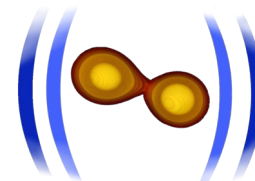




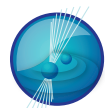
PennState
Eberly College of Science



CoRe collaboration

Compact Binary Mergers in the dHz Band and Beyond

David Radice – Sept. 29, 2026



NP3M



N3AS

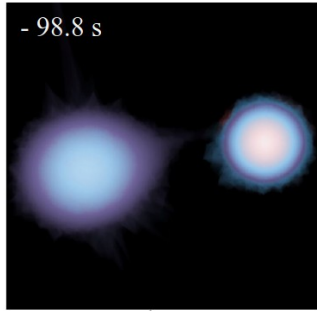
Network for Neutrinos,
Nuclear Astrophysics,
and Symmetries

PHYSICS FRONTIER CENTER

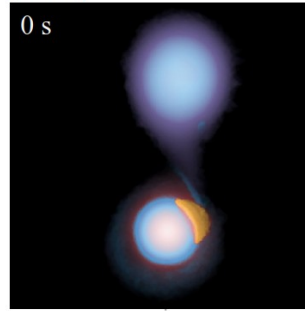


Binary WD mergers

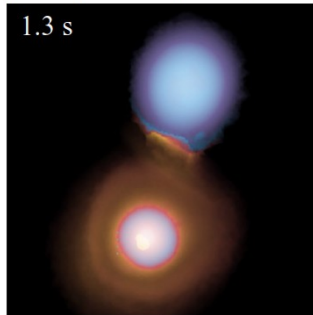
Start of mass-transfer



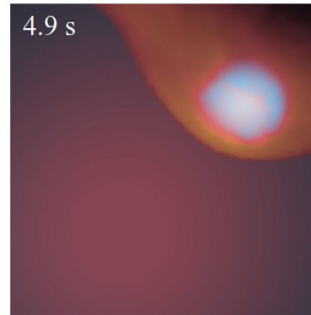
Helium shell ignition on primary



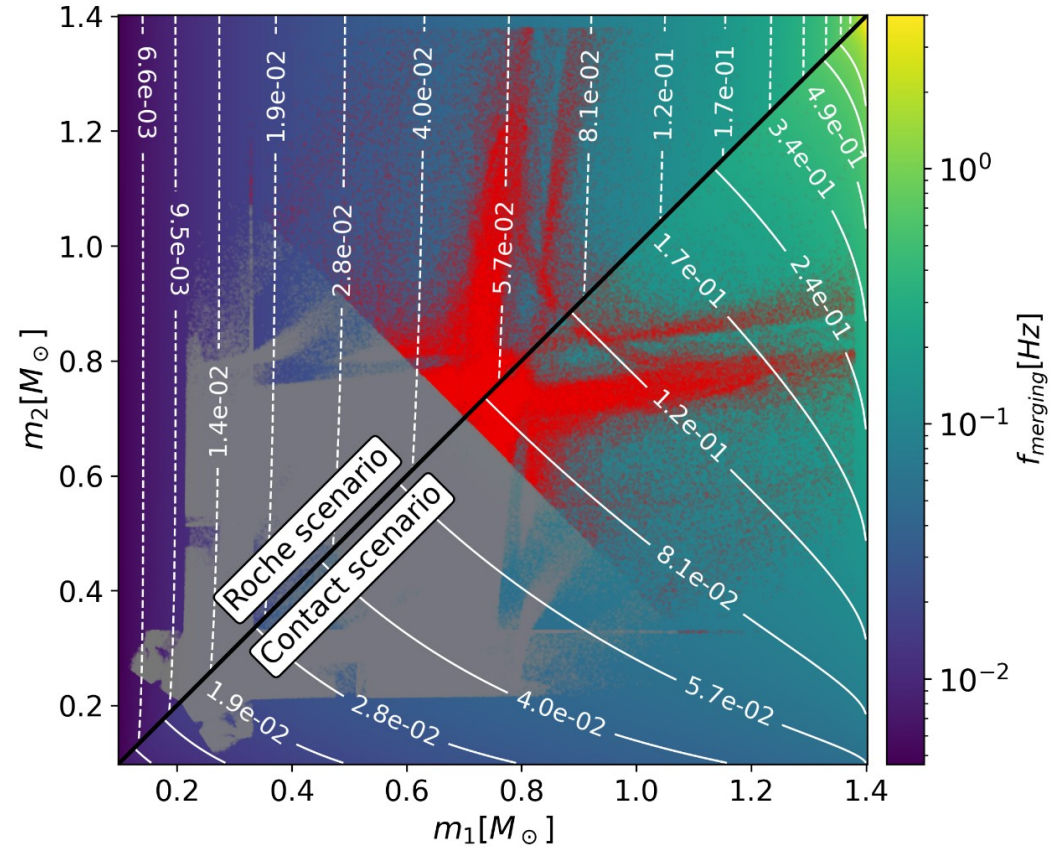
Carbon detonation in primary's core (SN Ia)



Helium shell ignition on secondary by shockwave

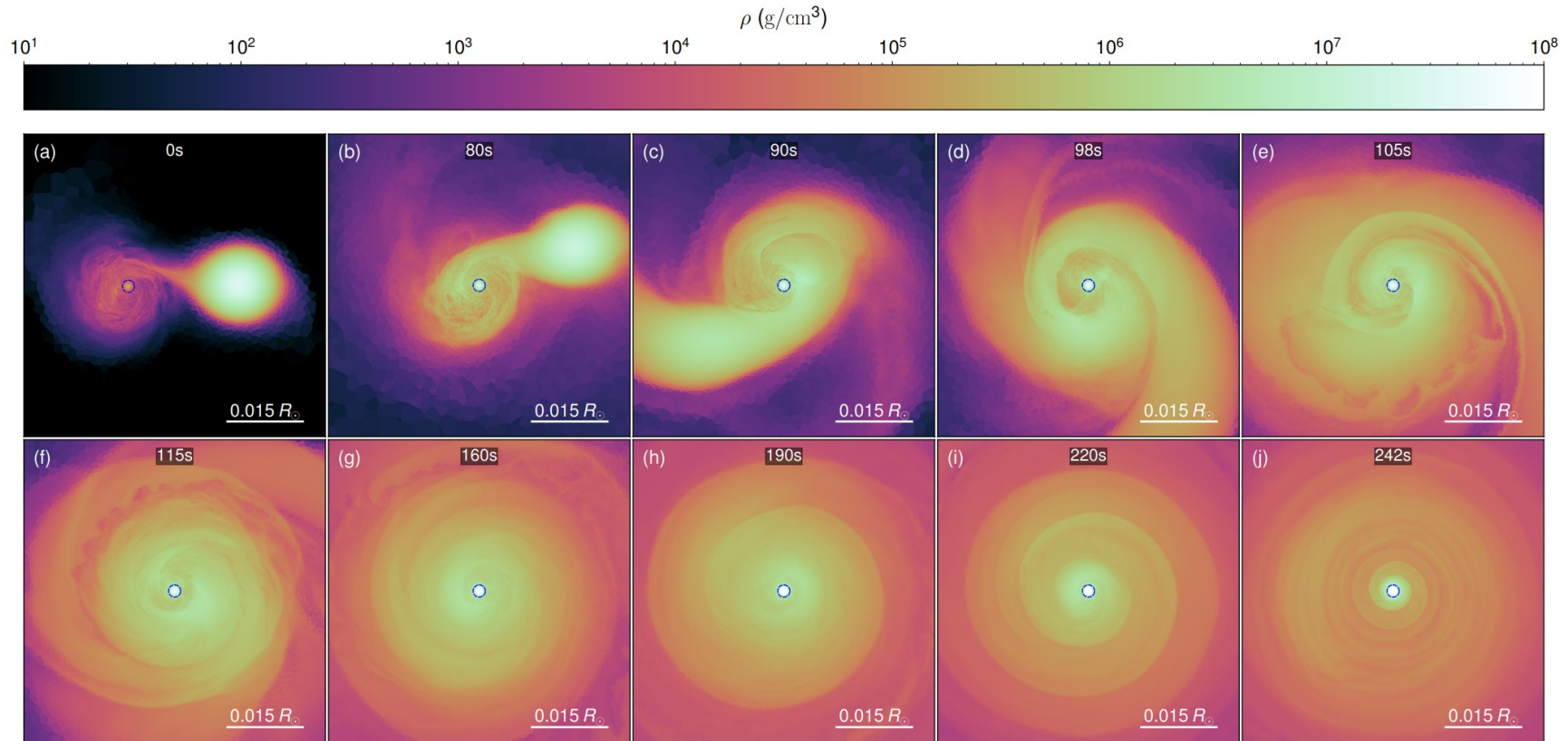


From Korol+ (2024)



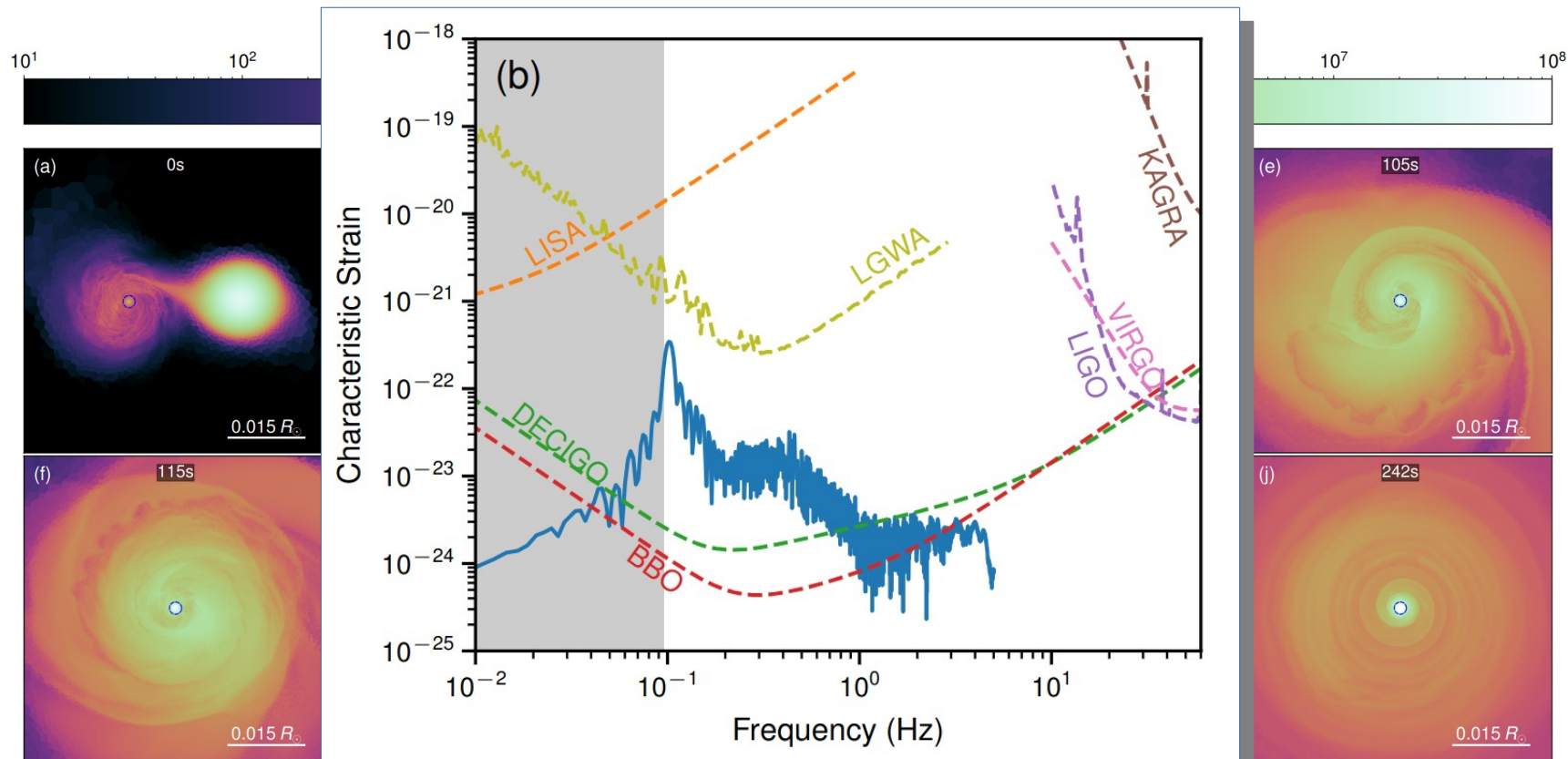
From Benetti+ (2026)

