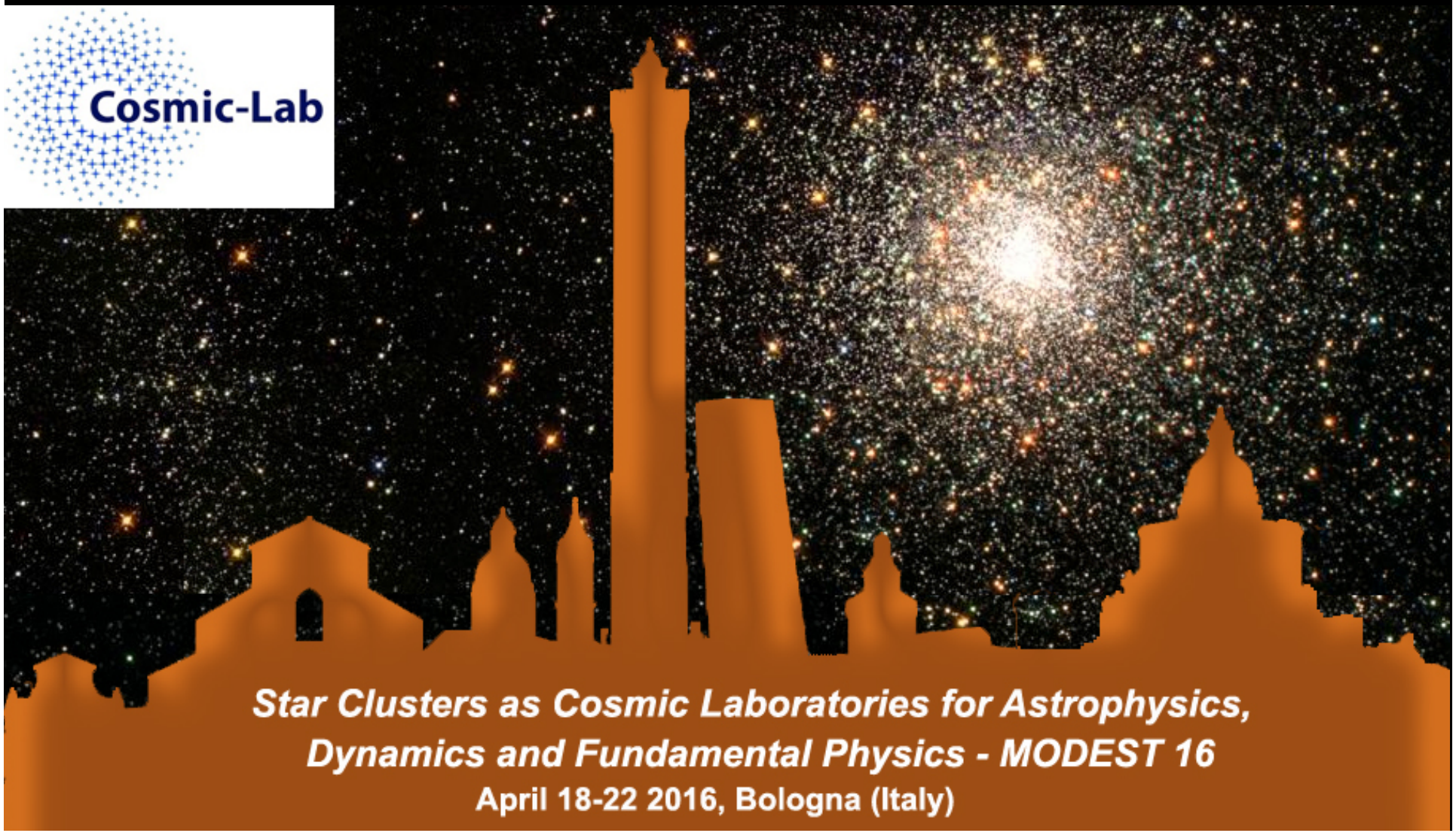
Spurious and real iron spreads in globular clusters

ALESSIO MUCCIARELLI

Physics & Astronomy Department – University of Bologna (Italy)



An iron roadmap for the globular clusters

Globular clusters

Spread in [Fe/H] < 0.04-0.05 dex
(NO Fe spread)

