Galaxy Properties in Fossil Groups

Observations and simulations

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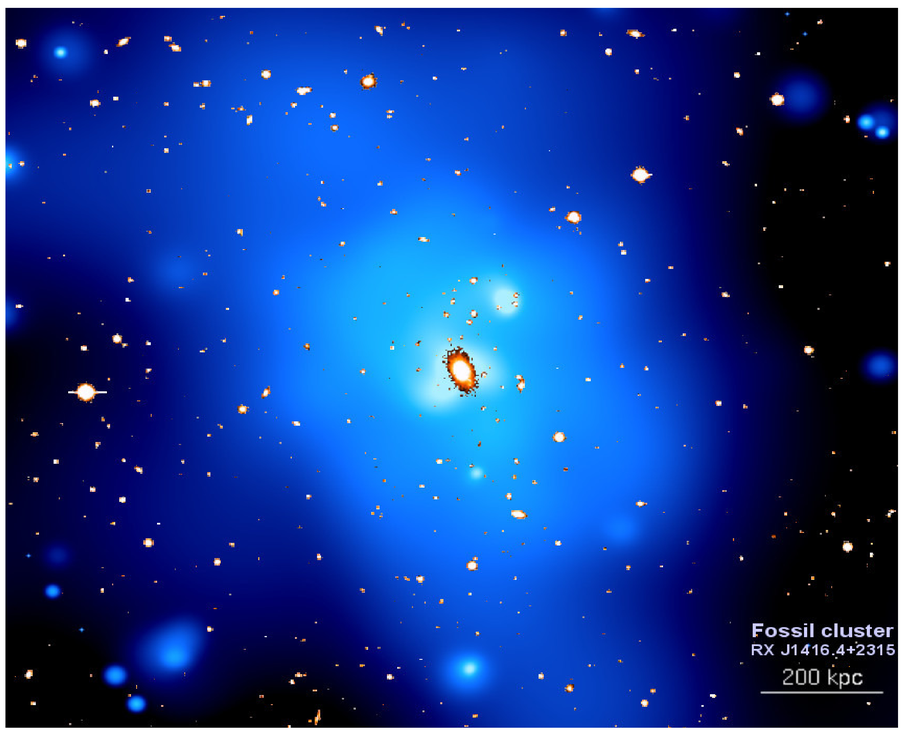


Fossil groups

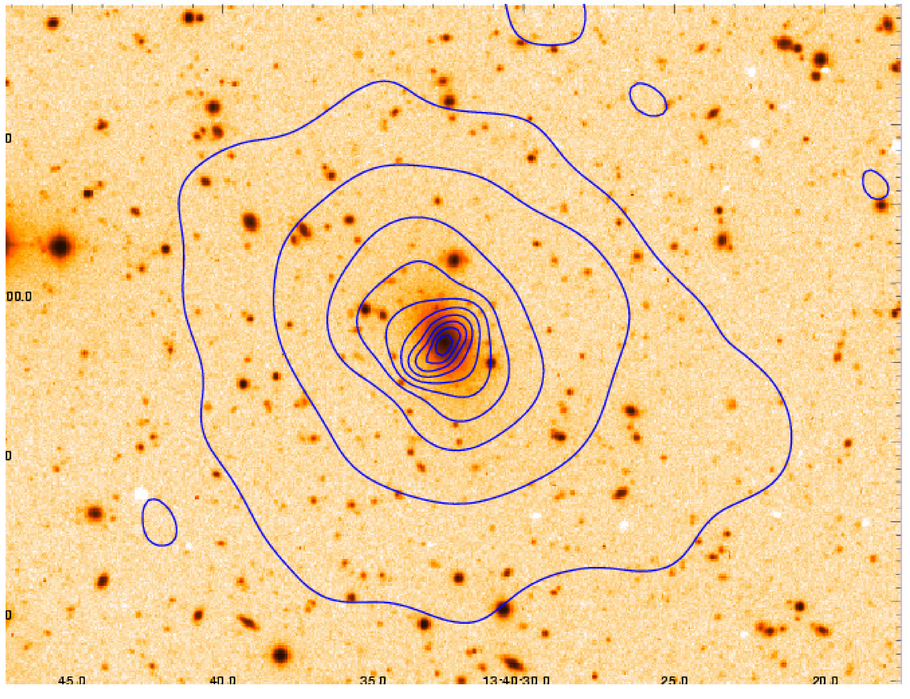
- End product of galaxy merger within a group
- Symmetric and regular X-ray emission
- No recent major merger: simple laboratories …

