



Galaxy clustering with photo-z's

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Statistical challenges for large-scale structure in the era of LSST, Oxford

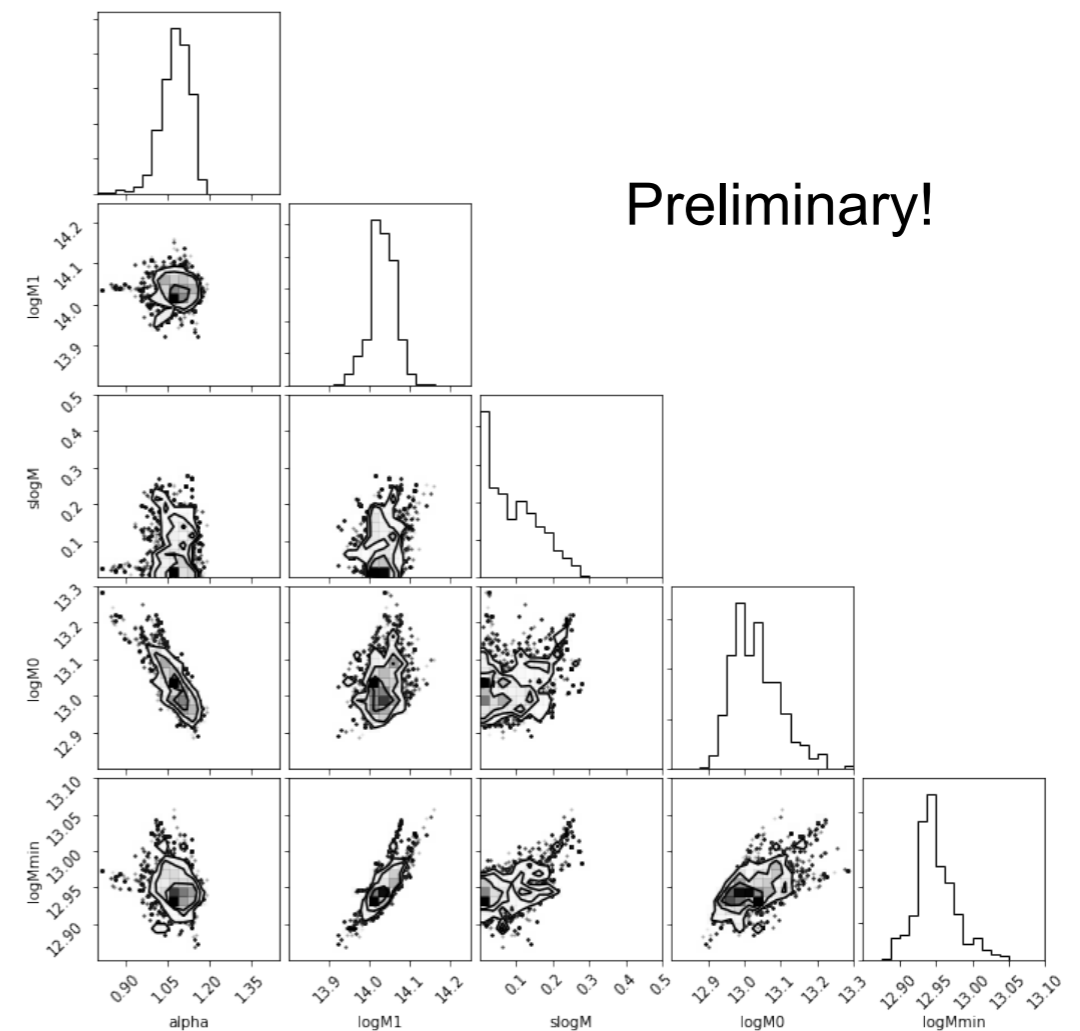
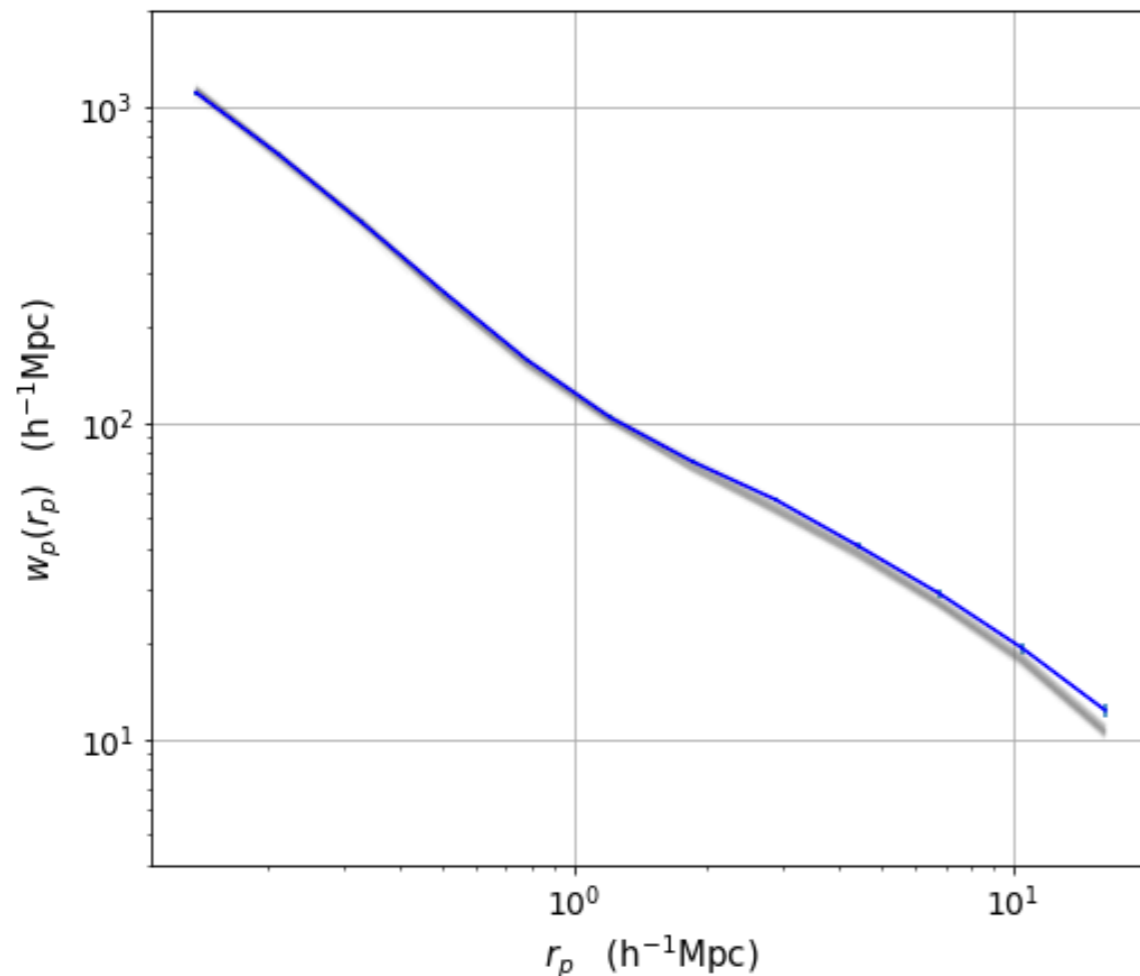
2018/04/20

