# Satellite Number Density Profiles of Galaxies in SDSS

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# Introduction

- The properties of satellite galaxies can not only help us test the galaxy formation theories and cosmological models, but also could help us understand the nature of dark matters.

# Introduction

## satellite data of external galaxies

- Yet, most satellite data that all theories and models compare with are merely those of two, Milky Way (MW) and Andromeda (M31).
- Analysing satellites of external galaxies is challenging because of the the limited observation.

# Introduction

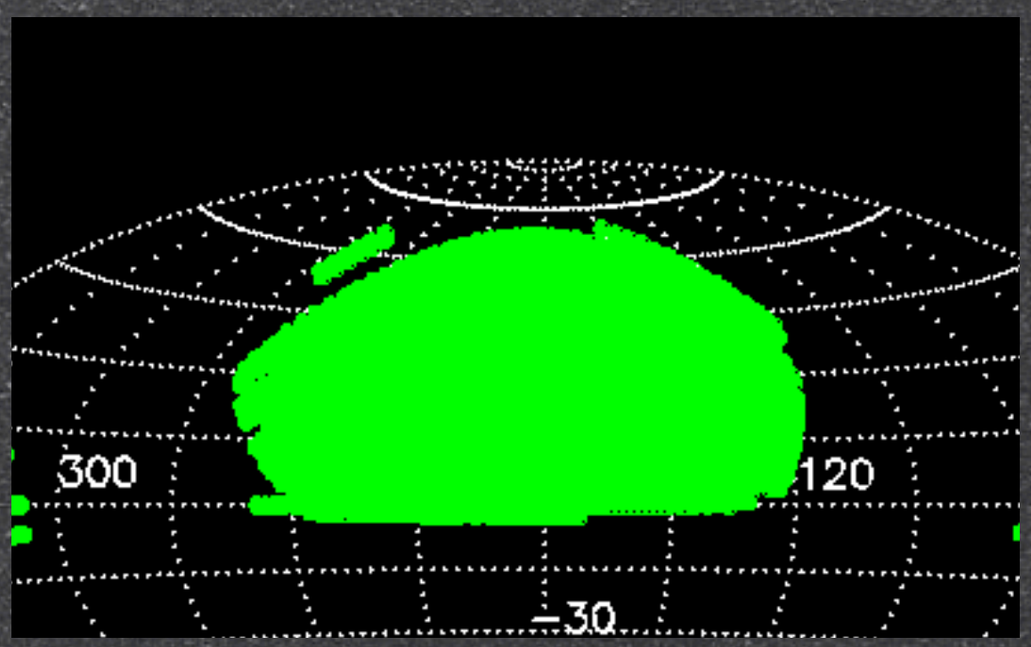
## Stacking the external galaxy systems

- By stacking plenty of galaxy system, we can obtain statistical results about the satellites properties.

