# APS NEWS

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**Top Physics News Stories of 2008**
**See page 3**


## APS Membership Reaches Record High

The official APS membership count has set a new all-time record, reaching a total of 47,189 as of January 2009. This is an increase of 920 over 2008.

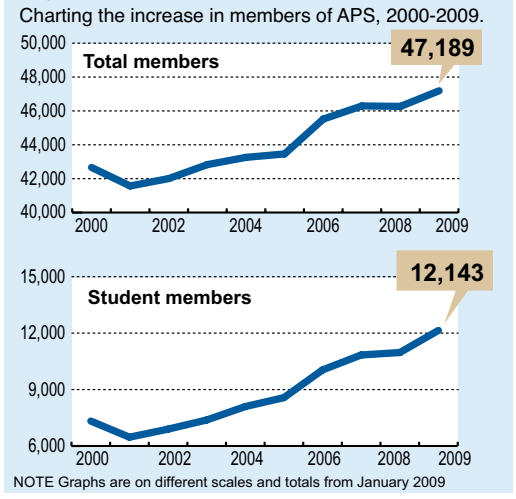
Much of the recent increase can be attributed to growth in the student member category. The total number of student members increased from 10,986 in 2008 to 12,143 in 2009, the highest number ever.

Many of the new students are taking advantage of the one-year free trial membership available to new student members from North America.

"The goal is to get students in, get them active in the Society, and see them continue into the Junior membership category," said APS Director of Membership Trish Lettieri. "Reaching that goal will help maintain the health of the Society membership by offsetting the number of retiring members expected over the next ten years." In line with demographic trends, the number of "regular" members has declined slightly over the past year, while the number of senior (retired) members has grown.

**By the numbers**

Charting the increase in members of APS, 2000-2009.




NOTE Graphs are on different scales and totals from January 2009

Source: APS Membership Dept. *APS News* staff

**RECORD continued on page 4**

## President Obama Names Harvard Physicist John P. Holdren as Science Adviser

APS Fellow John P. Holdren, an international expert on energy and climate change, will serve as President Obama's Science Adviser and Director of the Office of Science and Technology Policy.

"With President Obama's selection of John Holdren as his science adviser, the nation has a powerhouse for energy and environment leadership. John will provide strong and effective leadership of the OSTP team dealing with the broad array of highly desirable goals expressed in the Obama/Biden science and technology program," said 2008 APS President Arthur Bienenstock.

Holdren, who served as a top adviser to the Obama campaign, is the Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology and Public Policy at Harvard's Kennedy School of Government. He is also Professor of Environmental Science and Policy in Harvard's Department of Earth and Planetary Sciences. From 2005-2008, he served as President-Elect, President and Chair of the Board of the American Association for the Advancement of Science.

In 1995, Holdren received the APS Burton Forum Award, "for his many insightful contributions to the analysis of global energy issues, for his unstinting leadership in arms control and for the clear and lucid presentation of these ideas to scientists and to the general public."

Photo courtesy of www.change.gov

John P. Holdren

Trained in fluid dynamics and plasma physics, Holdren has devoted much of his career to energy and climate change research. In an opinion piece published in 1998 for APS, he wrote that "the greenhouse gas most responsible for the growing threat of human-induced disruption of climate is carbon dioxide, some of it emitted by deforestation, but mostly coming from the combustion of fossil fuels." To effectively address the greenhouse issue, he called for "increased investments in the science of climate and climate-change impacts."

Holden is the second physicist slated to join Obama's Administration. His selection follows that of Steve Chu, Nobel Laureate, APS Fellow and lifetime member, who has been nominated as Secretary of the U.S. Department of Energy.

In announcing the selection of Holdren in December, Obama said: "A physicist renowned for his work on climate and energy, he's

**HOLDREN continued on page 5**

## New Topical Group on Energy Research Proposed

A proposed new topical group on energy research has drawn significant enthusiasm from APS members. A petition to form the new group was circulated in December to the membership of several relevant APS divisions. Over 1000 APS members signed the petition. Only two hundred signatures are required for a petition for a new topical group to be sent to the APS Council. APS topical groups may hold sessions at APS meetings and nominate members for APS Fellowship.

"I am delighted to see this high level of interest in a topical group on energy research," said APS Executive Officer Judy Franz.

A planning committee has been formed and is charged with creating a proposed vision and set of by-laws in time for APS Council consideration. "I'm very pleased to chair the committee that has strong representation from university, national laboratory, and corporate sectors, as well as physical chemists, material scientists and engineers" said Robert McGrath of Stony Brook University.

The APS Council will consider the formation of the new topical group at its next meeting in May. "Assuming a positive outcome, we look forward to acting for the topical group in setting up initial programs, sessions and communications, and in setting up the inaugural officer and executive board elections in the fall," said McGrath.

The members of the ad hoc advisory committee for the new topical group are:

**Robert McGrath**, *Stony Brook University (Emeritus)*, Chair

**Claudio Pellegrini**, *UCLA*

**Joseph Poon**, *University of Virginia*

**William Marlow**, *Texas A&M University*

**Keith Jackson**, *Florida A&M*

**Rachel Goldman**, *University of Michigan*,

**Roberto Car**, *Princeton University*

**John Torkelson**, *Northwestern University*

**Ryan Stillwell**, *Florida State University*

**Alex King,** *Ames Laboratory*

**Larry Kazmerski**, *National Renewable Energy Laboratory*

**Robert Biefeld**, *Sandia National Laboratories*

**Thomas Thundat,** *Oak Ridge National Laboratory*

**Jill Dahlburg**, *Naval Research Laboratory*

**Mike Tamor**, *Ford*

**Yi-Qiao Song**, *Schlumberger*

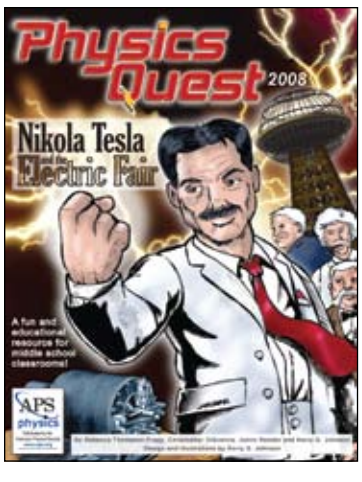
## Lighting Up Classrooms: 2008 PhysicsQuest Kits Launched

*By Nadia Ramlagan*

In 1893, Nikola Tesla's alternating current (AC) lit up the 1893 World's Columbian Exposition in Chicago, also known as the Chicago World's Fair. Over two hundred thousand electric light bulbs were illuminated by Tesla's AC system. It was here that electrical power was first introduced to the general public.

The recently launched 2008 PhysicsQuest kits use colorful comic book style illustrations to accompany four experiments, which unravel the story of Tesla and his quest to beat Thomas Edison's direct current (DC) for the contract to power the Fair. Middle school students will learn about light, magnetism, and electricity while striving to help Tesla find his missing tools and beat Edison in the "War of the Currents."

APS provides a free PhysicsQuest experiment kit, which includes instruction manual and all materials, to registered sixth through ninth grade physical science classes, home school groups, science clubs, and after-school programs. This year, over 11,000 kits have been requested.




"I think the comic book is definitely a highlight of this year's kit. APS Art Director Kerry G. Johnson did a beautiful job with the drawings, and writing in comic-strip format was a neat challenge," said Rebecca Thompson-Flagg, Head of APS Public Outreach.

The majority of experiments are designed to highlight the basic relationship between electricity and magnetism. "The experiments are very different from past kits. It was difficult to find simple, cheap, middle-school level experiments dealing with electricity and magnetism. Once we found experiments we liked, the greater challenge was making them consistently give correct results," said Thompson-Flagg.

Activities include using "disappearing" water gel crystals to probe the principles behind the index of refraction, and "dancing" compasses to show that current creates a magnetic field. A coiled wire and magnet experiment demonstrates that a changing magnetic field can create a current. Finally, students will weave together all the concepts they've

**KITS continued on page 3**

## Bang!

Photos by Peter Byron

On December 9, APS presented a plaque to Bell Labs as part of its historic sites initiative. The plaque commemorates the discovery of the Cosmic Background Radiation that provided evidence for the Big Bang. For this discovery, Arno Penzias and Robert Wilson shared the Nobel Prize in physics in 1978. At the December 9 ceremony, Wilson (top photo) gave a talk, and APS vice-President (now President-elect) Curtis Callan (bottom photo, left) presented the plaque to Bell Labs President Jeong Kim.

# Members in the Media

"For the last eight years and even before that, things in the nuclear world have really been drifting. Now there is a lot more discussion and thought about the role of nuclear weapons."

***John Browne**, Los Alamos National Laboratory,* USA Today, *December 14, 2008*

"I think you would have a hard time designating $CO_2$ from Coca-Cola as a major contributor to global warming,"

***David Haase**, North Carolina State University,* CNSNews.com, *December 15, 2008*

"We want to make an anchor that can dig itself down to the right position to hold the vessel securely–and then, just as critically, easily reposition or free itself."

