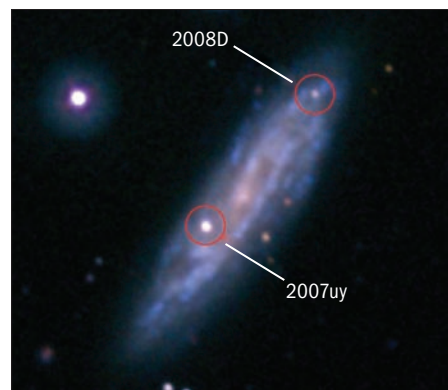
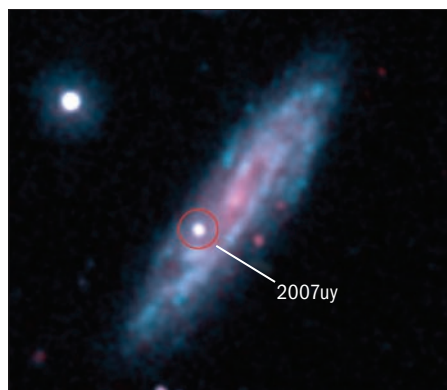


A supernova is caught in the act of exploding

Astronomers have, for the first time, observed a star in the act of exploding. The event happened in January while NASA's Swift satellite was observing another supernova in the same galaxy. The supernova explosion was preceded by an X-ray outburst of about seven minutes. This new milestone in the study of supernova explosions was published just a week after the announcement of the discovery of the remains of the most recent supernova in our galaxy.

Supernova explosions occur about twice a century in spiral galaxies. This is also the case in our galaxy as derived from the rate of radioactive aluminium decay observed by ESA's INTEGRAL satellite (*CERN Courier* January/February 2006 p10). It is therefore surprising that since the supernova observed by Johannes Kepler in 1604 (*CERN Courier* December 2004 p15), no other exploding star has been seen in the Milky Way. It was long suspected that some supernovae could have been missed due to dust absorption along the line of sight. The first evidence of a recent, unnoticed explosion comes from the dating of the supernova remnant Cassiopeia A (*CERN Courier* October 2004 p19), which is only about 330 years old. A team led by Stephen Reynolds from the North Carolina State University has now identified another remnant, G1.9+0.3, precisely dated to be only 140 years old, located close to the galactic centre. The remnant was observed to be rapidly expanding between 1985 and 2008 in radio images obtained by the Very Large Array (VLA) in New Mexico.

Because of the rate of only two supernovae



Images recorded on 7 and 9 January 2008 (left and right respectively) show how Swift caught supernova SN 2008D in the act of exploding, while monitoring SN2007uy. (Courtesy NASA Swift Team.)

per century, it is unlikely that two exploding stars can be seen simultaneously in the same galaxy, but it happened in the spiral galaxy NGC 2770. On 9 January 2008, while the Swift satellite performed on going observations of a first, one-month-old supernova, a second stellar explosion occurred. This time, Swift did not even have to use its rapid repointing ability – as it had for the supernova SN 2006aj following an X-ray flash (*CERN Courier* October 2006 p13). It was already pointing its optical, ultraviolet and X-ray telescopes towards the dying star.

The surprise was to observe a strong X-ray outburst lasting about 400 s and preceding the supernova detection in visible light by 1.4 h. Although very luminous, the X-ray outburst was not detected in gamma-rays and is about thousand times less energetic than typical gamma-ray bursts.

The analysis of the multi-wavelength

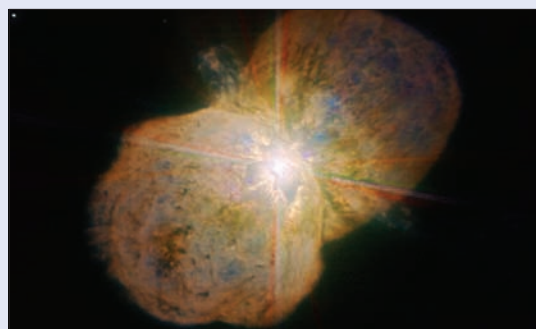
observations of SN 2008D has been published in *Nature* by an international group led by Alicia Soderberg from Princeton University. They show that the supernova is of type Ibc, the kind of stellar explosions associated with long gamma-ray bursts and X-ray flashes. However, they have no evidence of relativistic motion, and suggest that the X-ray outburst is not from a highly relativistic jet but is radiation associated with any normal supernova. The origin of the X-ray outburst would be the “shock break-out”, when the ejected material, having bounced off the collapsed stellar core, crosses the surface of the dying star. But other astronomers interpret the outburst as a weak X-ray flash, the low-energy cousin of gamma-ray bursts.

Further reading

S P Reynolds *et al.* 2008 *ApJ* **608** L41.

A M Soderberg *et al.* 2008 *Nature* **453** 469.

Picture of the month



On the 10th anniversary of the Very Large Telescope, the European Southern Observatory (ESO) has released a stunning view of Eta Carinae, the most luminous star known in the Galaxy. Located about 7500 light-years away in a very active star-forming region (*CERN Courier* June 2007 p12), Eta Carinae is actually a very complex system of two massive stars with interacting winds producing energetic X-rays detected by the INTEGRAL satellite. It is surrounded by an expanding bipolar cloud of dust and gas known as the Homunculus (“little man” in Latin), which astronomers believe was expelled from the star during a great outburst seen in 1843. The fine structure of this near-infrared image, obtained thanks to adaptive optics correcting the blurring effect of the atmosphere, is just as detailed as the famous optical image of 1996 by the Hubble Space Telescope. (Courtesy ESO.)