Intergalactic Gas in Groups:
Implications for Dwarf Spheroidal Formation and Missing Baryons

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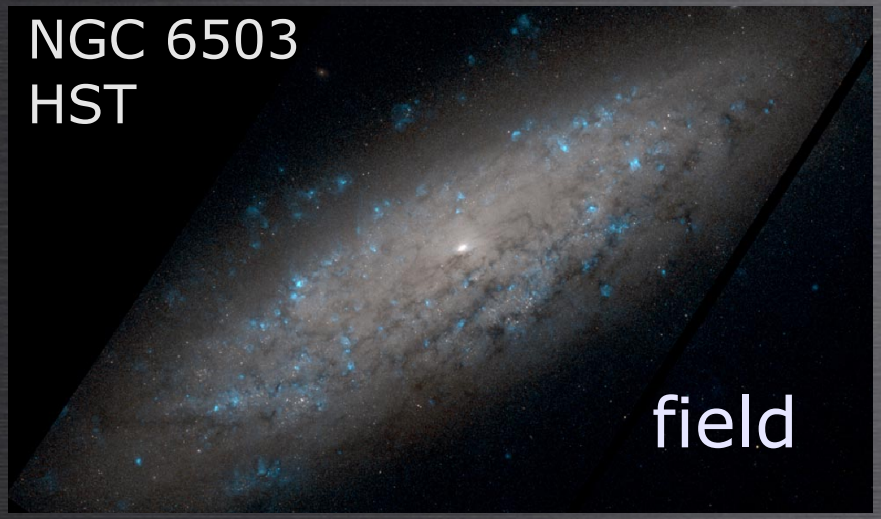
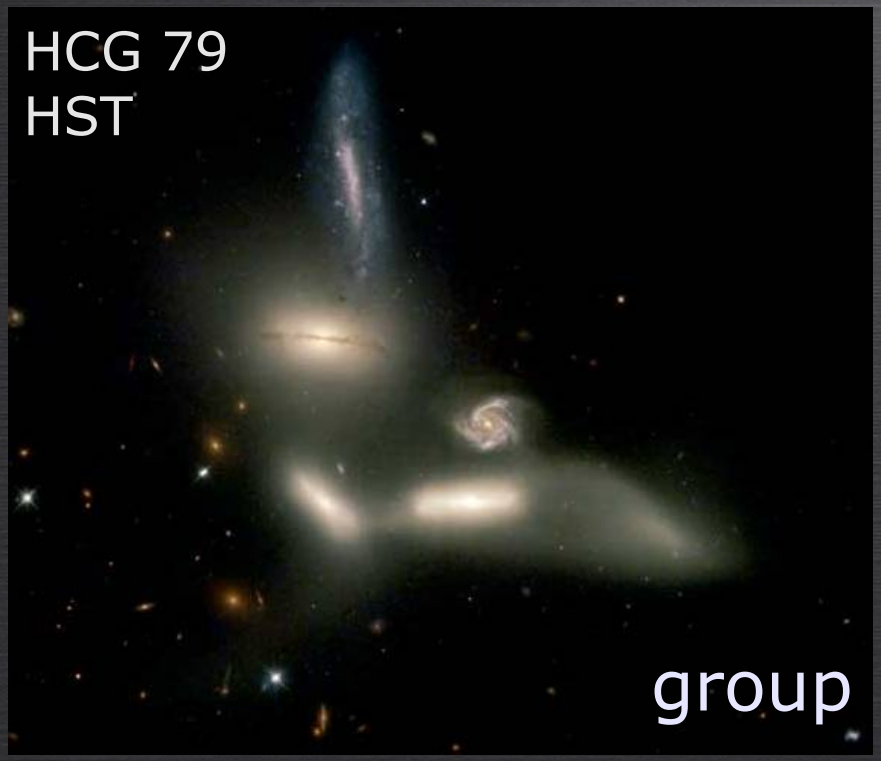
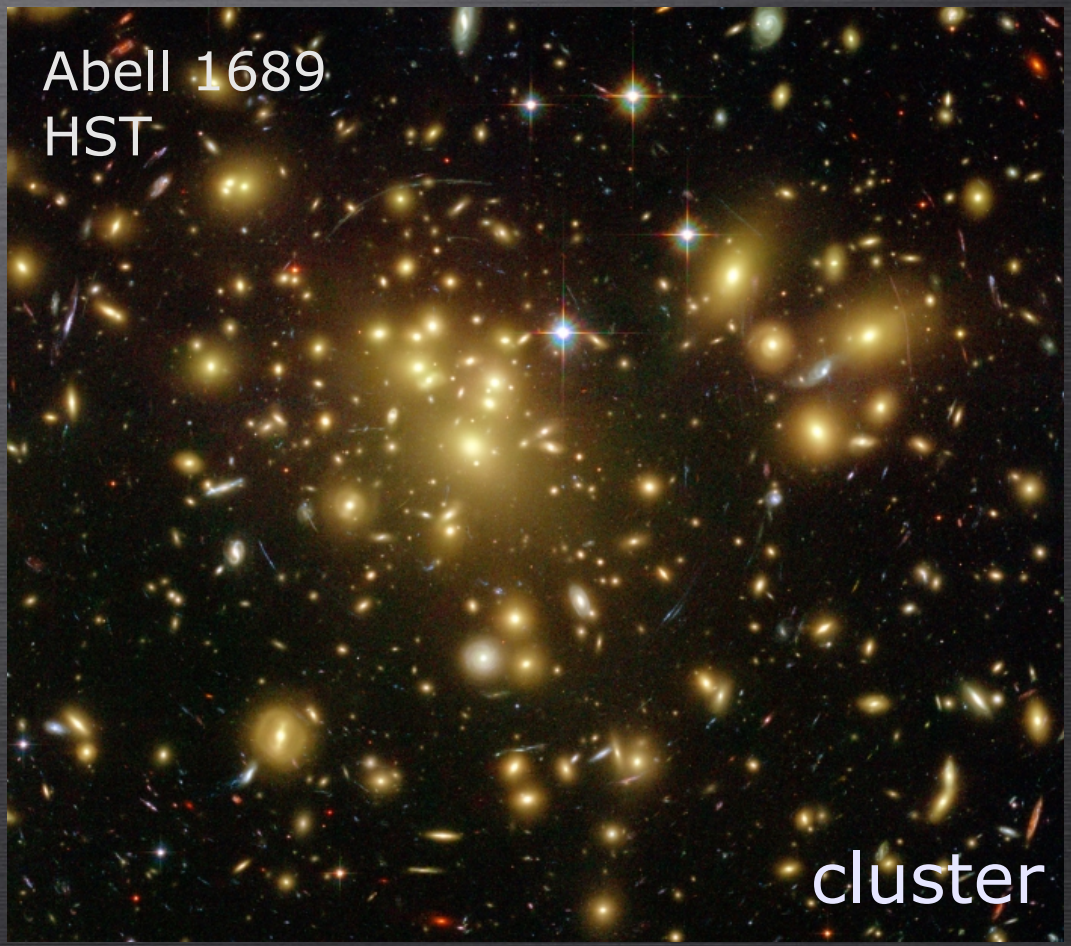
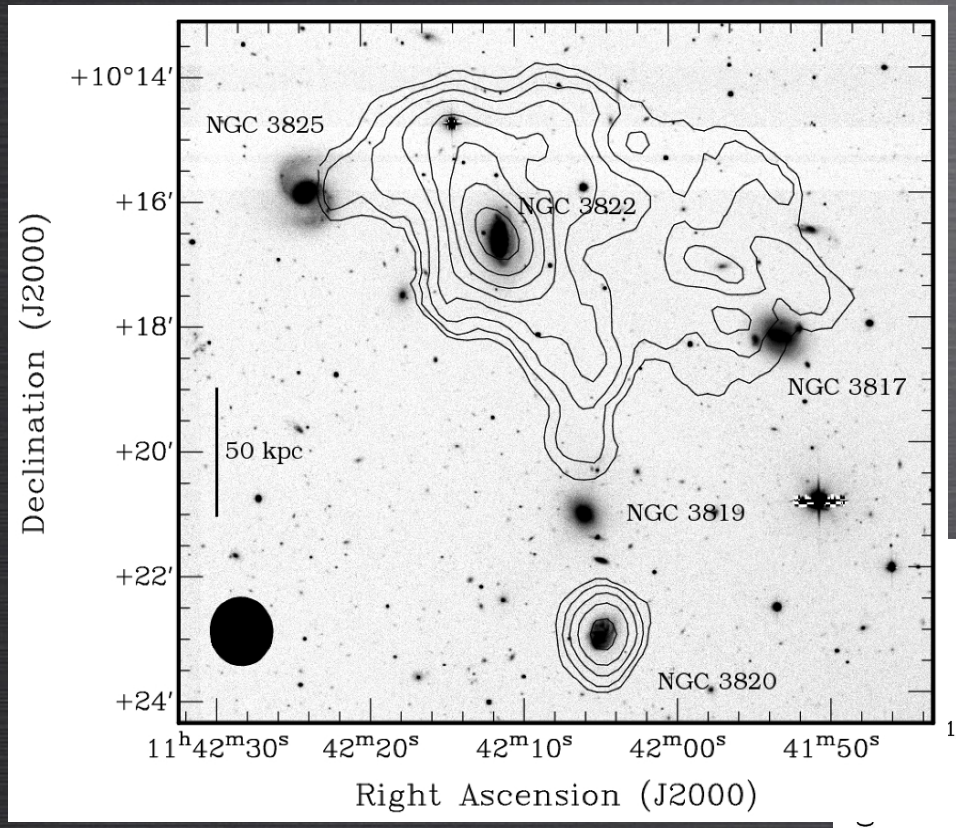
Galaxy Evolution & Environment



