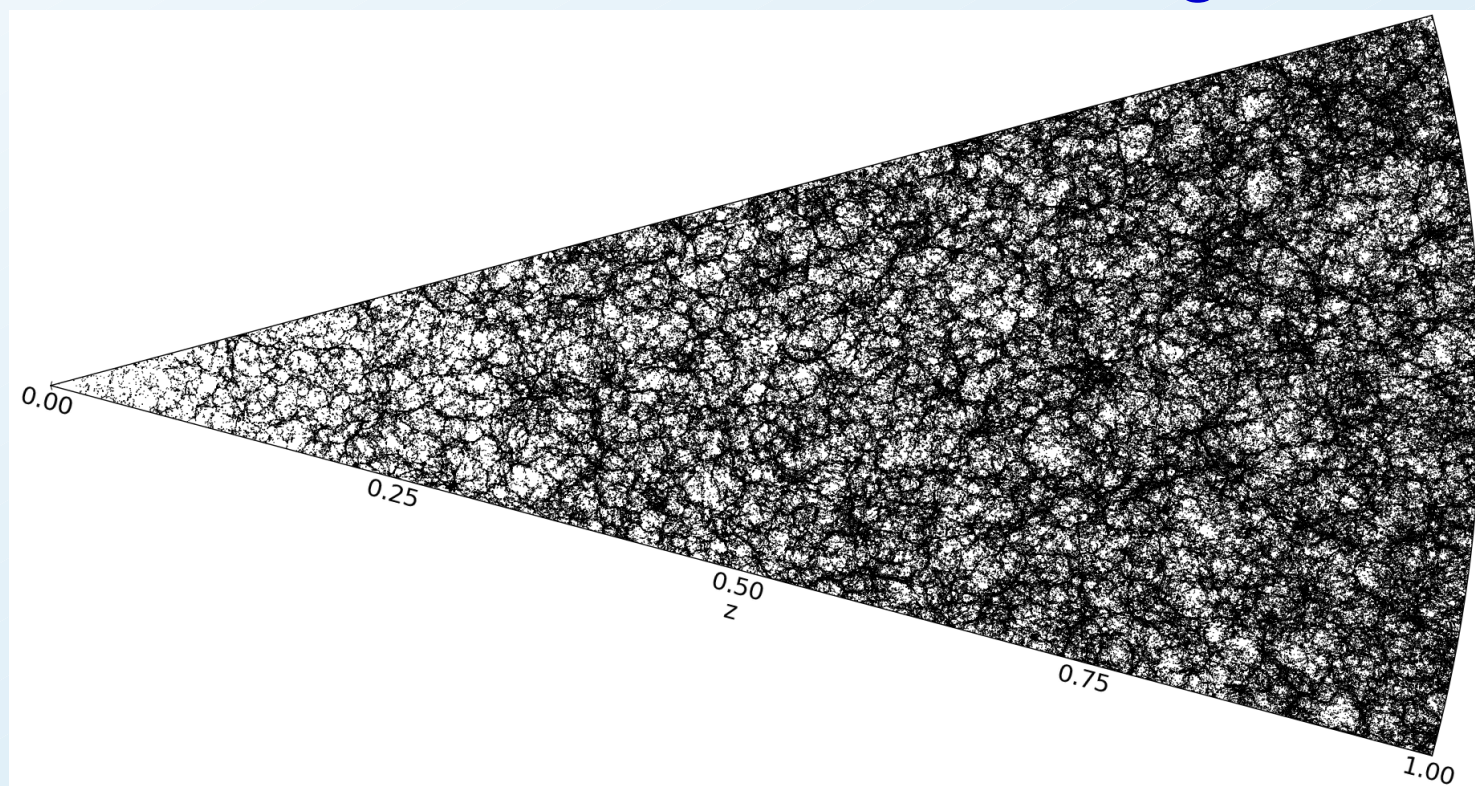


A Lightcone Catalogue from MXXL

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Overview

- Why do we need mock galaxy catalogues?
- The MXXL Simulation
- Halo lightcone catalogue
- HOD galaxy catalogue
- Ongoing work

Why do we need mock catalogues?

