

“Interactions of galaxies: systems with tidal bridges”

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ABSTRACT

In this work we present a sample of interacting galaxy pairs connected by a bridge, obtained from a visual classification of the catalog Sloan Digital Sky Survey (SDSS-DR7). Preliminary results of the general characteristics of systems such as star formation rate, age of the stellar populations, concentration indices, colors and local density through parameter Σ_5 , are presented.

1) INTRODUCTION

Over the history of the universe, galaxy-galaxy interactions link the process of star formation with the growth of galaxies. According to hierarchical structure formation models, these interactions play a critical role in the formation and evolution of galaxies as discussed by Woods et al. (2007, and references therein).

Lambas et al. 2012, stressed the importance of studying different types of interactions. In particular, tidal interactions show a bimodality in their properties. Mesa et al. 2014 presented a sample of interacting galaxies with tidal structures, but only study the systems of spiral interacting galaxies showing tidal tails.

Motivated by the results of this work, in this poster the tidal interactions between two elliptical galaxies connected by a bridge are analyzed.

The main goal of this study is to explain the excess in the red colors and old populations in pairs of galaxies reported by several authors (Alonso et al. 2006,2012, Pérez et al. 2009, Darg et al. 2010; Patton et al. 2011, Lambas et al. 2012).

2) DATA

From Data Release 7 of Sloan Digital Sky Survey (SDSS-DR7; York et al. 2000; Abazajian et al. 2009) we obtained galaxies with spectroscopic data. A sample of galaxy pairs was selected with projected separation $r_p < 50 \text{ kpc h}^{-1}$ and relative radial velocities $\Delta V_{\text{spec}} < 500 \text{ km/s}$, within $z < 0.1$.

From this sample we obtained a catalog selecting only the tidal interactions connected by a bridge between elliptical galaxies. Fig. 1 show some examples of this interactions.

Table 1 provides the classification, number of pairs and percentages in the spectroscopic tidal pair samples. It was found that about 42% of the galaxies in this sample are AGN.

Classification	Number of galaxies	Percentages
Elliptical galaxies	604	57.85%
Elliptical AGN	440	42.15%
Total	1044	100%

Table 1. Classification, number of galaxies and percentages in the spectroscopic sample.

3) ANALYSIS

3.1 General properties of the sample

We study the distributions of z , M_r , C y $\text{Log}(\Sigma_5)$ for the samples of galaxy pairs, AGN and a control sample were assigned to each sample according to the values of these parameters (Fig. 2).

