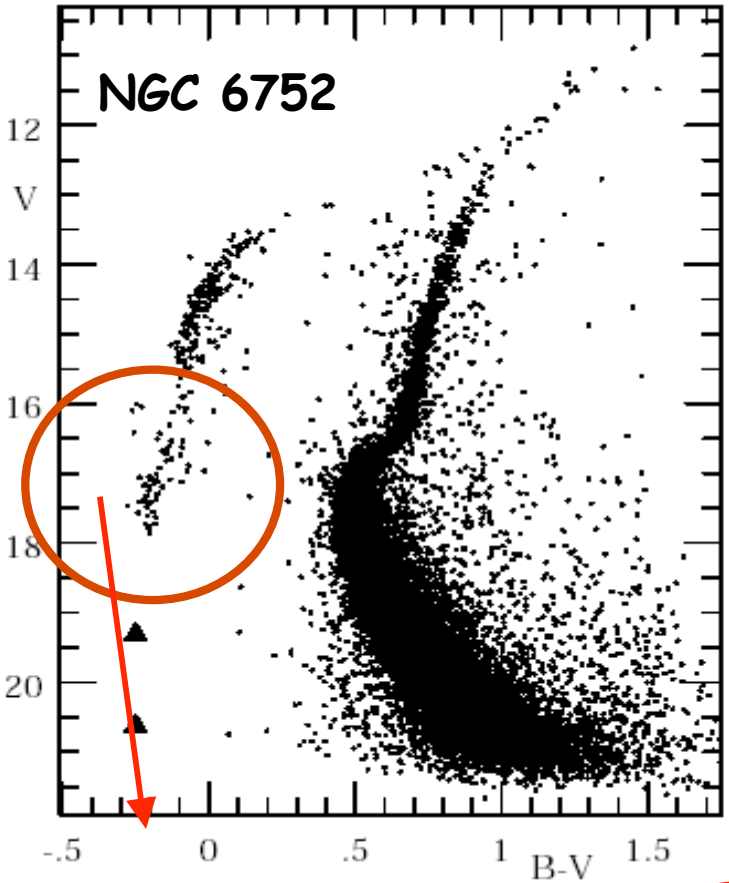
How much Helium from massive AGBs ?

Paolo Ventura **OAR**

Francesca D'Antona **OAR**

Annibale D'Ercole **OABo**

Blue tails in NGC 6752 and NGC 6441



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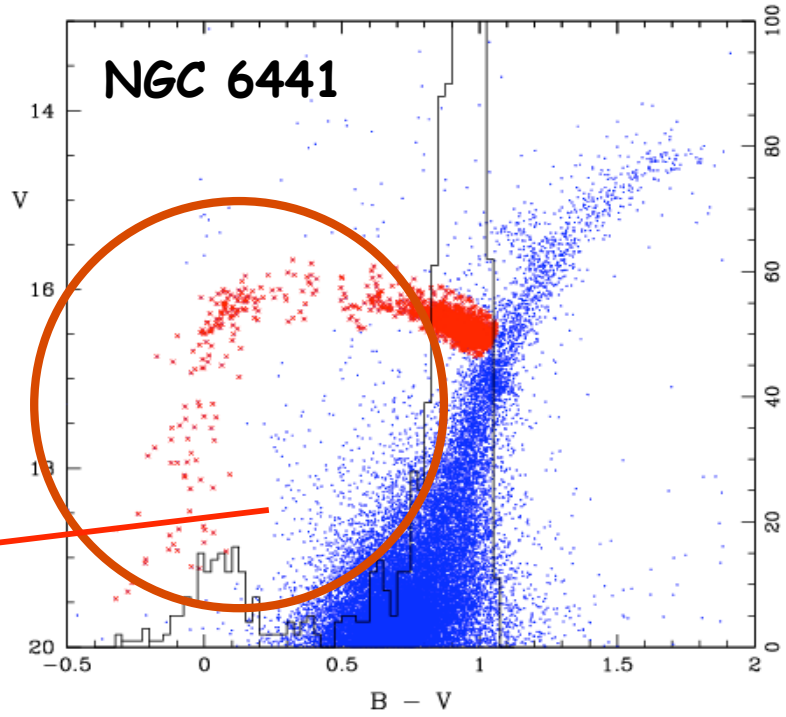
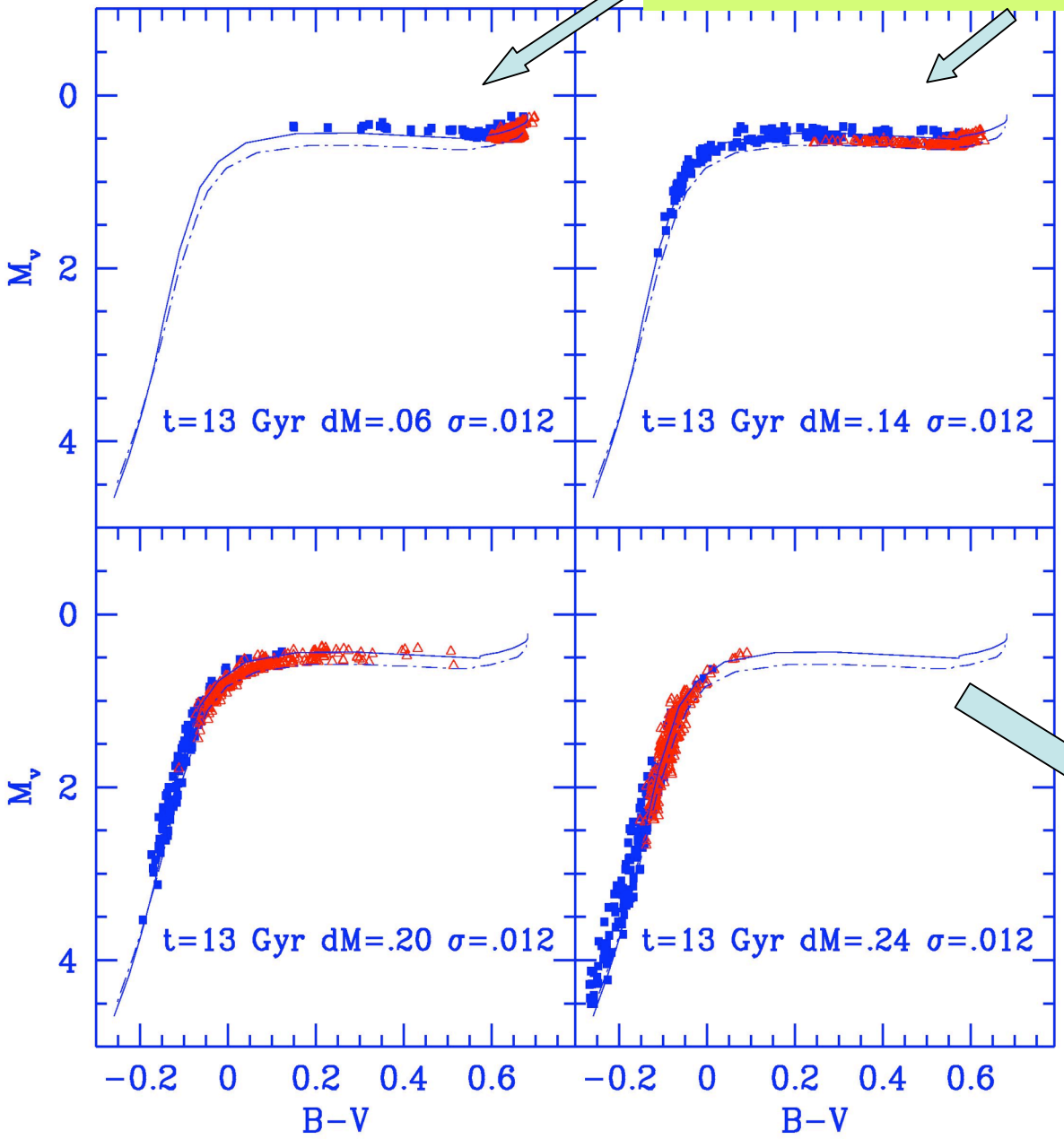
both clusters showing
O-Na anticorrelation

