

A Unified Picture for the Origin of Compact Binary GRBs



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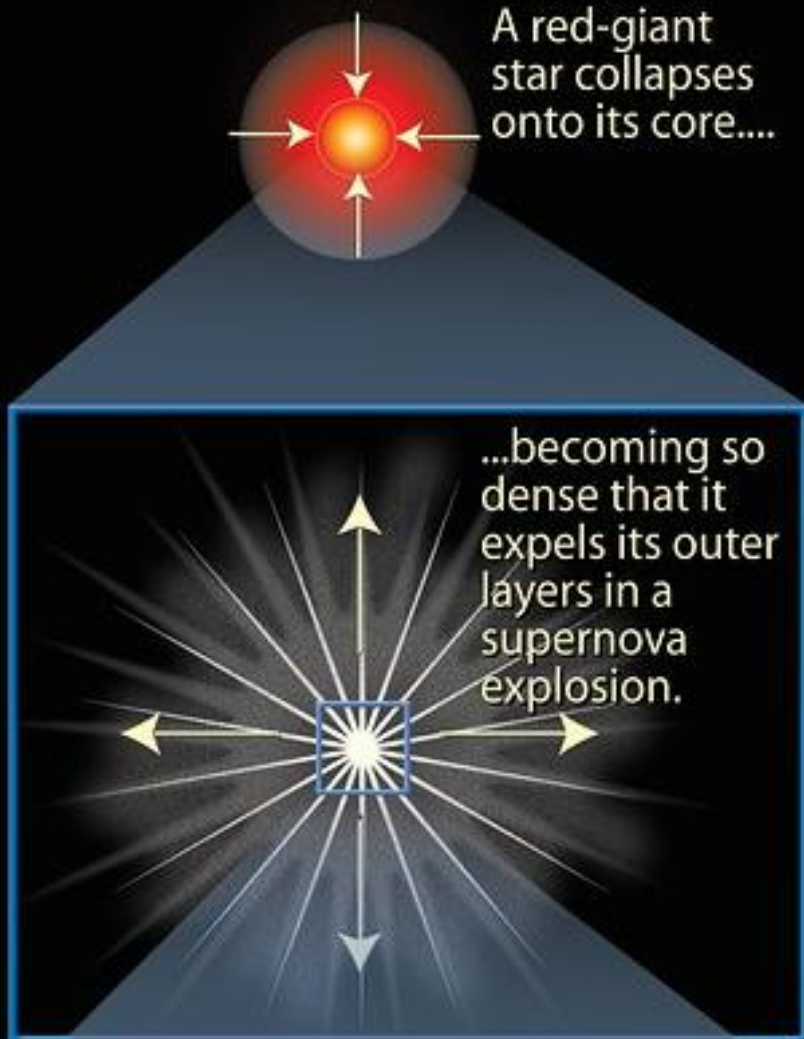
With:

B. Metzger, E. Quataert, D. Issa, T. Martineau, F. Foucart

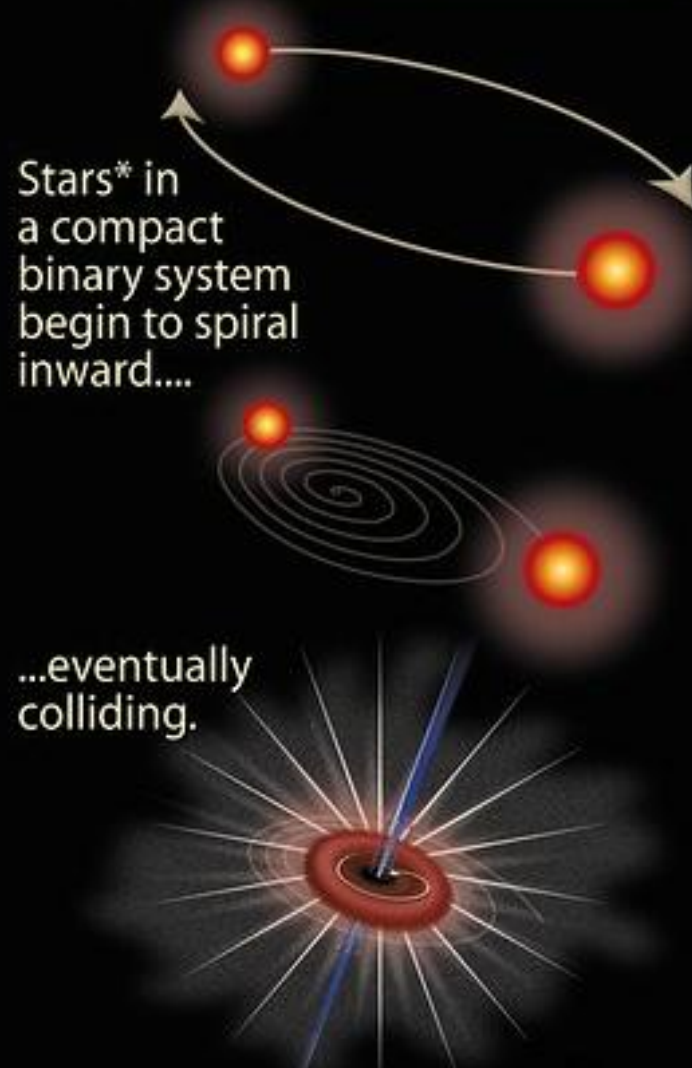


Types of GRBs

Long gamma-ray burst (>2 seconds' duration)