WD-CO mergers



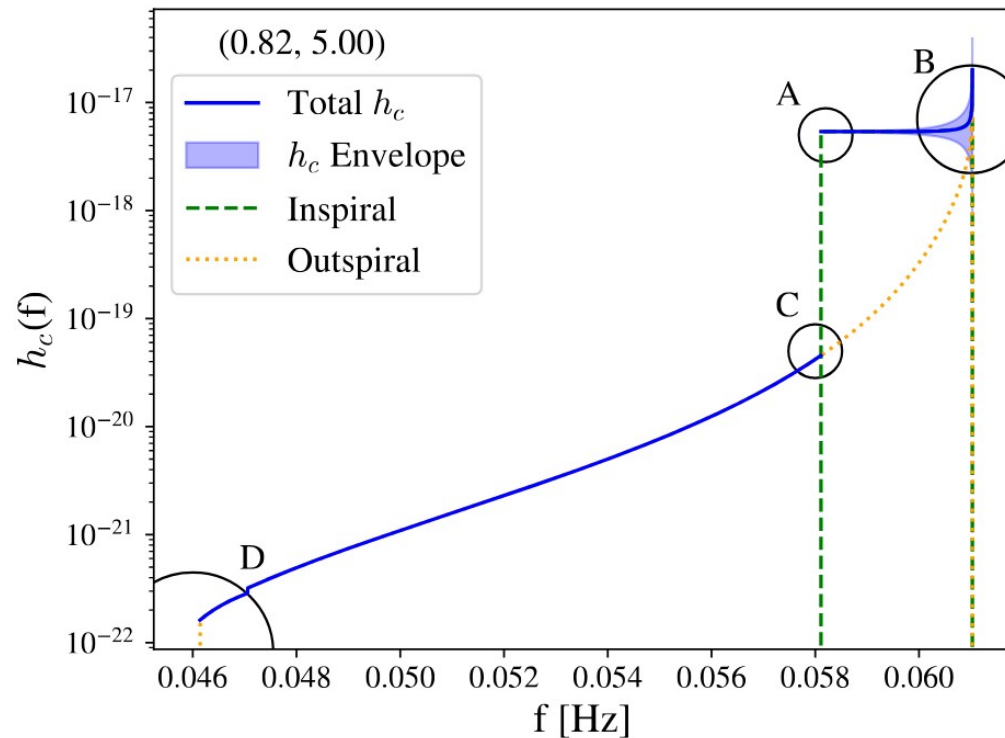
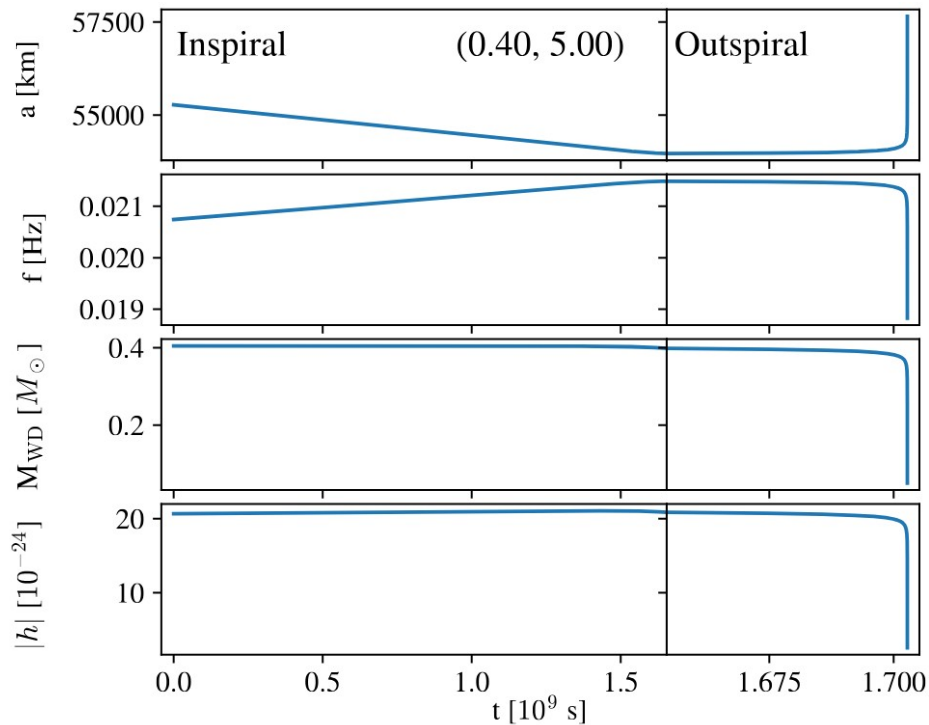
From J. Moran-Fraile et al. (2024)

WD-CO mergers

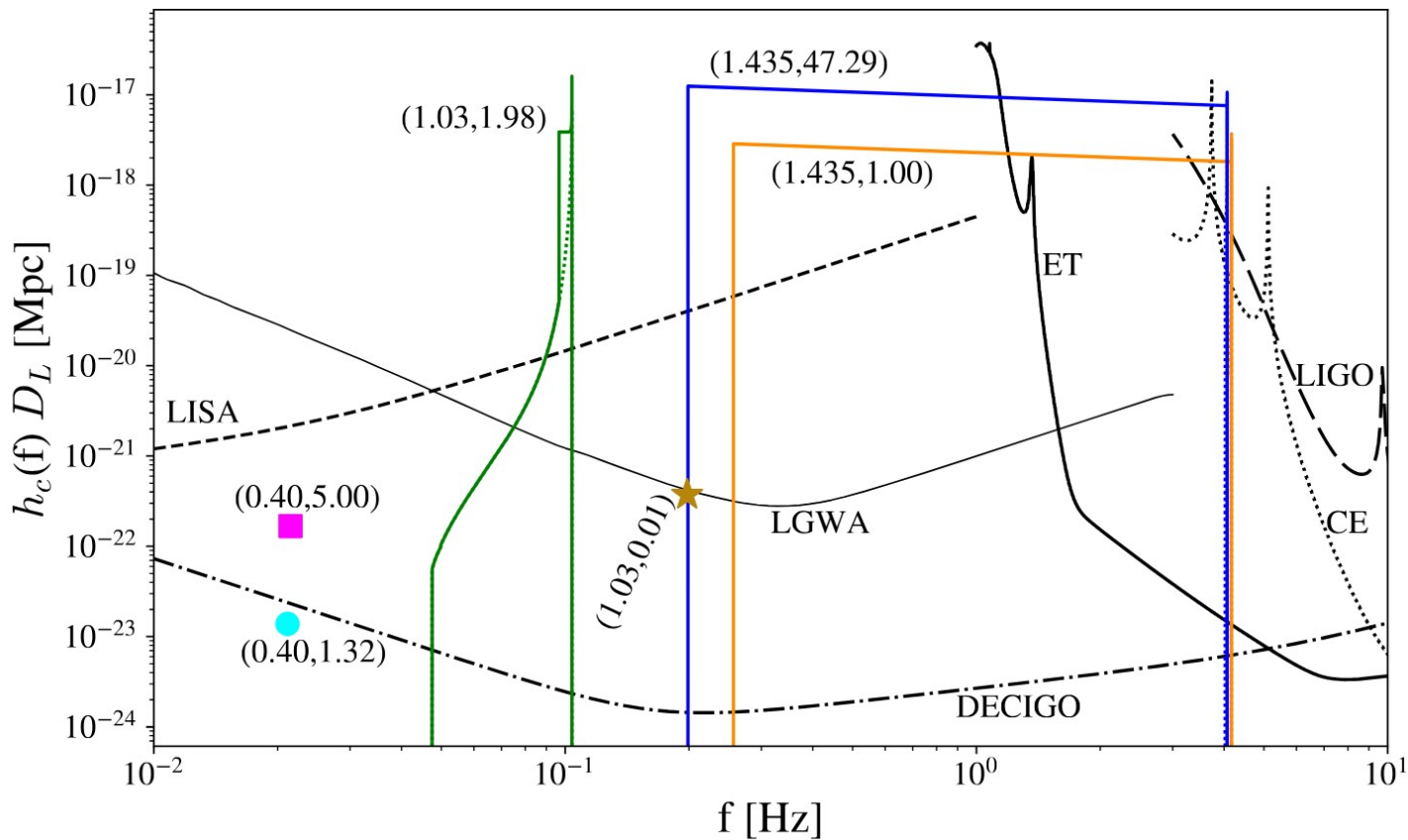


From J. Moran-Fraile et al. (2024)

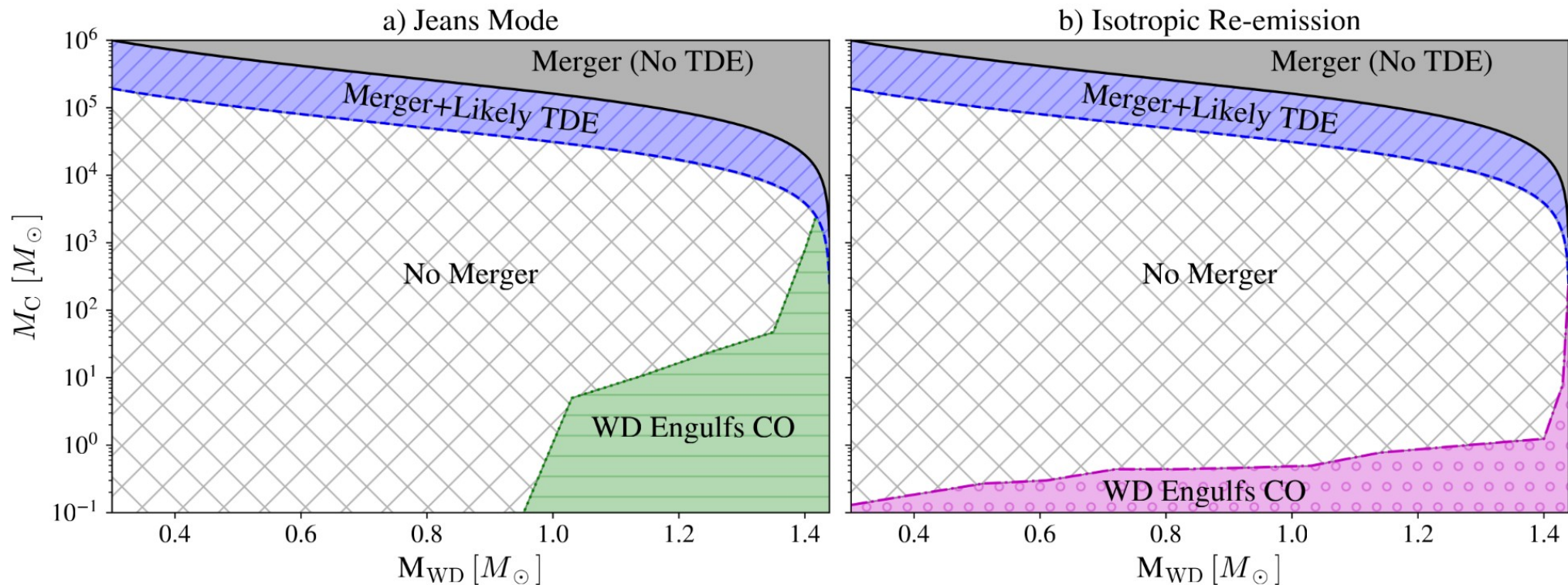
GWs from WD+CO mergers (I)



