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

Massive early-type galaxies (ETGs) are mainly populated by old stars that dominate the optical spectral range. We analyse optical and near-ultraviolet (NUV) absorption lines from integrated spectra of massive ETGs to study its young stellar content, thanks to the extreme sensitivity of the NUV to young stars. We find that young stellar populations are ubiquitous in massive ETGs at $z \sim 0.4$, measuring average mass fractions of 0.5% in stars formed within the last 2 Gyr of their evolution. This fraction decreases with galaxy stellar mass, consistent with a down-sizing scenario. We also study spectra of 6 massive brightest cluster galaxies (BCGs) to find that the young stars are concentrated in their central regions (< 0.8 kpc), decreasing outwards to virtually no young stars beyond 2 kpc.

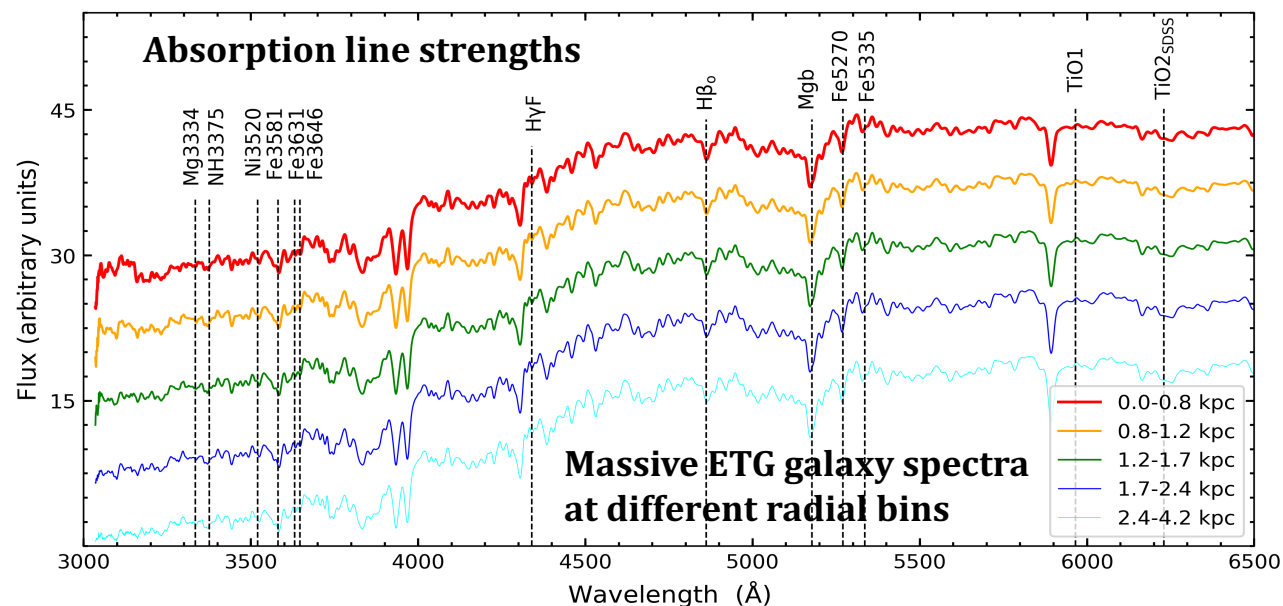
[Salvador-Rusiñol et al. 2019](#), [Salvador-Rusiñol et al. 2020 \(submitted\)](#)

Introduction

- ETGs formed the bulk of their stars early ($z > 1-4$) and fast (< 1 Gyr).
- Their optical spectral range is mainly contributed by the overwhelming dominating old stellar populations, making it very difficult to constrain small episodes of recent star formation.
- Fortunately, the UV is extremely sensitive to small ($< 1\%$) contributions from young stars (< 1 Gyr).

