Extensions to halo occupation distribution models for accurate clustering predictions

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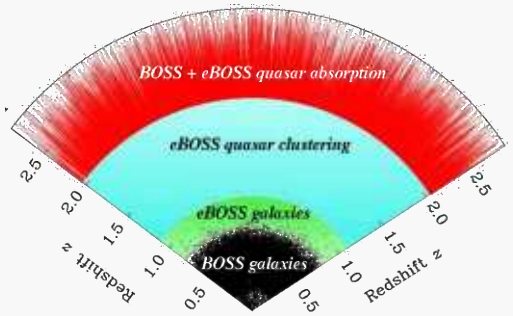
Mock Córdoba, April 2019

Centro UC
Astro - Ingeniería

Galaxy catalogues

euclid



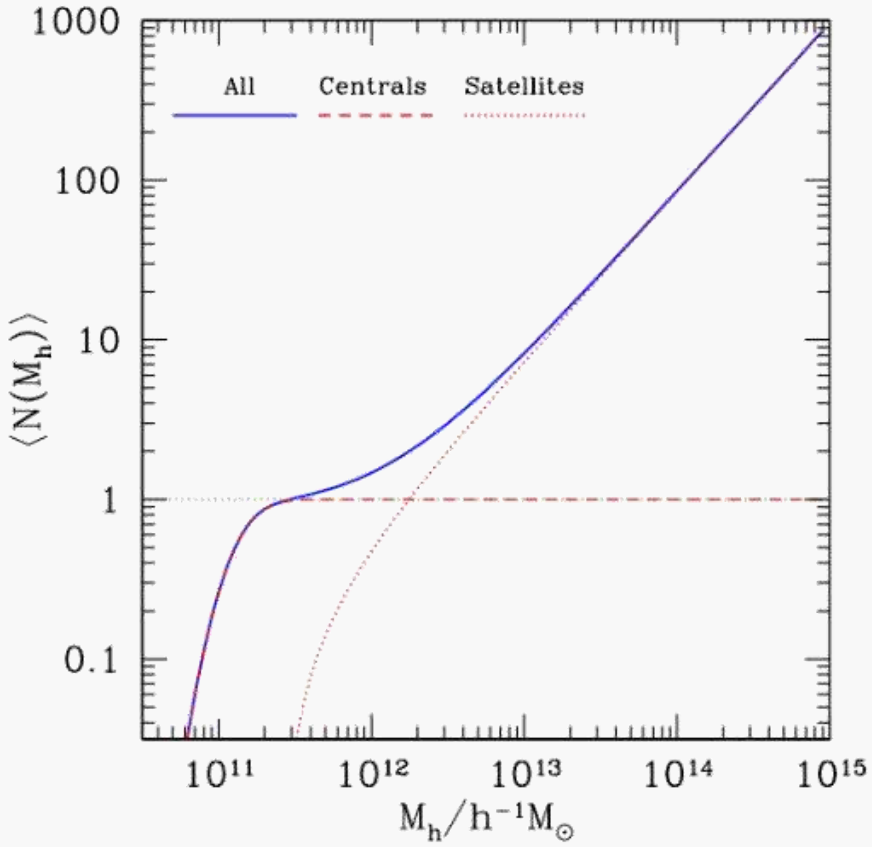
- Catalogs of Emission Line Galaxies (ELGs) from different surveys (eBOSS, DESI, Euclid)

- Cosmological information can be obtained from galaxy distribution: **two-point correlation function ($\xi(r)$)**

The halo occupation distribution

- **Halo Occupation Distribution (HOD)** relates the average number of galaxies with the host halo mass

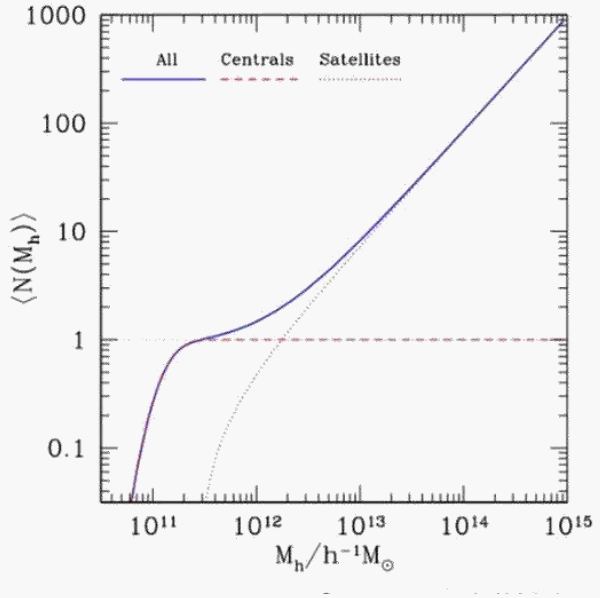
- A fast and easy way to build **mock galaxy catalogues**



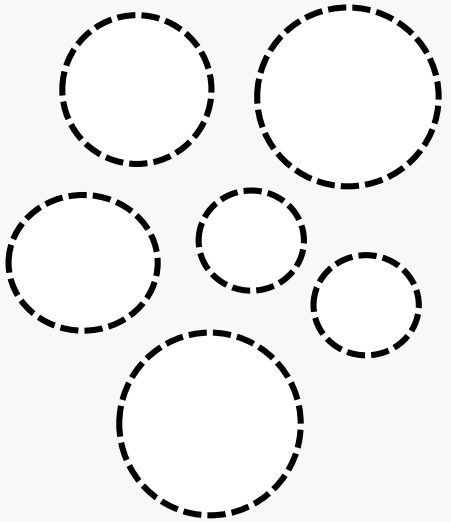
Contreras et al. (2017)

