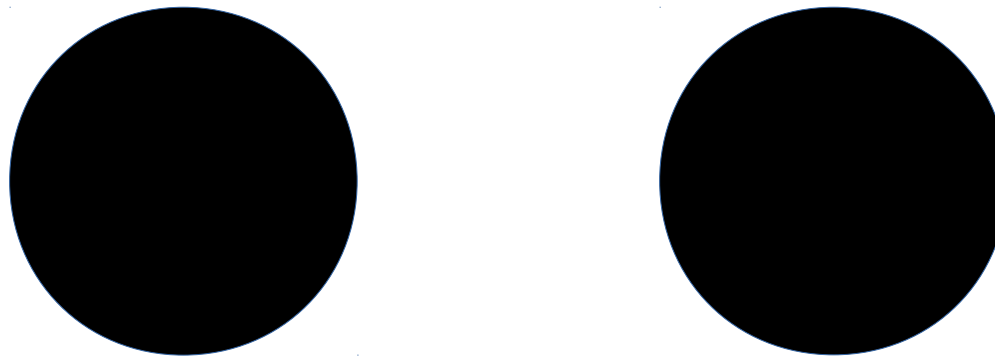


How to make (binary) black holes?

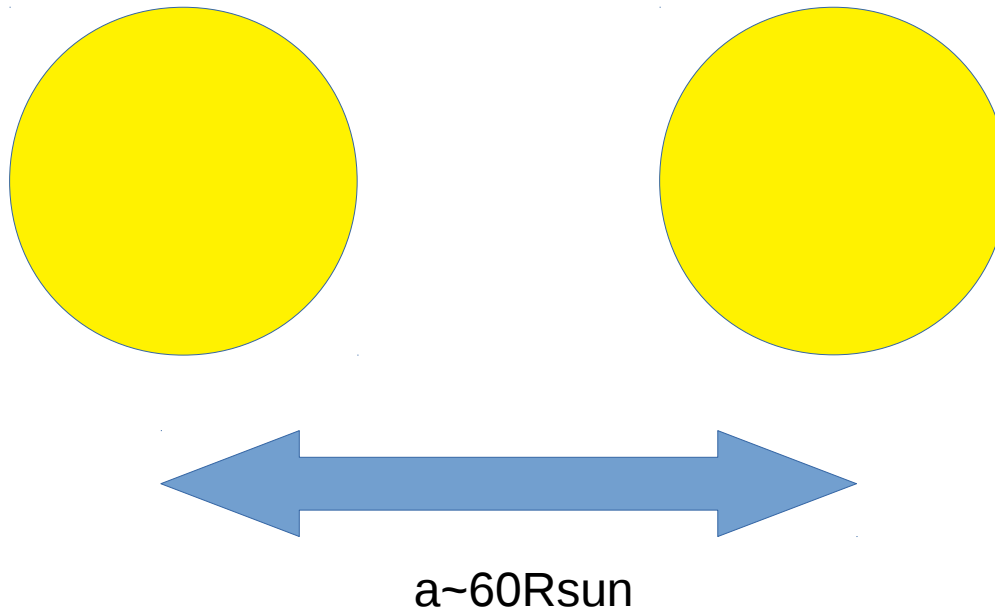
Rob Farmer
University of Amsterdam

How to merge

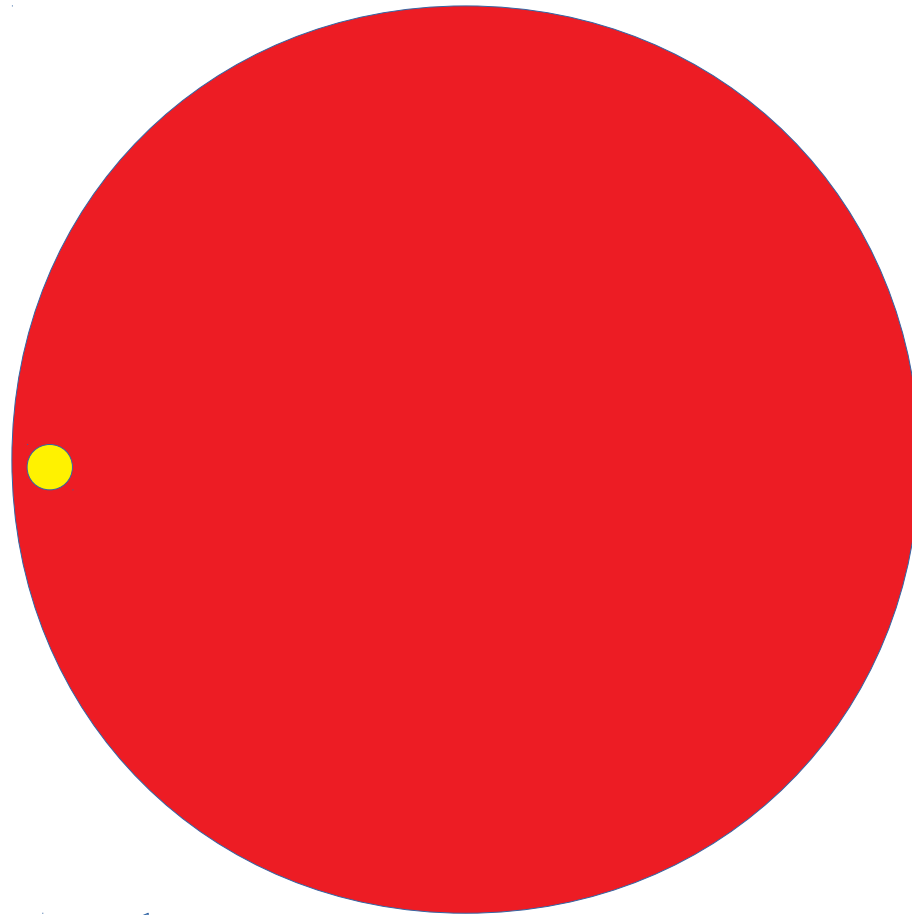


a~60Rsun
