rather than undoing all the canals, levees, and dikes that have diverted the water to agriculture and cities, the idea is to pump the water they carry into more than 330 wells drilled in the Florida aquifer and then release it during dry spells. Congress approved a down payment of $1.4 billion for the 20-year restoration last fall, and the Army engineers plan to begin two pilot projects in 2003 that will involve drilling test wells and collecting water-quality and geological data.

But some ecologists and hydrologists have taken issue with the idea, arguing that it would be better to remove more barriers to natural water flows. The NRC's Committee on the Restoration of the Greater Everglades Ecosystem (CROGEE) was set up a year ago in response to such criticisms.

In its first report, a review of two planned aquifer pilot projects, the CROGEE notes that the overall aquifer plan, which would require storing up to 6.3 million cubic meters of water per day, is "unprecedented" in scale. Showing that it will work "will require studies that go beyond the scope of the proposed … pilot projects," the report says. It urges agencies to go forward with a proposed regional modeling study of how the new wells would affect the aquifer. The panel also recommends that more data be collected during the pilot projects, including studies of whether storing water in the aquifer would degrade the water quality, leading to harmful effects on ecosystems.

Corps officials say they've already begun responding to these comments since they were aired at a CROGEE workshop last fall. "It's a good report. It gives us some good guidance," says Stu Applebaum, ecosystem restoration chief for the corps in Jacksonville, who says the agency expects to carry out the regional study when the pilot projects begin.

Those data, however, will be only a beginning. CROGEE's first report notes that more analysis, including an assessment of energy costs and evaporation rates, is needed to determine whether aquifer storage is preferable to surface storage. And the committee is now reviewing the environmental measures that will be used to assess whether restoration is working. –JOCELYN KAISER

PLANETARY SCIENCE

Caltech Picks Insider To Lead JPL

The Jet Propulsion Laboratory (JPL) in Pasadena, California, has had a hard time of it in the past 18 months. Two prominent Mars failures sullied its formidable reputation, its longtime director stepped down, and its dominant position in solar system exploration is being threatened by NASA's decision to open up a Pluto mission to competition.

But the center soon will have a new leader who promises to confront the lab's troubles. Charles Elachi, now chief of space and earth science programs at JPL, will take over as director on 1 May. "I'm not afraid of competition," he said at a 31 January press conference. He said he plans to spend the interim developing a plan to handle a bevy of smaller missions within NASA's constrained budget.

The decision by the California Institute of Technology (Caltech), which runs the lab under contract from NASA, surprised many in the space science community who assumed the job would go to an outsider. But Elachi's knowledge of the lab, scientific credentials, and vision vaulted him to the top of a list of 74 candidates. "We're not merely anointing a prince here," said Caltech President David Baltimore. "He simply provided insurmountable competition."

Propelling JPL. New Director Charles Elachi says he's "not afraid of competition."

Elachi has had a management role in the Mars program, which had to be revamped after the failures of the Mars Polar Lander and the Mars Climate Orbiter in late 1999. But several NASA officials and space scientists say that Elachi's responsibility for those failures was minimal. "He was the fall guy," adds one senior researcher who knows the lab well. The departing director, Ed Stone, was blamed by NASA officials for failing to speak out more publicly about the lab's responsibility. Stone, age 65, will return to teaching at Caltech after 10 years as head of the lab.

The 53-year-old Elachi studied physics, geology, and business administration and earned his electrical engineering doctorate from Caltech before joining the lab in 1971. He helped develop a series of radar instruments used on the space shuttle that revealed archaeological sites just under Earth's surface in Egypt, China, and Saudi Arabia. He also is team leader for a radar experiment on the Cassini mission to Saturn.

At the press conference, NASA Administrator Dan Goldin told Elachi exactly what he must do: "Figure out how to double the number of missions with a similar workforce—and maybe double that again." One former NASA official who has worked with Elachi says he's up to the task. "Elachi

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ScienceScope

Climate Costs How hard will greenhouse warming hit the global pocketbook? The United Nations Environment Programme (UNEP) has an answer: $304.2 billion per year in 2050, according to a study released this week by insurance company members of UNEP's financial services initiative. The big number prompted UNEP executive director Klaus Toepfer to plead at UNEP's Governing Council meeting in Nairobi for more funds to implement his organization's work.