Fossil selection

X-ray: $L_X \geq 10^{42}$ ergs/sec

Optical: $\Delta m_{12} \geq 2$ (R-band)
within 0.5 r_{200}

Jones et al (2003)



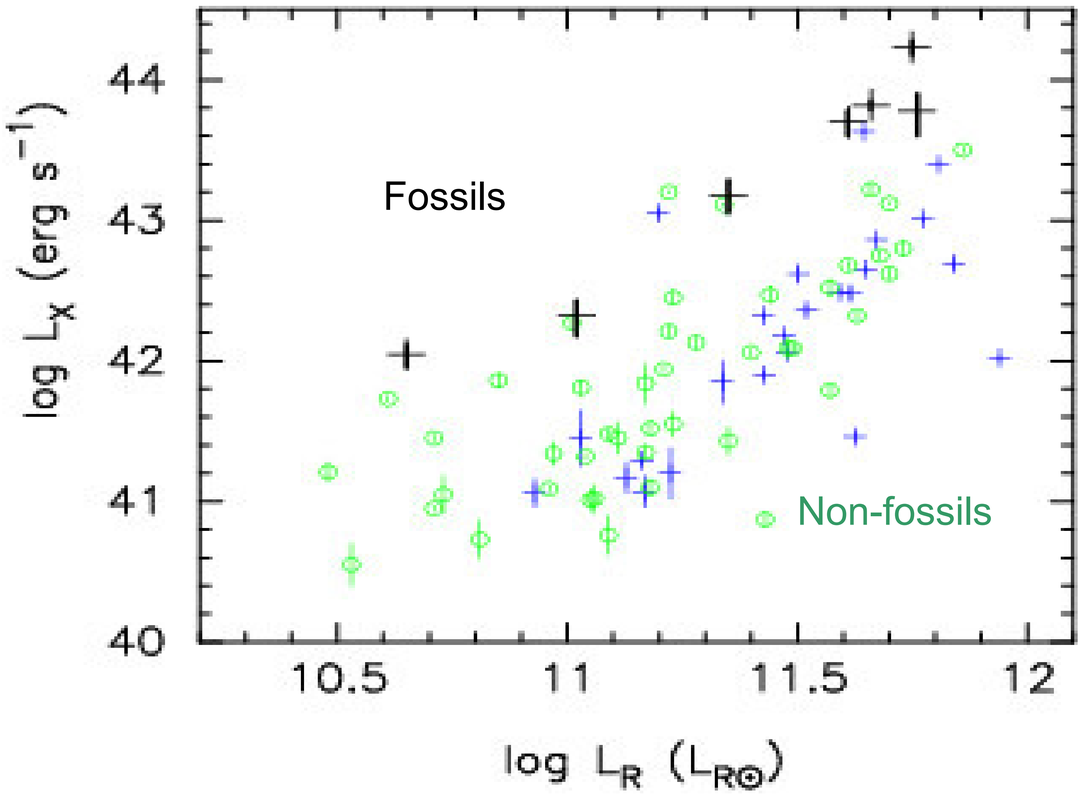
Fossil group (optical + X-ray)

Why study fossils?

- Are fossils really old systems?
- Are their halo and galaxy properties different?
  - Observations
  - Simulations
- Extragalactic astronomy can benefit from fossil studies:
  - Halo formation
  - Baryon physics
  - AGN Feedback
  - Galaxy formation

