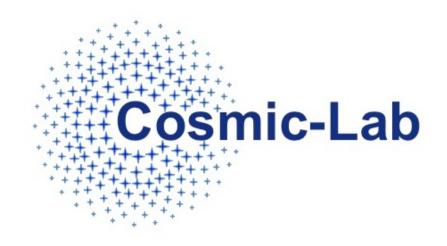
# ALESSIO MUCCIARELLI

The chemical composition

of AGB stars in globular clusters

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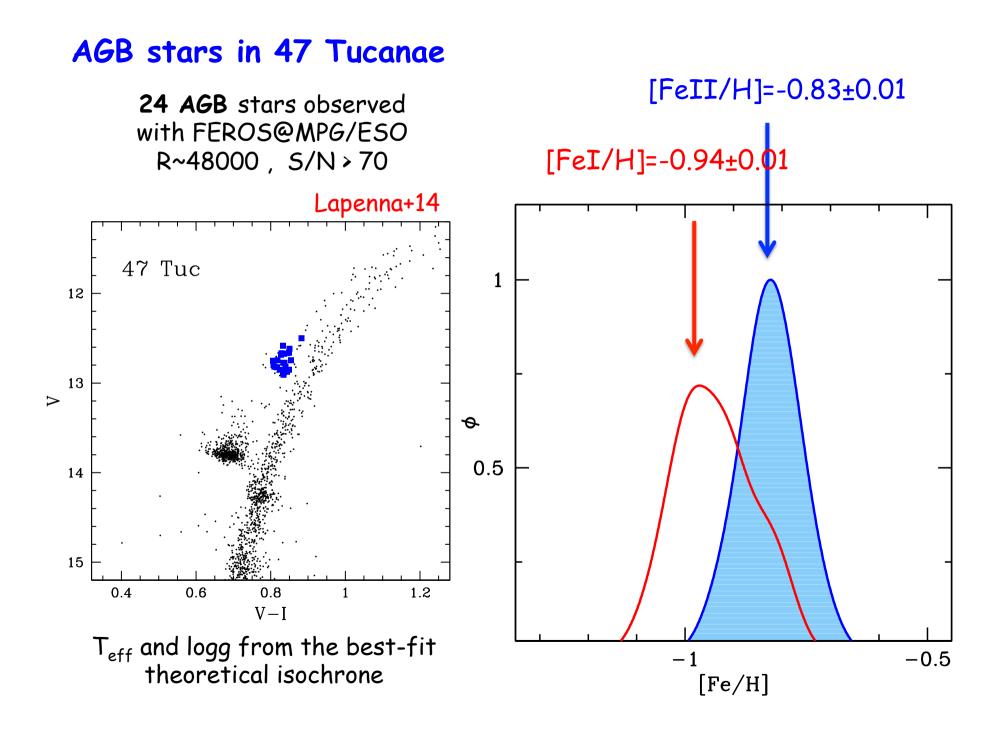
+ 5-year project

