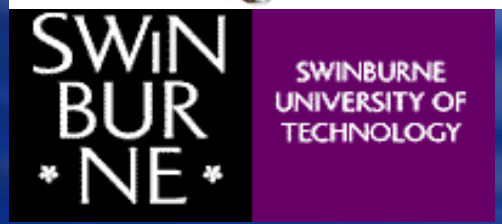
The Eridanus Supergroup



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Outline

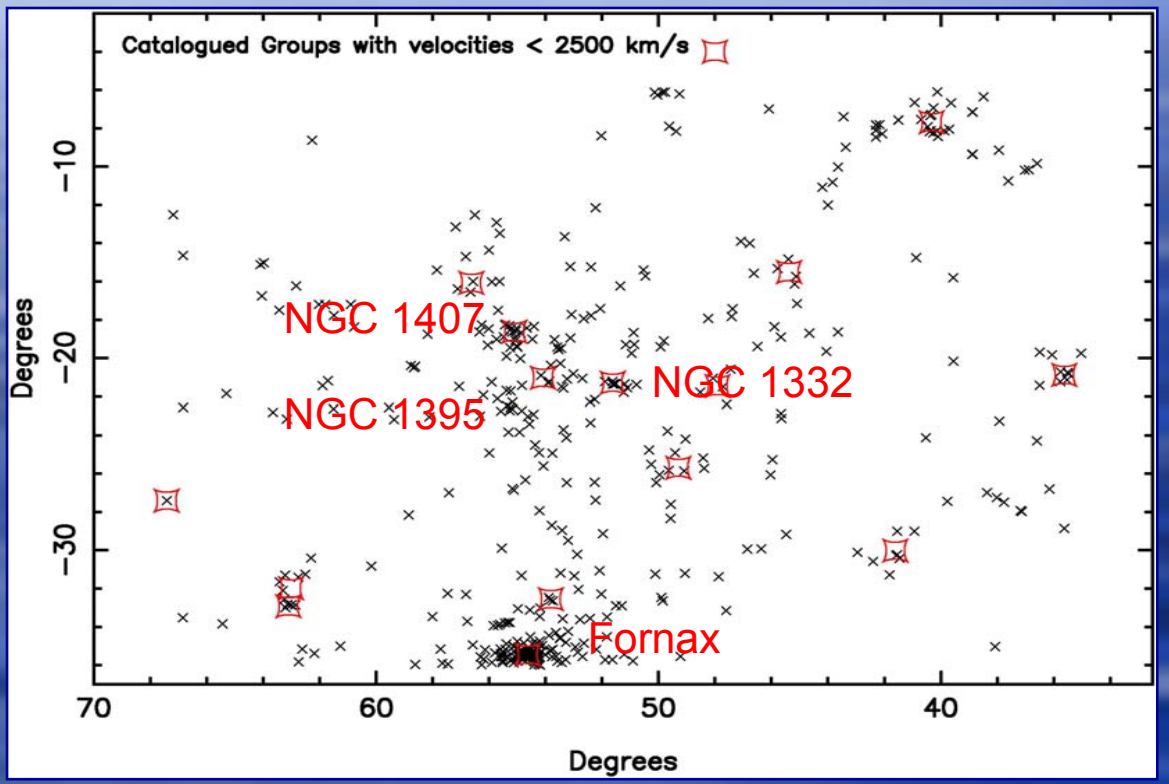
- What is a supergroup and why is it interesting?
- Eridanus
- Eridanus group dynamics
- Dependence of Eridanus galaxy properties on environment
- Southern GEMS Groups - Brightest Group Galaxies
- Conclusions

What is a Supergroup and Why is it Interesting?

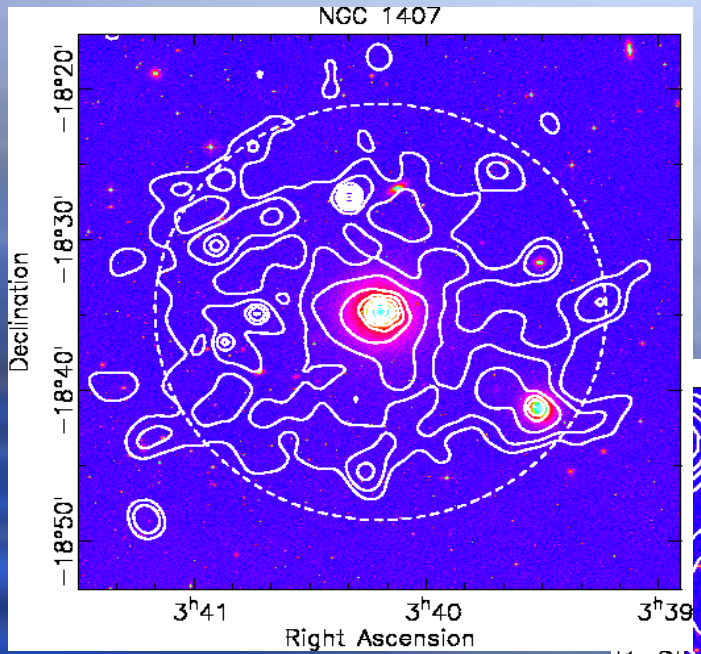
- A supergroup is a bound group of groups that will merge to form a galaxy cluster.
- A key prediction of hierarchical structure formation is that galaxy clusters assemble at late times from the merging and accretion of smaller structures (e.g. Peebles 1970).
- We lack clear early-stage examples of clusters being assembled from an ensemble of galaxy groups.

