Boletim da Sociedade Astronômica Brasileira, **36**, no. 1, 168-169


# Quenching of star formation in galaxies up to large clustercentric distances

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**Abstract.** We investigate how the fraction of star-forming galaxies ($f_{\rm SFG}$) in non-AGN satellites depends on different galaxy properties and their environment up to 20 virial radii (R/$r_{\rm vir}$), evaluating the impact of different star formation rate (SFR) estimation methods on these analyses. Using data from SDSS DR18, we define two stellar mass-complete subsamples and apply a logistic regression model that incorporates galaxy and group properties such as $M_{\rm h}$, $M_{\rm star}$, R/$r_{\rm vir}$, and $\sigma$. Our results show that $\sigma$ is the most influential property, with environmental effects becoming more significant for less massive galaxies. We find that $f_{\rm SFG}$ increases with R/$r_{\rm vir}$, although its dependence varies with $\sigma$. Additionally, we note that different SFR estimation methodologies affect the measured $f_{\rm SFG}$.

**Resumo.** Nós investigamos como a fração de galáxias formadoras de estrelas ($f_{\rm SFG}$) em satélites sem AGN depende de diferentes propriedades de galáxias e seu ambiente até 20 raios viriais (R/$r_{\rm vir}$), avaliando o impacto de diferentes métodos de estimativa da taxa de formação estelar (SFR) nessas análises. Utilizando dados do SDSS DR18, definimos duas subamostras completas em massa estelar e aplicamos um modelo de regressão logística que considera propriedades das galáxias e dos grupos, como $M_{\rm h}$, $M_{\rm star}$, R/$r_{\rm vir}$ e $\sigma$. Nossos resultados mostram que $\sigma$ é a propriedade mais influente, enquanto os efeitos ambientais se tornam mais importantes para galáxias menos massivas. Observamos que $f_{\rm SFG}$ aumenta com R/$r_{\rm vir}$, embora sua dependência varie com $\sigma$. Além disso, destacamos que diferentes metodologias de estimativa de SFR afetam os valores medidos de $f_{\rm SFG}$.

**Keywords.** Galaxies: evolution – Galaxies: groups: general – Methods: statistical

## 1. Introduction

It is well known that galaxy properties depend on their environment, with high-density regions tending to have a lower fraction of star-forming galaxies ($f_{\rm SFG}$) compared to low-density regions. However, isolating the factors that genuinely influence the observed $f_{\rm SFG}$ is challenging because other galaxy properties correlated with $f_{\rm SFG}$ are also environment-dependent. This work aims to explore how the $f_{\rm SFG}$ of non-AGN satellite galaxies varies to 20 virial radii (R/$r_{\rm vir}$). Also, we aim to know how different star formation rate (SFR) estimation methodologies influence our understanding of environmental effects.

## 2. Data and Methods

Our analysis is based on non-AGN satellite galaxy data from the Sloan Digital Sky Survey DR18. We incorporate SFR and stellar mass measurements from two different catalogues: the GSWLC catalogue (Salim et al. 2007), obtained by UV/optical spectral energy distribution (SED) fitting, and the MPA-JHU catalogue (Brinchmann et al. 2004), using H$\alpha$ emission. Also, we define two stellar mass-complete samples: a "less-massive" subsample with galaxies up to $z \leq 0.03$ and stellar masses $M_{\rm star} \geq 10^{9.2}\ M_{\odot}$ and a "more-massive" subsample with galaxies up to $z \leq 0.1$ and stellar masses $M_{\rm star} \geq 10^{10.5}\ M_{\odot}$. The less-massive subsample contains $\approx$ 40000 galaxies while the more-massive subsample contains $\approx$ 4000 galaxies.

We assign galaxies to groups (Lim et al. 2017) up to 20 R/$r_{\rm vir}$ from their centres using the Trevisan et al., (2017) assignment scheme. To estimate $f_{\rm SFG}$, we use a logistic regression model that accounts for the continuous variation of galaxy properties over the entire parametric range, avoiding the need for binning and mathematically quantifying the relationship between each property and $f_{\rm SFG}$. We include as covariates in the model: group halo mass ($M_{\rm h}$), galaxy stellar mass $M_{\rm star}$, clustercentric distance ($R/r_{\rm vir}$), and stellar velocity dispersion ($\sigma$).

## 3. Results and Conclusions

In Figure 1, we show the logistic model for the two subsamples using the two different SFR measurements. The logistic model achieves an average accuracy of approximately 80% in predicting whether a galaxy is star-forming or not, with $\sigma$ playing the most significant role in determining how $f_{\rm SFG}$ varies between samples. Environmental factors (R/$r_{\rm vir}$ and $M_{\rm h}$) become more influential in the sample of less massive galaxies, while stellar mass is less critical. The $f_{\rm SFG}$ increases with R/$r_{\rm vir}$, in agreement with previous findings in the literature. However, the dependence of $f_{\rm SFG}$ on R/$r_{\rm vir}$ varies depending on the observed range of $\sigma$. Although the overall trends are consistent, different SFR estimation methodologies result in different values of $f_{\rm SFG}$, which in turn affect the relative importance of each galaxy property in the prediction of $f_{\rm SFG}$.

