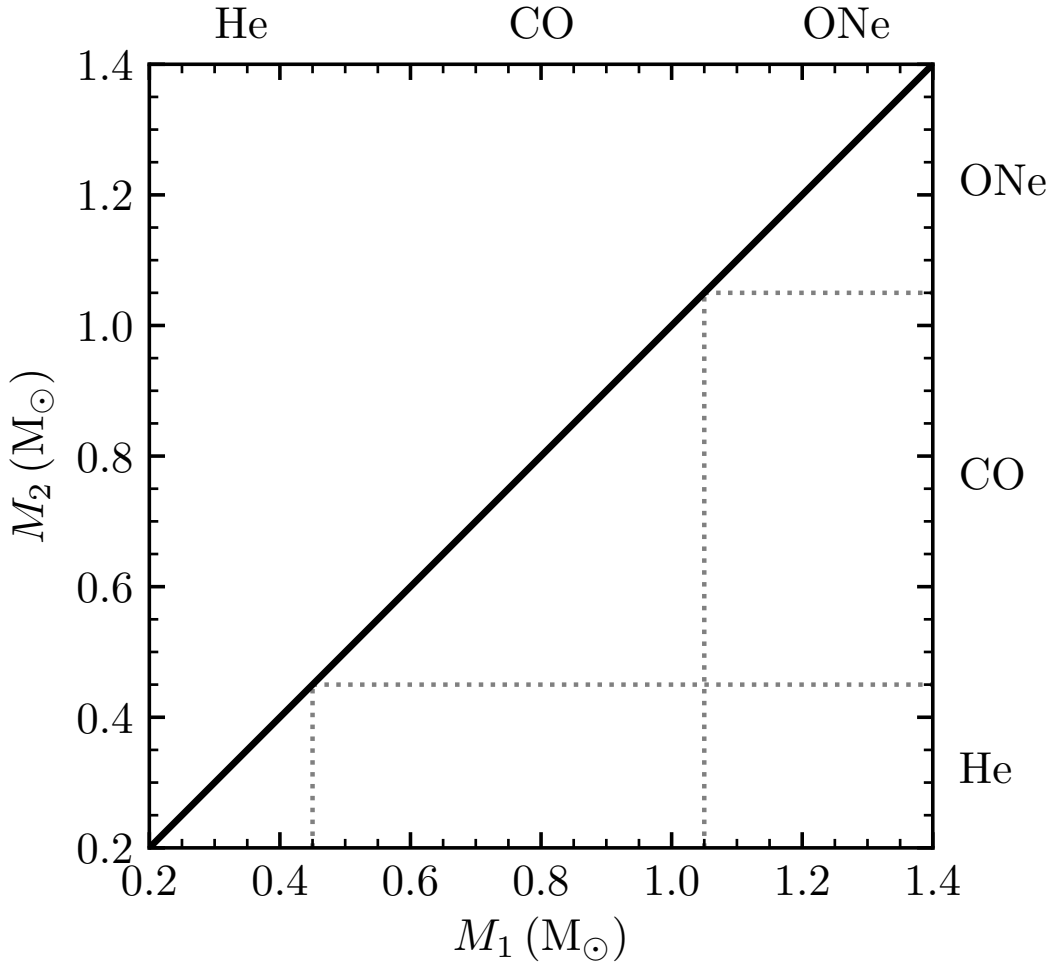
# The Long-lived Remnants of Massive WD Mergers

