Double-star systems cycle between big and small blasts

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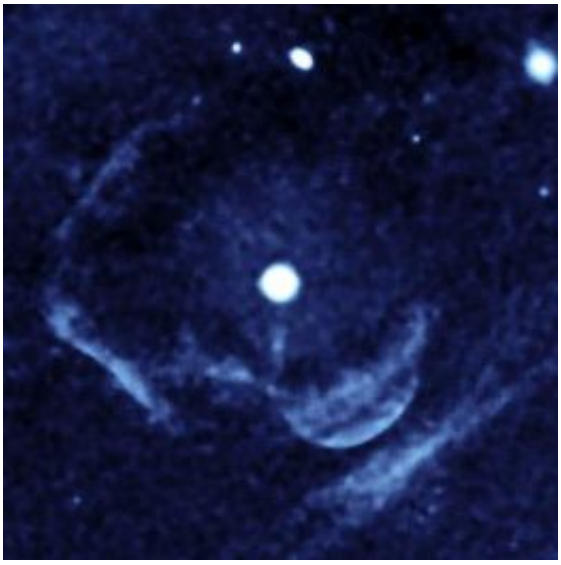

This image, from the far-ultraviolet detector on GALEX, was processed to enhance the appearance of the diffuse emissions from the shell around Z Cam. Credit: Image courtesy NASA/JPL-Caltech

Certain double, or binary, star systems erupt in full-blown explosions and then flare up with smaller bursts, according to new information gathered by NASA's Galaxy Evolution Explorer (GALEX) and analyzed by a team of astronomers, including postdoctoral researcher Mark Seibert of the Carnegie Observatories.

The data bolster a 20-year-old theory suggesting that double star systems

experience both explosion types, rather than just one or the other. It also implies that the systems cycle between blast types, hiccupping every few weeks with small surges and experiencing giant outbursts every 10,000 years or so.

The discovery, appearing in the March 8 issue of the journal *Nature*, centers around a binary system called Z Camelopardalis (Z Cam). Astronomers have long known Z Cam to be a cataclysmic binary—a system that features a collapsed, dead star, or white dwarf, which sucks hydrogen-rich matter from its companion like a stellar vampire. The stolen material forms an orbiting disk of gas and dust around the white dwarf.

Astronomers divide cataclysmic binaries into two classes—dwarf novae, which erupt in smaller, "hiccup-like" blasts, and classical novae, which undergo huge explosions. Classical novae explosions are 10,000 to one million times brighter than those of dwarf novae, and they leave behind large shells of shocked gas.

In 2003, Seibert examined ultraviolet images collected by GALEX during its Survey of Nearby Galaxies. He noticed a never-before-seen arc and linear features surrounding Z Cam that indicated the presence of a massive shell—evidence that the dwarf nova had in fact undergone a classical nova explosion a few thousand years ago. The features had remained invisible up to this point because they cannot be easily detected at optical wavelengths. However, they are easily seen at the ultraviolet wavelengths detected by GALEX.

"You could actually see it immediately, but we had to convince ourselves that we were really seeing a nova remnant," Seibert said. "If true, it would represent the largest nova remnant yet known. But it was especially shocking to find it associated with such a diminutive dwarf nova system. Everyone was skeptical and it took a considerable amount

of time and effort to be certain."

About 530 light years from Earth, Z Cam was one of the first dwarf novae ever detected. For decades, observers have watched the system hiccup with regular outbursts. It brightens about 40-fold every 3 weeks or so, when an instability causes some of the material drawn by the white dwarf to crash onto its surface. Theory holds that Z Cam and other recurring dwarf novae should eventually accumulate enough matter and pressure from their swirling disks of hydrogen to trigger gigantic classical novae explosions. But no one had found definitive evidence for this until Seibert's discovery in 2003.

Other team members confirmed that the structures detected by GALEX were indeed parts of a massive shell of gas surrounding Z Cam. Narrowband images from Kitt Peak National Observatory near Tucson, Ariz., Palomar Observatory near San Diego, Calif., and the Wise Observatory near Mizpe Ramon, Israel, along with optical spectroscopic measurements made at the Lick Observatory near San Jose, Calif., contributed to this verification.

"The new images are the strongest evidence yet in favor of the cyclic evolution scenario of these binary stars," said lead author Mike Shara of the American Museum of Natural History in New York. "It's gratifying to see such strong evidence for this theory finally emerge after all this time."

Source: Carnegie Institution