STELLAR POPULATIONS OF NINE PASSIVE SPIRAL GALAXIES FROM THE CALIFA SURVEY: ARE THEY PROGENITORS OF S0s?

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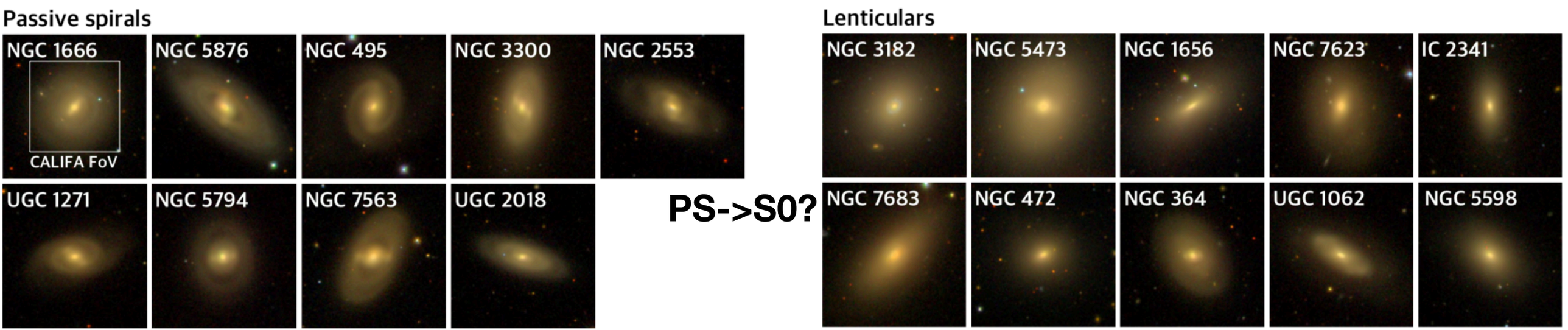
ABSTRACT

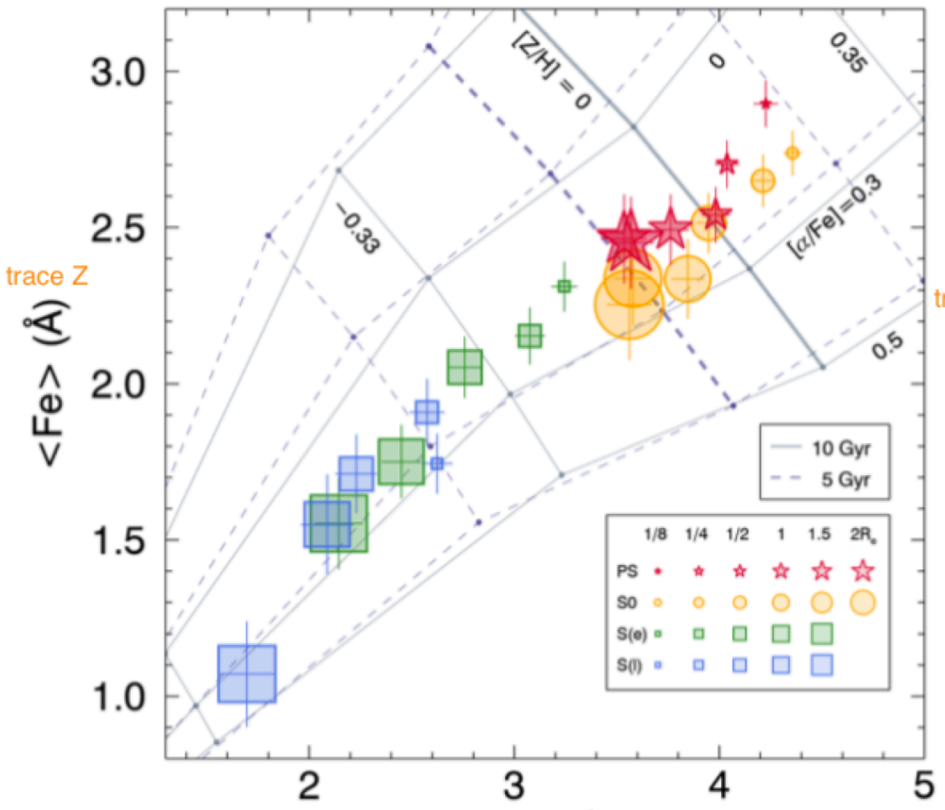
We investigate the stellar population properties of passive spiral galaxies in the CALIFA survey. Nine spiral galaxies that have NUV−r > 5 and no/weak nebular emission lines in their spectra are selected as passive spirals. Our passive spirals lie in the redshift range of $0.001 < z < 0.021$ and have stellar mass range of $10.2 < \log(M_\star/M_\odot) < 10.8$. They clearly lie in the domain of early-type galaxies in the WISE IR color-color diagram. We analyze the stellar populations out to two effective radius, using the best-fitting model to the measured absorption line-strength indices in the Lick/IDS system. We find that stellar populations of the passive spirals span a wide range, even in their centers, and hardly show any common trend amongst themselves either. We compare the passive spirals with S0s selected in the same mass range. S0s cover a wide range in age, metallicity, and [α/Fe], and stellar populations of the passive spirals are encompassed in the spread of the S0 properties. However, the distribution of passive spirals are skewed toward higher values of metallicity, lower [α/Fe], and younger ages at all radii. These results show that passive spirals are possibly related to S0s in their stellar populations. We infer that the diversity in the stellar populations of S0s may result from different evolutionary pathways of S0 formation, and passive spirals may be one of the possible channels.

