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New Experiment Casts Doubt on Elusive Pentaquark

By Ernie Tretkoff

A dedicated hunt for the pentaquark has found nothing, further calling into question previous reports of pentaquark sightings. An experiment at the CEBAF Large Acceptance Spectrometer (CLAS) at the Thomas Jefferson National Accelerator Facility, found no evidence of the five-quark particle, researchers reported at the APS April meeting in Tampa. These new results have greater statistical significance than previous experiments that claimed to have seen the pentaquark.

Quarks normally exist in groups of two (mesons) or three (baryons). But groupings of four quarks and one anti-quark should be possible, according to the theory of quantum chromodynamics.

The first experimental evidence for a pentaquark was reported in 2003 by the LEPS/Spring-8 group in Japan. Several other groups quickly confirmed the pentaquark sightings. But other studies soon produced null results, casting doubt on the original positive sightings and stirring up a controversy over the existence of the five-quark states.

At the April Meeting, Raffaella De Vita of Italy's National Institute of Nuclear Physics, presented new analysis from the CLAS experiment at Jefferson lab, which was specifically designed to detect pentaquark states.

The experiment, which ran from May to July 2004, fired high energy photons at protons in a target of liquid hydrogen to try to produce the pentaquark.

The particular pentaquark that CLAS searched for, called the theta+, is composed of two up quarks, two down quarks, and an anti-strange quark. It is predicted to have a mass of about 1.5 times the mass of the proton, or about 1540 MeV.

The CLAS experiments found no evidence of a pentaquark state, said De Vita.

This is in contrast to SAPHIR, a similarly designed experiment at the Electron Stretcher Accelerator (ELSA) in Bonn, Germany, that did claim to have seen a pentaquark. The CLAS experiment has a precision 50 times higher than the SAPHIR result.

The new results don't entirely rule out the possibility of a pentaquark, but they do provide strong evidence against it. The CLAS collaboration is still analyzing some of the data, and they plan to conduct further studies to look for the pentaquark in a different channel and at higher energies.

"This doesn't imply that the theta+ doesn't exist. We are searching other channels," said De Vita, "We really need to complete the analysis." More results from the CLAS analysis are expected later this year.

Also at the April Meeting,

See Pentaquark on page 6

April APS Prize Recipients

Photo Credit: Universal Comentum Photography

Seated (l to r): Andriy Kurylov; Robert Austin; Pier Oddone; Martin Klein. Standing (l to r): Cecile DeWitt-Morette; Lawrence Krauss; Ronald Walsworth; Daniel Kleppner; Roy Holt; David Vaughan; Jonathan Heckman; Keith Symon. Not shown: Susumu Okubo, Stanford Woosley.

APS Picks Grand Prize Winner In PhysicsQuest Competition

Photo Credit: James Riordon

APS Treasurer Tom McIlrath picks the winning PhysicsQuest class while an honored guest looks on approvingly.

Eighty-seven pieces of paper swirled inside the drum, and then APS Treasurer Tom McIlrath reached in to pick the winner of the PhysicsQuest competition.

Among the entries, from classes in grades 5 through 9 around the country, that had arrived at APS by the April 22 deadline, 87 had correctly found the answer to the contest: the time and exact location on the 800-acre grounds of the Institute for Advanced Study in Princeton at which Einstein's treasure would be revealed. But only one class would get the grand prize: an all expenses paid trip to the Institute, where, at the appointed hour on May 21, each student would receive an Apple iPod Shuffle, and the class as a whole would receive a reflecting telescope.

PhysicsQuest was conceived and carried out by APS in celebration of the World Year of Physics. Funding was provided by the DOE's Office of Science and the NSF, together with an additional grant from Cadmus Communications Corporation for the prizes.

The winners determined by McIlrath's fateful foray into the

See PhysicsQuest on page 5

Asymptopia is Over There

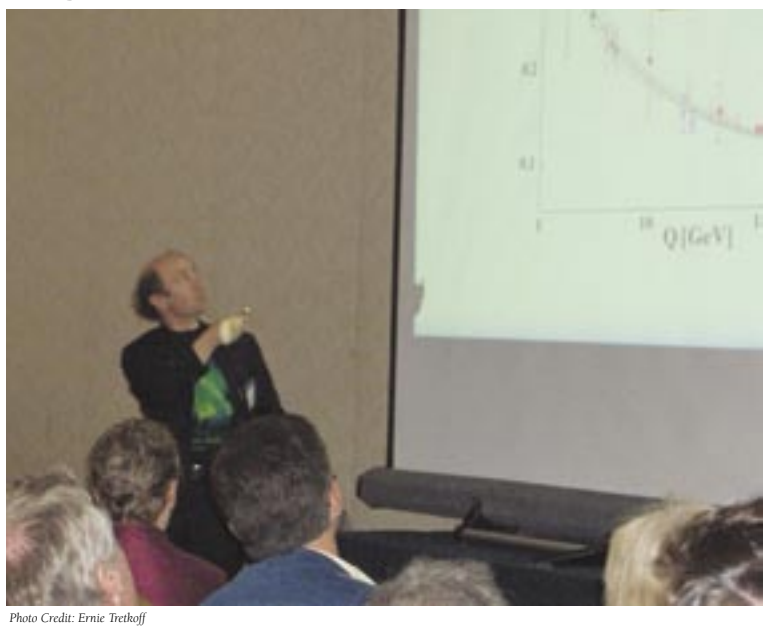

Photo Credit: Ernie Tretkoff

Frank Wilczek, who shared the 2004 Nobel Prize in Physics, explains the concept of asymptotic freedom during a talk entitled "Understanding the Feebleness of Gravity" at the APS April meeting in Tampa.

Newest Topical Group Holds Sessions at 2005 March Meeting

Among the many technical sessions at the 2005 March Meeting was an invited session and six contributed sessions organized by the Society's newest Topical Group, Quantum Information, Concepts, and Computation (GQI). Topics ranged from quantum entanglement and entropy; quantum dots, gates and single photon devices; quantum computing; and SQUIDs.

The GQI's invited session on recent progress in quantum physics and quantum information featured an impressive array of speakers. IBM's Charles Bennett, a pioneer in the fields of quantum computing and quantum cryptography, presented recent results on quantum channel capacities. Michel Devoret of Yale University discussed his work on constructing superconducting quantum bits with Josephson junctions, while NIST's Dietrich Leibfried gave an overview of his group's work on constructing quantum computers with an array of ion traps. Markus Aspelmeyer of the University of Vienna described recent progress in realizing "one-way quantum computing" using entangled cluster states. And Wojciech Zurek of Los Alamos National Laboratory rounded out the session by discussing his own fundamental concept of "envariance."

Approved by the APS Council in April 2004, the GQI is dedicated to "bringing together a vertically integrated community of researchers" that spans a broad range of activity–from quantum information technology and computer science, to basic research in the conceptual foundations of quantum mechanics–and of "promoting future work that more strongly connects its basic and applied aspects."

According to Daniel Greenberger (City College of New York),

See Topical Group on page 5

RHIC Detects Liquid State of Quark-Gluon Matter

By Ernie Tretkoff

Analysis of the weird quark-gluon matter produced at RHIC shows that the substance is more like a liquid than a gas, researchers reported at the APS April Meeting. The researchers from the Relativistic Heavy Ion Collider at Brookhaven National Laboratory announced the results of recent analysis of the quark gluon matter they have been producing for years–a state many scientists expected would be the "quark gluon plasma."

"Theorists expected this phase to exist. The properties of this phase are surprising. The big surprise is that it's a liquid," said Brookhaven theorist Dmitri Kharzeev.

The RHIC collaborations made this announcement at a press conference during the APS April Meeting in Tampa. They will also publish a set of papers in the journal *Nuclear Physics A*.

Researchers from all four RHIC

See RHIC on page 6

Highlights

Members in the Media

"There is usually enough random energy around to create disorder. This random energy can be a breeze or a vibration, but often it takes the form of a child, spouse or pet."

—Lawrence Brehm, SUNY Potsdam, using entropy to explain why objects like pens often get lost, New York Daily News, May 1, 2005

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"Our hope is that when scientists realize fusion can be scaled down and self-contained, that it generates a lot of new ideas."

—Seth Putterman, UCLA, on the small nuclear fusion device he built, USA Today, April 28, 2005

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"What Putterman's made is an amazing little accelerator. It's a version of that that doesn't need any high voltage."

—Will Happer, Princeton University, on Putterman's device, The New York Times, April 28, 2005

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"Anytime you're measuring something to 20 decimal places, you're pretty cutting-edge."

—Bruce Allen, University of Wisconsin-Milwaukee, on the LIGO gravitational wave detector, Baltimore Sun, April 22, 2005

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"It just goes to show how much smaller the world has become now, how we can communicate so easily and efficiently, which was a luxury that people didn't have back in Einstein's time."

—Adrian Liu, Princeton University, on the "light around the world" relay, Princeton Packet, April 22, 2005

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"Until his day, people were tied to this idea of time as being fixed. Einstein took an operational viewpoint that time is what clocks measure and nothing more."

—Clifford Will, Washington University, National Geographic online, April 15, 2005

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"I found at Jones High a vibrant community. In fact, my roots in doing science can be traced back to Jones High."