Creating a synthetic universe

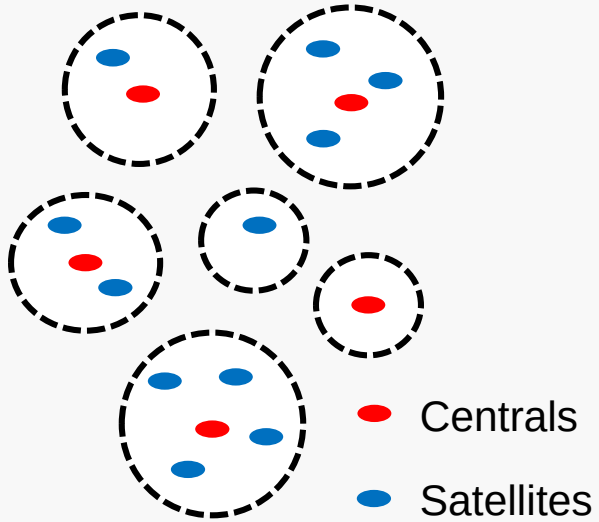
HOD from SAM



Dark matter haloes



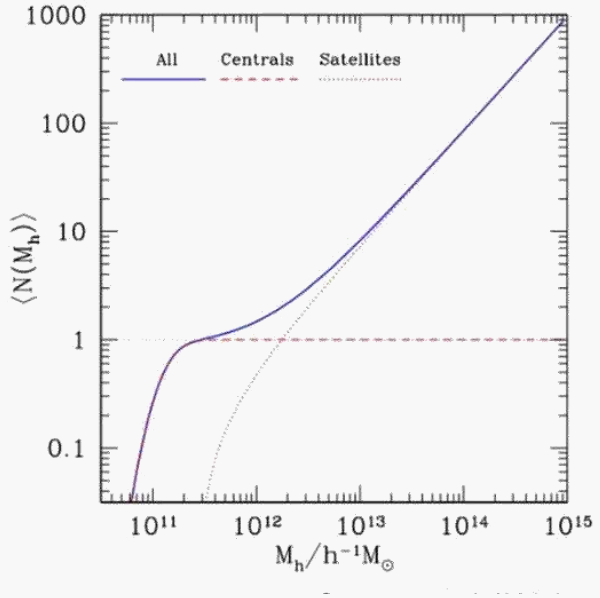
Mock galaxy catalogue



Creating a synthetic universe

What is the best way to use the HOD modelling to produce mock galaxy catalogues?

HOD from SAM



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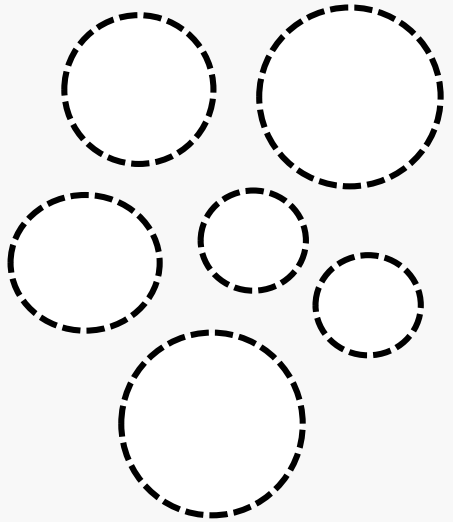

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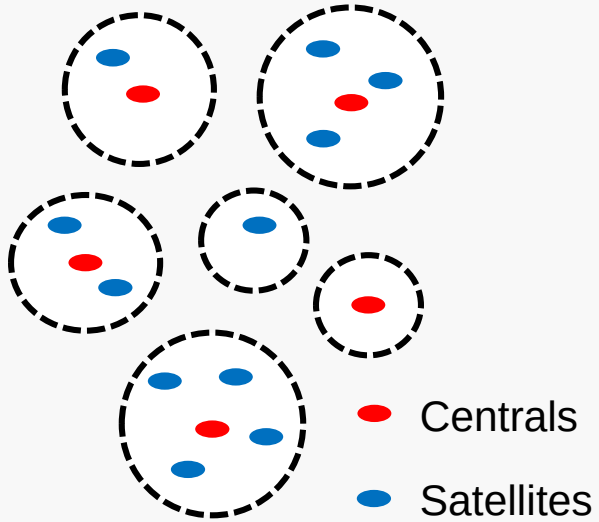
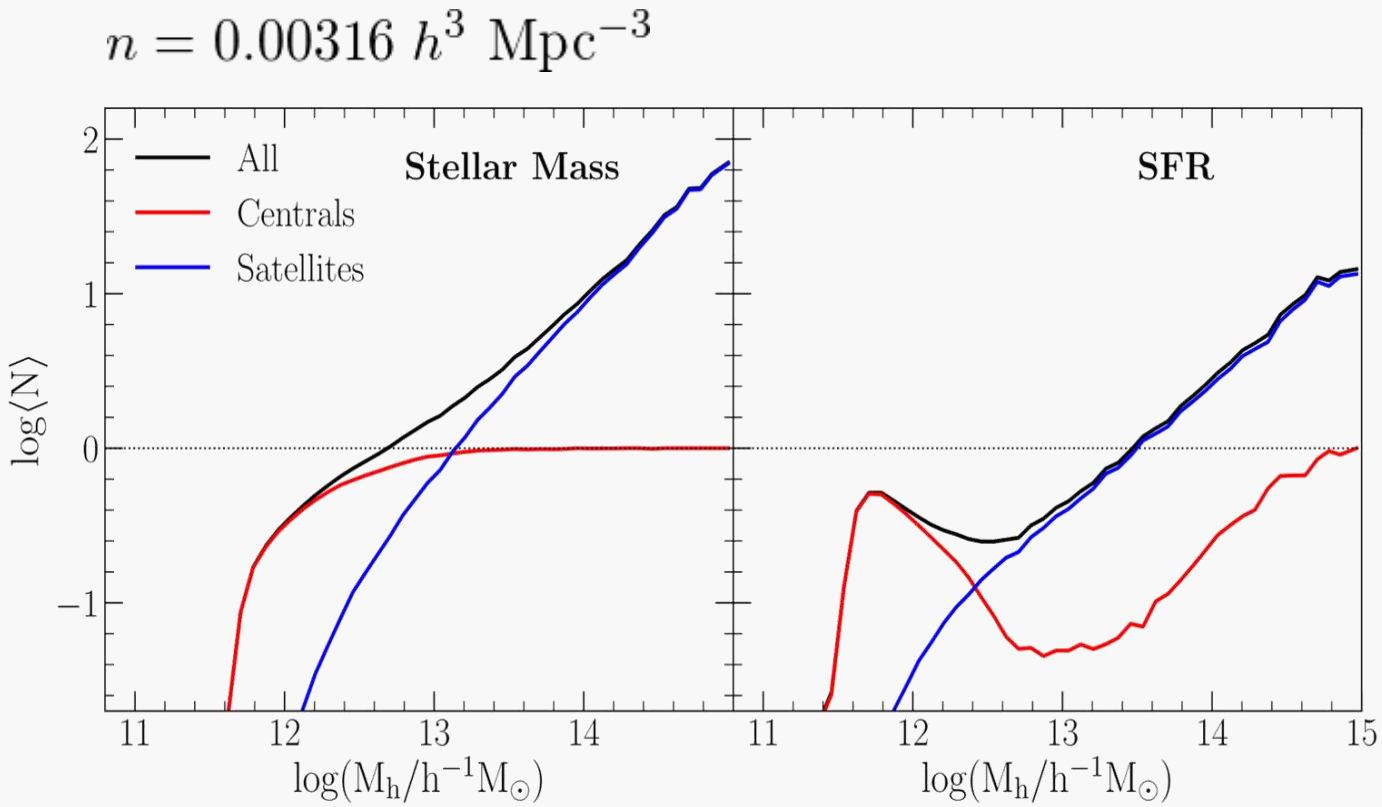