***Anette Hosoi**, MIT, on RoboClam,* Boston Globe, *December 22, 2008*

"My wife and I went to Greenland last summer where the global warming is most intense and it's very spectacular, you really see that the country is getting warmer very rapidly. But the point is that the people who live there love it and they hope it continues. So I would say that it's perfectly clear that global warming is real but it's not at all clear that it's harmful."

***Freeman Dyson**, Institute for Advanced Study, on global warming, The Science Show,* ABC Radio *(Australia), December 13, 2008*

"It's considered a holy text, the 'Citizen Kane' of comic books. When I was done vibrating like a gong, I said I'd be happy to do something."

***James Kakalios**, University of Minnesota, on being asked to be a science advisor to the upcoming Watchmen movie,* Cleveland Plain Dealer, *December 14, 2008*

"I had poor attendance, and was failing 10 to 15 percent, and grading the tests and shaking my head in despair about how little was getting across. And this is a subject–electromagnetism–that I love."

***John Belcher,** MIT, on lectures at MIT,* The New York Times, *January 13, 2009*

"The one thing that has always intrigued me is, can we take the same idea and do it in three dimensions?"

***Daniel Rugar**, IBM, on using a magnetic resonance force microscope to get a 3-d image of a virus,* The New York Times, *January 12, 2009*

"If this does turn out to come from that epoch, it would be a new window into what was going on there. It suggests there's something out there we're missing."

***David Spergel**, Princeton University, on an unexplained background radio noise coming from the early universe that may cast light on the formation of the first stars,* Philadelphia Inquirer, *January 8, 2009*

"The thermal conductivity of rocks is so low that the inside of a lava flow can be red hot, and the outside stone cold, and it could still take years for the heat to come out."

***Stephen Morris**, University of Toronto, explaining how it can take years or decades for lava to cool,* The National Post, *(Canada) January 5, 2009*

"The better we can understand [the structure of the galaxy], the better the chance for finding more evidence of dark matter.

***Martin Pohl**, Iowa State University, on his new map of the Milky Way,* Time, *January 6, 2008*

"Life is sort of a small fraction of what the universe is about–depending on your perspective. If you look out in the universe, it's a pretty dead place. . . . Anyone coming from [Galileo's] time would be shocked by the diminution of mankind in the context of the universe."

***Adam Burrows**, Princeton University,* Washington Post, *January 14, 2009*

"The mesoscopic is where you've got many molecules, and the manyness matters."

***Athene Donald**, Cambridge University, describing her research interests,* The Guardian *(UK) January 13, 2009*

"I started to think how can I use these exotic quantum mechanical forces for technology."

***Federico Capasso**, Harvard University, on his proposed way to levitate tiny objects using the repulsive Casimir effect,* Reuters, *January 7, 2009*

# This Month in Physics History

## February 1928: Raman scattering discovered

On a boat trip back from England in 1921, Indian physicist C.V. Raman, considering the question of why the sea is blue, got started on a line of research that would lead to the discovery in February 1928 of a new scattering effect, now known as the Raman effect, which is important in physics and chemistry.

C. V. Raman (his full name, Chandrasekara Venkataraman, was shortened during his school years) was born in November 1888 in southern India. His father was a lecturer in physics and mathematics. In 1902, at age 13, Raman entered Presidency College, Madras. He received his bachelor's degree in 1904 and master's degree in 1907. As a student he did research in optics and acoustics.

Photo courtesy of the Emilio Segré Visual Archives/AIP

C.V. Raman

He loved science, but saw few career opportunities for a scientist in India, so after receiving his degrees he took the financial civil service exam and went to work for the government as an Assistant Accountant General. But he didn't give up science–in his spare time he carried out experiments at the Indian Association for the Cultivation of Science at Calcutta. His research included studies of the physics of the violin as well as stringed Indian instruments and Indian drums. He also became known as a good lecturer, offering popular science lectures to the public.

In 1917 Raman was offered the Palit Chair of Physics at Calcutta University. In order to take the position he had to leave his prestigious and well paid civil service job, but he was finally able to devote himself full-time to science.

In 1921 he made a trip to England, where he met with distinguished British physicists. He returned to Bombay aboard the *S.S. Narkunda*, leaving England in September 1921. That was when he began contemplating the striking blue color of the Mediterranean Sea. Lord Rayleigh, who had previously explained the blue color of the sky as due to elastic scattering of light by molecules in the atmosphere, had suggested that the blue color of the sea was simply a reflection of the sky. Raman wasn't so sure this was the case.

Aboard the ship, Raman had carried with him some simple optical equipment, including a pocket-sized spectroscope and a prism. He used these to examine the water and became convinced that water molecules could scatter light just as air molecules could. He sent a letter to *Nature* as soon as he got to port in Bombay.

Inspired by his insight aboard the ship, when he got back to his lab in Calcutta he and his research group embarked on a new line of studies on light scattering effects.

In 1922 Arthur Compton had found that X-rays could lose energy, and thus shift to longer wavelengths, in inelastic collisions with electrons. Raman believed that something similar to the Compton Effect could be demonstrated with visible light scattering inelastically off molecules.

Raman and his research group in Calcutta set up some simple experiments to look at the scattering of light in various liquids. As a light source they initially used sunlight, which was abundant in Calcutta. Using a colored filter they separated out blue-violet light, which then scattered off the target liquid. They used yellow-green and other colored filters to visually detect a change in color of the scattered light. The effect is weak and difficult to see, so they soon realized they needed a more intense light source. The research center acquired a seven inch telescope, which Raman used to concentrate sunlight for their experiments. Even with the fairly simple setup, they were able to observe a shift in the color of light scattered by many different liquids.

In February 1928 Raman observed that the scattered light was polarized, which distinguished the new scattering effect from fluorescence. He and colleague K.S. Krishnan sent off a short paper to *Nature* titled "A New Type of Secondary Radiation," in which they reported having examined sixty different common liquids and observed the new scattering effect to some degree in all of them. Shortly afterwards Raman measured the exact wavelengths of the incident and scattered light using a spectroscope, and presented the quantitative results in a lecture to the south Indian Science Association in March and in the *Indian Journal of Physics*.

Other researchers at the time had also been investigating light scattering effects. For instance, Russian physicists Grigory Landsberg and Leonid Mandelshtam in 1925 began looking at light scattering in quartz. They were at first hindered by poor samples of quartz with many impurities, but by 1928 they managed to get a pure enough sample of quartz, and in February 1928 they independently observed the same scattering effect that Raman had found. They reported their results in at a conference in Moscow in April.

Physicists quickly recognized the importance of the Raman Effect. It provided another verification of quantum theory, and was useful in the study of vibration and rotation of molecules. Within a few years chemists were commonly using Raman spectroscopy for chemical analysis.

Raman received the 1930 Nobel Prize for the discovery, as well as numerous other honors. He was knighted by the British Government in 1929. He later became director of the Indian Institute of Science and established the Raman Research Institute in Bangalore. He died in 1970. In honor of C.V. Raman and his discovery, India observes a national science day on February 28 each year.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# Education Corner

A column on educational programs and publications

## Physics Teacher Education Coalition (PTEC) Conference

The annual PTEC Conference is the only national event in the country dedicated to physics and physical science teacher education. This year's event will explore the theme of "Institutional Transformation: How do we change departments and universities to embrace the mission of preparing tomorrow's teachers?" National leaders in physics and physical science teacher education will lead 90-minute workshops in four parallel sessions. In addition, the program will include plenary speakers, a contributed poster session, two half-day post-conference workshops (see below), and ample opportunity for networking and sharing ideas. The conference will take place in Pittsburgh on March 13 and 14, immediately prior to the APS March Meeting. For more information and to register, please see www.ptec.org/conferences/2009.

## Education Workshops at the APS March Meeting

The Physics Teacher Education Coalition (PTEC) will sponsor two half-day workshops prior to the APS March Meeting in Pittsburgh. These workshops are intended to help faculty improve their undergraduate physics courses while recruiting undergraduates into teacher preparation programs. Ed Prather of the University of Arizona, a leader in research-based teaching techniques, will lead a workshop on how to make lectures more interactive and effective. Valerie Otero and Steve Pollock, professors at the University of Colorado at Boulder, will lead a workshop on their nationally recognized Learning Assistant program, which recruits undergraduates into teacher education programs with experiences as peer mentors. Both workshops will take place from 8:30 a.m. to noon on Sunday, March 15. For more information and to register, go to www.ptec.org/conferences/2009/.

The APS Forum on Education is organizing a half-day workshop prior to the APS March Meeting entitled "Incorporating Simulations and Computer Modeling into Upper Level Physics Courses." Presenters Wolfgang Christian, Harvey Gould, Anne Cox, and Chandralekha Singh will expose participants to recently developed computer-based curricular material that improves student understanding of upper-level physics topics and that makes many previously inaccessible topics accessible to undergraduate and graduate students. The workshop will take place from 1:30 to 5:30 p.m. on Sunday, March 15. For more information please see www.aps.org/meetings/march/events/workshops/fed-dcomp.cfm.