Eridanus

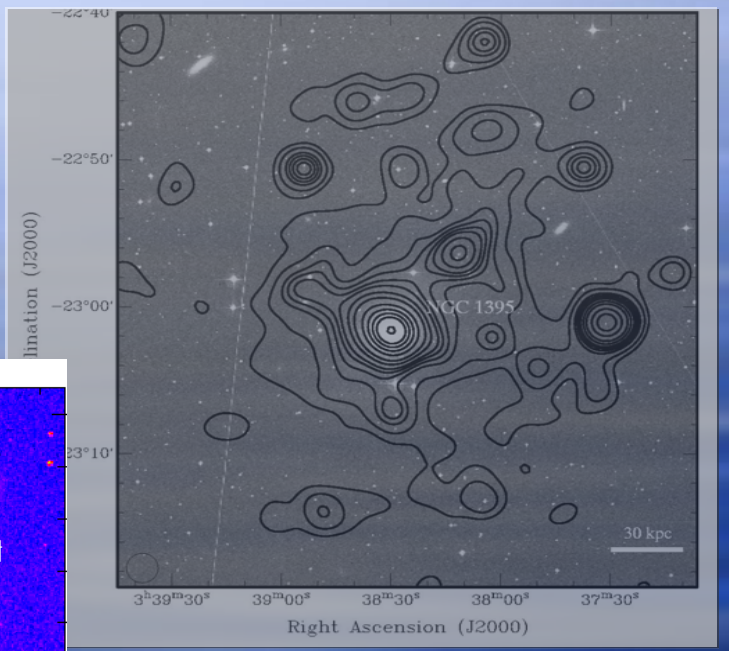
- Eridanus is a cloud of galaxies ~21 Mpc away (Baker 1933,1936; de Vaucouleurs 1975)
- Forms a filamentary structure with the Fornax cluster (da Costa et al. 1988).
- Includes previously optically classified groups of galaxies NGC 1332 and NGC 1407



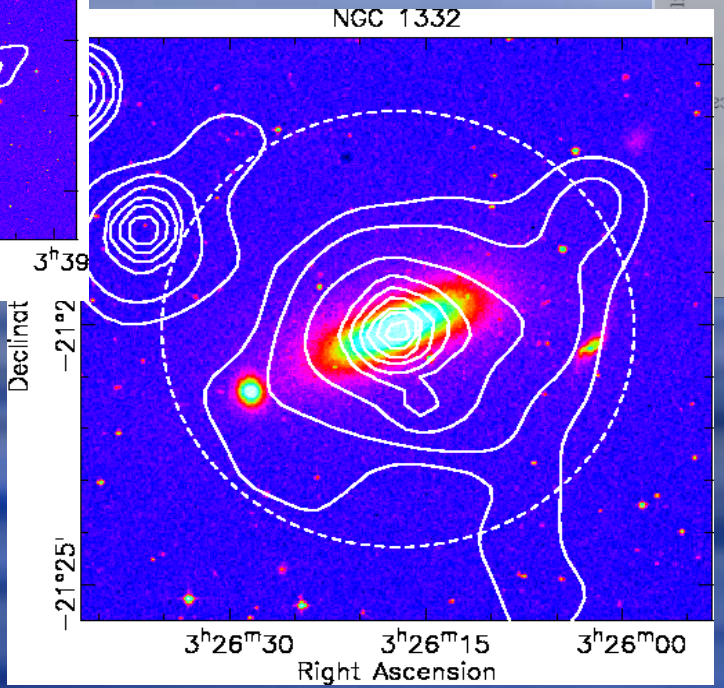
X-Ray Images



Osmond & Ponman (2004)



Omar & Dwarakanath (2005)



Osmond & Ponman (2004)