**Josiah Schwab**

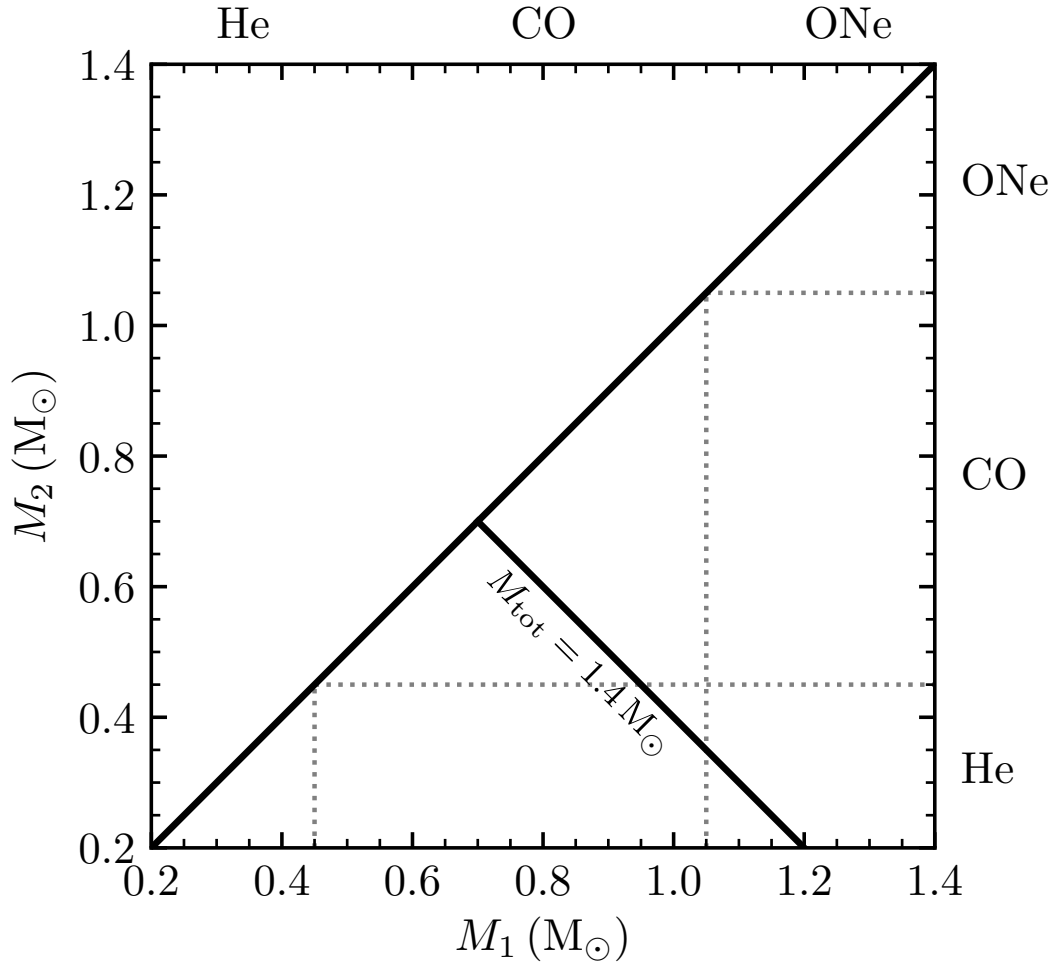
Hubble Fellow, UC Santa Cruz

05 July 2019

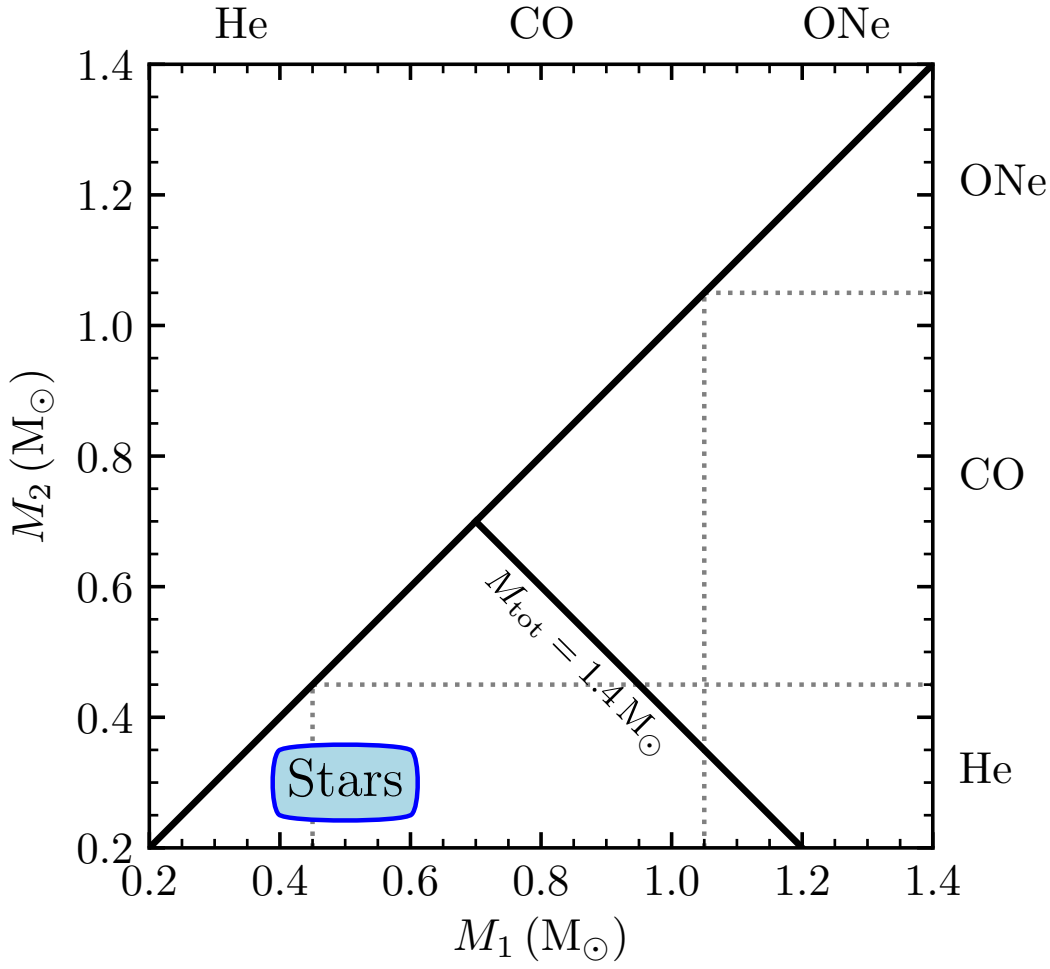
# What is the final fate of two WDs that merge?