## The Noyce Scholarship

The National Science Foundation's (NSF) Robert Noyce Teacher Scholarship program provides scholarships of $10,000 or more per year for future science and math teachers. Since 2002, the Noyce program has supported over 1,500 future teachers from over 90 colleges and universities. The scholarships can go toward a teacher's undergraduate or graduate education, and recipients must commit to teaching for two years in a high need school district for every year of scholarship support. The term "high need" is defined quite broadly, and includes districts in every part of the country.

A new component of the Noyce program called the NSF Teaching Fellowship/Master Teaching Fellowship program will support science, technology, engineering, and math (STEM) professionals who enroll in master's degree programs leading to teacher certification, as well as exemplary teachers who wish to become Master Teachers in high need school districts. This program will provide academic courses, professional development, and salary supplements to these fellows, in exchange for a commitment to serve in a high need school district.

Proposals for both the pre-service scholarships and the teaching fellowships are due March 10. More information can be found on the NSF's website at www.nsf.gov by searching on "noyce."

APS and the American Association of Physics Teachers recently won an award to provide Noyce scholarships to future physics teachers at PhysTEC institutions. For more information on this program, please see www.PhysTEC.org/noyce or the November 2008 issue of *APS News*.

**KITS continued from page 1**

explored by constructing a magnet-powered pinwheel, to illustrate how current can make a magnet turn.

"Everything from lightning to computers ultimately relies on a few fundamental principles of electricity and magnetism. Students will discover that these principles apply to their everyday lives," said Chris DiScenza, APS Public Outreach Specialist.

PhysicsQuest is a middle school competition that aims to give students a positive experience with physics, as well as introduce them to physics concepts. The competition consists of four physical science experiments centered on a mystery. Each story-based experiment gives students a clue needed to advance their journey towards solving the mystery. Classes submit their answers online and are entered into a random drawing for prizes.

The program focuses specifically on middle school students because these grades have been identified as the point when many students are in danger of losing interest in math and science. PhysicsQuest 2009 kits will be laser-themed, in conjunction with LaserFest in 2010.

# Education Award Recognizes 2-Year College Workshop Team

Established 3 years ago, the APS Award for Excellence in Education is primarily intended to recognize a group, rather than an individual. This year's recipient, approved by the APS Executive Board last spring, is the Two-year College Workshop Team, whose leaders are (l to r): David Maloney (Indiana-Purdue University, Fort Wayne), Curtis Hieggelke (Joliet Junior College), and Tom O'Kuma (Lee College).

Photo by Regina Barrera

In recommending the award, the selection committee noted that "physics faculty members in two-year colleges are frequently very isolated from their colleagues and are usually members of general science departments. Very often, there is only one physicist on the faculty of the institution. Approximately 25% of students who enroll in introductory physics do so at two year institutions, and the percentage is higher for those students who will become K-12 teachers. In addition, the TYCs are the portal to higher education for minority students and currently constitute the fastest growing segment of higher education in the US. By reaching out to these faculty and building a network among them, the Two Year College Workshop Team has had a critical impact in improving physics instruction."

# The Top Ten Physics News Stories of 2008

The following ten stories were selected by science writers and editors of the American Institute of Physics and of APS as the top ten physics news stories of 2008. They are in no particular order. In many cases, more information about these topics can be found in the new APS online publication, *Physics*.

**Superconductors**–An entirely new line of compounds capable of superconductivity at comparatively high temperatures has been isolated. Materials using an iron-arsenic base were found to conduct electricity with zero resistance at temperatures just over 50 Kelvin. This is the first time that a material other than a copper-based compound showed such electrical characteristics at these high temperatures. In addition, these new iron-arsenic-based conductors have been shown to be less brittle and easier to form than older, copper-based materials, potentially lending themselves to more practical uses in the future. Not only does this discovery come with many prospective functional uses, but also it offers clues towards answering the fundamental question of what actually causes high-temperature superconductivity.

Read more about iron-based superconductors: *Physics* 1, 21 (2008)

Read more about the most recent iron superconductor discovery: *Physics* 1, 28 (2008)

**LHC**–After the better part of a decade, the Large Hadron Collider, located along the Franco-Swiss border, was completed in June. With its 17 mile-long collider tunnel, it is not only the world's largest particle accelerator but also essentially the largest science experiment in the world. The accelerator will propel protons with energy on the order of 7 TeV per proton, registering their impacts in one of four giant detectors around the track. Physicists hope that these collisions will be energetic enough to produce a variety of exotic particles, including the elusive Higgs boson, the theorized elementary particle that gives matter its mass. A malfunction in September knocked several of its superconducting magnets badly out of alignment, temporarily shutting down the facility. Repairs are under way and technicians expect the LHC should be up and running by the summer of 2009.

**Planets**–Major planetary discoveries were made from near and far. Perhaps the biggest discovery comes from outside our solar system. For the first time, astronomers have been able to image extra-solar planets. In addition, scientists have detected spectroscopic evidence of both carbon dioxide and water vapor in some of these planets' atmospheres. More locally, the Messenger Spacecraft, though still more than two years from reaching its target orbit around Mercury, has already started beaming back spectacular images of the planet's surface, and discovered its magnetic field to be unexpectedly symmetrical. Numerous probes all over Mars continue to transmit evidence about the red planet's watery past. The now inert Phoenix Lander found strong evidence of a layer of water ice just under the surface around the polar regions. At the same time, images from the orbiting Mars Reconnaissance Orbiter show landscape features that likely came as the result of a liquid ocean sometime during the planet's warmer history. The Venus Express has taken outstanding images at a variety of wavelengths of Venus's cloud cover. Cassini's continuing mission to Saturn has returned an unprecedented amount of new data about its moons and extensive ring system. Photos and telemetry from the sixth planet have shown a mysterious aurora around its poles, an unexpectedly thinning ring system, and tremendous geysers on its icy moon Enceladus.

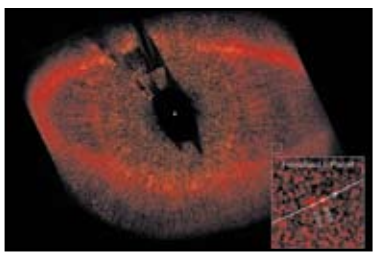

Photo courtesy of NASA

Debris ring around Fomalhaut location of extrasolar planet Formalhaut b.

**Quarks**–A new baryon was detected by Fermilab's DZero experiment. The new particle, dubbed Omega-sub-b, contains two strange quarks and a single bottom quark. Baryons containing a bottom quark are extremely rare and short-lived. The team at Fermilab recorded only 18 instances of the new particle after nearly 100 trillion recorded collisions, each surviving only for about a millisecond before decaying. This discovery continues to fill in the periodic table of baryons and furthers the understanding of the fundamental interactions of quarks and their strong nuclear forces. At the SLAC BaBar experiment in California, scientists have isolated the lowest energy state of bottomonium, a particle composed of a bottom and anti-bottom quark. In addition, in Japan's KEK laboratories, scientists believe they have detected the first four-quark particles.

Read more about bottomonium: *Physics* 1, 11 (2008)

More about four-quark particles in *Physics Today*, June 2008

**Farthest Gamma Ray Burst** – On September 19th NASA's Swift satellite caught sight of the most distant gamma ray burst ever detected. A tremendous gamma ray burst nearly 12.8 billion light years away was first spotted by the Swift satellite and soon tracked by several ground-based observatories. After analyzing the objects redshift using telemetry from observatories in Chile, scientists were able to calculate the huge distance the object's light had to travel before reaching Earth. A gamma ray burst that size comes from a super-massive star, many magnitudes larger than our sun, after it has exhausted all of its nuclear fuel and collapsed into itself, forming a black hole. Not only is the September burst the farthest observed event, it is also the oldest. Based on the amount of time for its light to reach Earth, the burst happened when the universe was less than 825 million years old.

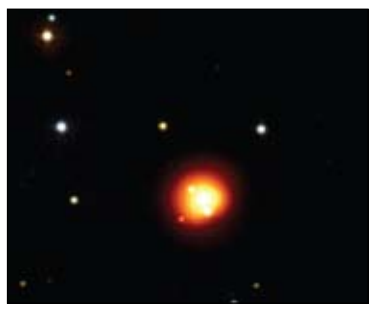

Photo courtesy of NASA/Swift/Stefan Immier

Gamma Ray burst 080913, the most distant gamma ray burst detected

**Ultra Cold Molecules**–For the first time, entire molecules have been cooled to a few hundred-billionths of a degree above absolute zero. By modifying an established laser cooling technique used on individual atoms, two teams were able to create the coldest molecules in history. The team in Boulder, Colorado isolated several individual atoms of potassium and rubidium in an optical lattice formed by crossed laser

**TOP TEN continued on page 6**

# Letters

## Economic Theories not Scientific

I congratulate H. Eugene Stanley for his very illuminating Back Page (*APS News*, December 2008) on the role of physics in the current financial crisis. I wholeheartedly agree with him regarding the contention that physicists are responsible for it. That is simply a red herring, introduced to shield those who are truly responsible.

