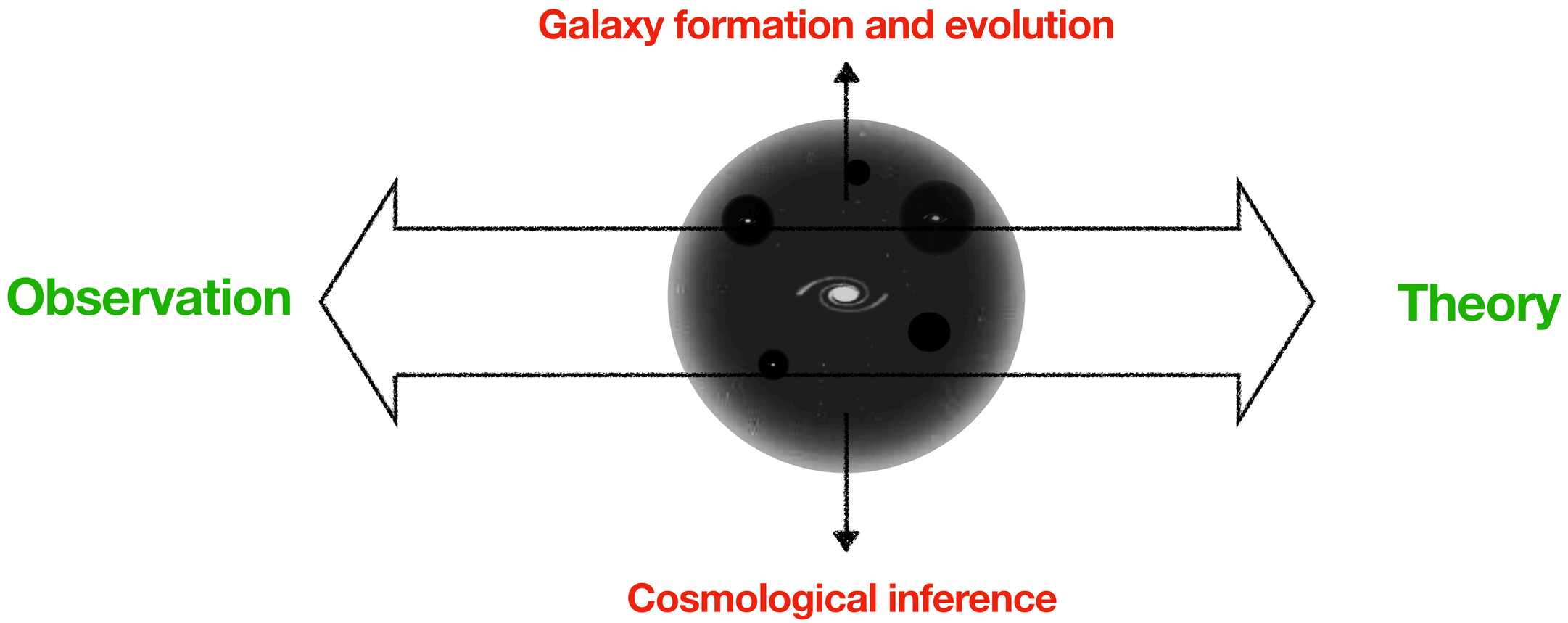
Constraining Galaxy Assembly Bias with Count Statistics

Kuan Wang; Yao-Yuan Mao;
Andrew R. Zentner; Frank C. van den Bosch;
Johannes U. Lange; Hong Guo;
Chad M. Schafer; Antonio S. Villarreal;
Andrew P. Hearin; Duncan Campbell

Galaxy–halo connection



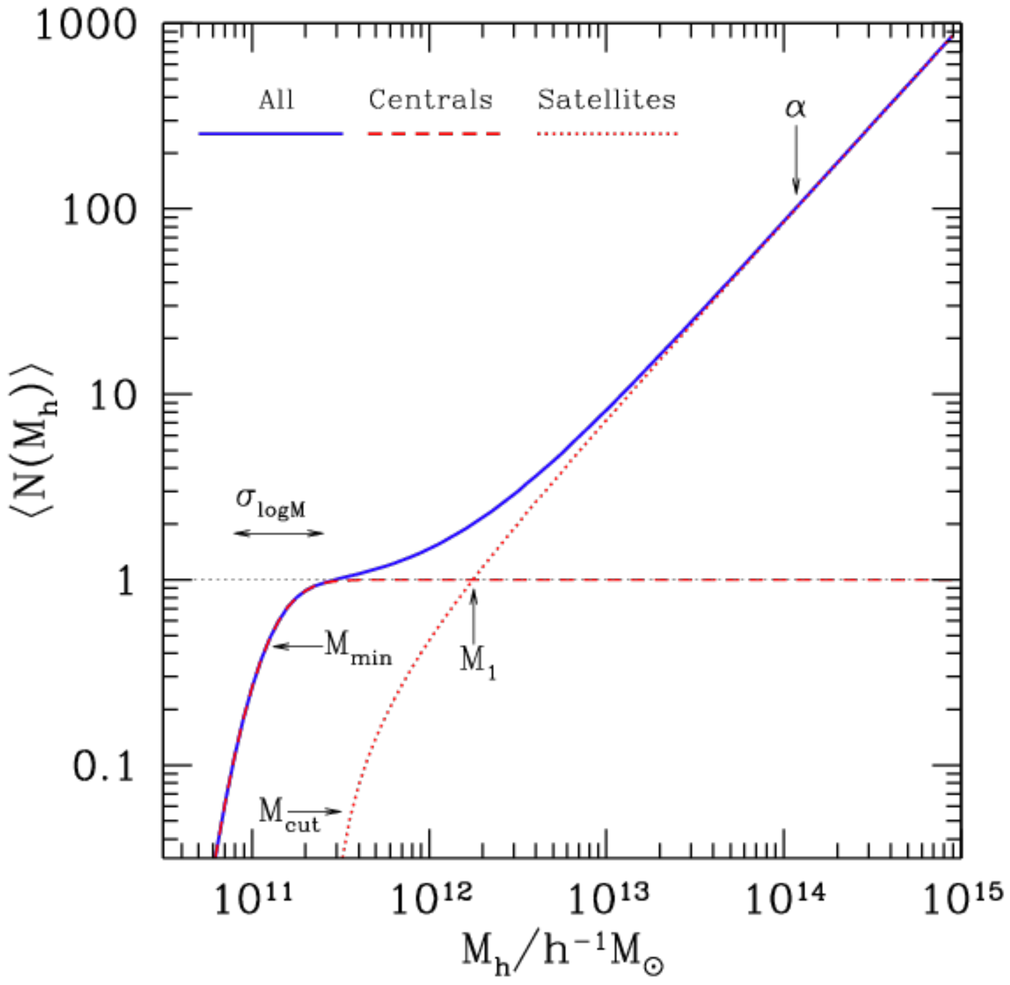
Kuan Wang 王宽

kuanwang.astro@gmail.com

Empirical models

Halo occupation distribution

(HOD)



