APS Joins Science Organizations in Urging Better Visa Regulations

In May the APS joined more than 20 other science, higher education and engineering organizations in a joint statement urging the federal government to adopt six practical recommendations for improving the current visa processing crisis by removing unnecessary barriers to multi-national collaborations. Taken together, the group represents 95% of the US research community. It is the first time that US science and academic leaders have endorsed a comprehensive plan to address the visa-processing quagmire in the wake of heightened security concerns following the 9/11 terrorist attacks.

The statement is careful to express strong support for the US government’s efforts to establish new visa policies while bolstering national security. “We are confident that it is possible to have a visa system that is timely and transparent, that provides for thorough reviews of visa applicants, and that still welcome[s] the brightest minds in the world,” the statement reads. “It is not a question of balancing science and security... These priorities are not mutually exclusive; to the contrary, they complement each other, and each is vital to the other.”

There is ample evidence that the visa processing system is sinking under the weight of stricter security requirements. In 2000, only 1000 non-immigrant visa applications were flagged for review under the Visa Antiterror program, one of several US screening systems. But by 2002, that number had jumped to 14,000. By the spring of 2003, some 1000 cases were under review at any given time. An increasing number of cases are being set aside for even more detailed screening. The result is massive backlogs and delays that prevent students from attending university and scientists from participating in research and conferences.

In addition, a survey earlier this year by the American Council of Education, among other organizations, found a substantial drop in applications by international graduate students to leading US research institutions for the 2004-2005 academic year. “If action is not taken soon to improve the visa system, the misperception that the US does not welcome international students, scholars and scientists will grow, and they may not make our nation their destination of choice now and in the future,” the statement says. “The US cannot hope to maintain its present scientific and economic leadership position if it becomes isolated from the rest of the world.”

Six major problems are outlined. See VISA on page 4

April Meeting Prize Recipients


QKD, XFELs Highlight 2004 DAMOP

The latest research results in quantum key distribution, quantum entanglement, and next-generation free electron lasers (XFELs) were among the technical highlights at the 35th annual meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP). It was held May 25-29 in Tucson, Arizona, in conjunction with the corresponding division of the Canadian Association of Physicists.

During the special events was a welcoming reception Tuesday evening at the Arizona Historical Society Museum, and an after-dinner lecture by Rice University’s Neal Lane, former director of both the National Science Foundation and the Office of Science and Technology Policy.

The conference also featured a public lecture on Wednesday evening by JLAB Eric Cornell, winner of the 2001 Nobel Prize in Physics for his contributions to realizing Bose-Einstein Condensation.

Searching for a Quantum Key. Quantum key distribution (QKD) uses single-photon communications to generate the shared, secret random number sequences that are used to encrypt and decrypt secret communications. The secret to the techniques’s security is based on the interplay between quantum physics and information theory, according to Richard Hughes (Los Alamos National Laboratory). “An adversary cannot successfully tap the transmissions nor evade detection,” he said, since eavesdropping raises the key error rate above a set threshold value. Hughes described a recent QKD experiment performed over multi-kilometer line-of-site paths, serving as a model for a satellite-to-ground key distribution system. His system uses single-photon polarization states, with active switching, and is capable of continuous operation through day and night.

XFEL Generation X. Stanford Linac Accelerator Center’s planned Linac Coherent Light Source is an example of the next generation of X-ray free electron lasers (XFELs). These instruments will offer users the ability to study ultrafast, time-dependent phenomena with resolutions at atomic length scales.

APS Journals To Cost Less in 2005

For the first time in many years, the price for APS journal subscriptions will decrease for 2005, largely due to a technology-driven reduction in the cost of production. As is the case for most scientific journals, the trend for APS journals, which include Physical Review A-E, Physical Review Letters, and Reviews of Modern Physics, has been increasing prices over the past several decades. In addition to normal inflation in the costs of production, the journals have been steadily growing in size every year, said Tom McIlrath, APS Treasurer/Publisher. The journals are expected to grow by 4% from 2004 to 2005.

While the size of APS journals has been increasing, the number of subscriptions has been decreasing. Large institutions have canceled duplicate subscriptions because electronic access makes multiple print copies unnecessary, and smaller institutions have been forced to cancel subscriptions for financial reasons. This trend is seen throughout the journal publishing industry.

