Multi-Dimensional Explorations in Supernova Theory

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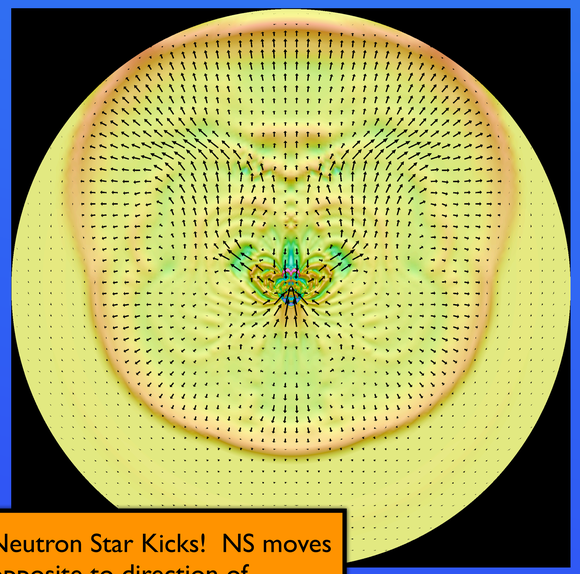
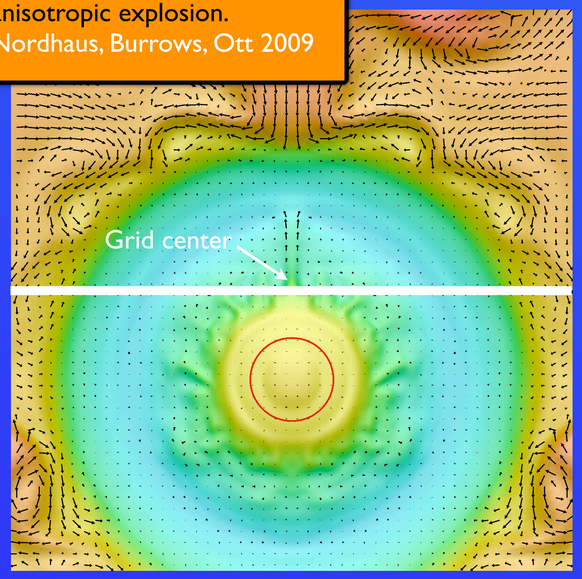
ABSTRACT

With the advent of peta-scale computational facilities and access to sophisticated 3D codes, it is an exciting time to study the theory of core-collapse SNe and hunt for the explosion mechanism. Here we detail recent and ongoing results using two of our radiation hydrodynamic codes.



Neutron Star Kicks! NS moves opposite to direction of anisotropic explosion. Nordhaus, Burrows, Ott 2009

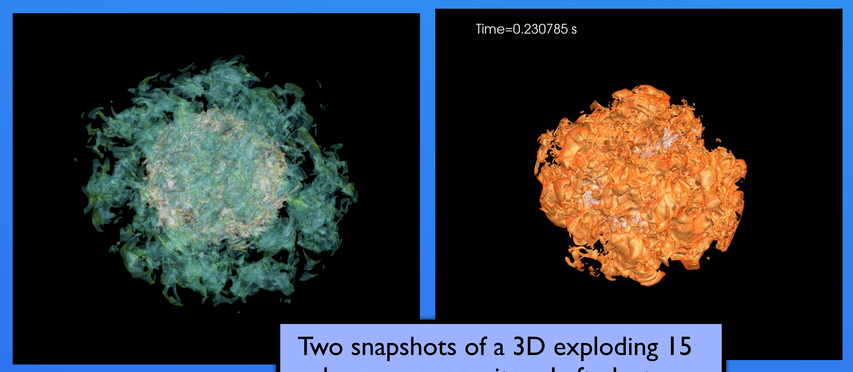


VULCAN/2D

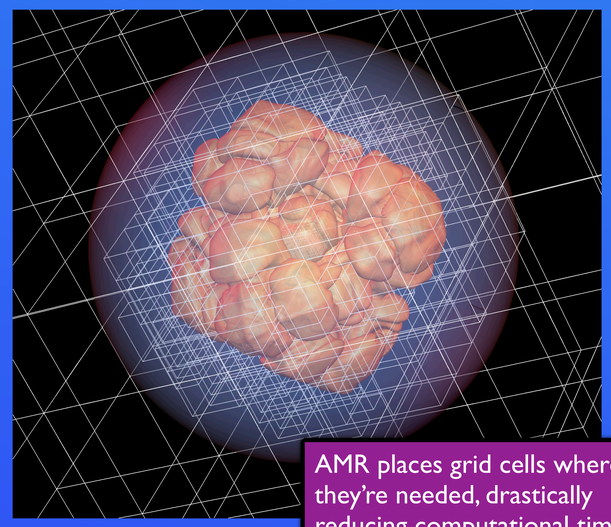
VULCAN/2D is a 2D radiation hydrodynamics code which incorporates an implicit, conservative, multi-group, multi-angle Boltzmann transport and multi-group flux limited diffusion transport scheme with an Arbitrarily-Lagrangian-Eulerian Newtonian hydro code.