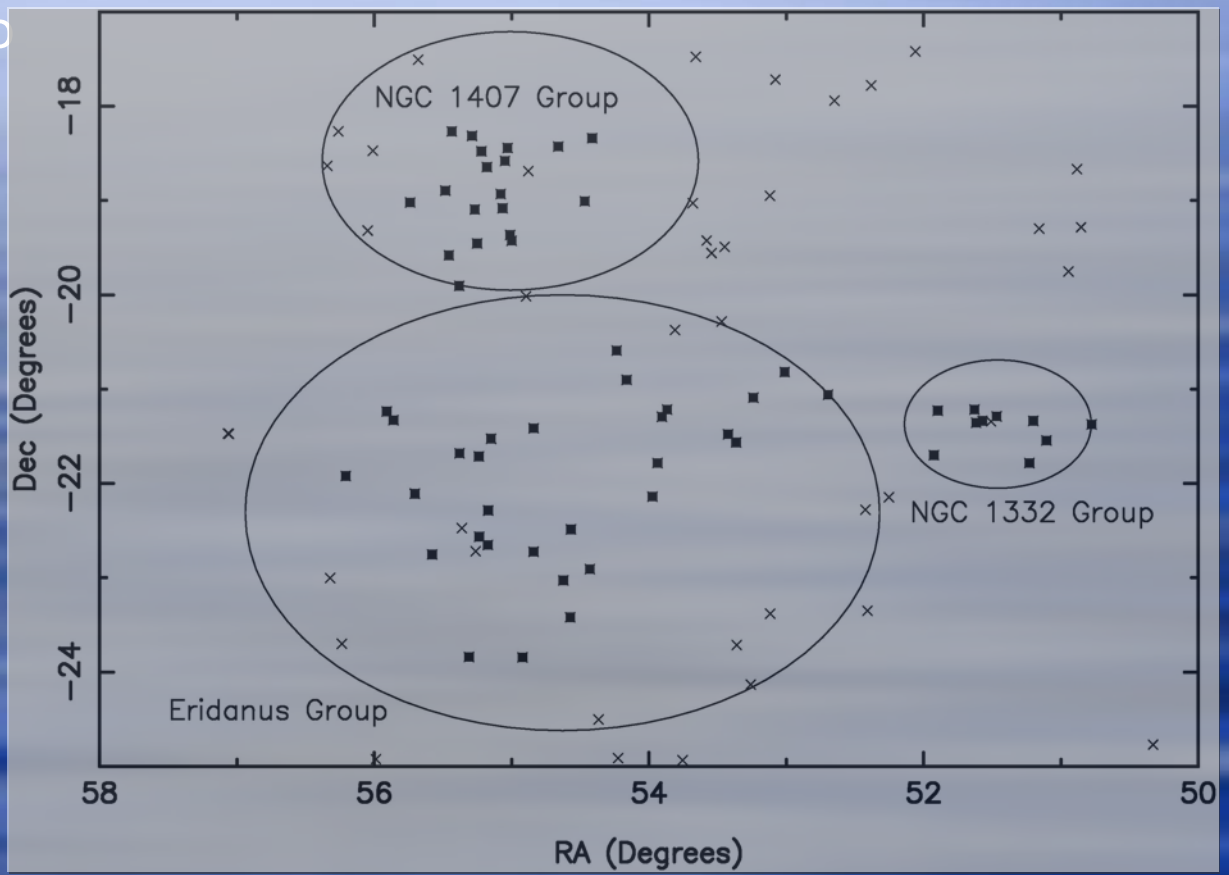
FOF Determined Structures

In order to study region need to define which galaxies are associated with which sub-clump/group/cluster.

Use friends-of-friends technique (Huchra & Geller 1982)

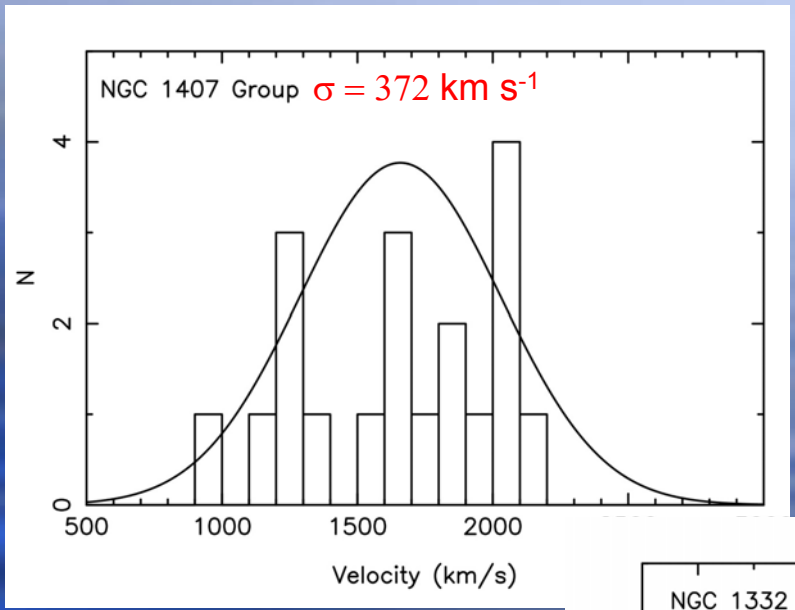
Following the prescriptions of 2PIGG (Eke et al. 2004a):
$\delta\rho/\rho = 150$
$2\sigma/r = 1200$