For BH to merge in ~10Gyr

How not to merge

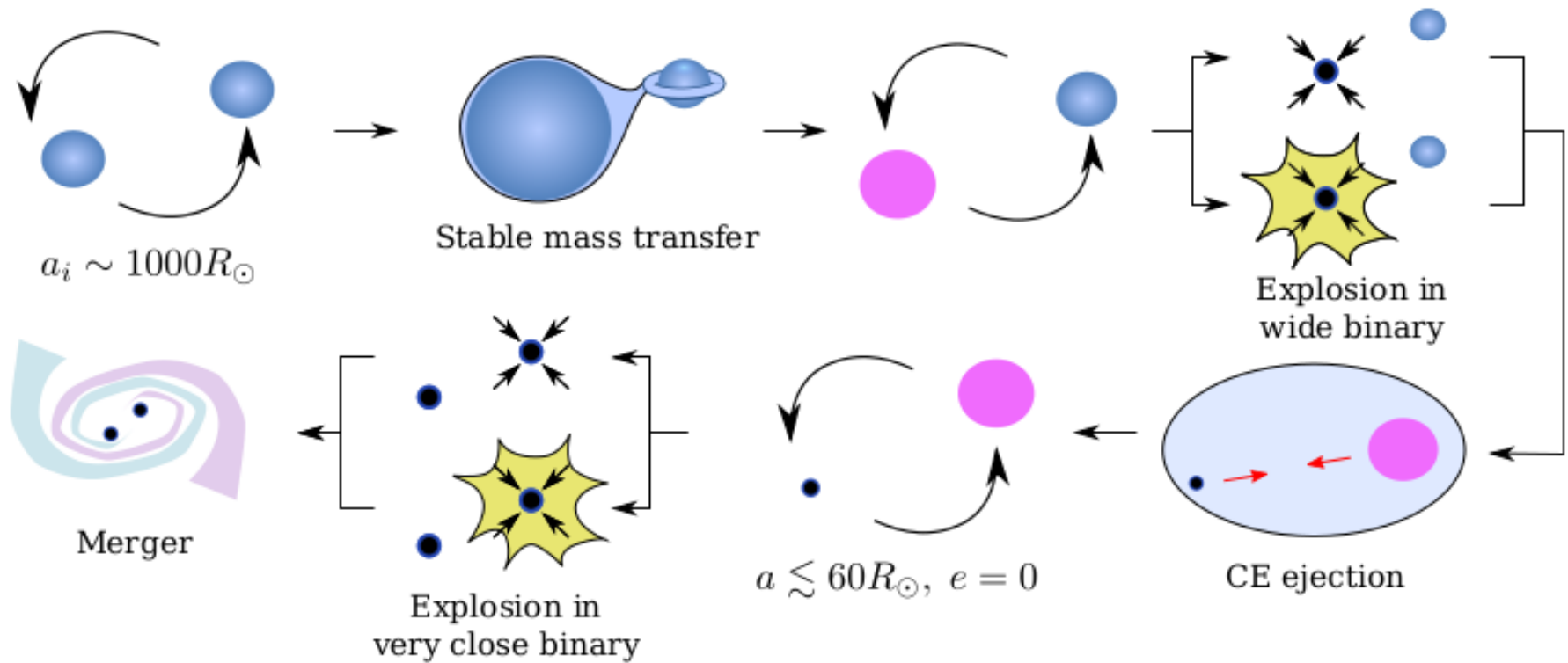


How not to merge

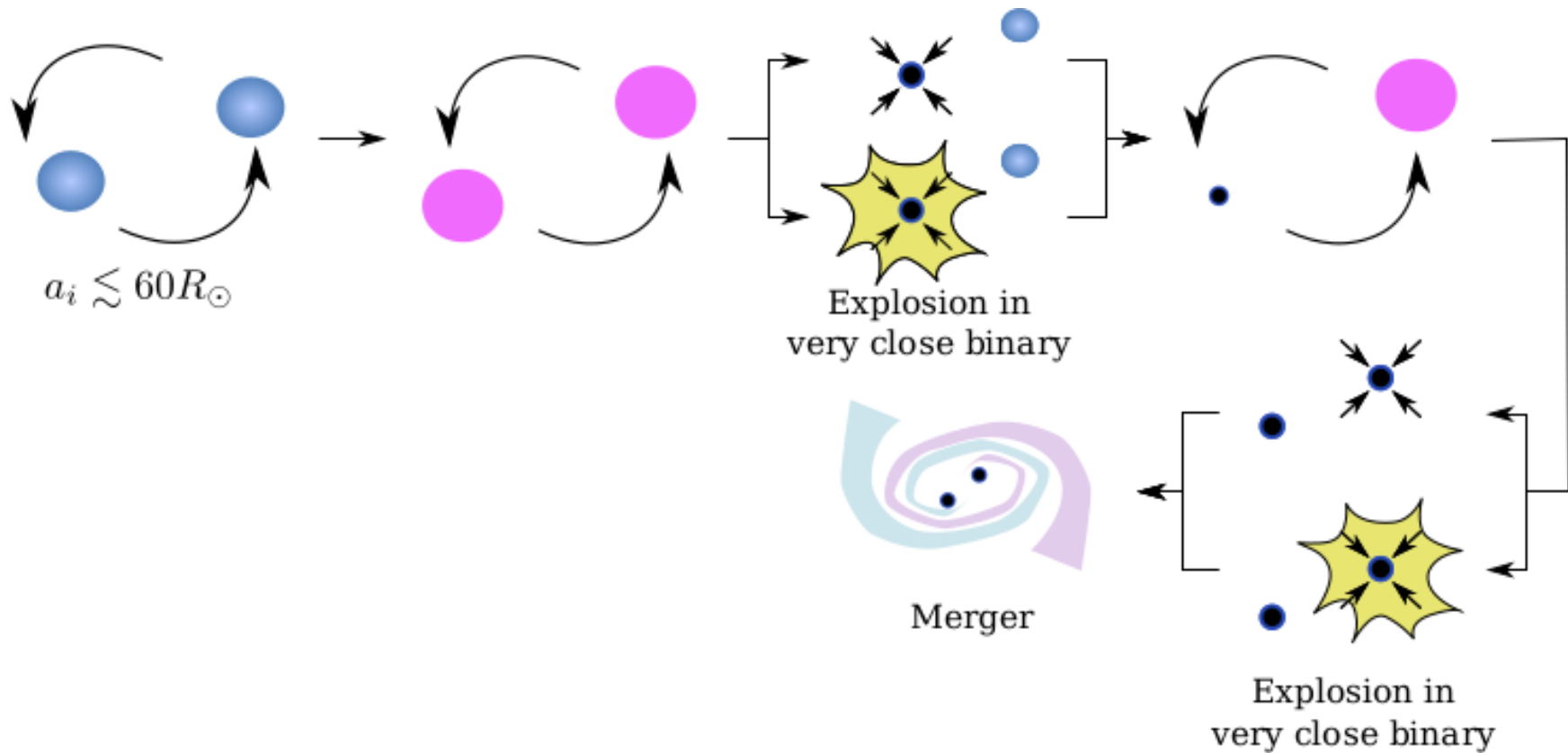


~1000Rsun

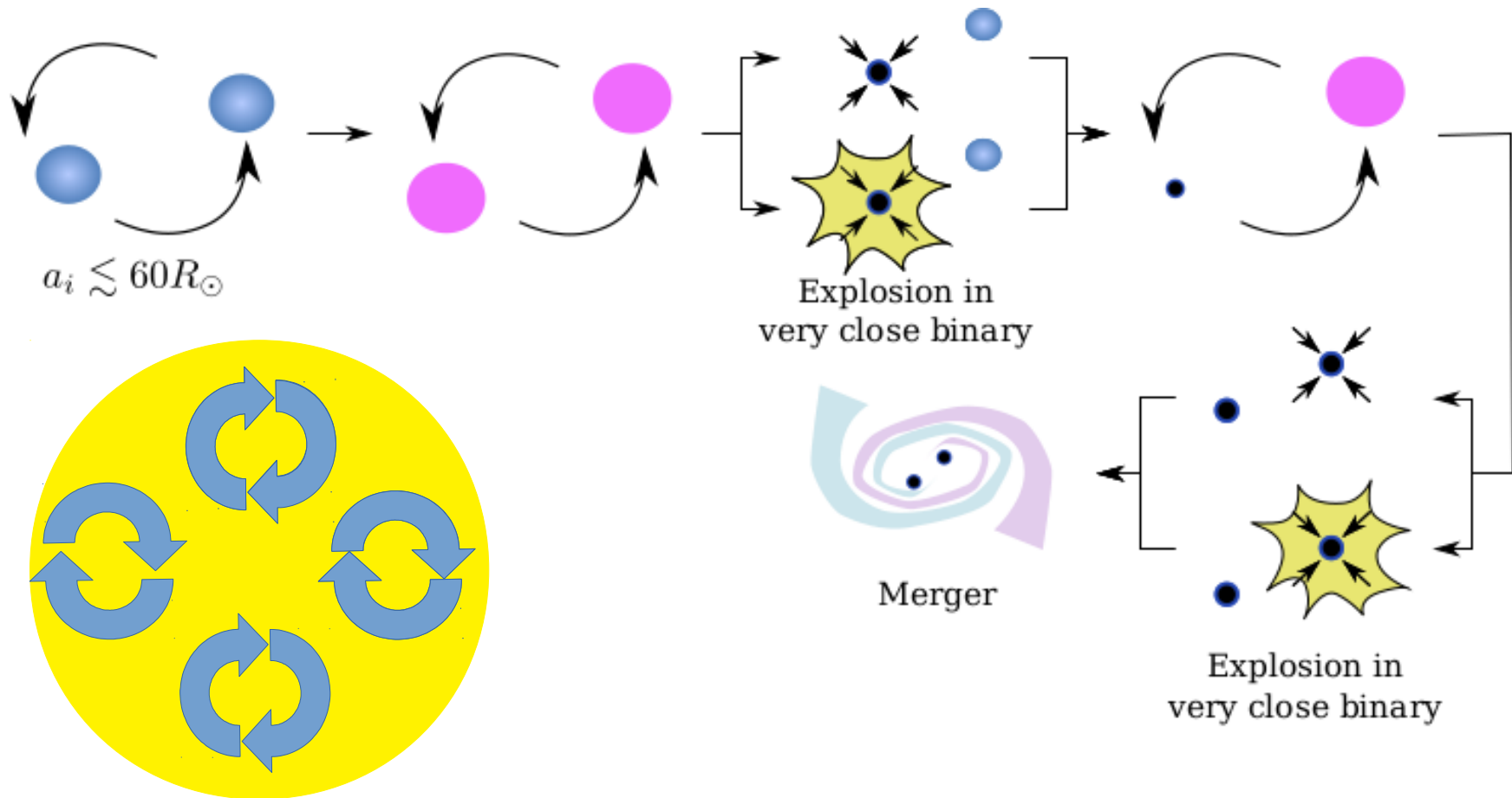
Classical Massive star