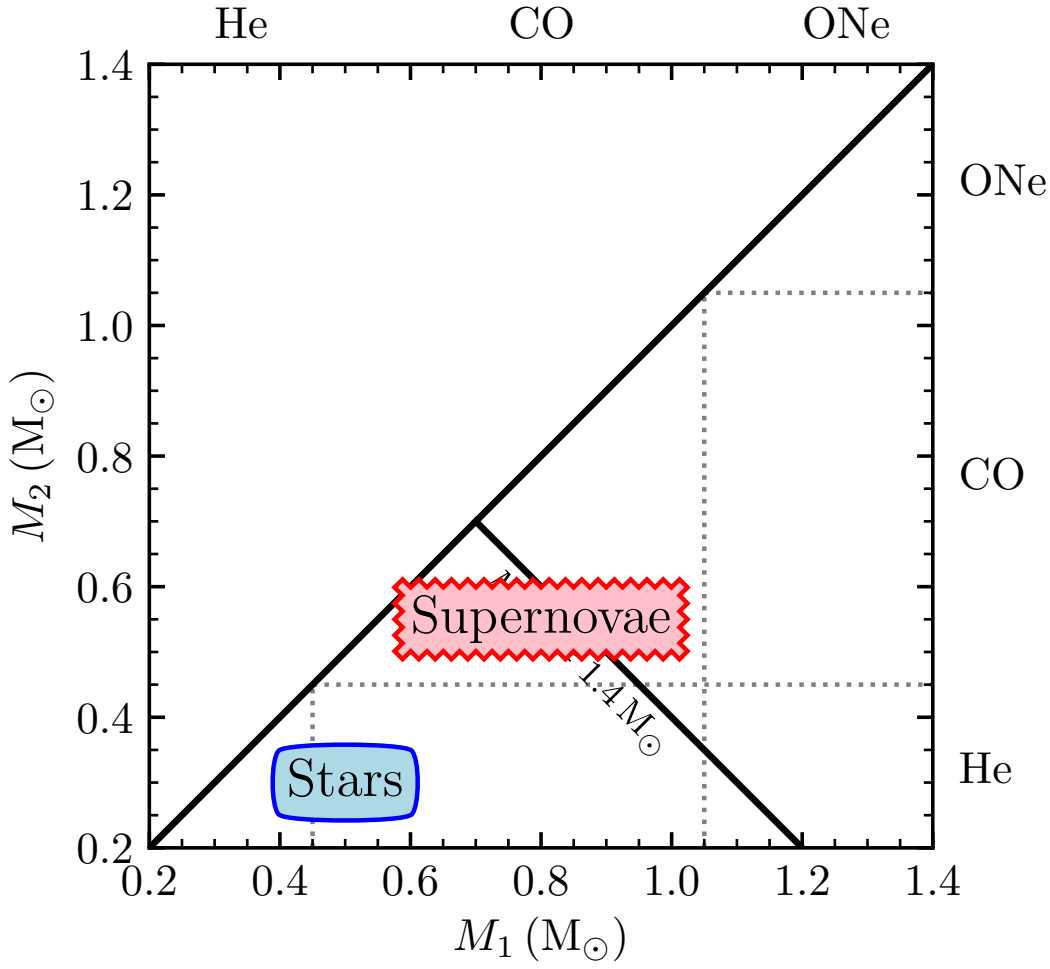
# What is the final fate of two WDs that merge?



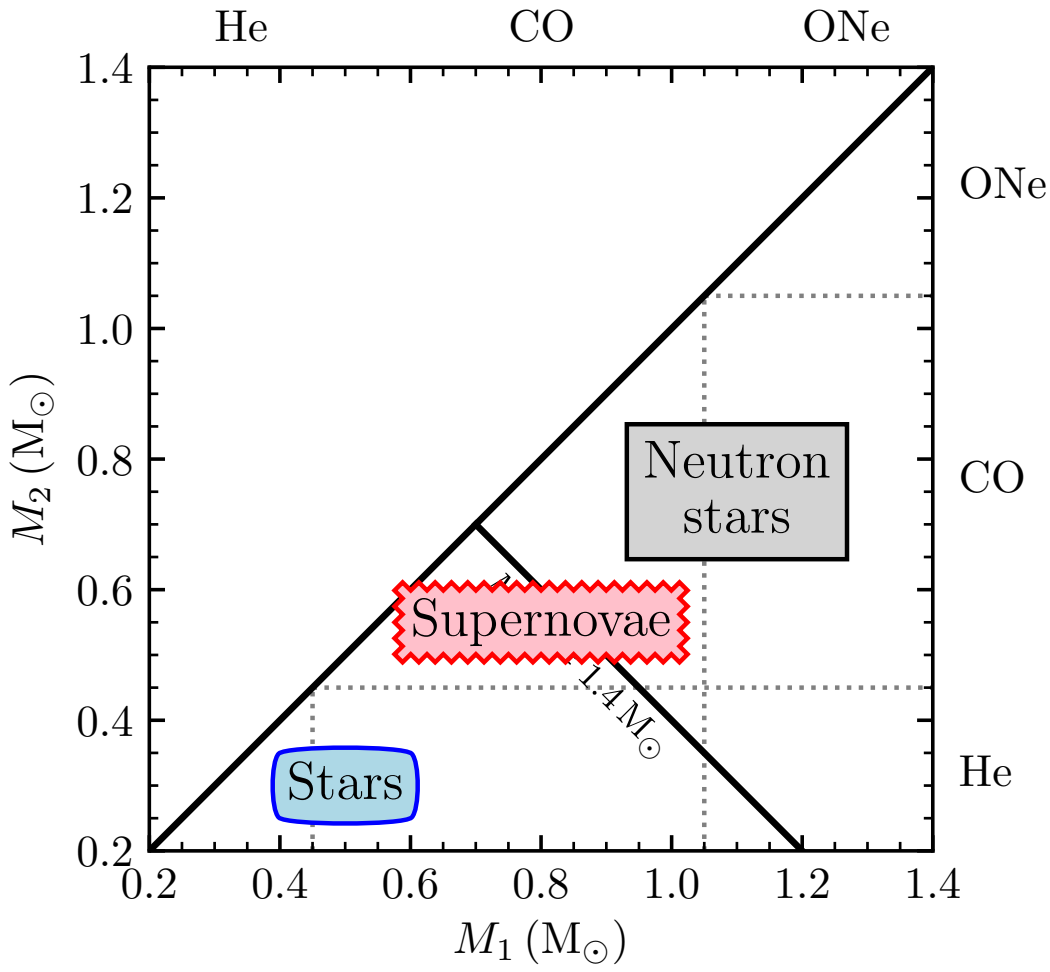
# What is the final fate of two WDs that merge?



