The Hottest Horizontal Branch Stars in ω Cen – Helium Enhancement or Hot Flashers?

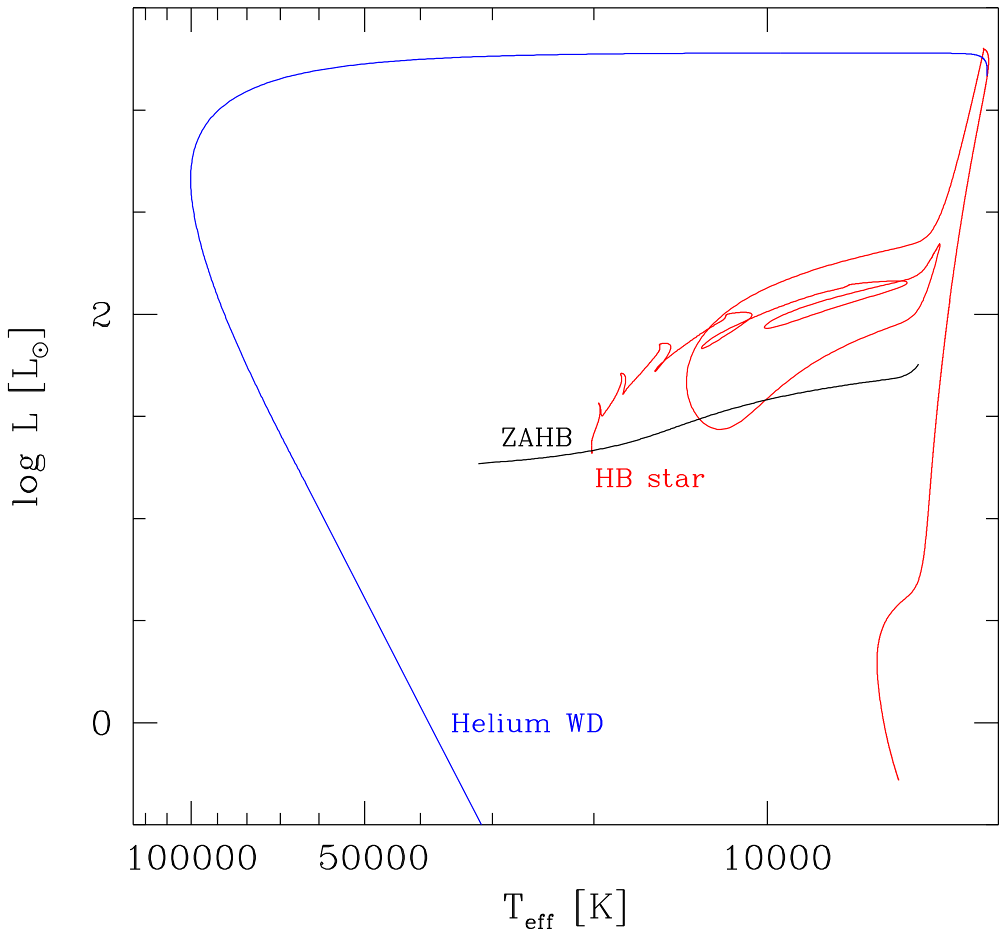
Sabine Moehler, Stefan Dreizler, Thierry Lanz, Giuseppe Bono, Allen V. Sweigart, Annalisa Calamida, Matteo Monelli, Mario Nonino

Hottest Horizontal Branch Stars

- ⋆ helium-burning core of $0.5\,M_\odot$, surrounded by hydrogen-rich envelope of less than $0.02\,M_\odot$
- ⋆ temperature increases with decreasing envelope mass
- ⋆ hottest HB stars in ω Cen are too hot for canonical evolution
- ⋆ lie up to $0\overset{m}{.}7$ below zero-age HB (ZAHB) in UV-visual colour-magnitude diagram
  $\Rightarrow$"blue hook" (D'Cruz et al. 2000)

