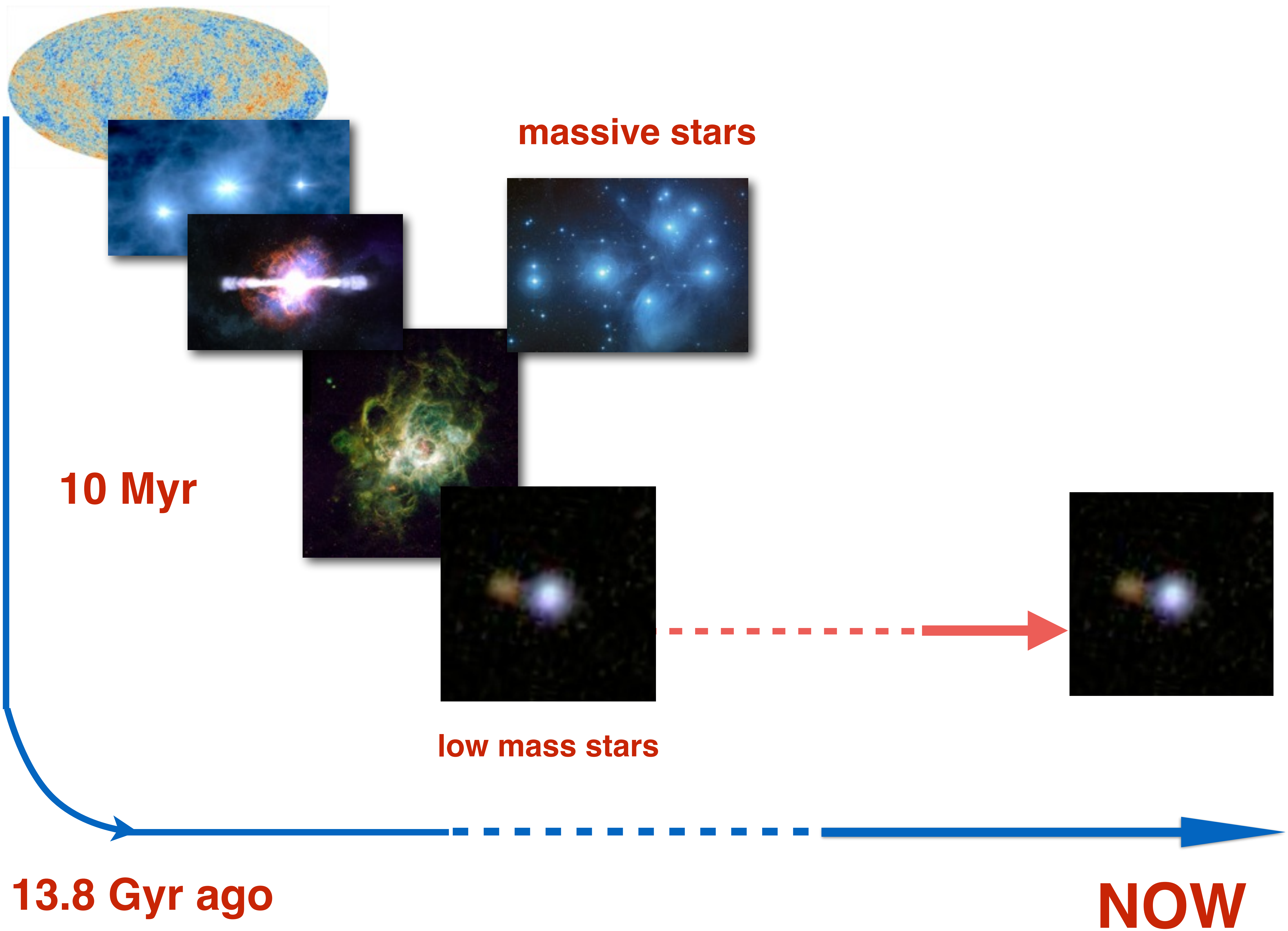
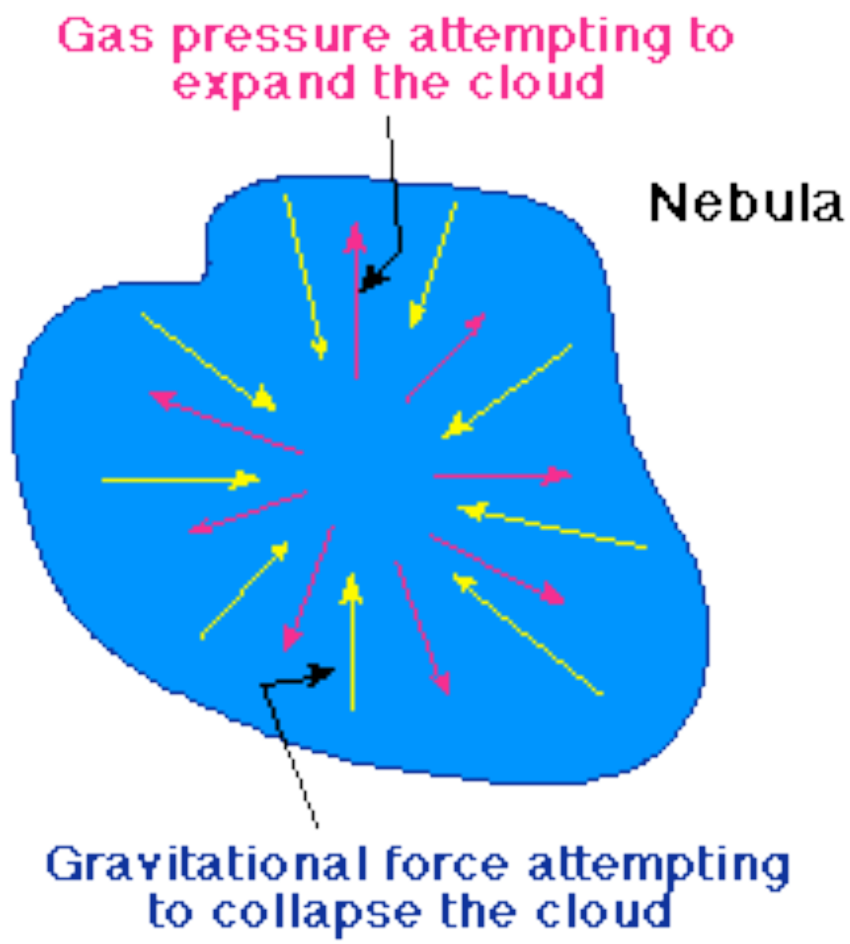
UV Spectra of extremely metal-poor stars

