

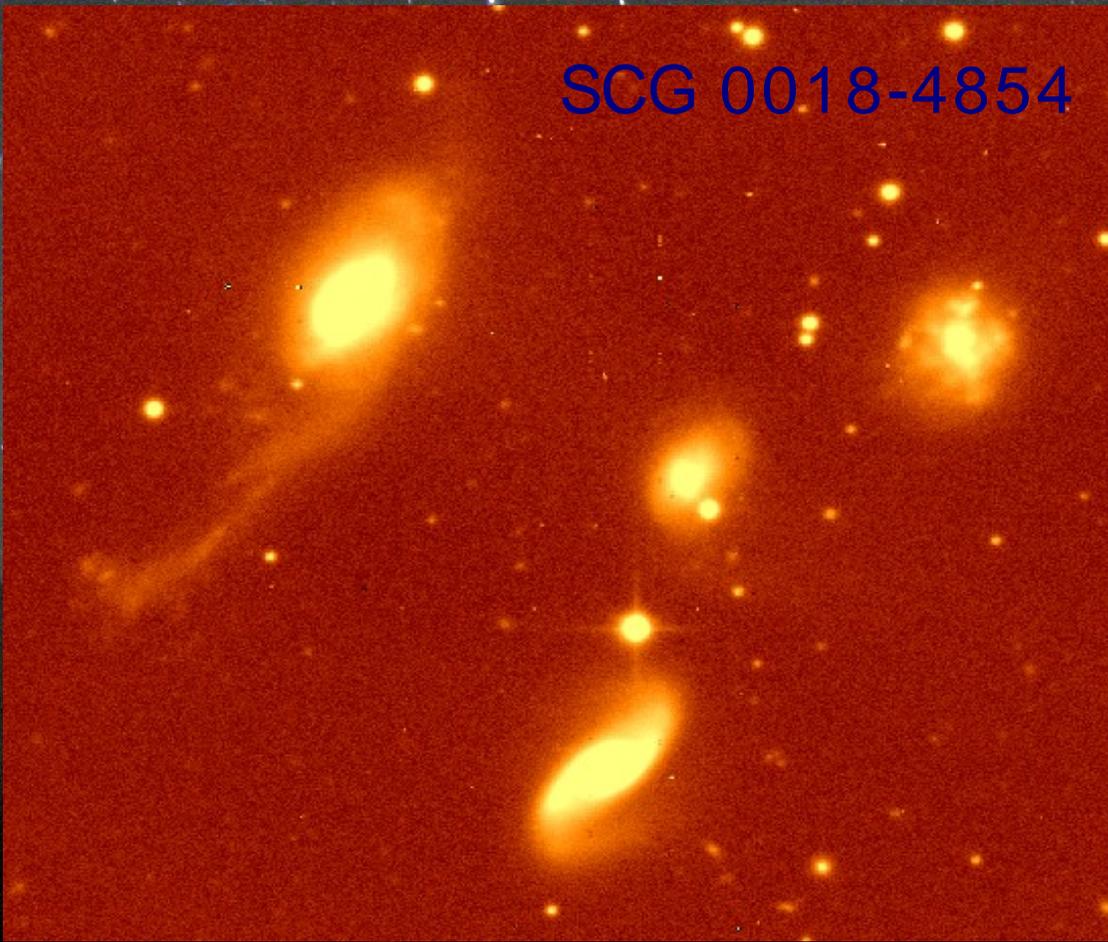


DPOSS II compact groups: EMMI/NTT survey

by:

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Compact groups: what are they?



SCG 0018-4854

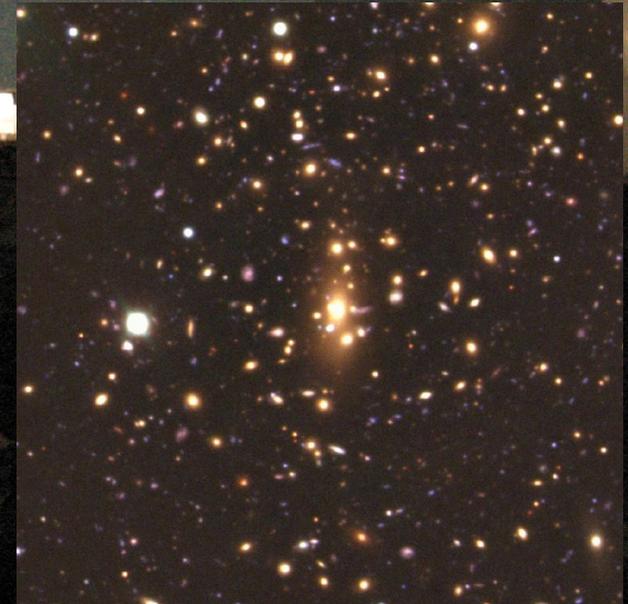
“The criteria” (HCGs)

Richness: $n \geq 4$

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

Compactness: $\mu_G < 26$

Compact groups: why do we care?



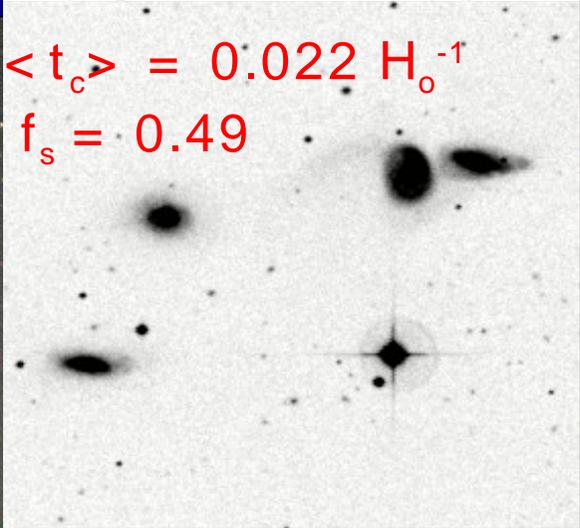
Formation?
Fraction of groups?
Final end-product?