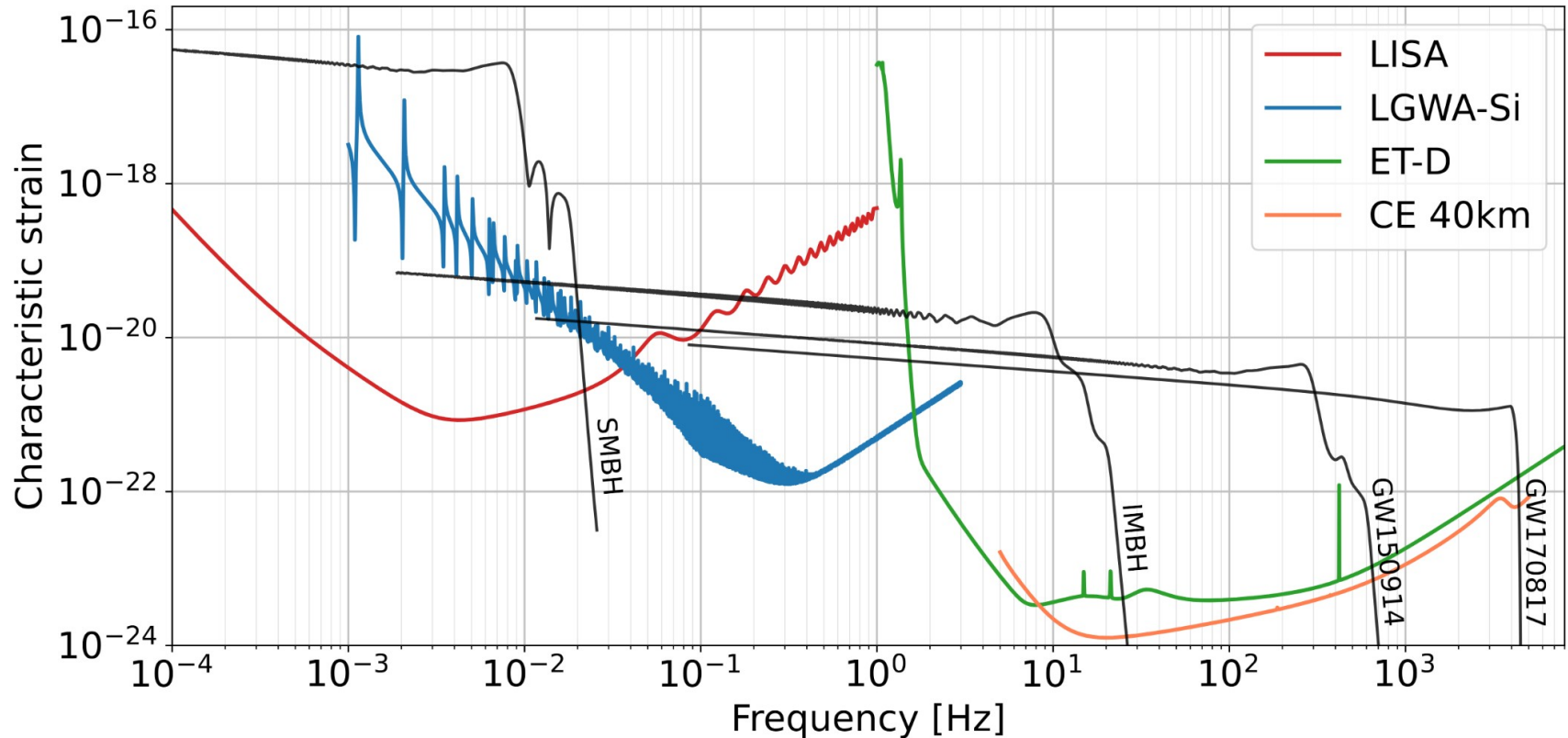
GWs from WD+CO mergers (II)



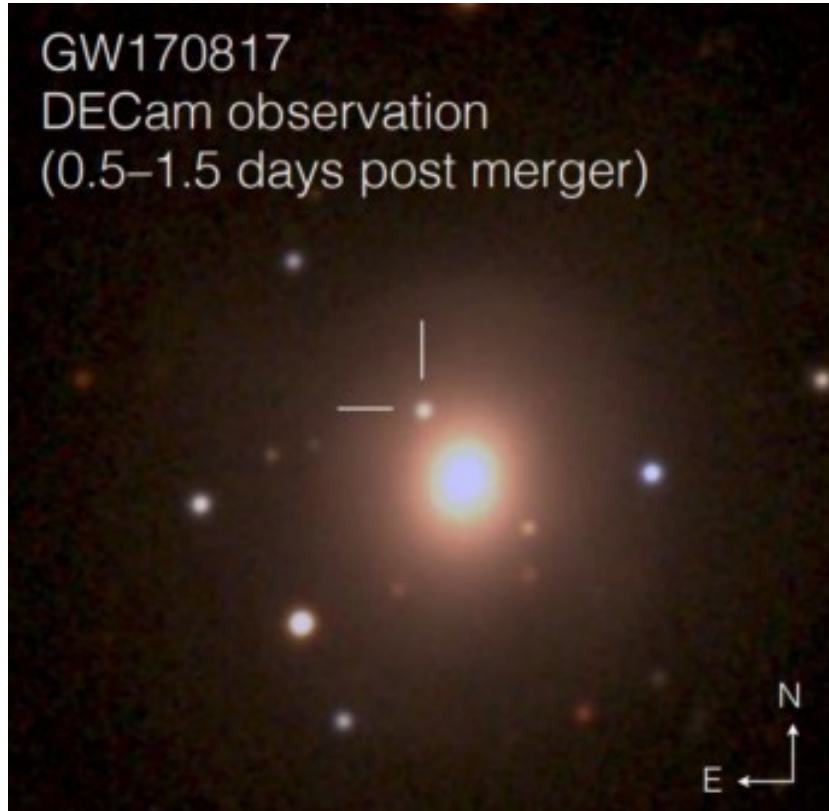
WD+CO merger outcomes



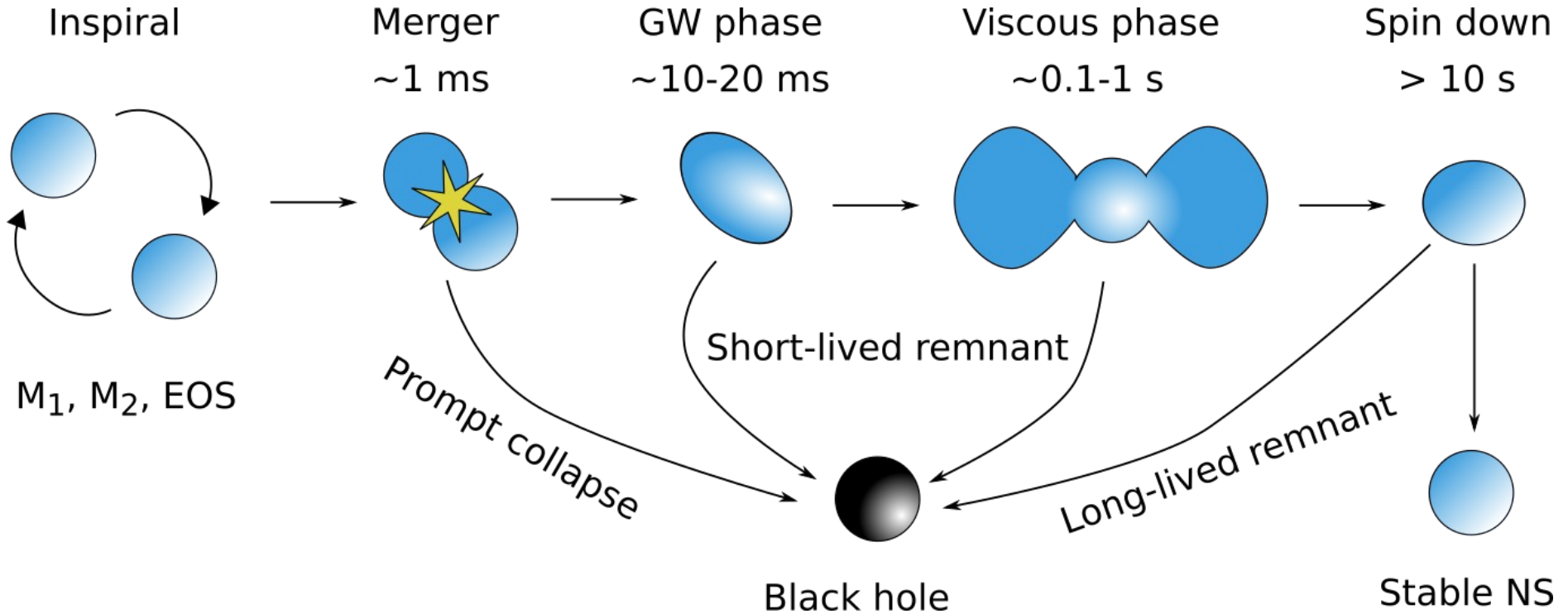
Multiband observations

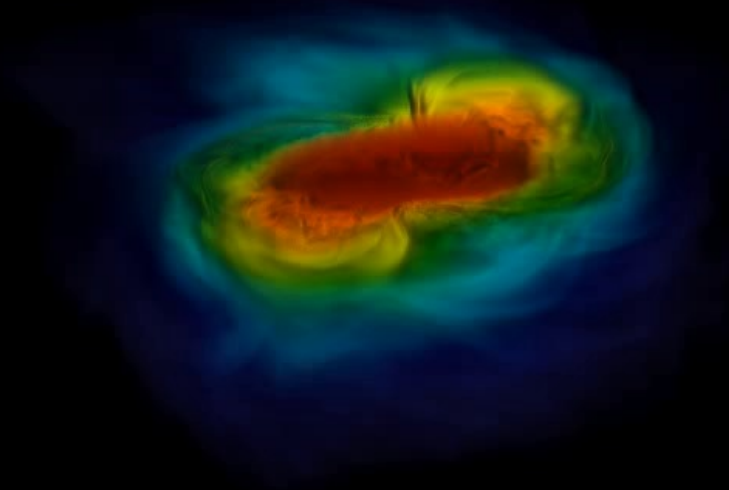
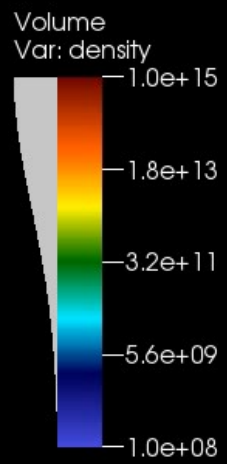


Kilonova or no kilonova?