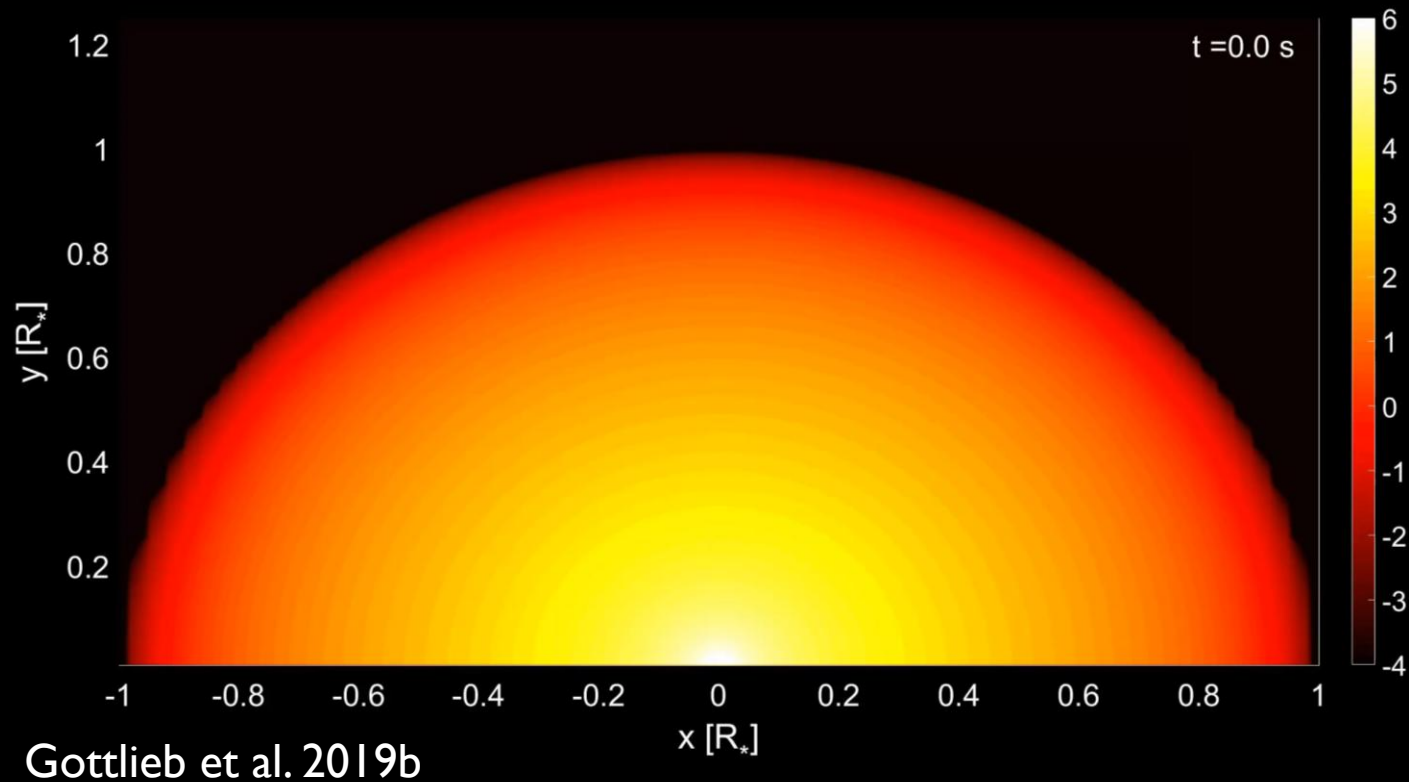


Short gamma-ray burst (<2 seconds' duration)