Piotto et al. 2002



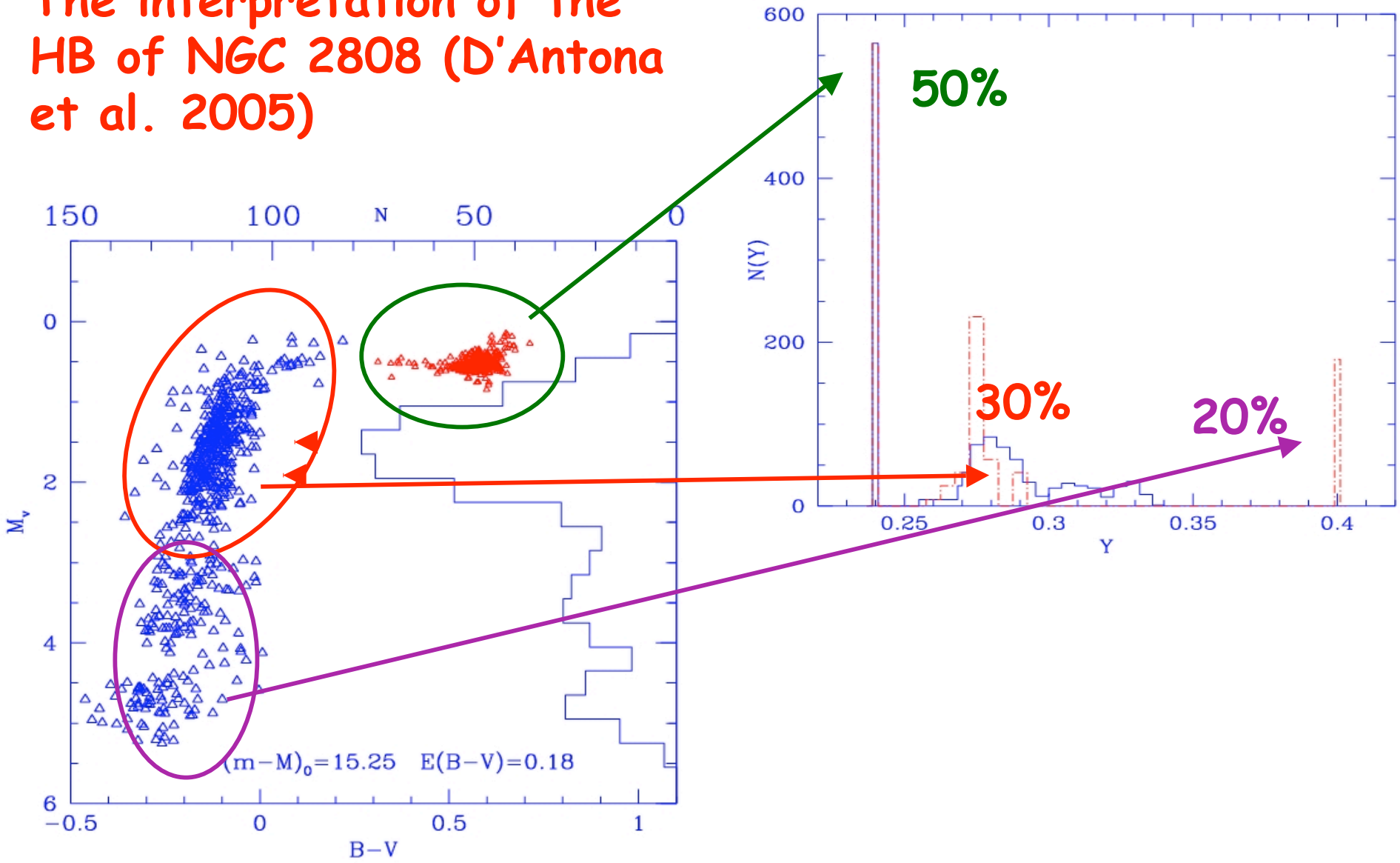
He-rich HB stars are more luminous!
See 47 Tuc ..... and M3



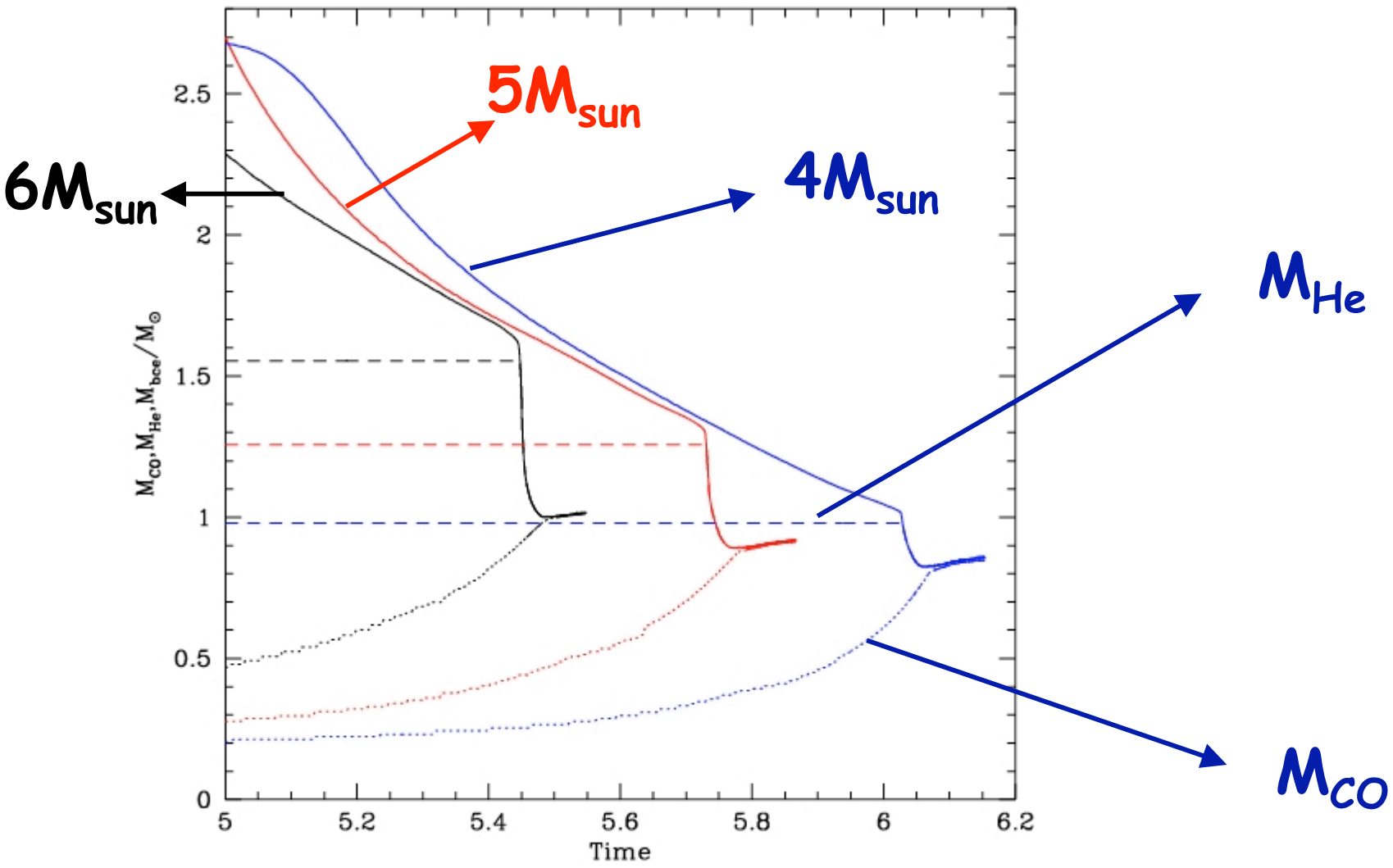
- Y=0.24
- 0.24<Y<0.28

No difference in the HB luminosity for blue HBs

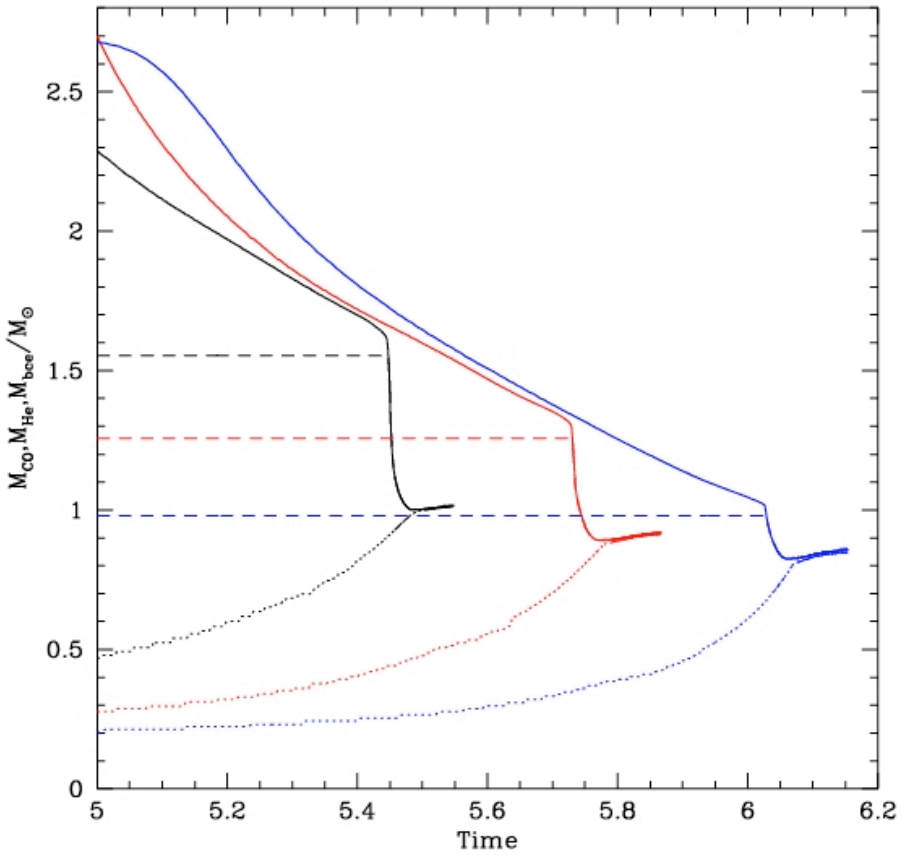
The interpretation of the HB of NGC 2808 (D'Antona et al. 2005)