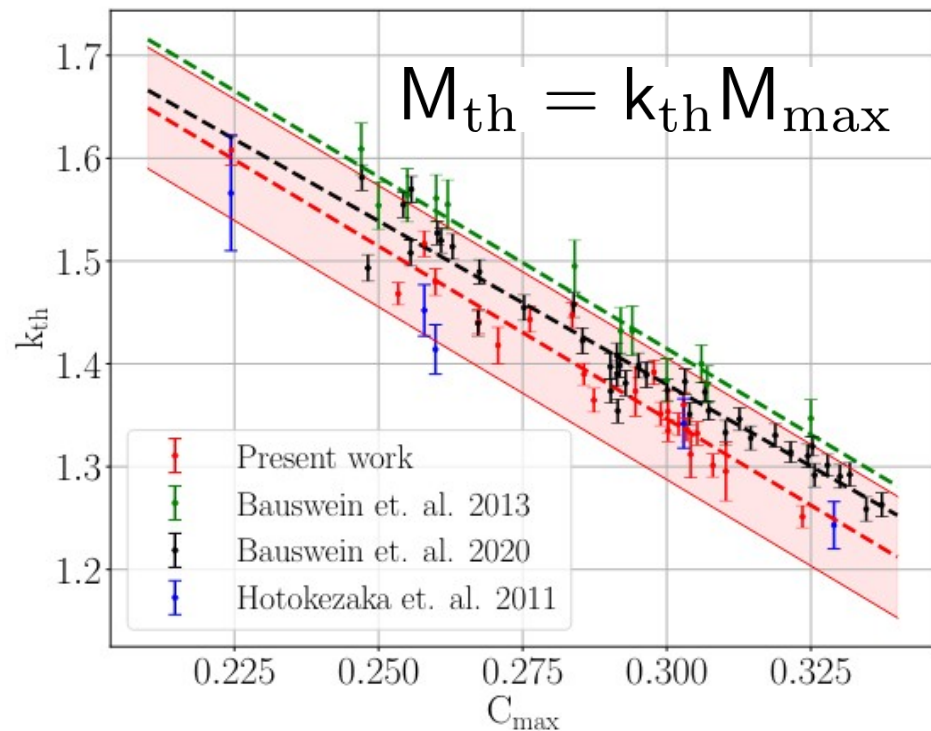
NS mergers outcomes





Time = 9.4989 ms

Prompt collapse: $q \approx 1$

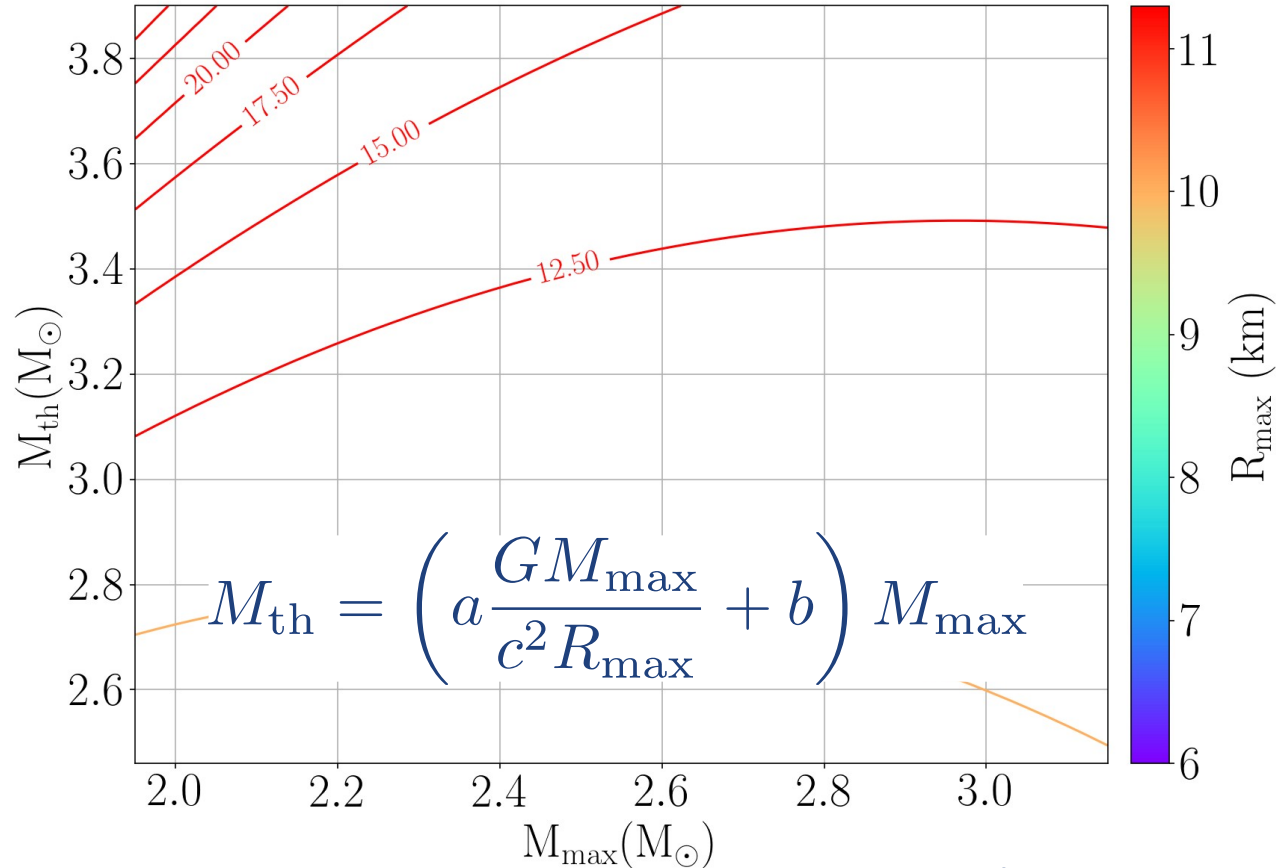


- Prompt collapse: no bounce after merger, direct BH formation
- EOS has a qualitative impact
- If $q \simeq 1$ expected to be EM quiet
- Alternative: use postmerger GWs (likely with 3G)
- Needs of high-quality NR data

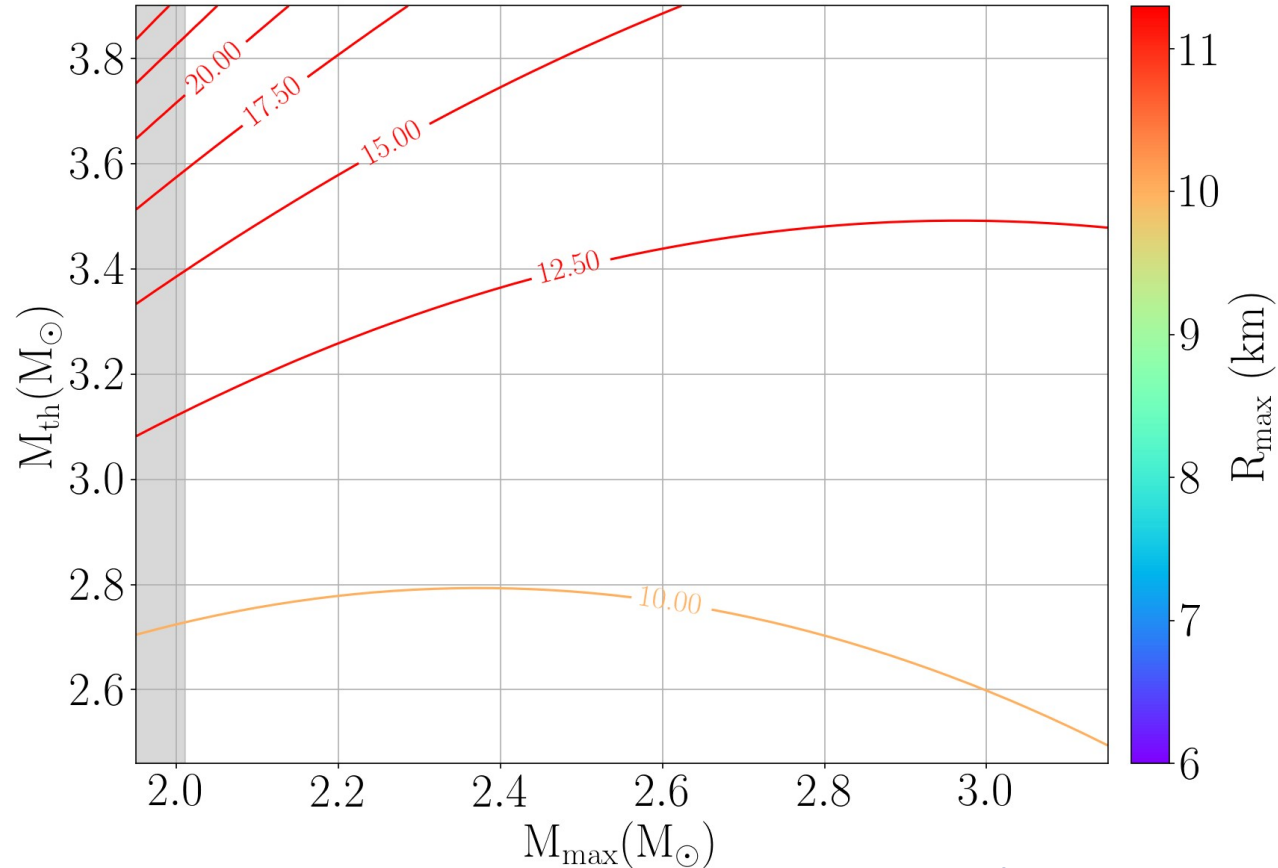
See also Hotokezaka+ 2011, Bauswein 2013, 2020, Koepfel 2019, ...

From Kashyap, Das+, PRD 105 103022 (2022)

Prompt collapse: equal masses



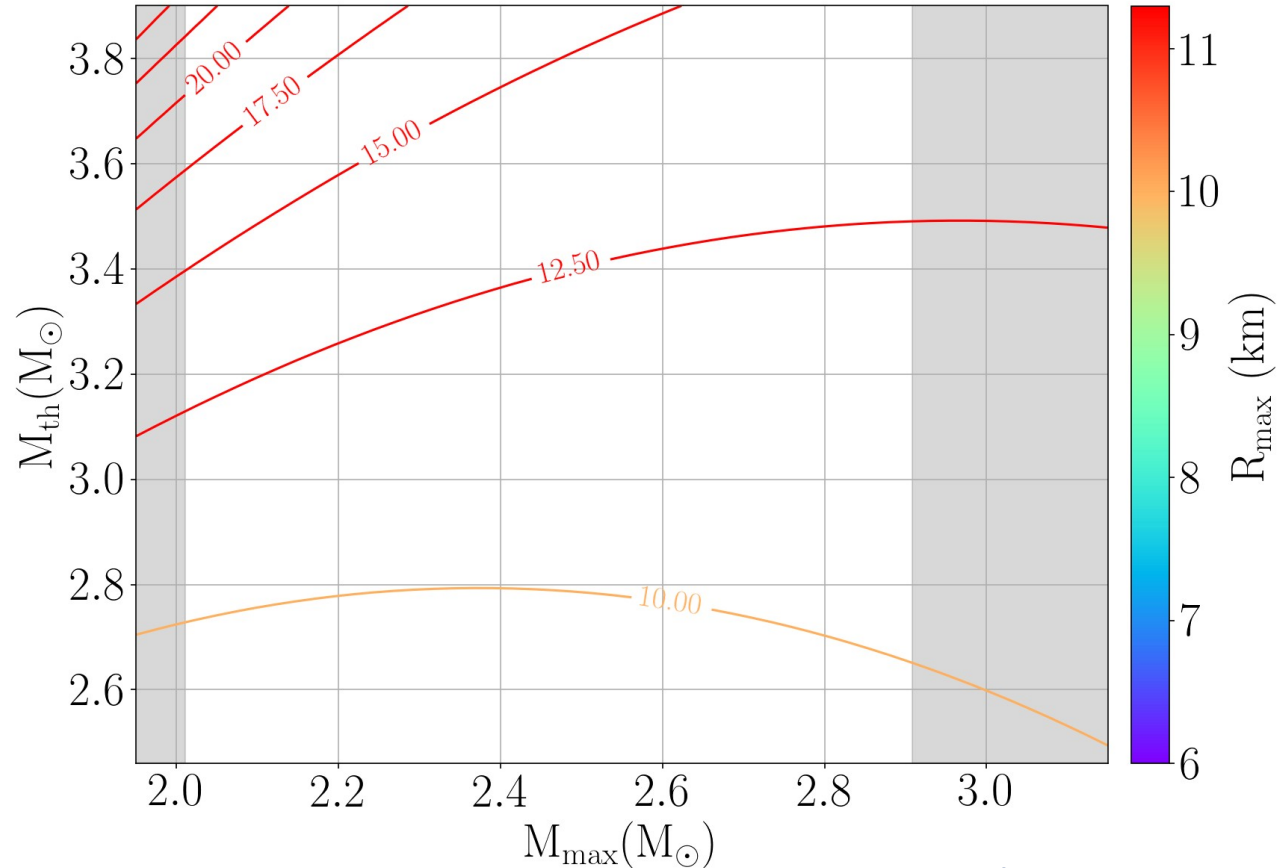
Prompt collapse: equal masses



See also Bauswein+ 2017

From Kashyap, Das+, PRD 105 103022 (2022)

