Young stellar populations in early-type galaxies from BOSS spectra

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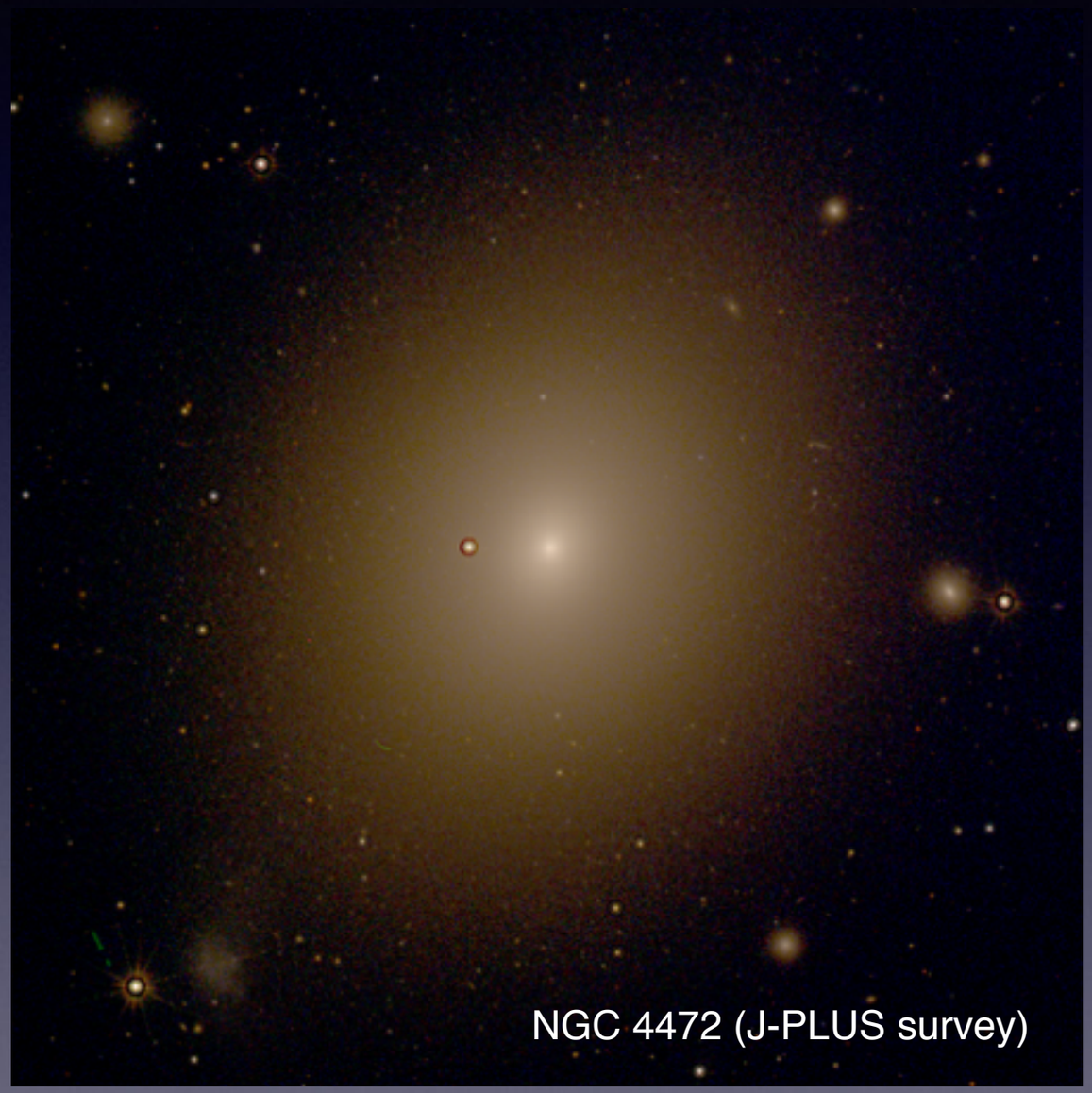
Scientific background


NGC 4472 (J-PLUS survey)

Early-type galaxies

~ 10-20% of the galaxies but contain ~70% of the stellar mass of the Universe.

Stellar populations from spectro/photometric studies using the **OPTICAL/IR**:

- Massive ETGs older and more metal-rich than the lower massive

- They formed the bulk of their stars earlier but faster (<1.5Gyr).

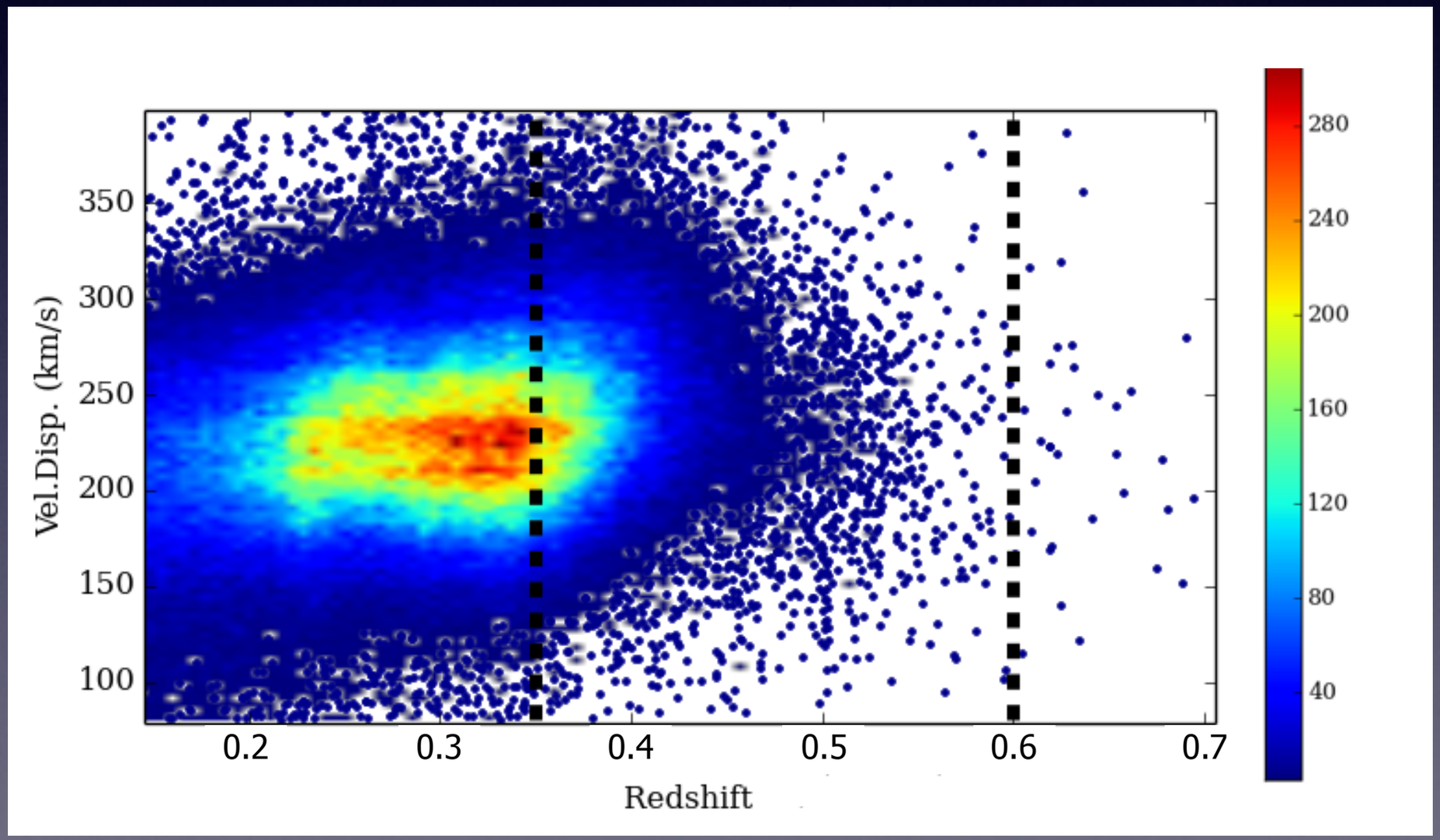
WHAT THE UV CAN REVEAL TO US?

The sample

- SDSS-III DR12 : BOSS survey (fibers 2”)
- Spectrograph: 360nm - 10000nm (fibers)
- Luminous Red Galaxies

Selection criteria:

z = 0.35 - 0.6



The sample

individual BOSS spectra have low SNR

Selection criteria:

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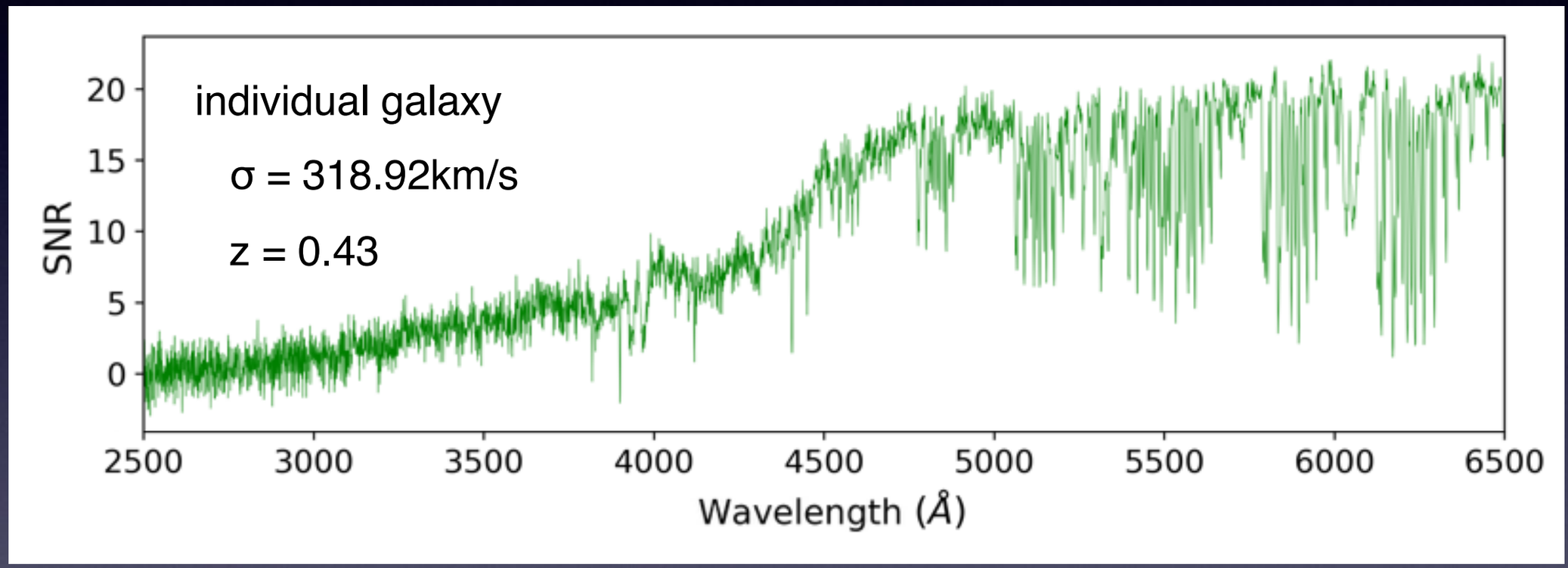

