

Studying
the mass assembly and luminosity gap
in
fossil groups of galaxies
from
the Millennium Simulation

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Fossil galaxy groups

Fossil galaxy groups are interpreted as systems that have **formed early** in which L^* galaxies have been merged over billion of years (Jones et al., MNRAS, 2003).

Observational criteria

Fossil groups are dominated by a single **giant elliptical** galaxy at the centre of an extended bright **X-ray halo**

$$\Delta m_{12} > 2 \text{ (within } 0.5r_{\text{vir}})$$

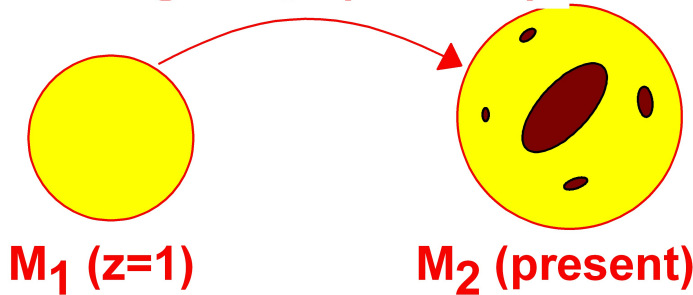
$$L_X > 0.25 * 10^{42} h_{100}^{-2} \text{ erg s}^{-1}$$

Evidence from **Scaling relations**

- For a given optical luminosity of the group, fossils are **more X-ray luminous**.
- Fossils show **higher X-ray luminosity and temperature** for a given group velocity dispersion.
- **Mass concentration** in fossils is higher than in non-fossil groups and clusters.

(Khosroshahi et al., MNRAS, 2007)

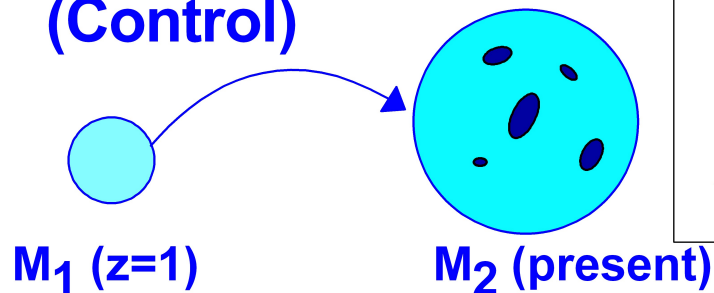
Old group (Fossil)



$$0.5 < \alpha_{OLD} = M_1/M_2 < 1.0$$

$$\Delta m_{12} > 2$$

Normal group (Control)

