Detailed Elemental Abundances in the M31 Stellar Halo

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arXiv:

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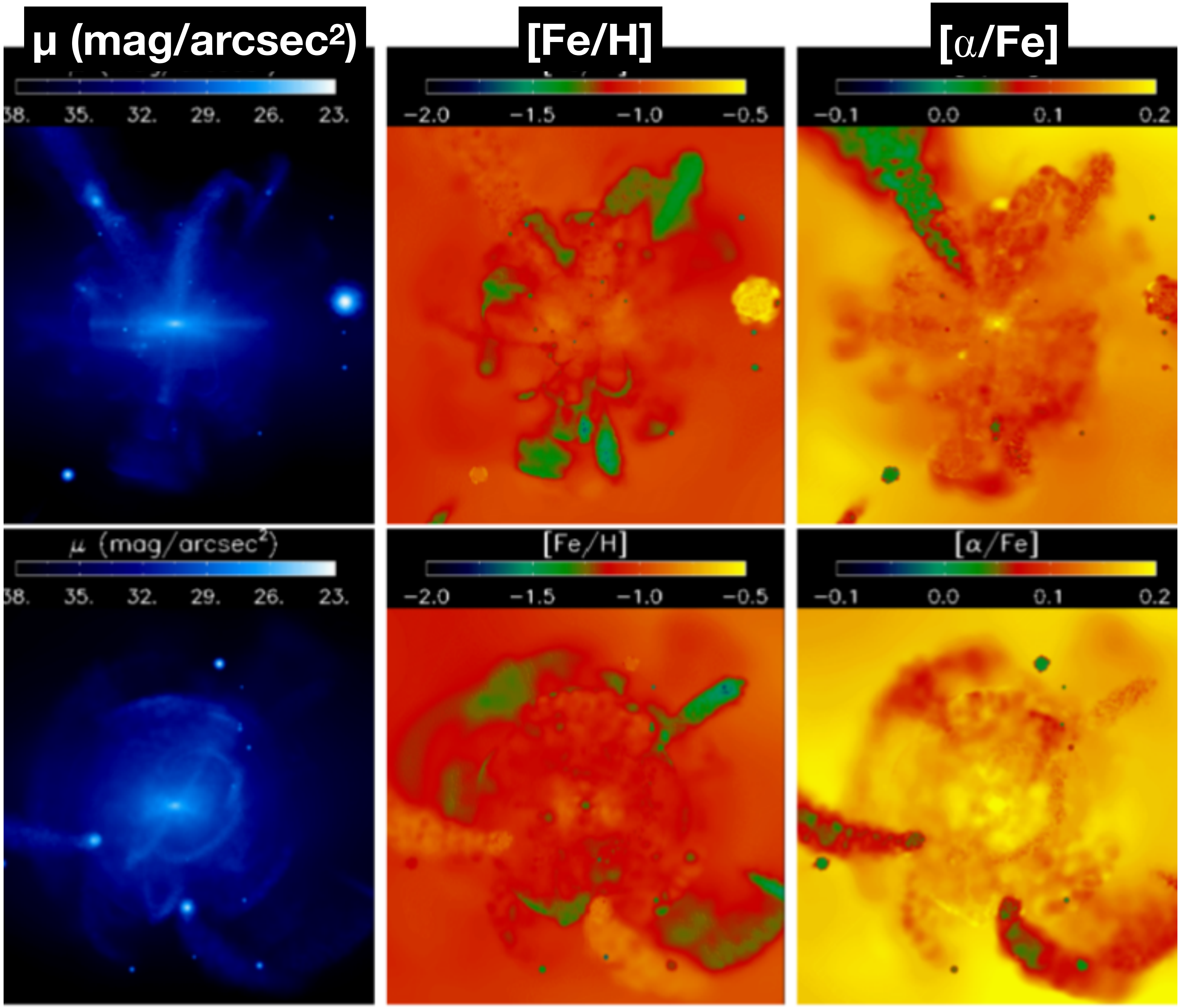
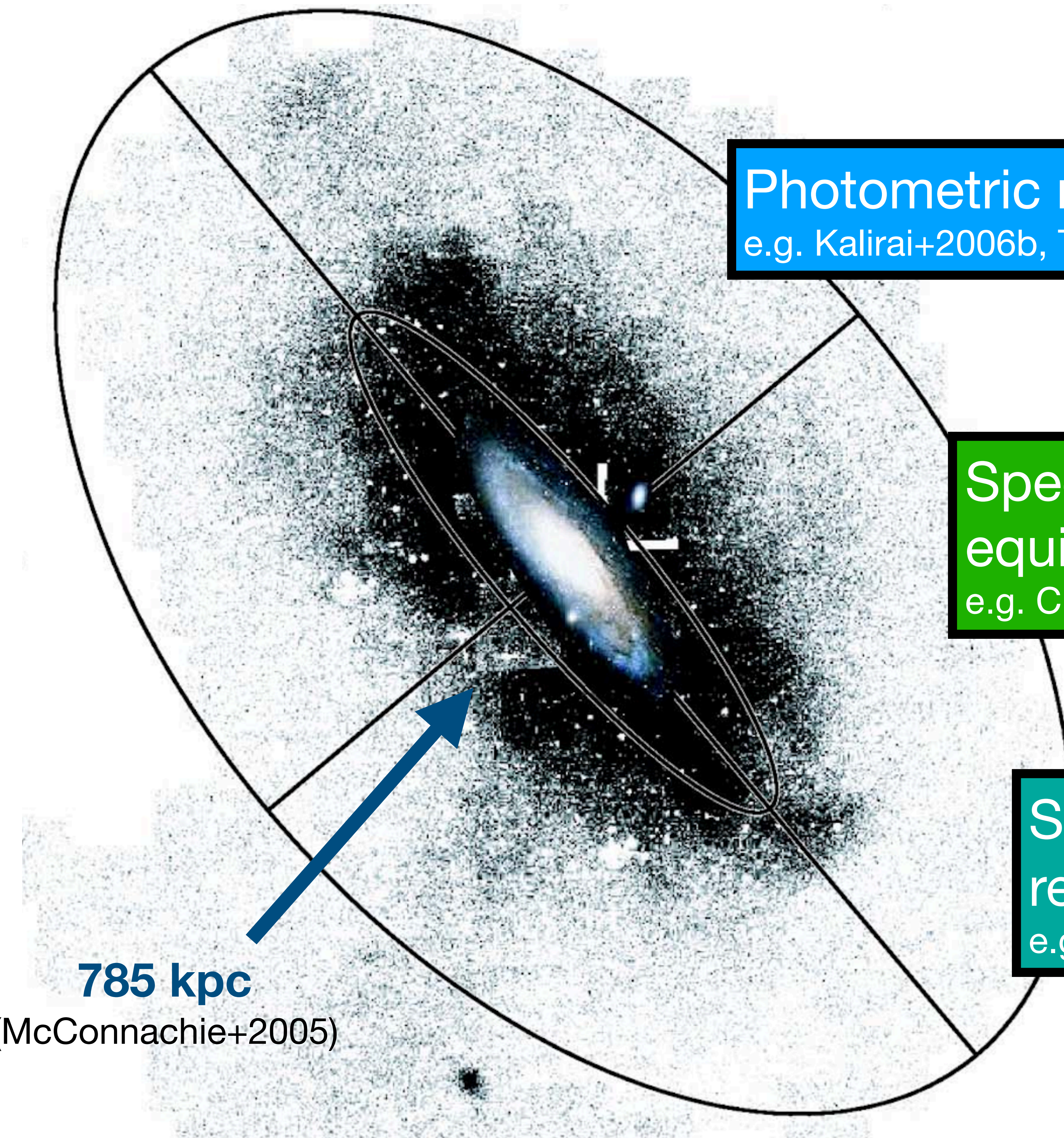
[Fe/H] and [α/Fe] trace the formation history of M31's stellar halo



