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DIGEST

DANIELLE FUTSELAAR AND NATHALIE DEGENAAR, UNIVERSITY OF AMSTERDAM

Artist's impression of a neutron star, consuming nearby star and producing an ultra-fast jet.

The Australia Telescope Compact Array, CSIRO.

ALEX CHERNEY / CSIRO

Cosmic speed camera reveals staggering pace of neutron star jets

How fast, you ask? One-third of the speed of light.

IN A WORLD FIRST, astronomers have measured the speed of a neutron star's powerful jets. Turns out these energetic beams of energy and matter travel at 114,000 km per second – or about one third of the speed of light.

Neutron stars are among the densest objects in the universe. They form when a *supergiant* star, 10–25 times the mass of our Sun, runs out of fuel and its core collapses in on itself. A neutron star is only a few tens of kilometres across, but weighs between one and three times as much as the Sun. A single teaspoon of neutron star material weighs about a trillion kilograms.

Because they are so dense, neutron stars have an immense gravitational pull. Sometimes they pull matter in from other nearby stars. This can cause thermonuclear explosions which shoot matter out into space.

Until now, astronomers knew virtually nothing about these jets, including their speed. But in this latest study, the jets were detected by the European Space Agency's Integral observatory and then tracked for three days by the CSIRO's Australia Telescope Compact Array (ATCA) to determine their speed.

"The explosion tells us when the enhanced jets were launched, and we simply time them as they move downstream – just like we would time a 100-metre sprinter as they move between the starting blocks and the finish line," says co-author James Miller-Jones, from Curtin University node of the International Centre for Radio Astronomy Research.

"Radio telescopes are extremely versatile," says leader of ATCA operations, Jamie Stevens, who is not an author on the recent paper. "Five of ATCA's six dishes, for instance, take on different configurations by moving along a track. [The array] can be used to look at everything from nearby objects in our galaxy to some of the most distant objects in the universe.

"The sensitivity and stability of ATCA allowed this research team to observe rapid changes in the neutron star's surroundings over three days. This new method will help astronomers to better understand jets in many different environments and the complex events that build our universe."

The results of the study – led by Thomas Russell from the Italian National Institute of Astrophysics in Palermo – are published in *Nature*.