

A search for neighbours around isolated galaxies using the SDSS

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Abstract

The AMIGA project (Analysis of the interstellar Medium of Isolated GALaxies) aims to build a well defined and statistically significant sample of isolated galaxies that can serve as a reference for quantifying the role of the environment on the formation and evolution of galaxies. The completed statistical analysis of the multiwavelength AMIGA sample allows us to initiate an evaluation of nurture (environment) driven effects. In this framework, we present preliminary results of a search for previously undetected neighbours around a subsample of AMIGA galaxies included in the SDSS DR7. This will allow us to refine our knowledge about the environments of AMIGA galaxies. SDSS CCD imagery and spectroscopy allow a stronger test of the degree of isolation in our sample galaxies.

The sample

The AMIGA project provides a well defined and parameterised sample based on the Catalogue of Isolated Galaxies (CIG) compiled by Karachentseva (1973) from photography material (DPOSS) (Verdes-Montenegro et al. 2005).

We found 654 AMIGA galaxies in SDSS DR7 using the photometric table (PhotoObjAll table) and 420 galaxies with spectroscopic data (SpectObj table). We selected a subsample of 24 CIG galaxies as representative of the full sample in terms of velocity, luminosity, morphological type, isolation parameter and spatial distribution (Figures 1, 2). This pilot study allows us to estimate the feasibility and time needed in order to re-evaluate the degree of isolation of the galaxies in the full AMIGA sample, using the SDSS data.

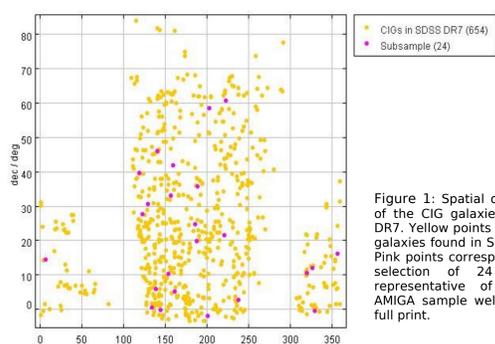


Figure 1: Spatial distribution of the CIG galaxies in SDSS DR7. Yellow points are AMIGA galaxies found in SDSS (654). Pink points correspond to our selection of 24 galaxies representative of the full AMIGA sample well inside in full print.

We searched for neighbours of these 24 galaxies within a cylinder of minimum physical radius $r=0.5$ Mpc centered on each CIG galaxy. This corresponds to 27.5 arcmin for galaxies with velocity $V>4687$ km/s (17 galaxies), 55 arcmin for galaxies with V between 2343-4687 km/s (5 galaxies) and 82.5 arcmin for galaxies with V between 1500- 2343 km/s (2 galaxies) (Verley et al. 2007a).

The SDSS provides data nearly 100% complete regarding the photometric data, and about 50% for the SDSS redshift data for the 608 neighbour galaxies listed by Verley et al. (2007a) around the 17 CIG galaxies.

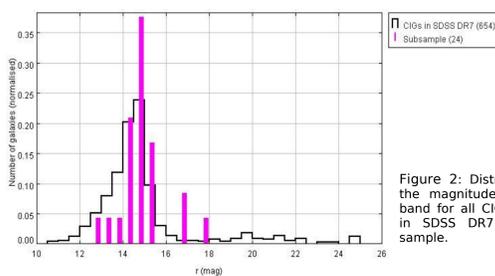


Figure 2: Distribution of the magnitude in the r band for all CIG galaxies in SDSS DR7 and our sample.

Star-Galaxy separation

We present preliminary results for the field of CIG 233 (11092 km/s). Figure 3 shows the results of the cone search including the 39974 objects found in the SDSS photometric table as well as the 41 neighbours catalogued in S. Verley (2007a) from a POSS search. Discrepancies were found and are detailed below.

In order to check the star-galaxy classifications in SDSS we constructed a size/magnitude diagram (g band) calculating the object area from the Petrosian radius which does not depend on the model fits (Berdardi et al. 2010). In Figure 4 we show this diagram for the CIG 233 field. The resolution of SDSS images allows us determine that some galaxies in the neighbour catalogue (red points) are really stars. We carried out a similar analysis for the other 17 CIGs with velocities $V>4687$ km/s. The star-galaxy classification from SDSS works well for objects with Petrosian g magnitude less than 20.

