tions much simpler." As for JWST's instruments, the University of Arizona is building a near-infrared camera, ESA will provide a near-infrared spectrometer, and U.S. and European researchers will collaborate on a midinfrared camera-spectrometer.

The big surprise in NASA's announcement last week was the name. Like NASA's current Administrator Sean O'Keefe, James E. Webb (1906–1992) had a top position at the government's Office of Management and Budget (then called the Bureau of the Budget) before he led the space agency from 1961 to 1968, at the height of the moon race. NASA spokesperson Don Savage confirms rumors that the new name "originated from the current Administrator." NASA's senior JWST project scientist, John Mather of Goddard, says "this is certainly a surprising break with the tradition within NASA." But it might be no bad thing: "To me it's a clear sign that NASA is very committed to building and operating this telescope."

–GOVERT SCHILLING

Govert Schilling is an astronomy writer in Utrecht, the Netherlands.

ASTROPHYSICS

Orbiting Scopes Shoot 'Movie' of Crab Nebula

The Crab Nebula, a tangled web of cosmic debris cast off by a supernova nearly 1000 years ago, is starring in a new action-packed film. The hot fall release comes from the Hubble Space Telescope and the Chandra X-ray Observatory, which teamed up to take more than 30 images of the nebula's heart. The dynamic sequence, which spans about 8 months, is winning raves from astrophysicists who are accustomed to static snapshots or mere points of light. In the words of theorist Jonathan Arons of the University of California, Berkeley: "Wow!"

The spiky nebula is the famed remnant of a giant star that exploded when it ran out of fuel, seeding space with elements for new stars and planets. At the Crab's center a dense neutron star spins 33 times each second, unleashing pulses of radio waves, visible light, and x-rays. As it gradually slows down, this pulsar sheds energy along the axis of its intense magnetic field at a fantastic rate—equivalent to "a few thousand nuclear wars per square meter [of the pulsar's surface] per second," according to Arons. The rotation and magnetism combine to whip particles around the pulsar into a frenzy approaching the speed of light, but how that works is poorly understood.

Now, the new images have exposed jets, wisps, knots, and other features that roil the nebula's innermost cauldron, dramatically changing its shape from week to week. "This is relativistic astrophysics in action," says team leader Jeff Hester, an astronomer at Arizona State University in Tempe. "The Crab is the only object in the sky where we can watch these kinds of processes in real time."

Hubble aimed its Wide Field Planetary Camera at the nebula's core 24 times between August 2000 and April 2001, while Chandra took eight x-ray images during the same interval. Each Chandra observation consisted of about 15,000 exposures lasting an unusually short 0.2 seconds each, which prevented the bright nebula from saturating the detectors. And by gathering about five times more light per observation than previous images, Chandra revealed fainter x-ray features, says astronomer Koji Mori of Pennsylvania State University, University Park.

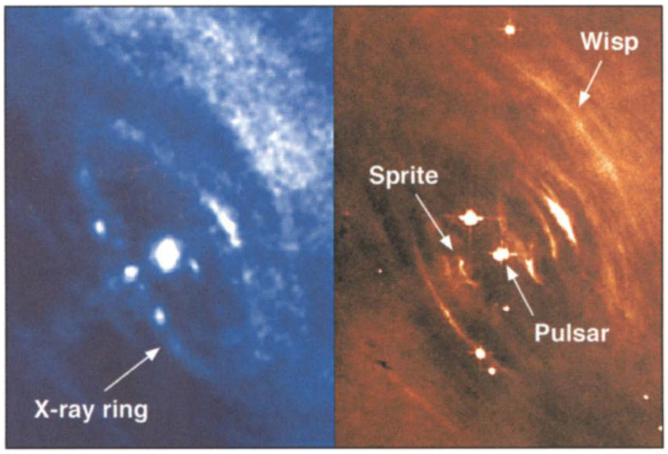
The new images, released this week at NASA headquarters in Washington, D.C., and published in the 20 September *Astrophysical Journal Letters*, illuminate striking sets of shock waves near the pulsar. A blazing x-ray ring girdles the plane of the pulsar's equator. At that spot, says Hester, the violent but steady wind streaming from the pulsar careens into a frothy shock front of disordered electrons. The electrons emit synchrotron x-rays—as well as visible light—as they cascade around magnetic fields in the plasma. "It's no longer speculation that the synchrotron emission begins at this shock front," Hester says. "We can just see it."