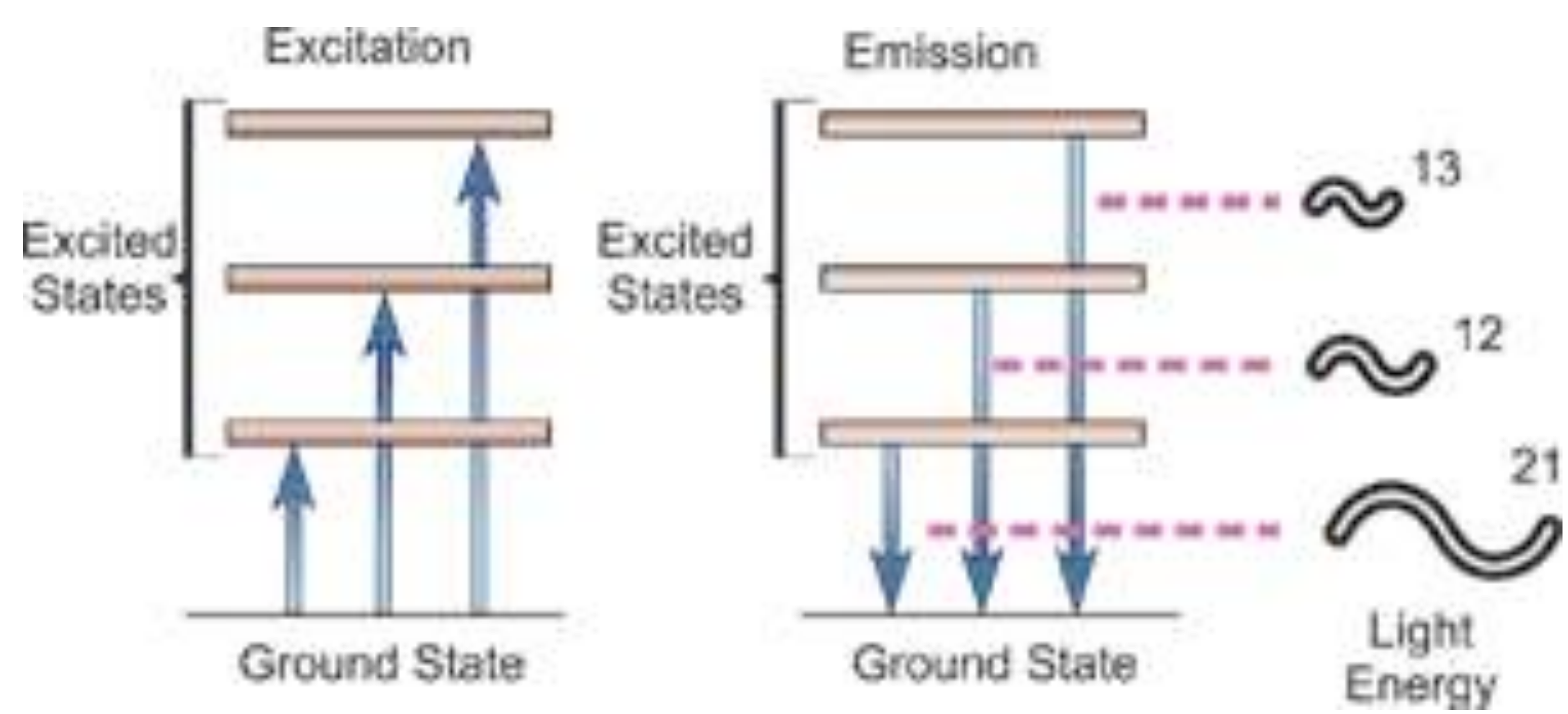
Piercarlo Bonifacio


massive stars
10 Myr
low mass stars
13.8 Gyr ago
NOW



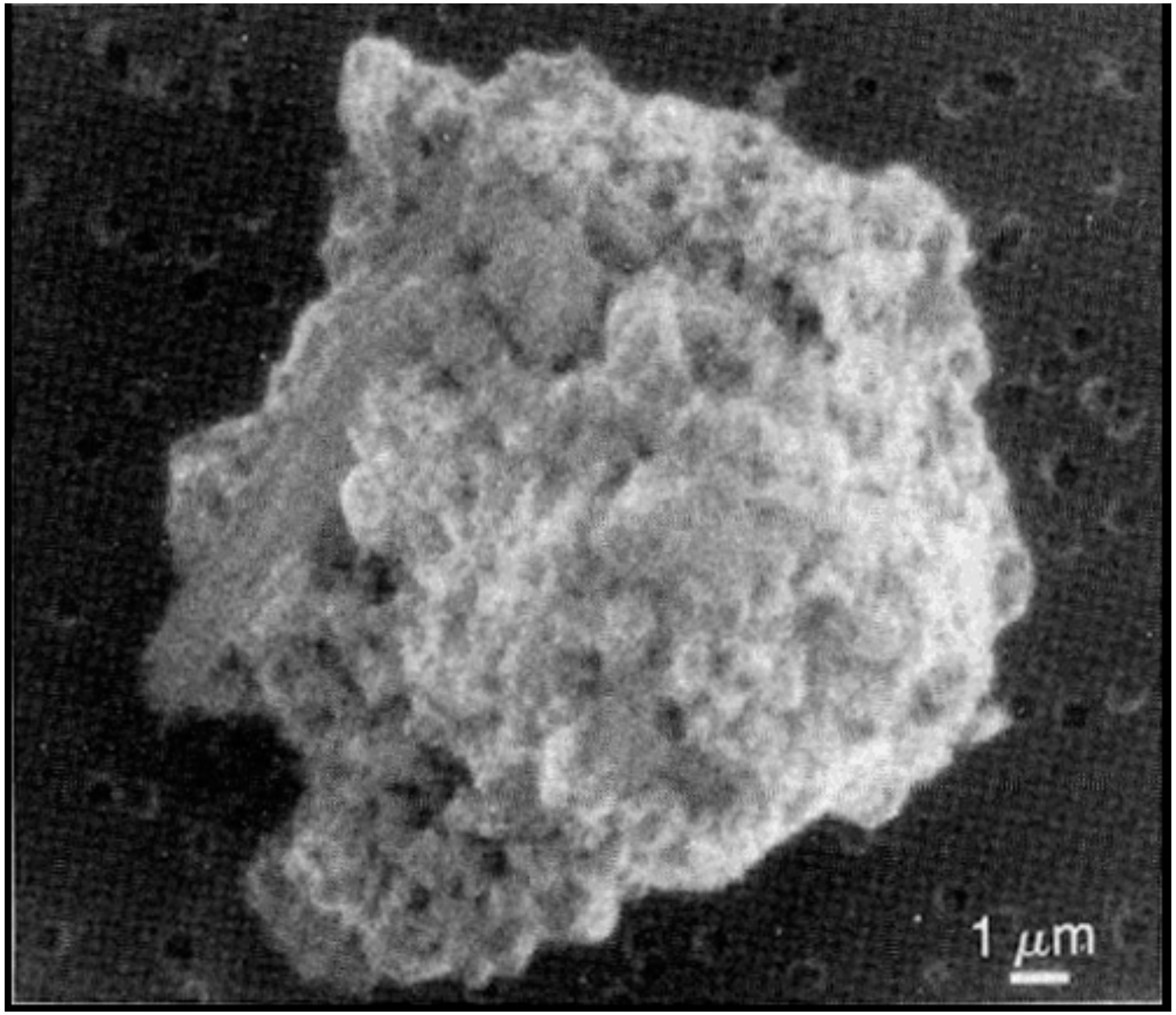
As a gas cloud contracts it heats, PV=nRT, thus also pressure increases, tends to balance the gravitational force. If the mass is small, contraction stops. To keep contracting I need to cool the gas.

Line cooling: collisional excitation, followed by radiative recombination.



Dust cooling

Dust grain collected from the Earth's orbital environment. Likely origin in the ISM.



Collisions with gas particles heat the grains. The energy is then radiated in the IR and these low-energy photons are not absorbed, thus the energy is effectively removed from the thermal pool.

Formation of low mass stars

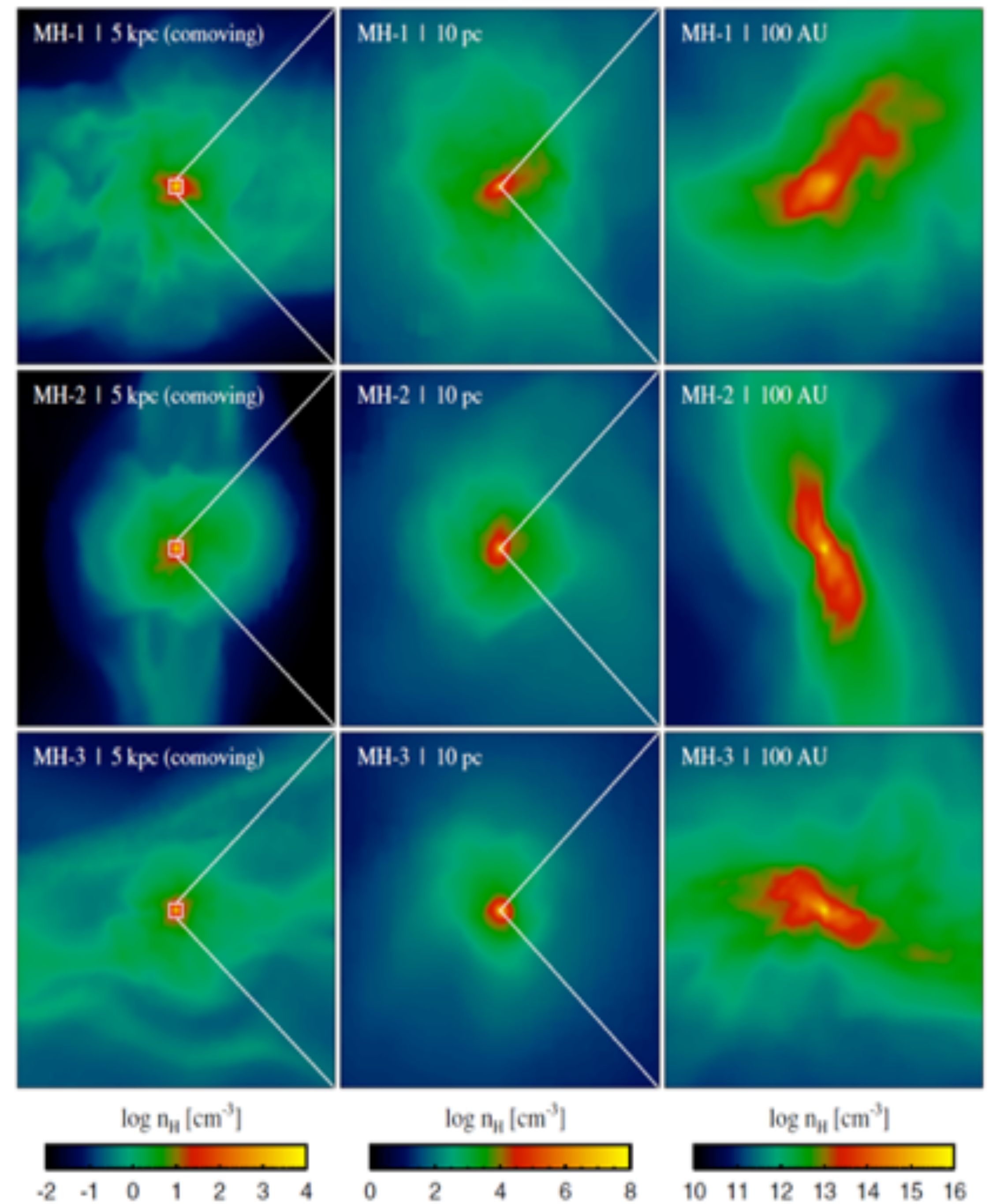
- Zero metallicity ⇒

  FRAGMENTATION (Clarke et al. 2011, **never observed**)

