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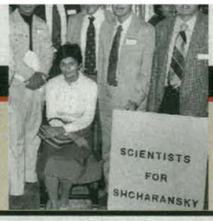
Infection wipes out snail species

LEAD STORY 216
Physicists and human rights



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Probing night vision


Speaker Newt Gingrich (R–GA), among others, raising doubts about whether Congress would back the plan. "Everyone except the White House appears to have woken to the reality that it is time to change the program," claims one Republican staffer.

Indeed, one NASA official wonders if the new agreement marks the end of Russia's major role in the space station project. "It certainly sends the signal that, rather than a partner, they are more like a hired hand," he says. But Russian Space Agency spokesperson Sergey Gorbunov says that's not the case. "NASA is just renting some space [from us]," he says. **–DAVID MALAKOFF**

With reporting by Elena Savelyeva in Russia.

PHOTONICS

Optical Circuits Turn a Corner

The ultimate aim of today's telecommunications researchers is to quit dealing with electricity. Communication systems already zip messages across the globe via satellite as microwaves or through optical fibers as infrared light, but at either end of such transmissions the messages must be converted into electrical signals and passed through electronic circuits—a process that slows them down considerably. The solution is to develop circuits that can process the infrared or microwave signals directly. On page 274 of this issue of *Science*, a team of researchers from Sandia National Laboratories in Albuquerque, New Mexico, and the Massachusetts Institute of Technology (MIT) describe a crucial element of such optical circuits: an artificial structure called a photonic crystal that can transmit light with minimal loss and make it turn a corner.

Photonic crystals manipulate light in much the same way as semiconductor chips manipulate electricity. But the tiny components of a photonic circuit need to be wired together, and existing technology, such as fiber optics, is too crude, worse than joining the rooms of your house with a 12-lane freeway. "This experiment models the future wiring" of tomorrow's optical microcircuits, says photonic crystal pioneer Eli Yablonovitch of the University of California, Los Angeles. "I think it could really revolutionize the way that we are making optical circuits," says Katie Hall of Lincoln Laboratory in Lexington, Massachusetts.

The key feature of photonic crystals, which were first demonstrated by Yablonovitch in 1991, is a repeating pattern of reflective elements, spaced at roughly the wavelength of the light or other electromagnetic waves to be manipulated. The Sandia experimenters, led by Shawn-Yu Lin, made a photonic crystal from columns of alumina, or aluminum oxide, each a half-millimeter in diameter, set in a grid. Their spacing, about a millimeter apart, enabled the array to manipulate electromagnetic waves of millimeter wavelength, somewhere between the microwave and infrared parts of the spectrum.

At the surface of each column, part of each wave is reflected and part passes through. "The multiple reflections create a range of frequencies for which the propagation of electromagnetic waves is not allowed inside the crystal," says team member Pierre Villeneuve of MIT. The photonic crystal's repeating pattern causes the reflected waves to superimpose out of step, so that peak meets trough and they cancel out. "There's destructive interference between all the different waves that bounce back and forth," says Villeneuve. Exactly which waves have the correct frequency to re-

Guiding light. Sandia's Shawn-Yu Lin holds a photonic crystal.

bound around the crystal and cancel out is determined by the diameter of the rods and the spacing between them.

Although they work beautifully as filters, photonic crystals get really interesting when you add defects—in the case of the Sandia-MIT work, a missing row of alumina columns—which can support a wave otherwise banned from the crystal interior. This offers the prospect of micromanaging light within the body of the crystal. "If you open up a channel in that photonic crystal … the light's going to follow the small channel you've carved out," says Villeneuve. Lin and fellow Sandia experimenters Edmund Chow and Vince Hietala found that they could pass millimeter waves along the missing row of alumina columns with virtually no loss.

MIT theorists led by team member John Joannopoulos had predicted that under the right circumstances, waves would turn a corner from one such corridor into a second. When the researchers added a second corridor at right angles to the first, they found that they could get waves to do just that, cornering in a distance roughly equal to their wavelength. Reproduced at higher frequencies, this bending would mean that infrared waves—of interest to the telecommunications world—could turn through 90 degrees in about a micrometer, 1000 times tighter than anything possible using optical fibers.

The team's eventual aim is to integrate numerous components, such as waveguides, filters, light sources, and modulators, onto a single photonic crystal. The challenge, however, is manufacturing such chips, because the pillars of an infrared photonic crystal have to be fashioned accurately on a scale of micrometers. The necessary size reduction is "pretty tricky," says Hall. But Villeneuve says light-bending photonic crystals are already in sight: "The first samples at 1.5 microns, which is the telecommunications wavelength, have been fabricated: They are waiting on Shawn's [Lin's] desk ready to be tested." **–ANDREW WATSON**

Andrew Watson is a free-lance science writer in Norwich, U.K.

SPAIN

R&D Budget Request Reverses Long Decline

MADRID—In an effort to invigorate its poorly funded science community, Spain's conservative Popular Party government this week announced plans to ask for a major increase in research funding in the 1999 budget. Currently, Spain spends just 0.8% of its gross domestic product (GDP) on research and development, placing it firmly in the bottom tier of European research spending. Observers expect parliament—in which the Popular Party has an overall majority—to approve the increase by the end of the year.

Excluding military programs, the research portfolio will go up about 8%, to $1.8 billion. The government has cited biotechnology and medical research as priority areas for a cash infusion, but it says

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