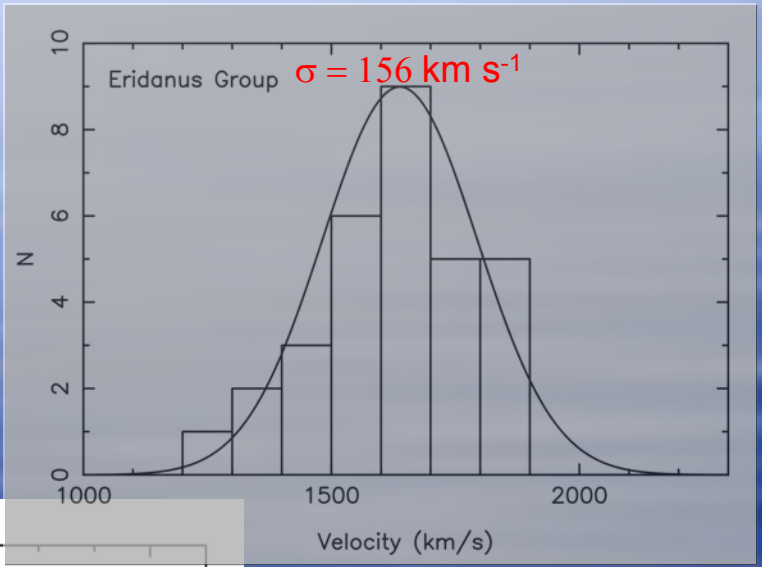
$D_0 = 0.3$ Mpc
$V_0 = 350$ km s^{-1}

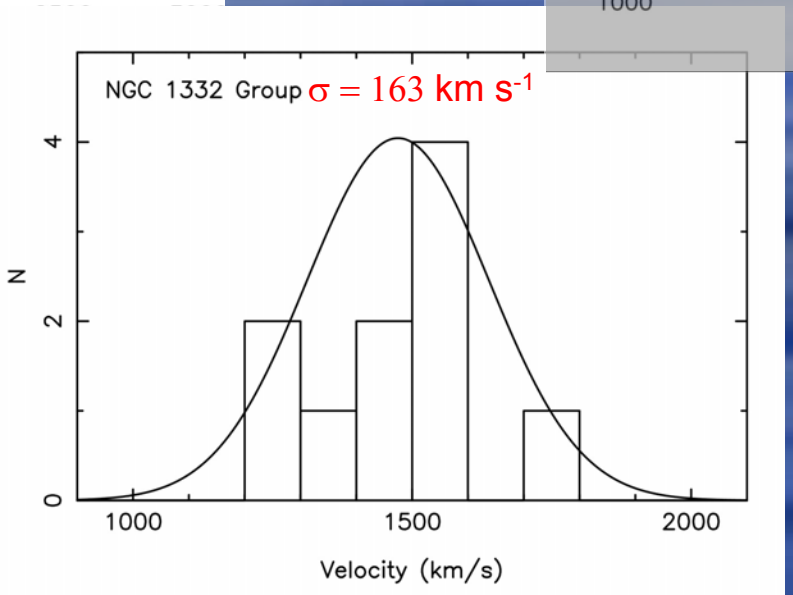


Brough et al. 2005 (MNRAS submitted)

Velocity Distribution







Derived Properties

	Eridanus	NGC 1407	NGC 1332
No. of members	31	19	10
Mean Velocity (km s^{-1})	1638±5	1658±26	1474±18
Velocity Dispersion (km s^{-1})	156±23	372±48	163±35
Crossing time (H_0^{-1})	0.06	0.03	0.04
Virial Mass (10^{13} $M_\odot$)	0.9	5.3	0.6
R_{500} radius (Mpc)	0.21	0.51	0.22
M_V/L_K	27	230	82

