The Long-Term Outcome of WD+WD Mergers

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with Drew Clausen & Marius Dan

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The primary WD remains relatively undisturbed;
The secondary WD is disrupted, forming a disk.

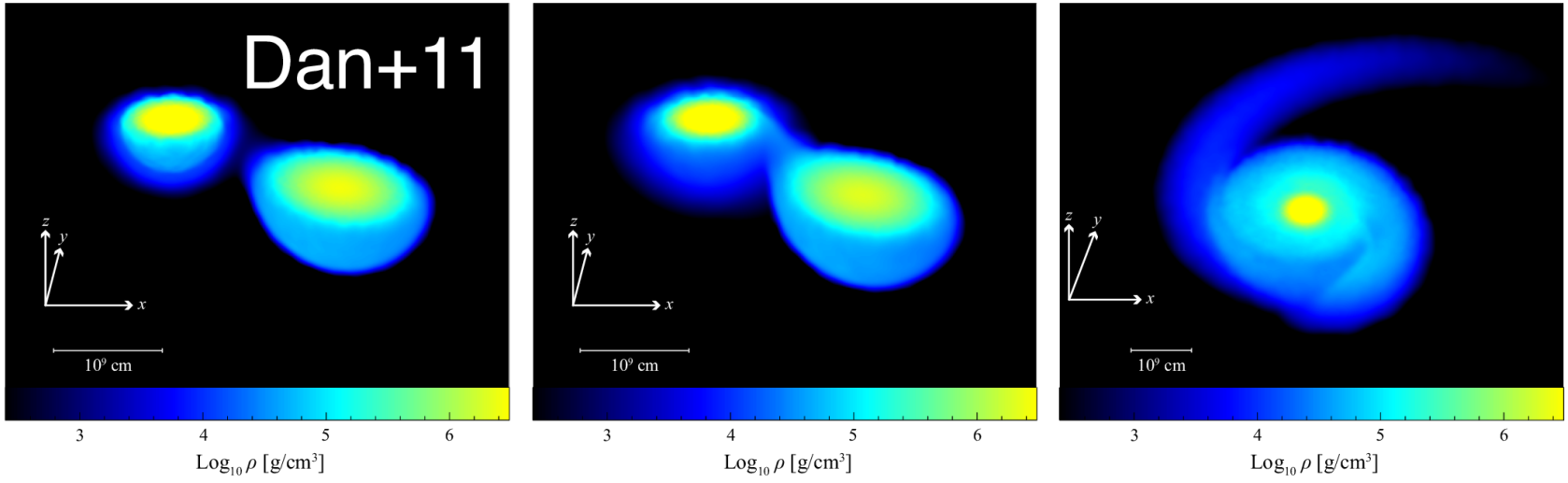


Fig. from Dan et al. (2011)

The kinetic energy in the disk will be converted into heat long before the remnant can cool.

Viscous Time (hr)

Redistribute ang. mom.

$t_{\text{visc}} \sim \alpha^{-1} P_{\text{orb}}$

Thermal Time (kyr)