MAIN GOAL

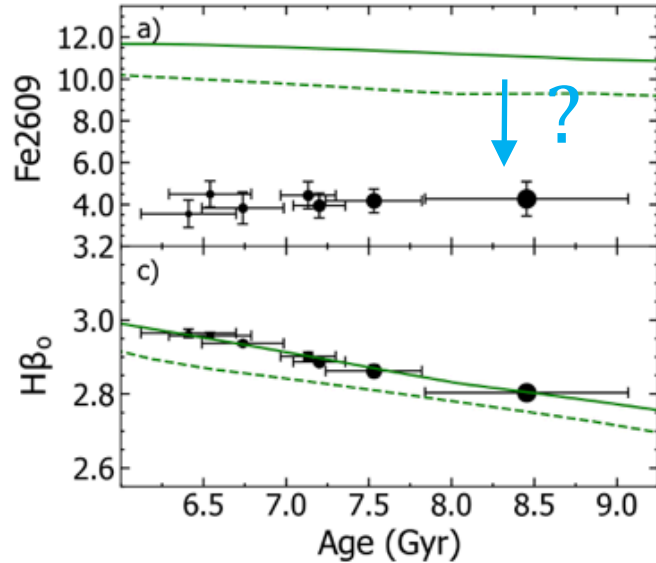
To constrain the young stellar component of massive ETGs by analysing the NUV absorption line indices from their integrated spectra



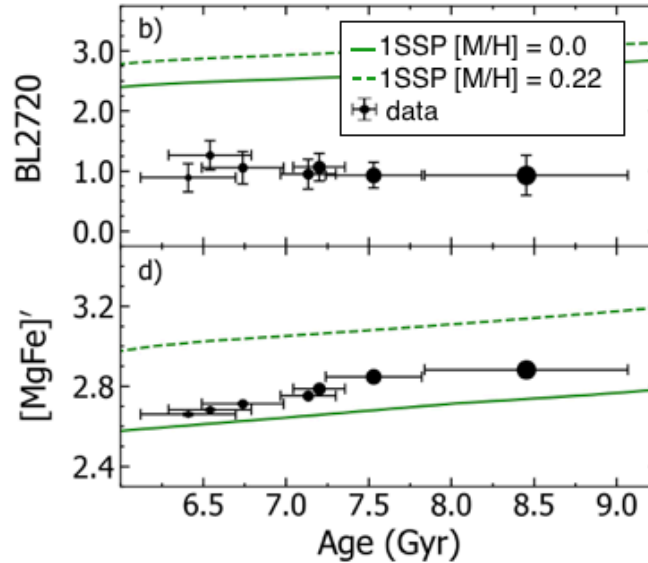
Methodology

We compare observed with predicted NUV and optical indices:

NUV



optical



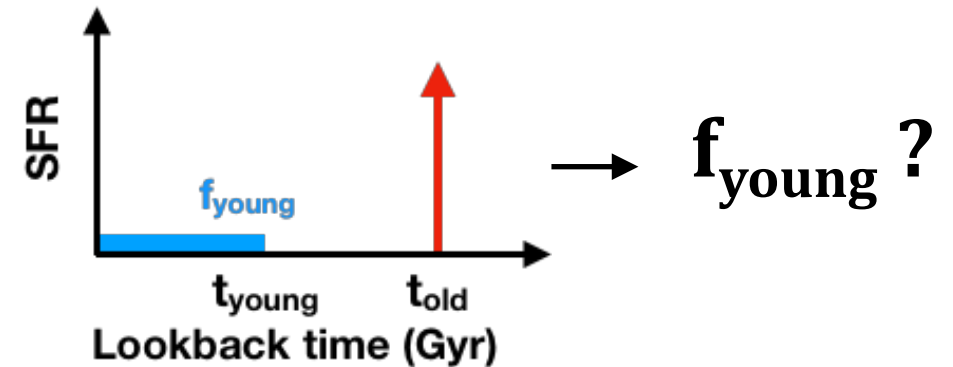
Green lines: E-MILES single-burst (SSP) models for old metal-rich stellar populations. Vazdekis et al. 2016

Observed **NUV indices** show **deviation** from purely old SSP model, although there is agreement in the optical range

