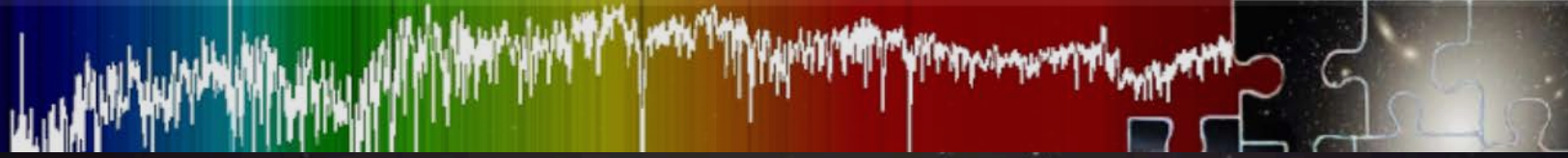
ULTRAVIOLET ASTRONOMY IN THE XXI CENTURY

e-Workshop 2020 – October 27-29



Young stellar populations in massive early-type galaxies from UV spectroscopy

Universidad de La Laguna

Núria Salvador Rusiñol

NUVA Virtual meeting, October 27th – 29th 2020

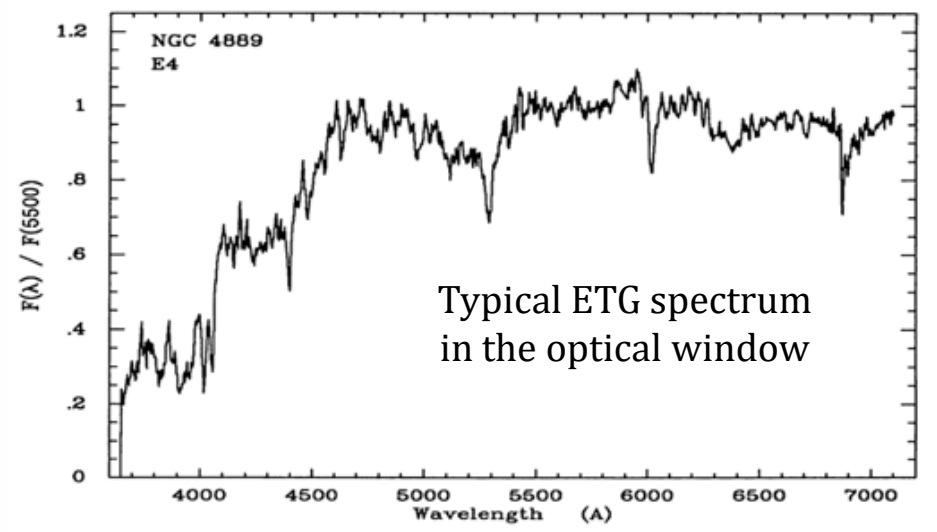
Stellar populations in Early-Type Galaxies (ETGs)

Image: M87 elliptical galaxy in Virgo

The bulk of their stars was formed at high redshift (z>2)

They are dominated by old stellar pops.

Thus, their luminosity contributes mainly in the optical range



Typical ETG spectrum
in the optical window

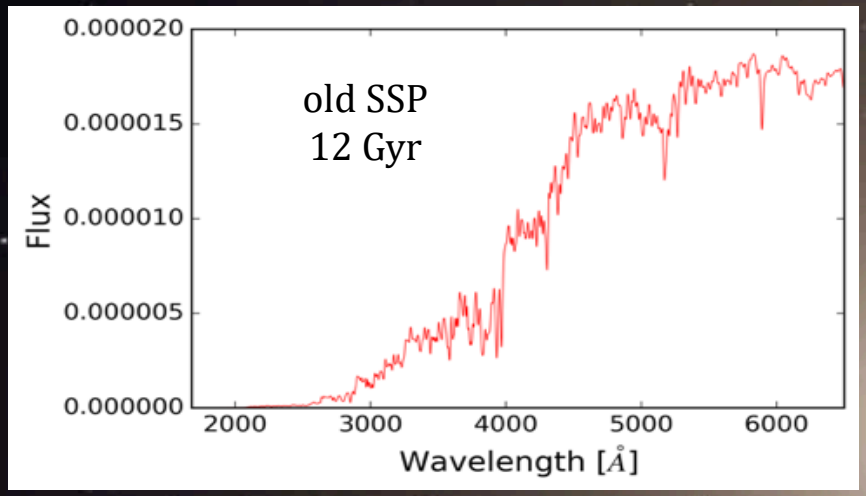
Do ETGs host young stars?

