Compact groups of galaxies: small, dense, elusive

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Compact groups: what are they?

“The criteria” (HCGs)

Richness: \( n \geq 4 \)

Isolation: \( R_{\text{isol}} > 3 \times R_{\text{group}} \)
no galaxy in isolation ring

Compactness: \( \mu_G < 26 \)

SCG 0018-4854
Compact groups: open questions

What is their origin?
What is their evolution?
What is their relation with clusters?
Compact groups at low $z$: the **Southern Compact Group survey**

**Southern Compact Groups (SCGs):**
nearby ($z < 0.03$) compact groups.

Imaging and spectroscopic follow-up,
groups with high percentage of spirals

$\Delta m = m_{est} - m_{int} > 3.35$

**NEW!**

Foreground/background galaxies allowed in the isolation ring if $m_{isol} > m_i$

120 groups over 5200 sq. deg.
60 groups with $b_j \leq 14.5$
Southern Compact Groups at low $z$: observations and results

$\langle t_c \rangle = 0.051 H_0^{-1}$

$\sigma_{3D} = 330 \text{ km/s}$

$f_s = 0.69$

$\delta \rho/\rho \sim 80$

$R_c \sim 50 \text{ Kpc}$

$\langle M \rangle = 7.7 \times 10^{12} M_\odot$

$\langle M/L_B \rangle = 207$

$\langle z \rangle \leq 0.02$

$3.6m + EFOSC2$
Southern Compact Groups at low z: 3D-NTT

Gas kinematics vs ...
HI (ATCA)

Phase I

Phase 2

Phase 3a

Phase 3b
Southern Compact Groups at low $z$: 3D-NTT

Diffuse ionized gas
Southern Compact Groups at low $z$: 3D-NTT

Danish 1.54m+DFOSC Image (Pompei et al., 2007)

VLT+FORS2 H$_\alpha$ image (Temporin et al., 2005; Temporin et al., in prep.)

Outflows kinematics?
Southern Compact Groups at low $z$: 3D-NTT

Strong mergers, kinematics, PNs and diffuse gas abundance
Group lifetime:

\[ <t_c> (SCGs) = 0.051 \, H_0^{-1} \sim 0.76 \, \text{Gyr} \]

\[ <z> (SCGs) = 0.03 \sim 0.43 \, \text{Gyr} \]

Groups are still evolving!

So, let’s go back in time…
Compact groups at high z: what’s going on

★ Four main surveys: Las Campanas, 2dF, SLOAN and DPOSS II

★ Las Campanas: 76 compact groups from redshift survey, $<z> \sim 0.08$

★ 2dF compact group survey: compact group catalog from redshift survey. $<z> \approx 0.11$

★ SDSS compact group survey: compact group catalog from imaging and spectroscopic survey. $r^*_{lim}=21, 14 \leq r^*_{brightest} \leq 18, <z> = 0.126$

★ DPOSS II compact group survey: 459 compact groups from a search on digitized DPOSS plates. $r \sim 21, 16 \leq r_{brightest} \leq 17, <z> = 0.13$ Spectroscopic follow-up in progress.
Compact groups at high z: DPOSS II survey

- Automated search of ~6200 sq. degrees of DPOSS II plates for small, high density groups

- **Search criteria:**
  - **Richness:** \( n \geq 4 \), with \( \Delta \text{mag}_{\text{comp}} \leq 2 \)
  - **Isolation:** \( R_{\text{isol}} \geq 3 \times R_{\text{gr}} \)
  - **Compactness:** \( \mu_{\text{gr}} < \mu_{\text{limit}} \), \( \mu_{\text{limit}} \), \( r = 24 \)

- **Found:**
  - 459 candidates, with:
    - \( \langle z \rangle = 0.13 \), extending out to \( z \sim 0.2 \)
    - an expected contamination: \( \frac{N_{\text{random}}}{N_{\text{real}}} \approx 10\% \)
Compact groups at high $z$: $z \sim 0.2$ → 2.5 Gyr

$Z = 0.01$ 1$'$ = 13 Kpc

$Z = 0.1$ 1$'$ = 119 Kpc

$Z = 1$ 1$'$ = 340 Kpc

$<R_{\text{group}}>$ ÷ 50-70 Kpc

It’s difficult to find compact groups!
Compact groups at high z: the DPOSS II Compact Groups survey

- 65% concordant groups
- $\sigma_{3D} = 299 \text{ km/s}$
- $<t_c> = 0.018 H_0^{-1}$
- $\delta \rho/\rho \sim 80$
- $R_c \sim 50 \text{ Kpc}$
- $<M> = 4.5 \times 10^{12} \text{ M}_\odot$
- $<M/L_B> = 92$
- $<z> = 0.12 \pm 0.06$

NTT+EMMI spectroscopic follow-up
Distant compact groups: group kinematics and…

$v \sim 30000-45000$ km/s
the infall business

Z = 0.1832

Abell 1689, Cortese et al, 2007)

EMMI-DPOSS survey (Pompei et al., 2008)

Abell 1689
Compact groups: final destiny (?)

Loose group of galaxies

Core+halo system

Compact group
Compact groups: want to know more?

http://www.sc.eso.org/~epompei/Compact_groups/SCGs

http://www.sc.eso.org/~epompei/Compact_groups/DPOSS/

Southern Compact Groups (SCGs) survey
1989 - 2009: 20 years of NTT
1979 - 2009: 30 years of 3.6m

Celebrating half a century of Astronomy in La Silla

conference

~ February 2009