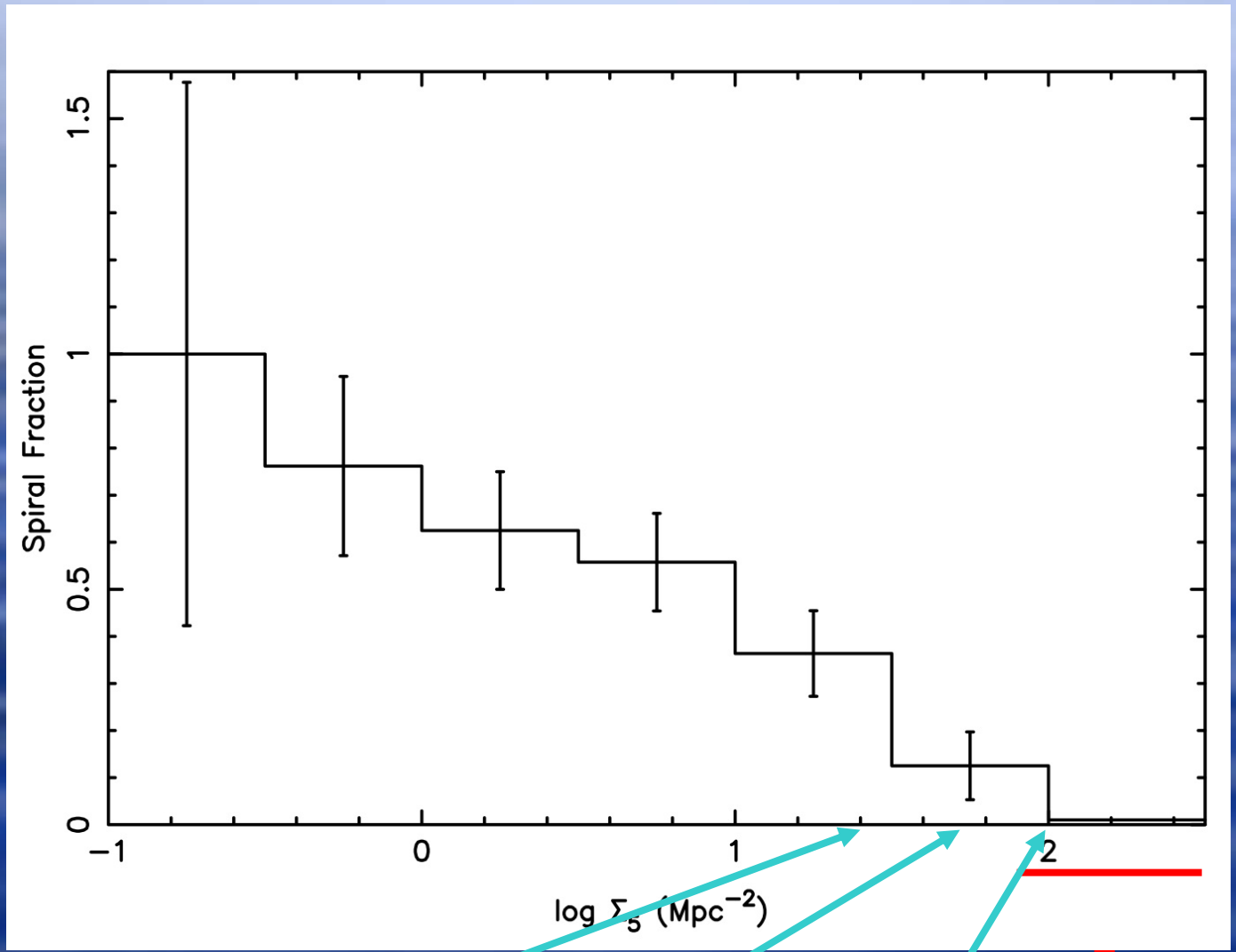
Eridanus Group Dynamics

- 2 bodies are bound if $GM/R_V(\sin i)^{-1} > v^2/2$
- Repeat analysis for 3 pairs. Conservatively, probability that groups are bound is minimum of 3 probabilities - 83 %.
- Treating supergroup system as one-body it is also likely to be bound to Fornax at a similar probability.