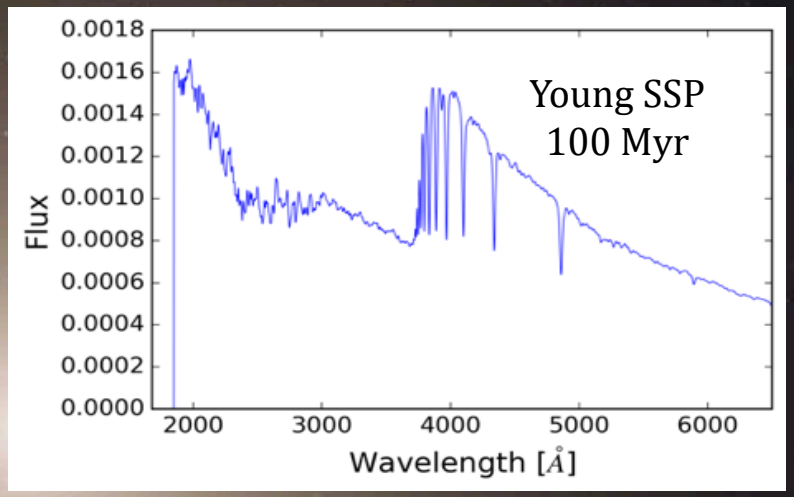
↓

UV spectral range

The ultraviolet spectral range

E-MILES single stellar population (SSP) models miles.iac.es Vazdekis et al. 2016





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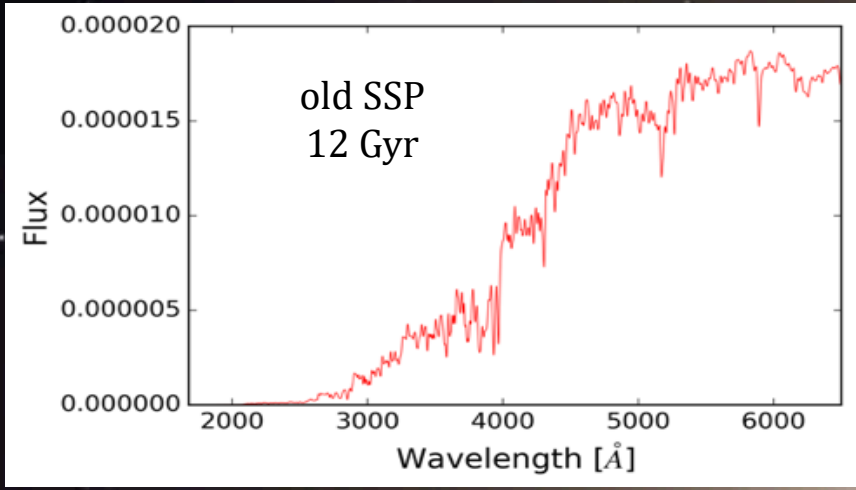
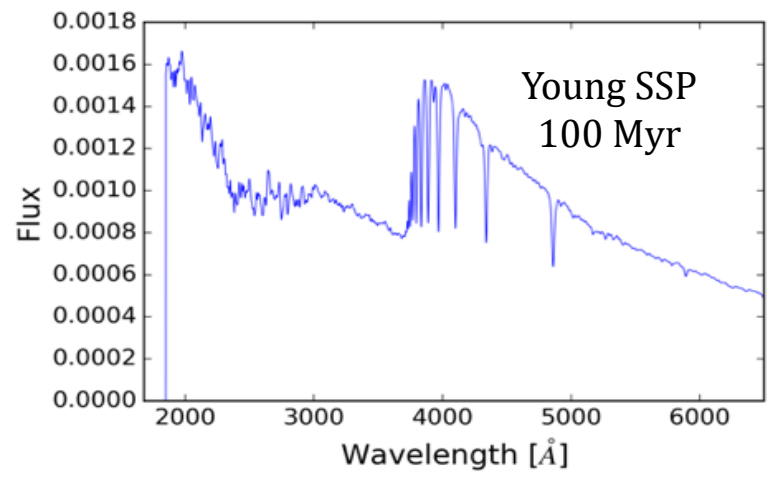
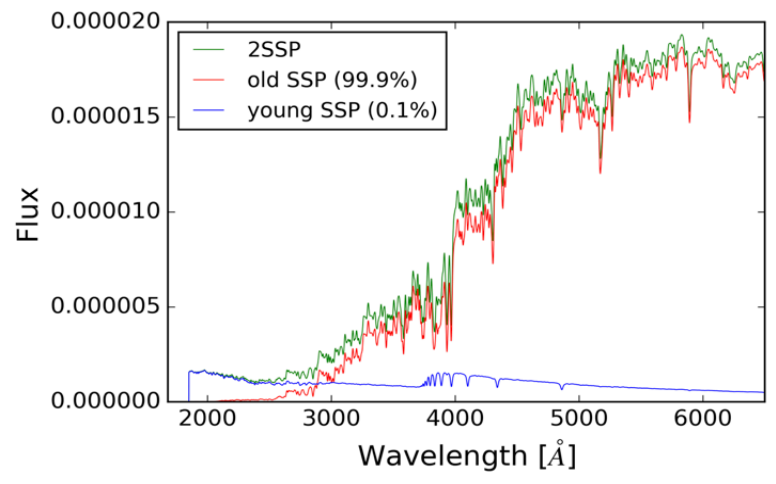




2SSPs = 99.9%SSP_{12Gyr} + 0.1%SSP_{100Myr}



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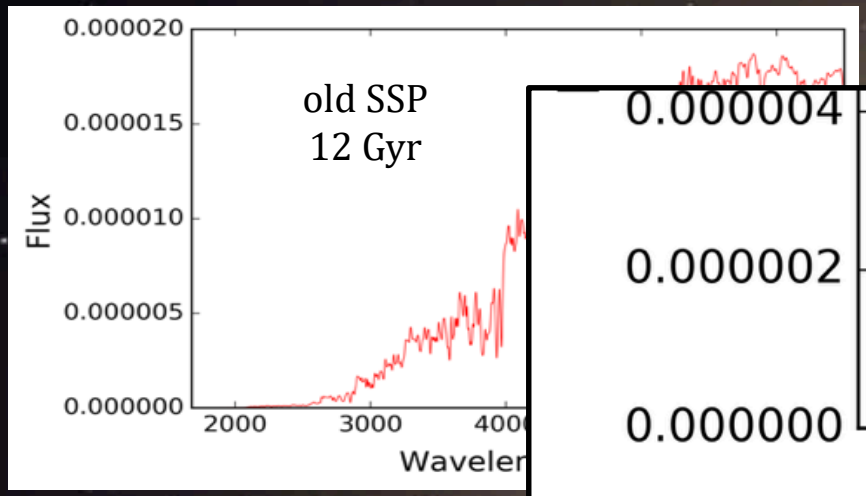
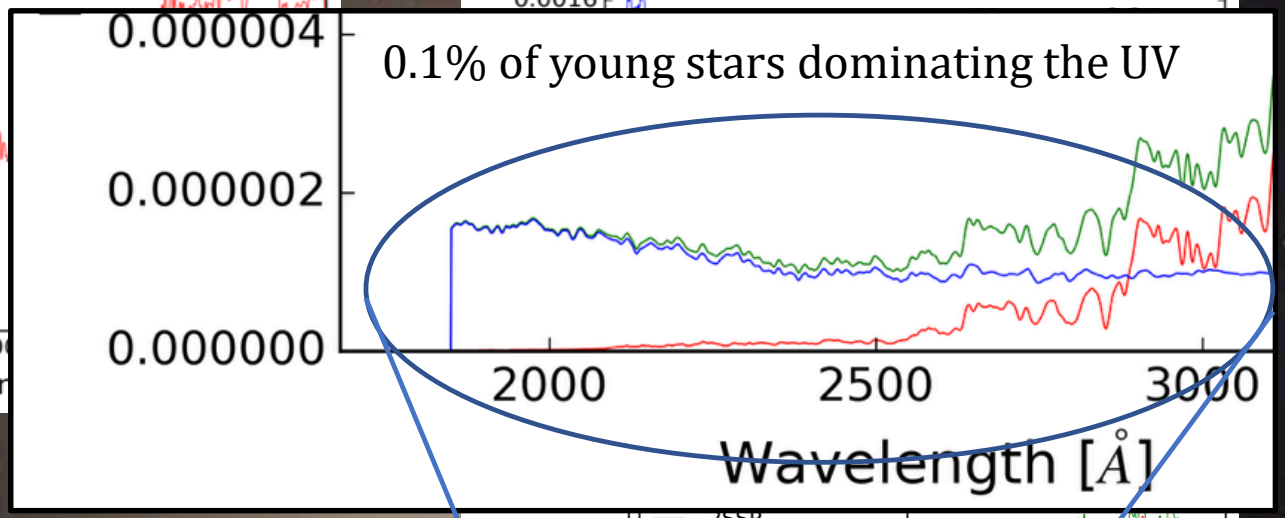