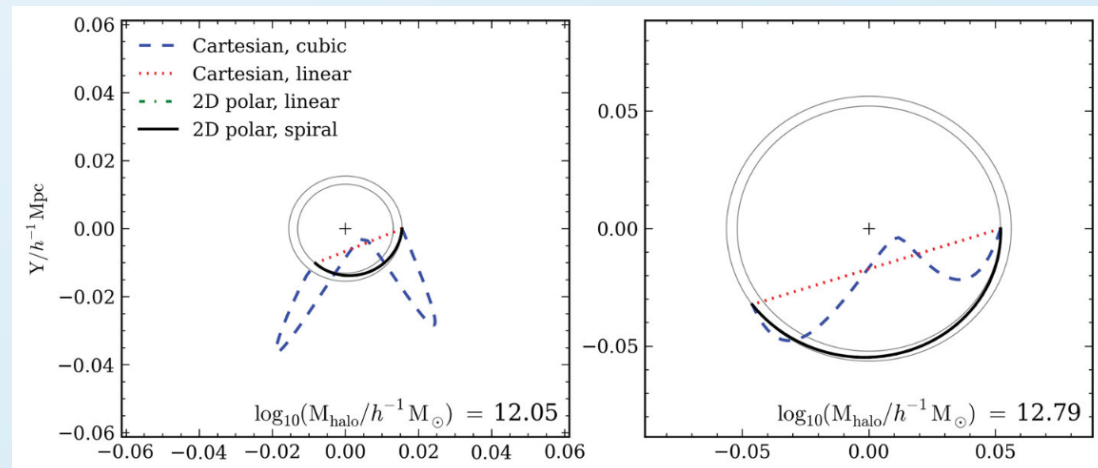
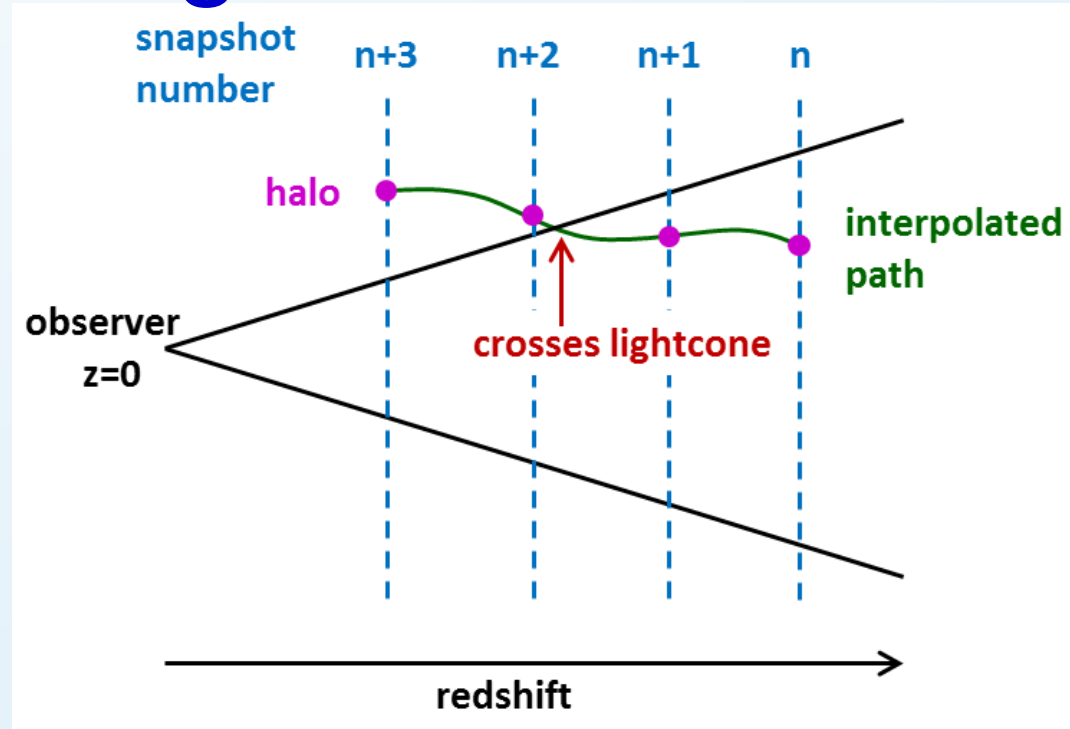
- Can compare 'actual' value of a statistic with what would be measured in a survey
- Test different methods for measuring a statistic from the survey and methods for removing systematic effects
- Very useful for upcoming galaxy surveys such as DESI and Euclid

Millennium-XXL (MXXL) Simulation

- Large dark matter only simulation
- Same (WMAP1) cosmology as Millennium Simulation
- Box size 3Gpc/h, particle mass $8.456e9$ Msol
- Merger trees for SUBFIND subhaloes
- 20 particle mass resolution
- Also contains information about FOF group each subhalo belongs to
- Merger tree files needed re-organising to make constructing the lightcone more efficient (over 700 million haloes per snapshot)