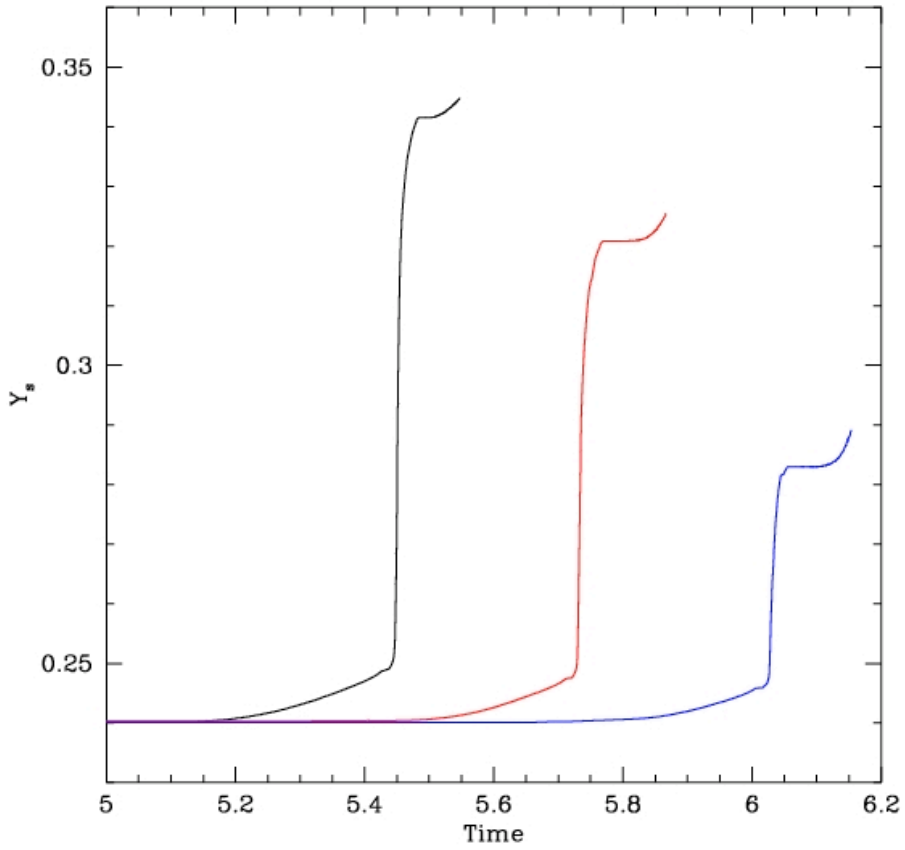


The surface Helium increases in the intermediate masses ($3<M/M_{sun}<7$) via the II dredge-up

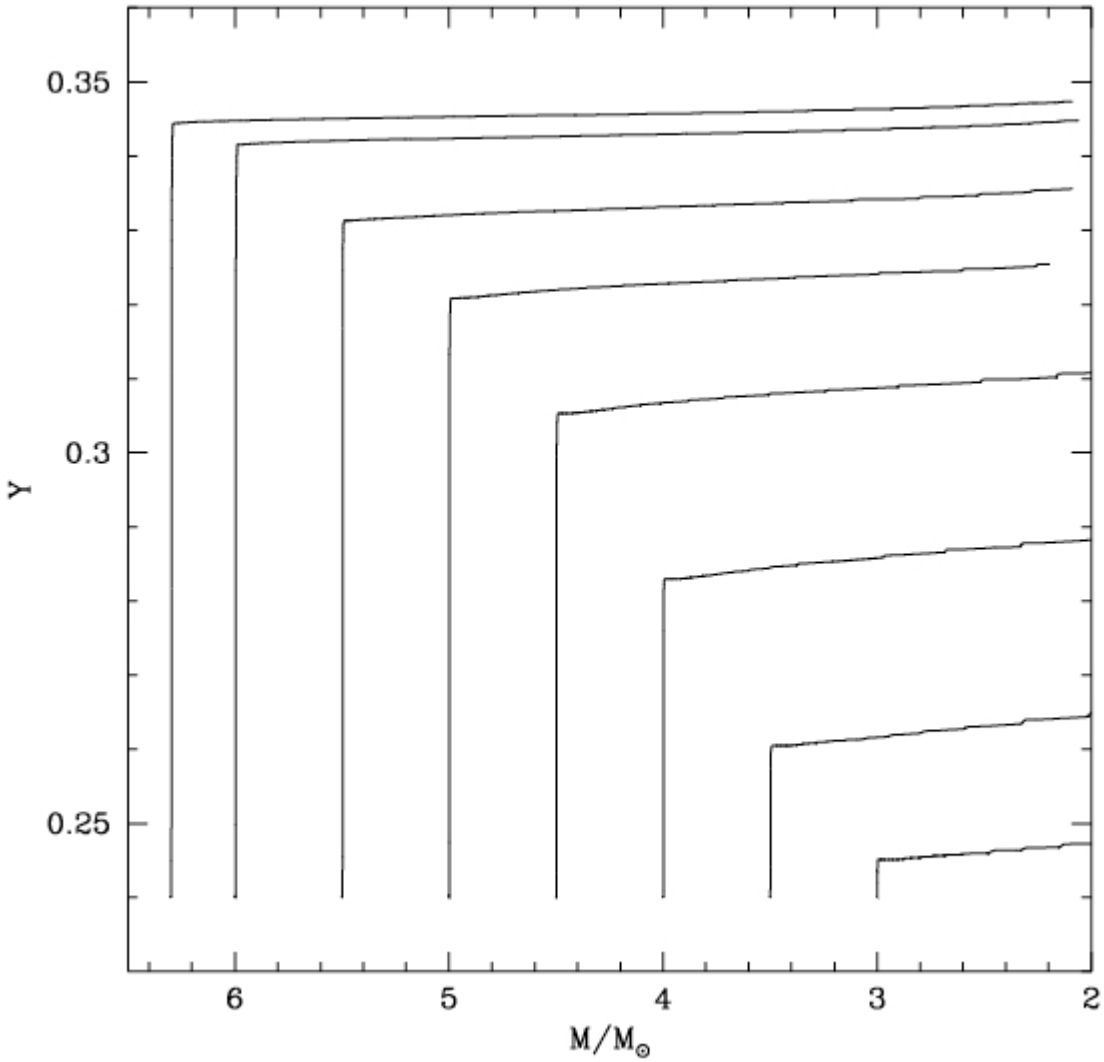


The surface Helium increases as the external mantle penetrates into the He-rich buffer