Radiate away energy

$t_{\text{therm}} \sim E/L$

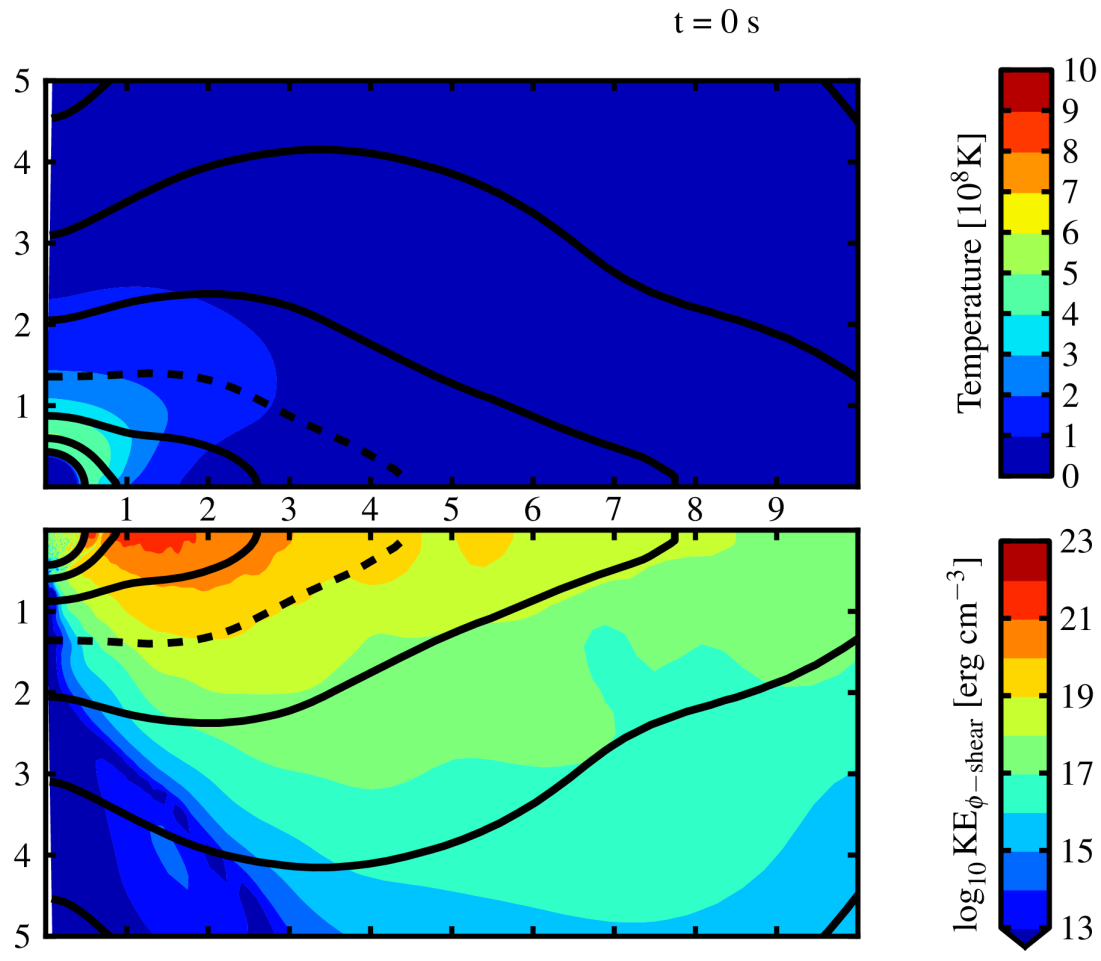
Shen et al. (2012) & Schwab et al. (2012)

also Yoon et al. (2007), van Kerkwijk et al. (2010)

I've done multi-D hydro calculations of the viscous evolution (Schwab et al. 2012)

z [10^9 cm]

ϕ ⊙⟶ R [10^9 cm]



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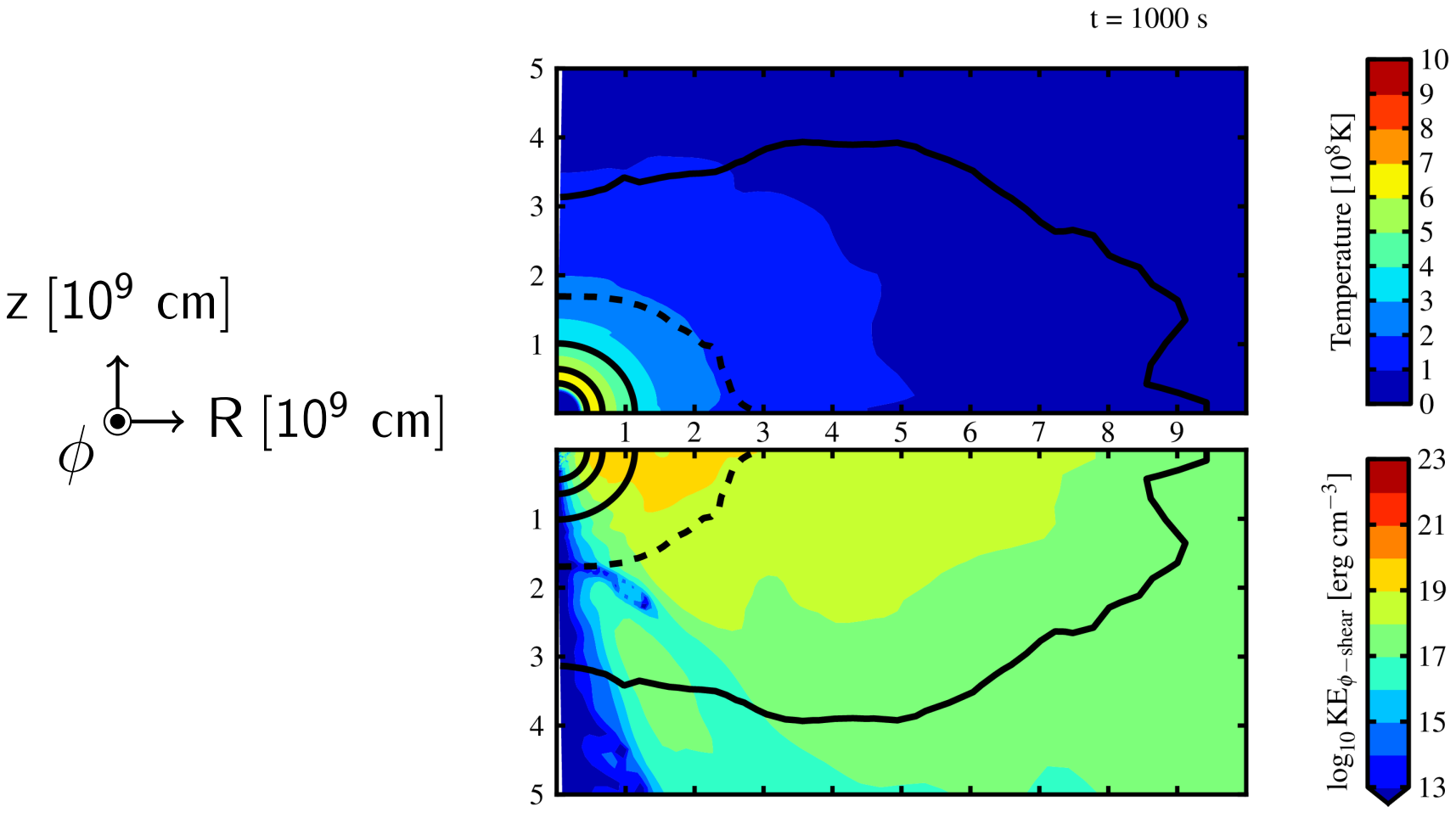