Contreras et al. 2017

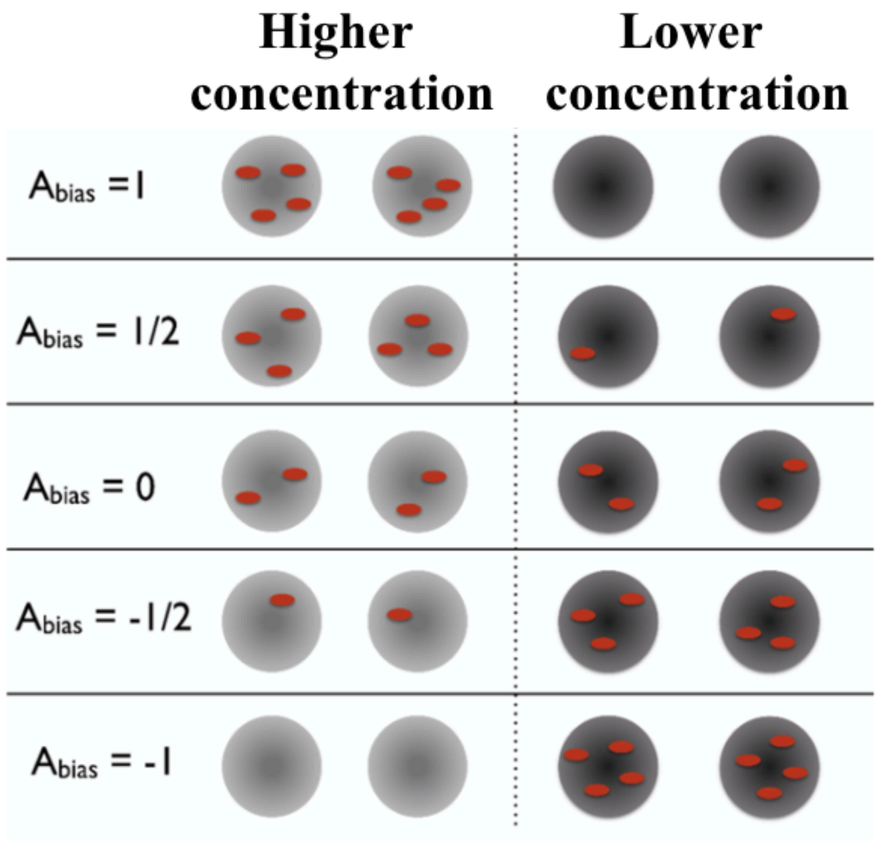
Kuan Wang 王宽

kuanwang.astro@gmail.com

Galaxy assembly bias

Decorated halo occupation distribution

(dHOD)



Hearin et al. 2016

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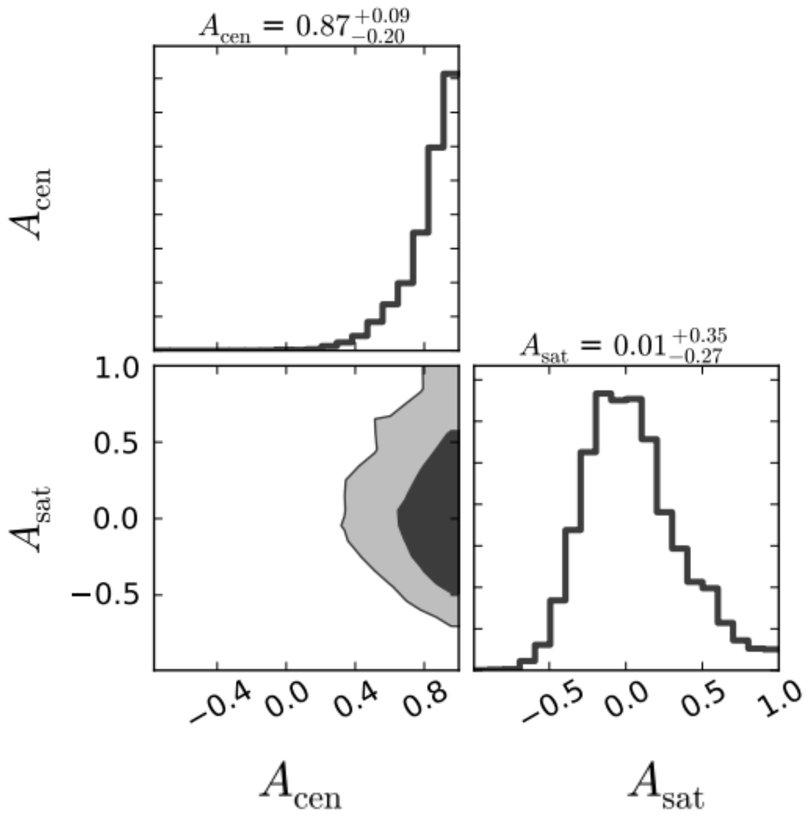
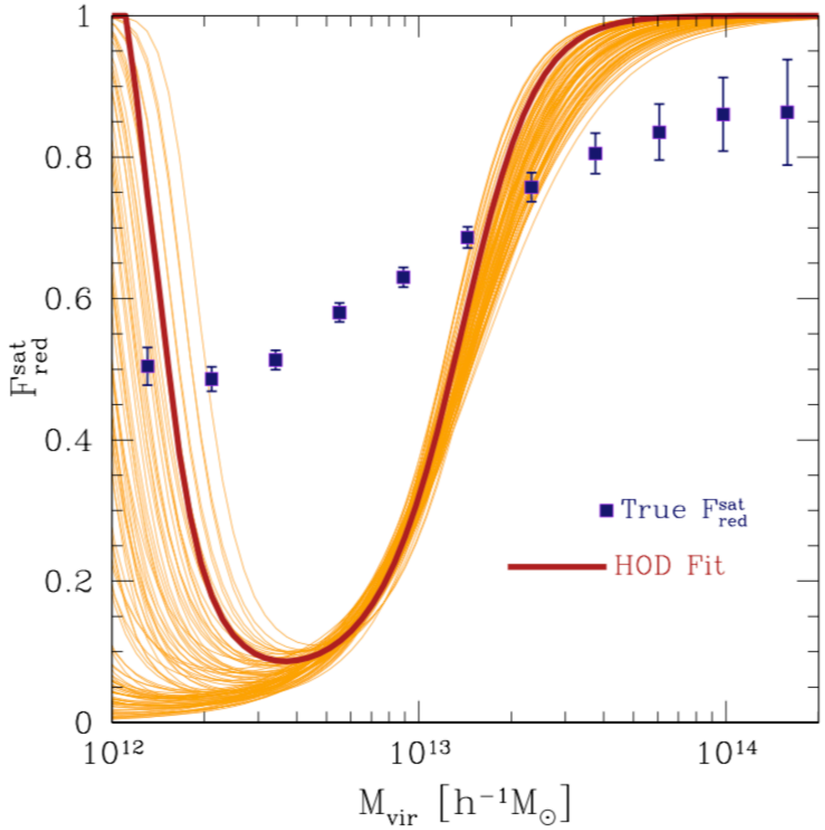
Why does it matter?