—Jim Gates, University of Maryland, on the segregated high school he attended, Orlando Sentinel, May 1, 2005

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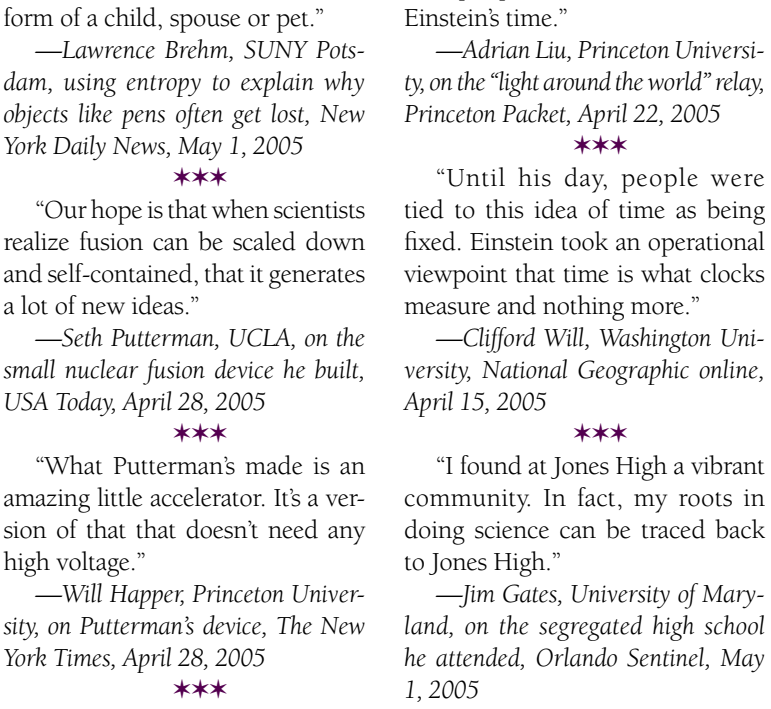
"I think it's just possible that we live in a city of brilliant young women."

—Eric Cornell, JILA/University of Colorado, on the election of two Boulder women to the National Academy of Sciences, Rocky Mountain News, May 4, 2005

Did Einstein Get It Wrong?



Lawrence Krauss of Case Western Reserve University was featured together with Einstein on the science page of the April 18 Tampa Tribune, as shown in this photo. The article promoted a public lecture that Krauss gave that evening at the APS April meeting, and perhaps partly as a result there was an excellent turnout to hear about "Einstein's Biggest Blunder," which is how Einstein himself allegedly described his introduction of the cosmological constant. Although Einstein's original motivation was unfounded, we now know that the cosmological constant, or something very much like it, is the dominant source of energy in the present-day universe.

This Month in Physics History

Einstein and Women

by Nina Byers

C. P. Snow wrote regarding Albert Einstein, "To me he appears as out of comparison the greatest intellect of this century, and almost certainly the greatest personification of moral experience." Snow's assertion is nearly uncontroversial in this "Einstein Year" in which we celebrate the centenary of publication of his great 1905 papers. But during Einstein's lifetime, he was vilified by people who found objectionable some political views he expressed. He was an avowed socialist, and he was a staunch defender of civil liberties and human rights as well as a pacifist throughout most of his life. J. Edgar Hoover, director of the Federal Bureau of Investigation, kept him under surveillance after he emigrated to the United States in 1933. The copious file compiled by the FBI is detailed by Fred Jerome in a recent book. With one possible exception, what is known about Einstein's life supports Snow's assertions. The exception has to do with critical views expressed with regard to the tragic failure of his first marriage and reported infidelities in his second. One finds, for example, that Jerome refers to many published works saying "there is no doubt about Einstein's sexism." This is an inaccurate and misleading statement. It does not take into account the many interactions of Einstein with women in his scientific and public life. There is no known evidence indicating that his treatment of female physicists, mathematicians and other professionals was anything but exemplary. This is in stark contrast with the widespread gender discrimination that was practised by scientists and scientific institutions in his lifetime. From a historical point of view it is worthwhile to draw a distinction between Einstein's behavior with women in his public life and with female partners in his private life.

Information about the scientific lives of women who contributed to physics in the twentieth century is becoming widely available. History records numerous instances of sexist behavior on the part of physicists. For example, Max Planck admonished Lise Meitner at a reception for young physicists in Berlin in 1908 "Fraulein Meitner I understand you have a doctorate from

Einstein with his wife Mileva and son Hans Albert.

the University of Vienna, what more do you want?" Another more egregious example was the treatment of Henrietta Leavitt by Edward C. Pickering, head of the Harvard College Observatory. After her discovery of the period—luminosity relation of Cepheid variable stars, which enabled measurement of intergalactic distances for the first time (this was published under Pickering's name in 1912—see http://cwp.library.ucla.edu /articles/leavitt/leavitt.note.html), Leavitt was obliged to go back to work in photographic photometry rather than pursue the consequences of her discovery. Sexism in the professional sphere caused female scientists major difficulties in the twentieth century. However, the record so far as we know it does not show any evidence of such behavior on the part of Albert Einstein. On the contrary we have evidence he treated the women with whom he interacted scientifically and professionally with dignity and respect, and gave them unequivocal career help when needed. For example, he wrote letters for Marietta Blau when, as an Austrian refugee from the Nazis in 1938, she needed a job. A letter in the Einstein Archive in The Hebrew University in Jerusalem speaks of her excellence as an accomplished experimental physicist without the usual caveat such as "among the best women working in the field". And finally one might mention a note he wrote to David Hilbert in 1916 regarding Emmy Noether saying "It would not have done the old guard at Göttingen any harm had they picked up a thing or two from her."

The question of Einstein's role in relation to his first wife Mileva Maric' is complex. In the years they studied together in Zurich before the birth of their children, he freely and unabashedly shared his passion for physics with her. This is clear from the letters he wrote to her in this period. No signs of sexism there. But it is clear that from the early days of the marriage he did not share domestic chores equally with her. Indeed she wrote to her friend Helene Savic' in 1903, two and a half months after they married, "We have a nice little household which I am taking care of quite alone." It is unlikely they had domestic help. Albert's salary from his job in the patent office was quite low. Given the environment in which he was raised, it seems unrealistic to expect him to have washed diapers and fixed meals for his wife and infant son. Not without love for his wife and son, born May 14, 1904, he nevertheless devoted attention when he could to physics. His wife wanted more time with him than he was able to give. From her letters it would seem that in the competition between the demands of his physics and his wife, physics won out. The joyous life they had had together did not persist beyond the birth of their second son. For female physicists, it is difficult not to be sympathetic with Mileva but it is also difficult to disparage Albert. What is not difficult, however, is to disparage the historic gender discrimination and institutional denial of support and equal opportunity faced by women wanting to do physics. It is notable, therefore, that the historical record indicates Einstein treated female physicists with dignity and respect and did not engage in the gender exclusion which was common among his contemporaries.

Nina Byers is research professor and professor emeritus of physics at UCLA and Visiting Scholar, Harvard University. She is past chair of the APS Forum on History of Physics.

She would like to acknowledge helpful comments from historians and archivists of the Einstein papers, Gerald Holton, John Stachel, Diana Buchwald, and Ze'ev Rosenkranz.

For further reading: Fred Jerome, *The Einstein File*, St. Martin's Press, 2003.

Albert Einstein/Mileva Maric': the Love Letters edited and with an introduction by Jürgen Renn and Robert Schulmann and translated by Shawn Smith, Princeton, N.J., Princeton University Press, 1992.

In Albert's Shadow: The Life and Letters of Mileva Maric', Einstein's First Wife, edited by Milan Popovic', The Johns Hopkins University Press, Baltimore, 2003.

Lise Meitner, "The Status of Women in the Professions," *Physics Today,* August 1960.

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Washington Dispatch

A bimonthly update from the APS Office of Public Affairs

ISSUE: RESEARCH FUNDING

Responding in part to more than 6,600 letters generated by APS's Contact Congress campaign, 68 senators sent a "Dear Colleague" letter to the Senate Energy Appropriations Subcommittee supporting a 3.2% increase in the budget for the Department of Energy Office of Science, as opposed to the 3.8% cut proposed by the Bush Administration. Over 100 House members have signed a similar letter supporting a "significant increase" for the Office of Science, and over 165 have signed a letter requesting an 11% increase for the National Science Foundation. Congressional appropriators, however, are working under tight constraints and the outlook for research budgets remains uncertain.

The first indications of how science will fare in FY 2006 will come as appropriations bills are drafted in May and June. But Congressman Frank Wolf (R-VA), chairman of a newly formed appropriations subcommittee responsible for NSF, NIST and NASA funding, is also turning an eye toward future budgets. He recently wrote to President Bush expressing concern that current levels of federal investment in scientific research are too low to ensure continued US economic leadership and suggesting that we make a "bold commitment to invest in the future of our country by tripling the innovation budget."

