Prevalence of Active Galactic Nuclei in isolated galaxies versus clusters and compact groups

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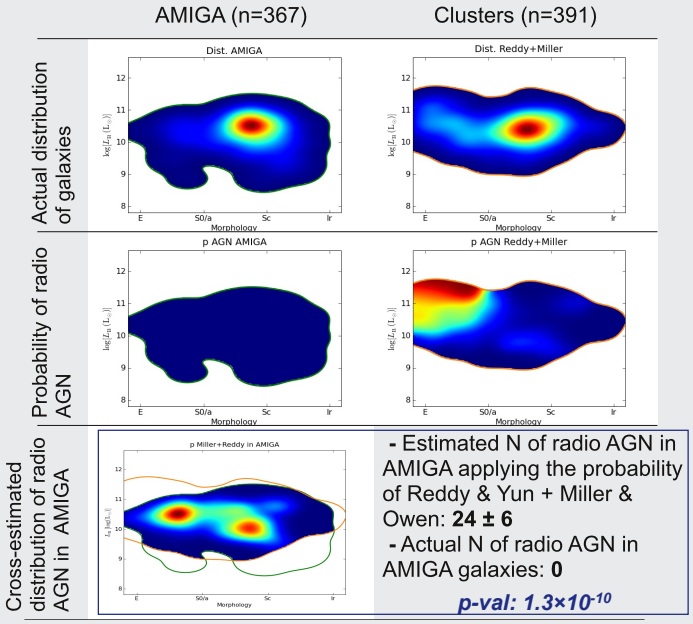
Introduction

We present a study of the effect of environment on nuclear activity focussing both on radio and optical nuclear activity types. In order to determine the effect of the environment and interactions in nuclear activity, we compare the prevalence of nuclear activity between samples of galaxies in dense environments (clusters) or affected by interactions (compact groups) and the AMIGA sample of isolated galaxies (http://amiga.iaa.es/; Verdes-Montenegro et al. 2005).
In Sabater et al. (2008) it was found that the effect of the environment is fundamental for the triggering of radio nuclear activity. Although account was taken of the possible bias caused by the morphology-density relationship, we present a revision of the study which also considers the luminosity-density relationship using a new statistical method.

An empirical probability density function as a function of optical luminosity (L), morphology (t) and the presence of an active galactic nucleus (AGN), based on the actual data from the samples, is built (Sabater et al. 2012). The differences in the probability of harbouring an AGN as a function of L and t for different samples should be driven by an independent factor like the environment or the interaction.
In order to compare, we apply to each sample its own probability function (actual values) and the one of the comparison sample (estimation). The results should be similar if there is no effect of the environment/interaction, and different otherwise. We compare only within the region in common between both distributions (less than 2% of the galaxies out of the boundaries). The data for L and t were homogeneously compiled from the LEDA catalogue.

Radio nuclear activity

The rate of radio AGN galaxies was compared between isolated galaxies and galaxies in clusters from Miller & Owen 2001 (nearby Abell clusters) and Reddy & Yun 2004 (nearby X-ray clusters).
A galaxy is considered as a radio AGN when it has a factor 5 radio excess above the radio (NVSS) to far infrared (IRAS) correlation (Yun et al. 2001). We show the results obtained when we merge the data of the two cluster samples to improve the statistics, but results are similar if we compare independently with each cluster sample.



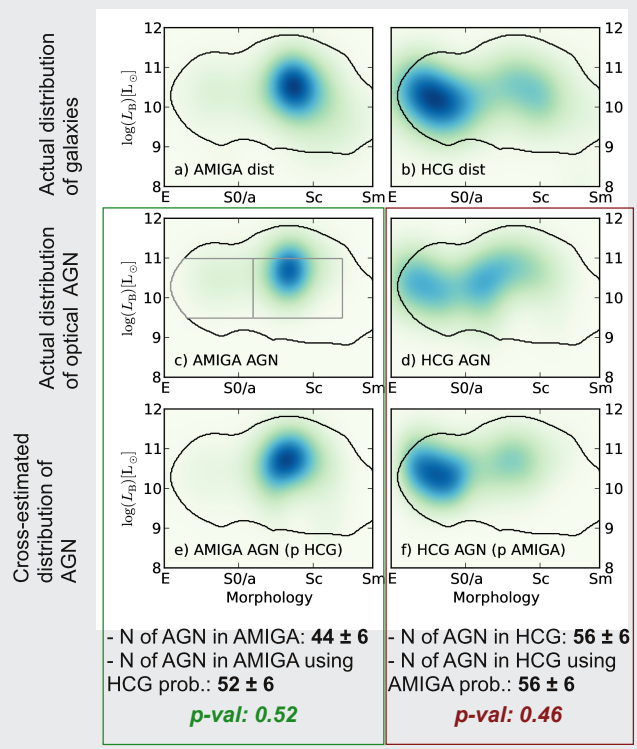
- Estimated N of radio AGN in AMIGA applying the probability of Reddy & Yun + Miller & Owen: **24 ± 6**
- Actual N of radio AGN in AMIGA galaxies: **0**

p-val: 1.3×10^{-10}

Clearly different values. The independent factor between both samples (environment) seems to be crucial for the presence of a radio AGN.

Optical nuclear activity

We also compared the rate of optical AGN of isolated galaxies (Sabater 2009; Sabater et al. 2012) with the one for galaxies in Hickson Compact Groups (HCG; Martinez et al. 2010).
The spectra for both the AMIGA and HCG samples are processed in a similar way.



- N of AGN in AMIGA: **44 ± 6**
- N of AGN in AMIGA using HCG prob.: **52 ± 6**

p-val: 0.52

- N of AGN in HCG: **56 ± 6**
- N of AGN in HCG using AMIGA prob.: **56 ± 6**

p-val: 0.46

Similar rate and distribution of optical nuclear activity within the error.

Conclusions

1 - **Radio nuclear activity is strongly influenced by the environment.** A galaxy with a given morphology and luminosity has a higher chance of harbouring a radio AGN when is located in a denser environment.
2 - On the other hand, **the prevalence of optical AGN in compact groups and isolated galaxies is undistinguishable**. This may be explained if the increase of activity produced by the interaction is compesated by the lack of a cold gas supply at higher densities.

References

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