The Influence of Galaxy Environment on the Stellar Initial Mass Function of Early-Type Galaxies

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Scientific Motivation:

ETGs: Despite appearing simple objects, they are still a challenge for semi-analytic models which aim at reproducing their properties at z=0.

Environment: ETGs prefer denser environments.
Hierarchy (central vs. satellites) and host halo mass shape the properties of ETGs (prolonged star formation and quenching).

IMF: Has been found to be non-Galactic in ETGs.
With advances in instrumentation and simple stellar population (SSP) models $\Longrightarrow$ more thorough study.

The Question

Can galaxy environment influence the IMF of ETGs?

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We answer this question for the first time.

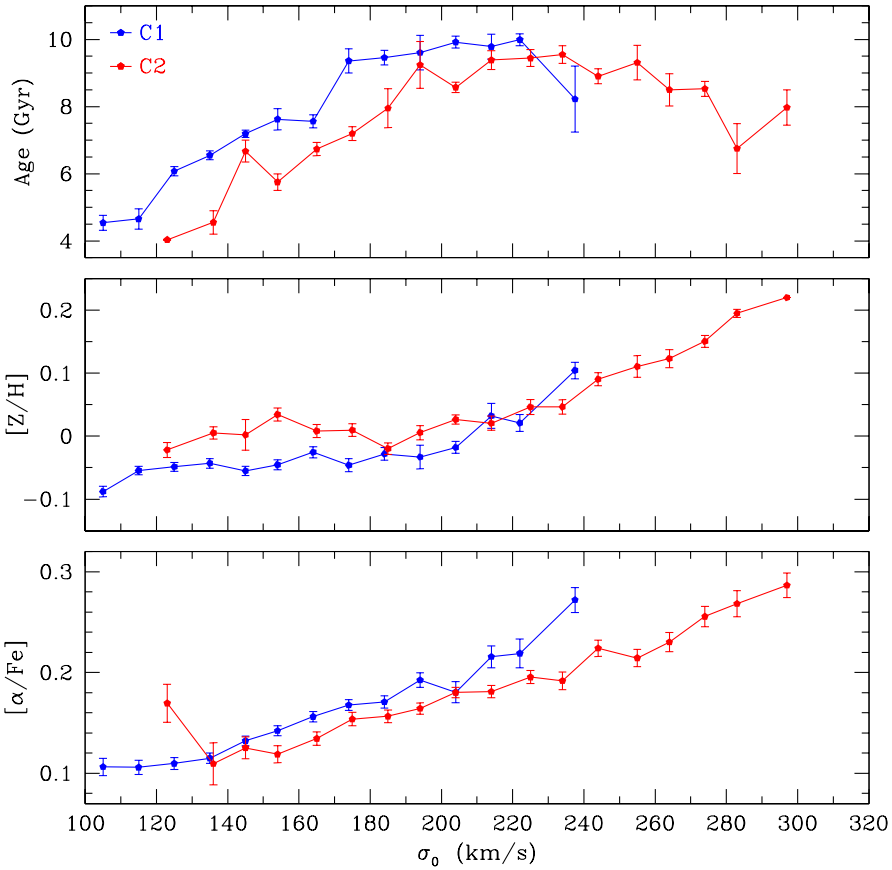
Since the stars are not resolved in these systems, the integrated properties of the these objects needs to be considered.

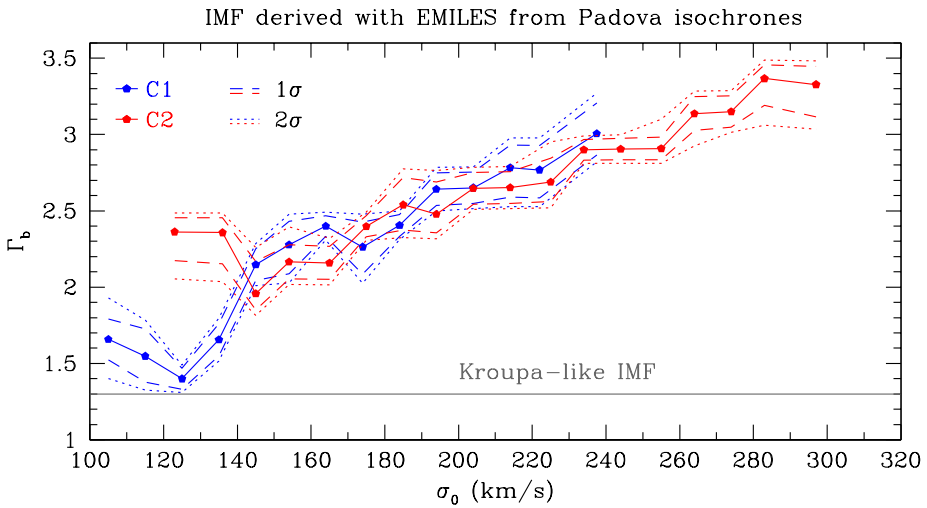
The Method

- Divide the 20996 ETGs SDSS spectra by galaxy hierarchy, then by host halo mass, finally bin in central velocity dispersion.
- Stack the spectra in velocity dispersion bin to enhance S/N ($\sim$ factor of 10 improvement).
- Measure IMF sensitive absorption features: Mg4780, NaI8190, Ca4227, TiO1 i. e.
- Check the dependence of the indices on σ_0, galaxy hierarchy and host halo mass.
- Estimate $[\alpha/Fe]$ from measured Mg and Fe indices.
- Fit the observed indices with synthetic SSPs (EMILES, Vazdekis et al. 2016) to estimate age, metallicity and IMF slope as a function of σ_0, galaxy hierarchy and host halo mass.