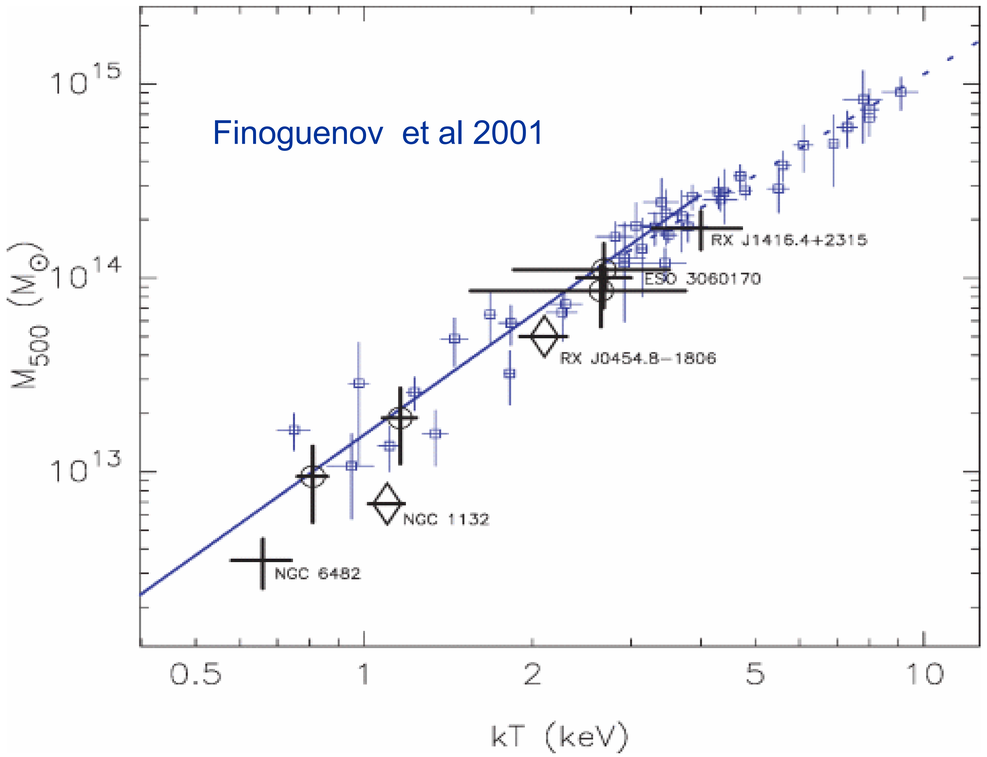
X-ray properties

from Chandra observations



L_X - L_{opt} relation

Excess X-ray luminosity for a given optical luminosity of the groups



M - T_X relation

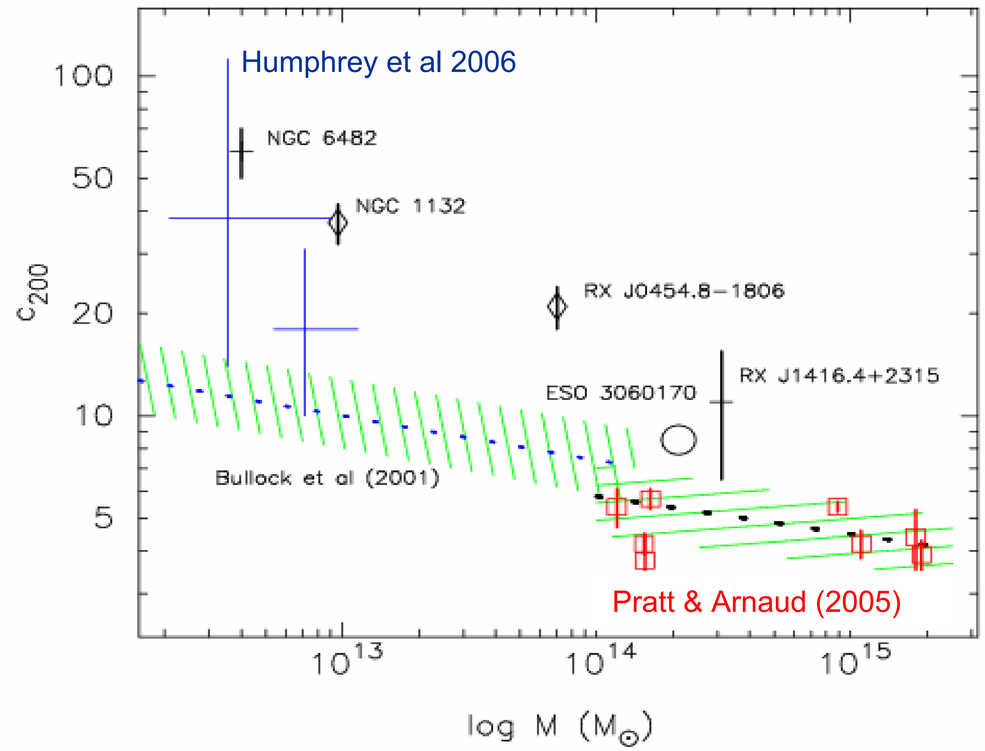
Fossils appear to be hotter than normal groups for a given mass of the system