Strange beasts

Omega Centauri
Terzan 5
M54

Spread in [Fe/H] > 0.3 dex

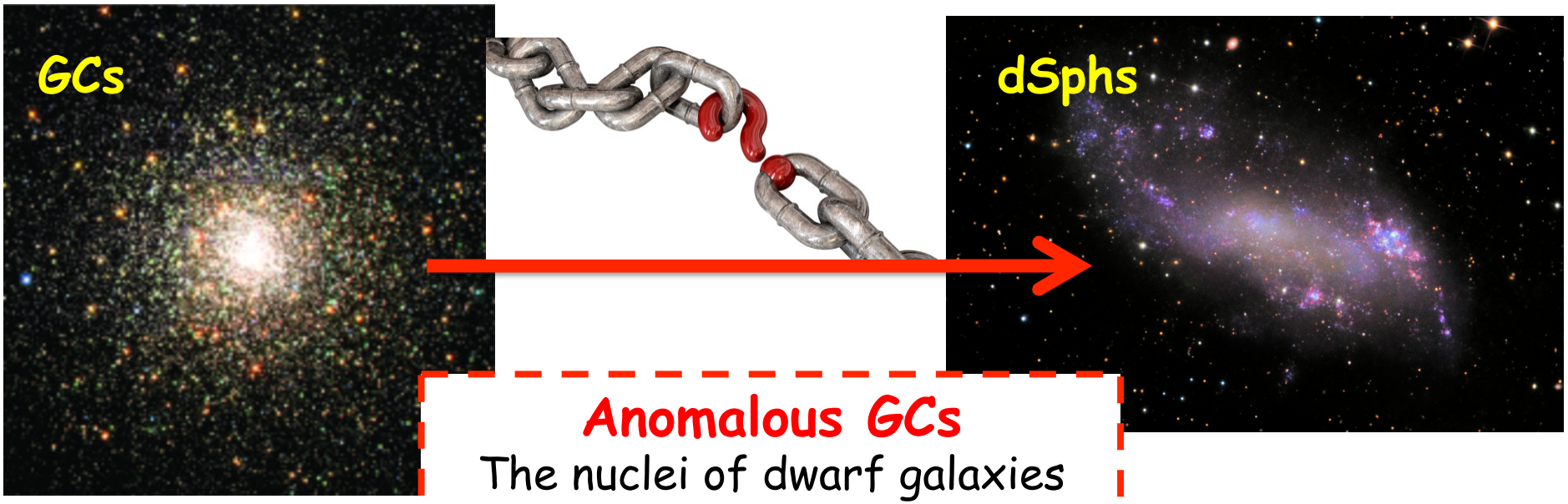
over than 1 dex of [Fe/H] range

New GCs with measured Fe spreads

M22 (Marino+09,Marino+11)
M2 (Yong+14)
NGC3201 (Simmerer+13)
NGC1851 (Carretta+10)
NGC5286 (Marino+15)
M19 (Johnson+15)

Spread in [Fe/H] ~ 0.1-0.15 dex

Anomalous GCs



Anomalous GCs

The nuclei of dwarf galaxies tidally disrupted through the interactions with MW

???

New MW satellites?
Important for the missing satellites problem

A new (but simple) method to check the iron spreads

The lesson from AGB stars (see Lapenna's talk)

- In AGB stars **Fe I** lines provide systematically lower abundance with respect to RGB stars
- In AGB stars **Fe II** lines + **photometric logg** provide the correct abundance
- Spectroscopic logg for AGB stars lead incorrect abundances

WARNING !!!

Several works use the spectroscopic gravities, including those about the clusters with Fe spread

An iron spread should be detected both with photometric and spectroscopic logg

The case of NGC3201

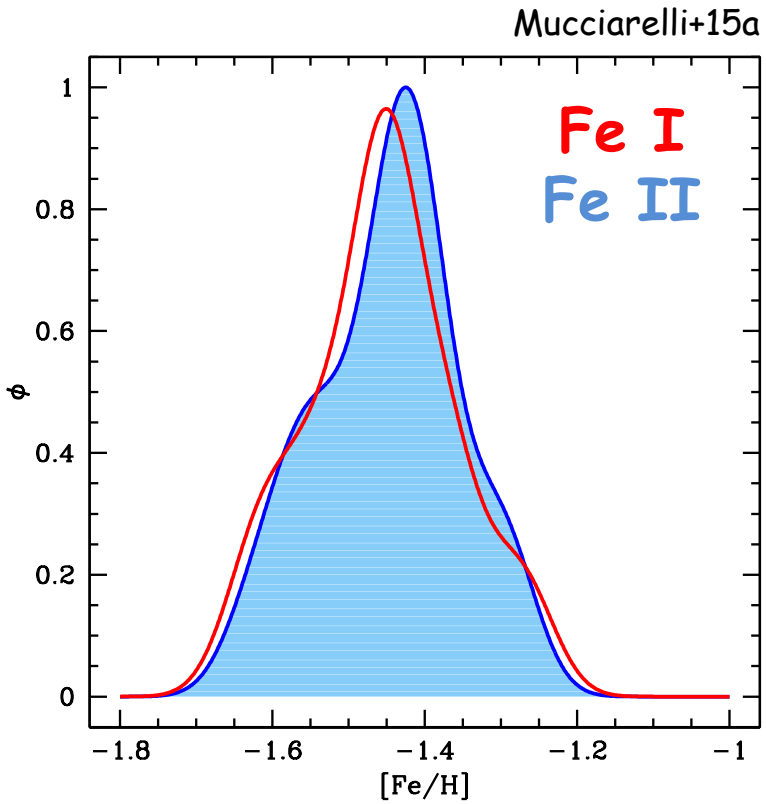
Simmerer+13: analysis of 21 giant stars (FLAMES-UVES)
A 0.4 dex wide metallicity distribution
(Analysis based on spectroscopic logg)

The case of NGC3201

Spectroscopic logg

σ = 0.10

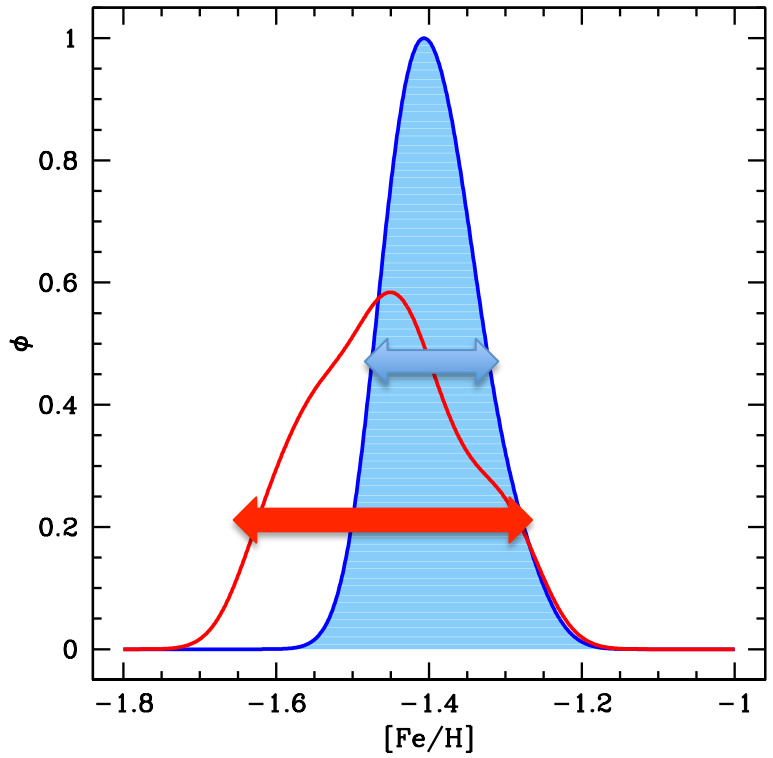
INTRINSIC FE SPREAD !!!



