

Modeling Core-Collapse Supernova Explosions

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At the confluence of much of 20th-Century physics, lies an astrophysical puzzle that has taxed theorists and the computational arts for almost half a century. Supernova explosions, the source of much of the heavy elements in the Universe and the birthplace of neutron stars and stellar-mass black holes, are still not understood. However, using sophisticated numerical tools and platforms, theorists have been able to conduct multi-dimensional simulations with increasing physical fidelity that have provided insight into the variety of phenomena that attend stellar death and explosion. The core of the emerging theoretical synthesis is the centrality of asphericity and the breaking of spherical symmetry. In this talk, I will review the state of the field, the contending explosion models, and the connections with other exotic objects, such as gamma-ray bursts and hypernovae. In the process, I will highlight the state-of-the-art computational astrophysics which has been applied to date, and which may be necessary in the future, to credibly unravel this mystery.