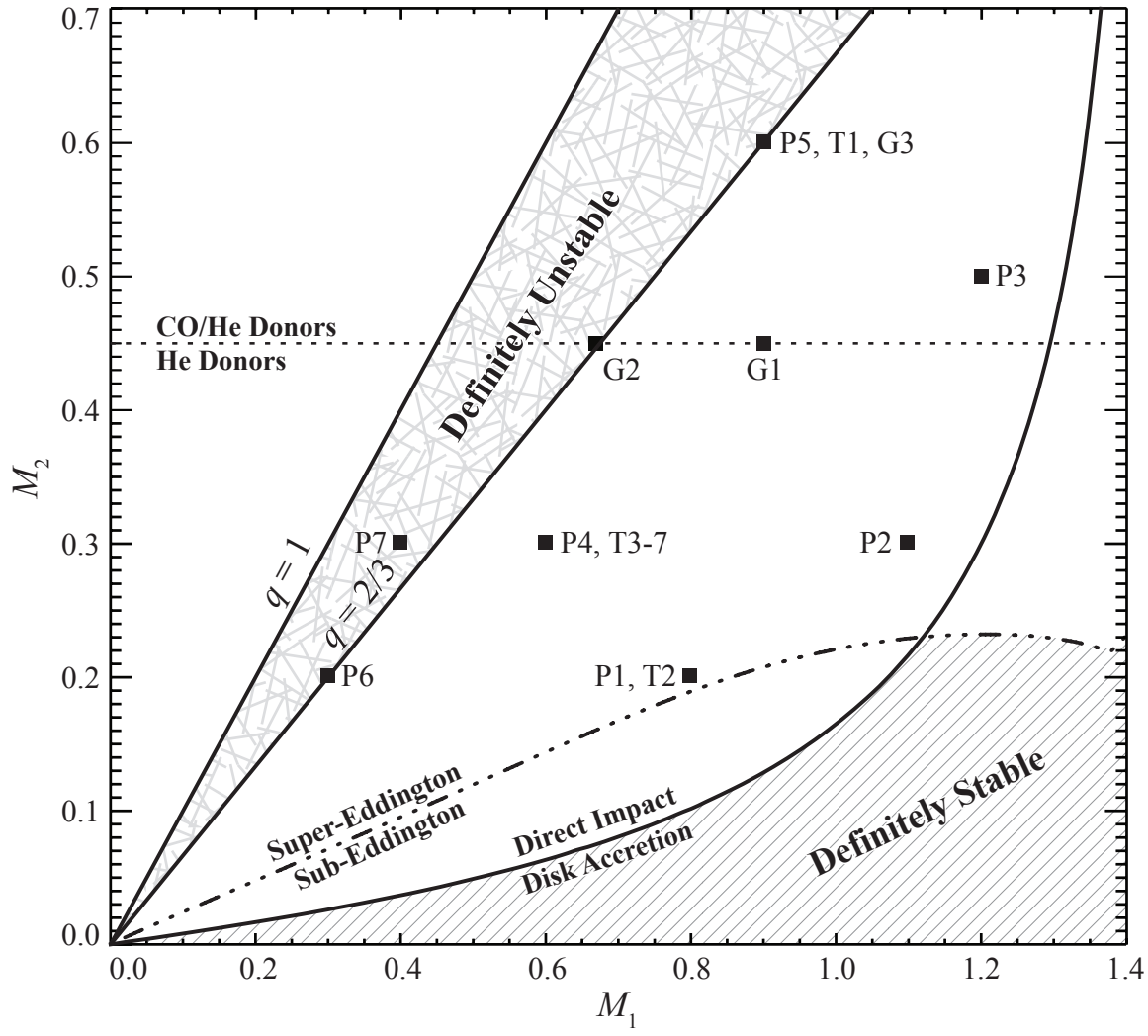
# What is the final fate of two WDs that merge?



