Using satellites to investigate the growth of galaxy groups and the quenching of (central) star formation

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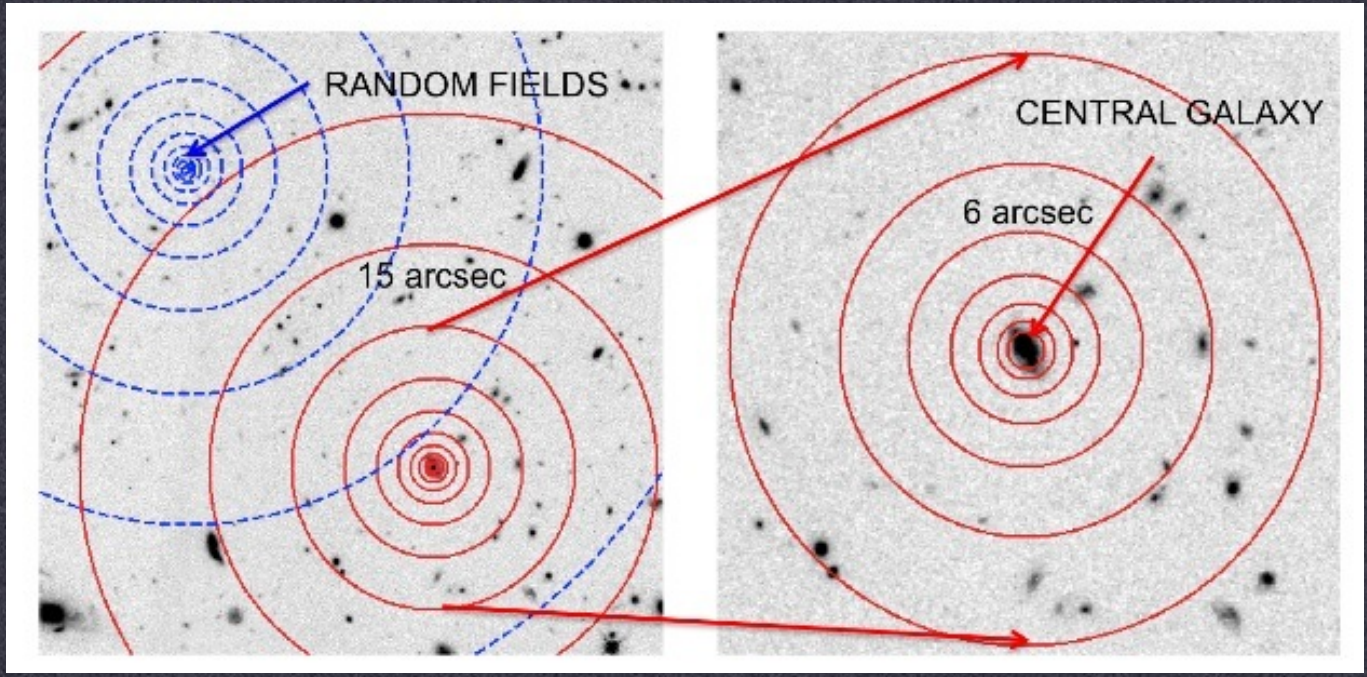
