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Differences in central (gaseous and stellar) metallicities between barred and unbarred galaxies.

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Abstract:

The contribution of secular processes to galaxy evolution is a hot topic under an intense debate. Numerical simulations predict that bars are main drivers of gas inflows, which enhance central star formation and change the gaseous-phase and stellar-phase metallicities. This mechanism is crucial to understand galaxy evolution and how metals distribute in our own Galaxy. Currently only a few studies compare the central gaseous metallicities, with contradictory results. Even less studies have been done on the stellar metallicities, and none of them compares the gaseous and stellar metallicities simultaneously. In this work we present a comparison between gas-phase and stellar-phase central metallicities in a sample of barred and unbarred galaxies from SDSS. These results are helping us to understand the role of bars in galaxy evolution.

Sample:

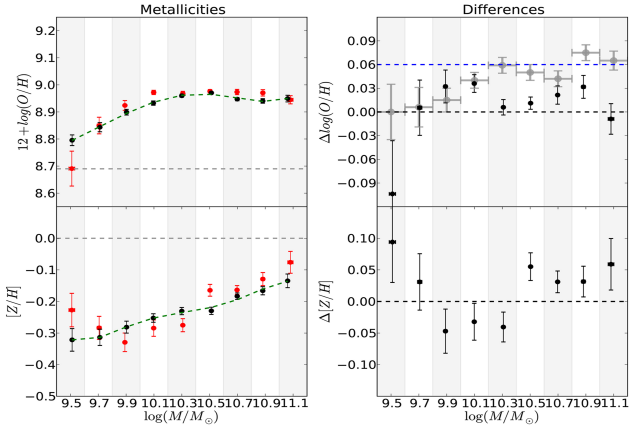
Barred (414) and unbarred (1180) galaxies from SDSS with similar distributions of redshift, mass, inclination and morphological type. AGNs were removed using the Kauffmann (2003) criterion in a BPT diagram (Baldwin, Phillips and Terlevich, 1981).

Analysis:

- Gaseous metallicities: R23, [NII]/[OII] and the recipes in Kewley and Dopita (2002).
- Stellar parameters: full spectral fitting with STECKMAP (Ocvirk 2006, 2008) and MILES library (Sánchez-Blázquez et al, 2006; Vazdekis, 2010).

Mass-metallicity relation:

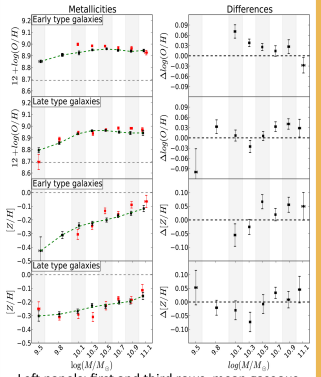
We binned the galaxies in mass intervals and calculated the differences among barred and unbarred galaxies at a given mass. The differences are not significant, but the the metallicity of abrred galaxies is systematically larger than the metallicity of unbarred galaxies.



Left: Mean gaseous (up) and stellar (low) metallicities vs. mean stellar mass in each interval (delimited by gray marks). Red points represent barred galaxies. Green dashed line is a polynomial fit to unbarred (black) points. Right: differences between red points and polynomial fit (none of them is significant at 3σ). Gray round points are the differences given by Ellison et al. (2011). Error bars represent the uncertainties in the means.

Morphology:

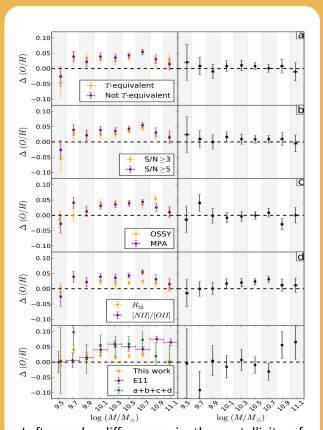
As the differences may depend on the morphology, we compared the metallicities separating the galaxies in early (S0-Sab) and late (Sb-Sm) galaxies.



Left panels: first and third rows, mean gaseous and stellar metallicities for early type barred (red) and unbarred (black) galaxies in each mass bin. Second and third rows, same for late type galaxies. Right panels, differences among red and black points in left panels. The differences are never significant, but the trends in the gaseous metallicities are different for early and late type galaxies.

Discrepancies:

We investigated the differences among previous works depending on several selection criteria.



Left panels: differences in the metallicity of barred respect to unbarred galaxies for different selection criteria (*T*-type distribution, S/N cut, flux database and metallicity calibration). Orange points represent this work. Right panels: differences among purple and orange points in left panel. Bottom left panel, differences in this work, those in Ellison et al. (2011) and this work plus the differences in right panels. Bottom right panel: differences among purple and green points.

Conclusions:

- Simulations predict that, if bars play a major role in secular evolution, central regions in barred galaxies should be more metal-rich than in unbarred galaxies. But we only see hints of those differences (not significant at 3σ confidence level).
- We found that the specific Star Formation Rate is slightly higher in barred galaxies, which could be the responsible of the small differences found.
- This topic has been investigated many times before with contradictory results. We found that the discrepancies mainly owe to different selection criteria and put into agreement our results with previous works which found opposite results.