MNRAS **000**, 1–2 (2015) Preprint 27 June 2017 Compiled using MNRAS LATEX style file v3.0

Galaxy Zoo: Star Formation Histories in the COSMOS Survey

[1★] [2] [2,3] [3]
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Accepted XXX. Received YYY; in original form ZZZ

ABSTRACT

Key words: keyword1 – keyword2 – keyword3

1 INTRODUCTION

2 METHODS

Starpy from becky's paper Smethurst et al. (2015). Becky's group environment paper Smethurst et al. (2017). UltraVista catalogue paper Muzzin et al. (2013)

3 DATA

3.1 Multi-wavelength data

This study is based on a K_s-selected catalog of the COSMOS/UltraVISTA field from Muzzin et al. (2013). The catalog contains PSF-matched photometry in 30 photometric bands covering the wavelength range $0.15\mu m \rightarrow 24\mu m$ and includes the available *GALEX* (Martin et al. 2005), CFHT/Subaru (Capak et al. 2007), UltraVISTA (McCracken et al. 2012), S-COSMOS (Sanders et al. 2007), and zCOSMOS (Lilly et al. 2009) datasets.

- Used rest frame U-V and V-J colours provided by Muzzin et al. (2013)
- These were calculated using the EAZY code Brammer et al. (2008), and the errors obtained from the error template in this paper.
- Filters for the bands: U,V Johnson filtres from Maíz Apellániz (2006), J - 2Mass Filter from Skrutskie et al. (2006).

For the U and V filters the Johnson response curves found in Maíz Apellániz (2006) were used. The J filter used the 2MASS response curved from Skrutskie et al. (2006).

3.2 Environment data

Environment data from Darvish et al. (2015).

- Method used is Weighted Voronoi Tessellation
- Quote from darvish: Unlike the nearest neighbor, Voronoi tessellation is scale-independent and is able to span a wide range of physical lengths. Also, it does not make any assumptions about the geometry and morphology of the structures in the density field. This characteristic makes it superior to adaptive kernel and nearest neighbor methods.
- Quote from Darvish: However, this comes at the expense of a computationally expensive process by making several Monte-Carlo samples. Apart from its computational time, it is a robust estimator.
- formula:

$$\Sigma(r_i) = \frac{1}{A_i} \tag{1}$$

3.3 Galaxy Zoo Hubble Morphological classifications

Morphological classifications of galaxies were obtained from the Galaxy Zoo Hubble[1] (GZH) citizen science project (Willett et al. 2017). GZH allowed serveral independant visual classifications of each galaxy image by volunteers, the question flowchart for each image is shown in figure 4 of Willett et al. (2017).

The GZH project consists of 119,849 images

4 METHODS

4.1 Modelling Star Formation History

We used the publically available STARPY[2] code. STARPY infers the star formation history (SFH) of a single galaxy by using Bayesian Markov Chain Monte Carlo methods (Foreman-Mackey et al. 2013). Inputs of redshift, rest-frame U - V and V - J colours, combined with the stellar population model of Bruzual & Charlot (2003), a solar metallicity, and a Chabrier IMF Chabrier (2003) produces a SFH for a

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[1] https://hubble.galaxyzoo.org
[2] http://github.com/zooniverse/starpy/

galaxy. These models do not account for intrinsic dust. An explanation of how STARPY works can be found in section 3 of Smethurst et al. (2015).

The SFH model used is parameterised by t_q and τ [Gyrs], where t_q is the onset time of quenching and τ characterises the rate of quenching. Increaing τ represents an exponetially slower quench. Assuming that all galaxies formed at $t = 0$ [Gyrs] with an initial burst of constant SFR (SFR_0), we write the SFH over cosmic time ($0 \leq t$ [Gyrs] ≤ 13.8) as:

$$\mathrm{SFR}(t) = \begin{cases} \mathrm{SFR}_0(t_q) & t \leq t_q \\ \mathrm{SFR}_0(t_q) \exp\left[-\frac{(t-t_q)}{\tau}\right] & t > t_q \end{cases} \tag{2}$$

$$P(\theta_k) = \begin{cases} 1 & 0 \leq t_q \text{ [Gyr] } \leq 13.8 \text{ and } 0 \leq \tau \text{ [Gyr] } \leq 4 \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

5 CONCLUSIONS

ACKNOWLEDGEMENTS

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