On the other hand, I disagree with his characterization of economics as a science. Current economic theories are essentially political, and insofar as I can discern are divorced from a number of well established scientific facts: that resources are finite, for instance. While we see criticisms of capitalism as being incapable of recognizing the worth of things that cannot be valued in units of currency, such as clean air and water, biodiversity, and human dignity among others, the same can also be said of other recent economic theories such as Marxism and Maoism.

Because economic theories are essentially political, they tend to be ideological, putting them in the same category as religion. Which as we all know is the antithesis of science.

Stanley's intuition that an over-connected system is disadvantageous is correct in my opinion. Since the introduction of requirements for quarterly reporting, listed corporations have largely abandoned long-term planning, focusing instead on short-term results to please the analyst-priests. In addition, programmed trading enhances the connectivity, providing a substantial positive feedback response. A simple fix would be to introduce significant but random delays in large programmed trades, in an effort to partially decouple them.

***Stephen Schiff***
*Aldie, VA*

## Malthus Still Relevant

The Back Page on Econophysics by H.E. Stanley does not mention an equally or even greater failure. Malthus warned of the problem, but prematurely. Today only a few lonely voices are heard, when it should be clear that "solving" the energy problem without simultaneously addressing the population growth is counterproductive. The most important contribution Physics can make is promoting the importance of considering all the interacting parts, rather than developing a technical fix for one part while ignoring its effect on the whole.

***Elmer Eisner***
*Houston TX*

## Correction Offered to Science and History of Cosmic Acceleration

As a member of the High-Z Supernova Search Team (HZT), I think it is worthwhile to correct both the science and the history that were described in "This Month in Physics History" that appeared in the January *APS News.*

On the science, Type Ia supernovae are not standard candles: their luminosities vary by a factor of 3. Sorting the bright from the dim by the shape of their light curves to get precise distances was introduced by HZT member Mark Phillips in 1993.

Similarly, absorption by interstellar dust can mimic dimming that is due to accelerated expansion. Riess, Press, and Kirshner developed a solution to this problem, published in 1996, which was essential to the analysis of distant supernovae submitted by Riess and HZT to the *Astronomical Journal* on March 13, 1998. This paper was accepted on May 6, and published in September 1998. The Supernova Cosmology Project also developed an effective way to measure dust absorption to individual supernovae, but not until 2003. Their article on cosmic acceleration was submitted to the *Astrophysical Journal* on September 8, 1998 and appeared in the June 1999 issue.

On the history, the January 1998 AAS meeting was not the time and place where the world learned we live in an accelerating universe. At the AAS press briefing, 5 speakers, including Peter Garnavich from HZT, concurred that we live in a low density universe that would expand forever. In that public setting, no one claimed that the universe was accelerating [see, e.g. John Noble Wilford, *The New York Times*, Jan 9, 1998 "New Data Suggest Universe Will Expand Forever".] The first clear public statement that evidence from supernovae indicated cosmic acceleration took place in February 1998, at the Dark Matter meeting in Marina Del Rey. Alex Filippenko of HZT said "the dimness of the supernovae–pointing to unexpectedly large distances–implies that cosmic expansion has actually sped up in the years since the stars exploded." This triggered a flood of public attention, including an interview of HZT member Adam Riess on The News Hour. Cosmic acceleration seemed like news to the world in February. Not January.

In March 1998, Saul Perlmutter was asked by the *New York Times* to explain his reluctance to assert cosmic acceleration at the AAS in January. According to the *Times*, "Describing their results in January, Dr. Perlmutter acknowledged that the evidence strongly suggested a cosmological constant, but went no further. 'We were trying to be very conservative until we had more observations'." Nobody claimed to have announced cosmic acceleration in January 1998. I think we should mark the dates of scientific discoveries from the submission of refereed publications, not commemorate the extrapolations of reporters who get ahead of prudent scientists in drawing reliable conclusions. I say we should have the anniversary on March 13! On this basis, I look forward eagerly to the next "This Month in Physics History."

References to the articles mentioned above can be conveniently found at http://www.cfa.harvard.edu/~rkirshner/whowhatwhen/Thoughts.htm

***Robert P. Kirshner***
*Cambridge, MA*

## Meeting Planners Need to Think Green

In this era of green thinking and friendliness to Planet Earth, I make a plea to all those who organize (APS and other) conferences. Surely, it makes sense, when deciding on a venue, to avoid far-flung corners of the US. Holding a major scientific meeting inevitably means that some participants will need to fly, but choosing Hawaii, for example, as a destination means that every participant will clock up thousands of air miles and be responsible for significant $CO_2$ emissions. Why not choose a major airline hub, or somewhere that is close to the workplace of many of the attendees? This will minimize the carbon footprint of the meeting, reduce costs associated with travel, and lessen the tedium of hours and hours spent confined in a metal tube.

***Paula Rosen***
*Reading, Berkshire, UK*

## APS Copyright Revision Expands Author Rights

*By Nadia Ramlagan*

APS has recently revised the copyright transfer form for journal articles, in order to give the author additional rights. The new agreement allows authors to make and hold copyright for "derivative works" that contain at least at least 10% new material, and not more than 50% of the published APS journal article. If these conditions are not met, the author must obtain explicit permission from APS.

Revisions to APS copyright policies have been under discussion with input from the community over the last two years. The emerging philosophy regarding copyright is to keep only those rights that APS needs to safeguard the continuity and value of the journals and to cede the rest to authors.

APS strongly advocates reusing article ideas and material in conference proceedings and classroom lectures; it is the posting of full articles on open content encyclopedia projects like Wikipedia or Quantiki that presents a copyright issue, as such sites have strict regulations requiring that authors hold copyright to material that they post. The policy lets authors reuse material from their APS journal articles when writing for a new audience, widening the scope of freedom of authors to create derivative works and to post on sites like Wikipedia.

"The APS goal is to allow authors maximum freedom to repurpose their papers for other audiences, and take only the rights that we must have to continue to provide quality publications to the physics community," said Gene Sprouse, APS Editor- in-Chief.

APS also gives authors the right to post and update a paper on their (or their employer's) website and on free e-print servers such as arXiv. Authors are entitled to provide full copies of their paper, for research purposes, to a colleague or third party as long as a fee is not charged. Third parties can use copies for teaching also, but incorporation into course notes for more than one semester requires APS permission.

The change reflects the accommodation of APS Journal polices to advances in the way scientific literature is communicated, and the means by which APS takes into consideration future dissemination of knowledge, while protecting and preserving the archive of physics research.

"*Physical Review* is really a community project–a public record of what is important in physics, and we try to act in a way that doesn't harm that. But it's hard to tell where technology is going and what will be most useful to subscribers," said APS Treasurer Joe Serene.

**RECORD continued from page 1**

APS membership also has a significant international component. There are now roughly 10,000 members from outside the US, representing 21% of the total, approximately the same percentage as in recent years.

One area in which membership totals can play an important role is with respect to lobbying activities. As a registered lobbyist in Washington, APS seeks to promote the health of the profession by arguing for funding for science, research and education and to bring science into the policy arena by advocating on issues mandated by Council. The impact that APS can have depends on having a large, active membership.

More information about APS membership can be found at the membership website, www.aps.org/membership/.

## Washington Dispatch

*A bimonthly update from the APS Office of Public Affairs*

**ISSUE: Science Research Budgets**

Just prior to the January 16th *APS News* deadline, House Speaker Nancy Pelosi released a draft of the Second Economic Stimulus bill (officially known as the "American Recovery and Reinvestment Act"). The proposal includes "$10 billion for science facilities, research, and instrumentation" and $2 billion for energy efficiency and renewable energy research. Key elements of the $12 billion total include:

• **National Science Foundation (NSF):** $3 billion, including $2 billion for expanding employment opportunities in fundamental science and engineering; $400 million to build major research facilities; $300 million for major research equipment; $200 million to repair and modernize science and engineering research facilities at the nation's institutions of higher education and other science labs; and $100 million to improve instruction in science, math and engineering.

• **Department of Energy:** $1.6 billion for basic research in the physical sciences (including high-energy and nuclear physics, fusion energy sciences and high-speed computing; and improvements to DOE laboratories and scientific facilities); $400 million for the Advanced Research Project Agency–Energy (ARPA-E) to support high-risk, high-payoff research into energy sources and energy efficiency; $2 billion for competitive energy efficiency and renewable energy grants to universities, companies, and national laboratories.

• **National Institute of Standards & Technology (NIST):** $300 million for competitive construction grants for research science buildings at colleges, universities, and other research organizations; and $100 million to coordinate research efforts of laboratories and national research facilities by setting interoperability standards for manufacturing.