But the $304.2 billion figure is hardly as imposing as the decimal point would imply, economists say. It works out to just a few tenths of a percent of world gross domestic product (GDP), notes economist James Edmonds of the Washington, D.C., office of the Pacific Northwest National Laboratory; the United States already spends about 2% of its GDP on pollution control. And most experts would not even attempt to put a price tag on global warming. "There are just so many difficulties in making that kind of estimate," says Neil Leary of UNEP's Intergovernmental Panel on Climate Change (IPCC) office in Washington, D.C.

On 19 February, the IPCC working group that Leary manages will be releasing its own 5-year report on the impacts of climate change. But he promises that "there won't be any dollar cost"—with or without decimal points—in the report.

Aftershocks India is scrambling to conduct a "scientific postmortem" of the Bhuj quake last month that killed more than 20,000 people in the western state of Gujarat. The research program will include extensive monitoring of the surface with global positioning system units for clues to what may be happening deep within the Indian plate, some 30 kilometers underground near the quake's epicenter. "A major event like this can cause long-term changes in the Indian plate, and we do not want to miss the opportunity to understand them," says V. S. Ramamurthy, secretary of the Indian Department of Science and Technology. He also promised "rapid, interim clearance" for proposals to help scientists sidestep the "long, drawn-out" review process. The region has been the subject of ongoing paleoseismic studies by the Center for Earth Science Studies in Thiruvananthapuram, Kerala.

is smart, competent, and adept at giving Goldin what he wants," says the official.

Elachi says he's "very confident" he can do more with less. He's also hoping that the launch of a new Mars orbiter in April, and additional Mars missions in 2003, will boost morale at the battered lab.

–ANDREW LAWLER

HIGH-ENERGY PHYSICS

Nuclei Crash Through The Looking-Glass

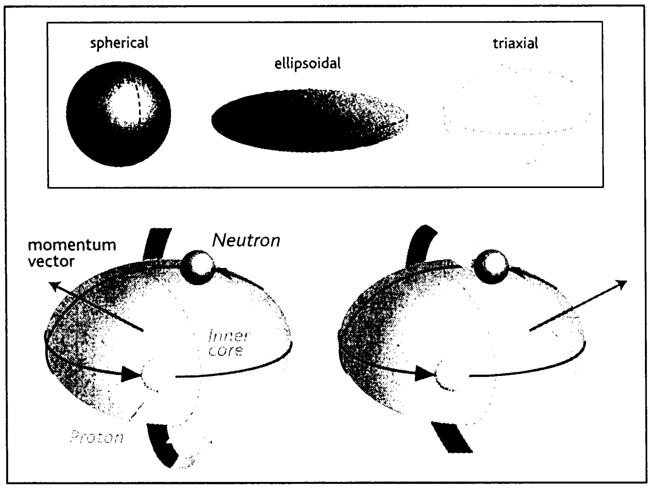
Gloves do it. Toupees do it. Even twists of DNA do it. And now, for the first time, physicists have discovered that atomic nuclei come in right- and left-handed models, too. In the 5 February issue of *Physical Review Letters (PRL)*, a team of researchers from the State University of New York (SUNY), Yale, the University of Tennessee, and Notre Dame reports observations of rapidly spinning nuclei morphing into mirror-image forms. In the process, the physicists also uncovered solid evidence that a long-disputed feature of nuclear anatomy really does exist.

"These results are causing quite a stir among nuclear structure physicists," says Rod Clark of Lawrence Berkeley National Laboratory in California. Although more work is needed to nail down the conclusions, Clark says, "it is tremendously difficult to come up with an alternative interpretation" of the findings.

The discovery springs from work by Stefan Frauendorf, a nuclear theorist at the University of Notre Dame in Indiana. In 1997, Frauendorf and colleagues were exploring the possible properties of atomic nuclei with a hypothetical feature called triaxial symmetry. In theory, nuclei can have varying degrees of symmetry, from spherical to ellipsoidal to triaxial, depending on how the neutrons and protons arrange themselves. An ellipsoidal nucleus resembles an American football; a triaxial nucleus is similar, but squashed. "It actually looks a bit like a kiwi fruit," says Krzysztof Starosta, lead author of the *PRL* paper and a visiting professor at SUNY, Stony Brook.

