Merger runaways: stellar evolution point of view

Clusters'09

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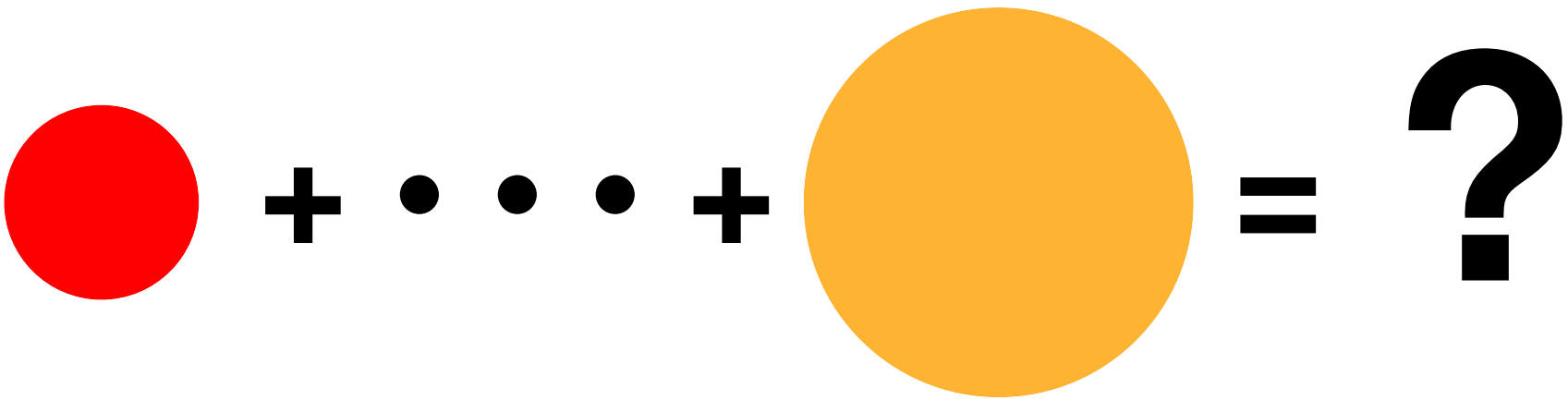
Main question

Does a merger runaway lead to the formation of an IMBH?



Collision sequences

- Sequences taken from Portegies Zwart et al. (Nature, 2004) simulation of MGG-11
- 10 – 20 collisions in 3 Myr
- Time between collisions usually longer than thermal timescale