Johnston et al. 2008

Current methods generally cannot provide [α/Fe] in M31



Ibata et al. 2005

~~Photometric meta[...]ty estimates~~
~~e.g. Kalirai+2006b, Tana[...] Gilbert+2014, Ibata+2014~~

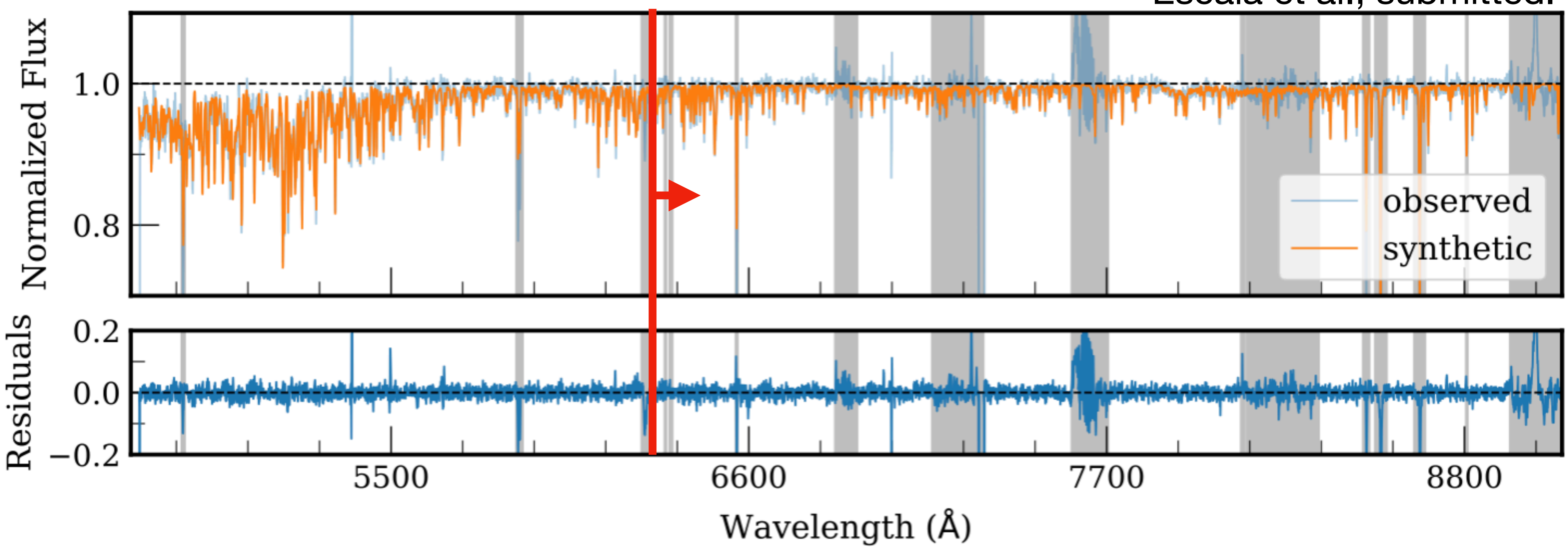
~~Spectroscop[...]ium triplet equivalent wi[...]measurements~~
~~e.g. Chapman+20[...]008~~

Spectral synthesis of ***medium*** resolution spectroscopy ✓
e.g. Vargas+2014a, Vargas+2014b

Moving to low-resolution spectroscopy increases the available abundance information

Keck II/DEIMOS
R ~ 2500 at 7000 Angstroms
Wavelength coverage: ~4500 - 9100 Angstroms

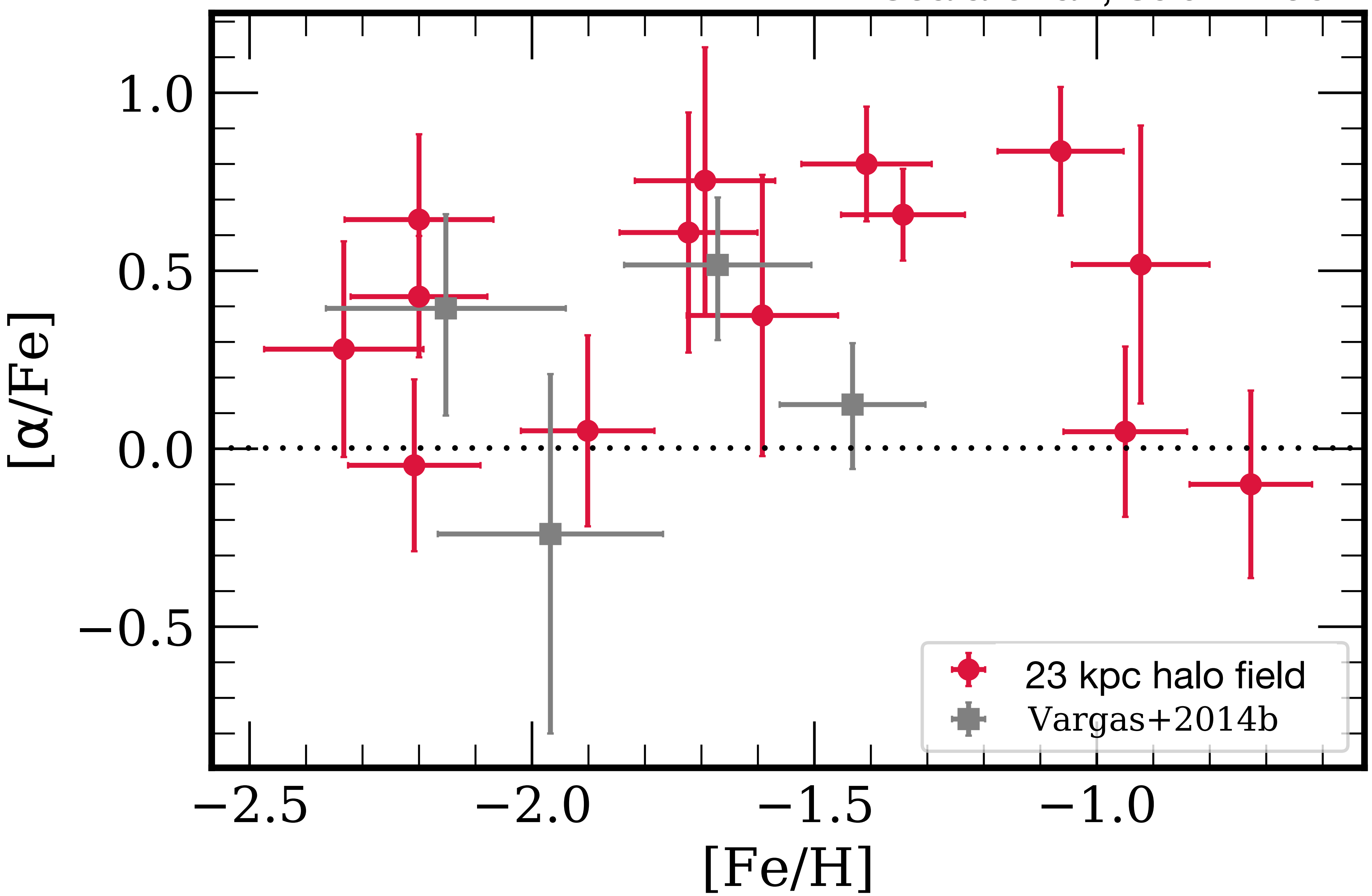
Escala et al., submitted.