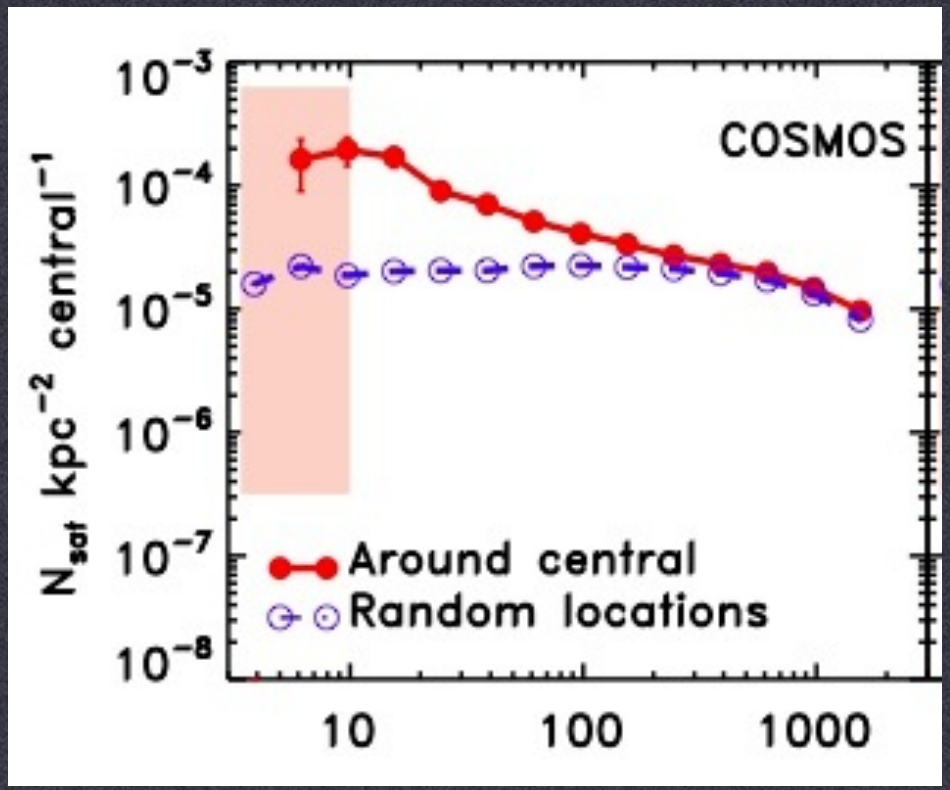
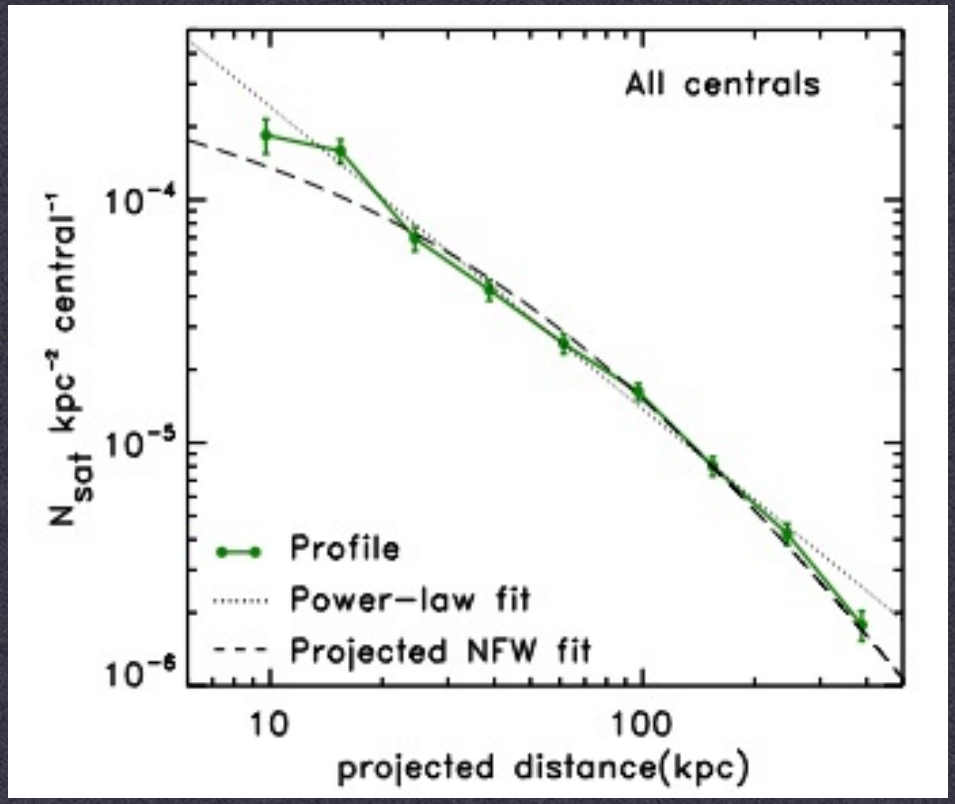
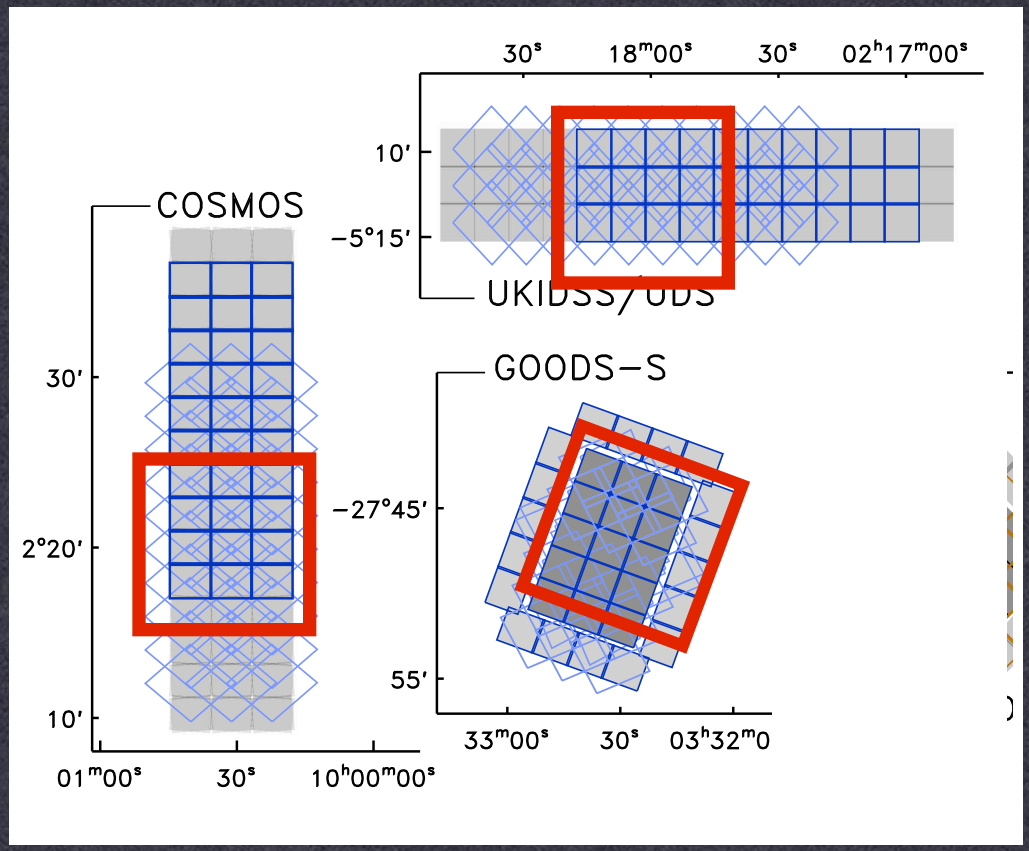
Distribution of satellites around SFing and quiescent galaxies