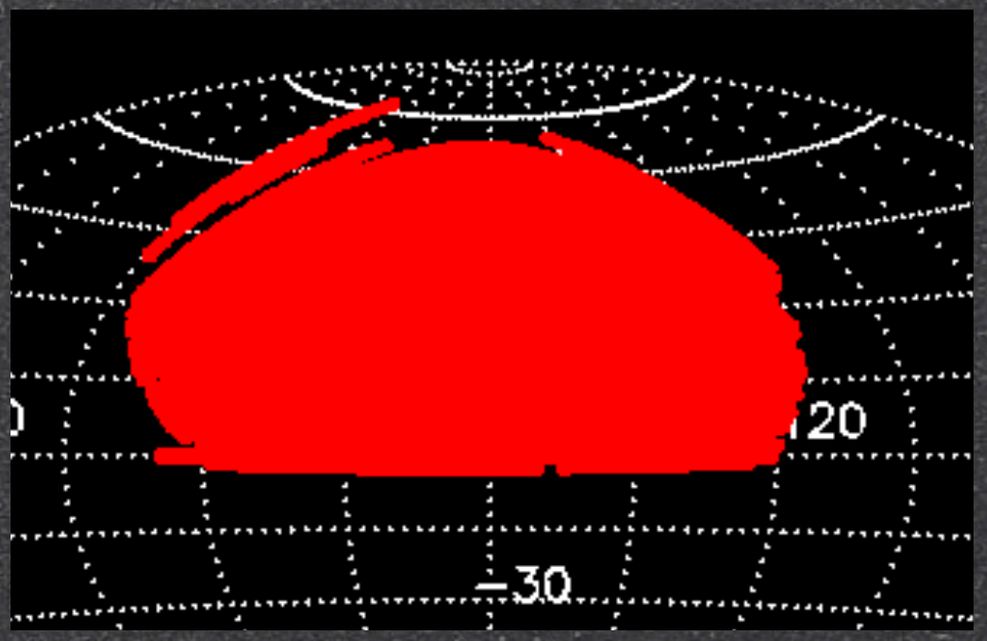
# Data and Methods

## Two catalogue: one for primaries,the other for satellites

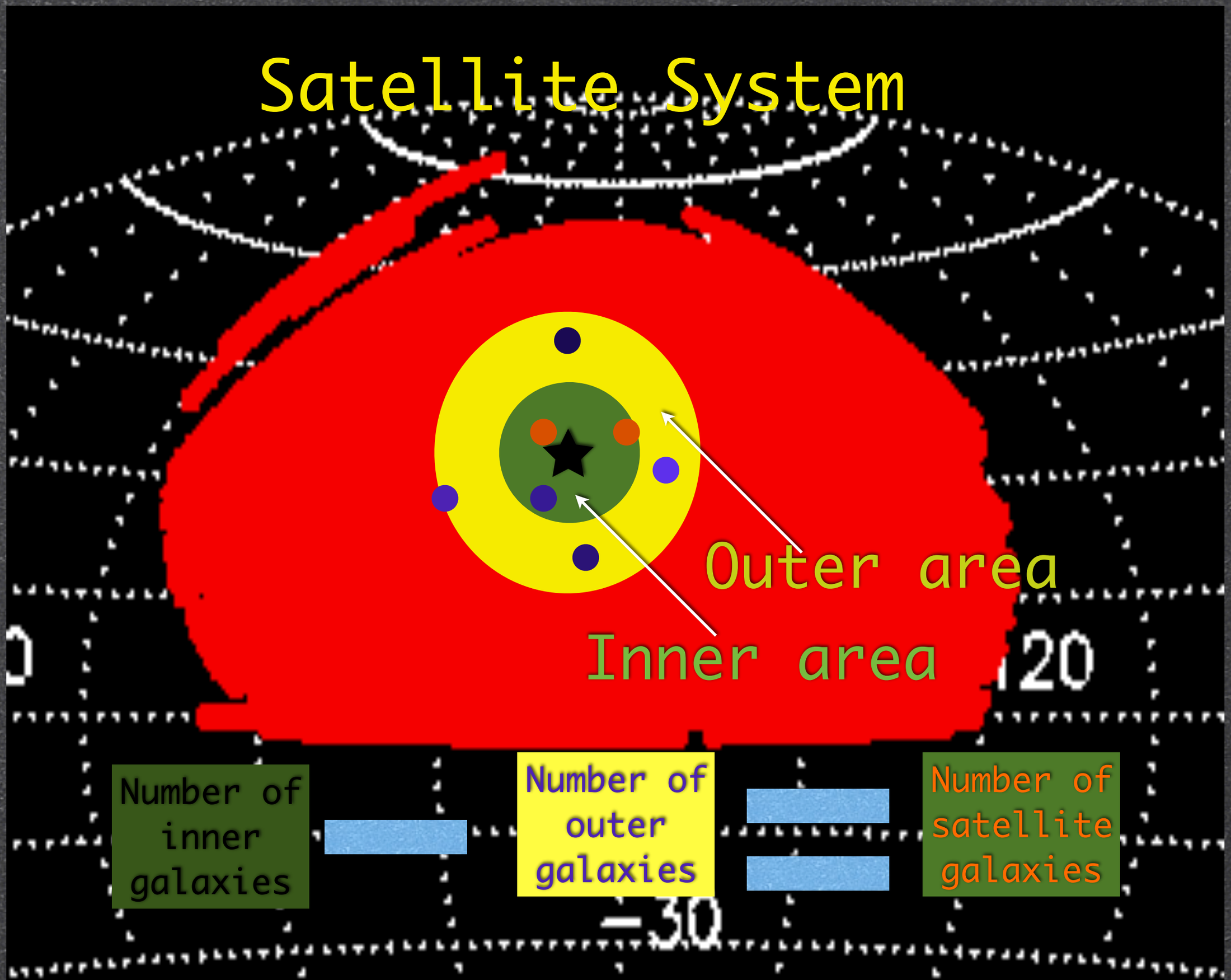
- SDSS DR8 main spectroscopic galaxy catalogue: $m_r<17.7$