Galaxy samples and HODs

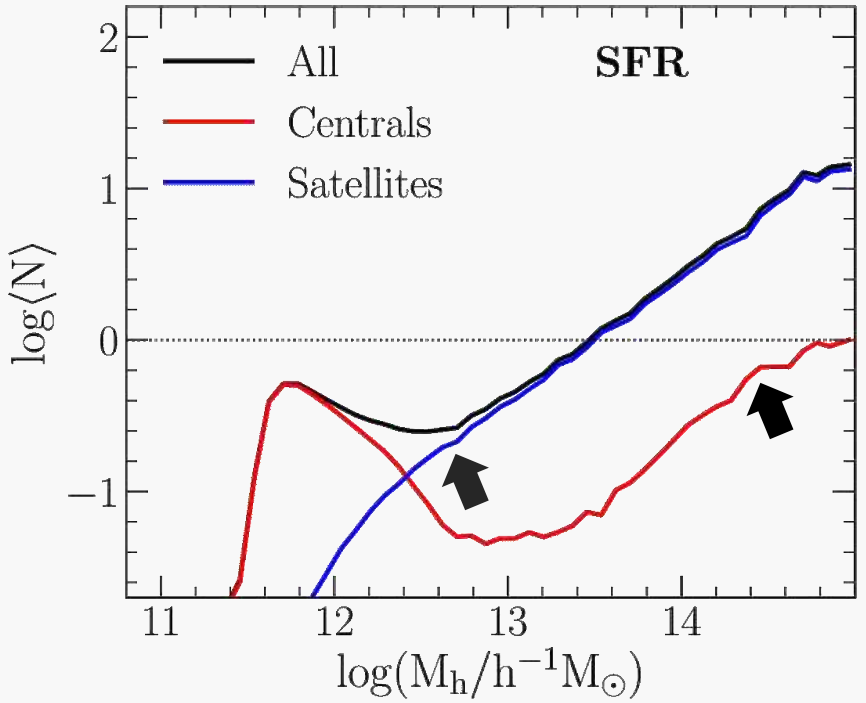
- **Catalogue**: Guo+13 semi-analytical model (SAM) run over the Millennium simulation.
- Galaxy samples selected by **stellar mass** and **SFR** according different number densities



Creating a synthetic universe

What is the best way to use the HOD modelling to produce mock galaxy catalogues?

1. **What HODs are used?**
2. What is the probability distribution of the HOD of satellites?
3. Radial distribution of satellites in haloes



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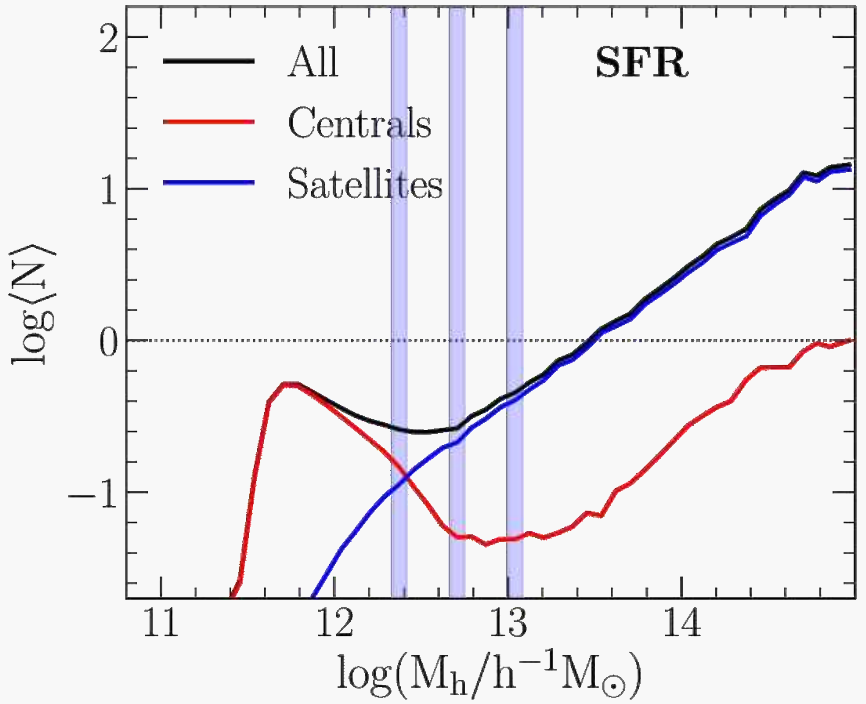
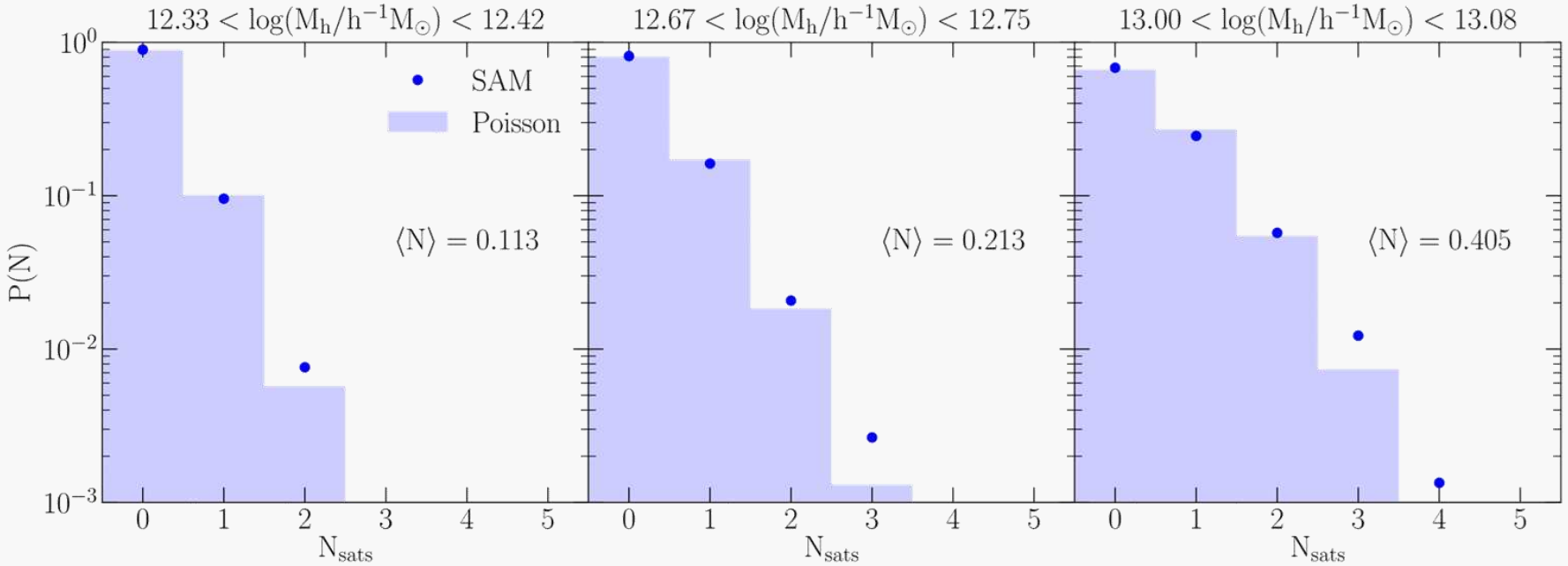
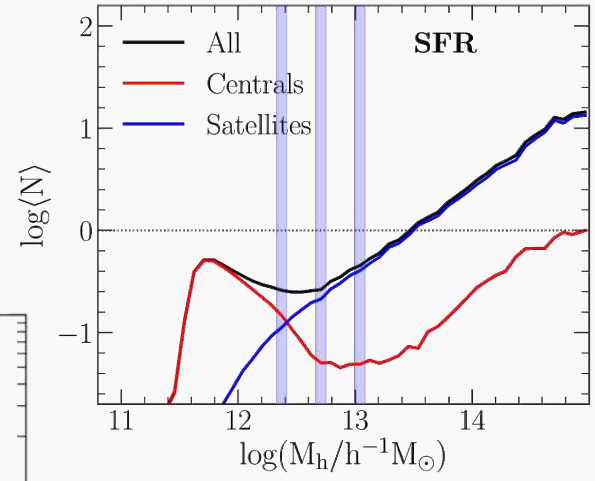


