Dynamical aspect of halo/galaxy bias

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Maybe the most important point
in the following discussion is:

Samples of galaxies/(sub)halos are defined
by a lower luminosity/mass cut

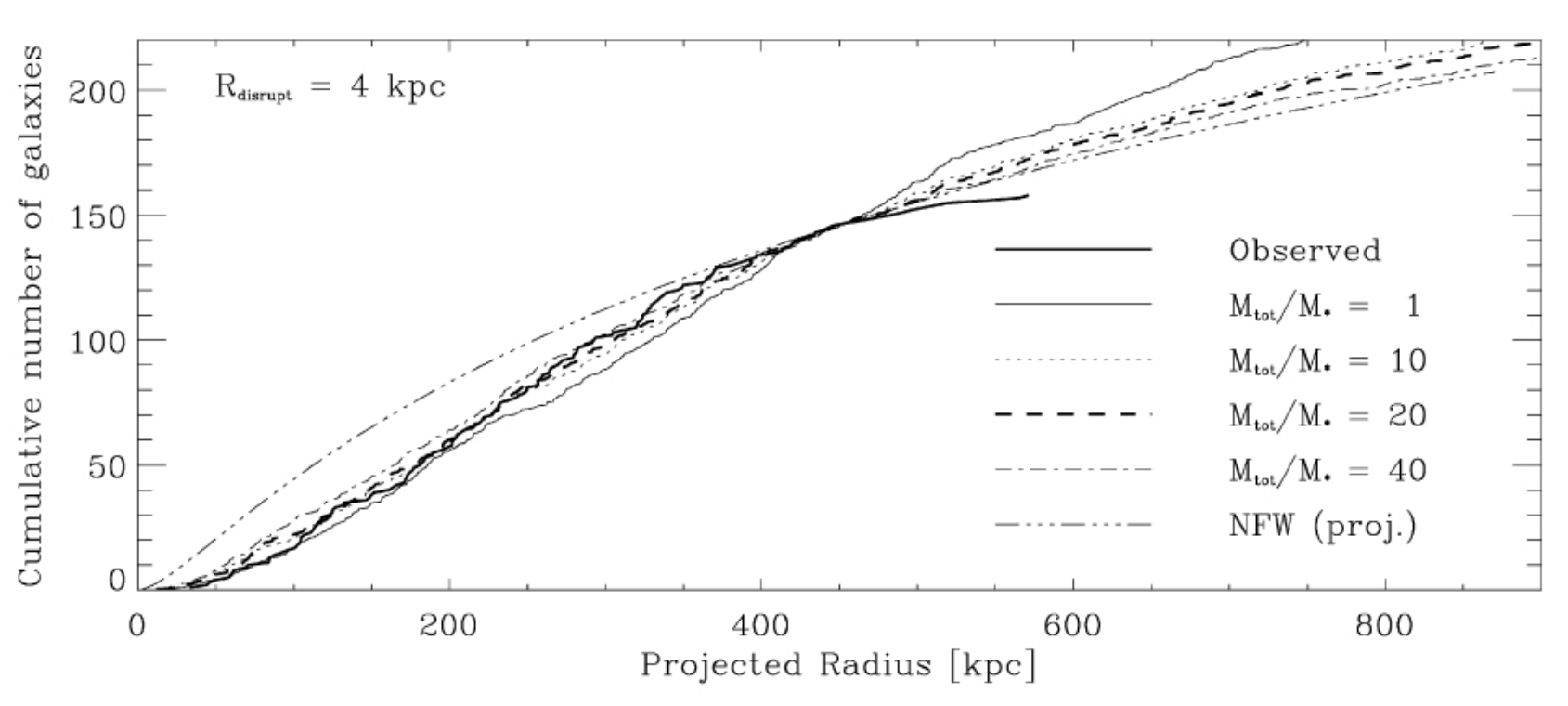
Objects which fall below the cut
are considered to be **dissolved/destroyed**

In the astronomical context statistics are
often dominated by small objects close to the cut