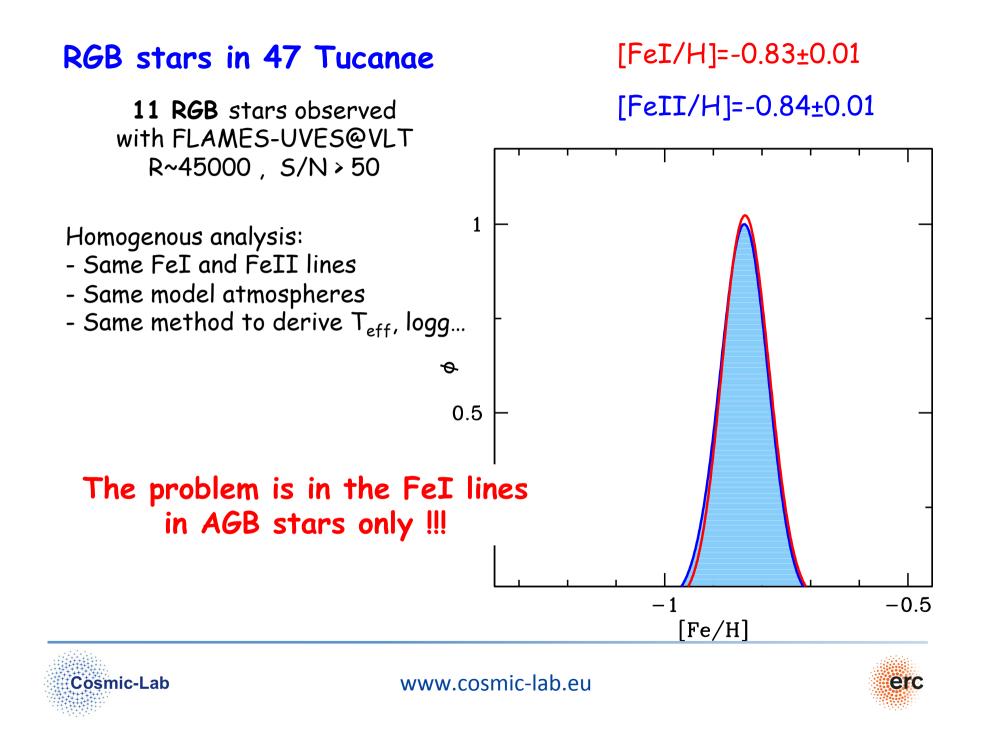
- + Advanced Research Grant funded by the European Research Council (ERC)
- PI: Francesco R. Ferraro (Dip. of Physics & Astronomy Bologna University)
- + AIM: to understand the complex interplay between dynamics & stellar evolution
- + HOW: using **globular clusters** as cosmic laboratories and











## Checks

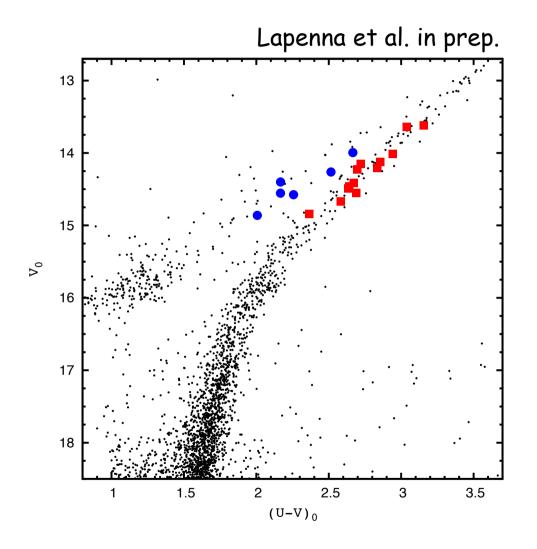
- $\checkmark$  Both spectroscopic and photometric T<sub>eff</sub> provide the same results
- ✓ To reconcile FeI and FeII we need to decrease logg (FeII is sensitive to logg, at variance with FeI), but ...
  - [FeI/H] ~ [FeII/H] ~ -1.0 dex too low abundance, large difference with the RGB stars
  - the spectroscopic logg imply low stellar masses, ~0.4  $M_{\rm SUN}$  (too low mass for a GC AGB star, ~0.7  $M_{\rm SUN}$  for 47Tuc)

No realistic set of atmospheric parameters able to reconcile FeI and FeII in the AGB stars, matching the Fe of RGB stars





