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Effects of Magnetoconvection in Core-Collapse Supernovae

Multi-dimensional instabilities coupled with magnetic fields, such as the magnetorotational instability (MRI), are considered important contributors to the explosion mechanism of core-collapse supernovae in extreme scenarios. In this work, we present three-dimensional simulations of a 40-solar-mass progenitor using the GPU-accelerated magnetohydrodynamics code GAMER. We investigate the effects of magnetic field strength, initial rotation, and spatial resolution on the explosion dynamics and resulting multi-messenger signals. Our preliminary results indicate that MRI can be triggered in the convective region within the proto-neutron star when the spatial resolution reaches below 250 meters. The development of MRI leaves distinct multi-messenger signatures, which may be detectable in future gravitational wave observations.

Section

High Energy

Primary author: HSIEH, He-Feng (Institute of Astrophysics and Department of Physics, National Taiwan University)

Co-authors: Prof. SCHIVE, Hsi-Yu (Institute of Astrophysics and Department of Physics, National Taiwan University; Theoretical and Computational Astrophysics, National Center for Theoretical Sciences); SONG, Inhyeok (Institute of Astronomy, National Tsing Hua University); Prof. PAN, Kuo-Chuan (Institute of Astronomy and Department of Physics, National Tsing Hua University; Theoretical and Computational Astrophysics, National Center for Theoretical Sciences)

Presenter: HSIEH, He-Feng (Institute of Astrophysics and Department of Physics, National Taiwan University)

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