Creating a synthetic universe

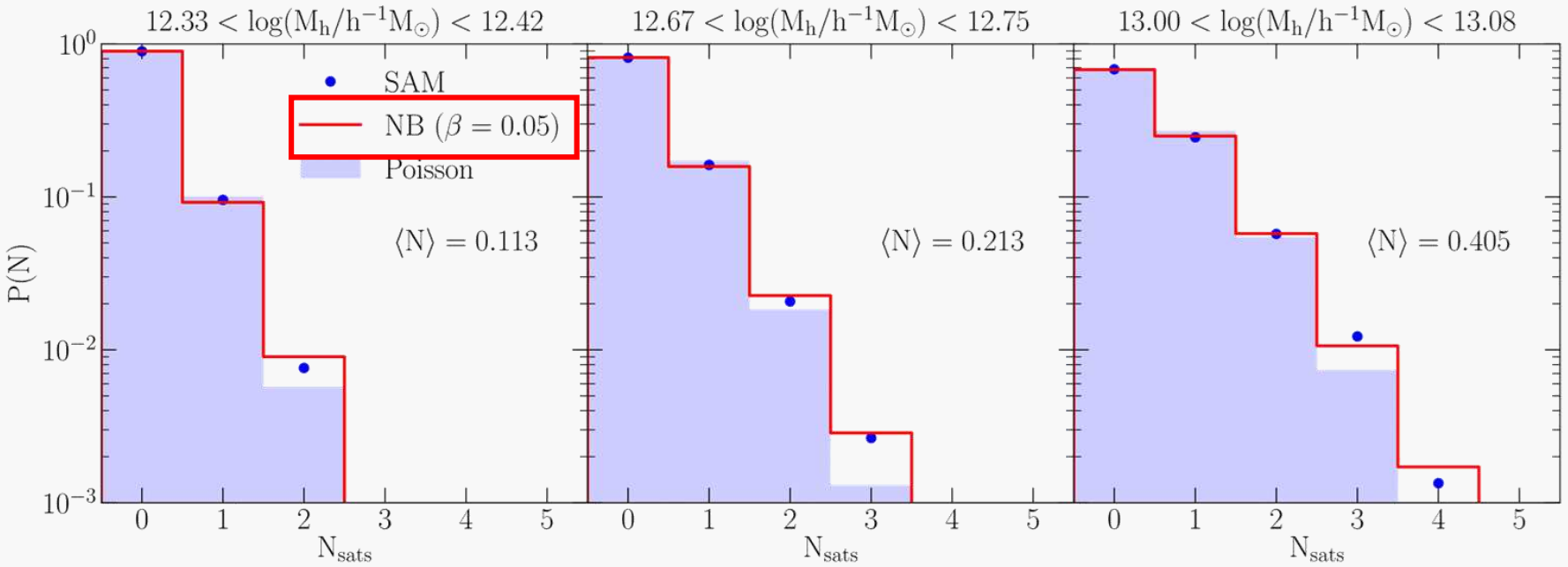


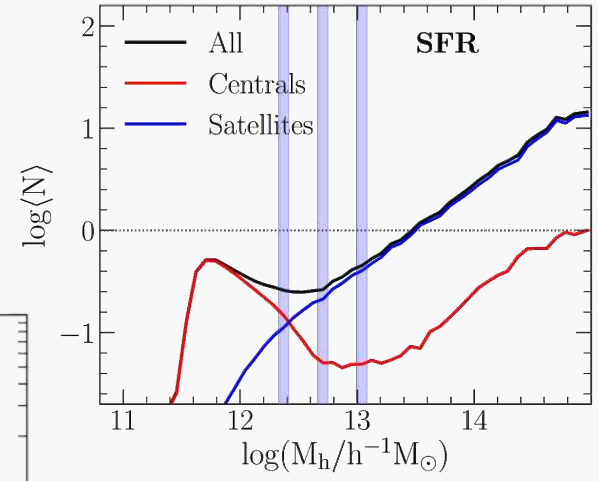


Creating a synthetic universe

Negative binomial distribution (NB) vs Poisson distribution

$$\sigma_{\rm NB} = (1+\beta)\sigma_{\rm Poiss}$$





