applied Chemistry said they wouldn't recognize the discovery until an outside group confirmed it. That confirmation came this year, and now researchers get to argue about what to call it.

Voyager 1

For the first time, a human-built object left the bounds of the solar system. In **September** 2013, NASA released its official statement that the Voyager 1 space probe had entered interstellar space. Launched in 1977, the spacecraft visited Jupiter and Saturn before setting its course for the stars. It actually passed through the heliopause, the outermost edge of the solar wind, in August of 2012, but after several previous false positives, scientists needed more data to be sure.

NIF

In **October**, a rumor started floating around that the National Ignition Facility had achieved ignition, in which more energy is released from a fusion reaction than was put in. Alas it was not to be. After a mistaken *BBC News* article touched off a flurry of escalating headlines on the Internet, reason prevailed and it turned out that the facility was still a long way from its goal. The timing couldn't have been worse. The article was published in the middle of the government shutdown, when there was no one at the lab to set the record straight.

See also the top physics research stories of 2013 published in the APS journals and highlighted by the editors of *Physics* (http://physics.aps.org/articles/v6/139)

MEMBERSHIP continued from page 1

year. But the total number of members living abroad, which makes up about 23 percent of the total membership, increased from 11,319 last year to 11,492 this year. "A primary concern I have is turning our early career members into regular members," Lettieri said.

One of the strategies is to build a greater sense of community early on by establishing a number of hyper-local regional groups for students and early career members so they can network about career options outside of the usual academic path. "It's going to be a slow process in building up the regular member count," Lettieri said. "But we're moving in the right direction."

KAVLI continued from page 1

When he sold the company in 2000 for $340 million, he established The Kavli Foundation to advance science for the benefit of humanity and promote increased public understanding and support for scientists and their work.

Since that time, the Foundation has donated more than $200 million and established 17 institutes at universities across the globe that focus on fundamental research in theoretical physics, astrophysics, nanoscience, and neuroscience. It has also sponsored projects and programs that bolster scientific endeavors, from special symposia at both the APS March Meeting and April Meeting, to the NIH Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative, to science journalism prizes and travel fellowships.

And then there are the Kavli Prizes. Designed to parallel the Nobels, the Prizes are awarded every other year in Oslo in a partnership of The Norwegian Academy of Science and Letters, The Kavli Foundation, and The Norwegian Ministry of Education and Research. They recognize scientists for their seminal advances in astrophysics, nanoscience and neuroscience, and consist of $1 million for each of the scientific fields, according to the Kavli Prize website. "Fred was proud to say (in jest) that the Kavli medal was 1 mm larger than the Nobel medal," says Michael S. Turner, APS Past President.

For the people who knew Kavli, his actions as a zealous benefactor and advocate on behalf of basic research is not bewildering. "He believed that philanthropy is crucially important to moving science forward," says Conn, "and through science, the world becomes a better place."

"Fred was proud of the fact that he was a physicist," says Kate Kirby, APS Executive Officer. "He really saw the value of physics and was so concerned that physics should receive the kind of support it needed. Through the established institutes, he helped bring important researchers together to work on fundamental problems. It's wonderful to see a Foundation focused on basic science."

The Foundation's gifts to the Kavli institutes are almost always unrestricted, says Conn. The endowments which support the institutes, including the Kavli Institute for Theoretical Physics at UC Santa Barbara (the first established), provide about $400,000 annually in income, designed to seed research that otherwise might not be funded.

Case in point: the South Pole Telescope (SPT), an early endeavor of the Kavli Institute for Cosmological Physics at the University of Chicago, which Turner heads. The SPT examines cosmic microwave background (CMB) radiation and galactic evolution and structure. Since taking first light in 2007, the telescope has provided physicists with unique insight into the early universe, including new knowledge concerning stellar and galactic formation and evolution, which has led to a better understanding of dark energy and stronger tests of inflation. But the project never would have gotten off the ground, notes Turner, had it not been for the seed money from the Kavli Foundation. "We leveraged the gift from the Foundation to allow us to go after a $40 million grant from the National Science Foundation," which resulted in the telescope being built, he adds. "It enabled an incredible range of research on CMB and discoveries of clusters of galaxies."