For 2005, APS will begin to reverse the trend of increasing prices by taking advantage of the cost reductions made possible by new technology. For example, said McIlrath, software that automatically copies and formats manuscripts greatly reduces the manpower needed. Also, almost all manuscripts are now submitted on-line, saving the cost of having to reenter them. Outsourcing some of the production processes to other countries accounts for some of the lower costs, but technology is really the major factor in controlling costs, said McIlrath.

After hearing input from the Publications Oversight Committee, the APS Council set the journal prices for 2005, deciding to pass the cost savings on to libraries. Large institutions have been steadily growing in size every year, said Tom McIlrath, APS Treasurer/Publisher. The journals are expected to grow by 4% from 2004 to 2005.

What’s a Nice Equation Like You Doing in a Cartoon Like This?

Earlier this year an animated feature called The Tripods of Belleville was playing in movie houses around the country. It got some attention from the critics, and garnered two Oscar nominations (for best animated feature film and best original song). Among its many interesting attributes is something that was probably noticed by only a very tiny segment of the audience: the opening credits run, the bottom of the screen displays Einstein’s field equations of general relativity (see illustration).

There is no obvious reason for this. Neither Einstein nor physics plays any role in the film itself. The film is a French/Belgian/Canadian collaboration, directed by Sylvain Chomet of France, that was the only thing on the list of credits for people with no particular raises db at all with very little doing.

If any of our readers have other inside knowledge, or a good theory as to why the equations are there, we would be eager to hear about it. We will even offer a copy of the coffee-table book, “Physics in the 20th Century” for a particularly convincing explanation.
perspective some difficult subjects, like extra-dimensional spaces. It's a little hard to visualize. — John Schwant, Caltech, on giving a public lecture about string theory, Los Angeles Times, May 13, 2004

“I do what works. I see what causes people to fall asleep.” — Carl Wieman, University of Colorado, on giving public lectures, Los Angeles Times, May 12, 2004

“If the universe was finite, and had a size of about 4 billion to 5 billion light-years, then light would be able to wrap around the universe, and with a dark enough telescope we could view the Earth just after it solidified and when the first life formed. Unfortunately, our results rule out this tantalizing possibility.” — Neil Cornish, Montana State University, SPACE.com, May 24, 2004

“I am a theoretical physicist, and there are some problems for which there aren’t answers. You can only understand that science through simulations.” — Raymond Orbach, DOE Office of Science, BusinessWeek, June 7, 2004

“I always like to say that one of the compelling things about doing science is that it provides you with the knowledge that there is an ultimate truth and our mistakes will be discovered.” — Persis Drell, SLAC, San Jose Mercury News, June 1, 2004

“...'tis tough to get an animal to lie still for 40 minutes. It's tough enough to get people to do it.” — Craig Woody, Brookhaven, on a device he's developing called RatCAP, a compact PET scanner for awake lab rats, Newsday, May 31, 2004

"Always assume this is your last clear night on the telescope. Set aside time for things you'll be embarrassed not to have done.” — John Huchra, Harvard, on selecting projects for the Hubble telescope, New York Times, May 25, 2004

"Maybe it's my age, but I'm really beginning to think I know what it feels like to be the Hubble telescope. One faces a finite future.” — Robert Kirshner, Harvard, New York Times, May 25, 2004

"The equations that govern a violin string are pretty close to the equations that govern the strings we talk about in string theory. So although the notion of strings is metaphorical, it's pretty close.” — Brian Greene, Columbia University, New York Times, May 25, 2004

"The cloudier the earth, the brighter the earthshine, and changing cloud cover is an important element of changing climate.” — Steve Koonin, Caltech, San Jose Mercury News Chronicle, May 28, 2004

...
Physics societies, laboratories and other organizations around the world are gearing up for the 100th anniversary of Albert Einstein's "miracle year" and the three-volume publication that revolutionized the field of physics.

The American Institute of Physics (AIP) is no exception, organizing a wide range of education and outreach activities to capitalize on the event. Among other activities, Physics Today—AIP's flagship publication—is planning a monthly feature throughout the year in honor of the World Year of Physics.

And AIP's Center for the History of Physics is raising funds to enhance its immensely popular 1996 on-line exhibit on Albert Einstein (http://www.aip.org/history/einstein/).

New features will include a new site design, a new bibliography, a digital library of distinguished essays by noted historians on various aspects of Einstein's thinking in 1905.

The various chapters of the Society of Physics Students around the country will be sponsoring physics department anniversary events, such as a "Physics Department Challenge." Awards for the best proposals will be handed out and featured at the upcoming EPS Congress this October in Albuquerque, New Mexico.