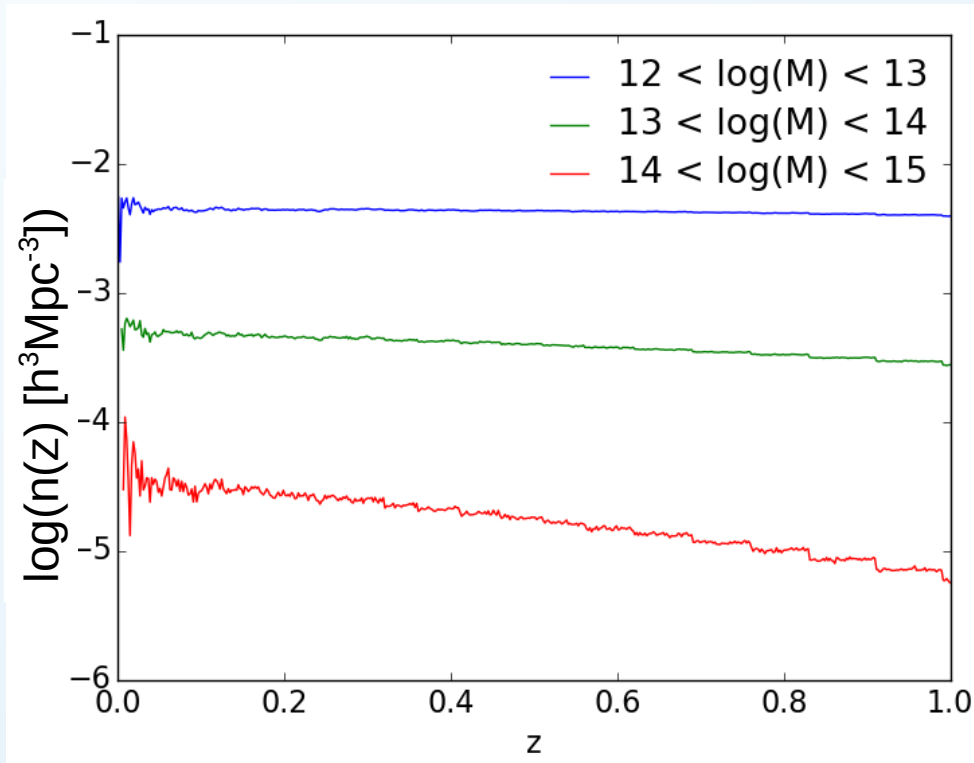
MXXL Halo Lightcone

- Method described in Merson et al 2013
- Place observer in the box
- Periodic replications of box
- Interpolate the positions and velocities of halos between snapshots
- Cubic interpolation for centrals
- Linear interpolation in polar coordinates for satellites
- Interpolate masses linearly

