is considered foreign travel," for the 2009 NA PAC in Vancouver.

As of earlier this year, DOE regulations were tightened so that agency labs wanting to send more than 30 people to a conference—domestic or international—or spend more than $10 000 for conference attendance must now get approval from the DOE Office of Science. But, says Robin Staffin, the office's associate director for high-energy physics, "that's a reporting threshold, not a cap." Moreover, he says, if the NA PAC is switched to a three-year cycle, "we would make every effort to accommodate this decision by facilitating travel." **Toni Feder**

NASA's future workforce a complex problem

Concern has grown in both NASA and Congress over the past few years about how the space agency—a massive and complex bureaucracy with 17 000 civil service employees and more than 40 000 contract workers—would reorient its workforce as the quest to return to the Moon has waxed and the space shuttle program has waned. In April, NASA officials tried to address those concerns by submitting to Congress a "workforce strategy" document showing that the agency has a plan to ensure it has the right people in the right positions to return to the Moon, prepare to go to Mars, and conduct myriad other scientific projects over the next 15 to 20 years. But although the document was full of language about new approaches to workforce planning and integration of business and resource activities, an interim National Research Council (NRC) report on NASA's workforce issues says the agency has "not yet translated that [workforce] analysis into a strategy and action plan."

While the issues facing the NASA workforce can easily be lost in a fog of bureaucratic planning jargon, members of the House subcommittee on space and aeronautics tried during a hearing in June to better understand the problems the agency faces. The hearing's background document put together by the subcommittee staff noted that NASA is entering a critical period for ensuring that it has a workforce of the appropriate size and with the proper skills to carry the agency through the next 15 years. "NASA has several major new undertakings related to the goal of returning to the Moon by 2020," the document said. "To free up funds for that purpose, it is terminating the space shuttle program in 2010, reducing aspects of the International Space Station research, and reducing the budget for aeronautics."

The NRC report says NASA needs to develop a plan that first deals with the next five years, which covers the end of the space shuttle program, and then lays the foundation for a longer-term process. In addition to space-oriented programs, the report says, NASA needs to fund university-based research programs in aerospace sciences to ensure that "universities continue to sustain curriculum, faculty, and student interest."

NASA must also determine the right balance between scientists and engineers who are federal employees and those who work for outside contractors. The concern expressed by congressional staff members and several people testifying at the hearing was that if NASA contracts out too much work, it will lose the in-house science and engineering expertise that has been critical to the agency's past successes.

Testifying as the co-chair of the NRC report, David Black, president of the Universities Space Research Association and an astronomer at Rice University, said the NRC committee's "initial reaction to NASA's work done so far is that it is incomplete and reflects a top-down view of what skill mixes are needed and as such is more theoretical than empirical." Black also said that NASA management must find a way to give a sense of "hope and promise to potential future members of the agency's workforce. Twenty years ago, the mere mention of NASA was an attractor," he said. "It had vocational pizzazz. That is no longer the case."

Black cited the delay and cancellation of NASA projects over the past few years and added, "There are fewer opportunities for NASA staff to be engaged in meaningful science and engineering. I am concerned that many of the best and brightest young people are attracted to the science part of what NASA does, but the inability of the administration and Congress to properly fund NASA's implementation of [President Bush's Moon/Mars initiative] will mean that support for science will erode."

NASA also faces a "retirement bulge," and subcommittee chairman Ken Calvert (R-CA) called the age distribution of the agency's workforce "troubling." More than 30% of NASA's employees are currently eligible for regular or "early out" retirement, and NASA estimates that by 2011, just after the space shuttle program is shut down, 28% of its engineers and 45% of its scientists will be eligible to retire. Currently, 12% of its engineers and 21% of its scientists are eligible to retire.

Calvert noted that NASA's civil service workforce has shrunk by more than 20% during the past 10 years and asked how NASA will prepare for its future needs and how it can successfully recruit and retain the necessary scientists and engineers.

Toni Dawsey, NASA's assistant administrator for human capital management and chief human capital officer, told committee members that NASA's workforce strategy plan will allow the agency to "deal effectively with the critical issues" that loom. She added that NASA "does recognize that some future events, such as the retirement of the space shuttle program, require long-term planning."

Black said it is clear from the data gathered for the interim NRC report that NASA officials don't know how to manage a workforce problem as complex as the one confronting them. "Does anybody know how to do it? I can't give you a categorical yes or no on that," he concluded. The final NRC report is due out early next year. **Jim Dawson**

Nakamura wins prize for solid-state lighting

The creator of the first blue, green, and white light-emitting diodes and the first blue laser diode—each of which has represented an important milestone in the development of new energy-saving light sources—has won the 2006 Millennium Technology Prize.

Shuji Nakamura will receive the award from Finland's Millennium Prize Foundation at a September ceremony in Helsinki. The honor, which carries a cash prize of €1 million ($1.3 million), recognizes outstanding technological achievement aimed at promoting quality of life and sustainable development. Nakamura is a professor of materials and of electrical and computer engineering at the University of California, Santa Barbara, where he is also codirector of the solid-state lighting and display center.