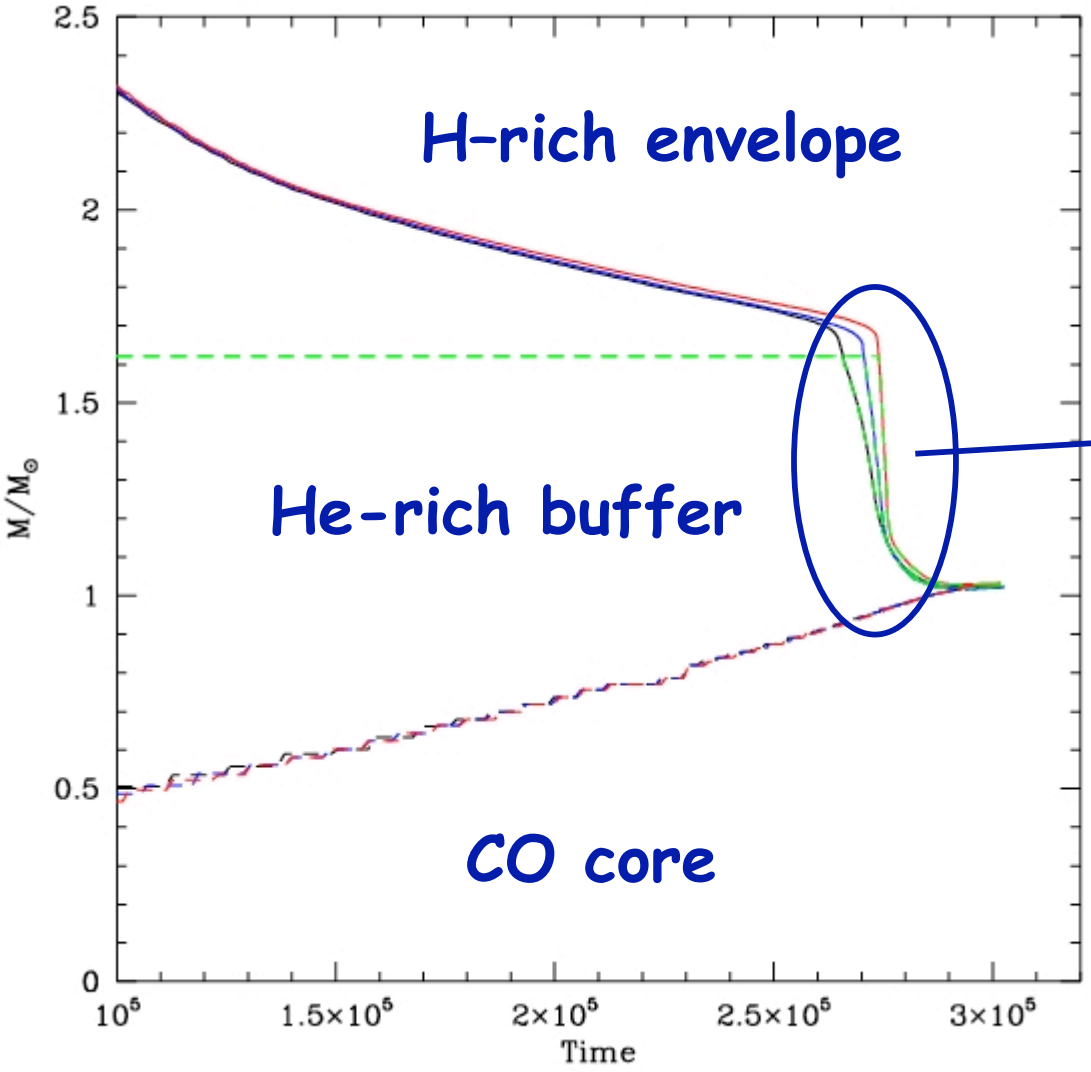
Which yields from AGBs ?



The surface Helium is approximately constant until the ejection of the envelope

The Helium yield is strictly related to the second dredge-up

What if we allow a deeper penetration?



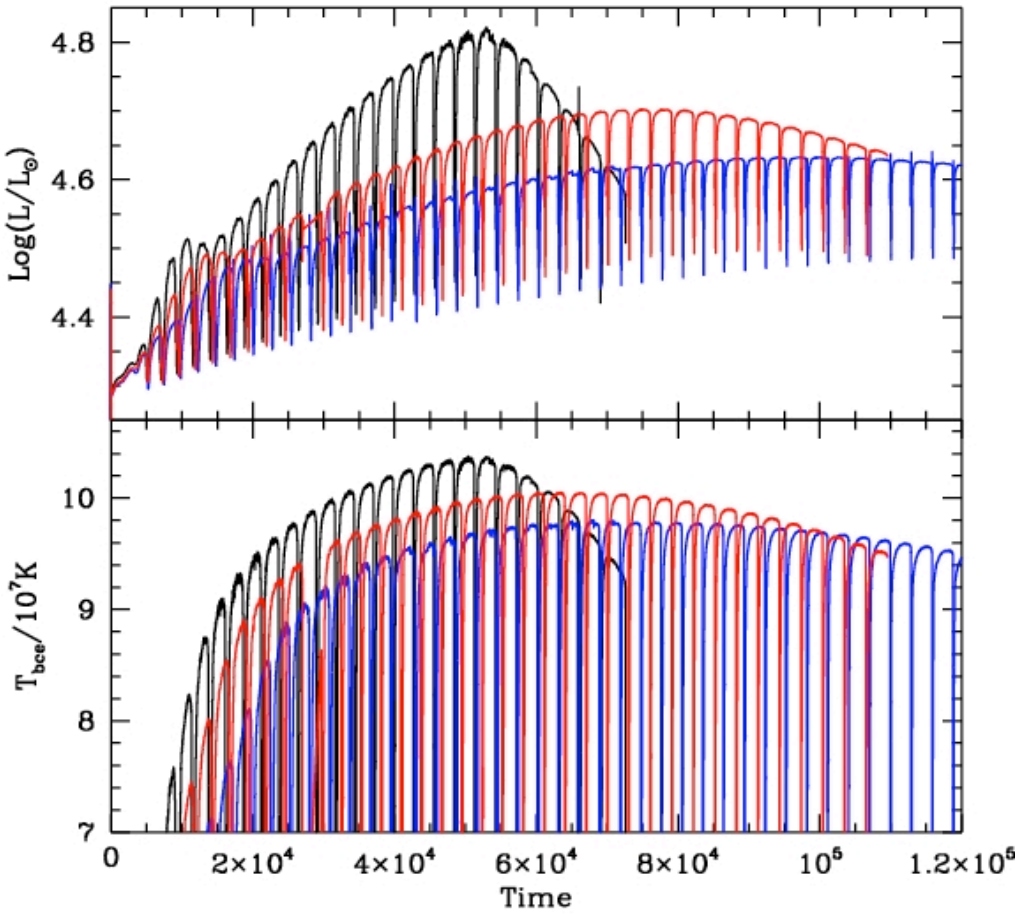
$V = V_b * \exp(-P/\zeta P_b)$

$\zeta = 0.02$

Extra-mixing from the bottom of the envelope anticipates the penetration

$$\frac{\Delta Y}{\Delta \zeta} \approx 1$$

AGB modelling is extremely sensitive to the treatment of convection



FST

MLT (α=2.1)

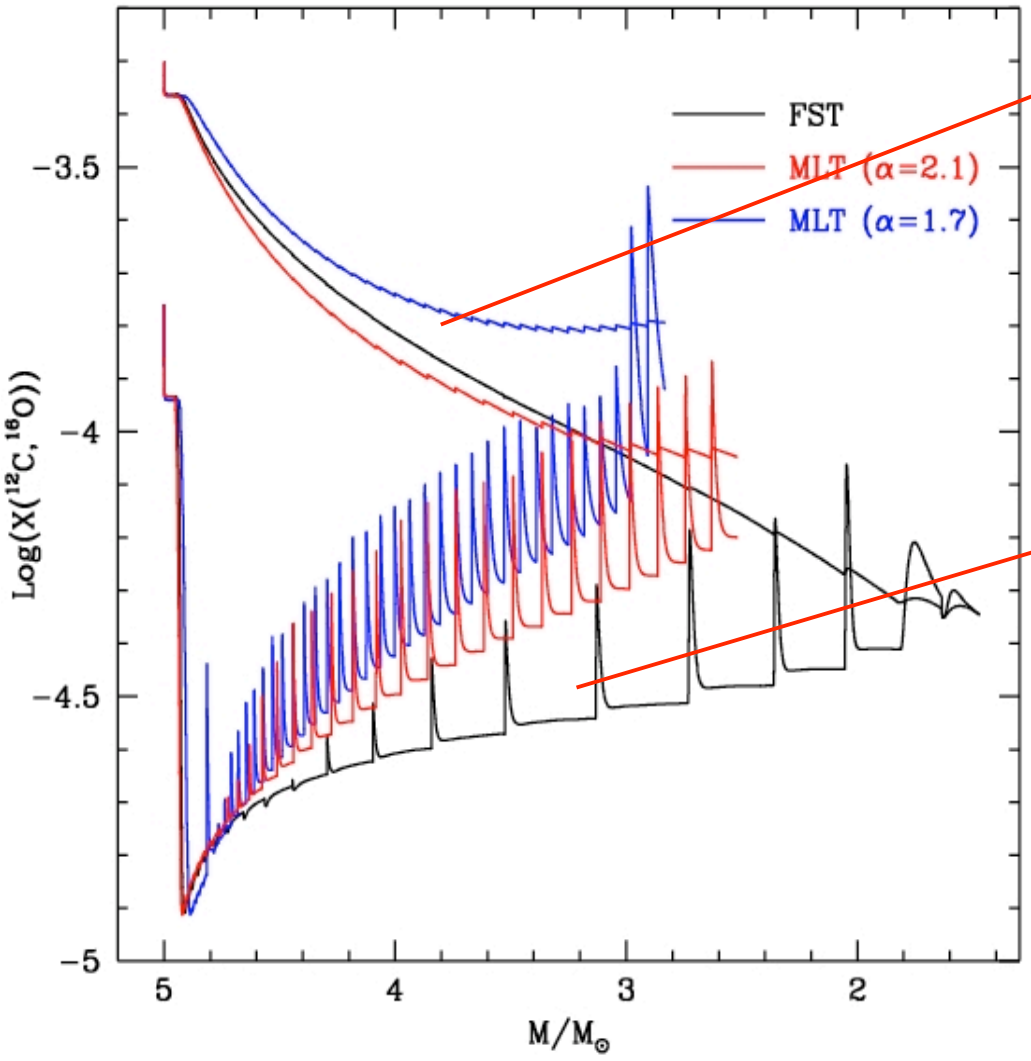
MLT (α=1.7)

The FST model evolves more rapidly at larger luminosities

This is related to the larger temperatures attained at the bottom of the envelope

$M=5M_{sun}$

Which effects on the surface chemistry ?