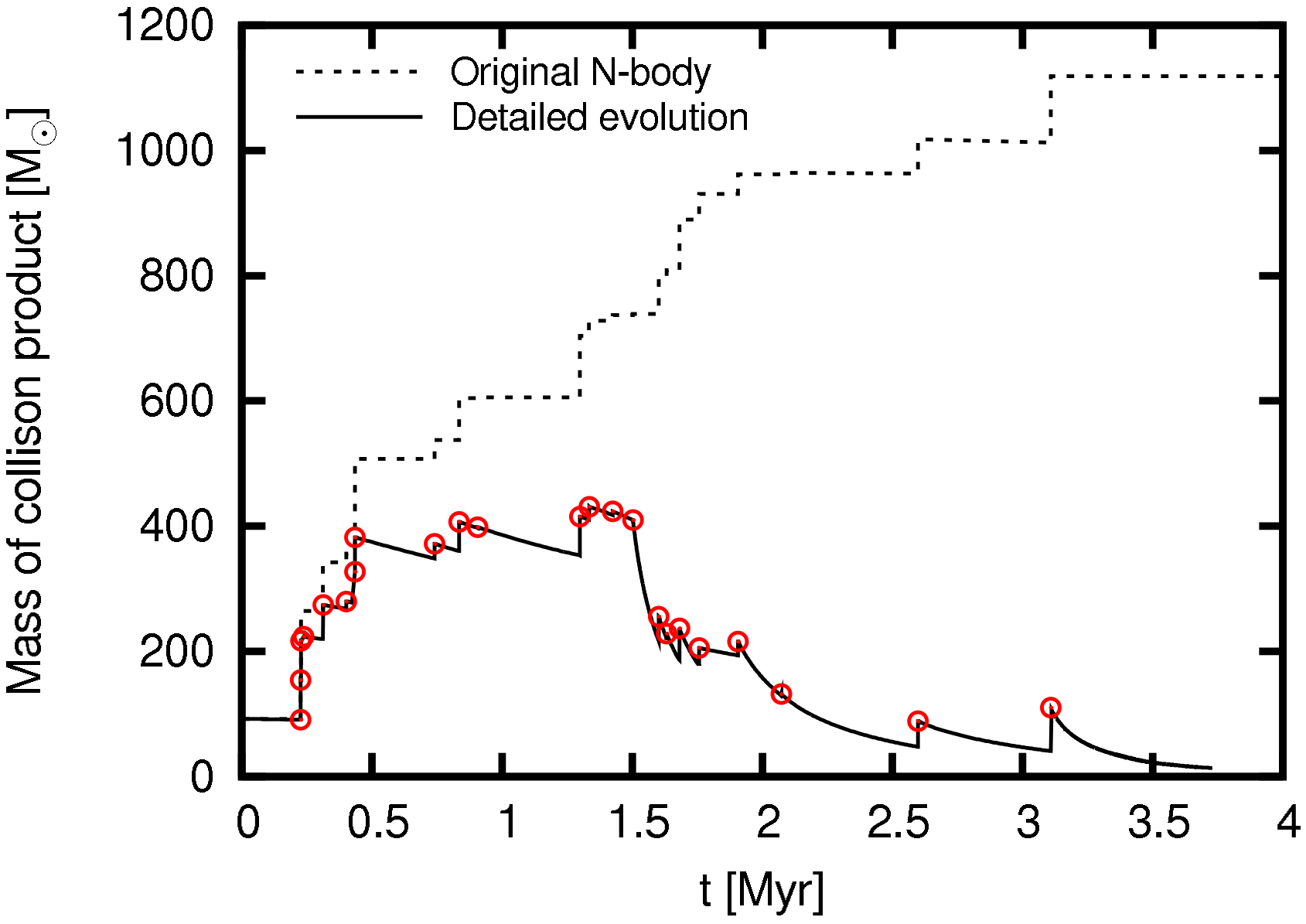
Hydrodynamics of the collision

- Used "Make Me A Massive Star" code (Gaburov et al. 2008) for initial collisions
- Collision product (in this case) well represented by homogeneous mixing of colliding stars
- Use mass loss prescription from MMAMS