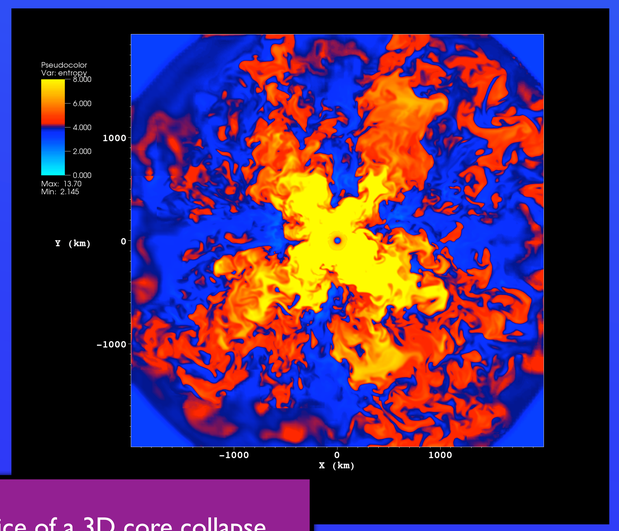
CASTRO (3D)

CASTRO is a 3D, compressible, adaptive mesh refinement (AMR), Eulerian, radiation hydrodynamics code. CASTRO has a multi-grid Poisson solver to handle self-gravity, a multi-component advection scheme with reactions and multi-group flux limited diffusion transport.

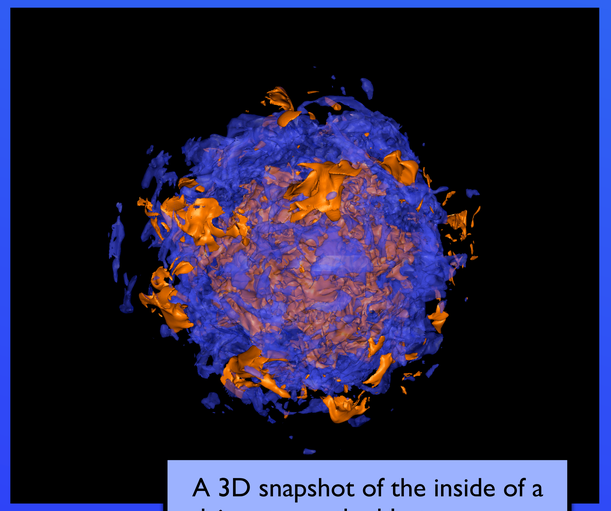


Two snapshots of a 3D exploding 15 solar mass progenitor. Left electron fraction. Right entropy.



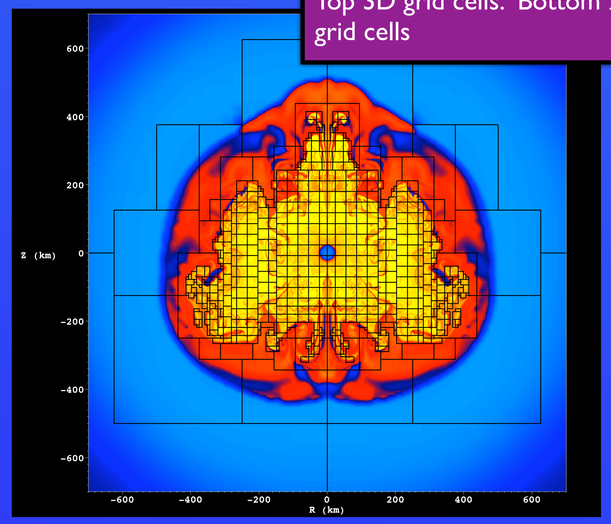


A slice of a 3D core collapse explosion. Entropy is plotted.



A 3D snapshot of the inside of a dying star as the blast wave propagates outward from the center.

AMR places grid cells where they're needed, drastically reducing computational time. Top 3D grid cells. Bottom 2D grid cells



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