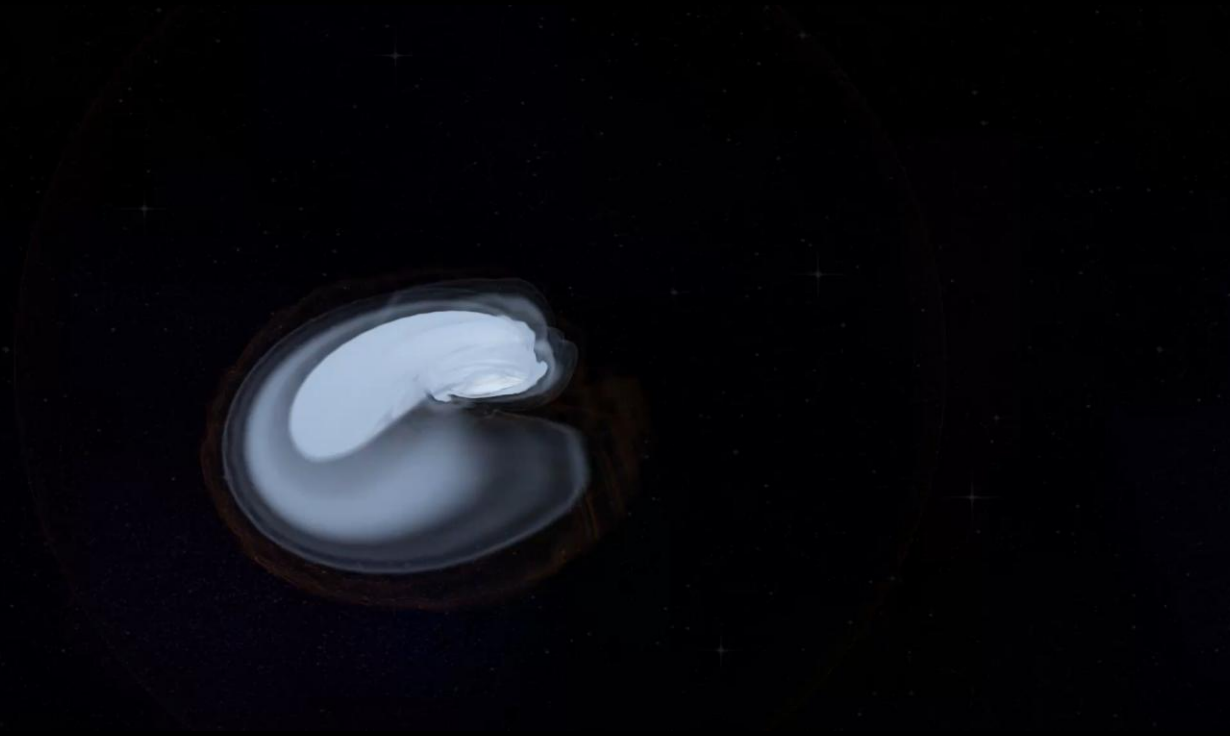
Long GRBs

- Collapse of a massive star
- Formation of an accretion disk
- Blandford-Znajek jets (Blandford & Znajek 77')



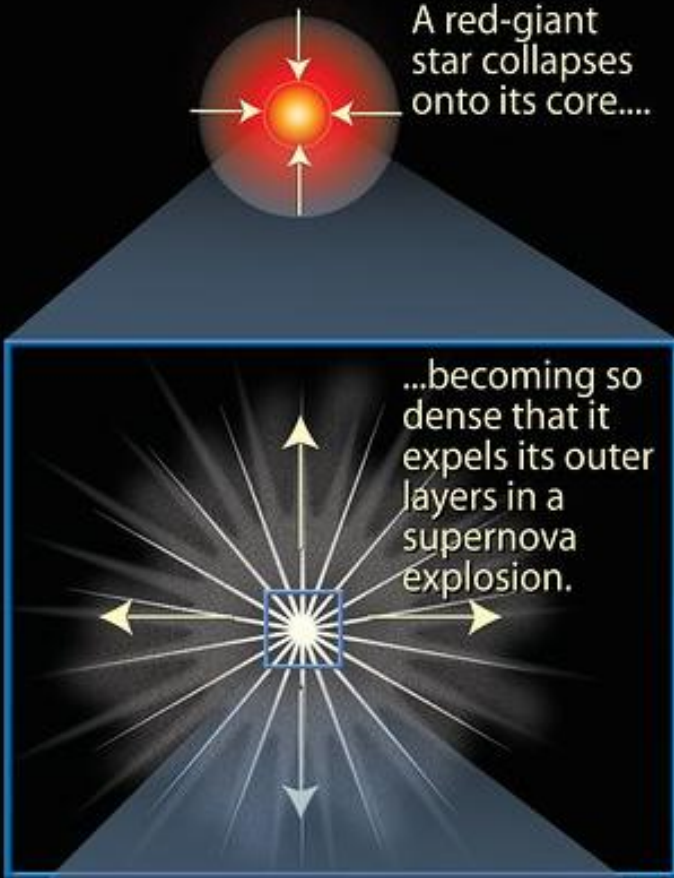
Short GRBs

- Merger of compact stars
- Formation of an accretion disk
- Blandford-Znajek jets (Blandford & Znajek 77')