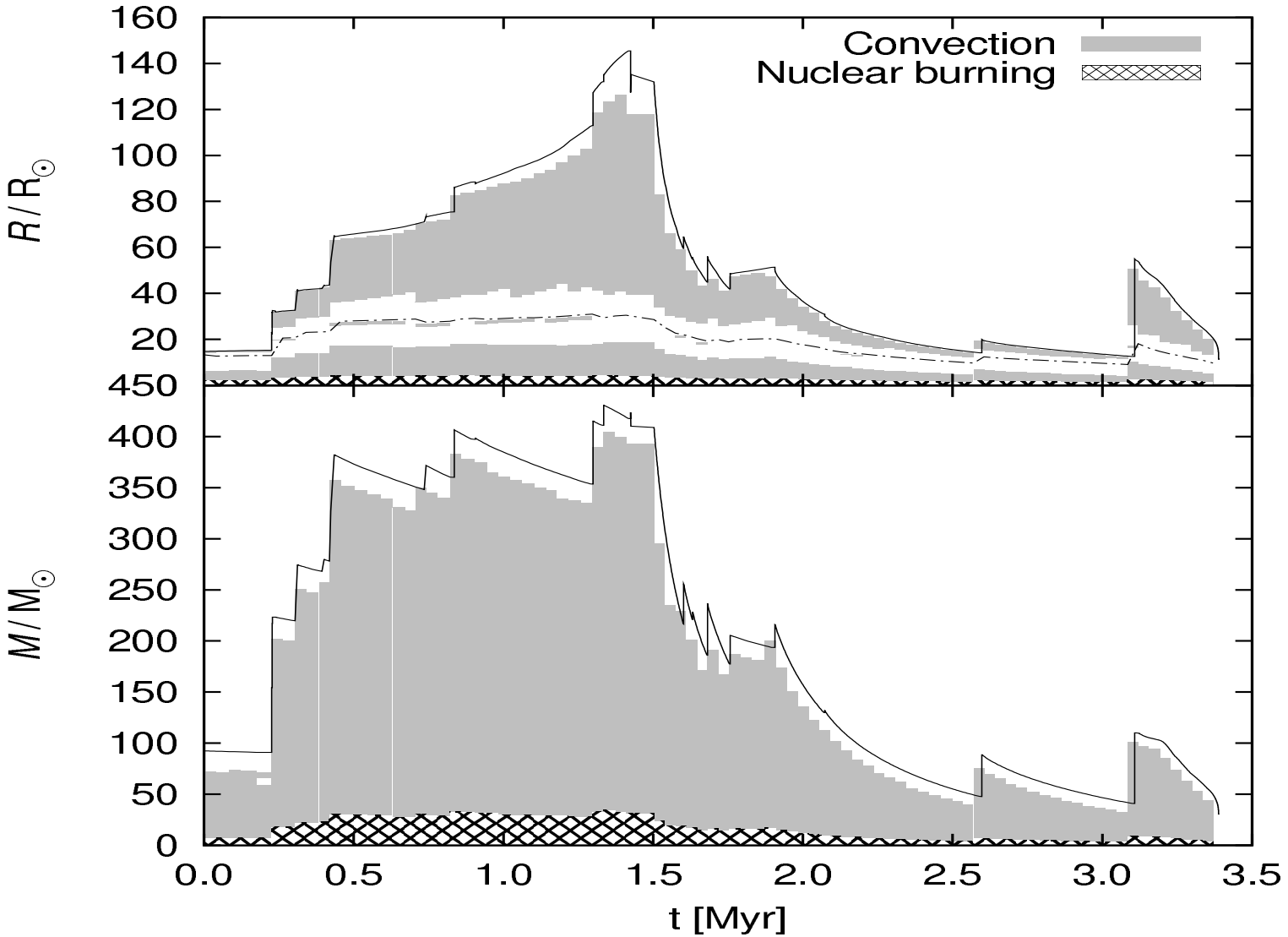
Why care about stellar winds?

- If the runaway is to form a black hole, the collision product has to pass through a stage where it looks and behaves like a very massive star
- The evolution of (very) massive stars is determined by their mass loss rate
- Mass loss rates of very massive (and luminous) stars are uncertain!

