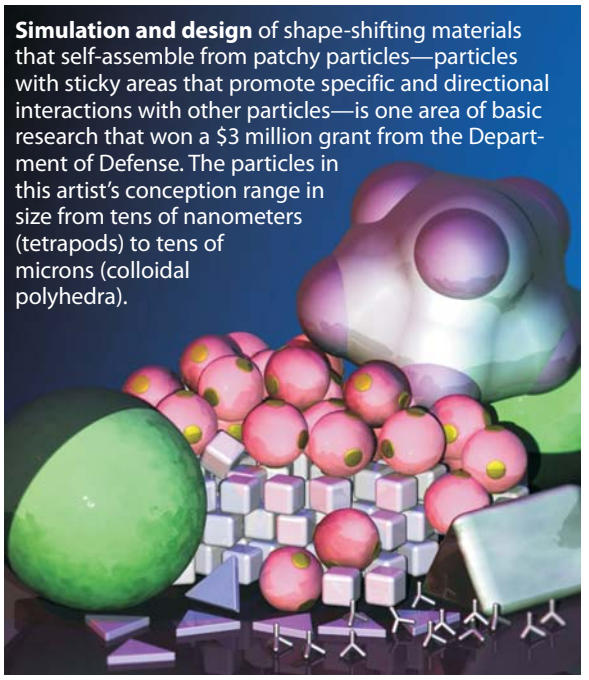

CHRISTOPHER R. IACOVELLA AND SHARON C. GLOTZER, UNIVERSITY OF MICHIGAN

Simulation and design of shape-shifting materials that self-assemble from patchy particles—particles with sticky areas that promote specific and directional interactions with other particles—is one area of basic research that won a $3 million grant from the Department of Defense. The particles in this artist's conception range in size from tens of nanometers (tetrapods) to tens of microns (colloidal polyhedra).

over the past decade or so, he adds, the NSSEFF program is meant to serve two purposes. "Many transformative breakthroughs—GPS, the Internet—were funded by DOD. But in the 90s, with the cold war over, we decreased the amount of basic research funding. There is now a realization we want to get it back up." The second purpose is to cultivate a new pool of faculty advisers for the DOD. "Many of the top faculties in the top departments at the top universities have been advisers for national security. But younger faculty haven't really been rotating on as much as we would like," Rees says. "These are two different reasons, and each would be compelling by itself, but the combination made it a bipartisan, bicameral sell."

"There are very few grants that an individual PI [principal investigator] can get of this magnitude and this duration to really go after a big problem," says the University of Michigan's Sharon Glotzer, one of this year's awardees. The NSSEFF grants make for "a profound change in the way we can do research." The $3 million, or $600 000 a year, is for basic research; on top of that, DOD pays the university overhead. "It's fantastic. A typical grant for a physicist, especially a computational scientist like myself, might be as much as $150 000 a year, including overhead," Glotzer says. Other awards in the same vein include the Pioneer Awards from the National Institutes of Health, the Howard Hughes Medical Institute investigator awards, and the MacArthur "genius" awards.

Glotzer uses simulations to design self-assembling materials whose properties can change. "Many possible applications lie ahead, provided we can work out the basic scientific principles," she says. "DOD wants to protect war fighters in extreme conditions, for which one could imagine fabrics that change their weave or switchable coatings for aircraft or subs to provide stealth capabilities. What we are doing is fundamental statistical mechanics and thermodynamics, but applied to these very new systems. I can't think of any sector that would not benefit from reconfigurable materials, but there are particular applications that would be especially interesting for DOD."

Stanford University physicist Mark Kasevich, another 2009 awardee, does atomic interferometry. "We build sensors based on the interference of atomic de Broglie waves. They perform in the lab at a very high level, and our proposed work is to continue this to enable new tests of basic principles—deviations in Newton's inverse square law and a test of Einstein's equivalence principle." Applications, he adds, "are further down the road, but if these techniques come to fruition, they would enable new inertial navigation sensors and gravitational sensors."