Measuring $w_p(r_p)$ using photo-z's

Angular correlation function: photo-z information is only used for binning.

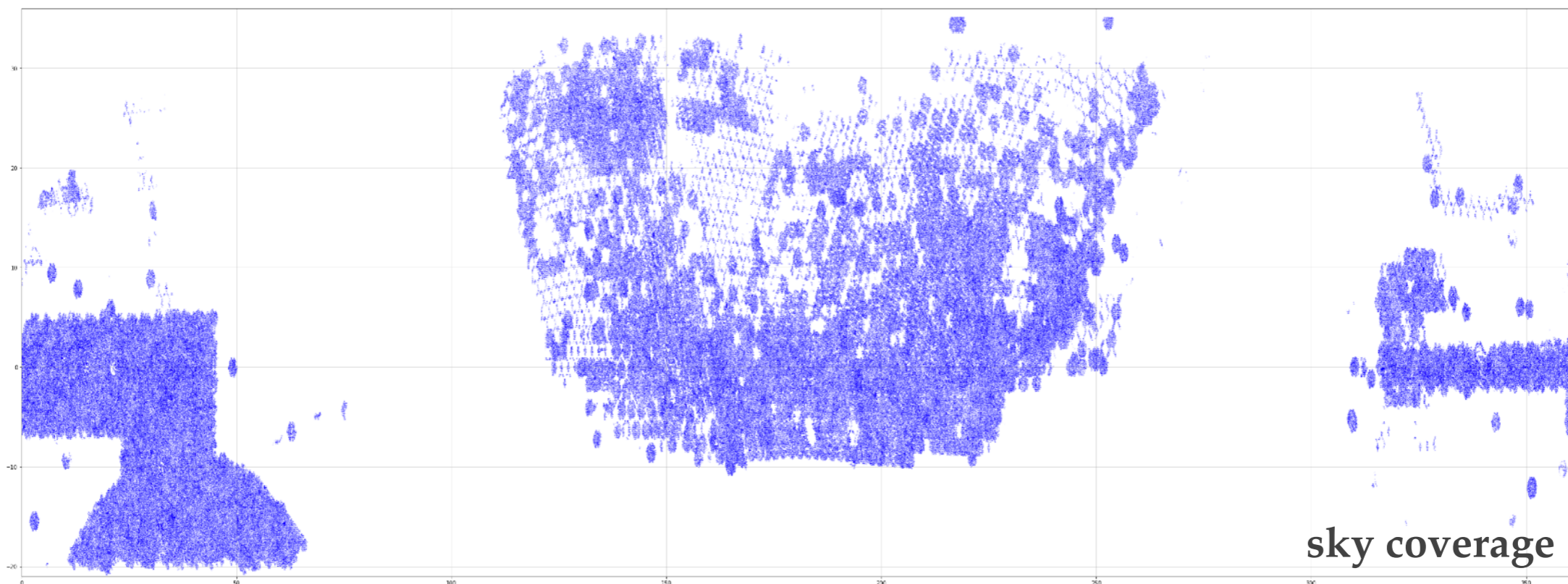
Projected correlation function $w_p(r_p)$ uses the photo-z information.

- Measure $w_p(r_p)$ using photo-z's from DECaLS data
- Model the photometric $w_p(r_p)$ with HOD



Dataset: LRGs from DECaLS

- ❖ Luminous red galaxies selected using DECaLS DR5 (*grz*) + WISE (*W1*)
- ❖ Photo-*z*'s computed using random forest, $\sigma_z \sim 0.02$
- ❖ 2.1 million objects over 3800 deg² used for computing $w_p(r_p)$
- ❖ Covariance matrices of $w_p(r_p)$ obtained from jackknife resampling



Interactive map: legacysurvey.org/viewer?layer=decals-dr5

Measuring $w_p(r_p)$ using photo- z 's

Projected correlation function:

