

Evaluating Systematic Dependencies of Type Ia Supernovae: The Influence of Central Density

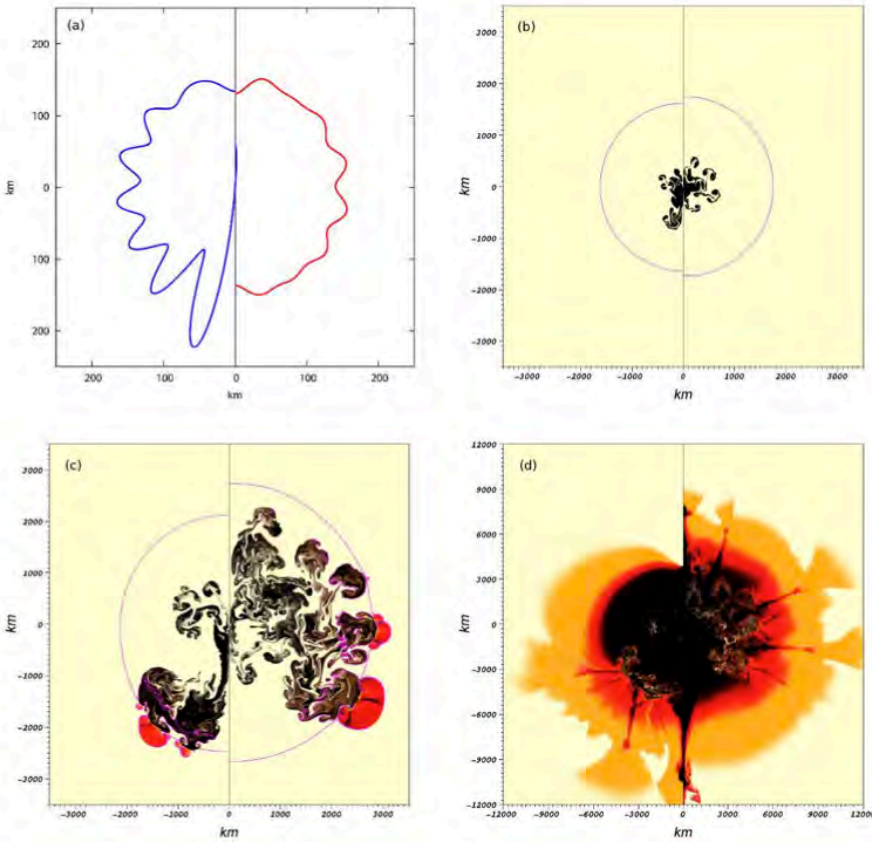


Fig 1 - Illustrations of the phases of a SNIa in the DDT model; each panel displays two of our realizations: 21 (left) and 10 (right). Panel 2a shows the initial flame surfaces; realization 21 has the greatest deviation from the mean radius, and realization 10 has the least deviation from the mean radius. Panels 2b – 2d are snapshots from our simulations, with $\rho_{c,0} = 3 \times 10^9 \text{ g/cm}^3$; Panel 2b shows the early deflagration phase, Panel 2c shows the first DDT events, and Panel 2d shows the later detonation phase. The colors represent the four stages of the burning model: cream represents unburned fuel, gold represents ash from carbon burning, red represents material in NSQE, and black represents material in NSE. Only in the deflagration stage do the three burning processes separate out spatially; they are co-located during the deflagration.

Observational studies of Type Ia supernovae (SNIa) indicate correlations between the brightness of an event and properties of the host galaxy including the age of the stellar population. One way to influence the explosion systematically is through the central density of the progenitor white dwarf at ignition, which is determined by the initial mass of the white dwarf and the binary evolution. We present the results of a statistically well- controlled study of the effect of varying the central density of the progenitor white dwarf at flame ignition on the explosion yield, particularly the production of radioactive ^{56}Ni that powers the light curve. We relate our central density results to the age of the host galaxy stellar population through the main sequence lifetime and the elapsed time between the formation of the white dwarf and the onset of accretion.

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Submitted: Krueger et al,
Astrophysical Journal, 2012

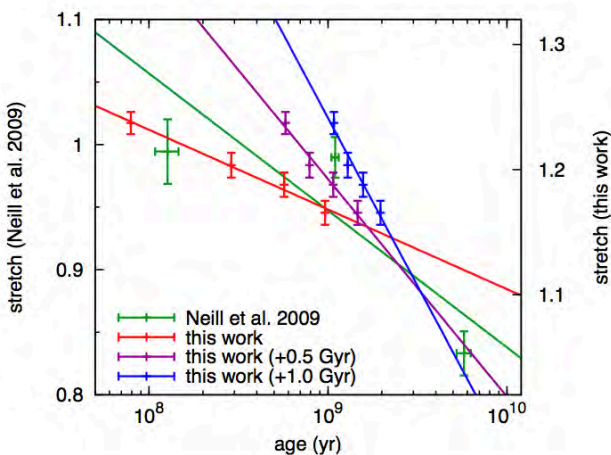


Fig 2 - Stretch vs. age. In red are the points from this study with no shift (i.e., $\tau_{MS} = 0 \text{ Gyr}$), along with the standard error of the mean and a best-fit trend line. The brown and gold curves show this same data with $\tau_{MS} = 0.5 \text{ Gyr}$ and 1.0 Gyr respectively. In blue are the binned and averaged points from Neill et al. (2009), along with a best-fit trend line.