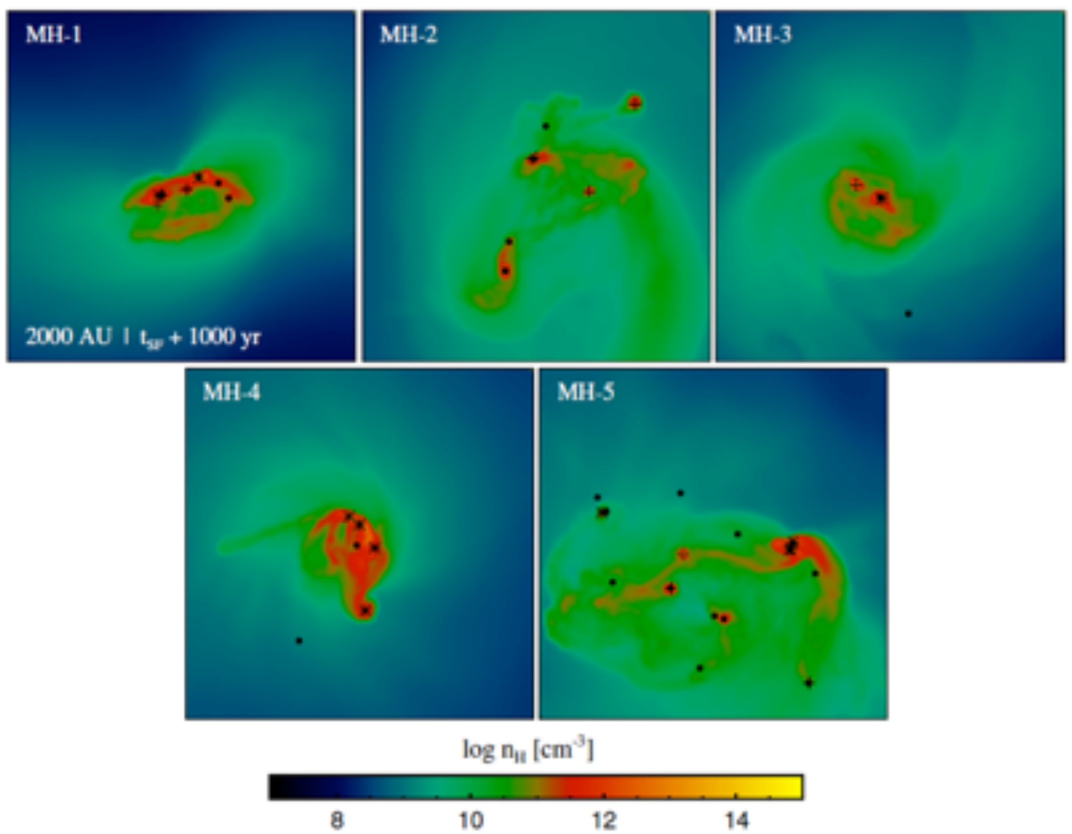
- Metallicity > Zcr⇒

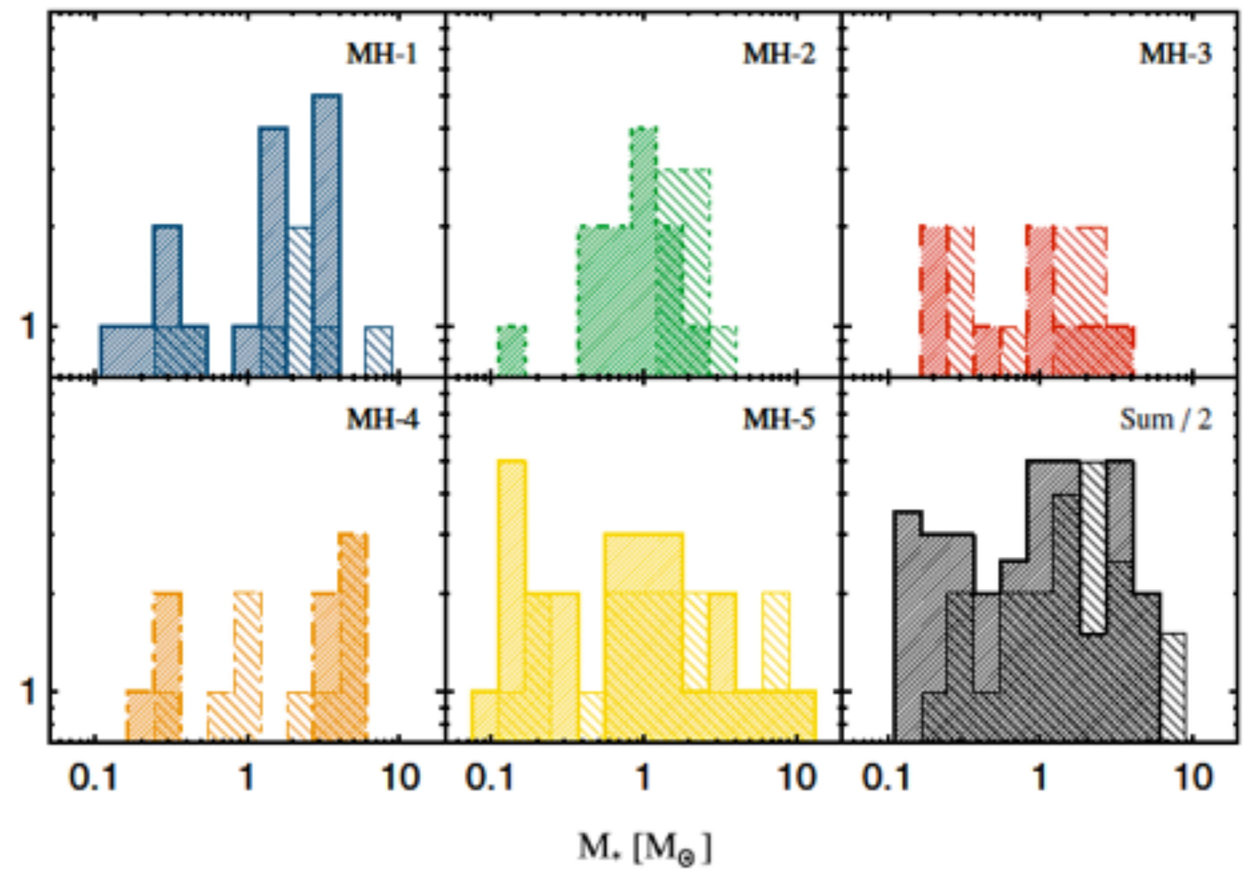
  ★ CII & OI fine structure cooling (Bromm & Loeb 2003)

  ★ dust cooling + fragmentation (Schneider et al. 2011)



From Greif et al (2011)





