Outskirts of Galaxy Clusters: Intense Life in the Suburbs
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A new sample of isolated galaxy pairs

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Abstract. A new volume-limited sample of 84 isolated pairs of galaxies has been selected from the UZC catalogue. Galaxies in pairs are brighter than $M_{Zw} - 5\log h = -18.9$. The projected separation between pair members is $r < 200h^{-1}$ kpc, the isolation criterion requires the pair to have no further companion within a $R = 1h^{-1}$ Mpc distance. Morphological classification for both members is available for 57 pairs. Out of these, 9 are early-type (E+E) pairs, 29 late type (S+S) pairs, and 19 mixed (E+S) pairs. We find a deficit of luminous dominants among E+E and E+S pairs relative to S+S pairs, while the distance between pair members is statistically undistinguishable. However, among the 12 pairs that are not only close but also luminous, the fraction of E+E and S+S pairs is 8% and 83% respectively. This result is consistent with star-formation being enhanced in S+S pairs (but not in spirals in S+E pairs) in extremely close isolated pairs.

1. Introduction

There is observational evidence that galaxy-galaxy interactions/mergers can significantly enhance the star formation rate (SFR) in galaxies (Kennicutt 1998), while it is still unclear whether close galaxy-galaxy interactions/mergers are common and fundamental episodes in the evolution of most galaxies. Galaxy pairs are ideal sites to analyse the effect of interaction/merging on galaxy formation and evolution. The most extensively studied pair sample (Karachentsev 1972) has been selected on plates, based on visual criteria. Reduzzi and Rampazzo (1995) have extended the Karachentsev's selection criteria to the southern sky. More recent flux-limited pairs samples (Barton et al. 2000, Patton 2002, Lambas et al. 2003), selected from large 3D galaxy catalogues, are based on both projected (r) and radial velocity (cz) distance. Results indicate that SF is enhanced in close pairs. Alonso et al (2004) claims that SFR enhacement is observed both in isolated pairs and in pairs in dense environments. On the other hand, on the basis of the analysis of Compact Groups (Focardi & Kelm 2002), we expect truly isolated galaxy pairs to display the largest evidence of galaxy interaction and, as a consequence, SF enhancement. We have thus selected a volumei-limited sample of Bright isolated Pairs of Galaxies (BPG) to investigate the role played by a close companion on galaxy properties.

2. Bright isolated pairs of galaxies: the sample

Isolated pairs have been selected in the UZC catalogue (Falco et al. 1999) applying an automatic neighbour search algorithm. A galaxy pair is defined as a system including a galaxy with one companion within projected radius $r = 200h^{-1}$ kpc and radial velocity difference $|\Delta(cz)| \leqslant 1000$ km/s. Isolated pairs fulfil the additional constraint that no further neighbour galaxy is found within the projected radius $R = 1h^{-1}$ Mpc and velocity difference $|\Delta(cz)| \leqslant 1000$ km/s.

The BPG is a volume-limited sample: it includes 84 isolated galaxy pairs with radial velocity in the range $[2500 - 7500]$ km s^{-1} and galactic latitude $b^{II} \geqslant 30°$. The absolute

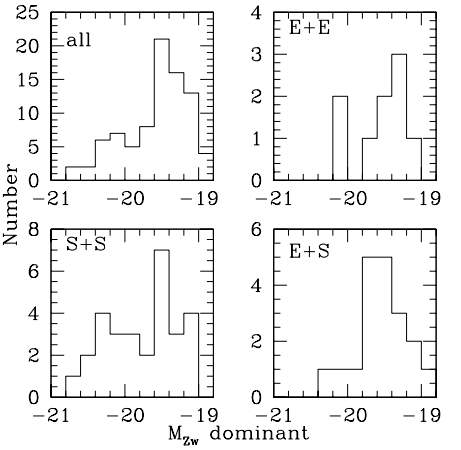

Figure 1. Distribution of the absolute magnitude of the dominant galaxies in pairs, for the whole sample, and for E+E, S+S and mixed pairs.

magnitude limit is $M_{Zw} = -18.87$ corresponding to the luminosity of a m_{Zw}= 15.5 galaxy (the completeness limit of the UZC catalog) at $cz = 7500$ km s^{-1}. The sample includes 77 symmetric systems (both galaxies fulfil all constraints).