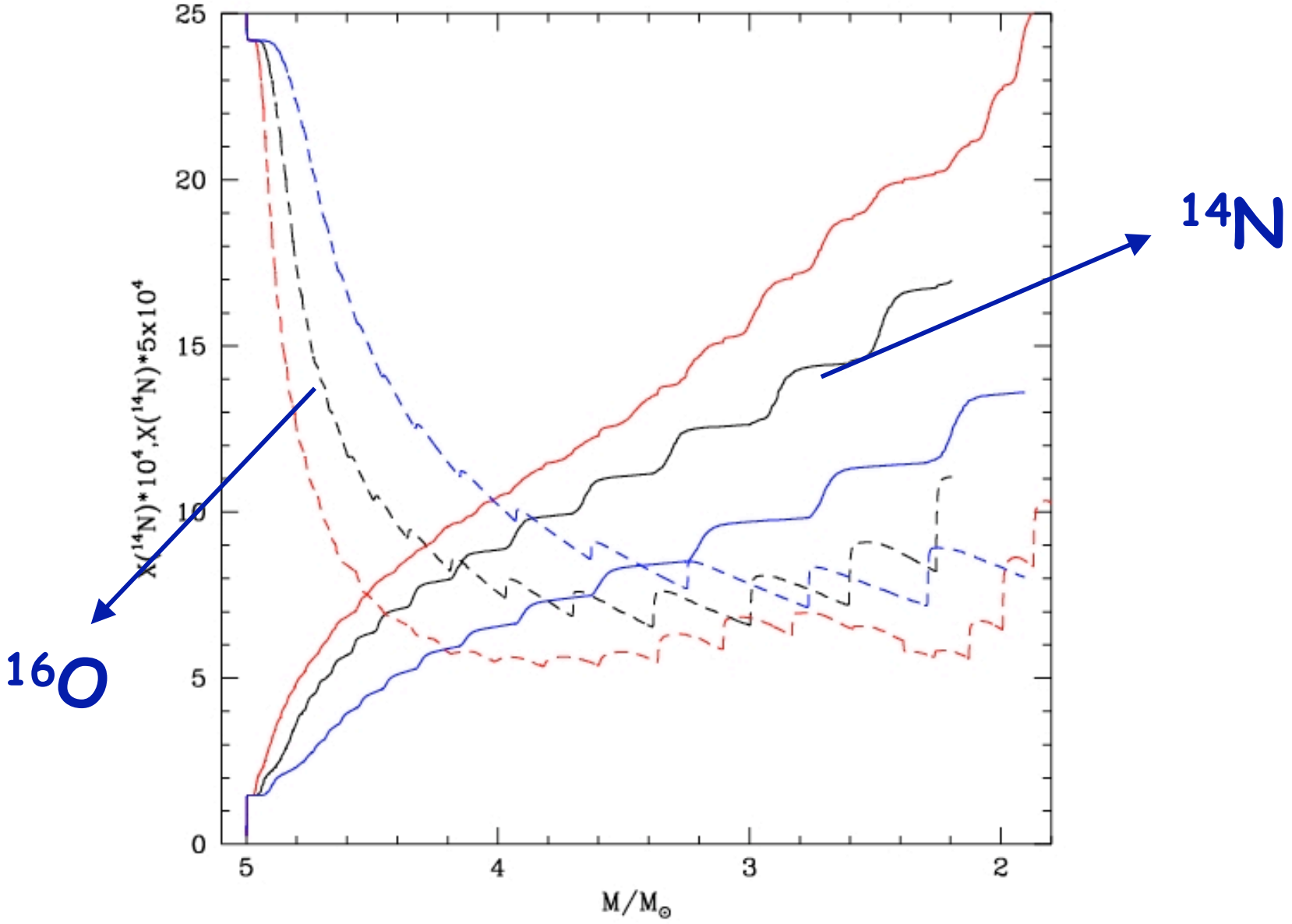


The extent of HBB, shown here by oxygen depletion, is stronger in the FST case

When the treatment of convection is efficient, the number of TPs is reduced, so that less 3rd dredge-up episodes are expected!

In the MLT case an increase of the CNO sum is expected, contrary to FST

The uncertainty associated to mass loss …



AGB YIELDS

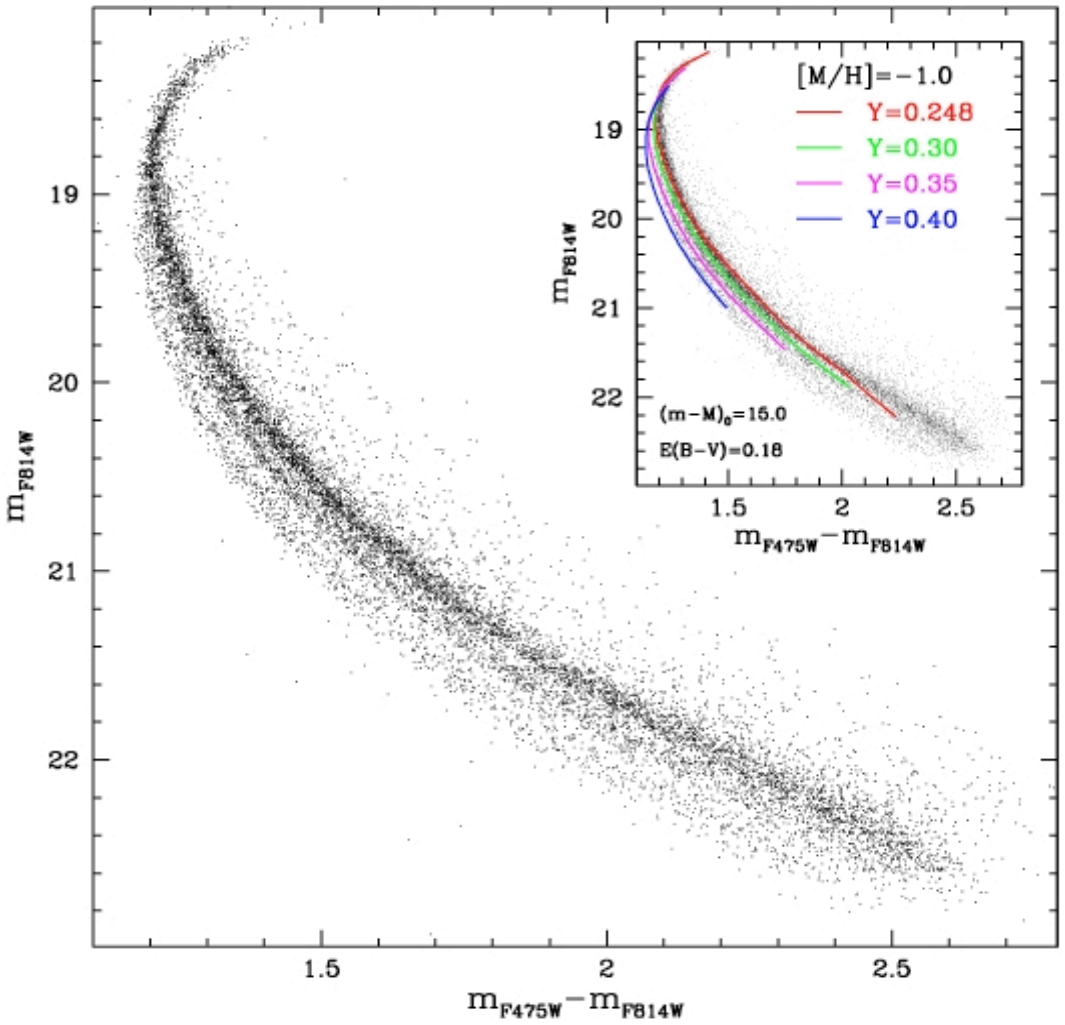
Yields from AGBs are rendered uncertain by the many ingredients, still unknown from first principles, that are used to calculate the models

CNO abundances depend on the treatment of mass loss, convection, and the possible extra-mixing from the bottom of the convective envelope during the Third Dredge-up

