Revista Mexicana de Astronomía y Astrofísica Serie de Conferencias, 60, 225-226, (2026)

OPEN ACCESS https://doi.org/10.22201/ia.14052059p.2026.60.190

"XVII LARIM", Montevideo, Uruguay, November 27 - December 1, 2023.Volume Editors: Gonzalo Tancredi, Cecilia Mateu & Juan José Downes

Stellar population properties of massive compact galaxies at z ∼ 0: Evidence of diversity in the formation pathways

Katia Slodkowski Clerici[1], **Allan Schnorr Müller**[1], **Marina Trevisan**[1] **and Tiago Vecchi Ricci**[2]

[1]*Universidade Federal do Rio Grande do Sul - Departamento de Astronomia – 91501-970, Porto Alegre-RS, Brazil.*
[2]*Universidade Federal da Fronteira Sul, Brazil.*

Keywords: *galaxies: evolution, galaxies: formation, galaxies: stellar content*

We compared the stellar population properties of massive compact galaxies (MCGs) at low-redshift ($z \sim 0$) with average-sized quiescent galaxies (CSGs) matched in z. We showed differences in the stellar population properties at fixed effective velocity dispersion (σ_e), especially in the metallicity, where MCGs have lower metallicities than CSGs at fixed σ_e. Our results provide evidence about the formation and evolution of MCGs.

Quiescent galaxies are systems with low gas fractions, old and metal-rich stellar populations. The first quiescent galaxies are observed at $z \sim 4$. These galaxies are extremely compact at high z compared to their counterparts at $z \sim 0$ (van der Wel et al., 2014). Their small size and faint stellar continua make spectroscopic studies of large samples very challenging with current facilities, requiring alternative methods to investigate these galaxies. A possibility is to investigate local analogues as massive compact galaxies at $z \sim 0$.

To select the MCGs sample, we established a new criteria using the distances from the effective radii-σ_e and stellar mass-σ_e relations that were fitted to quiescent galaxies from the Sloan Digital Sky Survey (Abolfathi et al., 2018). For the final sample, we selected MCGs with $z < 0.1$, totalling 1858 MCGs. To compare properties of MCGs to typical quiescent galaxies, we selected a control sample (CSGs) of average-sized quiescent galaxies (5574 galaxies) matched in z.

We used the Penalized PiXel-Fitting (PpXF) code (Cappellari & Emsellem, 2004) with the Vazdekis et al.(2015) models (ages: 30 Myr - 13.5 Gyr, [M/H] −1.3 - +0.4, and [α/Fe] = BaseFe) and spectral indices to estimate mass-weighted ages, metallicities, and luminosity-weighted [α/Fe], following the methodology described in Schnorr-Müller et al. (2021).

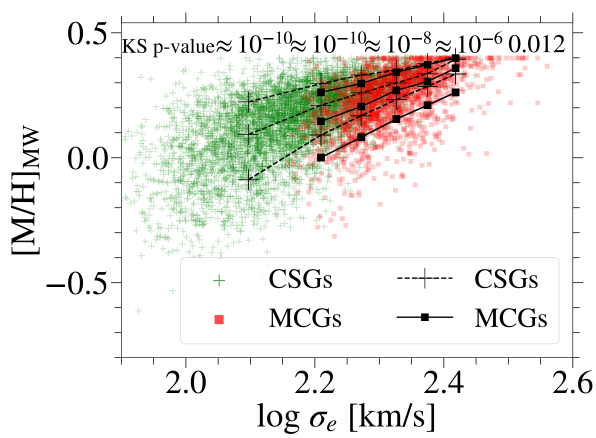

Figure 1. Metallicity as a function of σ_e to MCGs (red) and CSGs (green). The 16h, 50h, and 84h percentiles are showed in black squares (MCGs) and crosses (CSGs).

We compared the stellar population properties of MCGs and CSGs at fixed σ_e as previous works have shown that they correlate more tightly with σ_e than with other parameters such as stellar mass. At low-σ_e ($\sigma_e \leq 225$ km/s), MCGs are older and more α-enhanced than CSGs at fixed σ_e. At high-σ_e ($\sigma_e \geq 225$ km/s), MCGs and CSGs have similar ages and [α/Fe]. However, as shown in Fig. 1, MCGs have lower metallicities than CSGs in the entire range of σ_e.

Our results, taken together with the critical differences in the stellar mass at σ_e (CSGs are, on average, ∼ 0.7 dex more massive than MCGs of similar σ_e) indicate that MCGs and CSGs are descendants of different subgroups of the high z quiescent population. Lastly, we found that the metallicity of MCGs shows a dependence on stellar mass at fixed σ_e, while the age and [α/Fe] do not. These results can be associated with higher dark matter fraction within 1 effective radii (e.g. Graves & Faber (2010)). We suggest that this is possibly a signature of different quenching pathways followed by MCGs.

References

Abolfathi, B., Aguado, D. S., Aguilar, G., et al. 2018, ApJS, 235, 42, doi: 10.3847/1538-4365/aa9e8a

Cappellari, M., & Emsellem, E. 2004, PASP, 116, 138, doi: 10.1086/381875

Graves, G. J., & Faber, S. M. 2010, ApJ, 717, 803, doi: 10.1088/0004-637X/717/2/803

Schnorr-Müller, A., Trevisan, M., Riffel, R., et al. 2021, MNRAS, 507, 300, doi: 10.1093/mnras/stab2116

van der Wel, A., Franx, M., van Dokkum, P. G., et al. 2014, ApJ, 788, 28, doi: 10.1088/0004-637X/788/1/28

“XVII LARIM”, Montevideo, Uruguay, November 27 - December 1, 2023.Volume Editors: Gonzalo Tancredi, Cecilia Mateu & Juan José Downes