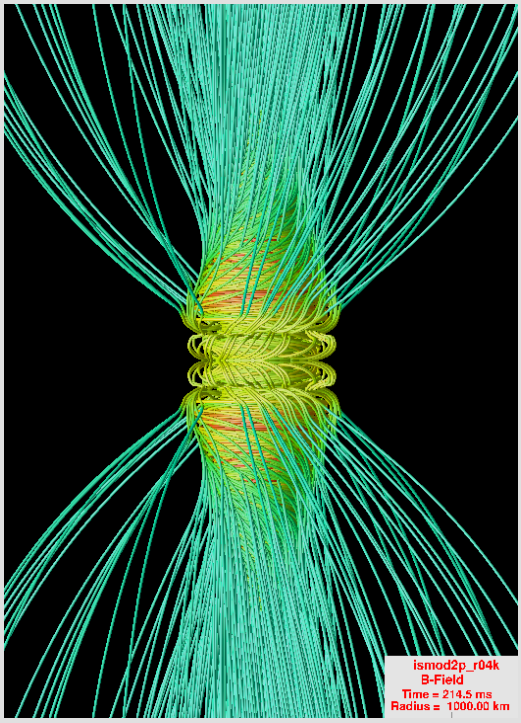
The Joint Institute for Nuclear Astrophysics

MHD Jet Explosions



The figure left is a 3D rendering of the magnetic-field structure ~215 milliseconds after the bounce of the core of a rapidly rotating 15 solar mass star. The object is exploding, driven by magnetic tower jets that are punching their way through the infalling mantle. The red/yellow lines are in the regions shocked by the penetrating jets; the outer, unshocked matter is coextensive with the light-blue lines of magnetic flux. The rotational twisting of the field lines and the location of the jets are clearly manifest.

Recently, the Arizona JINA collaboration has included magnetic fields into its code VULCAN/2D and has explored jet-powered supernovae. They have shown that faster than a certain degree of rapid rotation, which may obtain in an interesting subset of massive stars that give birth to some supernovae, hypernova, and GRBs, magnetic towers and jets that punch through the accreting core must drive explosions. The bipolar explosions are powered by the rotational energy of the matter simultaneously accreting along the equator. These are the first radiation-magneto-hydrodynamics calculations ever performed in supernova theory and the nucleosynthetic consequences of this novel explosion regime will be the subject of joint efforts with JINA teams at MSU and LANL.

Publications:
Burrows et al. 2007

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