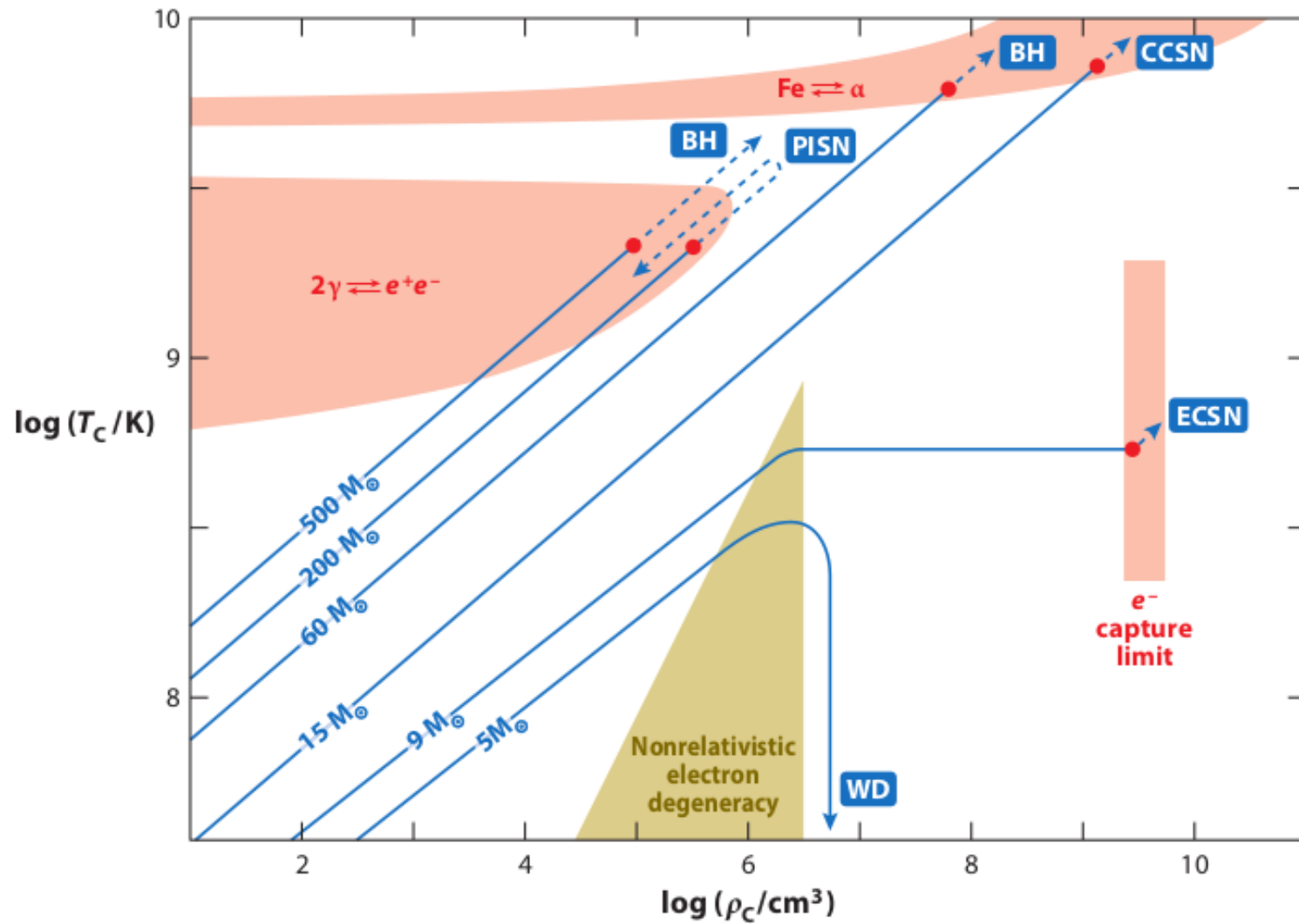
Chemically Homogeneous Evolution



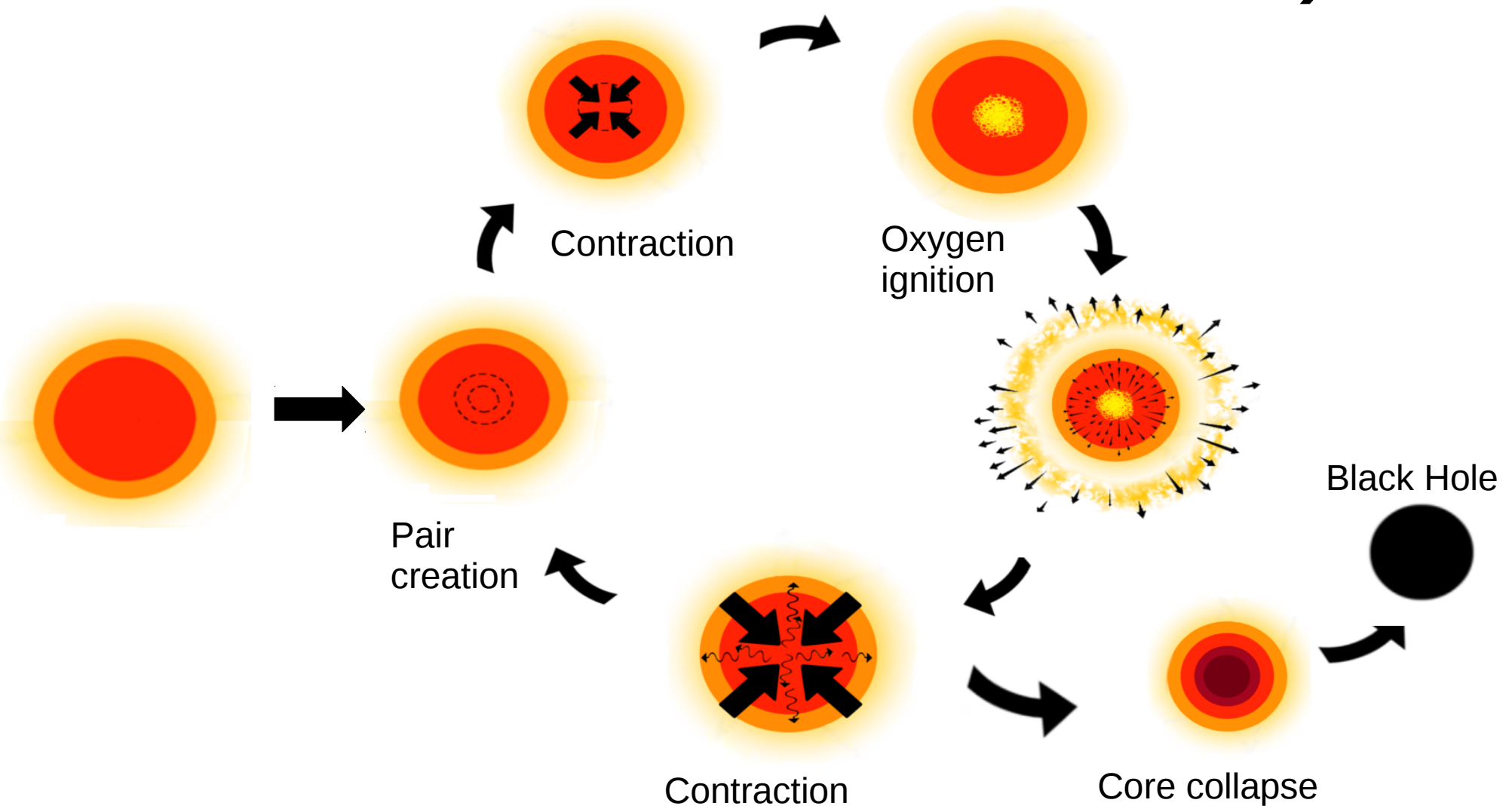
Chemically Homogeneous Evolution



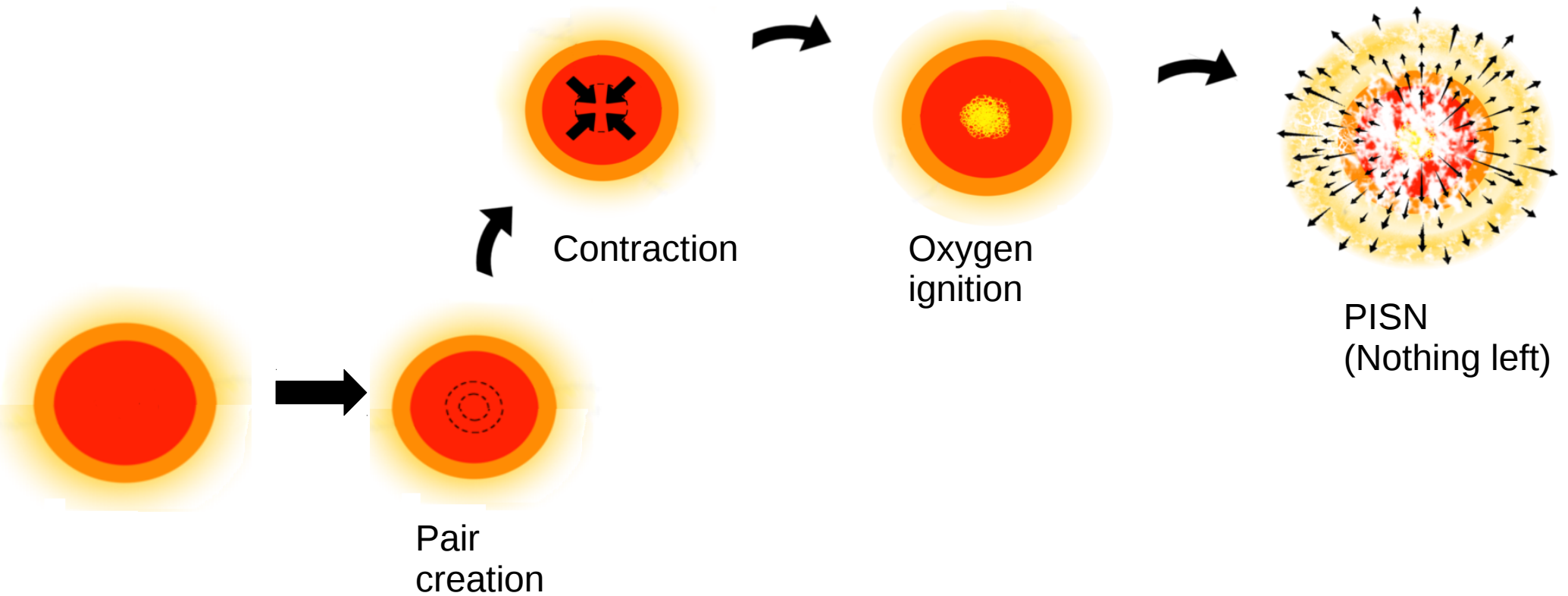
So how do they explode?