2SSPs = $99.9\%SSP_{12Gyr}$ + $0.1\%SSP_{100Myr}$

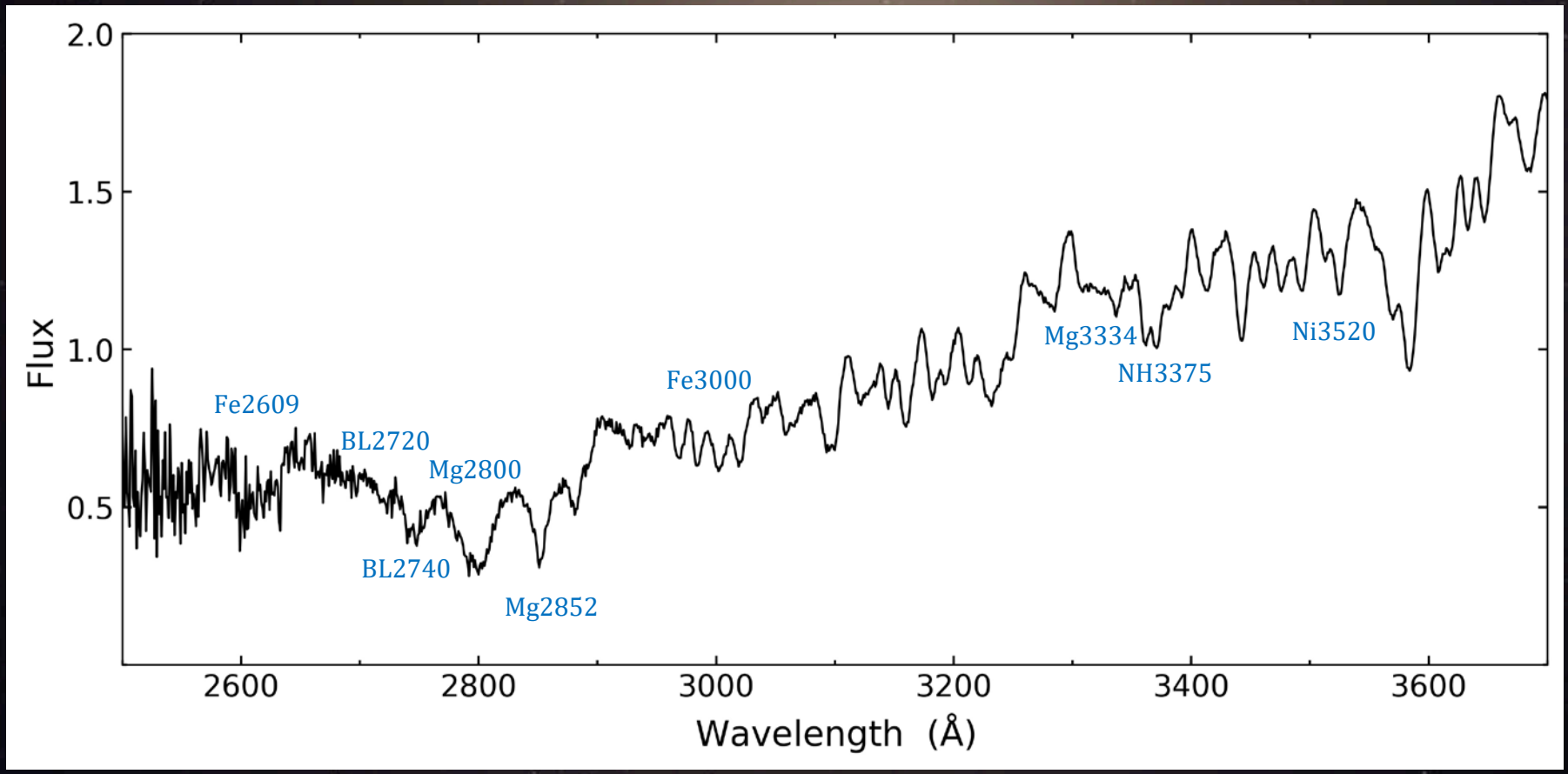
The UV is an excellent tracer of young stars,