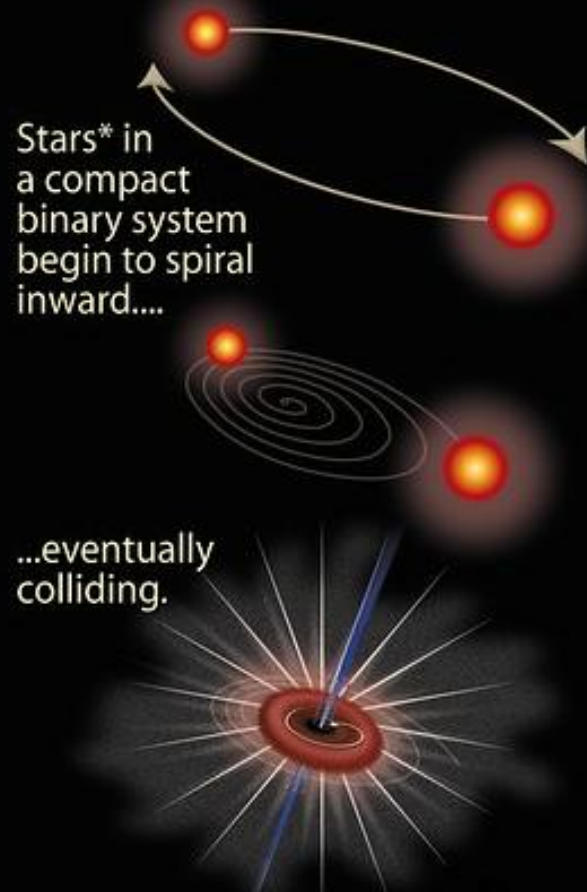


Types of GRBs

Long gamma-ray burst (>2 seconds' duration)

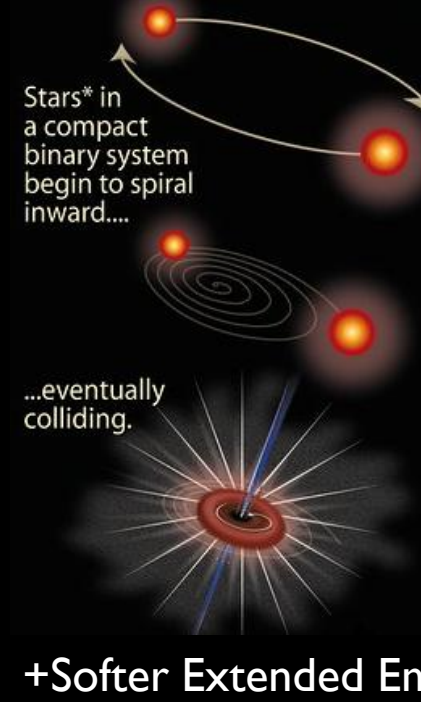


Short gamma-ray burst (<2 seconds' duration)



GRB 211211A (Rastinejad et al. 2022)
GRB 230307A (Levan et al. 2023)

Long gamma-ray burst (>2 seconds' duration)