Dots stars with
M< 1 Msun

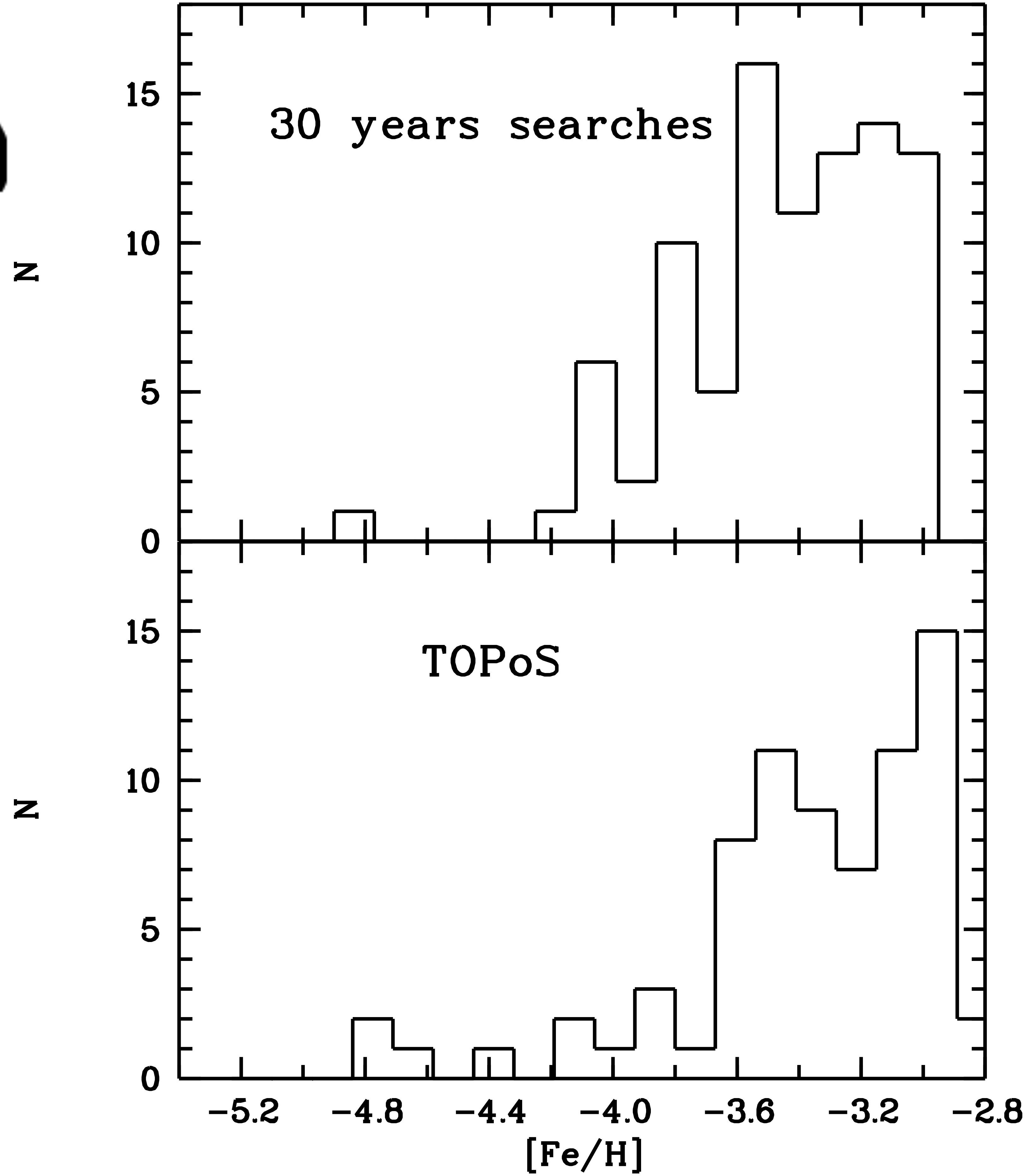
- flat distribution of masses between ~ 0.1 to 10

TOPOS project (PI E. Caffau)