# What is the final fate of two WDs that merge?

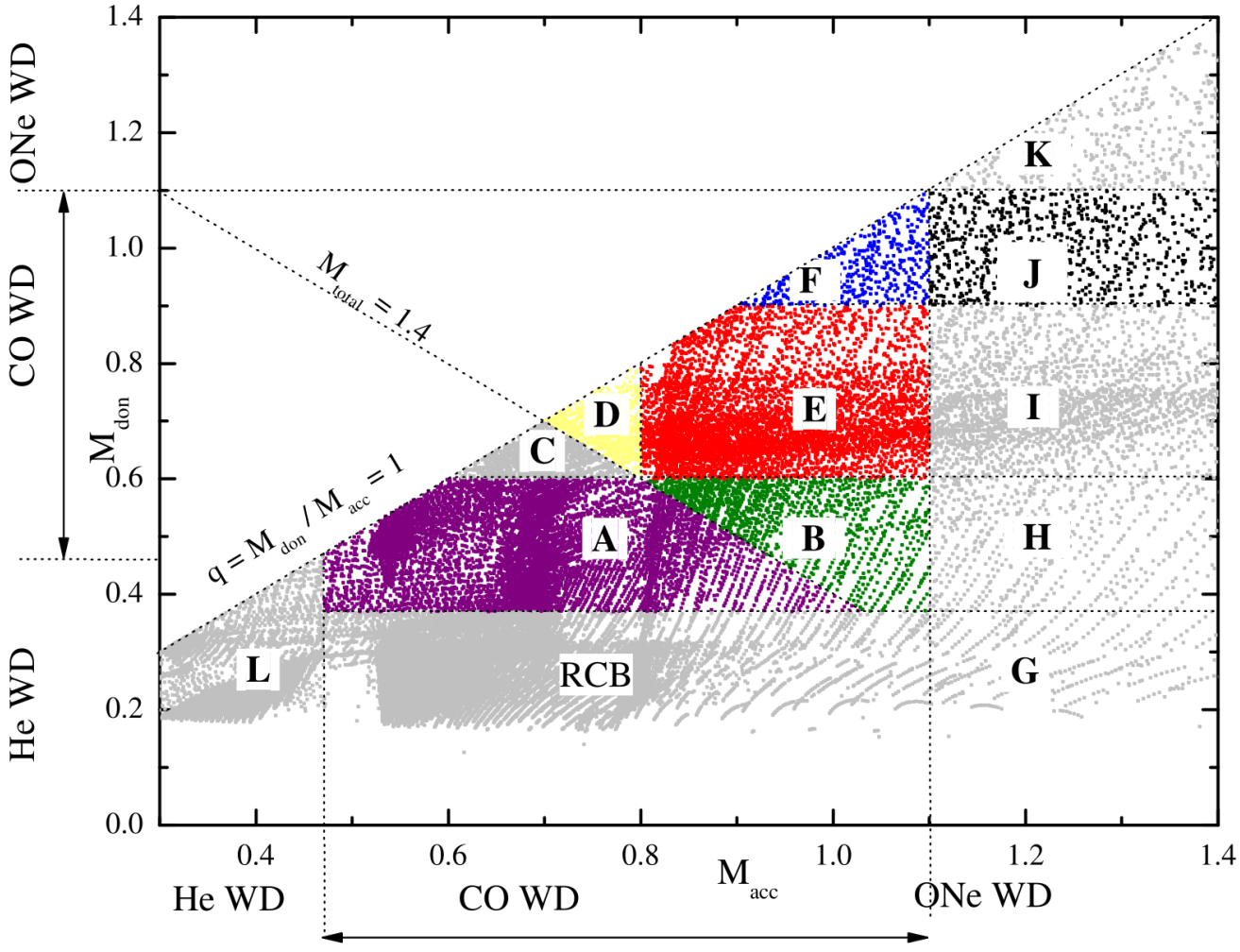


# But which binaries become unstable and merge?




e.g., Marsh et al. (2004); Fig. from Dan et al. (2011)

# And what populations of close double WDs form?



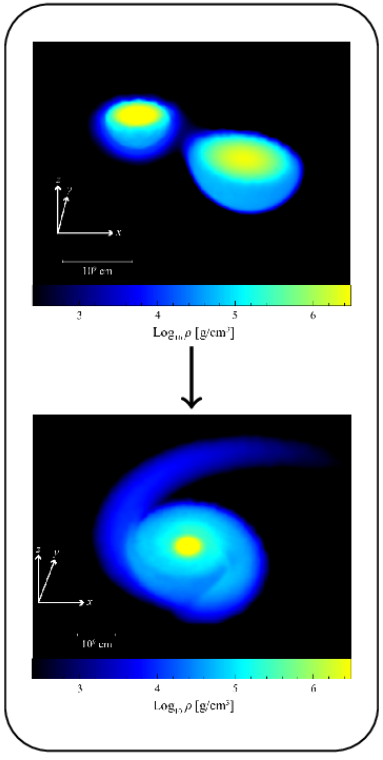

Yungelson & Kuranov (2017)

Review of white dwarf mergers

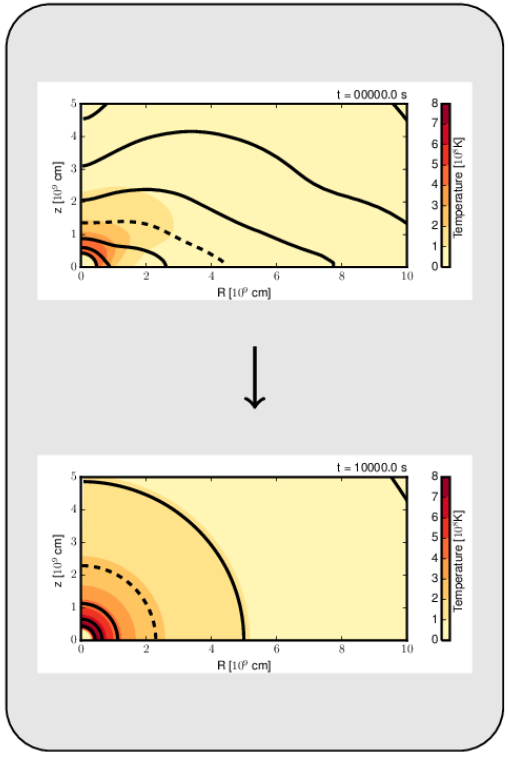
From super-Chandra merger to a neutron star

Summary

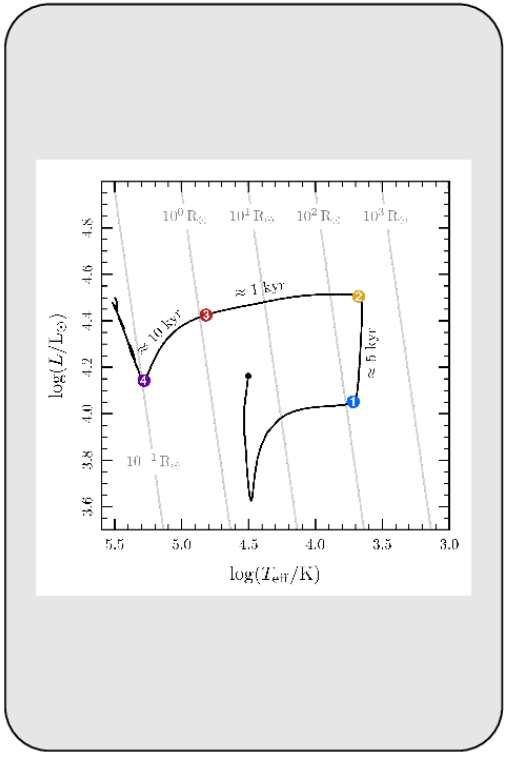
# On the way to their final fates, double WD systems evolve through multiple phases.