Low-resolution => Higher signal-to-noise per pixel for the same exposure time and observing conditions

From 14 M31 RGB stars, we find an α-enhanced halo at 23 kpc

Escala et al., submitted.



This work (23 kpc):
<[α/Fe]> = 0.49 dex
<[Fe/H]> = -1.53 dex

Previous work
(70-140 kpc)
(Vargas+2014b):
<[α/Fe]> = 0.28 dex
<[Fe/H]> = -1.70 dex

We are most likely probing the extended metal-poor halo

The progenitor(s) likely had rapid star formation histories and were accreted early in the history of M31

Extended metal-poor halo
(e.g. Chapman+2006, Gilbert+2012, Ibata+2014):
Low-luminosity, early accreted structures

HST/ACS star formation histories (Brown+2007):
Progenitor(s) with 8-10 Gyr old stars

Similar to MW halo (~0.4 dex),
M31 GCs (0.37 dex),
and old M31 dwarf galaxies (~0.5 dex)
(e.g. Venn+2004, Ishigaki+2012, Colucci+2009,
Vargas+2014a)

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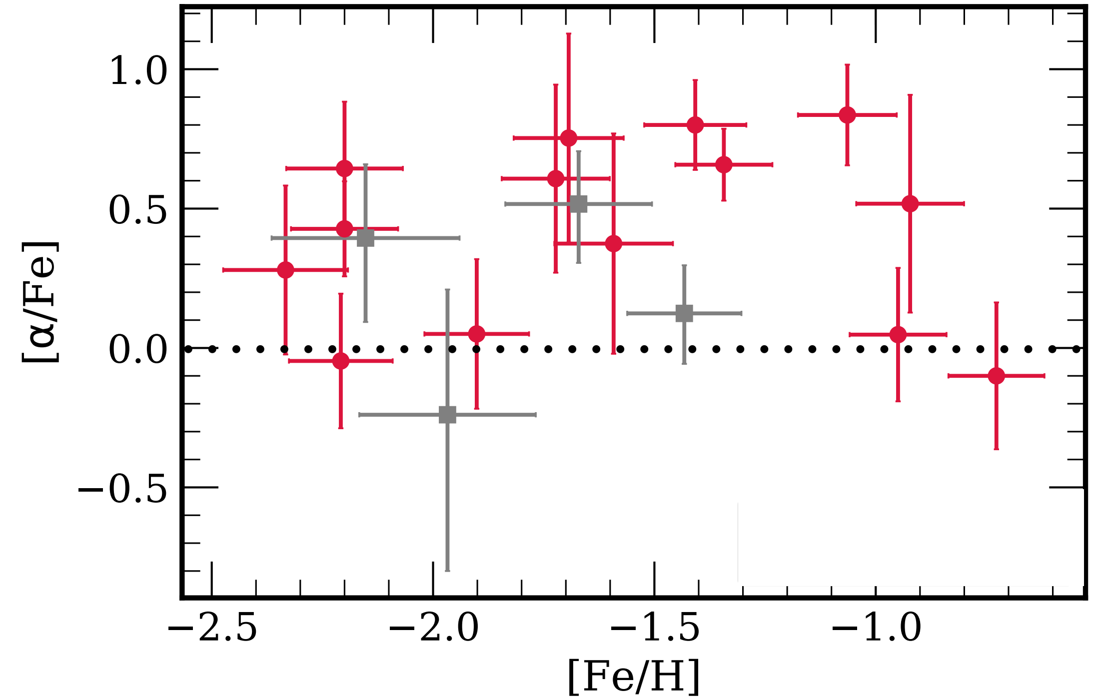
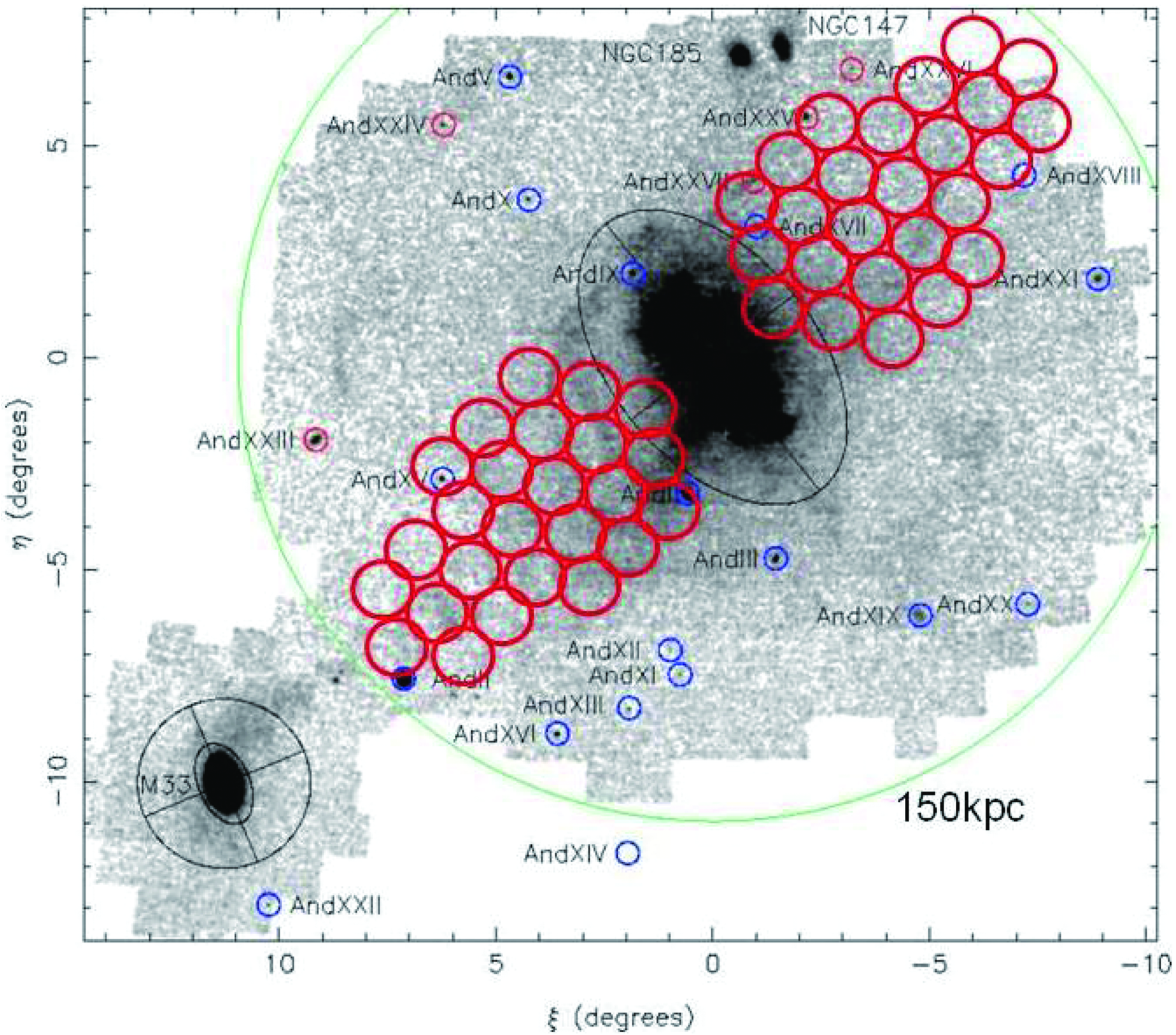


This work: α-enhanced and [Fe/H] poor
=> rapid, truncated star formation for progenitor(s)

Measuring abundances from low- (and medium-) resolution spectra of M31 RGB stars is directly applicable to Subaru PFS

