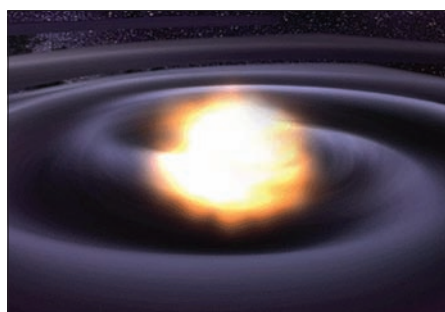
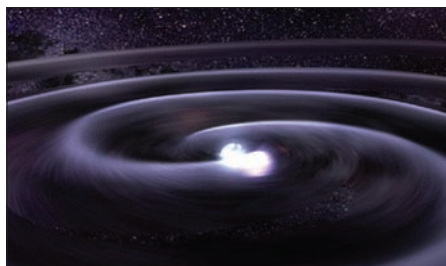


When white dwarfs collide...

A peculiar supernova discovered last year could be the first that is known to have originated from the coalescence of two white dwarfs. These compact stars orbiting each other slowly spiralled inward until they merged, triggering the giant explosion.

A supernova is the explosion of a star that, for several days, becomes as luminous as about thousand million stars similar to the Sun. They are bright enough to be detected in remote galaxies (*CERN Courier* October 2007 p13). Astronomers classify them according to whether their spectrum shows evidence of hydrogen (Type II), or not (Type I). This difference in spectrum reflects a completely different explosion mechanism. Type II supernovae (SN II) originate from the core collapse of massive, short-lived stars running out of nuclear power, whereas the most common Type I supernovae (SN Ia) occur when catastrophic nuclear fusion blasts apart a white dwarf that has accreted too much gas from a normal companion star.

White dwarfs are the remaining cores of stars not large enough to end their lives in SN II explosions. In about five thousand million years, the Sun will become such a compact star, as small as the Earth and mainly composed of carbon and oxygen. The possibility of producing a supernova by the merger of two white dwarfs remained purely theoretical until now. However, there is strong evidence that a supernova discovered on 26 September 2006, called SN 2006gz, comes from such a peculiar



An artist's impression of two white dwarf stars spiralling in towards each other until they collide and explode as a luminous supernova like SN 2006gz. (Courtesy NASA/Dana Berry, Sky Works Digital.)

origin. This is at least the conclusion of a team of astronomers led by Malcolm Hicken, a graduate student of the Harvard-Smithsonian Center for Astrophysics (CfA). They found three observational features that suggest that this explosion – first classified as a Type Ia supernova – was caused by some different mechanism. The most important evidence for this is that

SN 2006gz has the strongest signature of unburnt carbon ever reported. Merging white dwarfs are expected to have carbon in their outer layer that would be pushed off by the explosion from the inside. The spectrum of SN 2006gz also shows evidence for silicon that would have been compressed by the shock wave rebounding from the surrounding layers of carbon and oxygen. Additionally, SN 2006gz was brighter than expected, indicating that its progenitor exceeded the 1.4 solar-mass Chandrasekhar limit – the upper bound for a single white dwarf. Only one other potential example of a super-Chandrasekhar supernova has been seen (SN 2003fg), but this supernova did not show the carbon and silicon spectral characteristics of SN 2006gz, which are predicted for merging white dwarfs by computer models.

As a first example of a different kind of supernova, the observations of SN 2006gz will allow astronomers to distinguish these more powerful explosions more clearly from the single white dwarf blasts. This is particularly important for cosmology, as the similarities among normal Type Ia supernovae was used to reveal the accelerated expansion of the universe thought to be driven by dark energy (*CERN Courier* September 2003 p23).

Further reading

M Hicken *et al.* 2007 *Astroph. Journal* **669** L17.

Picture of the month



Arp 87 is a stunning pair of interacting galaxies located in the constellation of Leo, the Lion, approximately 300 million light-years away. This image by the Hubble Space Telescope reveals the stream of stars, gas and dust flowing from the large spiral galaxy NGC 3808 (on the right) to form an enveloping arm around its smaller companion. Computer simulations show that the graceful dance of this pair will go on for about a hundred million years before merging, as the Antennae galaxies did, to form an elliptical galaxy (*CERN Courier* December 2006 p14). (Courtesy NASA, ESA and The Hubble Heritage Team (STScI/AURA).)