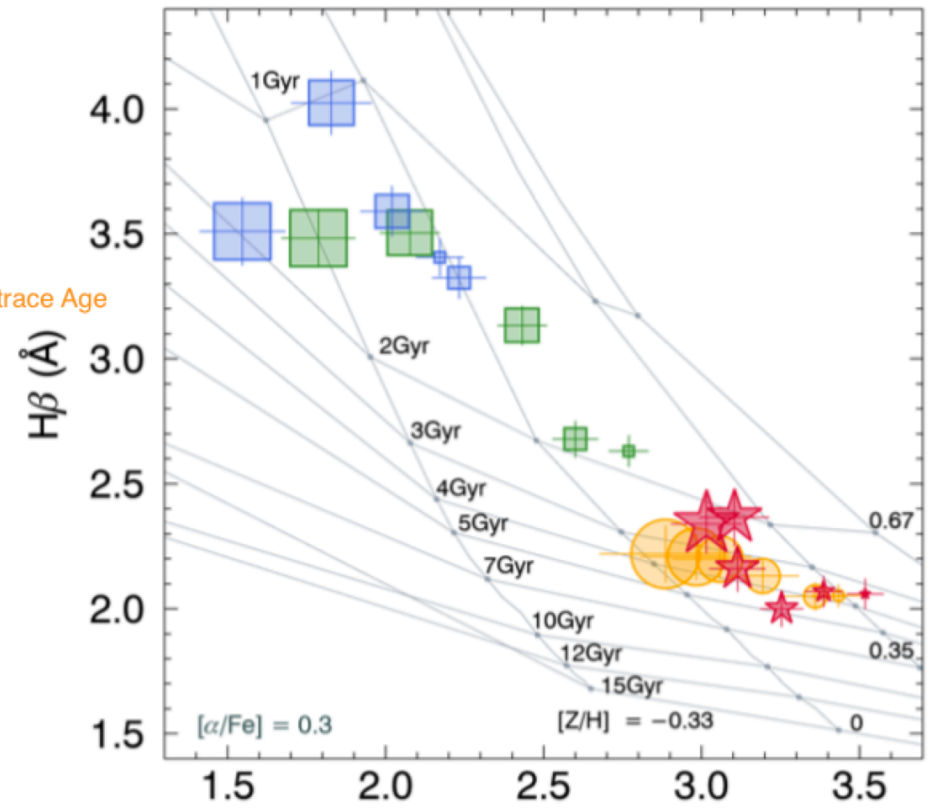
Subject headings: galaxies: evolution



[1] $[\mathrm{MgFe}]' = \sqrt{\mathrm{Mg}b \times (0.72 \times \mathrm{Fe5270} + 0.28 \times \mathrm{Fe5335})}$

