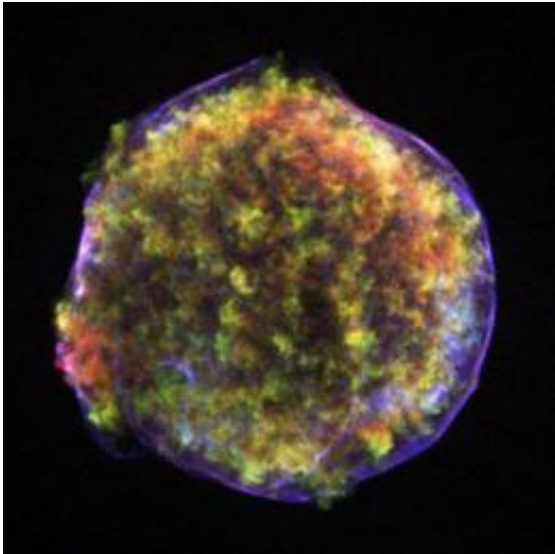


Where do supernovae come from?

September 17 2010



A false-color X-ray image of the type Ia supernova remnant, Tycho. Credit: NASA/CXC/Rutgers/J.Warren & J.Hughes

(PhysOrg.com) -- Supernovae, the explosive deaths of massive stars, are among the most momentous events in the cosmos because they disburse into space all of the chemical elements that were produced inside their progenitor stars, elements essential for making planets and life. One class of supernovae (type Ia) provide yet another benefit: they are thought to be "standard distance candles," and are used by astronomers to estimate the distances to remote galaxies whose supernovae appear faint because they are far away; thus they can calibrate the cosmic distance scale.

If an old star which has finished burning its nuclear fuel is less massive than about 1.4 solar masses, its gravity is not strong enough to collapse it against the pressure of its atomic ashes, and it lingers on, gradually cooling down over billions of years. If however enough outside material falls onto the star, perhaps from a companion star, to increase its mass above the limit of 1.4 solar masses, gravity will prevail and suddenly convert it into a type Ia supernova. (Even more [massive stars](#) also become [supernovae](#), but of other types -- they also seed the universe but are less reliable as standard candles.)

One of the outstanding puzzles in supernova research is the nature and role of the companion star that tips the mass balance and turns its neighbor into a cataclysm. Are these companion stars sometimes (always?) normal stars, or might they too be clumps of atomic ash that are gradually cooling off? And how does the in-falling matter manage to accumulate onto the neighboring star rather than just blow off as a puff of wind? Most disturbingly, why are putative companions and the effects they produce typically not seen at X-ray wavelengths where they are expected to be bright?

SAO astronomer Rosanne Di Stefano has been investigating these and related questions in a series of papers on type Ia supernovae. Writing in last month's [Astrophysical Journal](#), she shows that a star on the edge of becoming a supernova, having almost 1.4 solar masses, evolves with its companion in a complex way that is only occasionally detectable in X-rays. Whatever the nature of the companion star, there should be long intervals between episodes of X-ray brightness. Her results offer a convincing explanation for the absence of X-ray detections.

Provided by Harvard-Smithsonian Center for Astrophysics

Citation: Where do supernovae come from? (2010, September 17) retrieved 25 April 2024 from

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