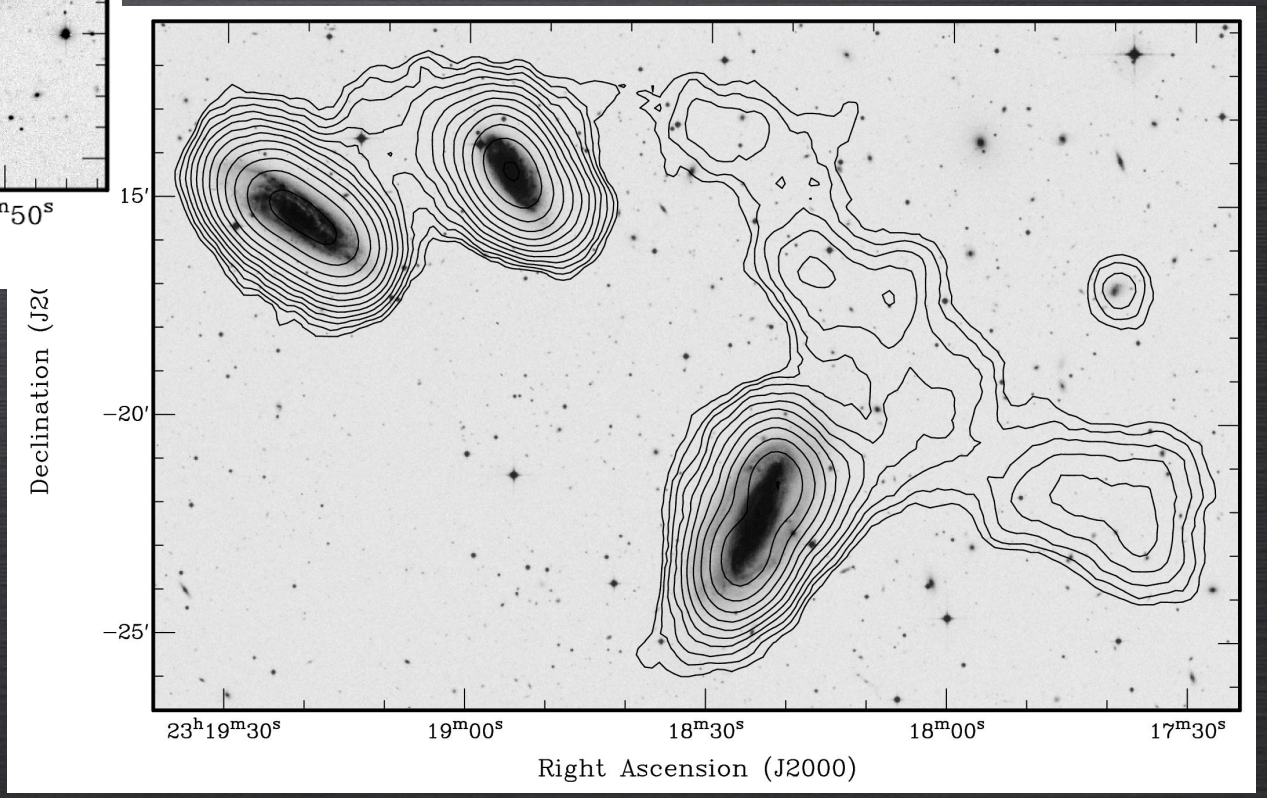




Gravitational interactions are common in groups.