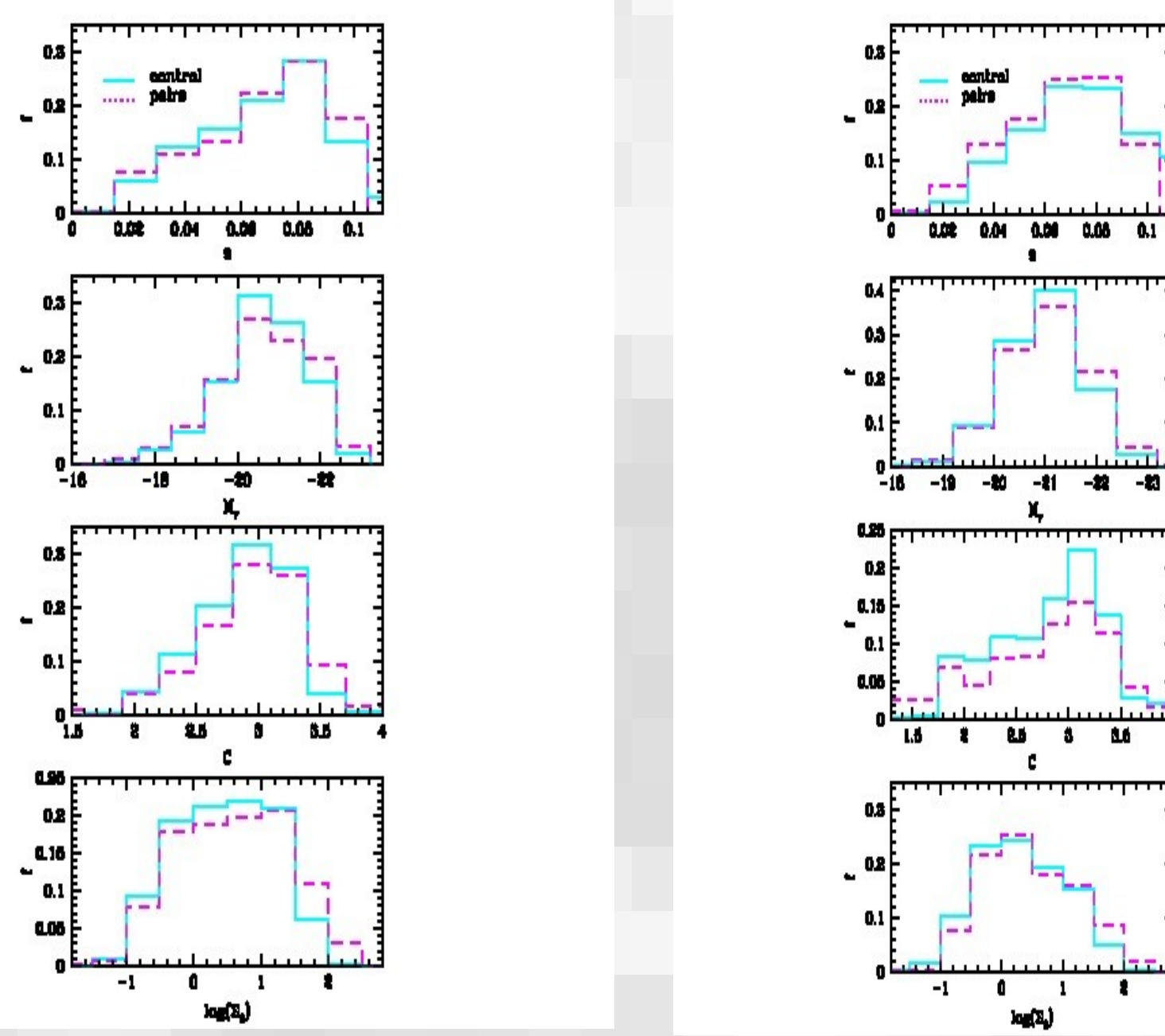


Figure 2. Distribution of z , M_r , C and $\text{Log}(\Sigma_5)$ for elliptical pair systems (l) And AGN elliptical galaxies (r) And the respective control sample, in all cases is performed a KS test showing that two samples come from the same distribution.

3.2 Analysis of the star formation rate, stellar populations and colors

The distributions of SFR/M^* , $D_n(4000)$ y $(u-r)$ were studied (Fig. 3 and 4).

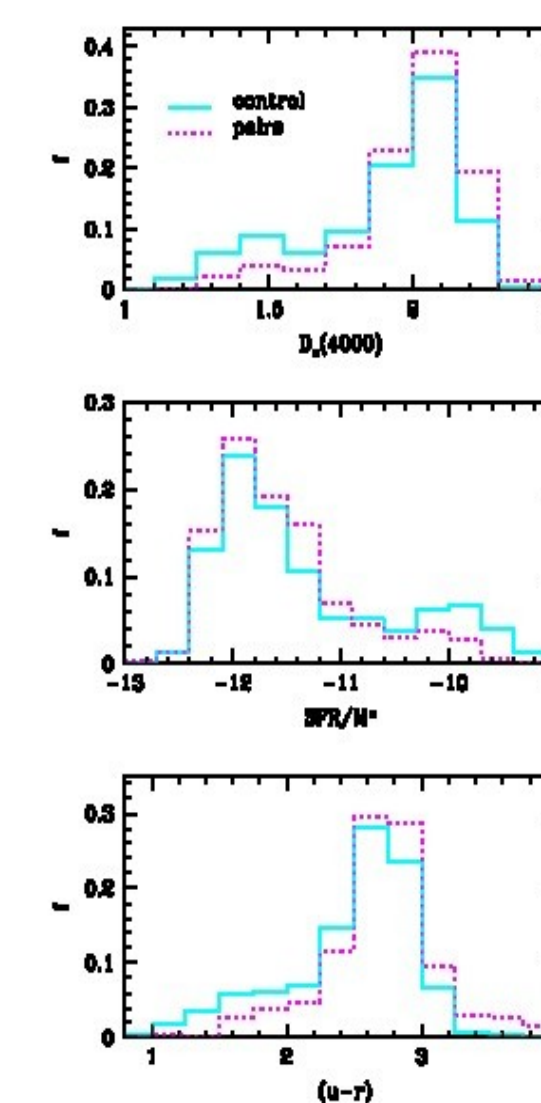


Figure 3. Distribution of $D_n(4000)$, SFR/M^* and $(u-r)$ for elliptical galaxy pairs and control sample.

