The impact of encounters on the members of Local Group Analogs. A view from GALEX

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Summary. The bright galaxy population of the Local Group Analog (LGA) LGG 225 has been imaged with the Galaxy Evolution Explorer (GALEX) through its Far- and Near-UV wavebands. A significant fraction of the group members appear to underwent recent/on-going interaction episodes that strongly disturbed overall galaxy morphology. UV-bright regions, sites of intense star formation activity accompanied by intense dust extinction, mark the galaxy outskirts forming irregular structures and tails. Compared to the Local Group, LGG 225 seems thus to be experiencing a more intense and active evolutionary phase.

1 Introduction

Poor groups of galaxies represent the defining aggregates of the so called “field”. Their importance comes from two facts: i) most of galaxies in the Local Universe is found in groups, rather than in the cluster environment [5]. ii) The transition between galaxy properties typical of field and clusters happens just at densities characteristic of poor groups, thus suggesting the existence of re-processing mechanisms driven by the environment richness [10, 6]. Groups show a wide range of properties when adopting a multi-wavelength approach. As far as X-ray emission is concerned, for instance, those dominated by ellipticals are rich in hot and diffuse intergalactic gas [11], while in spiral-dominated aggregates— as is the case of our own Local Group— a low X-ray emission comes from cold gas mainly confined within fine structures (shells etc.) of single galactic sources (see [13]). Whether a link exists between these two different evolutionary outputs in a hierarchical cosmological framework is still matter of debate.
In the group environment we know that galaxy encounters are extremely efficient in reshaping member morphology, being stellar velocity dispersion within galaxies comparable to that of the group as a whole. At the same time, both the merger/accretion rate and the frequency of processes giving rise to tidal dwarfs are still unknown. In this context, we are currently studying with \textit{GALEX} a sample of Local Groups Analogs which includes so far three systems, namely LGG 93, LGG 127 and LGG 225.

We present here a preliminary analysis of the LGG 225 group composed of about 10 galaxies (e.g. [14]). We imaged in the Near (NUV) and the Far (FUV) \textit{GALEX} bands the ultraviolet emission of NGC 3447, NGC 3447A, NGC 3454, NGC 3455 and UGC 6035 aiming at tracing the ongoing star formation (SF) and its distribution across galaxies and their intergalactic medium. In order to estimate the parameteres of these SF events we rely on the [1, 2] population synthesis models.

2 The LGG 225 group: UV Morphology and Photometry

Table 1 provides a list of spectroscopically confirmed group members, their optical classification [4] and total \textit{GALEX} FUV and NUV magnitudes. Our two \textit{GALEX} pointings cover five members of LGG 225 sample, i.e. the bright part of its galaxy population. The NUV and FUV images of the five prevailing spirals are shown in the panels of Figure 1.

| Name       | Type         | B  | $V_r$ | NUV (AB) | FUV     | (FUV - NUV) |
|------------|--------------|----|------|----------|---------|-------------|
| NGC 3370   | SA(s)c       |    |    | 12.28    | 1279    | 14.34 ± 0.01 |
| NGC 3443   | Sad          |    |    | 13.70    | 1132    | 16.15 ± 0.01 |
| NGC 3447   | Mult.        |    |    | 17.71    |         | 0.02         |
| NGC 3447A  | SAB(s)m pec  |    |    | 13.10    | 1066    | 15.80 ± 0.01 |
| NGC 3447B  | IB(s)m pec   |    |    | 1098     |         | 16.43 ± 0.01 |
| NGC 3454   | SB(s)c?      |    |    | 14.18    | 1101    | 18.01 ± 0.01 |
| NGC 3455   | (R)SAB(rs)b |    |    | 12.83    | 1102    | 14.719 ± 0.01 |
| NGC 3507   | SB(s)b       |    |    | 11.73    | 979     | 16.90 ± 0.03 |
| UGC 5947   | Im pec.      |    |    | 14.75    | 1251    | 14.251      |
| UGC 6035   | IBm          |    |    | 14.30    | 1072    | 16.25 ± 0.01 |
| UGC 61121  | Sd?          |    |    | 13.90    | 1033    | 16.89 ± 0.03 |

Very little is reported in the literature about these galaxies. NGC 3447A and its companion NGC 3447 are members of the KPG 255 pair in the [8] catalogue with a radial velocity difference of about 30 km s\(^{-1}\).

The two galaxies appear strongly interacting. A bar is still visible in NGC 3447A, while both the underlying disk and the (multiple?) arms are tidally
distorted. Interaction is so strong that, for NGC 3447, it is even difficult to figure out the original morphological type (irregular or late-type spiral?). As for NGC 3443, galaxy has no unambiguous closeby companions, at least in projection. Nevertheless, one can report that the northern half of the galaxy is completely different from the southern one: clearly, a 2D velocity field is necessary to understand the nature of this asymmetry.

NGC 3454 and NGC 3455 are close both in projection and in the redshift space (Table 1). The first galaxy displays a clean edge-on spiral morphology while the outer eastern arms of NGC 3455 could be tidally disturbed. Finally, both arms and disk of UGC 6035 are significantly asymmetric with star forming regions confined in the western part of the galaxy nucleus.

3 Preliminary UV analysis

When compared to the Local Group, LGG 225 seems to going through a much more active phase of evolution. Although the UV-optical colors of the innermost (often bar-like) bodies of the analyzed galaxies appear quite red and are dominated by an old stellar population, most of the systems show outstanding UV-bright regions. Their measured (FUV-NUV) and (UV-optical) colors are consistent with the UV fluxes being dominated by moderately young (few hundred Myr or less) bursts of SF, accompanied by the presence of dust clouds (see Fig. 2).

Such UV bright, extended sources, especially those located in the tidal tails are the ideal candidate to evolve towards HI-rich, dwarf satellites (e.g. [12, 7]), affecting the so-called “missing satellite problem” (cf. [9]) and, more generally, actively contributing to the current evolution of the group.
Fig. 2. Left panel: The GALEX FUV-NUV color for a Simple Stellar Population as a function of age (from the Padua synthesis models) for three representative metallicity values. The measured colors of some SF regions of NGC 3447 are indicated by the tick line shelf on the left. Right panel: Comparison of the integrated B vs. UV galaxy photometry of Table 1 (star markers) with the Buzzoni (2002) galaxy templates of different morphology (from type E to Im, as labelled on the plot). Big dots for theoretical models refer to a 15 Gyr age, with back-in-time evolution traced down to 1 Gyr (see tails for the E and Im templates). The bottom right arrow is galaxy (internal) reddening for a 2 mag visual extinction according to the Calzetti (1999) attenuation law. Note that observed galaxies seem to be strongly affected by dust in their UV colors, with a few 0.1 mag E(B-V) color excess.

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