The March White Awards for Physics Outreach will also be geared towards the best physics outreach projects in 2005. Meanwhile EPS will be putting together outreach catalyst kits around the theme of "Einstein in the 21st century." These will be disseminated to about 25 EPS chapters in the US this fall.

For more information about AIP's plans for the World Year of Physics, see http://www.aip2005.org/events/index.html.

AIP Plans Outreach Programs for World Year of Physics

The Physics of High Heels

By Stephen Strauss, Globe and Mail

England, the country that nurtured the genius of Isaac Newton, has now applied the brains of its physicists to a modern quandary. What is the height of the heels that Sex in the City’s Carrie Bradshaw could wear without falling over or cramping up in pain?

The answer, as calculated by Professor Paul Stevenson of the University of Surrey, is complicated as contemporary dating. Bradshaw, the show’s fashion mad lead character, is wearing shoes she really likes, looks terrific in, and are the latest thing, she can sashay about easily in a pair of her beloved Manolo Blahnik tots that top up at over five inches or almost 13 centimeters tall. If she has spent the night toasting the end of the television series, then she had better think about not wearing shoes with heels higher than about an inch because the alcohol will upset her balance.

Stevenson said the calculation made after Dianne Stiltwell, a publicist with the British physics institute, set her sized 3 heeled shoe in front of her, "sat there thinking: How can she wear heels that high? There must be some kind of formula that says you can only go so high before you fall over," Stiltwell said.

She then went over to the physicists at Surrey with her curious question. Stevenson took up the challenge and came up with an equation that more precisely expresses the pain that increasingly higher heels cause the wearer. As a result, she says the formula is entirely based on a stiletto model for the heel. A broader heel would keep the wearer steadier.

The formula that the equation does not address is how much pressure a woman stumbling about in high heels would exert if she stepped on you. For that the British physics institute has digitized people to its web site where it records that a 100 pound woman in stilettos will exert pressure under her foot that is 20 times that of a woman stumbling about in high heels.

L is the number of years experience you have wearing high heels.

s is a variable and is known to be a factor that is greater than 1.

p is defined as.

Q is a sociological factor and has a value between 1 and 1.5

s is shoe size (UK ladies sizes)

The Globe and Mail

Reprinted with permission. Kudos to AIP’s Inside Science News Service for finding it and posting the link on their website.

A new generation accelerator could hold key to Dark Matter, Energy

At the dawn of the 21st century, physicists are realizing that the knowledge of the particles and forces that characterize ordinary matter is incomplete: 95% of the cosmos is made not of ordinary matter, but of dark matter and dark energy.

In order to answer these fundamental questions, astrophysical experiments, since the enormous dynamical range of cosmological conditions cannot be created on Earth. But accelerators provide controlled, repeatable conditions.

Turner outlined some of the knowledge gained from experiments conducted at accelerator facilities. Most notably, he said, in the 1970s, quarks were found to be fundamental building blocks of Nature. However, "There are still many questions that remain to be answered, and those answers will all require particle accelerators," he said.

Those questions include determining the exact nature of dark matter, hopefully by directly producing that particular form of matter. Most notably, states Turner, "If many scientists rank on a par with Copernicus’ recognition in the 16th century that Earth was not the center of the solar system, string theory predicts seven undiscovered dimensions of space that may give rise to much of the apparent complexity of particle physics. Discovering those extra dimensions could help us understand the birth and evolution of the universe. And string theory could even reshape our concept of gravity. There is also the question of dark energy, most notably figuring out "why nothing weighs so little," said Turner.

According to Gerald Dugan of Cornell University, the particle physics community has reached a consensus that the next linear collider should be an electron-positron linear collider, with an initial center of mass energy of 500 GeV. This can be later upgraded to 1000 GeV, and ideally operated concurrently with the LHC. The International Linear Collider Steering Committee (ILCSC) was established to make a recommendation on whether the next accelerator system should make use of superconductivity or should operate at room temperature. Each of these has its advantages and disadvantages.
Shakespeare Would Have Been Blushed

Reading the headlines in the current newspapers, I was reminded of one of the amusing aspects of one of the limericks published in 1997. It dealt with the approach of a particular type of computer, in which they both die in a blaze of glory. Perhaps not all of the readers of APS News are familiar with the earlier humorous forms of the English language (e.g., that used by Shakespeare), the verb “died” was also a euphemism for experiencing sexual climax. So—the limerick was richer than might have appeared.