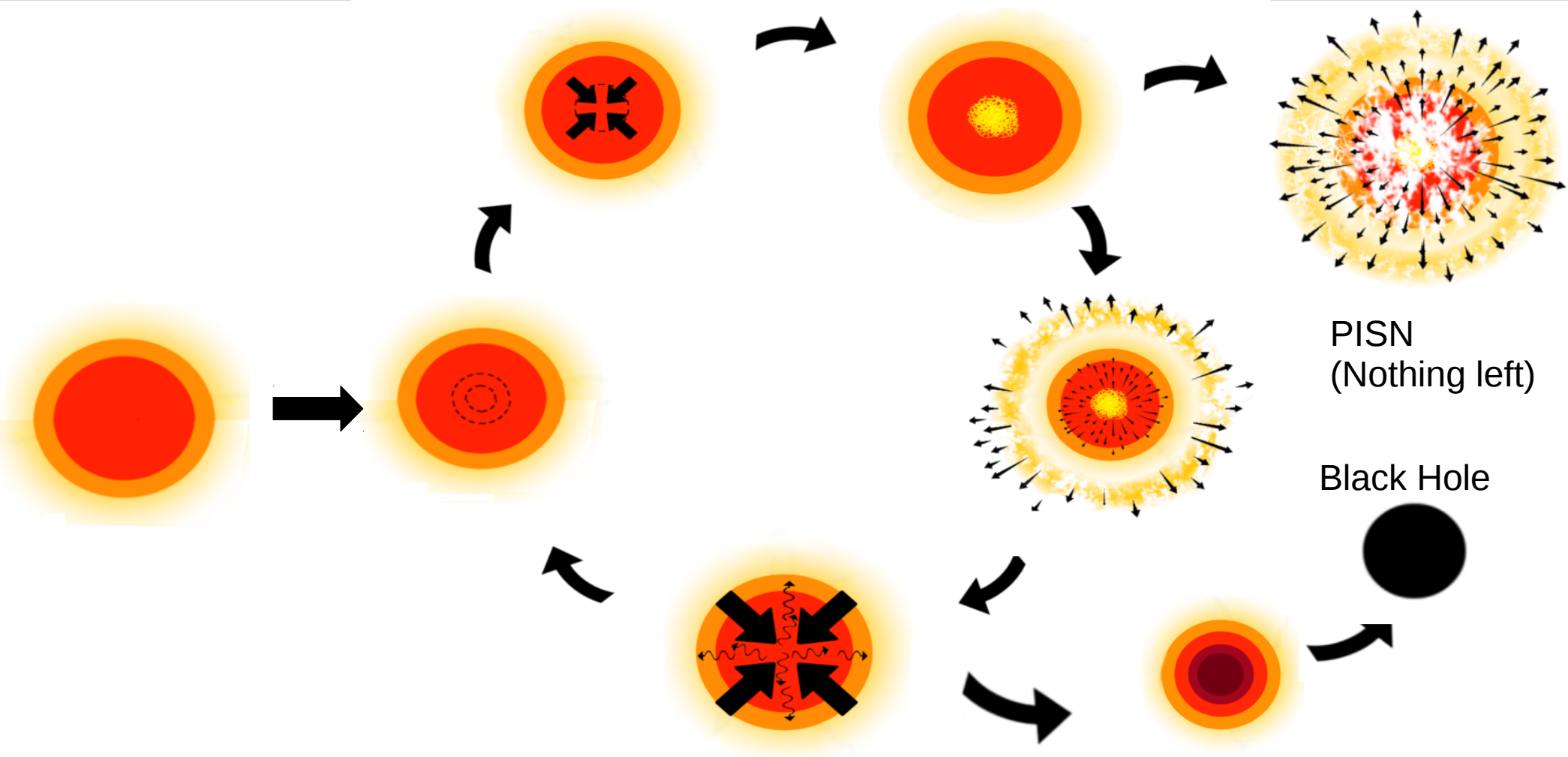
Pulsational pair instability supernovae (PPISN)

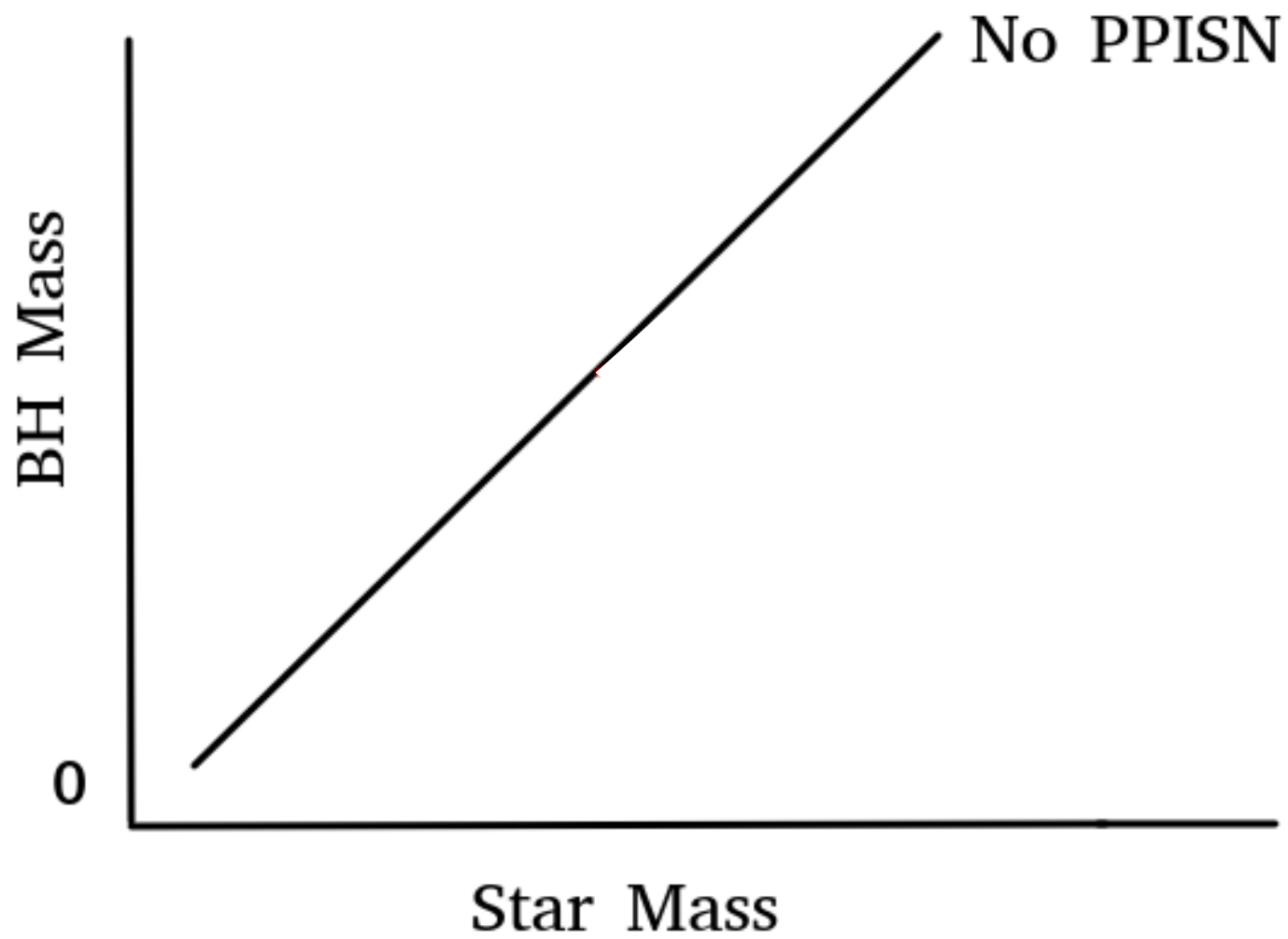


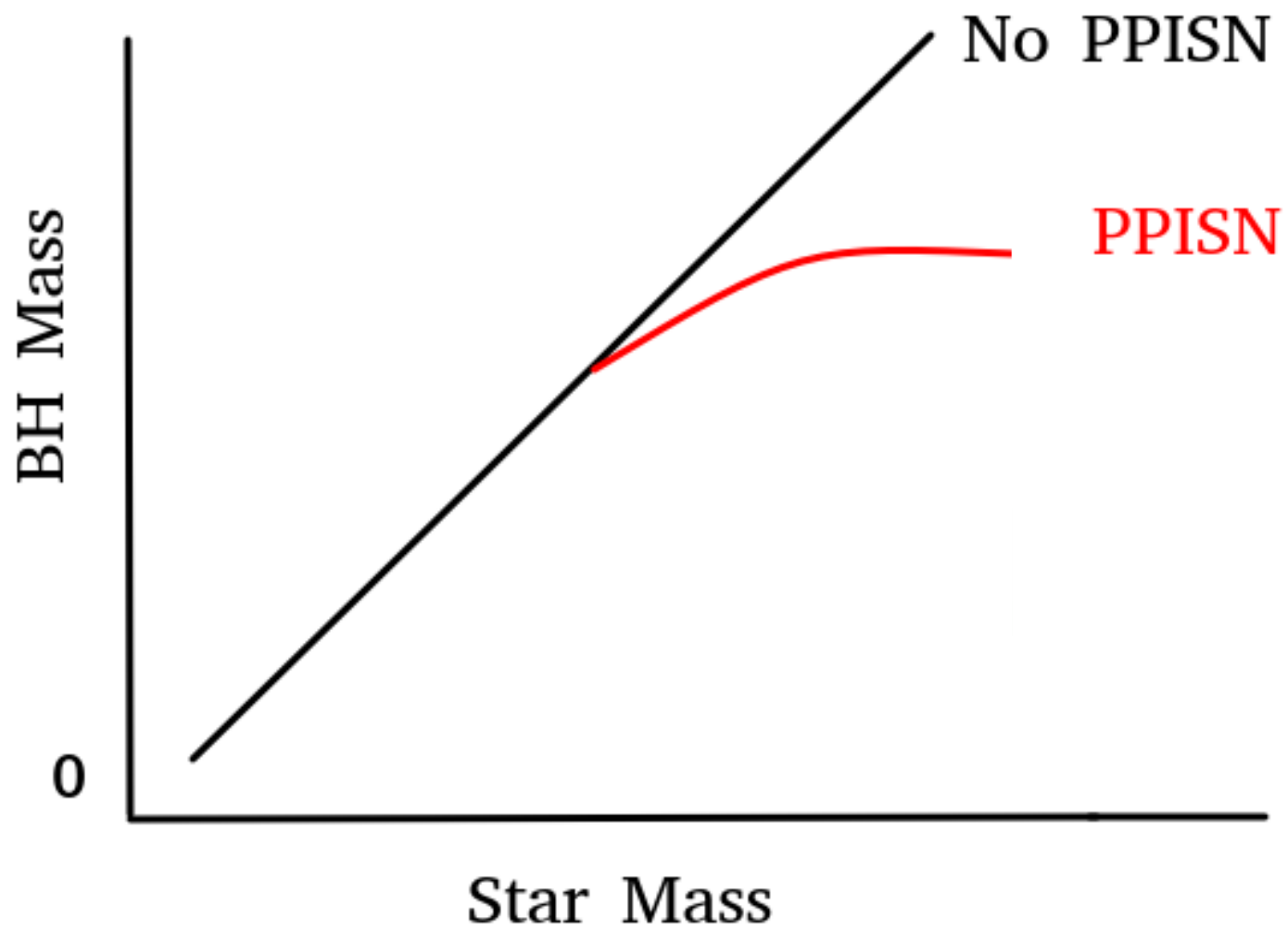
Pair instability supernovae (PISN)