Kavli is described as "extraordinarily smart, disciplined and determined," says Conn, which served him well in his various pursuits. In 2008, when the economy tanked, and the Foundation's assets decreased in value, "Fred came in everyday like a day trader to try to get the funds back up," says Turner. He was known for his frugality. The Foundation, "a lean and mean machine," he adds, has a staff of only six and its headquarters are in a nondescript office plaza in Oxnard, CA, by design. Kirby recalls hearing that Kavli never flew first class: "He said 'it's such a waste of money, which could be used to support science.'" But he did find pleasure in certain material outlets. "He loved driving his Bentley," says Turner with a laugh.

As for the future of the Foundation, Conn says that Kavli left a final surprise. "We knew Fred would leave money to the Kavli Foundation, but we didn't know how much," he says with a chuckle.

In fact, "Fred left the entirety of his estate to the Foundation. We expect in the next three to five years to be spending two to three times what we're spending now. The Kavli Foundation is here to stay and will continue to support science, and now, at an even larger scale."

"Fred took sheer joy took in supporting basic research," says Turner. "He realized what a gem he had in these institutes and that this would be his greatest legacy. He always spoke about the Kavli Institutes as his children."

ANNOUNCEMENTS

BOUCHET continued from page 1

esting materials," Martinez-Miranda said. "If you look at them in a microscope, they're visually very attractive."

The more she worked with the crystals, the more her background in experimental physics and chemistry came in handy. "I think that the field of liquid crystals requires [this combination] more than many other fields," Martinez-Miranda said.

After receiving her doctorate, she left for the West Coast to do her postdoc work at the University of California, Berkeley. "At MIT I was working on just the basics of liquid crystals," Martinez-Miranda said. "At Berkeley they were looking at it from the point of view of how liquid crystals interact with a surface….I went from being very basic to applications."

She then spent a year as a visiting professor at Kent State University at their liquid crystal center. While there, her research interests started to evolve. She started working on thin films as well and when she took a position at the University of Maryland, she expanded further into work on nanoparticles. "Studying nanoparticles is in a way very similar to doing a thin film study," she said.

In the process, she moved back toward basic research and away from finding immediate practical applications. "I am way [over] on the fundamental side," Martinez-Miranda said. "I'm interested in finding out how nanoparticles and films interact and how can you modify the interaction."

Her work on the interaction of liquid crystals and nanoparticles is helping to lay the groundwork for future generations of electronics and medicine. "It has applications not only in biophysics, but also in photovoltaics and many other fields," Martinez-Miranda said. One potential route is to use these materials in display devices.

She said that she's also excited about a new collaboration with a chemist in Chile, which pulled Martinez-Miranda toward another new direction. Up to this point, all of the materials she's worked with have been monomeric, but now she'll start exploring the potential applications of polymer liquid crystals. She said she expects that the mechanical properties of polymers could lead to entirely new applications.

She is also excited about the chance to travel to different universities and share her research as part of the Bouchet lectureship. She has already put together a list of schools she hopes to visit, many of which have large Hispanic populations. In addition she is also planning to lecture at the upcoming meeting for the Society for Advancement of Chicanos and Native Americans in Science (SACNAS).

"The APS meetings are described as general meetings, but they are specific to [physics]," Martinez-Miranda said. "The nice thing about the SACNAS meeting is you get all of [the sciences]."

FELLOW continued from page 1

the STEM Master Teacher Corps.

Mundy received her bachelor's degree in physics and chemistry and her masters in chemistry from Harvard University in 2006. After that, she spent two years teaching science through Teach for America, first in Baton Rouge with students who had been evacuated from New Orleans because of Hurricane Katrina, then in New Haven, Connecticut. She then attended Cornell for her doctorate in applied physics.

"As a high school science teacher, you're immersed in science education policy," Mundy said. "I was really interested after college in working as a teacher to provide high-level educational opportunities to all students."

The APS has been trying to establish such a fellowship at the Department of Education for years. The Society was one of the founding partners of the AAAS Congressional Fellowships in 1973, but placing individuals at the Department of Education has proven more difficult. In September when the other AAAS policy fellowships start up, the STEM Education Policy Fellow will join the rest of the cohort.

"Forty years ago APS was one of the founding member societies of the AAAS fellowships, and once again APS is leading the way," Glembo said. "There has never been a fellow [of this kind] at the Department of Education."

MEMBERS continued from page 1

"That's getting me back to a real love of my life….It gets me back to something I also feel passionate about."