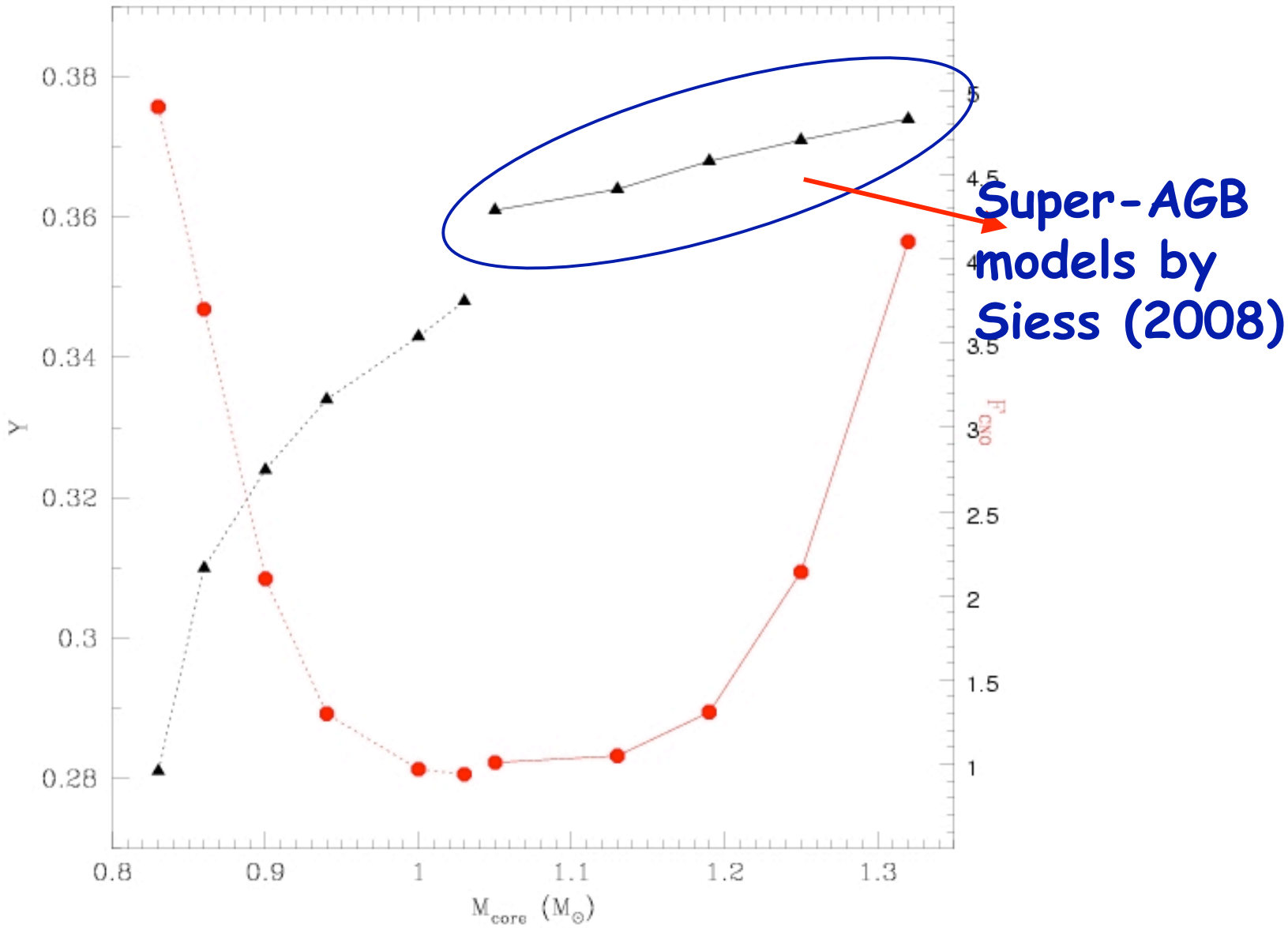
For other elements, e.g. Sodium, the situation is even worse, given the uncertainties in the relevant proton-capture cross-sections.

The Helium yields are the most robust!!

NGC 2808 photometry (Piotto et al. 2007 ApJL 661, L53)



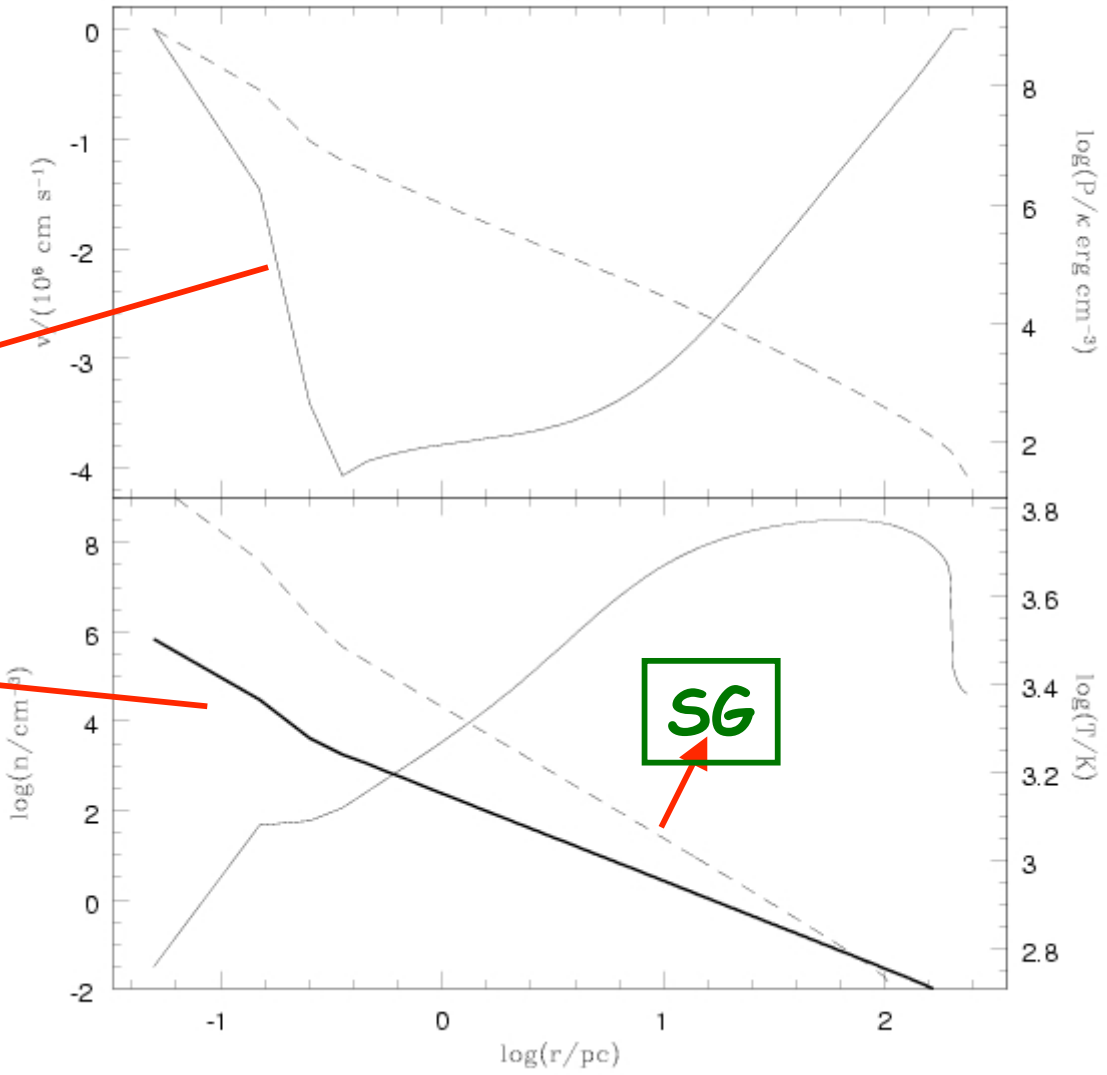
He-rich yields are also obtained by super-AGBs



D'Ercole model (D'Ercole et al. 2008)

GCs we observe today are the relics of structure ~10 times more massive, that at the beginning contained only a single stellar generation (FG)