RANDY LAMB, UCSB

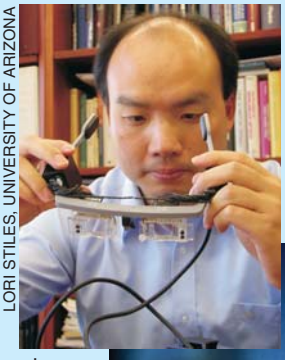
Nakamura

In a recent interview with PHYSICS TODAY, Nakamura said he started working with LEDs and laser diodes

Goodbye, bifocals?

An ultrathin liquid crystal layer sandwiched between layers of glass could render bifocals obsolete, say optical scientists at the University of Arizona and Georgia Institute of Technology in a recent paper in the *Proceedings of the National Academy of Sciences*.

"When we are young, we can look at objects at different distances—we can read, look at the computer, or drive—and our eyes compensate and focus everything to the retina," says Arizona's Nasser Peyghambarian. With age, the eye muscles get stiff and lose some of their responsiveness, leading many people to need eyeglasses. Nematic liquid crystals could adjust for focal length and thus correct for both near- and farsightedness, as well as for other aberrations in vision, he says.



LORI STILES, UNIVERSITY OF ARIZONA

In liquid crystals, the refractive index, which determines by how much light is bent, changes with applied voltage. The trick is to program a microelectronics chip to control the applied-voltage pattern to correspond to the accommodation needed by the wearer. The chip could be reprogrammed to adjust for changes in eyesight, so that one pair of liquid crystal eyeglasses could last a lifetime.

In the prototype glasses, a 5-μm layer of liquid crystal is sandwiched between transparent electrodes deposited on glass slabs 0.5 mm thick. Voltages of 2 V or less are applied, with changes in the index of refraction occurring in fractions of a second. The eyeglass wearer would not notice any focusing delay, Peyghambarian says.

"Vision correction has stringent requirements, such as large aperture, fast response time, high light efficiency, low operation voltages, and power-failure-safe configuration," says Arizona's Guoqiang Li. The team's prototype with liquid crystals is the first such effort "that is practical for vision correction," he adds.

In the prototype, the applied voltage comes via a bulky chip that is switched on and off manually, but eventually, says Peyghambarian, the glasses "would be adapted with a range-finder mechanism, so that things at different distances would automatically come into focus, like with an autofocus camera lens." A Virginia company is exploring commercializing the glasses. **Toni Feder**

Cacti as seen by a model eye with (right) and without correction from an activated liquid crystal lens. Researcher Guoqiang Li (above) models prototype liquid crystal eyeglasses. (Cactus images courtesy of G. Li et al., *Proc. Natl. Acad. Sci. USA* **103**, 6100 (2006), © 2006 National Academy of Sciences.)

some 26 years ago in hopes of developing more efficient light sources.

"The conventional incandescent bulb lamp and fluorescent lamp are technology-based vacuum-tube lighting. LEDs and laser diodes could replace [them] as the semiconductor-based transistor replaced the vacuum-tube-type circuit in the past," Nakamura said. LEDs convert electrical energy to bright light with 50% efficiency, he pointed out, a rate 10 times better than that of an incandescent bulb. Moreover, he added, the life span of an LED is "almost forever," meaning it requires virtually no maintenance.

Although LEDs had already been discovered by the time Nakamura began researching them, no one had yet determined how to make blue LEDs. According to Steven DenBaars, also a professor of materials at UCSB and the other codirector of its solid-state lighting and display center, discovering how to make blue LEDs was important because it increased the available palette of colors, which in turn increased the potential number of applications for the technology.

"You can't paint with just red and green. Blue was the missing color," DenBaars explained. "Everybody was looking for the blue LED, trying to find it with zinc selenide. But that did not produce a bright blue light or a reliable blue light. You couldn't see it, so it wasn't useful for room lighting or illumination. It was not commercially viable."

Nakamura successfully used a gallium nitride–based material to develop the blue LED and laser diode. And the LED light required significantly less power to operate.

Once he successfully created the blue LED in 1993, it took just two more years to discover how to create a green LED, by adding indium to a blue LED. Before Nakamura's invention, the green in full-color displays was a phosphorescent yellow. His technology gives the greens in large full-panel LED displays a far richer hue, the prize foundation said.

In 1996, Nakamura discovered how to convert the output of blue LEDs to make white LEDs. He said the efficiency of white LEDs is expected to approach 100% as they are more widely produced.

"Then, all of the conventional lighting, such as incandescent bulbs and fluorescent lamps, could be replaced with the white LEDs in order to save energy and resources," he said. "Also, the white LEDs could be operated by a battery powered by a solar cell in the daytime. So the lighting could be operated with clean energy thanks to its high efficiency and low voltage operation."

Nakamura believes that use of solid-state lighting in industrialized nations would save enormous amounts of energy. "In the US alone, using white

LED lighting could save the equivalent of 133 power plants of energy by 2025. It could also help reduce global warming by lowering carbon emission."

