



Fingerprinting a supernova explosion

Type Ia supernovae, such as the young supernova remnant (SNR) 0509-67.5 shown here, are integral to understanding how the universe expands. Because of their predictable luminosity, they're called standard candles, and astronomers use them to measure the distances of astronomical objects from Earth. The uniform luminosity was previously thought to be because white dwarfs explode at a standard 1.44 solar masses, the Chandrasekhar mass limit. Now it is hypothesized that white dwarfs become supernovae at masses significantly below that limit. SNR 0509-67.5, as captured by the European Southern Observatory's Very Large Telescope, detonated at a low mass. Studying it can help researchers understand how type Ia supernovae occur.

The artificially enhanced colors in this image reflect the

remnant's chemical composition: calcium in blue and hydrogen in orange. SNR 0509-67.5 has an unusual structure, with two concentric calcium rings in a hydrogen shell that marks the supernova's boundary. The structure is consistent with a previously theorized double-detonation mechanism, in which the supernova explodes twice. For double detonation to occur below the Chandrasekhar mass limit, excess helium around SNR 0509-67.5 had to condense into a thin, unstable blanket that ignited an initial explosion. The resulting shock wave traveled inward to the white dwarf's core and triggered a second detonation, which caused stellar material to plow into the surrounding interstellar gas. (P. Das et al., *Nat. Astron.*, 2025, doi:10.1038/s41550-025-02589-5; image by ESO/P. Das et al., background stars [Hubble] from K. Noll et al.) —MC

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