t=100 Myr

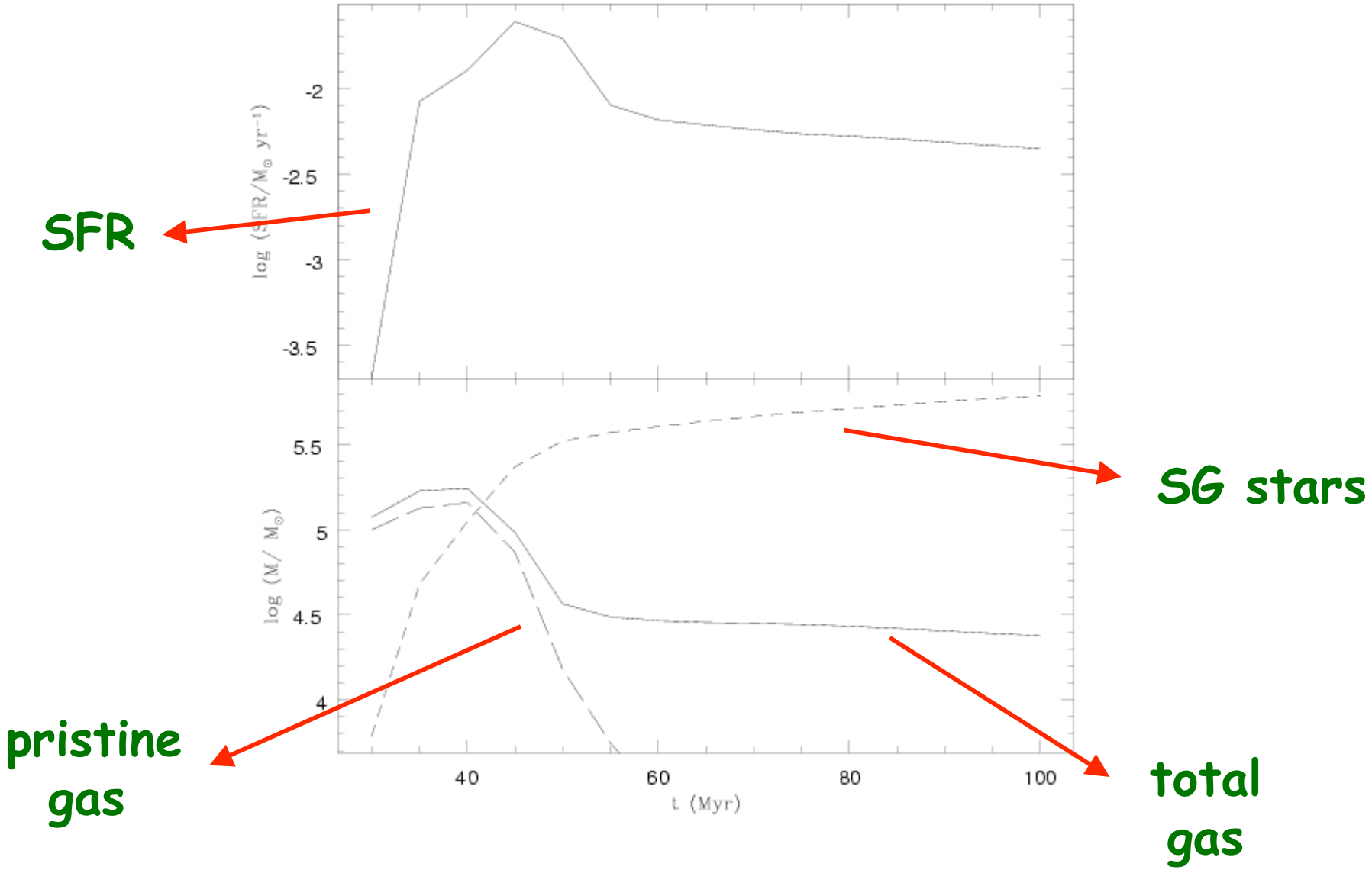


Gas velocity

Gas density

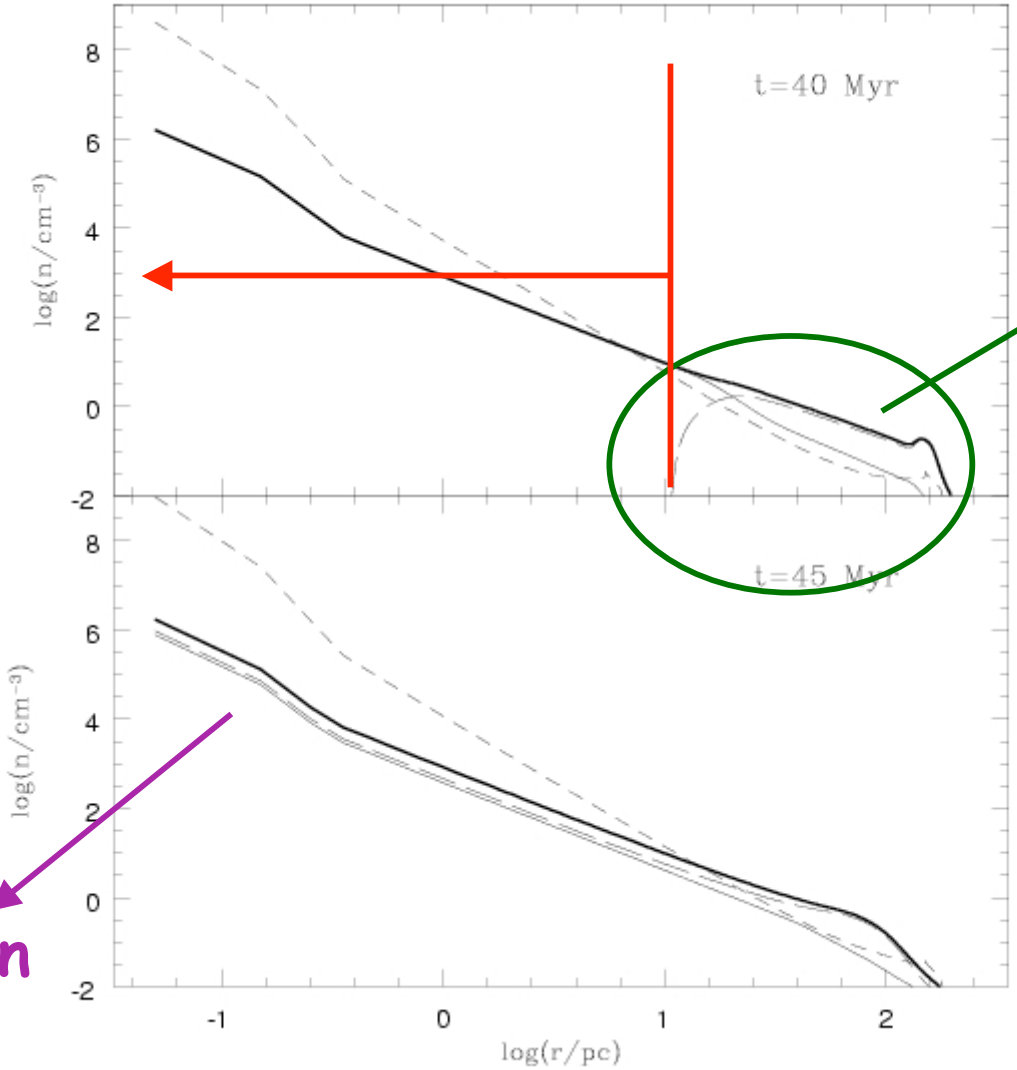
New stars form from the gas ejected from the AGB and S-AGB winds (SG)

Evolution of gas and stars density (D'Ercole et al. 2008)



Internal profiles of gas and stars density

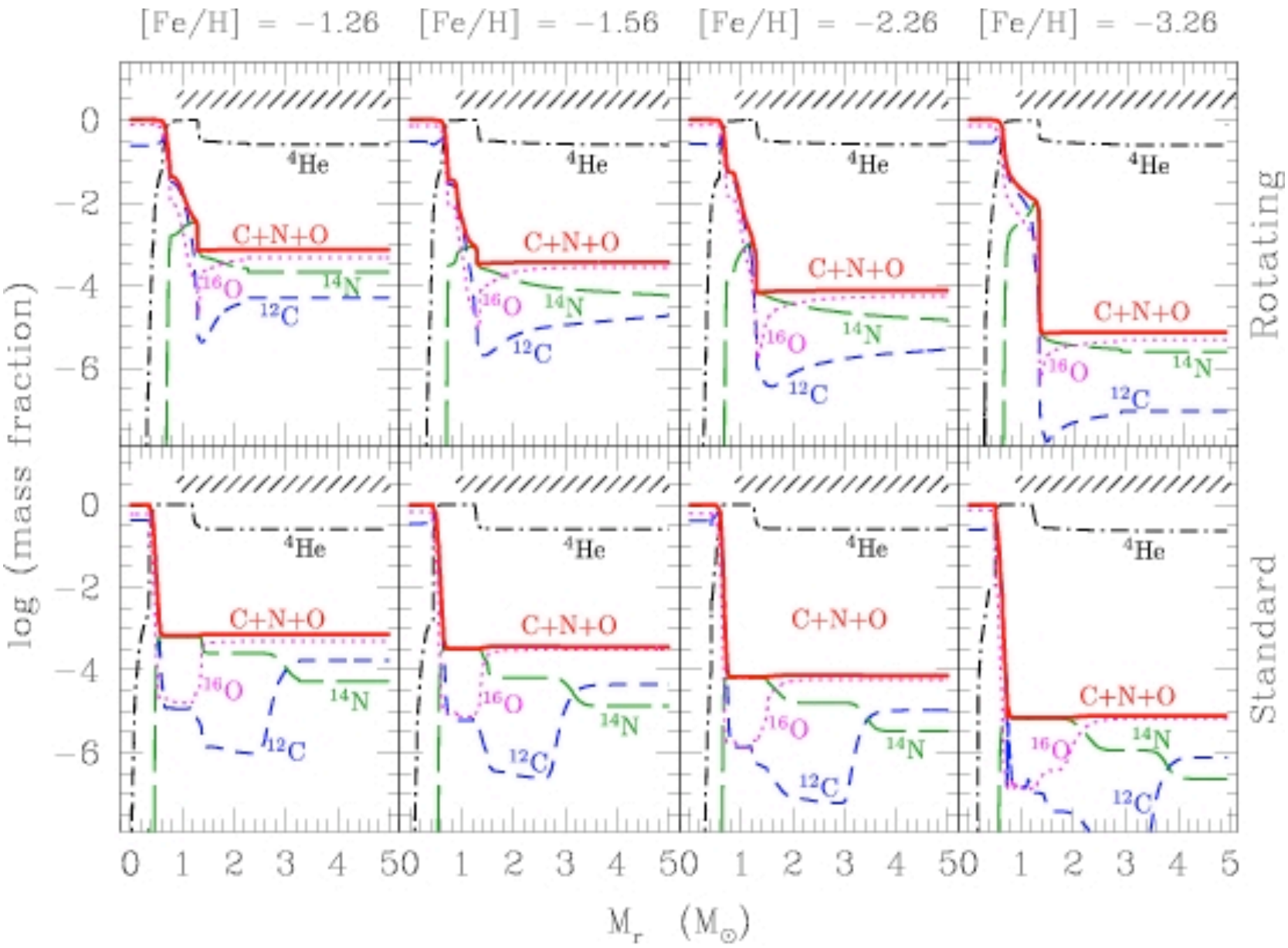
Region with the "pure" chemistry of AGBs