By the time *APS News* went to press, the Senate had not yet released its Stimulus draft. However, congressional leaders and President Obama have stated that the Stimulus is their top priority. The Senate and House hope to have a Stimulus bill passed and ready for the President's signature by the President's Day recess, which is scheduled to begin at the close of business on February 13th. If the legislative process slows down, the congressional leaders have said they will keep both chambers in session.

Readers will recall from the December Washington Dispatch that the majority of the Federal Government is operating under a Continuing Resolution (CR) for Fiscal Year 2009 (FY09) that holds federal funding at FY 2008 levels. An FY 2009 Omnibus Bill is nearing completion, but it is unclear when Congress will turn to consideration of the legislation. Should completion of the Stimulus bill bog down, preventing completion by the President's Day recess deadline, Congress may turn to the FY09 Omnibus, particularly in light of the expiration of the CR on March 6th. Should Congress not consider the Omnibus by that date, there is a possibility that Congress would vote to extend the FY09 CR for the remainder of the fiscal year, which would keeping funding at FY08 levels.

**ISSUE: POPA Activities**

Since the October 3rd, 2008 meeting of the APS Panel on Public Affairs (POPA), subcommittees have been busy at work on approved and proposed studies for the coming year.

POPA approved a study on non-biological $CO_2$ capture, and William F. Brinkman has agreed to be Study Chair. A POPA member, Robert Socolow, will Co-Chair. The study's committee has been assembled and leadership is finalizing budget details. The inaugural meeting of the committee is tentatively scheduled for March.

The POPA Energy & Environment Subcommittee is considering a proposal for a study focused on modernizing the current U.S. energy grid to enable significant expansion of renewable energy. This will be discussed at the February 6th POPA meeting.

The National Security Subcommittee has developed a study proposal on verification technology for reducing nuclear arsenals, a topic that arose as a supplementary item of interest from the report, *Nuclear Weapons in 21st Century U.S. National Security*, which was produced jointly by POPA, AAAS and the Center for Strategic and International Studies (CSIS) and released in late 2008. The National Security Subcommittee will present its proposal for consideration at the February 6th, 2009 POPA meeting.

Anyone who has suggestions for a POPA study can visit http://www.aps.org/policy/reports/popa-reports/suggestions/index.cfm and send in his or her ideas. Reports stemming from past POPA studies can be found on the web at http://www.aps.org/policy/reports/popa-reports/index.cfm.

**ISSUE: Washington Office Media Update**

Bloomberg news service and PhysicsToday.org published stories regarding the nomination of Steven Chu as Secretary of the U.S. Department of Energy. Chu is the current Director of the Lawrence Berkeley National Laboratory and an APS Fellow.

*USA Today* and *Global Newswire* published stories about the release of the APS/AAAS/CSIS Nuclear Policy report. Interested readers can find the report on the POPA Report website, at http://www.aps.org/policy/reports/popa-reports/index.cfm.

The APS Energy Efficiency report (http://www.aps.org/energyefficiencyreport/) has received coverage in the following media outlets:

*Print:* McClatchy News Service, Miami Herald, Seattle Times, Bellingham (WA) Herald, Lawrence (KS) Journal World, Politico, St. Louis Post-Dispatch, Grand Junction (CO) Daily Sentinel, Patriot News (Harrisburg, PA) and Epoch Times

*Magazine:* Science, Physics Today

*TV:* CNN, Clean Skies TV, Energy & Environment TV

*Radio:* An audio news release aired on 150 stations in the top-50 markets, reaching more than 15 million households. Some of the stations included: CNN Radio, Wall Street Journal Radio, Metro Networks (San Francisco, Oakland, CA) and American Urban Radio Network.

*Online:* CNNmoney.com, Newsweek On-Air, Energy Efficiency News (UK), Business Week, Clean Earth News, Climate Wire, CoStar Group, Energy & Environment News PM, Energy Bulletin, SLAC Today, Smart Brief, American Institute of Physics

*Blogs:* Grist, Energy Independence, Green Car Congress, Northern Crude Alaska, Peak Oil

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

**HOLDREN continued from page 1**

received numerous honors and awards for his contributions and has been one of the most passionate and persistent voices of our time about the growing threat of climate change. I look forward to his wise counsel in the years ahead."

Holdren will also serve as a Co-Chair of the Presidents Council of Advisors on Science and Technology (PCAST) along with Harold Varmus and Eric Lander. "Together, they will work to remake PCAST into a vigorous external advisory council that will shape my thinking on scientific aspects of my policy priorities," said Obama in his announcement.

## INTERNATIONAL News

*...from the APS Office of International Affairs*

# From oil wells to fountains of knowledge: building a research culture in Qatar

*by Millie Hyde-Smith*

The Arab region is not renowned for its research input. According to UN figures, Arab countries spend 0.15% of gross domestic product (GDP) on research, and this amounts to only fractionally over 10% of the global average. Yet, if the small Gulf country of Qatar has its way, all this will change. The state of Qatar, which has the fastest growing economy in the world, has dedicated 2.8% of its GDP to research with a view to diversifying its income from oil and gas revenues to one derived from a knowledge-based economy focused on science, technology and medicine. Put in real terms, that 2.8% equals 1.5 billion US dollars per year and compares to 2.7% in the US and 1.8% in the UK.

Nonetheless, Qatar is aware that it takes more than money to excel at research. Having looked at the success of other countries such as the UK, where research output greatly exceeds investment in comparison to other countries, it has recognized the need to focus, to invest in excellent universities, and to favor multi-disciplinary work.

So in order to allocate some of that capital whilst simultaneously, and perhaps more importantly, ensuring that a sustainable research culture is established, the Qatar National Research Fund (QNRF) was established in 2006. Its mission is to administer funding for original, competitively selected research that is in the national interest, but QNRF has been established as much more than a funding body. It promotes the concept and importance of research nationally, particularly to young people at undergraduate level. The Fund also ensures that the research it provides for adheres to international standards. In order to do this it has worked closely with a number of international bodies, such as the NSF, NIH and the U.S. Civilian Research & Development Foundation, and has deliberately kept the benchmark for funded research high to encourage excellence.

Another key role of the QNRF is to facilitate collaboration and multi-disciplinary research between Qatar-based institutions and international partners. Many of these projects involve one of the six US universities with branch campuses in Education City (the education & research hub established by Qatar Foundation), but increasingly state and private entities in Qatar are developing research programs and working in collaboration with academic partners abroad. To encourage these partnerships a delegation from QNRF visited a selection of UK and US universities over the summer of 2008 to explain what funding and partnership opportunities are available. Sattar Al Taie, Director of QNRF elaborates:

"We actively encourage collaborative research between institutions in Qatar and established research facilities abroad because promoting knowledge and technology transfer in this manner builds human capital. In this way we help our academic institutions attract and retain top faculty, and contribute to the development of a research culture here."

The principal funding program for professional researchers is the National Priorities Research Program, or NPRP as it is known. This annual program is currently in the midst of assessing applications to its 2nd cycle of funding and in Spring will be awarding a total of US $45 million with grants ranging from $20,000 to $350,000 per year, payable to projects spanning anywhere between one and three years. Applications are all independently peer reviewed by at least three international experts, and the process adheres to a strict policy of transparency and equality. Al-Taie feels this rigor, combined with encouraging collaboration, has contributed to the success of the NPRP:

"A manifestation of this is that QNRF received during the second NPRP cycle nearly 500 proposals from 277 institutions located in 46 countries."

Applications can come from within a range of broad research areas, including the natural sciences, engineering, and technology. At least one PI must reside in Qatar and 50% of the research effort must be conducted in the state; however, QNRF recognizes that modern research programs are not restricted by borders or institutional boundaries and can be coordinated across multiple sites.

QNRF is funding research in many disciplines of physical sciences, ranging from theoretical and fundamental physics to immediate applied physics. Physics research is also integral to many interdisciplinary research projects, particularly those springing out of the petrochemical industries. In keeping with its drive to develop home-grown knowledge, as opposed to relying on bought expertise, this field of research is of primary importance to Qatar.

An example lies in nanotechnology, which has great significance to Qatar's gas industry as nanocatalysts are used in the gas-to-liquid conversion processes. Enhancing the activity and selectivity of these nanocatalysts is a multi-disciplinary research field which is one of those supported by QNRF and involves joint teams comprised of both US- and Qatar-based researchers. The input of physics is crucial in understanding the processes of these catalytic reactions at the atomic and molecular level, and the identification and characterization of the active sites. This can inspire chemists to look for ways to design and make high performance nanocatalysts. For example, a research team composed of Professors Mahmoud Khader of Qatar University, Wayne Goodman at Texas A&M University, and Dragomer Burkur at Texas A&M at Qatar addressing issues related to the activation of supported cobalt nanoparticles.

University physics departments are also involved in a wide range of QNRF-funded activity, notably projects concerning biodetection, solar energy conversion, photocatalysis, photonics, laser spectroscopy and nonlinear optics. Funded research activities in applied mathematics and theoretical physics include projects aiming at understanding quantum entanglement, the outcome of which could have great applications in the security of communication within quantum information science.