Indications from data



Zentner et al. 2019

Wrong cosmological inferences if ignored



Zentner et al. 2014

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How do we tell?

Real galaxy distribution

Mock galaxy distribution

But not directly!

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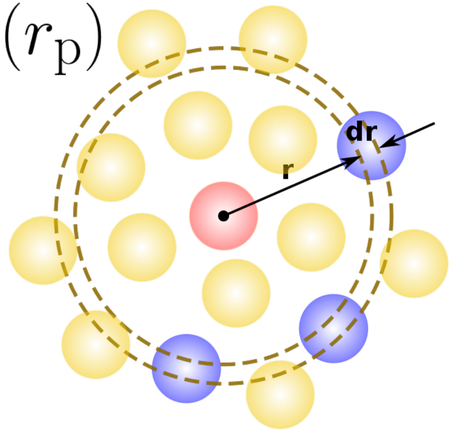
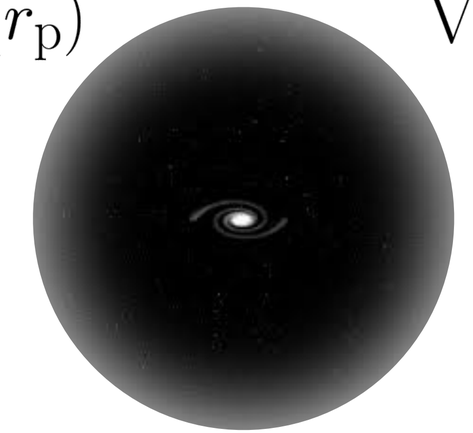
Candidate statistics

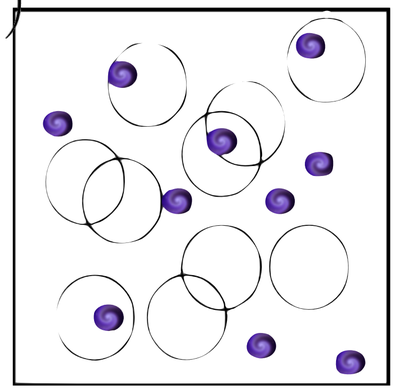
$w_{\rm p}(r_{\rm p})$



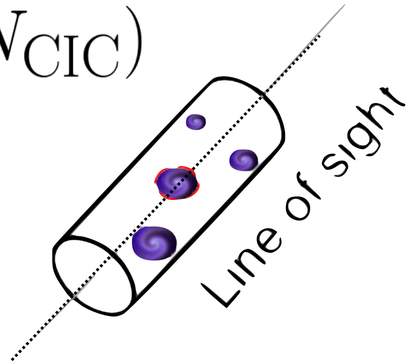
$\Delta\Sigma(r_{\rm p})$



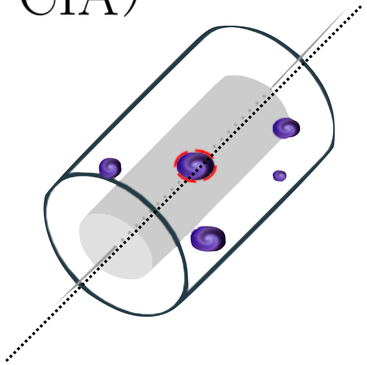
$\mathrm{VPF(r)}$



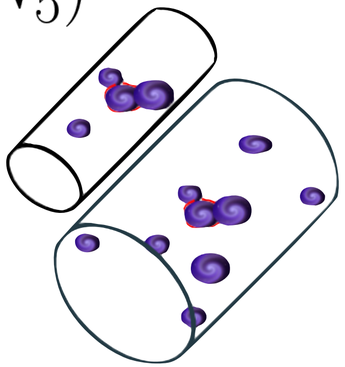
$P(N_{\rm CIC})$



$P(N_{\rm CIA})$



$P(N_2/N_5)$



Kuan Wang 王宽

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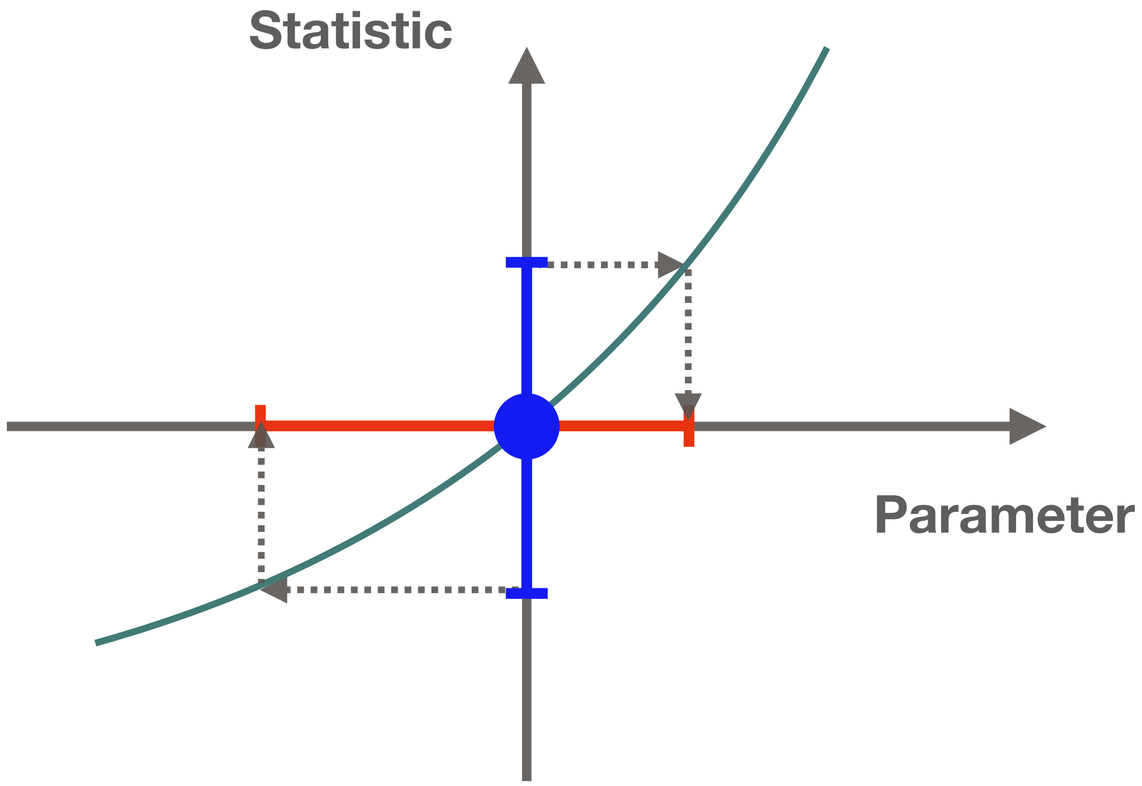
Wang et al. 2019
https://ui.adsabs.harvard.edu/abs/2019MNRAS.488.3541W/abstract