***Robert Shelton**, on leaving his position as executive director of the Fiesta Bowl to be president of the Research Corporation for Science Advancement,* The Associated Press*, January 14, 2014.*

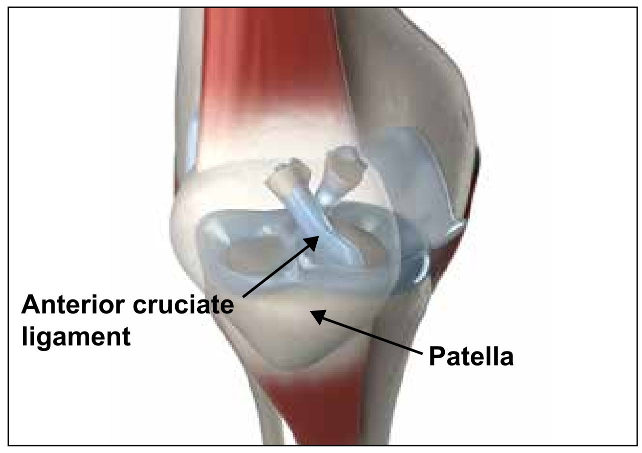
"We were watching these things [avalanches] go by…and we were running out of food. We began to get very depressed about it all."

***Irene Beardsley**, recalling her 1978 ascent of the mountain Annapurna I in the Himalayas,* The San Jose Mercury News*, January 14, 2014.*

The Back Page

Physical Review Applied: Bridging an Artificial Gap

By Troy Shinbrot



Photos by Thinkstock.com

A new twist in knee repair. It is well known among skiers and football players that the anterior cruciate ligament (ACL) can be torn. This can be devastating, since the ACL literally holds the back of the knee together. Conventional artificial replacements for the ACL substantially underperform the original ligament, but a new approach uses interwoven fibers–like a braided rope–to achieve a more natural response.

When I heard that the APS was proposing a new journal, *Physical Review Applied*, it seemed to me self-evident that the one thing we don't need is more journals. New journals appear monthly, providing increasing amounts of noise (in the form of low-quality papers) that dilute important signals (high-quality science) made by serious researchers. Moreover, there obviously are already strong applied physics journals, and I didn't feel that science would benefit from a fast-food philosophy: The presence of a McDonalds is justification to put up a Burger King next door. The natural question then is, what possessed me to become editor of *Physical Review Applied*?

The simple answer is that despite the excess of noise provided by what I call value-subtracting journals, there is a very real and significant gap at the intersection of physics and engineering that I believe needs to be filled, and as a consequence, many APS members doing important, valuable, and frankly very beautiful research have no publishing home for their work.

Speaking for myself, I am trained as a mathematical physicist, but I work in biomedical engineering. I have published in both engineering and physics journals, and I have found that whichever category of journal I choose, colleagues from the other category seldom learn of that work. I am certainly not alone in this: I know many physicists whose research involves eminently applicable topics, and they consistently bring elegant and useful ideas to the verge of realization, but struggle to go further for want of industry contacts and engineering knowhow. Likewise, I work daily with engineers who study useful and important problems that are physics through and through, but who publish in journals that are rarely read by physicists.

I'll give examples shortly, but coupled with these substantive gaps are cultural and semantic gaps between physics and engineering communities. Some of these lead to almost comical misunderstandings, as when an engineering colleague discussed "dispersion" with me and I was baffled because I couldn't understand what a relation between frequency and wavelength had to do with dissolving pharmaceutical tablets. I now know that engineers seldom deal with dispersion relations, and instead use dispersion and diffusion (almost) interchangeably.

On the other side, when I speak of "autonomous" systems, my bioengineering colleagues look at me with puzzlement –because they are thinking of autonomous robots and would call my system "endogenous." Similarly, to physicists "translation" results from linear motion, but to engineers this means bringing a technology to market–and a physicist could be forgiven for thinking that "systems biology" describes how systems of cells, organs or organisms interact, whereas in bioengineering it refers to (usually informatic) studies of how genes and proteins regulate cell functions.

More fundamentally, I have had several collaborations with bioengineers that took off only after several hours of recalibrating our understanding. One example: I have been trained to reason by forward chaining–making a hypothesis and deriving results–while my bioengineering colleagues tend to work by backward chaining–observing a phenomenon and dissecting it. And don't even get me started discussing "balance," which engineers use to describe anything from mass conservation to Newton's second law.

Despite this culture gap, physics-engineering collaborations that do take hold are enormously rewarding and productive. There is no shortage of examples. GPS is entirely based on physics, but has been introduced into our phones and cars by electrical engineers. Robotic surgery has revolutionized delicate operations, and could not exist without major contributions by physicists alongside mechanical, electrical, and biological engineers. The same is true of high-resolution tomography, confocal and convolution microscopy, and essentially every single part of a laptop computer, from memory to processor to display to mouse to touch-screen. All of these technologies have resulted from collaborations between physics and engineering, and the pace of similar developments is certain to accelerate in the future.