Mass concentration in fossils

C_{200}- M relation

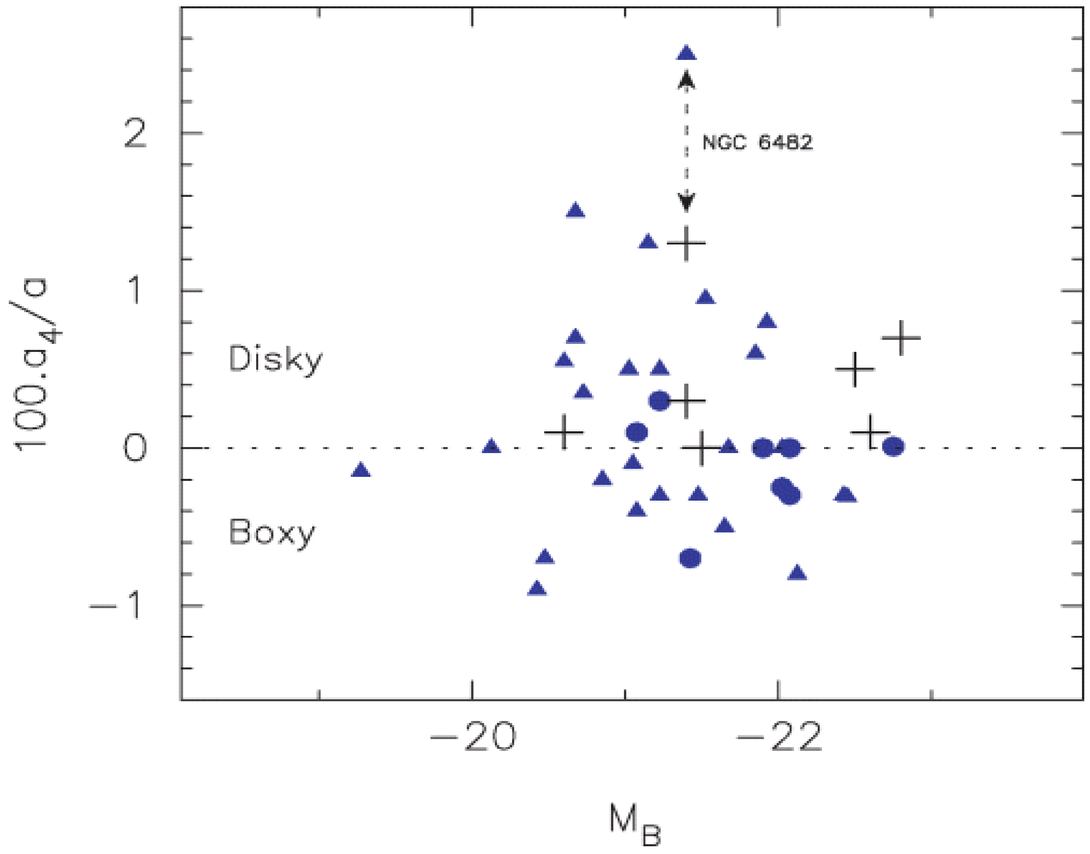
Dark matter haloes with an early formation epoch tend to be more concentrated (Navarro et al. 1996).

