intrigued by the possibility that the driver is not within the climate system itself, but is instead the sun. "I think there's increasing evidence of solar variability playing a significant role on century and millennial time scales," says paleoclimate modeler Thomas Crowley of Texas A & M University.

Supporters of this idea point to a variety of evidence suggesting that solar activity varies on a time scale similar to their climate oscillations. There is, for example, an approximate 2700-year cycle in salt deposition recorded in a now-dry saline arm of the ocean. The cycle is so old—more than 250 million years—that the sun is about the only thing whose behavior has been consistent enough over time to have caused it. If so, then the climate variations that caused the iceberg surges might also date back that far.

Still, says Alley, "I don't believe that anyone has a convincing story" about what's causing the oscillations. To convince him that the sun is indeed behind them, Alley wants to see variations in a uniquely solar signature in the ice cores. An approximate 2500-year oscillation has been reported in the amount of carbon-14 in tree rings, which could be reflecting the sun's influence on carbon-14 production in the atmosphere, but changes in the amount of carbon-14 returned from the deep ocean by varying currents could mimic the effects of solar variations. So Alley looks to ice core analyses of beryllium-10, an isotope whose abundance is solely dependent on solar activity. A search for beryllium-10 variations is under way, another factor that will keep climatologists' interest in the recent past high even as they try to predict the future.

–Richard A. Kerr

ANTIMATTER

Physicists Produce First Antiatom

European physicists revealed their first glimpse into the shadowy world of antimatter last week, with the announcement by the CERN particle physics center in Geneva that researchers there had created the first few antiatoms. An international team used CERN's Low-Energy Antiproton Ring (LEAR) to create a total of 11 atoms of antihydrogen, the simplest complete atom in the antiworld. "The CERN measurements are a milestone in the progress that physicists have made in producing exotic atoms," says theorist Stan Brodsky of the Stanford Linear Accelerator Center (SLAC) in California.

Physicists are intensely excited at the prospect of being able to study this entirely new atom, because it will provide a fundamental test for physicists' understanding of matter. "Astrophysicists tell us that in the big bang we should have antimatter as well as matter, but ... in space they do not find antimatter, at least not in the amounts they see matter," says Walter Oelert of the Institute for Nuclear Physics, part of the German National Research Center at Jülich, who led the LEAR team. "A principal question for us is 'why is the amount of matter and antimatter different?' " says Oelert.

Antimatter is the mirror image of the matter that makes up our world. Its existence was suggested by British theorist Paul Dirac in 1931, whose famous quantum equation postulated the existence of an antiparticle counterpart of the electron. Dirac theorized that this particle, dubbed the positron, would have the same mass as the electron but opposite charge, and that the two would annihilate on contact.

The positron was found 2 years later, by Carl Anderson of the California Institute of Technology, while antiprotons were spotted at the University of California, Berkeley, in 1955. But until now, nobody has been able to combine a positron and an antiproton to create antihydrogen, because they are usually created in violent collisions, and slowing them down or closely matching their speeds is far from easy.

In 1992, however, Brodsky and colleagues Charles Munger and Ivan Schmidt suggested a possible method for making antihydrogen. Oelert and his team, which includes scientists from the University of Genoa in Italy and other German universities, were the first to get it to work last September. The team directed a jet of xenon gas across the path of LEAR's antiproton beam. Very occasionally an antiproton is scattered by the positive charge of a xenon nucleus, converting part of its energy into an electron-positron pair. In a small fraction of these cases, the positron's velocity was sufficiently close to that of the scattered antiproton for the two particles to combine and create an antihydrogen atom. The process of combination is so rare that producing 11 antihydrogen atoms required 5×10^{12} antiprotons.

CERN

Forge for antimatter. CERN's Low-Energy Antiproton Ring made the first atoms of antihydrogen.

Initially, the antihydrogen atoms kept moving along with the antiproton beam, but as they have no net charge they evaded the magnets that bend the beam around LEAR's running track–shaped path. So at the first bend the atoms exited through a window into a custom-built silicon detector. Here, each antihydrogen atom broke up, only 40 billionths of a second after its creation, and the fragments produced a signal that enabled the researchers to identify the antihydrogen atoms. "We should have expected to see nine events and we saw 11 ± 2, which is extremely good agreement, better than we ever expected," says Oelert.

It will be a while, however, before physicists can start studying these intriguing new creatures, because they zip through the apparatus at close to the speed of light. "This is a problem," says fellow LEAR scientist John Eades. But physicists are very keen to solve it: All of the currently accepted theories for the four fundamental forces of nature depend on an absolute symmetry between matter and antimatter. Atoms of antihydrogen should emit light at exactly the same frequencies as hydrogen; any differences would be a huge jolt to the theories. "If we found a tiny discrepancy, that would have a tremendous influence on the way we look at the universe and the way we interpret the big bang," says Eades. Although it might provide some clues to why antimatter seems to be in short supply in the universe, "one would have to change essentially all of our ideas about the way the universe works and is constructed," Eades notes. Finding a break in the symmetry, he adds, "would shed new dark on everything."

Brodsky's colleague Munger will start a new experiment at SLAC later this year that will attempt simple spectroscopy on fast antihydrogen atoms produced in a similar way to Oelert's. Other researchers are taking a different route. "It's only a matter of time till slow antihydrogen will be available," predicts Harvard University's Gerald Gabrielse. His team hopes to produce antihydrogen using trapped antiprotons and separately trapped positrons, which would then be combined in a third trap.

While they wait for these new experiments, physicists find themselves confronting a different problem: dismissing popular reports that antimatter drives will soon be powering spaceships to the stars. Says Brodsky: "Rocket engines burning antimatter fuel will remain in the realm of fiction."

–Andrew Watson

Andrew Watson is a writer in Norwich, U.K.