This is the raison d'être of *Physical Review Applied*: to promote the publication of the highest quality papers at the intersection of physics and engineering, and to provide a forum for researchers at that intersection. There is a pressing need to fill the physics-engineering gap. It took more than three decades for Isidor Rabi's work on nuclear magnetic resonance in the 1930s to be developed into the first magnetic resonance images in the 1970s. The same is true of Gorilla® Glass: universally used in cellphone and computer displays today, this was developed using long-established methods of physical chemistry in the 1960s, but wasn't engineered into a device until the 1990s. We can't predict what physical ideas will evolve into which engineering applications, but we can all agree that while a 30-year wait may have been needed in times past for technology to catch up with science, 30 years is too long to wait today.

"...there is a very real and significant gap at the intersection of physics and engineering that I believe needs to be filled, and as a consequence, many APS members doing important, valuable, and frankly very beautiful research have no publishing home for their work."

In the presence of this need, the distraction presented by value-subtracting journals is unfortunate, but my interactions with engineers have led to the most rewarding, valuable, and downright fun collaborations that I have had, and I am convinced that a journal bringing physics and engineering together will add value far beyond what we might anticipate at first thought. Let me close with a small sampling of examples of problems to illustrate this point.

Example: A colleague of mine recently developed a ceramic that sequesters carbon dioxide–indeed, it doesn't just do this passively, it uses carbon dioxide in a reaction to solidify the ceramic. This is a terrific vision, right? But it was developed by a materials engineer, and in the ordinary course of events it would be published in an engineering journal to be discovered, only eventually, by physicists for broader research and analysis.

These ceramics can sequester up to 20% of their mass in CO_2 and produce strengths superior to Portland cement. But what allows this new material to attain this strength? What fraction is due to chemical versus physical bonds? Could we pave highways that absorb 50% CO_2 by weight? What is the theoretical limit to the material's strength? What other materials could be designed to sequester CO_2?

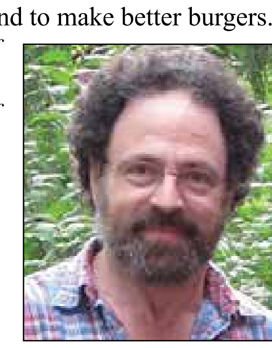
These questions involve fascinating and important materials science. But currently the separation between physics and engineering publications prevents physicists from even finding out about examples like this, except by chance. We need a forum for physicists to learn what the most current engineering research is producing–and what physics is needed to solve pressing technological problems.

Example: Artificial ligaments are known to be greatly inferior to natural ones because under repeated strain, the artificial materials plastically deform, leading to looseness in the joint–a completely unsatisfactory property for a knee ligament. I have another colleague who is taking advantage of the elegant idea that braids in an artificial ligament tighten when stressed to prevent the unwanted fibers from stretching at low stresses. This is a useful, beautiful, and totally physical idea–one that again deserves a forum for both physicists and engineers to appreciate and build on.

Example: In recent years, three independent groups have shown that absolutely identical materials, brought into symmetric contact and separated, spontaneously produce charges that grow with repeated contacts. The cause of this symmetry breaking is unknown, as is the mechanism for charge transport in these insulating materials. The buildup of charges is of practical importance because charging of identical materials is believed to be associated with lightning in sandstorms as well as industrial dust explosions that kill dozens of workers annually. So this problem involves both fundamental physics and very practical implications.

Yet only a handful of scientists are aware either that there is a major hole in our understanding of basic charge transport mechanisms or that this hole has important implications ranging from the geosciences to industry. In large part, I would argue that problems of this kind aren't recognized or appreciated because research crossing the physics-engineering divide has no publishing home. Contact charging is discussed in one place, sandstorms in another, and industrial hazards in yet a third. Moreover, an analysis of the implications of contact charging for geosciences and for industry would have a hard sell to get published in any one of those three places.

This is only a small set of the examples that I happen to have encountered, but there are many more and we plan to publish papers in a wide range of topics (see http://journals.aps.org/prapplied/about). Based on these examples alone there seems to me to be a compelling case for a journal that bridges the artificial divide separating physics from engineering, It seems equally certain to me that providing such a journal can only strengthen both disciplines. Our goal is to provide a publishing home for scientists and engineers whose work crosses that divide. Plus we intend to make better burgers.



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