they hadn't: "We were welcomed then, and we are welcomed now." Taylor was "treated like a rock star," he said, with 1400 students packing into a room with only 400 seats to hear his lecture.

"Scientists and engineers share a set of values that is independent of culture," Wulf remarked. That is particularly true at Sharif, he added, where 80% of faculty members were educated in the US.

Richter saw no evidence of the military or of an overbearing religious presence in either of the two cities he visited. He added that the country appeared to be prospering despite economic sanctions, although there was some evidence that the most recent round of UN-imposed sanctions might be beginning to pinch. Anderson said that he and his fellow travelers had steeled themselves for a possible hostile reaction from Iranians, but their hosts "couldn't have been more cooperative and friendly."

While at Sharif, Richter participated with top Iranian officials from the energy and environmental fields in a public roundtable discussion on those topics. He observed that from an economic perspective, it makes sense for Iran to adopt nuclear energy for its domestic electricity needs and to sell its abundant oil to the world market. Richter also was interested to learn that Iran had witnessed a 1 °C rise in its minimum annual temperature since 1950. With a climate similar to California's, the nation has counted on the winter snowpack from the mountains to meet its water needs during the warm months. Aware of the change looming if snow turns to rain, Iran is now planning to erect more dams, he said.

As for physics, Richter found a strong theory program in particle physics, particularly in string theory. (See the Opinion piece on physics in Iran, PHYSICS TODAY, May 2008, page 51.) Experimentally, Iranians are participating in the Compact Muon Solenoid collaboration at CERN's Large Hadron Collider and have a cosmic-ray program. A 3-meter telescope is also under construction.

David Kramer

Low-drag suit propels swimmers

Competition in the pool at this month's Beijing Olympics will be not only among world-class swimmers but also their swimsuits. Since its debut in February, the low-drag hydrophobic Fastskin LZR Racer swimsuit from Speedo International Ltd has had more than 44 world records broken in it; critics allege that the $600 "space-age" suit, in part developed by NASA scientists, gives its wearers an unfair boost in buoyancy and amounts to "technological doping." The company claims a 5% decrease in drag over the previous model but no buoyancy increase, and the suit, along with competing models, has been approved for Olympic competition by FINA, the international swimming federation.

The LZR Racer is a descendant of the full-body swimsuit Speedo introduced in 2000 to mimic the viscous-drag-reducing denticles on a shark's skin. The shark suit proved that surface-engineered synthetic materials can be made to have lower drag than a swimmer's shaved skin. The next move for Speedo's internal R&D unit was to form a team of external partners led by Barry Bixler, the late Honeywell Corp engineer and computational fluid dynamics (CFD) expert, to further cut the passive drag. (See the figure on page 33 and Back Scatter on page 84.)

NASA aerospace engineer Stephen Wilkinson joined the team in 2005 after Bixler suggested that NASA's aerodynamic testing of materials would provide valuable data for CFD simulations used to model the fluid flow profile around the swimmer–swimsuit system. Wilkinson measured the skin-friction coefficient of more than 60 fabrics in a low-speed wind tunnel with a cross section of 18 × 28 cm at the Langley Research Center's flow physics and control branch. The results led Speedo to go with lightweight woven elastane-nylon as the base fabric of the LZR Racer.

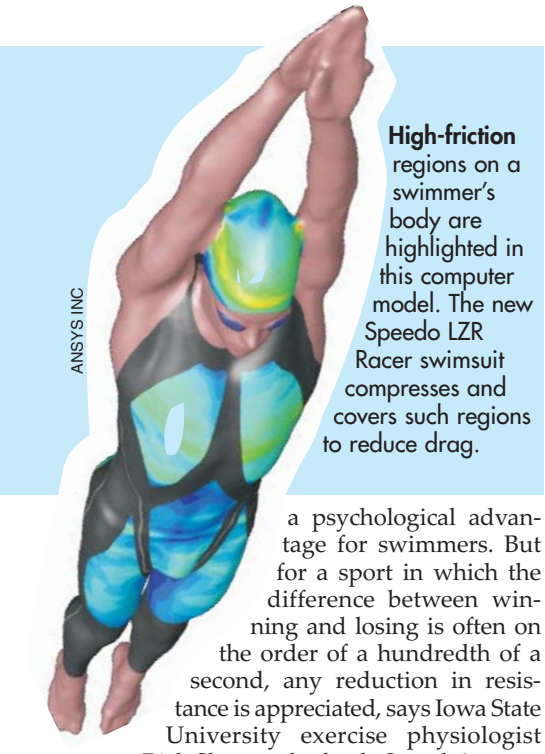
NASA LANGLEY/SEAN SMITH

A wind tunnel is used by NASA engineer Stephen Wilkinson to test skin-friction properties of fabrics for swimsuits.

With the new suit, Speedo abandoned denticles and turned its focus to minimizing form drag, which is due to body shape. "There is still debate as to what the primary source of drag is for a shark, but for a swimmer, it is primarily form drag," says Amy Lang, an experimental fluid dynamicist at the University of Alabama. From CFD simulations and studies in a swimming flume, the researchers determined that total drag is reduced when low-drag polyurethane panels are inserted to compress the chest, upper thighs, and other areas of the swimmer's body where form drag is most pronounced. "We spent a lot of time [on the previous model] drag testing anatomically accurate mannequins" in the flume, says David Pease, a biomechanist at the University of Otago in New Zealand. "This time around involved quite a bit more actual athlete testing in order to test differences in compression and support provided by the new suit."

