Astronomers Identify a New Class of Cosmic Explosions

May 24 2007

Astronomers are announcing today the discovery of a new class of stellar explosions. The finding is based on observations of a flash seen in the Virgo cluster in a galaxy known as Messier 85.

According to Shrinivas R. Kulkarni, the team leader announcing the discovery of M85OT2006-1, the event is thought to have resulted from the merger of two ordinary stars 49 million years ago.

"The discovery of this enigmatic event is merely the proverbial tip of the iceberg for an emerging class of cosmic transients," says Kulkarni, the MacArthur Professor of Astronomy and Planetary Science at the California Institute of Technology. The team, which consists of astronomers from Caltech and the University of California at Berkeley, is announcing its findings in the current issue of the journal Nature.

The puzzling explosion was discovered during the Lick Observatory Supernova Search with the Katzman Automatic Imaging Telescope, carried out by Alex Filippenko and Weidong Li of UC Berkeley. "Though the primary scientific goal of the program is discovering supernovae and it's quite successful at doing that, it is gratifying to find new classes of transient objects such as M85OT2006-1," said Li, who is in charge of the daily operation of the supernova search.

Kulkarni and his Caltech colleagues had been speculating on possible new classes of cosmic explosions. They mounted a major follow-up program with the Palomar 60-inch telescope, the famous Hale 200-inch

telescope, and the Keck telescopes atop Mauna Kea, Hawaii. Later, other telescopes in Hawaii and Chile were pressed into service.

The explosion was surprising because it was far too faint for a supernova, in which a star literally explodes, but clearly too bright for a nova or a thermonuclear explosion from the surface of a white dwarf star. Arne Rau, a postdoctoral fellow working with Kulkarni, said, "I was simply floored. In a short time we went from speculation to a real discovery. It was an exciting moment for me."

It took astronomers nearly a century to identify two major classes of cosmic explosions: novae and supernovae. Forty years ago gamma-ray bursts were added to the astronomical lexicon. M85OT2006-1 solidifies and defines a new class of cosmic explosions that the Caltech astronomers have dubbed as Luminous Red Novae. These events have very distinct (red) color and expand quite slowly when compared with novae, supernovae, and gamma-ray bursts.

The galaxy in which M85OT2006-1 exploded is composed mainly of old stars, which also indicates that the event probably arose from a population of stars with masses very similar to that of the sun. More than a decade ago, one other similar but poorly studied event was observed in the Andromeda galaxy.

Kulkarni speculates that the red luminous novae result when two stars merge and undergo what is called "common envelope evolution." Kulkarni added, "The common envelope phase has been inferred on strong theoretical grounds, but is now caught in flagrante delicto."

In a related study, Rau undertook observations of M85OT2006-1 with NASA's Spitzer Space Telescope. The object is detectable in the mid infrared a year after the explosion, long after it became too faint in the visual, even for the Hubble Space Telescope. The Spitzer telescope is

particularly well suited for the study of cold matter in space. Rau added, "Spitzer was vital in confirming that this object is a cosmic oddball. It is hard to imagine both a bright explosion which is also so cold."

There is little doubt that the discovery of this new class of cosmic explosions will make astronomers inspect ongoing searches carefully for similar events. Future imaging surveys will likewise be energized by this discovery. Kulkarni added, "It is a nice feeling when you know you have created a new cottage industry in your field."

Besides Kulkarni and Rau, the other authors of the paper are Eran O. Ofek, Stephen B. Cenko, Alicia M. Soderberg, Avishay Gal-Yam, Peter L. Capak, and Dae-Sik Moon, all of Caltech; Derek B. Fox of the Pennsylvania State University; Li and Filippenko of UC Berkeley; Eiichi Egami of the Steward Observatory; and Jeyhan Kartaltepe and David B. Sanders of the University of Hawaii.

Source: Caltech