Black Hole Formation in Failing Supernovae

Evan P O'Connor[1] and Christian D Ott[1]

[1]*California Institute of Technology, 1200 E. California Blvd. M/C 350-17,*
evanoc@tapir.caltech.edu

We present recent results from a parameter study of black hole formation in failing core-collapse supernovae. The electron-degenerate iron core of stars with initial masses of at least 8-10 solar masses undergo core collapse to nuclear densities as the final stage of stellar evolution and form a protoneutron star. Many of these core-collapse events will result in a supernova explosion with a neutron star remnant; for sufficiently massive stars the protoneutron star may surpass the maximum neutron star mass and undergo further collapse to a black hole. We use our open-source spherically-symmetric general-relativistic stellar collapse code, GR1D, to perform a parameter study and place limits on black hole formation in collapsing stars. Using a parameterized neutrino leakage/heating scheme to approximate the effect of neutrinos, we investigate the effect of both observational and theoretical unknowns: progenitor model, mass, metallicity, equation of state and rotation.

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