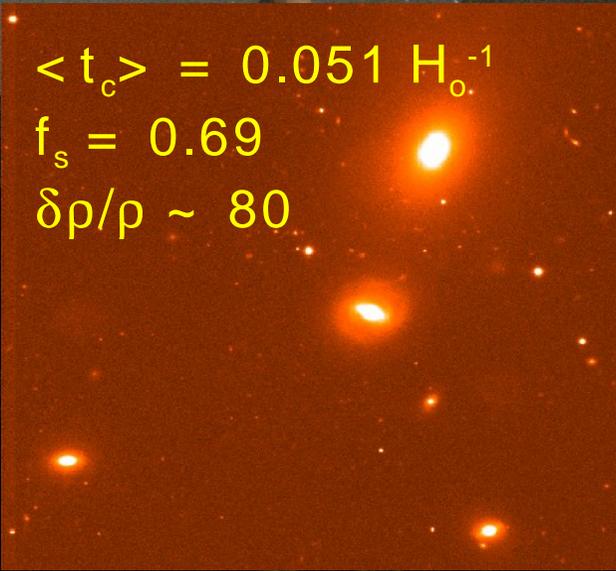
Compact groups at low z : existing studies

Hickson Compact Groups (HCGs):
nearby ($z < 0.03$) compact groups
dominated by early type galaxies.
One of the best studied samples.

Southern Compact Groups (SCGs):
nearby ($z < 0.03$) compact groups.
Imaging and spectroscopic follow-up,
groups with higher percentage of spirals



$\langle t_c \rangle = 0.022 H_0^{-1}$
 $f_s = 0.49$



$\langle t_c \rangle = 0.051 H_0^{-1}$
 $f_s = 0.69$
 $\delta\rho/\rho \sim 80$

Compact groups at **low** z : final destiny?



Loose group of galaxies



Core+ halo system



Compact group



Isolated early type galaxy? Or seed of cluster?

Compact groups at **high** z : what's going on

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

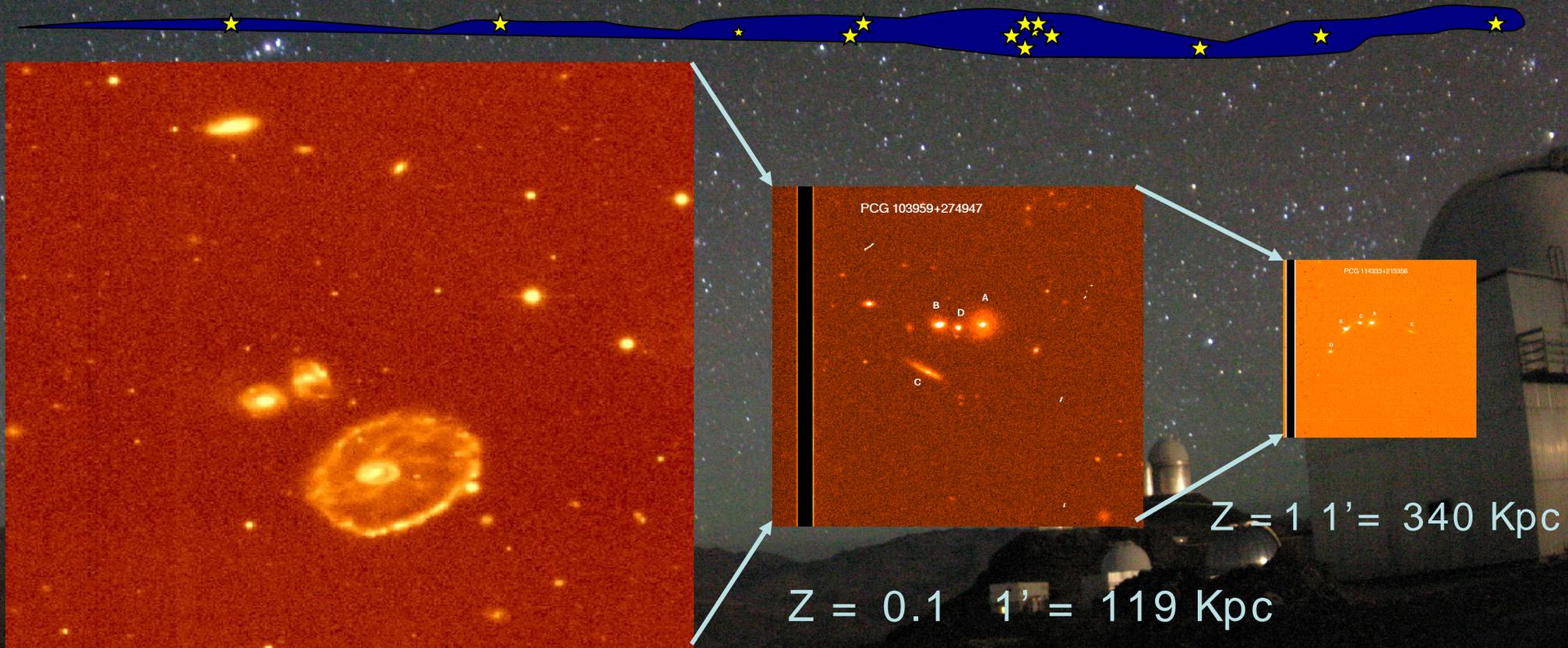
★ Las Campanas: 76 compact groups from redshift survey, $\langle z \rangle \sim 0.08$

★ **2dF** compact group survey: compact group catalog from redshift survey. $\langle z \rangle = 0.11$

★ **SDSS** compact group survey: compact group catalog from imaging and spectroscopic survey. $r_{\text{lim}}^* = 21, 14 \leq r_{\text{brightest}}^* \leq 18, \langle z \rangle = 0.126$

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

Compact groups at high z: is $z=0.2$ so high?



Z = 0.01 $1' = 13$ Kpc

$\langle R_{\text{group}} \rangle \div 50-70$ Kpc

IT'S DIFFICULT TO FIND COMPACT GROUPS!