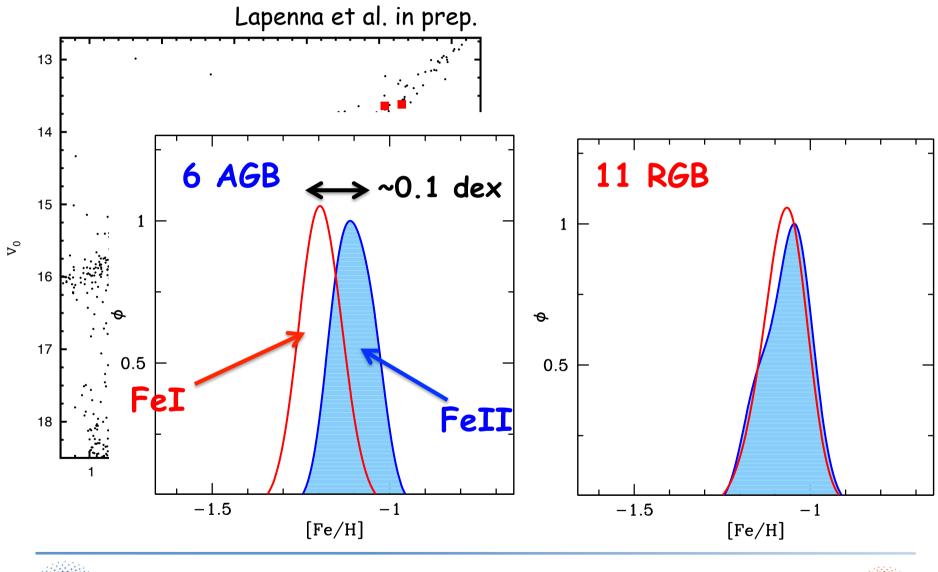
### The case of M62







### The case of M62







The discrepancy between FeI and FeII in AGB stars cannot be explained with uncertainties/errors in the adopted analysis procedure

"...when you have eliminated all which is impossible, then whatever remains, however improbable, must be the **truth**"

Sherlock Holmes





### A working hypothesis: NLTE ?

Departure from Local Thermodynamical Equilibrium (LTE) assumptions

### In NLTE:

neutral lines (Fe I) are affected (lower abundance when we use LTE calculations) single ionized lines (Fe II) unaltered

(see e.g. Thevenin & Idiart 1999, Asplund 2005, Mashonkina+11...)

### We are not still able to explain this effect but we learn a lesson

The best way to derive the Fe abundance

Photometric gravities + Fe II lines The case of NGC3201

<u>Simmerer+13</u>: analysis of 21 giant stars (FLAMES-UVES) A 0.4 dex wide metallicity distribution (Analysis based on spectroscopic logg)