$\sim$ minutes



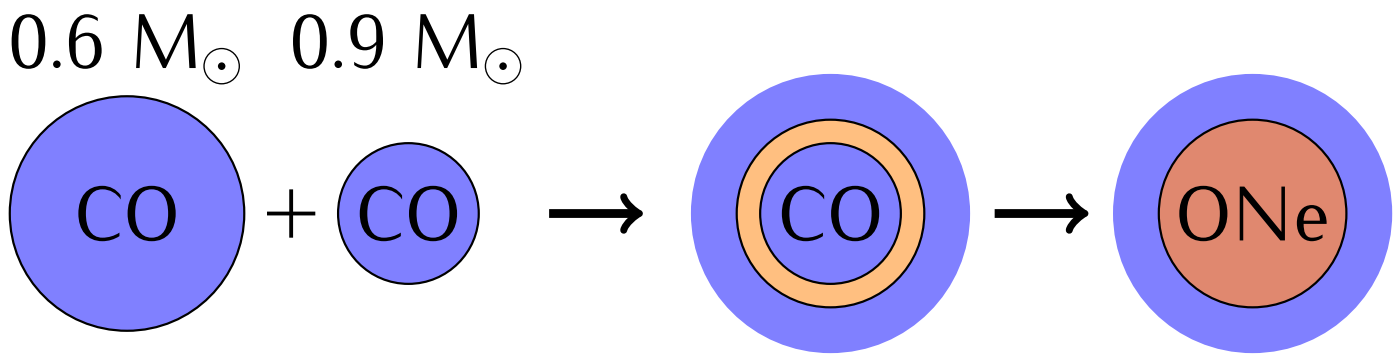

$\sim$ hours




$\sim 10^4 - 10^8$ yr

A super-Chandrasekhar total mass

does not imply a thermonuclear supernova.

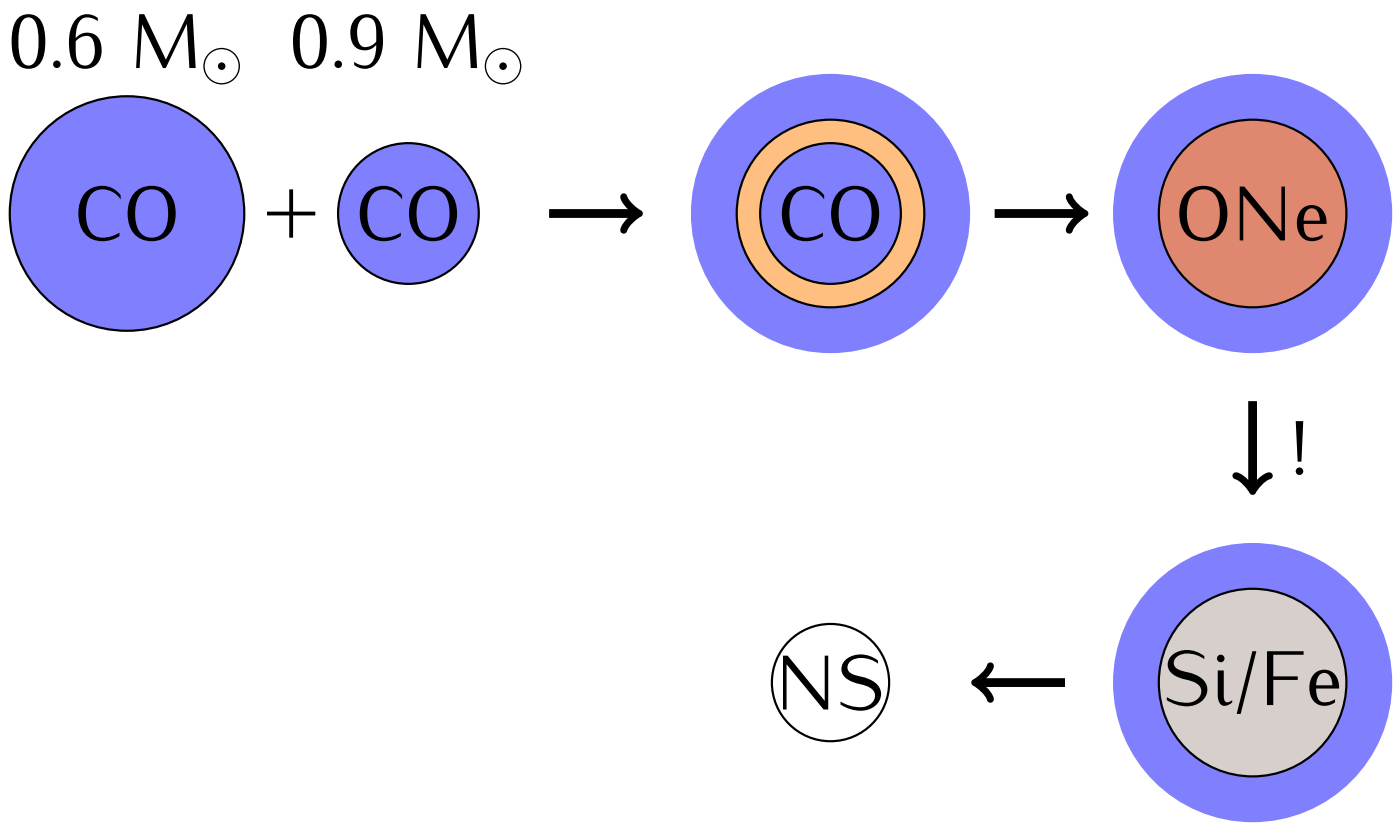



Nomoto & Iben (1985); Saio & Nomoto (1985)

