ASTROPHYSICS

Neutron Stars Spin Out Gravity Waves

Newborn neutron stars may be powerful beacons of gravitational waves, the ripples in the fabric of space-time predicted by Einstein's theory of gravity. Calculations reported in the 1 June *Physical Review Letters* suggest that just after a giant star collapses to form a neutron star, the hot, superdense matter quivers in a way that sheds large amounts of energy and angular momentum into gravitational waves. In as little as a year, the process could slow a spinning neutron star from 1000 rotations a second to a leisurely 100, which may explain why astronomers have never spotted a fast-spinning young neutron star. "Why you don't see young neutron stars spinning fast has long been a puzzle," says Kip Thorne, a Caltech astrophysicist. "Now there is a compelling explanation."

Although no one has directly detected gravitational radiation, Einstein's theory holds that clumps of matter emit it when they shake or move, just as moving charged particles spew electromagnetic radiation. People, cars, and even Earth emit only trivial amounts of gravitational radiation. But under the right circumstances, supermassive objects like neutron stars can shed vast amounts of energy and momentum as gravitational waves.

Neutron stars should be born with plenty of angular momentum, because they form in supernovae—the explosions triggered when a giant star suddenly collapses to a tiny fraction of its radius. The progenitor star may be spinning slowly, but it revs up when it collapses, like the proverbial skater drawing in his arms. Yet the highest spin rates are seen not in newborn neutron stars but in older, cooler stars that have gained spin when a companion star dumped material on their surface.

Theorists have known for some time that neutron stars can lose spin through gravitational radiation, but they thought that the loss was minor. The sloshing that generates the gravity waves, they thought, would be damped by friction in the fluid of neutrons and electrons making up the star.

Last year, though, Nils Andersson of Washington University in St. Louis found that a type of vibration pattern, or mode, in the rotating star grew stronger instead of weaker when the star emitted gravitational radiation. Called r-modes, the vibrations are a bit like the currents in oceans, says Lee Lindblom, an astrophysicist at Caltech. Lindblom and his Caltech colleague Benjamin Owen, with Sharon Morsink, a physicist at the University of Wisconsin, Milwaukee, have now calculated the exact strength of the interaction between gravitational radiation and the r-modes. They found that in the hot fluid of a young neutron star, the feedback leads to gravitational radiation so powerful that it slams the brakes on the star's spin.

Although experimentalists are now building a huge gravitational wave detector called LIGO, it is designed to detect the much more powerful waves that might be emitted when two neutron stars collide. Thorne says that after a round of enhancements, LIGO might be able to pick up the gravitational waves from a newborn neutron star. But in the short term, prospects for detection aren't bright, says Lars Bildsten, an astrophysicist at the University of California, Berkeley: "Having said that, I find just the astrophysical implication of the rapid spindown very exciting."

–Meher Antia

Meher Antia is a science writer in Vancouver.

ASTRONOMY

Giant Survey Wallpapers the Sky

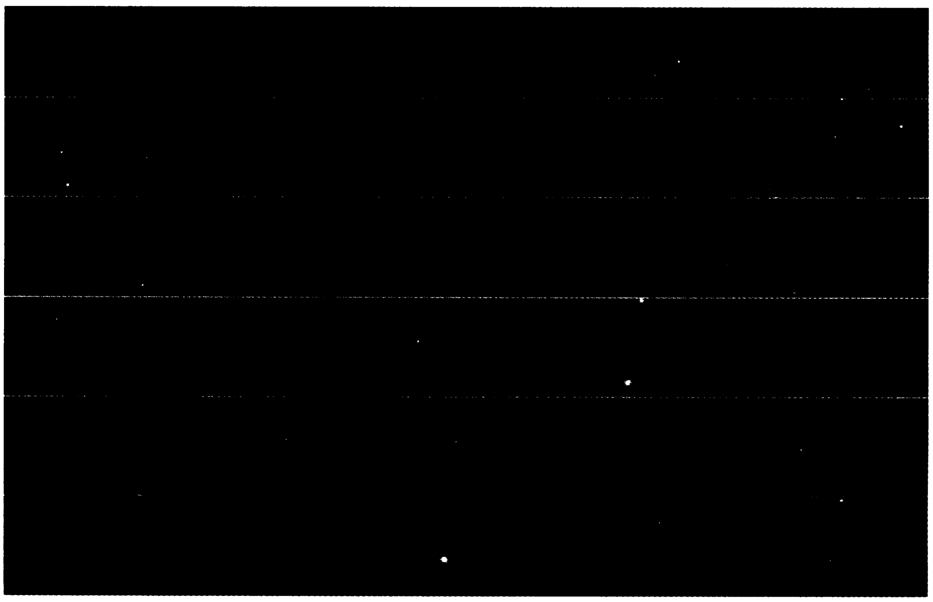
SAN DIEGO—A roll of photographic film 10 paces long marks the first step in a survey that will reach billions of light-years into space. The Sloan Digital Sky Survey's electronic camera, mounted on a 2.5-meter telescope in New Mexico, collected its first images of stars, galaxies, and quasars on the nights of 9 and 10 May (*Science*, 29 May, p. 1337). Converted into a photographic scroll, just 1% of the data from the first night drew gasps last week when five members of the team unrolled it during a press conference here at a meeting of the American Astronomical Society.

This first glimpse of the Sloan universe revealed a panoply of galaxies so varied that Michael Shull, an astrophysicist at the University of Colorado, Boulder, initially thought it could only be a computer simulation. "Oh, this is data?" asked a surprised Shull. "Right before us we're seeing the whole zoo of galactic morphology types. Here's a lovely one—an edge-on spiral," he said as he began scanning the images more closely.

After an initial shake-out period, the Sloan—a collective effort of eight universities and other institutions—will collect images of roughly 200 million objects over 5 years. The project will also determine "redshifts," or approximate distances, to the million brightest galaxies, revealing the large-scale structure of our corner of space. Equipped with six rows of charge-coupled devices—electronic light-gathering elements—the Sloan camera gathers the data across six strips of sky at once, in five colors, as Earth's rotation slowly pans the fixed telescope across the sky. "Not only are we wallpapering the sky, but our machine is doing six rolls at once," said Michael Turner of the University of Chicago, the Sloan survey's spokesperson. Eight minutes of data are shown below.

There were no major problems getting the enormously complicated camera working the first time, says Constance Rockosi, a team member at the University of Chicago: "When we put it on the telescope and opened up the shutter, it worked."

–James Glanz



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