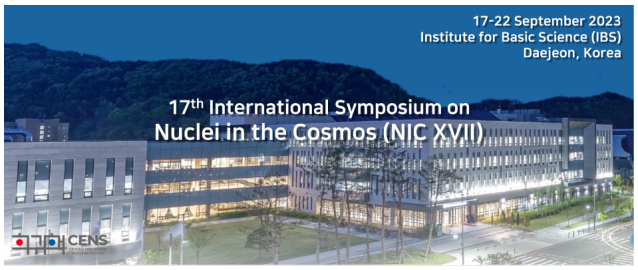

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Simulations of One and Two Star Explosions in the Double Degenerate Double Detonation Scenario for Type Ia Supernovae

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The precise origin of Type Ia supernovae (SNe Ia) is unknown despite their value to numerous areas in astronomy. While it is a long-standing consensus that they arise from an explosion of a C/O white dwarf, the exact progenitor configurations and explosion mechanisms that lead to a SN Ia are still debated. One popular theory is the double detonation in which a helium layer, accreted from a binary companion, detonates on the surface of the primary star, leading to a converging shock-induced detonation of the underlying core. Across a mass range of sub-Chandrasekhar progenitors, the double detonation scenario produces light curves and spectra that match many characteristics of individual SNe Ia as well as the breadth of the population. It has also recently been shown via simulation that the elusive donor companion may not survive but rather undergo its own double detonation triggered by the impact from the core detonation of the primary star. If this explosion of the companion does indeed occur in reality, it could have numerous implications for the observables and nucleosynthesis from SNe Ia. In this talk, we show 2D simulations of detonations in white dwarf binaries that model both stars undergoing a double detonation in addition to double detonations in isolated, thin helium shell progenitors. We also present radiative transfer results from these two scenarios, which includes the first multi-dimensional synthetic observables of the two star double detonation. We find that within a range of mass configurations of the degenerate binary, the synthetic light curves and spectra of these events match observations as well as theoretical models of single double detonations do. Notably, one and two star double detonations that are spectrally similar and reach the same peak brightnesses produce different amounts of Si- and Fe-group elements which would affect the impact of SNe Ia on the chemical evolution of the universe. Further understanding of this scenario is needed in order to determine if at least some observed SNe Ia actually originate from two stars exploding.

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