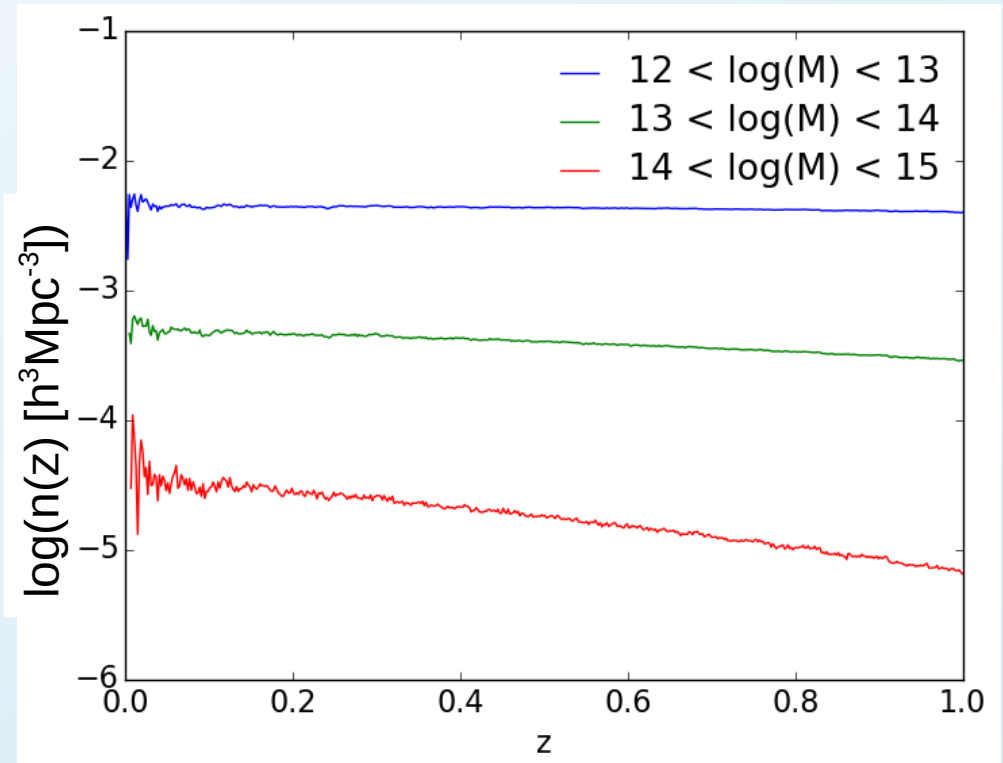


MXXL Halo Lightcone

- Number density of haloes with redshift

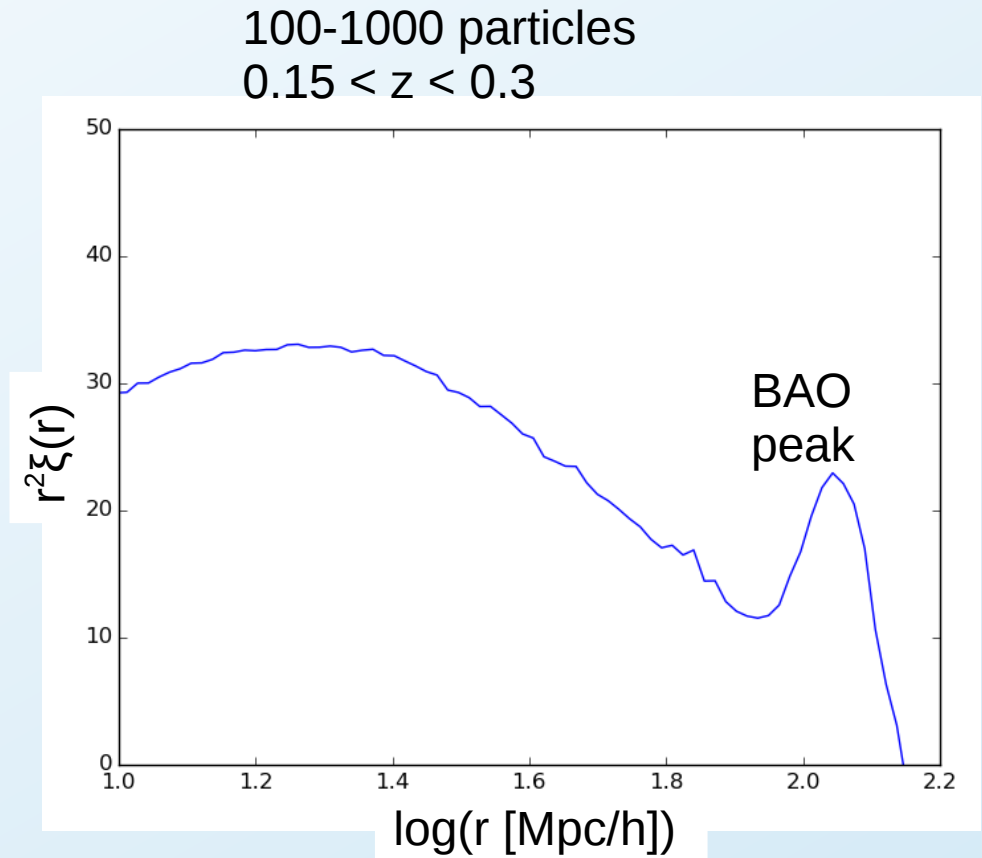
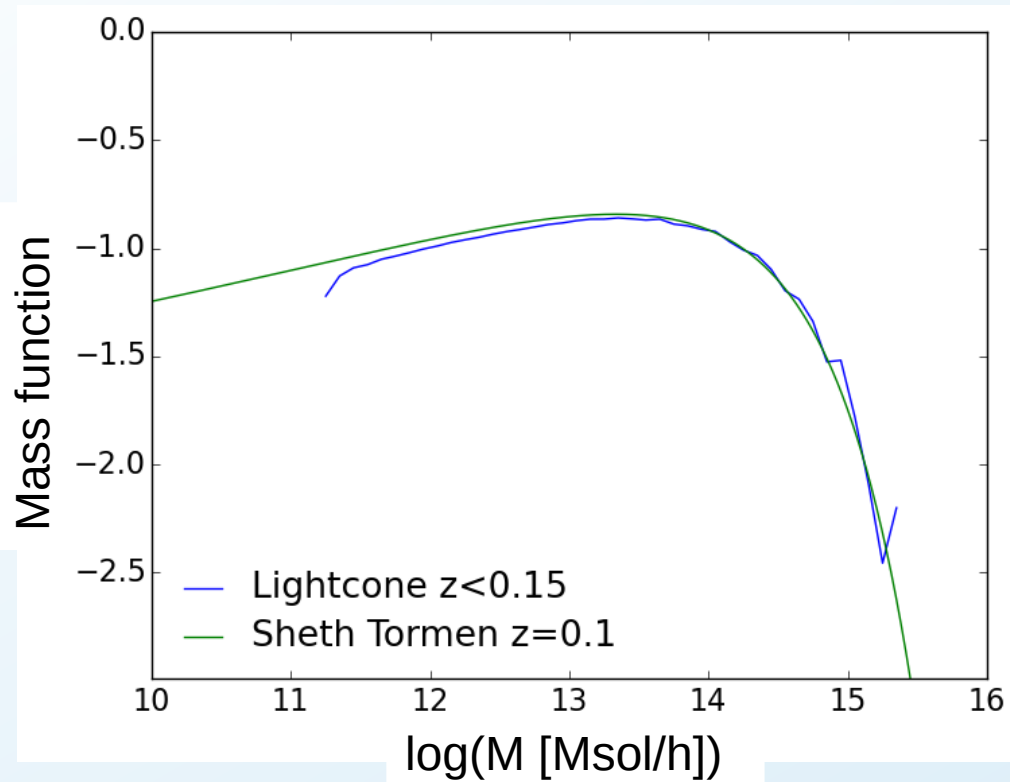