The sample

7 bins (in σ) of stacked spectra with very high S/N
within the range: $240 < \sigma < 320$ km/s

Selection criteria:

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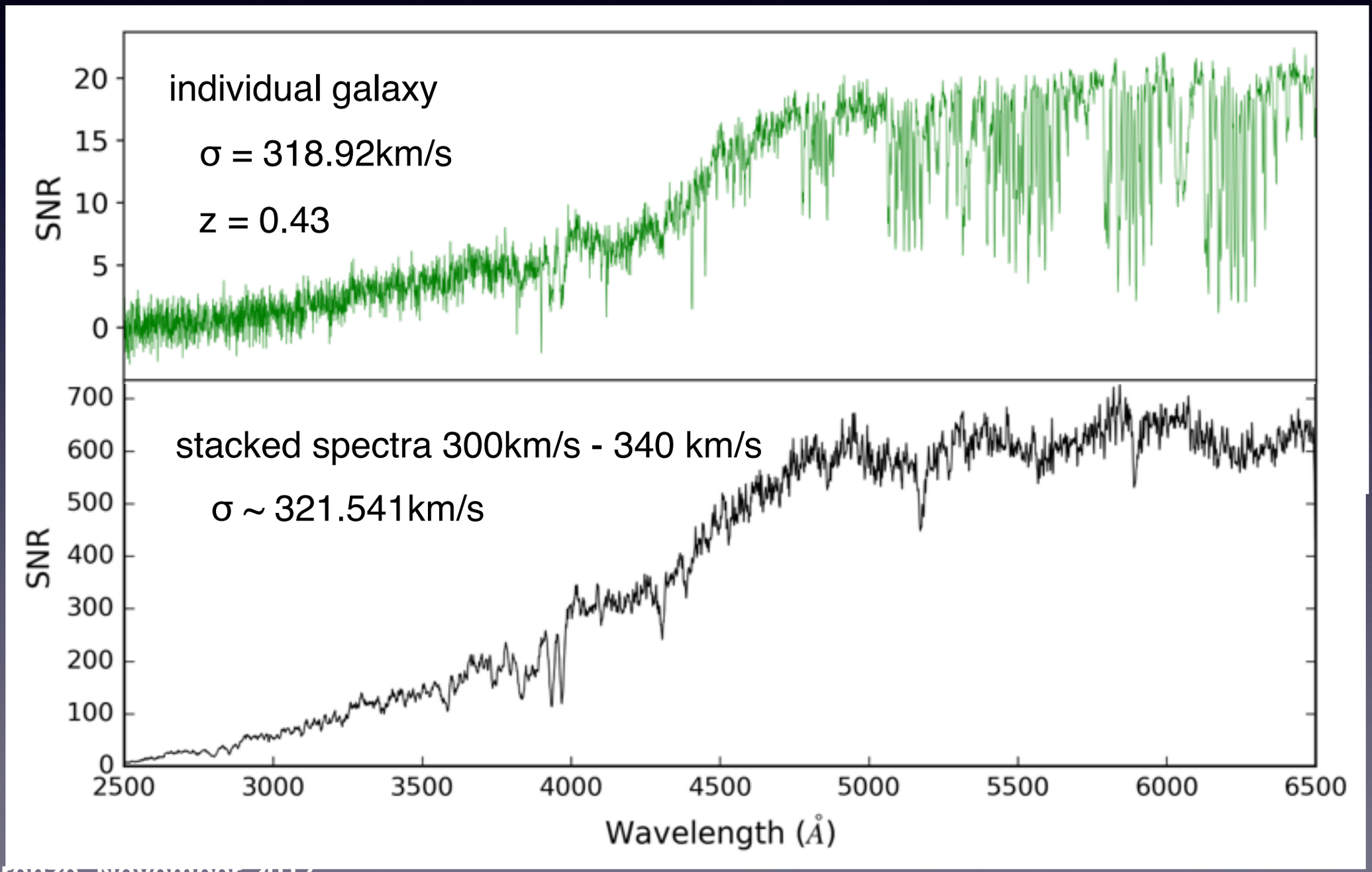
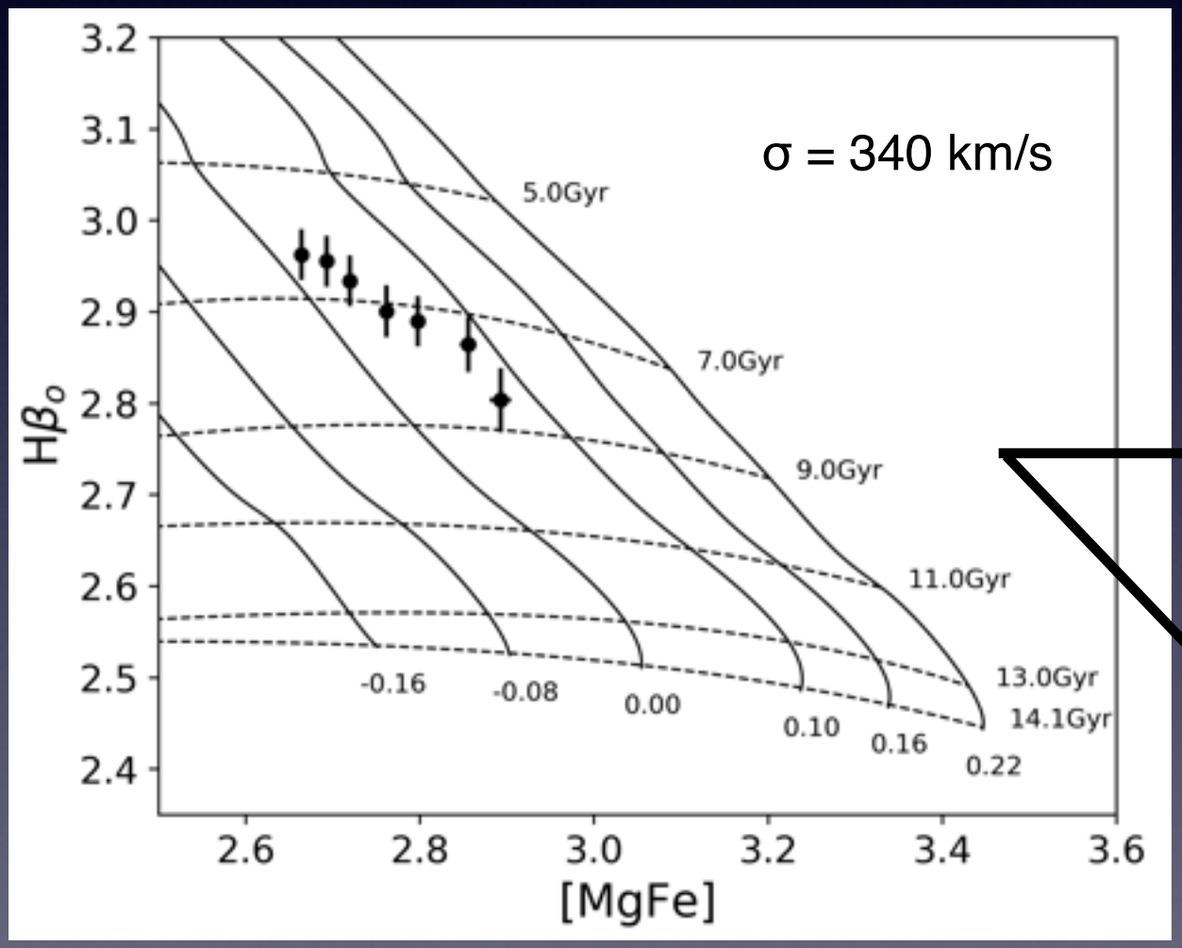


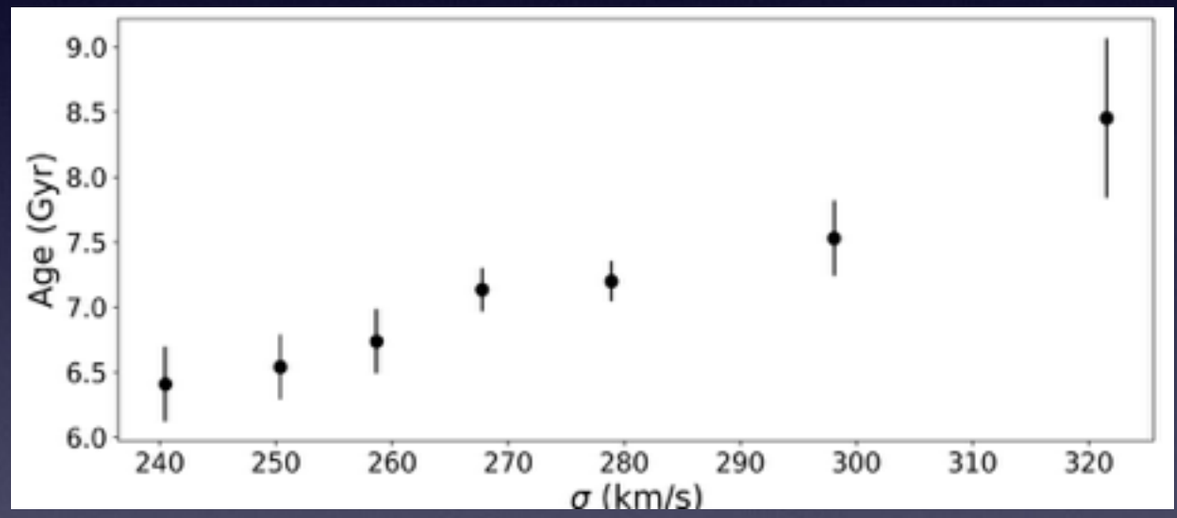
Stacked spectra SSP properties

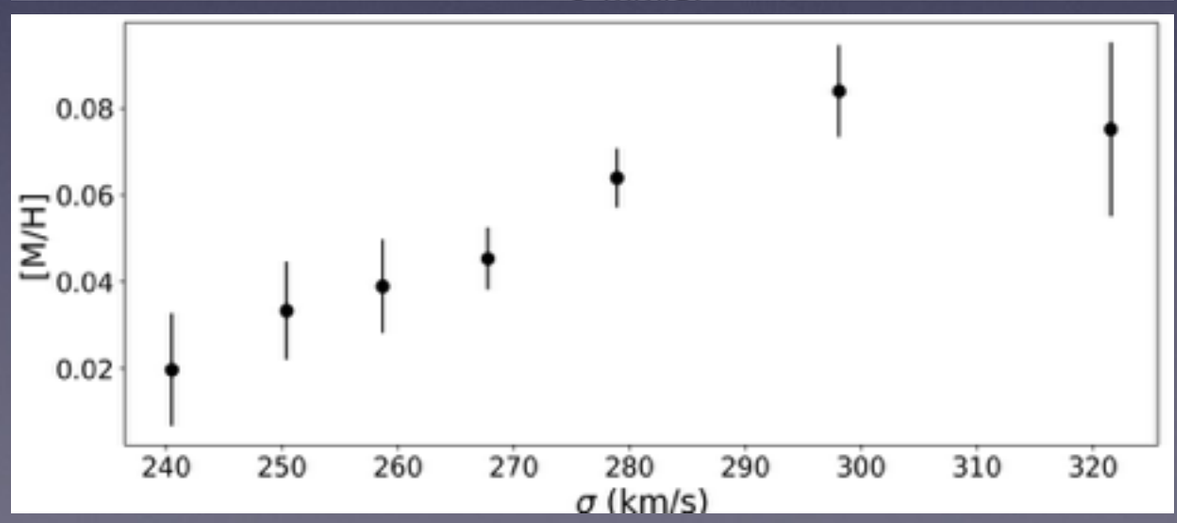
Extended E-MILES SSP models (0.17μm - 5μm) Vazdekis et al. 2016