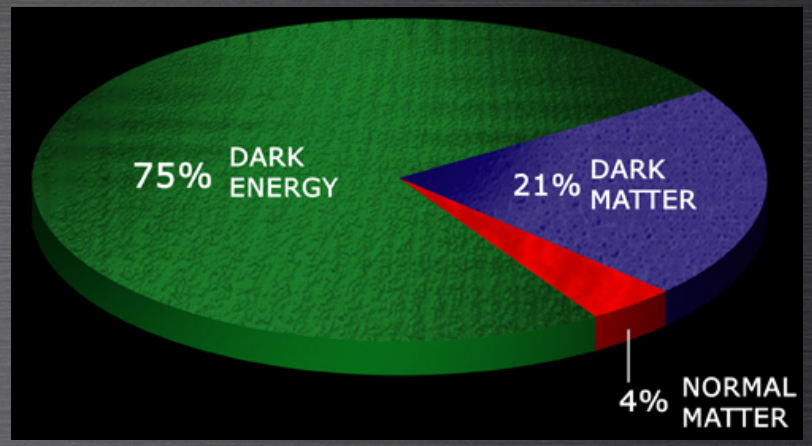


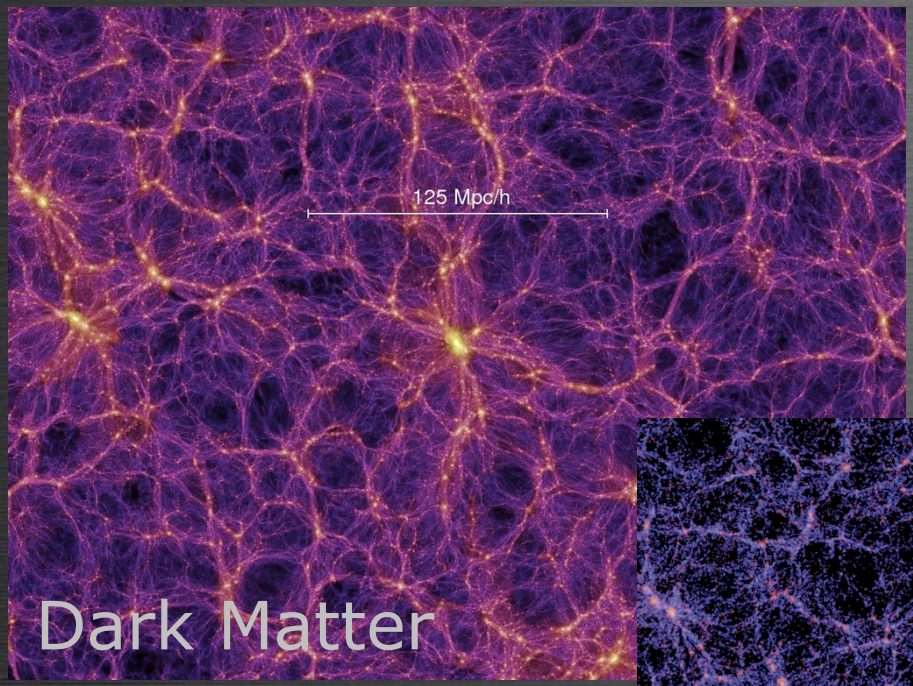
Spiral-rich groups
(HI contours)