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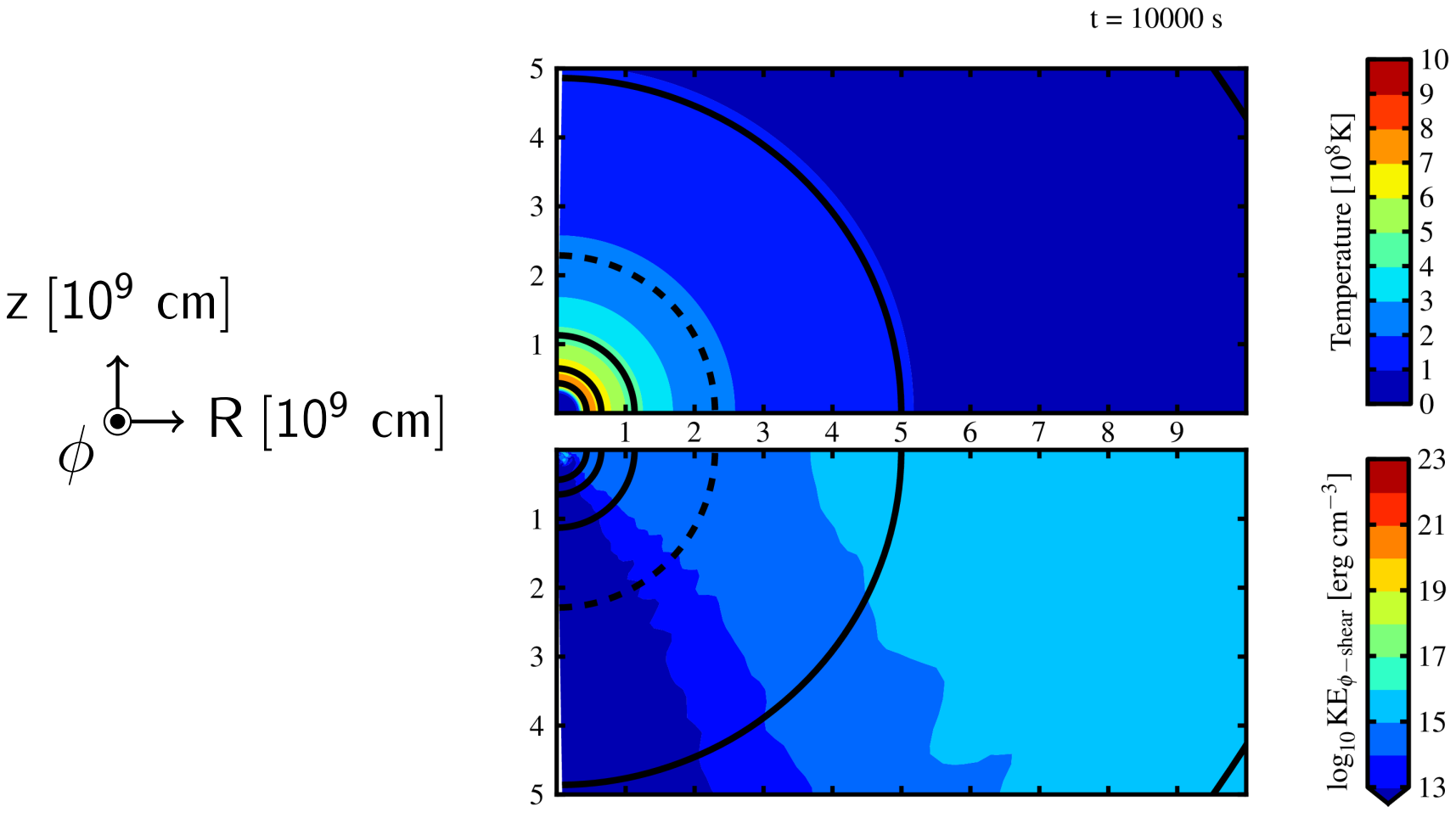