Stacking results in an average behavior of the galaxies in each σ_0 bin.

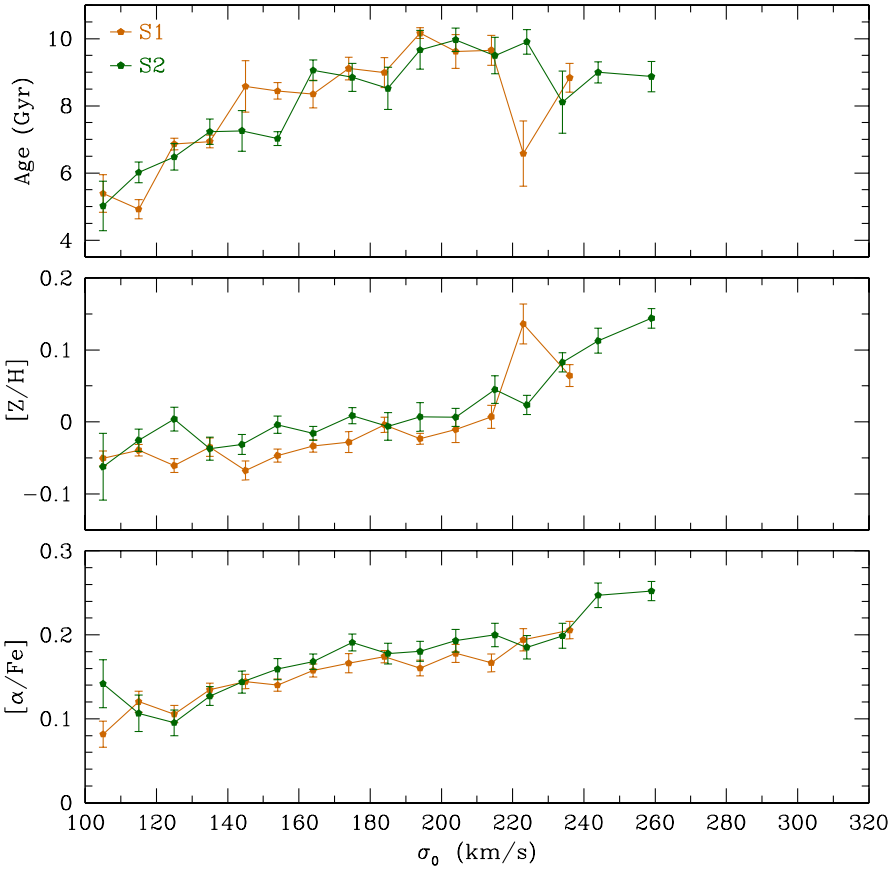
Centrals in comparison (C1 vs. C2)

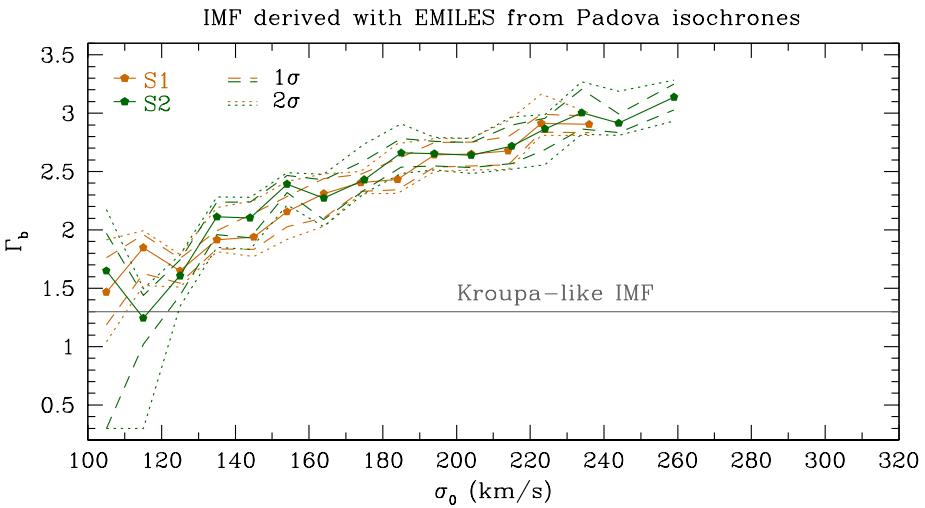




Comparing centrals we observe a trend of age, metallicity and $[\alpha/Fe]$ with environment, where centrals in more massive haloes (C2) are slightly younger, metal richer and have a lower $[\alpha/Fe]$. No dependence of the IMF with environment is detected, except for the lowest σ_0 bins, which we are still investigating.