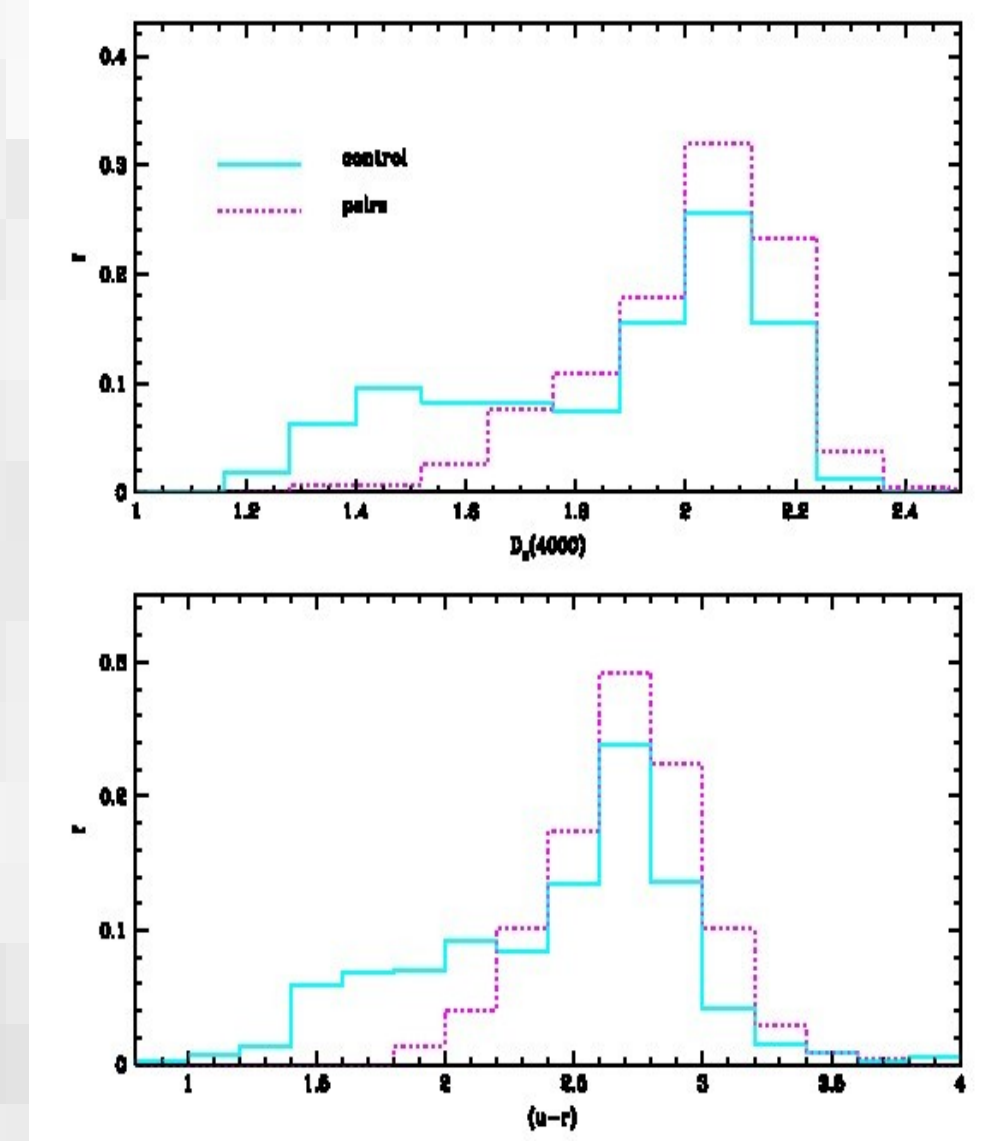


Figure 4. Distribution of $D_n(4000)$ and $(u-r)$ for elliptical AGN galaxy pairs and control sample.