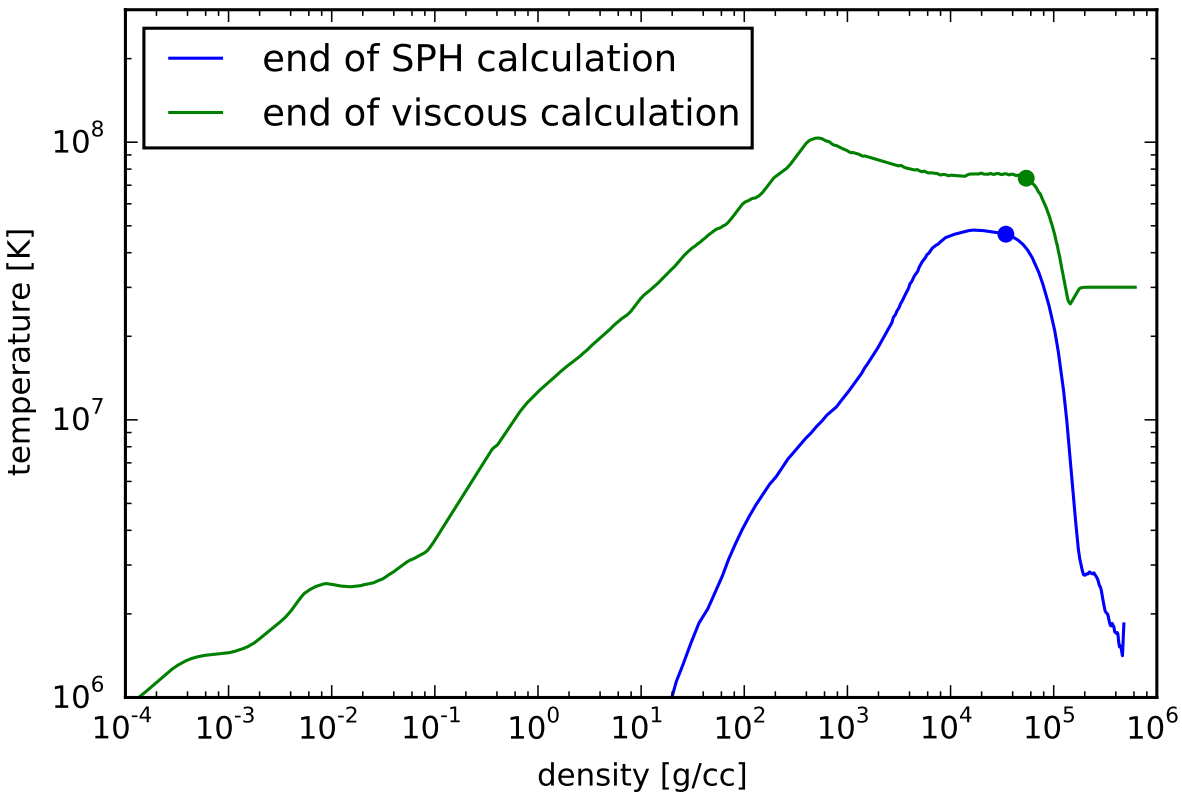
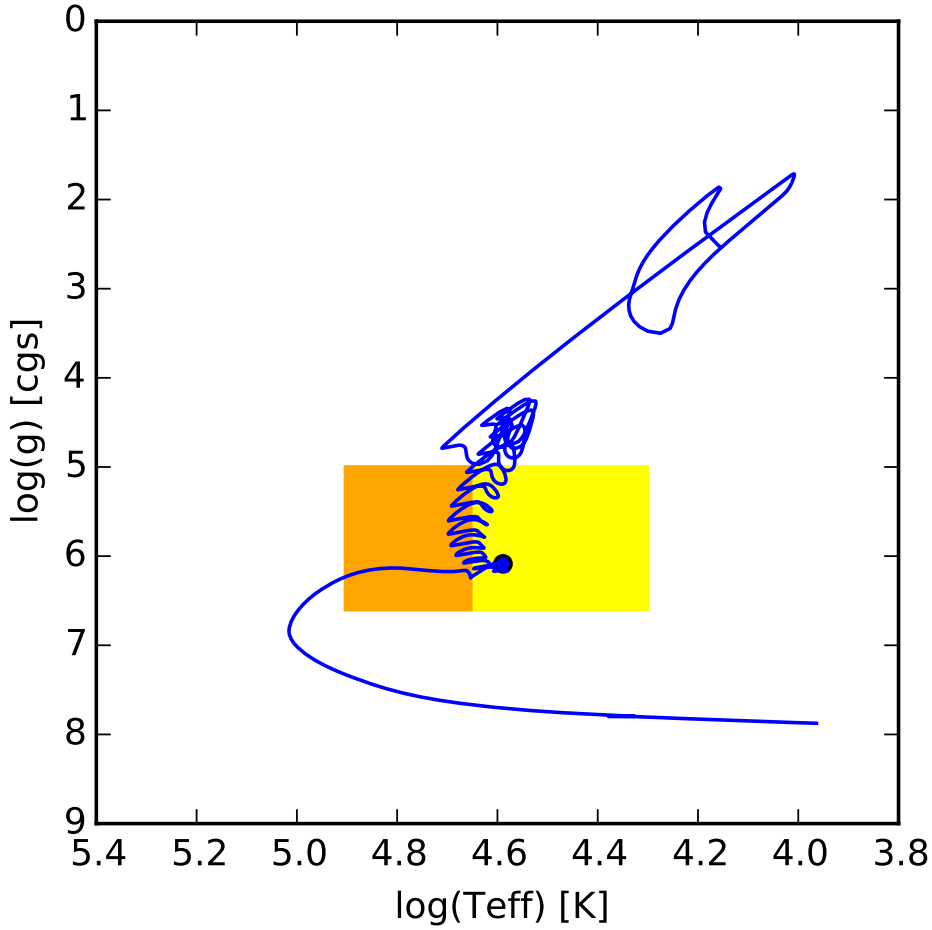