No mass interpolation



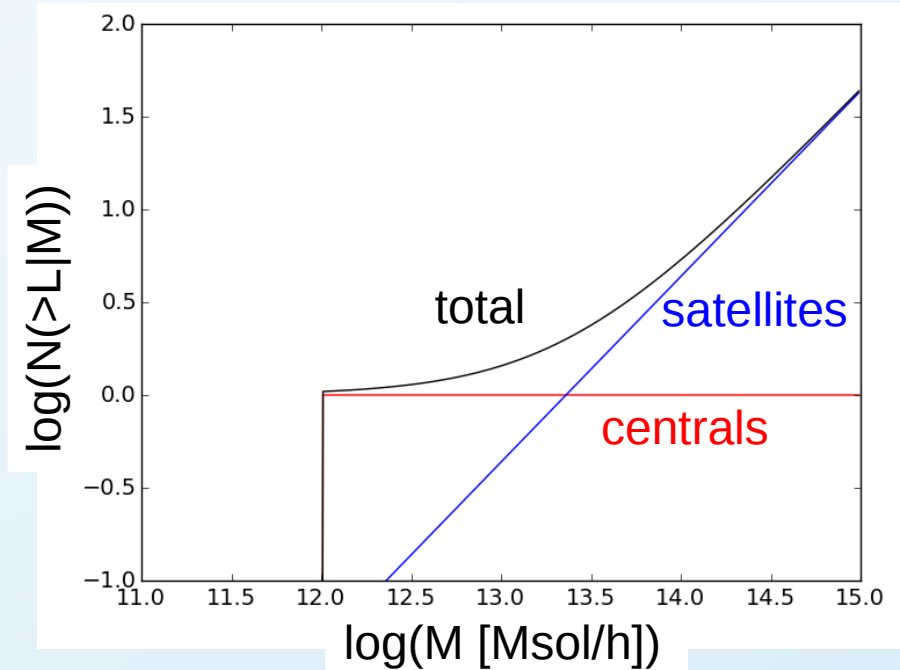
Mass interpolation

MXXL Halo Lightcone



Halo Occupation Distribution (HOD)

- For a luminosity threshold sample, number of galaxies brighter than L in haloes of mass M
- Parameters $M_{\min}(L)$, $M_1(L)$ and $\alpha(L)$