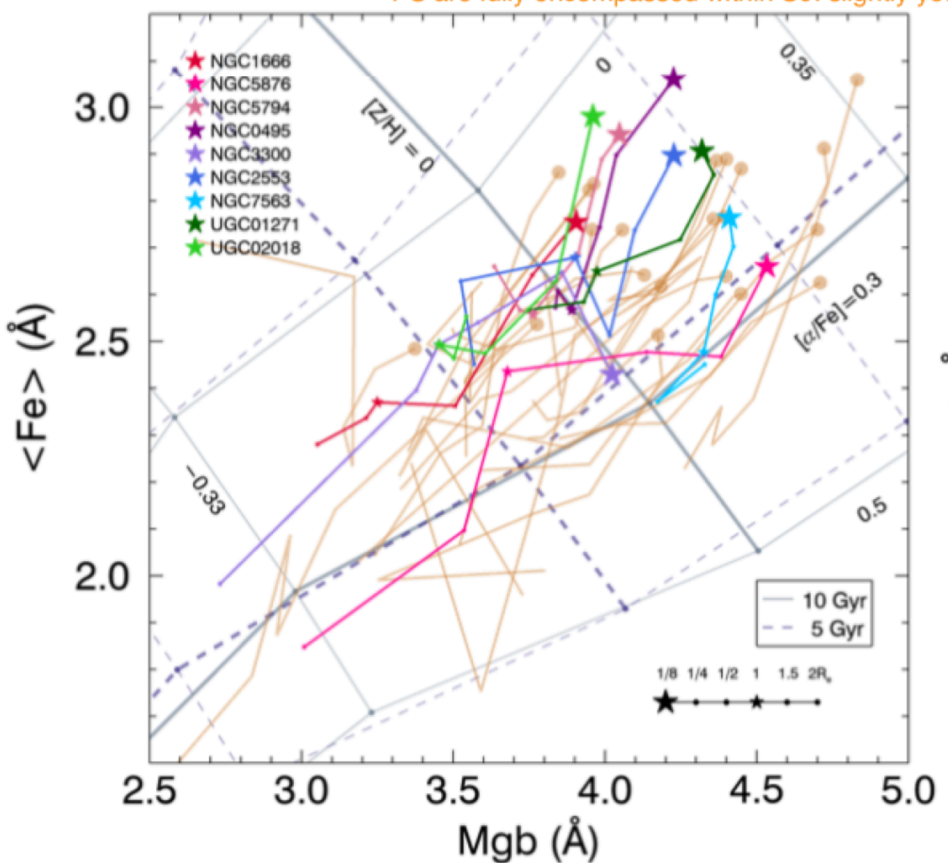
[2] $\langle \mathrm{Fe} \rangle = (\mathrm{Fe5270} + \mathrm{Fe5335})/2$

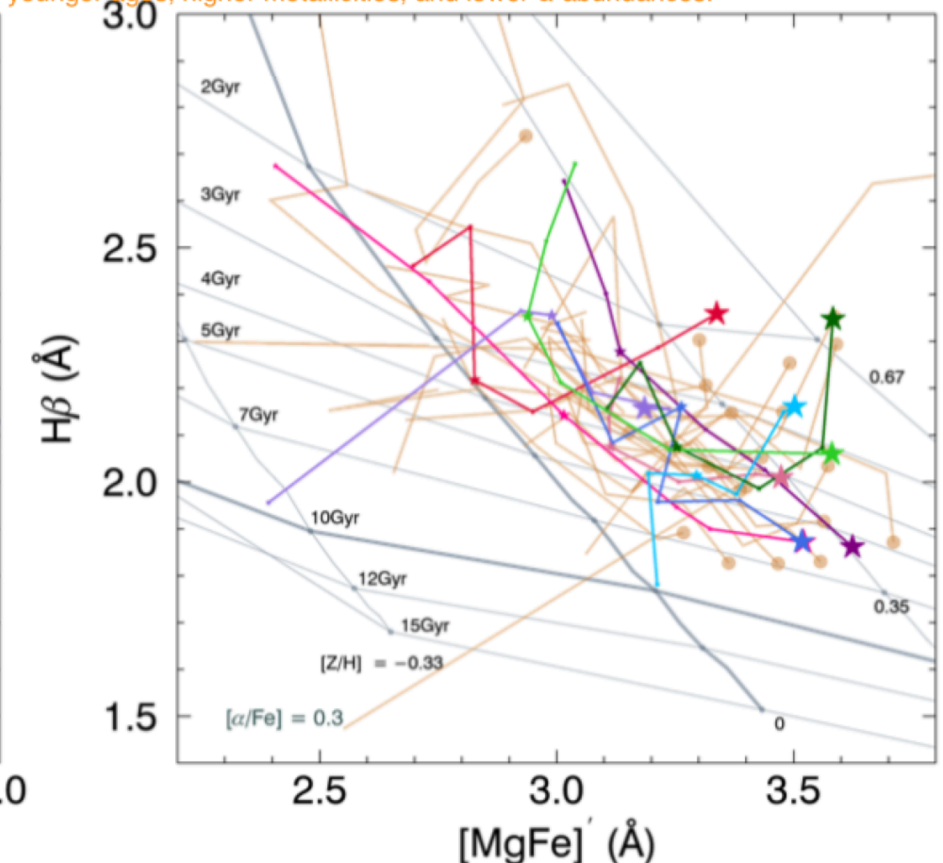




Stellar populations of **PS** are closer to those of **S0s** rather than SF spirals.

