

HMRC: HOD-based Catalogues

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some references (for more details)

Phase 1 HOD catalogue described in Muldrew et al. 2012 (and Skibba et al. 2013), using model adapted from Skibba et al. (2006) and Skibba & Sheth (2009), with Millennium Simulation haloes (Springel et al. 2005).

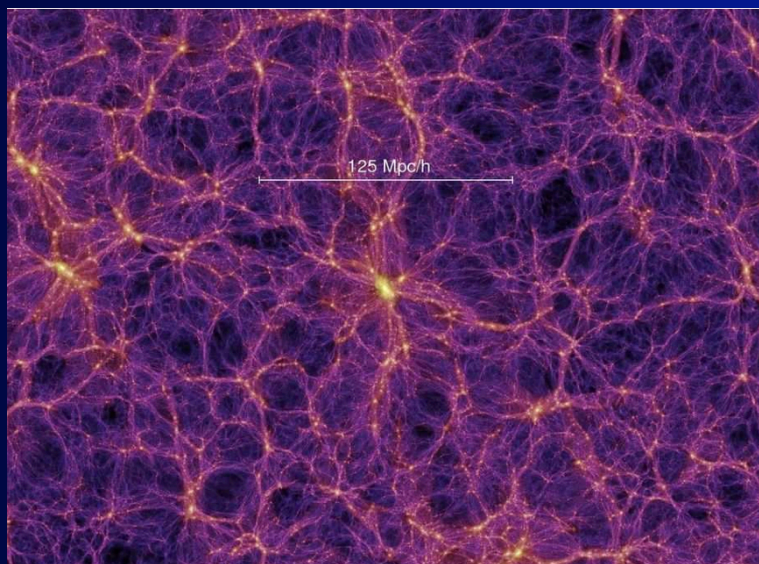
Phase 2 halo catalogue from Bolshoi simulation (Klypin et al. 2011) at $0 < z < 0.15$.

Observational constraints: SDSS luminosity and color-dependent clustering (Zehavi et al. 2005, 2011; my papers above); luminosity functions (Blanton et al. 2003; Yang et al. 2009); and optical color-magnitude distribution at $z \sim 0.1$.

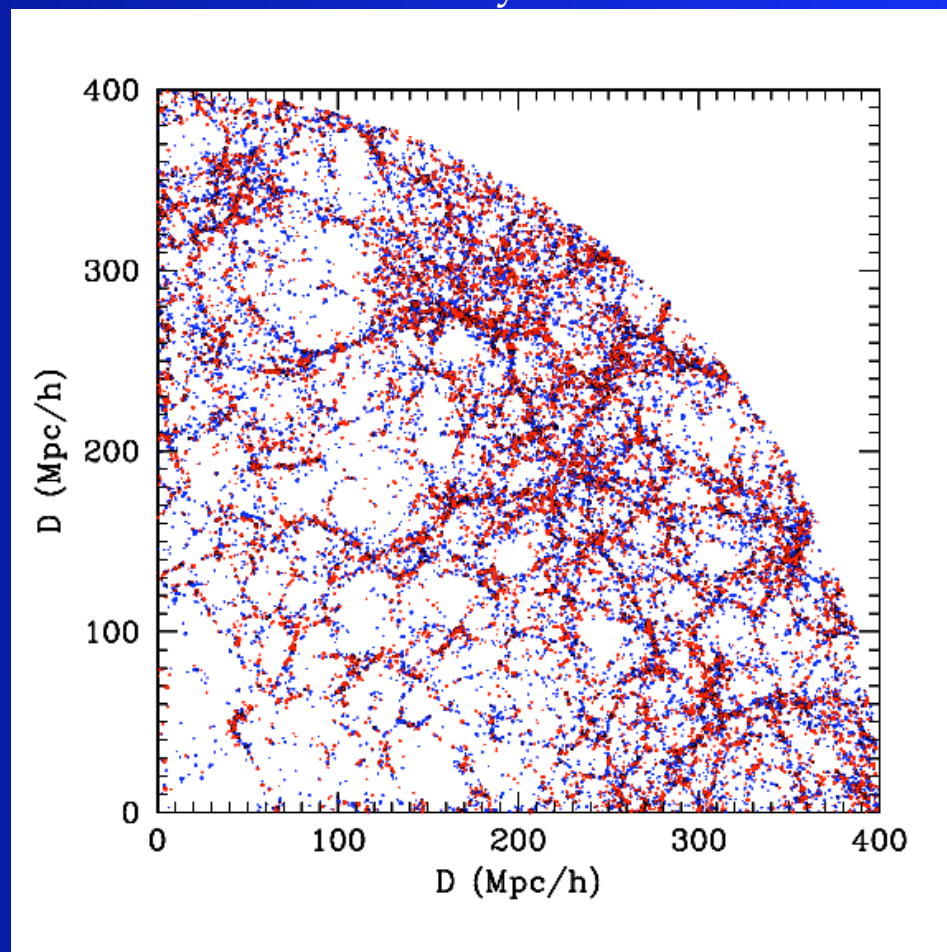
(Also consistent with Moustakas et al. 2013 stellar mass function, but not used as a constraint.)