NGC 5044 $\sim$ 160 galaxies

Jim Solomon, http://www.saratogaskies.com/image.pl?i=37

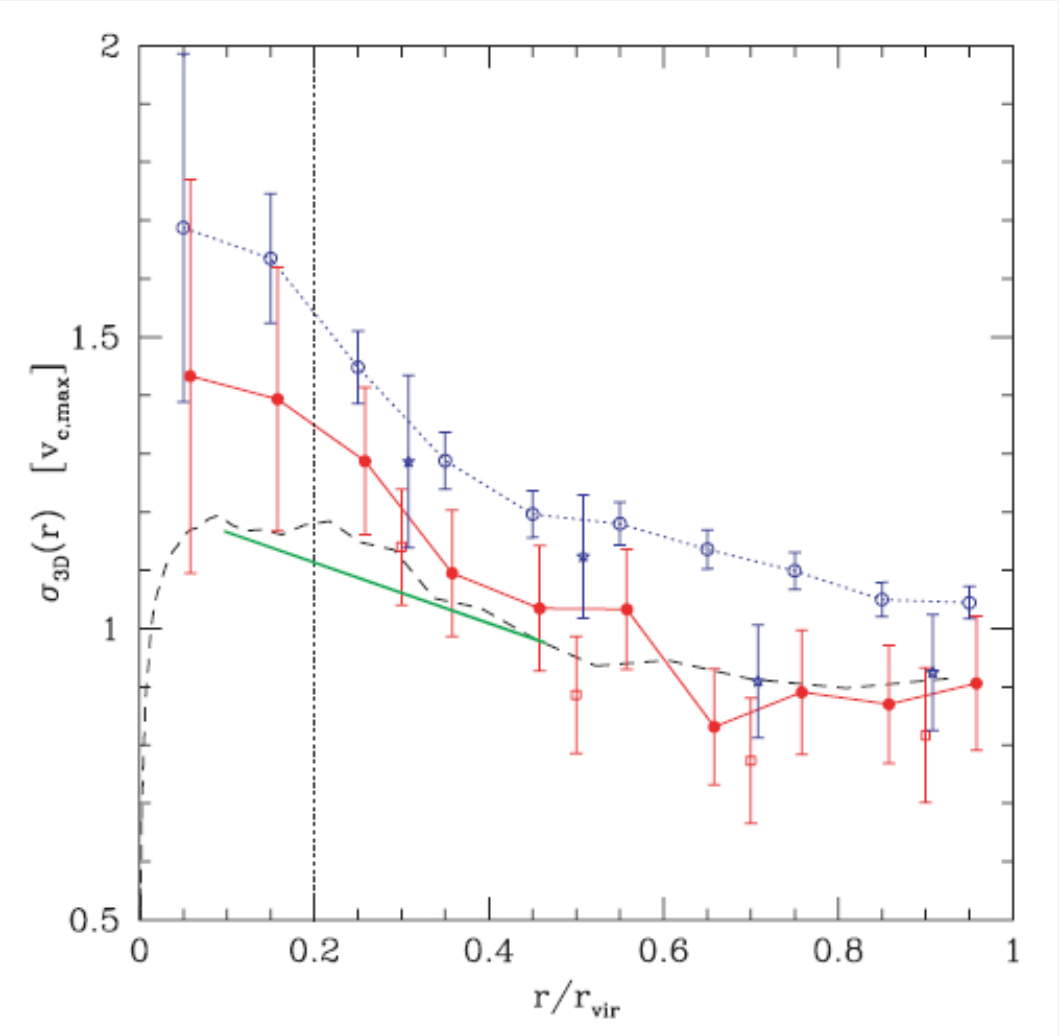
Number desity profile of satellite galaxies in NGC 5044



- Comparison of observed galaxy distribution to NFW profile
- Observed satellite distribution shows deviation
- Semi-analytical modeling of satellite distribution:
  - orbit parameters from N-body simulations
  - tidal destruction $\Rightarrow$ parameter

- Tidal destruction of satellites explains observed number density profile (137 disrupted)
- Intra group light: 35% of total luminosity
- Host dark matter halo follows a NFW profile
- **Galaxies can disappear ...**
  dark matter particles can't

The velocity bias between satellite halos and dark matter



- Velocity dispersion profiles of dark matter (dashed line) and satellite halos (symbols) based on a high resolution simulation of a cluster sized dark matter halo
- Satellite halos selected according to current mass show positive velocity bias
- Satellite halos selected according to peak mass show $\sim$ no velocity bias

- Tidal destruction explains velocity bias between satellites and the dark matter
- Selection of satellite halos according to current mass is biased towards late accreted, fast moving satellites
- Selection according to peak masses allows longer survival times, i.e, the halos become more **“particle like”**

MR: Satellite destruction statistics

- Satellite halos $M \geq 10^{12}\ h^{-1}\mathrm{M}_{\odot}$ (~ 350000)
- current and peak mass selection
- inward and outward moving satellites