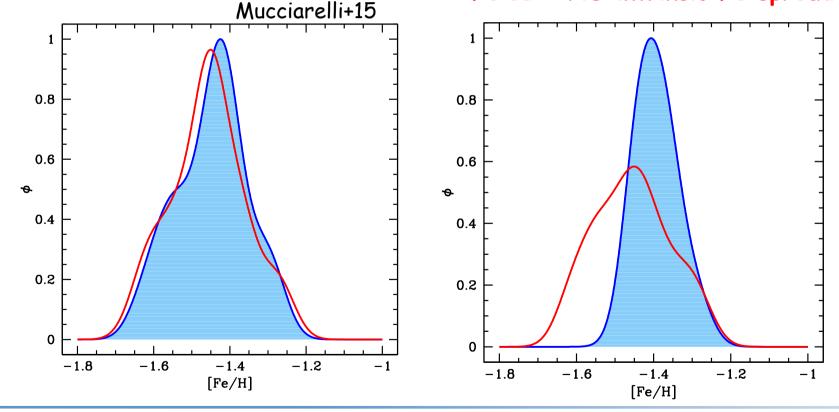


**The case of NGC3201 Spectroscopic logg** [Fe I /H] = -1.46 (σ=0.10)

#### INTRINSIC FE SPREAD !!!

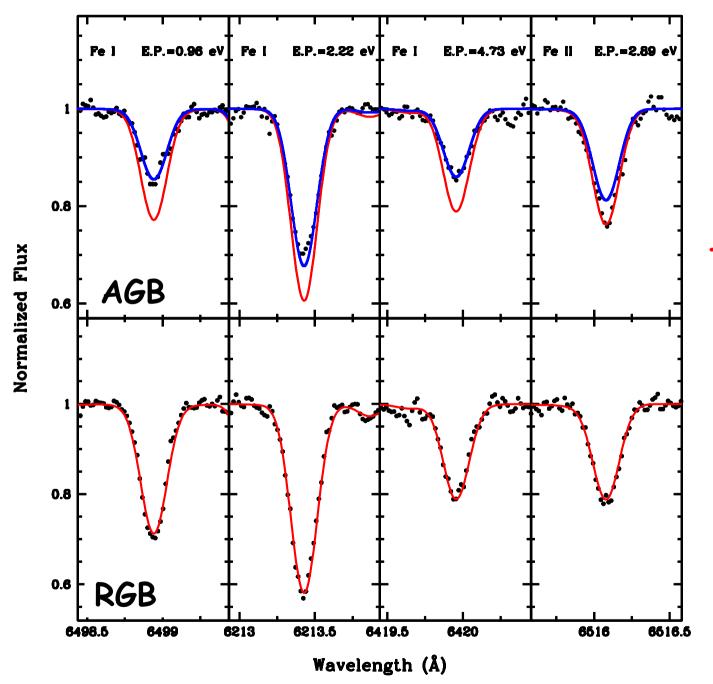
Photometric logg [Fe I /H] = -1.46 ( $\sigma$ =0.10) [Fe II /H] = -1.40 ( $\sigma$ =0.05)