even from very old systems such as ETGs

Methodology

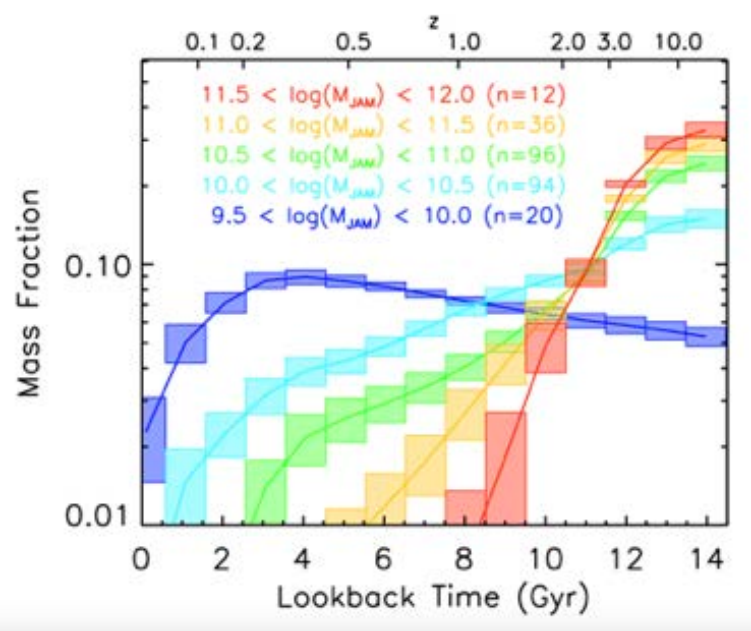
GOAL

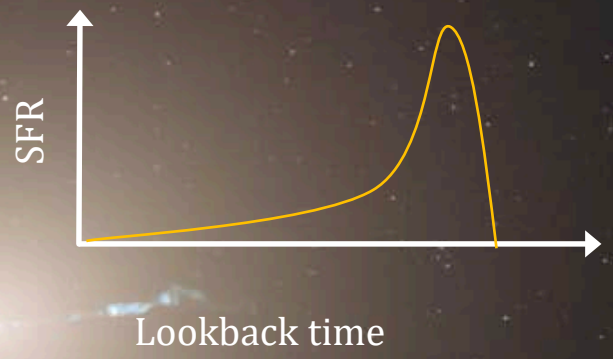
To constrain the young stellar component of massive ETGs by analysing the NUV absorption line indices from their integrated spectra



Methodology

Modelling approaches of the SFH for massive ETGs

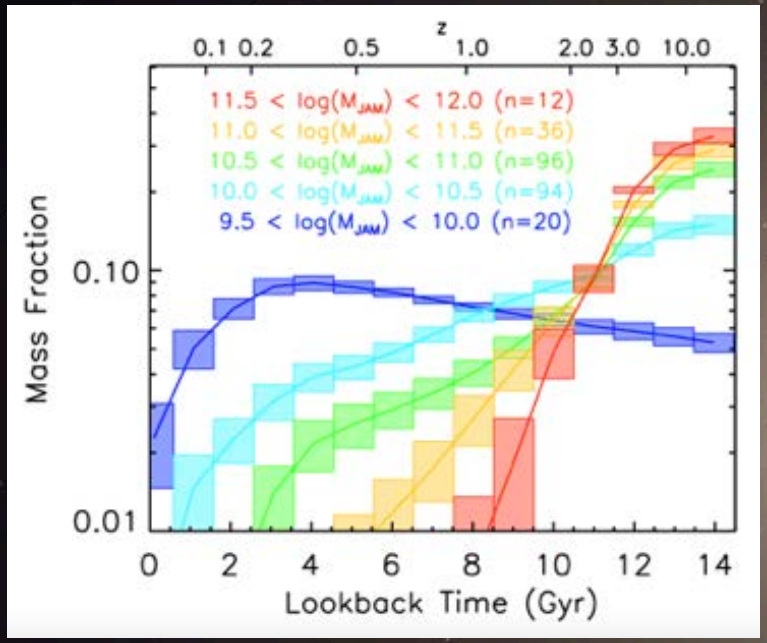




ATLAS-3D, McDermid et al. 2015
Thomas et al. 2005
De la Rosa et al. 2011

We compare observed with predicted NUV and optical indices to derive the fraction of young stars in massive ETGs

Methodology



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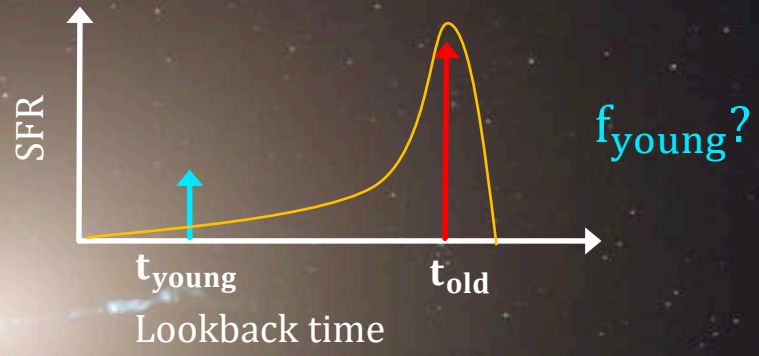
Modelling approaches of the SFH for massive ETGs

1: 2SSPs: old burst + young burst



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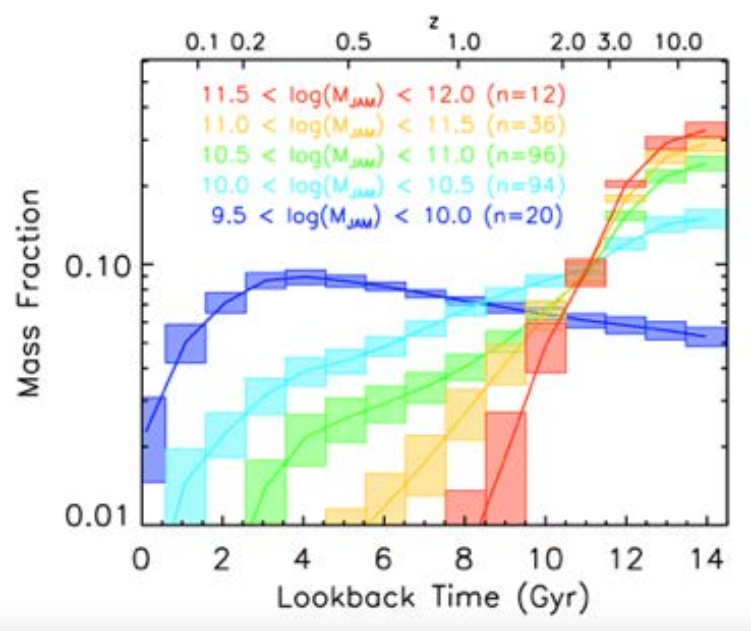