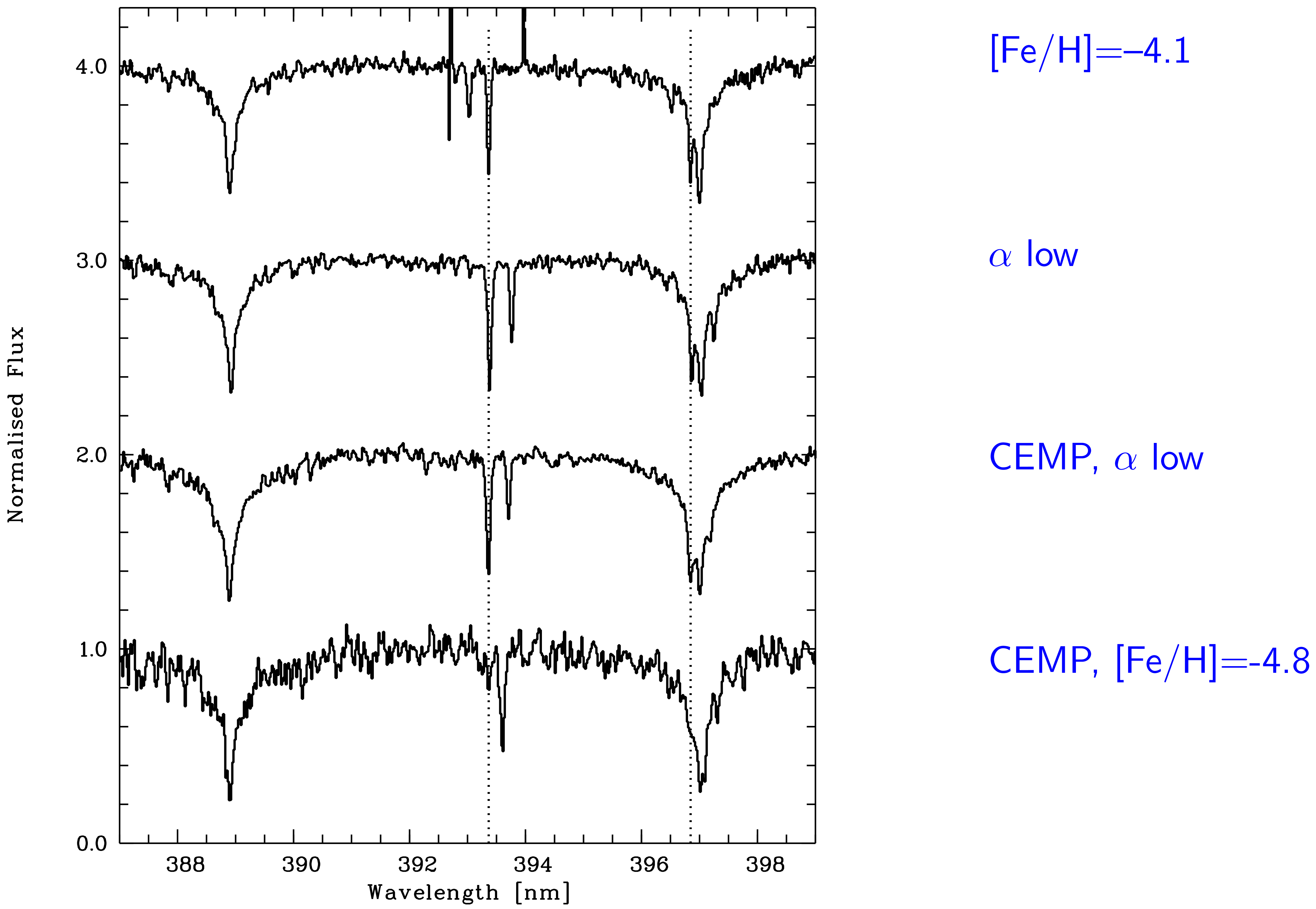
TOPoS

l'Observatoire de Paris

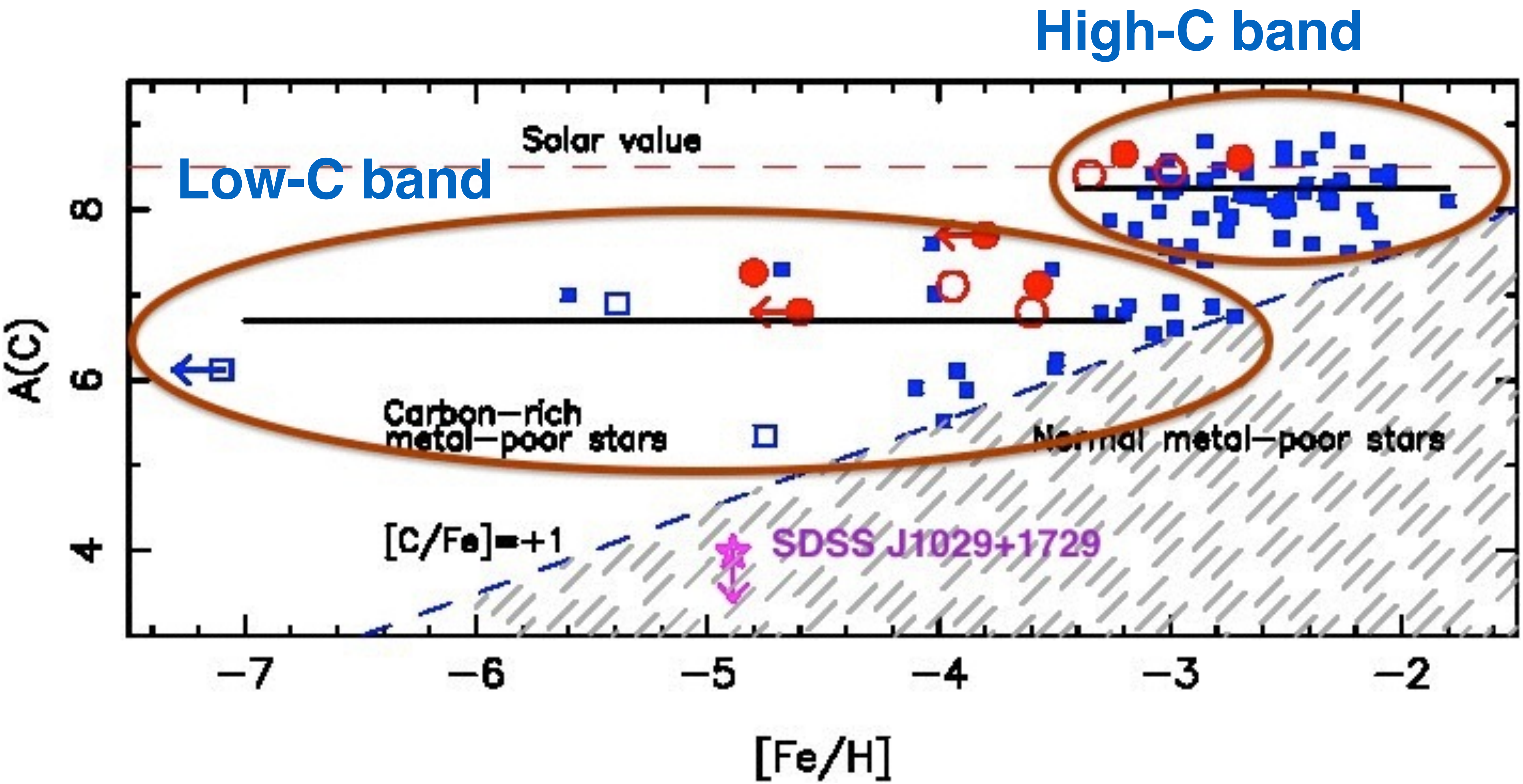
MERAC



Some typical X-Shooter spectra

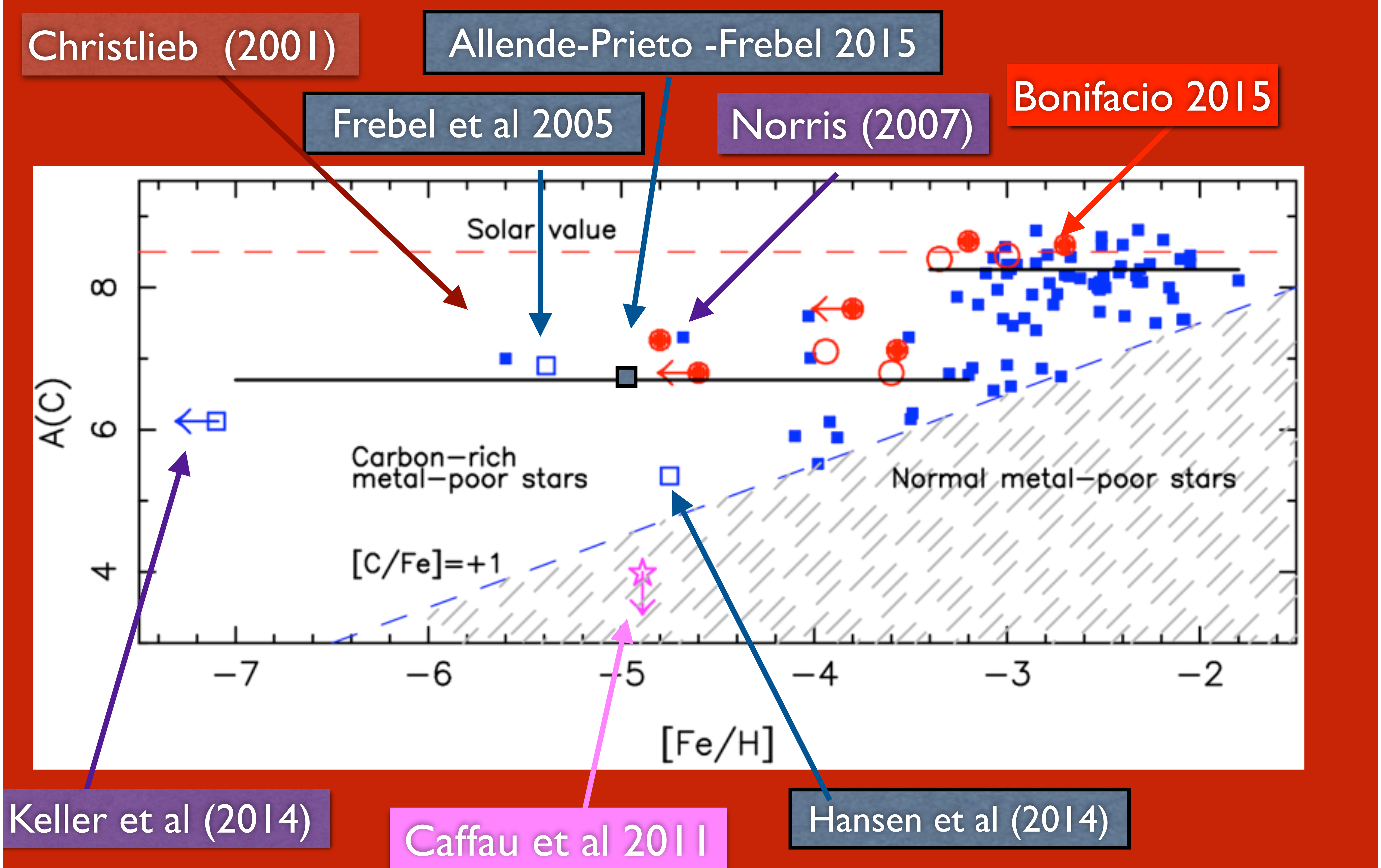


The carbon abundances in CEMP stars are bimodal