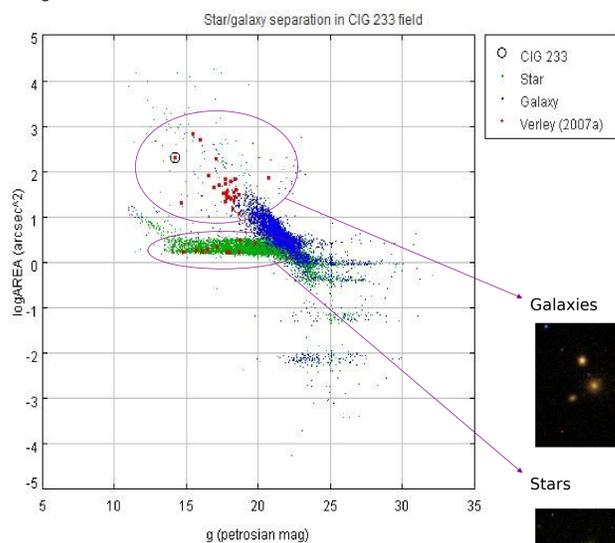


Figure 4: Star-galaxy identifications using SDSS photometric classifications for a cone search within 27.5 arcmin around CIG 233. Blue and green points indicate objects classified as galaxies and stars respectively. Objects from the catalogue of neighbours in this field (41) correspond to red points, 13 of these neighbouring "galaxies" were classified as stars by SDSS.

On the right we show images of a few objects in the field of CIG 233 from the SDSS catalogue. Galaxy images correspond to red points with $\logAREA > 1$ and star images to red points in the marked star zone.

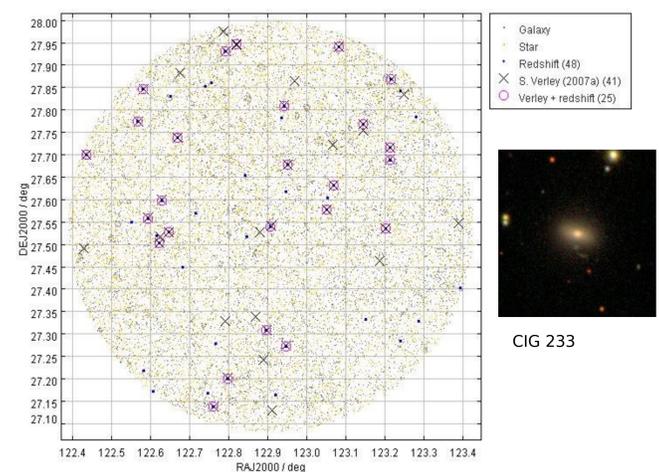
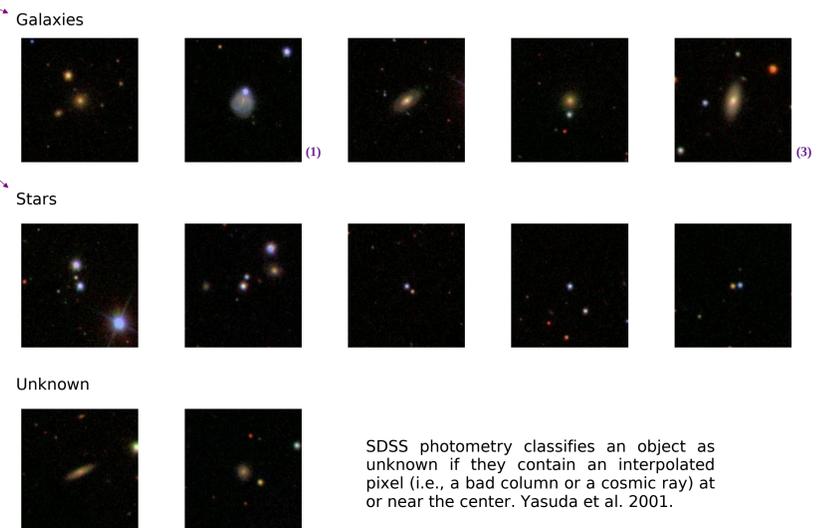


Figure 3: Spatial distribution for all photometric objects from SDSS in the CIG 233 field within 27.5 arcmin. Objects classified as galaxies and stars by SDSS correspond to grey and yellow points, respectively. Objects from the catalogue of neighbours around isolated galaxies (Verley et al. 2007a) correspond to cross (41). Fifteen objects of them were not classified as galaxies by SDSS: 2 with type unknown due to magnitude flags and the rest were classified as stars. Galaxies with redshift data in SDSS correspond to blue points (48). There are 25/41 candidate neighbours from Verley et al. (2007a) have SDSS redshifts.