Takada et al. 2014



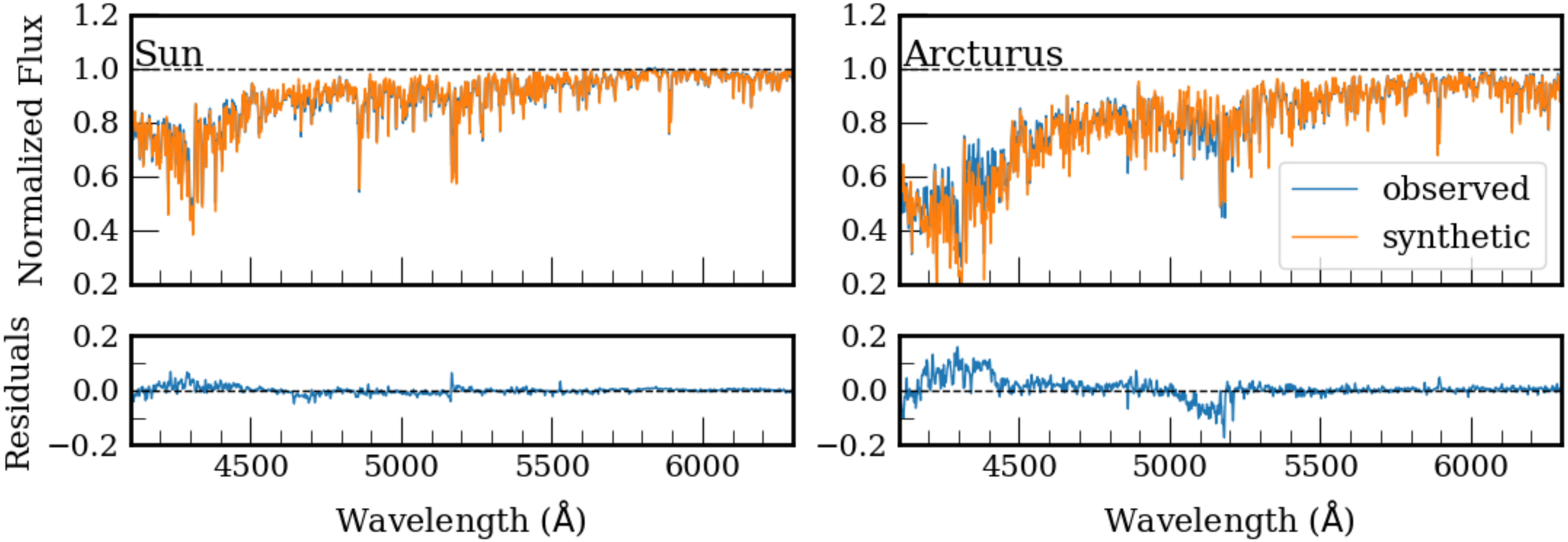
LRS blue arm
(3800 - 6500 Angstroms)

MRS red arm
(7100-8850 Angstroms)

<u>PFS goal:</u>
How does M31 differ from the MW in its merger history?

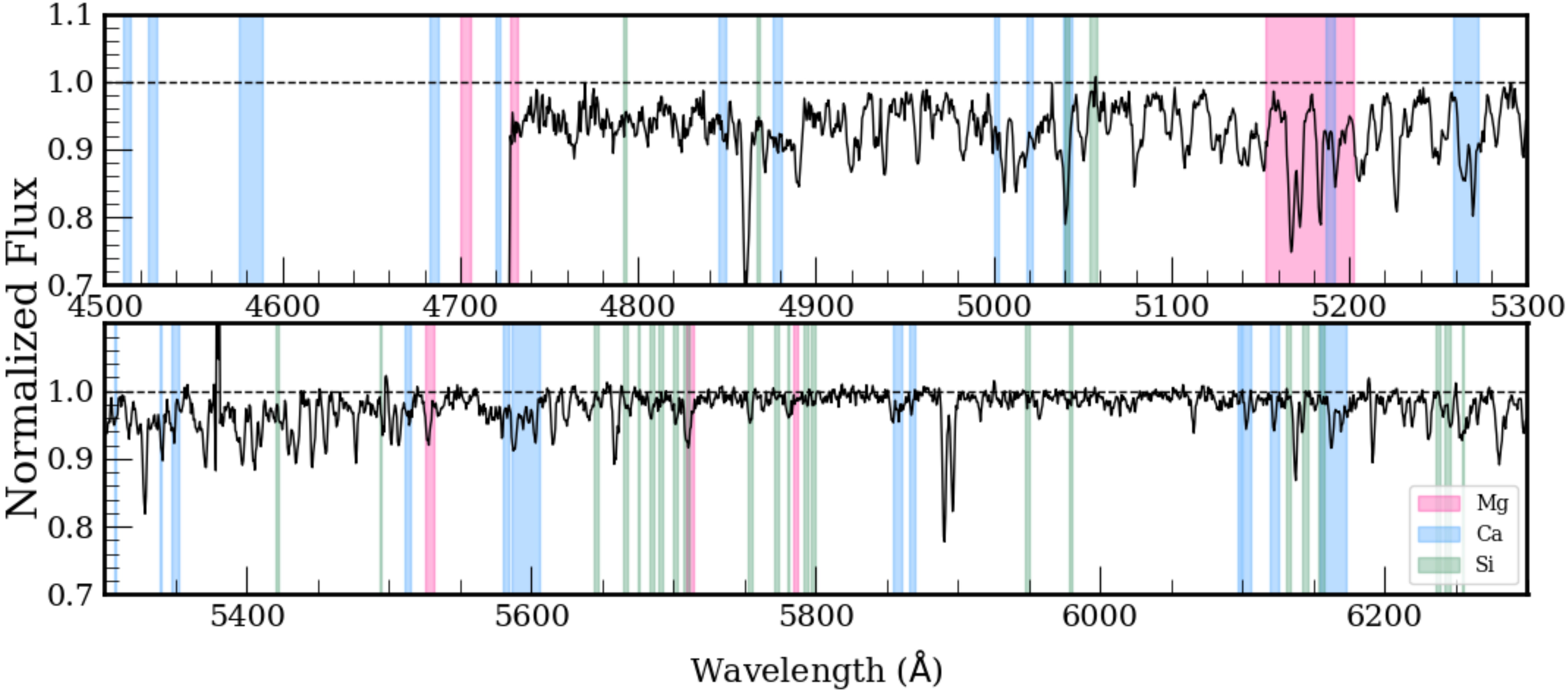
We compare synthetic spectra generated from our line list to high-resolution spectra