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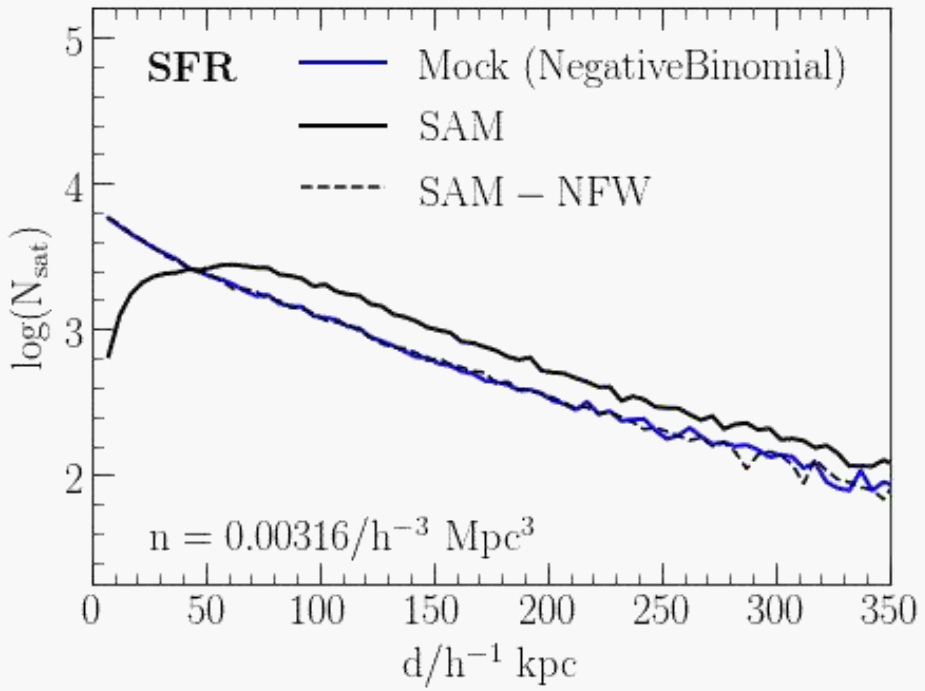
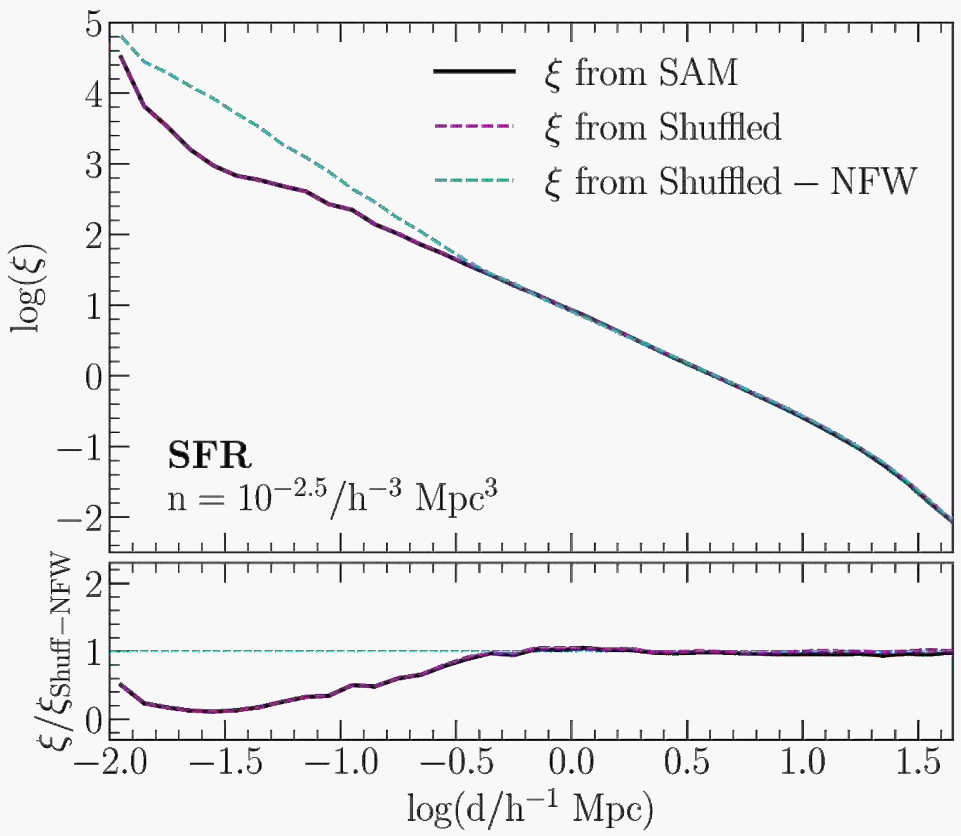


The shuffled-NFW catalogue



SAM catalogue

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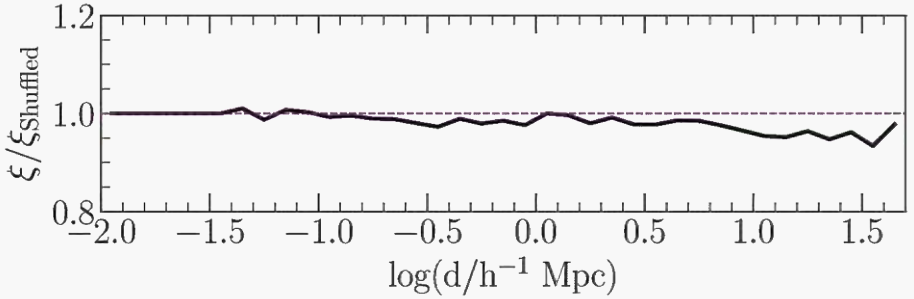
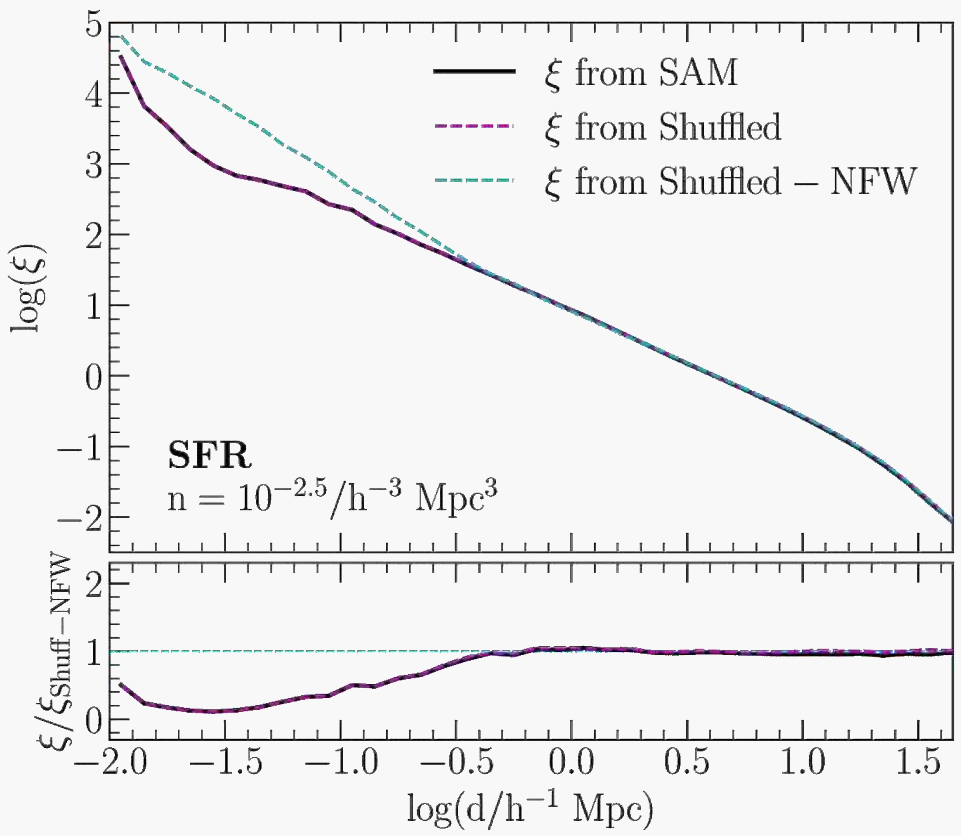
Shuffled catalogue

