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Star-formation in CALIFA early-type galaxies. A matter of discs

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Motivation: processes of triggering and shut-down of the star formation in ETGs are not well understood.
Method: explore the **SFR vs. M⋆ relation** of **ETGs** separated into their **bulge** and **disc** components (1st time)

Accepted XXX. Received YYY; in original form ZZZ

Sample: CALIFA **49**
Code: C2D + Pipe3d: B/T for each spaxel

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Spectro-photometric decomposition of galaxy structural components

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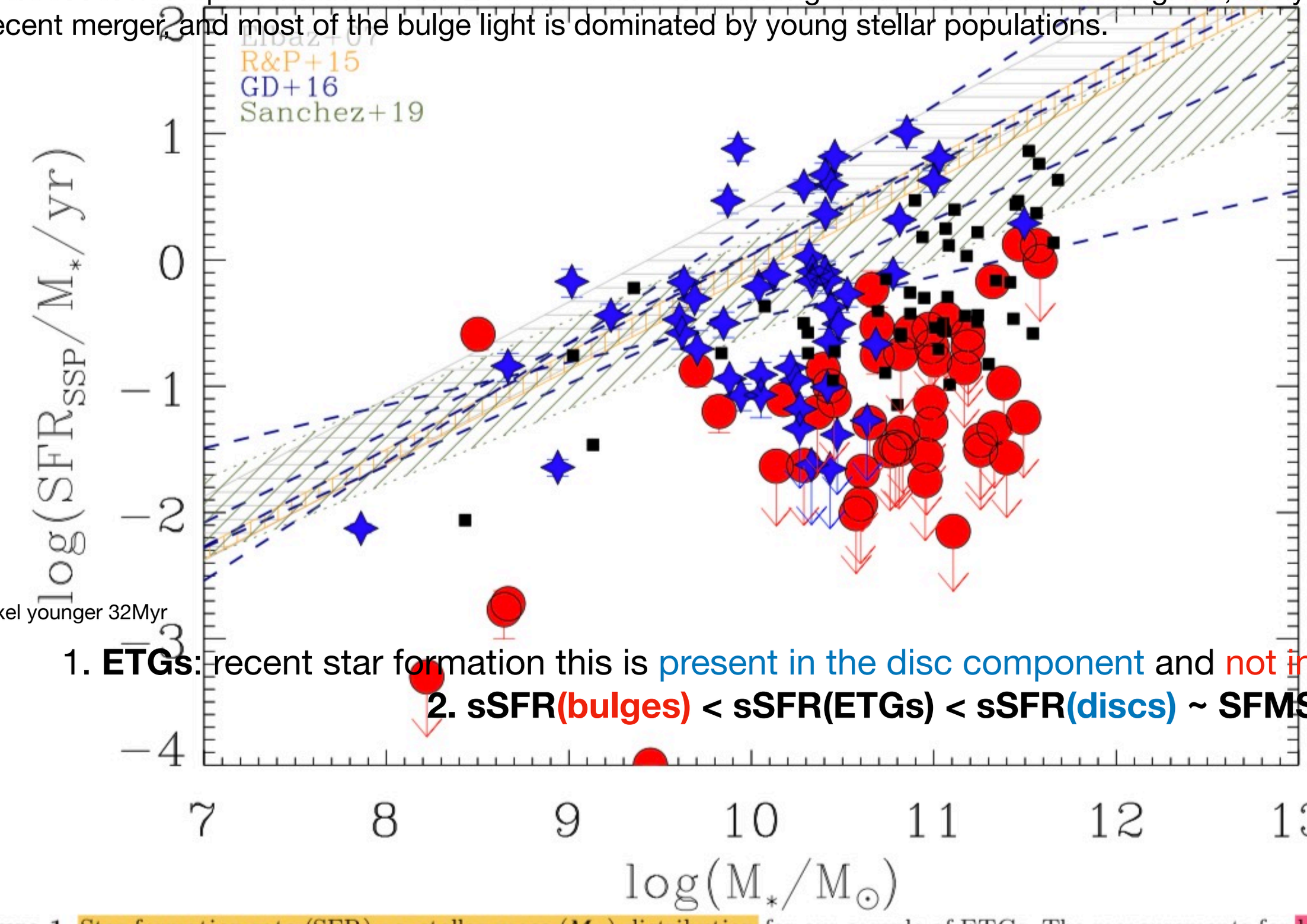
ABSTRACT

The star formation main sequence (SFMS) is a tight relation between the galaxy star formation rate (SFR) and its total stellar mass ($M_\star$). Early-type galaxies (ETGs) are often considered as low-SFR outliers of this relation. We study, for the first time, the separated distribution in the SFR vs. $M_\star$ of bulges and discs of 49 ETGs from the CALIFA survey. This is achieved using C2D, a new code to perform spectro-photometric decompositions of integral field spectroscopy datacubes. Our results reflect that: i) star formation always occurs in the disc component and not in bulges; ii) star-forming discs in our ETGs are compatible with the SFMS defined by star forming galaxies at $z \sim 0$; iii) the star formation is not confined to the outskirts of discs, but it is present at all radii (even where the bulge dominates the light); iv) for a given mass, bulges exhibit lower sSFR than discs at all radii; and v) we do not find a deficit of molecular gas in bulges with respect to discs for a given mass in our ETGs. We speculate our results favour a morphological quenching scenario for ETGs.

Key words: galaxies: bulge - galaxies: evolution - galaxies: formation - galaxies: structure - galaxies: photometry

NGC3773: not representative of the ETG since it hosts a strong starburst in its central regions, likely due to a recent merger, and most of the bulge light is dominated by young stellar populations.

