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Neutrino Transport in Core-collapse Supernova Simulations

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Neutrino transport is a key physical ingredient of core-collapse supernova simulations. Almost all of the gravitational binding energy released by the collapsing core of a dying massive star emerges in the form of intense neutrino fluxes. A small fraction of this energy is absorbed in the semi-transparent region outside the newly-born neutron star, and is believed to be responsible for powering the supernova explosion that follows core collapse. The ORNL group and its collaborators have used or are developing three different simulation codes, each with a different approach to neutrino transport: a full Boltzmann solve in 1D position space (spherical symmetry) + 2D momentum space; ray-by-ray flux-limited diffusion in 2D (axisymmetry) or 3D position space + 1D momentum space; and a two-moment variable Eddington factor method in 3D position space + 1D momentum space.