Theoretical Forecast

Done with the Bolshoi Planck Simulation

Fisher analysis

Wang et al. 2019
https://ui.adsabs.harvard.edu/abs/2019MNRAS.488.3541W/abstract



Uncertainty in statistic + dependence of statistic on parameter

→ uncertainty in parameter —— constraints

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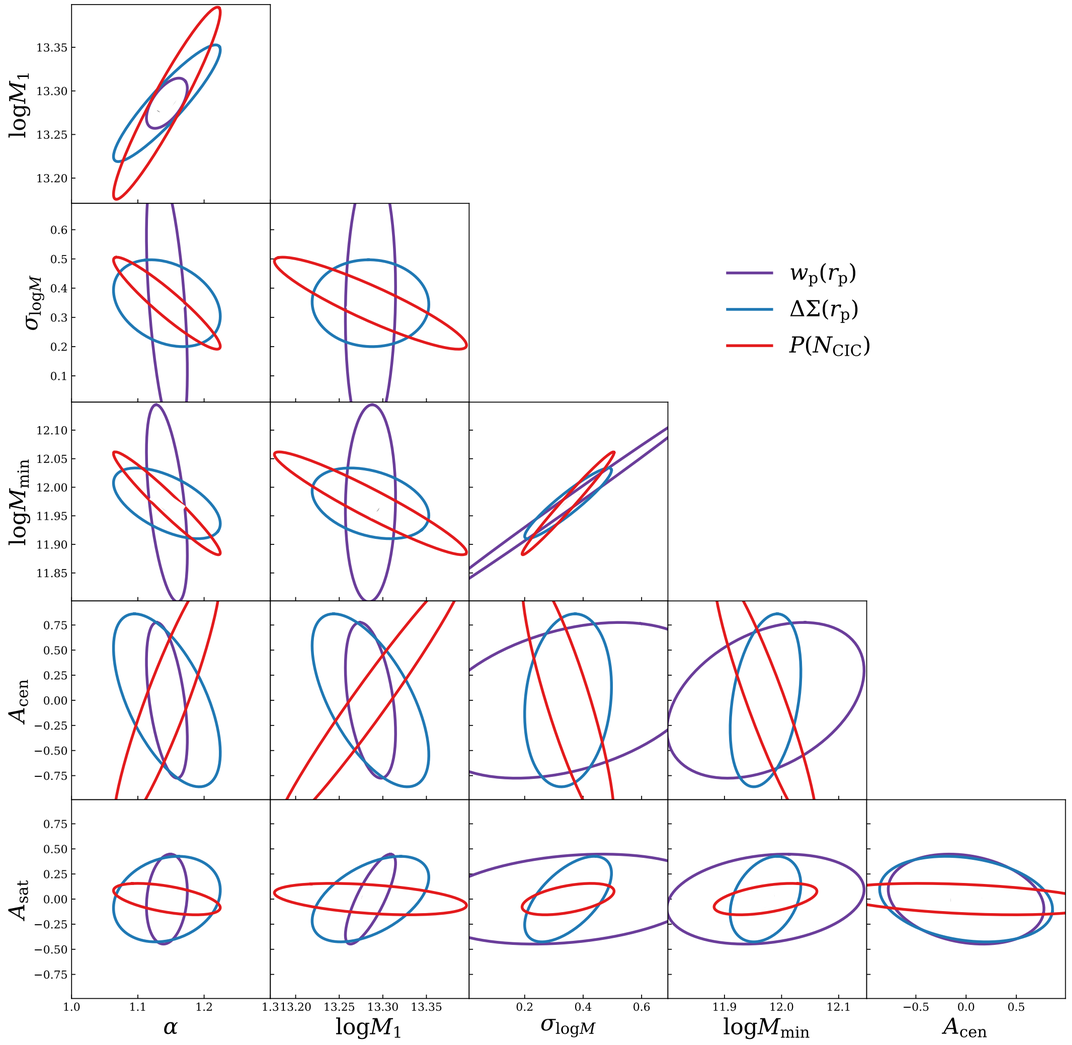
Results



