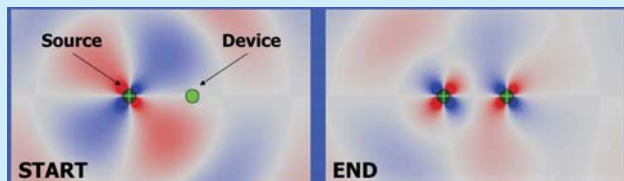


Unwired energy. Powering your laptop computer or cell phone might one day be done the same convenient way many people now surf the Web—wirelessly. The idea of wireless energy transfer is not new. Nikola Tesla worked on long-range energy transfer more than a century ago but failed to develop a practical method. And coils within power transformers inductively



transfer electric currents to each other without touching. At November's Industrial Physics Forum of the American Institute of Physics, held in San Francisco, Marin Soljačić described a new scheme he developed at MIT with Aristeidis Karalis and John Joannopoulos to transfer energy using electromagnetic resonances (see figure). One way to implement the scheme is via conducting wire rings interrupted by capacitors. An energy-transmitting ring would fill the space around itself with a nonradiative, evanescent electromagnetic field. Energy would only be picked up by appliances with special antennas designed to resonate with the field: Early designs could transfer energy up to a few meters. Unlike more traditional radiative means of energy transmission such as lasers and directional antennas, the new method does not require a direct line of sight to the source; it would also be innocuous to people and other nonmagnetic objects in the neighborhood. Having analyzed and modeled the scheme, Soljačić and his MIT colleagues are now working on demonstrating the technology in practice. (See <http://arxiv.org/abs/physics/0611063>.) —DC

Boiling crisis revealed. A new study carried out at a chilly 33 K explains why certain industrial heat exchangers, including those used at power plants, melt catastrophically during a so-called boiling crisis. The crisis occurs at a critical heat flux, when the bubbles that nucleate in the liquid on a heater's surface merge into a vapor film that inhibits further heat transfer to the liquid. The same thing happens when a water droplet hits a hot frying pan: A vapor layer insulates the drop so that it evaporates slowly. In a heat exchanger, though, the heater can rapidly overheat and even melt. What Vadim Nikolayev (Atomic Energy Commission in Grenoble, and ESPCI in Paris, France) and his colleagues have done is provide both a model for and a detailed look at the boiling crisis. The model invokes vapor recoil, whereby a molecule that escapes a liquid surface pushes against that surface, analogous to the gas thrust of a rocket engine. At high enough heat flux, a growing bubble can forcefully push the liquid entirely away from the heating element. That model was upheld by experimental work performed not at the blazing temperature of high-pressure steam but near the chilly critical temperature of liquid hydrogen, where boiling can occur very slowly. Nikolayev says that better understanding of the boiling crisis will facilitate certain countermeasures at industrial sites. (V. S. Nikolayev et al., *Phys. Rev. Lett.* **97**, 184503, 2006.) —PFS

Fishy sounds in slow motion. Many fish make sounds to communicate with each other. Fish commonly generate sound with an organ called the swim bladder, which also controls their buoyancy. Biological acousticians treat the swim bladder as a damped, pulsating underwater bubble that can radiate sound initiated by some of the fastest known muscles in vertebrates. For example, the oyster toadfish (*Opsanus tau*) routinely contracts its swim-bladder muscles at 200 Hz, generating a sound of the same frequency. Now Eric Parmentier (University of Liège, Belgium), Michael Fine (Virginia Commonwealth University, Richmond), and their colleagues have found a surprising new mechanism in at least one group of fish. Pearlfish of the genus *Carapus* take up housing inside sea cucumbers (see photo) and produce sounds that resemble taps on a drum or cymbal—the specific frequency varies among species. At the November 2006 joint meeting in Honolulu of the Acoustical Society of America and the Acoustical Society of Japan, Fine



presented evidence that carapid fish do not use their swim-bladder muscles at high speed; rather, the muscles slowly stretch a “window” near the front of the balloonlike bladder, much like drawing a bowstring or a rubber band. At a critical point, the window is released and snaps back, causing a wedge-shaped bony plate to vibrate and resonate with the bladder. The process is akin to sound production in cicadas, where muscle power drives a small mechanical resonator that in turn drives a larger acoustic resonator. (E. Parmentier et al., *J. Exp. Biol.* **209**, 2952, 2006.) —SGB

Warm detectors look at brain magnetism. The human brain generates magnetic fields 100 times weaker than those of the heart. Such fields can reveal subtle medical clues, different from those provided by electric fields, about such maladies as epilepsy and arrhythmias. Sensitive magnetometers, based on superconducting quantum interference devices (SQUIDs), are used to acquire detailed maps of the brain's feeble fields, but those devices require liquid helium and all the associated cryogenic equipment. Michael Romalis (Princeton University) and his team have now used an atomic magnetometer to detect the brain's faint magnetic fields without cryogenics. The core of the device is a heated cell filled with potassium atoms that have been polarized by a laser beam (see *PHYSICS TODAY*, July 2003, page 21). At near-zero ambient fields and with a volunteer's head resting on an insulating pad atop the device, the physicists monitored the atomic polarization. They could optically detect when and how much the K atoms precessed due to the brain's magnetic-field activity when the subject was exposed to auditory stimuli. The device has already attained a sensitivity of 3.5 fT/Hz^{1/2}, comparable to that for SQUIDs, with the prospect of improving by another factor of 10. Romalis says that four cells can provide almost complete head coverage, which would create new options for functional brain imaging. (H. Xia et al., *Appl. Phys. Lett.* **89**, 211104, 2006.) —PFS ■