- SDSS DR8 photometric catalogue:$m_r<20.5$

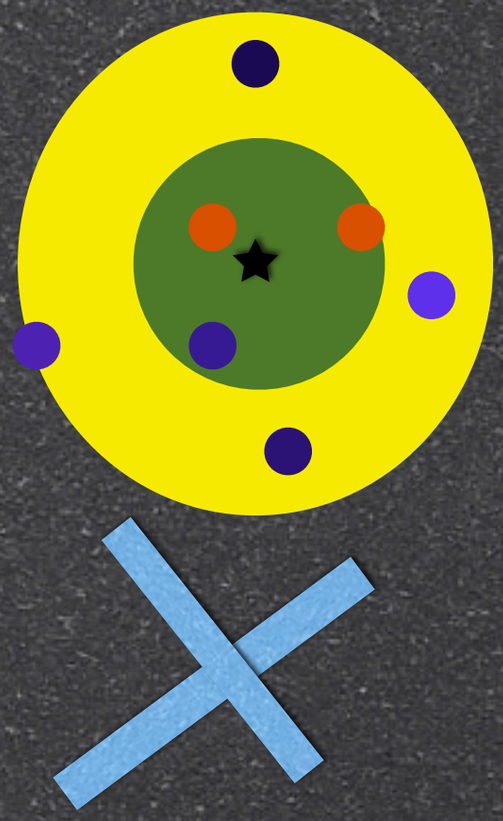


# Satellite System

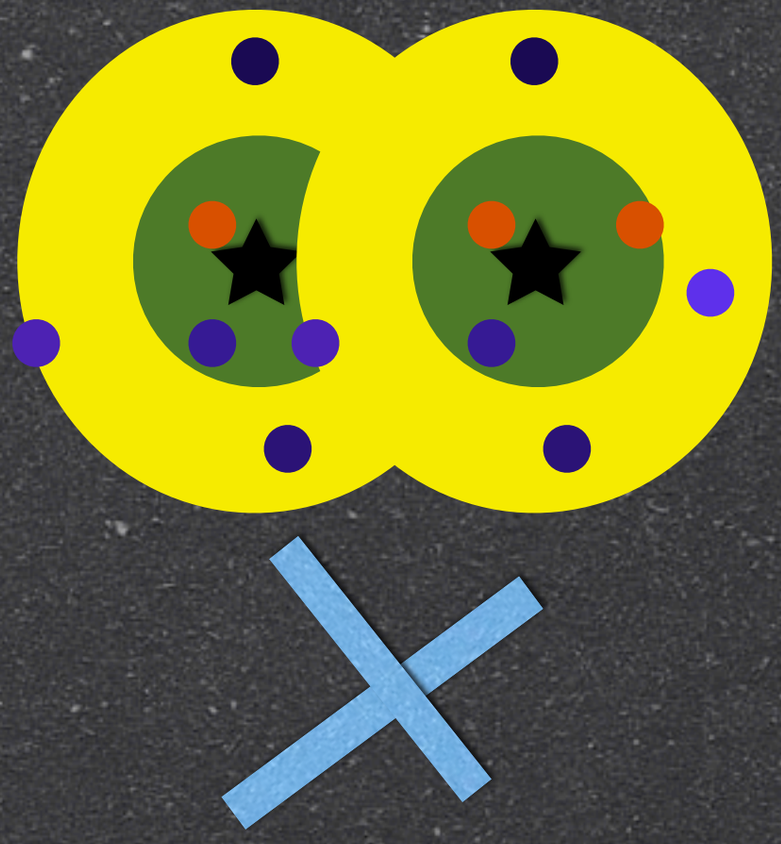


# Selected Systems

- The primary is not dominated

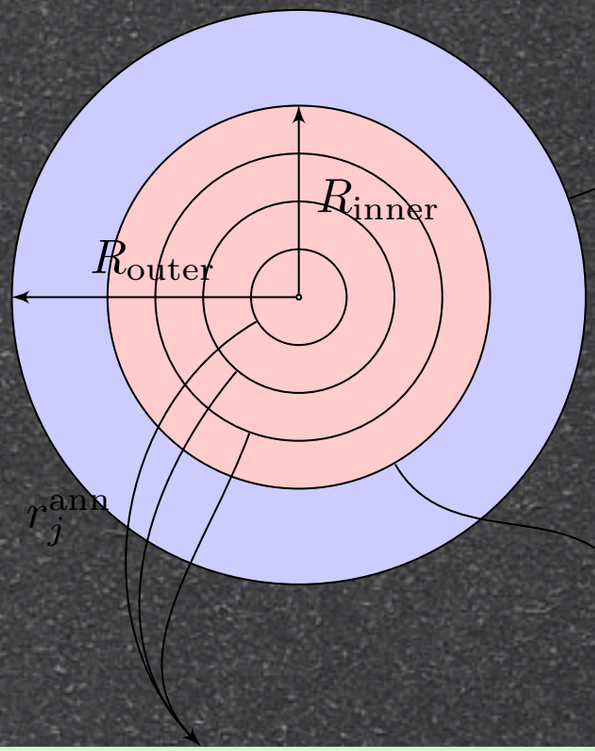


- The primary is not dominated



# Building Profiles

- Count the galaxy number in each annulus.




Outer galaxies:
$R_{\rm inner} < r_{\rm p} < R_{\rm outer}$ and $M > M_{\rm p} + \Delta M_{\rm faint}$ and, if $z_{\rm s}$ available then $|z_{\rm c} - z_{\rm s}| < \Delta z_{\rm s}$ or otherwise $|z_{\rm c} - z_{\rm p}| < \alpha_{\rm p}\sigma_{\rm p}^*$

Inner galaxies:
$r_{\rm p} < R_{\rm inner}$ and $M > M_{\rm p} + \Delta M_{\rm faint}$ and, if $z_{\rm s}$ available then $|z_{\rm c} - z_{\rm s}| < \Delta z_{\rm s}$ or otherwise $|z_{\rm c} - z_{\rm p}| < \alpha_{\rm p}\sigma_{\rm p}^*$