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ISSUE: ENERGY AND NATIONAL SECURITY

The APS Panel on Public Affairs (POPA) has issued a report, "Nuclear Power and Proliferation Resistance: Securing Benefits, Limiting Risk." Global electricity demand is expected to increase by more than 50 percent by 2025 and nuclear power is a primary carbon-free energy source for meeting this extensive global energy expansion. At the same time, the technologies used in peaceful nuclear power programs overlap with those used in the production of fissionable material for nuclear weapons. This report examines technological steps that the US can take to enhance the proliferation resistance of nuclear power systems. Roger Hagengruber of the University of New Mexico chaired the study. To view the report, please go to http://www.aps.org/public_affairs/proliferation-resistance/.

★★★★★

ISSUE: CREATION, INTELLIGENT DESIGN, AND EVOLUTION

The APS Panel on Public Affairs (POPA) has identified the Creationism/ID debate as an issue of concern for the Society. To address the issue, a subcommittee of POPA members, chaired by Robert Eisenstein, was formed to research the issue and make recommendations at the October POPA meeting.

Log on to the APS Web site (http://www.aps.org/public_affairs) for more information.

New Results Hint at Strangely Magnetic Proton

New results from experiments performed at the DOE's Thomas Jefferson National Accelerator Facility indicate that strange quarks may contribute to the proton's magnetic moment, according to Krishna Kumar, a physicist at the University of Massachusetts, Amherst and member of the Hall A Proton Parity Experiment (HAPPEx). If these preliminary findings are confirmed later this year, it would mean that strange quarks in the proton's quark-gluon sea contribute to at least one of the proton's intrinsic properties.

The experiment measures the neutral weak force between a polarized beam of electrons and target nuclei of hydrogen and helium-4 at a length scale of around one femtometer. The electromagnetic force conserves parity, while the weak force is not, so measuring the fractional difference in the number of scattered electrons due to the beam's changing polarization allows researchers to calculate the neutral weak force.

Physicists hope to use these measurements to learn about the strong force that binds up and down quarks into protons and neutrons, as well as the up, down and strange quark contributions to the nucleon's charge and current distributions. That's because the neutral weak force measurement is sensitive to the "weak" charge and current distributions inside nucleons, as opposed to the corresponding electromagnetic distributions. Thus, says Kumar, "One can infer whether s-quarks contribute to the charge and current distributions."

According to Kumar, the results indicate that the strange quark contribution to the nucleon's charge and current distribution is zero within the sensitivity of each measurement. However, he added, "There seems to be a trend towards a positive value for the average contribution of strange quarks to the proton's magnetic moment." This result will be "surprising and exciting," said Kumar, if it is confirmed with more precise measurements planned by HAPPEx later this year.

Data from several other recent experiments–including SLAC's E158, the SAMPLE experiment at MIT-Bates, the A4 experiment at Germany's Mainz Laboratory, and the G-Zero experiment at JLab–are also beginning to shed light on the weak interaction.

Do you know anything about accelerators?

Photo credit: Universal Convention Photography

Pier Oddone, left, seeks advice from Leon Lederman, Director Emeritus of Fermilab (1979-89). Oddone will take over as the new Director of Fermilab this summer when current Director Michael Witherell steps down. Oddone and Lederman met at the reception following the Prize and Award ceremony at the APS April Meeting in Tampa. Oddone was the recipient of the APS Panofsky Prize for experimental particle physics. Lederman, who received the Nobel Prize in Physics in 1988, was presented with the Karl T. Compton Medal of the American Institute of Physics for his contributions to physics education.

Global Event Celebrates Physics On Anniversary of Einstein's Death

Physicists around the world honored Einstein and celebrated the World Year of Physics with a worldwide optical relay on April 18, the 50th anniversary of Einstein's death.

An estimated 120,000 people worldwide participated in the event, called "Physics Enlightens the World." About 140 people or groups participated in the United States. The light relay was organized by Max Lippitsch of the University of Graz in Austria.

As the event was being organized, some astronomers complained that the event encouraged light pollution [see APS News, December 2004].

The event began in Princeton, NJ, where Einstein lived from 1933 until his death in 1955. On the evening of April 18, lights were turned off briefly, as a symbolic way to call attention to the issue of light pollution; then the university stadium and some nearby buildings were lit up, beginning the relay. The signal traveled west as participants lit lights one after another in a huge relay that circled the globe in a single day.

Any kind of light source was allowed, as long as it was legal. In some places, participants sent the signal using phone calls or email, which were allowed because these signals travel as light through fiber-optic cables.

The loop was completed with an email to Claire Gmachl, who organized the start of the relay in Princeton, from Olivier Buridant in France on behalf of the European Physical Society.

"The event was quite a success, both on our end here in Princeton and in Europe," Mira Guo, a student at Princeton University, told the Princeton Packet. "It still amazes me to think of how many people of different nationalities, speaking different languages, and living thousands of miles away from each other came together to participate in this joint effort."

Globalization of Science Brings Visa, Workforce Issues to the Fore

As science becomes increasingly globalized with the growth of major physics research facilities in Europe, Japan and Russia, the US is shifting its focus to a consortium approach, according to speakers at an April Meeting session. However, the country is facing a dwindling workforce. For decades, it has relied on foreign-born workers, but tightening restrictions on visa requirements in the post-9/11 environment are making this option less attractive to foreign students and scientists.

Charles Shank, former director of Lawrence Berkeley National Laboratory, cited SLAC's B factory and Fermilab's D0 collaboration as examples of consortium-style projects. Many of these rely heavily on foreign-born workers. As a measure of US dependence on foreign collaborators, he pointed to recent statistics: non-DOE visitors to the national labs number about 25,000 annually, of which 17,500 are visits of 30 days or more. Of those visitors, 50% are non-citizens and 16% are from sensitive countries. Nearly 40% of US faculty members are foreign born, as are fully one-third of US scientists awarded Nobel Prizes.

Unfortunately, there is a growing perception among potential foreign collaborations that the US is not an attractive program for large consortium projects, and one of the largest factors in that perception is continued visa difficulties. US visa laws often serve to prevent visiting scientists from participating in very long-range research projects. The most enduring problem, according to Shank, is the 214b requirement that incoming students, visitors and post-docs must prove their intention to return home after their visit. For visitors from "sensitive" countries who are currently working in England or Germany, for example, this is often considered proof of instability by consular officials.

While there is currently a proposed bill in Congress to relieve foreign visa applicants of this 214b burden, it is unlikely to pass. "If the situation is not addressed, the US will be perceived as the wrong place to put the next generation of international facilities," Shank cautioned.

"Government officials often resist these complaints by suggesting that the scientific community is irresponsible and insensitive to national security needs. This perception must be changed."

Tougher visa restrictions also impact incoming graduate students, according to Alice Gast, MIT's vice president for research and associate provost. Of the 27.8 million visas issued in 2003, 20.1 million were for tourism and 940,000 for F1 and J1 visas; of those, 131,000 were for graduate students. The US currently hosts 500,000 international students, and the percentage increased rapidly from 1982 through 2000.

However, a study in 2003 by

See Visa on page 7

Scientists Make First Measurement of Ni-78 Half-Life

The half-life of the unstable, exotic nucleus nickel-78 (Ni-78) has been measured for the first time, and was found to be only 110 ms, or about a tenth of a second, according to Hendrik Schatz, a researcher at Michigan State University. Its decay plays a key role in the synthesis of the heavy elements, the understanding of which is one of the 11 Greatest Unanswered Questions in Physics (Discover Magazine, February, 2002). Schatz reported on the most recent experimental results at Michigan State's National Superconducting Cyclotron (NCSL) during the 2005 April meeting in Tampa.

Physicists believe the heavy elements were built from lighter atoms, such as iron, in supernova explosions billions of years ago, which triggered a chain of nuclear reactions–a process known as rapid neutron capture. How this process takes place is still a mystery. The NCSL is designed to study this question by reproducing the conditions inside supernovas with energetic nuclear collisions.

Ni-78 is known as a "doubly magic" nucleus because it contains a "magic number" of both protons and neutrons–in

See Ni-78 on page 6

LETTERS

Progress By the Numbers is Not the Whole Story

After quite a few years as a "woman in physics", I was delighted when I got my April copy of *APS News*. On the cover was the much awaited headline "AIP report: women, men progress at the same rate" by Ernie Trekoff. At last!

However, my excitement gave way to disappointment when I read the column.

This conclusion is not supported by the column, and is nowhere to be found in the report. In fact, one of the report authors, Rachel Ivie, is quoted in your column pointing out that women in physics face harder conditions than men, and that women tend to get hired more in non-permanent positions than men. In addition, she says, women get paid an average of 5% less than male counterparts with the same level of experience doing the same job.

These two results seem to contradict the headline: if women are not getting the good jobs at the same rate as men, can we really say that they progress at the same rate? And even if they do get the same jobs, can we say they are progressing at the same rate when they get paid less for them? While the report indeed contains many encouraging results, your headline is not one of them. Perhaps the choice of the verb "progress" was not very fortunate. Or were you trying to cheer us up?

Isabel Echeverria
Buffalo, NY

Author Disputes *APS News* article, and Einstein too

Your article on $E=mc^2$ in the April issue perpetuates some common misconceptions. The title of Einstein's first paper on the topic was framed as the question, "Does the inertia [Trägheit] of a body depend on its energy content?" In the context of the equation $E=mc^2$, the word "mass" means "inertia."