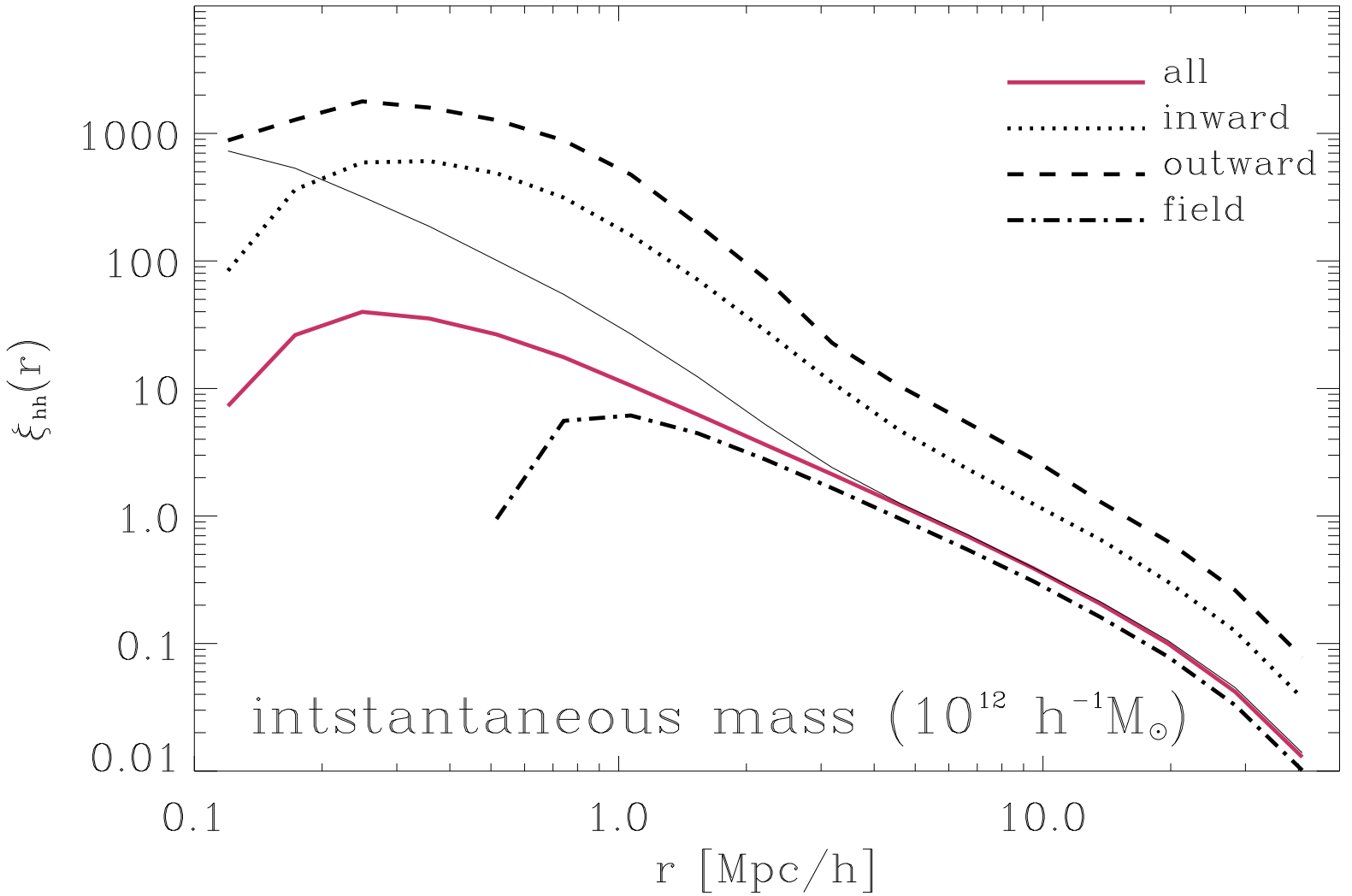
Satellites selected by current mass

$N_{tot} = 52235$ $N_{in} = 42119$ $N_{out} = 10116$ $\frac{N_{out}}{N_{tot}} = 0.19$