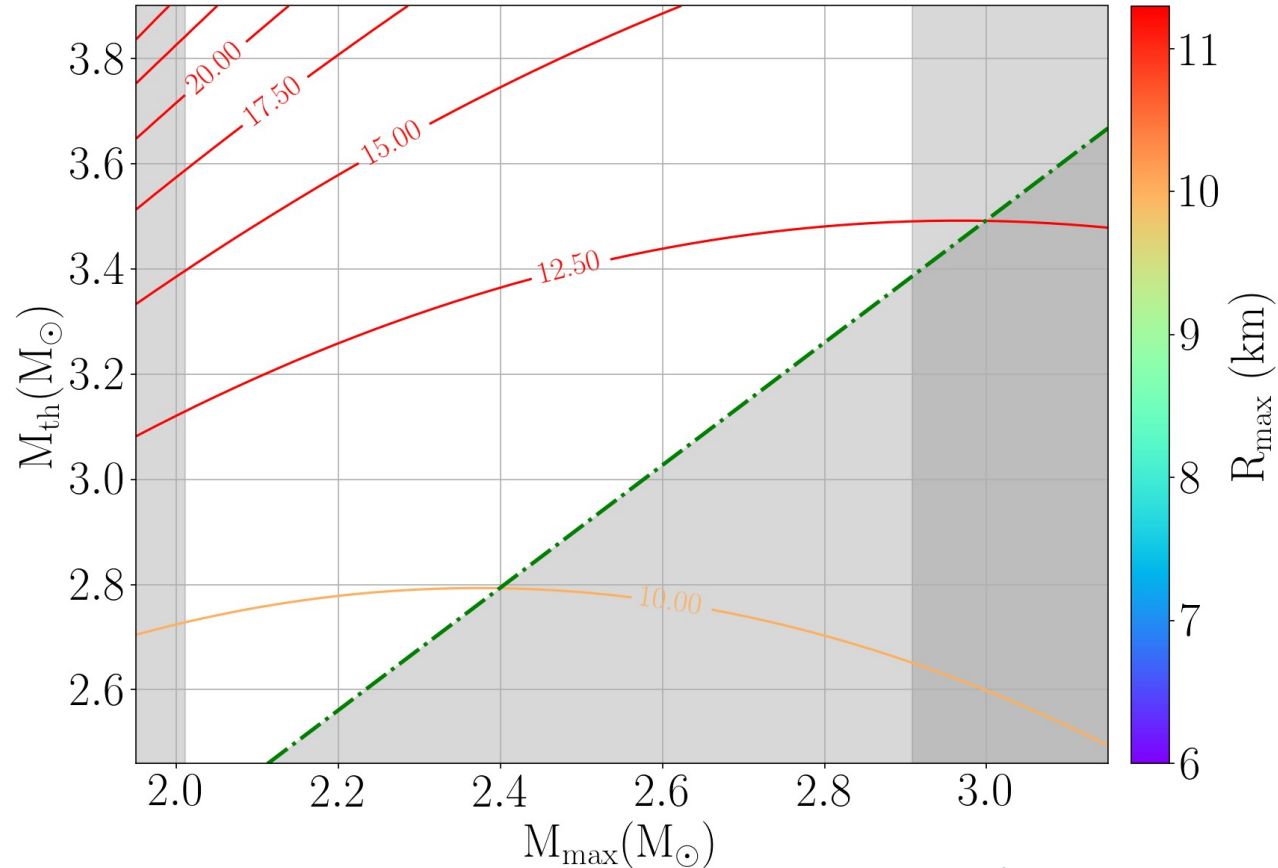
Prompt collapse: equal masses



See also Bauswein+ 2017

From Kashyap, Das+, PRD 105 103022 (2022)

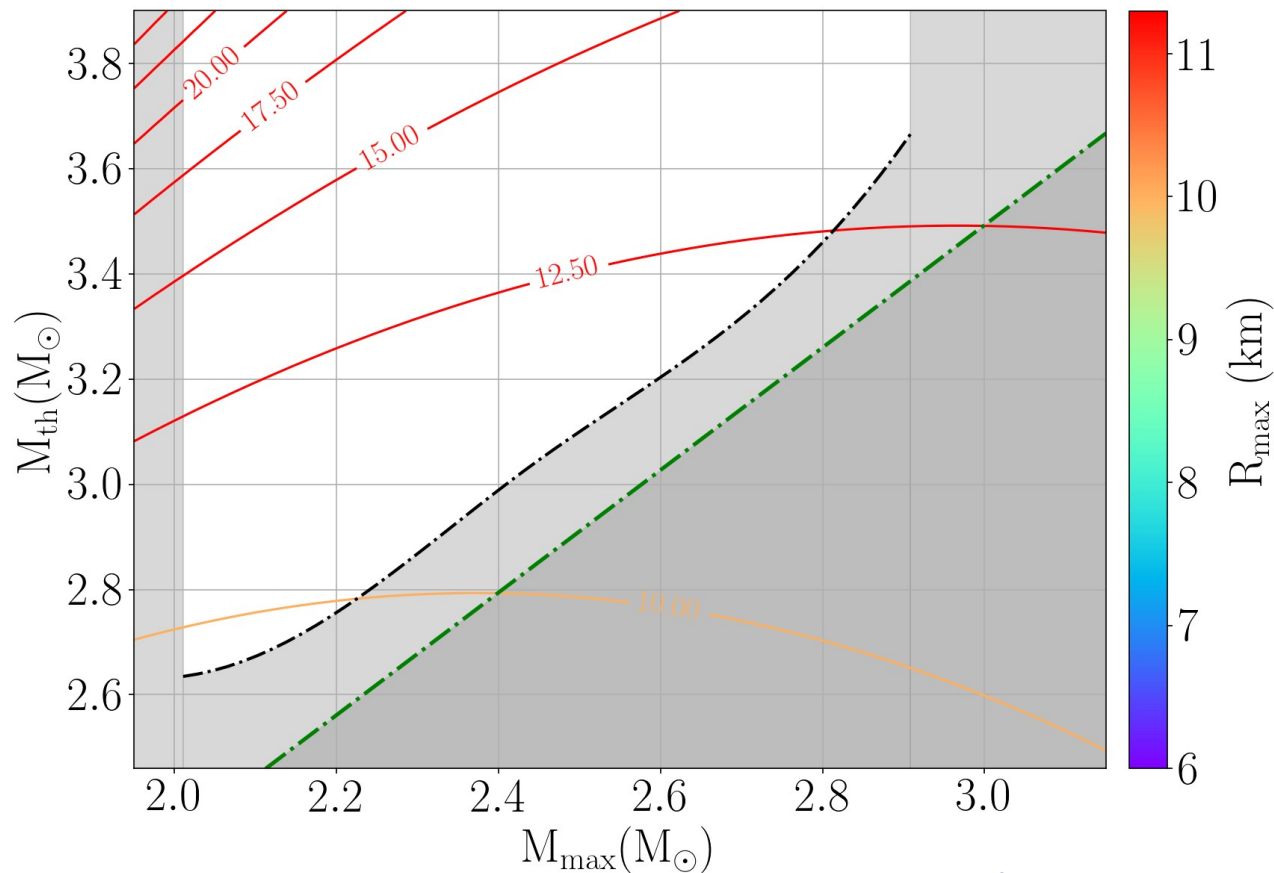
Prompt collapse: equal masses



See also Bauswein+ 2017

From Kashyap, Das+, PRD 105 103022 (2022)

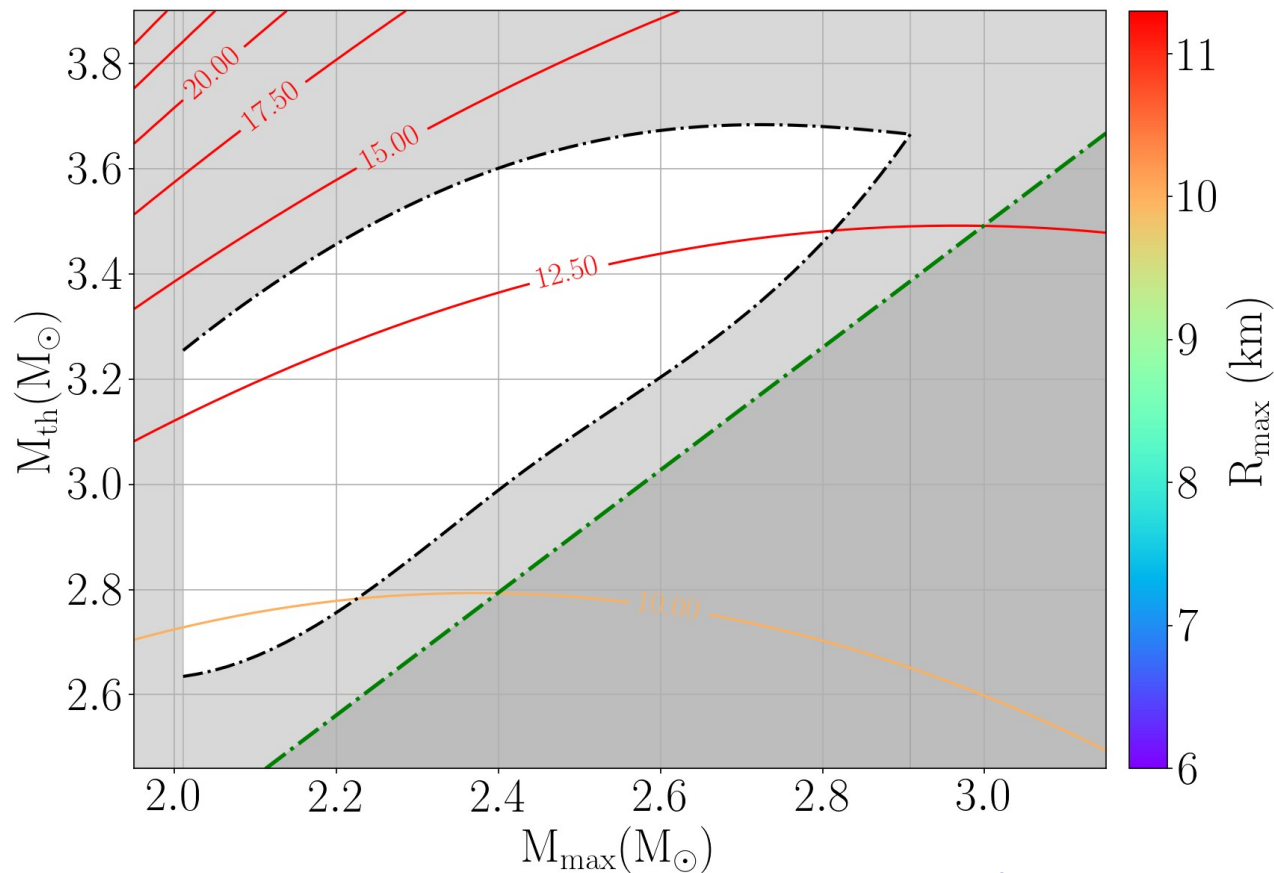
Prompt collapse: equal masses



See also Bauswein+ 2017

From Kashyap, Das+, PRD 105 103022 (2022)

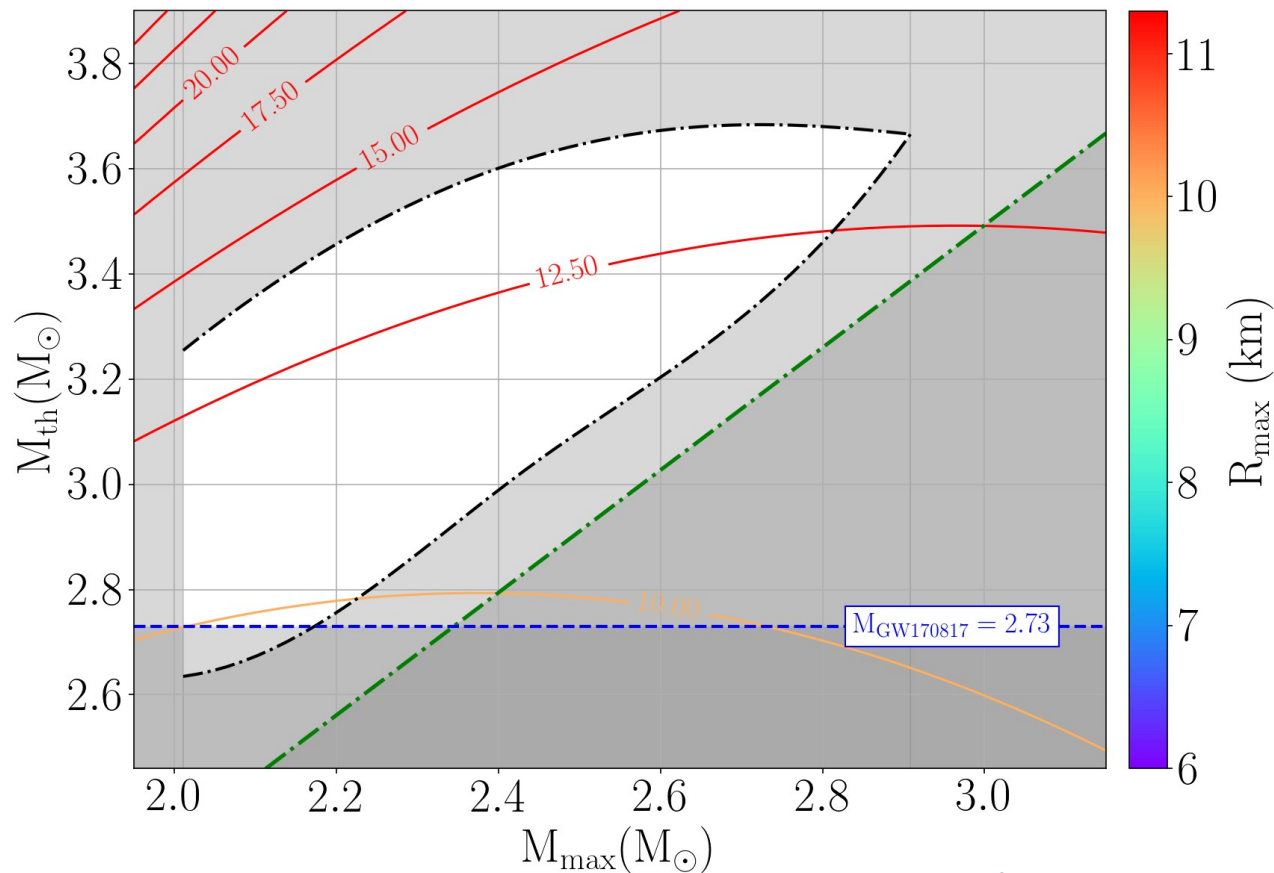
Prompt collapse: equal masses



See also Bauswein+ 2017

From Kashyap, Das+, PRD 105 103022 (2022)