Photometric logg

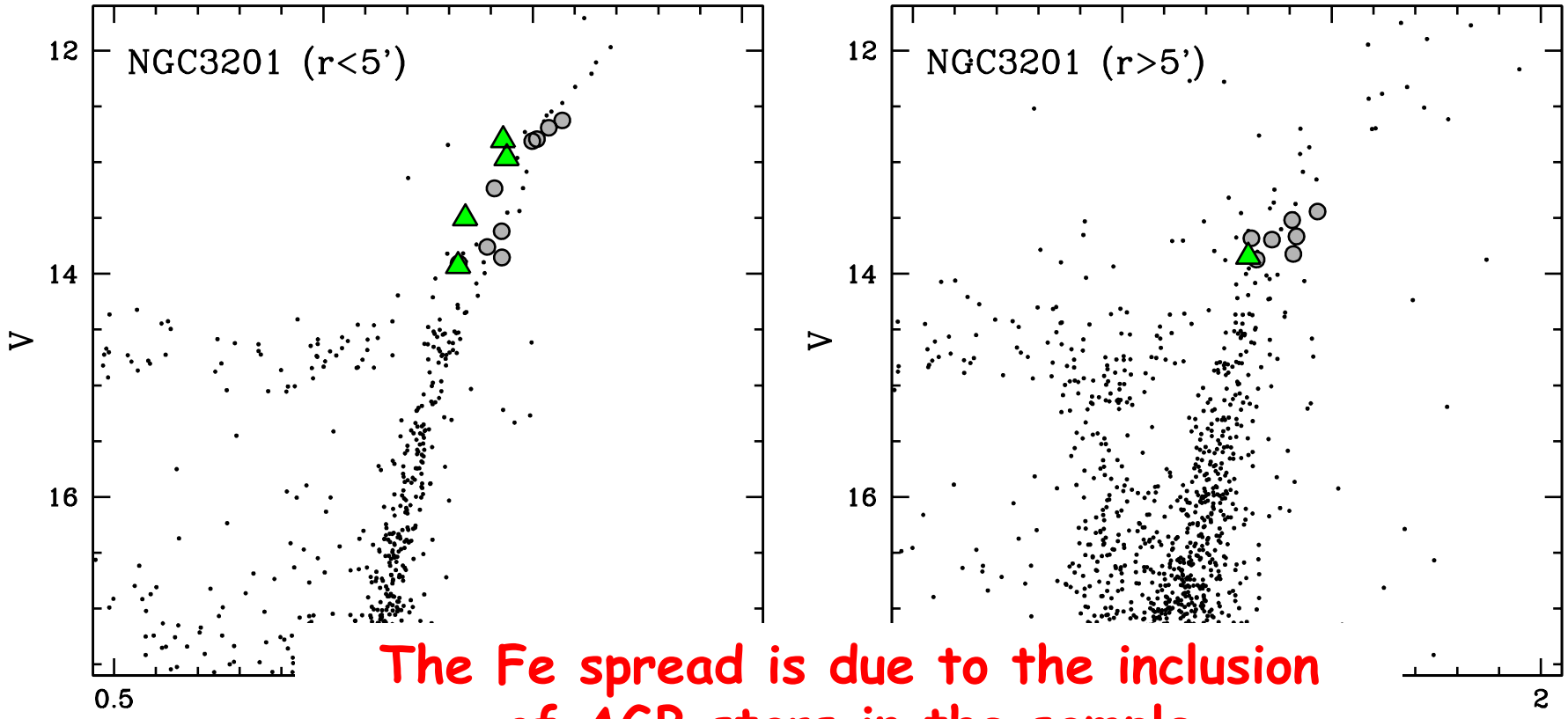
σ(FeI) = 0.10 σ(FeII) = 0.05

NO INTRINSIC FE SPREAD !!!



The case of NGC3201

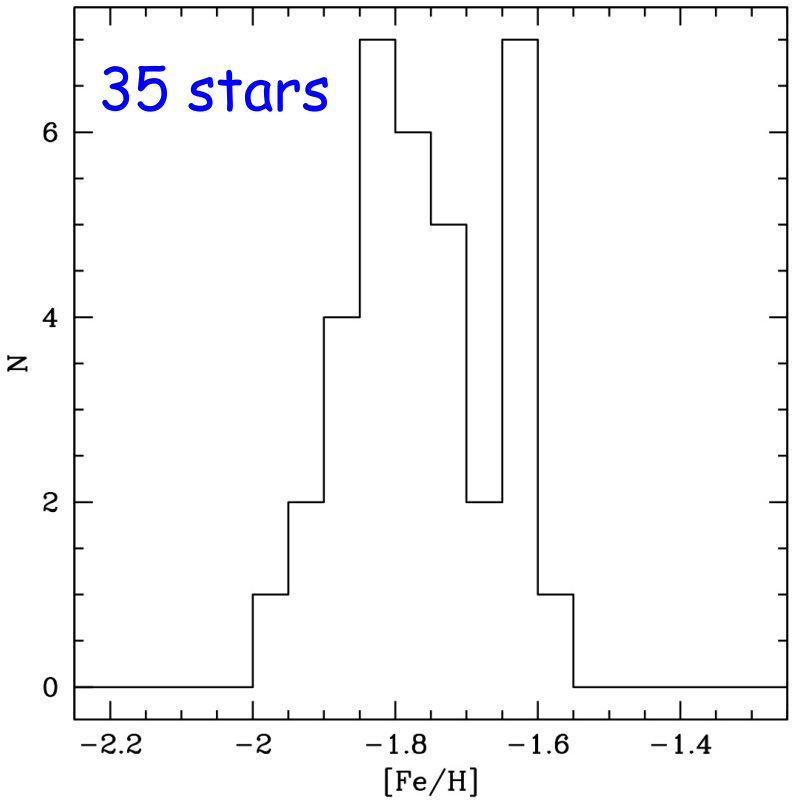
Simmerer+13: analysis of 21 giant stars (FLAMES-UVES)
A 0.4 dex wide metallicity distribution
(Analysis based on spectroscopic logg)