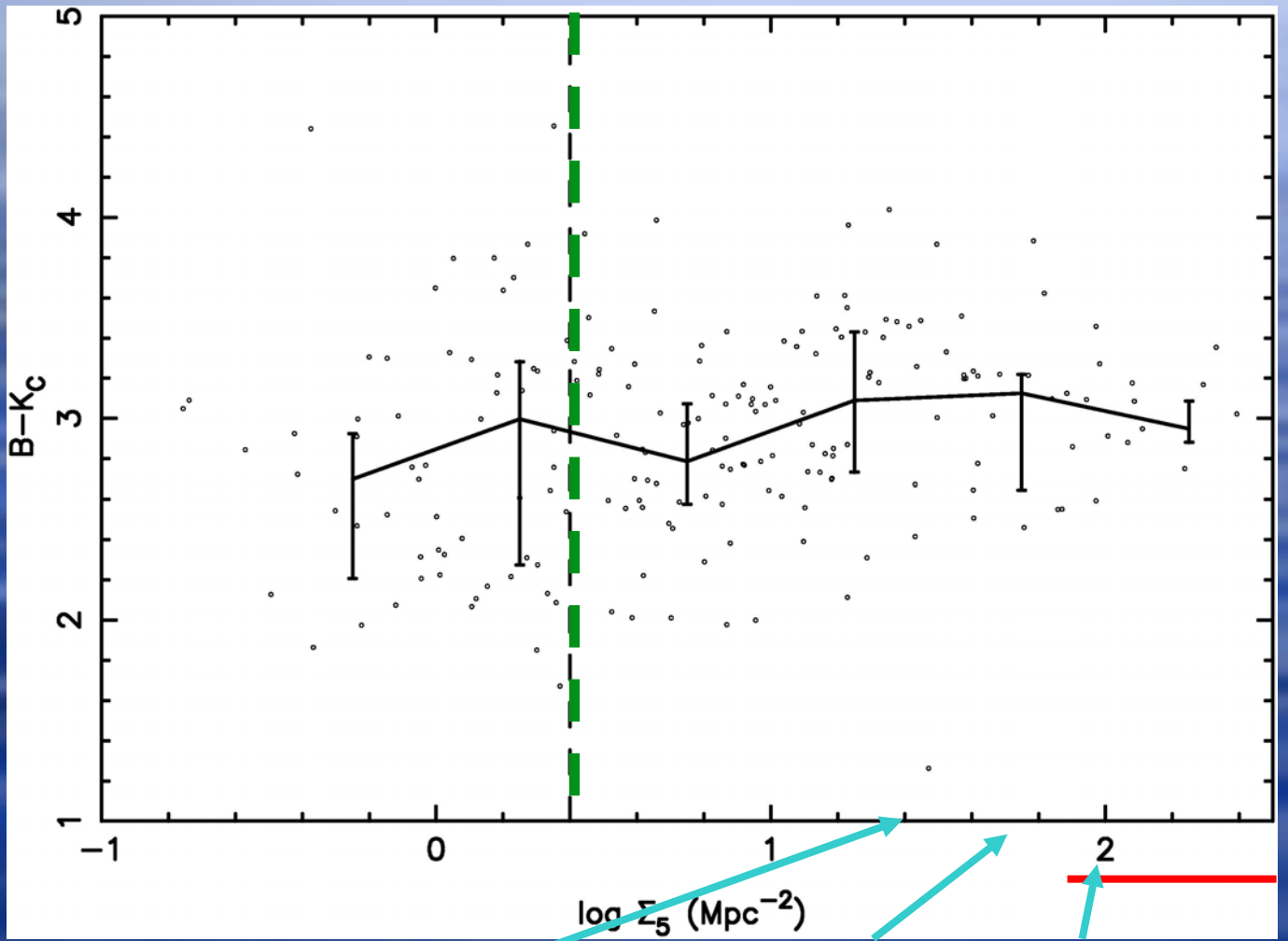
Dependence on Environment

- Determining how this environment affects its constituent galaxies is also important.
- K magnitudes from 2MASS, B magnitudes and morphological T-types from HyperLEDA
- Apparent magnitude limited sample (m_K<13.1)
- Density (Σ_5)is calculated as the projected surface density of 5 nearest neighbours