The viscous evolution sets the initial conditions for the thermal evolution.



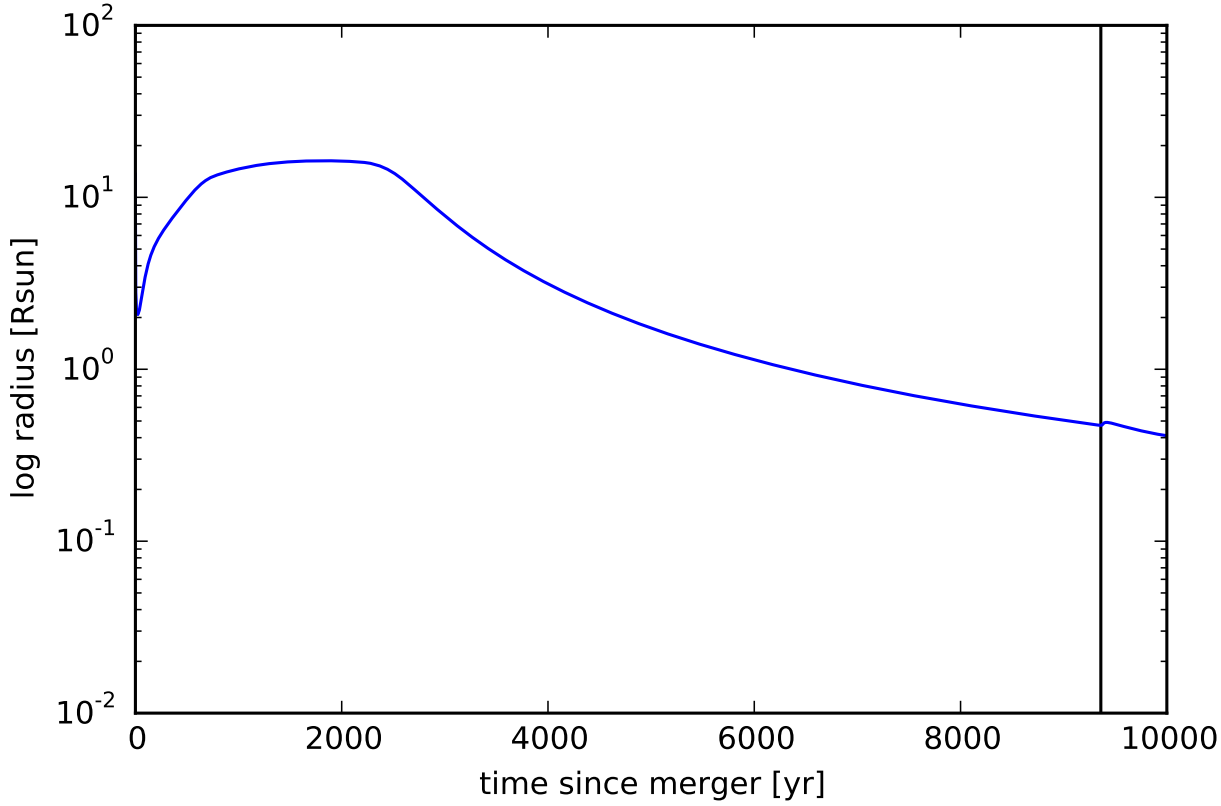
SPH calculation of $0.2 + 0.3\ M_\odot$ merger by M. Dan