Larry Silkin
Laramie, Wyo.

Arts/Science Collaboration Does the Job

I was intrigued last night in reading the article on the Back Page, “The Blood-Red Sky of the Krakatoa explosion,” by Edward Whymark. It is an amusing aspect of one of the limericks published in 1997. It was published in the March 1997 issue. For those whose recollection is not as good as Larry Silkin’s, it is reproduced below.

Readers can find, and most of the other limericks submitted to the conference, a list at www.aps.org/apsnews/limericks.cfm.

And Then There Were Photons

An electron, while in a fringe, Met a photon there, “face-to-face.” The electron then sighed, Indicating a sign, And they “died” in a loving embrace.

Jim Peterson
Palo Alto, CA

First Working Laser Due to Maiman

A. Laubereau’s letter in the May 2004 issue of APS News is correct when he says that the “first working laser” reflects the limitations of relying entirely on formally published scientific papers. These problems are particularly evident in studying the origin of the laser. I have explored the problem in a recent book, which forthcoming from Oxford University Press (Beam: The Race to Make the Laser), but feel obliged to cite this. Now, Maiman’s first laser used an imperfect ruby crystal which was the best he had available at the time. That was the basis of a manuscript he wrote and submitted to Physical Review Letters in June 1960, which then edited for publication. Samuel Goudsmit summarily rejected, either because he did not consider “an optical maser” to be a serious contender or because he considered it serial publication with a book, Maiman’s patent was rejected. Entanglement between stationary quantum states, although it cites the stimulated by Maiman’s press conference, does not give important points of context. The Collins et al. paper was the result of work stimulated by Maiman’s press conference, although it cites the nature paper. In fact, others also duplicated Maiman’s laser, with Ron Martin’s group at TRG Inc. prob-

APS Associate Director of Public Affairs Francis Slakey swore off Hill receptions and power lunches years ago in favor of more laid-back meetings over coffee with congressional staff. And he found he was much more effective in representing the interests of APS members on Capitol Hill when he detached himself from the public face of lobbying. In his new position directing the day-to-day activities of the APS Office of Public Affairs (OPA), in Washington, DC, his trademark low-profile approach continues to pay off. The OPA devotes the equivalent of 2% of its time to communications, focusing on budget issues, aimed at increasing federal funding for physics. This includes work on what terms “politically volatile” issues climate change, nuclear weapons, and terrorism, to name a few of the most recent. He has assisted in drafting federal legislation, written OpEds for Members of Congress, and helped write several APS studies, including the recent APS Hydrogen Report (See APS News, May 2004) and APS Modern Physics Study (The Race to Make the Laser).

“Slakey is creative, strategic and targeted in his approach to the Hill, which makes him particularly effective,” notes a congressional staffer for a House representative who has worked with Slakey on his key issues.

But he is also known for his low-key approach to the more controversial issues frequently called for unusual strategies. Take climate change, which with two basic components: reducing CO2 emissions, and increasing domic resilience to climate changes that were already occurring. The first step was fostering relationships with pivotal Republicans in Congress who might be receptive to a program aimed at resilience. Slakey contacted and was ultimately successful in working with Rep. JC Watts (R-O.K.), who at that time was Chairman of the House Republican Conference, a top position in the House of Representatives.

Slakey also sought out unusual allies: in this instance, the unusual opponent, who have a vested interest in averting weather-related disasters. He was initially criticized by left-wing environmental groups for this strategy, which some thought undermined efforts to reduce CO2 emissions, but most have now accepted the new focus on resilience.

Slakey used several examples to promote the issue. In Watts’ case he focused on the recent and severe droughts affecting the wheat crop in Oklahoma. Another example was a town in West Virginia that began suffering routinely from floods because of shifting weather patterns. Their solution was to blast the top off a nearby mountain to divert the entire town and move it across the river. “That’s about the most uncreative solution they could have devised,” Slakey says. “We needed a federal program that offered more creative problem solving.”

It took a year and a half to get the funding results. First, Rep. Watts wrote an OpEd and gave a speech calling for more federal emphasis on climate change resilience. Then, Watts introduced the Weather Safety Act calling for an additional million dollar program on resilience research.

Most recently, Slakey fostered ties with both Democrats and Republicans that makes Slakey so effective: “He works very well across the aisle to bring people together and find common ground on a given issue,” says a congressional aide who has worked with Slakey in the past. “There’s a reason why the Hill doesn’t let people get too hot under the collar. He makes sure that those who have worked with Slakey in the past. ‘There’s a reason why the Hill doesn’t let people get too hot under the collar. He makes sure that those who work with Slakey understand the bigger picture.’