## References

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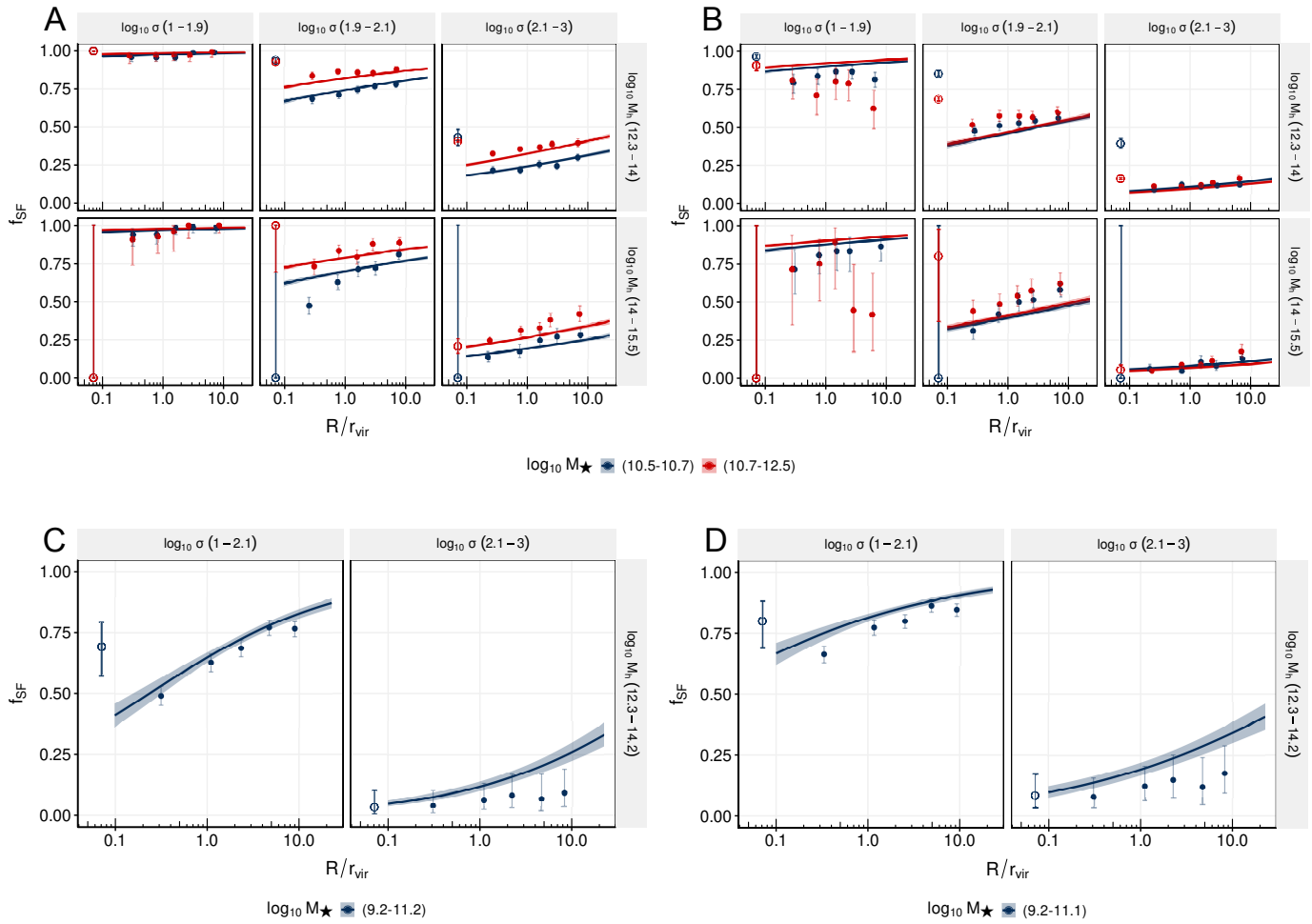


**Figure 1.** The top plots (A and B) refer to the more-massive subsample while the bottom plots (C and D) refer to the less-massive subsample. The plots on the left refer to the SFR measures from the GSWLC catalogue and the plots on the right refer to the SFR measures from the MPA-JHU. Binned data of galaxies are represented by solid symbols, and central galaxies are indicated as open symbols. Uncertainties are calculated using 95% binominal confidence intervals. The lines are the logistic model for satellite galaxies, and the shaded area around the lines is the 95% confidence interval of the models. Different panels correspond to bins of velocity dispersion (along columns) and halo mass (along rows), and in the more-massive subsample the colours (blue and red) indicate two different bins of stellar mass.