Baroclinic equilibria of rotating stars with Lagrange scheme

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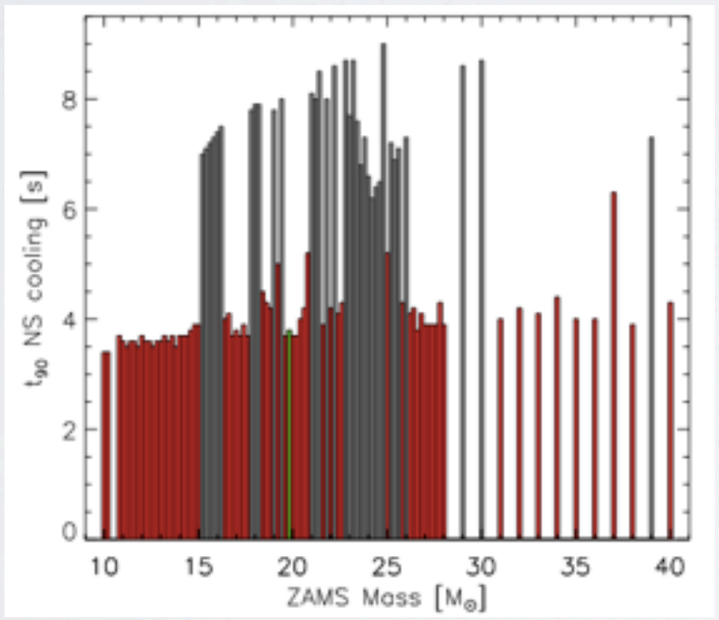
The important points of initial models in SNe are

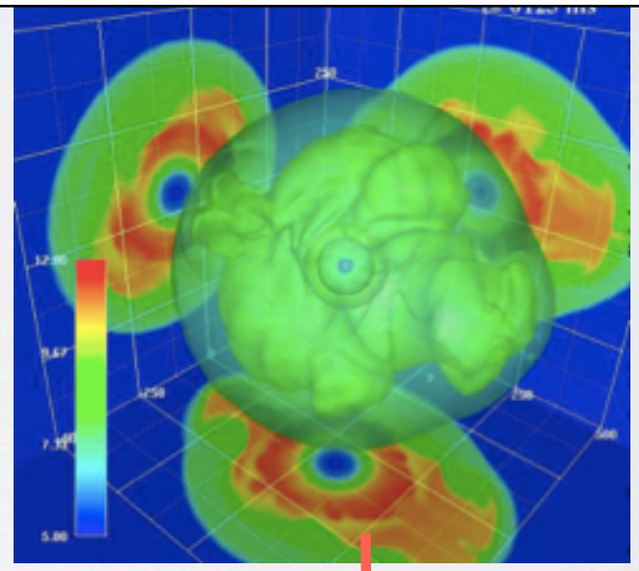
mass & **compactness.**

But how do they appear?



Ugliano et al. (2012)APJ, 757, 69

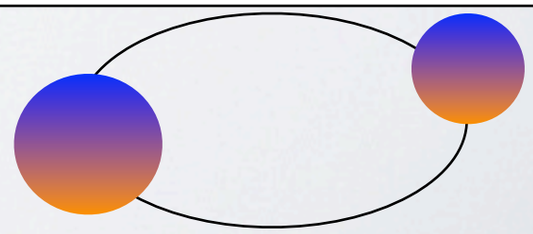
dynamical simulation(3D) of core collapse supernovae



K.Kotake, K.Sumiyoshi, S.Yamada, T.Takiwaki, T.Kuroda, Y.Suwa, H.Nagakura (2012) PTEP

? PNSs

NS-NS, BH-NS, BH-BH binaries?



"WEAK SOLUTION"

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$$E_{\mathrm{FEM}}(\boldsymbol{r}_i) = \sum_i \varepsilon_i m_i + \frac{1}{2}\sum_i \phi_i m_i + \sum_i \frac{1}{2}\left(\frac{j_i}{\varpi_i}\right)^2 m_i, \quad \delta E = 0$$

① Based on the variational principle, we can obtain baroclinic equilibria.
② However, numerical error is large close to the boundary with low mass element.