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: $\mu_{\text{gr}} < \mu_{\text{limit}}$;

$\mu_{\text{limit}} = 24$ in r

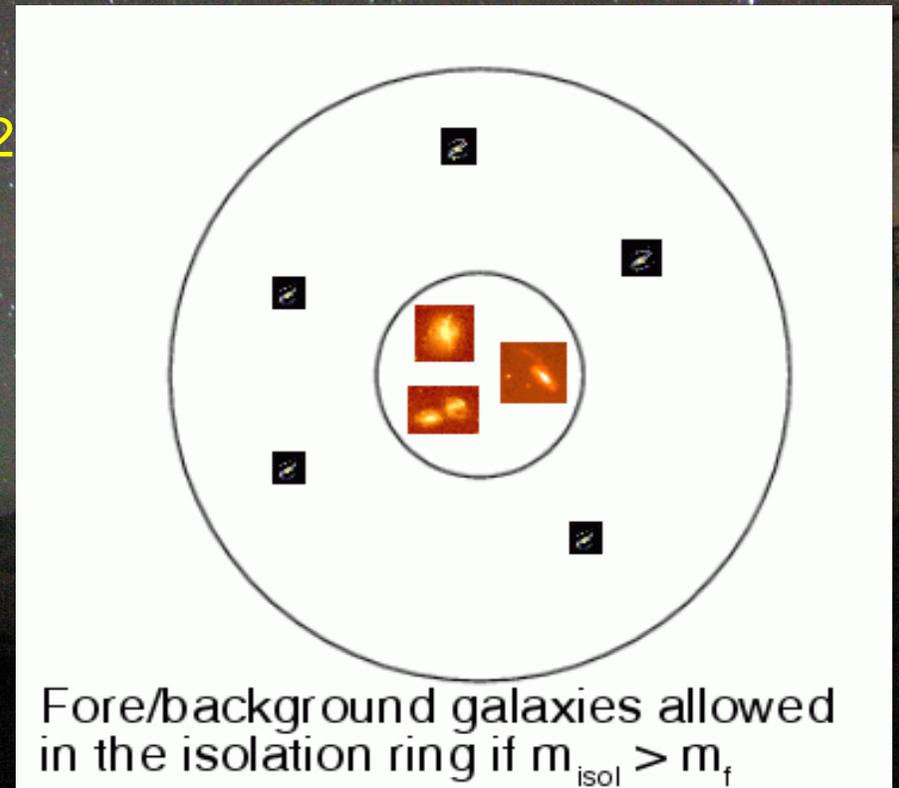
★ Found:

459 candidates, with:

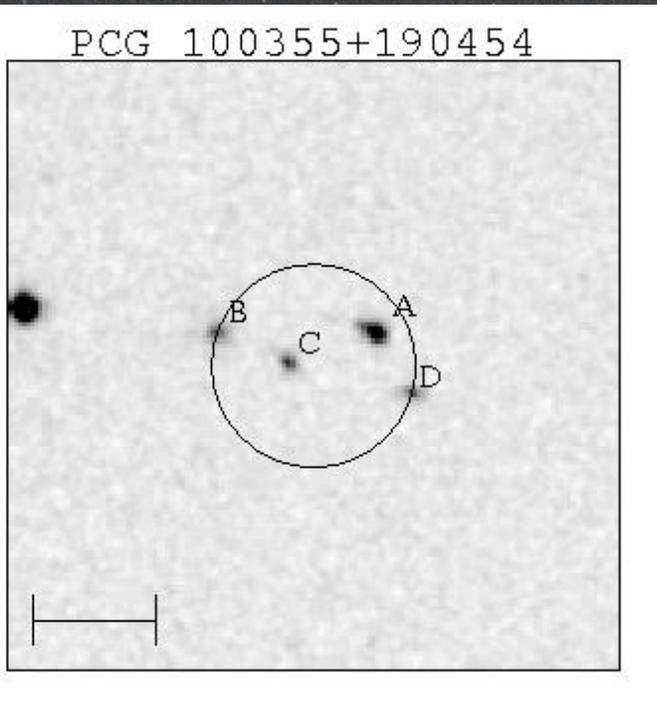
$\langle z \rangle = 0.13$, extending out to

$z \sim 0.2$ and an expected

contamination: $N_{\text{random}}/N_{\text{real}} = 10\%$



DPOSS II groups: what now?



★ Are these groups real?

★ What are their physical characteristics?

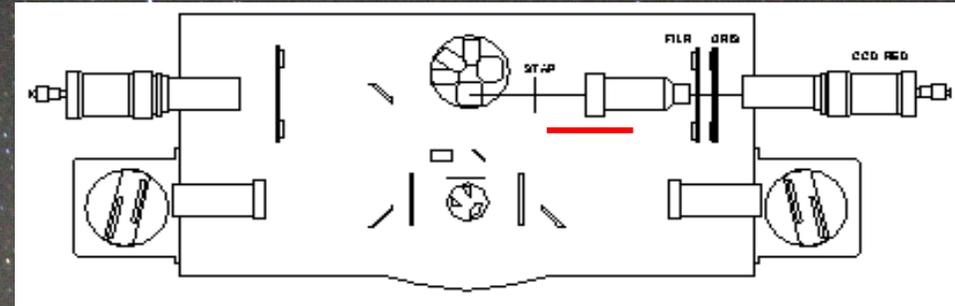
★ Are their galaxies different from those in nearby compact groups?

★ Are these the same groups we see in the nearby Universe?

DPOSS II groups: let's go observing!