Wisps of particles flit outward from the x-ray ring at half the speed of light. The wisps form crisp, narrowly defined arcs confined to the equatorial plane, probably held in place by tight lines of magnetic field whipping out from the pulsar. Meanwhile, at right angles to the plane, diffuse jets of particles blast into the nebula from the pulsar's rotation poles. The jets look like puffy plumes from industrial smokestacks on a windy day, buffeted to and fro by turbulence around them. The images show one jet plowing into slower material and triggering an amorphous shock that ebbs and flows, called the "sprite."

The different forms of the equatorial and polar shocks suggest that distinct mechanisms spew energy along those directions, says physicist Roger Romani of Stanford University in Palo Alto, California. "These structures and their variations will let us decipher or reverse-engineer the products of the particle accelerator at the center," he says. For example, Hester feels that a plasma consisting solely of electrons and positrons can account for the Crab's behavior, whereas Arons thinks that an underlying wind of charged atomic nuclei—mainly hydrogen and helium—plays a key role.

Settling such debates will take long hours of scrutinizing the rich images. "There is so much detail," says Chandra project scientist Martin Weisskopf of NASA's Marshall Space Flight Center in Huntsville, Alabama. "We all want to know how this pulsar converts its rotational energy into electromagnetic radiation with such amazing efficiency. It's a fascinating puzzle."

–ROBERT IRION



Heart of a crab. New images of the innermost Crab Nebula reveal fine structures in x-rays (*left*) and optical light (*right*).

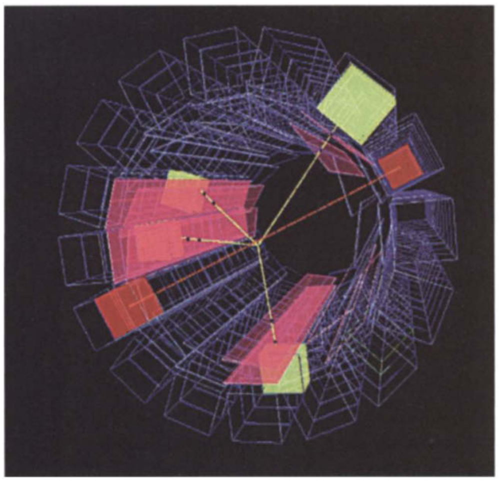
CREDIT: J. HESTER *ET AL.*/CHANDRA X-RAY OBSERVATORY AND SPACE TELESCOPE SCIENCE INSTITUTE

PHYSICS

CERN Team Produces Antimatter in Bulk

They're still a long way from powering the antimatter drive of Captain Kirk's *Enterprise*, but researchers are generating surprising quantities of antihydrogen. Scientists at CERN, the European laboratory for particle physics near Geneva, report in this week's issue of *Nature* that they have produced about 50,000 slow-moving atoms of antihydrogen, the antimatter doppelgänger of the most abundant element in the universe. Because such atoms are very cold and slow moving, the team hopes it will be able to study them long enough to probe the fundamental asymmetries between matter and antimatter.

"Previous attempts have used accelerators to make [antihydrogen] at high energy, so the atoms have flown away and annihilated," says CERN physicist Jeffrey Hangst. He and his colleagues on the ATHENA collaboration at CERN, however, used a series of magnetic traps to slow down antiprotons and antielectrons from thousands of kelvin to about 15



End of the line. An antihydrogen atom in the ATHENA detector decays into pions (yellow) and gamma rays (red).

kelvin. Yet another trap mixes the antiprotons and antielectrons, and some of those particles combined to form antihydrogen, which, being neutral, can escape from the magnetic trap.

The researchers knew they had antihydrogen because they could see the constituent particles decay: The antiproton winds up as a handful of pions, whereas the antielectron becomes two gamma rays that shoot off in opposite directions. The scientists detected about 130 events in which an antiproton decay was seen right next to an antielectron decay, and from the expected rates of decay they concluded that they had produced about 50,000 cold antihydrogen atoms in all.

Gerald Gabrielse, a Harvard physicist who works on a rival experiment at CERN known as ATRAP, warns that it's easy to be fooled by subtleties of the magnetic traps. But if the result is correct, "it would be an impressive milestone," he says. "It's an initial step, though." Physicists want to use antihydrogen as a tool to see if there is any difference between matter and antimatter. If, for example, hydrogen and antihydrogen absorb different frequencies of light—that is, if their spectra differ—physicists would have to revise a basic assumption about the way matter and antimatter behave.