Assembly bias signal



SAM catalogue with assembly bias removed

The shuffled-NFW catalogue



SAM catalogue

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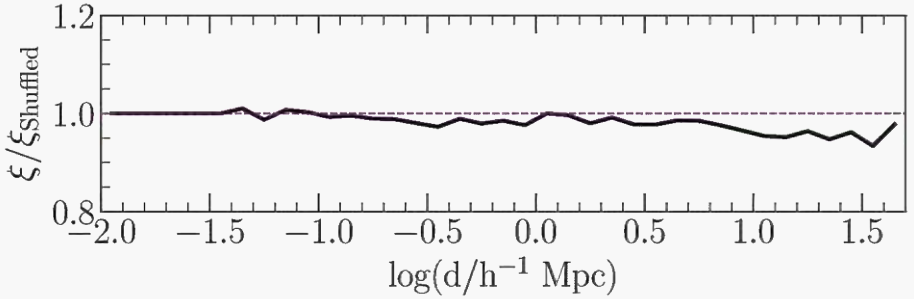
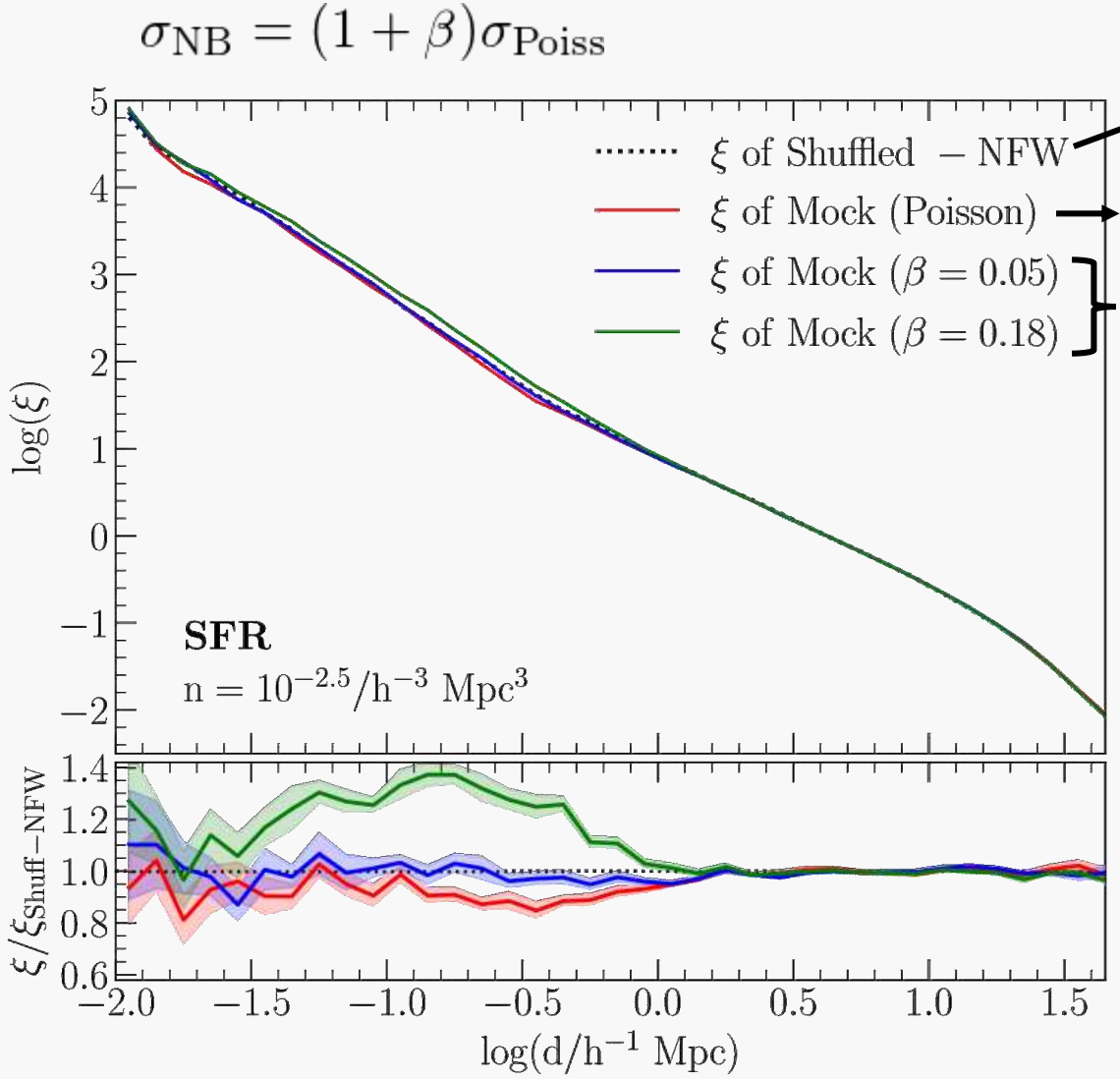


SAM catalogue with assembly bias removed

Shuffled catalogue with the same satellite profile of our HOD mocks

How accurate is the modelling?