Punchline: mass of the collision product

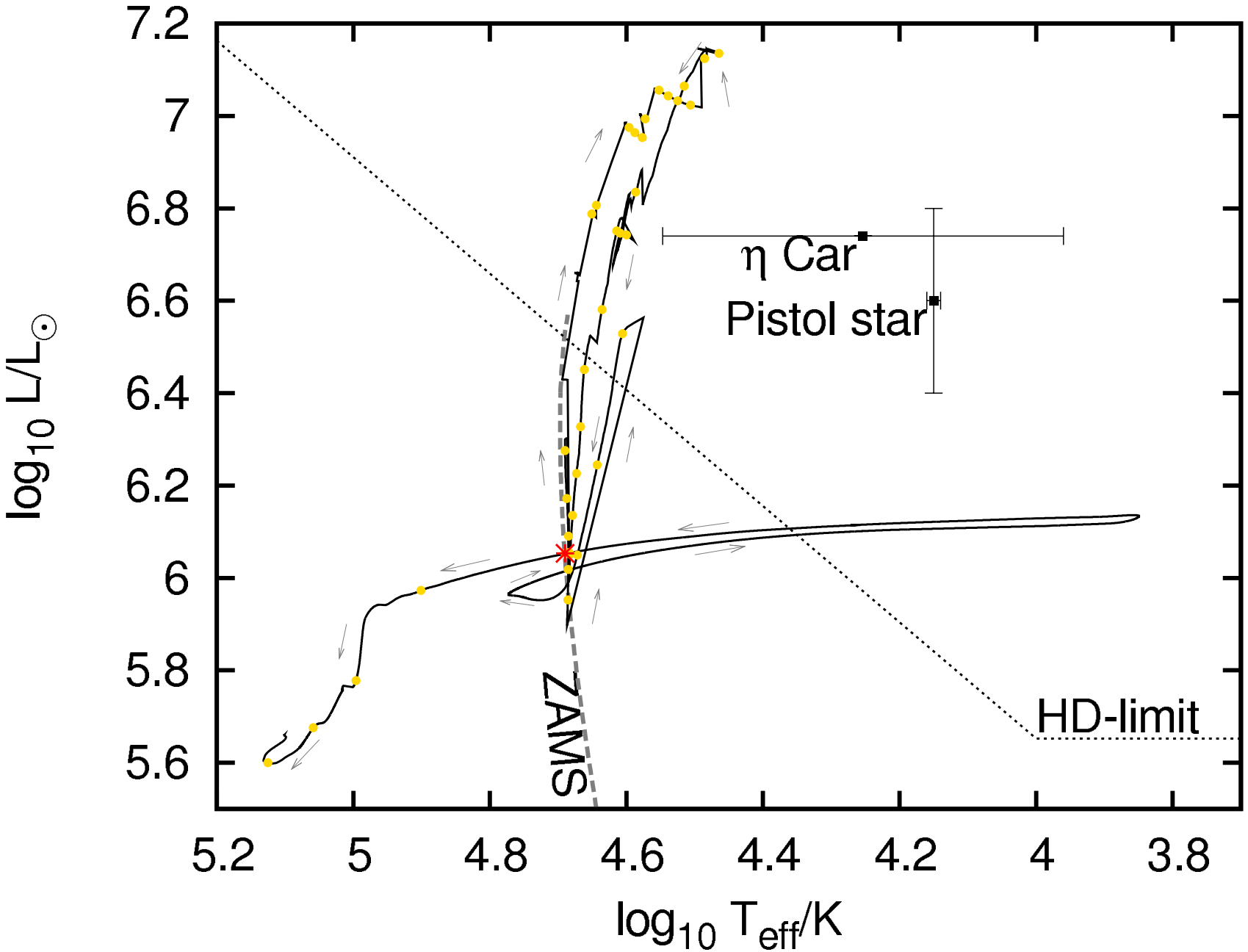


Internal structure/convection