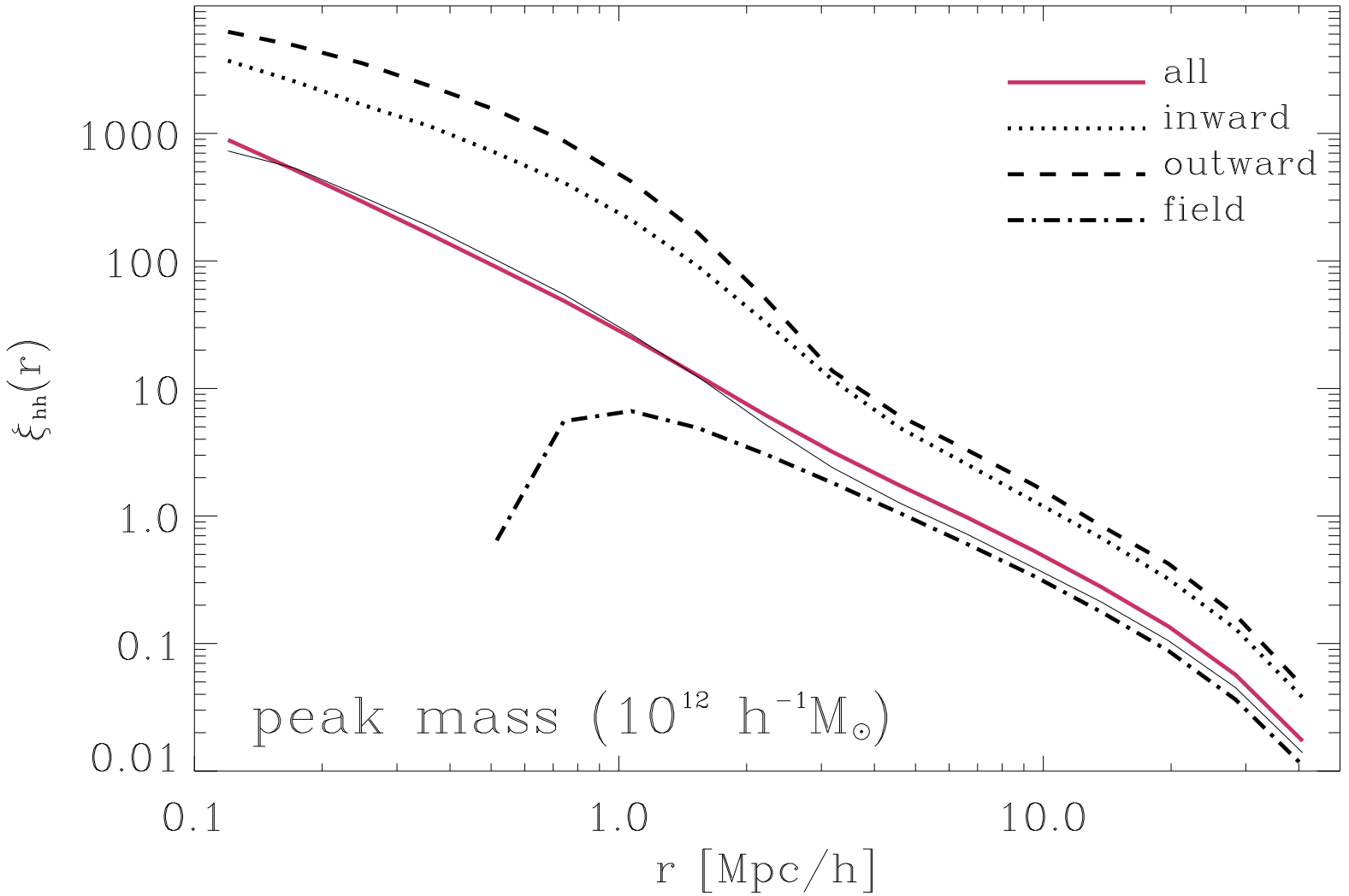
Satellites selected by peak mass

$N_{tot} = 118401$ $N_{in} = 81390$ $N_{out} = 37011$ $\frac{N_{out}}{N_{tot}} = 0.31$