3.3 Spectral synthesis

We apply this synthesis method to a subsample of our catalog, the synthesis code used was STARLIGHT (Cid Fernandes et al. 2004). Also we divided the sample in three regions according to the value of $\text{Log}(\Sigma_5)$ (Alonso et al. 2006) :

- low density: ($\text{Log}(\Sigma_5) < -0.57$)
- medium density: ($-0.57 < \text{Log}(\Sigma_5) < 0.05$)
- high density ($\text{Log}(\Sigma_5) > 0.05$)

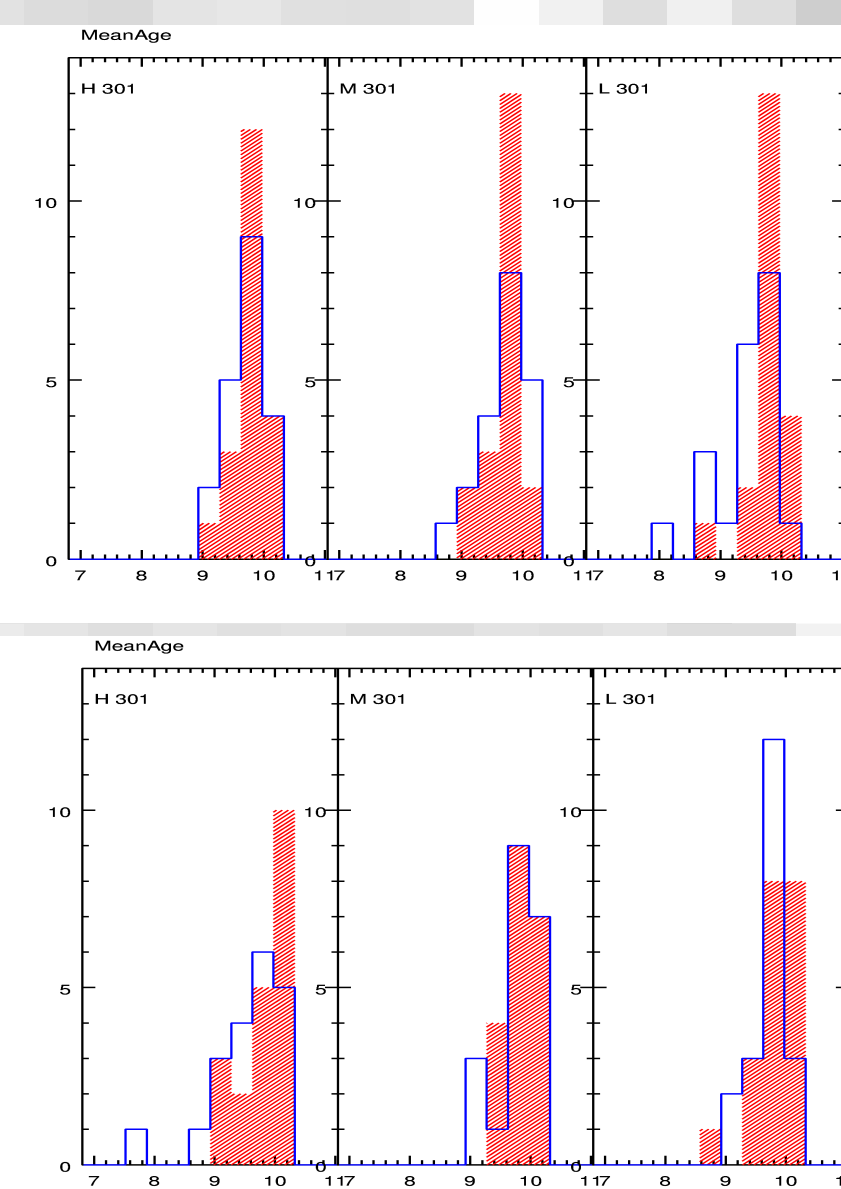


Figure 5. Distribution of mean ages for galaxy pairs (red) and control sample (blue) (above) and AGN elliptical galaxies (below), in high, medium and low densities.