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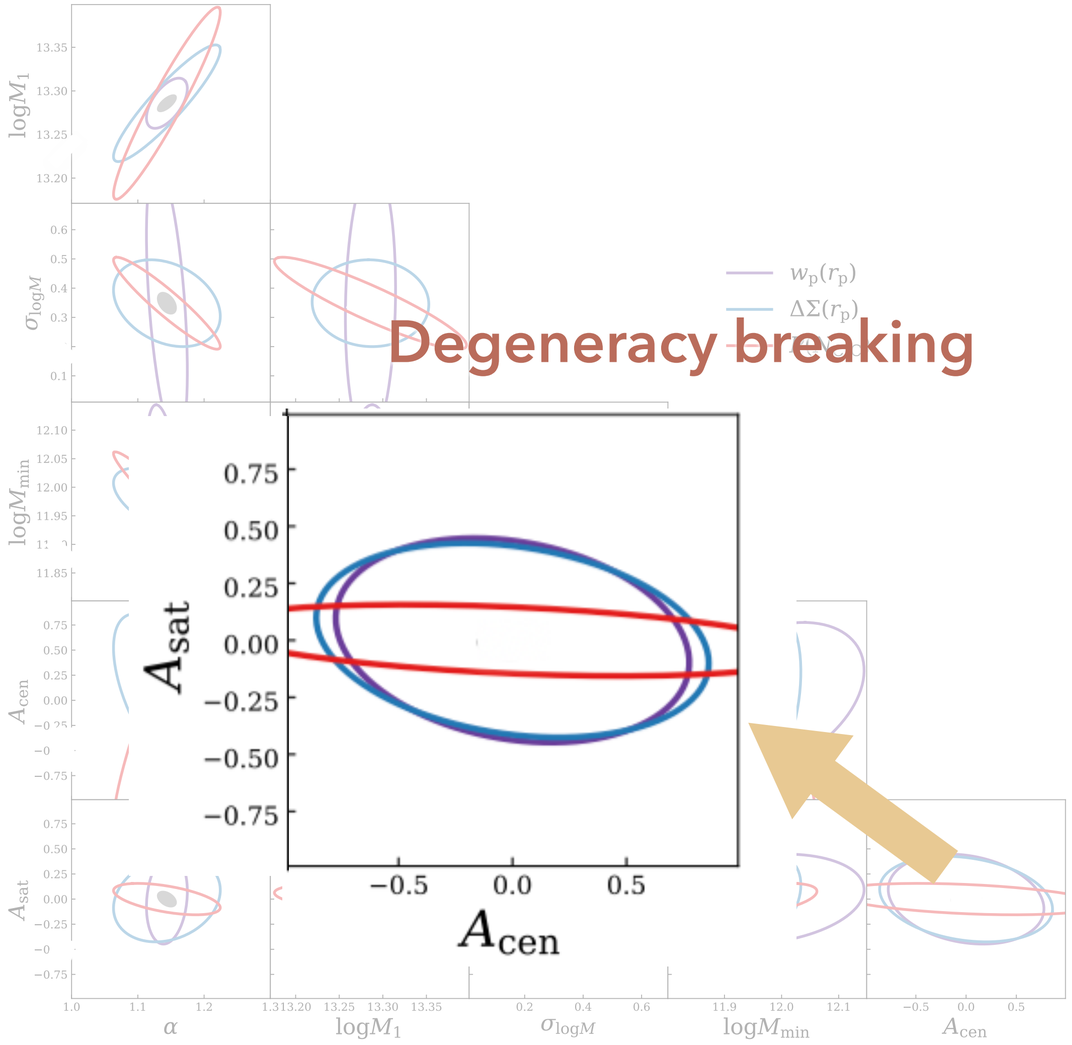
Results



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Results

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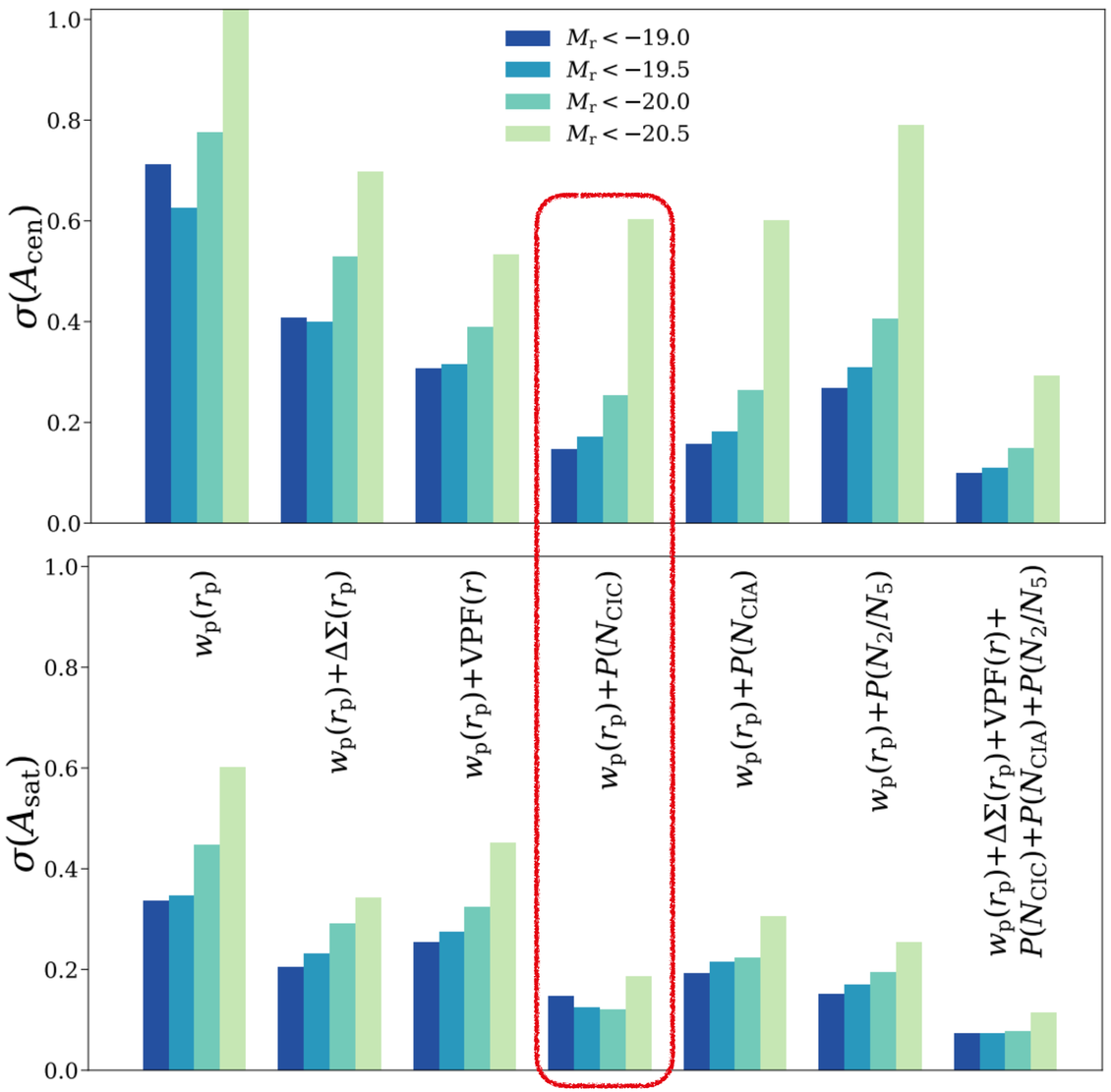
More constraining



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Count statistics best complement the canonical two-point correlation function in constraining **galaxy assembly bias** by breaking degeneracies in the parameter space