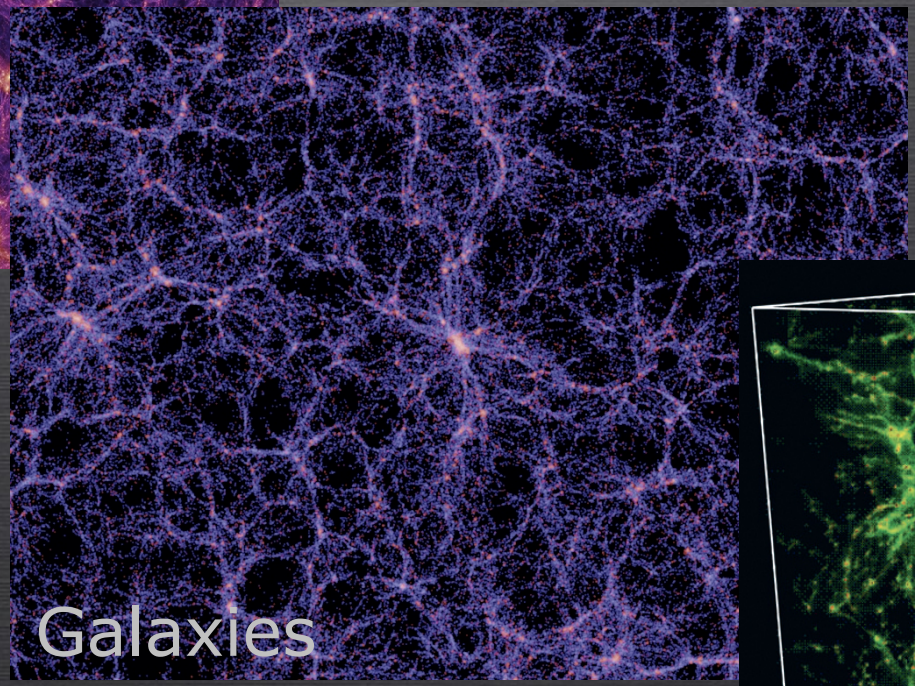


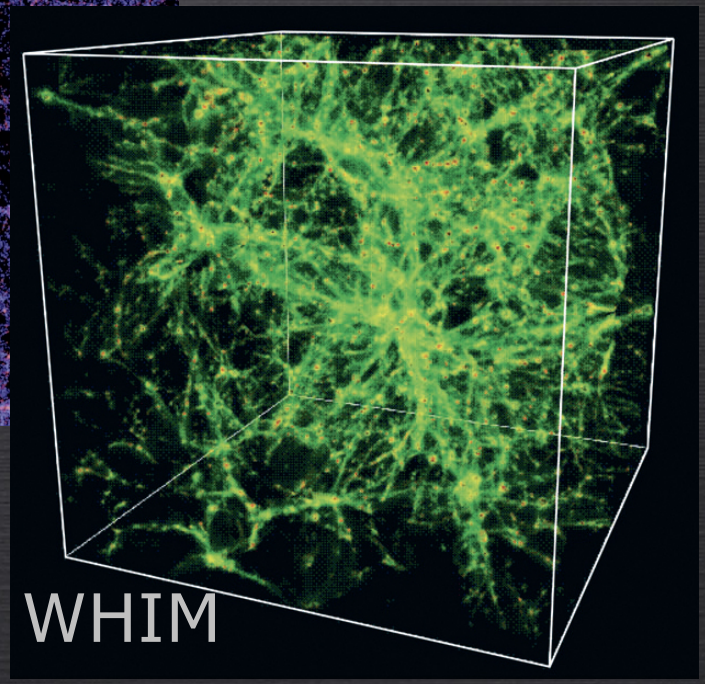
Freeland et al. 2009

Missing Baryons

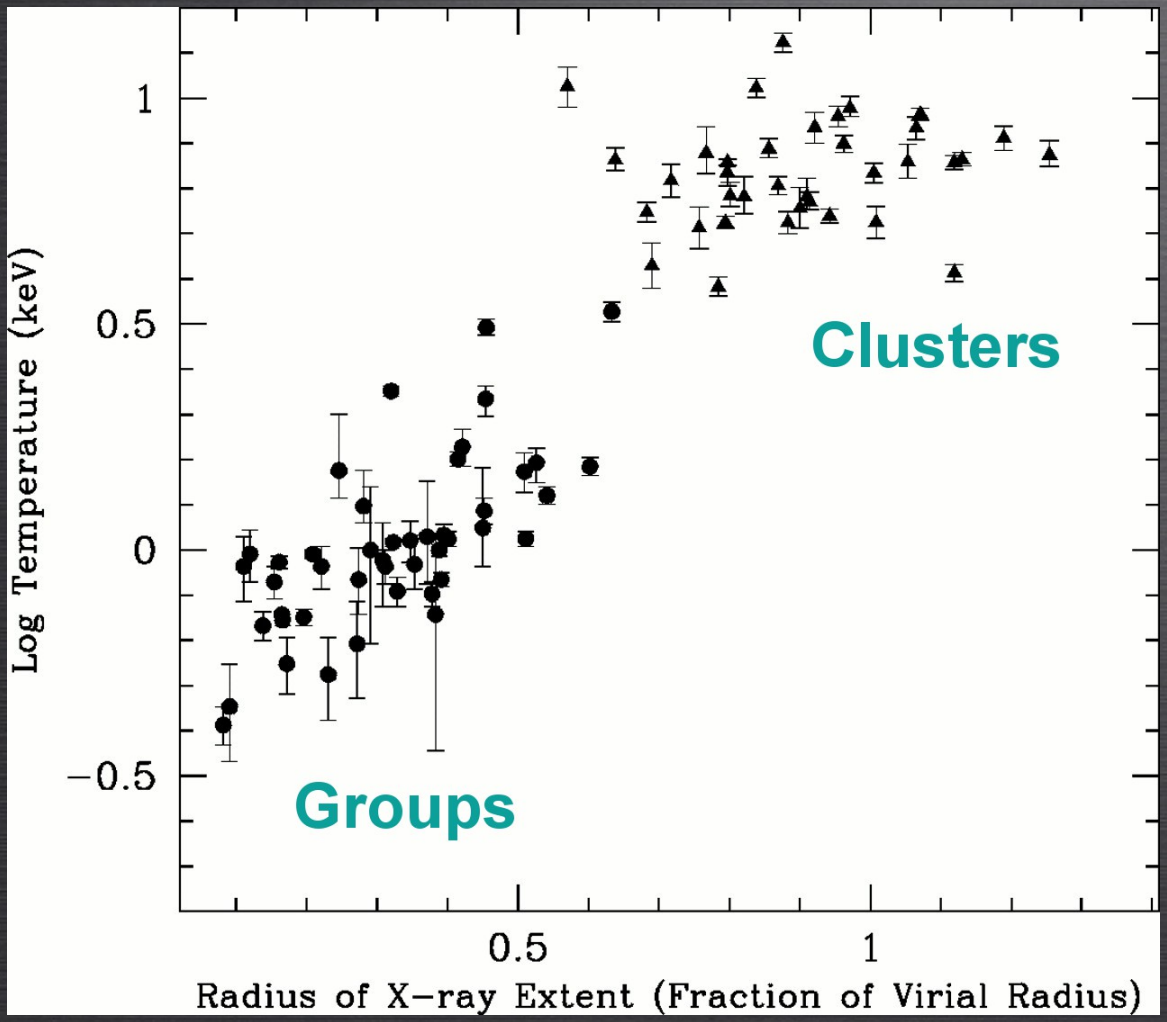




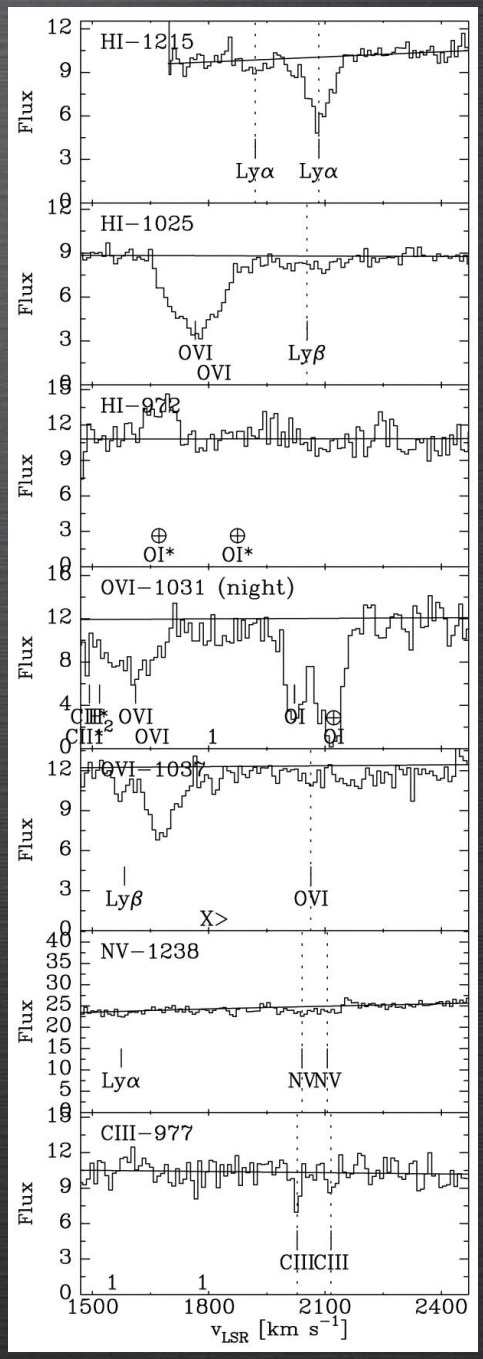




WHIM tracers : X-rays, UV absorption



Mulchaey 2000



Pisano+2003

Radio galaxies with bent jets are preferentially located in groups and clusters of galaxies.