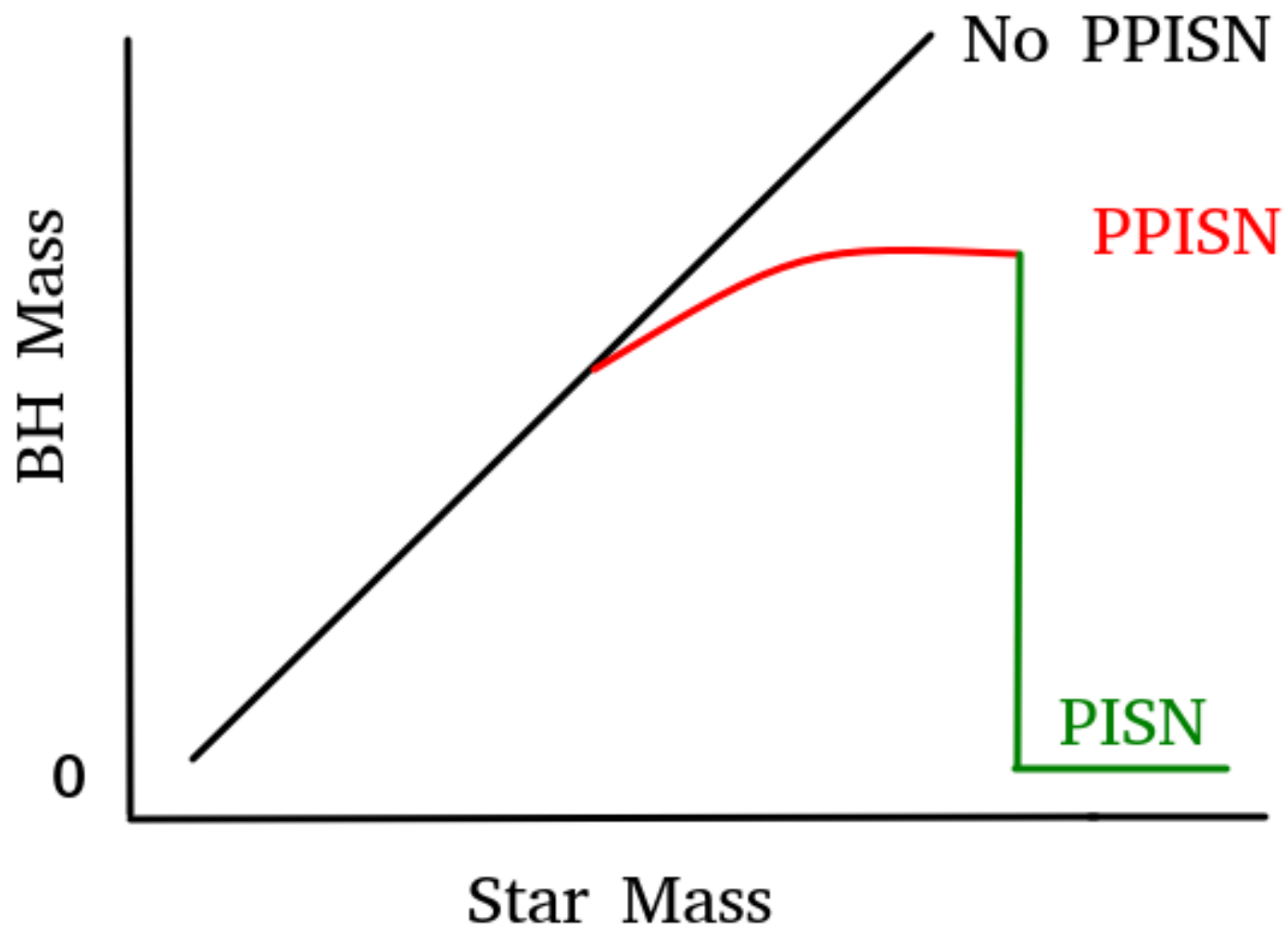


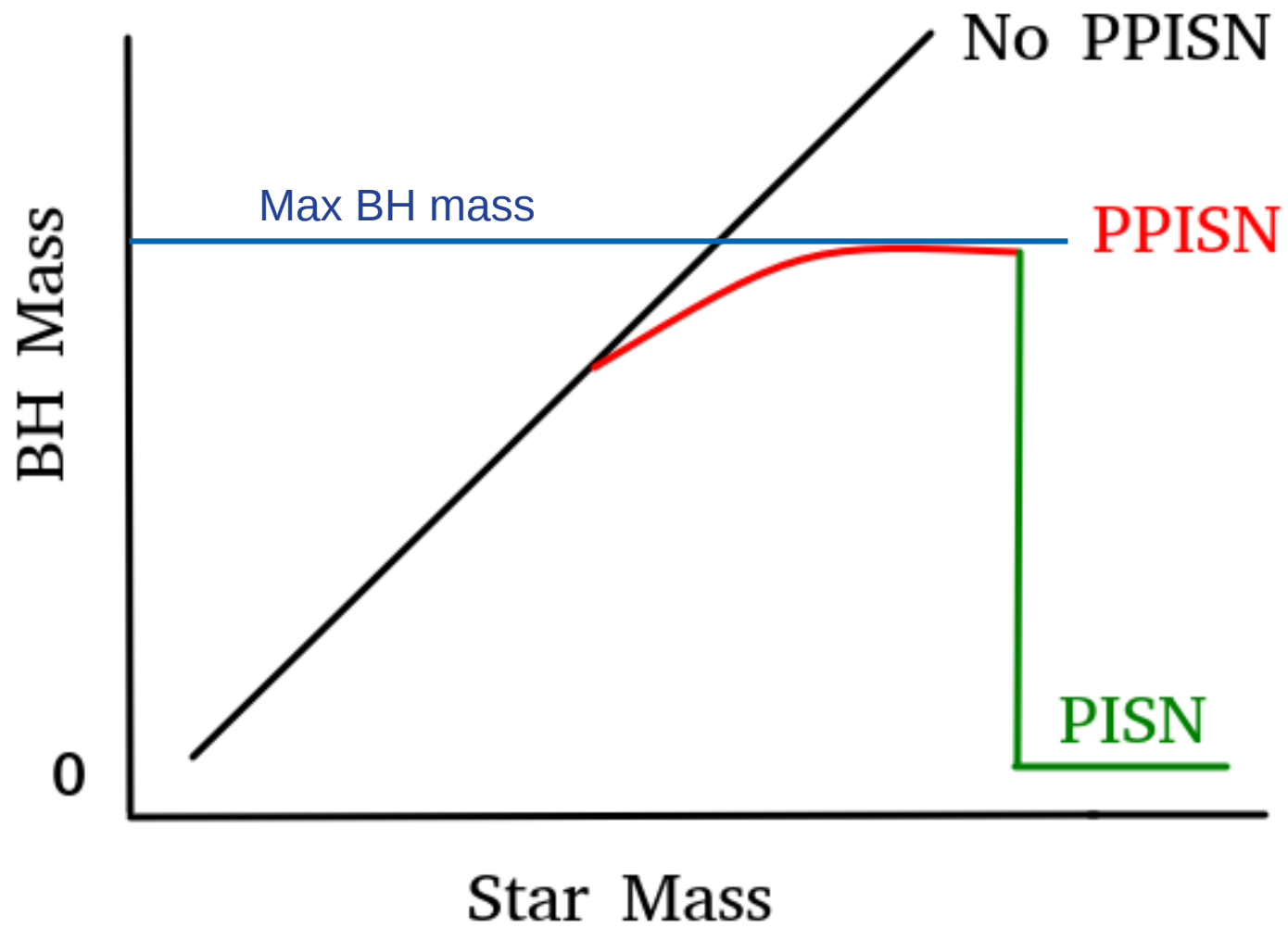
Pair instabilities



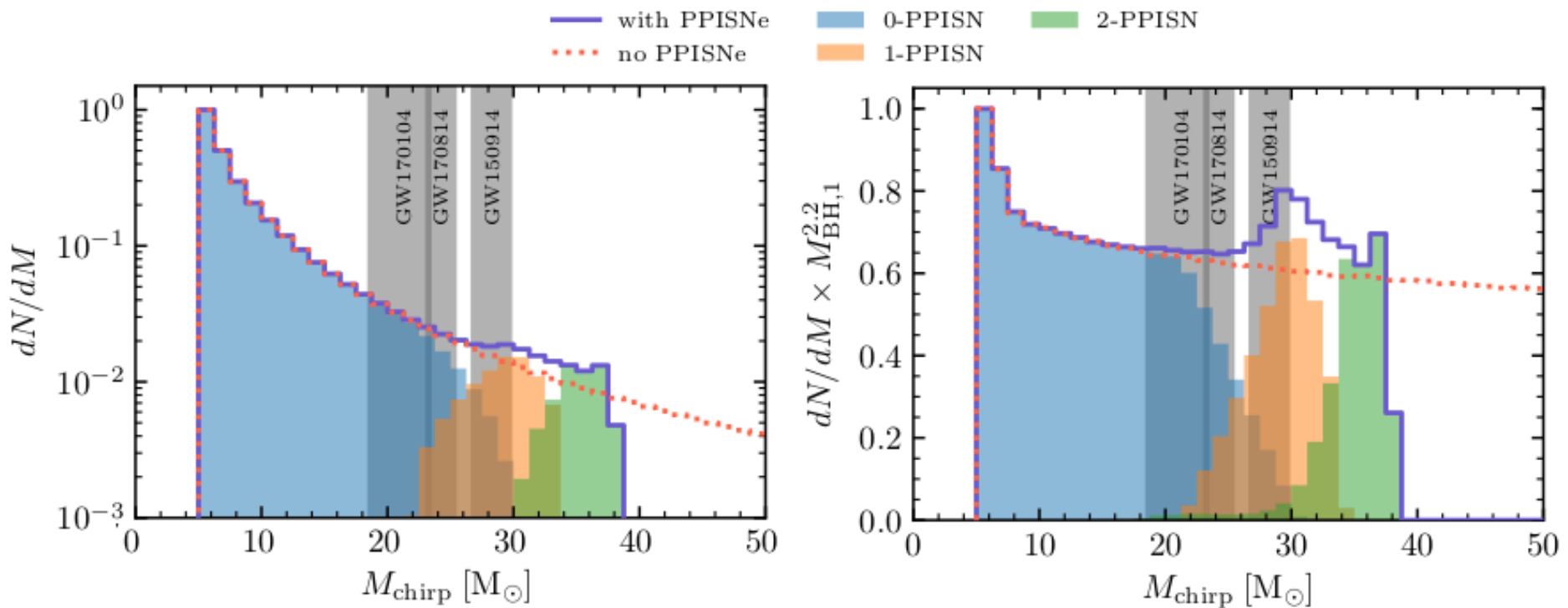