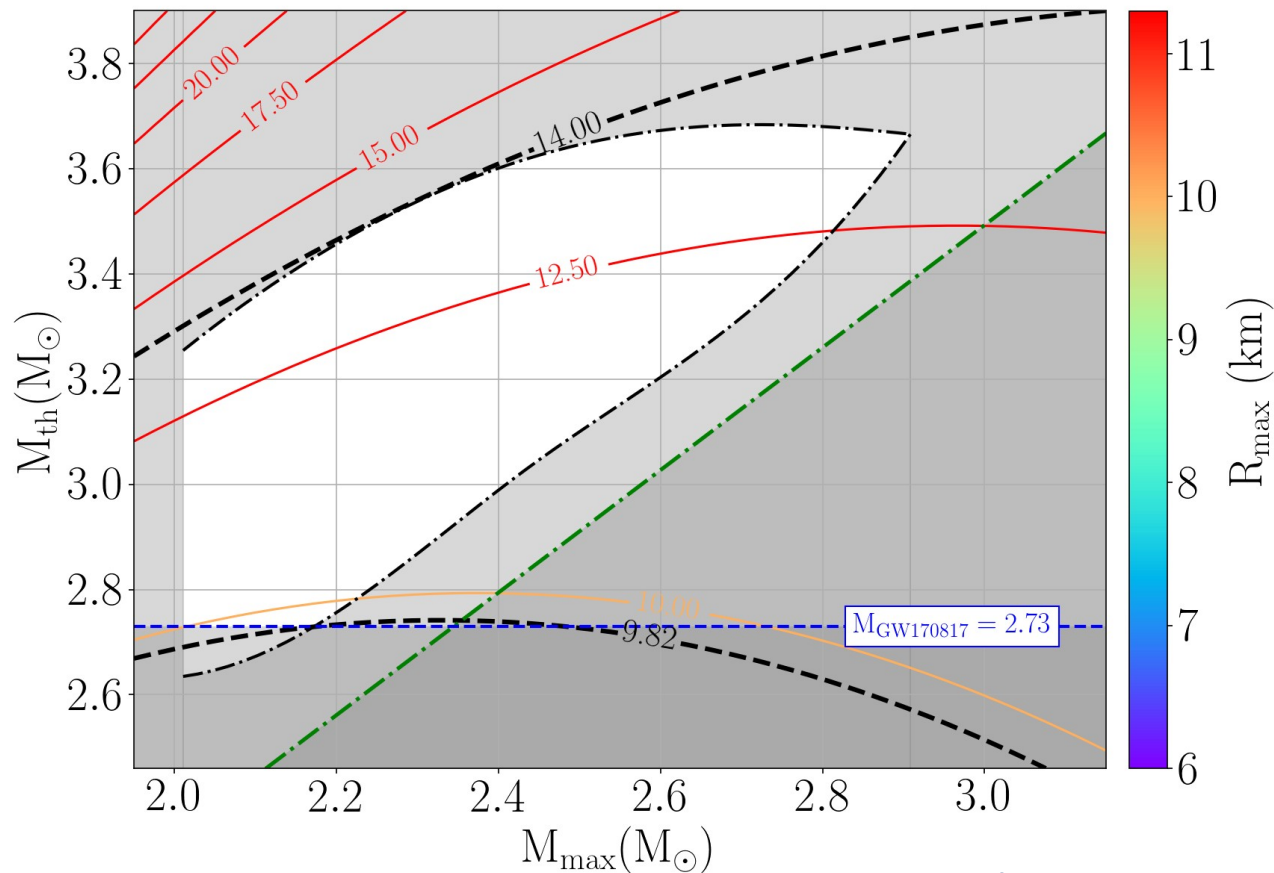
Prompt collapse: equal masses



See also Bauswein+ 2017

From Kashyap, Das+, PRD 105 103022 (2022)

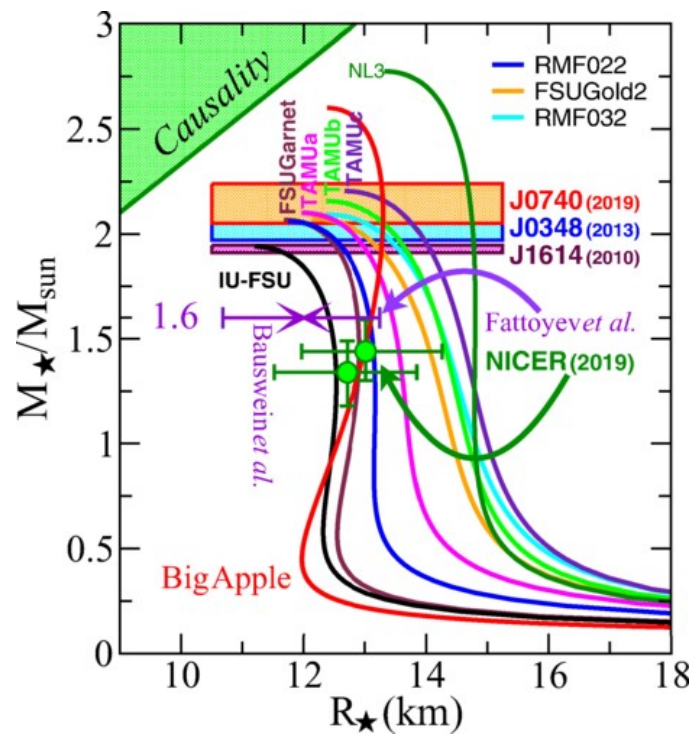
Prompt collapse: equal masses



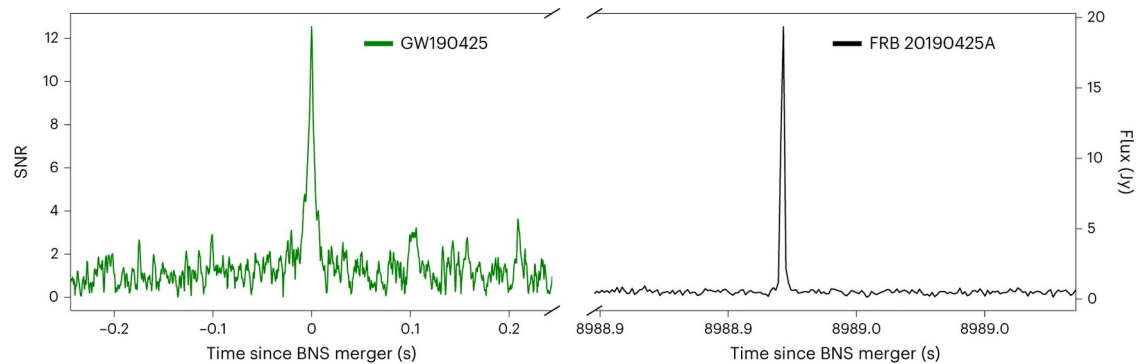
See also Bauswein+ 2017

From Kashyap, Das+, PRD 105 103022 (2022)