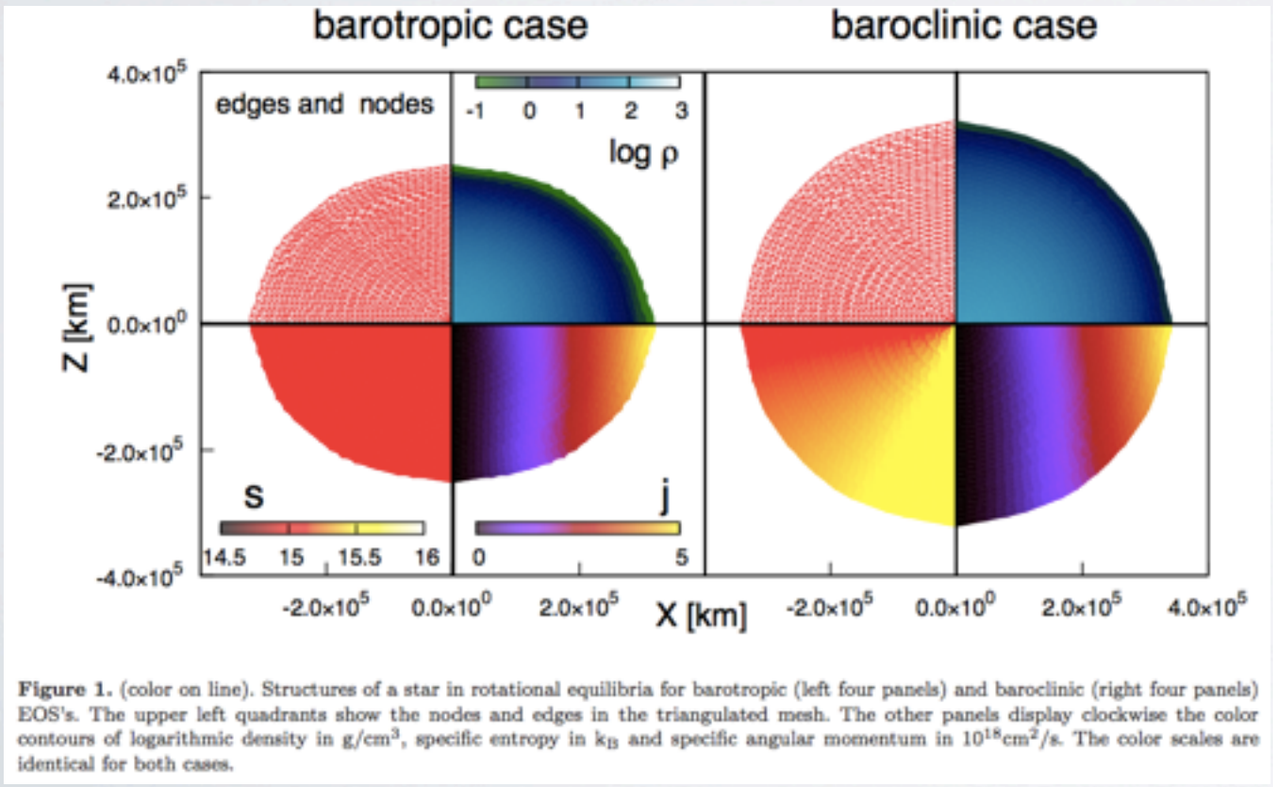
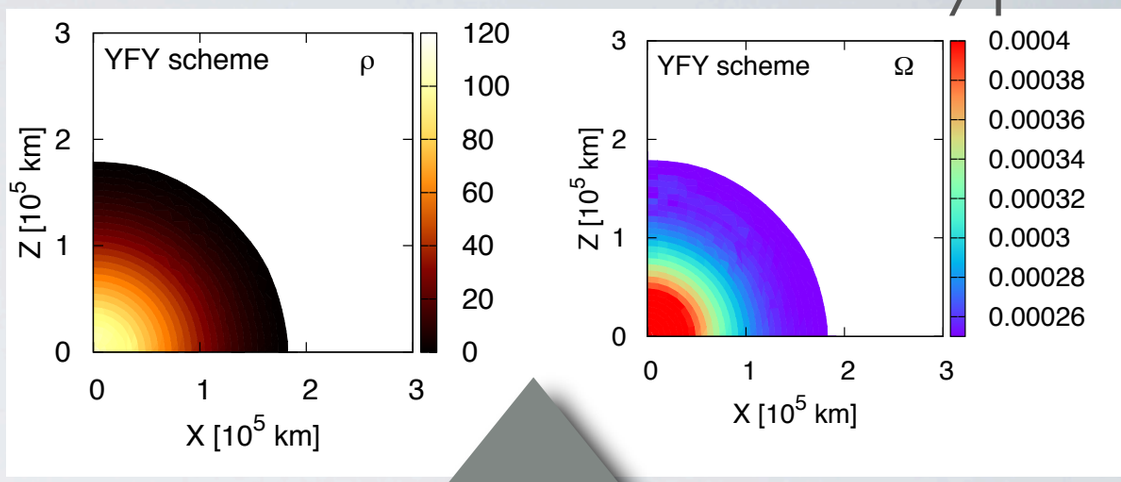