Bonifacio et al. 2015 A&A 579, A28

9 stars with [Fe/H]<-4.5



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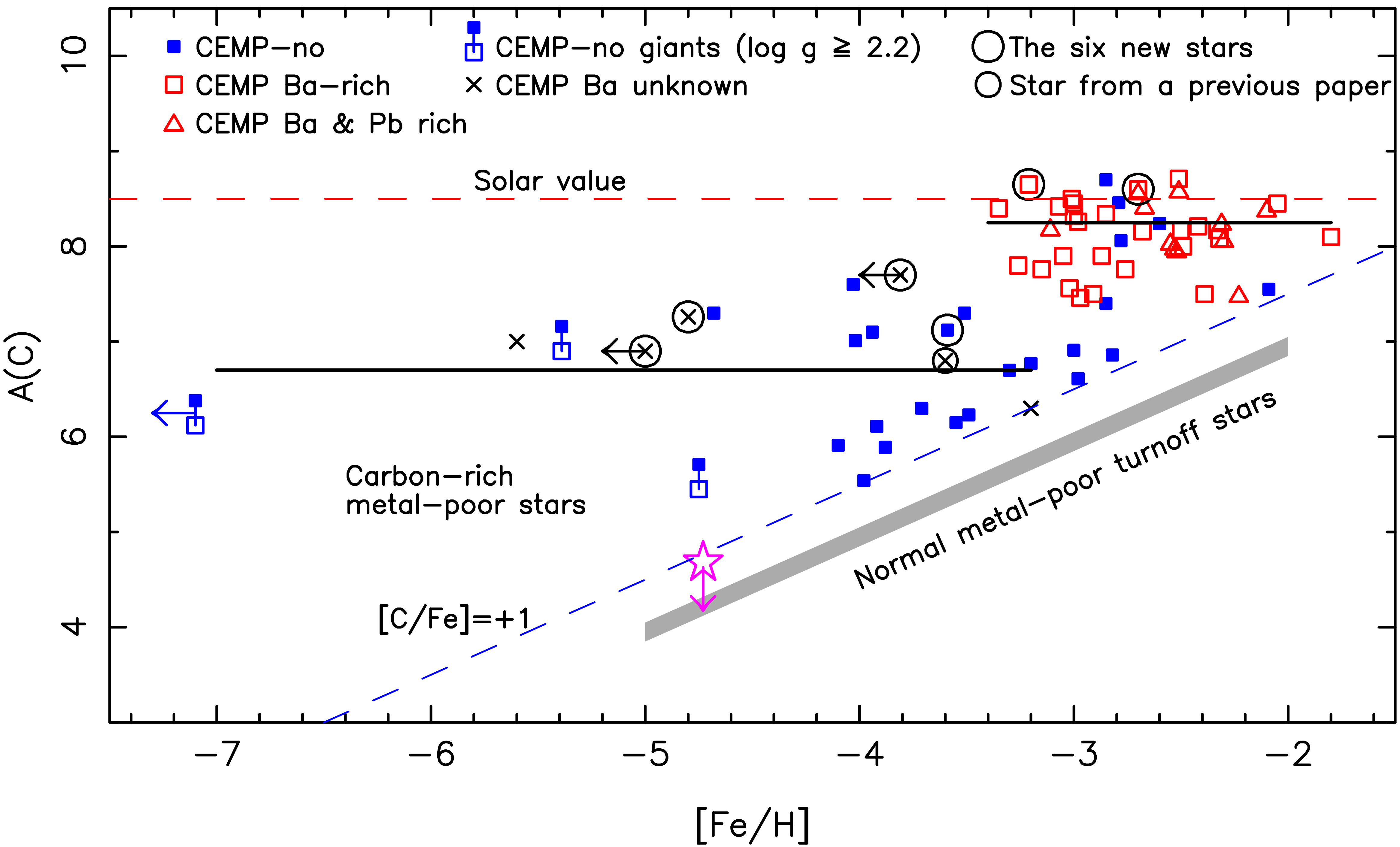
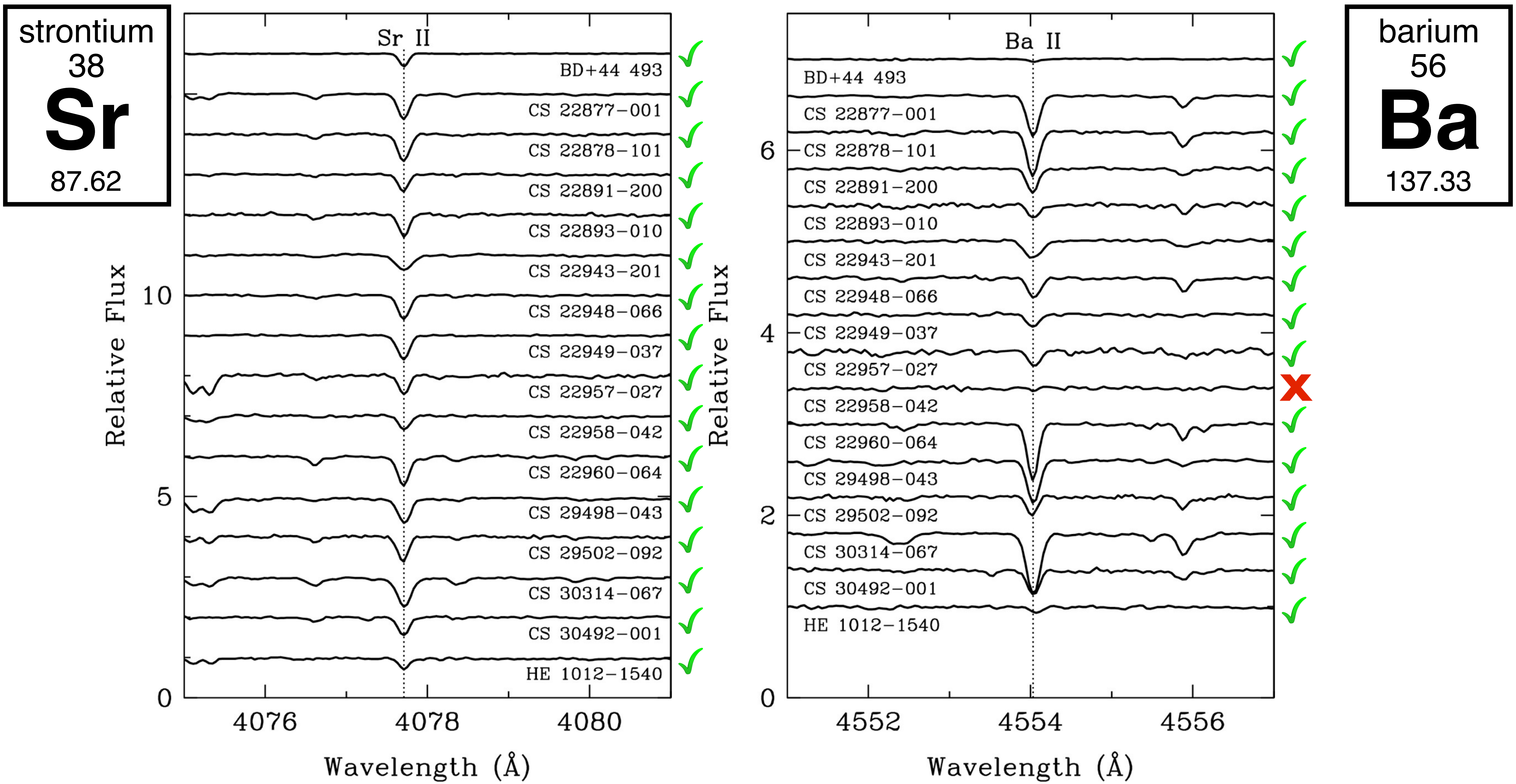
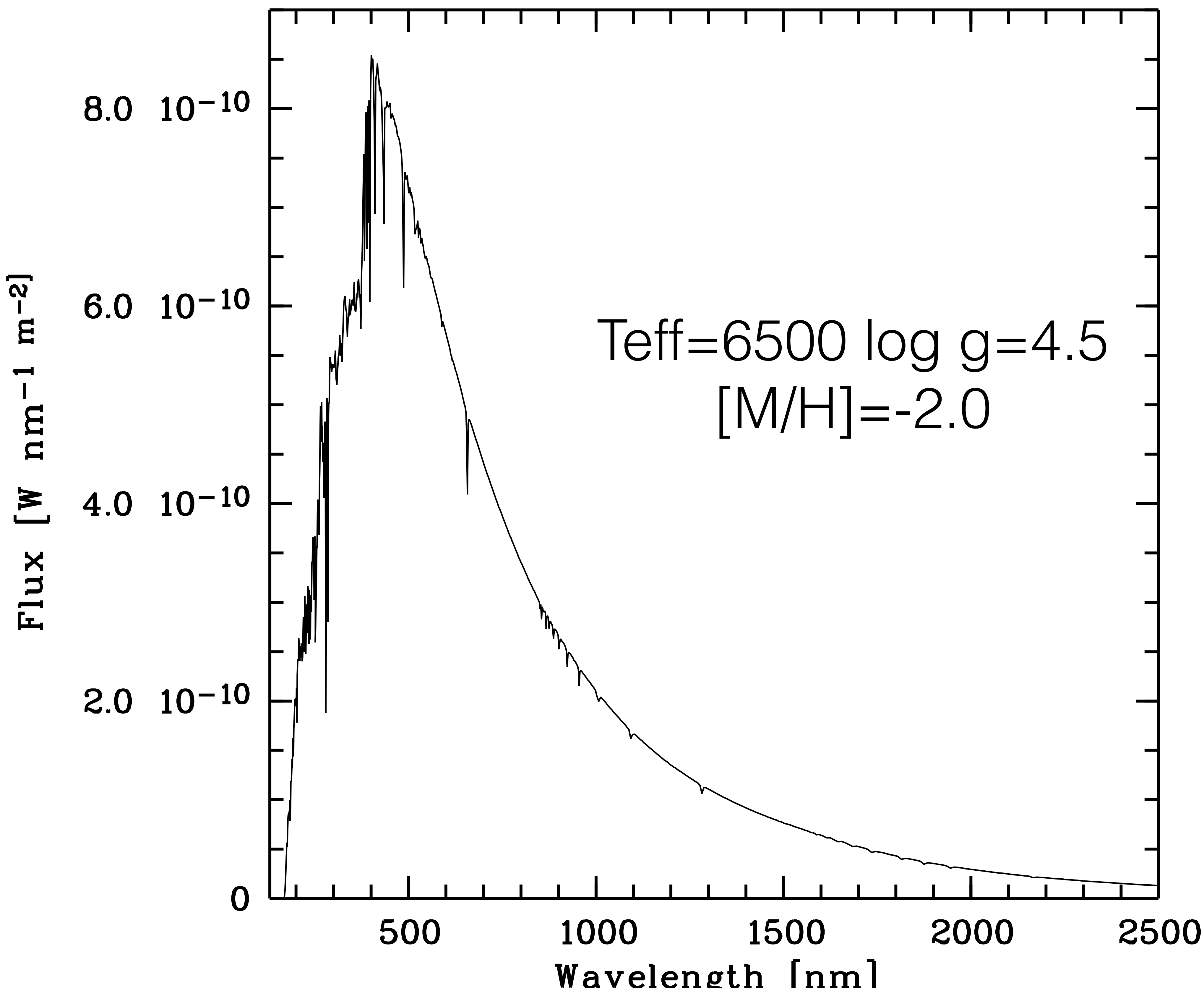