I map this profile into MESA and let it evolve.

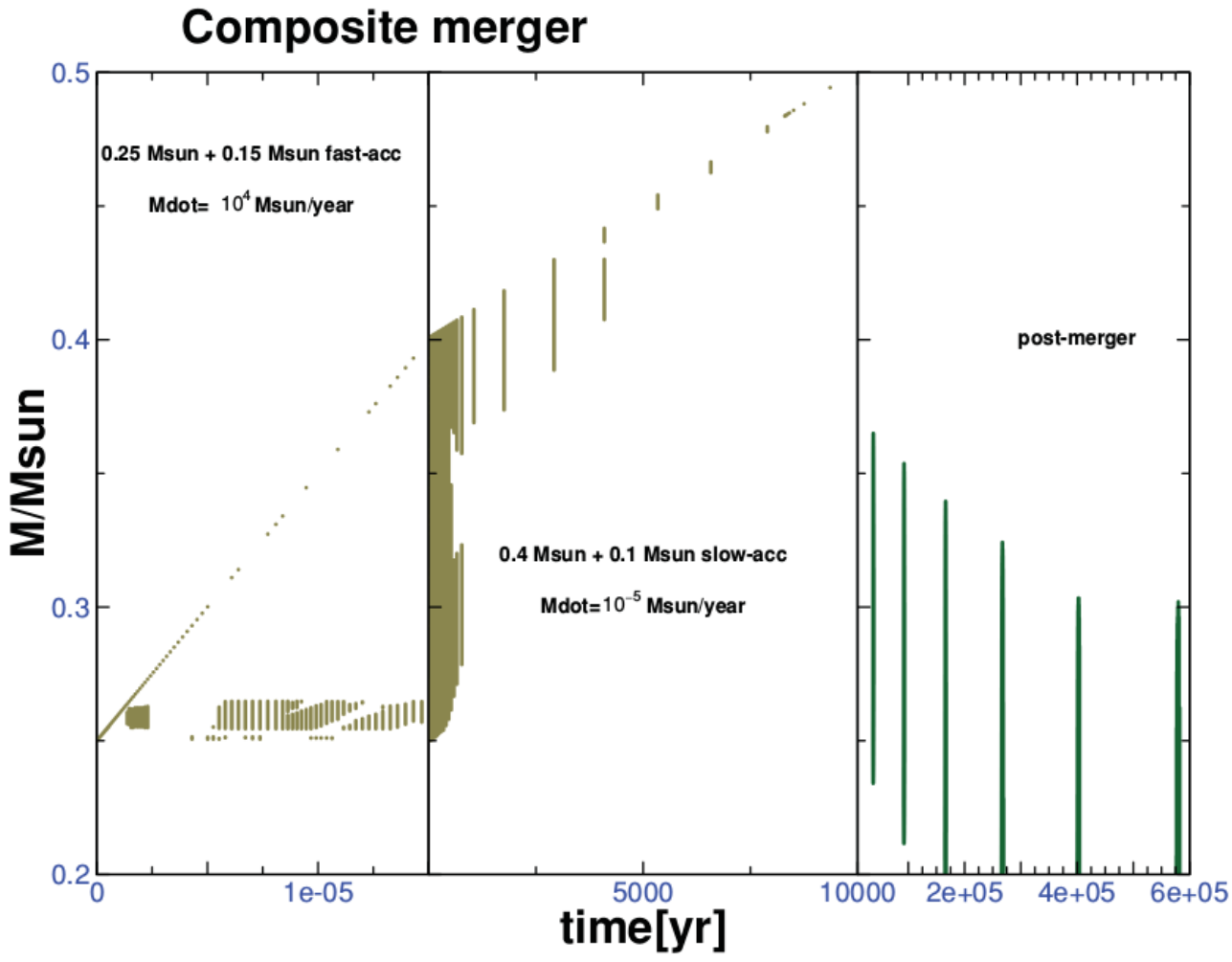


e.g., Saio & Nomoto (1998), Saio & Jeffrey (2000)