Wang et al. in prep
https://github.com/KuanWang-Astro/SDSS-CIC

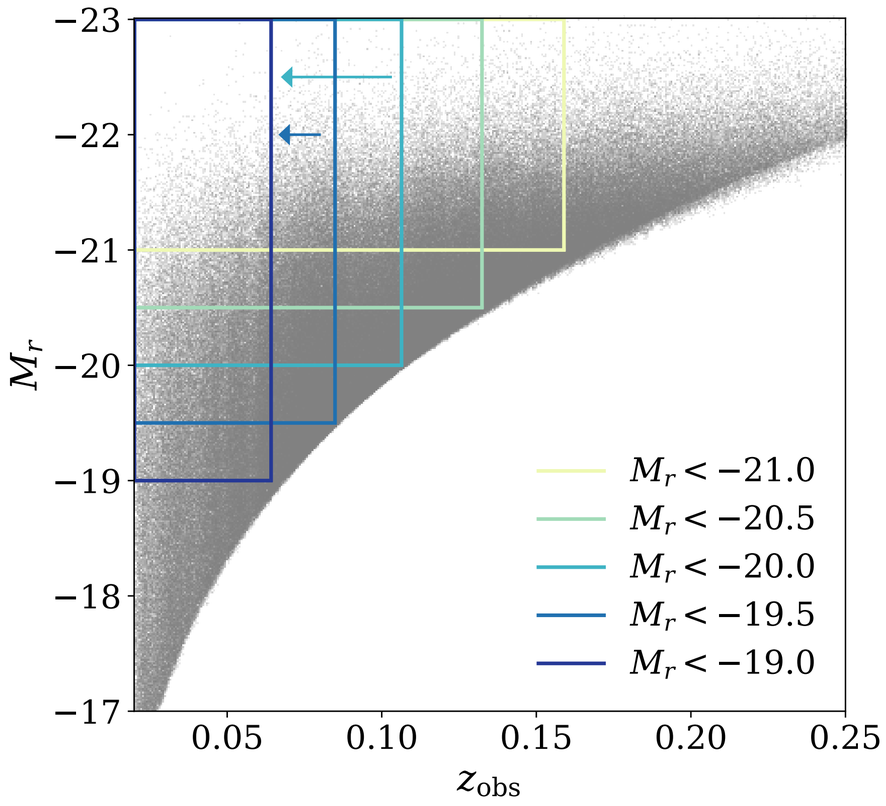
Data Constraints

Done with the Small MultiDark Planck Simulation and
Sloan Digital Sky Survey Data Release 7

SDSS data

Wang et al. in prep
https://github.com/KuanWang-Astro/SDSS-CIC

Volume limited, luminosity threshold samples



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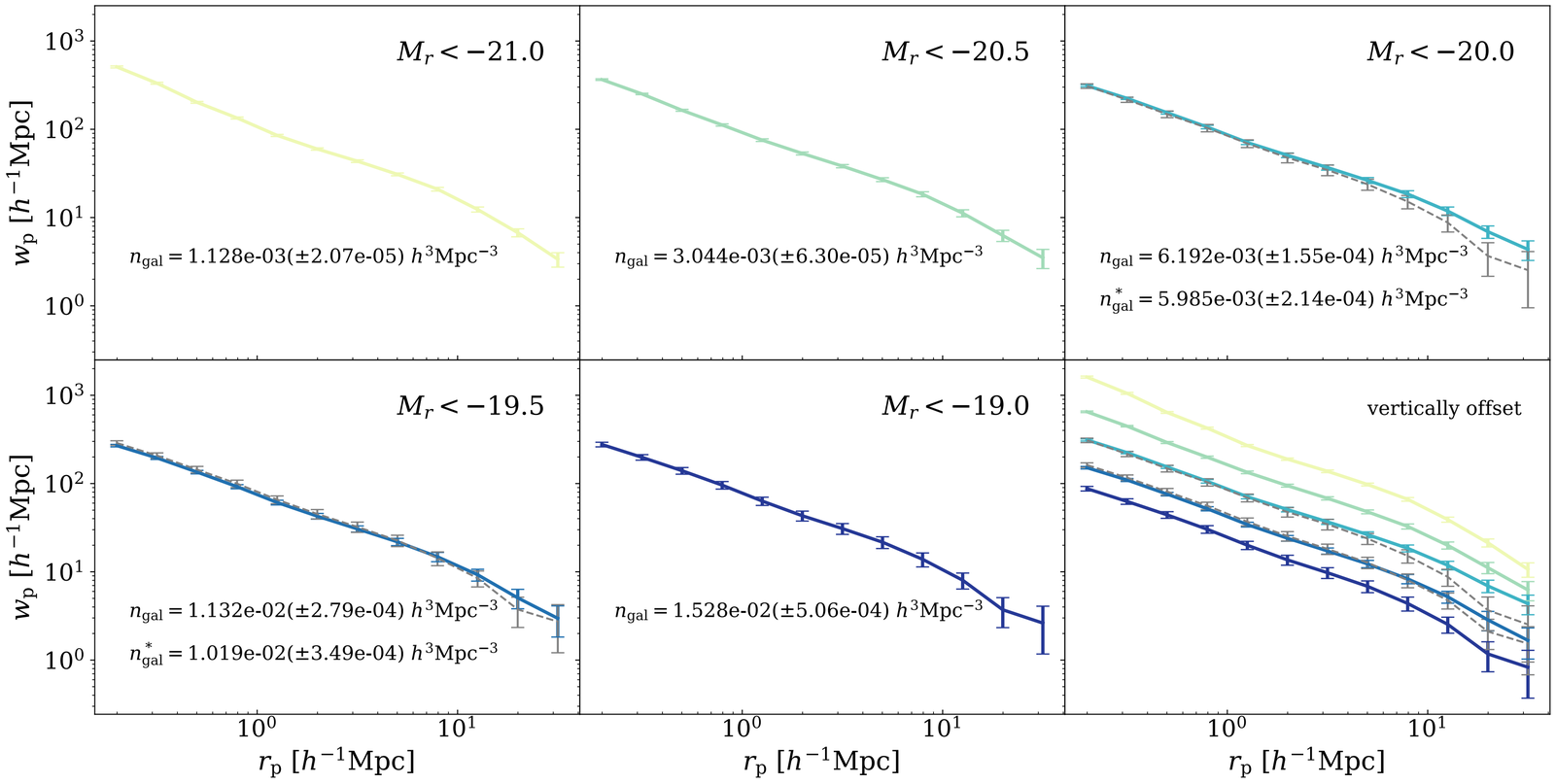
Data Measurement



