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A Fleeting Blue Glow

In the 2009 film “Star Trek,” a supernova hurtles through space and obliterates a planet unfortunate enough to be in its path. Fiction, of course, but it turns out the notion is not so farfetched.

Using the nearby Las Cumbres Observatory (LCO), astrophysicists from UC Santa Barbara have observed something similar: an exploding star slamming into a nearby companion star. What’s more, they detected the fleeting blue glow from the interaction at an unprecedented level of detail. Their observations revealed surprising information about the mysterious companion star, a feat made possible by recent advances in linking telescopes into a robotic network. The team’s findings appear in the journal Astrophyiscal Journal Letters.

The identity of this particular companion has been hotly debated for more than 50 years. Prevailing theory over the last few years has held that the supernovae happen when two white dwarfs spiral together and merge. This new study demonstrates that the supernova collided with the companion star that was not a white dwarf. White dwarf stars are the dead cores of what used to be normal stars like the sun.

“We’ve been looking for this effect — a supernova crashing into its companion star — since it was predicted in 2010,” said lead author Griffin Hosseinzadeh, a UCSB graduate student. “Hints have been seen before, but this time the evidence is overwhelming.”

The supernova in question is SN 2017cbv, a thermonuclear Type Ia, which astronomers use to measure the acceleration of the expansion of the universe. This kind of supernova is known to be the explosion of a white dwarf star, though it requires additional mass from a companion star to explode.

The UCSB-led research implies that the white dwarf was stealing matter from a much larger companion star — approximately 20 times the radius of the sun — which caused the white dwarf to explode. The collision of the supernova and the companion star shocked the supernova material, heating it to a blue glow heavy in ultraviolet light. Such a shock could not have been produced if the companion were another white dwarf star.

“The universe is crazier than science fiction authors have dared to imagine,” said Andy Howell, a staff scientist at LCO and Hosseinzadeh’s Ph.D. adviser. “Supernovae can wreck nearby stars, too, releasing unbelievable amounts of energy in the process.”

Co-author David Sand, an associate professor at the University of Arizona, discovered the supernova on March 10, 2017, in the galaxy NGC 5643. Only 55 million lightyears away, SN 2017cbv was one of the closest supernovae discovered in recent years, found by the DLT40 survey using the Panchromatic Robotic Optical Monitoring and Polarimetry Telescope (PROMPT) in Chile, which monitors galaxies nightly at distances less than 40 megaparsecs (120 million light-years). This was one of the earliest catches ever — within a day, perhaps even hours, of its explosion. The DLT40 survey was created by Sand and study co-author Stefano Valenti, an assistant professor at UC Davis; both were previously postdoctoral researchers at LCO.

Within minutes of discovery, Sand activated observations with LCO’s global network of 18 robotic telescopes, spaced around the Earth so that one is always on the night side. This allowed the team to take immediate and near-continuous observations.

“With LCO’s ability to monitor the supernova every few hours, we were able to see the full extent of the rise and fall of the blue glow for the first time,” Hosseinzadeh said. “Conventional telescopes would have had only a data point or two and missed it.”

Howell likened the event to gaining astronomical superpowers that give astronomers the ability to see the universe in new ways. “These capabilities were just a dream a few years ago,” he said. “But now we’re living the dream and unlocking the origins

of supernovae in the process.”

About UC Santa Barbara

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