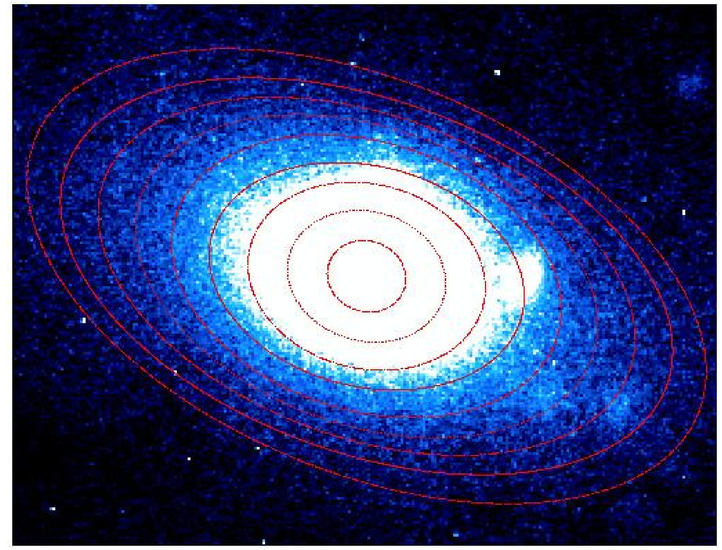
r_{200}/r_s=



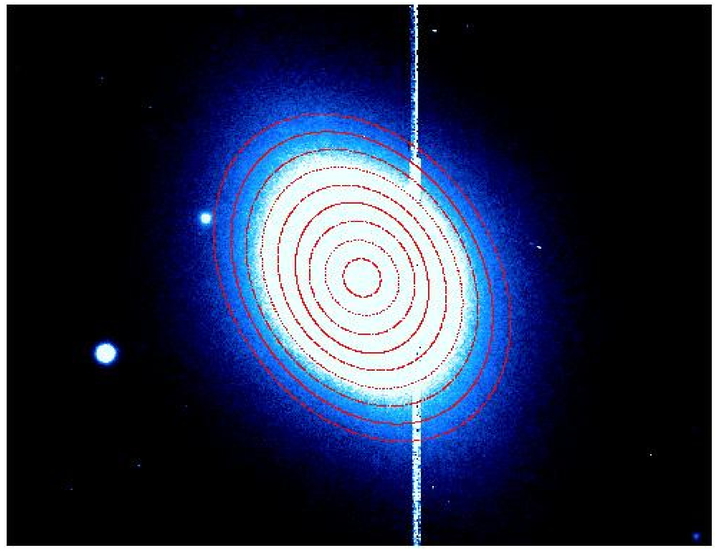
Fossils are outliers in some of the scaling relations which provide strong observational constraints for the simulations and analytical models

The central galaxy





K-band, J1416.4+2315



K-band, NGC 6482

The giant elliptical dominating fossils show non-boxy isophotes. No recent dry merger?

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Merger and star formation history