Euler's equation (Burns & Owen 1980),

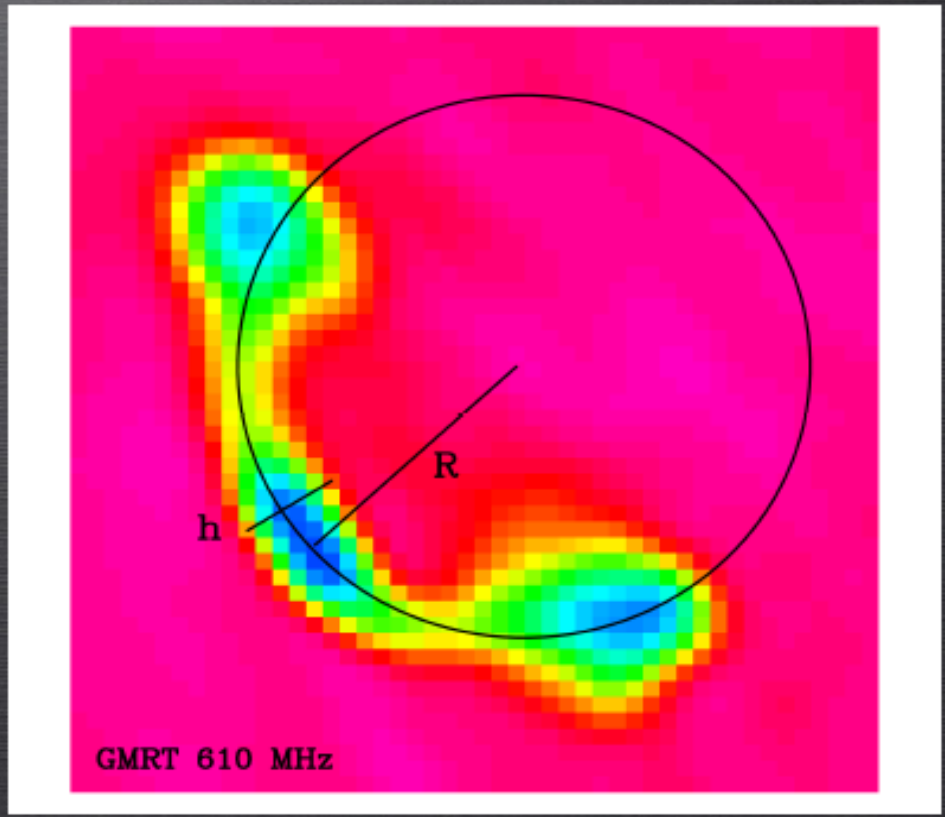
$$\frac{\rho_{\rm IGM} v_{gal}^2}{h} = \frac{\rho_{\rm jet} v_{\rm jet}^2}{R}$$