Jet launching



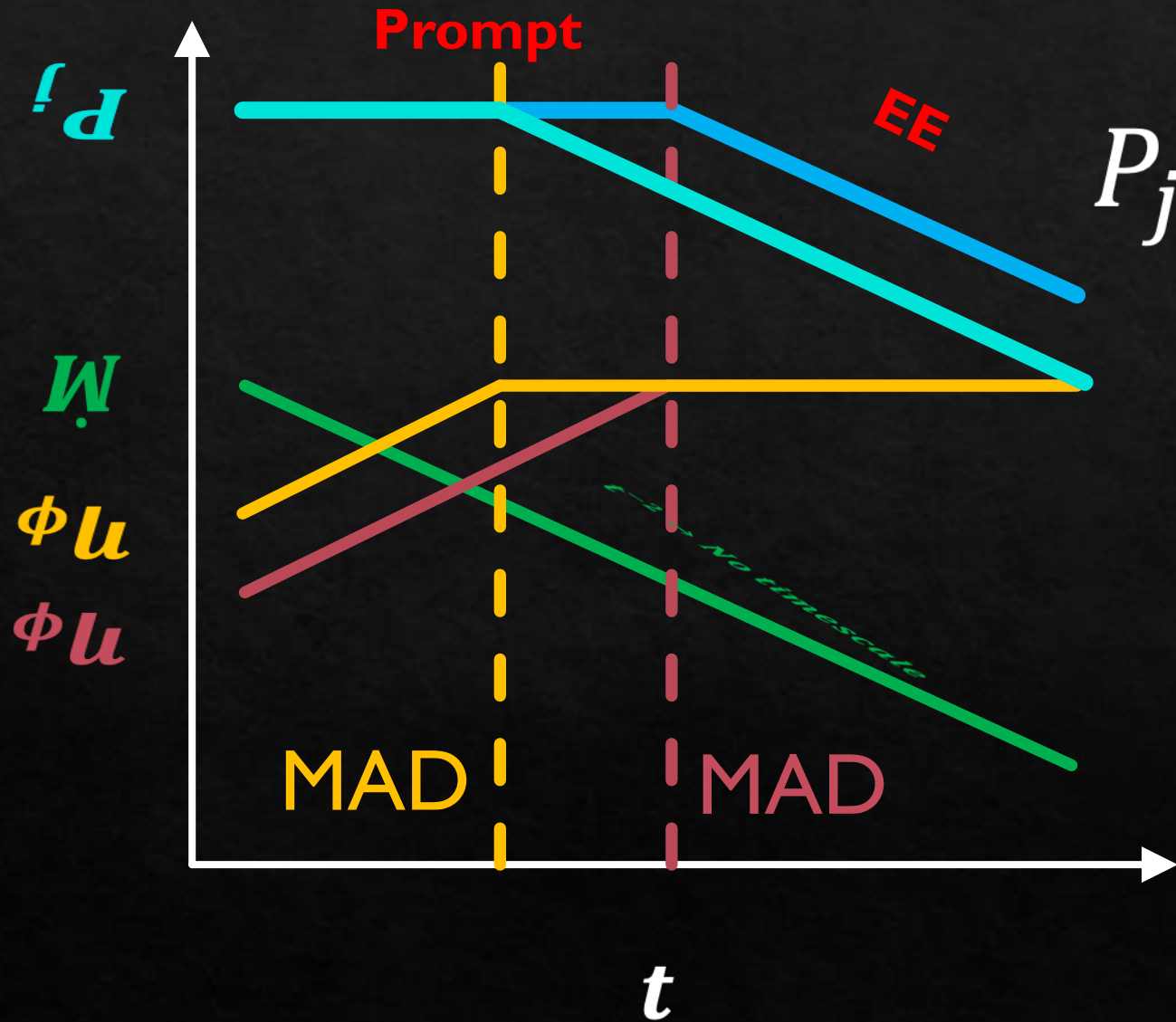
$$P_j = \dot{M} c^2 \eta_a(a) \eta_\phi(\phi)$$

\dot{M} – Mass accretion rate

η_a – Spin efficiency