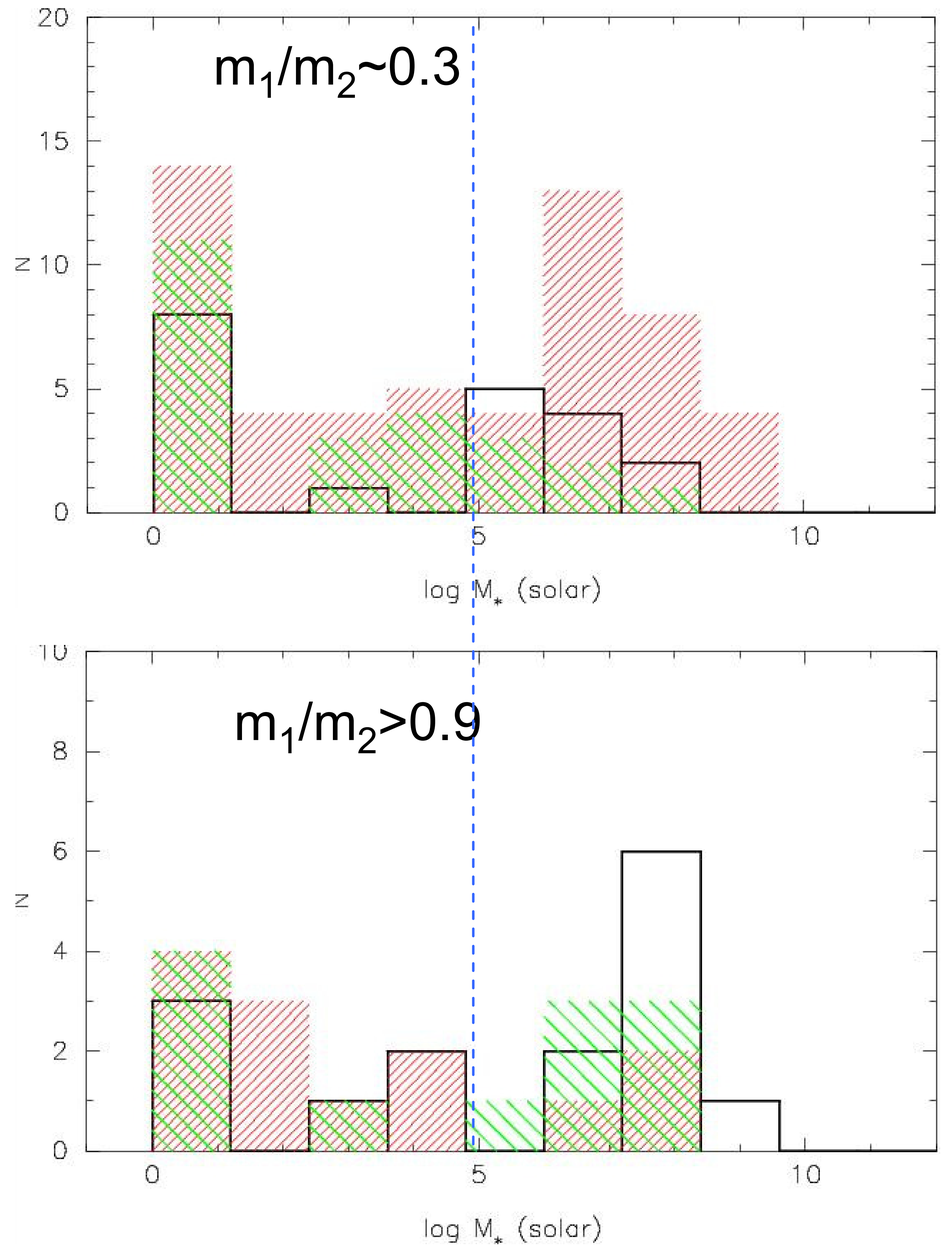
Star formation in central galaxy

Equal and non-equal mass mergers

$\Delta m_{12} \geq 2$

$\Delta m_{12} \sim 1.0$

$\Delta m_{12} \sim 0.2$