$$N_{gal}(>L|M) = N_{cent}(>L|M) + N_{sat}(>L|M)$$

$$M < M_{min}$$

$$N_{gal} = 0$$

$$M \geq M_{min}$$

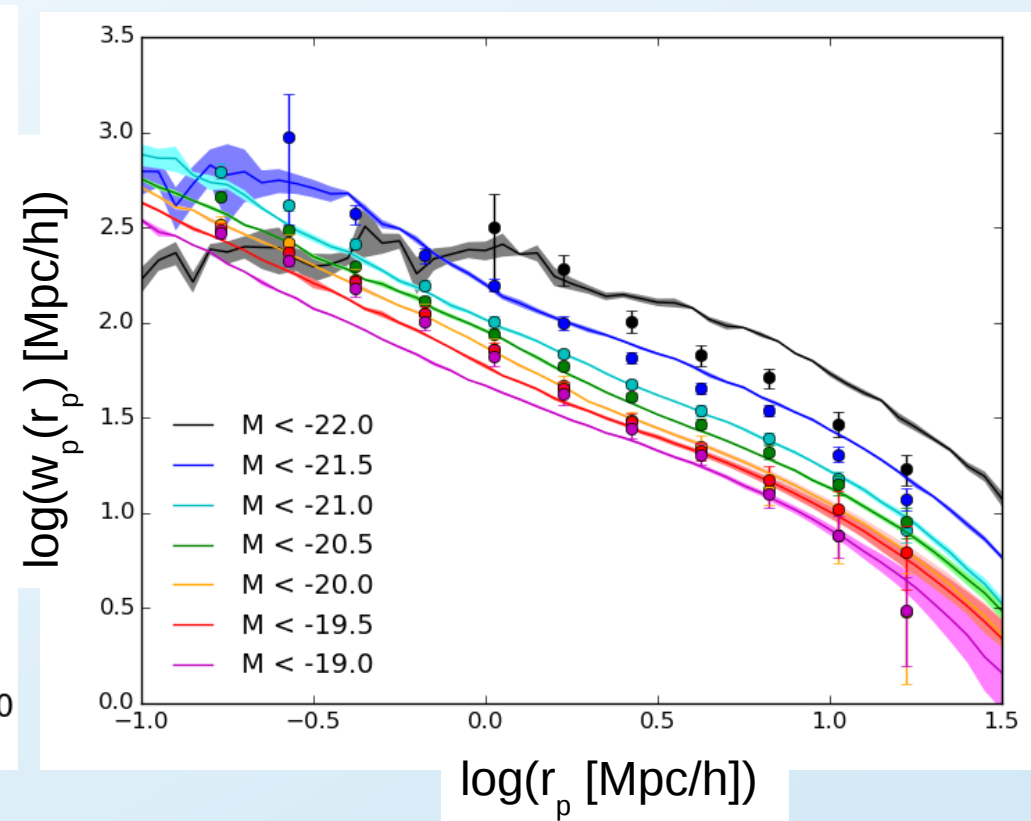
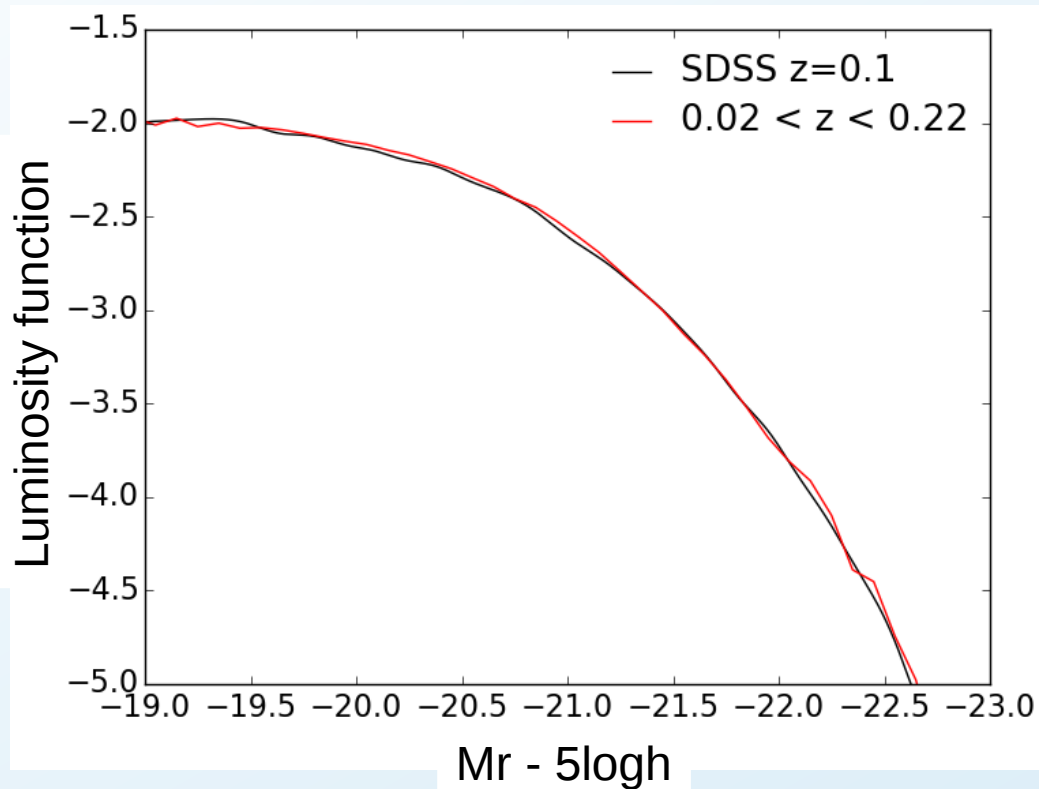
$$N_{gal} = 1 + \left(\frac{M}{M_1} \right)^\alpha$$

HOD Galaxy Catalogue

- Method of Skibba et al 2006
 - Invert $M_{\min}(L)$ relation to assign luminosity of central galaxy
 - Monte Carlo method to assign luminosities of satellites
 - Position satellites around centrals using NFW profile
 - Assign satellites random virial velocities from Maxwell Boltzmann distribution
- Use our fits of Zehavi et al 2005 HOD parameters as a function of L (SDSS $z \sim 0.1$)
- MXXL has different cosmology to Skibba/Zehavi
- Scale masses so we get the right luminosity function. Do we get the right clustering?