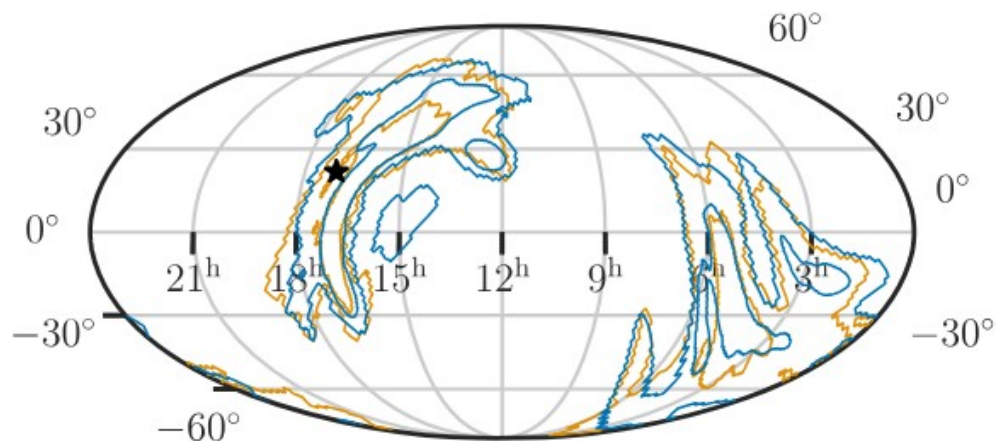
GW190425



Fattoyev+ 2020

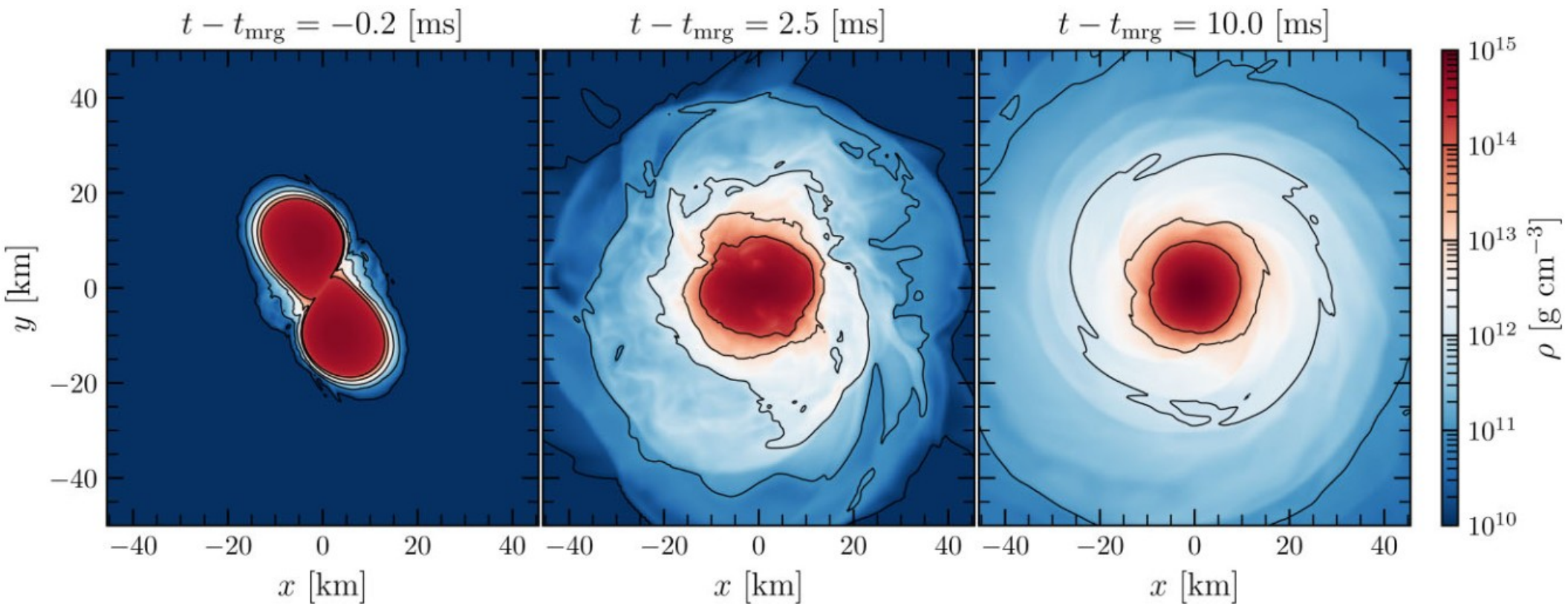


Moroianu+ 2023

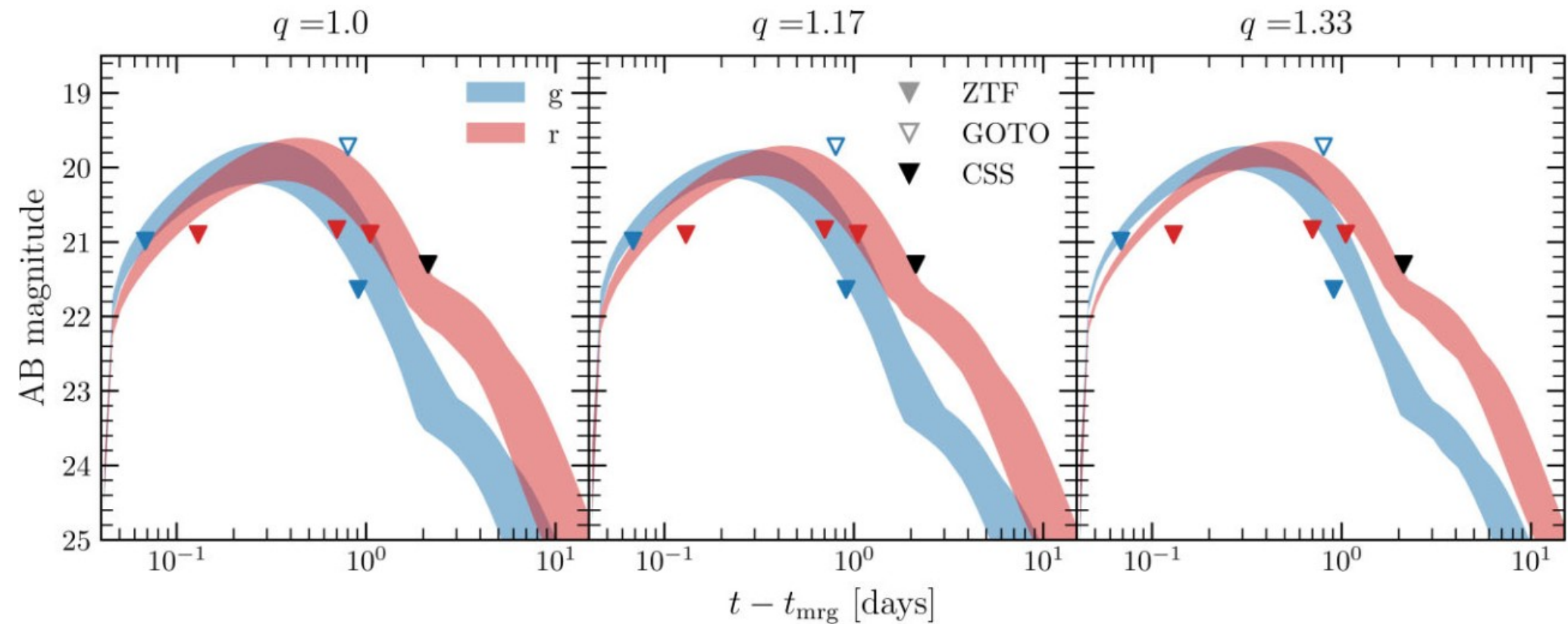


Bhardwaj, Palmese+ 2024

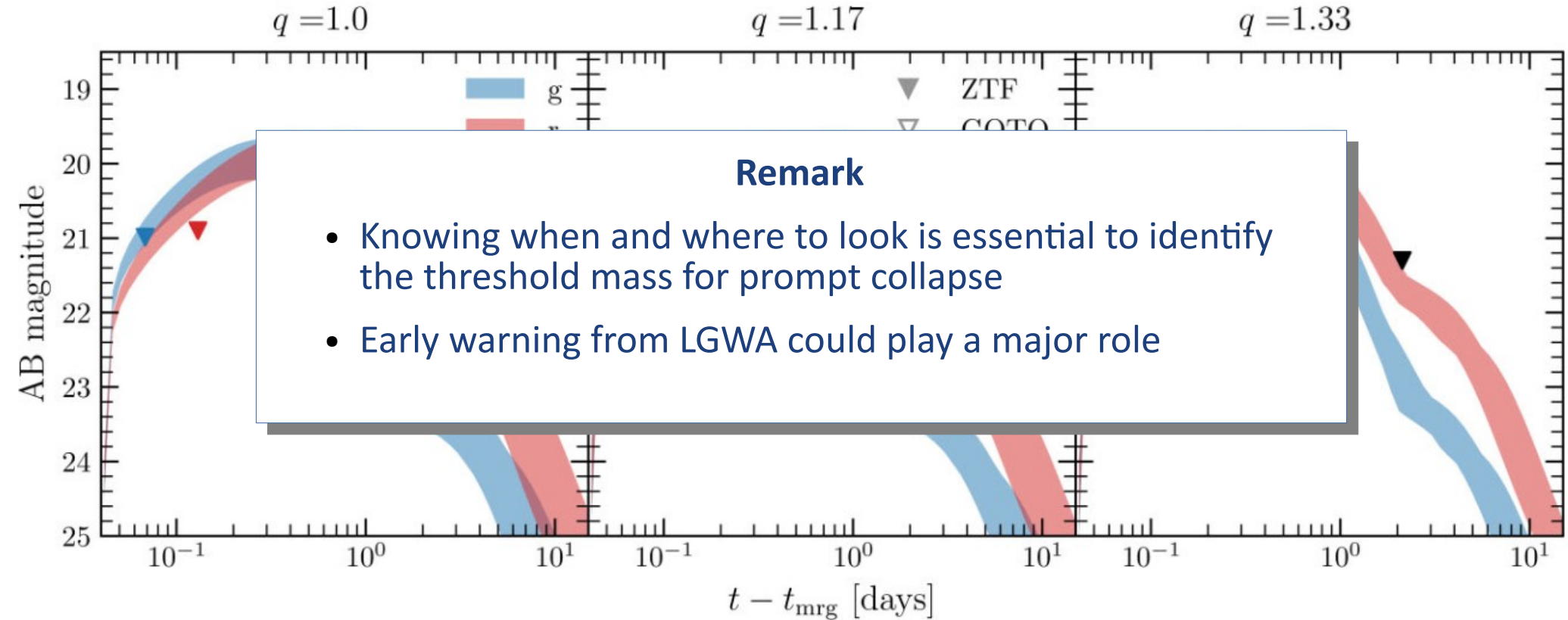
GW190425



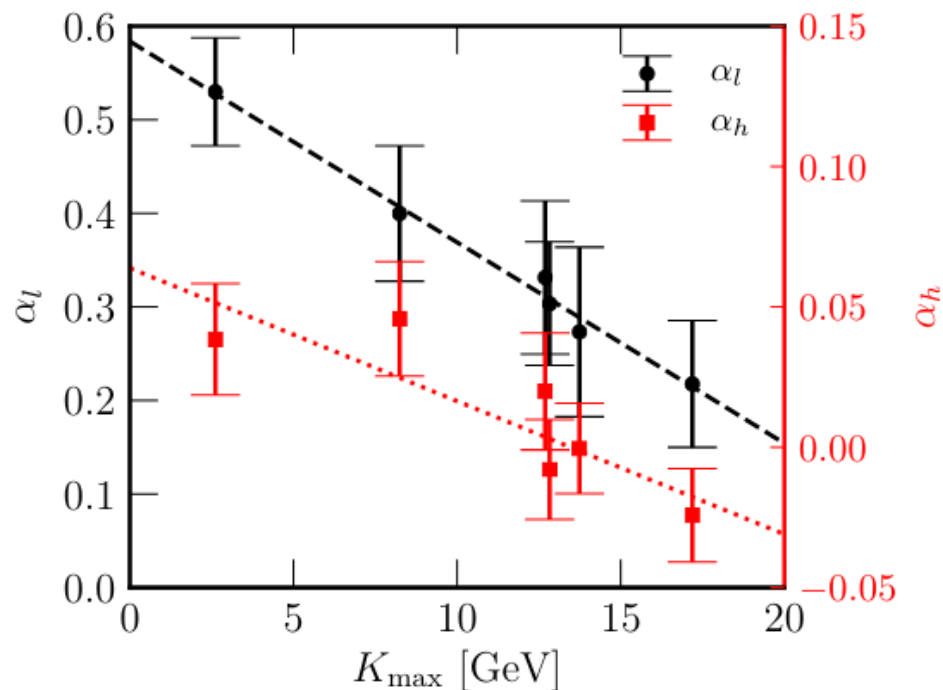
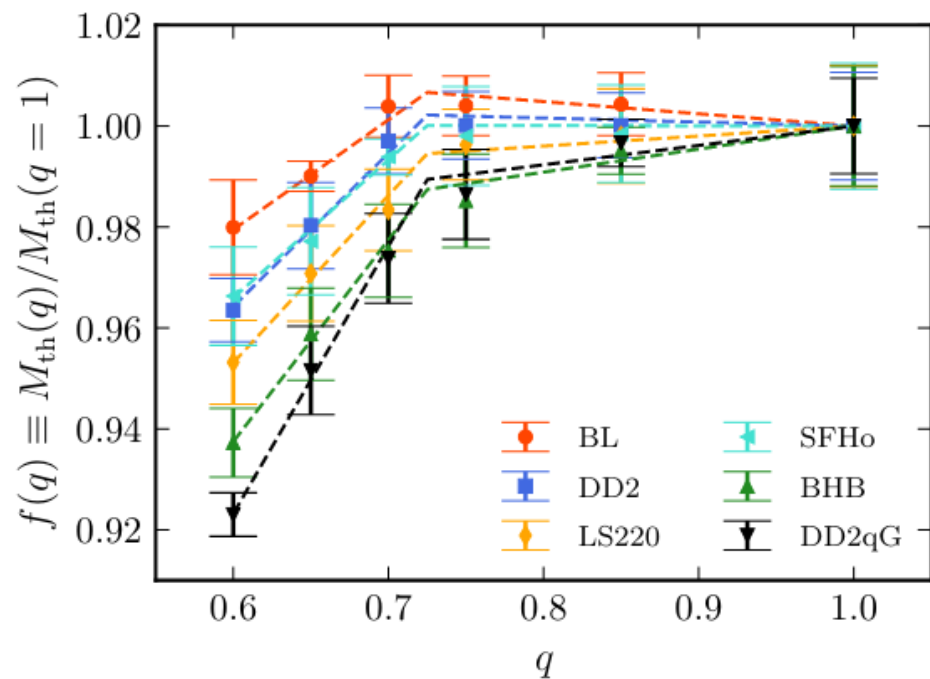
GW190425



GW190425

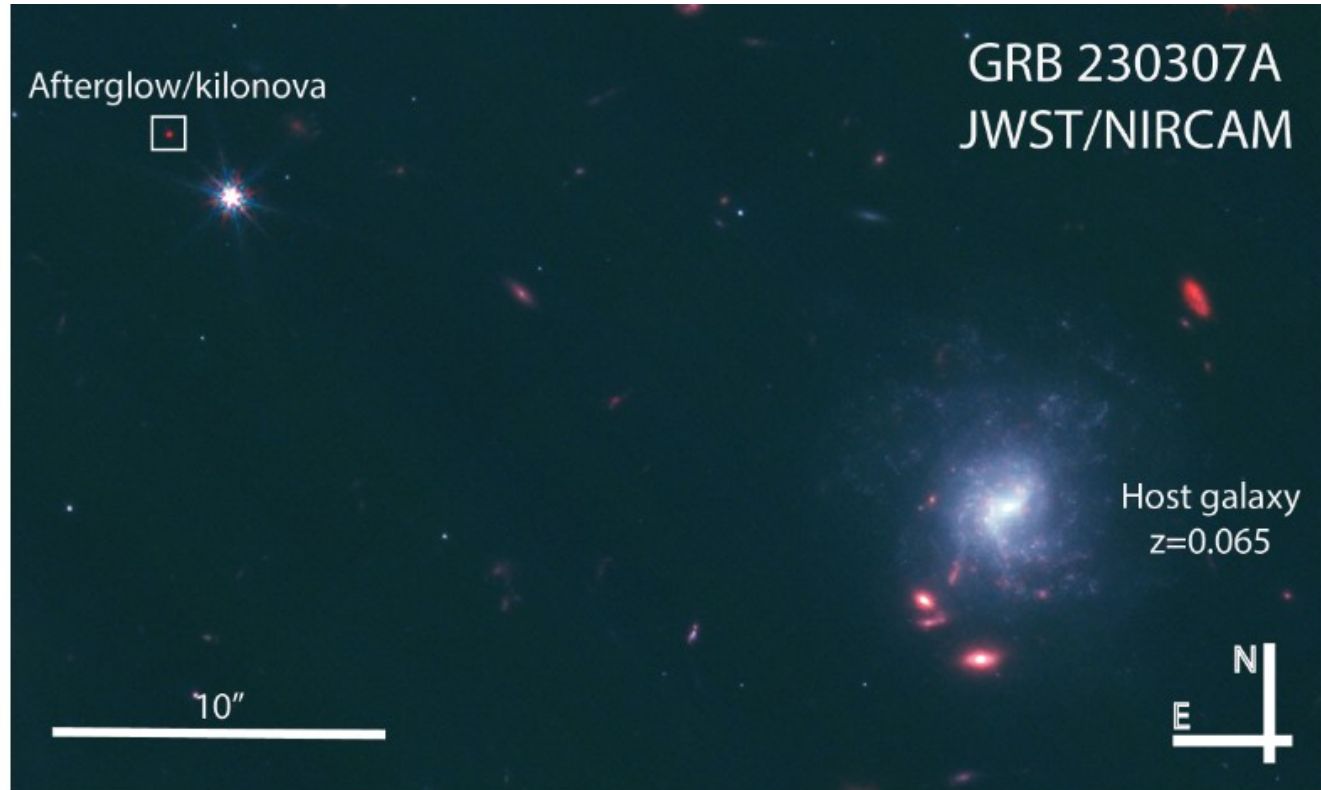


Prompt collapse: $q \neq 1$



Can constrain the **incompressibility** at the highest density achieved in NSs!