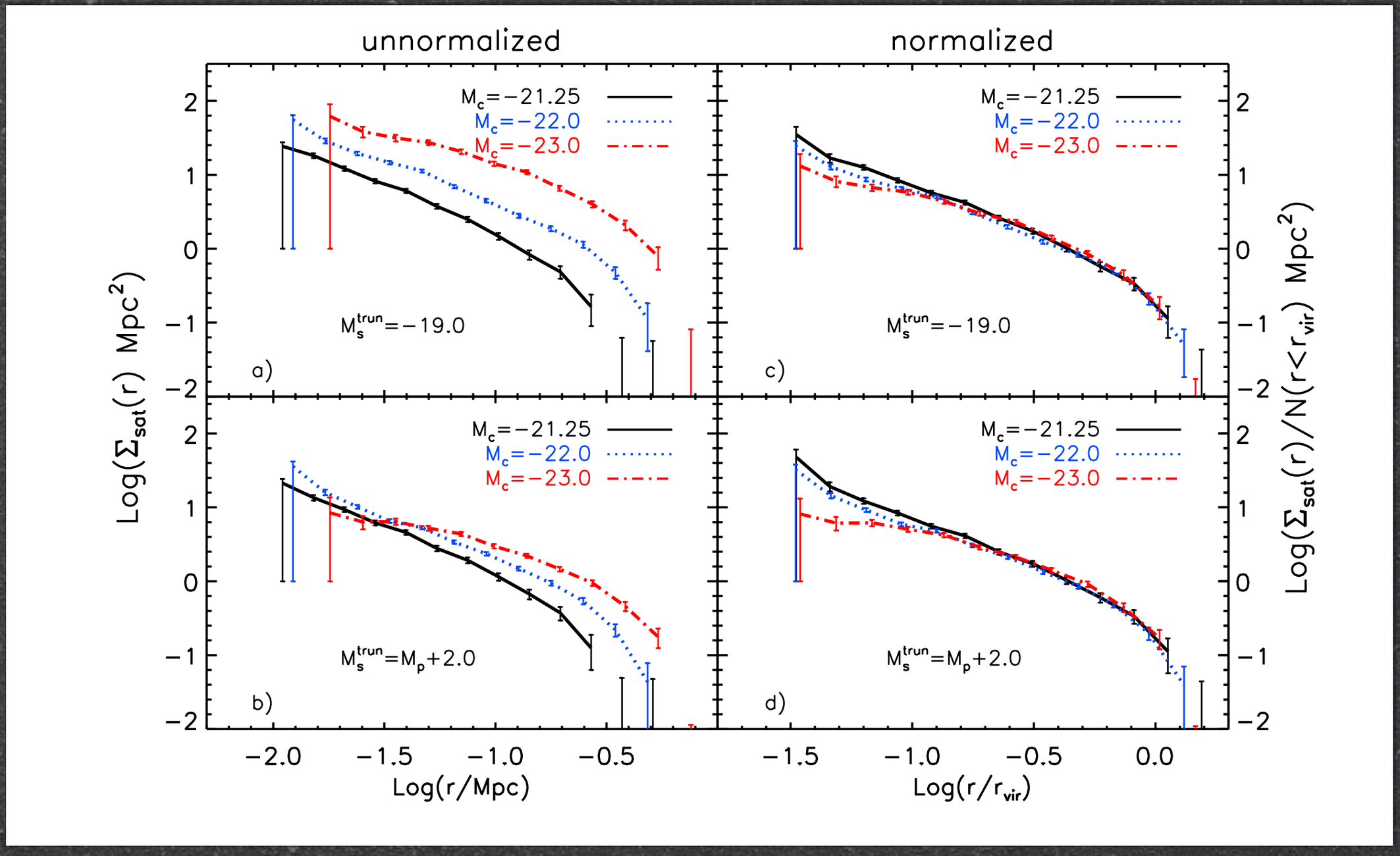
Inner annuals $r_j^{\rm ann}$:
Inner galaxies projected in the annuals $(j - 1) * R_{\rm inner}/N_{\rm ann} < r_{\rm p} < j * R_{\rm inner}/N_{\rm ann}$

# Results and Discussion

- The dependence of the satellite profiles on the properties of satellites
- The dependence of the satellite profiles on the properties of primaries