Blue Hook Stars

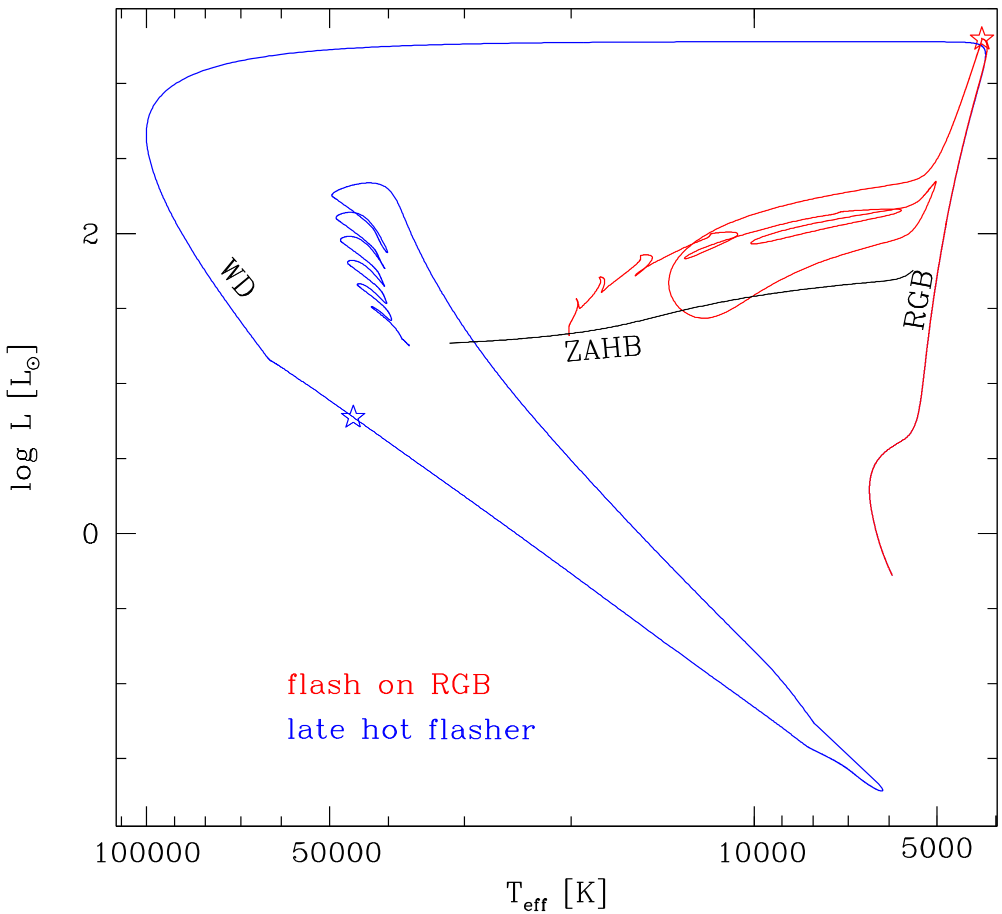
- ⋆ hotter than hottest canonical HB stars
- ⋆ higher mass loss on RGB required
- ⋆ higher mass loss than hottest HB star
  - ⇒ no helium flash on RGB
  - ⇒ star becomes helium white dwarf