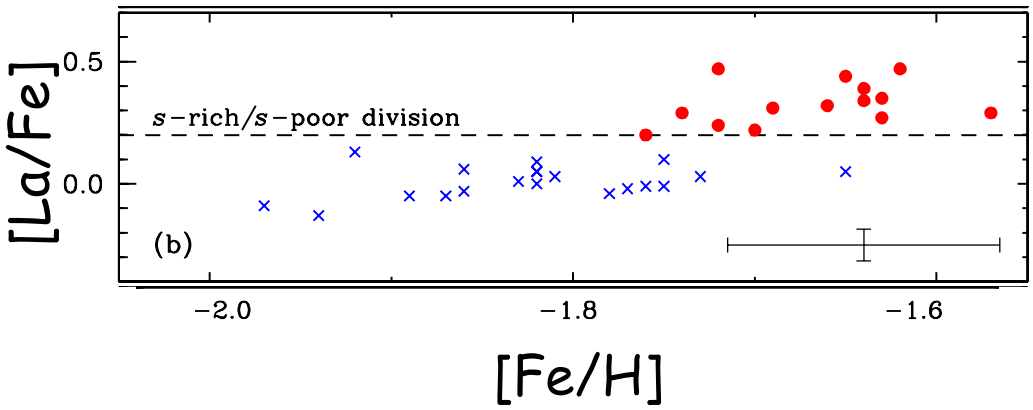
The Fe spread is due to the inclusion of AGB stars in the sample

The case of M22

data from Marino+09,+11



Marino+11

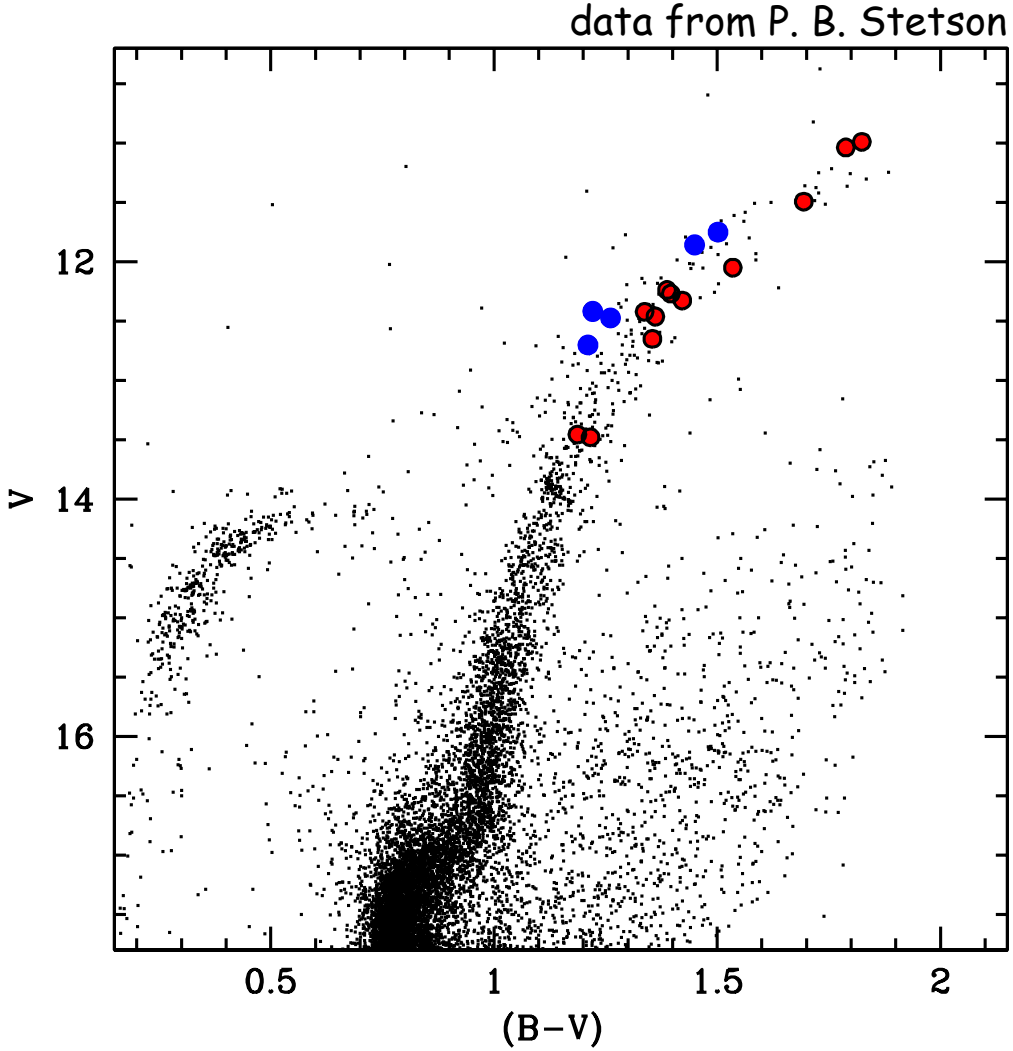


Two groups of stars with:
- different [Fe/H]
- different s-process elements
- different C+N+O …

… but based on spectroscopic logg

The case of M22

Re-analysis of the 17 stars by Marino+09 (FLAMES-UVES)