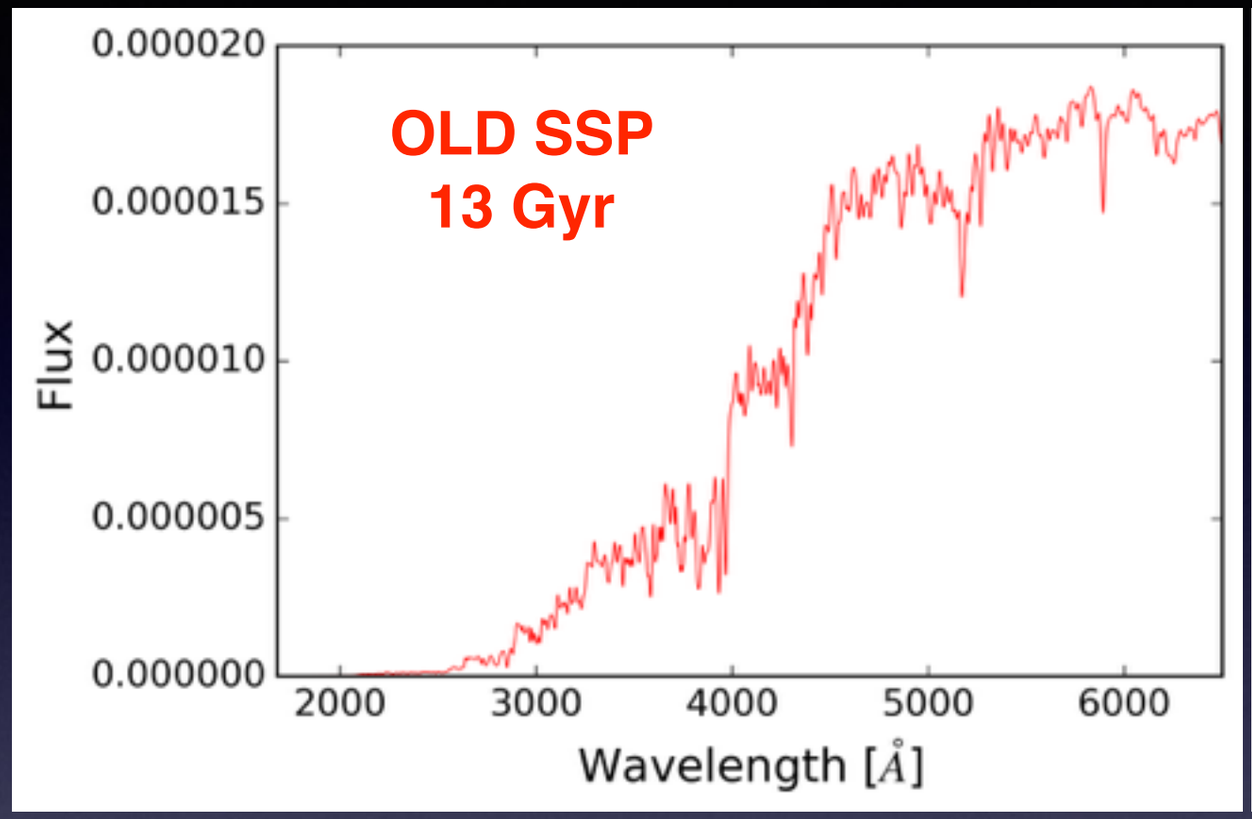
Salvador-Rusiñol et al. in prep

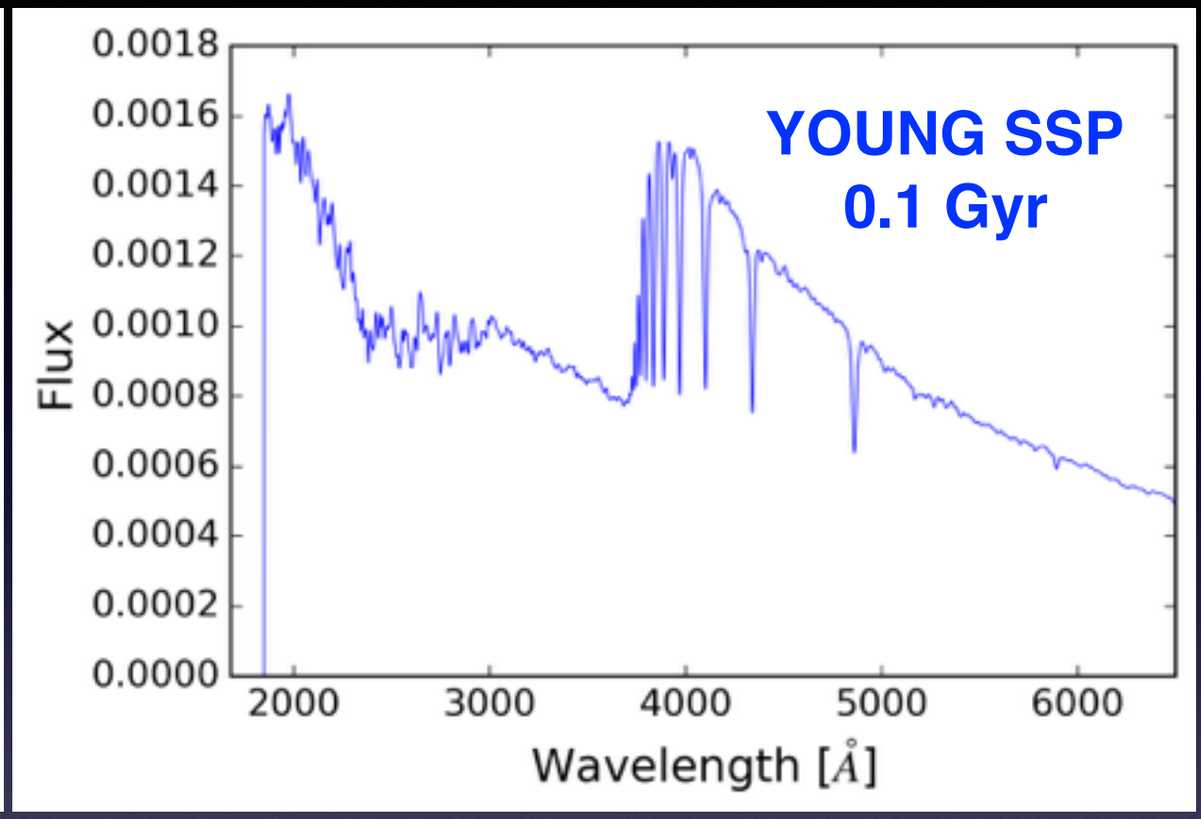
mean luminosity-weighted age





Why UV spectral features?