COSMOS
N_{sat} kpc^{-2} central^{-1}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
Around central
Random locations
10
100
1000


All centrals
N_{sat} kpc^{-2} central^{-1}
10^{-4}
10^{-5}
10^{-6}
Profile
Power−law fit
Projected NFW fit
10
100
projected distance(kpc)

ZFOURGE: The FOURSTAR Galaxy Evolution Survey



Instrument

- Magellan/FOURSTAR
- $J_1, J_2, J_3, H_s, H_l, K_s$
- 11'x11'

Survey

- 3 legacy fields
- J_{123}~25.5 Hls~25.0 Ks~24.8 (5σ, AB, total)

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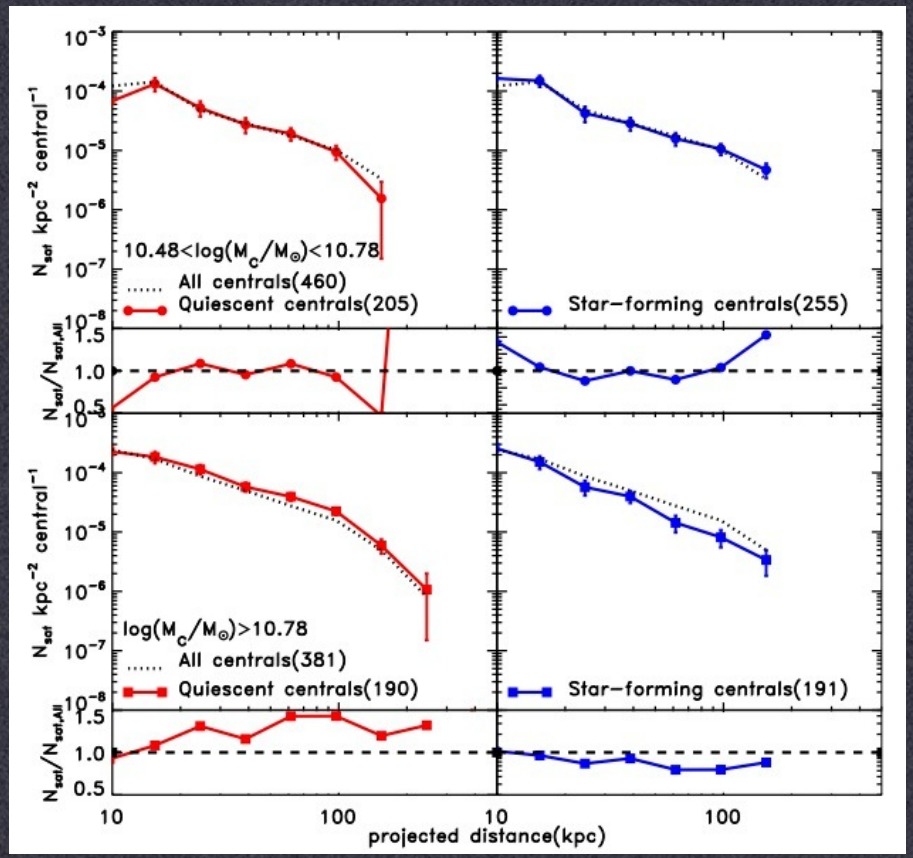

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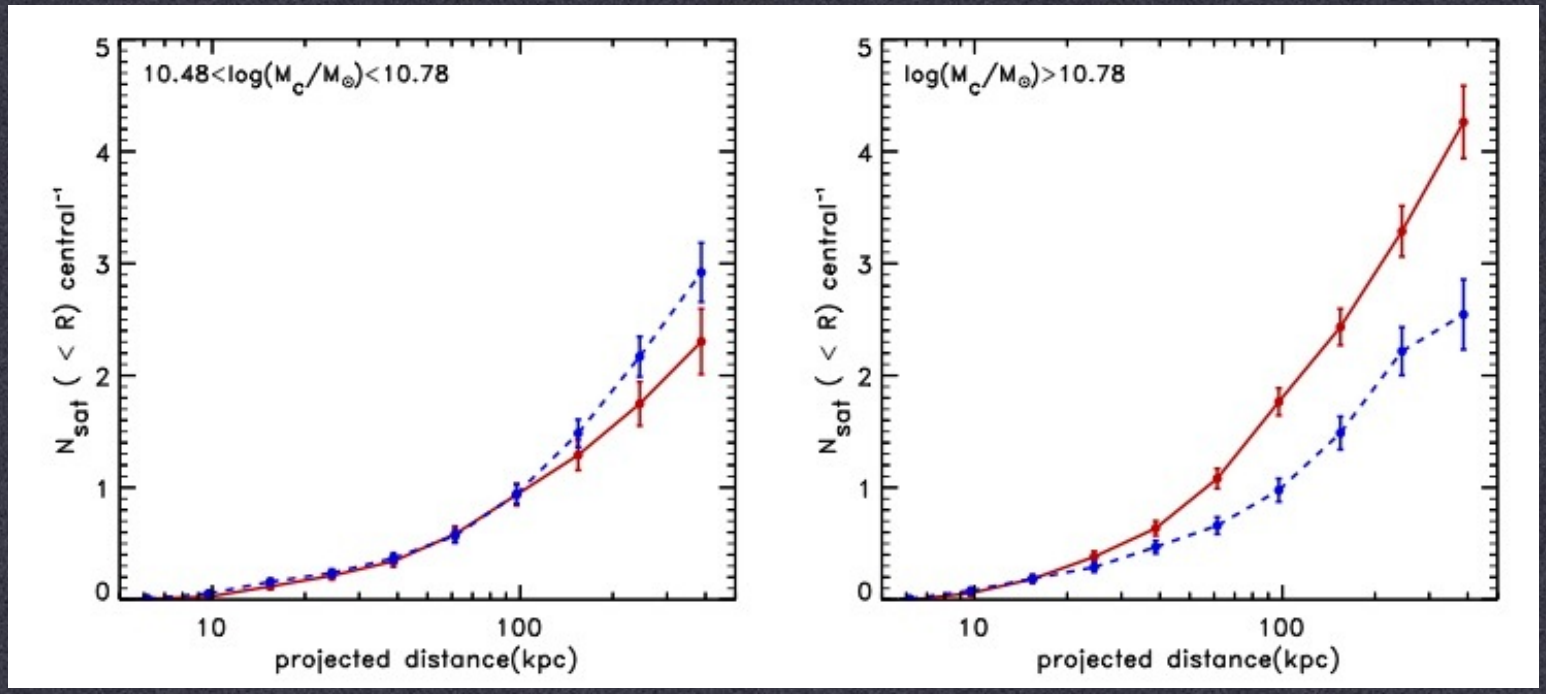
At high masses, quiescent centrals have a greater number of satellites than SFing centrals. But there is no significant difference at lower masses.