Morphology Distribution



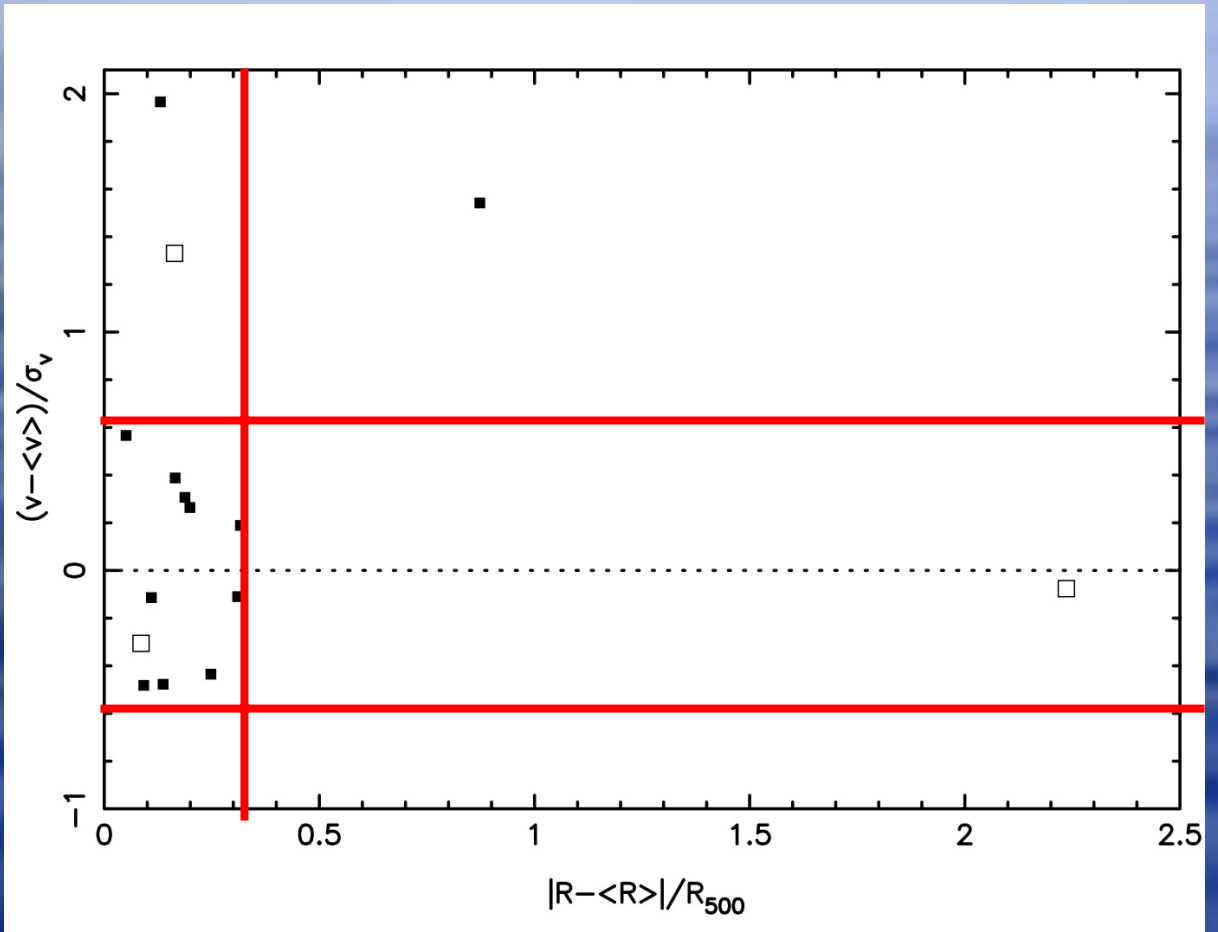
Colour Distribution



Brightest Group Galaxies

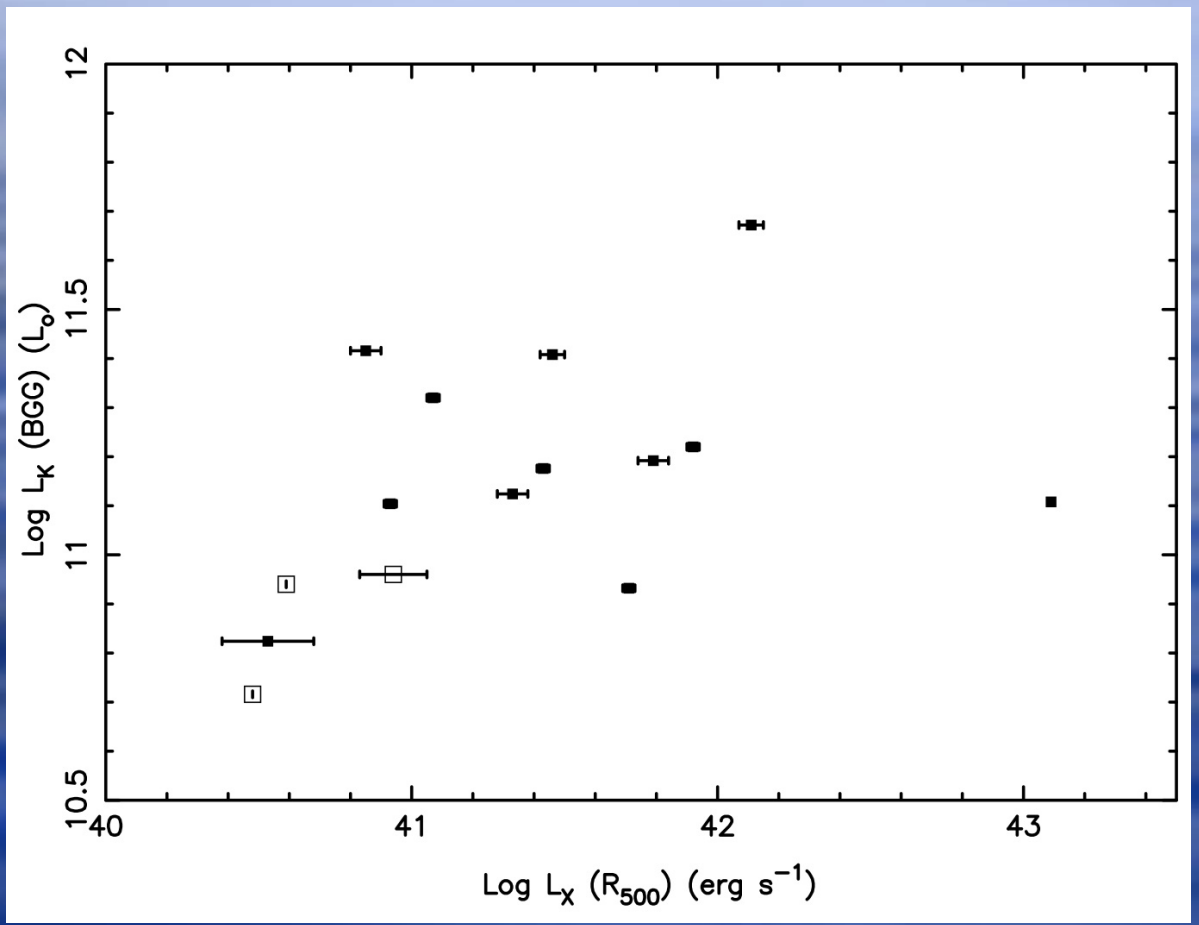
- Extend FOF analysis to further 13 Southern GEMS groups.
- Hierarchical structure formation predicts the brightest galaxy in the halo to be at the centre and to grow at the expense of other galaxies.
- Select BGG as brightest galaxy in K-band within 2σ of FOF group centroid.

