The DPOSSII distant compact groups of galaxies:
evidence of cluster-induced group evolution and isolated compact groups

E. Pompei - European Southern Observatory - epompei@eso.org
A. Iovino - INAF Osservatorio astronomico di Brera - iovino@brera.inaf.it

Compact groups at high z: selection criteria

Modified Hickson's' Criteria

(Iovino et al., 2003)

Richness: n ≥ 4, where n is the number of galaxies within 2 magnitudes of the brightest group member;

Isolation: $R_{isol} \geq 3\, R_{gr}$, where R_{isol} is the distance from the center of the circle to the nearest non-member galaxy within 0.5 magnitude of the faintest group member

Compactness: $\Sigma_{gr} < \Sigma_{limit}$, where Σ_{gr} is the mean surface brightness (mag/arcsec^2) of the group within the circle of radius R_{gr} and Σ_{limit} = 24.0 in r band

Compact groups: open questions


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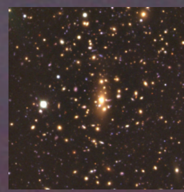


What is their origin?
What is their evolution?
What is their relation with clusters?

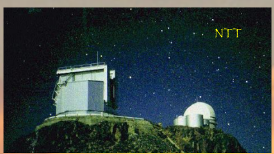
DPOSS II Compact Groups: observations

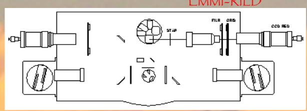
★ z < 0.2

★ 138 observed groups with δ < 20° (EMMI@NTT in La Silla)

★ Long slit observations of each candidate member galaxy

★ **96 groups spectroscopically confirmed (n ≥ 3 galaxies).**



EMMI-RILD


The environment of compact groups:

★ NED search of all cluster catalogs available, with the exception of the Zwicky one due to the lack of measured redshift for its members.
★ Extensive use of SDSS (DR7)

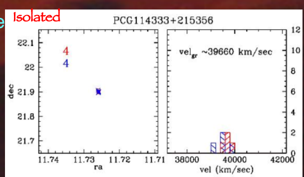
r_{search} = 1Abell radius at the redshift of each group ((1.72/z)')

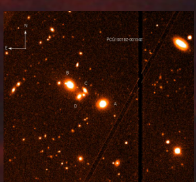
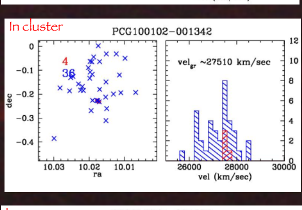
Cluster within $r < r_{search}$ — group is close to a cluster
No cluster in $r \geq r_{search}$ — group is isolated

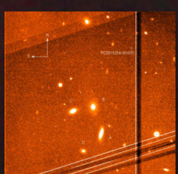
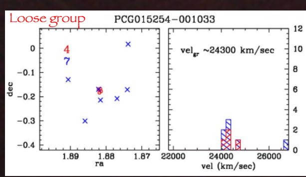
If redshift information is available for the clusters, then additional redshift constraint:

$(z_{group}-z_{cluster}) < 0.01$ — group is associated with the cluster
$(z_{group}-z_{cluster}) \geq 0.01$ — group is isolated

- **47** compact groups are **isolated** structures on the sky.
- **34** compact groups are close on the sky to a larger scale structure onto which they may be infalling.
- **9** are either part of looser groups or the core of them.
- **6** objects rejected (close

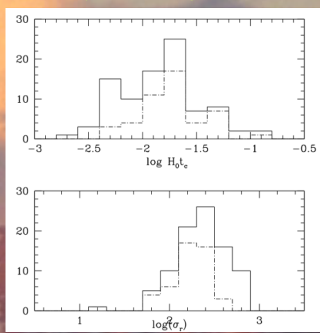
Results:

Isolated compact groups

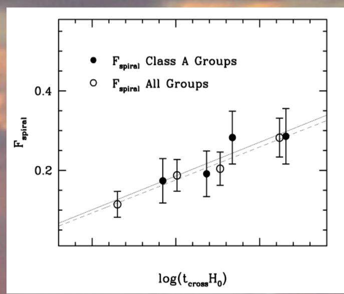
- $<\sigma_r>$ = 188 km/s
- $<\sigma_{3D}>$ = 250 km/s
- f_s (fraction of spirals) = 0.24
- $<R_{group}>$ = 50 Kpc
- $<R_{200}>$ = 310 Kpc
- $<M>$ = $6.6 \times 10^{12}\, M_\odot$
- $<M/L_B>$ = 80
- $<z>$ = 0.11
- $<t_c>$ = $0.024\, H_o^{-1}$

Compact groups close to clusters

- $<\sigma_r>$ = 310 km/s
- $<\sigma_{3D}>$ = 433 km/s
- f_s (fraction of spirals) = 0.14
- $<R_{group}>$ = 50 Kpc
- $<R_{200}>$ = 468 Kpc
- $<M>$ = $2.3 \times 10^{13}\, M_\odot$
- $<M/L_B>$ = 262
- $<z>$ = 0.12
- $<t_c>$ = $0.017\, H_o^{-1}$



Top panel: distribution of the crossing time for the whole DPOSS sample (continuous line) versus the *isolated* groups (dot-dashed line).
Bottom panel: same distribution for the radial velocity dispersion.



Spectroscopically selected fraction of spiral galaxies as a function of the crossing time for all spectroscopically confirmed groups and for the *isolated (class A)* groups only. The solid and dashed lines represent the fits for the *class A* groups and the whole sample, respectively.

Field density of compact groups: $n_{cg} = \dfrac{0.5N}{(A/41253\ deg^2)(4/3)\pi D_c^3}$ (Lee et al., 2004)

N = # of groups in the sample
A = sky area covered by the sample
D_c = comoving distance at the median redshift of the survey

Isolated compact groups n_{cg} = 1 x 10^{-6} Mpc^{-3} (this work)

Field early type galaxies n_{eg} = few x 10^{-6} Mpc^{-3}
(data from Verley et al., 2007; Allam et al., 2005; Giuricin et al., 2000)

Conclusions

✳ 25% of the confirmed groups are close on the sky to a larger-scale structure, to which they might be associated. Their measured mass and velocity dispersion are 2.5 and 1.6 times respectively larger than those of isolated compact groups, in agreement with models of hierarchical formation of galaxies (see for example Einasto et al., 2003).

✳ The compact groups close to a cluster show a smaller fraction of late type galaxies with respect to isolated groups.

✳ 34% of our confirmed groups are isolated compact groups on the sky; their characteristics are similar to those of nearby compact groups, but statistical tests show that the two populations are different at 97% confidence level.

✳ Qualitative estimates of the space density of isolated compact groups, compared with that of isolated early type galaxies show that it is plausible to assume that isolated compact groups are the progenitors of today's field early type galaxies.

Background image: winter sunset at La Silla