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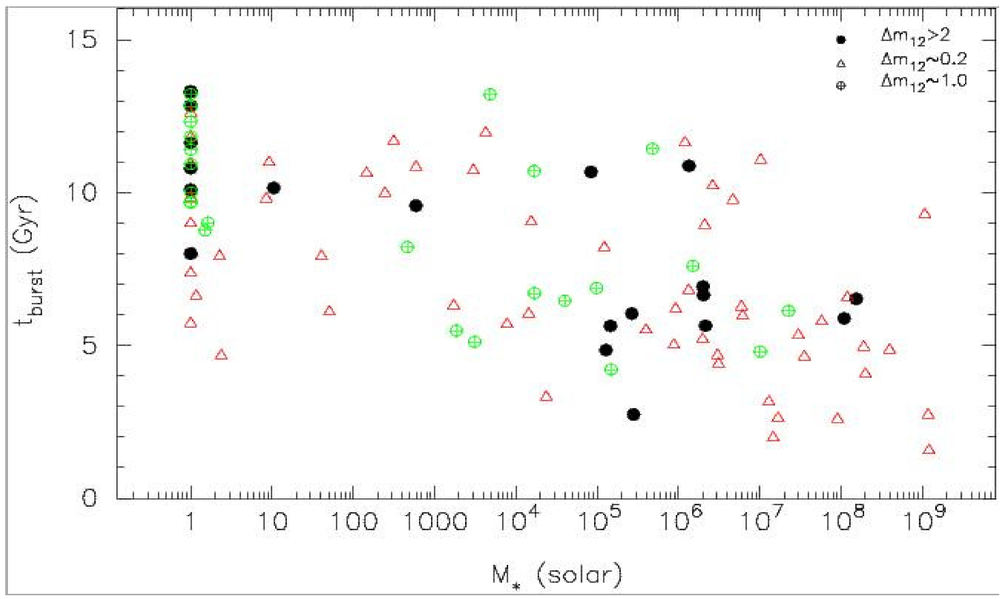
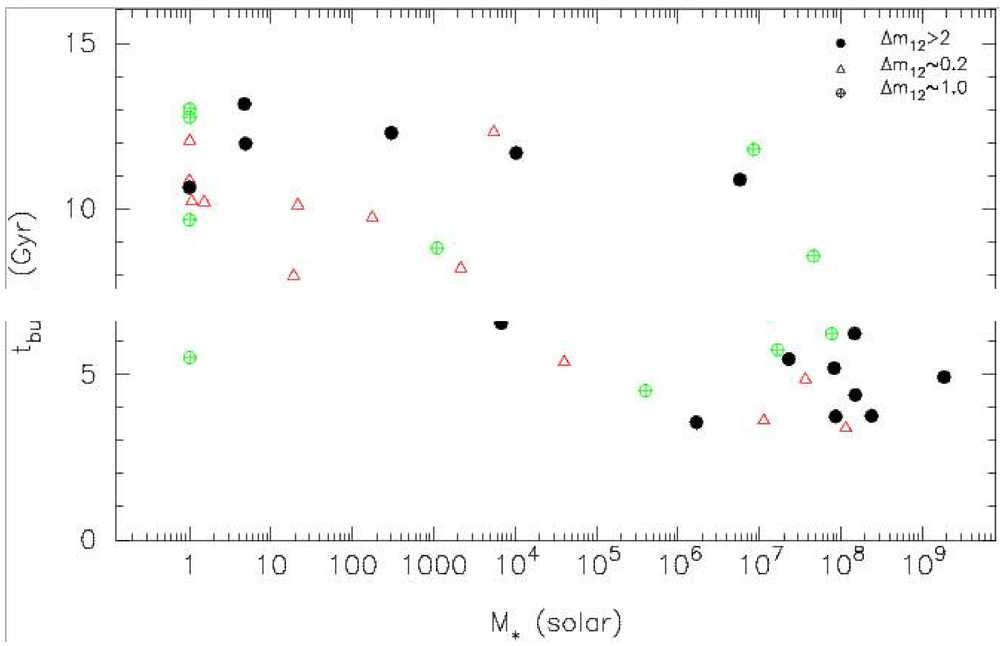
Merger and star formation history