Millennium Simulation: Two point correlation functions

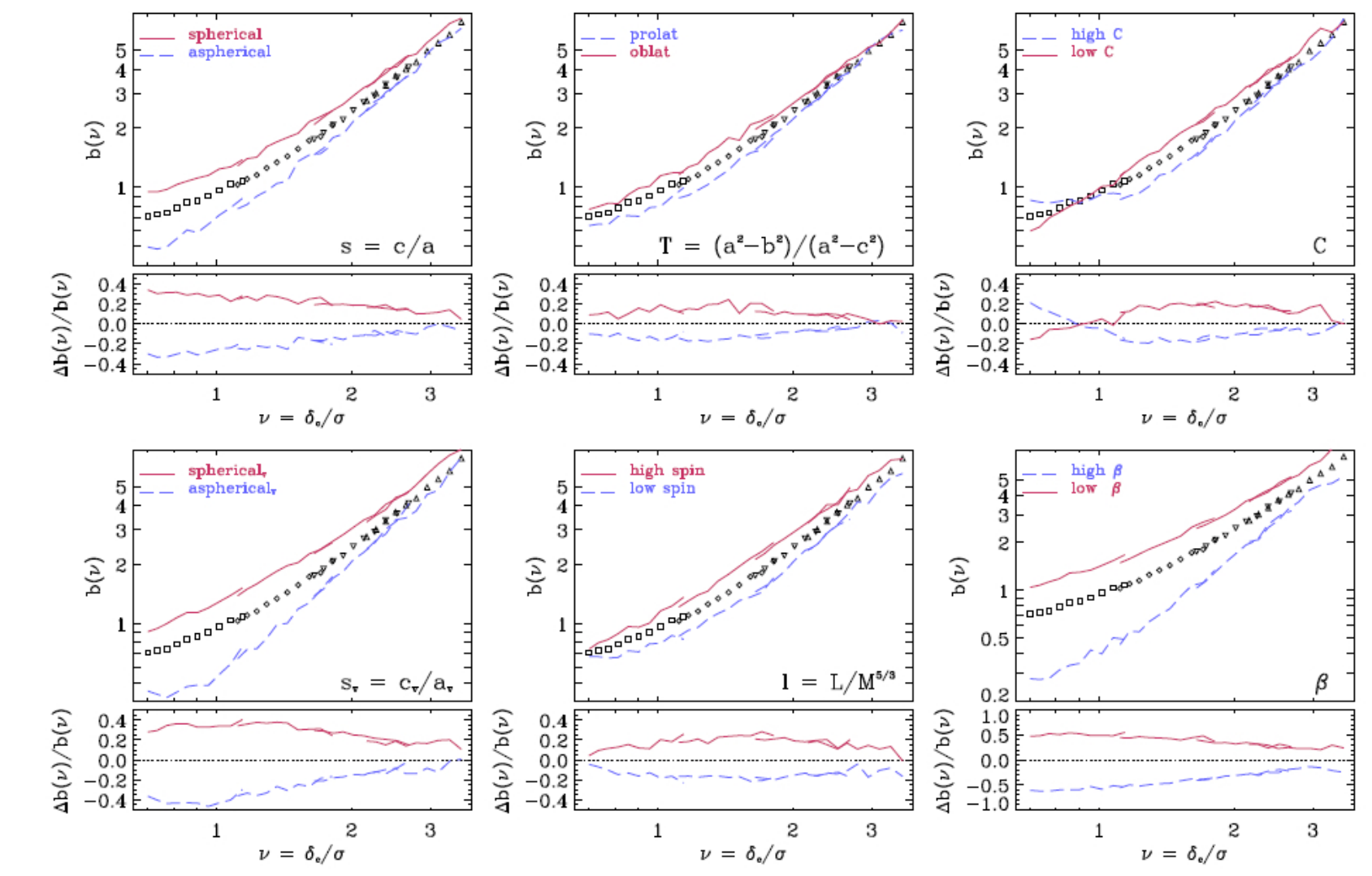


Millennium Simulation: Two point correlation functions

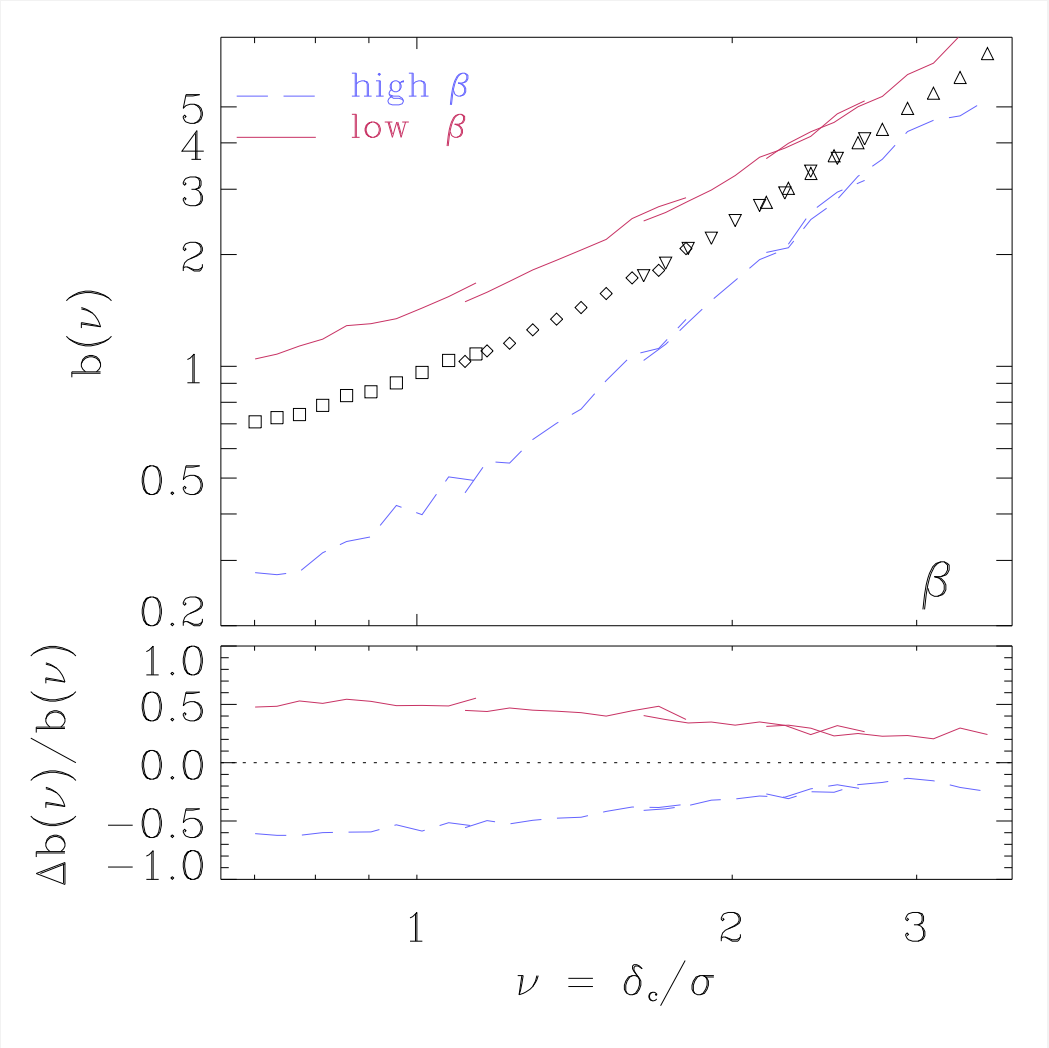


- More satellite halos move towards the centre of the host than in opposite direction
- Peri-centre passage is destructive, in the sense that halo mass drops below threshold
- Selection of satellite halos according to peak mass (SHAM) makes them durable
- The mass selection has an impact on the clustering behaviour

Instantaneous assembly bias (MR I & II)