BGG Spatial and Velocity Offset

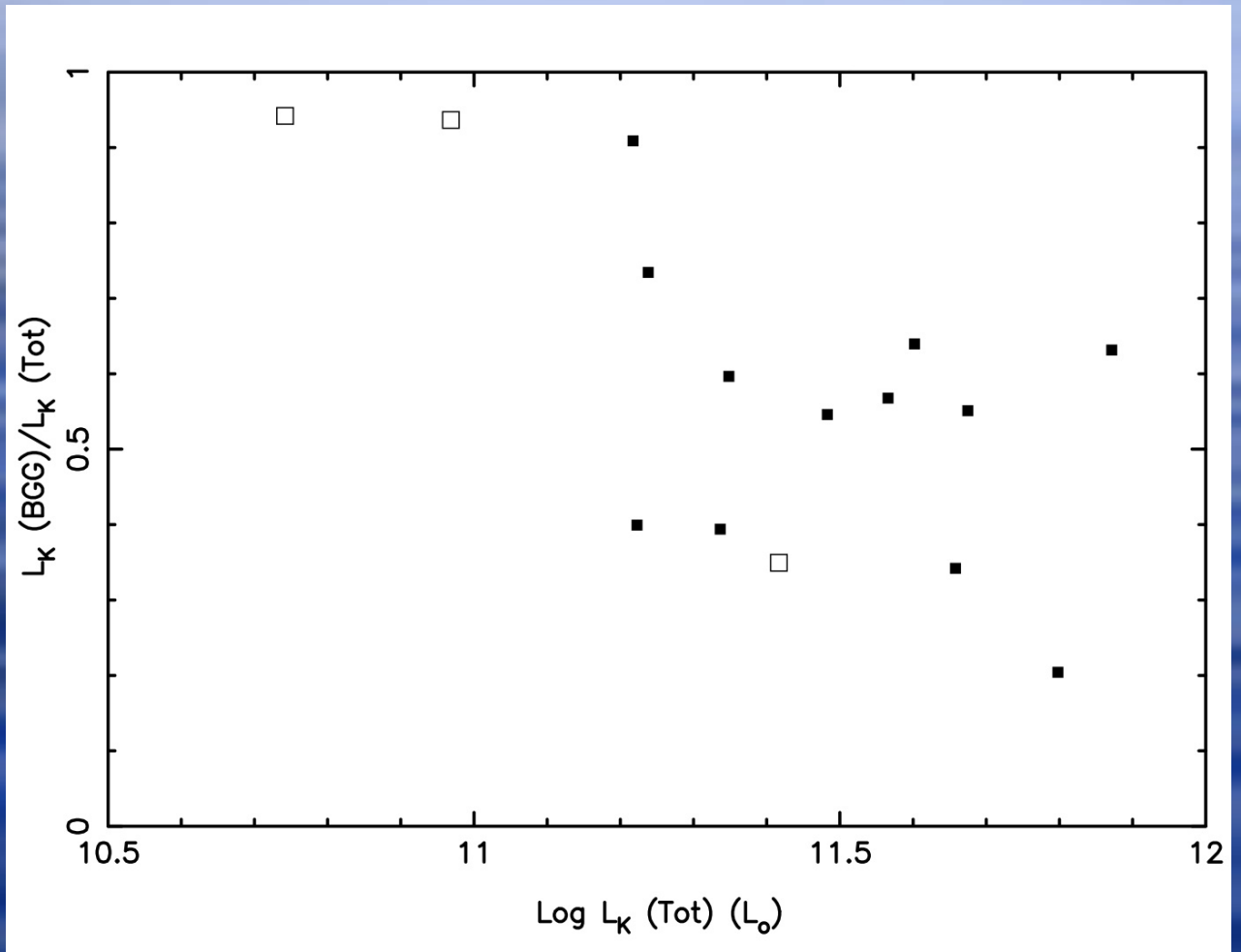


Brough et al. 2006 (in prep)

BGG luminosity vs Group X-ray Luminosity



Fraction of Group Light in BGG



Conclusion

- BGGs of all dynamically mature groups are early-type galaxies that lie within ~0.3 R_{500} and 0.6σ of centroid.
- Luminosity of BGG increases with group X-ray luminosity and fraction of group light in BGG falls with increasing total group luminosity.
- BGGs grow by mergers at early-times. Slower than groups accrete new galaxies.

Conclusions

- NGC 1407 is a massive group at a late stage in group evolution.
- NGC 1332 is a compact group.
- Eridanus is at an early stage of its evolution.
- These groups will coalesce to form a cluster $\sim 7 \times 10^{13}\ M_{\odot}$.
- The morphologies and colours of the individual galaxies indicate that changes in galaxy properties are occurring at densities equivalent to those on the outskirts of the groups.

- See no correlation of dominance m_1-m_2 with environment
- $m_{K,1}$-$m_{K,2}$ =1.53, greater than that found in clusters (0.66; Lin & Mohr 2004)