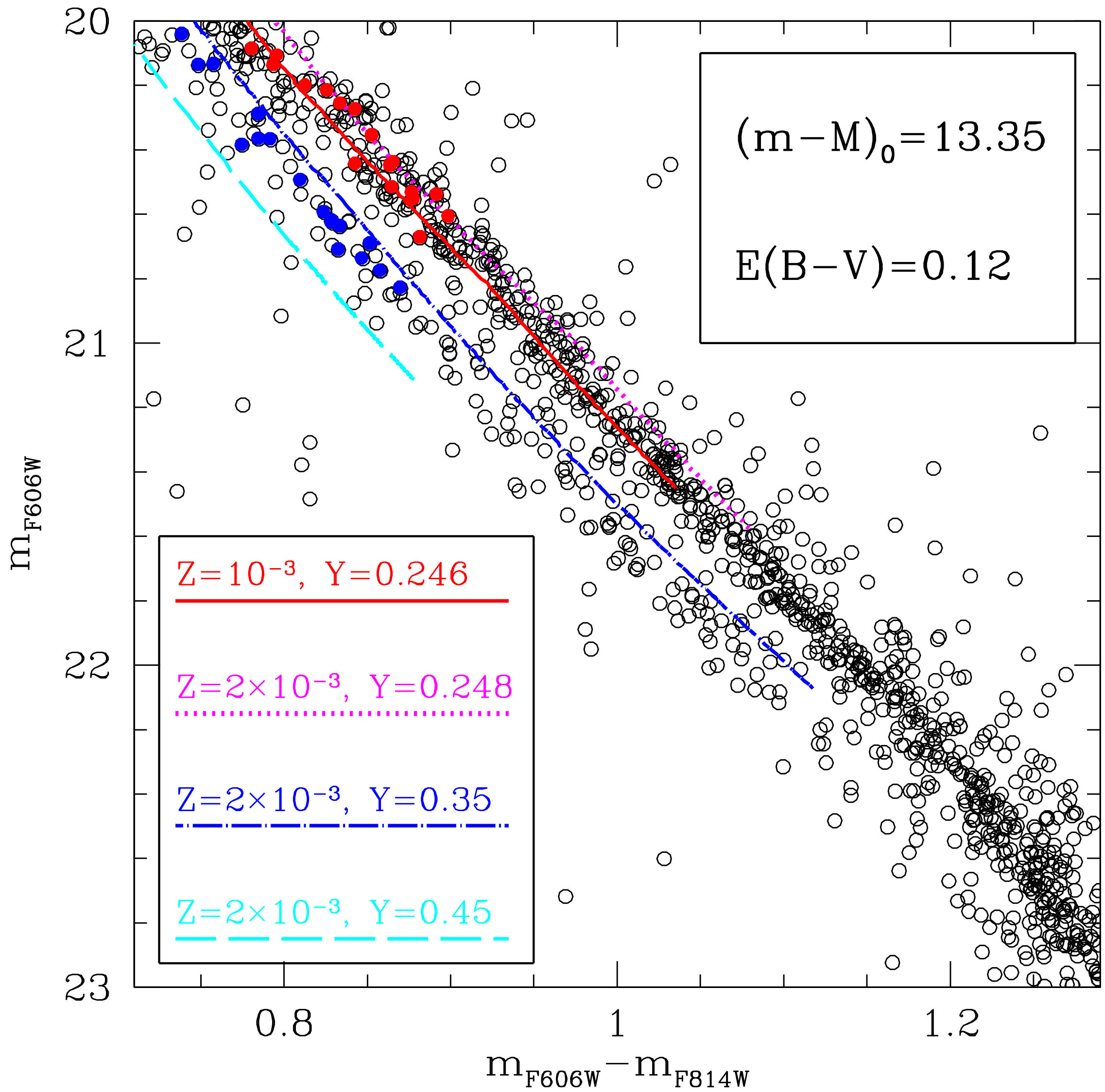
Late Hot Flasher

Brown et al. (2001): flash on white dwarf cooling curve
⇒ late hot flasher

- ⋆ flash convection zone penetrates hydrogen envelope
  - ⇒ surface composition: He/C-rich
  - ⇒ reduces UV flux
- ⋆ T_{eff} ≈35,000 K



Double Main Sequence



Double Main Sequence

Problem:

- ⋆ split main sequence with wrong number ratios between blue and red main sequence (bedin et al. 2004)
- ⋆ blue main sequence objects are more metal-rich than red main sequence objects (Piotto et al. 2005)