This observation leads to a simple expository rule: if you cannot substitute the word "inertia" for the word "mass" in your sentence, then you are misusing the word "mass".

Try this rule on the *APS News* article. The author writes of "photographic evidence of the conversion of energy into mass." Does the author really intend to imply the conversion of energy into inertia? By the test, the author writes nonsense here and in several other places.

Inertia and energy are always attributes of something, namely, fields and particles, to which physics assigns a different ontological status. What Einstein discovered was a universal proportionality between two attributes, inertia and energy. The secondary literature is full of misconceptions, but Einstein was clear and correct.

Ralph Baierlein
Flagstaff, AZ

Ed. note: If Einstein was clear and correct, then it is the letter writer who is guilty of a misconception. At the web site of the AIP history center, http://www.aip.org/history/einstein/voice1.htm, one can hear Einstein reading the following statement: "...the equation E is equal to mc^2, in which energy is put equal to mass, multiplied by the square of the velocity of light, showed that very small amounts of mass may be converted into a very large amount of energy and vice versa."

DEEP2 Data Suggests Fine Structure Constant Doesn't Change

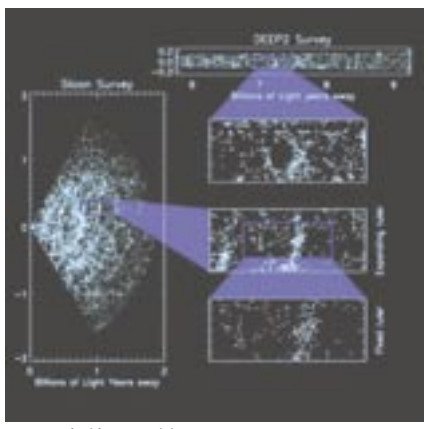

Image: U. of California at Berkeley

The first part of a new catalog of galaxies offering a snapshop of the universe about 6 to 9 billion years ago has been publicly released, according to Jeffrey Newman of Lawrence Berkeley National Laboratory.

At the APS April Meeting, Newman presented preliminary findings of the DEEP2 Galaxy Redshift Survey, specifically the conclusion that the fine structure constant, which sets the absolute scale of the electromagnetic force, does not appear to change in any statistically significant way even over cosmic timescales. Furthermore, the evolution of galaxy clustering in this distant epoch will soon be used to explore the nature of dark energy.

DEEP2 is a joint project of the University of California, Berkeley, and the University of California, Santa Cruz. It is a five-year survey of galaxies more than 7 to 8 billion light years away, whose light has been redshifted to nearly double its original wavelength by the expansion of the universe. The survey is now more than 80% complete and should finish observations this summer, with full data released by 2007.

Like the Sloan Digital Sky Survey (SDSS) and the 2dF sky survey, the DEEP2 project systematically maps galaxies over part of the sky. However, while SDSS and 2dF study objects with redshifts less than 0.2, DEEP2 has used one of the largest telescopes in the world–the DEIMOS spectrograph on the Keck II telescope in Hawaii–to measure the positions of 40,000 galaxies at a typical redshift of 1 in order to study the evolution of both galaxies and the universe itself.

The fine structure constant pops up in nearly all equations involving electricity and magnetism. It is equal to the square of the charge of the electron, divided by the speed of light times Planck's constant. However, despite its fundamental nature, some theorists have suggested that it changes subtly as the universe ages, reflecting a change in the attraction between the atomic nucleus and the electrons orbiting it.

Experimental results have been contradictory. For instance, Australian astronomers a few years ago measured the absorption of light from distant quasars as the light passes through galaxies closer to us. The team reported that the constant has increased over the lifetime of the universe by about one part in 100,000. Other astronomers using the same technique have found no such change.

Newman designed a new experimental approach, drawing on earlier work by the Institute of Advanced Study's John Bahcall, who pointed out that measuring emission lines from distant galaxies would be more direct and less error-prone than measuring absorption lines. The DEEP2 data allowed Newman and his colleagues to measure the wavelength of the emission lines of ionized oxygen to a precision of better than 0.01 Angstroms out of 5,000 Angstroms. They compared emission lines for 300 galaxies at various redshifts, and found the fine structure constant was no different from its current value: approximately 1/137. They found no change over a 4-billion-year time period, within one part in 30,000.

"Our null result is not the most precise measurement," Newman admitted. "But the alternative method (looking at absorption lines) that gives more precise results also involves systematic errors that cause different people using the method to come up with different results."

The DEEP2 survey has also completed measurements that may shed light on the nature of dark energy, now estimated to account for 70% of all the energy in the universe. Newman and his collaborators are counting the number of small groups and massive clusters of galaxies in a distant volume of space as a function of their redshift and mass. They believe this will make it possible to measure the amount by which the universe has expanded to the present day.

"What they are really trying to get at is how the dark energy density is changing as the universe is expanding," said UC-Berkeley's Martin White. "If the dark energy density is Einstein's cosmological constant, then the theoretical prediction is that it doesn't change. The holy grail now is to get some evidence that it's not the cosmological constant, that it is in fact changing."

See Deep2 on page 6

Human Rights Session Mirrors Einstein's Lifelong Interests

Several speakers honored Albert Einstein at a March Meeting invited paper session on "The Physics Community's Defense of Human Rights." The session was chaired by APS 2003 President Myriam Sarachik and sponsored by the Forum on Physics and Society (FPS). The session's five speakers were selected because of their own past human rights deprivations or their dedicated efforts on behalf of oppressed scientists. In their talks, most of them explicitly paid homage to Einstein's lifelong devotion to the cause of human rights worldwide.

The session opened with a talk by Li-Zhi Fang, who avoided imprisonment by the Chinese government after the Tiananmen Square massacre only by taking refuge in the United States Embassy. In his talk, titled "Einstein, Social Responsibility of Physicists and Human Rights in China," Fang reviewed the history of the suppression of intellectual freedom in China, which included attacks on relativistic physics and on Einstein personally. Fang, now at the University of Arizona, pointed out that Einstein, who had become acquainted with the Chinese scientific community during his initial 1922 visit to China, thereafter had openly protested the Chinese government's human rights violations on numerous occasions.

Fang was followed by Joel Lebowitz of Rutgers University, speaking as the recipient of this year's Nicholson Medal for humanitarian service. Lebowitz, whose talk was titled "Physicists and Human Rights: Reflections on the Past and Present," concentrated on the actions and inactions of scientists, especially physicists, in response to events involving the human and professional rights of colleagues. He illustrated his remarks mainly with events during the years the Nazis ruled Germany, and quoted various statements opposing Nazi abuses by Einstein who, as Lebowitz said, "was so quotable." Among the Nazi edicts, said Lebowitz to the amusement of the audience, was the requirement that all writings by Jewish authors, including presumably Einstein's scientific papers, had to be labeled "translated from the Hebrew."

Yuri Chernyak, in a talk titled "Physicists and Mathematicians for Human Rights in the USSR," then reviewed the contributions by physicists and their mathematician colleagues to the struggle for democratization and human rights in the USSR. He emphasized the important roles played by Andrei Sakharov and Yuri Orlov, as well as by the independent scientific seminars which bolstered the morale of so many scientist refusniks (persons whose emigration requests the Soviet government had refused). Chernyak, now at MIT and himself a former refusnik, had been chairman of the independent Moscow Sunday Seminar.

The next talk, by Hadi Hadizadeh, titled "Human Rights in Iran after the 1978 Islamic Revolution," concentrated on the threats to human rights enshrined in today's Iranian Constitution, which establishes non-elected theocratic bodies that have

See Human Rights on page 7

Pais Prize Debuts at April Meeting


Photo credit: Universal Convention Photography

The APS has awarded the Pais Prize, named after the late distinguished physicist and historian Abraham Pais, for the first time at its April Meeting in Tampa. The Prize recognizes outstanding scholarly achievements in the history of physics, and the inaugural recipient was Martin J. Klein, Eugene Higgins Professor Emeritus of Physics and History of Science at Yale. In the photo Klein (left) and Ida Nicolaisen, widow of Abraham Pais, hold the Pais Prize certificate. The Prize was established in collaboration with the Center for History of Physics of the American Institute of Physics.

Four APS Presidents Remembered In Council Resolutions

At its meeting in April, APS Council noted with sadness the death of four APS Presidents during the previous year. Council passed a memorial resolution for each of them, the texts of which follow.

Robert Fox Bacher
Aug. 31, 1905 - Nov. 18, 2004

The Council of the American Physical Society notes with great sadness the passing of Robert Bacher of the California Institute of Technology. Robert Bacher advanced wartime physics with his leadership at the MIT Rad Lab and at Los Alamos. He contributed nationally as an advisor at the United Nations, a member of the first Atomic Energy Commission, and a member of the President's Science Advisory Committee. He then chaired the division of Physics, Mathematics, and Astronomy at Caltech and brought it to international renown. He served as President of the American Physical Society in 1964. He ended his distinguished career at Caltech as Provost. The Council expresses its deep appreciation for his participation in the work of the Society and conveys its sincere sympathy to his family and to his many close friends.