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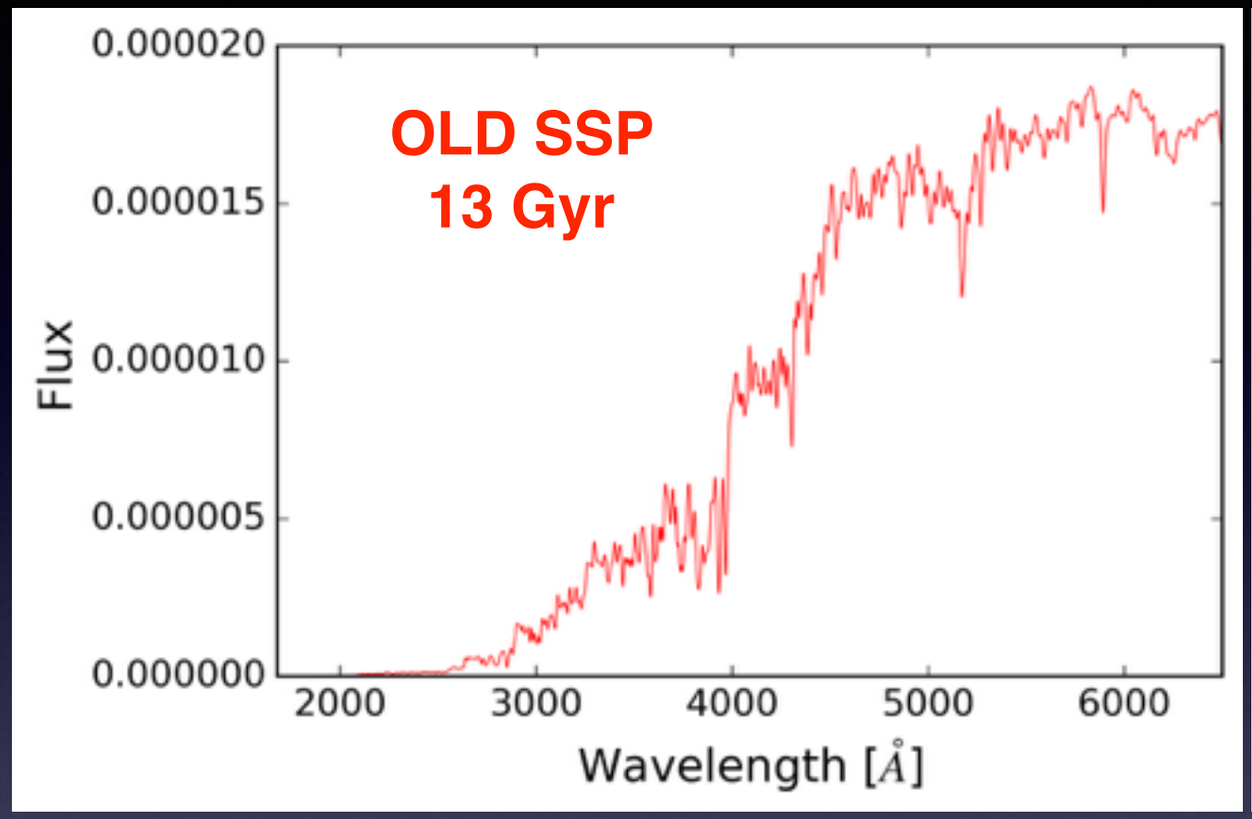
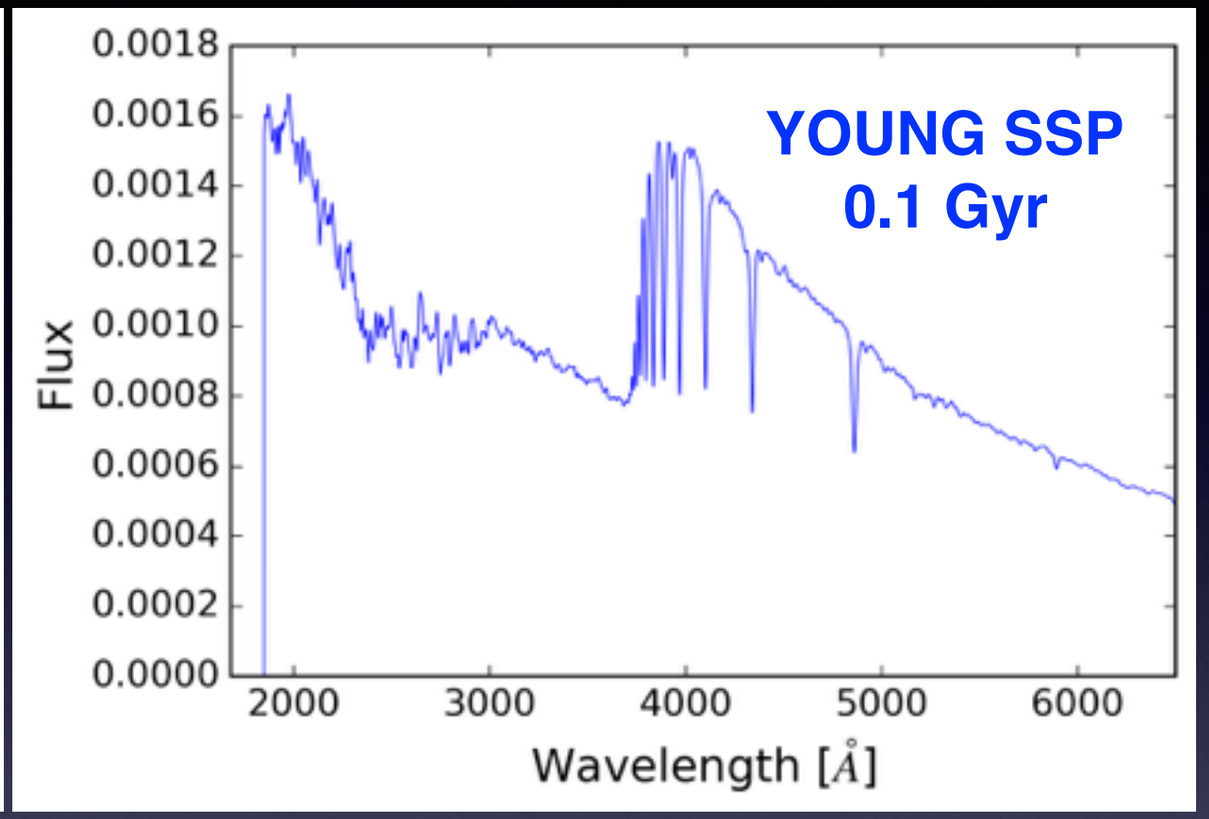
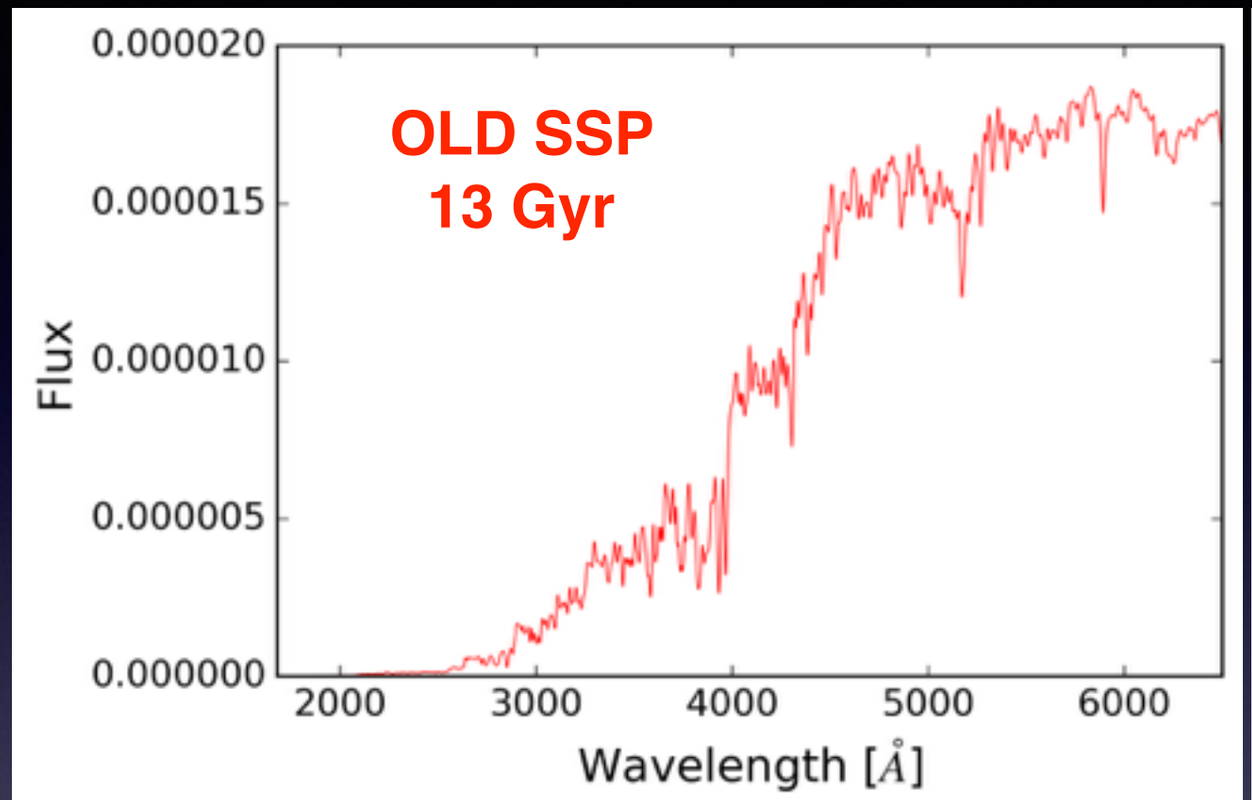
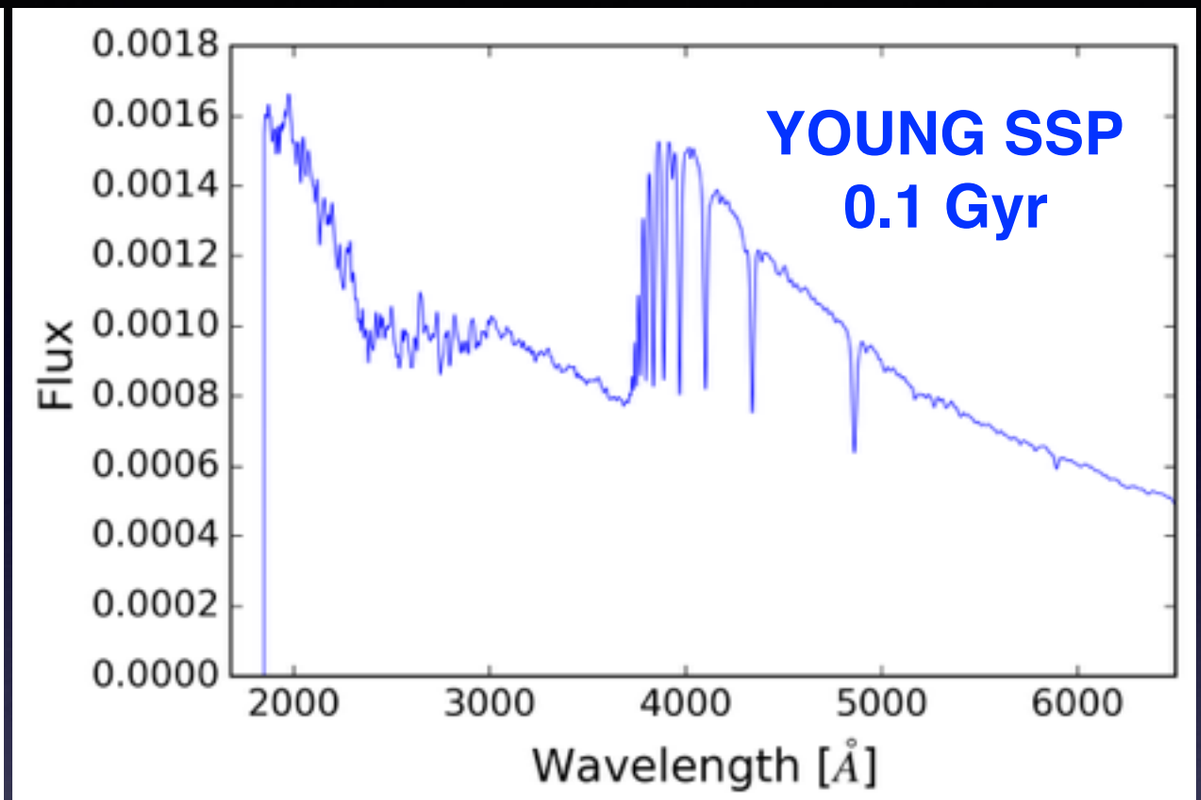