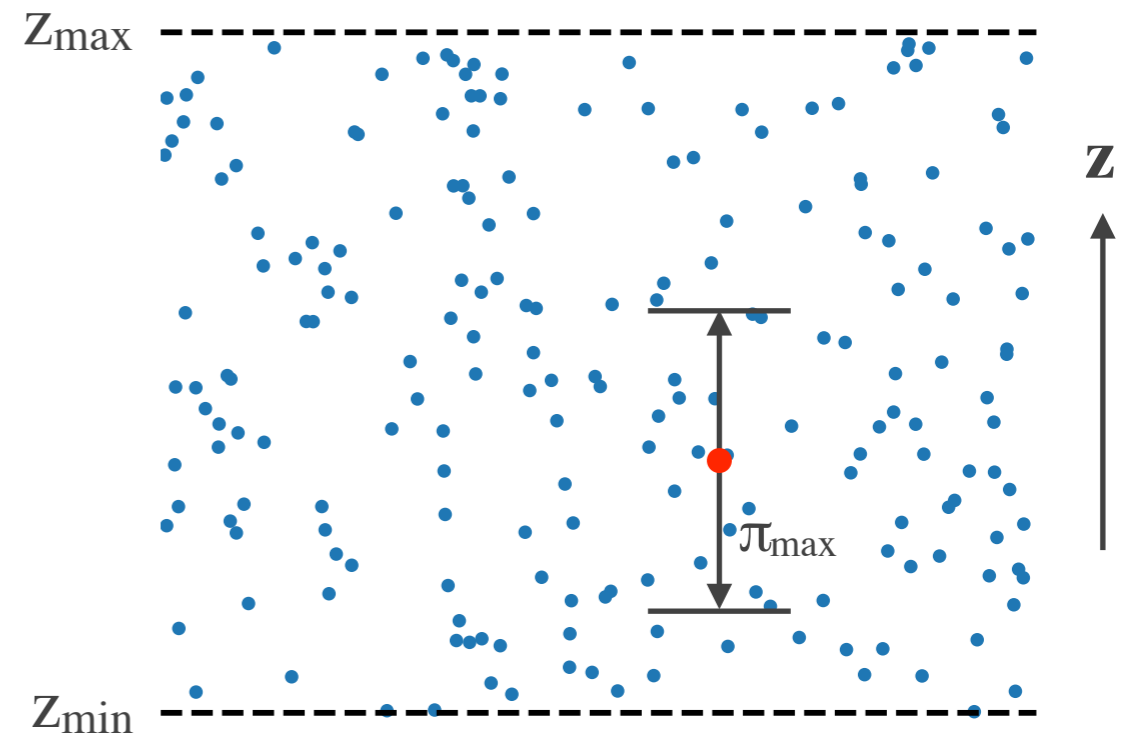
$$w_p(r_p) = \int_{-\pi_{max}}^{\pi_{max}} \xi(r_p, \pi) d\pi$$

Landy-Szalay estimator:

$$w_p(r_p) = \frac{(DD - 2DR + RR)}{RR}$$

D : data

R : randoms