Frauendorf, also a co-author of the *PRL* paper, suggested that certain triaxial nuclei should come in left- and right-handed varieties. His calculations showed that the development of handedness, which physicists call chiral symmetry breaking, should occur in rapidly rotating "odd-odd" nuclei—those containing both an odd number of neutrons and an odd number of protons.

Much as electrons in an atom pair up to form shells surrounding the nucleus, the protons and neutrons in the center of the atom pair up, like with like, to create their own structures inside the nucleus. In an odd-odd nucleus, however, one neutron and one proton are left over. In some cases, these "valence nucleons" orbit at right angles to each other outside the nuclear core made up of the other protons and neutrons, just as valence electrons whiz around the electronic shells of an atom. Meanwhile, the core is spinning, too (see figure).



Doubles match. In some atomic nuclei with triaxial symmetry, a lone proton and neutron whizzing around a whirling nuclear core give different nuclei mirror-image values of momentum.

According to Frauendorf, those three motions—of the two valence nucleons and the triaxial core—should create a chiral effect. Added together, they give the nucleus its overall momentum. But because the core can spin in either of two directions with respect to the orbiting particles, the overall momentum can take on two different values, too. Those values, Frauendorf said, establish the left-handed and right-handed states.

The catch was that nobody knew whether triaxial nuclei really exist. Nuclei with three distinct axes of symmetry had been predicted in the 1960s and hotly debated ever since, but no one had definitively observed one. Some physicists suspected that the triaxial shape might be a fleeting oscillation of the nucleus, too unstable to have a measurable effect.

To find out, Starosta and his collaborators looked at gamma rays, a kind of radiation that atomic nuclei emit after being excited to high-energy spin states. If the nuclei were triaxial and were undergoing chiral symmetry breaking, the gamma rays ought to cluster into pairs of closely related frequencies known as doublets—evidence that the energy levels of the nuclei had split into pairs of right- and left-handed states.

The collaborators focused their efforts on odd-odd nuclei of cesium, lanthanum, praseodymium, and promethium. Using accelerators at SUNY and Yale, they shot beams of heavy ions—carbon, boron, and magnesium—into targets of tin and antimony. The smashups initiated fusion reactions that created excited nuclei of just the right type and pumped them up to the right spin states. As the nuclei settled down, they emitted a panoply of gamma rays with various energies. The telltale clustering was there; by sorting out doublets, the physicists confirmed the existence of chiral symmetry breaking.

The next step, Starosta says, is to see whether odd-odd nuclei of other elements also form mirror images: "We started probing the nuclei around atomic mass 130 because the theory pointed us there, but we will be searching in other mass regions now." Clark says understanding how these complex nuclear structures behave may spill over to other fields as well. "The ideas and methods for understanding nuclei, molecules, metallic clusters, and atomic condensates all feed off of each other," he notes.

–DAVID VOSS

ATMOSPHERIC CHEMISTRY

Stratospheric 'Rocks' May Bode Ill for Ozone

It looks as if the infamous antarctic ozone hole—the springtime thinning of the protective stratospheric layer—has reached its natural limits, but atmospheric chemists worry about the ozone over the Arctic. It, too, thins in springtime as the rising sun spurs the chlorine and bromine from humanmade chemicals to destroy ozone. Although no real "hole" has opened over the Arctic, that could change in the coming greenhouse era. And on page 1026 of this issue of *Science*, a team of researchers studying the Arctic stratosphere reports the discovery of bizarre particles in clouds there that could make arctic ozone more vulnerable to changing climate.

The discovery came during a January 2000 research flight nearly to the North Pole, report atmospheric chemist David Fahey of the National Oceanic and Atmospheric Administration (NOAA) in Boulder, Colorado, and 26 colleagues from more than a dozen institutions in North America and Europe. An instrument on NASA's highflying ER-2 coughed out what looked like disastrous noise as it measured nitrogen-containing gases.

On closer inspection, however, the

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