Far down the road is just what the DOD has in mind. In five years, says Rees, "we won't be able to tell" whether the work of an NSSEFF awardee proves to have national security applications. "In 10 years we won't be able to tell. The way to tell would be to give the grade in 20 years. One message we are trying to get out is that you can't judge basic research on the 5–10-year time scale."

The DOD is not directing how the award money is spent, Rees adds, "but we are encouraging that [awardees] be involved with DOD." Awardees get a security clearance, and they're required to visit DOD engineering and development sites.

In addition to Glotzer and Kasevich, the 2009 NSSEFF awardees are Graham Candler, who simulates hypersonic flow at the University of Minnesota; Rice University's Naomi Halas, who works in three-dimensional nanophotonics; MIT's Christine Ortiz, whose NSSEFF focus is on engineering designs for protective armor; and John Rogers of the University of Illinois, who works on stretchable electronics.

Toni Feder

Science and energy are big winners in House economic stimulus plan

Probably nowhere else but in Washington could the outlook for science and technology spending actually brighten as the economy tanks. But with President Barack Obama and Congress under pressure to inject $825 billion into the economy, and do so as quickly as possible, additional federal R&D funding—for energy research in particular—looks to be in the mix.

In his inaugural address, Obama alluded to the key role he wants science and energy to play in the unprecedented federal bid to shore up the economy. "We will restore science to its rightful place," he declared. "We will harness the sun and the winds and the soil to fuel our cars and run our factories."

As PHYSICS TODAY went to press, House appropriators were marking up a $550 billion spending bill that proposes to heap a total of $43.9 billion in new one-time spending upon the Department of Energy, an agency whose budget was less than $24 billion in fiscal year 2008. (DOE, like most federal agencies, continues to operate at FY 2008 levels, awaiting completion of the FY 2009 appropriations bills.) Much of that new spending, though, would go for loan guarantees and grants to state and local government energy programs. Government-wide, the bill proposes $10 billion in additional spending for research, equipment, and scientific facilities, plus a whopping $32 billion to modernize the nation's electric grid and expand the production of renewable energy.

Within DOE, the Office of Science, which doles out 40% of federal funding for basic physical science research, would see its budget jump from just over $4 billion to $5.9 billion. DOE's fossil energy program would get $2.4 billion for carbon capture and storage R&D. Renewable energy and energy-efficiency technologies would see a $2 billion increase, with $1 billion more for grants to support advanced battery development for vehicles.

Moreover, the House bill would provide DOE with $16.4 billion worth of additional loan guarantees to help the private sector finance renewable energy, energy efficiency, and grid modernization projects.

The House measure also calls for a 50% increase at NSF, from its current $6 billion to $9 billion. Most of the new money—$2.5 billion—is proposed for NSF's competitively awarded grants to academic researchers. The new spending will fund 3000 more "highly rated" grants that will create jobs for 12 750 scientists and graduate students, according to the report that accompanies the bill. But $300 million is reserved for competitively awarded grants to help universities acquire major research instrumentation, and $200 million is set aside to pay for a fraction of the estimated $2.6 billion backlog of needed repairs and renovations at university research facilities. An additional $400 million is proposed for NSF's major research equipment and facilities to accelerate construction of large projects such as telescopes.

Considerably smaller yet significant increases are in store for NASA, including $400 million for its basic science programs and a $150 million add-on to the aeronautics research program. NIST would see its budget rise from $600 million to $1.1 billion, including $300 million for a grant program initiated last year for the construction of university research facilities.

House speaker Nancy Pelosi (D-CA) has promised to have a bill approved by the full House by mid-February. The Senate is expected to consider similar legislation, though no counterpart to the massive House bill had appeared by press time.

Energy back in style

"From an energy policy perspective, this is about as exciting as the 1970s," said a staffer at the Senate Committee on Energy and Natural Resources, referring to the spike in federal funding for alternative energy research in response to that decade's two oil shocks. Spending fell back sharply as soon as oil prices sank, and energy R&D, in inflation-adjusted terms, hasn't neared those levels since. Now, as the 111th Congress gets under way, lawmakers have cleared their calendars to take part in the effort to rescue the US economy.