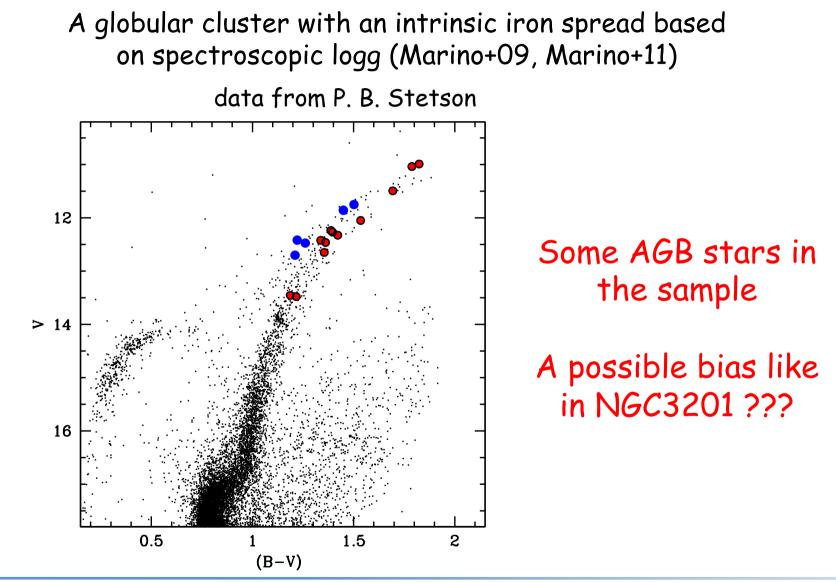
Fe abundance from Fe I lines

Fe abundance from Fe II lines

Fe abundance from Fe I lines

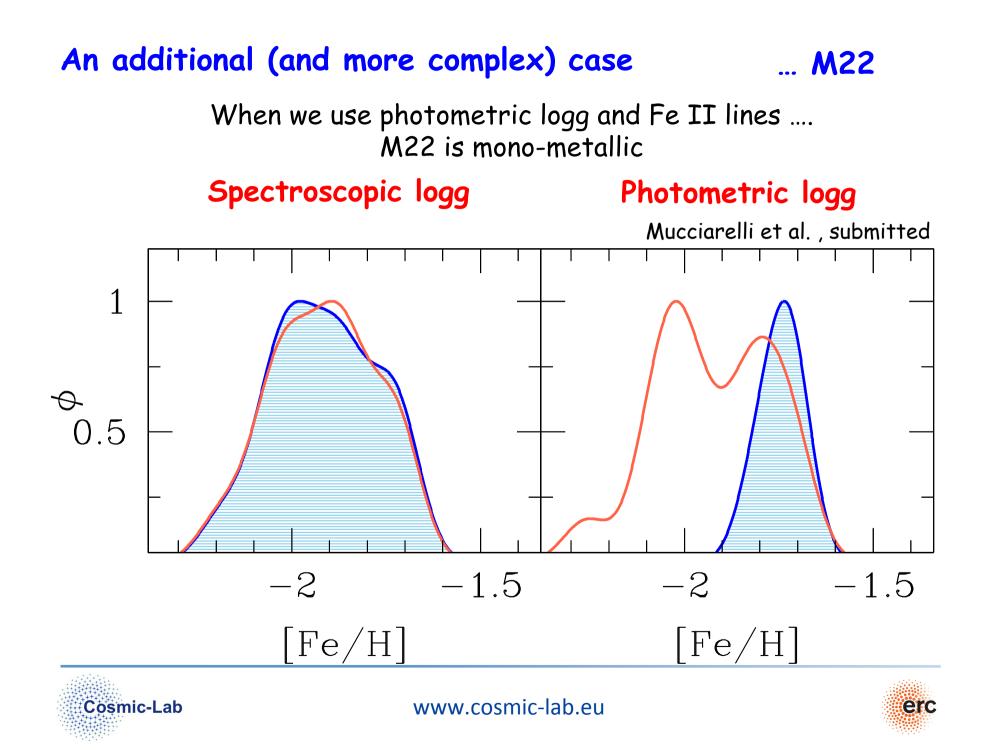
### An additional (and more complex) case

