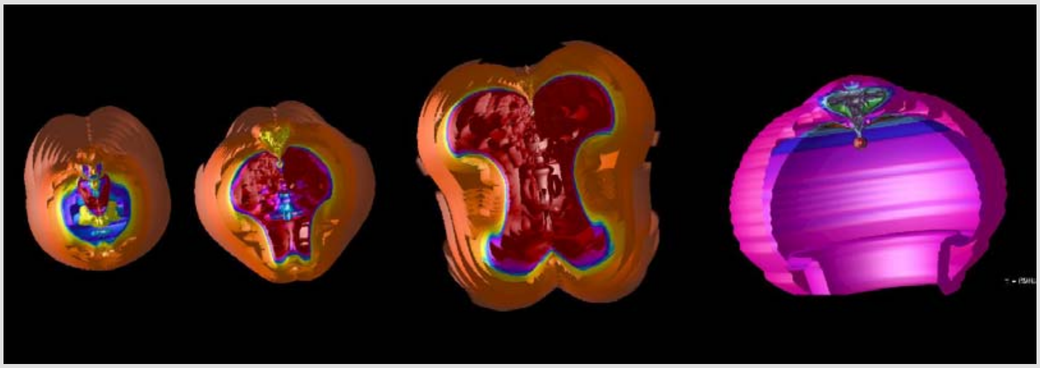
The Joint Institute for Nuclear Astrophysics

JINA

Multi-Dimensional Explorations in Supernova Theory



The figure left is a time sequence from the work of Burrows et al. (2006, 2007) depicting the unipolar explosion by the acoustic mechanism of the core of an 11.2 solar mass star. The shells are iso-denisty contours. The red region are high-entropy. The last panel shows the cavity left behind, occupied by the protoneutron star at its center. The scale for each stage is approximately 5000 kilometers.

The JINA collaboration at the University of Arizona, led by Adam Burrows and including JINA postdoc Christian Ott and JINA graduate fellow Jeremiah Murphy, has expanded its numerical studies of core-collapse supernovae. Recently, they have published in archival journals multi-dimensinal radiation hydrodynamic studies of the explosion of stars from 11 to 25 star masses (Burrows et al. 2006,2007). All models explode by a novel acoustic mechanism, though they, along with others, show that neutrino mechanism works for the lightest massive stars below 11 solar masses. Importantly, these calculations have shown for the first time, and in a natural fashion, that theoretical supernova ejecta can contain high-entropy matter in which r-process nucleosynthesis can occur, and that the yields (~10**[-5] solar masses) are consistent with measured galactic yields. However, whether the detailed r-process abundance patterns can be reproduced is the subject of an ongoing collaboration with other JINA groups performing detailed network calculations.

Publications:

Adam Burrows et al.
in archival journals,
2006, 2007

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