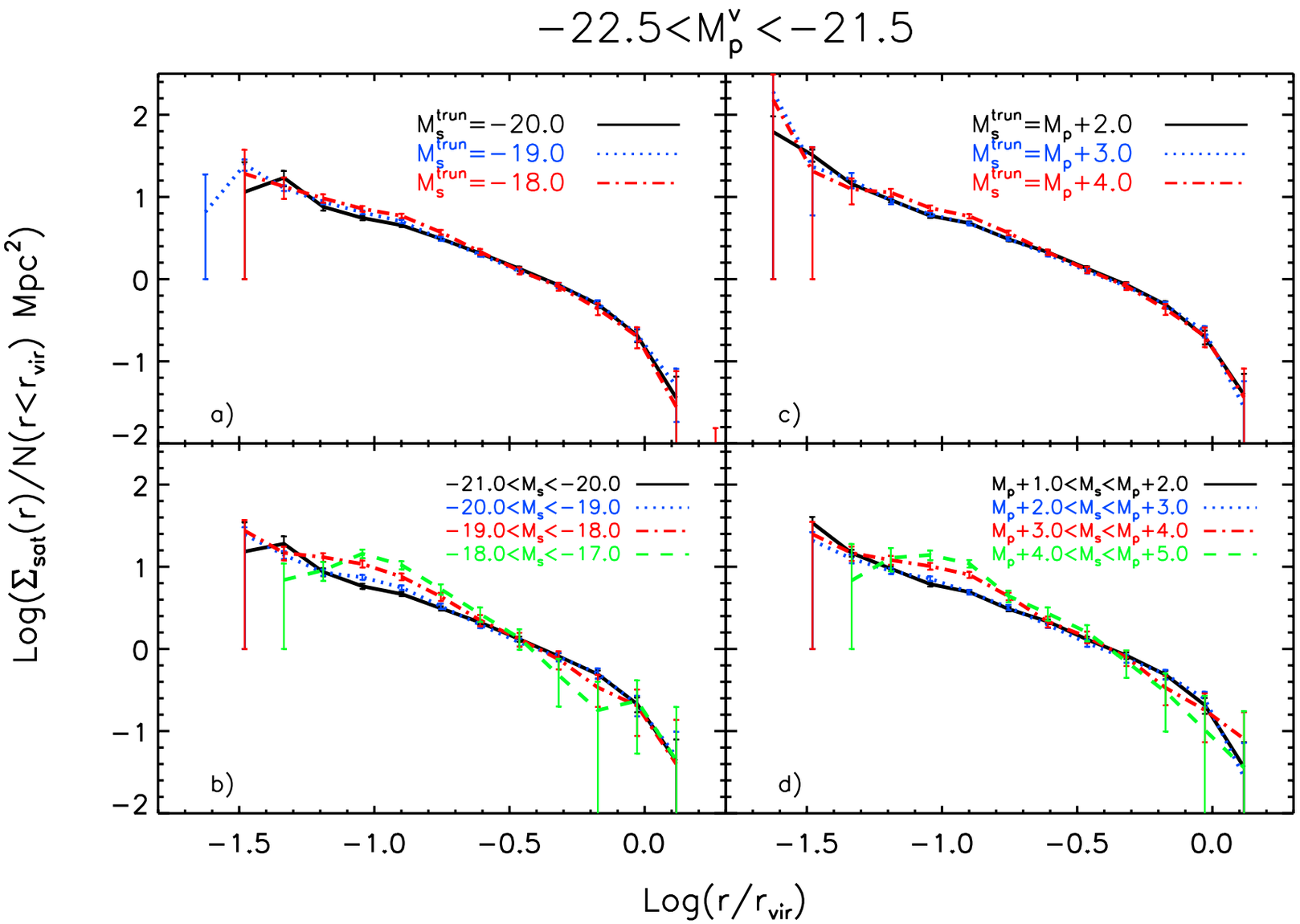
# Normalising Profiles

scale the projected radius by virial radius
scale the satellite number density by total number