✶ ✶ ✶

Hans Albrecht Bethe
July 2, 1906 – March 6, 2005

The Council of the American Physical Society notes with great sadness the death of Hans Albrecht Bethe of Cornell University. He is best known for his work on stellar nucleosynthesis, which earned him the Nobel Prize for Physics in 1967. In addition, he made important contributions to quantum electrodynamics as well as atomic, molecular and condensed matter physics. He was the lead theoretician in the US development of the first nuclear weapons. He later became an outspoken opponent of nuclear weapons proliferation and testing, and a proponent of peaceful applications of nuclear energy. Bethe also served on the first US President's Science Advisory Committee, established under Dwight D. Eisenhower. In addition to the Nobel Prize, Bethe received numerous other prizes and awards including the German Physical Society's Max Planck medal in 1955 and the Eddington Medal of the Royal Astronomical Society in 1961. He served as President of the American Physical Society in 1954. The Council expresses its deep appreciation for his participation in the work of the Society and conveys its sincere sympathy to his family and to his many close friends and admirers worldwide.

✶ ✶ ✶

D. Allan Bromley
May 4, 1926–February 10, 2005

The Council of the American Physical Society notes with great sadness the death of D. Allan Bromley, Sterling Professor of the Sciences at Yale University. A Canadian by birth, he left an indelible print on the landscape of American science and nuclear physics, in particular. He founded the A.W. Wright Nuclear Structure Laboratory at Yale in 1963 and served as its director until 1989 when he left to become Science Advisor to George H.W. Bush. Accorded Cabinet rank by President Bush, Dr. Bromley is widely regarded as one of the strongest advisors ever to have held the White House post. He returned to Yale in 1994 as Dean of Engineering, revitalizing the program during his six-year tenure. He received numerous awards including the National Medal of Science in 1988. As president of IUPAP and AAAS he was a spokesman for U.S. science and international cooperation. The Council takes particular note of his service to the APS, of which he was president in 1997, and of his unswerving advocacy for federal support of science. The Council conveys its sincere sympathy to his wife, his family and his many friends around the world.

✶ ✶ ✶

The Council of the American Physical Society notes with sadness the death of James A. Krumhansl of Cornell University. He had a major impact on a broad spectrum of topics in theoretical materials physics as his research traveled through phonon and soliton dynamics,

James A. Krumhansl
August 2, 1919-May 6, 2004

disordered crystals and alloys, first-order and martensitic phase transitions, biophysics, and pattern formation in solids. He was also a civic-minded scientist, serving the Government in numerous advisory capacities and as the National Science Foundation's Associate Director for Physics, Mathematics, and Engineering. We especially note his service to the Society as the Editor of the Physical Review Letters, the Chair of its Division of Condensed Matter Physics, and the President of the Society (1989-1990). The Council expresses its deep appreciation for his participation in the work of this Society and conveys its sincere sympathy to his family and to his many close friends across the globe.

zero gravity
The Lighter Side of Science

The 2004 Annual Pigasus Awards

On April 1st, magician and debunker James Randi announced the winners of the 2004 Pigasus Awards. The awards are announced via ESP to the winners, who are of course allowed to predict their winning of this honor by precognition. The Flying Pig trophies are sent to the winners via psychokinesis. "We send. If they don't receive, it's perhaps due to their lack of PK ability," Randi's Web site claims. This year, the prizes for 2004 performances go to these lucky folks:

Category #1, to the scientist who said or did the silliest thing related to the supernatural, paranormal or occult: The award goes to Dr. Rogerio Lobo, professor/chairman of the department of obstetrics and gynecology at Columbia University, who co-signed a paper titled, "Does Prayer Influence the Success of in Vitro Fertilization-Embryo Transfer" published in the Journal of Reproductive Medicine (JRM). It was written by Dr. Kwang Cha, once head of Columbia's fertility center, and a lawyer, Daniel Wirth, who had no medical credentials. The paper, concluded that women in South Korea who had received in vitro fertilization were twice as likely to conceive if they had been prayed for by Christians who were thousands of miles away. Dr. Lobo then revealed that he'd only "reviewed and edited" the material, having been asked to sign it well after the research had already been done and evaluated. Wirth, who has a 20-year legal record of fraud, has now been sentenced to five years in Federal prison for financial improprieties unrelated to the Columbia study. Columbia has quietly withdrawn the name of Dr. Lobo as the lead scientist of the project. The JRM still supports the study, and still carries the paper in their records.

Category #2, to the funding organization that supported the most useless study of a supernatural, paranormal or occult claim: The award goes to the United States Air Force Research Laboratory, who paid $25,000 to Dr. Eric W. Davis at a Las Vegas company called Warp Drive Metrics to study the "conveyance of persons by psychic means" and "transport through extra space dimensions or parallel universes." For their money, the USAF received a 78-page report, "Teleportation Physics Study," a mass of mathematical calculations and diagrams with much dissertation on "wormholes" and "parallel universes." An annual expenditure of some $7 million on this project was recommended by the report, since Warp Drive Metrics con-

See Zero Gravity on page 7

TOPICAL GROUP *from page 1*

one of the founders, the primary motivation for forming the group arose from a sense that scientists who work on foundational problems in quantum theory "have no natural home in the APS," despite the fact that there is a strong overlap with several divisions, including Atomic, Molecular and Optical Physics, Computational Physics, and Laser Science. "If you are using a neutron interferometer to explore a fundamental problem in quantum theory, you don't really have a natural audience in neutron physics," he explains. The same goes for researchers using advanced laser techniques to elucidate the finer points of Bell inequalities.

"It is meant to be a broadly inclusive home for researchers whose professional lives may have kicked off in various traditional disciplines, but who nonetheless share an over-arching interest in the foundations and 'surprising implications' of quantum mechanics," said Caltech's Hideo Mabuchi, GQI's acting chair.

Greenberger also feels the field needs an effective lobbying group to represent its interests to federal funding agencies, most notably the National Science Foundation. "Many young people are becoming interested in the field, but there are few opportunities for having their research funded," he said.

Part of the problem is that quantum theory suffers from the perception that it is a field for "old men," since the debate dates back to 1935 and the famous Einstein-Podolsky-Rosen paradox. (That paper is still the most downloaded publication from the APS journal archives, 80 years after it was written.) But Greenberger points out that it is, in fact, a vibrant exciting field at the forefront of physics, using all the latest laboratory techniques, and spinning off the newly emerging fields of quantum cryptography and quantum computing.

Efforts are currently underway to increase membership in the topical group and to hold official elections. For the time being, the GQI is operating under the guidance of an inaugural advisory board, headed by Mabuchi. Founding members Greenberger and Anton Zeilinger (University of Vienna) are board members, as are Jonathan Dowling, Barry Sanders, H. Jeff Kimble, Rob Spekkens, Anthony Leggett, Paul Kwiat, David Bacon, Devoret, and Mark Kasevich.

PHYSICSQUEST *from page 1*

drum were from the 9th-grade class of Julie Mooney at St. Albert Catholic Schools in Council Bluffs, Iowa. "We are shocked, so excited, so thrilled," said Mooney. "I am in awe of Einstein. It is unbelievable that my students will get to walk on the grounds where he did his work."

Her students were likewise startled and joyful upon learning they had won the grand prize trip.

"I'm really excited. It doesn't seem real," said 15-year old Danielle Cain.

Seconding this feeling was her classmate Amanda Burkey. "When I started the experiment, I didn't think we would win," she said. "So when I found out I was just in complete shock!"

Mooney and her class were among the 1362 teachers and their combined total of over 69,000 students from all 50 states who signed up for the PhysicsQuest project.

PhysicsQuest is a set of four experiments designed to illustrate basic physics principles including pendulum motion, shapes of bubbles, laser light diffraction, and magnetism. It is organized as a treasure hunt to find the exact spot–using a map of the Institute for Advanced Study's grounds–and time the prizes are to be revealed.

Teachers who signed up but did not meet the deadline for the trip are eligible for a second chance to win the prizes, although not the trip, provided they successfully completed the experiments by Memorial Day weekend. Another drawing will determine the second winner. A report on the events at the Institute on May 21, and on the results of the second drawing, will appear in the July *APS News*.

Mooney has taught math and science for 14 years starting out in Denver, Colorado and then in Iowa, and she hopes to incorporate the background material into her curriculum next year.

Her trip to New Jersey will be her first to the East Coast. "You would not believe how much we are looking forward the trip," Mooney said. "I've never been out East and I don't think many of my students have been, either."

Council Statements Address Research Funding, Power Lines, and Advice for Congress

At its April meeting, Council passed three statements expressing the views of the Society on a variety of issues. One statement dealt with research funding for the sciences, another with alleged hazards of electric power lines, and a third with the need for Congress to obtain adequate and timely advice on scientific and technical matters.

Physical Science Research Funding

Federal investments by agencies such as DOE, NSF, NASA, DOD and NIST are indispensable to the vitality of our nation's research programs in physics and the physical sciences. The investments are essential for maintaining economic growth and generating jobs; ensuring national, homeland and energy security; educating and training the workforce of the future; and contributing to disciplines such as biomedicine and engineering.

