an overall annual budget of $280 million. The research ministry's refusal to heed this advice has plunged Germany's genome community into despondency. "There's a real danger that with genomics, just like with microelectronics, Germany is going to miss out on another scientific revolution—which will seriously jeopardize its future as a high-tech country," says Lehrach. "It's like we're on the *Titanic* and nobody's interested in icebergs." Balling admits that the scientific community has to take part of the blame. "Obviously we weren't able to communicate the prime importance of genome research. Space scientists, for instance, succeeded in speaking with one voice. That's something we still have to learn," he says.

At last week's meeting, researchers did express some hopes that, when the genome effort moves from brute sequencing to sifting through the data to tease out the roles genes play in cells and organisms, the DHGP's vice—a watering-can approach to funding—may turn into a virtue. "In the U.S. there are fewer and fewer people with bigger and bigger institutes [that get most of the funding]. For functional genomics that is not the way to go; you don't need gigantic institutions for that," says Cox. But even small, specialized functional genomics groups need funding, and making this point loud and clear in Munich was a big step for the genomics community. Says Cox, "If policy-makers still don't understand [the impact of genome research], there's no hope for them."

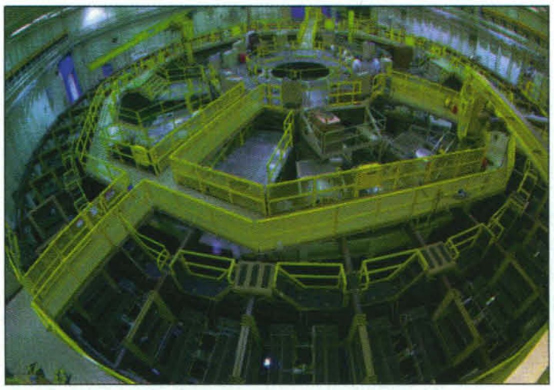
–MICHAEL HAGMANN

ASTROPHYSICS

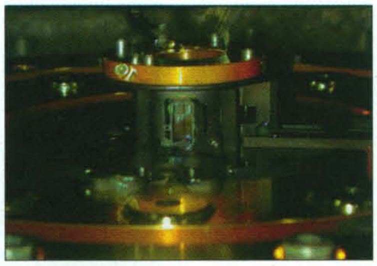
Z Mimics X-rays From Neutron Star

When a massive object such as a neutron star or a black hole steals matter from a companion star, the process is anything but stealthy. Material cascading from the star to its greedy partner forms a disk and heats up, illuminating the in-falling material and surrounding gas with a blaze of x-rays in one of the cosmos's more spectacular displays. The spectrum of the x-rays could reveal the temperature and density of the accretion disk and the forces that shape it—if only astrophysicists knew how to read the spectral clues. Computer models are de rigueur, but until recently astrophysicists had nothing on Earth against which to check their results. Now, thanks to an earth-shaking experiment at Sandia National Laboratories in Albuquerque, New Mexico, they do.

The key is Sandia Laboratories' Z-pinch machine, known to its users simply as Z and ordinarily used for defense and fusion research. To anybody who has derived a perverse pleasure from shooting sparks across the terminals of a car battery, Z is the ultimate thrill, the world's greatest fuse blower. At the flick of a switch, an 18-million-amp current surges through a cylindrical array of 300 fine tungsten wires, each just 10 micrometers in diameter. The immense current creates a magnetic field that squeezes the wires toward the center of the cylinder at nearly the speed of light. When the wires collide, they vaporize to create a hot ionized gas, or plasma, that spawns a mighty 120-terawatt blast of x-rays—making Z the world's most powerful x-ray source.



Hell on Earth. At the heart of the Z machine, the world's most powerful x-rays vaporize a small iron foil *(below)* to simulate conditions found near a neutron star.



"When you set off Z the whole building shakes, the ground shakes. You can feel it for a few hundred meters in any direction," says Robert Heeter of Lawrence Livermore National Laboratory in California, a plasma physicist who will present the first results of the effort to mimic astrophysical x-rays with Z at a workshop at the Goddard Space Flight Center in mid-December. "It's very exciting."

Even more exciting for Heeter and his colleagues is what the x-ray blast does to an iron-foil target next to the cylinder. "Iron is a very popular element amongst astrophysicists," says Mark Foord, the Livermore plasma physicist who heads the Sandia-Livermore collaboration along with Sandia's James Bailey. Iron, Foord explains, is easy to spot at x-ray wavelengths and is abundant in space. "It's found in almost every astrophysical body."

As a result, researchers often study iron as a stand-in for cosmic matter in general. But features of the spectrum of highly ionized iron are "notoriously complex" to predict, says Andrew Fabian of the Institute of Astronomy in Cambridge, U.K., which makes it difficult to turn iron spectra gleaned from satellites such as the Chandra X-ray Observatory into astrophysical know-how. "We can't calculate the relation between temperature, density, and line brightness directly; we have to observe it," adds Stanford Woosley, an astrophysicist at the University of California, Santa Cruz.

That is where Z comes in. Literally in a flash, it rips anywhere from 10 to 16 of the 26 electrons off each iron atom, converting the foil into a thin, highly ionized gas whose spectrum mimics that of the iron in the gas cloud of the cosmic x-ray source. "Instead of having a neutron star, we're using the Z machine x-rays as our x-ray source," Foord says. "We're watching what the effects are of those x-rays on our target and trying to reach similar conditions that are found out in space."

The name of the game, says Woosley, is "to study how iron behaves in some of the most extreme conditions in the universe so that when we see emission lines of iron, we can use those lines to understand stars and black holes so dense and exotic that most of their emission comes out as x-rays." One prize, Foord says, will be the ability to work out the sizes, shapes, and compositions of the accretion disks in binary systems. And if astronomers can quantify the relation between the accretion rate and the x-ray brightness, they could estimate how hungrily one partner in a binary system is gathering in matter—a clue to whether it is, for example, a white dwarf or a neutron star.

Fabian thinks iron spectra may not bare all the secrets of neutron stars and black holes, because their motion and gravity will blur the x-ray emission. But he says the spectra "will be very important for modeling the gas in clusters of galaxies and stars." Astronomers would like to study the x-rays emitted by the gas for clues to where shock waves are heating it and where supernovae have exploded.

"What they're doing at Sandia couldn't be done elsewhere," says astrophysicist Francis Keenan, who with his colleagues at Queens University, Belfast, is part of the worldwide consortium of groups working with the Sandia-Livermore team. But the accretion disk of knowledge will grow if funding allows more earth-shaking astrophysics with Z, along with studies on Z's smaller sibling, Saturn. "I think this work in general, of using plasmas in the laboratory to mimic very faraway plasmas in astronomy, is going to be very important over the next few years," says Keenan. –ANDREW WATSON

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

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