S0s have a wider range of age, metallicity and α-abundance at all radii out to 2 Re.
PS are fully encompassed within S0: slightly younger ages, higher metallicities, and lower α-abundances.





S0s: wider range.
PS within S0: slightly higher metallicities, lower α-abundances, younger ages.

PS within S0: there is no systematic difference
slightly higher [Z/H], lower [α/Fe], and younger ages.

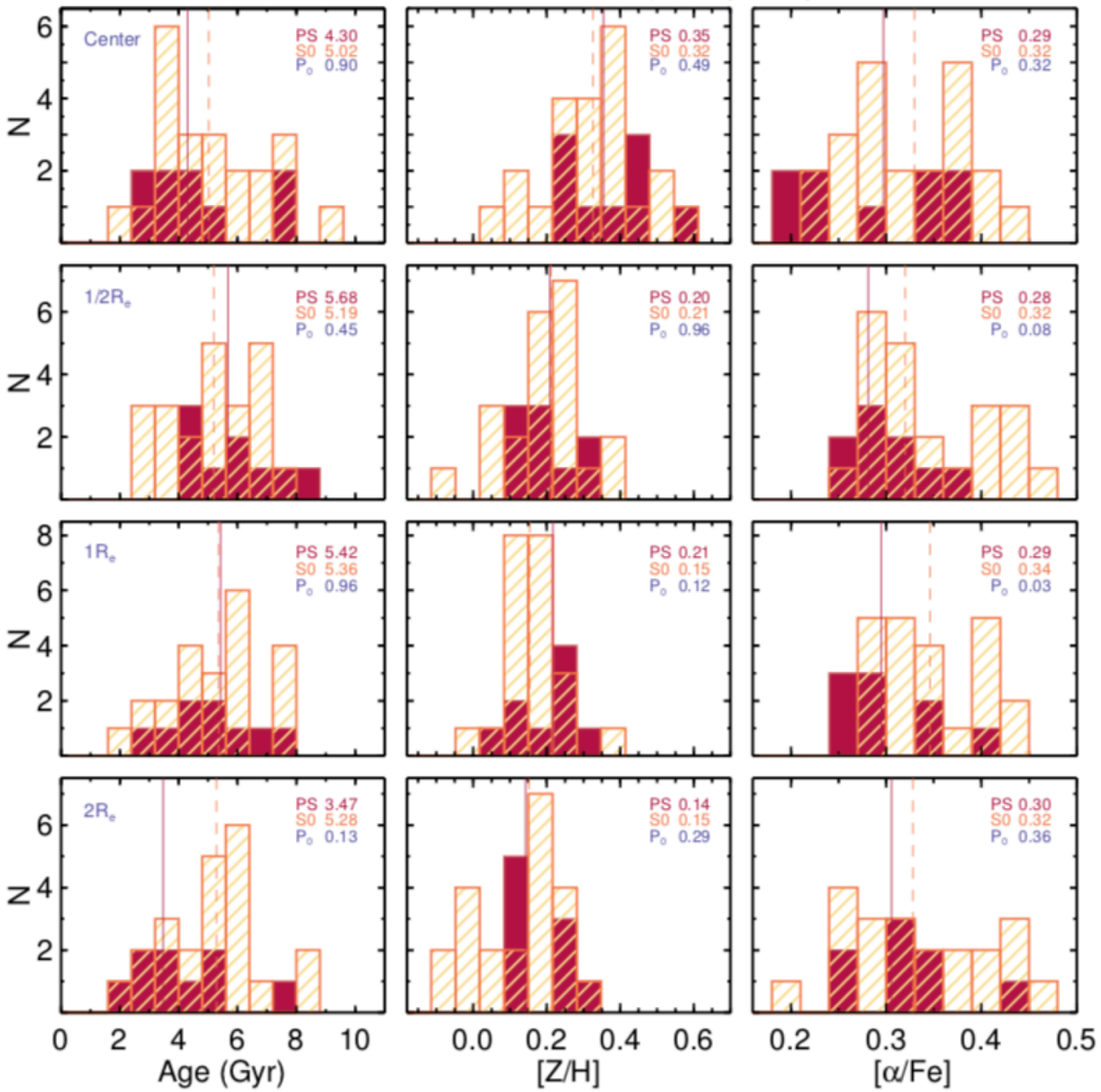


FIG. 7.— Comparison of luminosity-weighted age (left column), metallicity (middle column) and α-abundance (right column) at the center (1/8 R_e), 1/2 R_e, 1 R_e, and 2 R_e from top to bottom rows for passive spirals (red filled histogram) and S0s (orange hatched histogram). The median values of passive spirals and S0s are denoted in the top right corner of each panel.