The American Physical Society urges increased federal support of the physical sciences. Recent policy reports identify this as a critical need.

The American Physical Society calls specific attention to the following statements embodied in these reports.

•"Federal support of science and engineering research in universities and national laboratories has been key to America's prosperity for more than half a century. A robust educational system to support and train the best US scientists and engineers and to attract outstanding students from other nations is essential for producing a world-class workforce and enabling the R&D enterprise it underpins. But in recent years federal investments in the physical sciences, math and engineering have not kept pace with the demands of a knowledge economy, declining sharply as a percentage of the gross domestic product. This has placed future innovation and our economic competitiveness at risk."

–*The Knowledge Economy: Is the United States Losing Its Competitive Edge?* (The Task Force on the Future of American Innovation, February 2005)

•"Increase significantly the research budgets of agencies that support basic research in the physical sciences and engineering, and complete the commitment to double the NSF budget. These increases should strive to ensure that the federal commitment of research to all federal agencies totals one percent of US GDP."

–*Innovate America* (The Council on Competitiveness, December 2004)

•"…[T]he US government has seriously under-funded basic scientific research in recent years… [T]he inadequacies of our systems of research and education pose a greater threat to US national security over the next quarter century than any potential conventional war that we might imagine. American national leadership must understand these deficiencies as threats to national security. If we do not invest heavily and wisely in rebuilding these two core strengths, America will be incapable of maintaining its global position long into the 21st century."

–*Road Map for National Security: Imperative for Change* (Phase III Report of the Commission on National Security/21st Century, January 2001)

Electric and Magnetic Fields and Public Health

On April 23, 1995, the American Physical Society issued a policy statement concerning Power Line Fields and Public Health. The APS concluded that "the conjecture relating cancer to power line fields has not been scientifically substantiated."

Since that time, there have been several large in vivo studies of animal populations subjected for their life span to high magnetic fields, and also epidemiological studies, done with larger populations and with direct, rather than surrogate, measurements of the magnetic field exposure. These studies have produced no results that change the earlier assessment by APS. In addition, no biophysical mechanisms for the initiation or promotion of cancer by electric or magnetic fields from power lines have been identified.

Science and Technology Analysis for Congress

Science, engineering and technology are increasingly important components of the issues that come before the US Congress. From long-term energy security to decisions about nuclear weapons policy and the exploration of space, it is imperative that congressional decision-makers have access to good technical advice. However, members of Congress and their staff report gaps in the advice currently available to them. They have identified a need for advice that:

(a) addresses problems that require significant study but must be acted on within a matter of months; and

(b) effectively supports policy development with expert technical assessment.

Therefore, the APS encourages Congress to enhance the capabilities of its support organizations or create other mechanisms to carry out timely technical analyses of policy options.

INTERNATIONAL News

Iranian String Theorist Delivers Beller Lecture, Promotes International Collaboration

By Ernie Tretkoff

Iranian physicist Hessamaddin Arfaei delivered the Beller Lecture at the APS April Meeting in Tampa. In addition to his research in string theory, Arfaei has worked hard to establish interaction between Iranian scientists and the international scientific community, and he is continuing to encourage more international collaboration.

Arfaei is a professor of physics at the Sharif University of Technology, Tehran, and an associate director at the Institute for Studies in Theoretical Physics and Mathematics (IPM).

The Beller Lectureship supports a prominent international physicist each year to attend the March or April APS meeting. Arfaei had been invited to deliver the Beller lecture last year, but was unable to attend because the war in Iraq made it difficult for him to travel. This year, he said he had no problems. Because the United States has no embassy in Iran, Arfaei had to travel to Milan to get a visa to come to the meeting, but he said the visa application process went smoothly and he was approved promptly.

Arfaei, a noted string theorist, was probably the only person who traveled from Iran to attend the April Meeting, though he said he met two Iranian students at the meeting who were already in the US. He says he would like to encourage more scientists to travel to each other's countries to attend conferences.

The APS is now partnering with the American Association for the Advancement of Science and the National Academy of Sciences to work to increase scientific cooperation with Iran. While in the US, Arfaei met with the APS, the AAAS, and the NAS to explore ways of increasing scientific cooperation between the US and Iran. These discussions were designed to launch a dialogue and help identify priorities and opportunities for strengthening cooperation and collaboration. Arfaei was also a featured speaker at the 30th annual AAAS Forum on Science and Technology Policy in Washington, DC, April 21-22.

Photo Credit: Ernie Tretkoff

Hessamaddin Arfaei

Arfaei earned his PhD from UC Berkeley in 1976. He then returned to Iran and has been there since 1979. For several years after the Iranian revolution he was entirely isolated from the international scientific community, he said. But since 1984 things have improved dramatically, and continue to improve.

Though there is still a long way to go, Iranian science is rebuilding, said Arfaei. For instance, just after the revolution Iranian researchers were publishing around 500 scientific papers a year, and the number is now around 3500.

Science education in Iran is quite good, said Arfaei, but as in many developing countries, there is a problem with "brain drain." In fact, he said, most of the talented scientists choose to leave Iran, especially experimentalists who want to work on projects at large facilities that don't exist in Iran.

Arfaei said it is important to have collaboration between Iranian and American scientists. "You need contact with other people," he said. More joint conferences and other opportunities for contact and collaboration would be a good step, he said.

NI-78 *from page 3*

this case 28 protons, and 50 neutrons–that fill shells in the nucleus.

There are only 10 such nuclei in nature, and Ni-78 has the largest neutron excess. Because the Ni-78 isotope must dispose of so many extra neutrons, it is extremely unstable and does not exist in nature, except briefly in exploding supernovae. The NCSL scientists were able to create the isotope by accelerating a stable isotope of krypton gas to high speeds and then colliding it with a target of beryllium metal. The NCSL is the nation's premier rare isotope accelerator, capable of shooting 100 billion krypton atoms a second. Even then, Ni-78 is so rare, it only shows up about twice a day.

Ni-78 acts as a kind of valve in the rapid neutron capture process. A shorter half-life would be like opening the valve a little, allowing the process to develop more quickly. Since the NSCL team found that the half-life was substantially shorter than expected, this means nature can produce heavy elements faster than previously thought.

DEEP2 *from page 4*

Marc Davis, DEEP2's principal investigator and a professor of astronomy and physics at UC-Berkeley, is now comparing the DEEP2 measurements with simple predictions of dark energy theory, but hopes to also collaborate with other theoreticians to test more exotic dark energy theory. Some, such as those that involve many extra dimensions, predict a gradual evolution of the fine structure constant.

PENTAQUARK *from page 1*

Curtis Meyer, a physicist at Carnegie Mellon University and a member of the CLAS collaboration, gave a separate talk reviewing the data from various pentaquark experiments. He concluded that the claimed pentaquark sightings were probably incorrect.

"The data [for the pentaquark] do not look very convincing," said Meyer. "I'm not going to buy any pentaquark stock."

RHIC *from page 1*

collaborations–PHENIX, STAR, PHOBOS, and BRAHMS–participated in the announcement. The new results are based on analysis of data from the 2000-2003 run.

RHIC creates the blob of quark-gluon matter by smashing gold nuclei together at very high energies. Under these extreme conditions, the quarks and gluons normally bound in nucleons can become unbound. The quark gluon matter is extremely hot and dense, nearly 150,000 times as hot as the sun's core and 100 times the density of a nucleus, said the researchers. The blob lasts for only about 10^{-23} seconds.

By analyzing the distribution of particles that spray out of the quark-gluon blob as the state decays, researchers from the four collaborations have concluded that this strange, short-lived state behaves like a liquid, rather than a gas, as some physicists had predicted. In this state, the quarks and gluons interact with each other more strongly than expected, and flow together with very little viscosity, like a nearly perfect fluid. "It's more fluid than the water in this glass," said Kharzeev, pointing to the glass in front of him.

Some theorists have been saying for several years that this quark gluon matter produced by RHIC is the much sought-after quark-gluon plasma, a state that is thought to have existed briefly in the very early universe. "Circumstantially, that fits the data," said Sam Aronson, Associate Director for High Energy and Nuclear Physics at Brookhaven. "Every physicist has his own take on whether this is the quark-gluon plasma. I think it is."

But the RHIC scientists have cautiously avoided making an official announcement of the quark-gluon plasma. They said at the press conference in Tampa that they are more concerned with studying the properties of this bizarre state of matter than with naming it.

Some researchers believe that the quark-gluon plasma would have filled the universe in the first microseconds after the big bang, and therefore the RHIC studies could help provide insight into the extreme conditions in the early universe. "We think we're looking at a phenomenon last seen in the universe more than 13 billion years ago," said Aronson.

However, Kharzeev said, "The findings are so new no one has looked at implications for cosmology."

RHIC researchers plan to continue to study the properties of this unusual state of matter by measuring its heat capacity, viscosity, and temperature.

"There are lots of exciting questions. We're at the edge of new terrain. We need to go explore it," said Aronson.

However, due to budget cuts, RHIC will have to decrease its operating time from 30 to 12 weeks per year. "This clearly slows down the productivity of the program," said Aronson.