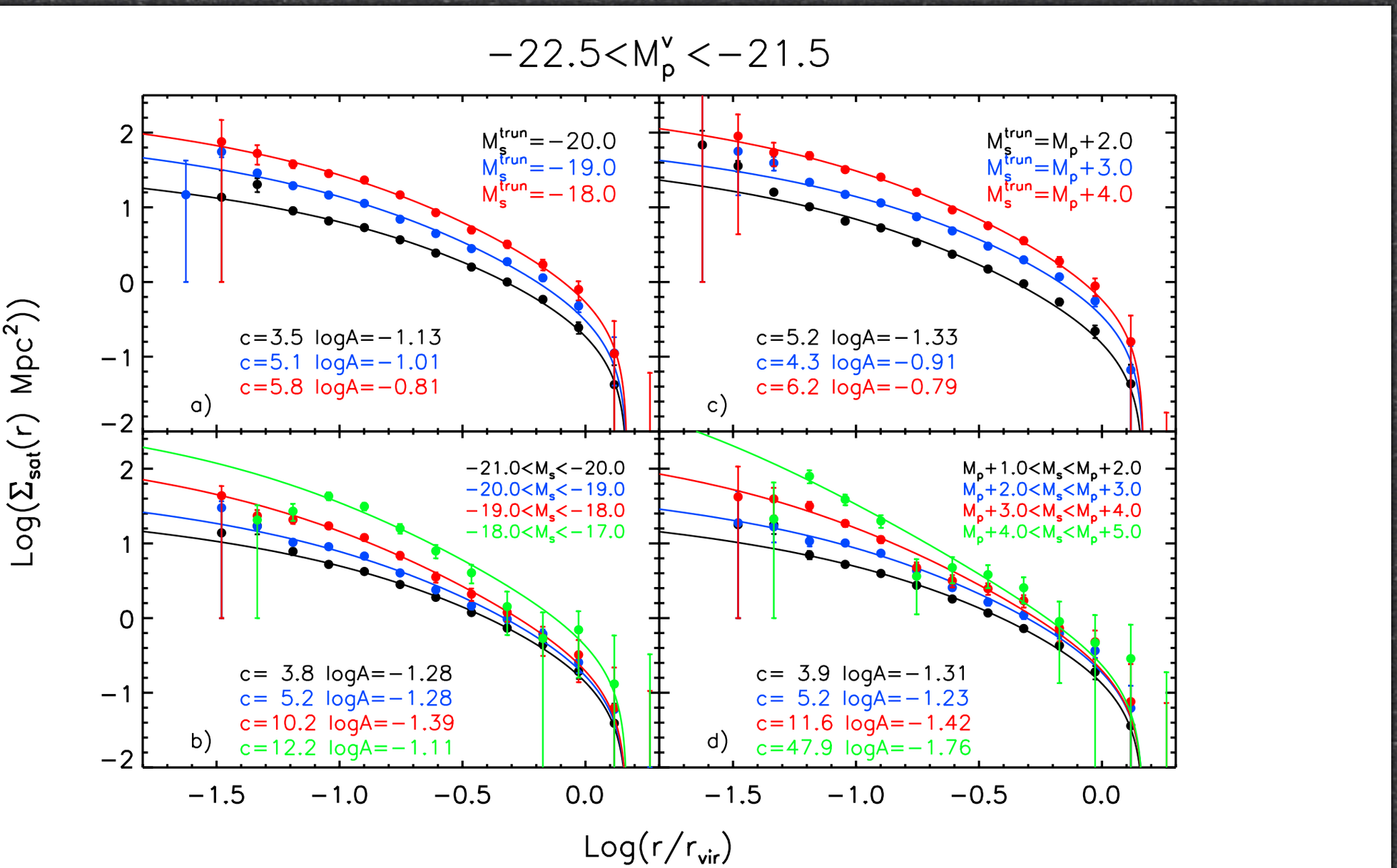


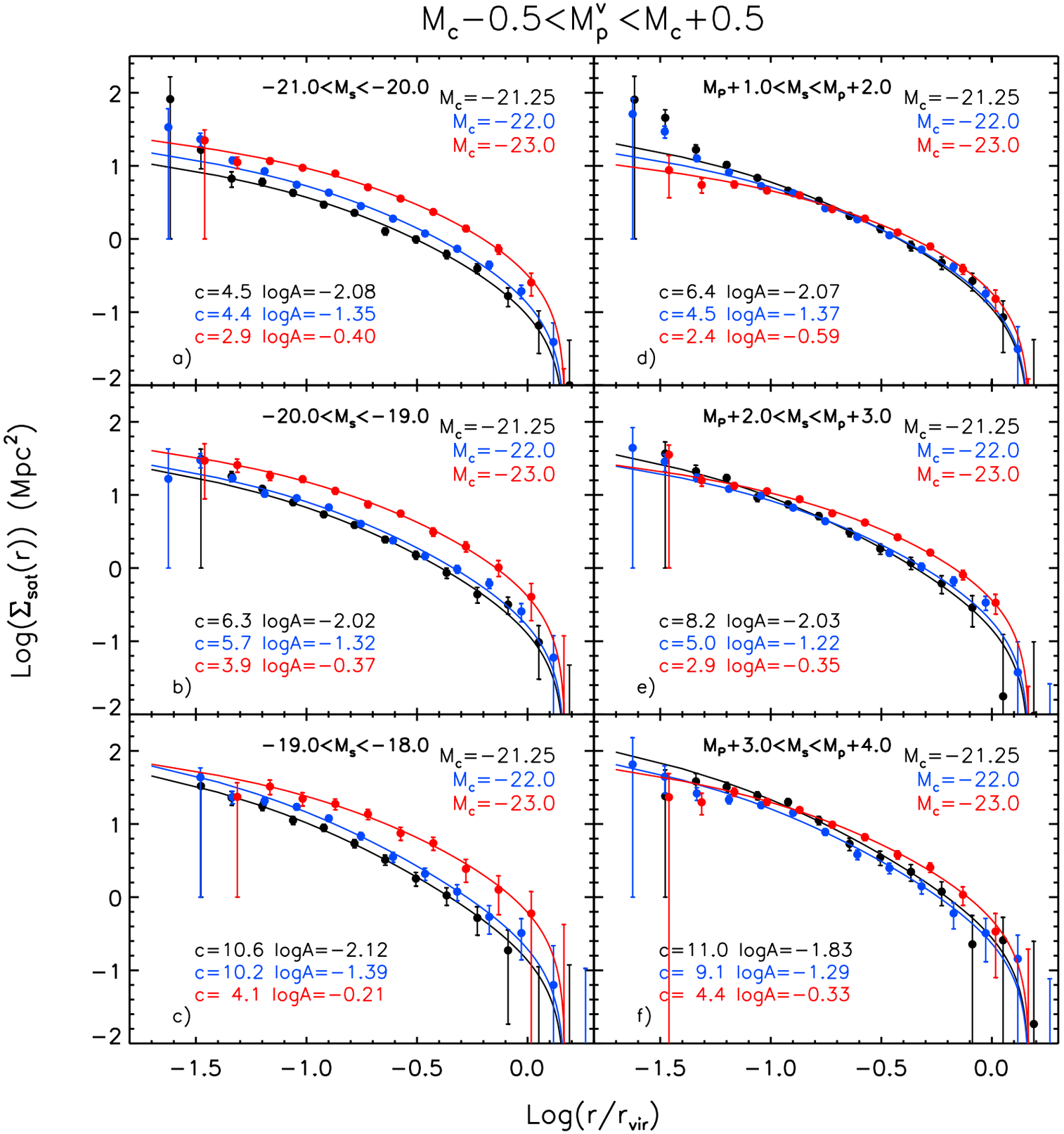
# The dependence of the scaled satellite density profiles on satellite luminosity for primaries in the magnitude range −22.5 < Mp < −21.5.

The upper panels, which are very similar, show profiles for satellites brighter than a threshold that is either a fixed value (panel a) or specified as a magnitude difference with respect to the corresponding primary (panel c) (see legend). The lower two panels show profiles for satellites in bands of magnitude again either specified as between fixed values (panel b) or values relative to the corresponding primary (panel d).