$$\rho_{\rm jet} v_{\rm jet}^2 = P_{min}$$

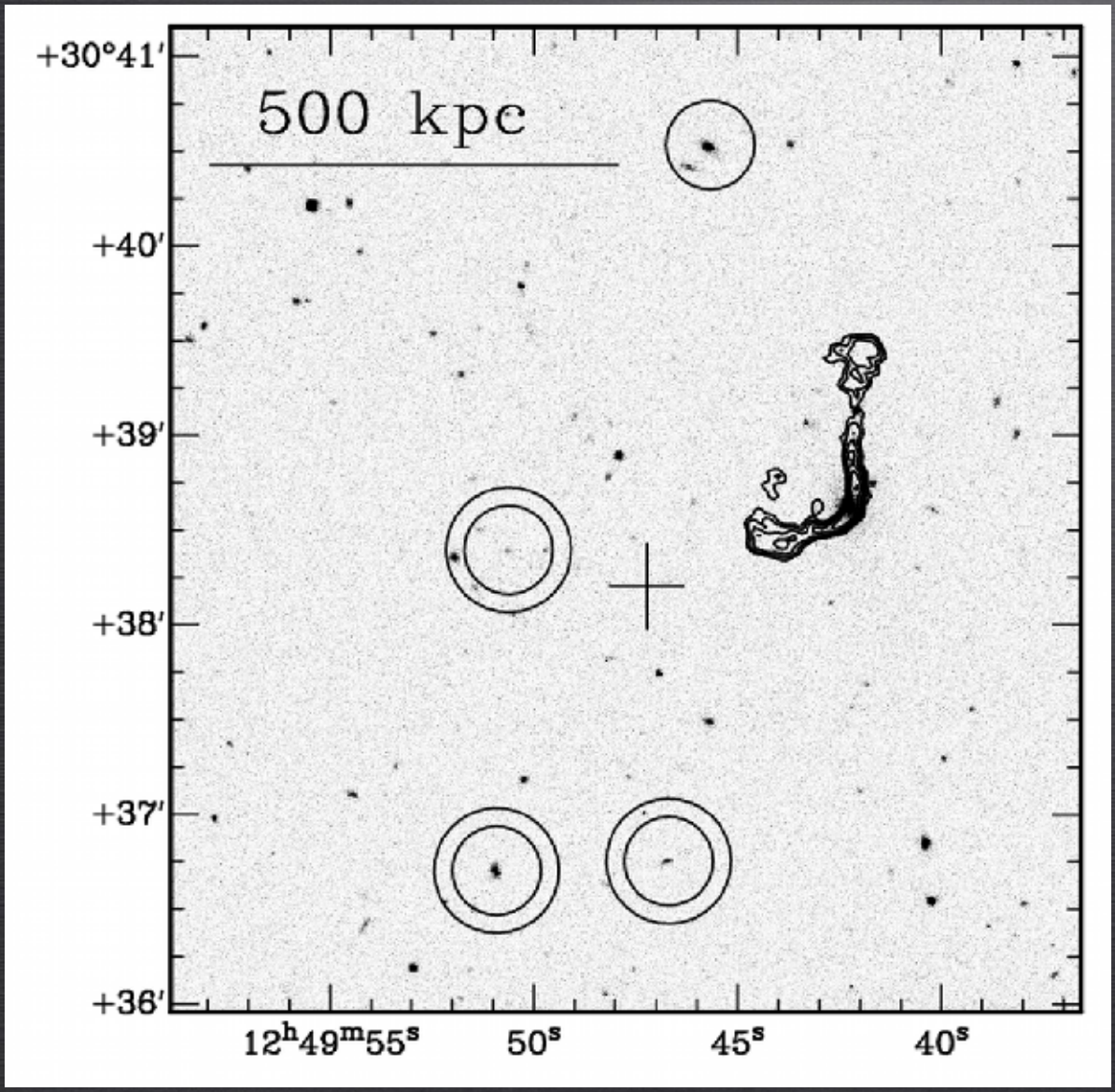
$$v = \sqrt{3}\sigma_v$$

$h =$ jet width

$R =$ radius of curvature



FIRST J124942.2 + 303838



Freeland et al. 2008

$z_{gal} = 0.194$

$\sigma_{group} = 250^{+20}_{-100}$ km s^{-1}

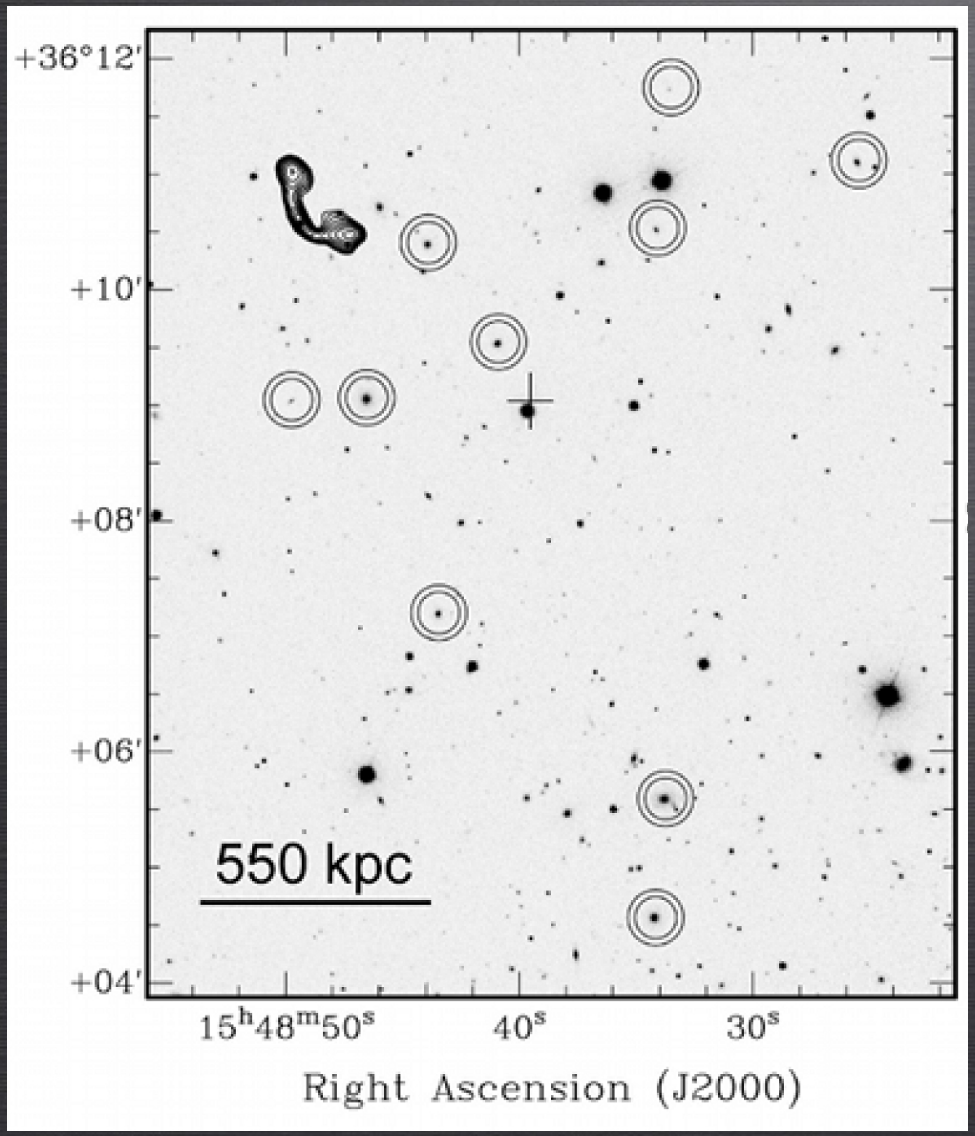
$r \sim 300$ kpc

$n_{\rm IGM} = 3 \pm 2 \times 10^{-3}$ cm^{-3}

Chandra : 35 ksec

$T < 2 \times 10^6$ K

SDSS J154849.35 + 361035.3



$z_{gal} = 0.233$

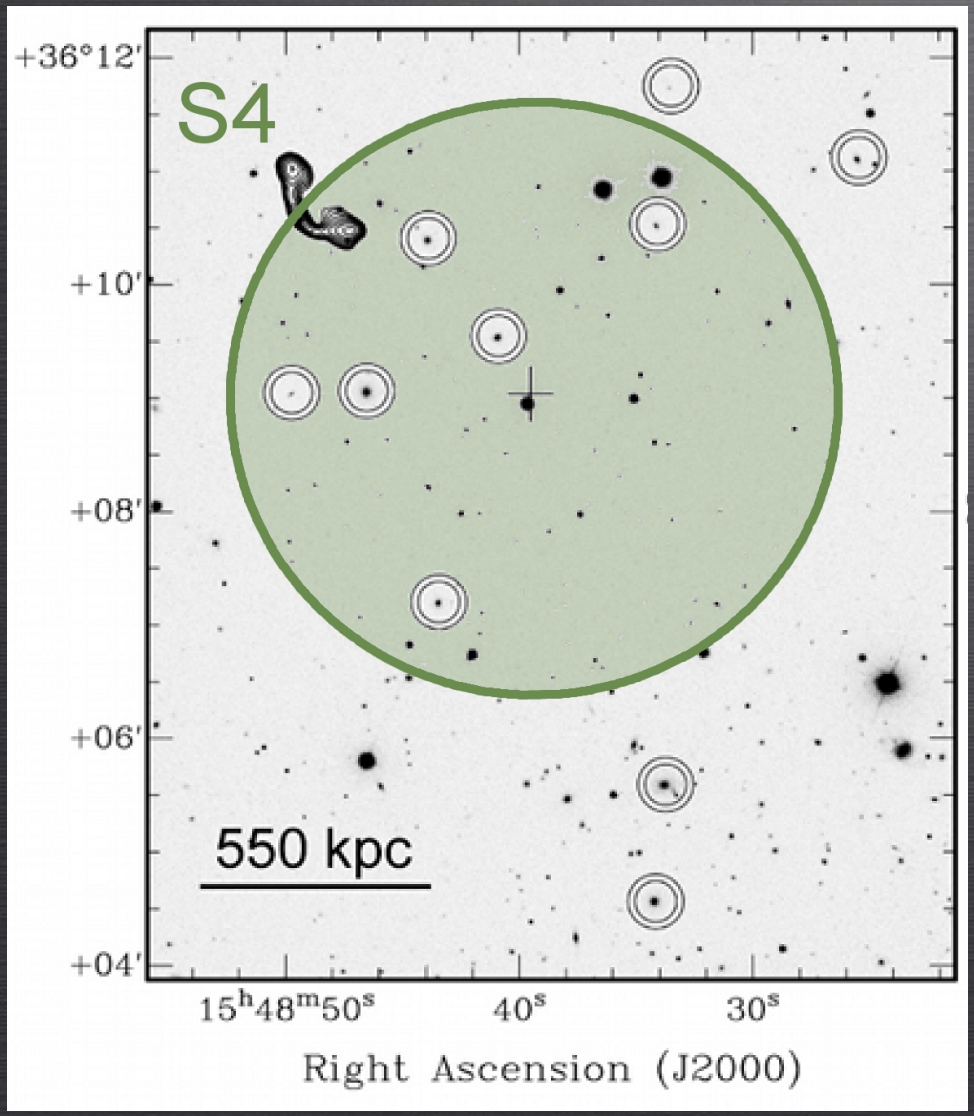
$\sigma_{group} = 550^{+120}_{-80}$ km s^{-1}