VISA *from page 3*

the American Institute of Physics conducted in 2003 found a 10% decline in foreign physics graduate students from 2000-2002. Fully two-thirds of the physics departments responding indicated that there were some visa denials for students accepted for admission to US graduate programs that prevented them from attending.

Gast believes that the visa duration must be extended to better meet the needs of research programs and prospective students, and that more re-entry visas are needed to allow students and scholars to attend conferences outside US borders.

There have been some improvements, according to Gast. The State Department now gives priority to student visa applications, and Mantis (security review) delays are decreasing. Re-entry is less of a problem for visa holders from many non-sensitive countries, since Mantis reviews are now good for four years. And while Gast has seen a drop in foreign applications to MIT since 2002, she added that there has been no evidence that the quality of those applicants has decreased.

Ron Webb, manager of doctoral recruiting and university relations at Procter and Gamble, is less optimistic about the future, despite these minor improvements. His company runs a $50 billion business in nine countries on four continents, and also operates 20 R&D programs with a research workforce of 7500. P&G employs 900 PhD-level scientists and roughly 50 doctoral candidates each year.

But the number of US doctorates awarded has been flat or declining for decades, so the company has become increasingly dependent on the supply of foreign doctoral students in the US. Even that solution is becoming less viable as the competition for scientific talent intensifies as the hiring pool shrinks and other countries catch up to the US in technological and industrial development. The situation will only become more severe as the baby boomers begin to retire.

Furthermore, visa difficulties are dissuading many US companies from pursuing foreign hires. And federal funding for math and science in the US continues to decline in the face of a soaring federal budget deficit.

"All in all, it is clear that future doctorate production in the US will not meet business demands, and there will be little chance of balancing hiring with the retaining of foreign workers," Webb said. "Where is the future workforce? The answer is obvious. Companies will move to where the workforce is, and will act to create more work overseas."

James Langer, vice president of the National Academy of Sciences and a professor at the University of California, Santa Barbara, cautioned in an earlier session on globalization that the long-standing US dominance in science and technology is rapidly eroding. Many nations are catching up to the US in the granting of patents and graduate degrees, and the best foreign students who study in the US are opting to return home after finishing their degrees. At the same time, industry is developing rapidly in many underdeveloped global regions. "We must learn to live in this new world," he said, emphasizing that "Global prosperity is in everybody's interest."

HUMAN RIGHTS *from page 4*

essentially unlimited powers and are not supervised by any elected bodies. Hadizadeh, now at Ohio University, only very recently received a visa permitting him to reside and work in the US; he faces imprisonment should he return to Iran.

The last talk, by Edward Gerjuoy of the University of Pittsburgh, was titled "The American Physical Society's Involvement in the Defense of Human Rights." Gerjuoy, the organizer of the session, praised the APS for its past and continuing steadfast support of human rights. Gerjuoy argued that this APS support, which since 1980 has been the province of its Committee on the International Freedom of Scientists, illustrates the unusually intense resistance of physicists to governmental restrictions on intellectual freedom. In so arguing, Gerjuoy echoed an important theme of the talks by Fang and Chernyak, who had remarked on the surprisingly large number of physicists at the forefront of the human rights struggles in their respective nations.

In closing remarks, Sarachik praised the session's concentration on the human rights of scientists and urged the audience to join the APS efforts to preserve those rights.

ANNOUNCEMENTS

M. Hildred Blewett Scholarship

M. Hildred Blewett Scholarship for Women Physicists

This scholarship has been established to enable women to return to physics research careers after having had to interrupt those careers for family reasons. The scholarship consists of an award of up to $45,000. The applicant must currently be a legal resident or resident alien of the US or Canada. She must be currently in Canada or the US and must have an affiliation with a research-active educational institution or national lab. She must have or completed work toward a PhD.

Applications are due by July 1. Selection will be made by a subcommittee of the APS Committee on the Status of Women in Physics. Announcement of the award is expected to be made by September 1.

Details and on-line application can be found at **http://www.aps.org/educ/cswp/blewett/index.cfm**

Contact: Sue Otwell in the APS office at blewett@aps.org

Dark Energy Task Force Call for White Papers

Submission deadline: 15 June 2005

In February 2005 the NSF-NASA-DOE Astronomy and Astrophysics Advisory Committee (AAAC) and the NSF-DOE High Energy Physics Advisory Panel (HEPAP) established a Dark Energy Task Force (DETF) as a joint subcommittee to advise NSF, NASA, and DOE on the future of dark energy research.

The names of the DETF committee members, as well as the charge to the committee, may be found at **http://www.nsf.gov/mps/ast/detf.jsp.**

We expect that the DETF will prioritize techniques for studying dark energy but will not rank specific projects.

Because the funding agencies will use the DETF report to help direct their resources, it is important for the committee to have information from all experimental groups, including an outline of each project's scientific goals and experimental approaches.

Hence, the DETF announces a "Call for White Papers" from all projects relating to the study of dark energy, including those that address emerging or high-risk techniques. The DETF is very interested in considering creative projects of high risk but which may produce large impacts on the measurement of dark energy. A similar but separate call will be issued to solicit contributions describing theoretical studies of dark energy.

White paper submission instructions may be found at **http://www.nsf.gov/mps/ast/detf.jsp.**

New Membership Directory Feature

APS Members may now search the Online Member Directory by institution. Please visit **http://www.aps.org/memb/enter-directory.cfm** to login to the Member Directory. From there you will see the original single member search and the new "Search by Affiliation" option.

An email request was sent to all members during the last year to verify the accuracy of all affiliation linking that we have on record. Please note that not all members have provided affiliation information and may not be listed in the institutional directory. If you did not receive an email, have a correction to a listing or don't see an affiliation, please contact a membership representative at **membership@aps.org** for assistance.

Thank You

The APS Membership Department

Distinguished Lecturers Program in Division of Plasma Physics

The Division of Plasma Physics of the American Physical Society is pleased to announce the Distinguished Lecturers in Plasma Physics for 2005–2006. This program is intended to share with the larger scientific community exciting recent advances in plasma physics. Under the Plasma Physics Travel Grant Program funded by the US Department of Energy, the lecturers are available for talks at US colleges and universities for the academic year 2005–2006. Their travel expenses will be supported by the grant. The Lecturers may be invited by contacting them directly.

The following Distinguished lecturers have been chosen by the DPP:

Michael Brown
Title: Self-Organization in Magnetized Plasmas
Department of Physics and Astronomy
Swarthmore College
email: doc@swarthmore.edu

Gail Glendinning
Title: Experiments on the National Ignition Facility
Lawrence Livermore National Laboratory
email: glendinning1@llnl.gov

Chuck Greenfield
Title: Advances and New
Developments in Fusion Energy Research Using the Tokamak
General Atomics
email: Chuck.Greenfield@gat.com

David Newman
Title: Plasmas as a Prototypical
Complex System: Self-Organized Criticality
as a Paradigm for Plasma Transport
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Edmund Synakowski
Title: Fusion Energy, Plasma
Turbulence, and a Shifting Scientific Landscape
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Title: Heating the Solar Corona: A Hot Topic in
Plasma Astrophysics
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Additional information about the Plasma Travel Grant Program can be obtained from the Chair of the DPP Education and Outreach Committee:

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cluded that, "We are still very far away from being able to entangle and teleport human beings and bulk inanimate objects."

Category #3, to the media outlet that reported as factual the most outrageous supernatural, paranormal or occult claims: The prize goes to the film "What the [Bleep] Do We Know?", a fantasy docudrama cult hit supposedly about the "nature of reality." More than a dozen scientists, theologians and mystics appear. However, the product placement reveals that among the physicists, neurologists and academics who expound the film's thesis is "new age" icon J.Z. Knight, who claims to be channeling a 35,000-year-old god/warrior from Atlantis named Ramtha. The films' producers, writers, directors, and some of the stars are members of the Ramtha School of Enlightenment in Washington State. Several of the scientists are affiliated with Knight's school, and the film was largely financed by one of Knight's students. It is still filling theatres all over the world.

Category #4, to the "psychic" performer who fooled the greatest number of people with the least talent: This award goes to "that persistently wrong psychic, prophet, seer, and visionary," Sylvia Browne. In July of 2004, Sylvia said that Osama Bin Laden was dead, but a video released three months after that mentioning Bush and Kerry, proved when it was made. Wrong. She also predicted that Saddam Hussein would be found dead before the end of 2003. And in October of 2003 she said that Yellowstone Park would erupt between January and March of 2004. "We could go on and on, but suffice it to say that Ms. Browne easily wins this category," Randi writes.

The Back Page

Maintaining America's Competitive Edge

By Senator Jeff Bingaman

Unquestionably, America today is the world's R&D powerhouse. There are, however, disturbing indications that US dominance in science and technology is starting to wane. More and more ideas are being generated in laboratories outside the US. We can no longer take the supremacy of America's scientific and technological enterprise for granted because other nations are on a fast track to overtake the US in discovery and innovation.

Moreover, the Administration's proposed FY 2006 budget for science and technology contains some poor decisions which could further weaken our economic and scientific posture. A number of mid-course corrections, new policies, and additional investments will be needed to put us back on the solid path of scientific preeminence which this nation has enjoyed since World War II.

