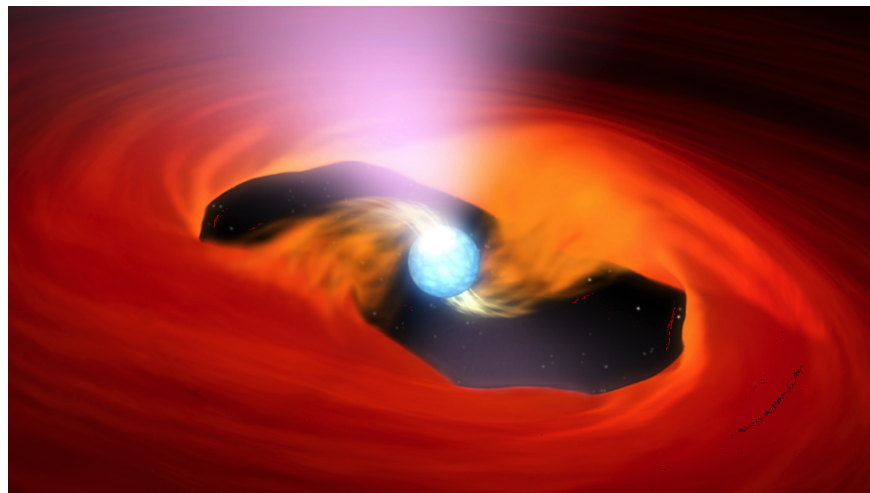


# Astronomers watch a dead star 'power up' for the first time

A pulsar gobbling up its companion star gives scientists an unprecedented look at some of the universe's most bizarre phenomena.

Stars are voracious eaters. That's a fact of life in the harsh wilderness of space. Debris, planets and even other stars are all on the menu at the Universe Buffet. And pulsars, a kind of neutron star, can be messy eaters. Sometimes when they devour their companion stars, they can vomit out a huge amount of energy. For the first time, astronomers have captured the moments leading to this violent outburst in exquisite detail.

A new study, presented at the virtual American Astronomical Society conference on Monday, details the extreme outburst of SAX J1808.4-3658 (let's call it SAX), an accreting neutron star approximately 11,000 light-years from Earth that spins unfathomably fast, making 401 rotations every *second*. This is par for the course, though, in neutron star terms because these bizarre cosmic beasts are responsible for some of the most extreme physics we see in the universe.



"Neutron stars are so dense that if you cupped your hands together and filled them with neutron star material, on Earth you would be holding something that weighs about five Mount Everests," says Adelle Goodwin, doctoral candidate at Monash University, Australia and lead author on the new paper. Because they're so dense, they produce some of the most powerful gravitational fields in the universe.

And those extreme physics are partly what makes them so captivating for astronomers like Goodwin. Her research is focused particularly on "accreting neutron stars" -- those surrounded by disks of gas and debris. These types of pulsars are in orbit with a "normal" star (like our sun) and because of their huge gravity, they siphon off material from the star over "months to years", according to Goodwin. Eventually, they pull in enough

material that it heats up and spirals into the star, resulting in a huge outburst, releasing energy thousands of times more powerful than the sun.

Goodwin and a team of international collaborators were watching SAX with seven different telescopes, including NASA's Swift X-ray Observatory and the NICER instrument aboard the International Space Station. Catching a star in the act of outburst, or "powering up" as Goodwin calls it, is incredibly rare but the team knew an outburst was coming in 2019 thanks to previous analysis of SAX, which meant they were able to focus various instruments on the star that observe it in different wavelengths of light.

"What we saw was the accreting pulsar transitioning into the outburst state, and we were watching with seven telescopes for the whole process," says Goodwin. "These outbursts are not common, and we usually don't catch them until they are very bright."

The team measured the delay between detecting bright optical light from SAX and the energetic X-ray outburst. But when they sifted through their observations, Goodwin and her team saw something unexpected.

"This powering up process took much longer than the theory suggests it should," says Goodwin. Current theories suggest the powering up process should take about two to three days, but the delay observed by the team was 12 days long. They suggest this delay could be because the disk of dust and gas around SAX is made up of more helium than most disks. This may have slowed down the powering up process.

"This could definitely be explained by different hypotheses and is challenging to understand because it contradicts the theory," Goodwin notes.

Unravelling the reasons for this delay will require a closer look at SAX, a system that Goodwin is becoming pretty familiar with. "You could say it's my favorite accreting neutron star system," she says. Scientists predict outbursts for this system occur once every four years, so Goodwin says the team will patiently wait to see it again around 2023. Until then, they plan on targeting similar accreting neutron stars (there are only 18 we know of) to see if they can pull apart the mystery a bit more.

The work will be published in the journal Monthly Notices of the Royal Astronomical Society and is available on preprint server arXiv from Friday.

You finished reading the article "**Astronomers watch a dead star 'power up' for the first time**" edited by the [TipsMake](#) team. We hope this article has provided you with many useful tech tips and tricks. You can search for similar articles on tips and guides. Thank you for reading and for following us regularly.