Qatar's efforts to create a knowledge-based economy, which started over a decade ago with the establishment of a world-class educational infrastructure before the focus transferred to research and development, represent a unique experiment. Ultimately it is hoped that some of the research funded by QNRF and others will result in the ultimate prize of intellectual property rights and commercialization. Only time will tell if Qatar's ambitious plans, enviable wealth, and unbridled enthusiasm pay off.

Researchers who are interested in collaborating with researchers in Qatar and applying for NPRP funding for the next cycle, which begins in summer 2009, should refer to the NPRP proposal submission section of the website: www.qnrf.org.

*Millie Hyde-Smith is a consultant for QNRF.*


# Finding Sanctuary in Faith and Physics

*By Alaina G. Levine*

A Priest and a Rabbi walk into a physics lab. It could be the start of a joke, but in this case it's the premise of the lives of Michal Heller, a Catholic priest, and Ronald B. Kopelman, a rabbi, both of whom also happen to be physicists.

Drawn to science as youngsters, Reverend Heller, 72, and Rabbi Kopelman, 56, both see religion and science as inherently connected. "Science gives us knowledge, and religion gives us meaning," says Heller. And as Kopelman puts it: "Science asks how and religion asks why…they deal with two sides of the same coin."

The two clergymen completed their physics and religious training in reverse order–Kopelman worked as a physicist for almost 15 years and then became a rabbi, whereas Heller went to Seminary in his teens and studied physics following his ordination as a priest.

Rabbi Kopelman received his PhD in physics, in the area of critical point phenomena in gas and liquid transformations, from the University of Maryland. He went straight into an industrial physics career, but had always been very interested in Judaism. Having been raised in an Orthodox Jewish household in Detroit, he had first contemplated becoming a rabbi in his younger days, although he ultimately chose to first pursue a career in science.

Kopelman had been attracted to physics because he was magnetized by measurements. "I was always excited at the thought of doing a measurement, of finding a number," he explains. "I liked the challenge of doing an experiment and getting a number with greater accuracy than anyone else had done before."

His career transition from physicist to spiritual leader began in 1990, although Kopelman says it was "a midlife crisis 20 years in the making." At that time, at the age of 41, he was working for NASA in Cleveland while his family lived in Utica, NY. Every weekend, he drove the three hours home and during the long drives he found himself thinking more and more about Judaism. He started reading books on the subject and learning Hebrew, and before he knew it, he realized he needed formal training to go further with his studies. "What started out as an avocation turned into a full-time pursuit," he says. He quit his job, enrolled in the Jewish Theological Seminary in New York City, and seven years later, emerged as a rabbi.

His first pulpit out of seminary was at a synagogue in Bowie, MD. Looking back, Rabbi Kopelman asserts that he would not have done his training any other way. "What I am today is a reflection of both worlds and I wouldn't give either one up," he says. In fact, "I wish I could have spent a whole lifetime doing both."

Reverend Heller feels the same way. He was excited by science as a child, and says "my dream from the very beginning was to study the sciences. It was quite natural." And yet he knew "religion was something that was absolutely necessary (to be part of)".

"I was too ambitious," Heller admits, "I always wanted to do the most important things, and what can be more important than science and religion?" By the time he was in his teens, he knew he would pursue both. However, growing up in Poland at the end of World War II, and then under a communist regime, he knew getting a degree in physics was not a simple option. He chose the priesthood first. After graduating from seminary and being ordained, he went to study physics at Catholic University in Lublin, which at the time was the only university in Poland at which a priest could study openly.

Rabbi Kopelman

Reverend Heller

Although there was no physics department at the institution, Heller was still able to take physics and mathematics courses. By 1966, he had graduated with a master's and a PhD in "philosophy of nature", with a thesis in relativistic cosmology. Since then he has served in academic positions in physics and astrophysics at universities throughout Europe, and has conducted astronomical research at the Vatican Observatory in Castel Gandolfo, Italy, among other places. He has also written several books with titles such as *Some Mathematical Physics for Philosophers*, *The New Physics and a New Theology*, and *Theoretical Foundations of Cosmology–Introduction to the Global Structure of Space-Time*.

Both the rabbi and the priest see connections and parallels between religion and science. "Religion permeates everything," Heller says, and "science concerns everything." He believes that everything was created by God, and through science, "we figure out how God did it."

The rabbi distinguishes many places where science and Judaism, in particular, cross. For example, when someone creates a new material, Kopelman ponders whether one can make a kosher dish out of that material. "You're taking very ancient laws that people know well but applying them in uncharted regions," he says. "It's the same thing when a new species is discovered; you have to determine if it is kosher. You have to ask: can you take the text that's there and adapt it to new situations?"

Rabbi Kopelman notices that "you find very much the same thing in the lab." "You know what the technology is," he explains. "Can you take that technology and adapt it to find a new and better measurement? In a way both challenges are the same thing–you are looking at a specific question and you're trying to see it in a new and novel way."

Neither Heller nor Kopelman sees a conflict between religion and physics. Says the Rabbi: "I have come to the conclusion that if Torah and science seem to be in conflict, then you're not posing the question the right way. At no time should the two of those be in conflict. My scientific background lets me step back and see how these two could not be in conflict."

Heller agrees. "(Science and religion) both are prerequisites of the decent existence," he says. "The paradox is that these two great values seem often to be in conflict. I am frequently asked how I could reconcile them with each other. When such a question is posed by a scientist or a philosopher, I invariably wonder how educated people could be so blind not to see that science does nothing else but explores God's creation."

Rabbi Kopelman jokingly says he "hopes" that having studied physics has made him a better spiritual leader. "It has allowed me to see my religion and what goes on in the Bible in unique ways that other rabbis don't see," he states. Furthermore, "it gives

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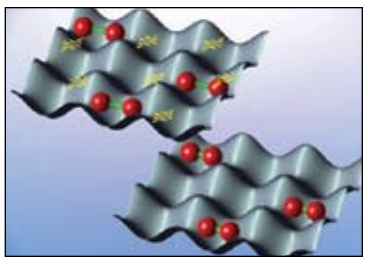
**TOP TEN continued from page 3**



Loosely bound molecules (left) containing two Rb atoms can be made by magnetic forces in optical traps at nK temperatures. When an extra radio wave field is applied the molecules become more tightly bound (right). Reported by: Lang et. al., *Phys. Rev. Lett.* 101, 133005 (2008)

elements together using Feshbach resonance to bind the atoms into a single molecule, without accidently infusing any energy into the cold atoms. At the same time, a team in Innsbruck, Austria combined two rubidium atoms to form their ultracold molecules using the same method. In the past, getting a molecule to remain stable at such low temperatures has been devilishly difficult because of its complex structure. However by first chilling then bonding the individual atoms, the teams were able to increase the life of each molecule dramatically.

Read more: *Physics* 1, 24 (2008)

**Diamond Detectors**–Work on the molecular structure of carbon continues to show great promise for quantum computing. This year scientists were able to construct a nano-scale light source that emits a single photon at a time. The team first removed a solitary atom from the carbon's otherwise regular matrix and then introduced a nitrogen atom nearby. When they excited this crystal with a laser, single polarized photons were emitted from the empty space. These photons could be used to detect very small magnetic forces. Additionally the photons emitted contained two spin states and were able to exist in that state for nearly a millisecond before their wave function collapsed. The emitted photon is essentially a long-lasting qbit which could, with further development, be entangled with other adjacent qbits for uses in quantum computing. Another team at the University of Delft in the Netherlands, working in conjunction with UCSB, was able to detect the spin of a single electron in a diamond environment. At the same time, a group at Harvard was able to locate within a nanometer a single Carbon-11 impurity using its nuclear spin interactions.

Read more: *Science*, Vol. 320. no. 5874, pp. 352–355 (18 April 2008); *Nature* 455, 644-647 (2 October 2008)

**Cosmic Rays**–Research into high energy cosmic rays keeps posing new questions faster than old ones can be answered. On the one hand, researchers at the Pierre Auger Observatory in Argentina seem to have finally pinned down the uppermost energies of cosmic rays at about $10^{19}$ electron volts. However when the Milagro Gamma-Ray Observatory mapped the skies, it found the majority of the high energy (ten trillion plus electron volts) cosmic rays originated in only a few specific directions, prompting the scientists to ask what's out there? Perhaps even more tantalizingly, several independent observers detected surprisingly large numbers of high energy electrons and positrons hitting the upper atmosphere. These findings have prompted a lot of speculation that they could have originated from some previously unknown type of radio-silent pulsar, or possibly even the product of decayed dark matter particles.

Read more about the highest energies of cosmic rays: *Physics* 1, 9 (2008)

Read more about the unexpected directions of cosmic rays: *Physics* 1, 37 (2008)

For more about the high energy electrons and protons: PAMELA: arXiv:0810.4995

**Light Passes through Opaque Matter**–Ordinarily when light falls on an opaque object, interference due to the material's entropy scatters the photons so few if any get through to the other side. Technicians at the University of Twente in the Netherlands have now been able to send large numbers of photons through normally opaque objects by finding low interference paths called "necklace states." By specially angleing different phases of light at thin zinc strips, the photons travel through these necklace states, avoiding much of the chaos within. Under these conditions, approximately 1000 times the number of photons that would have otherwise been blocked are able to cross the zinc strip. This is the first experimental confirmation of the previously predicted necklace states.