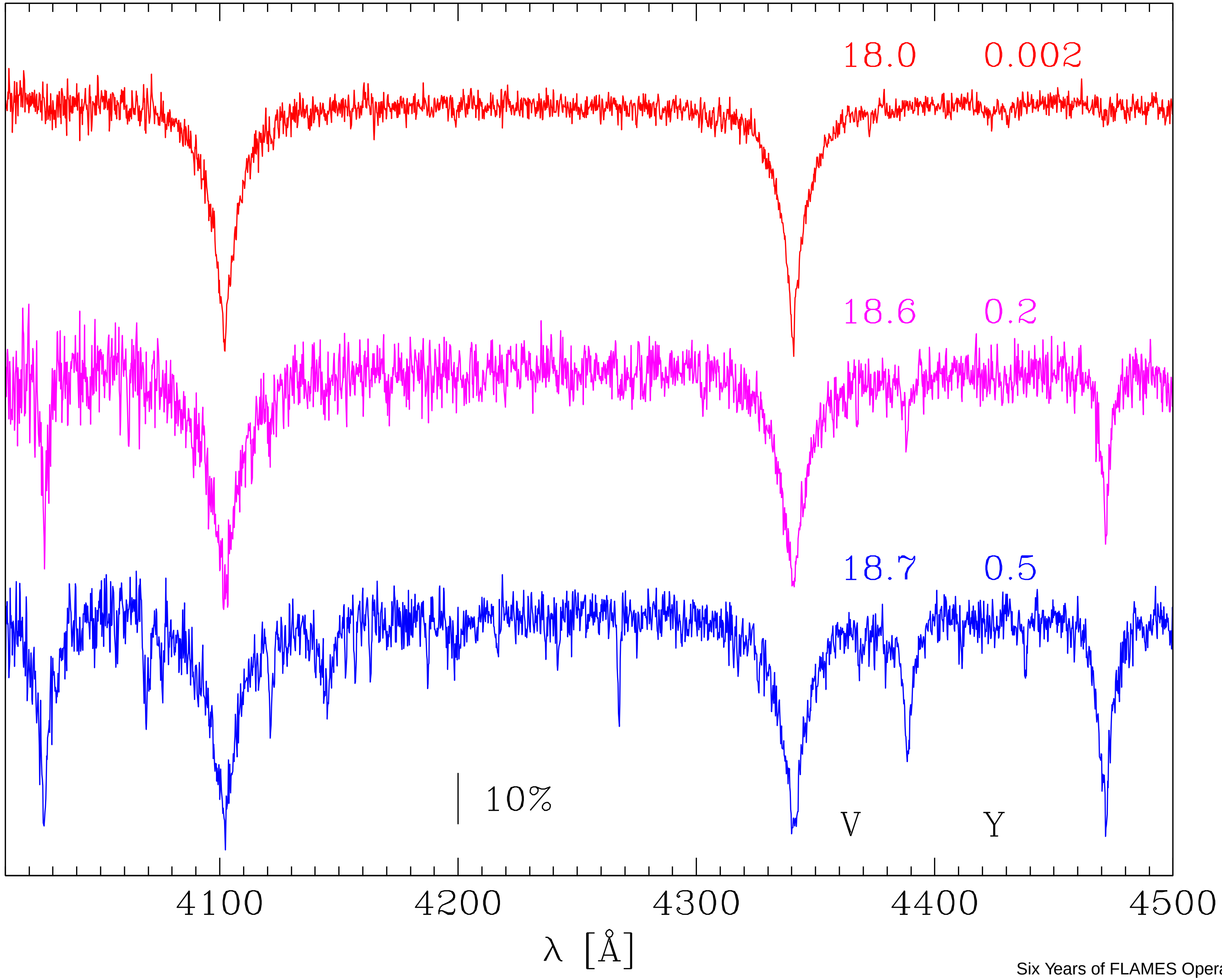
Possible Solution

- ⋆ Helium Enrichment (Bedin et al. 2004; Norris 2004; Piotto et al. 2005)
- ⋆ might also explain hottest HB stars (Lee et al. 2005)