We assume a model approach of the SFH for a massive elliptical galaxy:

old burst + constant SFR in the last 1 or 2 Gyr

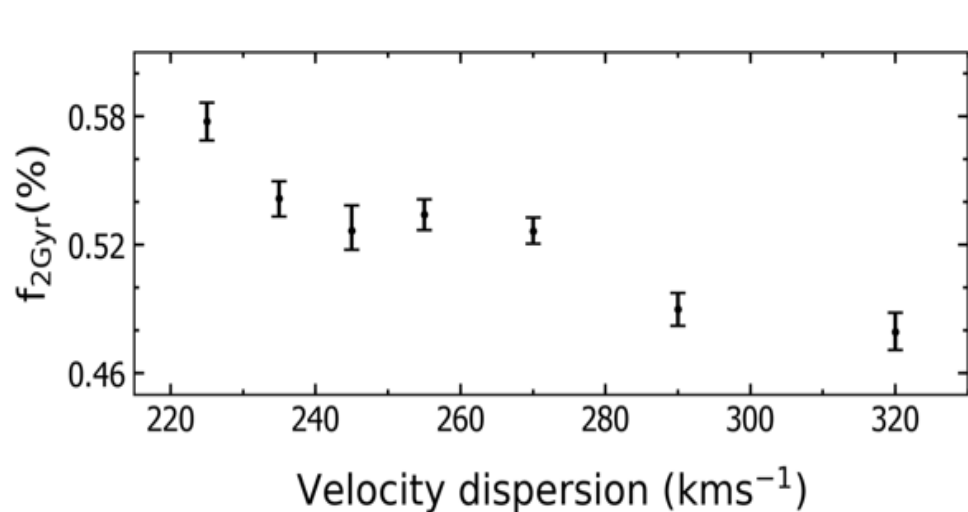
to derive the fraction of young stars in massive ETGs