Researchers have already moved into the UV with LEDs, Nakamura added. UV LEDs with a wavelength of 370 nm have been used for air purification for cars and refrigerators, while 280-nm UV LEDs are used to purify water.

Karen H. Kaplan

news notes

Underground lab ins and outs. For 10 days in June, it looked like Washington State's Cascade mountains might be back in the running to host the Deep Underground Science and Engineering Laboratory. NSF granted an appeal, which meant the Cascades site, like the Henderson mine in Colorado and Homestake mine in South Dakota, would receive $500 000 for developing a conceptual design for DUSEL.

But NSF withdrew its support when it learned that in the months since filing the appeal, the Cascades group had shifted its focus from Icicle Creek, an undeveloped site, to Pioneer Tunnel. "We recognized this was a better location," says the University of Washington's Wick Haxton, one the chief backers of building DUSEL in the Cascades. "It had power, drainage, and ventilation in a parallel tunnel that we could piggyback off of."

NSF has left the door open for a Cascades site—and others—to rejoin the DUSEL site competition this fall. But, says Haxton, "we're in a catch-22. Too much time has been lost. It's better for science if we support one of the other sites."

That support comes easy because the Homestake and Henderson sites have "excellent proposals," Haxton adds, and "the problems I felt were insoluble at Homestake—the ownership and the flooding of the mine—have, in fact, been solved."

In other DUSEL news, T. Denny Sanford, a Sioux Falls, South Dakota, banker, donated $70 million in late June for improving the Homestake mine's infrastructure and creating a science and education center. **TF**

NSF picks Chan. Tony Chan, a mathematician and dean of physical sciences at UCLA, has been named the new head of mathematics and physical sciences at NSF. Chan, who received his PhD in computer science from Stanford University in 1978, will take over as assistant director for MPS on 1 October. Astronomer Michael Turner, the previous MPS head, left NSF earlier this year to return to the University of Chicago.

Citing Chan's administrative experience as a dean at UCLA, NSF director Arden Bement Jr said the foundation can benefit from "Tony's extraordinary record as a scientist and an administrator, especially at this critical time in the history of mathematics and physical sciences." Chan will begin his job just as NSF begins implementing a new strategic plan intended, according to foundation officials, to redefine the "mission, vision, goals, and objectives" of the foundation. His job may be easier than Turner's since the Bush administration has proposed an 8.3% budget increase for NSF funding.

UCLA

Chan

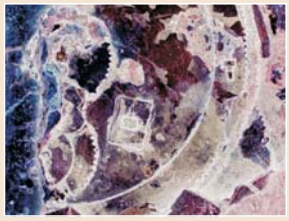
UCLA chancellor Albert Carnesale described Chan as an "outstanding scholar and a visionary administrator" who has a "strong commitment to interdisciplinary research, involving units within the physical sciences, engineering, medicine, and the life sciences." Chan describes his research as applying "linear and non-linear algebraic algorithms to the solution of large systems of equations arising in scientific computing." **JLD**

Political science? The ranking Democrat on the House Committee on Science subcommittee on environment, technology, and standards has asked the Government Accountability Office (GAO) to formally investigate ongoing complaints that the Bush administration has suppressed science research that doesn't agree with its policy positions. In his request, Oregon Representative David Wu cited attempts by a political appointee at NASA earlier this year to prevent a prominent agency scientist from talking about global warming (see PHYSICS TODAY, May 2006, page 27; also this issue, page 24). Wu also pointed to the suspension of a forest research grant at Oregon State University "because it reflected adversely on commercial forestry interests." Wu complained about the grant suspension to presidential science adviser John Marburger, and the funding was reinstated.

"Despite assurances [by Marburger and other administration officials] to the contrary, it appears that the roles of science and political policy continue to be confused," Wu said in his May GAO request. In addition to investigating allegations by government scientists that

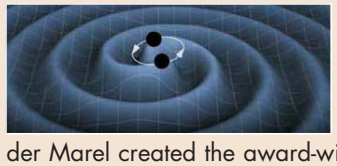
web watch

To suggest topics or sites for Web Watch, please visit http://www.physicstoday.org/suggestwebwatch.html. Compiled and edited by Charles Day



http://www.antikythera-mechanism.gr
In 1902, an archaeologist noticed that a rocklike block recovered from a wrecked Roman ship had a cog attached to it. By the 1950s, the block had been dated to 80 BC and cleaned enough to reveal the outlines of a sophisticated mechanism of clocklike gears. Its purpose was the calculation of planetary orbits. Research on the remarkable find continues to this day and is summarized and illustrated on the website of the **Antikythera Mechanism Research Project**.

http://www.janetsaadcook.com
Curved metallic reflectors and natural sunlight are the ingredients for what artist Janet Saad-Cook calls her **Sun Drawings**. Photographs and descriptions of the intricate, rainbow-hued illuminations can be found on her website.



http://hubblesite.org/go/blackholes
Black Holes: Gravity's Relentless Pull offers an extensive and richly illustrated tour of black hole physics. Astronomer Roeland van der Marel created the award-winning site.