Discovered: A New Kind of Pulsar

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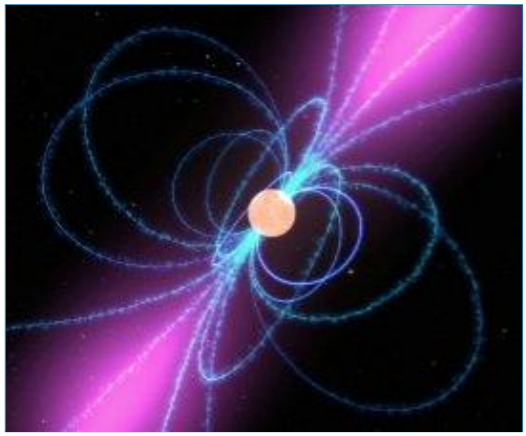
Oct. 17, 2008: About three times a second, a 10,000-year-old stellar corpse sweeps a beam of gamma-rays toward Earth. Just discovered by NASA's Fermi Gamma-ray Space Telescope, the object, called a pulsar, is the first one known that "blinks" in pure gamma rays.

"This is the first example of a new class of pulsars," says Stanford University's Peter Michelson, principal investigator for Fermi's Large Area Telescope. "[We think] it will give us fundamental insights into how these collapsed stars work."



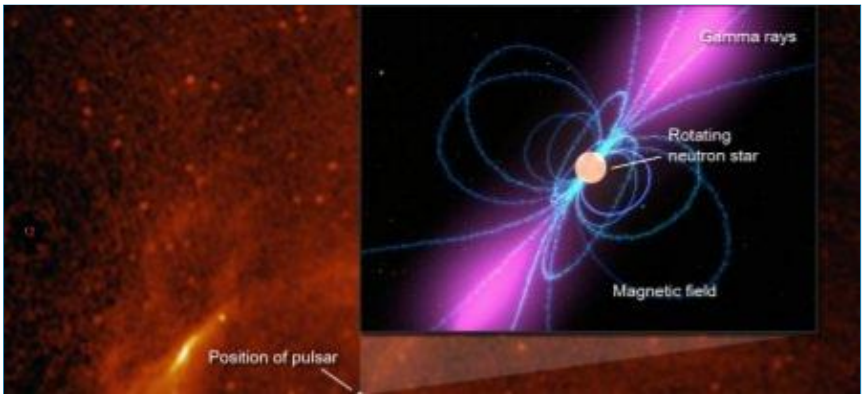
Right: An artist's concept of the newly discovered pulsar. Clouds of charged particles move along the pulsar's magnetic field lines (blue) and create a lighthouse-like beam of gamma rays (purple). [Larger image]

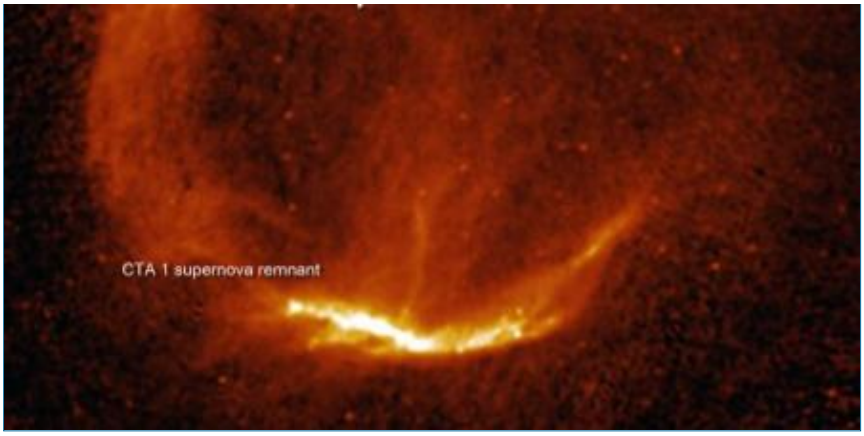
Pulsars were first discovered in 1967 by student radio astronomer Jocelyn Bell and her thesis advisor Tony Hewish. The radio pulses they recorded were uncannily steady--so much so that some astronomers wondered if they were picking up signals from extraterrestrial civilizations. The correct explanation was even stranger: Pulsars are spinning neutron stars packing the mass of the sun into a sphere about 20 km across. Whirling around thousands of times each hour, they beam radio pulses into the cosmos in the style of a rapidfire lighthouse.

Since then, about 1800 pulsars have been discovered mainly via their radio emission. A fraction of pulsars go beyond radio; they also emit pulses of visible light, X-rays, and even high-energy gamma-rays. This discovery by Fermi is different because it is a purely gamma-ray pulsar. The star is silent across parts of electromagnetic spectrum where pulsars are normally found and hints at a whole population of previously unsuspected pulsars waiting to be picked out of the heavens.

The gamma-ray-only pulsar lies within a supernova remnant known as CTA 1 located about 4,600 light-years away in the constellation Cepheus. Its lighthouse-like beam sweeps Earth's way every 316.86 milliseconds. The pulsar, which formed in a supernova explosion about 10,000 years ago, emits 1,000 times the energy of our sun.

"The Large Area Telescope provides us with a unique probe of the galaxy's pulsar population, revealing objects we would not otherwise even know exist," says Fermi project scientist Steve Ritz of the Goddard Space Flight Center.





Above: The pulsar is not located at the center of the surrounding supernova remnant CTA 1. Click on the image to view a larger map.

The pulsar in CTA 1 is not located at the center of the supernova's expanding gaseous shell. Supernova explosions can be asymmetrical, often imparting a "kick" that sends the neutron star careening through space. Based on the remnant's age and the pulsar's distance from its center, astronomers believe the neutron star is moving at about a million miles per hour -- a typical speed for neutron stars.

Fermi's Large Area Telescope scans the entire sky every three hours and detects photons with energies ranging from 20 million to more than 300 billion times the energy of visible light.

"This observation shows the power of the Large Area Telescope," Michelson adds. "It is so sensitive that we can now discover new types of objects just by observing their gamma-ray emissions."

A paper about the new pulsar appears in the Oct. 16 edition of Science Express.

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