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Simulations of thermonuclear astrophysical transients

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Astrophysical thermonuclear explosions typically arise from interactions in binary star systems. Their predicted observational characteristics span a wide range in parameter space and include Type Ia supernovae, as well as other classes of transient events. Understanding and interpreting the rich set of new data expected from upcoming transient searches requires advances in modelling the underlying events. I discuss approaches to simulating thermonuclear explosions arising from various scenarios in detailed three-dimensional (magneto-)hydrodynamic models. Improvements in numerical methods allow us to constrain the explosion physics and progressively enable us to study the initiation of the explosions from the dynamics of the progenitor system. These three-dimensional explosion models then serve as an input to nucleosynthesis and radiative transfer calculations, from which implications for observables can be derived. I will give an overview of recent simulations and discuss how such approaches can help understand the enigmatic nature of Type Ia supernovae but also guide the modeling of the zoo of newly observed transient events.

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