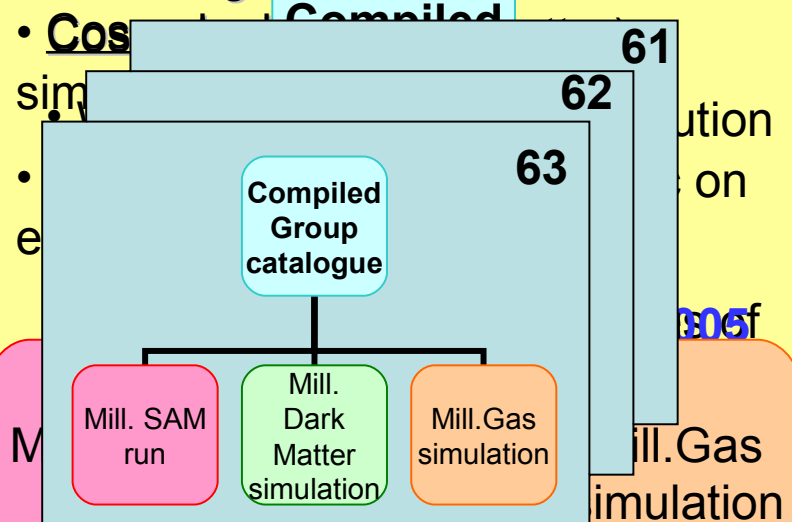


$$0 < \alpha$$

$$\Delta m_{12}$$

$$\Delta m_{12} \sim \alpha \text{ \& } \alpha_{OLD}$$

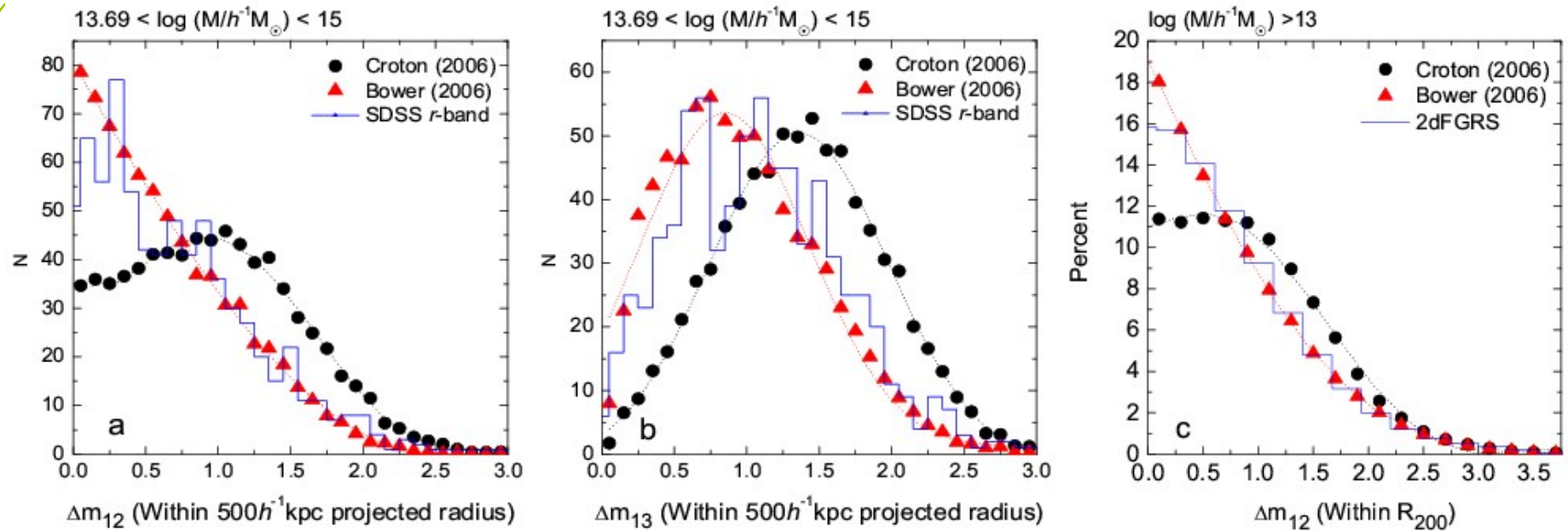
The Millennium Simulation



Pearce(+08)

Magnitude gap SAM vs. OBSERVATION

Dariush et al. (2008, *in preparation* + **NAM08**)



Magnitude gap **vs.** Mass assembly

Dariush et al. (2008, *in preparation* +**NAM08**)

Better definition !!!

$$\Delta m_{16} > 3$$

- Earlier formation
- More isolated
- Occupied by low mass groups
- Larger fraction of fossils

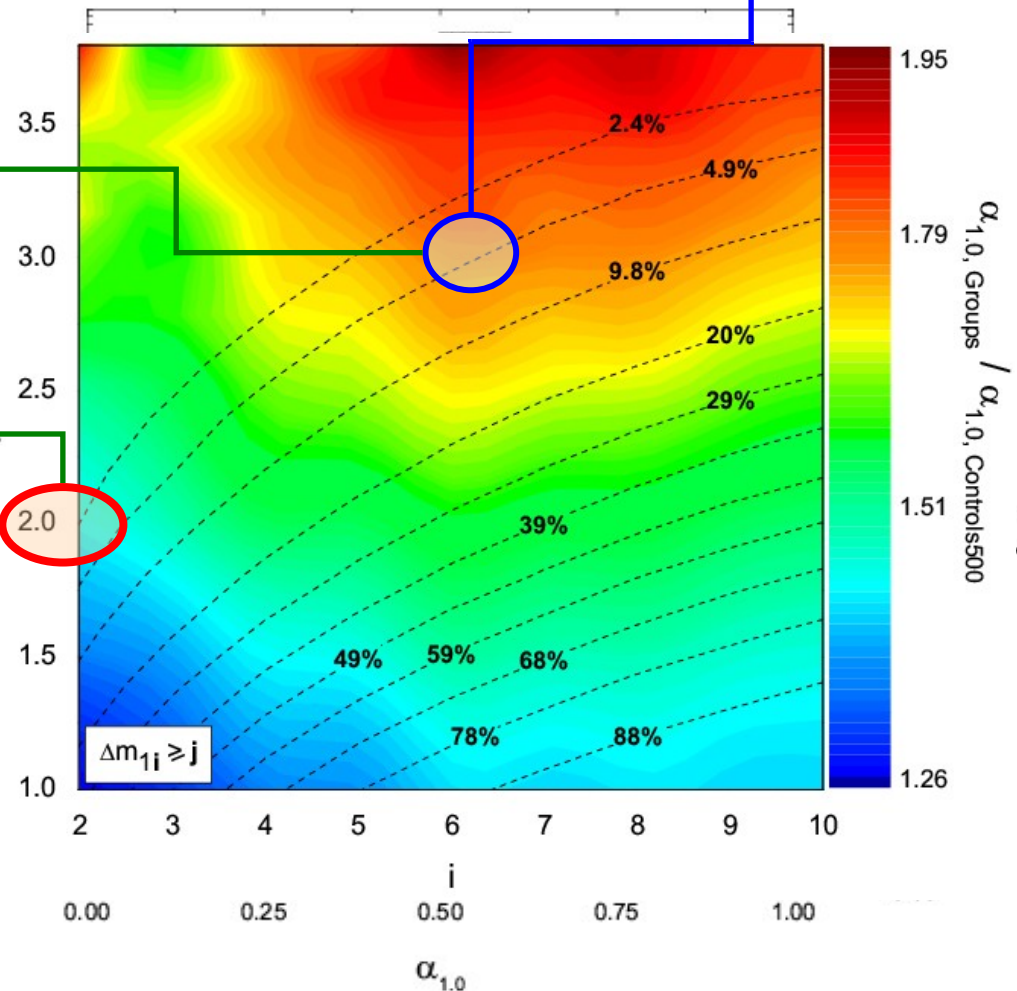
magnitude gap
needs to be
revised

$$\Delta m_{12} \sim \alpha \text{ \& } \alpha_{\text{OLD}} / \alpha_{\text{NORMAL}} > 1.0$$

Current definition

$$\Delta m_{12} > 2$$

Dominated by





Conclusion

- Agreement between the **observed** magnitude gap (**SDSS / 2dFGRS**) and **SAM** (**Bower+06**)
- Early formed groups *do not* necessarily develop large magnitude gaps $\Delta m_{12} > 2$ (problem with **SAM** or **current definition of fossil groups**).
- Assuming that the current **SAM** **predicts properly** the observed properties of early formed groups, then the optical condition $\Delta m_{16} > 3$ does better separate old/early formed groups from normal groups.

