



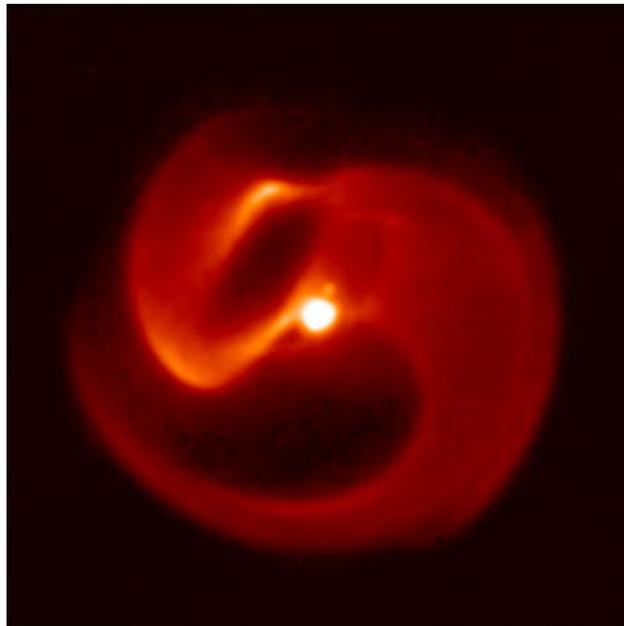
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Doomed star in Milky Way threatens rare gamma-ray burst



University of Sydney astronomers, working with international colleagues, have found a star system like none seen before in our galaxy.

The scientists believe one of the stars – about 8000 light years from Earth – is the first known candidate in the Milky Way to produce a dangerous gamma-ray burst, among the most energetic events in the universe, when it explodes and dies.

The system, comprising a pair of scorchingly luminous stars, was nicknamed Apep by the team after the serpentine Egyptian god of chaos. One star is on the brink of a massive supernova explosion.

The findings, [published today in *Nature Astronomy*](#), are controversial as no gamma-ray burst has ever been detected within our own galaxy, the Milky Way.

Yet in the southern constellation of Norma, nestled just beneath Scorpio's tail, astronomers have discovered this uniquely beautiful star system.

At its heart, wrapped in an elegantly sculpted plume of dust and gas, lies a powerful binary pair.

The two hot, luminous stars – known to astronomers as [Wolf-Rayets](#) – orbit each other every hundred years or so, according to the research conducted at the [Sydney Institute for Astronomy](#).

This orbital dance is embossed on a fast wind streaming off the stars. Using spectroscopy, the astronomers have measured the velocity of the stellar winds as fast as 12 million kilometres an hour, about 1 percent the speed of light.

[Dr Joe Callingham](#), lead author of the study, said: “We discovered this star as an outlier in a survey with a radio telescope operated by the University of Sydney.

“We knew immediately we had found something quite exceptional: the luminosity across the spectrum from the radio to the infrared was off the charts,” said Dr Callingham, who is now at the [Netherlands Institute for Radio Astronomy](#).

“When we saw the stunning dust plume coiled around these incandescent stars, we decided to name it ‘Apep’ – the monstrous serpent deity and mortal enemy of Sun god Ra from Egyptian mythology.”

That sculpted plume is what makes the system so important, said [Professor Peter Tuthill](#), research group leader at the University of Sydney.

“When we saw the spiral dust tail we immediately knew we were dealing with a rare and special kind of nebula called a pinwheel,” Professor Tuthill said.

“The curved tail is formed by the orbiting binary stars at the centre, which inject dust into the expanding wind creating a pattern like a rotating lawn sprinkler. Because the wind expands so much, it inflates the tiny coils of dust revealing the physics of the stars at the heart of the system.”

However, the data on the plume presented a conundrum: the stellar winds were expanding 10 times faster than the dust.

“It was just astonishing,” Professor Tuthill said. “It was like finding a feather caught in a hurricane just drifting along at walking pace.”

[Dr Benjamin Pope](#), a co-author from New York University, said: “The key to understanding the bizarre behaviour of the wind lies in the rotation of the central stars.

“What we have found in the Apep system is a supernova precursor that seems to be very rapidly rotating, so fast it might be near break-up.”

Wolf-Rayet stars, like those driving Apep's plume, are known to be very massive stars at the ends of their lives; they could explode as supernovae at any time.

“The rapid rotation puts Apep into a whole new class. Normal supernovae are already extreme events but adding rotation to the mix can really throw gasoline on the fire.”

The researchers think this might be the recipe for a perfect stellar storm to produce a gamma-ray burst, which are the most extreme events in the Universe after the Big Bang itself. Fortunately, Apep appears not to be aimed at Earth, because a strike by a gamma-ray burst from this proximity could strip ozone from the atmosphere, drastically increasing our exposure to UV light from the Sun.

“Ultimately, we can't be certain what the future has in store for Apep,” Professor Tuthill said.

“The system might slow down enough so it explodes as a normal supernova rather than a gamma-ray burst. However, in the meantime, it is providing astronomers a ringside seat into beautiful and dangerous physics that we have not seen before in our galaxy.”

This study was conducted using the [Anglo-Australian Telescope](#) at Coonabarabran and the [Very Large Telescope](#) in the Atacama Desert, Chile, and involved support from colleagues at the University of Edinburgh, University of Sheffield and the University of New South Wales.

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Download images of the star system, a GIF of the star system's rotation, pre-press PDF of the research and photographs of Professor Peter Tuthill [at this link](#).

Images and gifs with captions of the system in infrared [at this link](#).

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