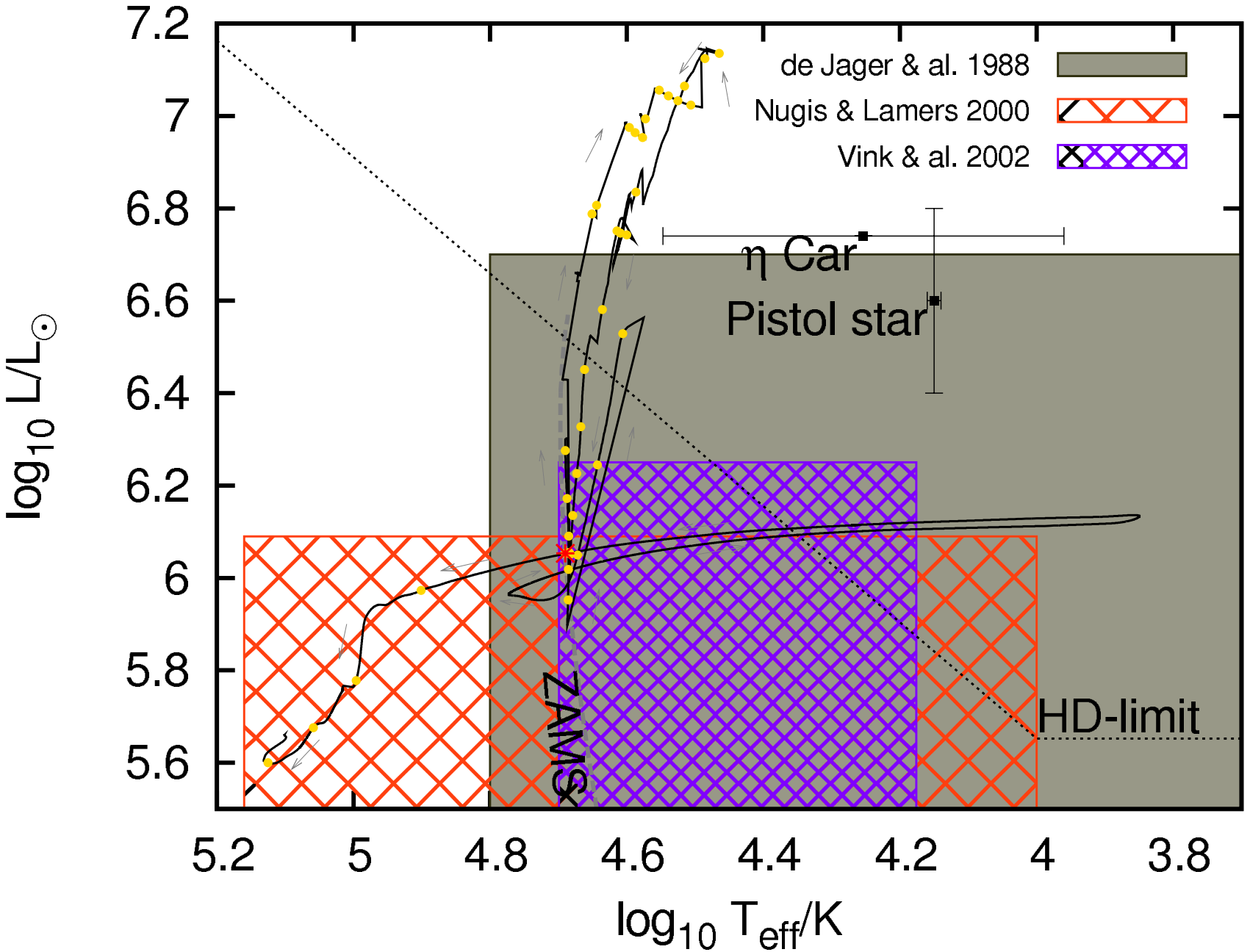


See also massive star models by Yungelson et al. (2008)