Distribution of satellites around SFing and quiescent galaxies



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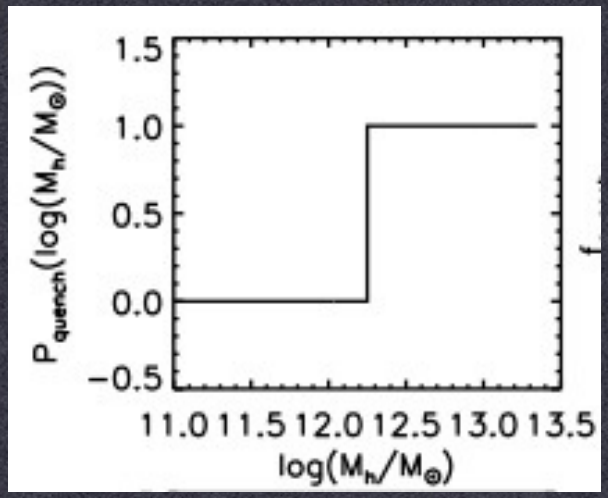
Quiescent galaxies have more satellites. Why?

- A comparison to N-body simulations suggest that a *~2x difference in the number of satellites suggests a ~2x difference in halo mass*
- So massive quiescent galaxies occupy more massive halos than SFing galaxies, but the difference is smaller at low masses.
- Is this telling us something about quenching?

Simple quenching model: hard halo mass threshold

Populate halos according to the stellar-to-halo mass relation, add in some scatter, and randomly quench some galaxies according to the halo mass



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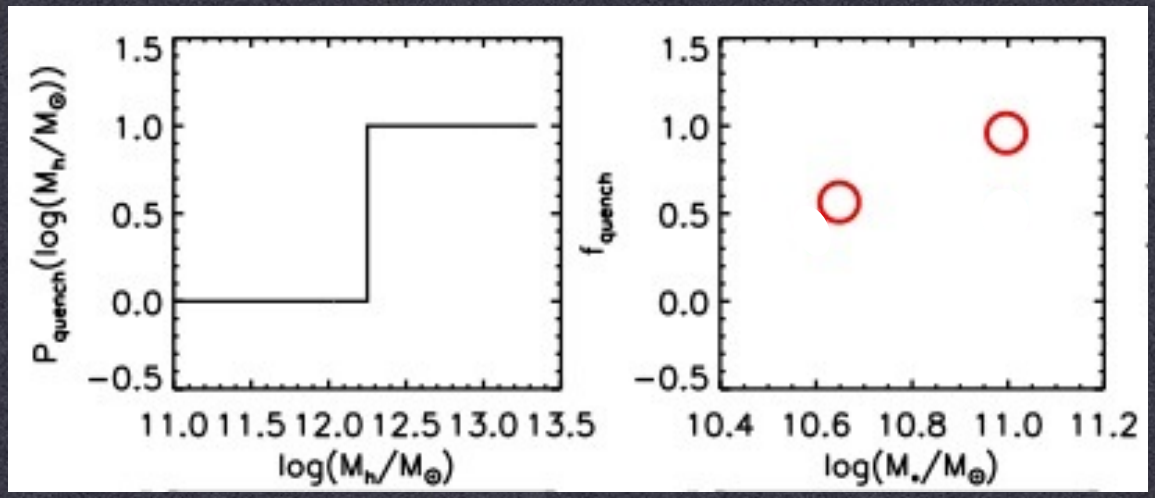

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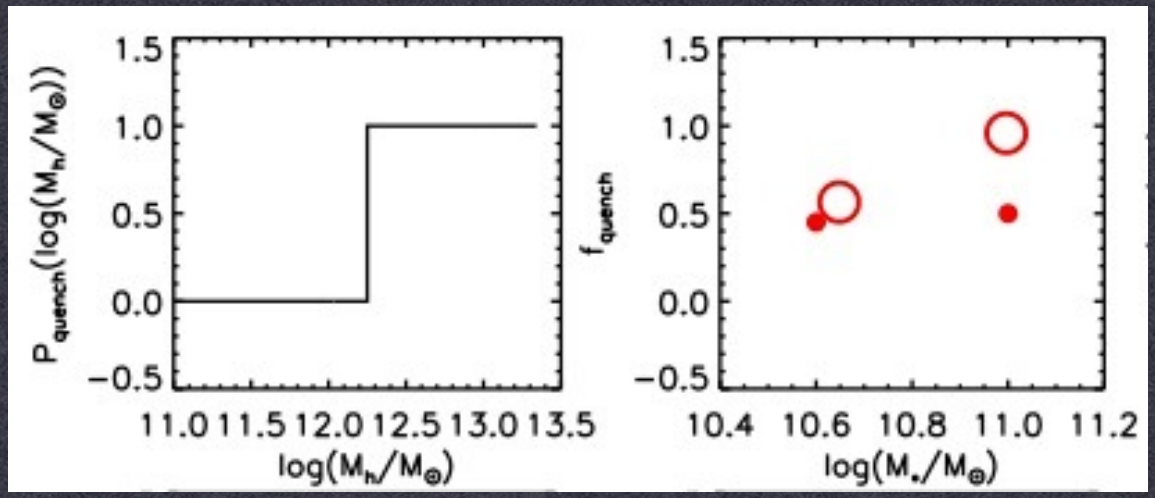