The chairmen of the House and Senate committees that oversee energy research have said they will push for the creation of a new office at DOE that they believe will accelerate the commercialization of innovative energy technologies. Modeled after the successful Defense Advanced Research Projects Agency, ARPA-E would fund high-risk technologies that could help the US to reduce its dependence on oil imports while lowering greenhouse gas emissions. In the House, Representative Bart Gordon (D-TN), returning for a second term as chairman of the Committee on Science and Technology, told reporters that ARPA-E would invest in energy technologies the private sector can't afford to touch. Though it was authorized by a law signed by George W. Bush in 2007, the former president ignored the ARPA-E provision. A House-passed appropriations bill for FY 2009 includes $15 million for the new office, but the Senate counterpart has none.

The new entity was one of the recommendations of the influential National Research Council report *Rising*

As citizen scientists, students tackle societal problems

Expand outreach on the nature of science, critical thinking, and the scientific method. Investigate and promote policy opportunities for undergraduates and recent graduates. Those were among the top proposals to emerge last month for the Society of Physics Students (SPS), following the fifth Quadrennial Congress of its honor society, Sigma Pi Sigma (ΣΠΣ). The congress was held at Fermilab in Batavia, Illinois, last 7–9 November.

The students weren't kidding around. Centered on the theme of "Scientific Citizenship: Connecting Physics and Society," the 2½-day event was packed with plenary talks, breakout groups, tours, meals, and endless networking opportunities for the 600 or so attendees. Among the topics presented and discussed were energy efficiency, the political process, diversity, and creationism. "The 14-hour days were long, and a little exhausting," reflects Krystle Williams, a graduate student in biophysics at the University of Rochester. "But when I think about how much I got to experience during the congress it was definitely worth it."

Rounding out the top four recommendations—out of more than a dozen—were that SPS encourage scientific citizenship at the local level and that SPS educate its members about existing resources in the American Institute of Physics, its member societies, and other organizations.

"Attendance far exceeded expectations, both ours and Fermilab's," said Gary White, director of both ΣΠΣ and SPS and associate director of education at AIP, which manages both of those organizations (and publishes PHYSICS TODAY). Part of the draw was undoubtedly the chance to get an up-close look at the accelerator facility, including the main injector and the D-Zero and CDF detectors. Shown here in front of two magnetic focusing horns in the MINOS neutrino experiment building are (l–r) Ben Carlson of Grove City College in Pennsylvania, Mark Stahl from Wittenberg University in Ohio, Denise Wood from Iowa State University, and Williams.

Addressing the next generation, Rice University's Neal Lane, former science adviser to president Bill Clinton, commended the enthusiasm he saw for scientific citizenship:

> I feel that my generation has made some progress but still has left you a world with many problems. Still, . . . when I meet young people like yourselves, I find—at least compared to me when I was your age—that (1) you are very aware of what's going on in the world; (2) you have access to the technology (we did at least give you that) that keeps you informed and also that can help solve many of the world's problems; (3) you find it natural to study and work with people from many different backgrounds, born in all parts of the world, having different values from your own; (4) you understand that the US [must] lead by good example and in partnership with other nations; and (5) you really care about what happens not only to this country but to other people around the world. For these and other reasons, I am optimistic that you will succeed where we have failed.

Stephen G. Benka

Above the Gathering Storm, issued in 2005. That report suggested a budget of $300 million for ARPA-E's first year and a ramping up to $1 billion within a few years. **David Kramer**

news notes

Confirming Chu. President Obama's incoming secretary of energy, physicist Steven Chu, faced lots of questions on nuclear power and coal at his Senate confirmation hearing on 13 January. Chu, a leading advocate of renewable energy, told members of the Committee on Energy and Natural Resources that he supports expansion of the US nuclear power industry and believes that a solution to the nuclear waste storage standoff can be found. The US should consider eventually lifting the ban on the reprocessing of spent nuclear fuel that was instituted during the Carter administration. "We're in a different place and time from then," said Chu, former director of Lawrence Berkeley National Laboratory (LBNL). But given that nuclear fuel is expected to be plentiful for at least the next 10 years, he added there is no urgency to reprocess, and more research should be devoted to developing a reprocessing technology that is more resistant to proliferation than the technologies in commercial use abroad. He pledged to find a solution to the nuclear waste issue, possibly in collaboration with other nations. Obama has promised to terminate the effort to locate a repository for nuclear waste at Yucca Mountain, Nevada, where at least $9.5 billion has been spent just to determine the site's suitability.