NTT

+



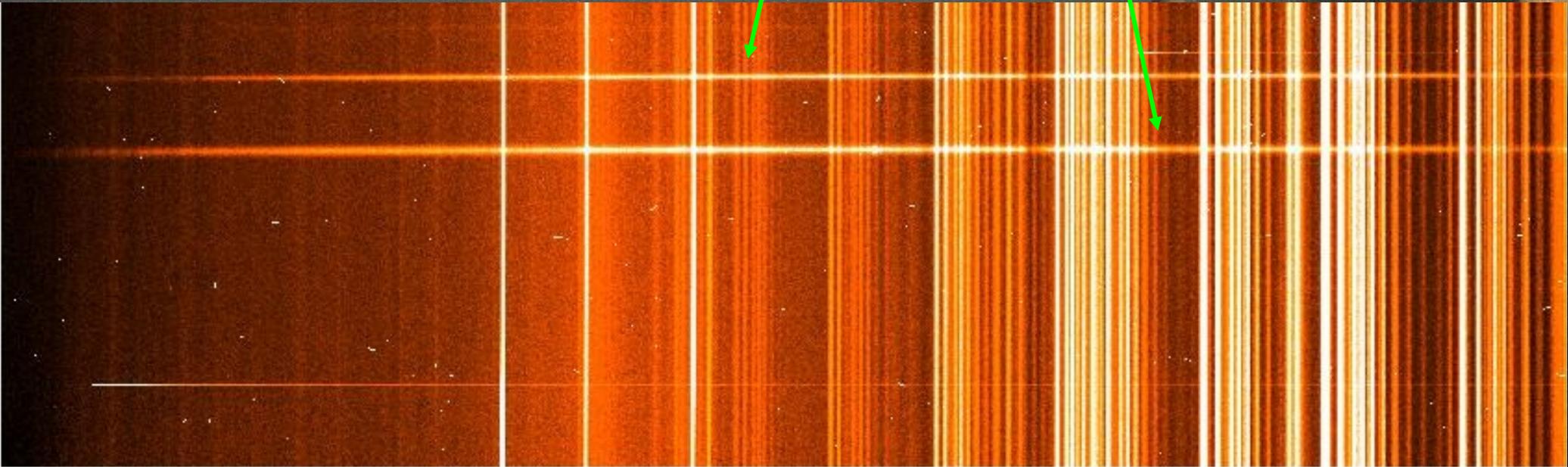
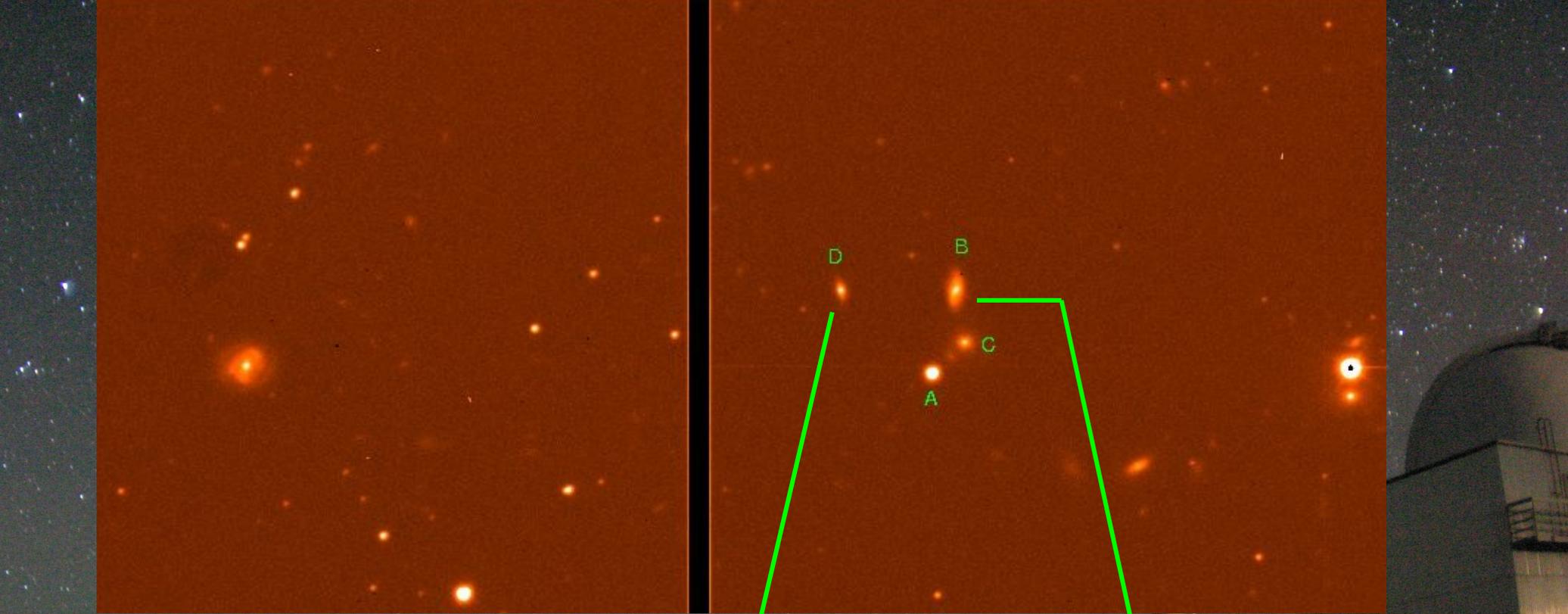
EMMI RILD

Observed so far:

