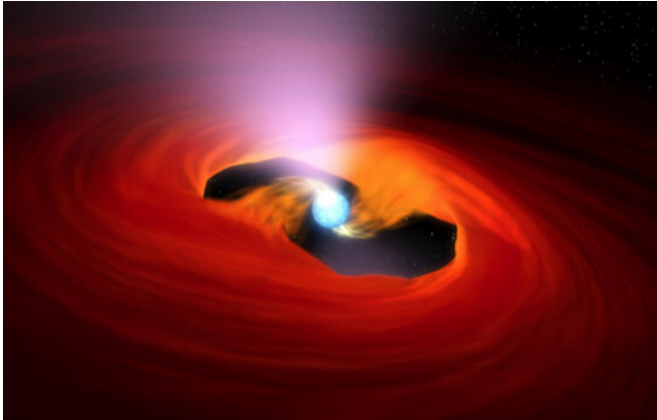


Astronomers capture a pulsar 'powering up'

2 June 2020, by Silvia Dropulich



An accreting pulsar. Credit: [NASA/JPL-Caltech](#)

A Monash-University-led collaboration has, for the first time, observed the full, 12-day process of material spiraling into a distant neutron star, triggering an X-ray outburst thousands of times brighter than our Sun.

The research, led by Ph.D. candidate Adelle Goodwin from the Monash School of Physics and Astronomy will be featured at an upcoming American Astronomical Society meeting this week before it is published in *Monthly Notices of the Royal Astronomical Society*. Adelle leads a team of international researchers, including her supervisor, Monash University Associate Professor Duncan Galloway, and Dr. David Russell from New York University Abu Dhabi.

The scientists observed an 'accreting' neutron star as it entered an outburst phase in an international collaborative effort involving five groups of researchers, seven telescopes (five on the ground, two in space), and 15 collaborators.

It is the first time such an event has been observed in this detail—in multiple frequencies, including high-sensitivity measurements in both optical and X-ray.

The physics behind this 'switching on' process has eluded physicists for decades, partly because there are very few comprehensive observations of the phenomenon.

The researchers caught one of these accreting neutron star systems in the act of entering outburst, revealing that it took 12 days for material to swirl inwards and collide with the neutron star, substantially longer than the two- to three-days most theories suggest.

"These observations allow us to study the structure of the [accretion disk](#), and determine how quickly and easily material can move inwards to the neutron star," Adelle said.

"Using multiple telescopes that are sensitive to light in different energies we were able to trace that the initial activity happened near the [companion star](#), in the outer edges of the accretion disk, and it took 12 days for the disk to be brought into the hot state and for material to spiral inward to the neutron star, and X-rays to be produced," she said.

In an 'accreting' neutron star system, a pulsar (a dense remnant of an old star) strips material away from a nearby star, forming an accretion disk of material spiraling in towards the pulsar, where it releases extraordinary amounts of energy—about the total energy output of the sun in 10 years, over the period of a few short weeks.

The pulsar observed is SAX J1808.4-3658 which rotates at a rapid 400 times per second and is located 11,000 light-years away in the constellation Sagittarius.

"This work enables us to shed some light on the physics of accreting [neutron](#) star systems, and to understand how these explosive outbursts are triggered in the first place, which has puzzled astronomers for a long time," said New York University Abu Dhabi researcher, Dr. David Russell, one of the study's co-authors.

Accretion disks are usually made of hydrogen, but this particular object has a disk that is made up of 50% helium, more helium than most disks. The scientists think that this excess helium may be slowing down the heating of the [disk](#) because helium 'burns' at a higher temperature, causing the 'powering up' to take 12 days.

The telescopes involved include two space observatories: the Neils Gehrels Swift X-ray Observatory, and the Neutron Star Interior Composition Explorer on the International Space Station; as well as the ground based Las Cumbres Observatory network of telescopes, and the South African Large Telescope.

Provided by Monash University

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