$r \sim 700$ kpc

$n_{\rm IGM} = 5 \pm 2 \times 10^{-4}$ cm^{-3}

Freeland & Wilcots 2011

SDSS J154849.35 + 361035.3



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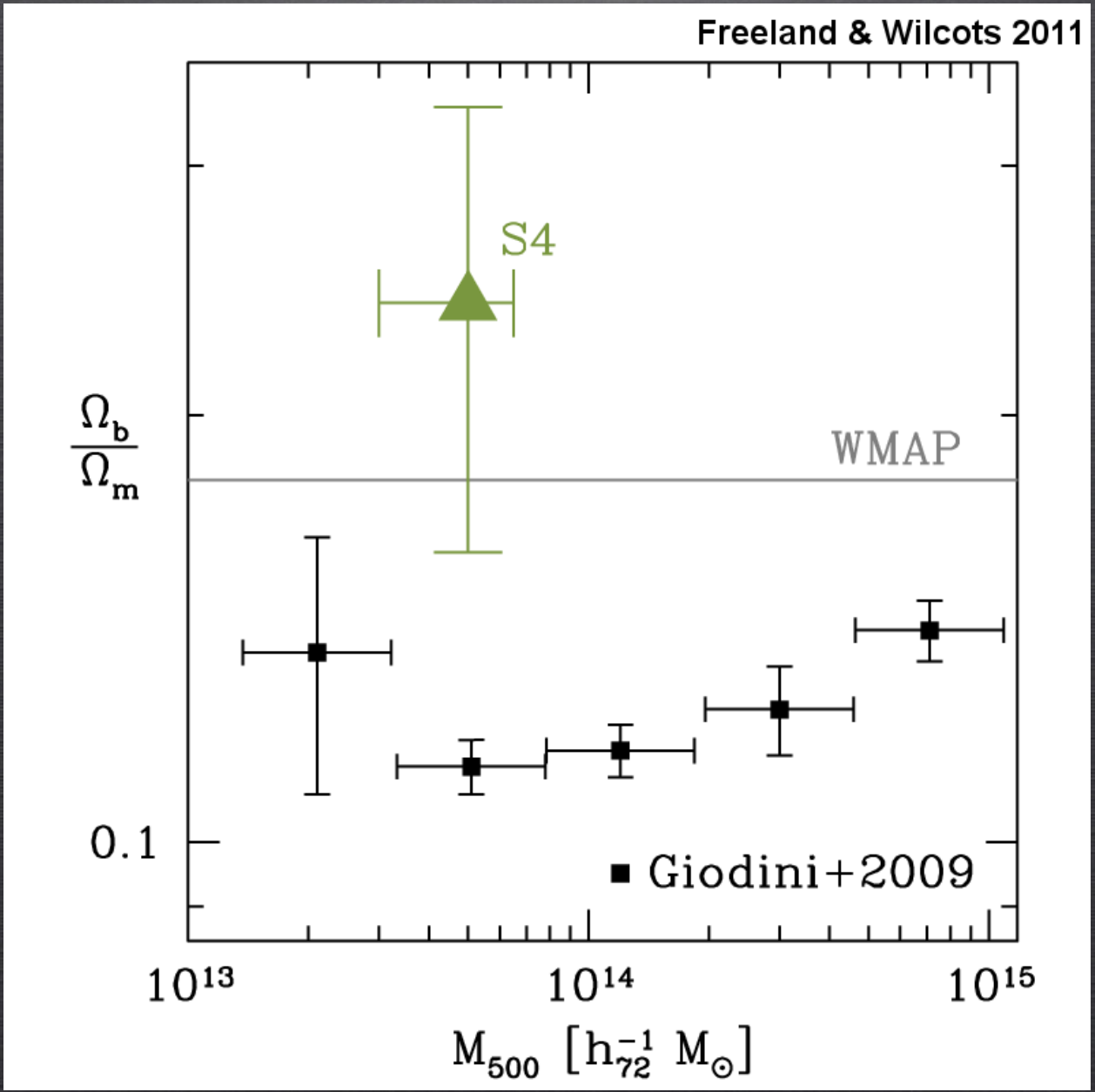
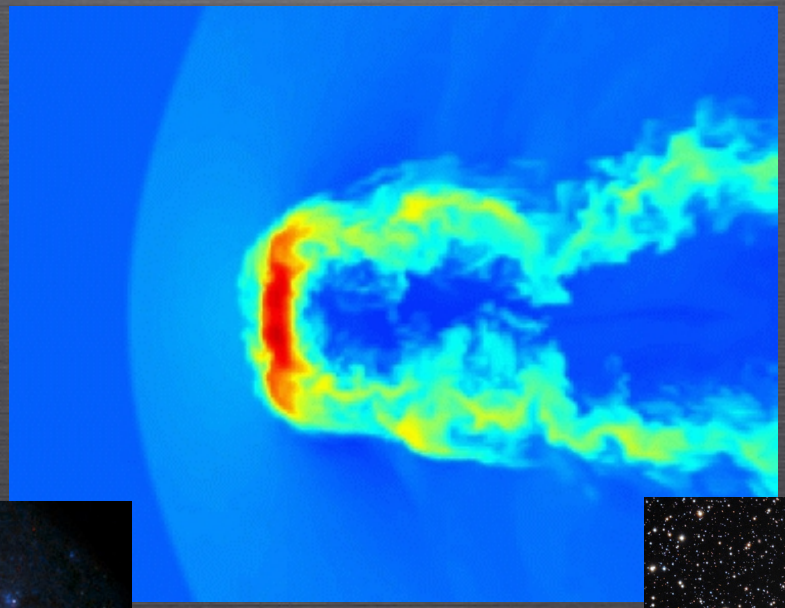
Freeland & Wilcots 2011

This estimate is consistent with the missing baryons being located in the intragroup medium in galaxy groups.



This intergalactic gas is dense enough to strip HI from dwarf galaxies.