Measuring $w_p(r_p)$ using photo- z 's

Projected correlation function:

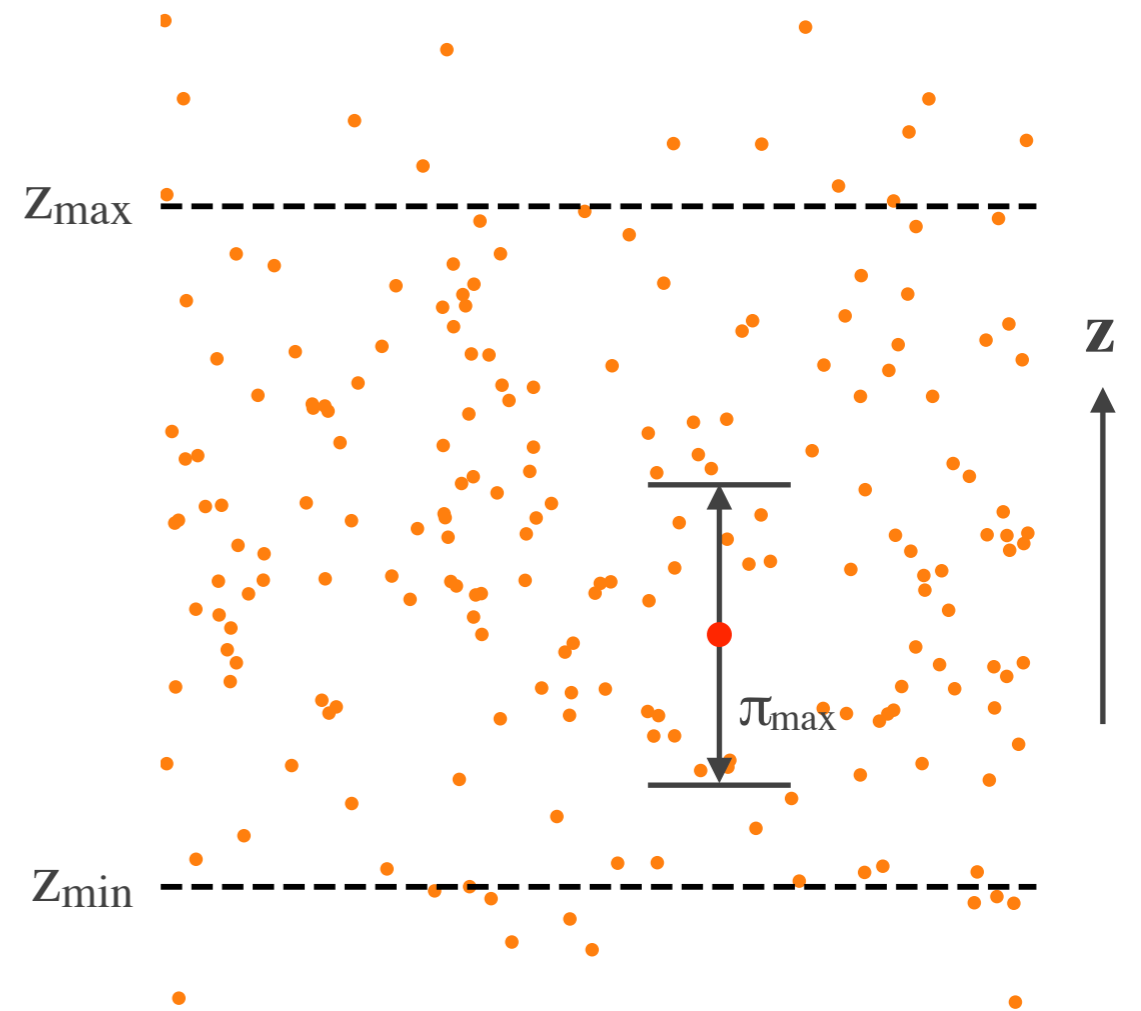
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Measuring $w_p(r_p)$ using photo- z 's