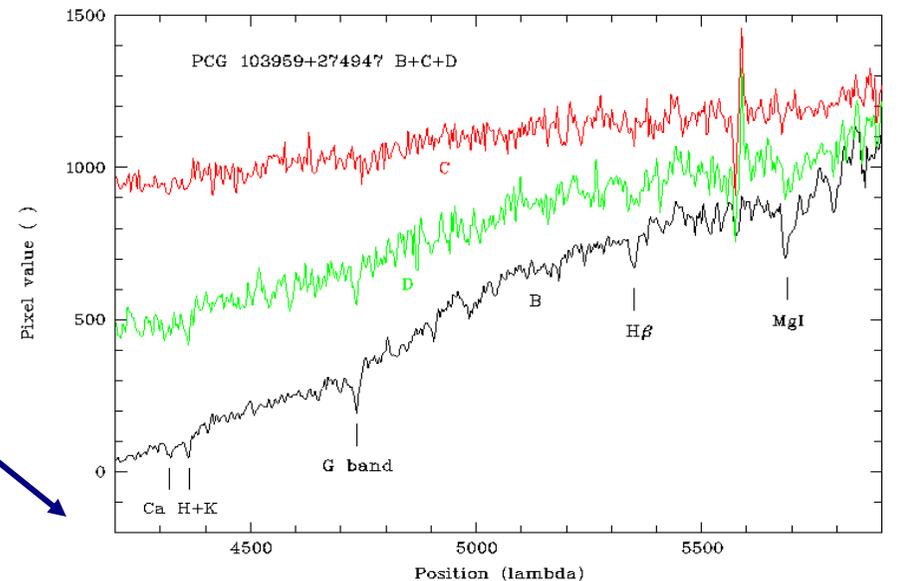
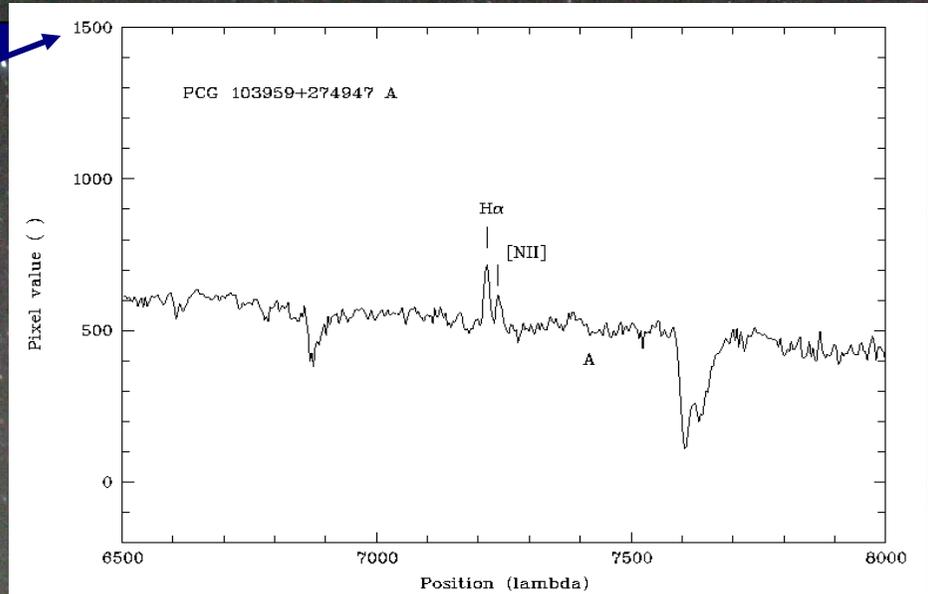
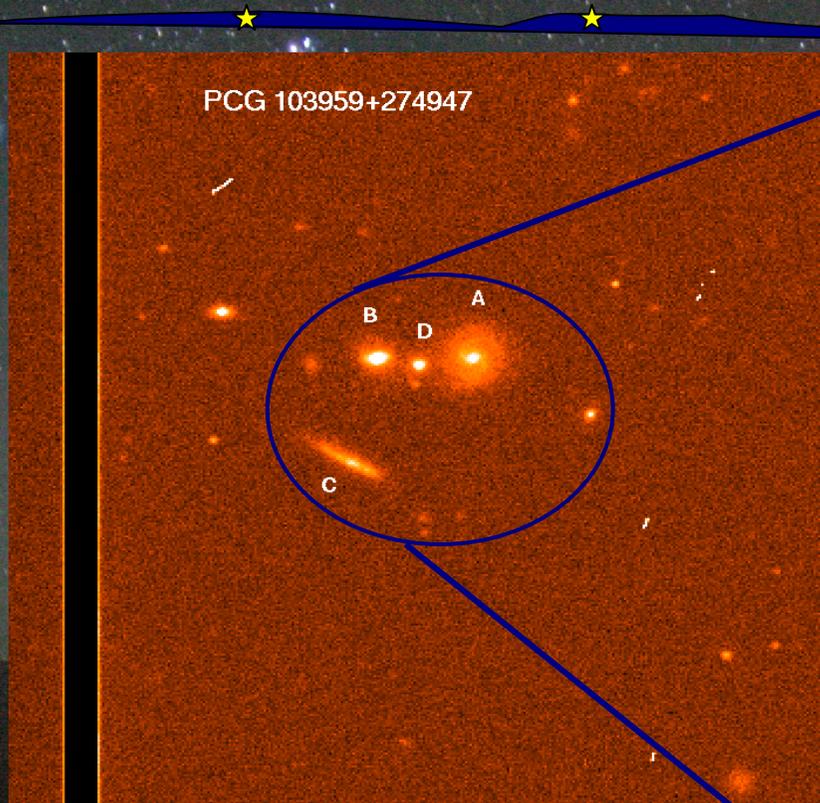
120 DPOSS group candidates
with: $\delta < 20^\circ$, plus radial velocity
standard stars and 3 template galaxies.

Grism # 2 + 1.5" x 9' slit
instrumental resolution = 322 km/s
S/N = 15-30/resolution element

www.sc.eso.org/~epompei/DPOSS.html



DPOSS II survey: spectroscopic follow up and results



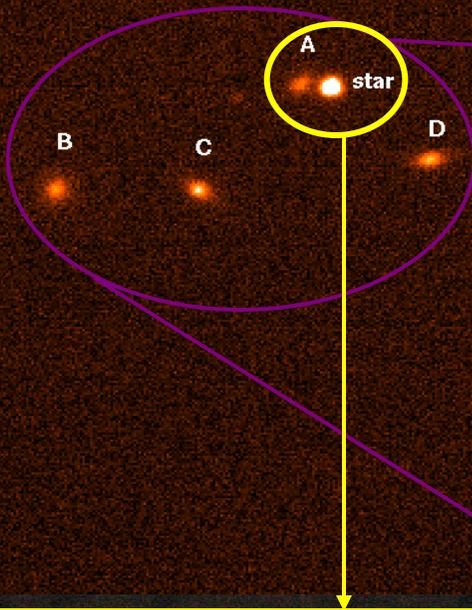
$$\Omega_m = 0.3; \Omega_\Lambda = 0.7;$$

$$H_0 = 67 \text{ km/s/Mpc}$$

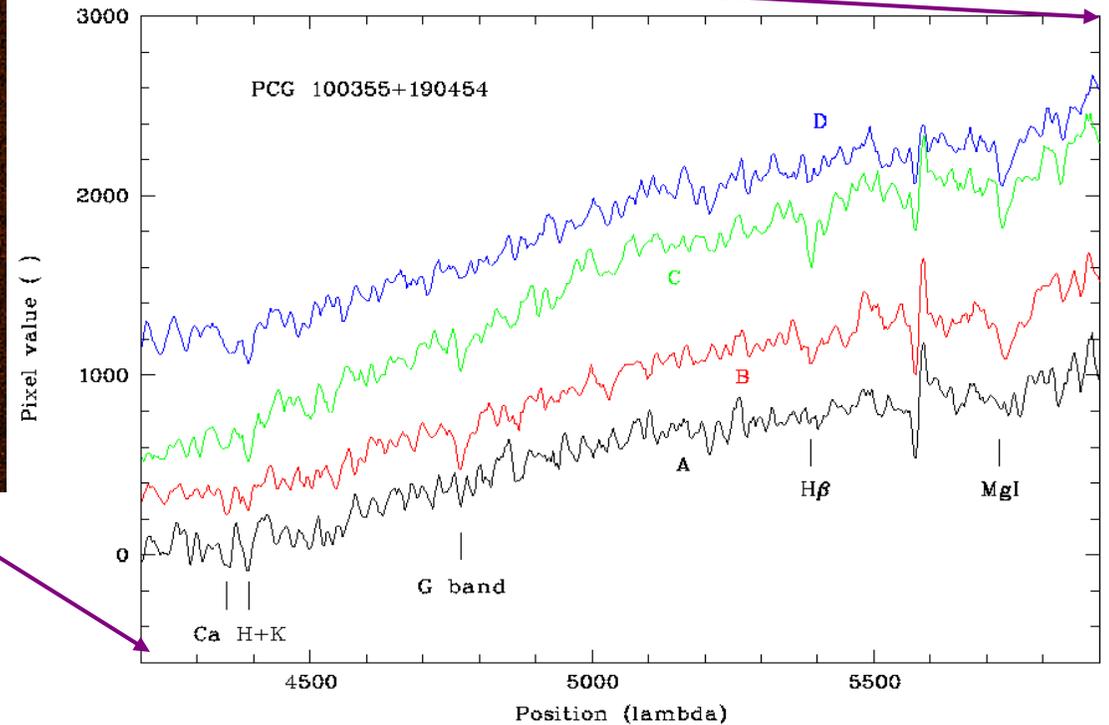
~ 60% of the groups are confirmed candidates: $\langle z \rangle = 0.12 \pm 0.06$