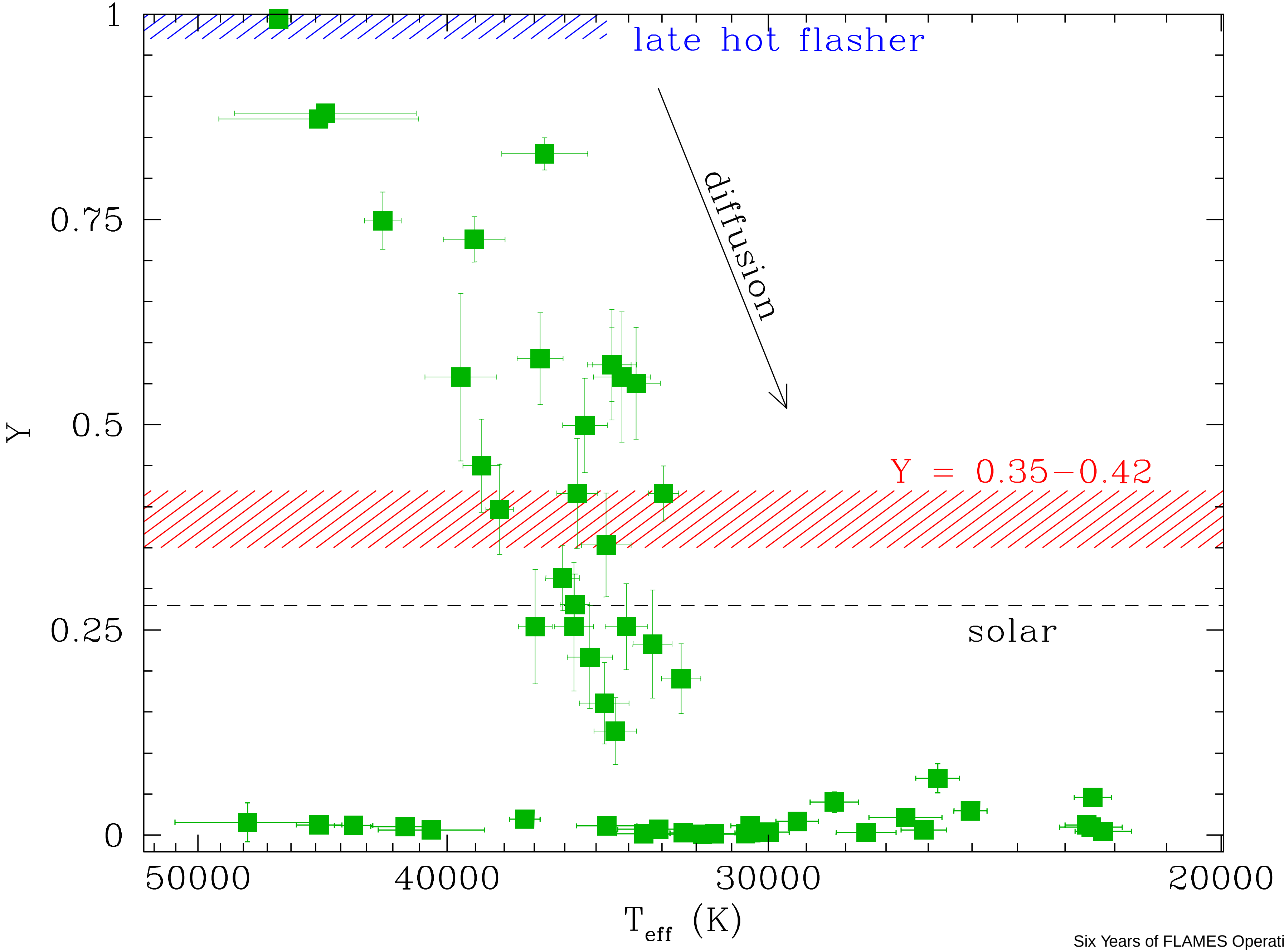
Spectroscopic Studies

- ⋆ FLAMES observations
  - ⋆ medium resolution (LR2) spectra of some 50 blue hook candidate stars
  - ⋆ due to weather problems only 9 of 20 observations performed
  - ⋆ pipeline reduced data used

Spectra



Results



late hot flasher
diffusion
Y = 0.35−0.42
solar
Y
1
0.75
0.5
0.25
0
50000
40000
30000
20000
T_{eff} (K)