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Modelling approaches of the SFH for massive ETGs

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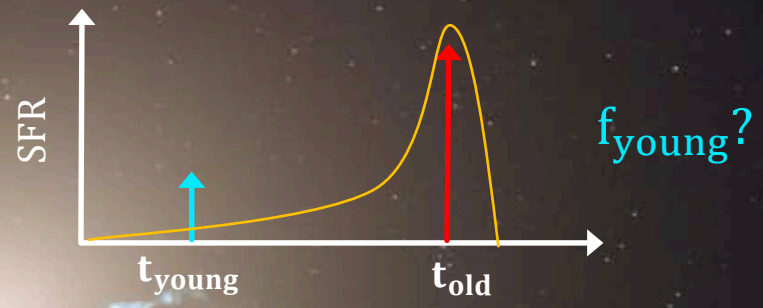


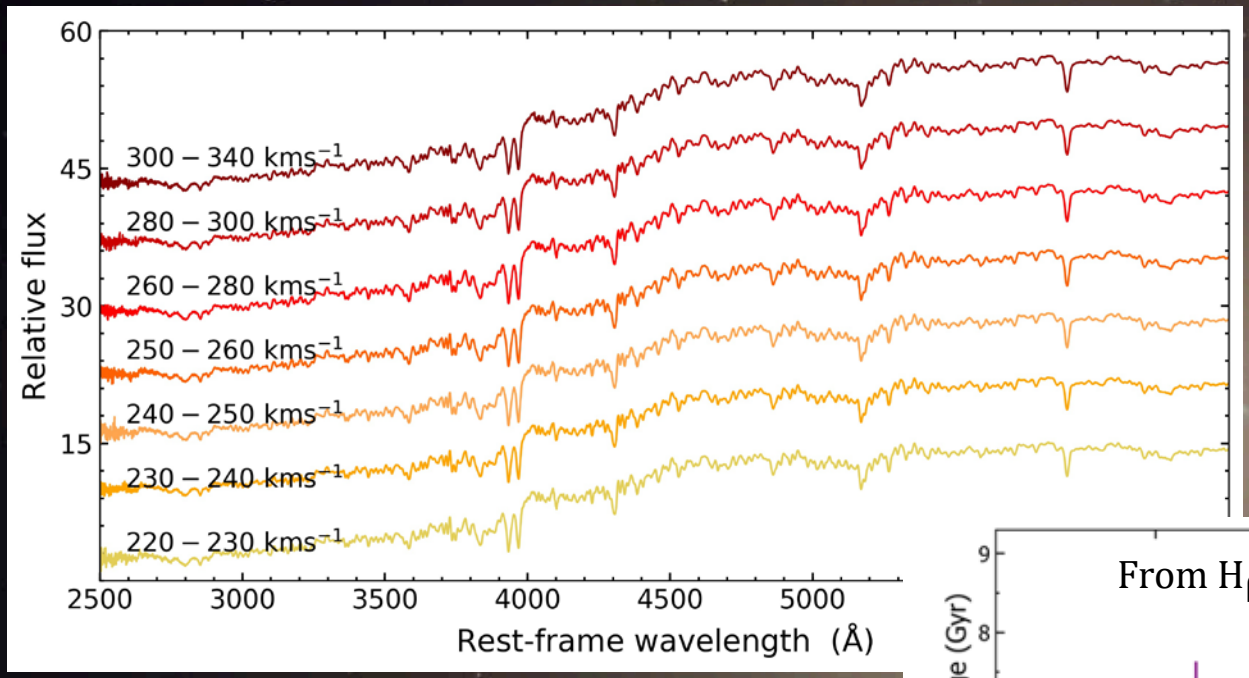
2: old burst + constant SFR in the last 2 Gyr

We compare observed with predicted NUV and optical indices to derive the fraction of young stars in massive ETGs

Massive ETGs at z~0.4

SDSS/BOSS stacked spectra in 7 velocity dispersion bins

$\sigma \propto M_*$



Our selection criteria:

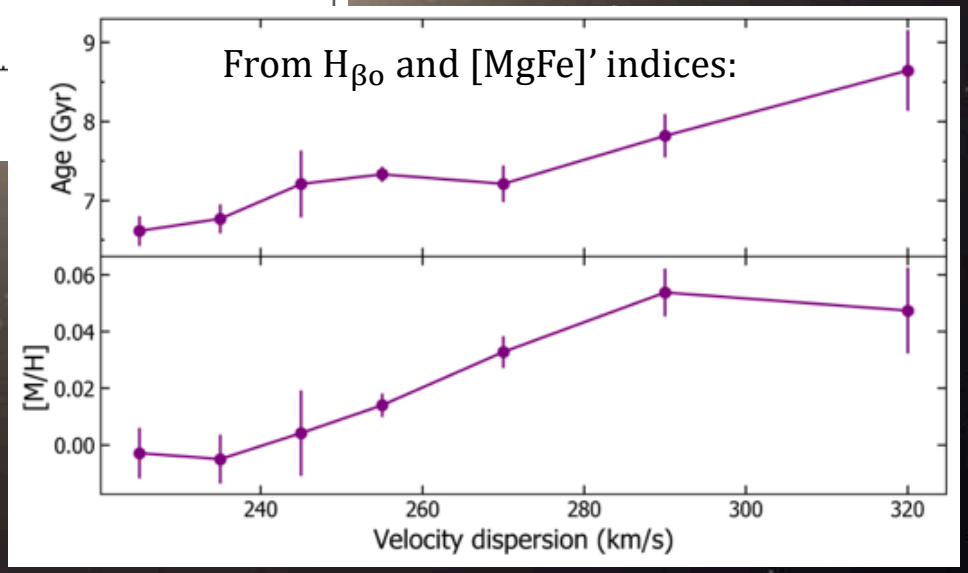
$0.35 < z < 0.6$ (> 2500 Å)