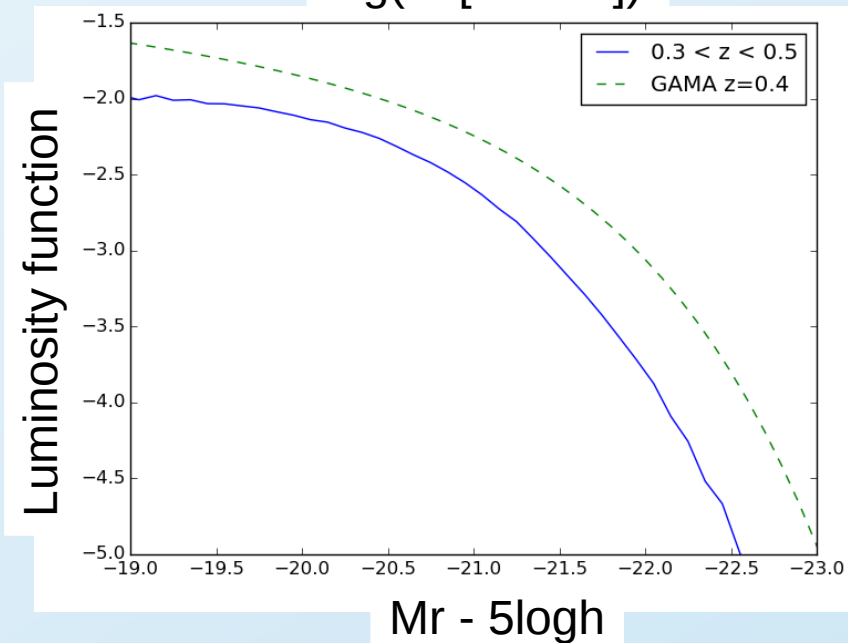
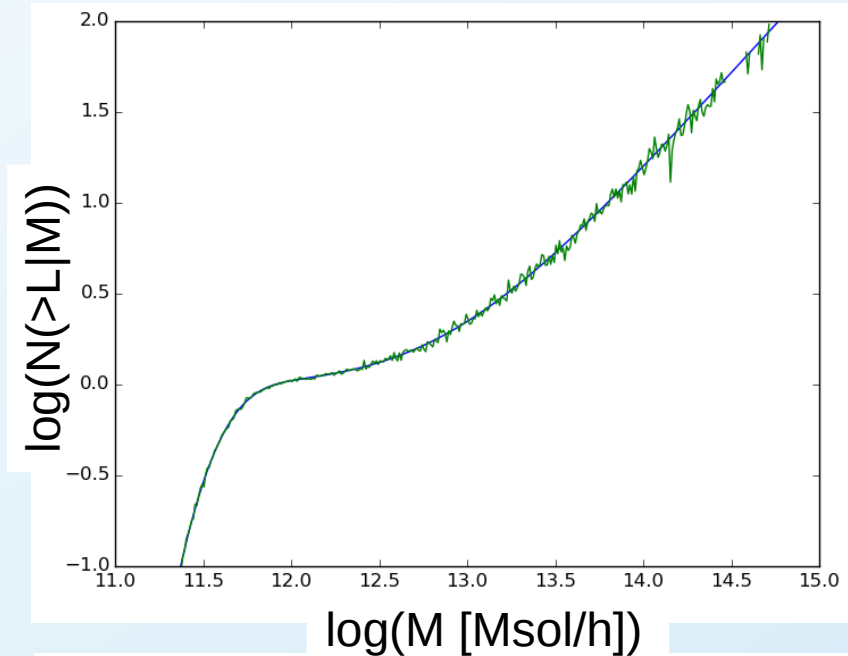
HOD Galaxy Catalogue

- Luminosity function and clustering at $z \sim 0.1$ compared to SDSS



Ongoing work

- Zheng Zheng has redone fitting of HOD parameters as in Zehavi et al 2011 (SDSS, 5 parameter HOD), but in Millennium cosmology
- Add smooth cutoff in HOD (ie scatter in luminosities of centrals)
- Redshift evolution of HOD parameters

