The Beginnings and Ends of Double White Dwarfs

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Type-Ia supernovae from mergers of hybrid He-CO WDs and CO WDs

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Type-Ia supernovae (SNe) are thought to originate from the thermonuclear explosions of carbon-oxygen (CO) white-dwarf (WD) stars. They produce most of the Iron-peak elements in the universe, and bright Ia-SNe serve as important "standard candle"cosmological distance-indicators. The proposed progenitors of standard type Ia-SNe had been studied for decades and can be generally divided between explosions of CO-WDs accreting material from stellar non-degenerate companions (single-degenerate; SD models), and those arising from the mergers of two CO-WDs (double-degenerate; DD models). However, current models for the progenitors of such SNe failed to reproduce the diverse properties of the observed explosions, nor did they explain the inferred rates and the characteristics of the observed populations of type Ia-SNe. Here we use detailed thermonuclear-hydrodynamical and radiative-transfer models to show that mergers of CO-WDs with *hybrid CO-He WDs* are a key ingredient for the origins of type Ia SNe. They provide a viable model for normal type Ia-SNe, as well as explain the origin of particular types of SNe such as Ca-rich SNe. We find that such mergers give rise to explosions that which synthetic light-curves and spectra resemble those of observed type Ia-SNe. Moreover, our population synthesis models show that the rate and delay-time distribution of such mergers are consistent with observations of normal type-Ia SNe. Such successful models for type Ia-SNe can, therefore, explain their origin, serve to study the detailed composition yields from SNe, and potentially probe the systematics involved in Ia-SNe measurements of the cosmological parameters of the universe.

Primary author: Prof. PERETS, Hagai (Technion)

Co-authors: ZENATI, Yossef (Technion- Israel); Prof. TOONEN, Silvia; Mr BOBRICK , Alexey (lUND uNIVERSITY)

Presenter: Prof. PERETS, Hagai (Technion)

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