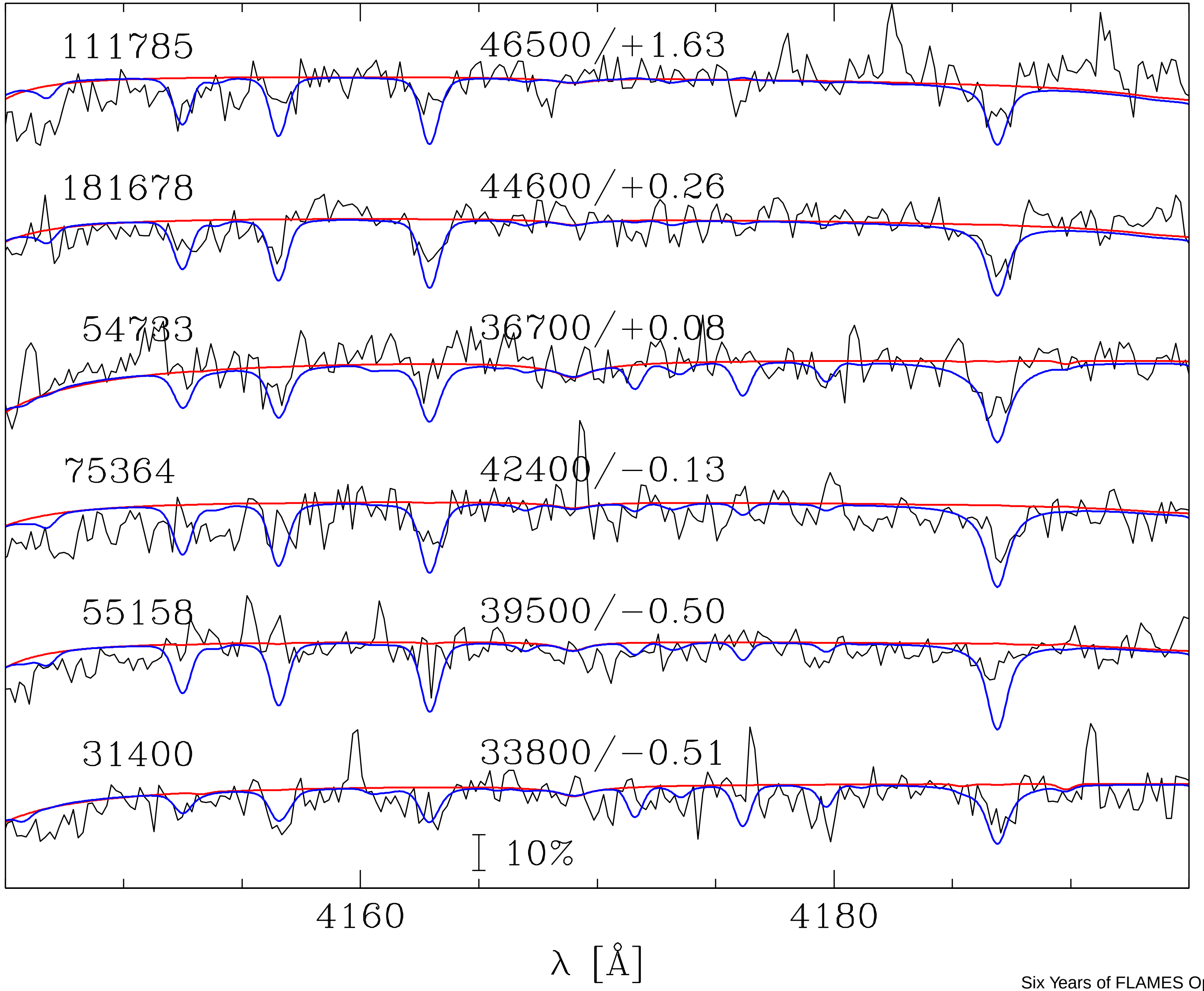
Results (cont'd)

- ⋆ blue hook stars have helium abundances between Y=0.1 and Y=1

late hot flasher: $Y \gtrsim 0.97$
helium enrichment: $Y \lesssim 0.42$

- ⋆ diffusion may reduce helium and carbon abundances

Results (cont'd)