Schwab et al. (2016)

A super-Chandrasekhar total mass

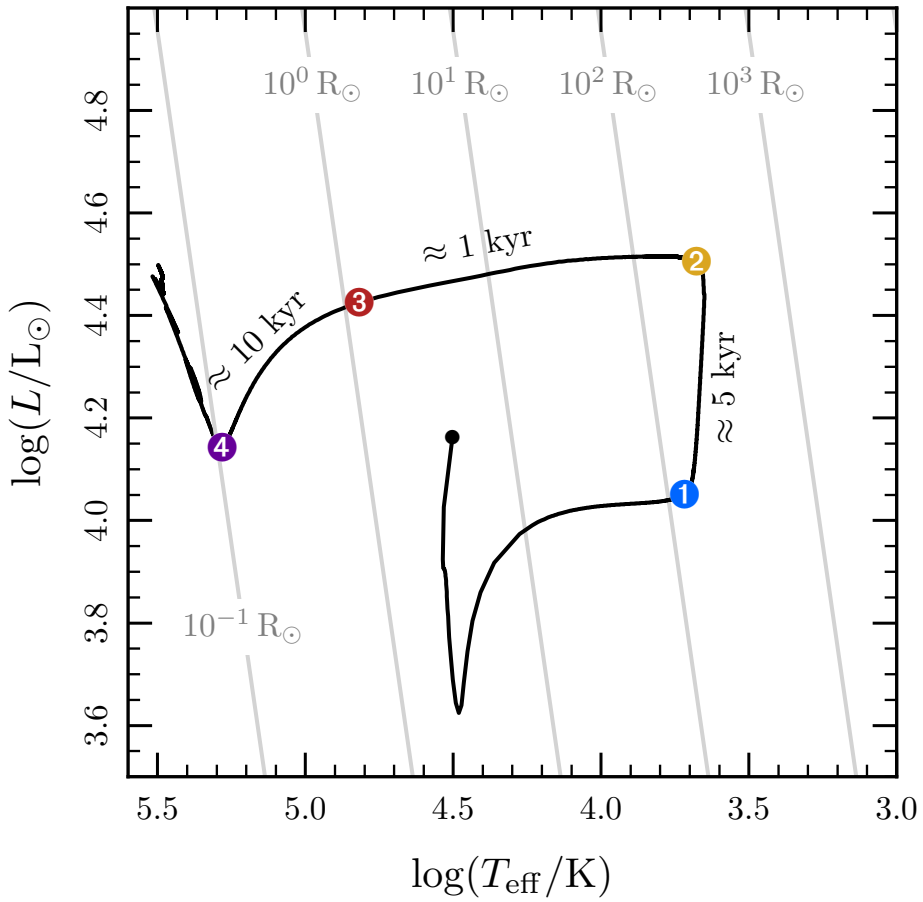
does not imply a thermonuclear supernova.




Nomoto & Iben (1985); Saio & Nomoto (1985)

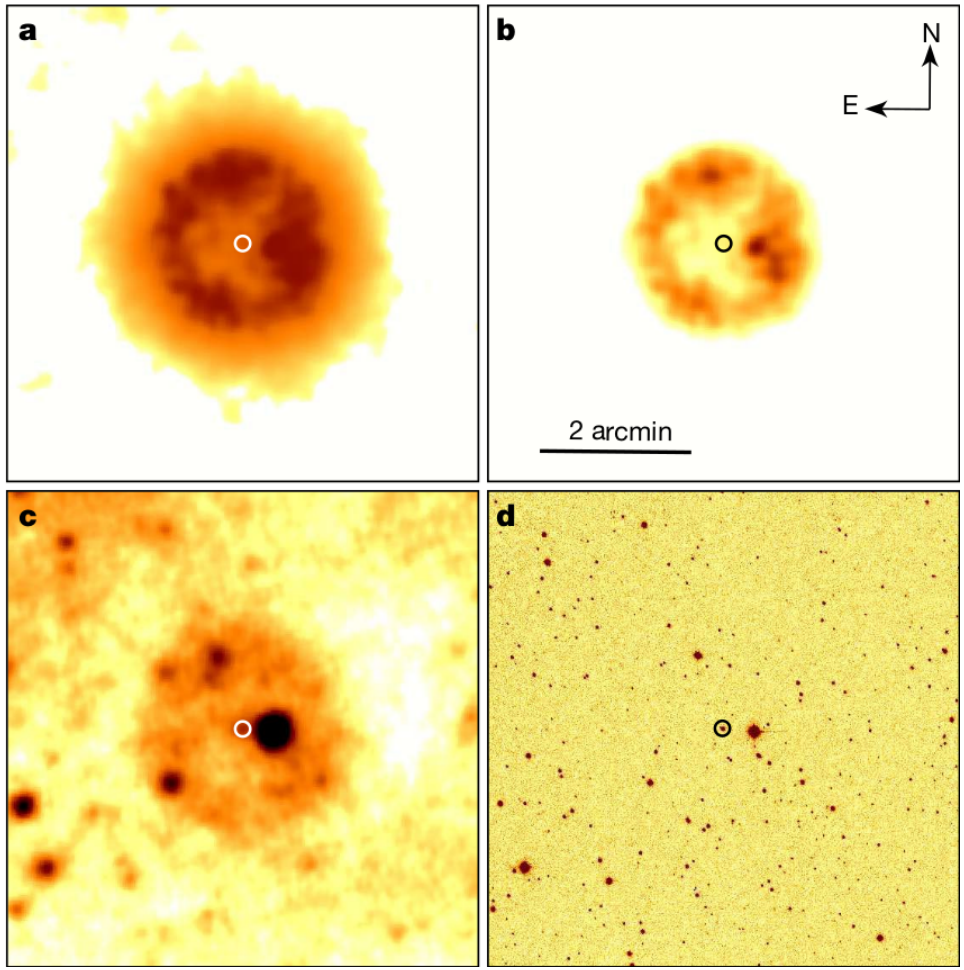
Schwab et al. (2016)