Instantaneous assembly bias: $\beta = 1 - 0.5\sigma_t^2/\sigma_r^2$



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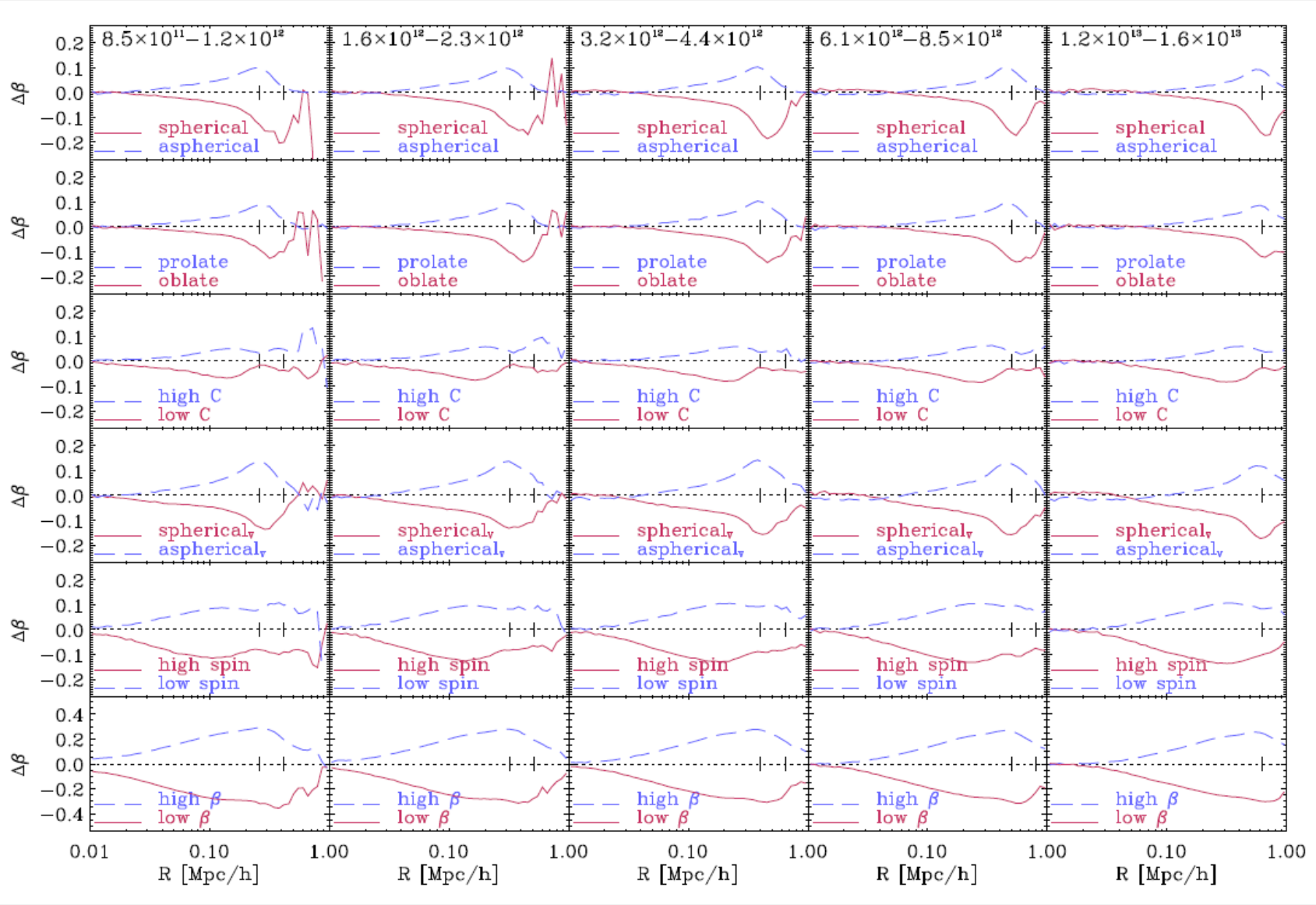
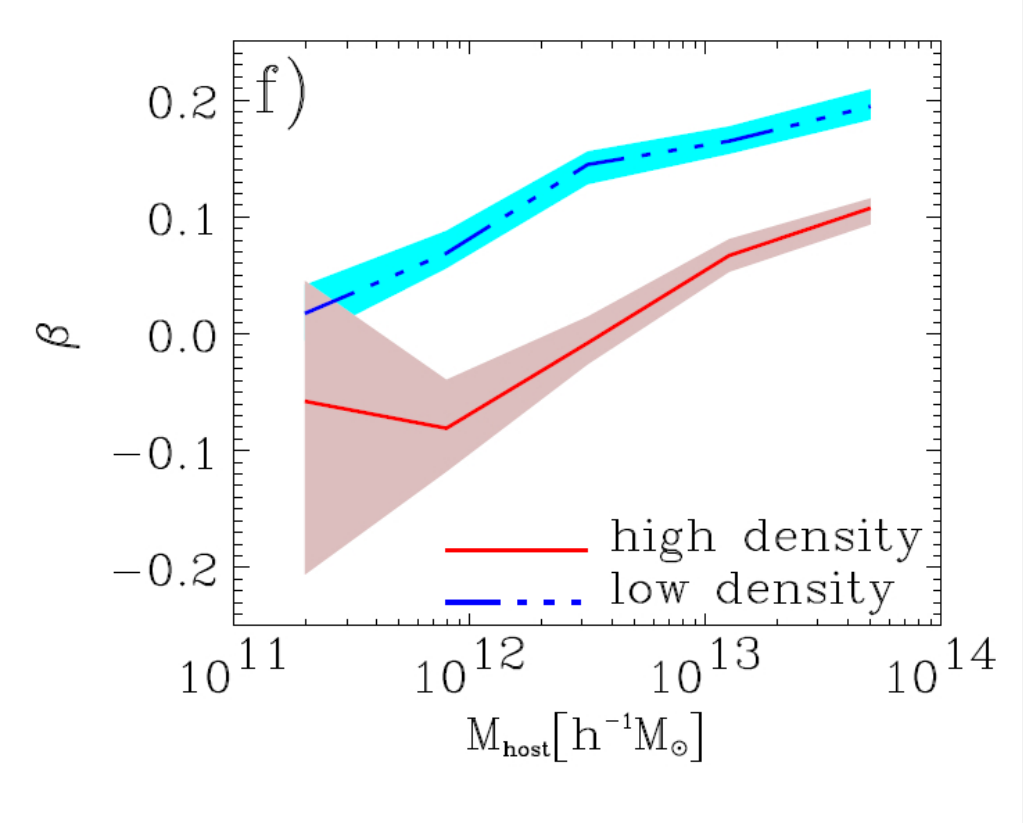