But this model produces the wrong quenched fractions as a function of mass

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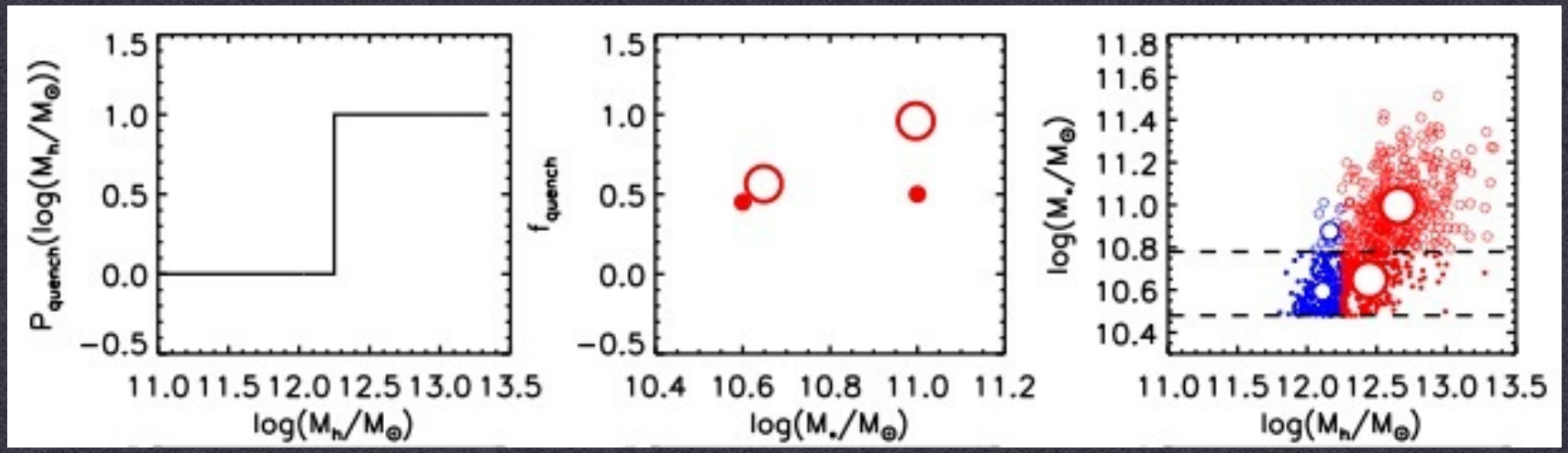
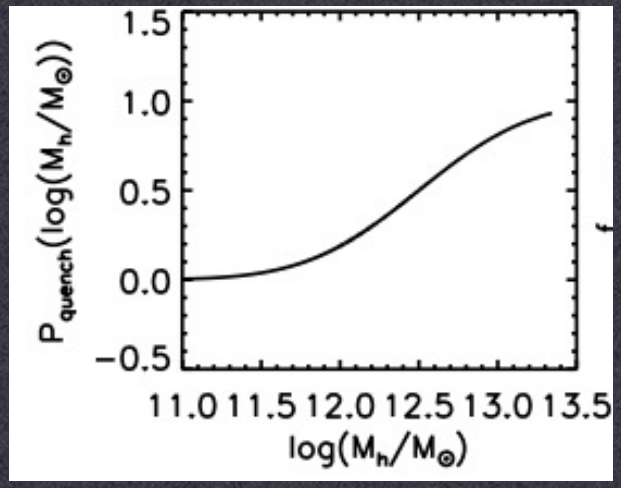


This model also produces too large of a halo mass difference at intermediate stellar masses

Simple quenching model: soft halo mass threshold

Populate halos according to the stellar-to-halo mass relation, add in some scatter, and randomly quench some galaxies according to the halo mass



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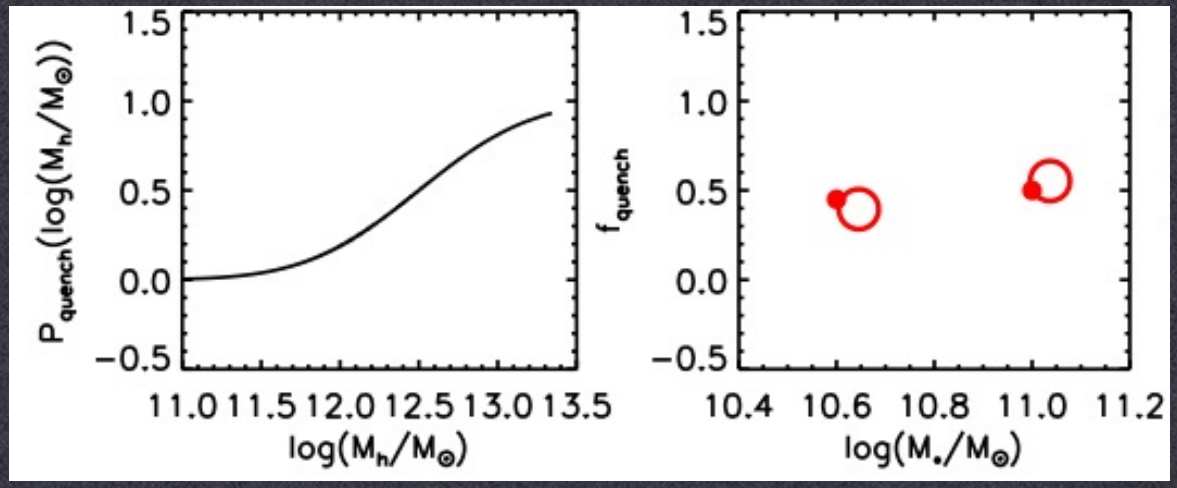