It goes without saying that one of the basic policies of our nation's economic security must be to maintain a sustained investment in science and technology. There is no dispute that science, and the technology that flows from it, are duly recognized as the principal engine of our economic growth.

Nor is there any contention of the fact that America's present strength, prosperity, and global preeminence depend directly on fundamental research. The scientific record of the past half century constitutes overwhelming proof. At the present time, we lead the world in such areas as nanoscience, genomics and proteomics, and advanced scientific computing.

Still, there are signs that we are beginning to slip in our world leadership role in science.

Troubling trends across the R&D spectrum were recently spotlighted in a recent report prepared by The Task Force on the Future of American Innovation entitled, "The Knowledge Economy: Is the United States Losing its Competitive Edge?"

In the area of education, undergraduate science and engineering degrees within the US are being awarded less frequently than other countries. In 2000, Asian universities accounted for almost 1.2 million of the world's S&E degrees, and European universities (including Russian and Eastern Europe) accounted for about 850,000 S&E degrees, while North American universities accounted for only about 500,000 degrees.

As for doctoral degrees, the US has a smaller share than both Asia and Europe. In fact, in 2000, about 89,000 of the approximately 114,000 degrees earned worldwide were earned outside the US.

Countries that once sent their students to learn in the US are now able to educate them at home. As a result, they have an expanding workforce of undergraduate engineers to staff manufacturing facilities, as well as a growing increase in intellectual property because of a flourishing number of graduate degreed scientists. Lagging international interest in US graduate study is not recovering from record lows. Last year applications dropped another 5 percent, and the number of Asian students pursing Ph.D.'s in the US has dropped by 19 percent, while it has doubled in their own countries.

Our science and engineering workforce is aging while many of those overseas are young and vibrant. In fact, more than half of those with science and engineering degrees in our workforce are now over 40.

Another troubling issue is in the area of R&D investment. Currently, the US invests about 2.7 percent of its GDP in R&D. That is pretty good and it puts us as number 5 in the world, yet still behind Korea and Japan, who invest over 3 percent.

However, the issue is not to look at the static picture, but the rate of change. From 1995 through 2001, the US increased its R&D investments by 34 percent, while the world's fastest growing economies such as China, Korea, and Taiwan, boosted their R&D investments by a whopping 140 percent.

During that same time period, China's R&D percentage of GDP jumped from 0.6 to 1.2 percent–still well behind the US–but it has doubled in slightly more than a half-dozen years at a 7 percent annual growth rate.

Moreover, considering benchmarks per GDP, federal funding of basic research in engineering and physical sciences has experienced little to no growth for the past three decades. In fact, as a percentage of GDP, federal investment in the physical sciences has declined by 50 percent over the past 30 years, from 0.1 percent per GDP to today's 0.05 percent.

What do these disturbing trends indicate? It means that other nations are coming up fast behind us on the scientific track. The rapidly developing Asian economies are forging ahead, nearly matching their R&D investments with their GDP growth rates, while the US is lagging behind.

What impressed me most from my recent science and technology fact finding trips to India, China and Taiwan is their growing skilled workforce.

In India, the President of Infosys, the first great Indian software company, told me that last year they received 1.2 million applications, they gave a standardized test to 300,000, interviewed 30,000 and hired 10,000–and they expect to repeat that again this year. This is the highly trained workforce we are now up against.

Another finding is that US and foreign high technology companies are now building their newest R&D centers in these developing nations to tap into their intellectual capital and highly skilled workforce.

Today, General Electric's largest R&D center is in Bangalore, employing 2300 Ph.D.'s in all areas of research from trains to cat scanners. In fact, these researchers are now telling production plant managers in Indiana what process controls to use.

Intel has just built an innovative center in Bangalore with 2000 engineers, soon to almost double in size, which designs chips that are produced at their Albuquerque plant.

So the paradigm of the US producing cutting edge R&D which is then manufactured in lesser developed countries has been turned on its head. US companies are not waiting for foreign students with visas to come here–they are simply building R&D centers over there where the intellectual capital is, bypassing the US visa bottleneck issue that has dramatically constricted the flow of foreign graduate students due to new security screening restrictions.

"...by the time the majority of our policy makers read the handwriting on the wall, their backs will be up against it."

The stark question is what are we currently doing in the R&D arena to reverse the situation–because by the time the majority of our policy makers read the handwriting on the wall, their backs will be up against it.

In order to make room for huge tax cuts and address the staggering budget deficits they have helped create, the Administration now proposes major cuts in the research our country depends on to maintain technical leadership. Next year's proposed "Federal Science and Technology" budget suffers a three percent decrease in real buying power.

The National Science Foundation is woefully underfunded. The Administration's request next year for NSF is $2.91 billion, or 34 percent below the FY2006 level authorized. At the Department of Energy, the Federal Science and Technology budget would drop by $278 million, or 5 percent. The science programs in the DOE that support much of the nation's premier work in physics and materials science is cut 6 percent in real spending. Renewable energy research is cut 9 percent in constant dollars and energy efficiency 5 percent. All other energy programs–nuclear, fossil, transmission and distribution–decline by 9 percent. In fact, the entire petroleum and natural gas R&D account has been zeroed out at a time when the price of oil has climbed past $50 per barrel. Even worse, budget constraints have forced the Office of Science to cancel several long lead time big physics projects at Fermilab, and to slash US fusion research by 40 percent due to commitments to the International Thermonuclear Experimental Reactor–when a site has not even been selected.

Additionally, buried within the Department of Defense budget are cuts to investments in science and technology that will substantially determine our war-fighting capabilities 10 to 15 years from now. Defense research–both basic and applied–are starved, and when inflation is factored in, we will end up buying less research than we did before.

What should we be doing?

The first thing we can do is increase funding–but for how much, what research, and for how long? That is a hard question for the Congress to answer in programmatic detail, but it seems realistic to me that we should develop a 5 year funding profile that grows our long-term basic sciences in the federal science and technology budget by 5 percent per year.

For FY 2006, that would mean increasing the science and technology account by $3 billion, bringing it up to $63 billion. In 2007, it would rise to $66 billion, and so on. That is not the entire federal R&D budget, which is now about $133 billion, but it is the R&D sweet spot where basic research spurs future innovation and strengthens our science and technology workforce.

Some small help may be on the way. Sixty-eight Senators recently signed a letter Senator Lamar Alexander (R-TN) and I wrote requesting appropriators to ignore the White House's proposed funding cut for the DOE Office of Science and instead provide a 3.2 percent increase over last year's appropriations.

We can also make some improvements that are not directly related to increasing science funding. I am introducing legislation to offer incentives to our existing science parks to expand while also constructing new ones. The rise of Taiwan's microelectronics miracle can be directly attributed to their government's role–not in picking winners and losers–but by building the necessary infrastructure allowing competition to flourish through their science parks. The same holds true with India's software science parks and their rise as a world powerhouse in that industry.

In addition, we should modify our R&D tax credits so that participants in a research consortium–five or more unrelated companies working on a specific type of mutually beneficial research–receive a flat 20 percent research tax credit. We should endorse collaboration to share the cost of research.

Furthermore, we should be encouraging at a national level foreign direct investment in the US to locate manufacturing plants that would be built by US or foreign firms overseas. Ideally, the Department of Commerce should administer a program that acts as the Overseas Private Investment Corporation in reverse. It would lay out incentives to encourage US and foreign firms to locate high tech manufacturing in the US. The details are complex, but such an effort would act to collect and analyze trends in the outflow of high technology investments from the US to such countries as China or India. It would develop incentives using public-private partnerships to attract new manufacturing operations in the US. Finally, it would act as the policy focal point across the US Government to coordinate efforts to make the US attractive for foreign high technology investment.

The challenge we face is global in nature and broader in scope than anything we have seen in the past. It will take great determination, considerable resources, and a sustained national effort involving academia, industry, along with state and federal governments to insure that America continues to be the world leader in science and technology.

My greatest fear is that we become so preoccupied with other issues that countries with rapidly developing S&T-based economies surpass us and become regional giants influencing the decisions of countries in that region who were staunch allies of the US. By the time we recognize that we as a nation have fallen behind, it will cost far more to remedy than it will be to address it head-on today.

America has always been a nation built on the hope that we can build a prosperous, healthy world for ourselves and for our children. But it is clear that these long-standing American aspirations depend critically on our far-sighted investment in science and technology. Leadership in science and engineering and the world's best education and training system are essential for ensuring Americans well-paying jobs and essential for our security.

When J. Robert Oppenheimer, the renowned physicist, warned President Franklin D. Roosevelt in 1943 about Germany's plan to build an atomic weapon, FDR replied in a secret letter that "whatever the enemy may be planning, American science will be equal to the challenge." Never has a prediction been so prescient.

We know that the dominance of our fundamental research enterprise is a core American strength that must be preserved–and we must not let our position erode and compromise our future economic and national security.

By sustaining our investments in basic research, we can ensure that America remains at the forefront of scientific capability, thereby enhancing our ability to shape and improve our nation's and the world's future.

Jeff Bingaman is the junior US Senator from New Mexico. A Democrat, he was first elected to the Senate in 1982.

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.*