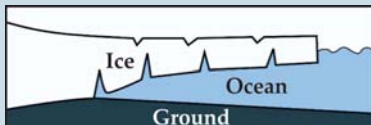


physics update

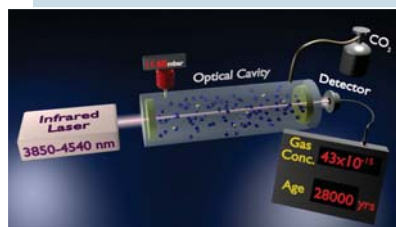
These items, with supplementary material, first appeared at <http://www.physicstoday.org>.

Crevasse may make ice shelves more stable. In Antarctica and elsewhere, ice sheets and glaciers flow down toward the coastlines and continue out into the ocean, where they form thick, floating ice shelves like the one sketched here. Such shelves eventually break, through calving or large-scale collapse. Crevasse on ice shelves are thought to contribute to those processes, but studies of their contributions have mostly focused on the stresses and dynamics near a single crevasse. New theoretical work by Wendy Zhang, Douglas MacAyeal, and colleagues at the University of Chicago considers multiple crevasses and shows that collectively they can add mechanical resilience to ice shelves. In a crevasse-free ice shelf, disturbances from ocean waves, tides, and storms will spread through, and flex, the entire shelf. But as the researchers demonstrate, a periodic arrangement of crevasses forms a bandgap. Like bandgaps in numerous other systems—including photonic crystals, semiconductors, and even underwater sandbars—the crevasse-induced bandgap blocks excitations in a certain range of frequencies from propagating through the ice shelf; instead, the flexing is confined to a small region near the shelf edge. The team finds that the bandgap persists in the presence of some disorder, such as in the crevasse arrangement or the shelf thickness. The ice-shelf responses within and outside the bandgap, suggest the researchers, may play a role in the differing regimes of ice-shelf evolution. (J. Freed-Brown et al., *Ann. Glaciol.*, in press.)



—RJF

A new suitor in the carbon-14 dating game. For more than 50 years, analysis of tiny amounts of radioactive ^{14}C has served for dating organic matter. Now Pablo Cancio Pastor and colleagues at Italy's National Institute of Optics-CNR and European Laboratory for Non-Linear Spectroscopy have developed a new method for measuring minute quantities of that isotope. Their method of saturated-absorption cavity ring-down spectroscopy (SCAR) is not as sensitive as the standard bearer for ^{14}C sensitivity,

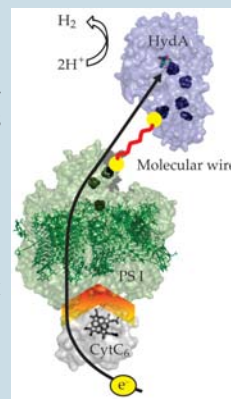


accelerator mass spectrometry. But whereas AMS needs a dedicated facility, SCAR fits on a lab bench and is less expensive. As shown in the figure, an optical cavity filled with carbon dioxide is illuminated with an intense continuous wave laser tuned to excite a particular molecular transition in $^{14}\text{CO}_2$. When the laser is turned off, the cavity intensity decays both from absorption by the $^{14}\text{CO}_2$ and because light leaks from the cavity. Because the bright light overwhelms (saturates) the ability of the $^{14}\text{CO}_2$ to absorb it, the initial instants of decay are due to leakage. Once that effect is isolated, the researchers can determine how much of the decay is due to molecular absorption and thus determine the quantity of $^{14}\text{CO}_2$. The Italian team reports a $^{14}\text{CO}_2/^{12}\text{CO}_2$ sensitivity of 4.3×10^{-14} , an order of magnitude shy of challenging AMS. Nonetheless,

says Cancio Pastor, SCAR is already developed enough for less-demanding biomedical applications. (I. Galli et al., *Phys. Rev. Lett.* **107**, 270802, 2011.)

—SKB

Tethered proteins speed up photosynthetic electron transfer. Few renewable-energy technologies can match the simplicity of the natural photosynthetic reaction in which water in chlorophyll-imbued plants and simple organisms is converted into O_2 and the fuel source H_2 . In cyanobacteria, a chlorophyll-containing organism, proteins shuttle electrons that drive the production of H_2 through the reduction of H^+ ; however, the process is limited by the diffusion. Now, researchers at the Pennsylvania State University and Ruhr University Bochum in Germany have devised a faster system in the lab. As shown in the image, the photosystem reaction center (PS I; green)—a photon-absorbing complex found in cyanobacteria—is cross-linked to CytC_6 , an electron-transfer protein. That hybrid molecule is then tethered to HydA —the proton-reducing catalyst—by a synthesized hydrocarbon chain (jagged red line) that acts like a molecular wire and allows electrons to tunnel through. Thus the system achieves an electron-transfer rate of 105 per second per reaction center—roughly twice the total rate achieved by an efficient cyanobacterium. The researchers say that the stability and flexibility of their design makes it suitable for a variety of commercial solar-biofuel-producing systems. (C. E. Lubner et al., *Proc. Natl. Acad. Sci. USA* **108**, 20988, 2011.)



—JNAM

Ocean acidification and coral reefs. In a shallow lagoon off the Yucatán coast, a US–Mexico team of marine scientists studied 10 natural springs of brackish water. The springs exhibit the low pH and resultant low carbonate saturation that scientists expect to see worldwide by the end of this century as increased carbon dioxide absorption from the air reacts with water and carbonate ions to form bicarbonate ions. That process reduces the amount of carbonate available to growing corals. Called *ojos* (eyes), the springs have existed for millennia in a mature ecosystem near the very large Mesoamerican Barrier Reef. Over two and a half years, the researchers sampled the waters and monitored coral populations at and near the *ojos*. The good news is that three varieties of hard coral, including the *Siderastrea radians* shown here, are able to calcify and survive even in the acidic, low-carbonate environment at the centers of the *ojos*. Only meters away, in the normal marine environment, six additional species thrive, including the large ones that form the major part of the reef framework. The bad news is that, if this system represents the future, then the reef's framework may be compromised along with the biodiversity it supports. The result was announced by Adina Paytan (University of California, Santa Cruz) last December at the American Geophysical Union meeting in San Francisco. (E. D. Crook et al., *Coral Reefs*, in press, openly available at <http://www.springerlink.com/content/w56q35571w7302n4/>.)



—SGB