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Type Ia explosions and progenitors: insights from spectral time series”

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The progenitor scenarios of Type Ia supernovae remain a mystery having a crippling effect on the many area that have strong connections to these explosive events (e.g. cosmology, chemical evolution of the Universe, stellar evolution, etc.). The current viable scenarios can be divided into two broad categories: 1) 1.4 $M_\odot$ white dwarves that are likely created in an accretion process and self-ignite due to high central pressure/density. 2) White dwarves of considerably lesser mass ($\approx$ 1 $M_\odot$) can be ignited in shell detonations or in the merging process that formed them. Both scenarios are able to correctly predict the bulk properties of Type Ia observations and thus determining which scenario is responsible for these events is difficult.

One difference in their scenarios is that the heavy white dwarf progenitor requires a deflagration with a subsequent detonation process, while the other reproduces the observations with a simple detonation. The former process is turbulent and results in a mixed ejecta, while the latter will result in a highly stratified remnant. Observed spectral time series have the power to distinguish between both of those burning modes through a technique known as supernova tomography.

In this talk, I will present the supernova tomography technique which uses observed spectral time series and radiative transfer code to reconstruct the explosion. I will focus on recent works that have shown how to infer supernova parameters by coupling traditional radiative transfer codes, Bayesian statistics, and machine learning to study observed spectral time series. The results can then quantitatively compared to explosion simulations to verify either scenario.

I will conclude with our study of Type Ia supernova SN 2002bo and will give an outlook of the next steps in determining the still mysterious origins of these events.

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