$220 < \sigma < 340$ km/s

SNR (r-band) > 7

(g-i) > 2.35 ETGs Masters+2012

~28000 galaxies



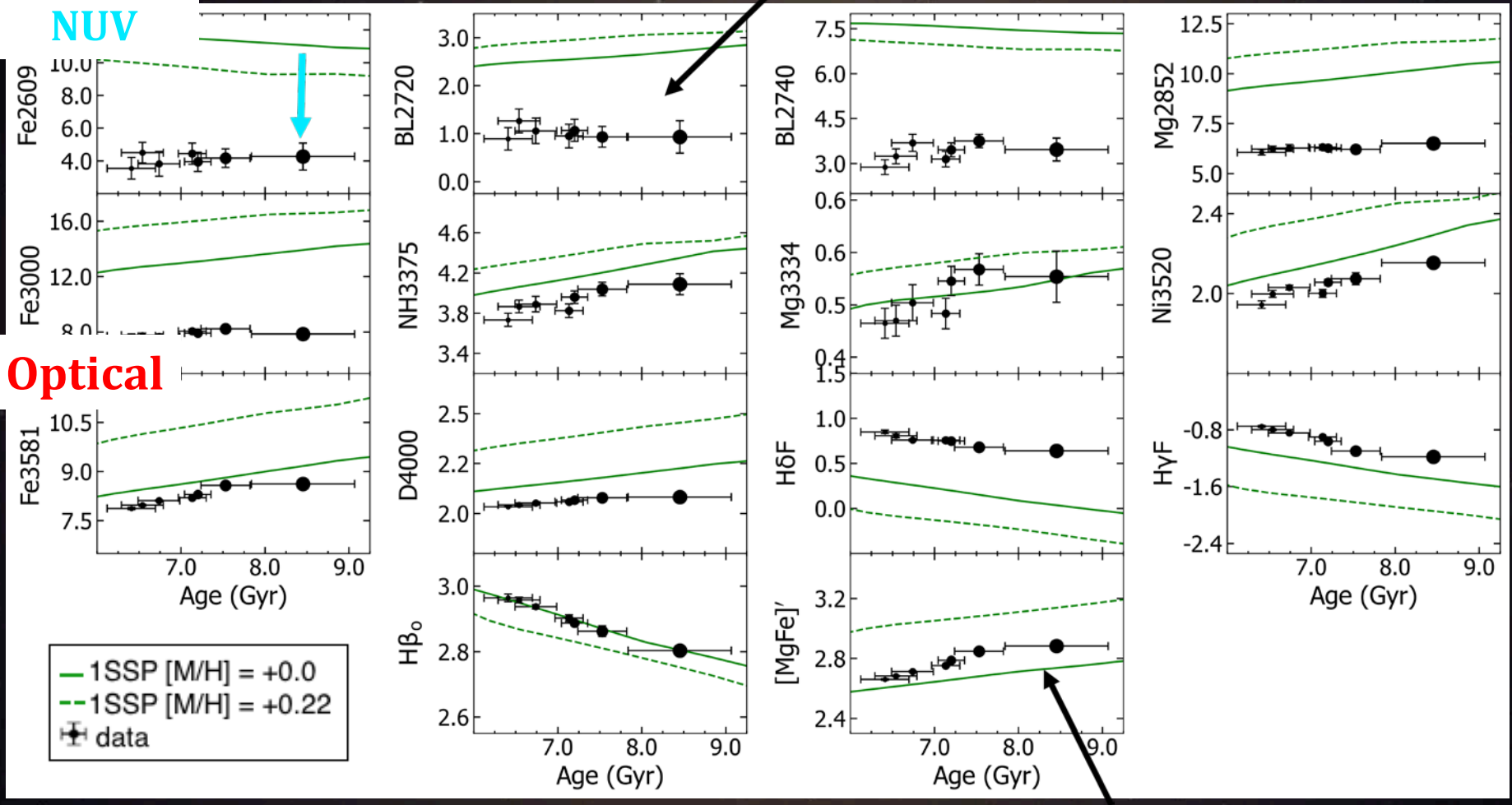
More massive ETGs have older and more metal-rich stellar populations

Salvador-Rusiñol et al. 2019

Massive ETGs at z~0.4

We are missing something!

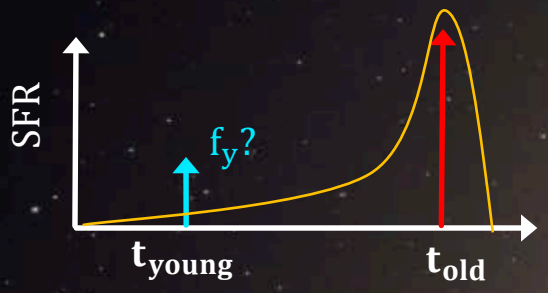
NUV indices show deviation with respect the old SSP model predictions