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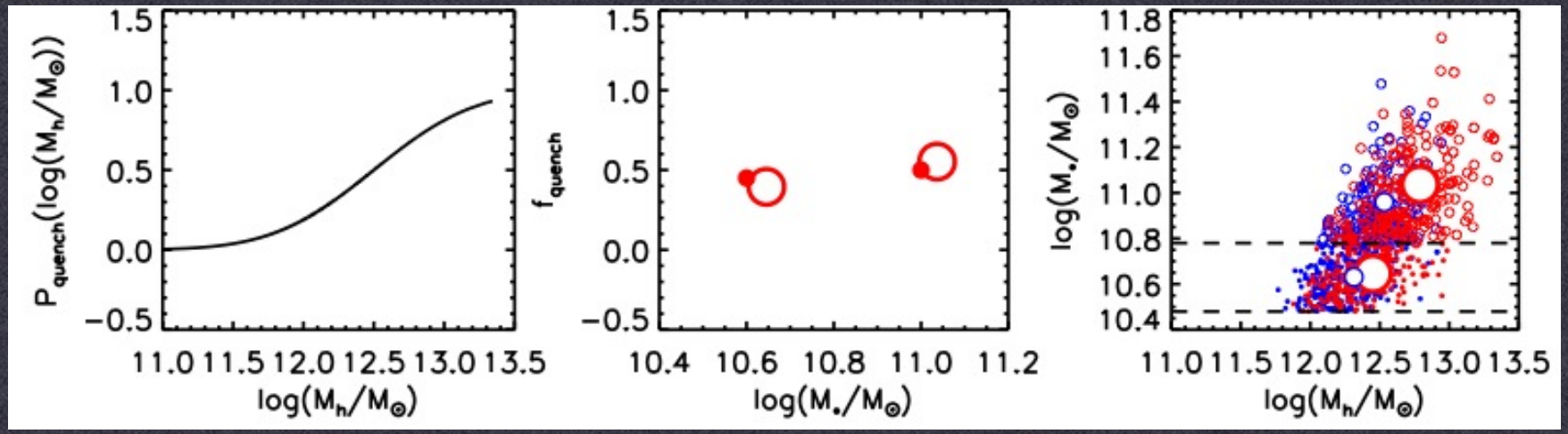

The data require soft halo mass threshold for quenching: something other than environment quenches central galaxies

Stellar mass function of satellites as a function of central mass

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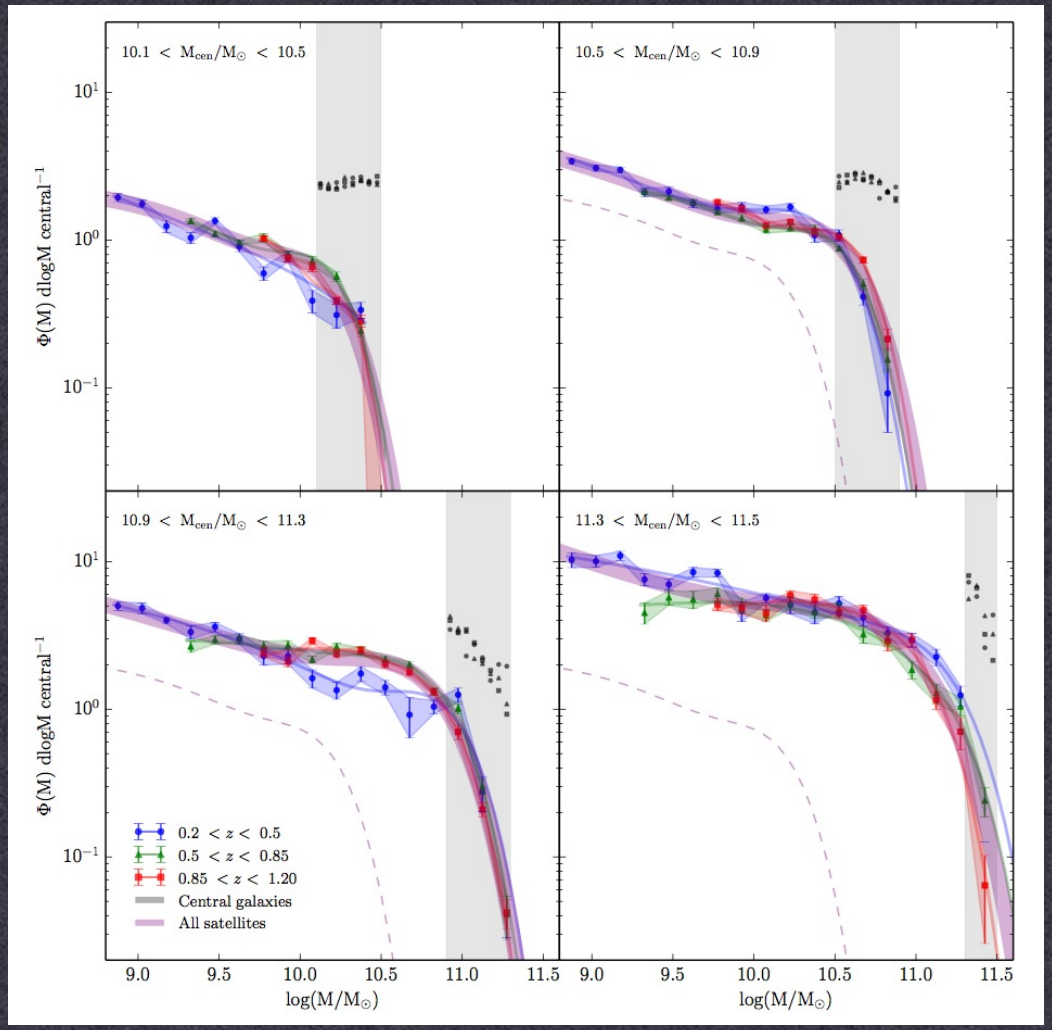