Growth of large-scale structure: haloes vs galaxies

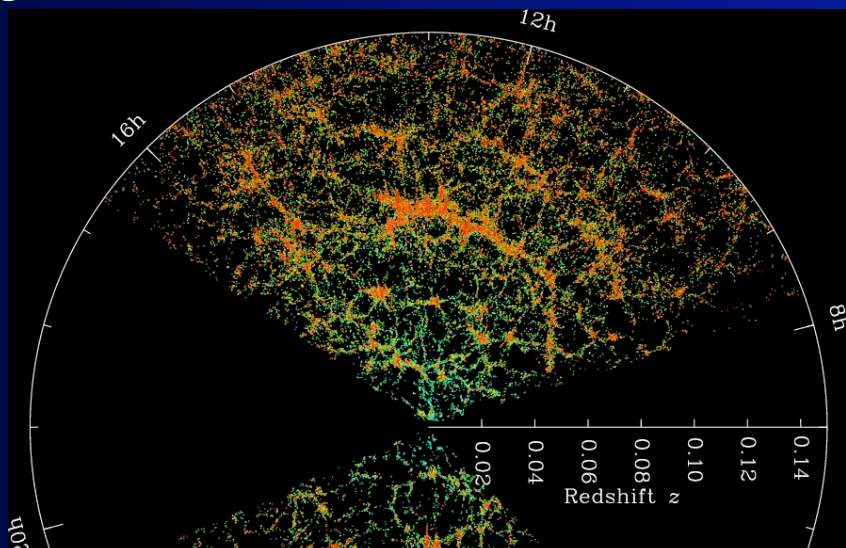
haloes in Millennium (Springel+ 2005)



galaxies in SDSS-like mock catalog,
assuming that galaxy properties are
determined by halo mass



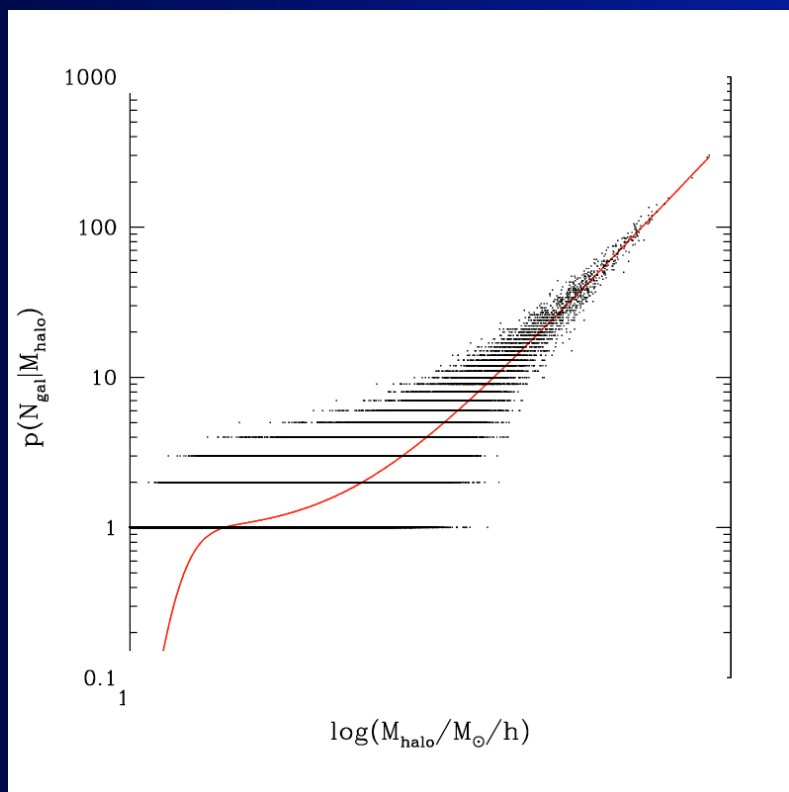
galaxies in SDSS (courtesy: M. Blanton)