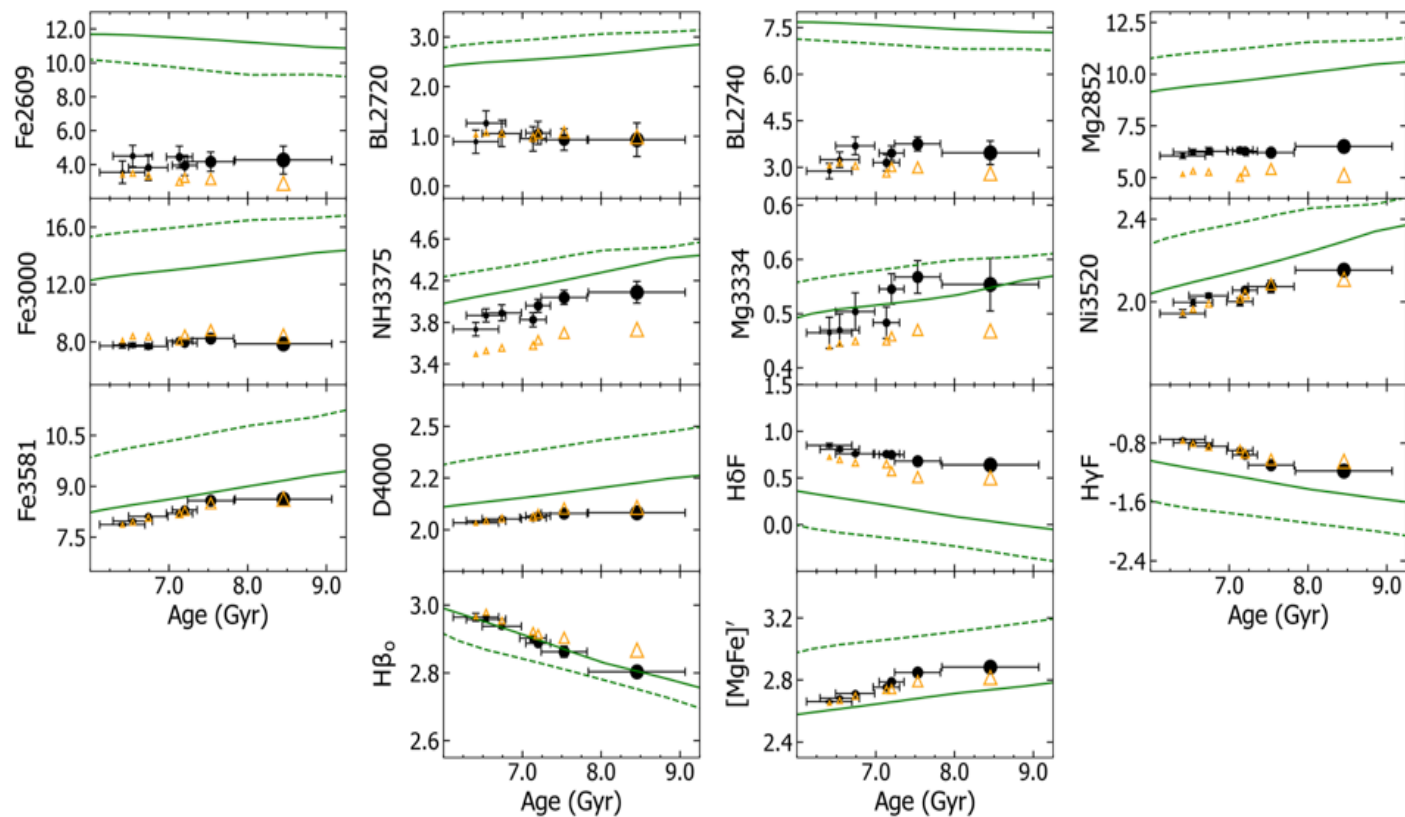
Results

Stacked spectra of SDSS ETGs at $z \sim 0.4$

We fit observed 14 NUV and optical indices from ETG stacked spectra with index predictions of our modelling approach. We aim to find the fraction in young stars (< 2 Gyr) at different velocity dispersion (i.e., mass) bins.



Result: $\sim 0.5\%$ young mass fractions are able to fit NUV and optical indices simultaneously.

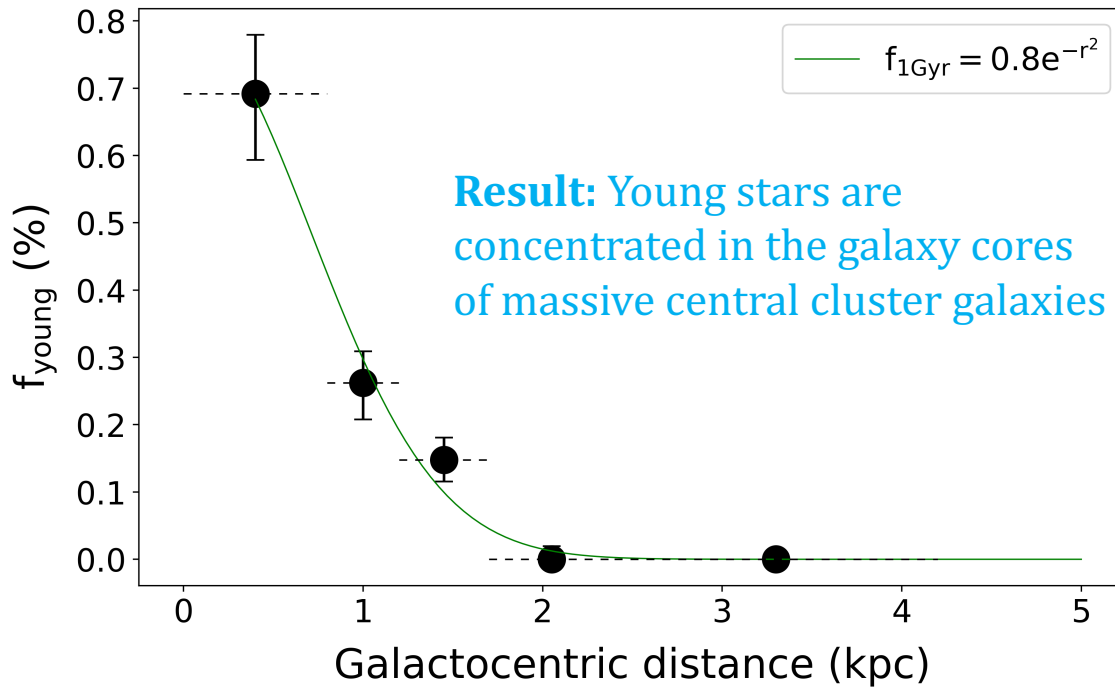


Salvador-Rusiñol et al. 2019, Nat. Astron.