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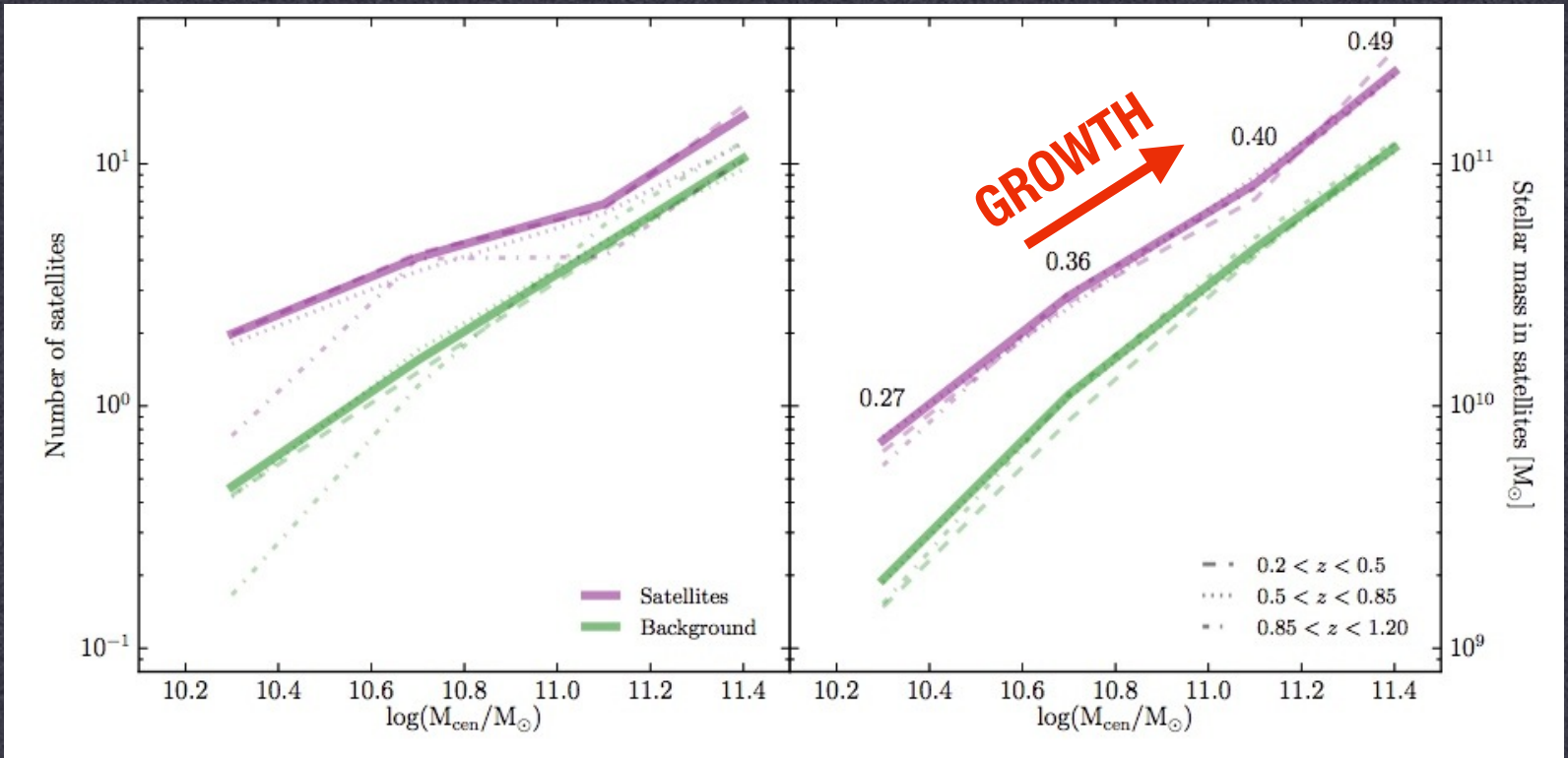
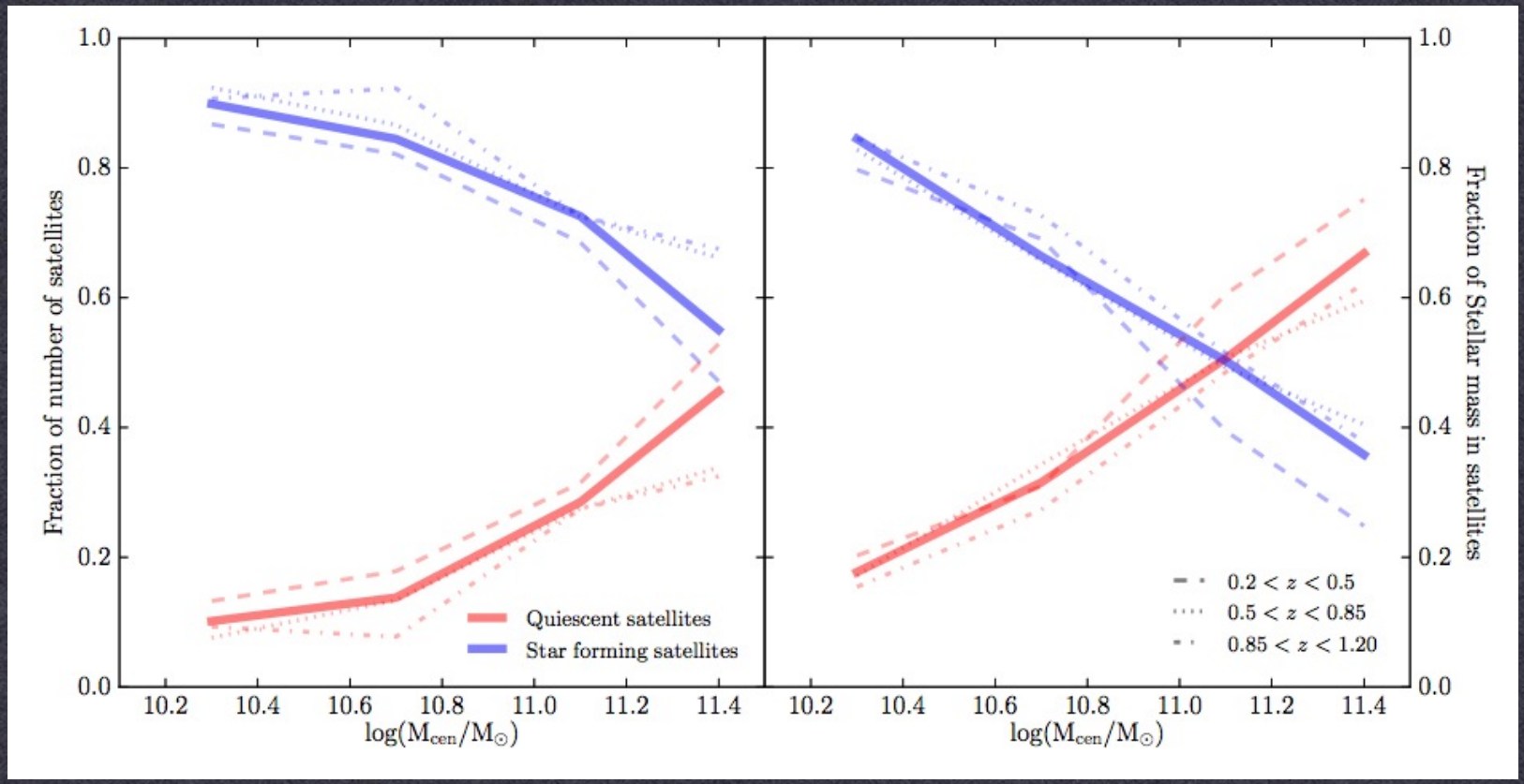
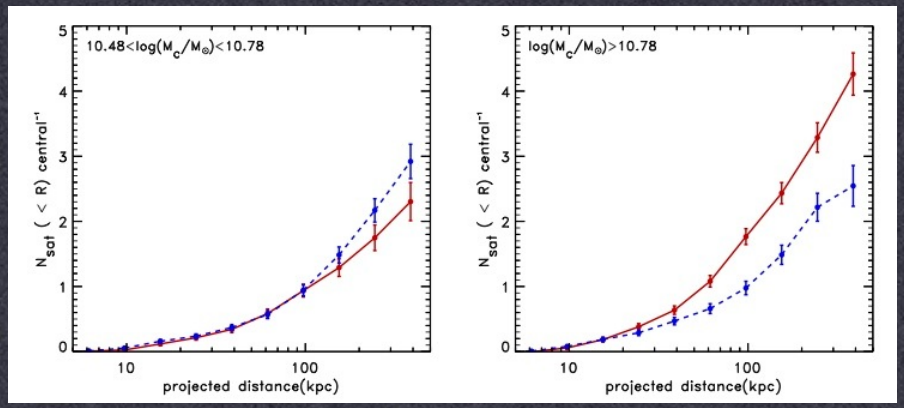