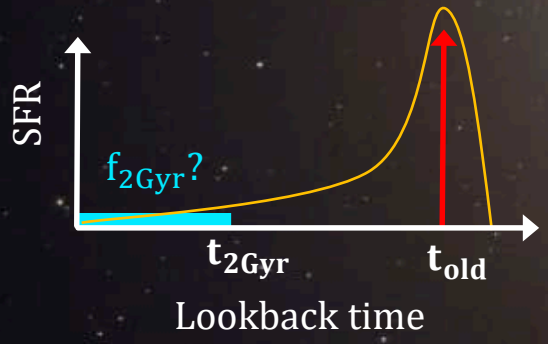


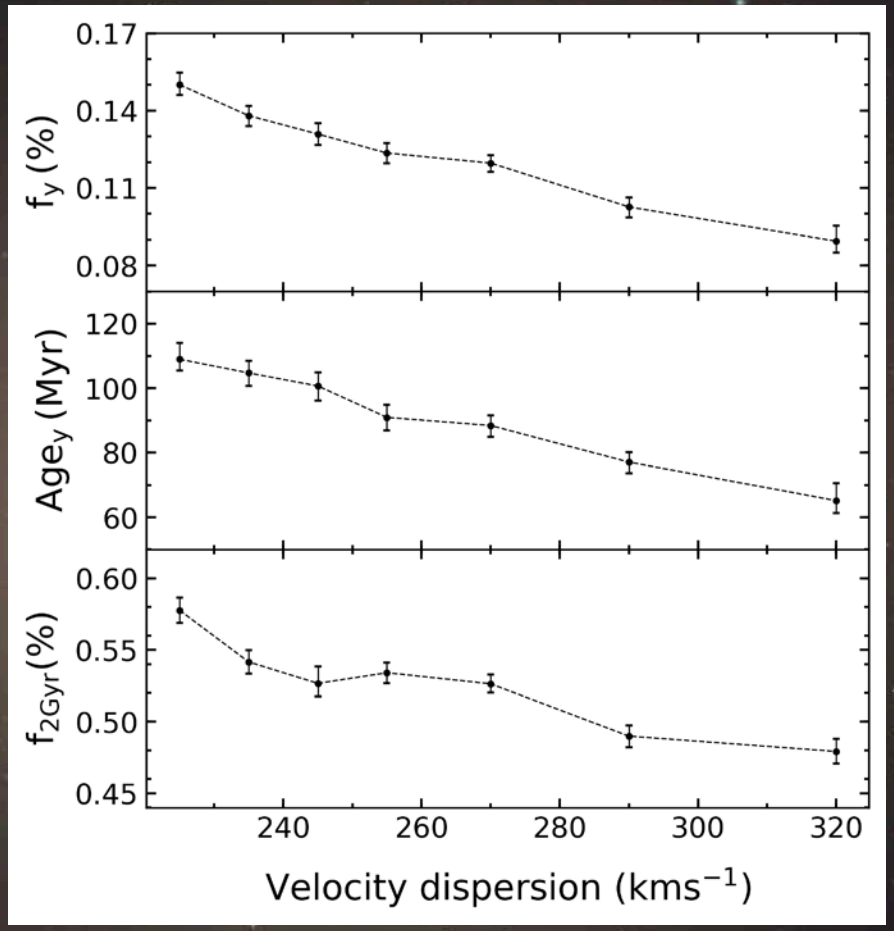
Optical indices are in agreement

Salvador-Rusiñol et al. 2019

Massive ETGs at z~0.4





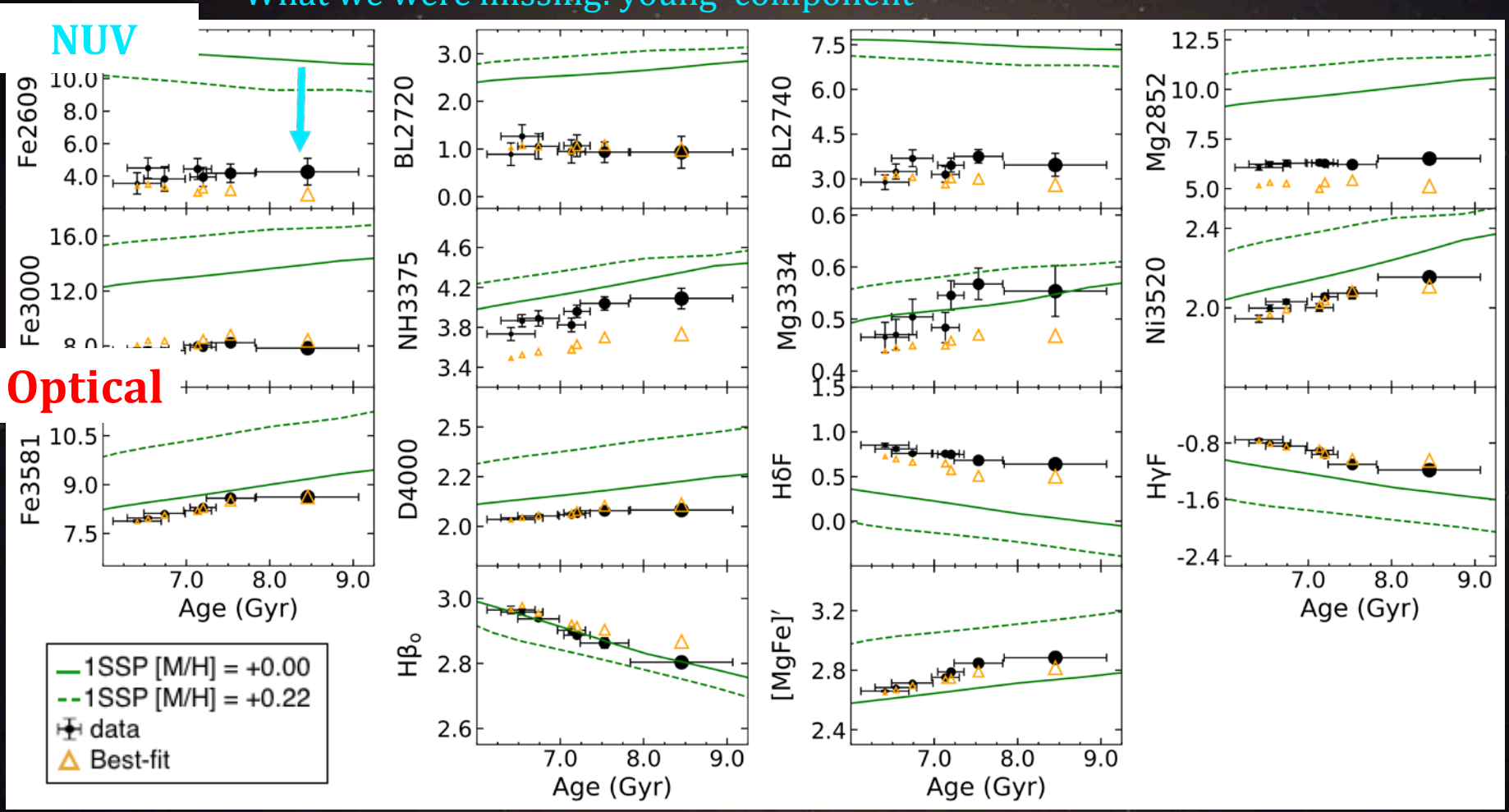


More massive ETGs have smaller fractions of young stars, consistent with the down-sizing scenario, where the SFH in less massive systems extends over longer time-scales