“Cross-correlation” L-S estimator:

$$w_p(r_p) = \frac{(D_1 D_2 - D_1 R_2 - D_2 R_1 + R_1 R_2)}{R_1 R_2}$$

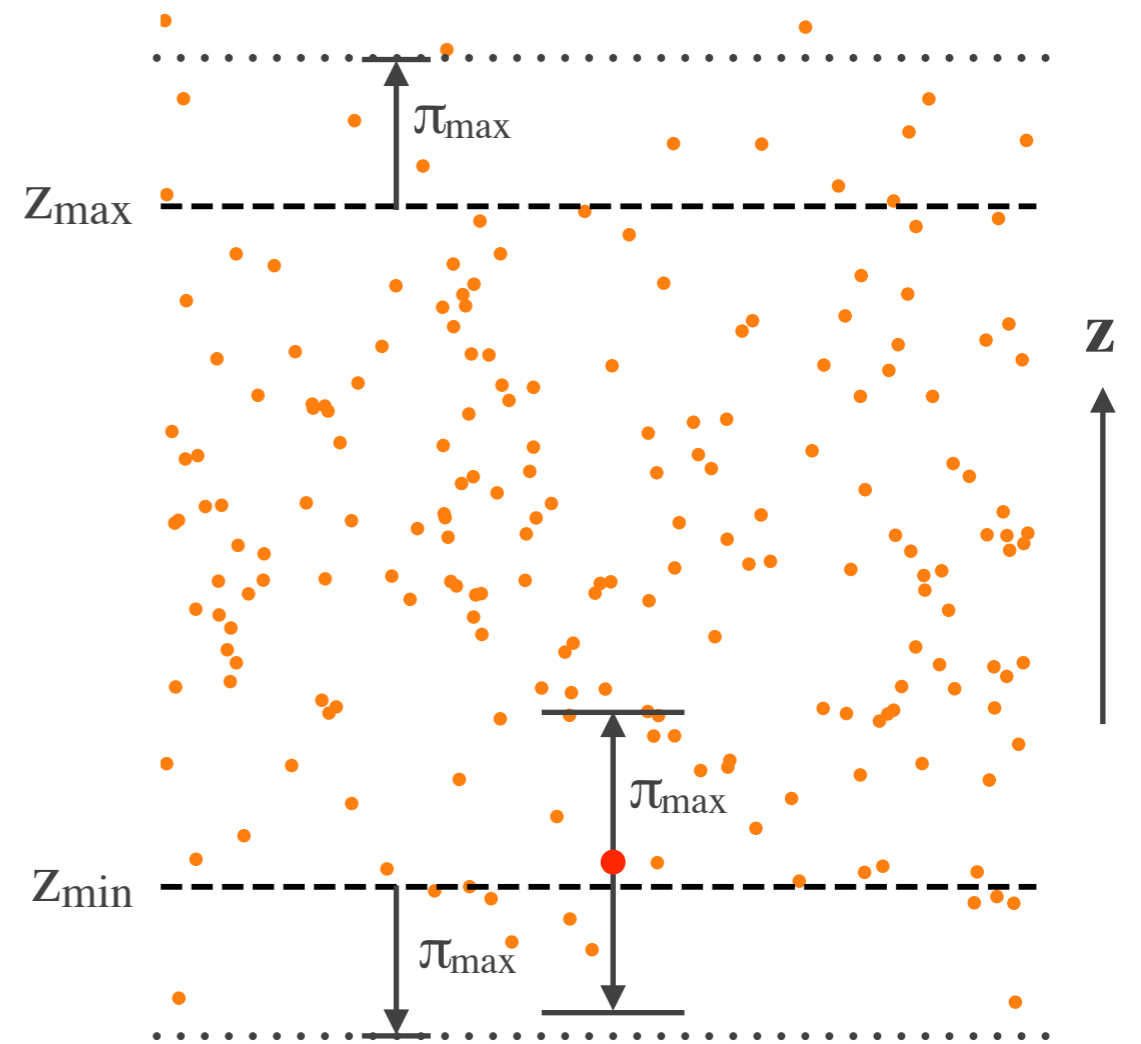
$$\pi_{\max} = 200 \text{ Mpc}/h$$

D_1 : data

D_2 : data in extended redshift bin

R_1 : randoms

R_2 : randoms in extended redshift bin



The extended redshift bin (D_2, R_2) allows for consistent modeling using mock galaxies.