Guo+ 13 galaxy sample, with no assembly bias and NFW profile for satellites

Mock using Poisson distribution for satellites

Mocks using different NB distribution for satellites

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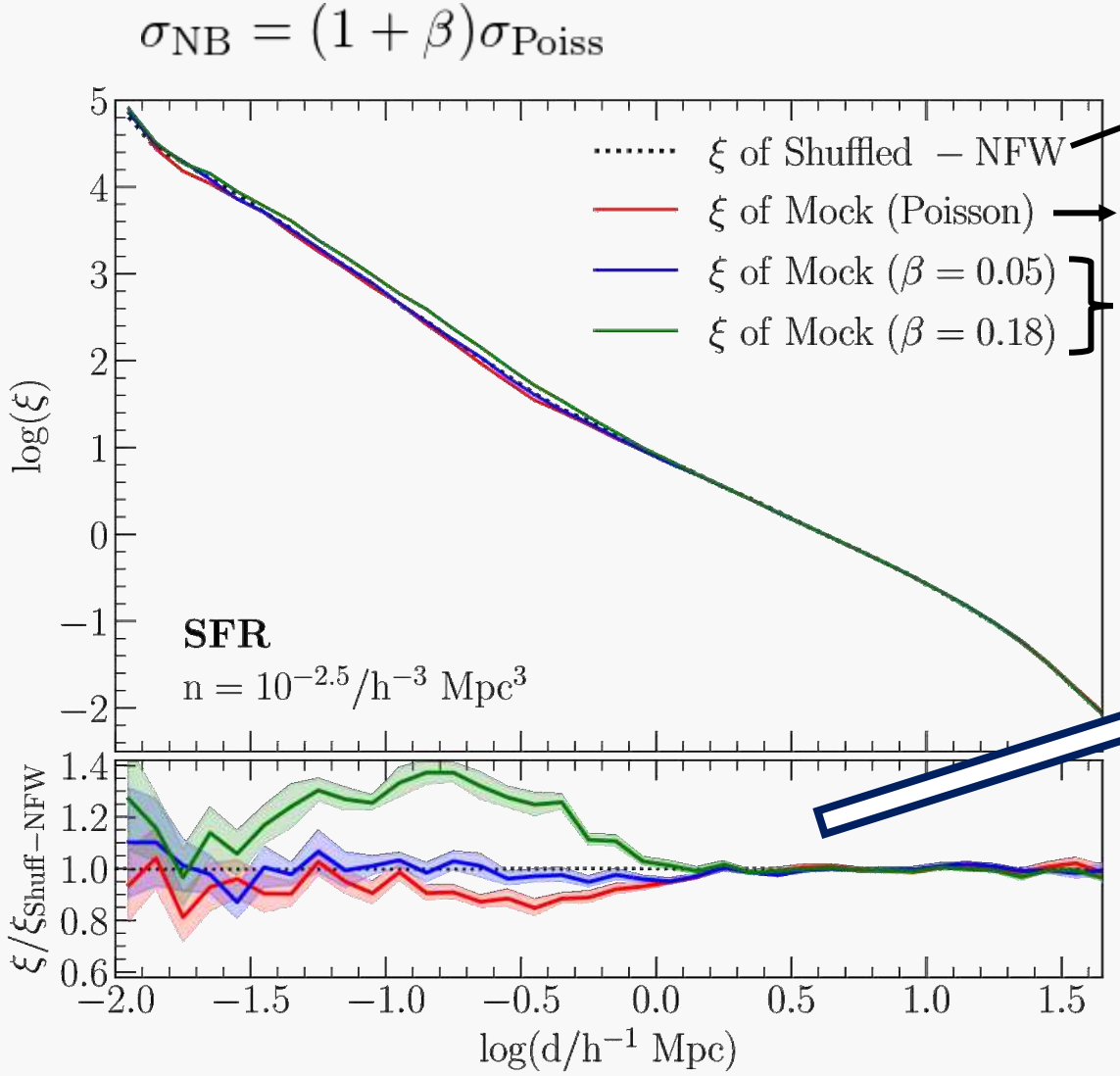

Guo+ 13 galaxy sample, with no assembly bias and NFW profile for satellites

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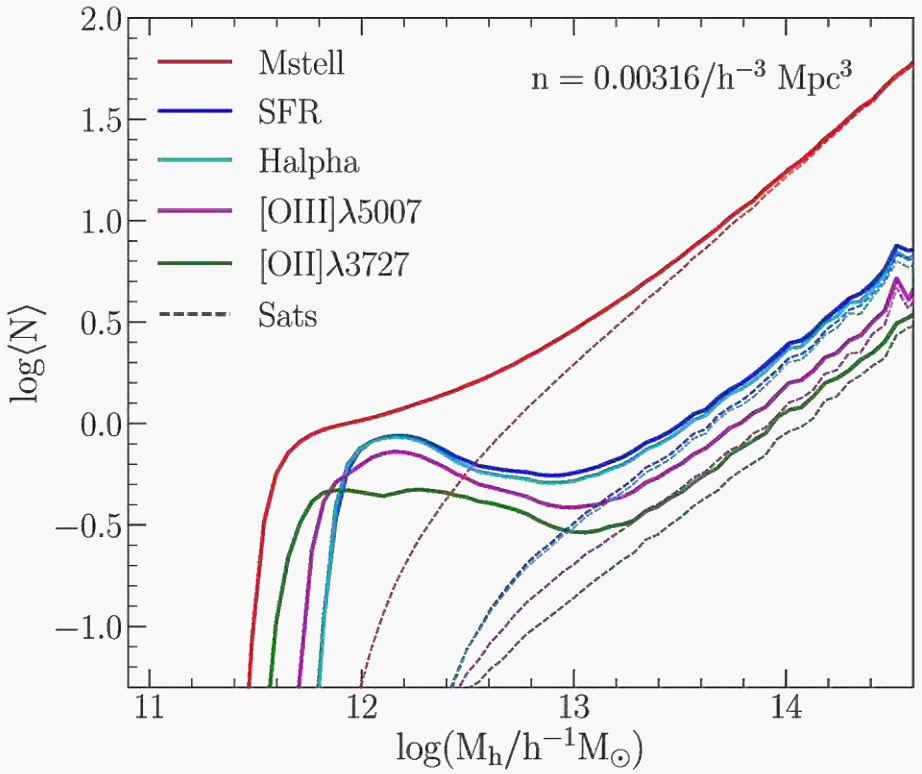
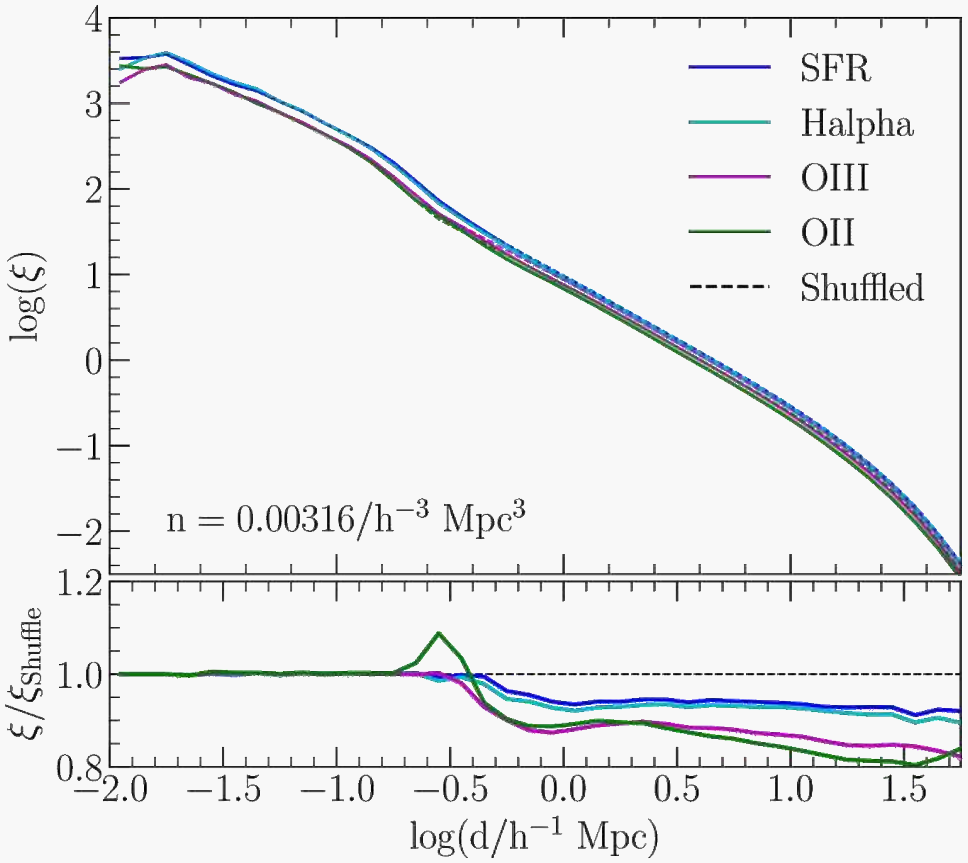
The scatter of the HOD of satellites has an strong impact in the clustering of star forming galaxies