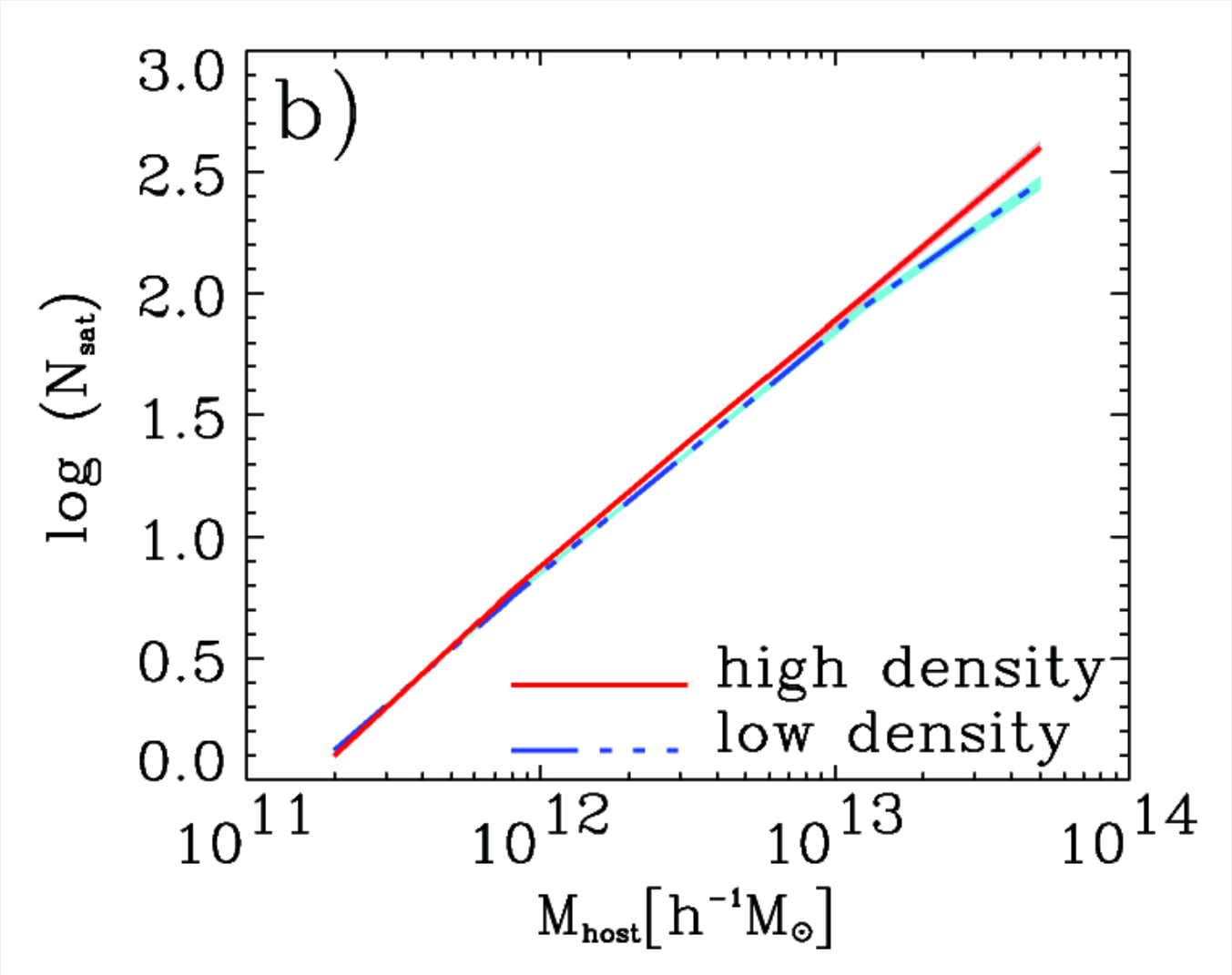
- Not only subdivision of halos according to their formation time causes different clustering behaviour for equal mass halos
- Separation according to shape, concentration etc. cause similar effects on clustering
- Velocity anisotropy is a particularly strong distinguishing characteristic

