starting well offshore at a depth of some 6000 meters and then moving toward the Javan coast, taking additional samples at depth intervals of 500 meters. Its measurements were to be part of a 15-month cycle of data collection in the region. Without that information, says Chapman, it will be harder for scientists to determine upper limits for the amount of water flowing through the Indonesian archipelago.

The gaps in WOCE would be larger if one hard-to-please nation, India, had not changed its mind about allowing the *Knorr* into its EEZ last February. For that visit, to the waters off the southern tip of India, "it took over a year from the time we put in the request," says Paul Maxwell, science counselor at the U.S. Embassy in New Delhi. He admits to having been "pleasantly surprised when the answer came back yes," and he suspects that the cruise benefited from a successful meeting last year between Indian Prime Minister P. V. Rao and U.S. President Clinton that included discussions on continued scientific cooperation.

Last spring India also granted permission for a second cruise, but only after protracted negotiations, Maxwell says. And last summer India turned down a third request to work off the Indian coast, from another U.S. research vessel, insisting on conditions that would have subverted its intended mission.

Although there is no indication that Indonesia's stance is likely to change any-time soon, U.S. and Australian officials haven't given up the fight. Both countries filed a diplomatic protest after the *Knorr* cruise, says science counselor Gary DeVight of the U.S. embassy in Jakarta, and on 14 December the LIPI-led committee that reviews requests to conduct marine research in Indonesia agreed to draw up and disseminate a written description of the procedures that foreign research vessels must follow to receive clearance.

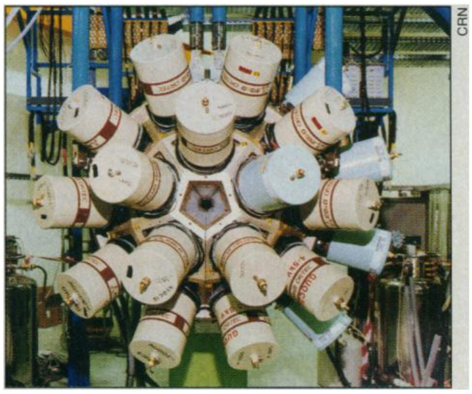
DeVight is hoping for the best—and expecting something short of that. "I'd give it a 25% chance of success," he says about the prospects for change. "But you have to start somewhere."

–Jeffrey Mervis

NUCLEAR STRUCTURE

Broken Belt Sets Back New Accelerator

Even the largest, most high-tech scientific projects can sometimes grind to a halt because of the failure of the most mundane mechanical components—a loose nut, an unspooled tape recorder, a broken seal. Take the case of the Vivitron, an 18-month-old electrostatic accelerator that is one of Europe's top facilities for nuclear structure research. A rapidly disintegrating rubber belt brought research on the machine to a standstill last March, and engineers at its home, the Center for Nuclear Research (CRN) in Strasbourg, France, have spent the past 9 months trying to solve the problem. Now, with fingers crossed, they hope that a new belt installed last month will get things moving again. "The new belt ... is functioning correctly. The beam is now stable, and the precision of the beam is according to the specifications. We are now ready to do physics runs," says Jean-Pierre Vivien, CRN's deputy director for research.



Revivified? Work with the Eurogam gamma-ray spectrometer should resume soon.

The Vivitron is a Van de Graaff electrostatic accelerator, designed to boost heavy ions with fields of up to 35 million volts. Unlike particle physicists, who smash particles together and look at the debris, users of the Vivitron aim to fuse colliding nuclei and study the resulting large nucleus. If the collision is off-axis, the fused nucleus will spin at up to 10^{20} rotations per second and become flattened out by centrifugal forces—what nuclear physicists call a "superdeformed" nucleus. "These nuclei are very rigid structures," says Vivien, "and their deformation allows us to study the structure of the nucleus, because its layered structure becomes changed during the deformation."

At the heart of the Vivitron is a fabric belt coated with rubber that runs at 10 meters per second, picking up electric charge at one end of the machine and depositing it at a central electrode, building up the required positive voltage over a few hours. This apparatus is sealed inside a 50-meter-long enclosure, shaped like two ice cream cones joined together at their open ends and filled with sulfur tetrafluoride gas to prevent sparks. Researchers inject beams of negative ions in one end of the enclosure, and the electric field of the central electrode pulls them toward it. At the center, the negative ions pass through a carbon sheet that strips off several electrons. The resulting positive ions pass through the electrode, and the field pushes them toward the other end of the machine, where they collide with a target material.

Construction of the Vivitron began in 1986, and it opened for business in June 1994 (*Science*, 21 October 1994, p. 362). It operated almost continuously until March of this year, when its original rubber belt was worn out. The Vivitron team had two spares made by the same manufacturer, but to their surprise "these belts were catastrophic to the machine," says Vivien. "We found that we had to increase continuously the voltage to deposit the same amount of charge on the belt, and after a while, because there was too much energy dissipation in the belt, it started to disintegrate." Engineers traced the problem to new coatings the manufacturer had applied on the spare belts—polyurethane instead of nitrile rubber. "The manufacturer had changed the production method without informing us," adds Vivien.

The original manufacturer was not willing to supply belts produced by the older nitrile rubber method, but in the end the Vivitron engineers were able to find an Italian belt manufacturer who could help out. "They were prepared to return to an old method of manufacturing, especially for us," says Vivien. "The only belt problem left was a problem of gluing its components together. We asked a company to do this, and it has been done properly."

The hiatus has significantly delayed some research projects, however. The major victim was Eurogam, an Anglo-French gamma-ray spectrometer for studying superdeformed nuclei. This spherical detector array was first used at Britain's Daresbury Laboratory before its accelerator was shut down in 1993. Before its debut with the Vivitron, researchers increased the number of individual detectors in the array from 45 to 54. "From September 1994 we had about 3 months of running. [Then] we managed to do experiments in laboratories in other parts of the world to lessen the effect [of the stoppage]," says Paul Nolan of Britain's Liverpool University, a principal investigator with Eurogam. "We are 9 months behind because of the delays in Strasbourg."

As soon as the Vivitron is running again, Eurogam will return to center stage. "The next phase of the operation is to spectroscopically check that [superdeformed] states decay the way they are predicted to, and to measure their lifetime," says Nolan. "We will also look for more exotic deformed shapes, the so-called 'hyperdeformed' shapes, which have a 3-to-1 axis ratio." Nolan and his colleagues are eager to put the revivified Vivitron through its paces.

–Alexander Hellemans

Alexander Hellemans is a writer in Amsterdam.