APR08-2008-001017

Abstract for an Invited Paper
for the APR08 Meeting of
the American Physical Society

Core-Collapse Supernova Mechanisms and their Signature in Gravitational Waves[1]

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Despite many decades of concerted theoretical effort and numerical modeling, the details of the core-collapse supernova explosion mechanism are still under debate. Indications are strong that the supernova mechanism is intrinsically multi-dimensional and involves (a combination of) postbounce energy deposition by neutrinos, convective instability, the standing-accretion-shock instability (SASI), unstable protoneutron star core g-mode oscillations, rotation, magneto-hydrodynamic effects, and nuclear burning. I review the current status of core-collapse supernova theory and modeling and introduce the ensemble of viable candidate explosion mechanisms that is emerging from recent multi-dimensional core collapse and postbounce supernova models. I go on to discuss gravitational-wave emission processes in core-collapse supernovae and present new results on the supernova gravitational-wave signature that were obtained with 2D/3D general relativistic and Newtonian simulations. I demonstrate how gravitational radiation from a core-collapse supernova observed by current and future detectors could be used to constrain the core-collapse supernova explosion mechanism.

[1]This work was supported by NSF through a Joint Institute for Nuclear Astrophysics Postdoctoral Fellowship and by the DOE through the Office of Science SciDAC Program