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Three-dimensional simulations of rapidly rotating core-collapse supernovae

We report results from a series of three-dimensional (3D) rotational core-collapse simulations for 11.2 and 27.0 $M_\odot$ stars employing neutrino transport scheme by the isotropic diffusion source approximation. By changing the initial strength of rotation systematically, we find a rotation-assisted explosion for the 27 $M_\odot$ progenitor, which fails in the absence of rotation. The unique feature was not captured in previous two-dimensional (2D) self-consistent rotating models because the growing non-axisymmetric instabilities play a key role. In the rapidly rotating case, a strong spiral flow is generated by the so-called low $T/|W|$ instability. That enhances the energy transport from the proto-neutron star (PNS) to the gain region, which makes the shock expansion more energetic. The explosion occurs oblately, which is different from previous 2D predictions.

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