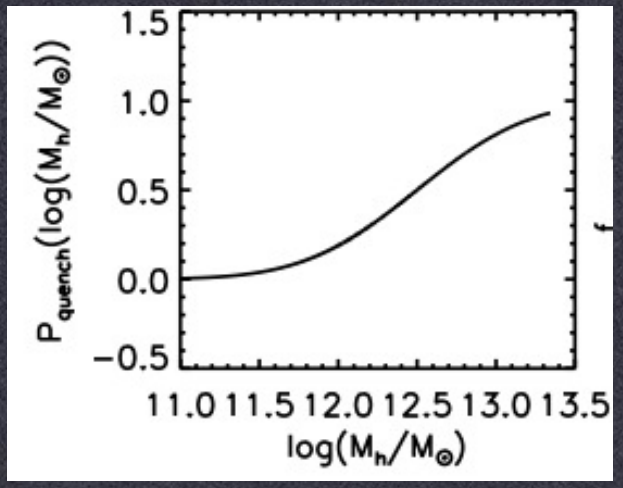
Stellar mass distribution in groups unchanged since z~1: the satellite population grows in tandem with the central galaxy


Fraction of number of satellites
Fraction of Stellar mass in satellites
log(M_cen/M_⊙)
log(M_cen/M_⊙)
Quiescent satellites
Star forming satellites
0.2 < z < 0.5
0.5 < z < 0.85
0.85 < z < 1.20

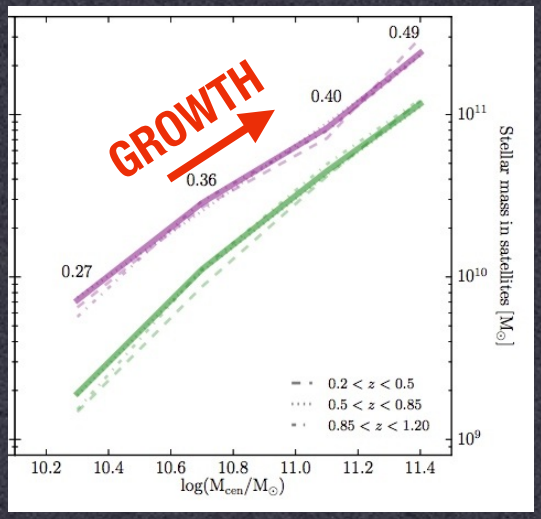
Summary



At high masses, quiescent galaxies have more satellites



implication: weak relationship between environment and central quenching



Stellar mass distribution in within groups unchanged since z~1: growth of centrals and satellites closely tied