DPOSS II survey: some caveats

PCG 100355+190454



Selection function!!!



$$m_r(A) > 17$$

This group is **not** included in the final sample!!

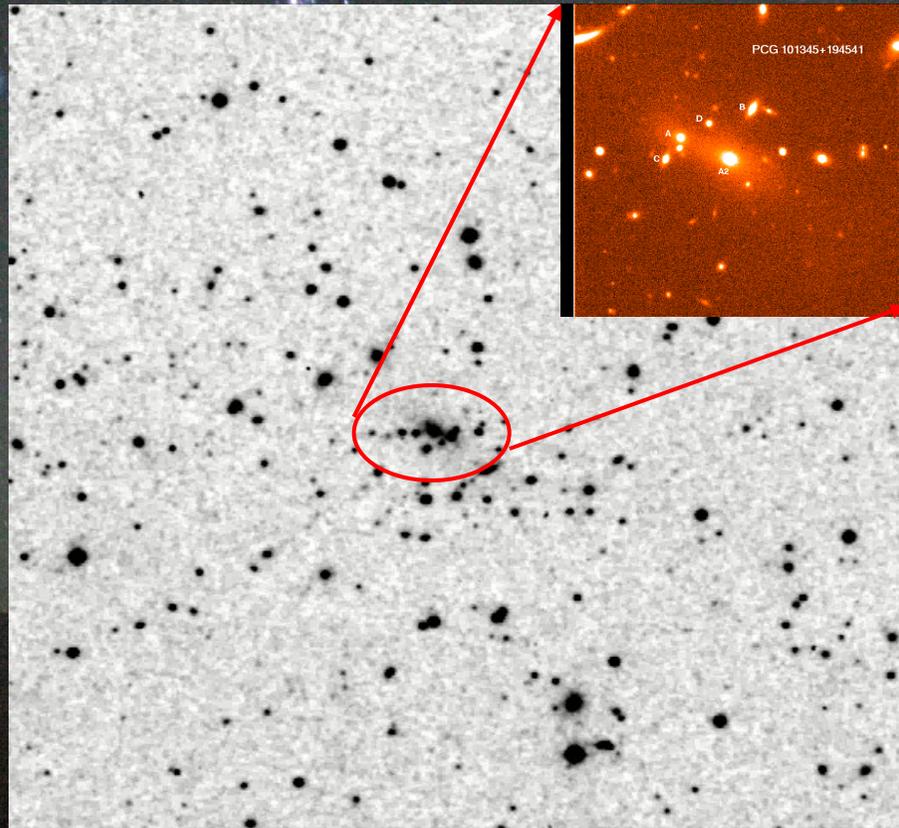
DPOSS II survey: spectroscopic follow up and results. Group environment

Are groups truly isolated? → Search on NED database and DPOSS II cluster catalog (Gal et al. 2003)

Search criteria : search radius $\leq 30'$, i.e. 3 x Abell radius at the distance of our farthest group, PCG130926+ 155359, and $\Delta z \leq 0.01$, i.e. a dispersion velocity difference ≤ 3000 km/s. When no redshift was available only the radius was used. Zwicky clusters without any other identification and/or measured redshift were discarded from the final search.

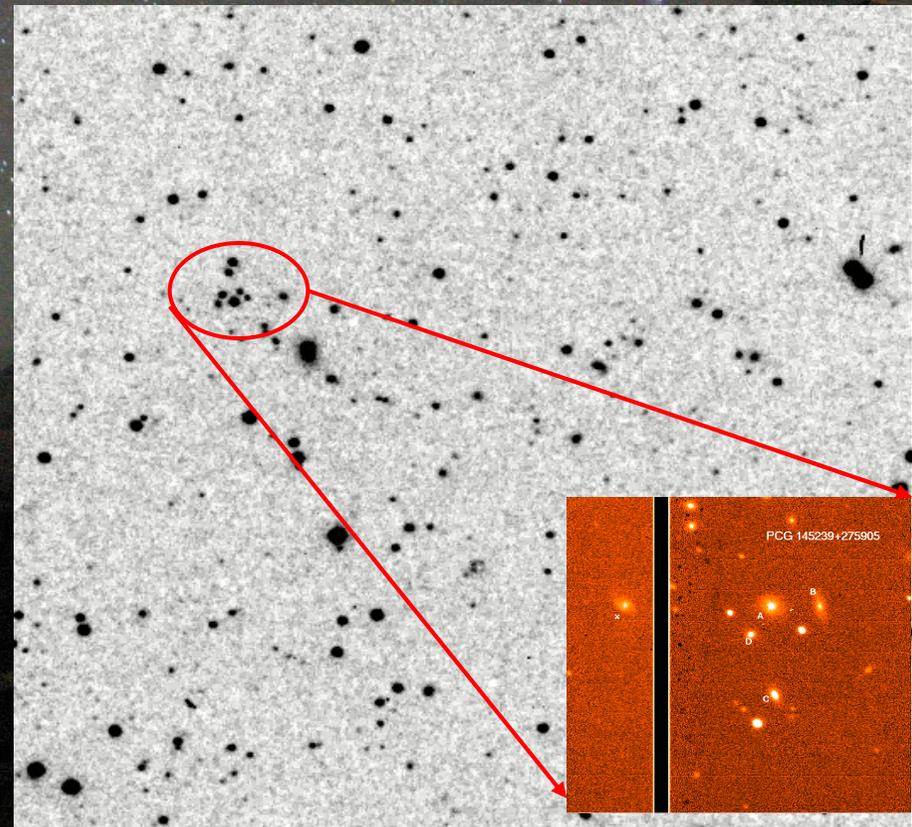
Class A Groups completely isolated on the sky
Class B Groups close to a cluster
Class C Groups with less than three concordant galaxies