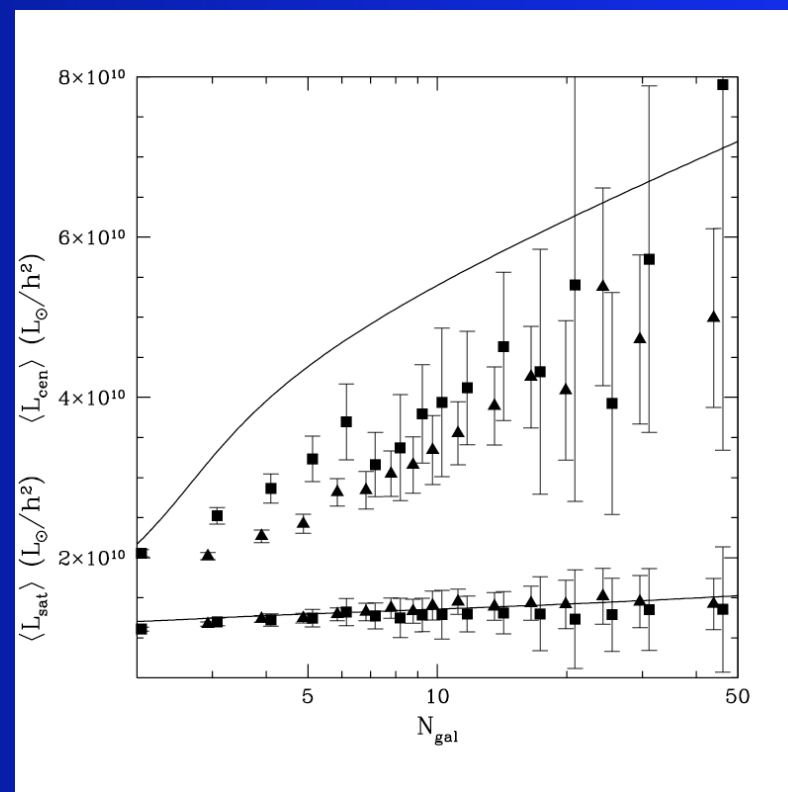
Skibba et al. (2013)

halo occupation distribution

HOD: $P(N_{\text{gal}} | M)$



M -dependent central & satellite luminosities



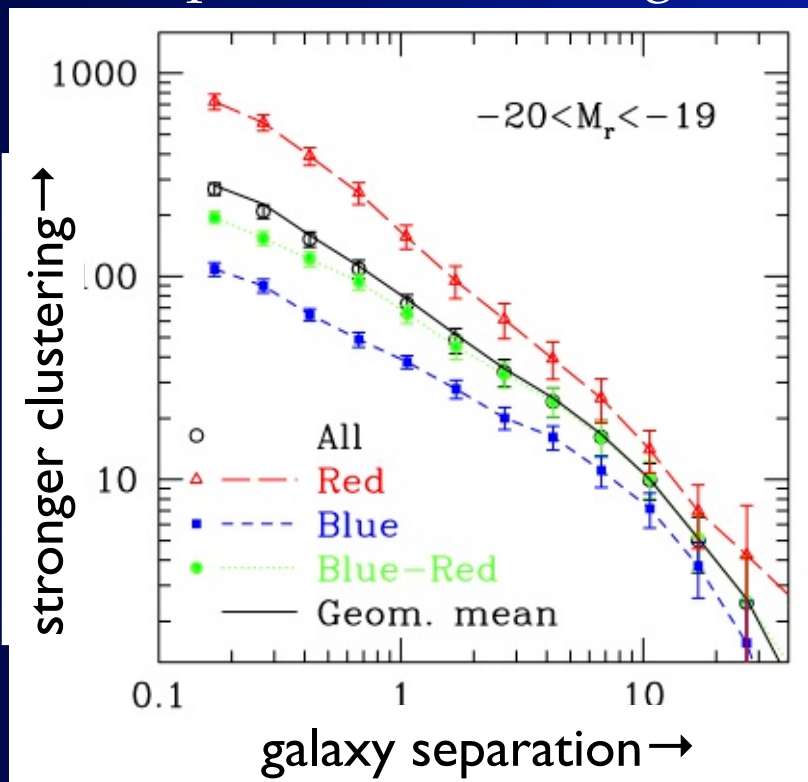
Skibba et al. (2007)