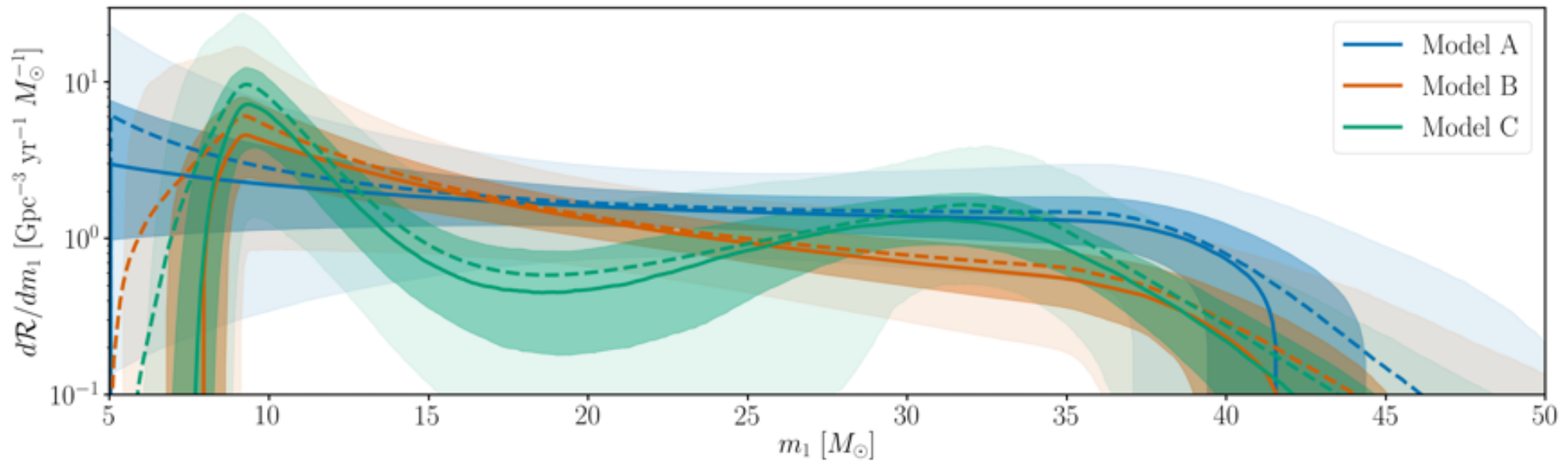




Predicted Chirp signal

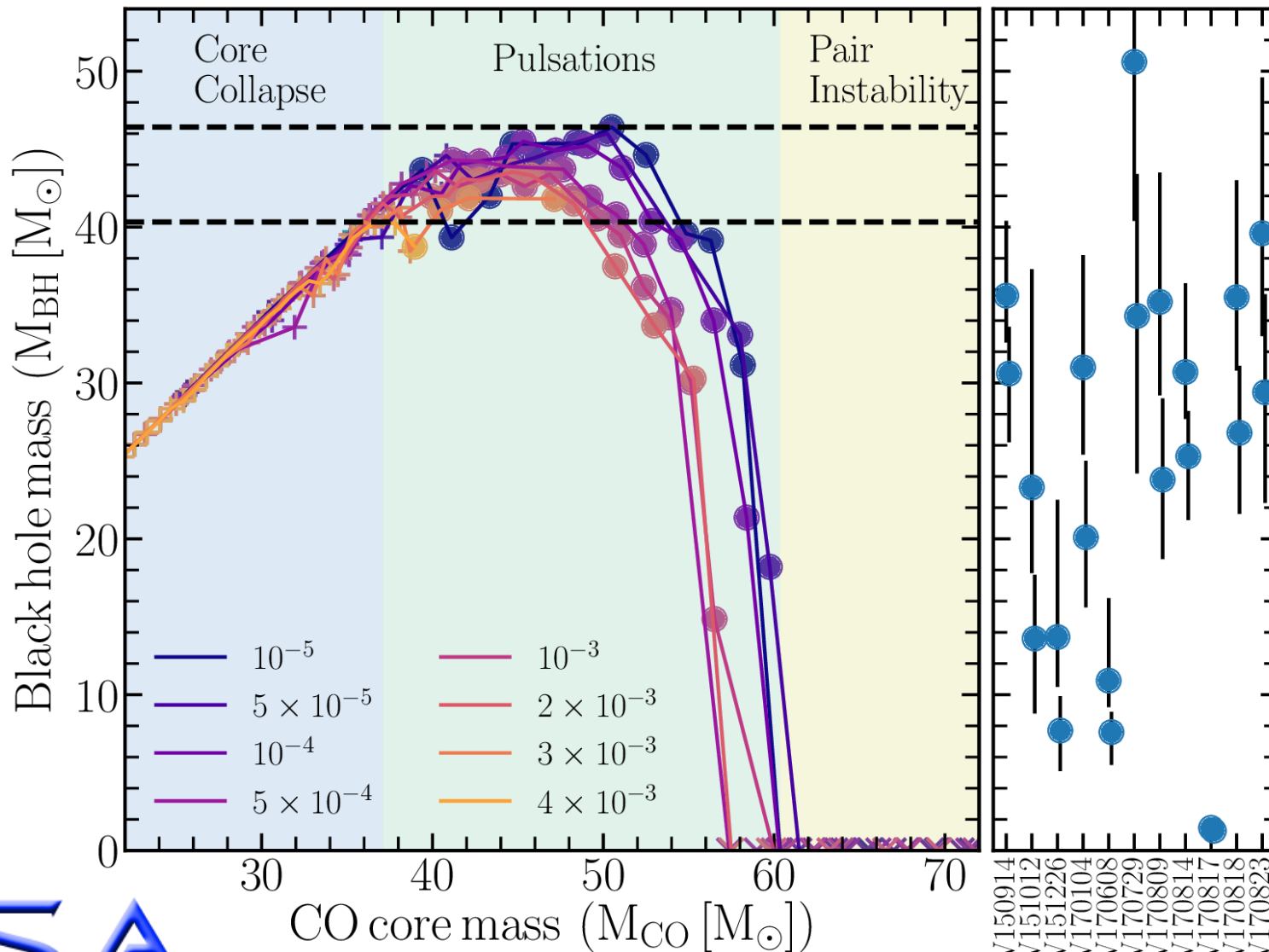


Did LIGO see a gap?