Results

- ⋆ blue hook stars have helium abundances between Y=0.1 and Y=1

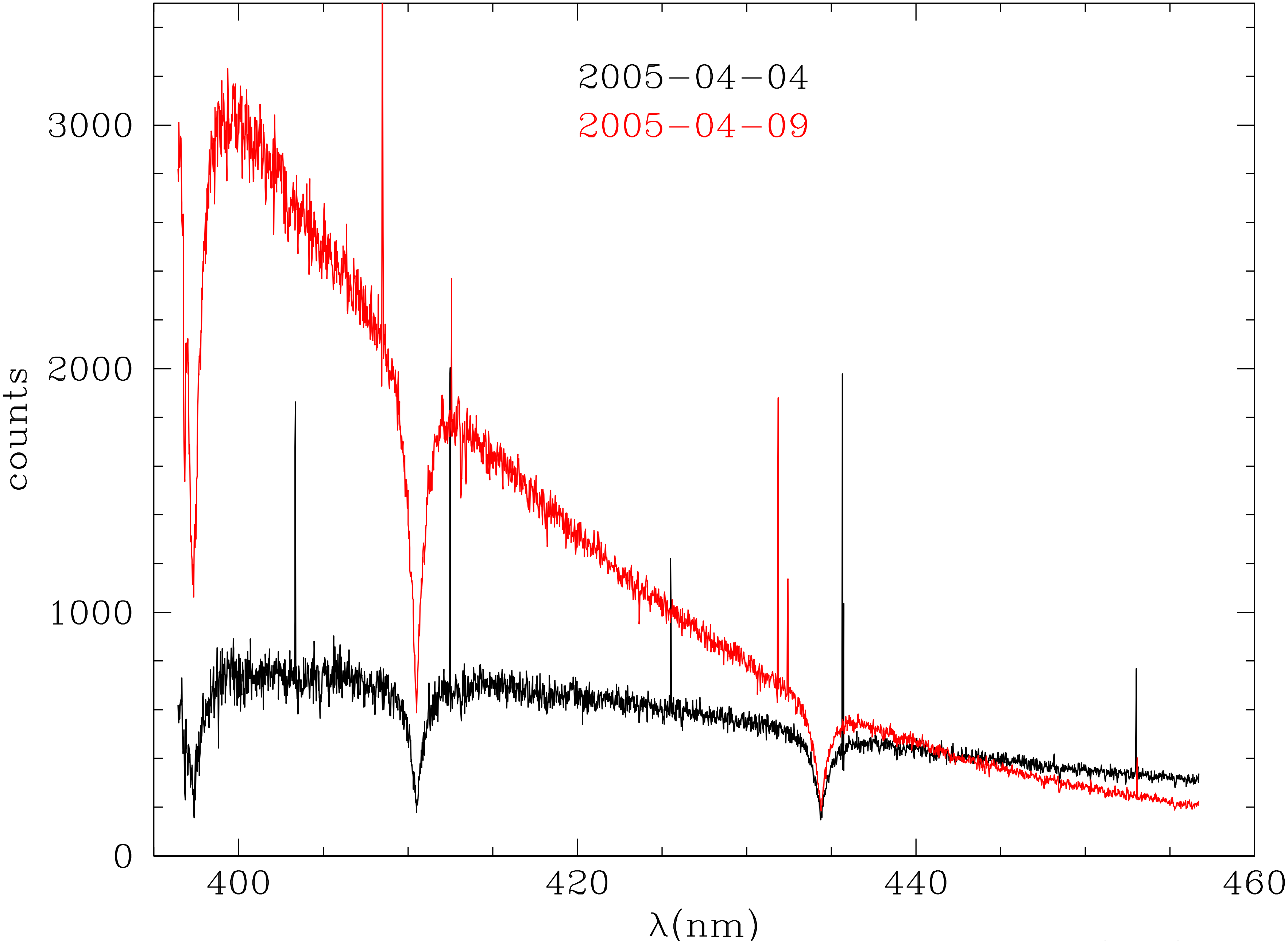
late hot flasher: Y$\gtrsim$0.97
helium enrichment: Y$\lesssim$0.42

- ⋆ diffusion may reduce helium and carbon abundances
- ⋆ helium-rich blue hook stars have carbon abundances of up to 3% by mass (more than a factor of 300 above cluster abundance)

late hot flasher: carbon abundance of 3% by mass
helium enrichment: no carbon enrichment

FLAMES remarks

- ⋆ extremly useful for observation in globular clusters
- ⋆ no significant difference found between pipeline reduced data and data reduced with the Geneva pipeline
- ⋆ no correction for bright spot in upper right corner in our data (P75/P77)
- ⋆ two observations show deviating flux distribution without clear cause
- ⋆ flux standard star observations for some fibres would be helpful



2005−04−04
2005−04−09
counts
0
1000
2000
3000
400
420
440
460
λ(nm)