Francis Slakey

More Low-Key Approach Pays Off for APS Lobbying Efforts

APS News, 8 May, by Olsen et al., “The Blood-Red Sky of the Krakatoa explosion,” by Edward Whymark. It is an amusing aspect of one of the limericks published in 1997. It was published in the March 1997 issue. For those whose recollection is not as good as Larry Silkin’s, it is reproduced below.

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Small Inequalities Can Influence Women’s Careers
By Ernie Tretkoff

At the APS April meeting, speakers in a session on keeping women and girls in science addressed real issues that can lead to the apparently low numbers of women in physics and what physics departments can do to change this "female-friendly." With the Project Access study in hand, Gerhard Sonnert of Harvard University investigated the careers of women and men who received physics graduate degrees, including a contingent of black and other minority students. The study covered women in many stages of their careers, from just starting out to a few years after graduation, in attempts to find small inequalities that might add up to account for the low numbers of women in physics.

Sonnert noted that these women did not drop out of physics at a higher rate than men did, but they cited different reasons for leaving the field. Women were far more likely to say they left physics for family reasons. The study did find some possible differences in the collaboration patterns between women and men. Sonnert noted that men were more likely to seek a "nice" advisor and to promote, while women were less inclined to engage in such social behavior. Sonnert said women also tended to be more perfectionistic, producing fewer papers, but perhaps higher quality.

Patricia Rankin of the University of Colorado, Boulder emphasized the importance of strong leadership in keeping women in science. She reported on a program at her university called LEAP (Leadership for Advancement and Promotion), which aims to increase the number of women in leadership positions in science and engineering. Rankin said she believes there are still some residual biases against women in science, but that they may have a large effect. These biases can be hard to avoid, she said, but even small changes in a department can help.

In Whitten’s study, the successful departments did not necessarily have more women faculty, or more pro- grams specifically aimed at women. Some students in Whitten’s study said they liked the "family atmosphere" in their departments, especially those students from the two historically black colleges Whitten visited. Historically black colleges and research institutes have a high proportion of women physics graduates. Whitten pointed out that physics bags behind other sciences in terms of participation of women. For instance, while less than 25% of physics bachelor’s degrees are awarded to women, 40% of math- ematics bachelor’s degree recipients are women. This implies that "what- ever it is that keeps women out of physics, it’s not the math," said Whitten.

Small institutions will get most of the benefit of the falling costs for 2005. These tier 1 schools, which account for 35% of all subscriptions, will see prices decrease 3%, while tiers 2 and 3, (54% of all subscriptions) will get a 1% decrease. The smallest, tiers 4 and 5, will receive a smaller decrease of 5%. “Everyone gets at least something,” said McIlrath.

This price decrease will apply to print-plus-on-line and online-only subscriptions. Prices of individual journals have changed to account for differences in growth. For instance, the price of Physical Review Letters is now a statistical, nonlinear, and soft- matter physics and interdisciplinary research, has increased for this year. This fluctuation pricing, which has been in place for several years, eases the burden on small, primarily research-oriented institutions, which use the journals less and are less able to carry the costs. Smaller schools may also join together with larger institutions to form a consorti- um. These individually negotiated deals also help reduce the burden on institutions and otherwise be able to afford access to the journals.

Not surprisingly, the approach he advocates in the classroom is a microscopic of the one he suc- ceeded in his department at APS: focusing on building a grassroots contingent and looking for provocative alliances. The stu- dents are trained to develop that solution, but often that’s all it takes. This past semes- ter, one team drafted their own bill to replace mercury thermometers with alcohol thermometers in schools across the country. On May 6, Rep. Tammy Baldwin (D-WI) introduced the “The Mercury Reduction Act” into the House of Representatives (H.R. 4260). The bill “calls on states where such plans exists and exactly which Member or Senator is most likely to cham- pion his causes,” a Capitol Hill staffer said. “And his personal style is easygoing and ego-less— a rarity on Capitol Hill!”

National Science Board: Getting It Wrong Again?