That will have to wait until they can trap enough of the stuff to tickle it with a laser to figure out its properties. "They're a long way from getting a spectrum," says Gabrielse. Hangst agrees: "We haven't measured any characteristics of antihydrogen." But now that the researchers can produce slow-moving antihydrogen in bulk, they hope to be able to measure its properties before too long.

And even though few scientists believe that antihydrogen will behave significantly differently from hydrogen, Gabrielse thinks it's vital to test that idea. "Just because our imagination is limited doesn't mean we shouldn't check."

–CHARLES SEIFE

CREDITS: (TOP TO BOTTOM) ATHENA/CERN; M. ELLISON

PALEONTOLOGY

China Issues Rules on Fossil Excavation

BEIJING—China has adopted new regulations on access to fossils that assign enforcement to a single administrative body. Most scientists see the new rules as a positive step toward bringing greater order to the current patchwork system, which did little to deter illegal digging and trafficking of fossils. But a few are worried that putting a single entity in charge could result in additional barriers to research.

In the past, valuable fossils were protected by China's Law on the Preservation of Cultural Relics. But the law failed to specify which organization would issue permits, guard against looters, and help customs officials crack down on smuggling. As a result, land and resources administrators often deferred to cultural heritage officials, who lacked any expertise in paleontology. Looters and smugglers took advantage of the lax enforcement, and scientists were left to work out their own arrangements with local officials.

"Now we are authorized to oversee the [regulation of] fossils, with help from experts in the field," says Jiang Jianjun, director of the Department of Geological Environment within the Ministry of Land and Resources (MLR), which issued the regulations last month. Jiang, who has a Ph.D. in paleontology, believes that the rules, 4 years in the making, will help preserve fossil sites for research.

The regulations, which go into effect 1 October, define in general terms what kinds of fossils are protected. A forthcoming list, says Jiang, will include so-called type specimens that have been named and categorized, rare vertebrates, fossils that illustrate key features of evolution, and those from large sites. Hou Hongfei, a retired paleontologist from the Chinese Academy of Geology under MLR, worries that a lengthy list could cause long delays in the approval process. Jiang admits that scientists might face additional paperwork before getting into the field, but he predicts that uniform rules will help the government enforce environmentally sound excavation practices and improve access to the sites.

However, some scientists from the Chinese Academy of Sciences (CAS) are concerned that the new rules could cause them to be treated like second-class citizens because their institutions fall under a different government entity. In the past, CAS scientists have complained that the former Ministry of Geology and Mineral Resources, which has been merged into the MLR, has tried to prevent them from digging at certain sites. "I feel uncomfortable with the thought that [the Ministry of] Land and Resources will monopolize the inspection of fossil excavation," says Jin Yugan, a paleontologist at the Nanjing Institute of Geology and Paleontology under CAS. "For example, I have a project that is already approved by the Chinese National Science Foundation. Now I also have to ask for a permit from the MLR or local land resource authorities before I can dig fossils."

Luo Zhexi, a paleontologist at the Carnegie Museum of Natural History in Pittsburgh, Pennsylvania, who has worked extensively in China, acknowledges that the rules might force some Chinese scientists to forge new bureaucratic ties. But he does not think the regulations will pose a hindrance to foreign scientists. "I would expect a short period of confusion before everyone sorts the system out," Luo says. "But in the long term I hope the system will facilitate scientific research while protecting resources."

Most scientists in China are also optimistic. "I think this is a small step in the right direction," agrees Zhou Zhonghe, a paleontologist at the Beijing Institute of Vertebrate Paleontology and Paleoanthropology. "But many of the rules need to be more specific. Most important, I am waiting to see concrete evidence of a firm commitment to enforcement."

Feather in its cap. One agency will now regulate many Chinese fossils, such as these *Confuciusornis* birds.

Han Lin, an official at the regional administration of land and resources in Inner Mongolia, is confident that will happen. "We will hold forums and symposiums to promote the regulations and to involve people for enforcement," he says. Jiang hopes that the regulations will eventually be submitted for approval by the Standing Committee of the National People's Congress and provide the basis for a new law on fossil protection.

–DING YIMIN AND XIONG LEI

With reporting by Erik Stokstad.