Some AGB stars in the sample

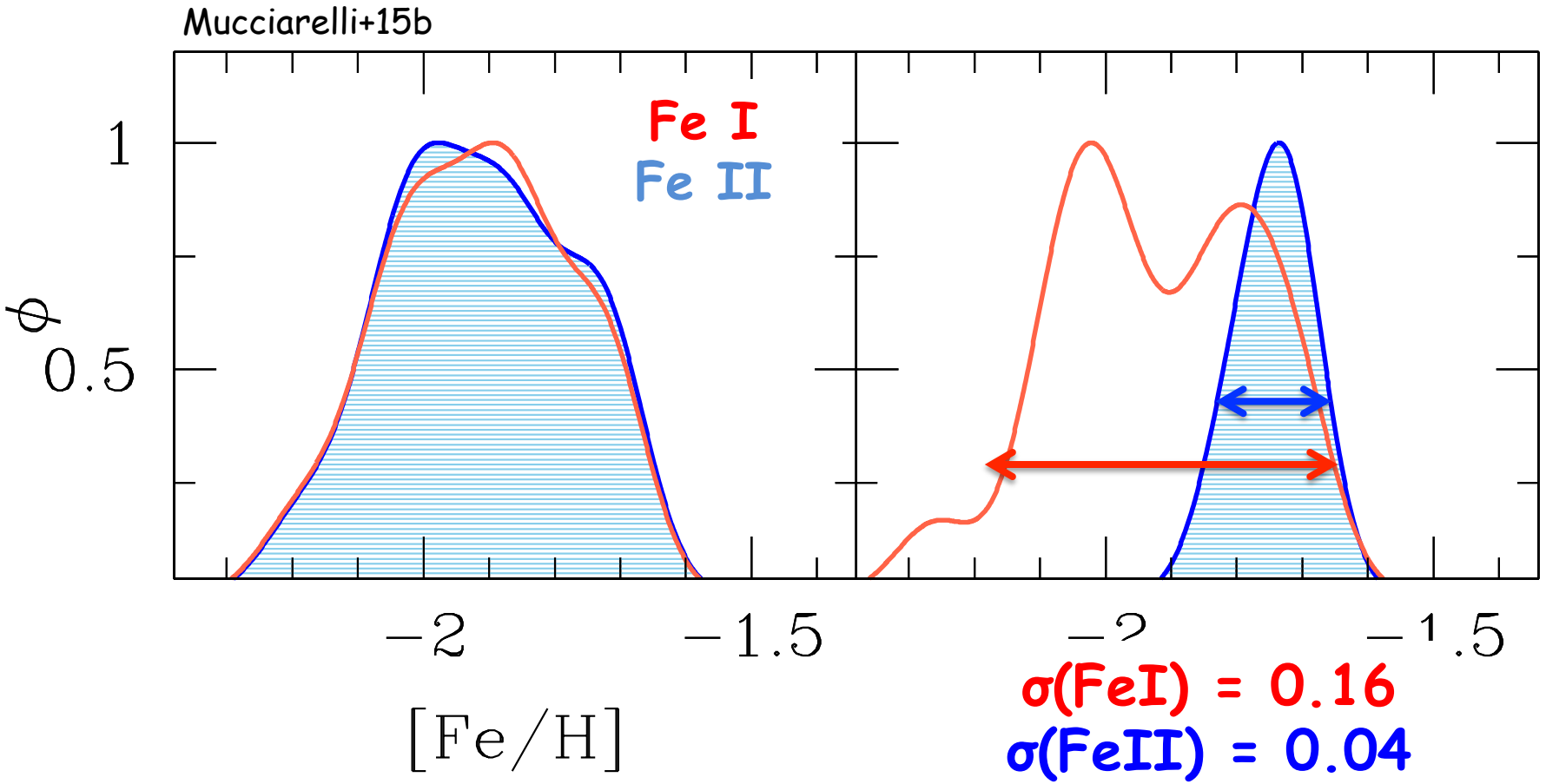
A possible bias like in NGC3201 ???

The case of M22

When we use photometric logg and Fe II lines ….

M22 is mono-metallic

Spectroscopic logg **Photometric logg**



Why FeII + photometric logg?

Fe II lines are most trustworthy than Fe I lines:

(1) Fe II is a dominant species in the atmospheres of late-type stars

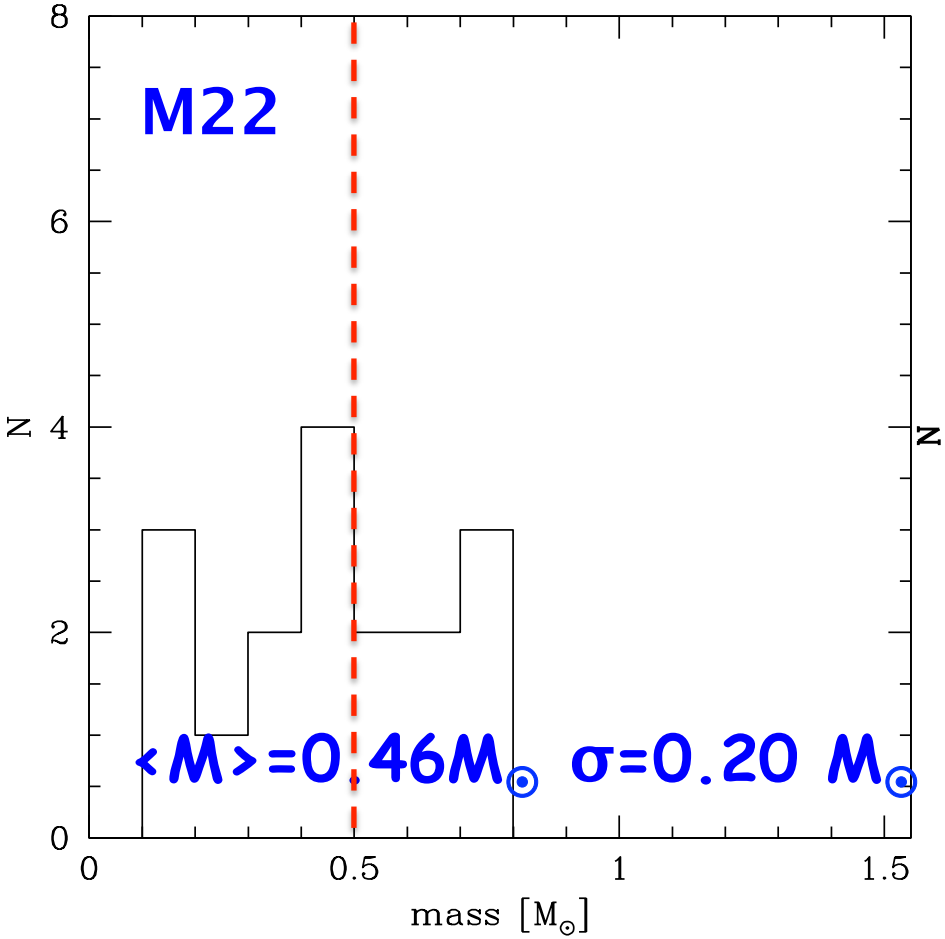
(2) Fe II lines are unaffected by NLTE

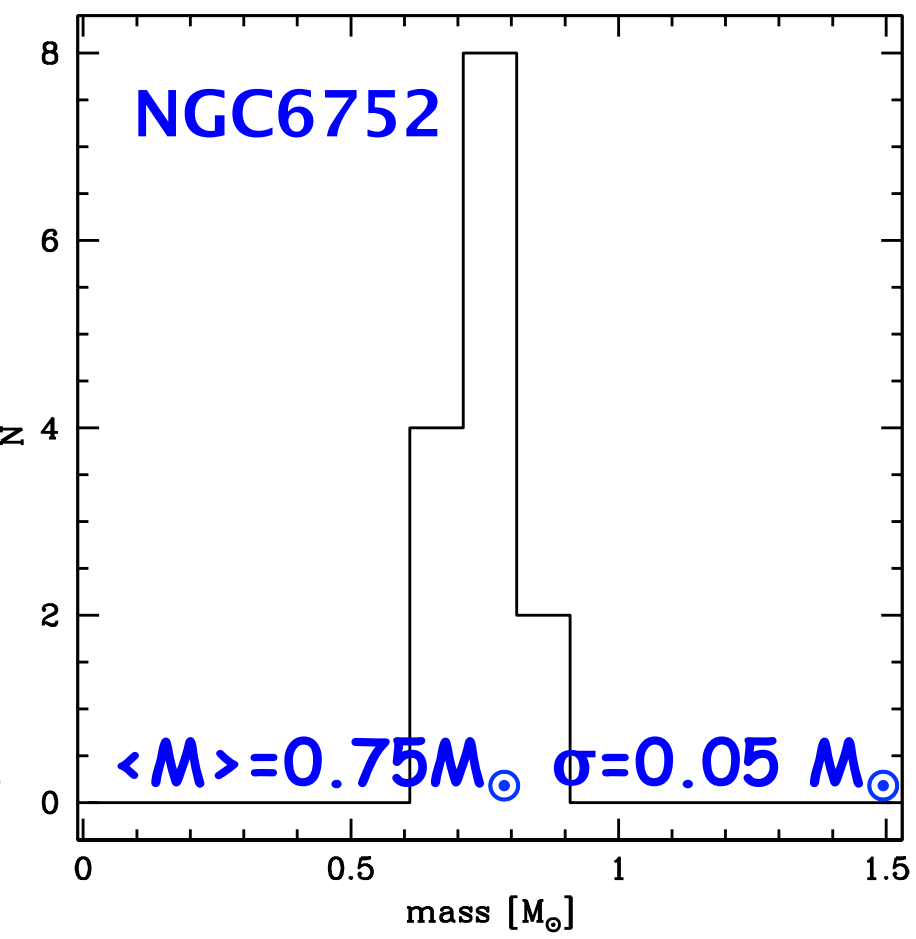
We can use the stellar masses from spectroscopic logg to check the gravities

Masses from spectroscopic gravities

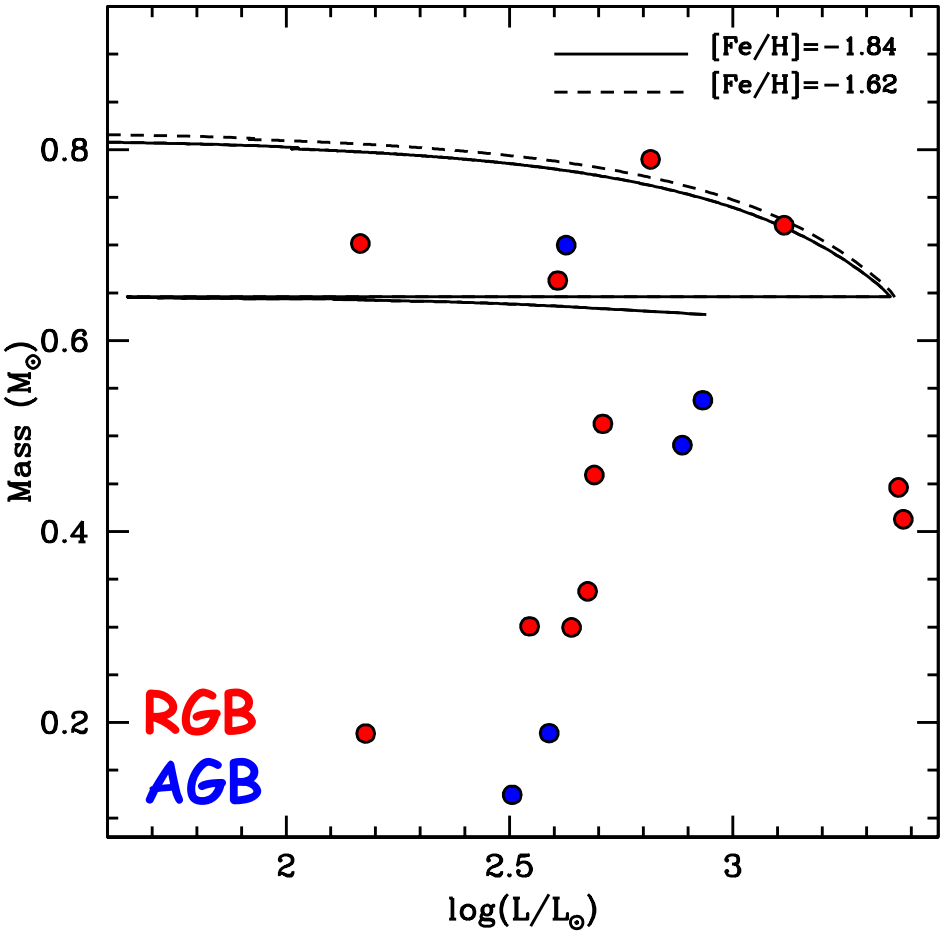
The spectroscopic logg imply very low stellar masses (and with a large dispersion)