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Data Measurement

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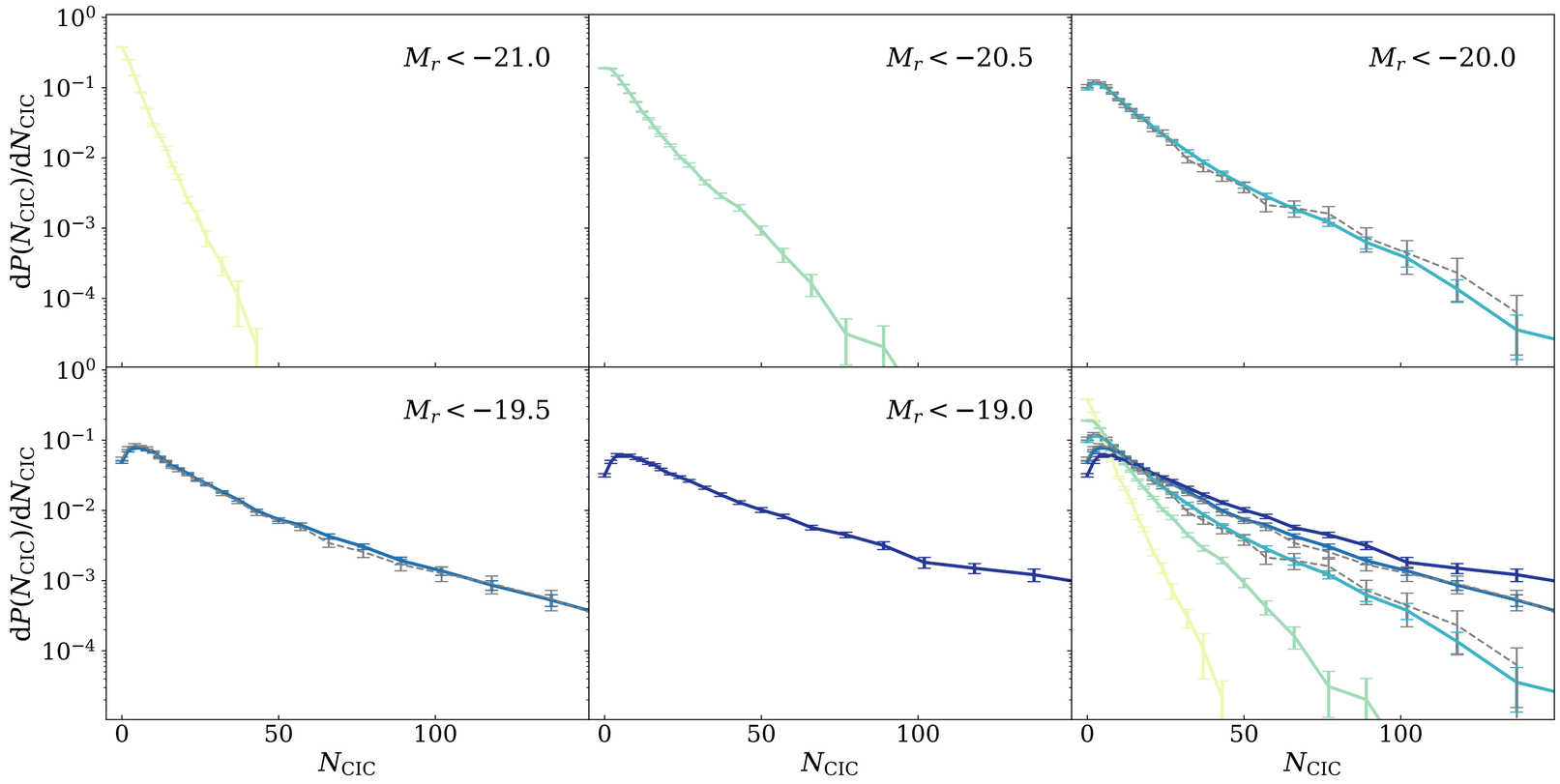

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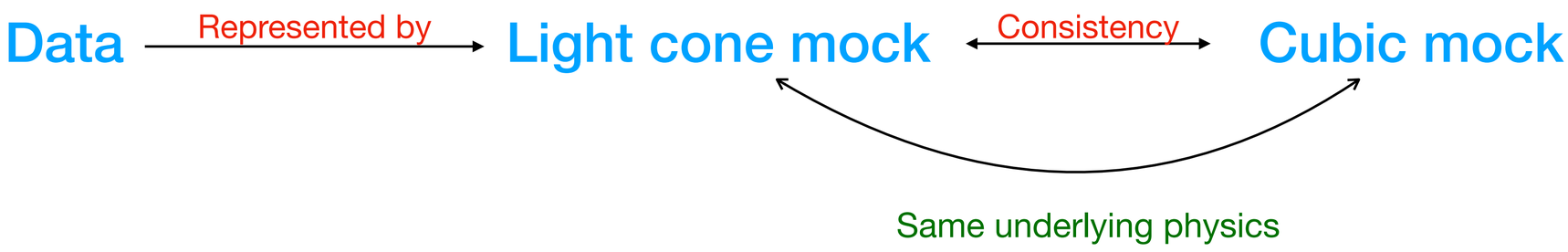
Estimator validation

Geometry, fiber collision…

—— Can a cubic N-body simulation estimate statistics in SDSS-like data without bias?



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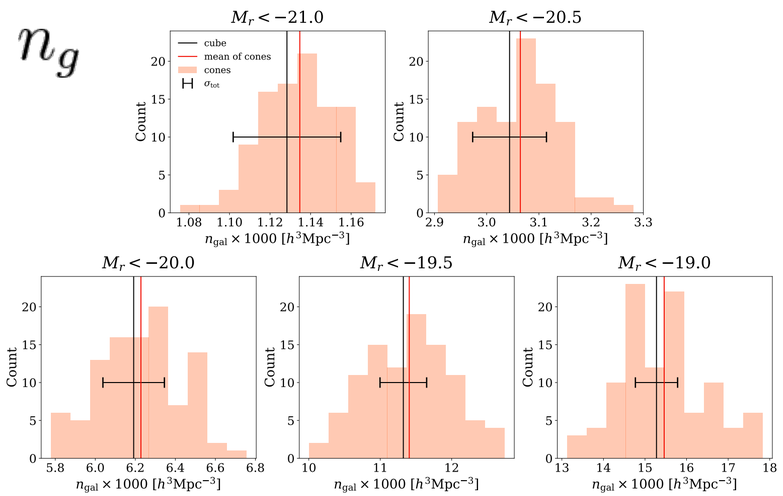
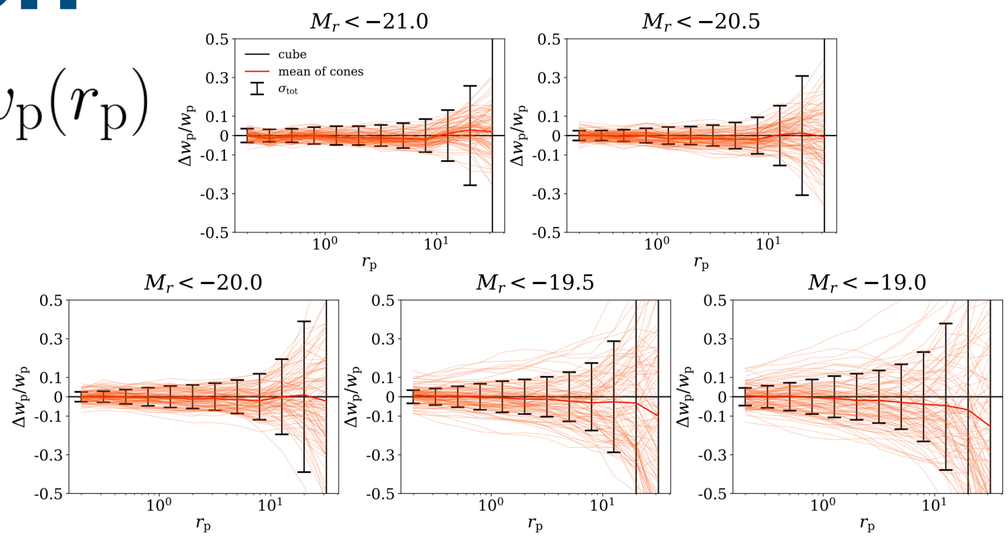
Estimator validation