η_ϕ – Field efficiency

Compact binary GRBs (cbGRBs)



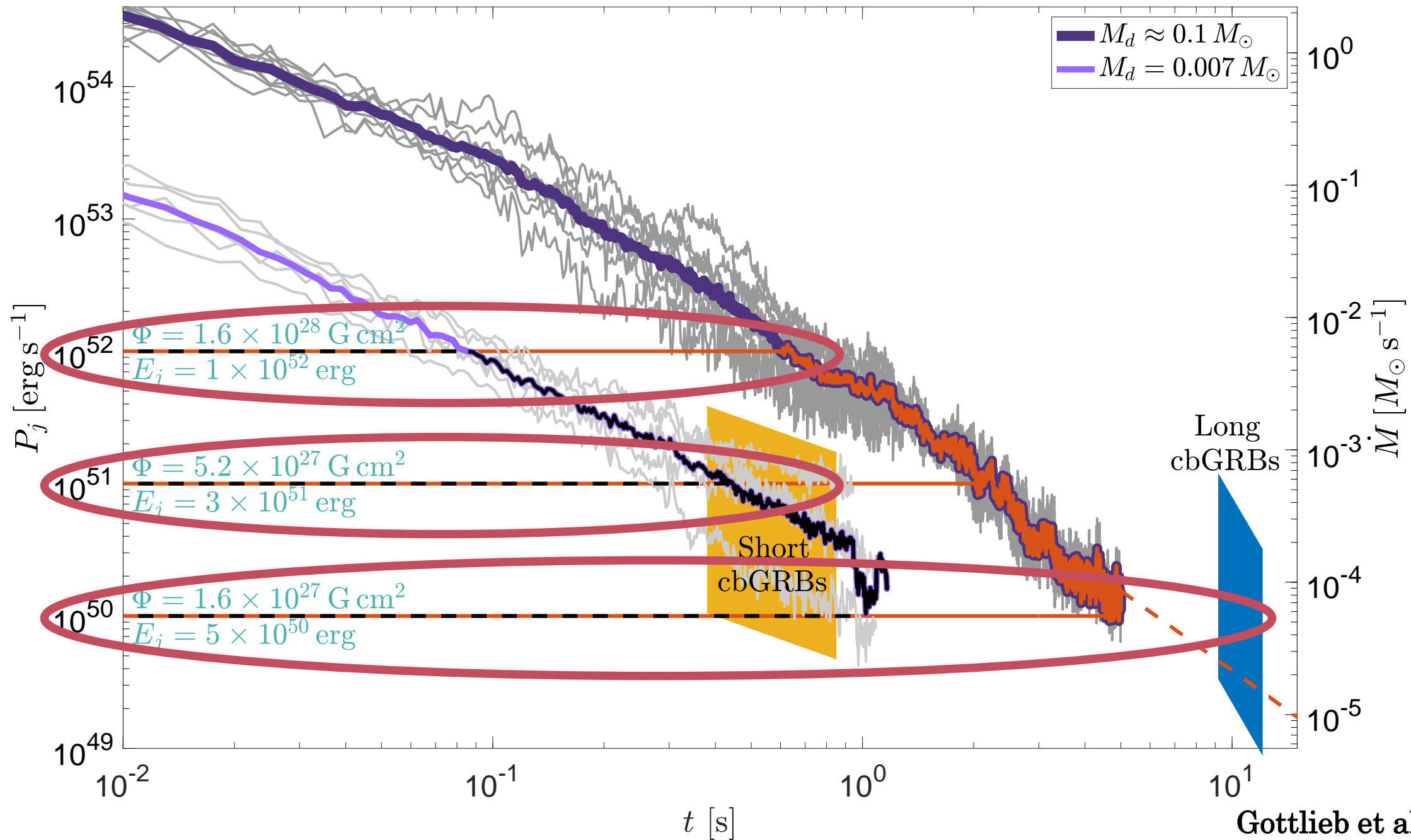
$$P_j = \dot{M} c^2 \eta_a(a) \eta_\phi(\phi)$$