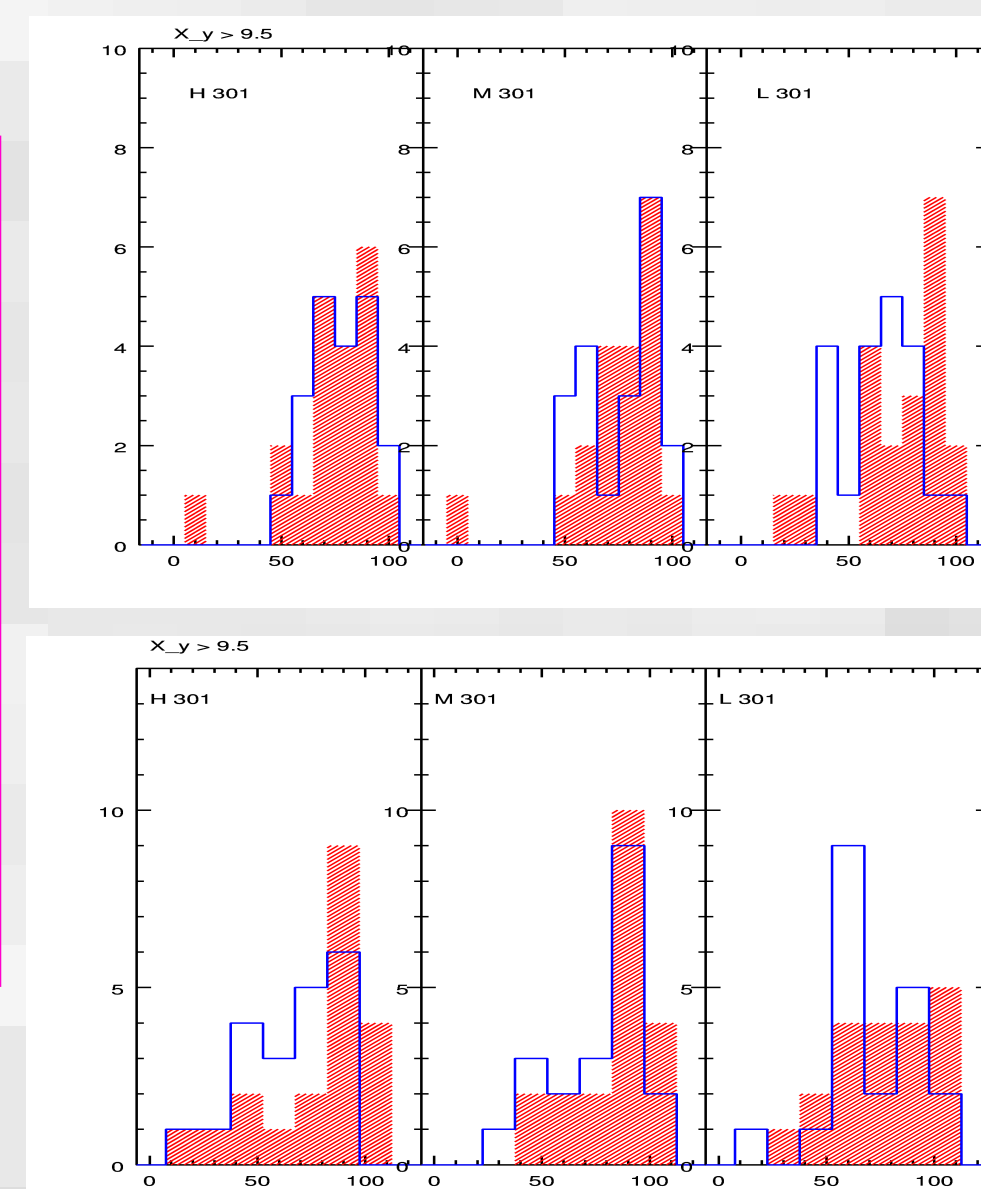


Figure 6. Distribution of fractions of old populations for galaxy pairs (red) and control sample (blue) (above) and AGN elliptical galaxies (below), in high, medium and low densities.

