The Galaxy Populations in Compact Groups of Galaxies at z=0.2 – 0.3

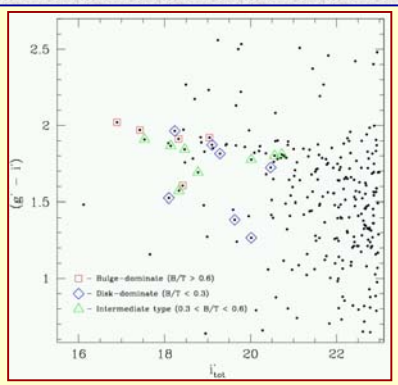
E. R. Carrasco[(1)], C. Mendes de Oliveira[(2)] & C. Brasseur[(3)]

(1) Gemini Observatory/AURA, La Serena, Chile; (2) IAG/USP, Brazil; (3) U. Victoria/Canada

Observations

- SDSS-*CG*-6 was observed using the Gemini Multiobject Spectrograph (GMOS, Hook et al. 2004, PASP, 116, 425) mounted at the Gemini South telescope in December 2005.
- Imaging:
  - g': 450secs, seeing 0.73" (450 sec.)
  - i': 360secs, seeing 0.55" (360 sec,)
  - Catalog is complete down to i'=23.5 mag
- Spectroscopy:
  - One masks: R400 grating centered at 630nm
  - Resolution: ~6Å, dispersion ~1.37Å/pix
  - 35 objects with redshift (i'< 21.5 mag)

GMOS composite color image showing the 4.5' of SDSS-*CG*-6 (~ 0.96 h^{-1} Mpc). The zoom (inner 0.2 h^{-1} Mpc region) shows the 5 central galaxies of the group. The galaxies *A*, B and *C* are aligned (SE-NW direction) and seem to be embedded in a common halo. The galaxies *A* (*BGG*) and *C* (3rd ranked galaxy by magnitude) appear to be interacting. They are separated only by 18 h^{-1} kpc (~ 5" on the sky).



Color-magnitude diagram for all galaxies with i'<22.5 mag. About 75% of the galaxies in the group are red (at the so-called the red sequence, (g'-i')~1.9). Only the 25% member galaxies are blue. All galaxies with (g'-i') < 1.5 show emission lines in their spectra.

Background and motivation

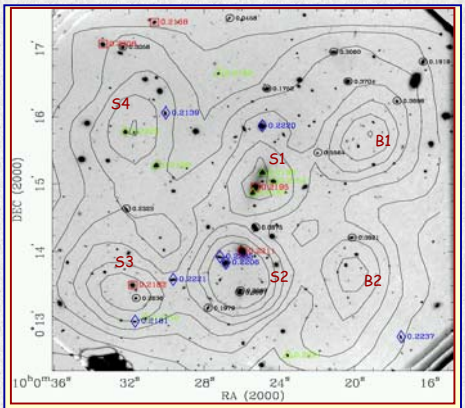
Group of galaxies are the most common galaxy association. They are small systems of typically a few L* galaxies, which comprise about 50%-70% of all galaxies in the nearby universe (e.g. Geller & Huchra 1983, ApJS, 52, 61). A small fraction of galaxy groups are classified as compact groups. Compact groups are small systems where the projected galaxy-galaxy separations are of the same order of the diameters of the galaxies themselves. Because their high densities and low velocity dispersions, compact groups are ideal laboratories for the study of galaxy evolution by dynamical interactions, and by the star formation which this interaction my trigger. Compact groups form from looser grouping of galaxies within they are embedded; they are bound systems which eventually merge in a short time scale (a few tenths of the Hubble time). If we believe this standard scenario (compact groups have extremely short dynamical life time: 1-2 Gyrs, and they will be replaced in approximately this time scale Diaferio et al 1994, AJ, 107, 868), then a key question is if there have been many generations of compact groups which have been merger already in the past of if, alternatively, we are in a special time of the Universe where the first compact groups are starting to amalgamate. One way to tackle this question is to look for more distant groups. If compact groups have been forming for, say, half or a third of the Hubble time, when presumably the first loose groups started collapsing to form more compact configurations, we should be able to identify a more distant (and younger) population of compact groups.

Main Goal

- Characterize the system structure of compact groups of galaxies at intermediate redshifts (0.2 < z < 0.3).
- Analyze the galaxy population and galaxy evolution.
- Compare with similar environments at z=0.