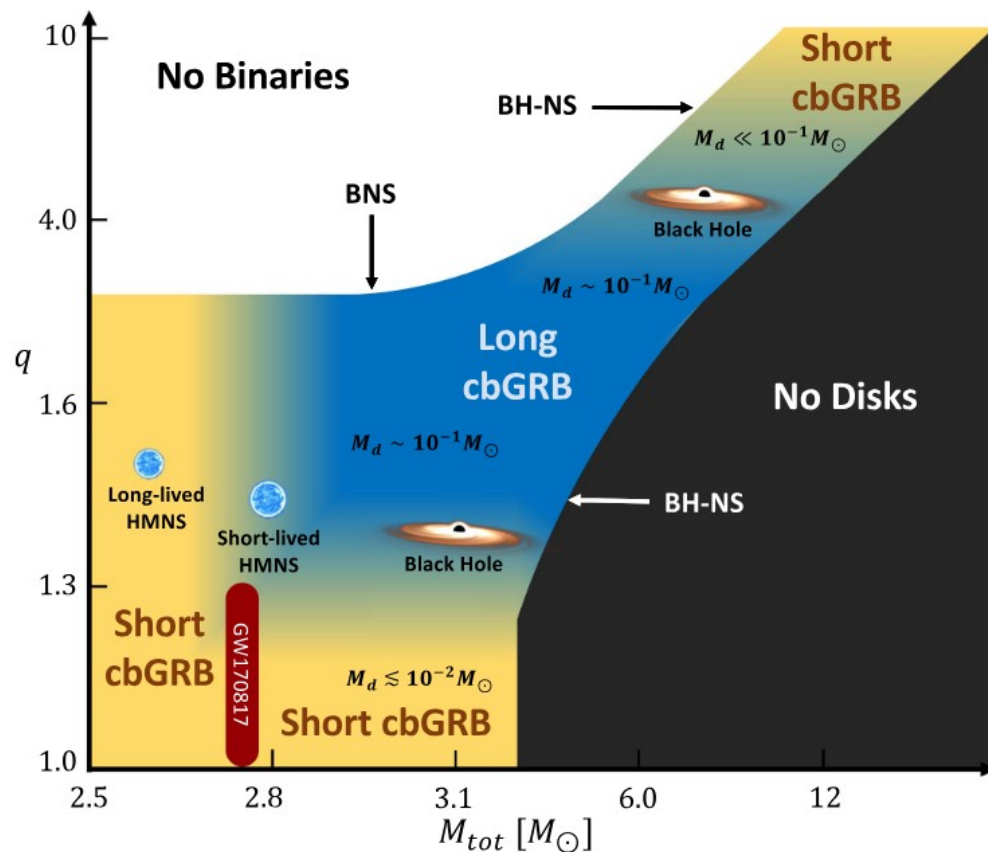
Kilonovae from long-GRBs?!?



See also Mei+ 2022; Rastinejad+ 2022; Troja+2022; Yang+ et al. 2022; ...

From Levan+, Nature (2023)

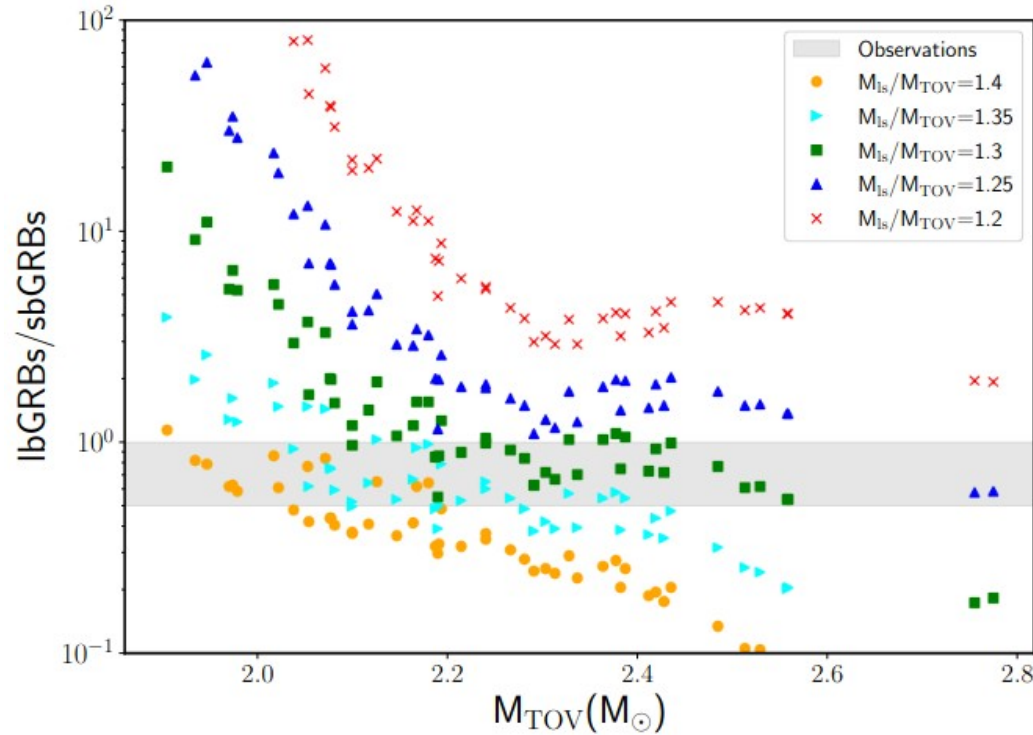
Long vs short bursts from mergers



- Mergers forming small disks power short-GRBs
- Mergers producing large disks power long-GRBs
- Ratio of long to short merger GRBs can tell us about ratio of long to short lived remnants

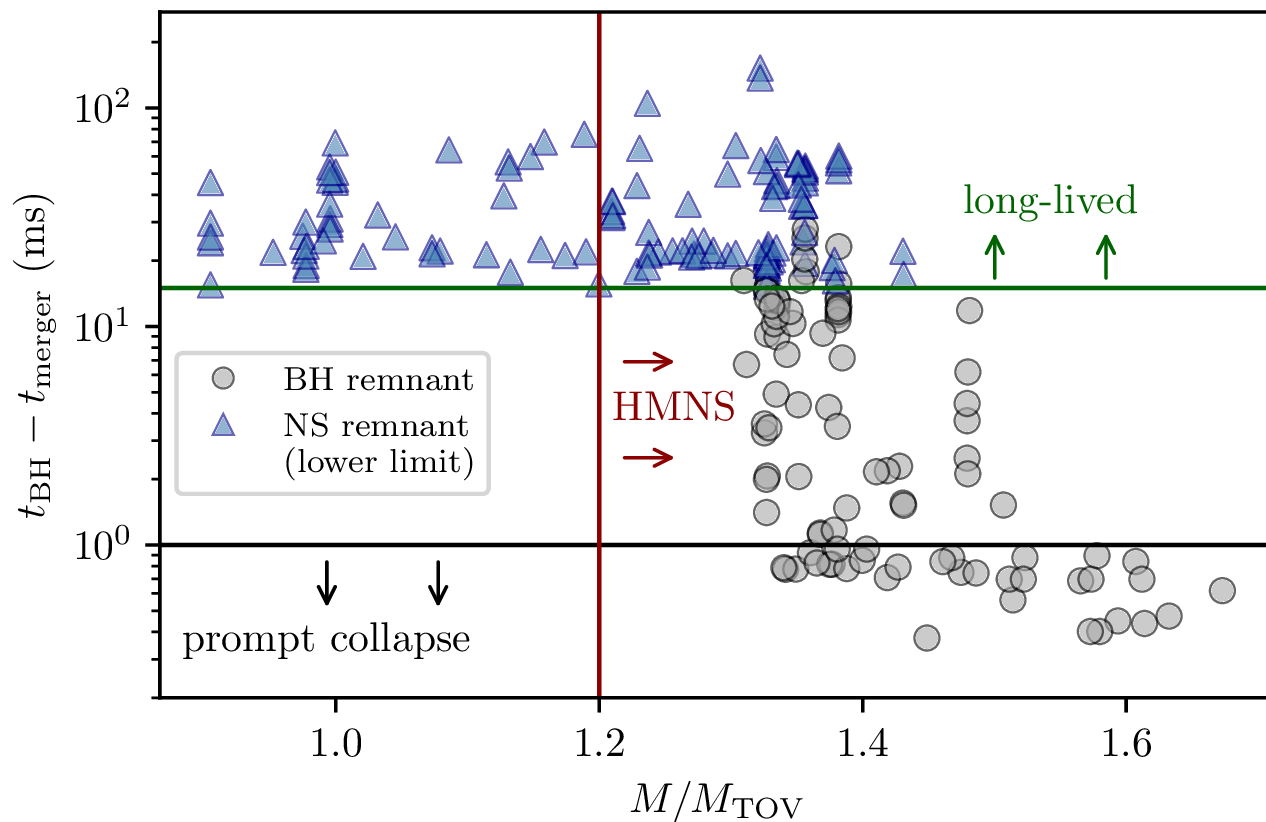
From Gottlieb+, ApJL 2023

Implication for NS mergers (I)



The ratio of long to short compact-binary GRBs could constrain k_{long}

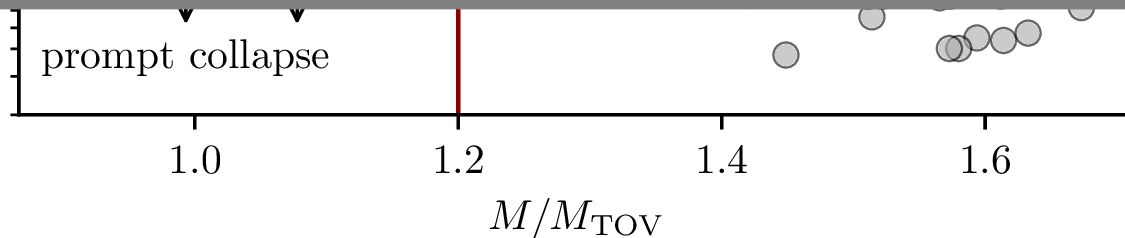
Implications for NS mergers (II)



Implications for NS mergers (II)

Caveats

- The mechanism by which mergers would power LGRBs is not well understood
- LGRBs from mergers could be other things: AIC, WD+NS, or WD+BH mergers
- Need GWs to distinguish all scenarios!



Conclusions

- LGWA will be an outstanding tool for multi-messenger astronomy
- White-dwarf mergers can be used as laboratories to study
 - mass transfer
 - type Ia and other thermonuclear transients
 - tidal disruption events (TDEs)
 - LGRBs
- Early warning from LGWA will be critical for MMA science with NS mergers