

Revisiting the Supernova Ia Rate at $z > 1$

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Abstract

Type Ia Supernovae (SNIa) are an extremely useful tool for astronomers, contributing important information for the determination of extragalactic distances, studies of stellar evolution and galactic chemical evolution, and providing the only direct evidence for cosmic acceleration. Despite this wide-ranging importance, the origins of SNIa are fundamentally mysterious. We have good reasons to believe that all SNIa are the product of a Carbon-Oxygen White Dwarf that reaches the Chandrasekhar mass limit and ignites carbon burning explosively. However, the precise nature of the explosion mechanism, the stellar type of the binary companion, and the physical requirements to reach the critical explosion point are still unclear. We cannot yet even be sure of whether all SNIa result from a single progenitor track or if there are multiple ways to set off the explosion.

One extremely important constraint on theoretical models of SNIa progenitors is the evolution of the SNIa rate (SNR) as a function of redshift. The SNR(z) can distinguish between competing progenitor models and help to unveil the mystery of these important objects. The most important (and difficult) component of this measurement is in the highest redshift bins, at $z > 1$, which requires the unique observing tools of the Hubble Space Telescope (HST). We propose to revisit the Hubble Space Telescope's Great Observatories Origins Deep Survey (GOODS) data to dramatically improve the accuracy and precision of the high- z SNIa rate measurement. We will utilize large numbers of synthetic transients, fully automated detection techniques, and an improved difference photometry algorithm to exploit the full potential of this important dataset. Our primary result will be a strong constraint on SNIa progenitor models from the SNR(z), and along the way we will also improve the value of this data for future SN studies by determining more complete and more precise light-curves for the highest redshift SNIa.

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