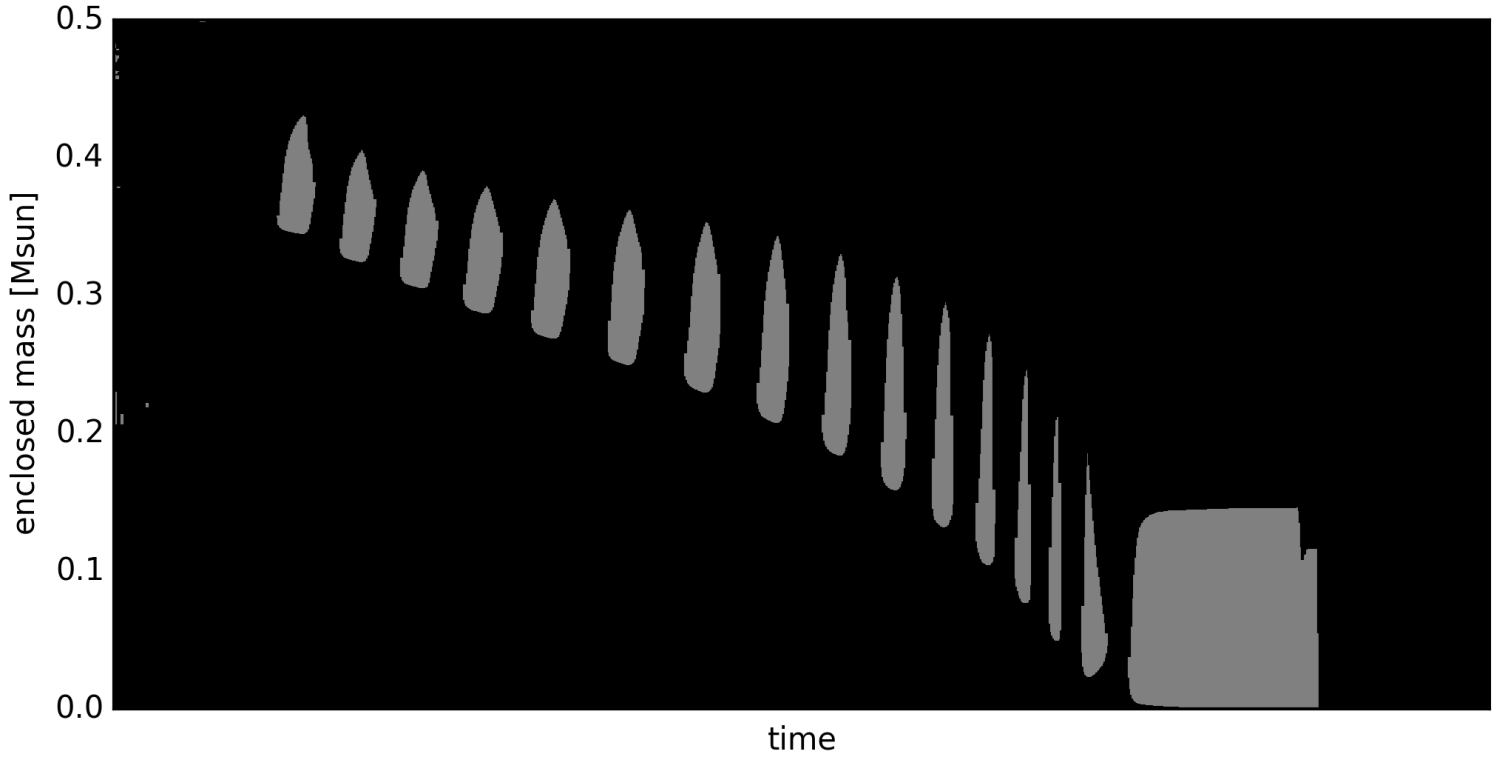
All of the angular momentum can be removed by shedding $\approx 0.01 M_\odot$ at $\approx 10 R_\odot$.