Read more: *Physics* 1, 20 (2008)

**Macroscopic Feedback Cooling**–An aluminum bar weighing one metric ton has been successfully cooled to approximately .2mK, the first time anything so massive has been cooled below one millikelvin. That alone is a tremendous achievement; however, the bar is integral to an experiment that could once and for all prove the existence of gravity waves predicted by Einstein. The aluminum mass works as a tuning fork in the AURIGA gravity wave detector in Padova, Italy. By cooling the mass, physicists hope to eliminate any background noise so they can more easily detect any harmonic vibration when the predicted gravity waves strike the aluminum. Should the harmonic effects of these waves be detected, it would be their first direct experimental confirmation since Einstein predicted them in 1918.

Read more: *Physics* 1, 3 (2008)

# ANNOUNCEMENTS

## RECESSION

***Means employers must hire highly skilled employees and jobseekers must set themselves apart.***

Register for the upcoming **APS March Meeting Job Fair** and give yourself an edge.

Employers will have access to hundreds of highly skilled candidates and jobseekers will have access to their ideal jobs.

## APS March Meeting Job Fair

**Date:** March 16-17, 2009
**Place:** David L. Lawrence Convention Center, Pittsburgh, PA

**Register today at:** http://www.aps.org/careers/employment/jobfairs.cfm

## Call for Proposals: India-U.S. Travel Program

The Indo-U.S. Science and Technology Forum (IUSSTF) and the American Physical Society (APS) are pleased to announce the launch of two new programs: 1) the **India-U.S. Physics Student Visitation Program**, and 2) the **India-U.S. Professorship Awards in Physics.**

Through the **Physics Student Visitation Program**, U.S. and Indian graduate students may apply for travel funds of U.S. $3,000 to pursue opportunities in physics. The travel funds could be used to attend a short course or summer institute, to work temporarily in a laboratory, or for another opportunity that the student and the host professor believe is worthy of support. The Physics Student Visitation Program aims to mostly support graduate student travel to India by U.S. citizens, while enabling some students of Indian citizenship to travel to the United States.

The **Professorship Awards in Physics** funds physicists in India or the United States wishing to visit overseas to teach short courses or provide a physics lecture series delivered at a U.S. or Indian university. Awards will be up to U.S. $4,000.

Further details about both programs, including proposal guidelines, are provided at www.aps.org/programs/international/us-india-travel.cfm.

The **upcoming deadline is 31 March 2009**. Recipients will be selected by a joint APS-IUSSTF Review Committee.

**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**

### Quantum entanglement

Ryszard Horodecki, Paweł Horodecki, Michał Horodecki and Karol Horodecki

From the point of view of quantum information science, entanglement is a resource that can be used to perform tasks that are impossible in a classical world. In a certain sense, the more entanglement we have, the better we can perform those tasks. Thus, one of the main goals in this field has been to identify under which conditions two or more systems are entangled, and how entangled they are. This paper reviews the main criteria to detect entanglement as well as entanglement measures and also discusses the role of entanglement in quantum communication and cryptography.

**SANCTUARY continued from page 6**

me another tool in my arsenal for studying Torah and our traditions and understanding them."

For example, since he finds joy in physics and religion, and is still charmed by measurements, his unique background allows him to examine certain portions of the Torah, such as the 10 plagues, for its scientific relevance. "The ninth plague is darkness," he notes, and "I as a physicist start thinking: can I find a solar eclipse that's complete over the land of Egypt in certain centuries that come at a certain time of the year? If I find that then I can date the Exodus." But he is quick to clarify that the majority of his teachings as a rabbi rely on his and his congregants' faith. "What we are talking about is the novelty of my approach," he explains. "That's only part of the approach. I have a certain love and faith in my religion that transcends science."

The rabbi and the priest have had extraordinary experiences. Rabbi Kopelman had the profound privilege of giving the sermon at a prayer service in memory of the victims of the Columbine massacre, as well as providing solace to the family of Liviu Librescu, an engineering professor (and Orthodox Jew) killed during the Virginia Tech massacre in 2007. Rabbi Kopelman performed *Shemirah*, a Jewish ceremony involving watching over the body from the time of death until burial, never permitting it to be alone. As the *shomer* (guard), he recited psalms and stayed with Librescu until other rabbis came to accompany his body to Jerusalem for the burial.

Reverend Heller was honored in early 2008 with the Templeton Prize, the world's largest annual monetary award given to an individual. Bestowed by the John Templeton Foundation, the Prize is worth more than $1.6 million. Heller is using the funds to launch the Copernicus Center for Interdisciplinary Studies in conjunction with Jagiellonian University and the Pontifical Academy of Theology in Cracow to further research and education in science and theology as an academic discipline.

Both theologians still consider themselves physicists. Rabbi Kopelman "doesn't do much physics", but "would feel comfortable at an APS meeting." He occasionally teaches mathematics at a community college. Reverend Heller, on the other hand, takes out a paper and a pencil and works out a problem almost every day. He often carries a math book or some exercises with him. "If you stop doing physics you forget everything," he says. So his math work "must be done." He quips that he regards himself as "the best physicist among priests and the best priest among physicists."

Was it divine intervention that led these two mortals to devote their lives to physics and faith? Was it free will? Or perhaps it was a combination of many elements, a celestial fusion of divinity, mortality, and quantum mechanics that directed these philosophers to incorporate science with the sacred. In any event, the priest and the rabbi have contributed much to the discussion of the bond between religion and science, as crystallized in the words of another philosopher physicist, who famously wrote that "science without religion is lame, religion without science is blind."[1]

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[1]ALBERT EINSTEIN, paper prepared for initial meeting of the Conference on Science, Philosophy and Religion in Their Relation to the Democratic Way of Life, New York City, September 9–11, 1940.—Einstein, *Out of My Later Years,* chapter 8, part 1, p. 26 (1950, rev. and reprinted 1970).

# APS Members Participate in AAAS Meeting

*By Nadia Ramlagan*

Several APS members will be speaking at this year's American Association for the Advancement of Science (AAAS) Annual Meeting in Chicago, February 12-16, 2009, which this year is held jointly with the American Association of Physics Teachers (AAPT).

Barbara Jacak of SUNY Stony Brook and John E. Thomas of Duke University will speak at the symposium, "Quest for the Perfect Liquid: Connecting Heavy Ions, String Theory and Cold Atoms." The talk will bring together experts from Brookhaven's Relativistic Heavy Ion collider (RHIC), string theory/cosmology, and atomic physics to discuss how RHIC's findings help us understand ultra cold matter and possibly high-temperature superconductors and neutron stars. Peter Steinberg, of Brookhaven National Laboratory (BNL) and William A. Zajc, of Columbia University, organized the symposium.

The symposium "Basic Research for Global Energy Security: A Call to Action", will feature Paul A. Alivisatos of UC Berkley and others discussing innovations in energy production, transmission, and storage, and explain how basic research–particularly in the emerging field of nanoscience–is enabling advances in catalysis, superconductivity, artificial photosynthesis and other areas. Research on identifying and advancing renewable and sustainable sources of energy, such as solar wind, hydro and biofuels/biomass will be presented. Member James Misewich of BNL co-organized the symposium.

Murray Gibson of Argonne National Laboratory and Uwe Bergmann of SLAC National Accelerator Laboratory will discuss how light source research facilities around the world are using state-of-the-art, nondestructive X-ray techniques to uncover fascinating secrets of our ancient world, in fields such as archaeology, paleontology, and anthropology in the symposium, "Casting New Light on Ancient Secrets".

The three symposia are sponsored by Brookhaven National Laboratory (BNL). In addition, Lene Vestergaard Hau, Mallinckrodt Professor of Physics and Applied Physics at Harvard, will give a topical lecture, "Wizardry with Light: Freeze, Teleport, and Go!" on ultra slow light as a novel tool for probing the fundamental properties of Bose-Einstein condensates.

The theme of this year's AAAS Meeting is "Our Planet and Its Life: Origins and Futures," in conjunction with the 200th anniversary of Charles Darwin's birth and the 150th anniversary of the publication of his book, *On the Origin of Species by Means of Natural Selection*. All meeting attendees are encouraged to come to these symposia.

## Keeping Tabs on Publications

Photo by Ken Cole

On January 8, the Publications Oversight Committee held its first meeting of 2009 at APS headquarters in College Park, MD. Among its important tasks is recommending a journal pricing structure for the coming year. Left to right: Vladimir Goldman, Stony Brook; Joe Krause (librarian advisor); Brad Cox, Virginia (Chair), Bert Halperin, Harvard (Past Chair); Judy Franz (APS Executive Officer); Guenter Ahlers, UCSB; Gene Sprouse (APS Editor-in-Chief); Thomas Glasmacher, Michigan State; Joe Serene (APS Treasurer/Publisher); David Singh, NRL.