During the week of May 10th, the National Science Board (NSB) announced two new reports: the 2004 NSF Science and Engineering Indicators (a biennial publication) and a companion piece titled An Employment Report on College and University Science and Engineering Labor Force. I highly recommend the Indicators to anyone who wants to understand the trends in international science and engineering both in the US and abroad. The following are a few remarks on the three basic issues raised by the NSB report. You can read or download a copy of this report at: http://www.nsf.gov/sbe/srs/nsb04407.pdf

First, the NSB states that they have "observed a troubling decline in the number of US citizens who are training to become scientists and engineers." I have examined the data carefully and see a very different pattern than the one they describe. Each year, the number of bachelor’s degrees awarded in the natural sciences and engineering combined (life sciences, computer science, engineering, mathematics, and the earth sciences) has increased by about 18% over the last decade, an even larger increase than during the decade of the 1990s. Sonnert also compared the GPA of women in physics with that of men, and found that women consist-ently had a higher GPA, possibly suggesting a difference in the self-confidence of women and men. However, there were more women faculty had more women stu- dents, and those women had less of a GPA advantage over male counterparts.

Although the Project Access study was carried out in the late 1980s, and there have obviously been positive changes since then, Sonnert said, progress has been slow. Barbara Whitten of Colorado College discussed her visits to nine undergraduate physics departments that grew out of her work on the Committee on the Status of Women in Physics site visit program. She reported on a program at her university, which has increased for about three times the rate of the US. The NSB’s projections were developed before the recent “dot com bust,” and while projections of future demand are always fragile at best, these are particularly problematic. The BLS projections were developed before the recent “dot com bust,” and their projected increases in the “steady state” demand driven largely by their assumptions about the continued high growth rate in the computer science and IT workforce.

In addition, the NSB appears to have ignored problems in the current S&E job market. The data for May 12, 2004 released by the BLS indicate that unemployment for electrical engi- neers is 5.5%, for computer software and systems analysts is 6.7%, and for computer programmers is at 9.0%. These data are troubling for the physics community. While most bachelors who enter the labor force after graduation usually find employ- ment in engineering and the IT workforce, molecular biology because of their starting growth rate during the 1990s (54%), we will see 10,000 more students (7%) earned bache-
Did Gamma Rays Cause Ordovician Mass Extinction? By Ernie Tretkoff

A gamma ray burst may have caused the Ordovician extinction, suggests Brian Thomas and colleagues at the University of Kansas. This mass extinction, the second largest ever, took place about 440 million years ago and wiped out about two-thirds of all species.

Scientists have blamed the extinction on a sudden ice age that occurred at the end of the Ordovician period. Thomas agrees that the ice age explains the extinction, but suggests that a gamma ray burst could account for both the onset of the ice age and other effects such as ozone depletion which may have also been a factor in the mass die-off. Thomas and colleagues first reported their hypotheses in a paper posted on-line last September (astro-ph/0309415). They presented further details at the April M. E. T.

Gamma ray bursts, the most powerful explosions known, are believed to come from supernovae, and are observed about once a day. A gamma ray burst may last about ten thousand light years, and Thomas estimates that such an event occurs about once in a billion years.

The intense radiation of a gamma ray burst could have depleted about forty percent of the ozone layer, according to Thomas’s recent calculations, presented at the April M. E. T. The ozone layer would take about ten years to recover from such a blast, said Thomas.

The loss of such a large fraction of the ozone layer would have allowed harmful ultraviolet radiation to reach Earth. Because ultraviolet flux is attenuated through water, marine organisms that dwelt closest to the surface would have received the most UV radiation, and thus would have been killed at higher rates than those that lived deeper, said Thomas. Indeed, geological evidence confirms that species living near the top of the water column were hit hardest in the Ordovician extinction.

In addition to depleting the ozone layer, a gamma ray burst may have initiated the sudden episode of global cooling that began at about the time of the Ordovician extinction. Gamma ray bursts break up nitrogen into the atoms in the atmosphere and convert them to nitrogen dioxide. Nitrogen dioxide, the brown gas that makes up smoke, blocks sunlight, thereby darkening and cooling Earth, and possibly setting off an ice age.

Some fossil evidence suggests that some species, including surfacewalking plankton, began to die off before the ice age began, lending support to the idea that something other than cooling contributed to the Ordovician mass extinction.

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Life’s Building Blocks Are Found All Over Galaxy By Ernie Tretkoff

A class of molecules that make up the building blocks of life is widespread in the galaxy, Emma Bakes of NASA/SETI reported at the April E. T. M.