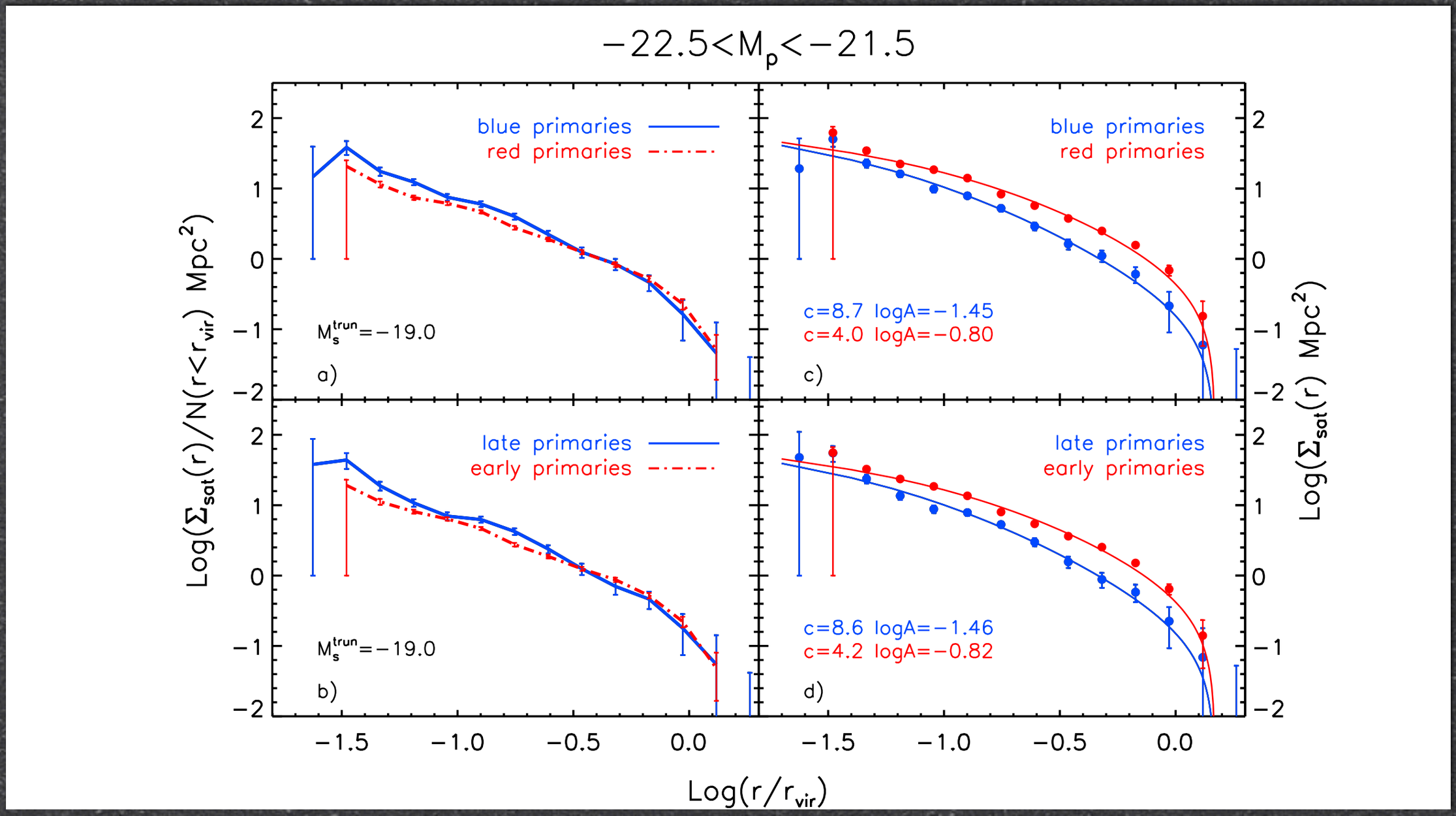
# NFW Fits

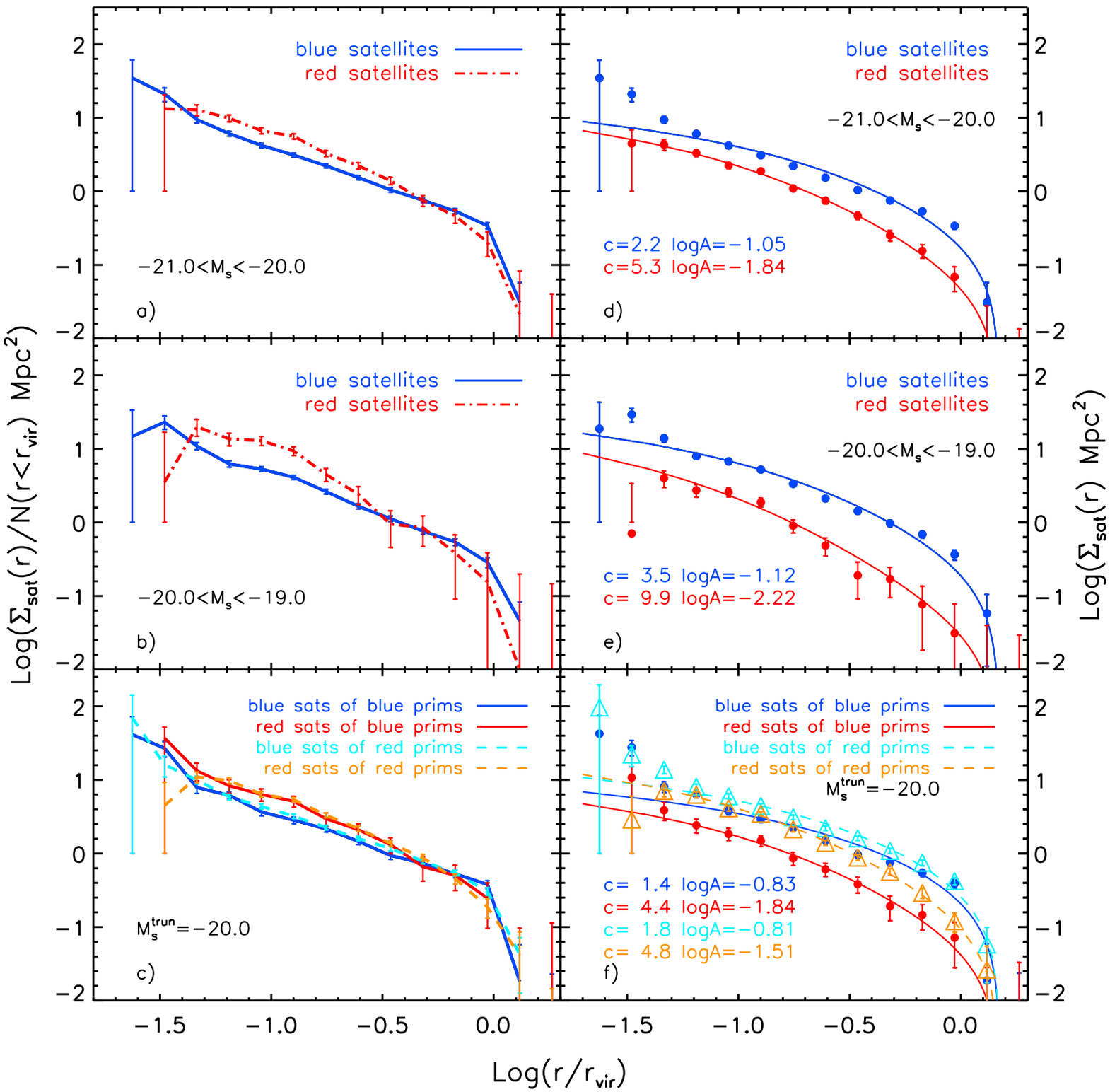

$-22.5<M_p^v<-21.5$
$M_s^{trun}=-20.0$
$M_s^{trun}=-19.0$
$M_s^{trun}=-18.0$
c=3.5 logA=−1.13
c=5.1 logA=−1.01
c=5.8 logA=−0.81
a)
$M_s^{trun}=M_p+2.0$
$M_s^{trun}=M_p+3.0$
$M_s^{trun}=M_p+4.0$
c=5.2 logA=−1.33
c=4.3 logA=−0.91
c=6.2 logA=−0.79
c)
$-21.0<M_s<-20.0$
$-20.0<M_s<-19.0$
$-19.0<M_s<-18.0$
$-18.0<M_s<-17.0$
c= 3.8 logA=−1.28
c= 5.2 logA=−1.28
c=10.2 logA=−1.39
c=12.2 logA=−1.11
b)
$M_p+1.0<M_s<M_p+2.0$
$M_p+2.0<M_s<M_p+3.0$
$M_p+3.0<M_s<M_p+4.0$
$M_p+4.0<M_s<M_p+5.0$
c= 3.9 logA=−1.31
c= 5.2 logA=−1.23
c=11.6 logA=−1.42
c=47.9 logA=−1.76
d)
$\mathrm{Log}(\Sigma_{sat}(r)\ \mathrm{Mpc}^2))$
$\mathrm{Log}(r/r_{vir})$
2
1
0
−1
−2
−1.5
−1.0
−0.5
0.0




NFW fits to the density profiles of satellites around primaries of different luminosity

The satellite profiles for primary galaxies of magnitude −22.5 < Mp < −21.5 split by the type (concentration) and colour of the primary.






Satellite density profiles split by the colour and luminosity of the satellites.

# Conclusion

- With the exception of the faintest satellites, which show an excess at small galactocentric projected distance,the density profiles are well fitted by projected NFW profiles that have been background subtracted to match the procedure that has been applied to the data.

- The concentration of the NFW fits decreases systematically with increasing satellite luminosity and is almost independent of the luminosity of the primaries. Thus bright satellites have more extended distributions and fainter satellites are more centrally concentrated.

- The radial distribution of satellites is dependent on the colour and morphology of their primaries. Satellites are more numerous around red/early primaries and have more extended, lower concentration, distributions

- The radial distribution of satellites also depends on the colour of the satellites. Blue satellites are more numerous than red satellites at all radii (for the luminosity range we probe) and red satellites are more centrally concentrated (higher NFW concentration) than blue satellites. Further sub-divided samples show that the concentration of blue or red satellites principally depends on the colour of the satellites and is almost independent of the colour of the primaries.

Thank you