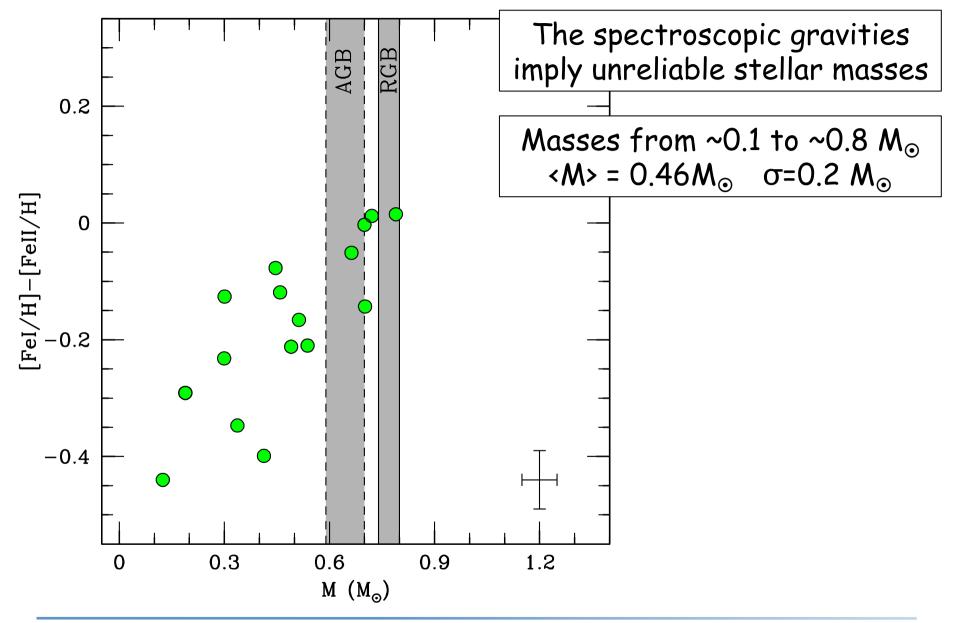






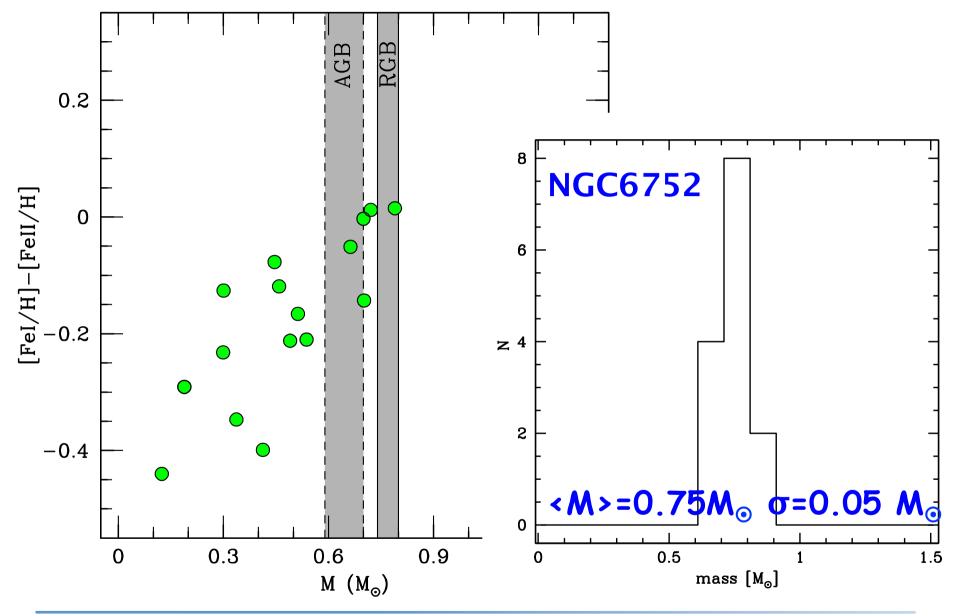






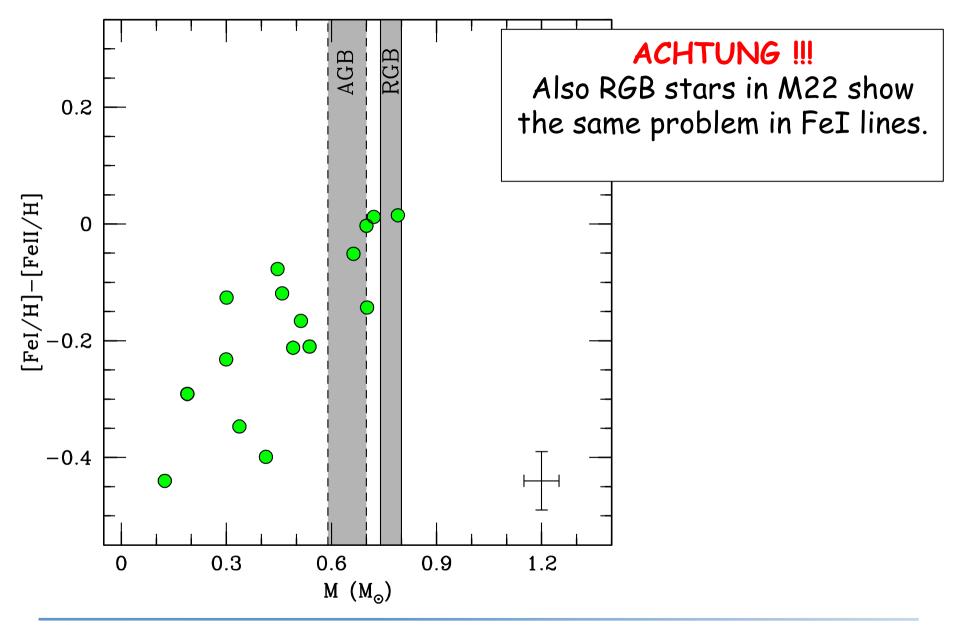
















### Summary ...

- ✓ AGB stars show systematic low [FeI/H] with respect to RGB stars ...
  but [FeII/H] is OK !!!
- A working hypothesis : NLTE
  (but it challenges the current NLTE calculations)

- ✓ AGB stars cannot be *blindly* analysed.
  The best approach: photometric logg + Fe II lines
- ✓ A general and efficient approach for all the clusters