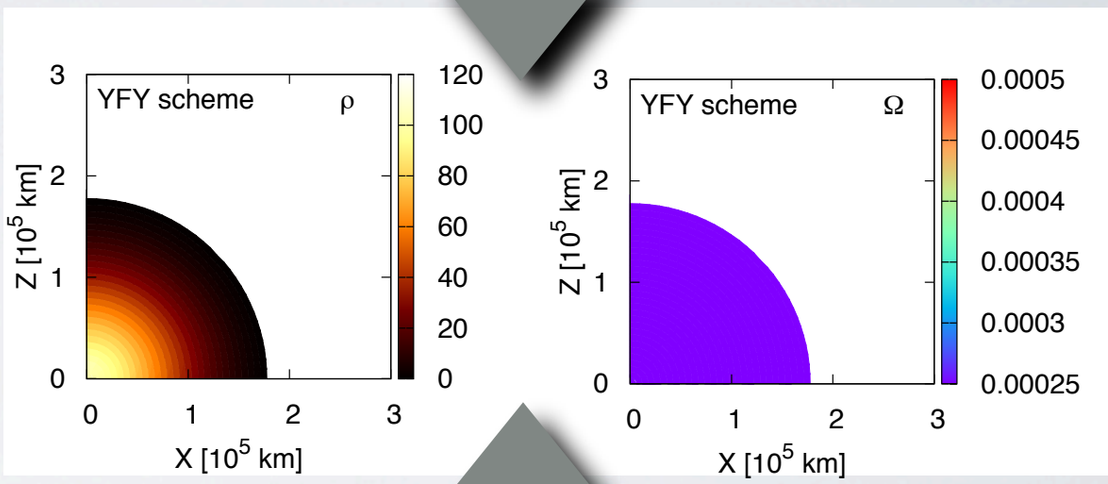
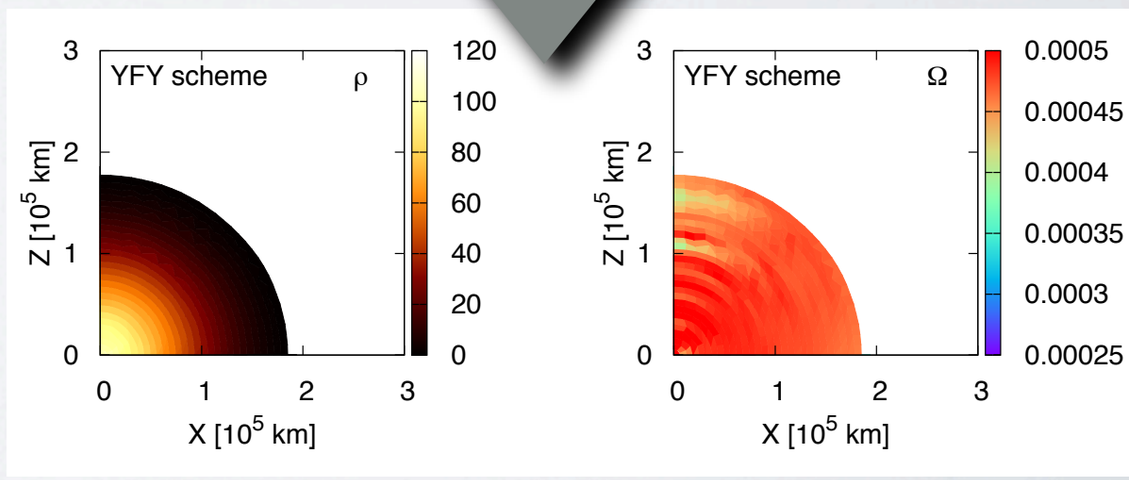