$99.9\%SSP_{13Gyr} + 0.1\%SSP_{0.11Gyr}$

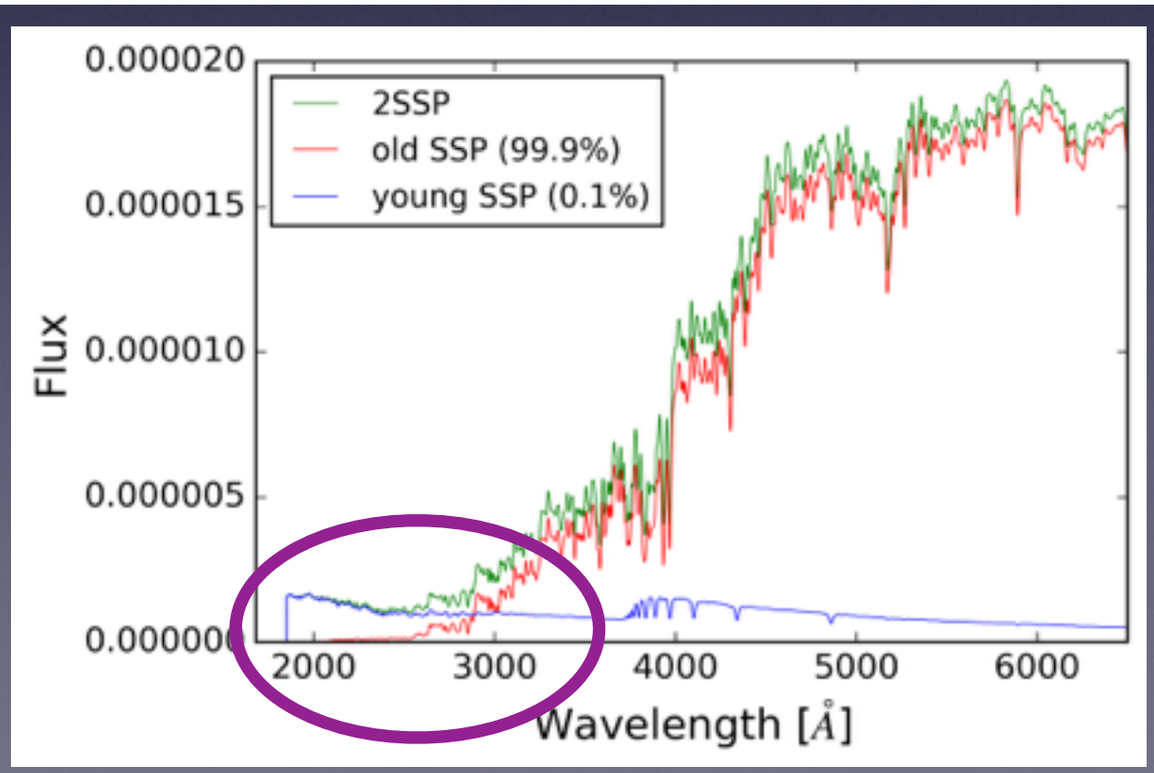
Why UV spectral features?



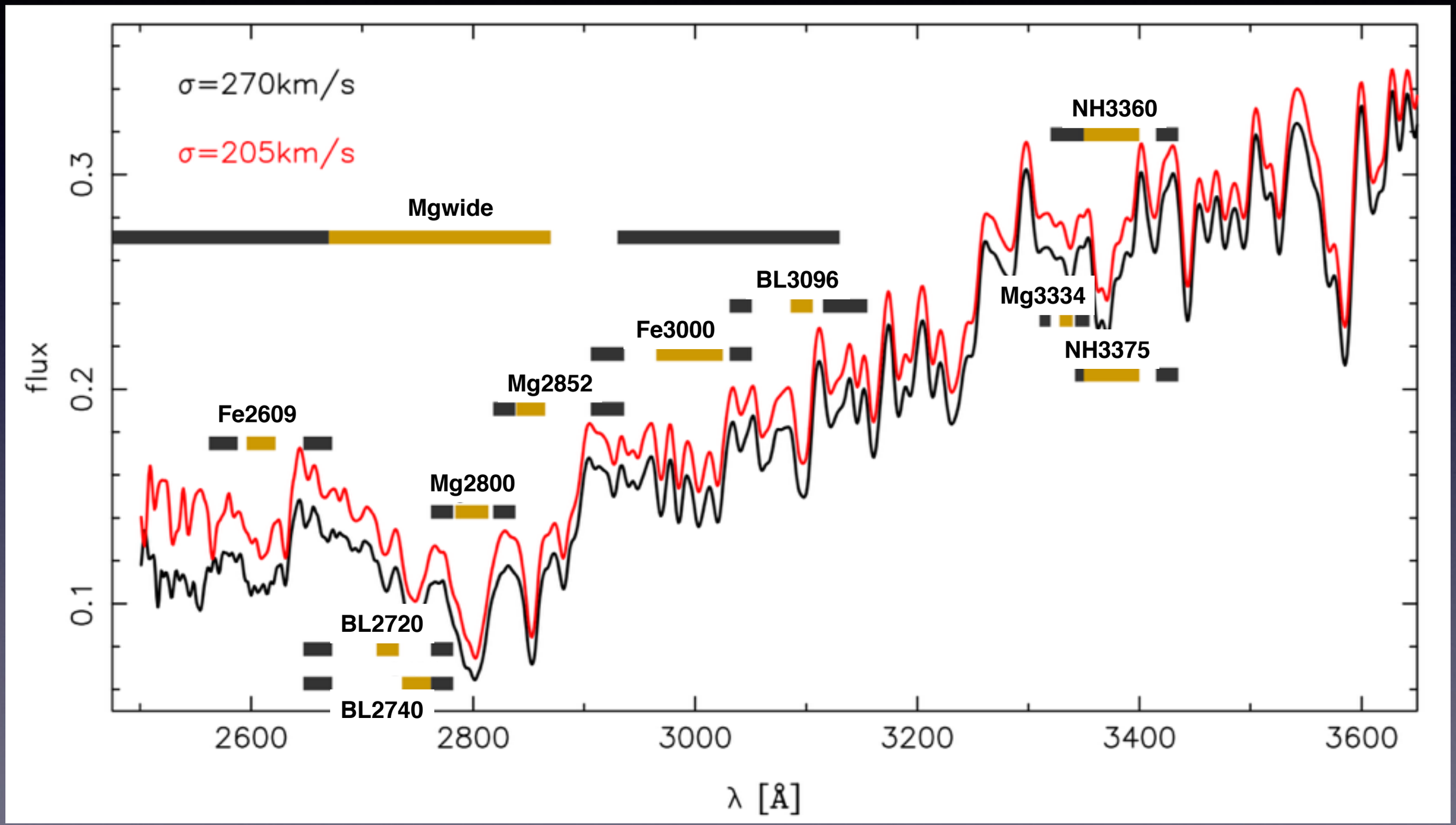


99.9%SSP$_{13Gyr}$ + 0.1%SSP$_{0.11Gyr}$

The UV is extremely sensitive to very small (< 1%) contributions from stellar populations with ages < 1Gyr