All known life depends on these carbon-based molecules, called nitrogenated aromatics, which are part of DNA, RNA, and other chemicals crucial to life, including the oxygen-producing photosynthesis in plants and the oxygen-storing pigments in animals. “They form the very foundations of all terrestrial life,” said Bakes.

Scientists have recently discovered that these molecules are present throughout the galaxy, said Bakes. Observations have turned up nitrogenated aromatics in the interstellar medium, in comets, in protoplanetary disks around stars, in planetary atmospheres, and in objects in the outer solar system.

These molecules are made up of nitrogen attached to a ring of carbon, with alternating single and double bonds. This class of molecules includes purines, pyrimidines, triazoles, and other chemicals. They are known as aromatics because many of them have distinctive odor.

Nitrogenated aromatics form in a variety of environments, including planetary atmospheres and the surfaces of icy dust grains in the interstellar medium. Bakes suggests that these molecules could also have formed in the atmosphere of early Earth. Her recent work, mainly with computer simulations, has focused on the atmosphere of Titan, which is thought to resemble that of early Earth. Titan is Saturn’s largest moon and the only moon in our solar system with an atmosphere. The dense, smog-like haze around Titan contains nitrogen, methane, and hydrocarbons, but little oxygen.

Bakes’ simulations indicate the presence of nitrogenated aromatics in Titan’s atmosphere, suggesting that these chemicals might also have been produced in the early Earth’s atmosphere. To confirm the composition of Titan’s atmosphere, the European Space Agency’s Huygens probe, currently on its way to Titan aboard NASA’s Cassini spaceprobe, will sample Titan’s atmosphere in early 2005.

Some scientists are also considering the possibility that a comet delivered the chemicals necessary for life on Earth, but Bakes said that aromatic molecules are fragile and might not survive an impact.

Though scientists acknowledge the importance of nitrogenated aromatics, they have no idea how to get from the molecules to life, said Bakes. “Themillion dollar question is, ‘How do we get from them to us?’”

Bakes said she would bet on life being widespread in the universe because these molecules are found in so many environments. “If they are made everywhere, perhaps life is everywhere,” she said. It might also be possible to have life based on an entirely different chemistry she added.

Sakurai Prize Celebrates 20 Years

This year marked the twentieth anniversary of the Sakurai Prize for Theoretical Nuclear Physics, established in 1984 as a memorial to and in recognition of the contributions of the late Prof. Yukawa, Sakurai. This year’s prize is being awarded to Prof. Itsuro Oki of Osaka University, who has made significant contributions to the field of particle physics.
Narayanamurti is currently the John A. and Elizabeth S. Armstrong Professor of Engineering and Applied Sciences and Professor of Physics at Harvard University. He also currently serves as the Dean of Engineering and Applied Sciences and Dean of Physical Sciences. Narayanamurti obtained his PhD in physics from Cornell University in 1965. He spent a major part of his scientific career at Bell Laboratories, Murray Hill, NJ where he had work in low temperature physics, ballistic phonon transport, non-equilibrium superconductivity in electron systems and amorphous materials. His current research is focused on the study of ballistic electron transport and imaging of semiconductor nanostructures using scanning tunneling microscopy-based techniques. Narayanamurti has held a variety of management positions. He served as Director of Solid State Electronics Research at Bell Labs from 1983 to 1987 and as Vice President of Research and Exploratory Technology at Sandia National Laboratories from 1987 to 1992. He moved to the University of California at Santa Barbara in 1992 where he served as Richard A. Aullill Professor and Dean of Engineering until 1998.
Illicit Trafficking of Weapons-Usable Nuclear Material

By Lyudmila Zaitseva and Friedrich Steinhauser

The issue of covert trade in nuclear material gained public prominence for the first time simultane-
ously claimed by British intelligence sources that the former Government of Iraq under Saddam Hussein had sought to obtain uranium from Niger. The far reaching consequences of such assessments for international security were revealed when it was reported by US President George W. Bush in his speech on January 28, 2003, using incorrect information as one of the reasons why terrorists and countries belonging to the "Axis of Evil" posed a poten-
tial nuclear threat.

In view of the occurrence of such significant errors even in the intelligence community, it is not surprising that information in the media on the topic of illicit traf-
ficking of nuclear material is frequently flawed by examples.

Examples of such errors include failure to differentiate nuclear weapons-usable material from other radioactive material, incorrect use of physical units of activity and dose rate, and misappa-
tation of isotopic characteristics and efficiencies.