DPOSS II survey: spectroscopic follow up and results. Group environment



Abell 0952 with superimposed
PCG 101345+ 194541. The cluster
redshift was measured for the first
time: $z = 0.11$

Abell 1984 ($z = 0.124$) with
superimposed
PCG 145239+ 275905 ($z = 0.125$)



DPOSS II survey: spectroscopic follow up and results. Velocity distribution

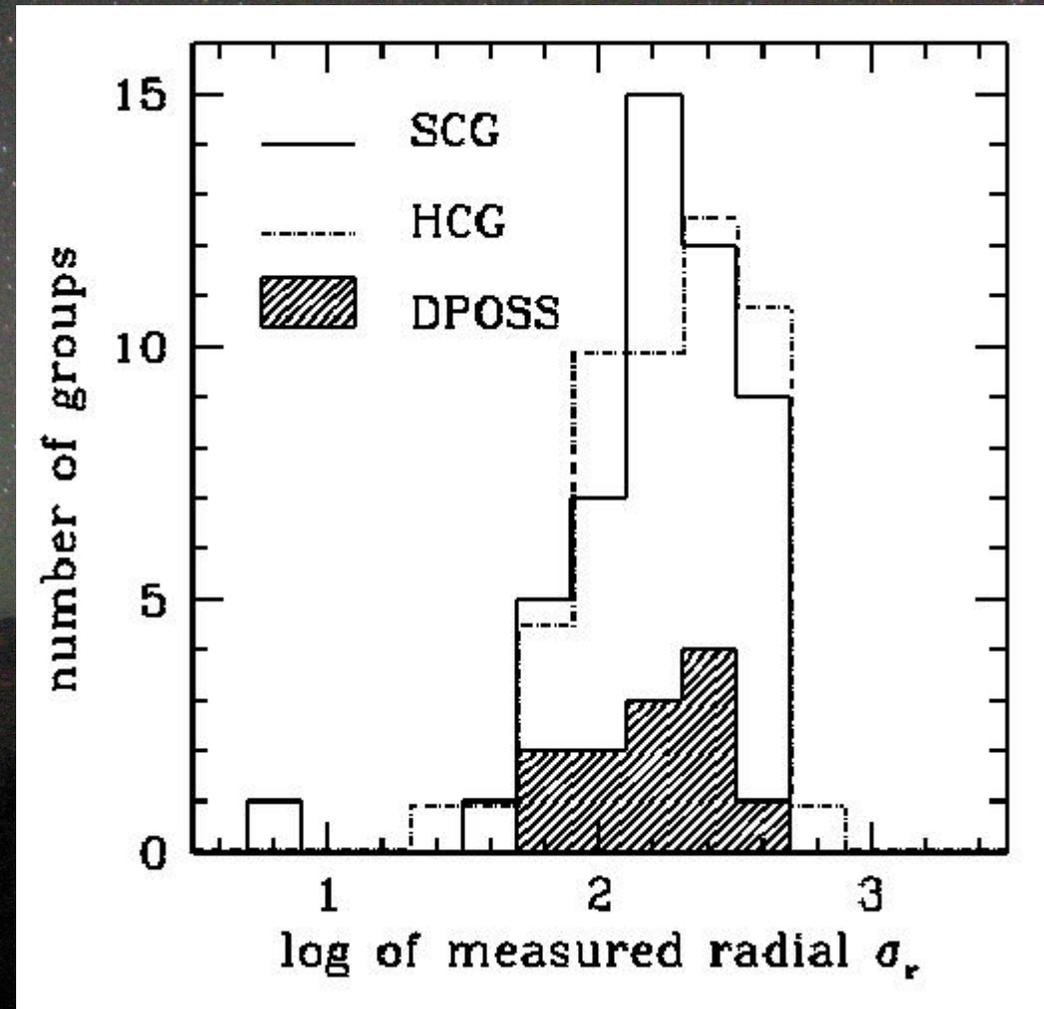
$$\log(\sigma) = 2.26 \pm 0.4$$

$$\sigma_{3D} = [3(\langle v^2 \rangle - \langle v \rangle^2 - \langle dv^2 \rangle)]^{1/2}$$