color distributions and clustering

galaxy colors are strongly bimodal at fixed luminosity

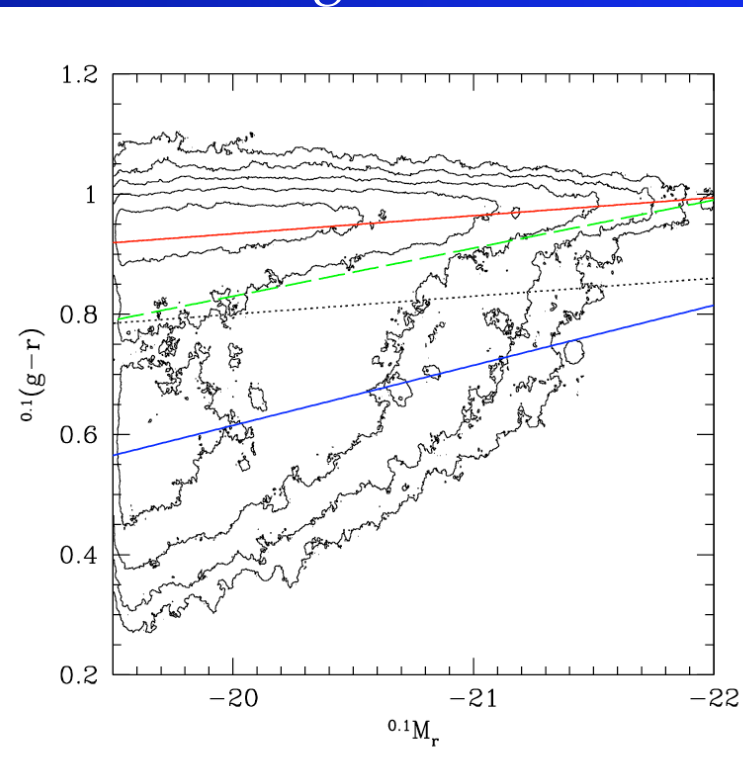
redder galaxies tend to be more strongly clustered than bluer ones

color-dependent clustering at $z \sim 0.1$



Zehavi et al. (2011)