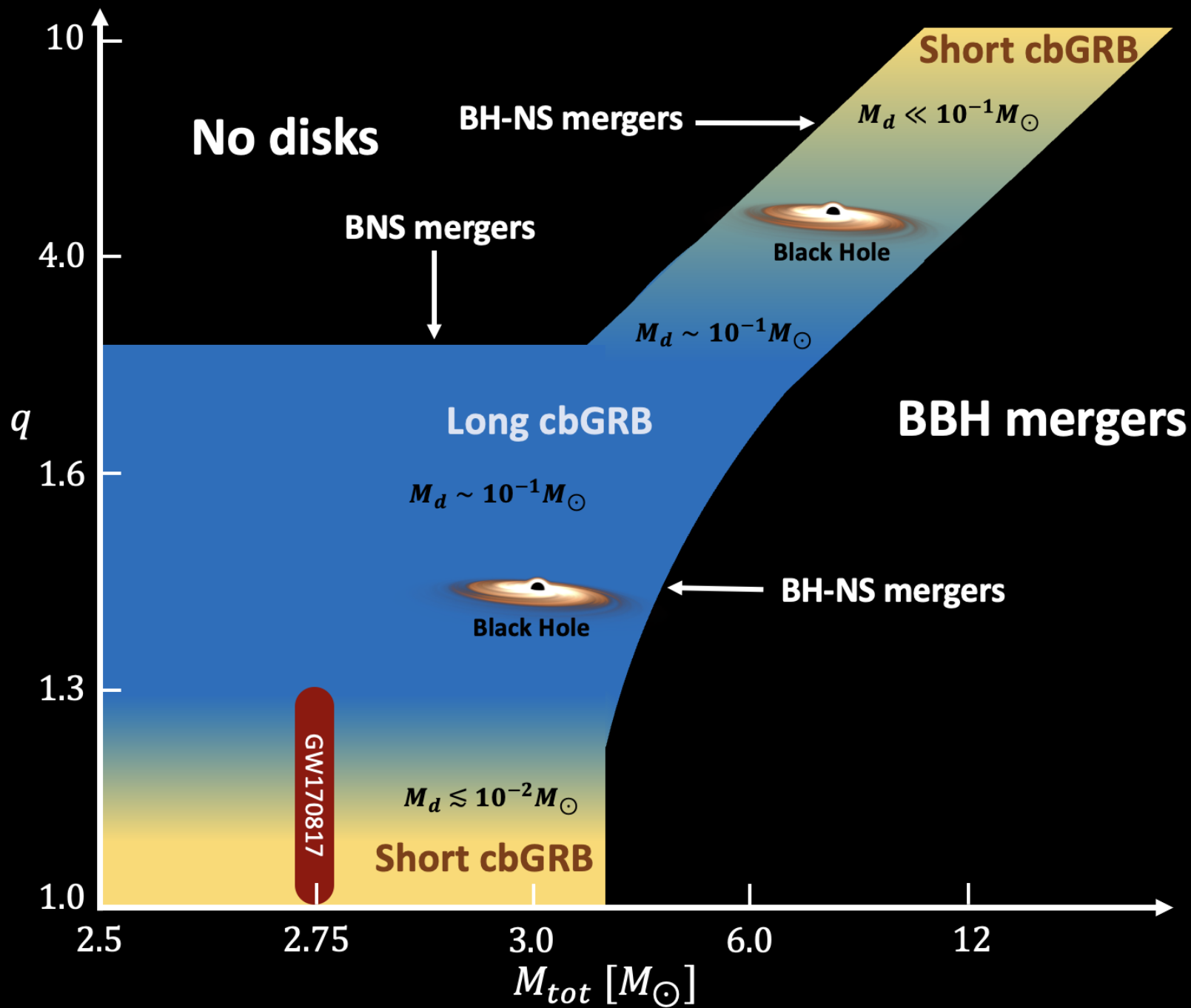
$$\eta_a(a) \approx 1$$

$$\rightarrow P_j \sim \dot{M} \eta_\phi$$

$$P_j \sim \text{const.}$$

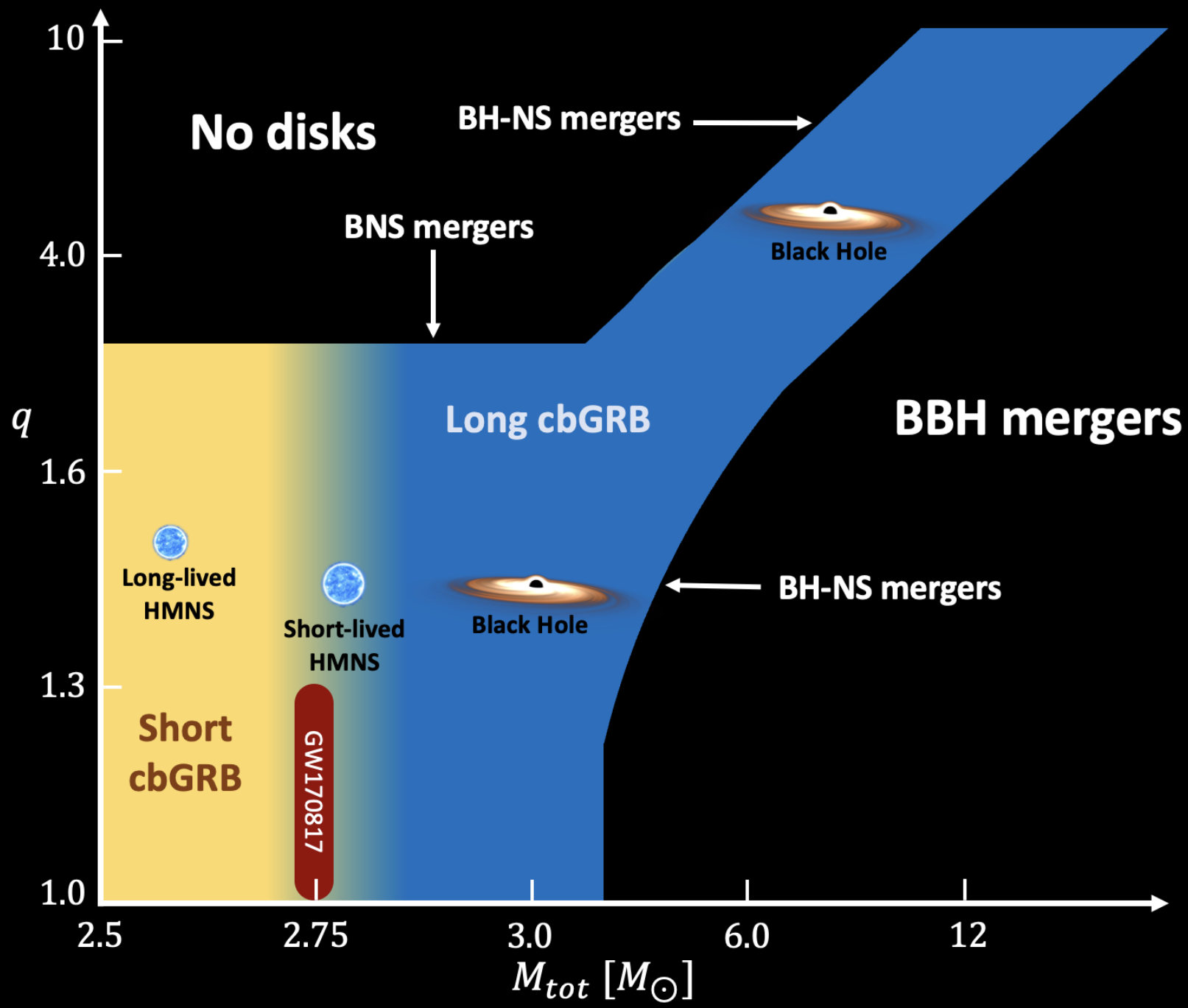
$$\rightarrow \eta_\phi \sim P_j \dot{M}^{-1} \sim t^2$$