SDSS photometry classifies an object as unknown if they contain an interpolated pixel (i.e., a bad column or a cosmic ray) at or near the center. Yasuda et al. 2001.

Results

The SDSS star-galaxy default pipeline misclassified many objects in our study. Size/magnitude diagrams like Figure 4 provide a method to separate stars and galaxies as a function of these parameters within the magnitude range $-14 < g < -22$. This limitation is not crucial for analysis of the neighbourhood in our 17 fields (Figure 5), but it can be important for many AMIGA galaxies in SDSS. We found that 627 out of 654 AMIGA galaxies were classified as galaxies by SDSS while 22 were classified as stars and 5 as unknown objects. Out of 608 galaxies in the catalogue of neighbours, 69 were classified as stars (11.35%). Our visual verification revealed that 57 were correctly classified as stars (9.4%) and 12 were in fact galaxies (2%).

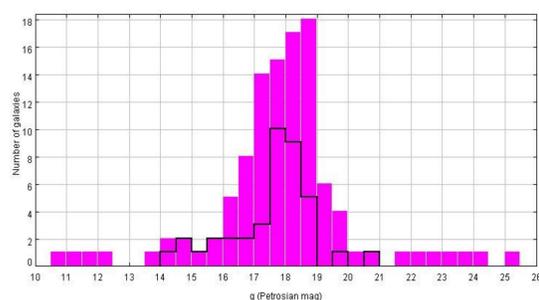


Figure 5: Distribution of Petrosian g band magnitudes for all neighbour galaxies in the subsample of 17 CIGs. We show with black line these objects for CIG 233. Maximum distribution is located in the range $15 < g < 20$.

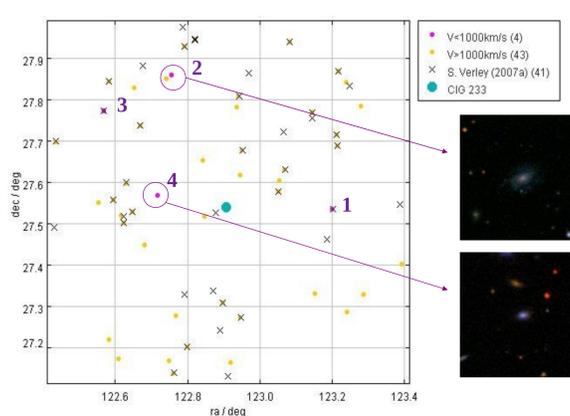


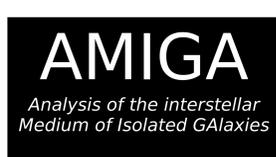
Figure 6: Distribution of SDSS sources within 27.5 arcmin of CIG 233 classified as galaxy and with redshift data. Galaxies with difference in velocity < 1000 km/s with respect to CIG 233 correspond to pink points. Galaxies with difference in velocity > 1000 km/s with respect to CIG 233 correspond to yellow points.

Verley et al. (2007a,b) revised the isolation for the CIG sample using an automated search for neighbours on the DPOSS, providing an exhaustive list of ~ 54000 possible satellites and an estimation of the isolation degree of each CIG. The SDSS makes feasible a 3D revision of the ~ 400 CIG fields covered by the DR7 spectroscopic catalogue. The size/magnitude diagrams and visual inspection for neighbours reveal that the DPOSS objects misclassified as galaxy were in fact double stars. SDSS provides a higher depth and accuracy in the photometry and higher angular resolution which helps us to better separate blended or very close objects.

Results of our SDSS-based reanalysis of the field of CIG233 reveals four galaxies that are potential neighbours projected within 27.5 arcmin and showing line-of-sight velocity differences < 1000 km/s. Most are much fainter than CIG233 but galaxy 3 (Figure 6) which was also in the Verley catalogue shows almost identical magnitude and recession velocity which is a clear violation of the original isolation criterion.

Acknowledgements

This work has been partially supported by DGI Grant AYA 2005-07516-C02 and the Junta de Andalucía (Spain).



References

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Poster related



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