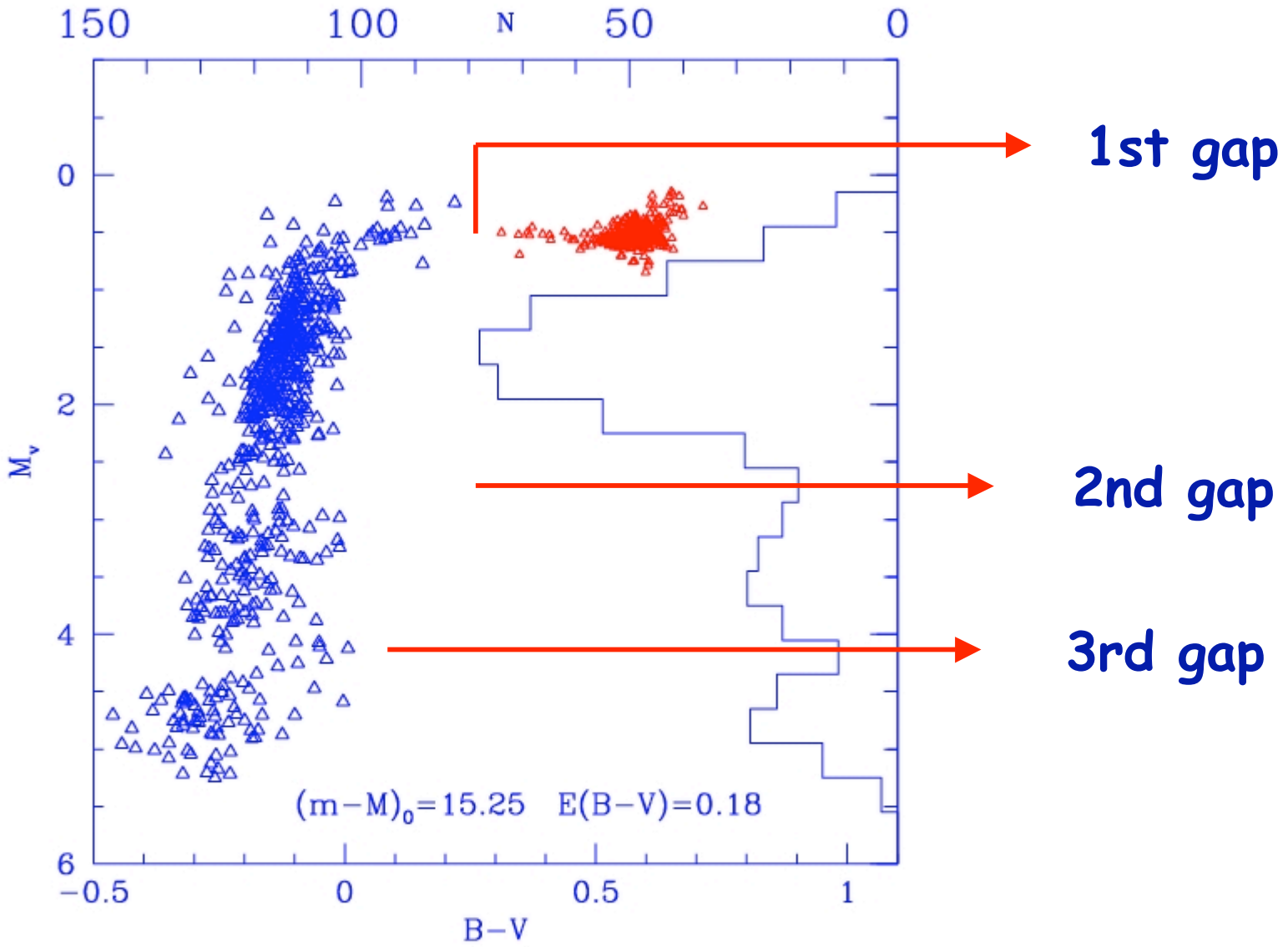
pristine gas

dilution

Rotating AGB models by Decressin et al. (2009)



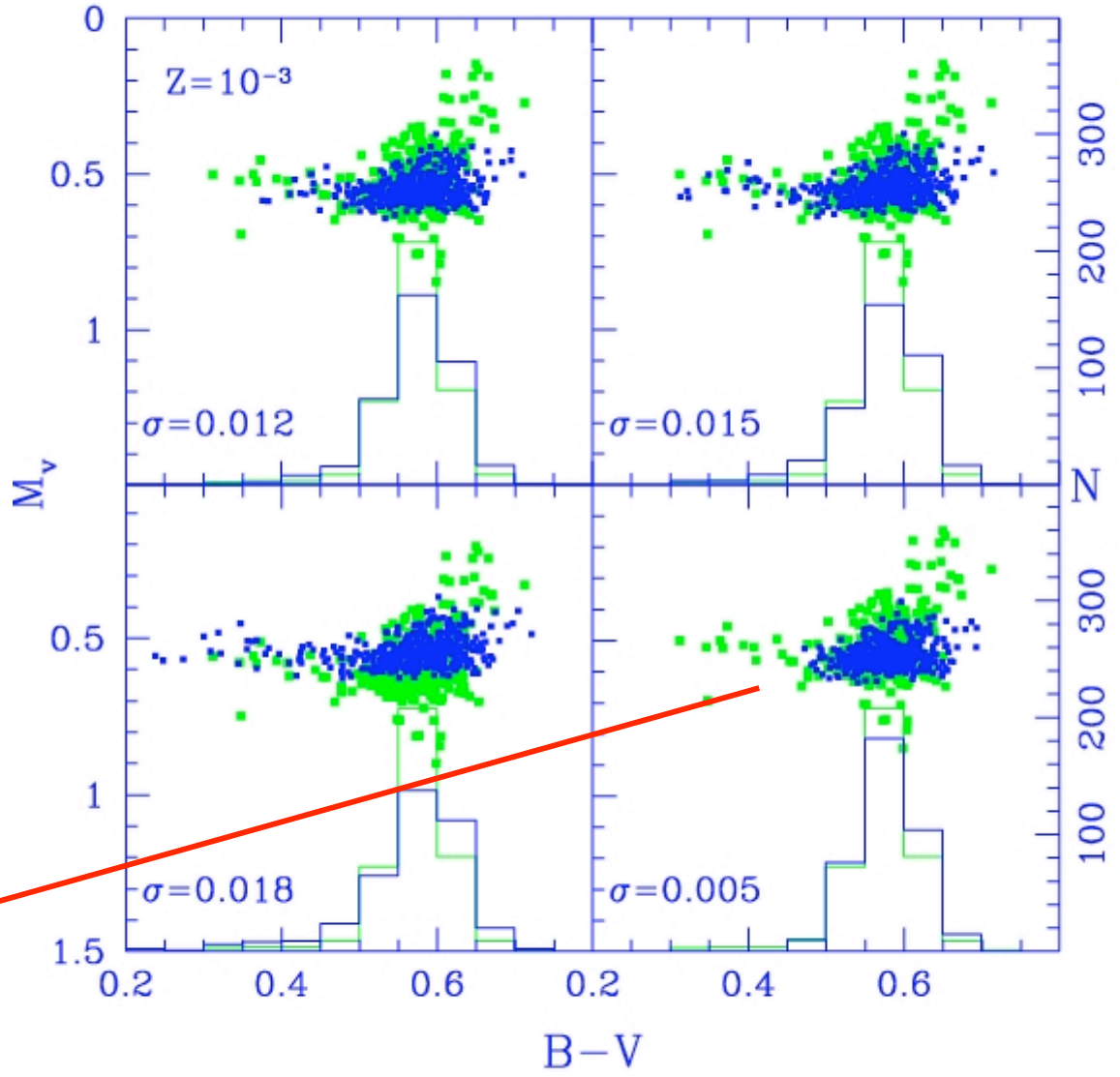
The HB of NGC 2808 (Bedin et al. 2000)



The red HB of NGC 2808 (D'Antona & Caloi 2004)

t ~ 13 Gyr

$\Delta M = 0.13 M_{sun}$



Too small!