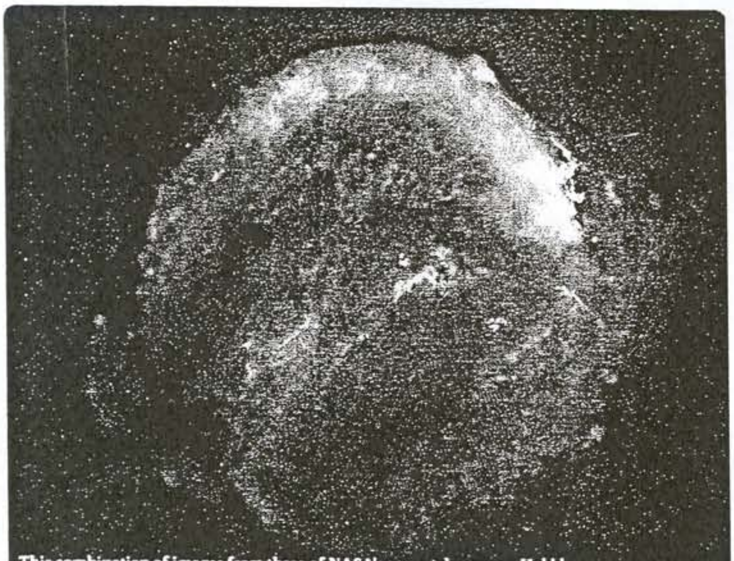
Supernova breakthroughs



This combination of images from three of NASA's space telescopes – Hubble, Spitzer and Chandra – reveals the expanding remains of Kepler's supernova. Image: NASA/ESA/R. Sankrit and W. Blair (Johns Hopkins University).

There have been only six known supernovae in our Milky Way over the last 1,000 years, all but one appearing before the invention of the telescope. However, centuries later, modern instruments are helping to piece together the stories behind these powerful explosions.

In a recent issue of *Nature*, a team of astronomers report that they have obtained the first direct evidence to support the theory that Type Ia supernovae originate in binary systems comprising a normal star and a white dwarf.

The evidence comes from a supernova that exploded in 1572, and was meticulously recorded by the renowned Danish astronomer, Tycho Brahe. Analysis of the records by modern astronomers enabled them to identify his discovery as a Type Ia supernova. But the accompanying star was never found – until now.

The first piece of the puzzle was provided by Stephen Smartt (Queen's University, Belfast), who used the William Herschel Telescope on La Palma to examine all of the stars near the centre of the Tycho supernova remnant.

The data showed one very peculiar star travelling across the sky more than three times faster than its neighbours – clear evidence that the supernova sent the white dwarf's companion star hurtling off into space, like a stone thrown by a sling. The result was later confirmed with the Keck Telescope and the Hubble Space Telescope.

Meanwhile, Ravi Sankrit and William Blair (Johns Hopkins University) have used NASA's Great Observatories to highlight distinct features of "Kepler's star", a supernova that appeared on October 9, 1604. The combined image shows a bubble-shaped shroud of gas and dust, 14 light-years wide and expanding at 4 million mph. The fast-moving shell of iron-rich material is surrounded by an expanding shock wave that sweeps up interstellar gas and dust.

Visible-light images from the Hubble Space Telescope reveal where the shock wave is slamming into the densest regions of surrounding gas. Bright glowing knots mark dense clumps that form behind the shock wave. The Hubble observations also tie down the distance of the supernova remnant to about 13,000 light-years.

The Spitzer Space Telescope detected infrared light from heated microscopic dust particles swept up by the expanding supernova shock wave. It also provided information about the chemical composition and physical environment of the clouds of gas and dust ejected into space.

Data from the Chandra X-ray Observatory show that the hottest gas is mainly located directly behind the shock front. Cooler gas resides in a thick interior shell and marks the location of the material expelled from the exploded star.

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