When do the stars form in different classes of groups?





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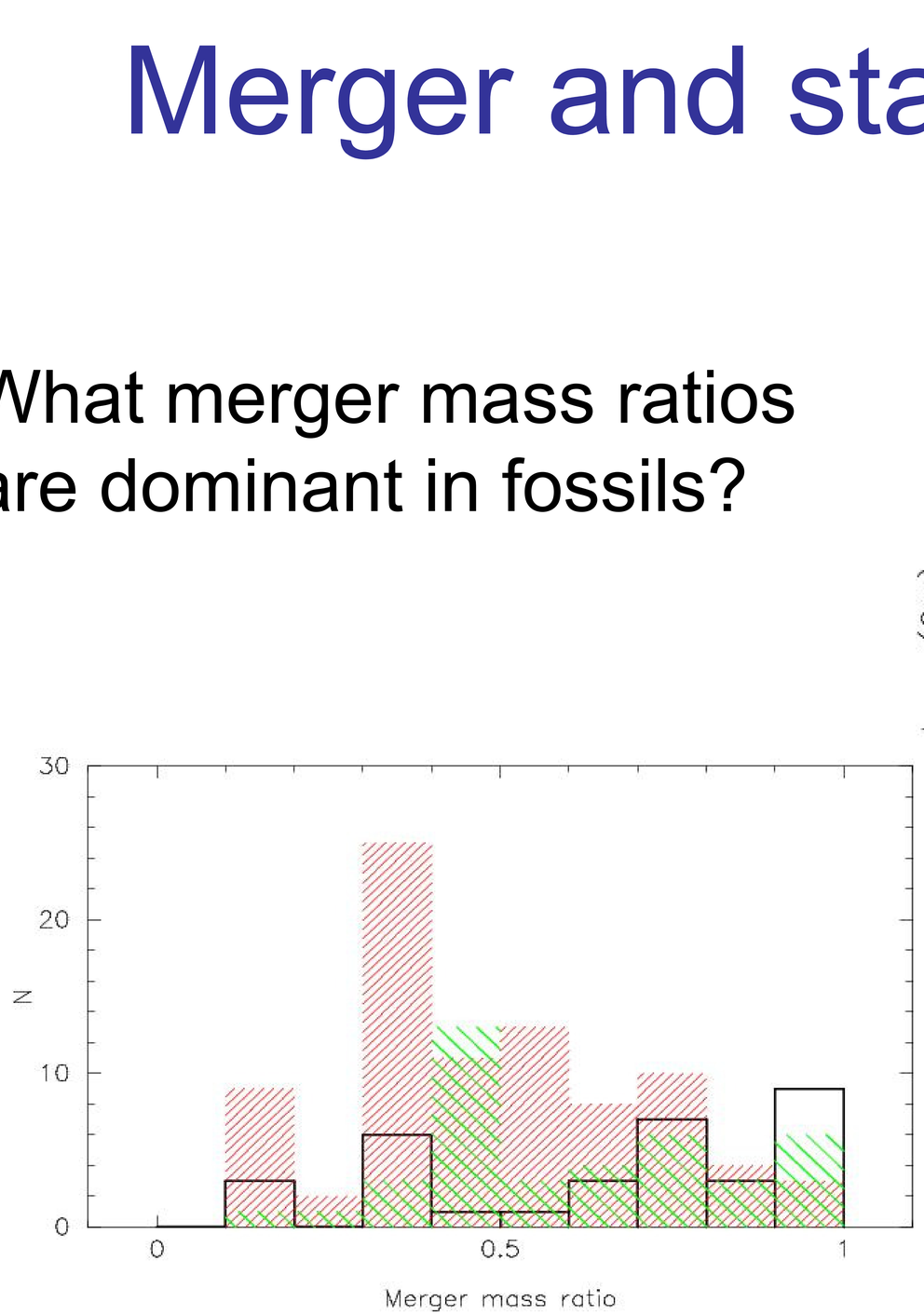
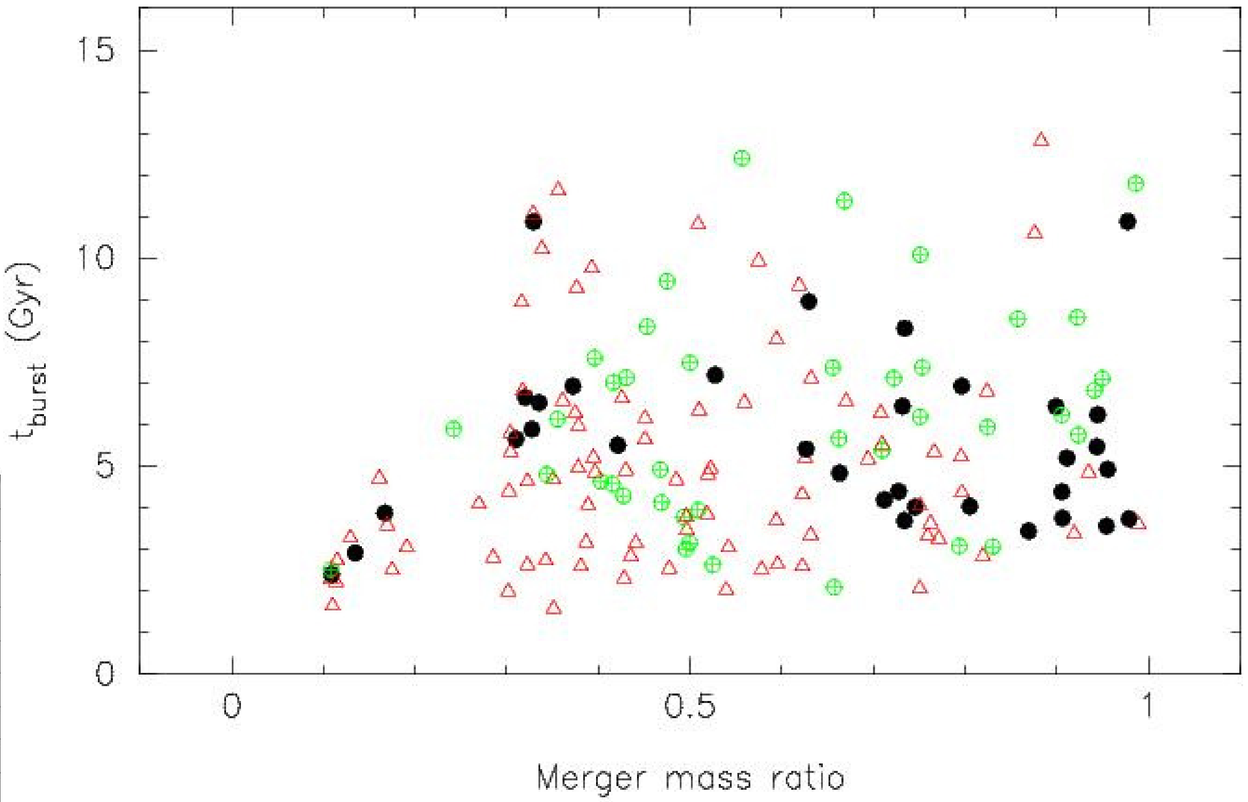
Merger and star formation history

What merger mass ratios are dominant in fossils?





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Summary

- Both the observations and simulations point at fossils' early formation
- Fossils appear to be the extension of galaxy clusters to lower mass systems
- Fossil central galaxies show non-boxy isophotes
- The younger stellar population in fossil central galaxies are metal poor
- Eqaul mass mergers form more stars in fossil central galaxies than in non-fossils.
- Non-equal mass mergers are the main source of star formation in non-fossils.

Khosroshahi, Ponman, Jones 2007, MNRAS, astro-ph/0702095
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