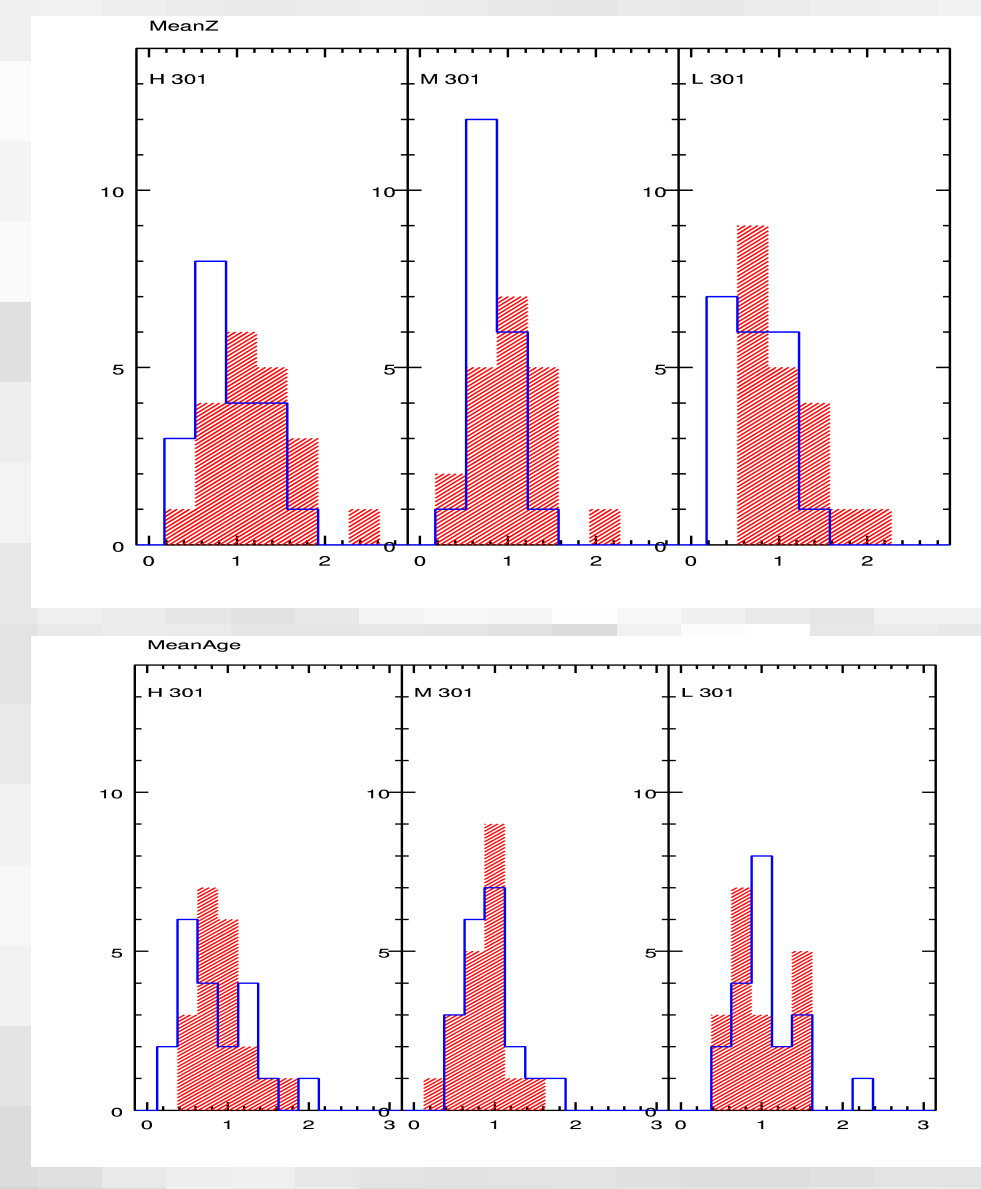


Figure 7. Distribution of mean metallicities for galaxy pairs (red) and control sample (blue) (above) and AGN elliptical galaxies (below), in high, medium and low densities.

4) CONCLUSIONS

- A sample of 1044 galaxies of early morphological type in interacting pairs selected from SDSS-DR7 with a limit of projected separation $r_p < 50 \text{ kpc h}^{-1}$ and relative velocities $\Delta V_{\text{spec}} < 500 \text{ km/s}$, for galaxies with spectroscopic redshift was obtained.
- We have selected only the interactions between elliptical galaxies connected by a bridge. The sample was divided in normal galaxies and AGN, we observed that the latter represents 42% of the total.
- Comparison sample was constructed based on the values of z , M_r , C and Σ_5
- An analysis of the star formation rate, stellar population and colors was performed, which shows that the interactions between elliptical galaxies have low star formation and their populations are old and reddened. In the case of AGN this characteristic is more remarkable.
- A subsample of spectra was studied using the method of spectral synthesis in different density environments, in this analysis we see fractions of old stellar populations, metallicities and mean ages, in all cases it is seen that these values are higher than the control sample for galaxies in interaction.
- Thus we note that the interactions between elliptical galaxies are showing red color distributions found by the above authors.

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Figure 1. Examples of pair images of galaxy pairs connected by tidal bridges.