Chu acknowledged that coal will continue to be a vital part of the US energy mix, but only with the addition of carbon capture and storage. Obama favors a cap-and-trade system to control carbon dioxide, Chu said, adding that he personally "philosophically" favors the simplest possible cap-and-trade regime. As for the national labs, he said, "I have challenged some of the best scientists at the Berkeley lab to turn their attention to the energy and climate-change problem and to bridge the gap between the mission-oriented science that [DOE's] Office of Science does so well and the applied research that leads to energy innovation. I have also worked to partner with academia and industry. I know that these efforts are working, and I want to extend this approach to an even greater extent throughout the department's network of national laboratories where 30 000 scientists and engineers are at work performing cutting-edge research." **DK**

More UK PhDs. Forty-four training centers are opening this fall at UK universities in a bid to up the number of PhD students in engineering and science. The centers, cross-disciplinary university collaborations with participation from industry, will recruit students with a goal of creating some 2000 PhDs over five years.

The centers will focus on such areas as energy, nanoscience, an aging population, climate change, water management, and high-tech crime. The £250 million ($375 million) for the centers comes from the Engineering and

Physical Sciences Research Council and will be used to pay lecturers, buy equipment, and support graduate students, among other things.

Paul Drayson (in photo, looking up), the UK state and science minister, says, "Britain faces many challenges in the 21st century and needs scientists and engineers with the right skills to find answers to these challenges, build a strong economy, and keep us globally competitive. EPSRC's doctoral training centers will provide a new wave of engineers and scientists to do the job." **TF**

Cavendish medicine. A new building at the University of Cambridge marks the permanent home of a five-year-old center launched to bring the tools of physics to clinical problems. Research at the £12 million ($18 million) Centre for the Physics of Medicine will focus on stem cells, cancer screening, the physics of the eye, and other areas.

"Our focus will be on the underlying science of disease," says Peter Littlewood, head of Cavendish Laboratory, which manages the center. The center, Littlewood says, has spent about £3–4 million for lab equipment and salaries for four lecturers hired to seed new research; funds have come from the university, government, and private donors.

The center has already spurred collaboration among various Cambridge departments, including the physical, clinical, and life sciences; mathematics; and engineering. One of the center's goals, says its director, Athene Donald, is to get each discipline to learn from the others. "Our plan is to promote dialog and collaboration through symposiums, graduate training programs, and interdisciplinary courses to get people fluent in more than one language of science." **JNAM** ■

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.ametsoc.org/videos.html

From the American Meteorological Society comes **The AMS Video Journal**, a series about the weather, climate, and their impact on society. In a recent video, Max Mayfield, the former director of the National Hurricane Center, examines how well forecasters predicted the devastating impact of Hurricane Katrina.

http://museum.nist.gov/exhibits/rabinow/exhibits.html

The prolific inventor **Jacob Rabinow** is the subject of an exhibit at NIST's Virtual Museum. Rabinow, who was born in 1910 in Kharkov, Ukraine, spent much of his career at NIST's precursor, the National Bureau of Standards. There, he invented, among other things, the first magnetic disk memory.

http://www.youtube.com/watch?v=G9NohlfWfQw

In **Magnetic Movie**, filmmakers Ruth Jarman and Joe Gerhardt superpose animations of solar magnetic fields on filmed scenes from the Space Sciences Laboratory at the University of California, Berkeley. The movie's soundtrack is provided by SSL scientists, who explain the nature of solar magnetism. The five-minute movie can be viewed on YouTube and as an installation at the Exploratorium in San Francisco, where it runs from 26 February through 31 May.