Figure 1. (color on line). Structures of a star in rotational equilibria for barotropic (left four panels) and baroclinic (right four panels) EOS's. The upper left quadrants show the nodes and edges in the triangulated mesh. The other panels display clockwise the color contours of logarithmic density in g/cm^3, specific entropy in k_B and specific angular momentum in 10^{18}cm^2/s. The color scales are identical for both cases.

sellular-type







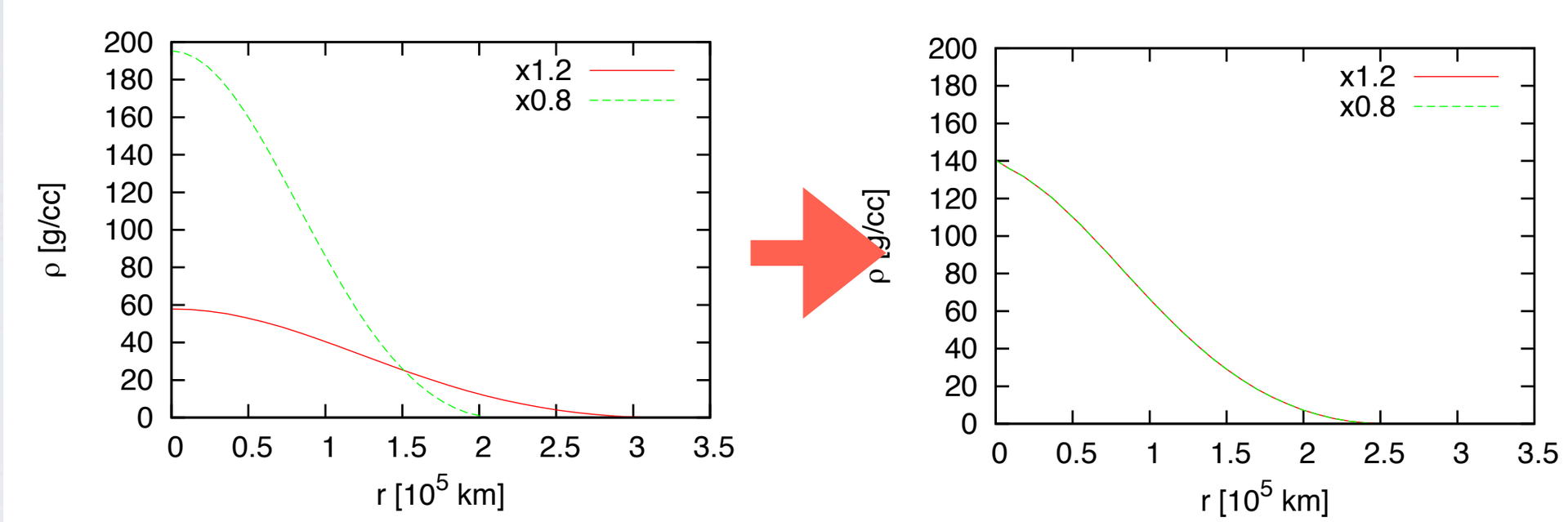
solar-like

"STRONG SOLUTION" **MNRAS (in prep)**

$$\nabla P + \rho \nabla \phi - \frac{\rho j^2}{\varpi^3} \mathbf{e}_{\varpi} = 0,$$

APPLICATIONAL RESULT(1D TEST)

Extended initial model and shrinked initial model provide the same result.



viral constant

$$V_C = \left| \frac{2T + W + 3\int P dV}{W} \right|$$

convergence condition

residual = $|\nabla P/\rho + \Phi|/(|\nabla P/\rho| + |\Phi|)$ $\mathcal{O}$max < 1.e-5