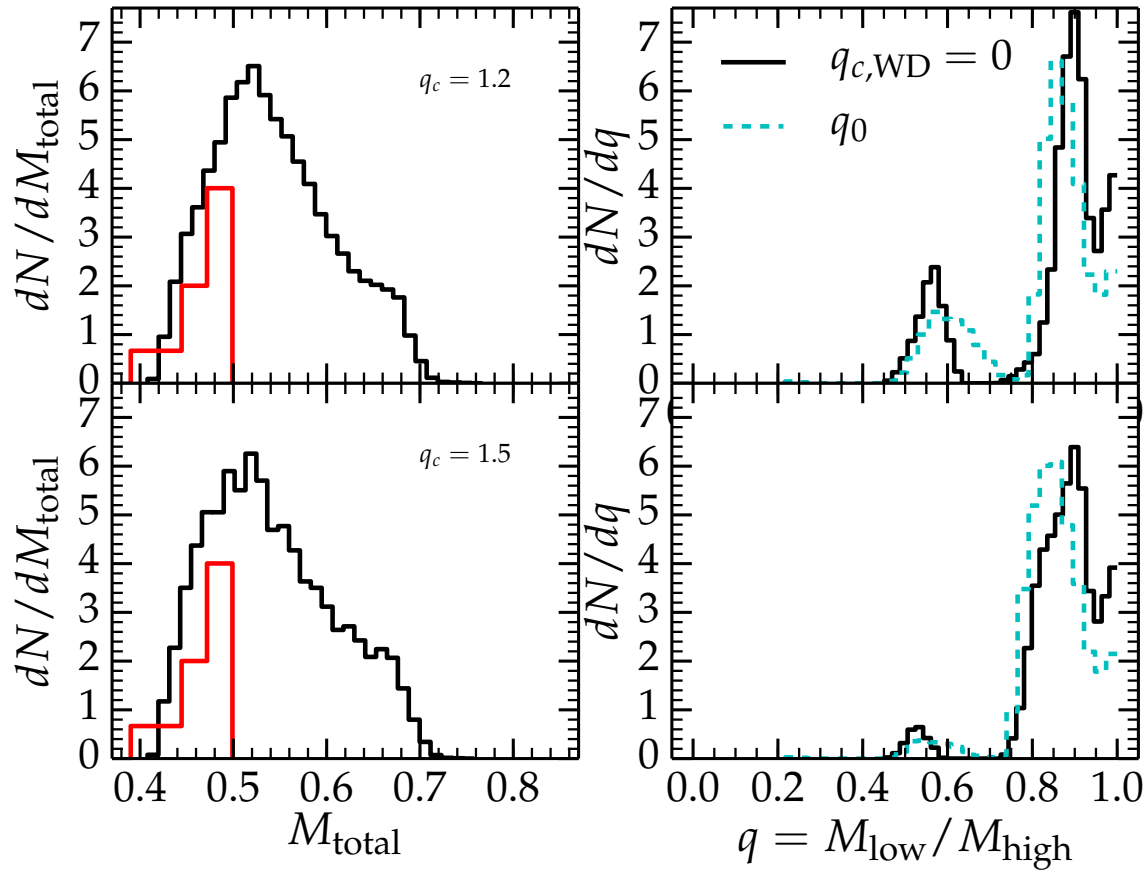
Zhang & Jeffery (2012) reproduced surface abundances using a "composite" merger model.



The thermal profiles from my merger simulations don't form a large convection zone.



The mass distribution peaks broadly ($0.4 - 0.7 M_\odot$); the mass ratio distribution peaks around $q \approx 0.9$.



Calculations by D. Clausen, c.f. Han (2003)

Questions for discussion & future work

- How much hydrogen can survive the merger?
- What are the observational constraints on the mass distribution of He-rich sub-dwarfs?
- What post-merger thermal profiles and/or additional mixing processes can reproduce the observed C/N enhancements?
- What range of (q, $M_{\rm tot}$) should be the focus of modeling?