This poster

- Preliminary results for SDSS-*CG*-6 compact group (from the Catalog of Compact Groups of Galaxies – Lee at al. 2004, AJ, 127, 1811): Redshift z=0.22, N° of galaxies: 5, with 14 < r* < 21 (SDSS r*-band model)

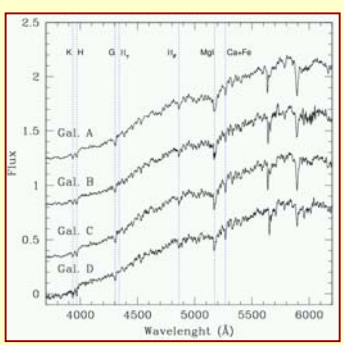


Projected density map of 290 galaxies with i'<23 mag superimposed on the i' band image (~ 5.3' FOV). Colored symbols: galaxies members of the group/cluster (see the CMD diagram). Circles: background/foreground galaxies. The map shows several sub-structures.

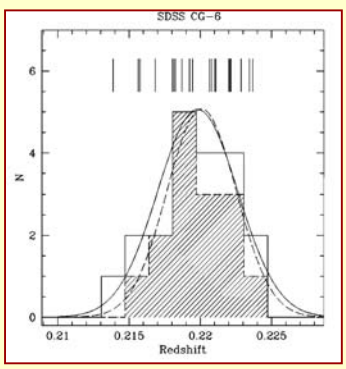
- S1: Core of SDSS-*CG*-6.
- S2, S3, S4 : The existence of several galaxies at the group redshift, suggests that these sub-structures are probably dynamically associated with the group.
- B1, B2: These two high density regions located W of SDSS-*CG*-6 are probably background clusters (by their average magnitudes and colors).

Gal.	$M_{i'}^{k\text{-corr}}$	$(g'-i')_{1.75''}$	Redshift	B/T	$r_{1/2}$ [h^{-1} kpc]
A	-22.5	2.03	0.21945		5.7
B	-22.4	1.97	0.21804		14.7
C	-21.8	1.92	0.21870		3.8
D	-21.1	1.90	0.21566		4.4

The table gives the basic parameters for four of five central galaxies with velocities. The mean separation between galaxies is ~12.1" (~40 h^{-1} kpc). The B/T is the bulge fraction and is used to classify the member galaxies. The parameter $r_{1/2}$ the half-light radius.



Smoothed spectra of the central galaxies of the groups. The most important absorption lines are marked.



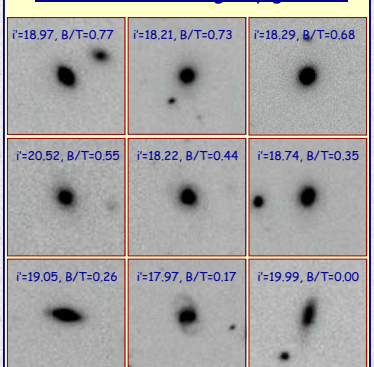
Velocity distribution of 20 galaxies within ±3000 km/s of the <z> of the SDSS-*CG*-6 group.

- For the total sample of 20 galaxies
  - <z>=0.219815, σ=703 km/s (solid line)
- Excluding the 5 emission line galaxies (3 of them are at the edge of the velocity histogram)
  - <z>=0.220087, σ=608 km/s (hashed histogram and dashed line).
- Mass estimates:
  - All galaxies: $M_{vir} = 2.41 \times 10^{14} M_{sun}$
  - Non emission lines: $M_{vir} = 0.95 \times 10^{14} M_{sun}$
- The high velocity dispersion derived for the system indicates that SDSS-*CG*-6 is not a compact group, but a cluster.
- The velocities show a gaussian distribution, with no evidences of gaps (line-of-sight sub-structures).

Galaxy population

- Structural parameters of the 20 group galaxies derived using the program GIM2D (Simard et al. 2002).
- Model: de Vaucouleurs bulge + exponential disk model to the surface brightness profiles of the member galaxies.
- Results:
  - 35% of the galaxies are disk-dominated (B/T<0.3), while 40% have intermediate type (0.3<B/T<0.6).
  - Only 25% of the galaxies are bulge-dominated (B/T > 0.6).
  - The majority of the bulge-dominated and intermediate type galaxies are located near the peak of the high density regions S1, S2, S3 and S4 (see the density map), while the disk-dominate galaxies are mainly distributed in the external regions of the cluster.

Thumbnails of few group galaxies



Based on observations obtained at the Gemini Observatory, which is operated by the Association of Universities for Research in Astronomy, Inc., under a cooperative agreement with the NSF on behalf of the Gemini partnership: the National Science Foundation (United States), the Particle Physics and Astronomy Research Council (United Kingdom), the National Research Council (Canada), CONICYT (Chile), the Australian Research Council (Australia), CNPq (Brazil) and CONICET (Argentina)