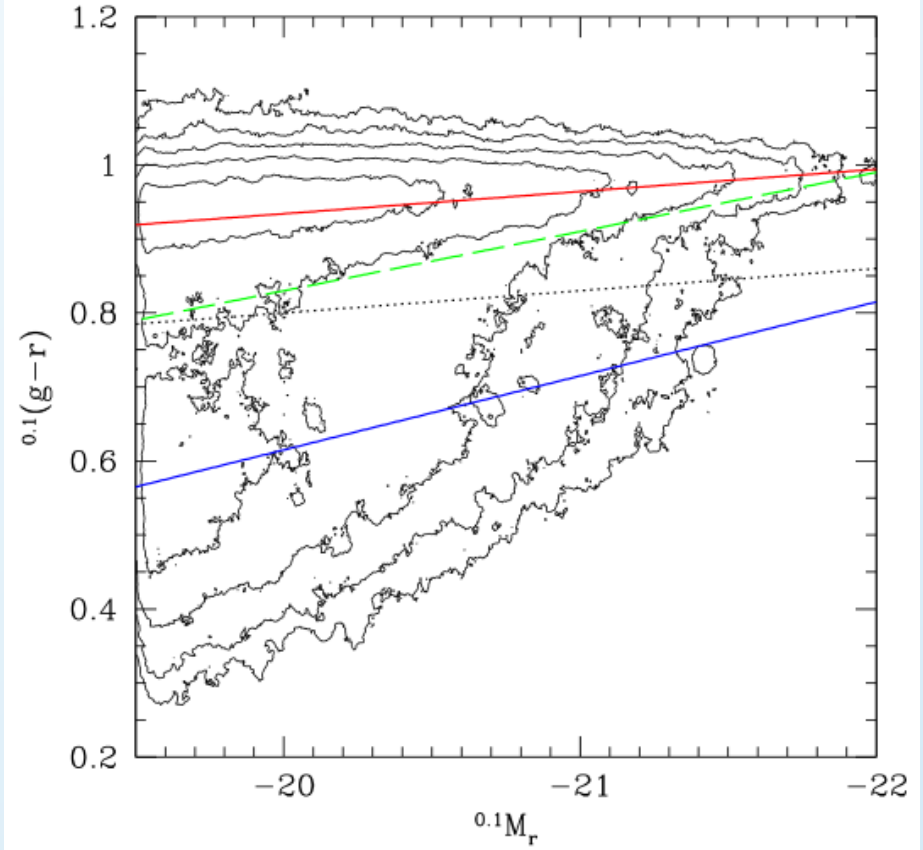
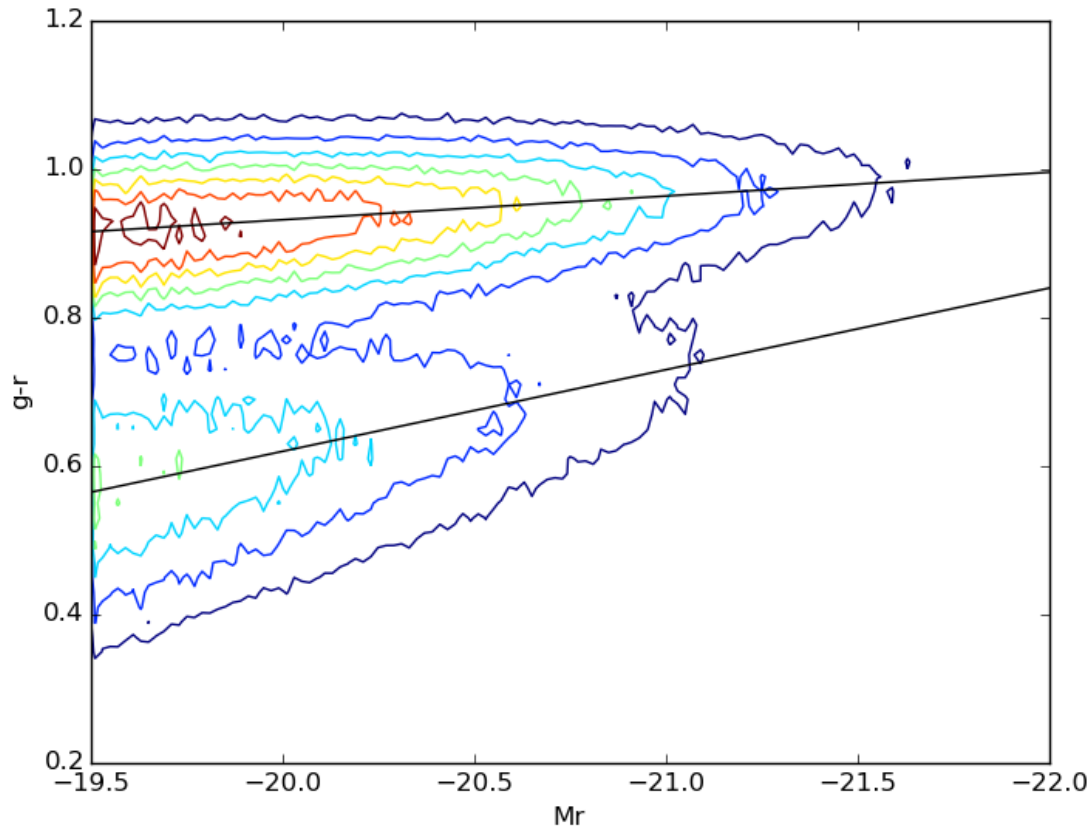


Summary

- Method of Merson et al 2013 used to construct halo lightcone catalogue
- Method of Skibba et al 2006 used to populate halos with galaxies using an HOD scheme
- Clustering agrees with SDSS reasonably well at $z \sim 0.1$
- HOD parameters need to evolve with redshift
- g-r colours assigned using method of Skibba & Sheth 2009
- Catalogues will be made available on database

What is the best way to evolve the HOD parameters with redshift?

SDSS
 $M_r < -19.5$



Skibba & Sheth
2009

Sheth, Mo, Tormen 2001 halo bias