Unclear correlations in PSs

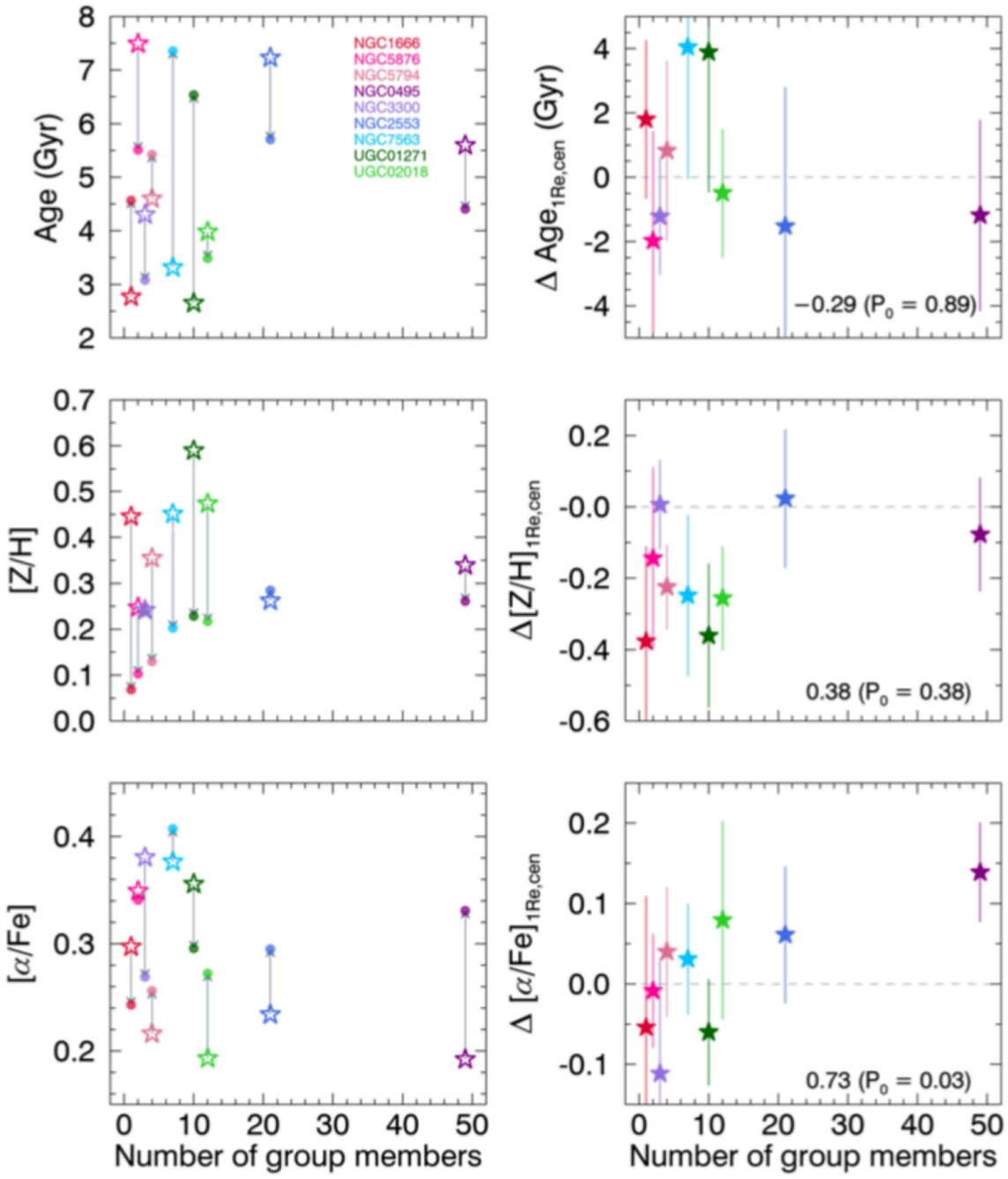


FIG. 8.— Age, metallicity, and α-abundance variations between the center (star symbol) and 1 R_e (dot symbol) in the left column and their differentials (1 R_e − center) in the right column for passive spirals with the number of group member. The measurement errors are shown. The Spearman's correlation coefficient and probability (P_0) are presented in the right panels. We adopt the membership information of each galaxy from the group catalog of Tully (2015).

Similarity in stellar populations between PSs and S0s: PSs could be one of the channels transforming to S0s.
High bar fraction: secular evolution by a bar could accelerate quenching.
The cessation of SF activity without destroying the spiral structure.