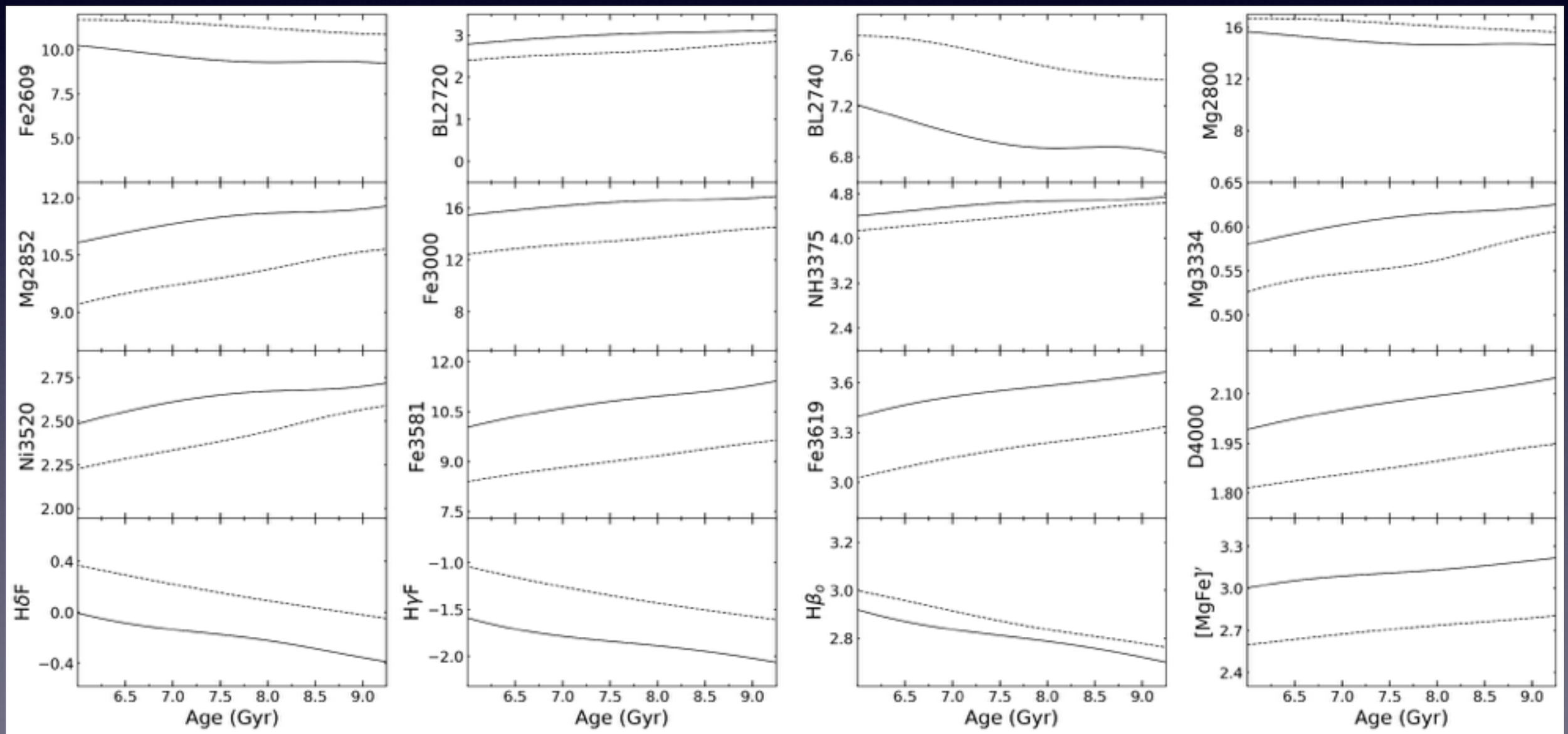
UV line-strength indices



UV line-strength indices

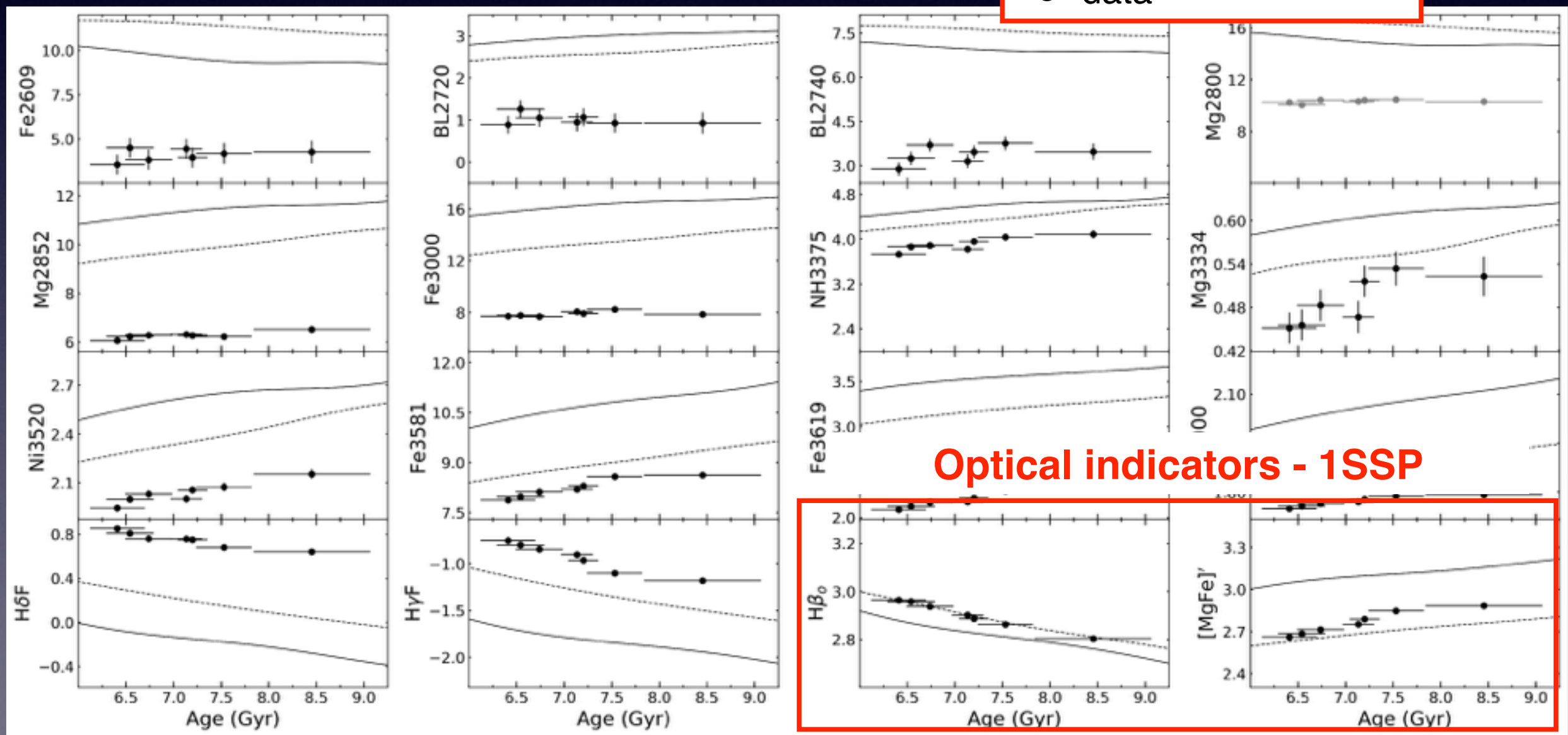
E-MILES SSP models Vazdekis et al. 2016

−− 1SSP [M/H] = +0.0
—— 1SSP [M/H] = +0.22



UV line-strength indices

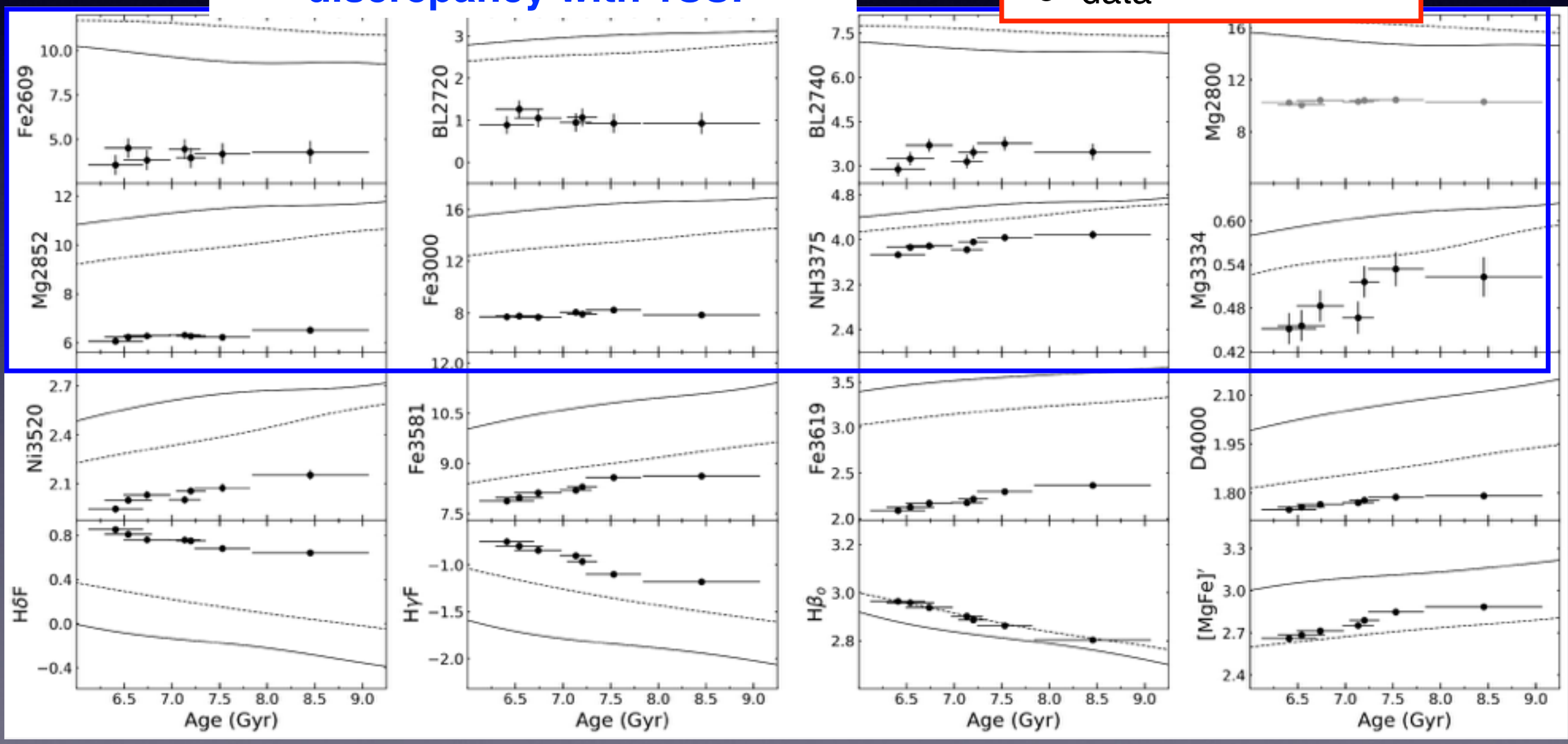
E-MILES SSP models Vazdekis et al. 2016



UV line-strength indices

E-MILES SSP models Vazdekis et al. 2016

UV indicators show discrepancy with 1SSP

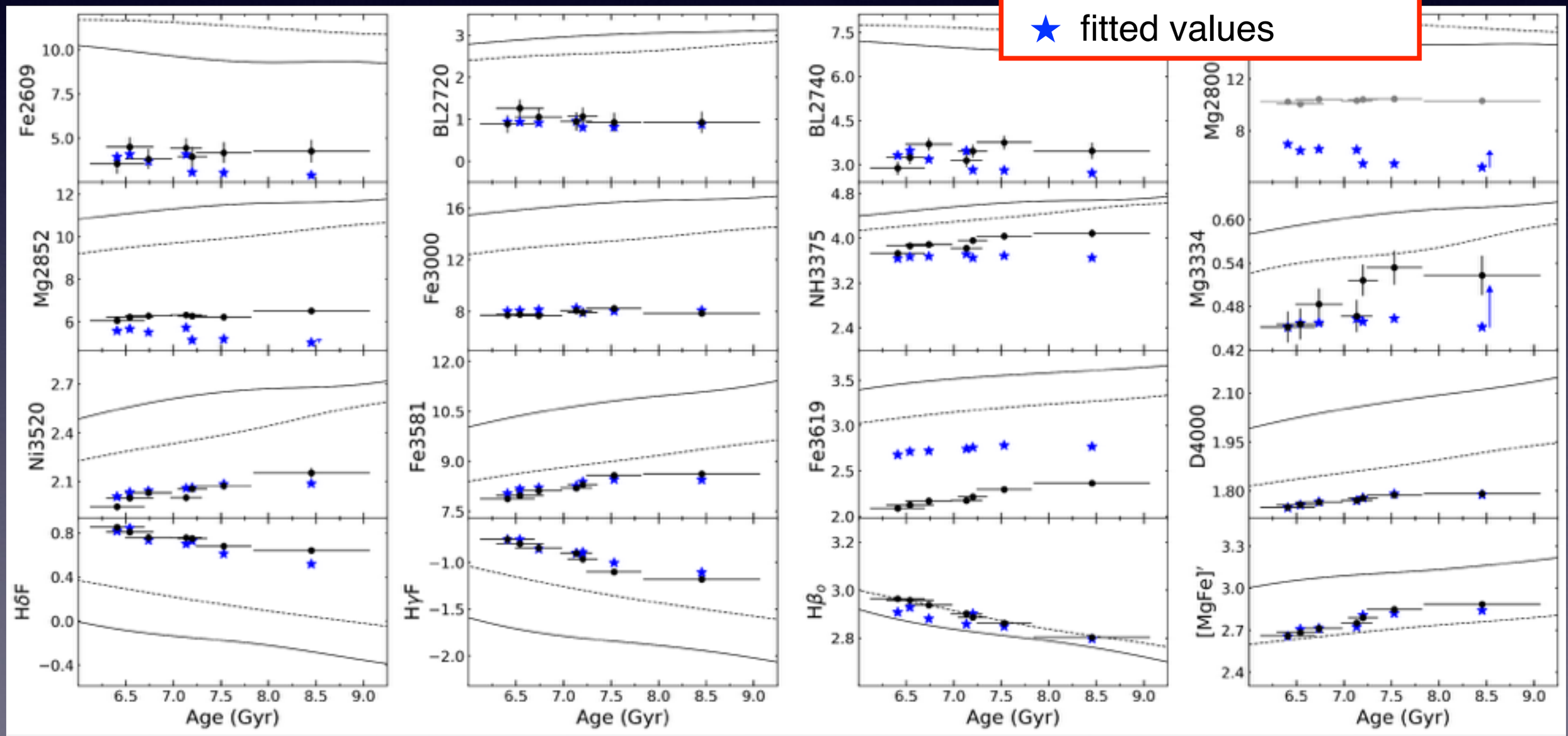


Young stellar component

2SSP = f_o·SSP$_o$ + (1-f_o)·SSP$_y$