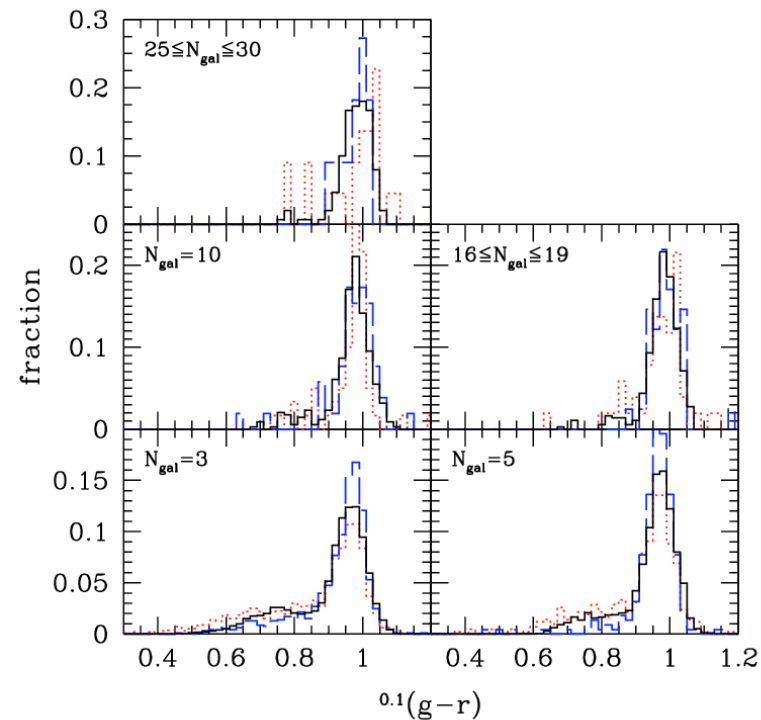
color-mag distribution



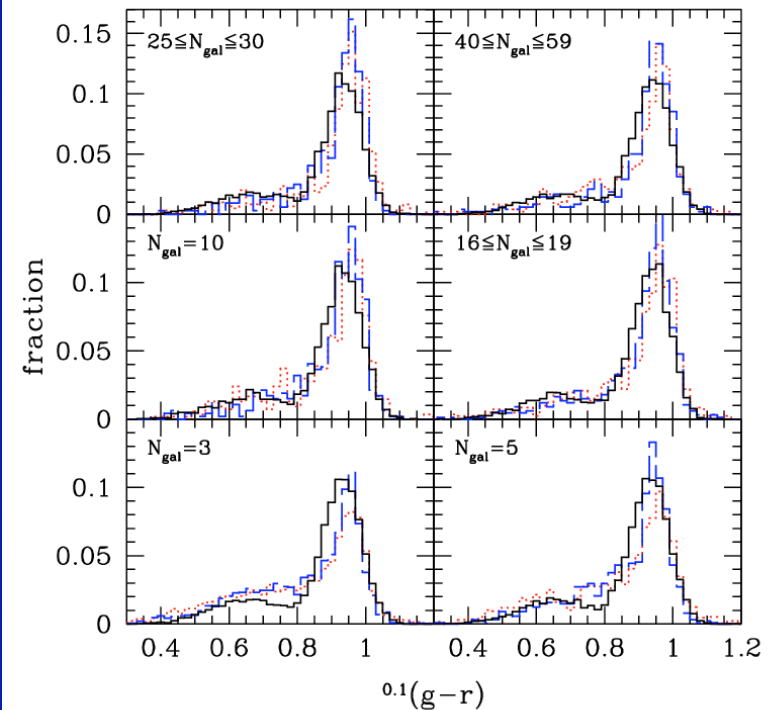
Skibba & Sheth (2009)

color distributions: centrals vs satellites

brightest halo galaxies



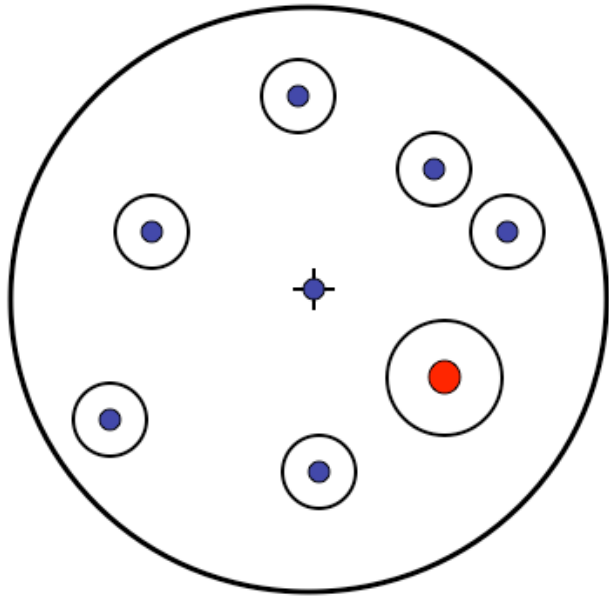
satellite galaxies



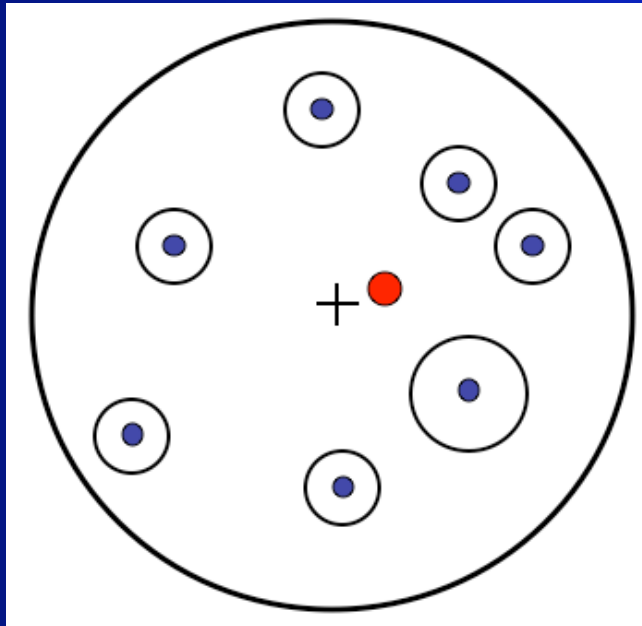
Skibba (2009)