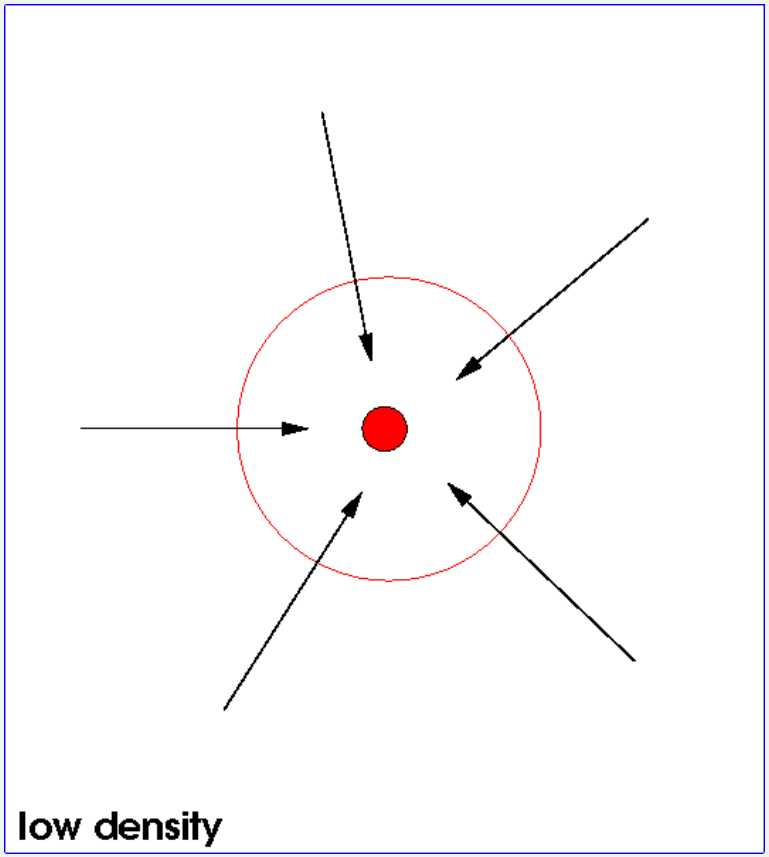
The velocity anisotropy of satellites MR II

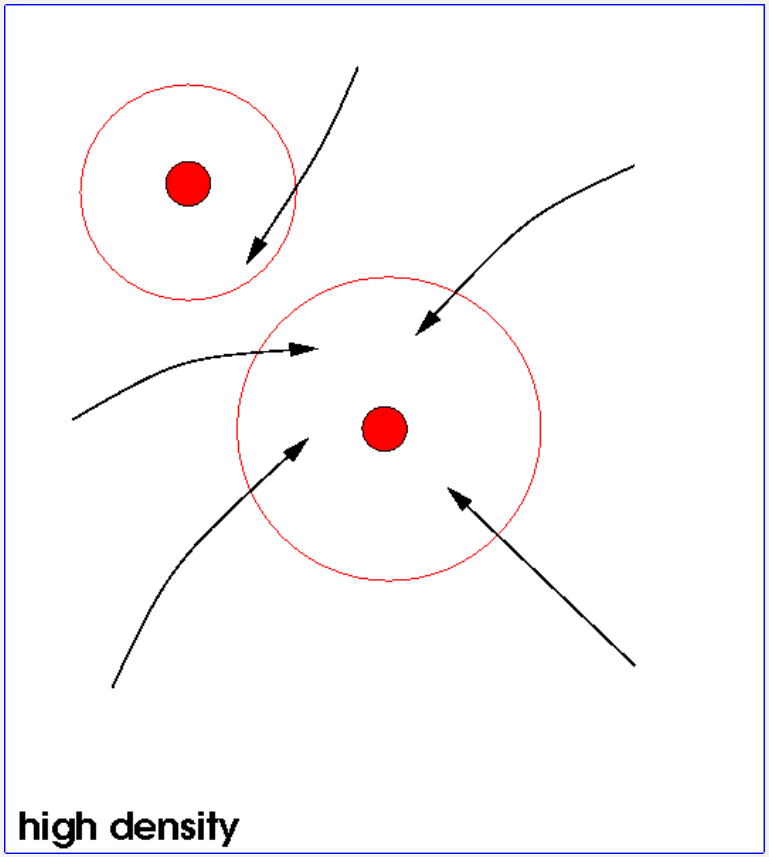


- Host halos classified according to environment/ background density
- For host halos of a given mass and background density the average velocity anisotropy parameter is determined
- Satellites populations in low density environments show more radially biased velocity distributions

Mean number of satellite halos as function of environment




low density


high density

Summary:

- Statistical measures in astronomy often dominated by "small objects"
- Galaxies/halos can be tidally dissolved
- The mass assignment scheme has an impact on durability (HOD,SHAM,SAM,Hydro)
- The disappearance of galaxies/halos affects their bias with respect to the dark matter density field
- Satellites in low density regions show (equal host mass) more radially biased velocity distributions