E-MILES SSP models Vazdekis et al. 2016

Salvador-Rusiñol et al. in prep



Young stellar component

$2SSP = f_o \cdot SSP_o + (1-f_o) \cdot SSP_y$

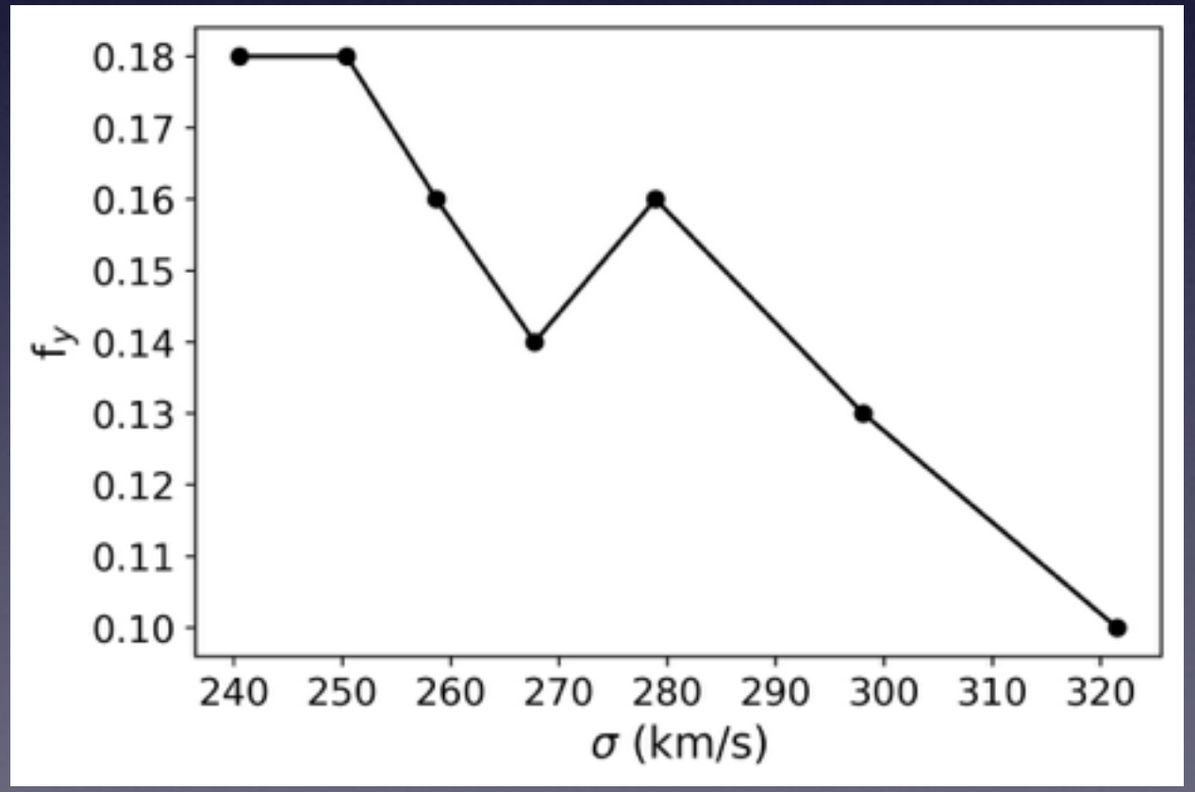
Fits for the optical/UV indices suggest these young mass-fractions:

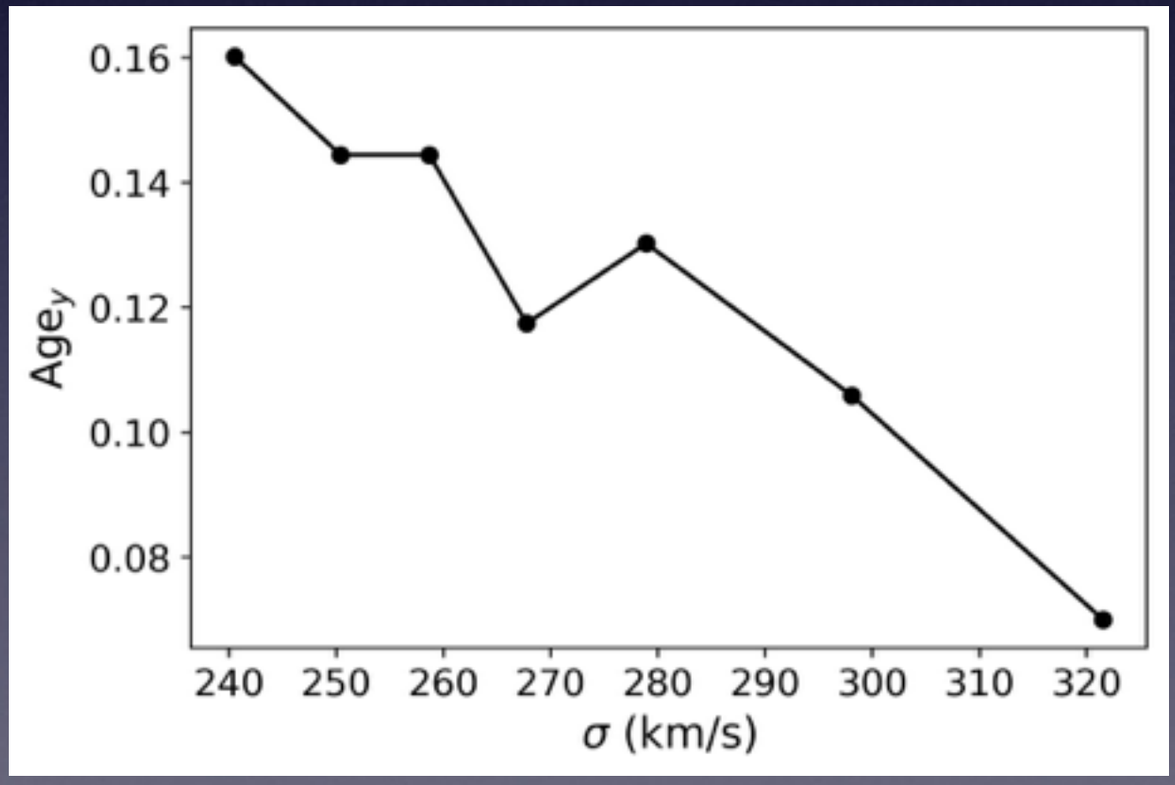
σ=320kms–1 (0.09%, 0.08Gyr)

σ=240kms–1 (0.18%, 0.16Gyr)

→

Upper limit of a young stellar component. Consistent with residual SF





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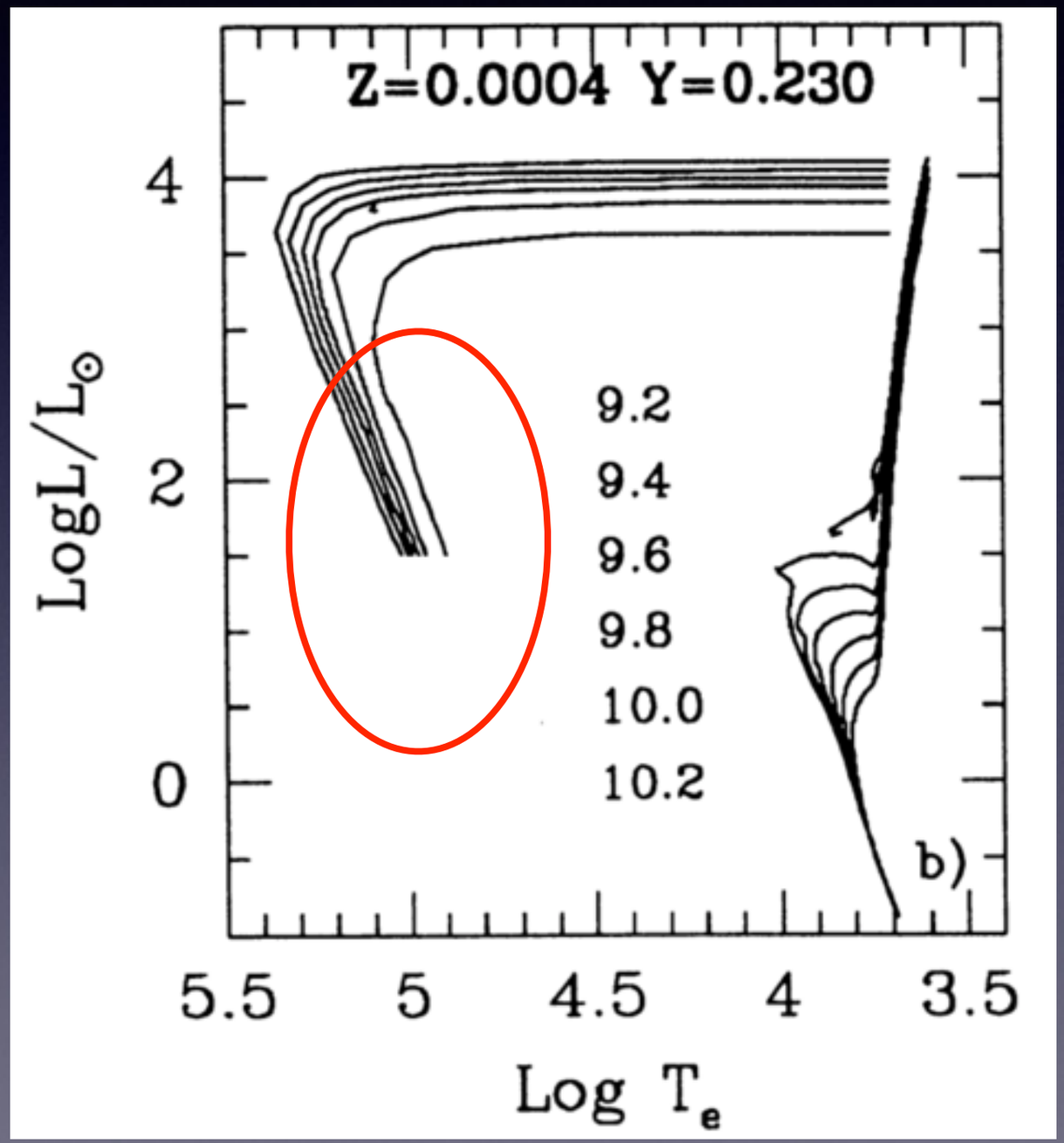
Hot PAGB star component