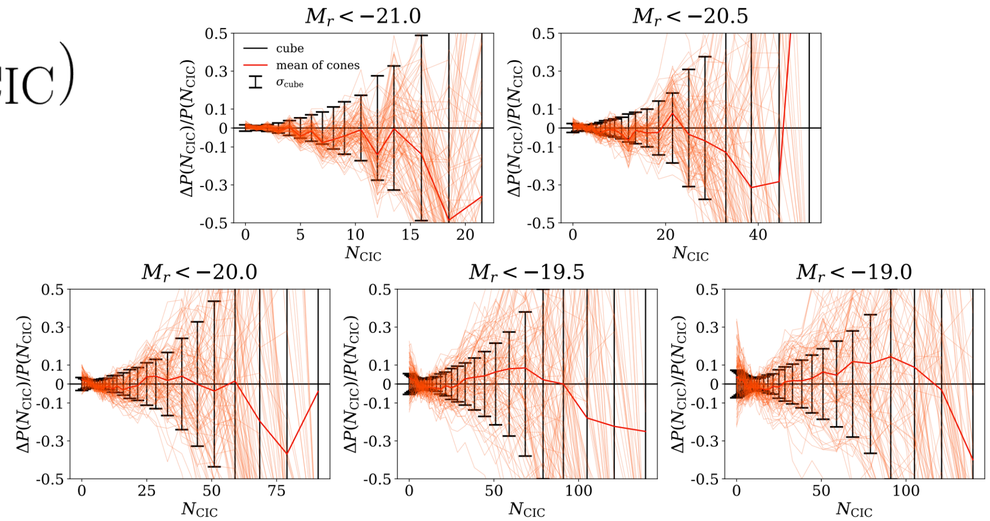
n_g



$w_{\rm p}(r_{\rm p})$



$P(N_{\rm CIC})$



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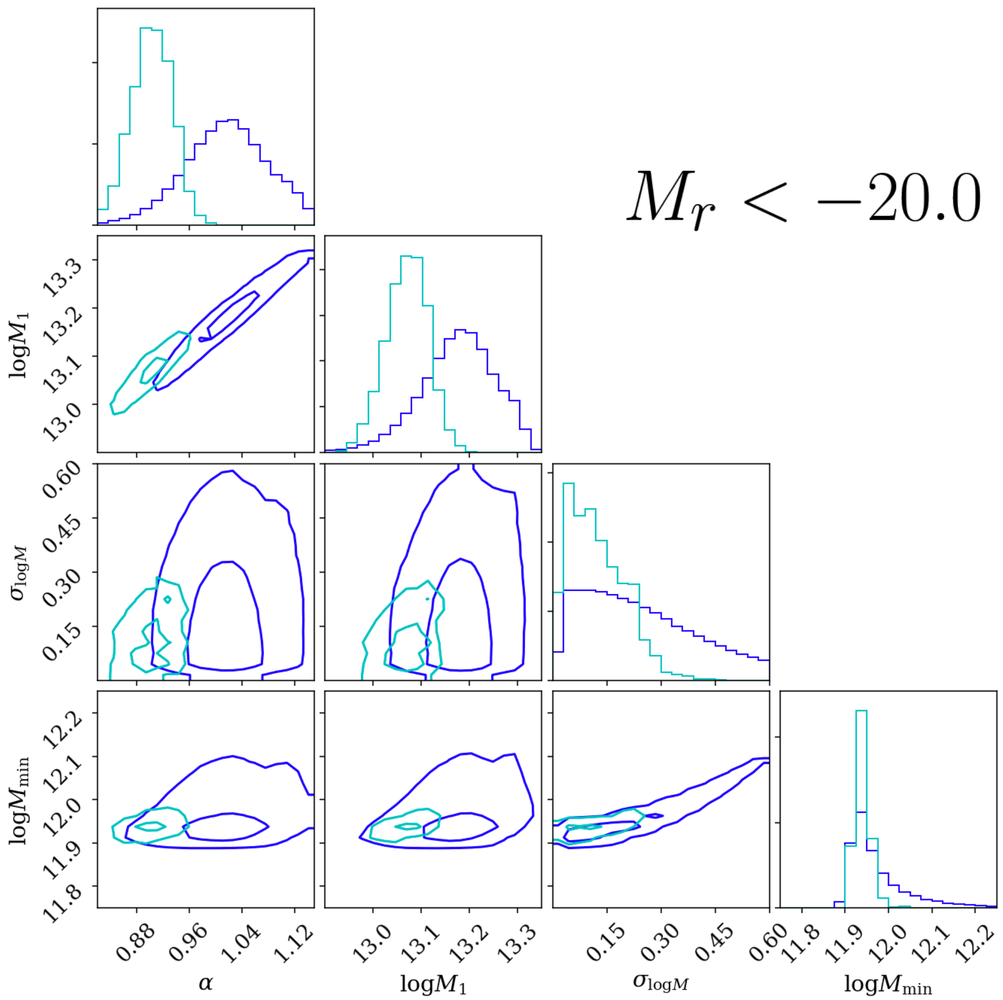
Model constraints

Thank you!



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kuanwang.astro@gmail.com