# The Back Page

## Tough Times

*By Soren P. Sorensen*

These are tough times. The stock market has plummeted, stores and factories are closing, and many people are losing their jobs. Here in Tennessee the tax revenues have been decreasing for the last year and will probably continue to do so for some time to come. As a direct consequence of the decreasing revenue the state funding for University of Tennessee was cut by 5% for this fiscal year, and during the recent budget hearings in Nashville, Governor Bredesen predicted budget cuts for higher education at the 10%-15% level for next fiscal year. And now the latest news sets the level at 20%. In general, our Governor has been providing as much funding for higher education in Tennessee as possible (after all Governor Bredesen is one of us, since he has a BS in Physics from Harvard), but even a physicist cannot violate the financial equation of continuity: when less money is coming in, there is less money to give out.

We are not the only state facing tough times. The trend all over our nation has been that state universities get less and less support from public funds. At some state universities the public support is now less than 10% of the total revenue. In 2009 this trend will escalate at a dramatic rate, including at University of Tennessee. Even when the financial situation for the state of Tennessee hopefully gets better in a few years, I do not expect we will be able to fully recover what is now being lost. The same will be true for most publicly funded universities. We simply have to get used to the fact that there will be fewer state funds available for higher education.

So how do these budget cuts influence our physics department here at University of Tennessee? Profoundly! We now have 25.5 Full Time Equivalent faculty members in our department. This is two less than just a year ago, since we lost two positions as a result of the budget cuts in June. We have to go all the way back to around 1960 to find fewer faculty members in our department. We have partly compensated for this loss in FTEs by having more Joint Faculty positions with Oak Ridge National Laboratory (ORNL), so the 25.5 FTE correspond to 33 actual living beings!

Our department used to have a large set of lecturers and adjunct teaching staff, who would be responsible for many of our big service courses and general education courses. Over the last several years we have lost many of them and have not had any funds to replace them, so we are now down to only 3 lecturers, and since two of them are part-time they only represent 1.7 FTE. This has placed a strong teaching responsibility on our faculty and they have responded well. Our physics faculty is now teaching more student credit hours than any other department at the university, because our faculty members have been willing and have had the skills to teach general education astronomy and physics for biologists, engineers, and architects. In some other departments at our university the students do not meet a real tenured professor before classes at the sophomore or junior level!

We have also had to reduce our staff in the department. We are now operating our Electronics Workshop with only two people instead of three, and our Mechanical Workshop will now be run by only four people after the recent death of our workshop supervisor, since we do not have any funds to replace his position. We might even be down to three, if another machinist chooses to retire in the spring. Our administrative and financial staff now consists of only five people, who manage to run a "business" with approximately 200 employees in the form of faculty, departmental staff, research staff, research and adjunct professors, and graduate research and/or teaching assistants.

This high efficiency, however, is coming at a cost. There is no more "slack" in the system in the form of professors who can teach more courses. If we have to implement additional budget cuts, we will have to cancel classes. This will result in much higher student dissatisfaction and, more importantly, longer graduation times for our majors, since many students will not be able to schedule the needed 15 credit hours each semester.

This is our situation right now, but it will be getting worse very soon.

As mentioned above the state of Tennessee, like many other states, will be cutting the funding to higher education in the next fiscal year, maybe up to 20%. Since state appropriations only count for approximately 35%-40% of the total university revenue, the cuts at departmental level might "only" be 5%-8%, but in a departmental budget dominated by salary expenditures this means just one thing: additional layoffs. The problem is being enhanced by the state control of tuition increases. Private universities have been able to increase tuition to unprecedented levels over the last couple of decades, but the Tennessee University system will not be allowed to implement tuition increases that can offset the decreasing state funding, even if most of our students now are covered by the HOPE scholarship funded by the state lottery.

So how do we implement budget cuts?

The fundamental problem is that in common with many other academic departments and colleges, we don't have any contingency plans for such a situation. Yes, we do have a fancy strategic plan, but like most strategic plans it deals with the much more pleasant problem of defining how to grow our department, not how to reduce it. "Fortunately" we are given some guidance by the university administration, who tells us that the cuts we implement should be "strategic" and preserve our "core mission". This sounds good, but the problem is that nobody seems to know what strategic cuts are, other than it is the opposite of "across the board" cuts. Similarly there are many different opinions about what the university's core mission is. If we ask the politicians or the general public it seems to be undergraduate education. My colleagues in the humanities and social sciences, who typically spend 2-3 times as many hours in the classroom as we do in physics, tend to agree with the emphasis on the undergraduate education, but many of them are also willing to place some emphasis on the graduate programs.

But most physics departments at research universities are different. In our case, we have more students in our graduate program than in our undergraduate program, and 2/3 of our total budget consists of external research grants and contracts. So for a physics department it is vital also to maintain the emphasis on excellence in research and graduate education, and that is not an easy task in the current climate. Letters to the editor of our local newspapers or online comments to articles about our university give the impression that a large segment of the public (and therefore maybe also the politicians) considers research a nice hobby for the faculty, but nothing that should have any priority during a financial crisis. Maybe Tennessee is different from the rest of the nation, but I doubt it. So one of our most important tasks as physicists in the coming years will be to intensify the efforts to educate the general public, politicians, and university administrators about the importance of the research component in our universities.

Placing emphasis on research at a university is not an abstract concept. In practice it means preserving faculty and staff positions in research intensive departments like physics, which might not produce as many Student Credit Hours in teaching undergraduates as do popular majors like Psychology, Sociology, or English. It means retaining Teaching Assistant slots for graduate programs, and it means preserving funds for startup expenditures for young faculty. If all this is not done for the next couple of years at our universities despite the financial downturn, we will lose many young people in the STEM fields, in general, and in physics, in particular.

So the recent emphasis on strengthening the efforts in STEM education and recruiting, as highlighted so well in the *Rising Above the Gathering Storm* report, might be another casualty. In our department we had developed a great plan for increasing our efforts in the undergraduate program on educating physics teachers. We thought that would be important in a state where there are approximately 700 public and private high schools, but only 250 certified high schools teachers in physics! An important component of the plan was to introduce a set of courses that would better suit the needs of future K-12 teachers than our upper-division core curriculum classes, which are nearly entirely taught as preparation for success in a graduate program in physics. But now the flow of memos from the administration requires our faculty to teach more classes and, in particular, larger classes, so implementing new classes that initially might only serve a couple of handfuls of future physics teachers is impossible. So much for doing something to "rise above the gathering storm."

Some of my good friends, who are working in private industry as physicists, engineers, or in staff positions, are not particularly sympathetic to our plight in academia. "Welcome to the club" they say, since they are used to living with the much more frequent layoffs and funding fluctuations seen in industry. But most of them have been able to compensate for this lower job security by having higher salaries than we can offer, at least in our department. So it seems that for a period our department will have to deal with both low salaries and low job security, at least for staff and non-tenured faculty.

However, in all this doom and gloom there is one bright spot. Our department has been blessed by wonderful alumni and donors, who over the last 8 years have increased our endowment by a factor of 20. This has enabled us to provide scholarships and support for many of our students at both the undergraduate and graduate level. Increasingly we will have to offset the diminishing state support by relying on the proceeds from our endowment to be able to provide a meaningful educational experience for our students. Many of our donors have graciously made the stipulations of their donations very broad, which has enabled us to use the funds to support a range of activities that used to be state-supported: research participation for undergraduate students during the summer semester, support for students on foreign exchange programs, support for equipment used by students in our educational labs, and even in a few cases support for research equipment benefitting our graduate students (and their advisors!). We will also increasingly be using our endowment proceeds as payment/scholarships for our junior and senior physics majors, when they work in our tutoring center. This tutoring center has been a great success and we want to expand that service.

I am mentioning these concrete examples of what have been done and what can be done with endowment funds, since we have come to the same realization as many other state universities: we cannot continue to rely on state funds, but increasingly we have to go the same route as the private universities and raise the funds needed for teaching and operation from our alumni. Demographics might help us. Many physics departments grew dramatically in the years after the Second World War and then after the "Sputnik" crisis. Many of our alumni from that time have now retired and have hopefully fond memories of their time in our departments. We have found that keeping in touch with them through a newsletter and occasional personal contacts greatly increases the likelihood that they will donate substantial amounts, especially in their estate. So the job of a department chair is changing. "Development" will be a major part of it in the future.

Many people have worked hard in the past in order to bring our physics departments to their current level, where we as a community can be proud of having what is probably the best higher education system in physics anywhere in the world. We should now be determined to avoid being the generation of physicists that will let the current financial crisis and the steady erosion of state support result in a significant weakening of that educational system.

*Soren P. Sorensen is a Professor and Department Head in the Department of Physics and Astronomy at the University of Tennessee, Knoxville.*

*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