3. Morphology and luminosity of BPG members

Only 57 pairs have morphological classification available, in the literature, for both member galaxies. Out of these 57 pairs, 9 (16%) are E+E pairs, 29 (51%) are S+S pairs, and 19 (33%) are E+S pairs. No distinction is made between ellipticals and S0s.

The morphological composition of the BPG sample is actually in excellent agreement with the morphological composition of the visually selected pairs in Karachentsev's and in Reduzzi and Rampazzo's samples.

In figure 1 we plot the luminosity distribution of the dominant galaxy in a pair for the whole sample and for E+E, S+S and E+S pairs respectively. There is evidence that dominant galaxies in E+E and E+S pairs are less luminous than dominants in S+S pairs: while 34% of the dominants in S+S pairs are brighter than $M - 5\log h = -20$, in E+E and E+S pairs the fraction decreases to 22% and to 11% respectively. Conversely, we find the luminosity distribution of the faintest members in pairs to be similar in all 3 pair classes. As a consequence we find the magnitude difference between pair members to be marginally larger in S+S pairs. Along with the observation that isolated E/S0s have fainter characteristic magnitude than E/S0s in Compact Groups (Kelm & Focardi 2004), this suggests that early-type galaxies in low density environments are typically faint, and that the majority of the luminous ellipticals are located in richer environments (groups).

4. Projected separation of BPG members

We next investigate whether E+E and S+S pairs exhibit similar projected separation distributions. In figure 2 we show distributions between pair members in the whole BPG sample and in the 3 morphologically defined subsamples. The fraction of E+E, S+S and E+S in loose pairs (16 with projected distance $r \geqslant 70h^{-1}$kpc) is 33%, 24% and 31% respectively. The fraction of E+E, S+S and E+S in close pairs (31 with projected distance $r \leqslant 25h^{-1}$kpc) is 56%, 66% and 53% respectively.

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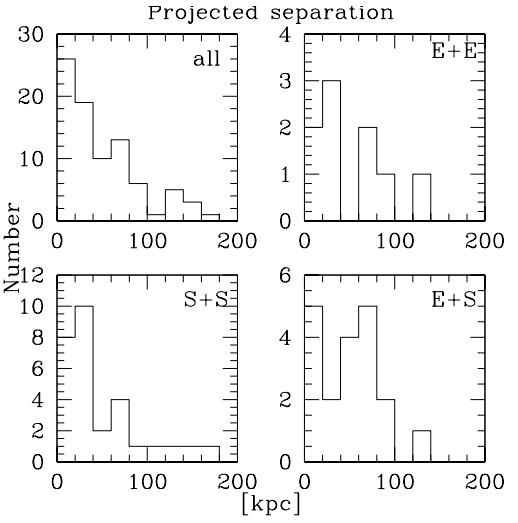

Figure 2. Distribution of the projected separation between BPG members for the whole sample and for E+E, S+S and mixed pairs.

The KS test indicates that there is no statistically significant evidence that the distribution of E+E and E+S pairs are different. However, we find that among the 12 pairs that are not only close, but also luminous ($M_{dom} - 5 \log h \leqslant -20$) the fraction of E+E and S+S pairs is 8% and 83% respectively. This is consistent with the luminosity of spirals in close and isolated pairs to be boosted and thus with enhanced star-formation activity, as found by Lambas et al. (2004) and Sorrentino et al. (2003) in 2dF pairs.

Optical observations are in progress, at the Loiano 152 cm telescope, to get complete and homogeneous spectral classification and broad band two colour photometry for the whole BPG sample. These data will allow us to confirm any enhancement in the SFR of late-type pairs and to further check if the fraction of AGNs among isolated pair members is increased relative to the low fractions found in Compact Groups (Coziol et al. 2004, Kelm et al. 2004).

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