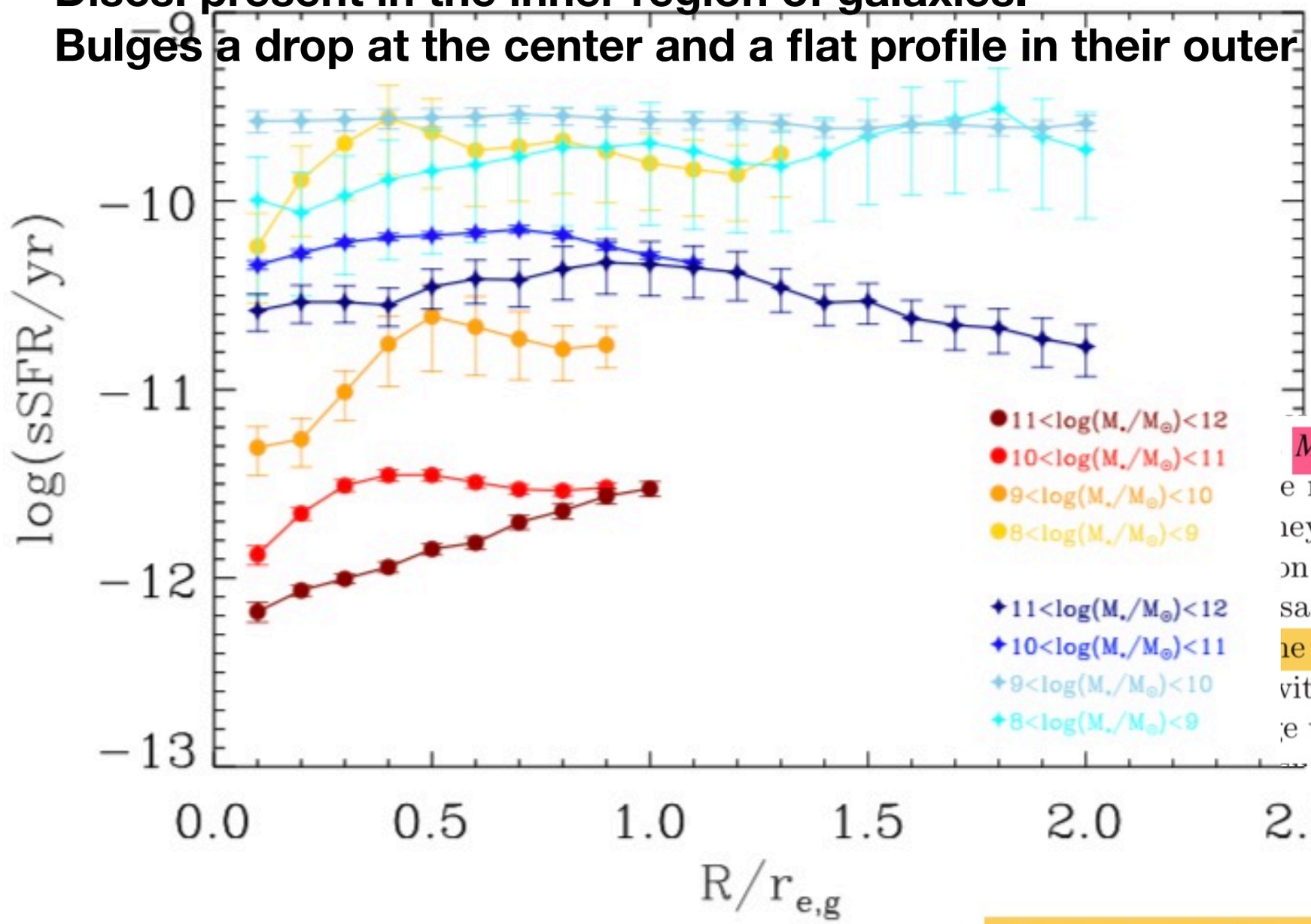


Spaxel younger 32Myr

1. **ETGs**: recent star formation this is present in the disc component and not in the bulge.
2. **sSFR(bulges) < sSFR(ETGs) < sSFR(discs) ~ SFMS**

Figure 1. Star formation rate (SFR) vs. stellar mass ($M_\star$) distribution for our sample of ETGs. The measurements for bulges and discs are shown with red circles and blue stars, respectively. Black squares represent measurements of the same ETGs, but for the galaxy as a whole. Yellow triangles display the position of the sample of elliptical galaxies described in the text. The best fit to the SFMS from Elbaz et al. (Grey; 2007), Renzini & Peng (Orange; 2015), González Delgado et al. (Navy; 2016) and Sánchez et al. (Green; 2019) are also shown for comparison. Downward arrows mark where the measured SFR is an upper limit (see text for details).

1. star formation in not only present in the outer regions, but at all radii
2 .sSFR profiles: disc > bulge
Discs: present in the inner region of galaxies.
Bulges a drop at the center and a flat profile in their outer regions,



M_{gas,A_V}=8.9±0.8 and 8.3±0.8, respec-
e numbers are not fully representative
ney are based on 17 bulges and 15 discs
on lines. In order to have a estimation
sample we also use the average dust at-
he stellar populations (A_{ssp}). We found
with larger uncertainties, for the bulges
e values $M_{gas,A_{ssp}}$=8.8±0.9 and 8.6±1.1,

$M_{gas,bulge} \sim M_{gas,disc}$ and $SFR_{bulge} < SFR_{disc}$,

Figure 2. sSFR radial profiles for the bulges (reddish colors) and discs (bluish colors) in our sample of ETGs. Different profiles represent the average distribution of the sSFR for the bulge/disc components within four different mass bins. The averaged radial profiles are normalised to the galaxy effective radius.

SFR = SFE x Mgas
SFE(bulge)<SFE(disc)
gravitational stabilization
Guess: morphological quenching