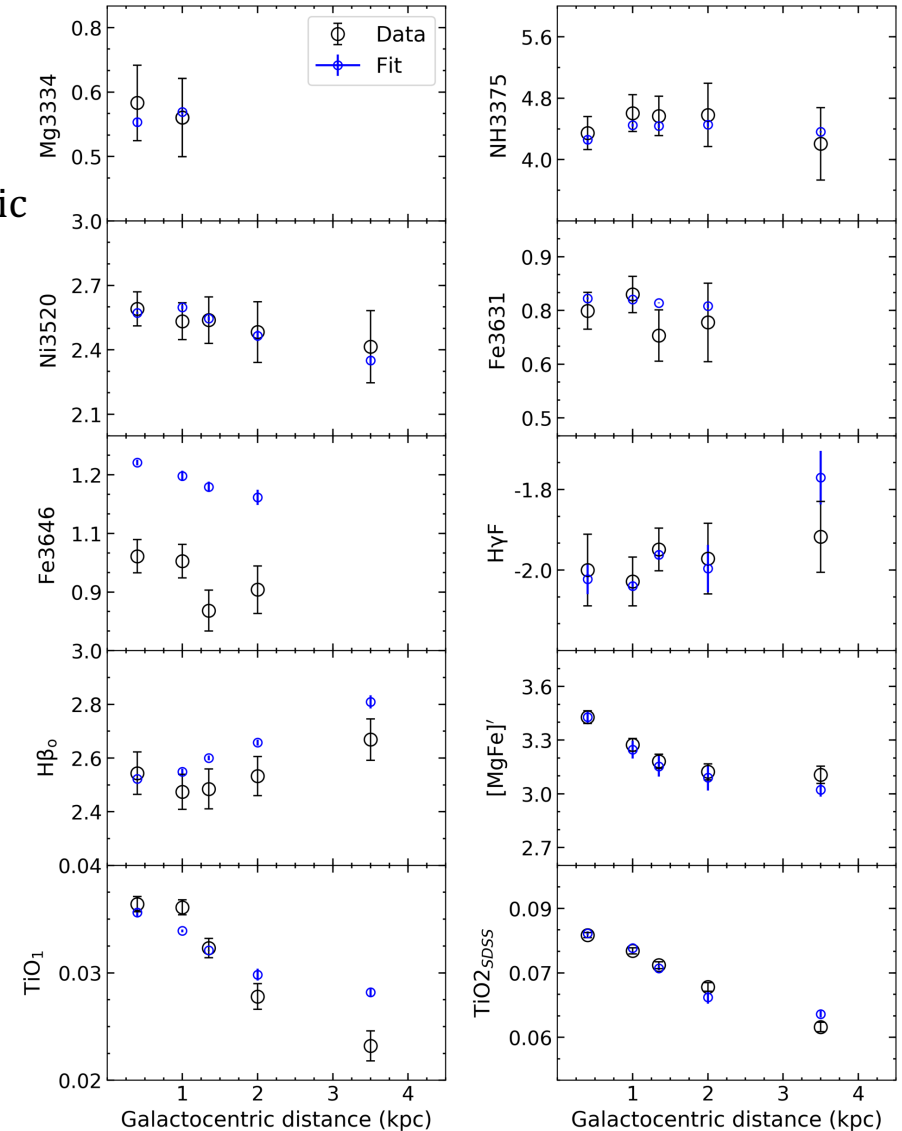
Results

X-shooter stacked spectra of 6 BCGs at $z \sim 0.05$

We fit 10 NUV and optical indices from BCG spectra, stacked at different galactocentric distances. We aim to find the fraction in young stars (< 1 Gyr) at each radial bin.



Salvador-Rusiñol et al. 2020 (submitted)



Conclusions & future work

- Massive ETGs at $z \sim 0.4$ are populated with 0.5% of stars formed within the last 2 Gyr of their evolution.
- More massive ETGs have smaller fractions of young stars than their less massive counterparts.
- 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.
- The origin of the gas needed to fuel the star formation to form these new stars may be related with in-situ processes, such as the returned gas from the stellar evolution.

Future work

Analysis of young stellar population gradients of individual galaxy spectra of massive ellipticals and relic galaxies (claimed to be representative of the first stages of the formation of present day ellipticals, such as NGC1277).