Collapse to an NS is essentially never prompt; it typically requires $\gtrsim 10^4$ years.



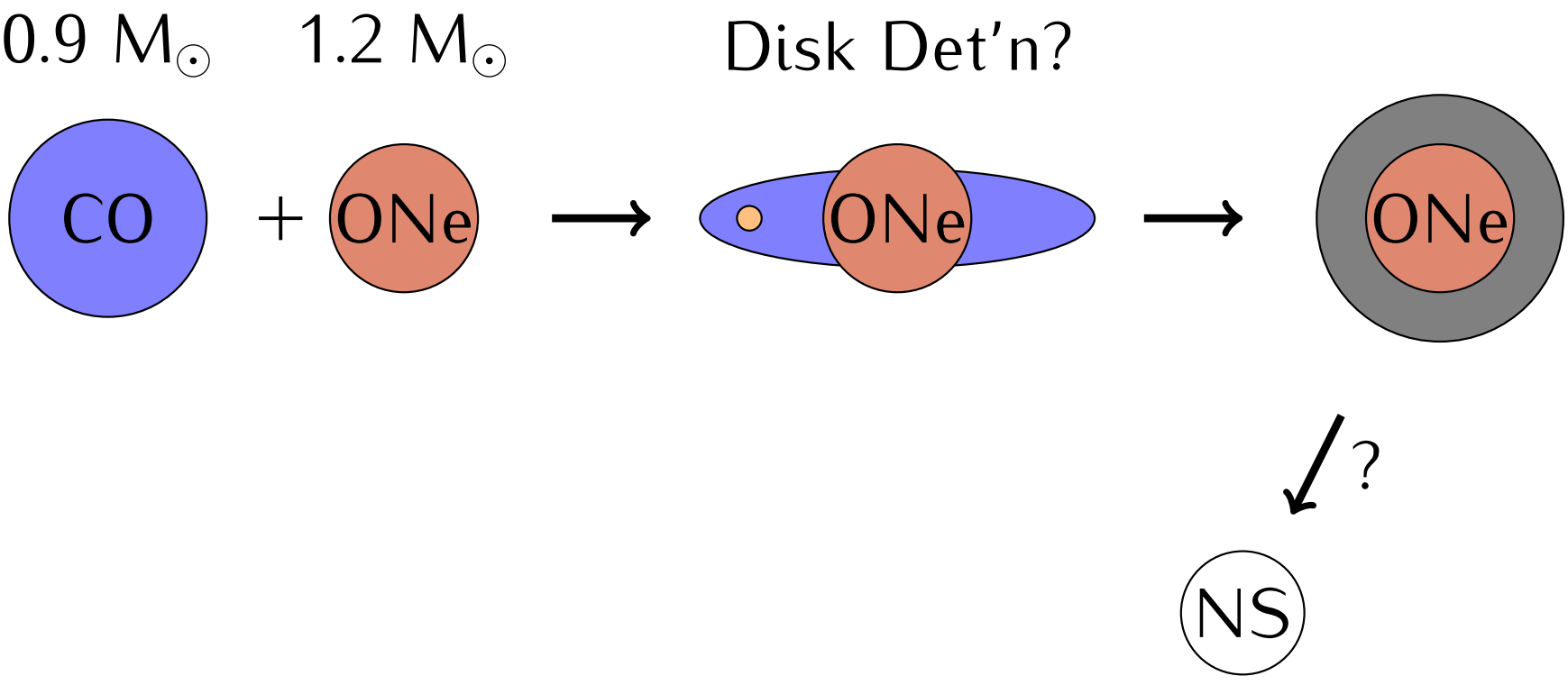

Schwab et al. (2016); see Gvaramadze et al. (2019)

A good candidate for such a merger remnant was recently found.




Gvaramadze et al. (2019)

# A CO + ONe merger may also produce an NS.




Lyutikov & Toonen (2018); Kashyap et al. (2018)

Review of white dwarf mergers

From super-Chandra merger to a neutron star

Summary

- Massive WD mergers make $\approx M_{\mathrm{Ch}}$ metal cores, whose evolution may mirror that of "low mass massive stars".
- Delay ($\sim 10^4$ yr) between merger and collapse, so look for systems on the way to becoming a NS.

Predicting the distribution of the products of WD mergers requires understanding:

- DWD formation

Predicting the distribution of the products of WD mergers requires understanding:

- DWD formation
- DWD post-formation evolution
  (tidal synchronization, mass transfer stability)

Predicting the distribution of the products of WD mergers requires understanding:

- DWD formation
- DWD post-formation evolution
  (tidal synchronization, mass transfer stability)
- the merger process

Predicting the distribution of the products of WD mergers requires understanding:

- DWD formation
- DWD post-formation evolution
  (tidal synchronization, mass transfer stability)
- the merger process
- the post-merger evolution