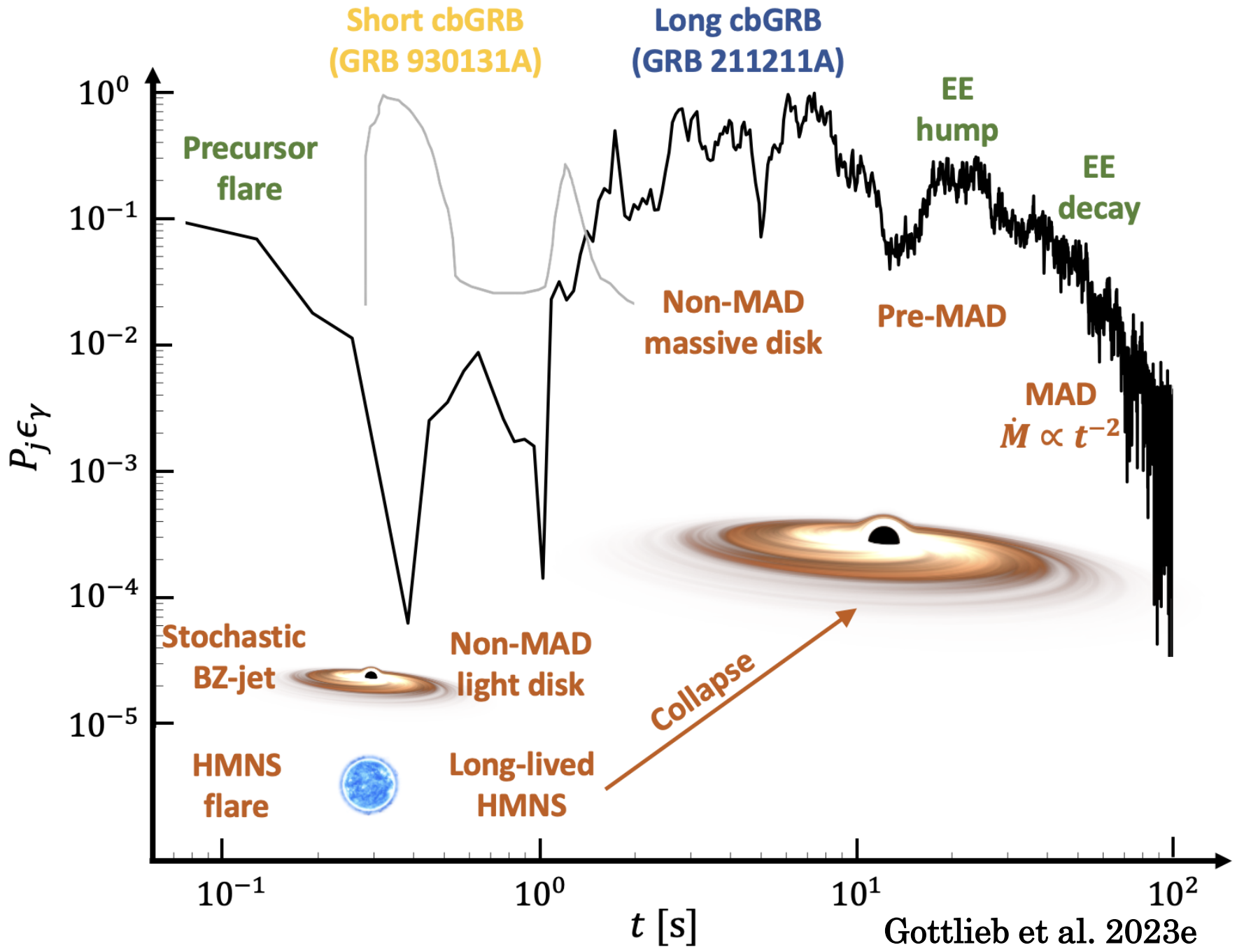
Need for more

- Most BNS mergers (incl. GW170817) have $M_{tot} \approx 2.75 M_{\odot} \rightarrow$ HMNS
- cbGRBs likely have a bimodal distribution



HMNS-powered jets

- HMNS can last for short cbGRB duration before collapsing
- Natural dichotomy between short and long cbGRBs



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- Transition to MAD marks the GRB duration and the onset of extended emission
- Unequal mass BNS mergers & $q \approx 2$ + high spin BH-NS mergers inevitably power long cbGRBs
- Other BNS and BH-NS mergers might explain short cbGRBs
- But HMNSs are preferred as short cbGRB engines
- Future GRB+kilonova observations will reveal GRB duration distribution → engine

