

GLUTTONOUS COSMIC 'BLACK WIDOW' IS HEAVIEST-KNOWN NEUTRON STAR

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A spinning neutron star periodically swings its radio (green) and gamma-ray (magenta) beams past Earth in this artist's concept of a black widow pulsar. | Photo Credit: via Reuters

Astronomers have observed the most massive known example of an object called a neutron star, one classified as a "black widow" that got particularly hefty by gobbling up most of the mass of a stellar companion trapped in an unhappy cosmic marriage.

The researchers said the neutron star, wildly spinning at 707 times per second, has a mass about 2.35 times greater than that of our sun, putting it perhaps at the maximum possible for such objects before they would collapse to form a black hole.

A neutron star is the compact collapsed core of a massive star that exploded as a supernova at the end of its life cycle. The one described by the researchers is a highly magnetized type of neutron star called a pulsar that unleashes beams of electromagnetic radiation from its poles. As it spins, these beams appear from the perspective of an observer on Earth to pulse - akin to a lighthouse's rotating light.

Only one other neutron star is known to spin more quickly than this one.

"The heavier the neutron star, the denser the material in its core," said Roger Romani, director of Stanford University's Center for Space Science and Astrophysics and a co-author of the research published this week in the *Astrophysical Journal Letters*.

"So as the heaviest neutron star known, this object presents the densest material in the observable universe. If it was any heavier it should collapse to a black hole, and then the stuff inside would be behind the event horizon, forever sealed off from any observation," Mr. Romani added.

A black hole's event horizon is the point of no return beyond which anything including light gets sucked in irretrievably.

"Since we don't yet know how matter works at these densities, the existence of this neutron star is an important probe of these physical extremes," Mr. Romani said.

The neutron star, residing in our Milky Way galaxy in the direction of the constellation Sextans and formally named PSR J0952-0607, is located roughly 20,000 light years from Earth, Romani said. A light year is the distance light travels in a year, 5.9 trillion miles (9.5 trillion km). The researchers studied it using the Keck I telescope in Hawaii.

Stars that are about eight or more times the sun's mass transform hydrogen into heavier elements through thermonuclear fusion in their cores. When they build up about 1.4 times the mass of our sun in iron, that core collapses into a neutron star having a diameter only about the size of a city, with the rest blown off in the supernova explosion.

Its matter is so compact that an amount about the size of a sugar cube would outweigh Mount Everest.

This neutron star inhabits what is called a binary system, in an orbit with another star. The neutron star is a kind dubbed a "black widow," named in honor of female black widow spiders that eat their male partners after mating.

It apparently was born with the usual mass of a neutron star, about 1.4 times that of our sun, but its gravitational pull poached material from its companion star, enabling it to grow to a mass seemingly at the uppermost limit before physics would dictate a collapse into a black hole, the densest of all known objects.

Its companion star has been stripped almost bare, losing perhaps 98% of its mass to the black widow, leaving it at about 20 times the mass of our solar system's largest planet Jupiter — a far cry for its original size.

"It has swallowed nearly a full sun's worth of mass without yet becoming a black hole. So it should be just on the edge of black hole collapse," Mr. Romani said.

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