Escala et al., submitted

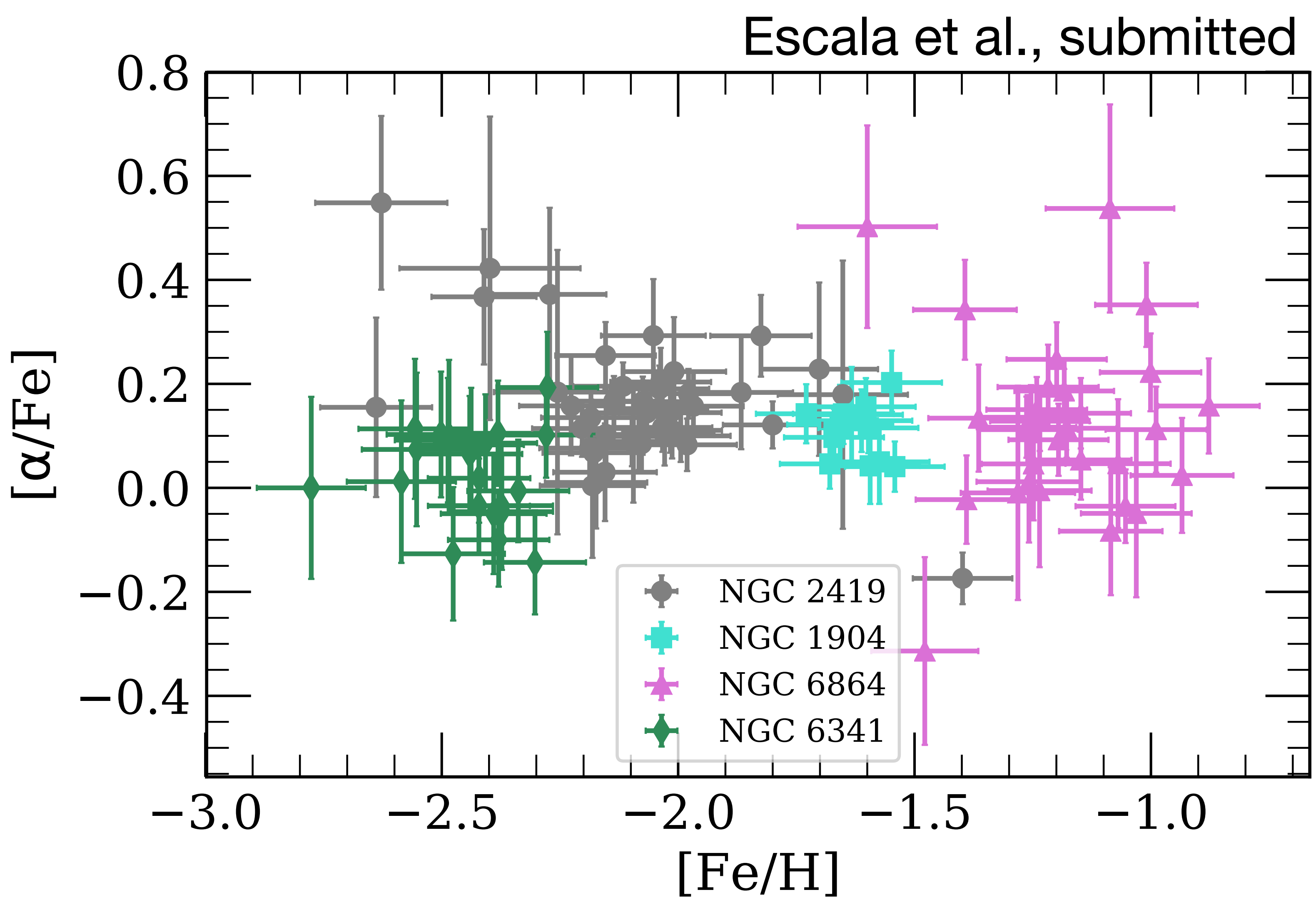


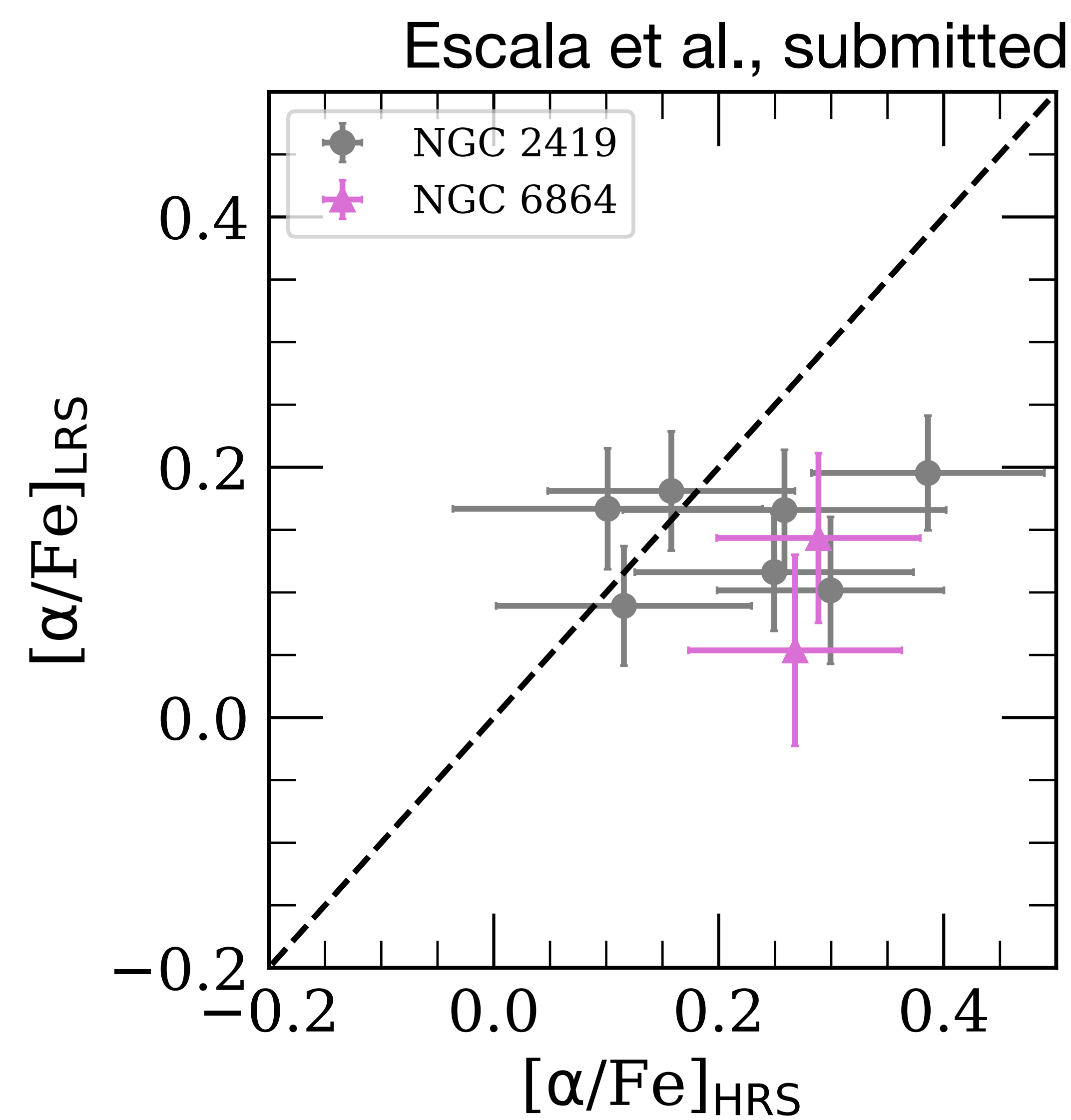
Mean absolute deviation:	8.3×10^{-3}	2.2×10^{-2}

We use spectral regions sensitive to [Fe/H] and [α/Fe] to measure abundances



Using RGB stars in 4 Milky Way globular clusters, we find that our method is robust





Robust to systematic trends (135 stars)

broadly agrees with HRS (9 stars)