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PRESENTACIÓN ORAL

Effects of mergers and galaxy interactions at intermediate densities in the SDSS-DR4

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Abstract. Recently, several observational works have provided evidence in favor of a pre-processing of galaxies at moderate environments. These evidences show that the transition of galaxies onto the red-sequence could take place in galaxy groups in the outskirt of clusters or in the infalling populations. Based on the evidence that interacting and merging systems are priviledged found at intermediate densities, we use the SDSS-DR4 data to analyse the role of mergers and close galaxy interactions as environmental processes to lead to evolutionary transformations. We explore the properties of galaxy pairs and merging systems at different local and global density environments, comparing them with those of isolated galaxies in an unbiased control sample.

Resumen. Recientemente varios autores han aportado evidencia observacional que sugeriría que las galaxias son pre-procesadas en regiones de densidad intermedia, produciendo una gran transformación en las mismas. Estos resultados observacionales muestran que la transición de las galaxias hacia la secuencia roja se produciría en regiones periféricas de los cúmulos de galaxias. Por otra parte, existe evidencia tanto teórica como observacional que indicaría que las interacciones y fusiones de galaxias son particularmente frecuentes en estas regiones. En este trabajo analizamos el rol de las interacciones y colisiones de galaxias en regiones de densidad intermedia, utilizando para tal efecto galaxias del catálogo SDSS-DR4.

1. Galaxy Pair and Control Sample Catalogues.

From the SDSS-DR4 galaxy survey, we select a reduced redshift range sample ($0.01< z <0.1$) in order to avoid strong incompleteness at larger distances. The

AGN sources have been removed from our sample because their contributions to the emission spectral lines could affect our interpretation of results. According to observational criteria (Lambas et al 2003), we build a Close Galaxy Pair Catalogue (CGP) imposing thresholds in relative projected separations and radial velocities ($r_p < 25\,\mathrm{kpc\,h^{-1}}$; $\Delta V < 350\,\mathrm{km\,s^{-1}}$). For comparison, we build a CS constructed by selecting galaxies without a near companion within these thresholds. In order to avoid bias effects, it is required that galaxies in the CS match one-to-one redshifts, stellar masses, local densities and host halo masses of galaxies in pairs (Perez et al. 2009a). We also consider a merging systems (MS) sample, selecting galaxies from the CGP with clear morphological disturbances (Alonso et al. 2007).

In order to investigate the effect of galaxy interactions at different environments, we have characterized the different environmental regions by the projected density parameter (Σ, computed by using the projected distance to the 5^{th} nearest brighter neighbour) and the host halo mass (M_{DM}, assigned following Zapata et al. (2009)) as local and global density estimators, respectively. For this study, we divided the local and global environments in three different bins. According to Perez et al. 2009b, the local environment was divided in Low: $\log\Sigma < -0.57$, Intermediate: $-0.57 < \log\Sigma < 0.05$ and High local densities: $\log\Sigma > 0.05$ (in units of $\mathrm{Mpc^{-2}h^{-2}}$), and the global one in terms of different halo mass, Small: $\mathrm{M_{DM}} < 13$, Medium: $13 < \mathrm{M_{DM}} < 13.5$ and Large: $\mathrm{M_{DM}} > 13.5$, (in units of $10^{10}\,\mathrm{M_\odot h^{-1}}$).

2. Results and Conclusion.

In order to check the hypothesis that mergers and galaxy interactions are effectively frequent at moderate densities, we compute the cumulative fraction of galaxies in CGP, MS and CS as a function of local projected density. In agreement with previous works (Mihos 2004; Moss 2006) we find that while a 40% of close pairs (and 50% of merging systems) populates the intermediate local densities, only a 25% of isolated galaxies in the CS are found in the same local environment. This result motivates the study of galaxy interactions and the effects that they have on galaxy properties at this particular moderate environment.

With the aim of segregating the effect of galaxy interactions from other possible environmental processes, we compare the properties of galaxies with and without a near companion, inhabiting at the same local and global environments. Particularly, we analyse colours ($u-r$) and concentration indexes ($C = r_{90}/r_{50}$) of galaxies in the CGP and CS, at the same local projected density and with the same DM halo masses. Thus, we have removed any possible environmental bias, in consequence, we expect that properties of galaxies with and without a near companion behave similarly, unless tidal interactions cause some effects.

The analysis of the fraction of red ($u-r > 2.8$) and bulge-dominated systems ($C > 2.5$) as a function of local densities shows the expected underlying trends, with an increase of these fractions with Σ for both isolated and interacting systems, regardless of the DM haloes. However, galaxy interactions seems to have an special role particularly at low and intermediate Σ. At the lowest local densities, we find a blue excess of disc-dominated galaxies in pairs which could

be associated to the higher level of SF tidally induced. This result was previously reported by Alonso et al. (2006) and Ellison et al. (2009, private communication) among others. Besides, we also find signals of galaxy interactions at intermediate local density regions, where a larger fraction of red and bulge-like systems have a near companion (Perez et al. 2009b). It is interesting to note that this excess of red-sequence objects is detected for all DM haloes, suggesting that galaxies could be efficiently transformed at intermediate local densities by close galaxy interactions, and that this process might not be totally regulated by mechanisms which operate at large scales.

We remark that this red excess in close galaxy pairs might indicate a dust obscured star formation, in agreement with previous observational reports which show an excess of dusty SF in moderate density regions (Wolf et al. 2005; Gallazzi et al. 2008). However, other interpretations are also possible; i.e., galaxy interactions could operate on evolved systems in this environment. Infrared observations of galaxy pairs at moderate density regions could provide the key to better understand the problem.

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