Main additions to Phase 2

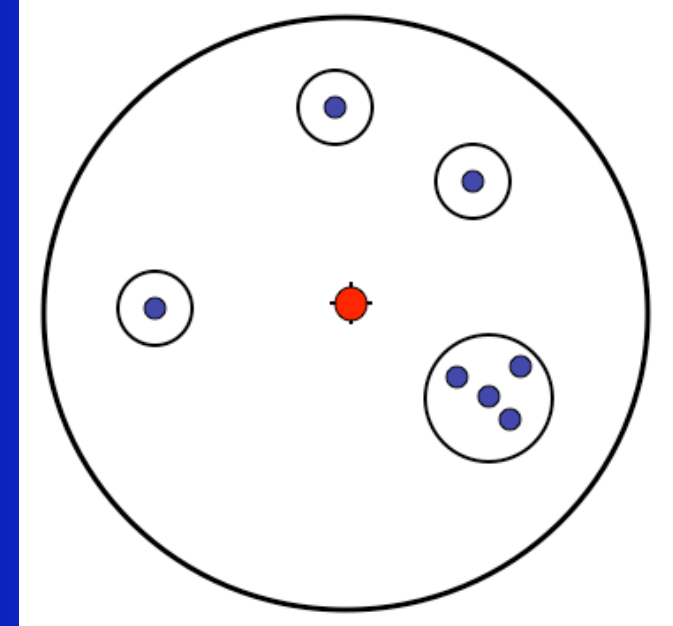
three effects are added to the new catalog...



brightest not central



central galaxy velocity bias

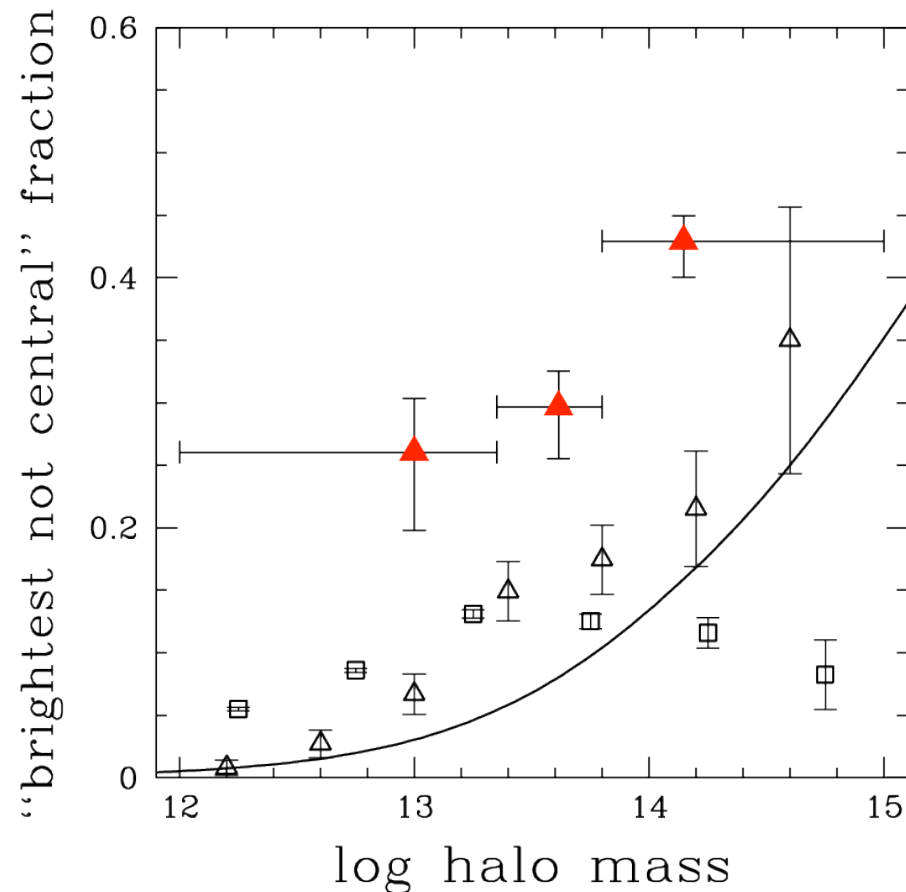


substructures

non-central brightest halo galaxies (BHGs)

