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Title: On Simulating Type Ia Supernovae

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Type Ia supernovae are bright stellar explosions distinguished by standardizable light curves that allow for their use as distance indicators for cosmological studies. Despite highly successful use in this capacity, the progenitors of these events are incompletely understood. We describe simulating type Ia supernova in the paradigm of a thermonuclear runaway occurring in a massive white dwarf star. We describe the multi-scale physical processes realistic models must incorporate and the numerical models for these we employ. In particular, we describe a flame capturing scheme that addresses the problem of turbulent thermonuclear combustion on unresolved scales. We present the results of our study of the systematics of type Ia supernovae including trends in brightness following from properties of the host galaxy that agree with observations. We also present performance results from simulations on leadership-class architectures.