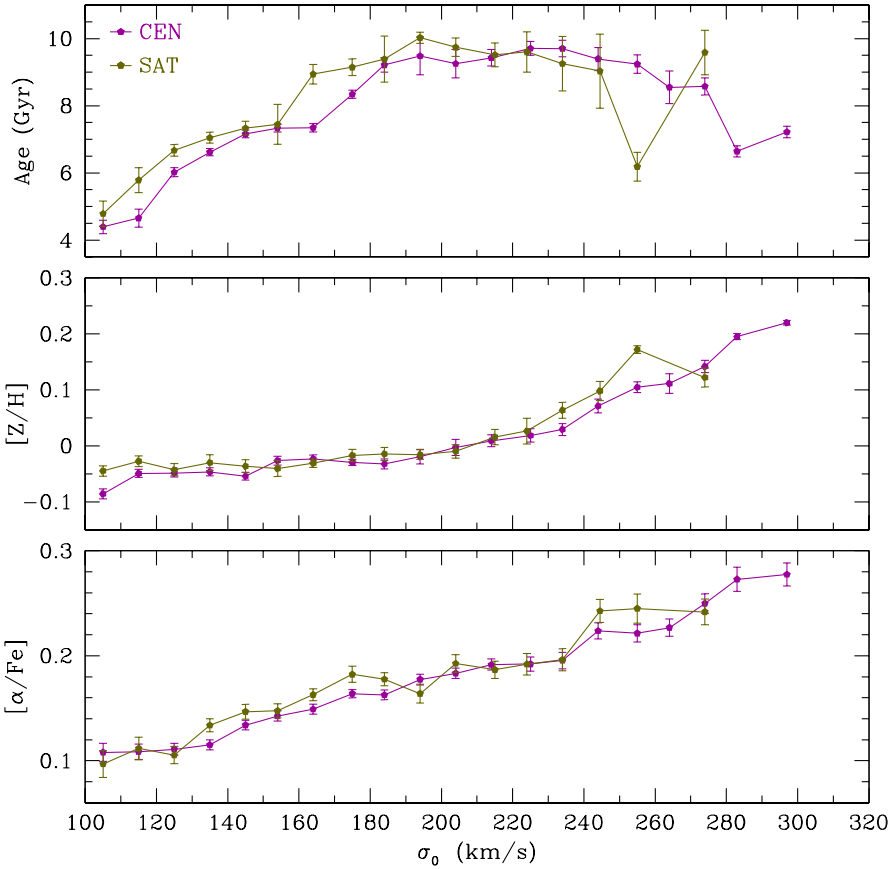
Satellites in comparison (S1 vs. S2)

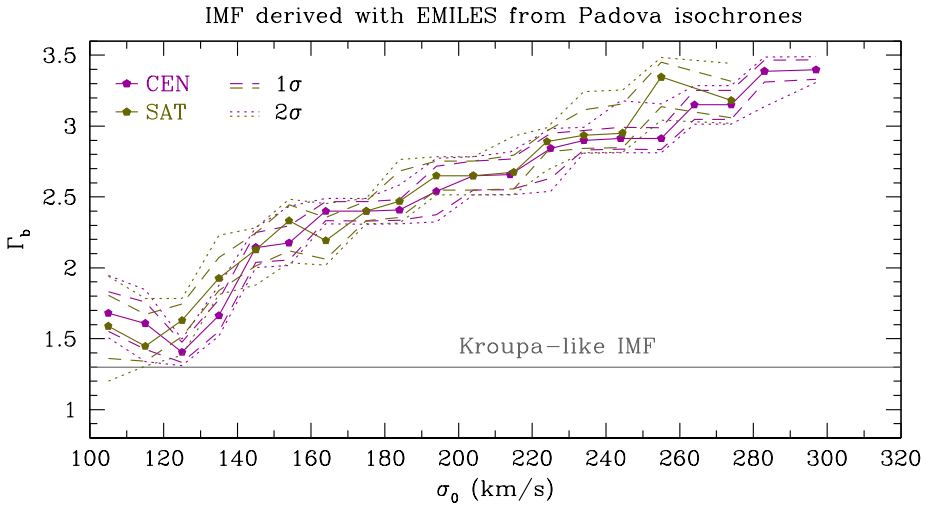




Satellites show trends of age, metallicity and $[\alpha/Fe]$ with environment that are reconcilable within their respective errors. S2 galaxies (satellites in more massive haloes) appear to be slightly metal richer with respect to S1 galaxies. No environmental trend of the IMF slope with environment is detected.

Centrals and Satellites compared (CEN vs. SAT)





If we compare centrals and satellites, independently of host halo mass, we notice that satellites are slightly older, slightly metal richer and have slightly higher $[\alpha/Fe]$ values. The IMF slope, however, shows no trend with hierarchy either.