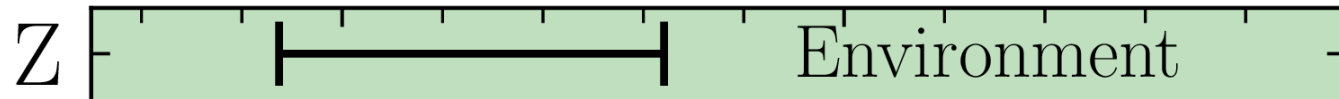


What can we learn (about stellar astrophysics)
if there is a mass gap?

How limited are we by the environment?

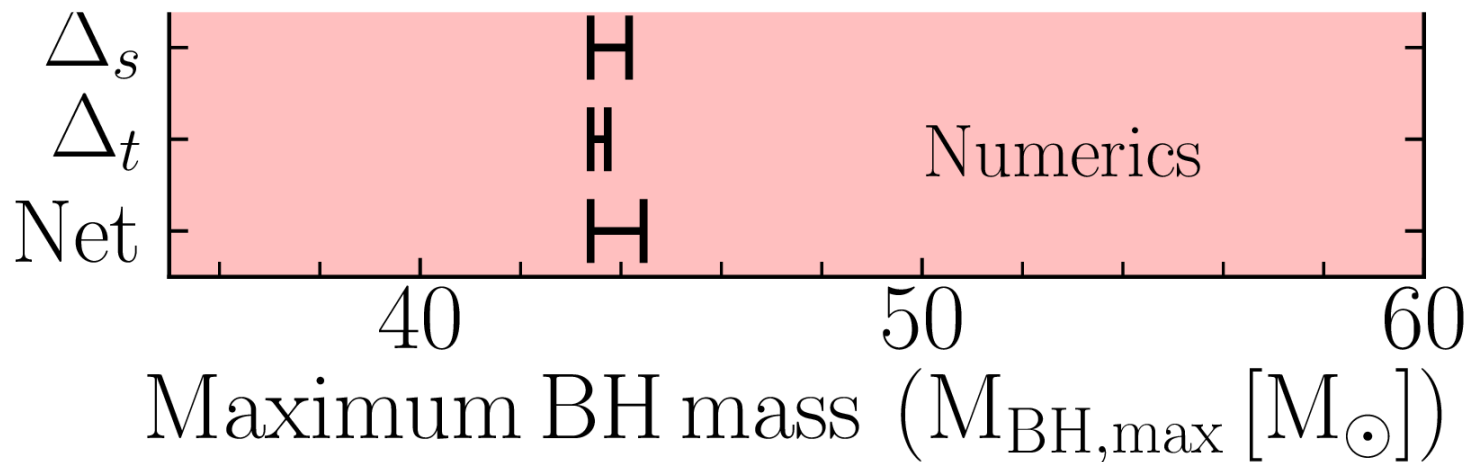
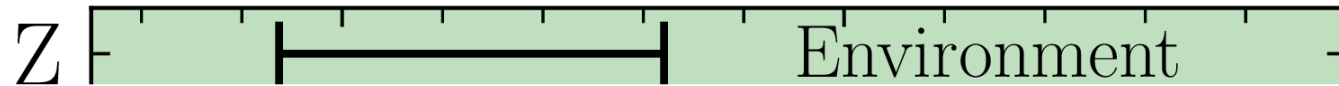


Other physics?

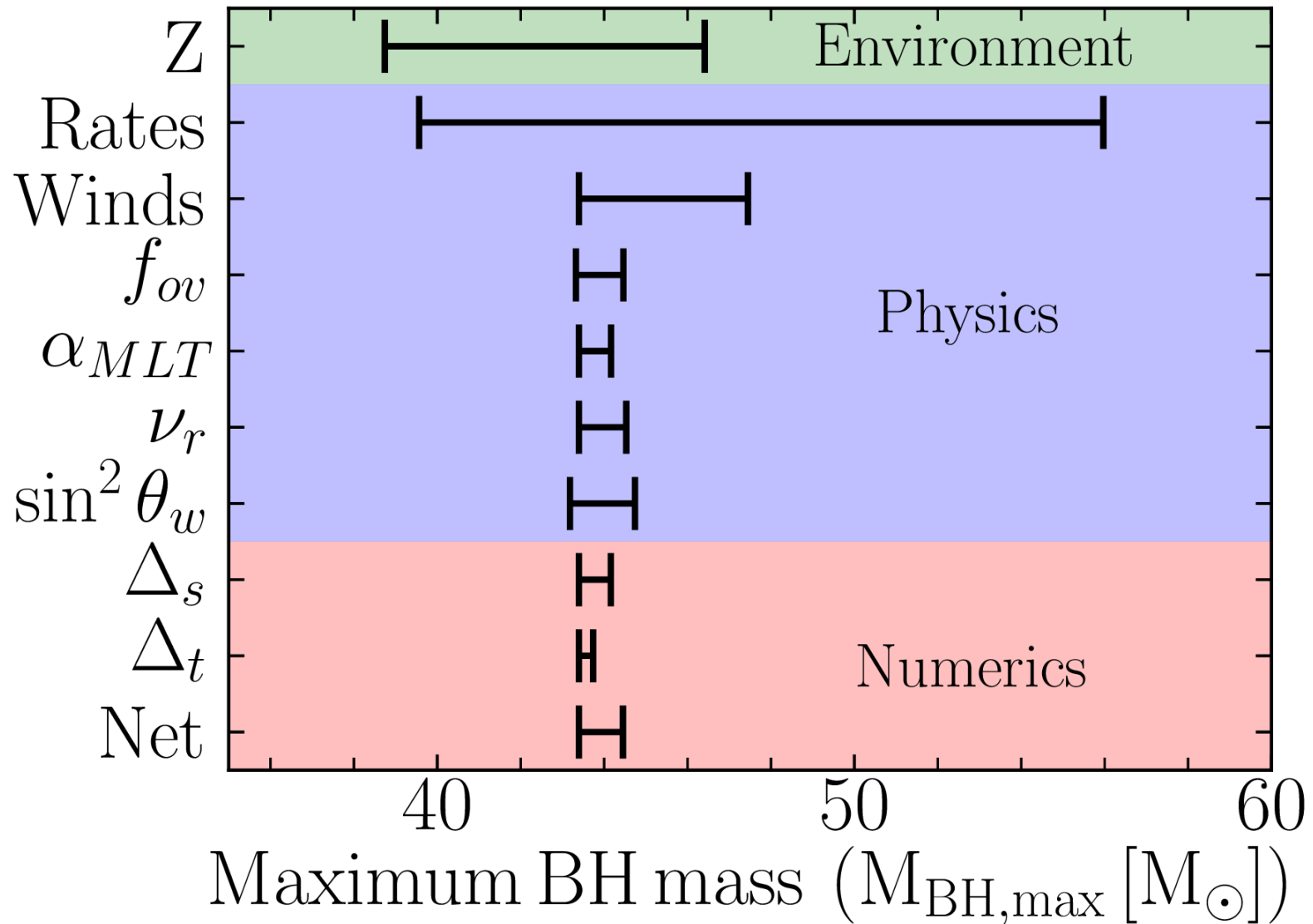


40 50 60
Maximum BH mass ($M_{\text{BH,max}} [M_{\odot}]$)

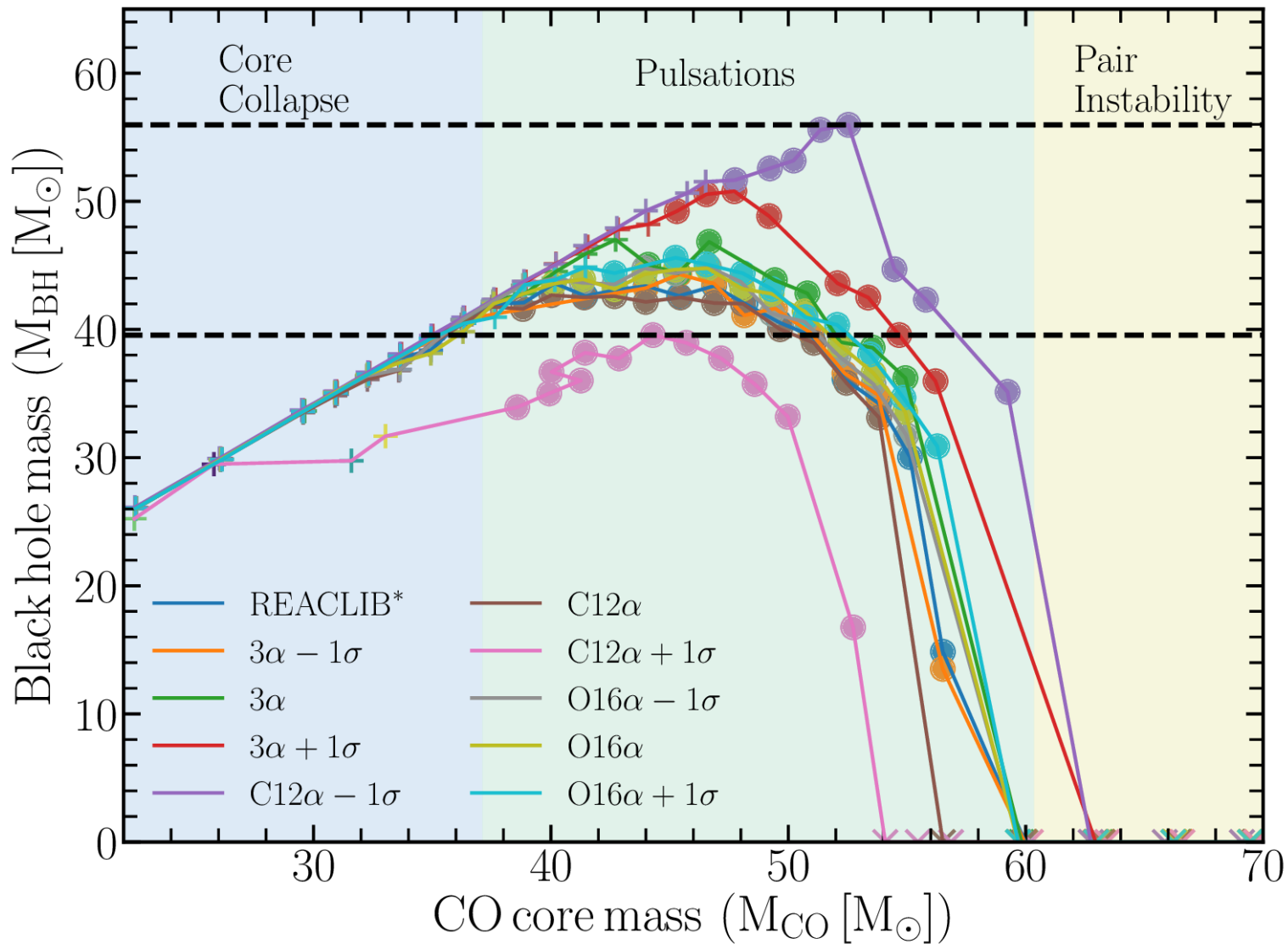
Other physics?