Measuring $w_p(r_p)$ using photo-z's

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D_1 : data

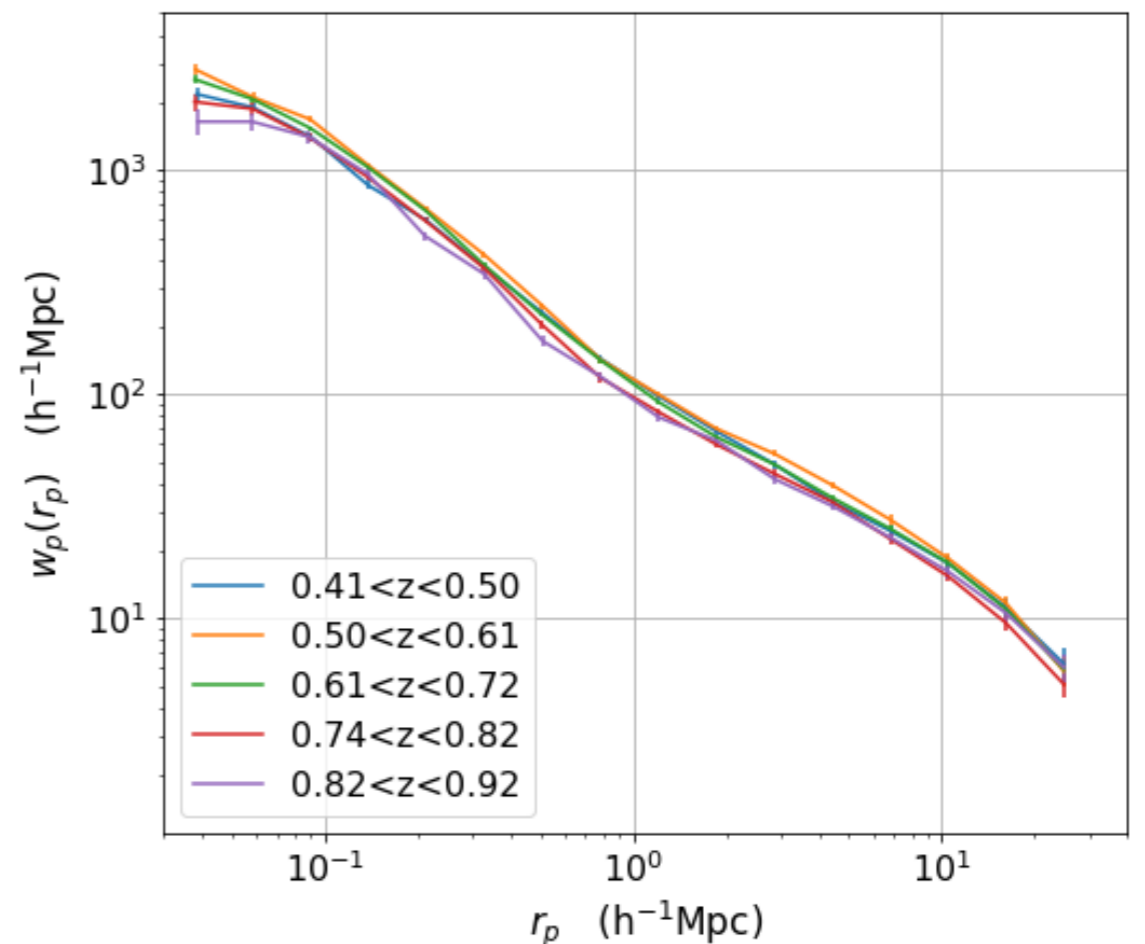
D_2 : data in extended redshift bin

R_1 : randoms

R_2 : randoms in extended redshift bin

The extended redshift bin (D_2 , R_2) allows for consistent modeling using mock galaxies.

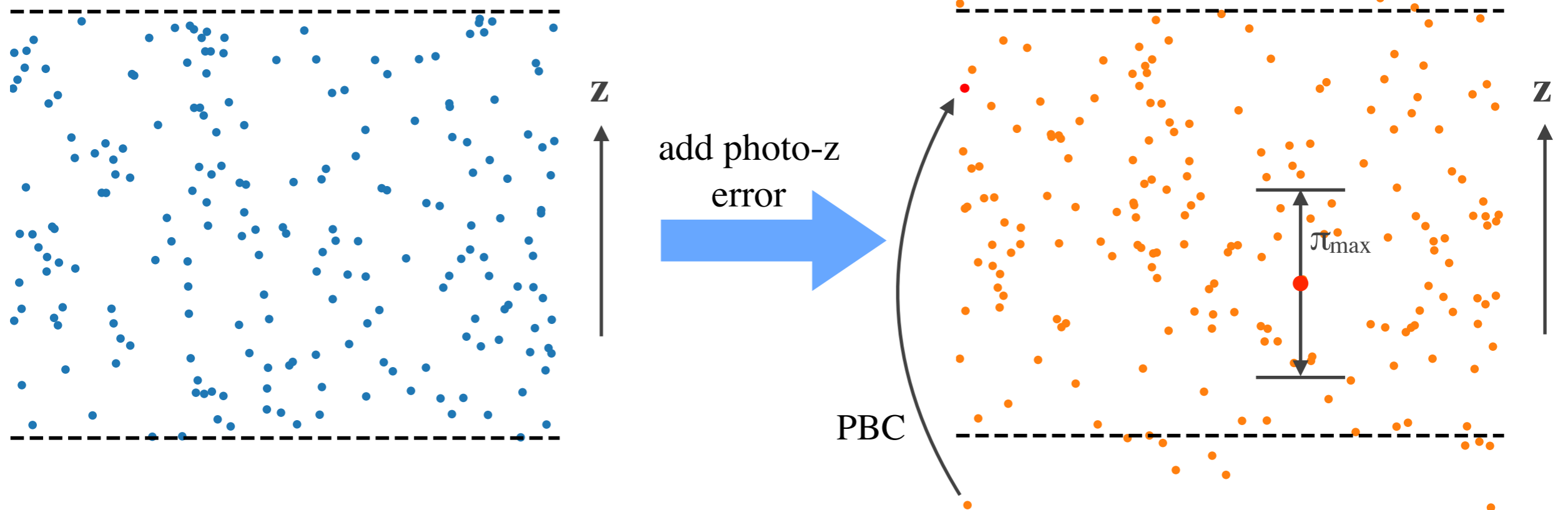
Preliminary!



Modeling with HOD

- ❖ Use the photometric $w_p(r_p)$ to constrain halo occupation distribution parameters
- ❖ Rockstar halo catalog from MultiDark Planck 2 simulation (box size: 1 Gpc/h)
- ❖ Perturb the radial position of the mock galaxies according to the photo-z errors and compute $w_p(r_p)$
- ❖ Sample HOD parameter space with MCMC

Mock galaxies populated with HOD



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