in a surprisingly large fraction of groups & clusters, the brightest or most massive member is *not* the central one

i.e., $f_{\text{BNC}}(M) \gg 0$



for details, see Skibba et al. (2011)

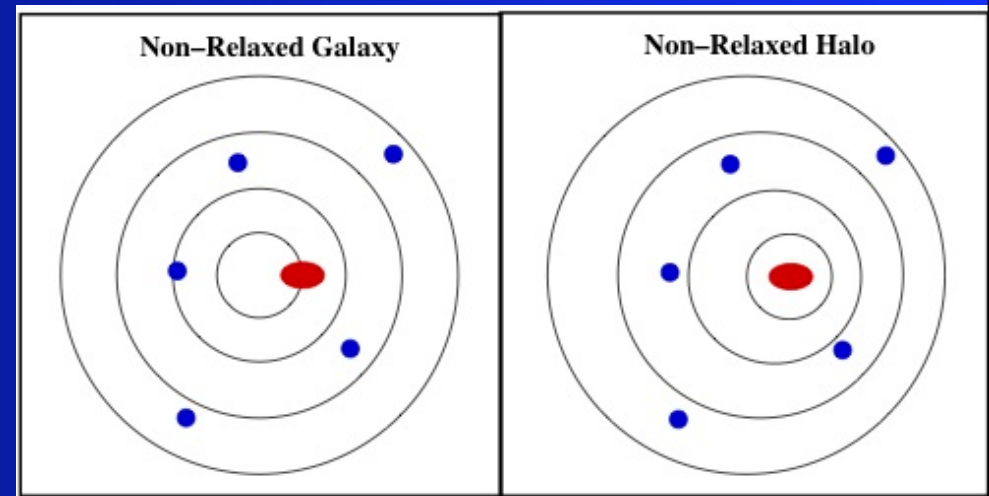
central galaxy velocity bias

velocity bias constrained by observed vs modeled spatial (projected) and dynamical (line-of-sight) offsets of BHGs w.r.t. satellites in groups & clusters.

$$R = \frac{\sqrt{N_{sat}} (\bar{v}_{sat} - v_{BHG})}{\hat{\sigma}_{sat}}$$

$b_{vel} \equiv \langle \sigma_{cen} \rangle / \langle \sigma_{dm} \rangle = \langle \sigma_{cen} \rangle / \langle \sigma_{sat} \rangle$,
such that central galaxy's radial coordinate follows a prob. distribution $P_{cen}(r | M)$

we found that $b_{vel} \approx 0.1-0.2$ at all halo masses



substructures and unrelaxedness

substructure abundances
& mass fractions f_{sub}
constrained by subhalo
MF (Giocoli et al. 2010)

subhaloes/substructures
are common, but *massive*
ones hosting many
galaxies are relatively rare

for more on halo
relaxedness, see also
Skibba & Macciò (2011)



Phase 2 updates

updated HOD constraints from SDSS (Zehavi et al. 2011)

updated concentration-mass relation, including scatter (Macciò et al. 2008; Muñoz-Cuartas et al. 2010)

less concentrated galaxies than DM (e.g., Klypin et al. 2011; Wojtak & Mamon 2013)

better accounted for joint M & L -dependent color dists. of centrals (see More et al. 2011; Hearin & Watson 2013)

satellite color gradients (Hansen+ 2007; van den Bosch+ 2008)

galaxies have different velocity dispersions than DM? (Munari et al. 2013; Old et al. 2013)

a few questions to answer

how realistic does the phase 2 HOD catalogue appear to be (*e.g.*, the redshift distributions, cluster abundances, etc.)?

how does it compare to the SAM catalogue?

are substructures identifiable? note that some random galaxy clustering may appear to be substructures.

are there additional effects that we should try to incorporate into the catalogue (*e.g.*, additional unrelaxednes effects, triaxial systems, etc.)?