In a normal GC we find reliable stellar masses (and a small dispersion)

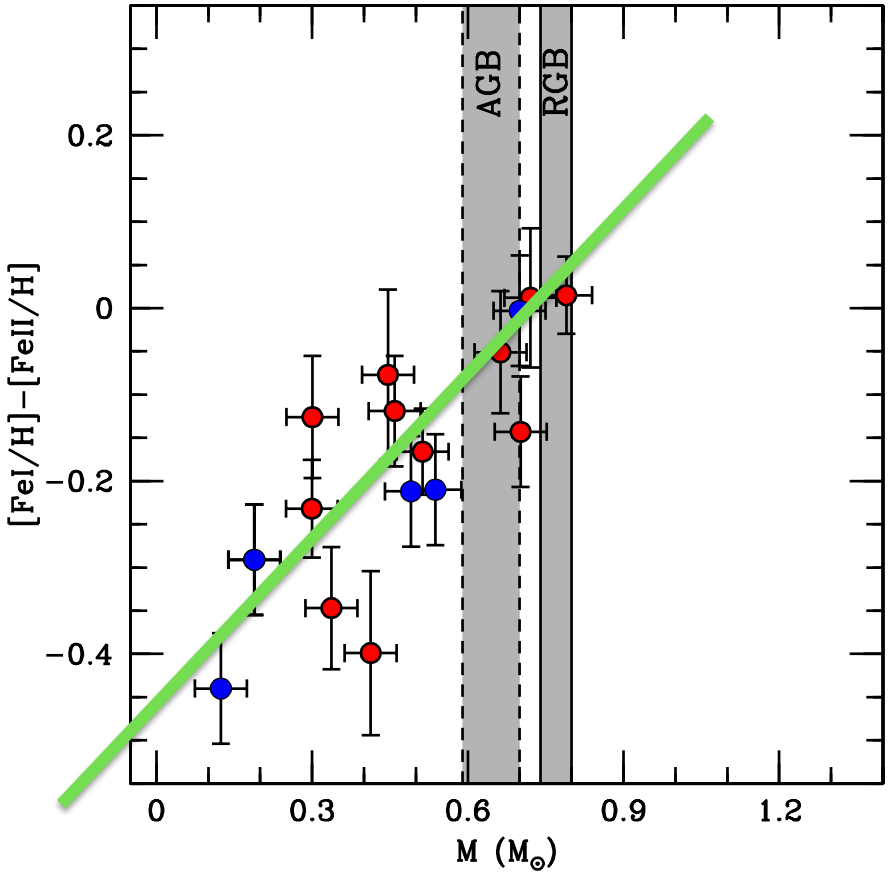




Masses from spectroscopic gravities



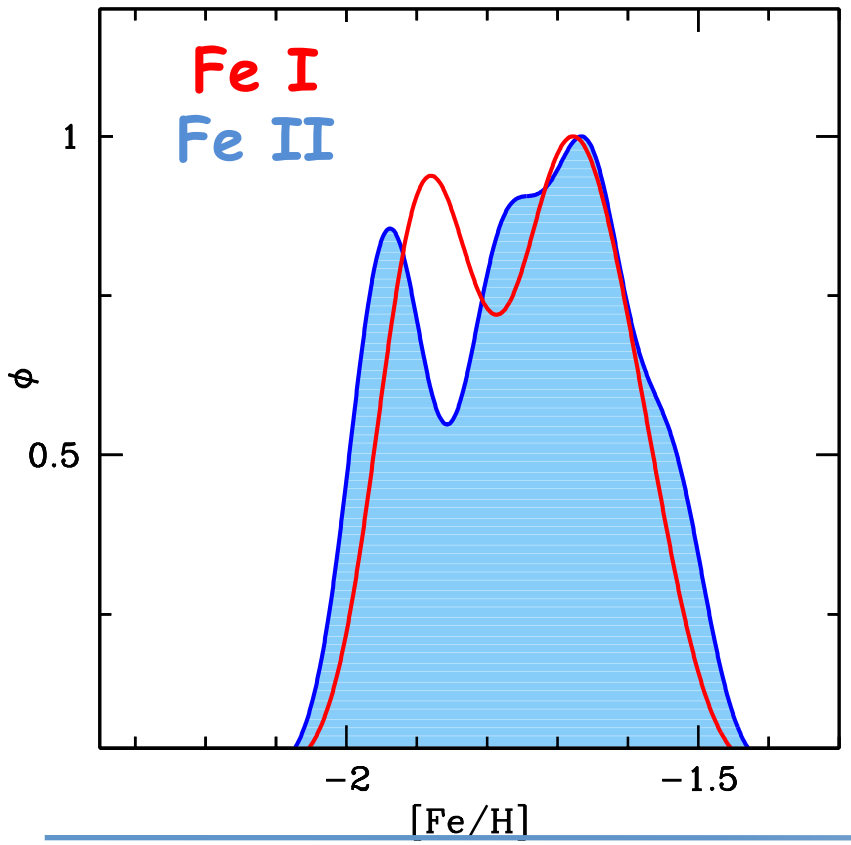
Some RGB stars are affected by the FeI-FeII discrepancy (not only AGB stars)