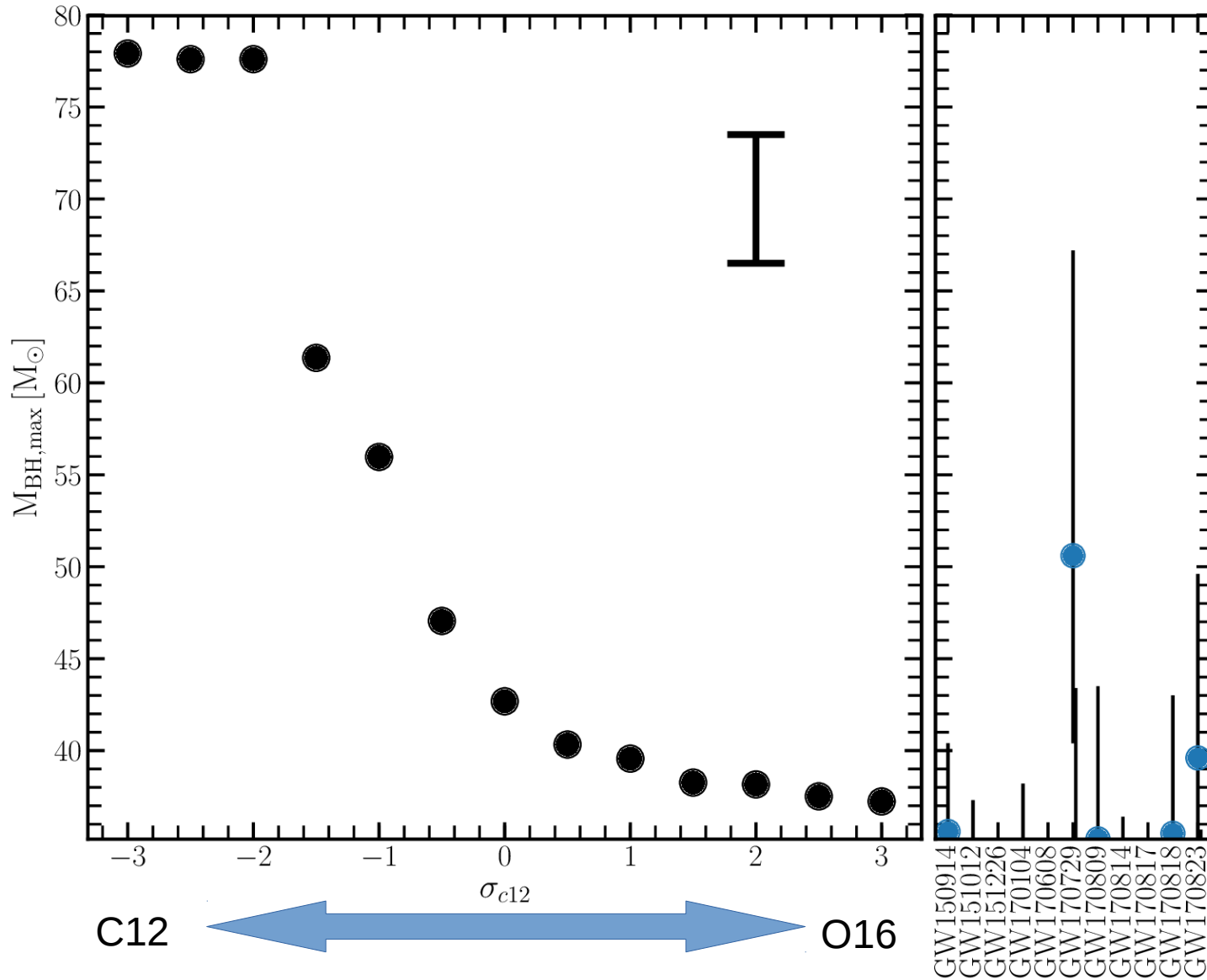
Other physics?



C12+He4 \rightarrow O16

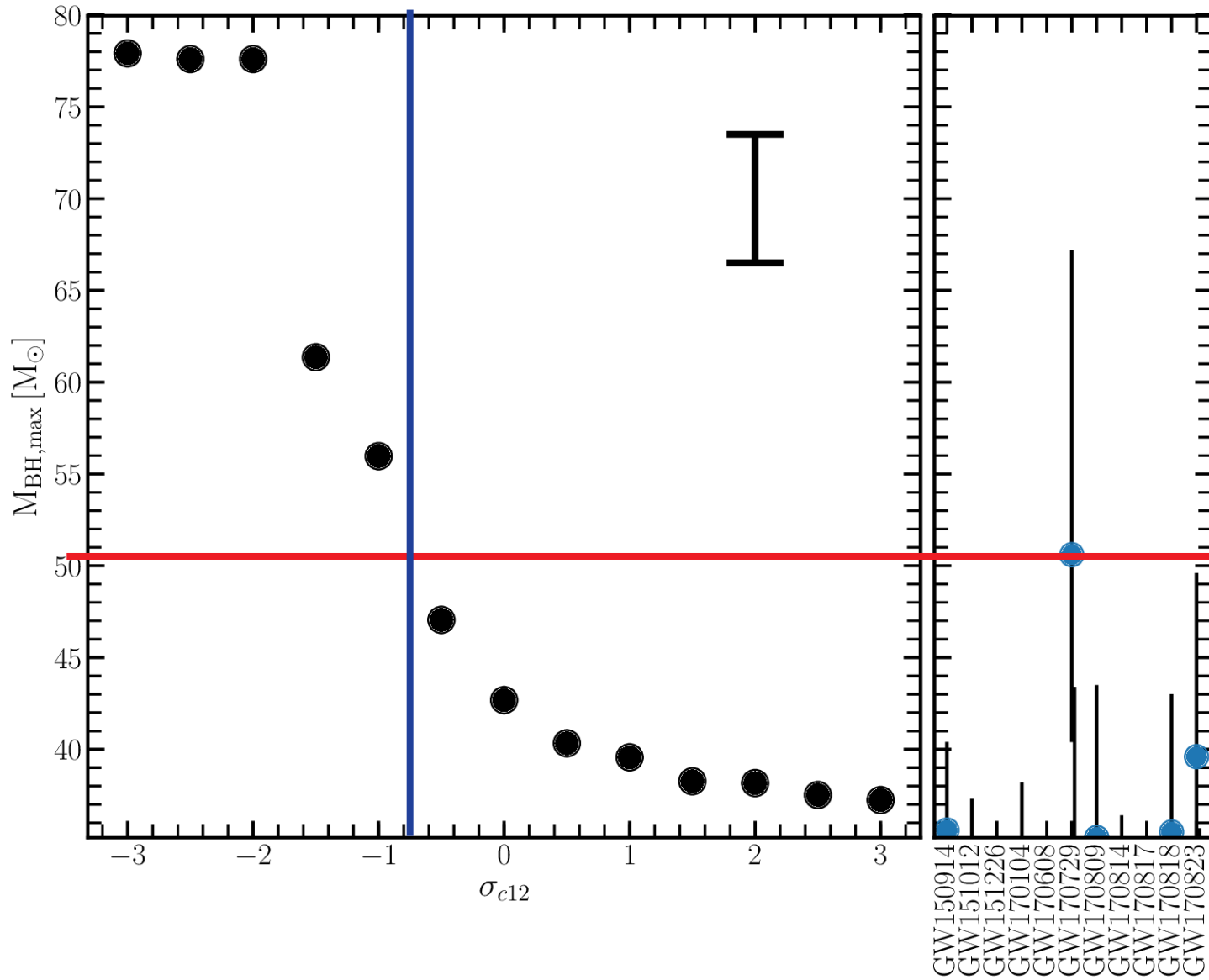


C12+He4 \rightarrow O16



Farmer+In
prep

C12+He4 \rightarrow O16



Summary

- PISN are what gives you a mass gap
 - PPISN set where the gap is
- “default” physics says 40-46msun
- Sensitive to assumed nuclear physics
 - Use the max BH to calibrate nuclear rates?
- Cosmology using with the gap?
 - Use max BH (which is ~independent of environment) as standard siren