The Olympic-ready design of the swimsuit is based on three-dimensional volumetric body scans of some 400 elite swimmers and the results of tests with prototypes at the Australian Institute of Sport. Instead of being stitched together, the various segments of the swimsuit are bonded by ultrasonic acoustic vibrations—a first for swimwear. "It's a complicated process to produce a fast swimsuit and that's why it took [nearly] four years to produce the LZR Racer," says Jason Rance, Speedo's head of innovation.

Speedo's external CFD expert, University of Nottingham fluid mechanist Hervé Morvan, says that the company's R&D collaboration is already looking to reduce active drag in preparation for the 2012 London Olympics. FINA will no doubt face mounting pressure to address advances in swimwear innovation. Some competitive swimming enthusiasts wonder whether the sport is becoming more like drag racing or golf, in which equipment is often as important as human skill, while skeptics say drag-reducing technologies offer at best



ANSYS INC

High-friction regions on a swimmer's body are highlighted in this computer model. The new Speedo LZR Racer swimsuit compresses and covers such regions to reduce drag.

a psychological advantage for swimmers. But for a sport in which the difference between winning and losing is often on the order of a hundredth of a second, any reduction in resistance is appreciated, says Iowa State University exercise physiologist Rick Sharp, who leads Speedo's external R&D team. "After the excitement dies down from the Olympic Games, what I hope the swimming community learns is that this suit has taught us that we stand far more to gain from drag reduction than we previously realized."

Jermey N. A. Matthews

War bill saves Fermilab jobs, boosts science

A federal supplemental appropriations bill signed into law to fund the Iraq war in late June included enough extra money for the Department of Energy to avert the layoff of 90 Fermilab employees and keep alive a neutrino experiment there. But the extra money was a fraction of the $300 million science lobbyists had been pushing for to restore to DOE's physics program.

Jeffrey Kupfer, DOE acting deputy secretary, told Fermilab employees that the department had allocated 60% of the $62.5 million it received in supplemental appropriations to shore up programs at Fermilab and at nearby Argonne National Laboratory, where a $7.5 million infusion is staving off staff reductions at the Advanced Photon Source. In January Fermilab announced it would have to shed 200 jobs (see PHYSICS TODAY, July 2008, page 24). By June, 60 staff members had left or retired. Another 50 individuals opted to accept a buyout offer, but 17 of them, including 12 physicists, reconsidered and will stay on in light of the new funding, according to a lab spokeswoman.

Kupfer announced that $9.5 million will be provided to the NO*ν*A neutrino experiment, which had been zeroed out in the fiscal year 2008 appropriations bill that was enacted in December. The supplemental spending measure provided identical amounts—$62.5 million—to NSF and to NASA's science, aeronautics, and exploration programs. For NSF, it amounts to a small chunk of the $500 million increase in funding that House and Senate appropriators had approved for the current year but that was later rescinded.

The supplemental bill also included $150 million for the National Institutes of Health, which has seen its budget decline in real terms for five years.

Meanwhile, the House and Senate appropriations committees approved spending bills for FY 2009, with both providing the Bush administration's full request of $6.9 billion for NSF—an increase of 12.5% from the current year. Both committees would increase NASA spending next year by a more modest 3.7%, to $17.8 billion.

House appropriators passed a separate funding bill that would boost DOE's basic science programs by $844 million, to $4.9 billion; add $796 million to its energy efficiency and renewable energy programs; and carve $416 million from the administration's $6.6 billion request for nuclear weapons programs. Notably, the committee rejected the administration's $145 million request to manufacture plutonium pits for new W-88 Trident II missile warheads, saying that the newest and most advanced weapon in the atomic arsenal "serves obsolete cold war concepts rather than current or future needs." The committee has told the administration that it won't fund new warheads until the executive branch produces a new weapons strategy reflecting current needs.

The Senate Committee on Appropriations reversed the cuts to DOE weapons programs a few weeks later, adding $227 million to the administration's request. New Mexico Republican Senator Pete Domenici, a staunch defender of the weapons program who is retiring this year, warned committee members to expect a continued assault on weapons programs from a House "that has been permitted to run rampant" and from an indifferent Bush administration. Representative David Hobson (R-OH), who began chipping away at the weapons program during his 2003–06 chairmanship of the DOE subcommittee, also is retiring.

The Senate measure would pare the House request for DOE basic research to $4.6 billion and trim the House increase for energy efficiency and renewable energy to $673 million above the administration's requested level. With President Bush pledging to veto spending bills that exceed his budget request, final action on appropriations is likely to be delayed until after a new president takes office. **David Kramer** ■

web watch

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http://www.dosits.org

Discovery of Sound in the Sea comprehensibly and accessibly covers nearly every aspect of marine acoustics, from the underlying science to its diverse applications. The website's extensive audio gallery encompasses natural sounds, such as the crackling of shrimp as they snap their claws, and manmade sounds, such as the whirring of a torpedo as it nears its target.

http://asterweb.jpl.nasa.gov/gallery.asp

From its vantage on NASA's *Terra* satellite, the Advanced Spaceborne Thermal Emission and Reflection Radiometer has been collecting high-resolution, multi-waveband images of Earth since December 1999. The **ASTER Online Gallery** is continually updated with new images of lakes, mountains, cities, forest fires, and so on.

http://www.physics.indiana.edu/~hake/GISME-5t-Part1.pdf

Gender Issues in Science/Math Education is the name Richard Hake and Jeffry Mallow have given to their huge list of research papers on how girls and boys, men and women learn and are taught science and mathematics. As of July, the compilation included more than 700 papers.