Bonifacio et al. 2015 A&A 579, A28

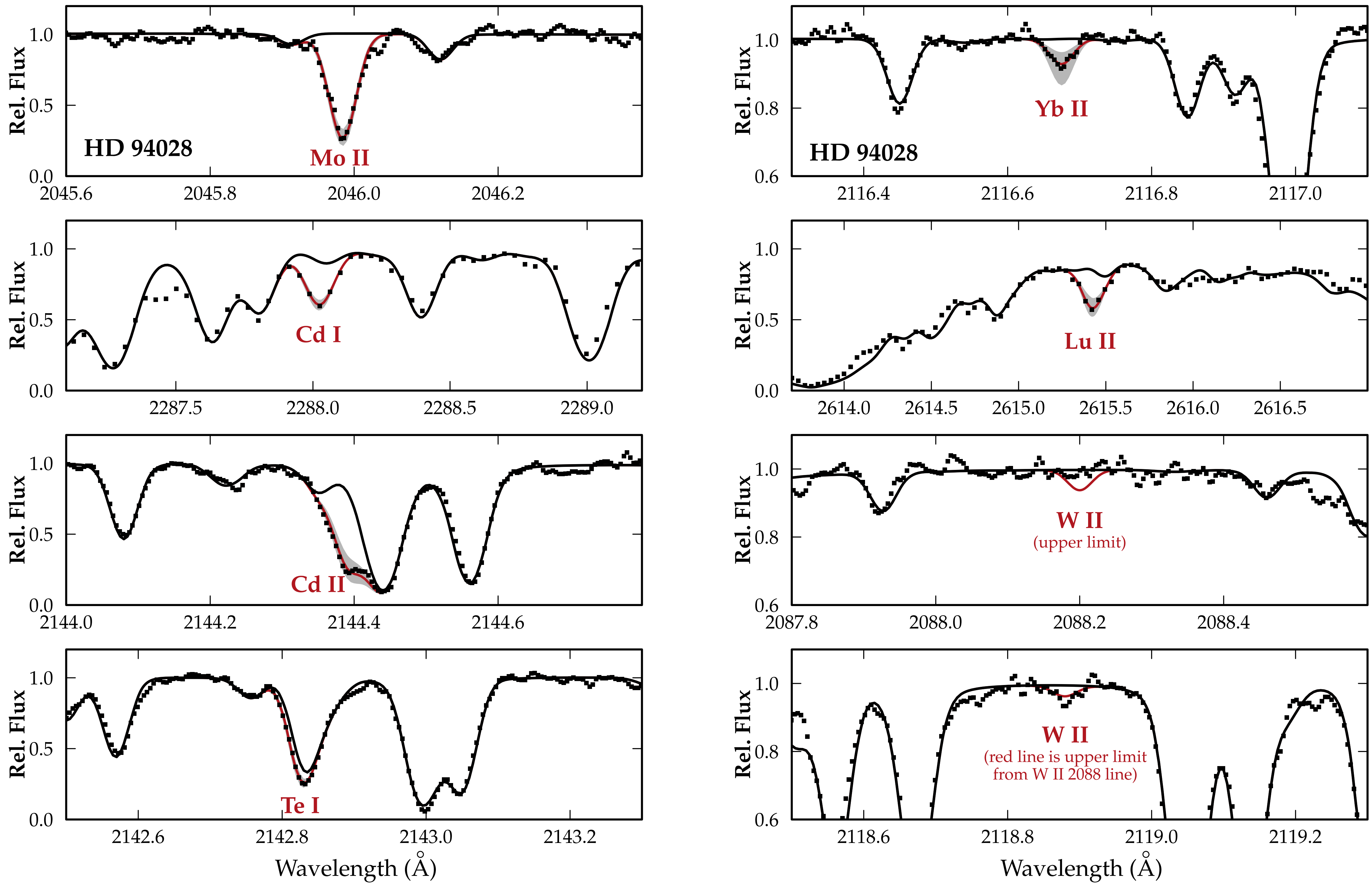


Roederer et al., Astrophys, J., 784, 158 (2014)

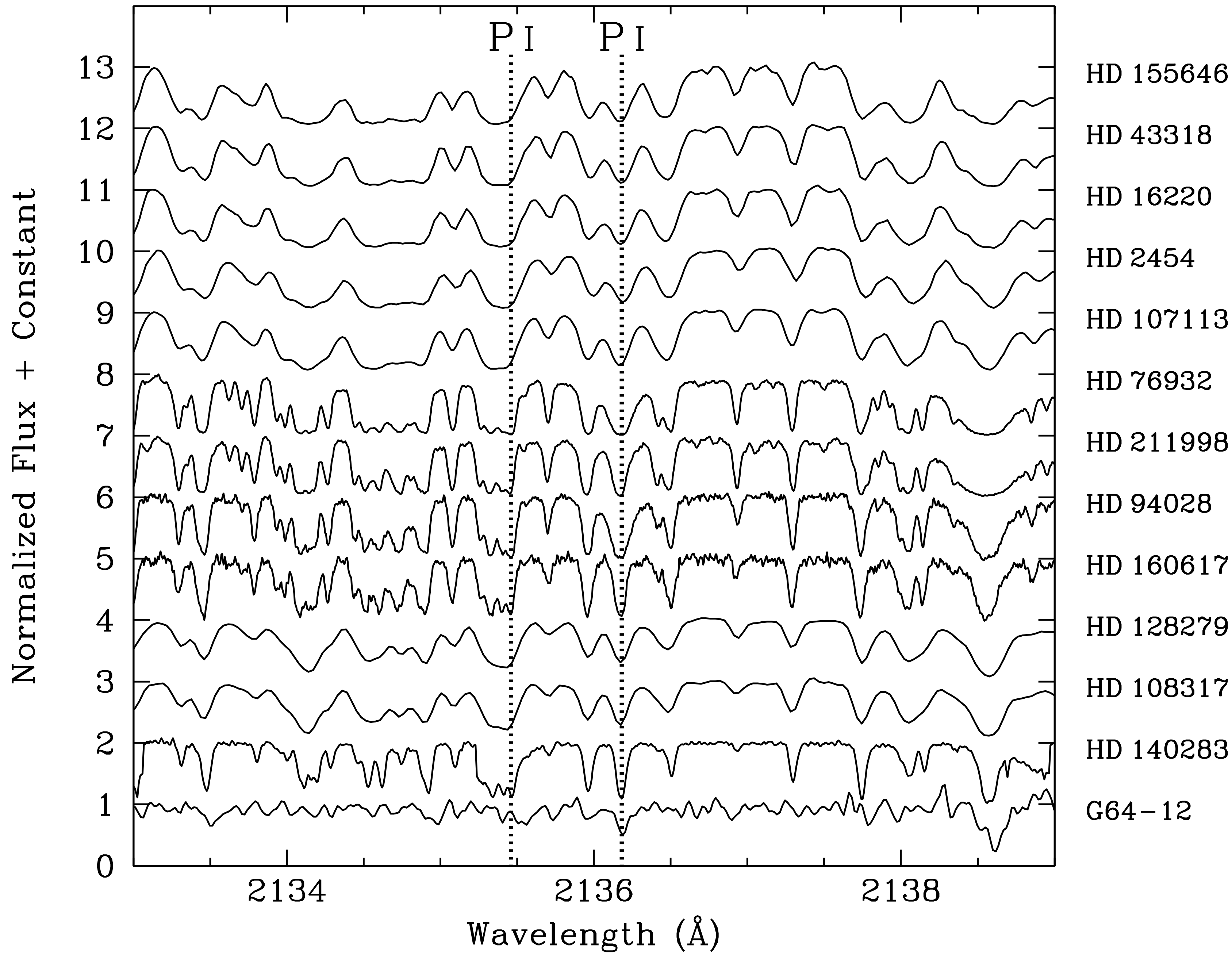
The problem is that these stars have very little flux in the UV !



The UV region allows a much richer and more complete inventory of n-capture elements