The case of NGC5286

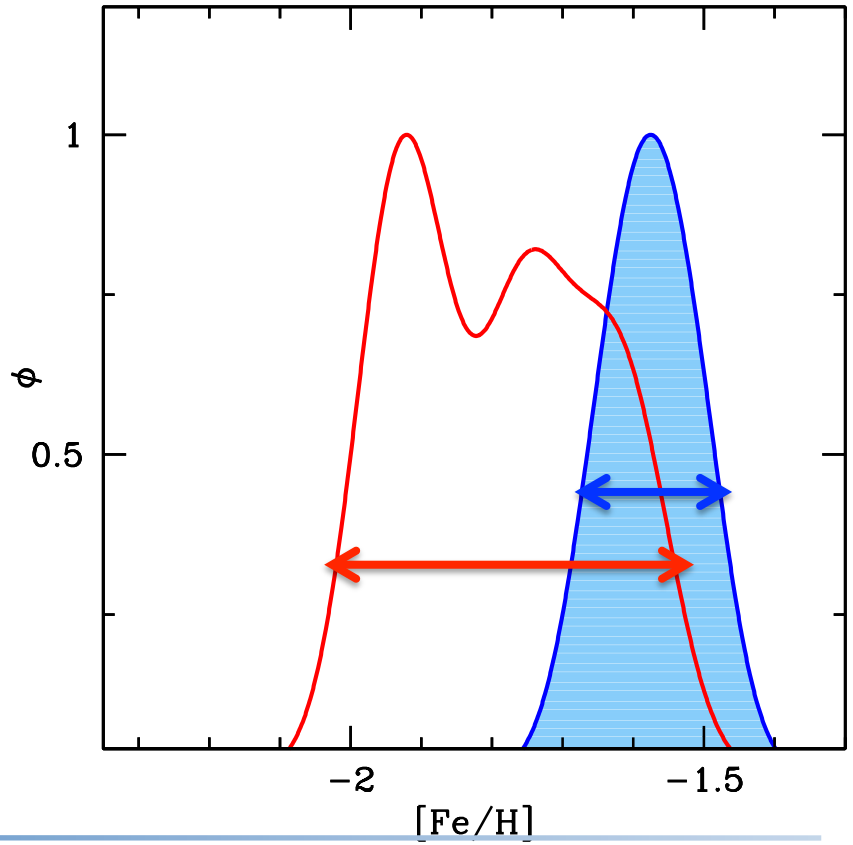
Marino+15: spread in [Fe/H] by using spectroscopic logg
spread in s-process

Spectroscopic logg



Photometric logg

Mucciarelli (in prep.)



Two cases where the iron spread are spurious

(1) Normal GCs (no s- and C+N+O anomalies)

AGB stars & spectroscopic logg

NGC 3201

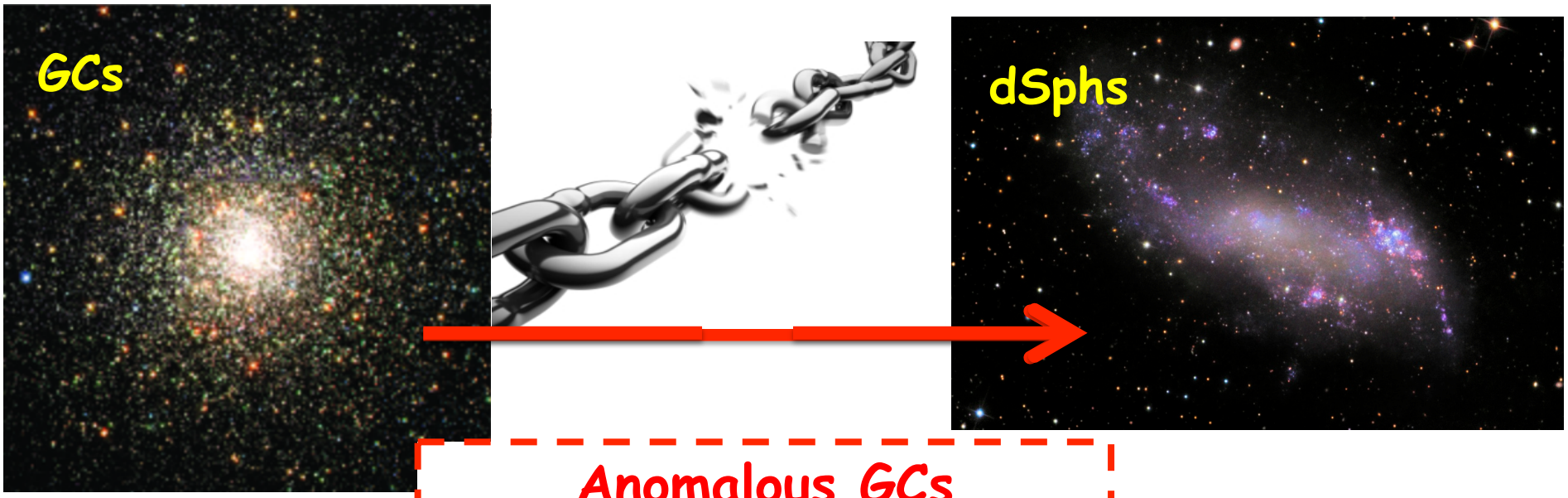
For these GCs use the logg that you prefer for RGB stars but photometric logg + FeII for AGB stars

(2) GCs with anomalies in s- and C+N+O

AGB + **RGB** stars & spectroscopic logg

M22, NGC 5286

For these GCs use photometric logg + FeII



Anomalous GCs

The nuclei of dwarf galaxies tidally disrupted through the interactions with MW

???

NO

They are mono-metallic

Summary

- A simple method to check Fe spreads: Fe II lines + photometric logg
- With this approach NGC3201, M22 and NGC5286 turn out to be mono-metallic
- **The anomalous GCs are genuine GCs (concerning Fe) !!!**

NO GLOBULAR CLUSTERS WERE HARMED IN THE MAKING OF THIS TALK

The End