Dwarf Irregular

Dwarf Spheroidal

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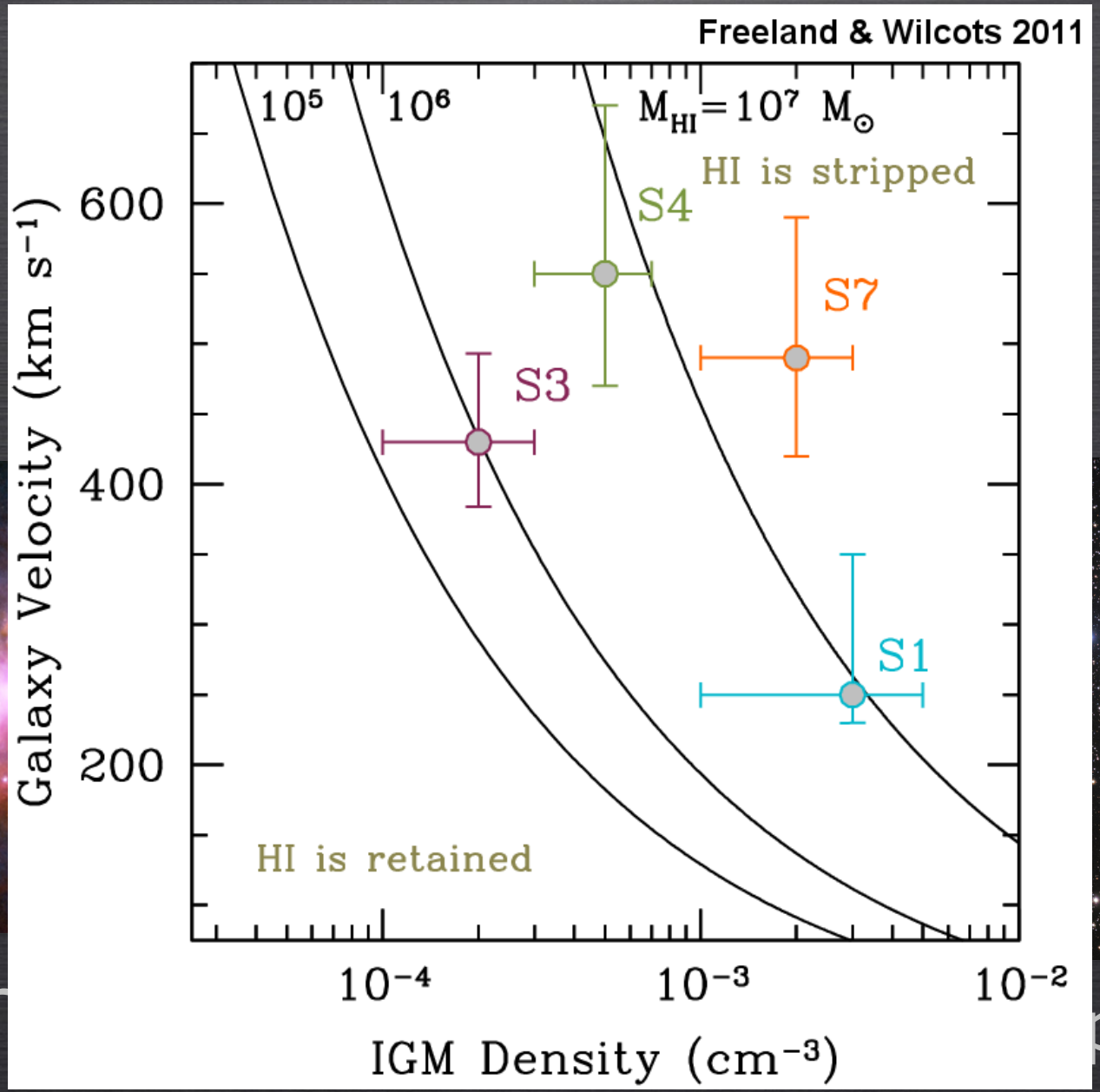
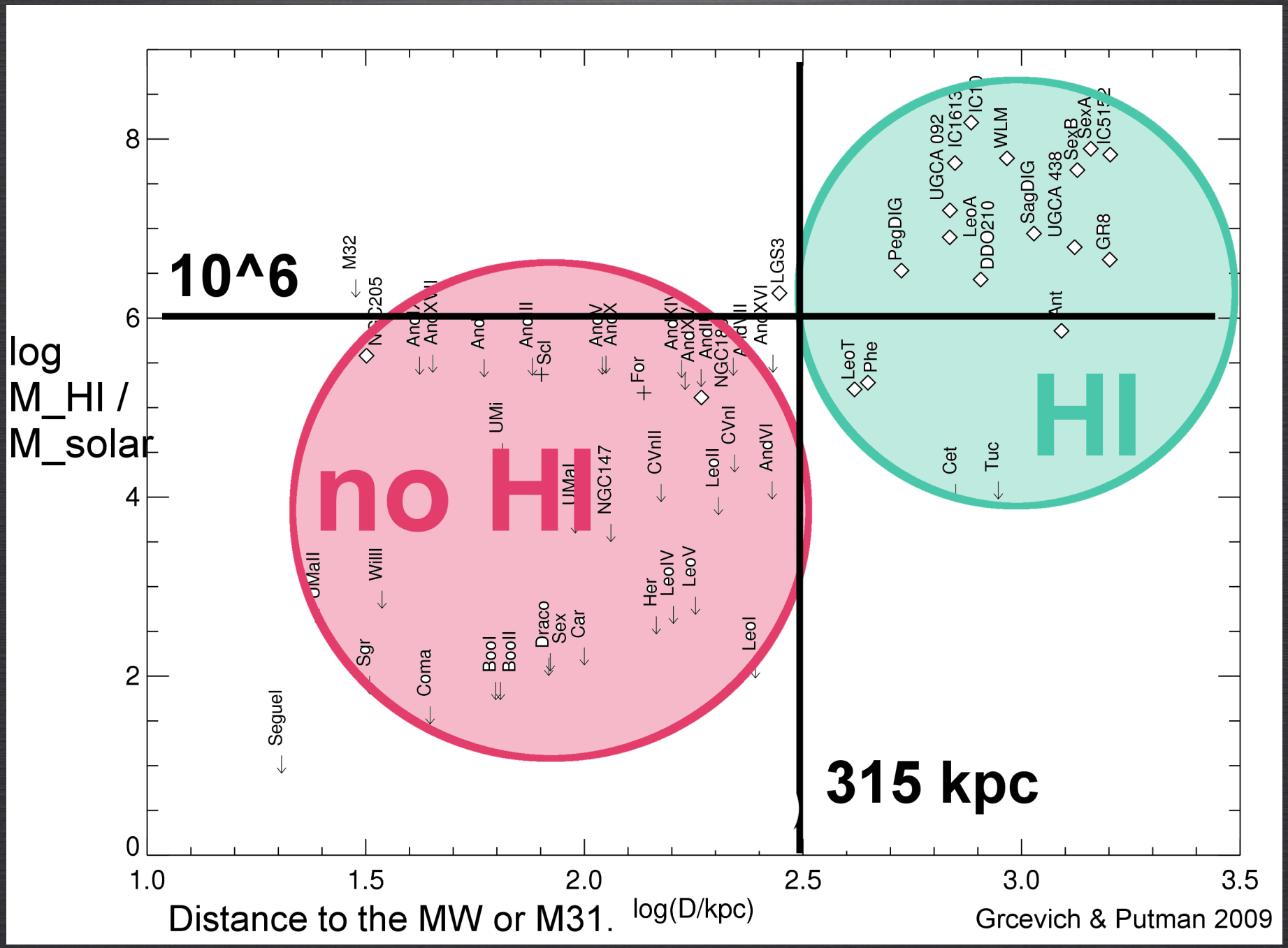
Dwarf Irr



pheroidal

What about the Local Group?



Summary

Radio sources with bent jets can be used to probe intergalactic gas densities.

Galaxy groups contain significant reservoirs of baryons in intergalactic gas.

The density of this gas is such that dwarf galaxies with HI masses < 10^6 solar masses will be stripped of their neutral gas.