Since the terror attacks on September 11, 2001, many publi-
cations envisaged domino terrorist scenarios, including the deployment of a nuclear device as a potential threat to society. Although this possibility can no longer be excluded, the probabil-
ity for it to actually happen is relatively low.

Nevertheless, the issue of los-
ing control over weapons-usable nuclear material has gained promi-
nence in the debate on national security. Many publications in this debate are frequently based on questionable intelligence sources or extrapolations.

This undesirable situation is largely due to the fact that infor-
mation on illicit trafficking of nuclear material is often associated with a high level of secrecy. In addition, there is a noticeable lack of sharing of relevant information among all parties involved due to the security-sensitive nature of the data and the justified concern by the intelligence community not to reveal any weakness in the physi-
cal protection system for nuclear material.

The Facts

The probability for losing control of nuclear level materials depends on the amount of material to be
secured, the number of storage sites, and the level of physical pro-
tective measures that are usually associated with a high level of secrecy. In addition, there is a noticeable lack of sharing of relevant information among all parties involved due to the security-sensitive nature of the data and the justified concern by the intelligence community not to reveal any weakness in the physical protection system for nuclear material.

Table 1. Government-confirmed cases involving weapons-usable nuclear material

<table>
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<tr>
<th>Date of Seizure</th>
<th>Location of Seizure</th>
<th>Type &amp; Amount of Material</th>
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<tr>
<td>24 Mar 1999</td>
<td>Vinkal, Lithuania</td>
<td>100 kg of 99% HEU</td>
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<td>Tengers, Germany</td>
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<td>2.97 kg of 90% HEU</td>
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<td>2.73 kg of 87.7% HEU</td>
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<td>1.17 kg of 93.3% HEU</td>
</tr>
<tr>
<td>8 Jun 1999</td>
<td>Ceske Budejovice, Czech Rep.</td>
<td>17 g of 87.7% HEU</td>
</tr>
<tr>
<td>28 May 1999</td>
<td>Sarajevo, Serbia</td>
<td>4 g of 72.8% HEU</td>
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<tr>
<td>2 Oct 1999</td>
<td>Kona-Barba, Kyrgyzstan</td>
<td>1.49 kg of HEU</td>
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<td>19 Apr 2000</td>
<td>Bautili, Greece</td>
<td>920 kg of 30% (C3) HEU</td>
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<td>16 Sep 2000</td>
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mation on illicit trafficking of nuclear material is often associated with a high level of secrecy. In addition, there is a noticeable lack of sharing of relevant information among all parties involved due to the security-sensitive nature of the data and the justified concern by the intelligence community not to reveal any weakness in the physical protection system for nuclear material.

When a nuclear device—about 50 kg of weapons-grade plutonium—is fabricated, 20 kg of 90% HEU may suffice. In either case, it is essential to place the most stringent physical protection measures that are usually associated with a high level of secrecy. In addition, there is a noticeable lack of sharing of relevant information among all parties involved due to the security-sensitive nature of the data and the justified concern by the intelligence community not to reveal any weakness in the physical protection system for nuclear material.

Once an elite of the Soviet society, nuclear scientists were sud-
denly faced with dramatically declining income and wages delayed for months, and bleak prospects for the future. As a result, the mass of nuclear material became very vulnerable to the so-called "insider" threat from facility employees, who stood to lose not only their jobs but also their cherished future by stealing the material and trying to sell it. In all credible thefts of weapons-usable material, it was known to state, the material was diverted by insiders with access
to nuclear weapon-usable material

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The inherent uncertainties in our current knowledge on nuclear smuggling make it difficult to judge whether trafficking in weapons-usable nuclear material is really such a relatively rare phenomenon, or whether it was and is still carried out in such a clandestine, professional manner that it remains largely undetected.

In either case, it is essential to improve our current understand-
ing of the true magnitude of illicit trafficking in nuclear material, since national security and inter-
national stability heavily depend on the correct threat assessment. [A slightly longer version of the above article appeared in the January 2004 issue of Physics and Society, the APS Forum on Physics and Society’s newsletter.]

Lyudmila Zaitseva joined jointly with Friedrich Steinhauser on the Database on Nuclear Smuggling, Theft and Unauthorized Dual Use (DSTO) as a Visiting Fellow at the Center for International Secu-
rity and Cooperation (CISAC), Stanford University. Friedrich Steinhauser, chair of biophysics and

Astronautics, stands at the Laboratory in Salzburg, Austria, is Director of the Govern-
ment Radiological Measurements Laboratory, Salzburg.

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