SSP$_o$ + hot PAGB star



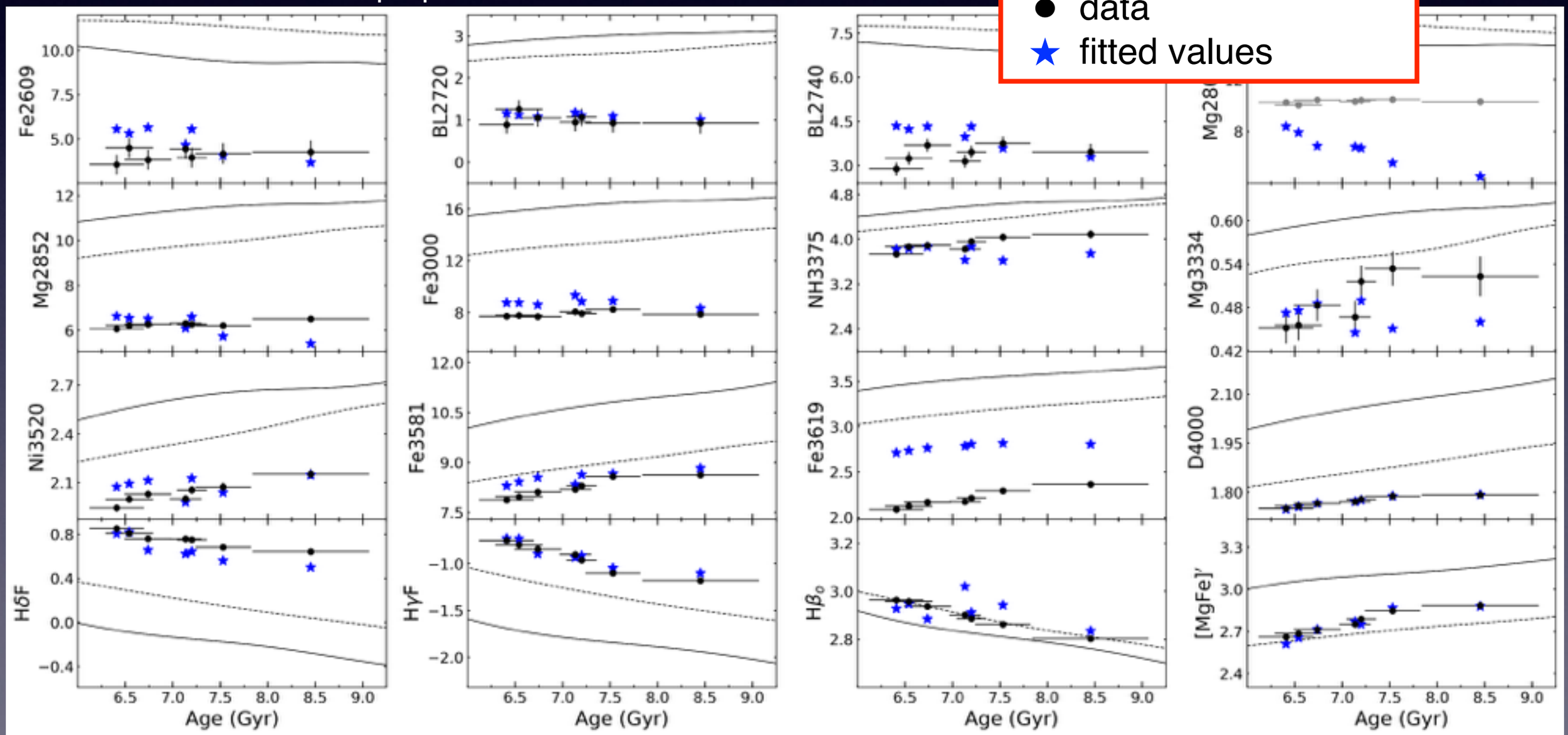
Bertelli et al. 1994

Hot PAGB star component

SSP$_o$ + hot PAGB star

E-MILES SSP models Vazdekis et al. 2016

Salvador-Rusiñol et al. in prep



Hot PAGB star component

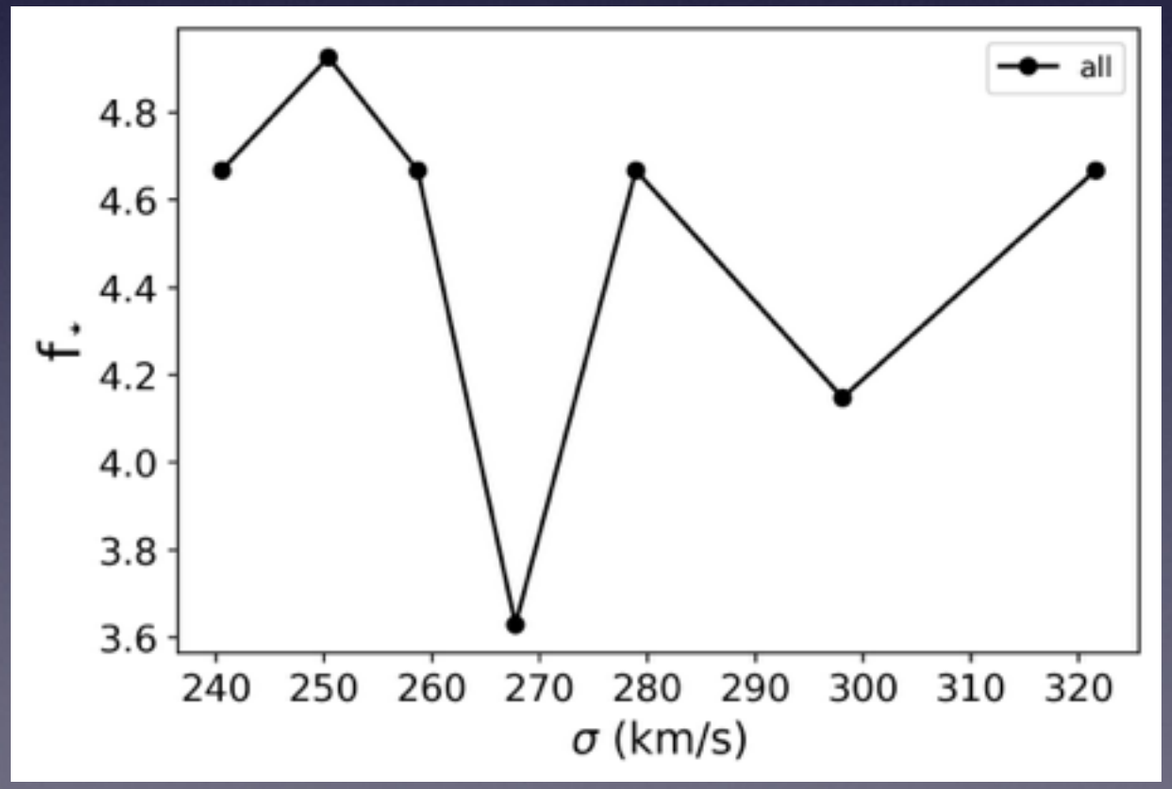
SSP$_o$ + hot PAGB star

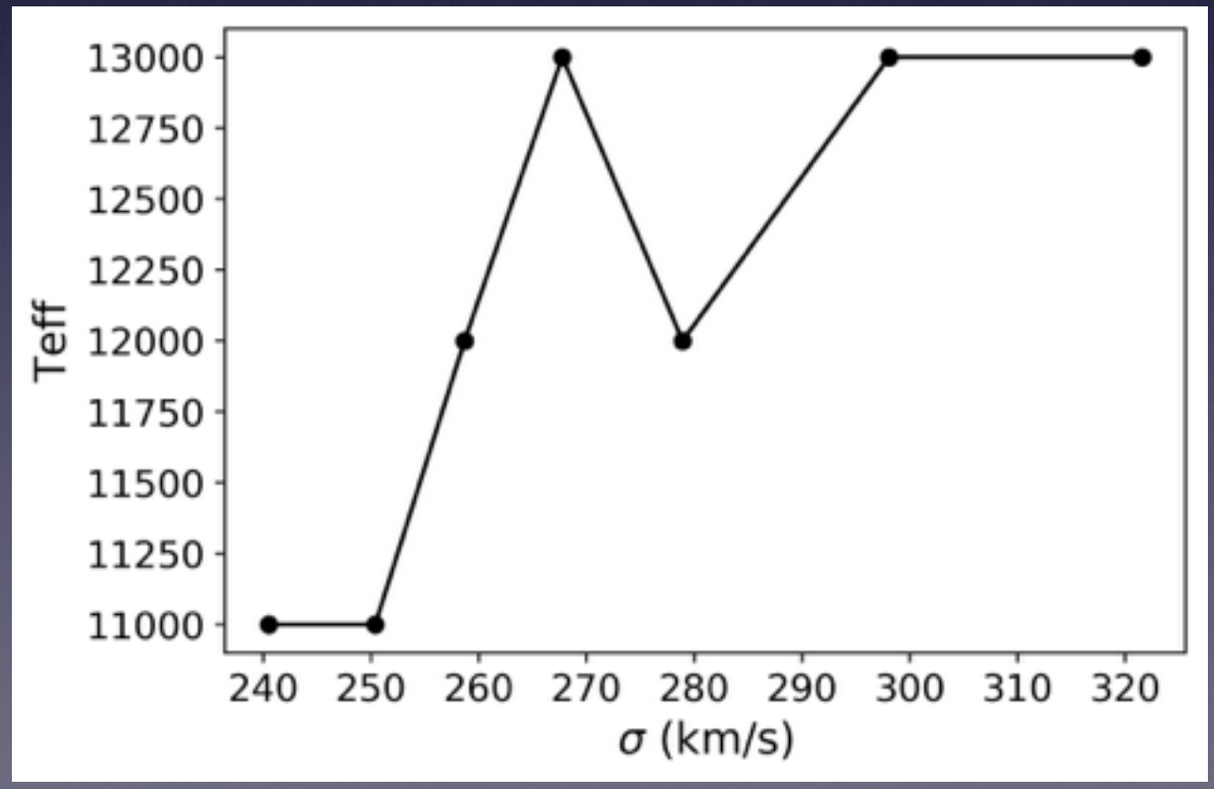
E-MILES SSP models Vazdekis et al. 2016

Fits for the optical/UV indices suggest a light contribution of a PAGB stellar component

σ=320kms−1 (4.6%, Teff = 13000K)

σ=240kms−1 (4.6%, Teff = 11000K)





Conclusions

Since the UV spectral range is very sensitive to the young stellar populations…

- Tiny mass fractions of **0.1-0.18% of stellar components with ages 0.08-0.16 Gyr** are required on the top of a dominant old stellar population to be able to fit the line-strengths in the UV and in the optical.

- These numbers should be understood like an **upper limit of the contribution of a young population** and are consistent with residual star formation over time and these ages as the mean luminosity-weighted age of the young component.

- Maybe a contribution of a hot PAGB star is playing a role, but could be the case that ETGs have contribution of young population and also hot stars.