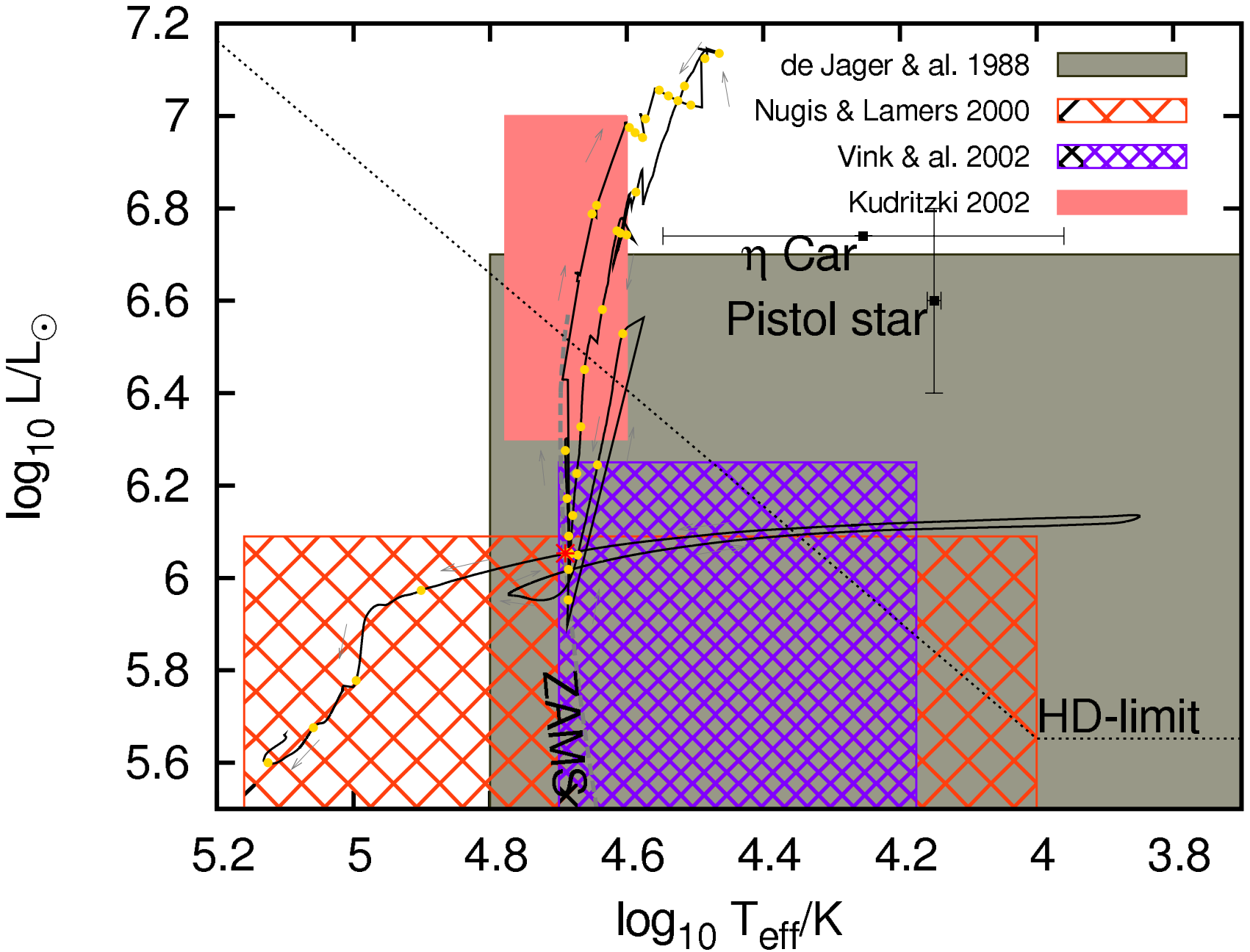
Evolution track



Stellar wind



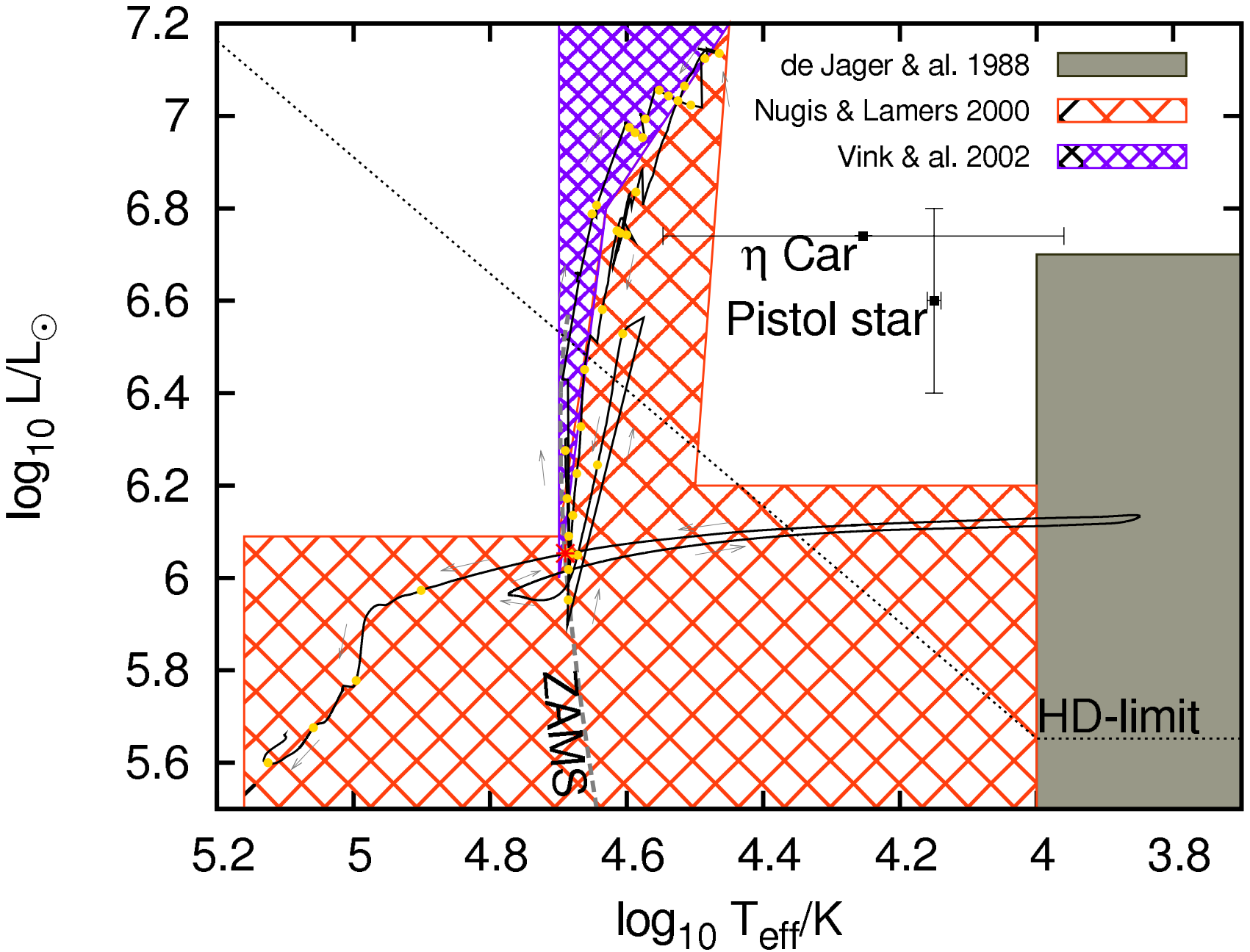
Stellar wind



Stellar wind

- Mass loss rates need to be extrapolated
- *Never* extrapolate mass loss rates in effective temperature!
- Need to extrapolate mass loss rates to higher luminosity, into LBV regime
- This extrapolation is still an underestimate

Stellar wind



Chemical yields

	Single stars	Merger sequence			
	Wind	Collision	Wind	Remnant	Total
ΔM	648	229	696	95	1020
H	0.4806	0.5648	0.4006	0.0899	0.4083
He	0.4965	0.4000	0.5794	0.8308	0.5627
C	0.0040	0.0012	0.0003	0.0306	0.0033
N	0.0092	0.0166	0.0132	0.0294	0.0155
O	0.0040	0.0013	0.0010	0.0060	0.0015