How Neutrino Oscillations Change Explodability of Massive Stars?

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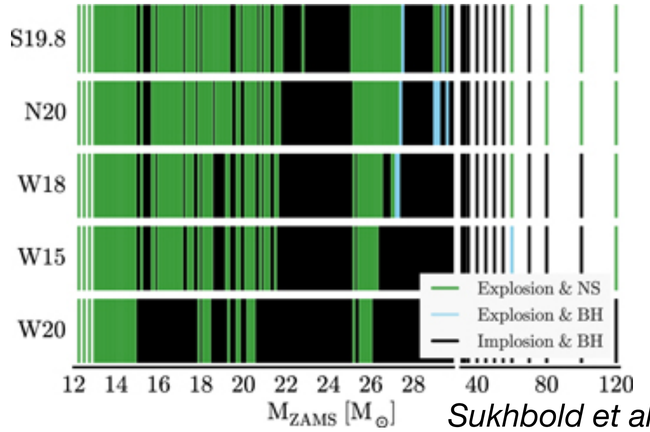
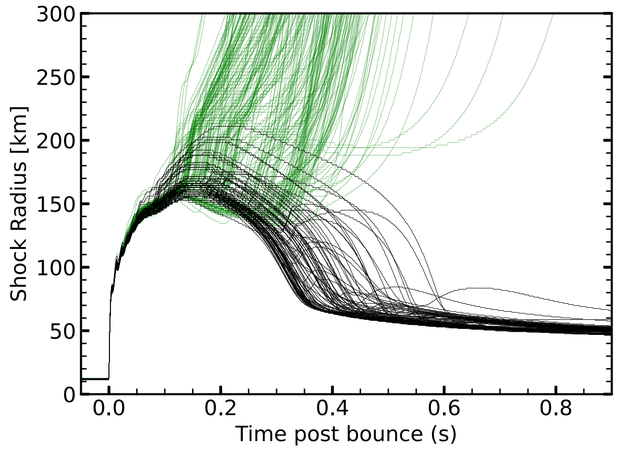
VILLUM FONDEN

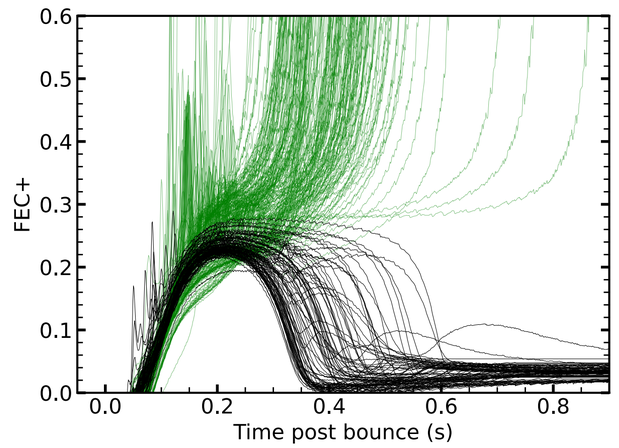
Which Massive Stars Explode?



Sukhbold et al. (2016)

Boccioli et al. (2024)



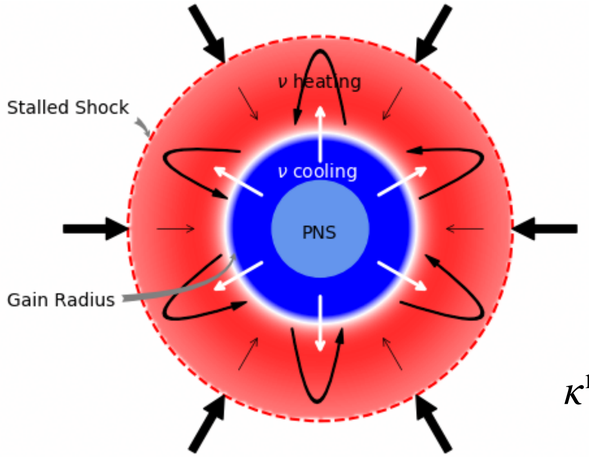


The Force Explosion Condition

$$\int_{R_{NS}}^{R_S+\epsilon} \frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \boldsymbol{v}) = 0$$

$$\rho\left(\frac{\partial \boldsymbol{v}}{\partial t} + (\boldsymbol{v}\cdot\nabla)\boldsymbol{v}\right) = -\nabla p - \rho \nabla \Phi$$

$$\frac{\partial(\rho E)}{\partial t} + \nabla \cdot \left[\rho \boldsymbol{v}\left(\varepsilon + \frac{p}{\rho} + \frac{v^2}{2} + \Phi\right)\right] = \rho H - \rho C$$



$$\tilde{L}_\nu \tau_g - a\tilde{\kappa} + \tilde{W}_b + c\tilde{R}^r_r > b$$

Gogilashvili et al. (2021, 2022, 2023)

Flavor Conversions and Explodability

$$n^{\text{new}}_{\nu_e(\bar{\nu}_e)} = \frac{1}{3}(n^{\text{old}}_{\nu_e(\bar{\nu}_e)} + 2n^{\text{old}}_{\nu_x(\bar{\nu}_x)})$$

$$L^{\text{new}}_{\nu_e(\bar{\nu}_e)} = \frac{1}{3}(L^{\text{old}}_{\nu_e(\bar{\nu}_e)} + 2L^{\text{old}}_{\nu_x(\bar{\nu}_x)})$$

$$\kappa^{\text{new}} = \frac{(L^{\text{old}}_{\nu_e} + 2L^{\text{old}}_{\nu_x})\left(\frac{1}{3}\kappa^{\text{old}}_{\nu_e} + \frac{2}{3}\kappa^{\text{old}}_{\nu_x}\right) + (L^{\text{old}}_{\bar{\nu}_e} + 2L^{\text{old}}_{\nu_x})\left(\frac{1}{3}\kappa^{\text{old}}_{\bar{\nu}_e} + \frac{2}{3}\kappa^{\text{old}}_{\nu_x}\right)}{(L^{\text{old}}_{\nu_e} + 2L^{\text{old}}_{\nu_x}) + (L^{\text{old}}_{\bar{\nu}_e} + 2L^{\text{old}}_{\nu_x})}$$

Gogilashvili et al. (2025 in prep)

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