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

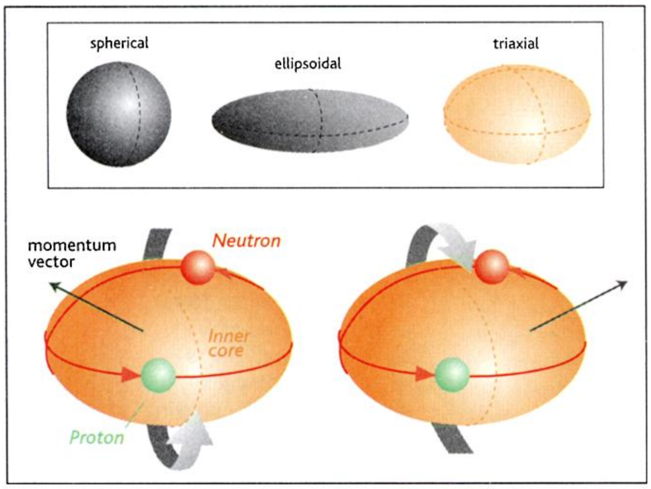
Gloves do it. Toupees do it. Even twists of DNA do it. And now, for the first time, physicists have discovered that atomic nuclei come in right- and left-handed models, too. In the 5 February issue of *Physical Review Letters (PRL)*, a team of researchers from the State University of New York (SUNY), 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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