$$\sigma_{3D} \text{ (HCGs)} = 350 \text{ km/s}$$

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

$$\sigma_{3D} \text{ (DPOSS)} = 299 \text{ km/s}$$



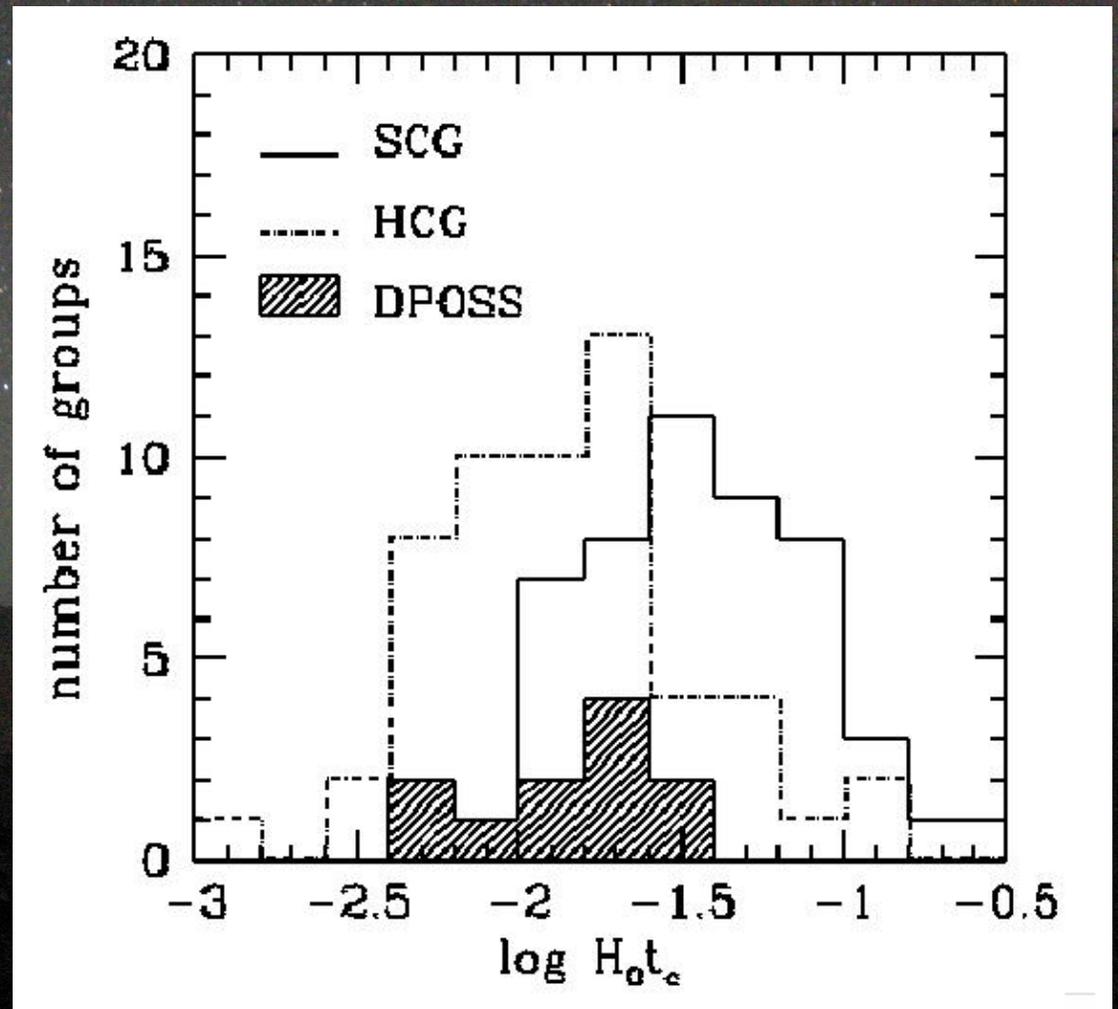
DPOSS II survey: spectroscopic follow up and results. Crossing times

$$t_c = \frac{4 R}{\pi V} S$$

$$\langle t_c \rangle \text{ (HCGs)} = 0.022 H_0^{-1}$$

$$\langle t_c \rangle \text{ (SCGs)} = 0.051 H_0^{-1}$$

$$\langle t_c \rangle \text{ (DPOSS)} = 0.018 H_0^{-1}$$



DPOSS II survey: spectroscopic follow up and results. Mass ...



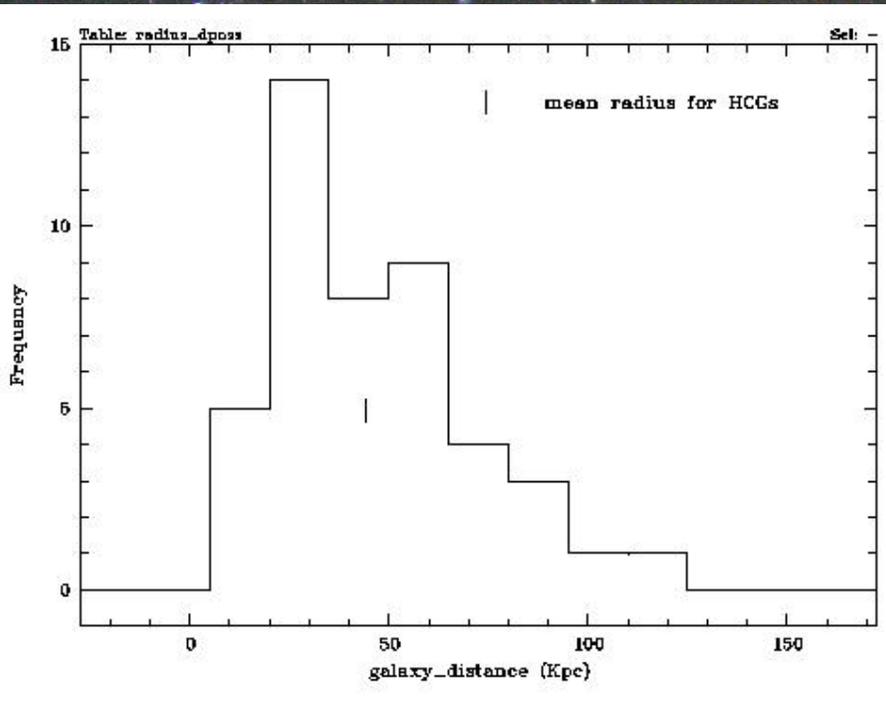
★ Virial mass estimator: $M_V = \frac{3\pi N}{2G} \frac{\sum_i V_{zi}^2}{\sum_{i<j} (1/R_{ij})}$

★ Projected mass estimator: $M_P = \frac{64}{2\pi G} \langle V_z^2 R \rangle$

$\langle M \rangle = 4.5 \times 10^{12} M_{\text{sun}}$ ($\langle M \rangle_{\text{HCG}} = \langle 1.5 \times 10^{12} M \rangle$)

$\langle M/L_B \rangle = 92$ ($\langle M/L \rangle_{\text{HCG}} = \langle 67 \rangle$) ($M_{r,\text{sun}} = 4.77$)

...radius and lifetime



We do resolve very dense groups!
(2dF: at $z \sim 0.1$,
 $1' \Leftrightarrow 80 h^{-1} \text{ Kpc}$)

NOW:

$$\langle t_c \rangle \text{ (DPOSS)} = 0.018 H_0^{-1}$$

0.21 Gyr

BUT....

$$Z = 0.12$$

1.56 Gyr

DPOSS II survey: spectroscopic follow-up. No evolution or a *very* fast one?

NO EVOLUTION

Early formation of a common, massive halo, within which galaxies form: individual galaxy properties do not correlate with global group properties.



VERY FAST EVOLUTION !

We see already the end-product of our groups: see van Dokkum, 2005 (astro-ph/0506661)