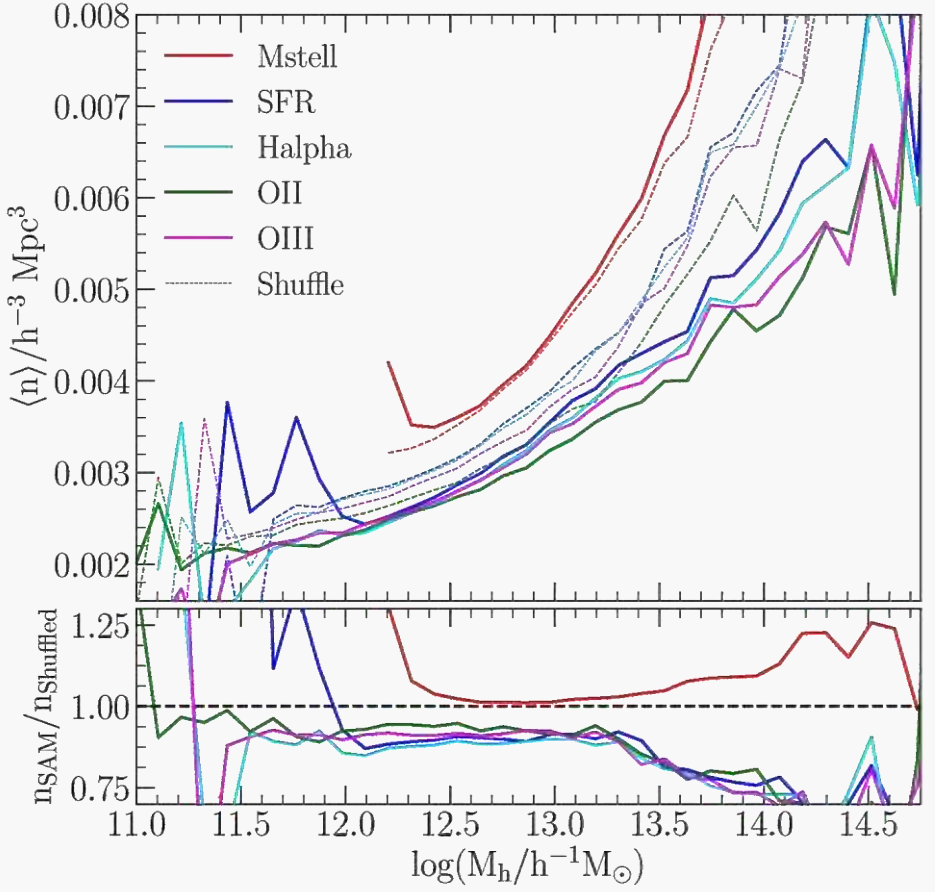
Assembly bias in ELG samples



- Haloes from the **Multi-Dark Plank simulation**
- **Catalogues**: Semi-Analytical Galaxies (SAG) and photoionizing code.
- **ELG luminosities** derived from SFRinst and Z

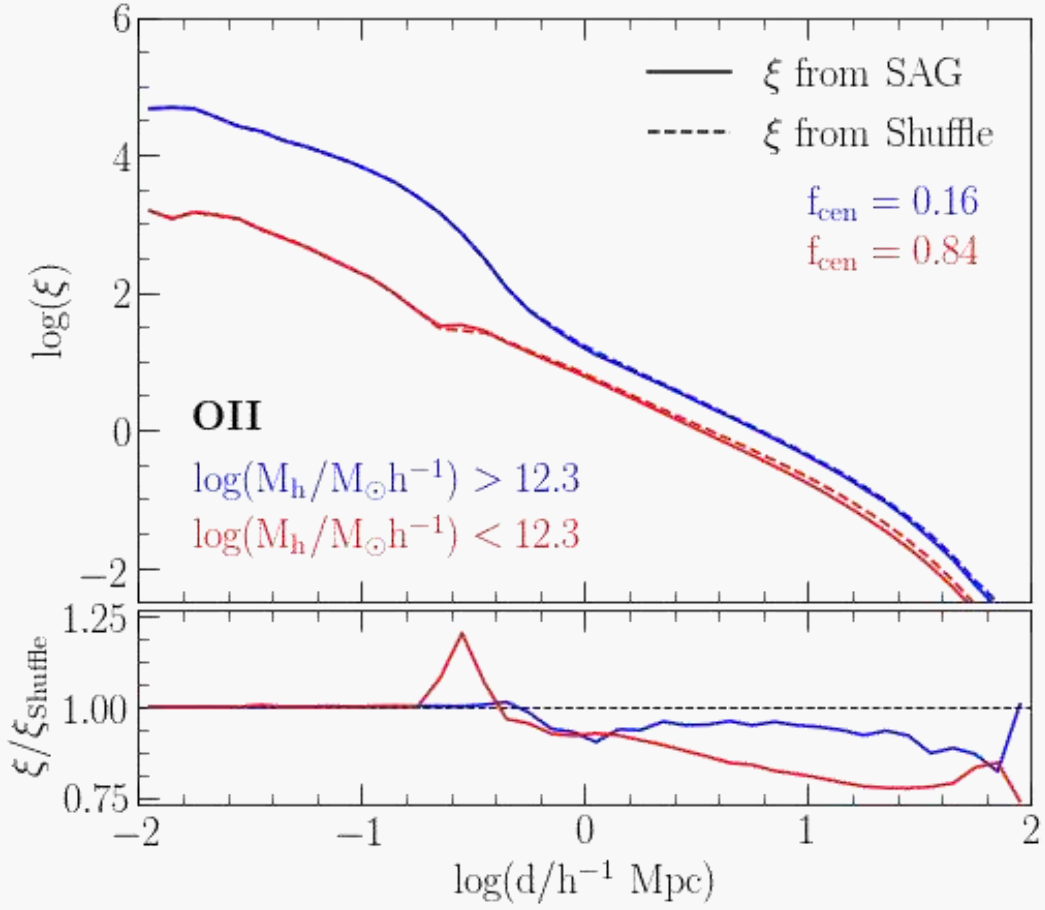
Assembly bias in ELG samples





ELGs tend to live in underdense regions

Assembly bias in ELG samples



- Scale dependent assembly bias in OII and OIII selected samples
- ELGs tend to live in underdense regions
- Scale dependent signal comes from low-mass haloes

Summary

- The HOD is a fast and a simple way to build mock catalogues.
- The scatter of the HOD of satellites in G13 samples is well fitted by a negative binomial distribution
- Accurate clustering predictions of SFR samples are obtained using this NB distribution for satellite galaxies.
- The assembly bias is scale-dependent in OII and OIII selected samples.