Salvador-Rusiñol et al. 2019

Massive ETGs at z~0.4

What we were missing: young component

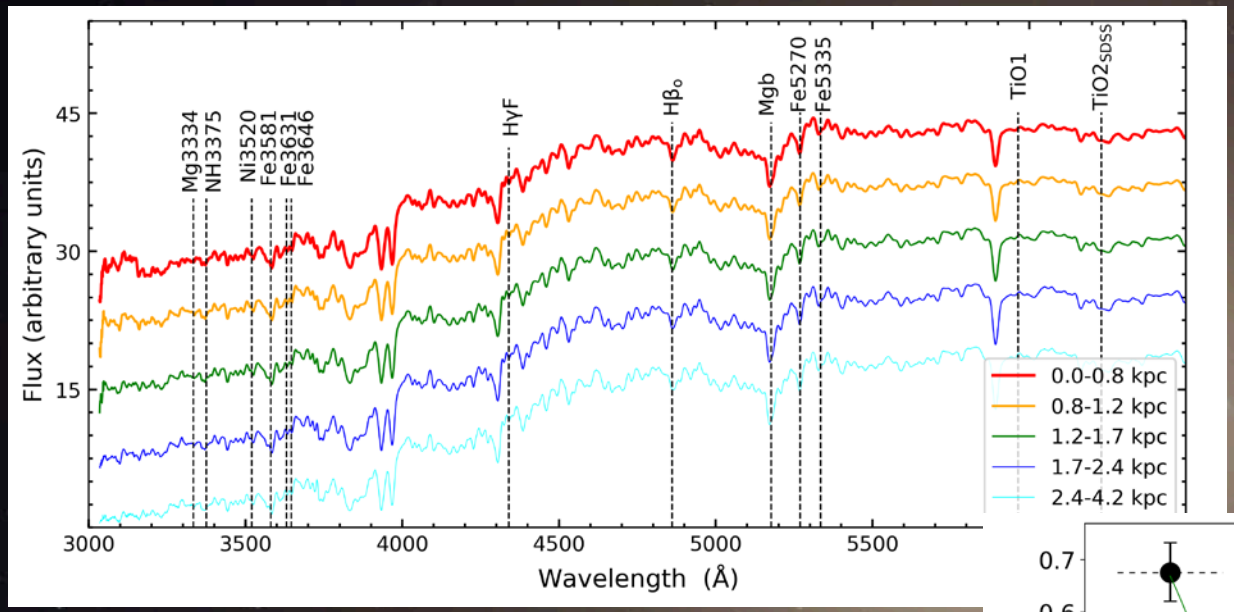


Small young mass fractions are able to fit NUV and optical indices simultaneously

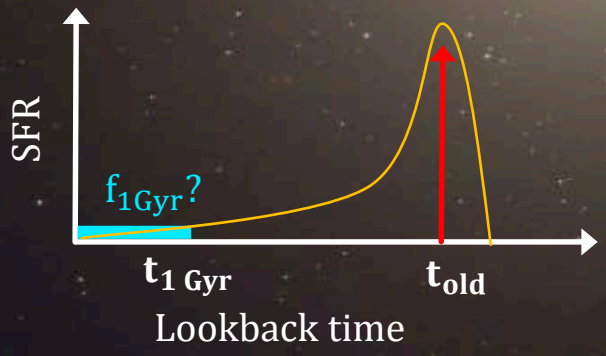
Salvador-Rusiñol et al. 2019

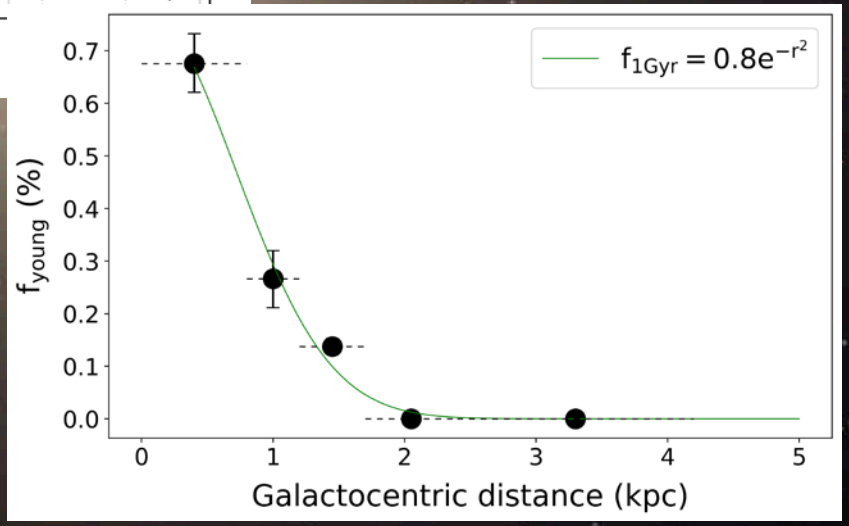
Brightest Cluster Galaxies at z~0.05

X-shooter stacked spectra of 6 BCGs (σ > 300 km/s) in 5 radial bins



Young stars (< 1 Gyr) are concentrated in the galaxy cores of massive central cluster galaxies





Salvador-Rusiñol et al. *accepted*

Take home message

- The UV range is extremely sensitive to the young components even from very old systems such as ETGs.
- Massive ETGs at z~0.4 are populated with 0.5% of stars formed within the last 2 Gyr of their evolution.
- Less massive ETGs have larger fractions of young stars, consistent with formation of stars in less massive systems extends over longer time-scales
- Young stars (< 1 Gyr) are concentrated within the galaxy cores of massive BCGs.
- Beyond 2 kpc galactocentric distances, our sample of 6 BCGs do not host young stars..
- We need the UV to constrain precisely the young stellar components of the most massive and oldest galaxies in the Universe.

Thank you