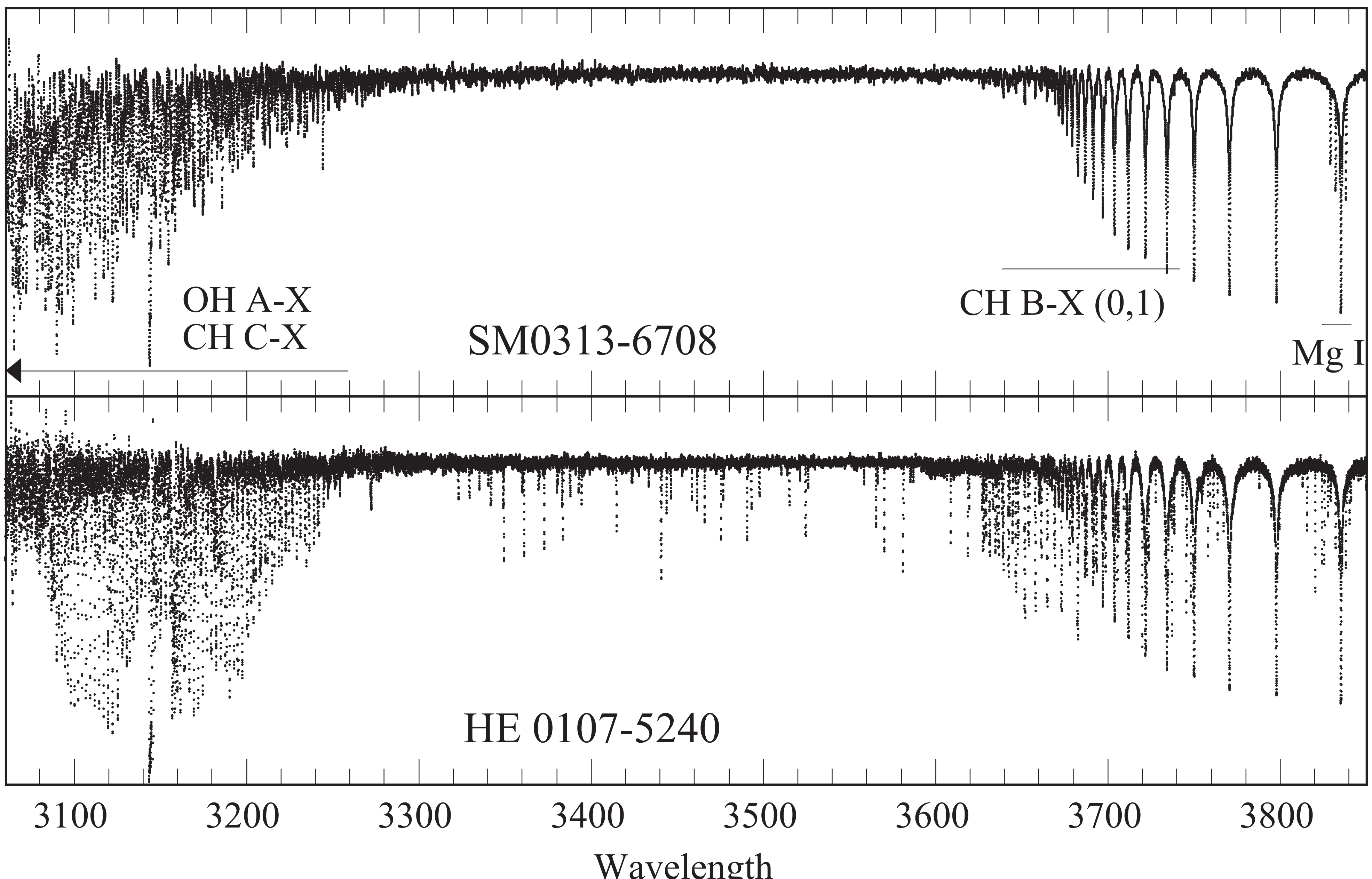


Roederer et al. (2016)



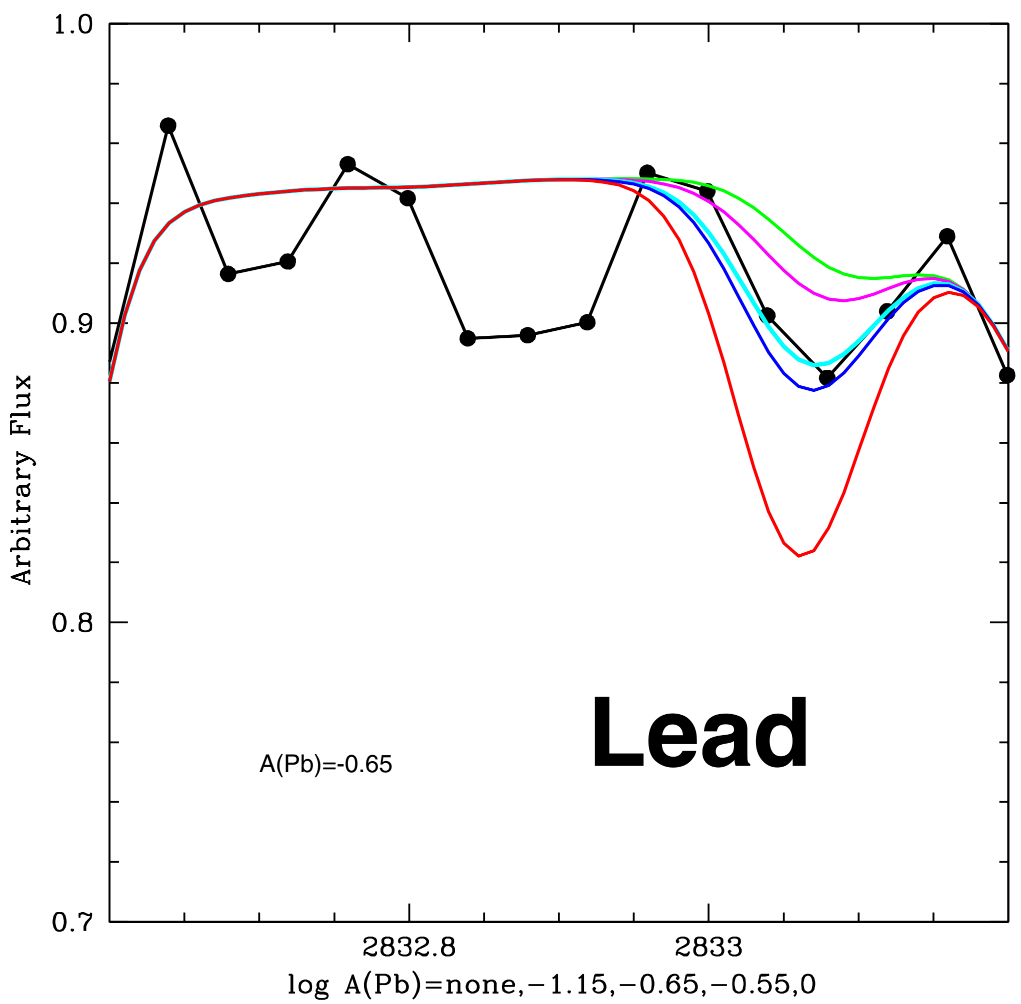
But not only. P cannot be measured in MP stars without going to the UV
Roederer et al. (2014)

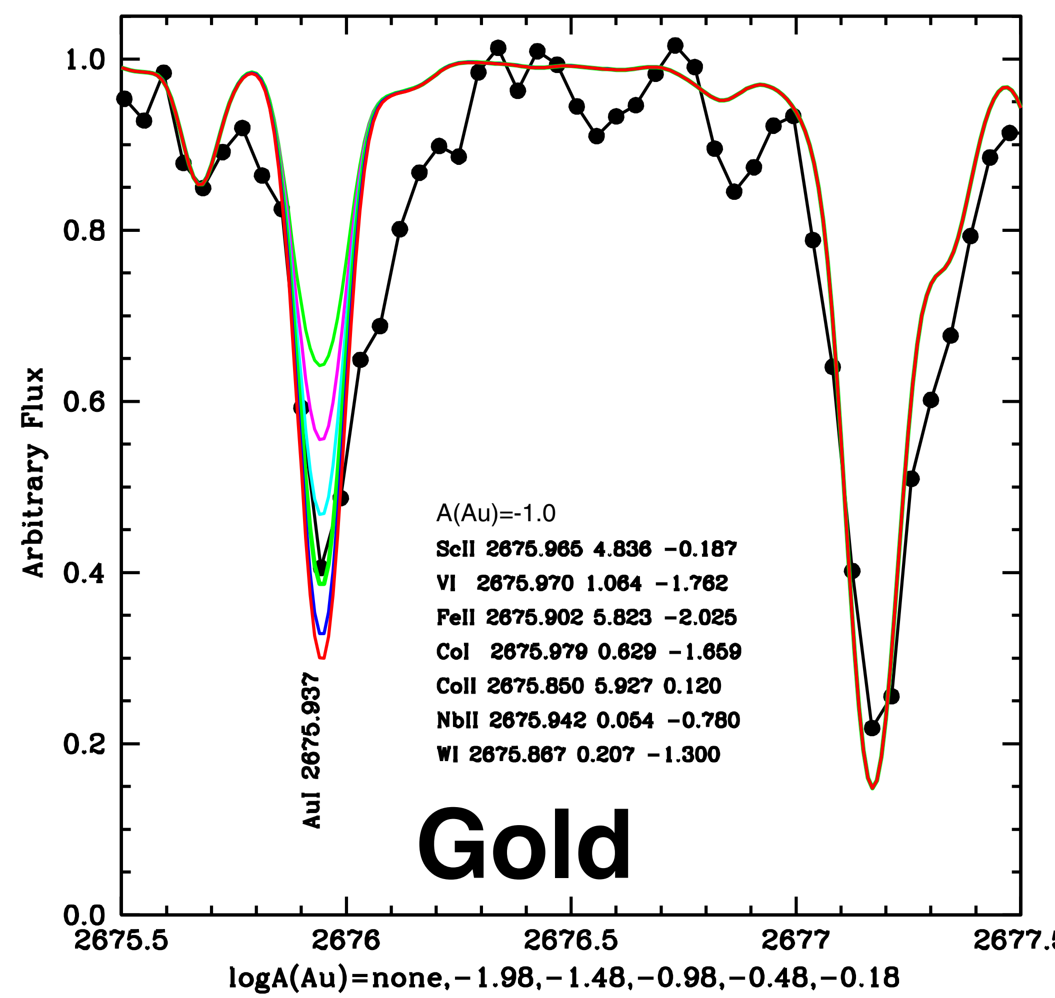
SMSS-J031300-670839 the most iron poor star known [Fe/H]<-7.2 still has no Fe line detected, in spite of 32000s integration with COS with HST : **V=14.7**



Bessel et al. (2015)

Barbuy et al. (2011)





CS 31082-001

45 HST orbits S/N~40 V=11.7 [Fe/H]=-2.9

This is one of the **brightest** stars of interest

Any TLRs ?

- Wavelength range: 120-300 nm
- Resolution: minimum 20000 desired 60000
- Sensitivity: be able to observe TO stars with g=18 and giant stars with g=15 (in how much time?) to obtain spectra with S/N~40