Intrinsic Alignments of Galaxies
Preliminary Results from SDSS-III LOWZ Sample

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Outline

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- Methodology
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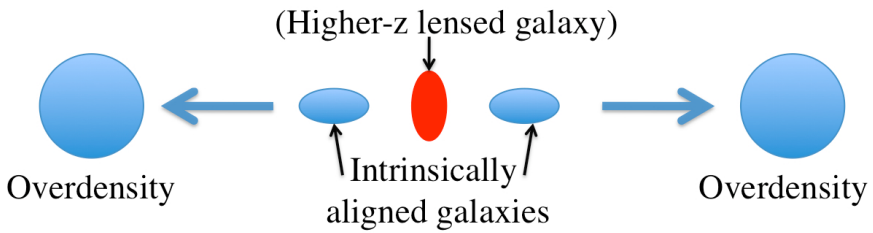
  - Groups
- Results

Introduction

The Big Picture



How IA affect weak lensing studies

Observables

$$\text{Galaxy Shape} \quad \epsilon^{(i)}(\theta) = \epsilon_G^{(i)}(\theta) + \epsilon_I^{(i)}(\theta) + \epsilon_{\text{rnd}}^{(i)}(\theta)$$

$$\text{Density contrast} \quad n^{(i)}(\theta) = n_g^{(i)}(\theta) + n_m^{(i)}(\theta) + n_{\text{rnd}}^{(i)}(\theta)$$

IA in two-point correlations

$$C_{\epsilon\epsilon}^{(ij)}(l) = C_{GG}^{(ij)}(l) + C_{IG}^{(ij)}(l) + C_{GI}^{(ij)}(l) + C_{II}^{(ij)}(l)$$

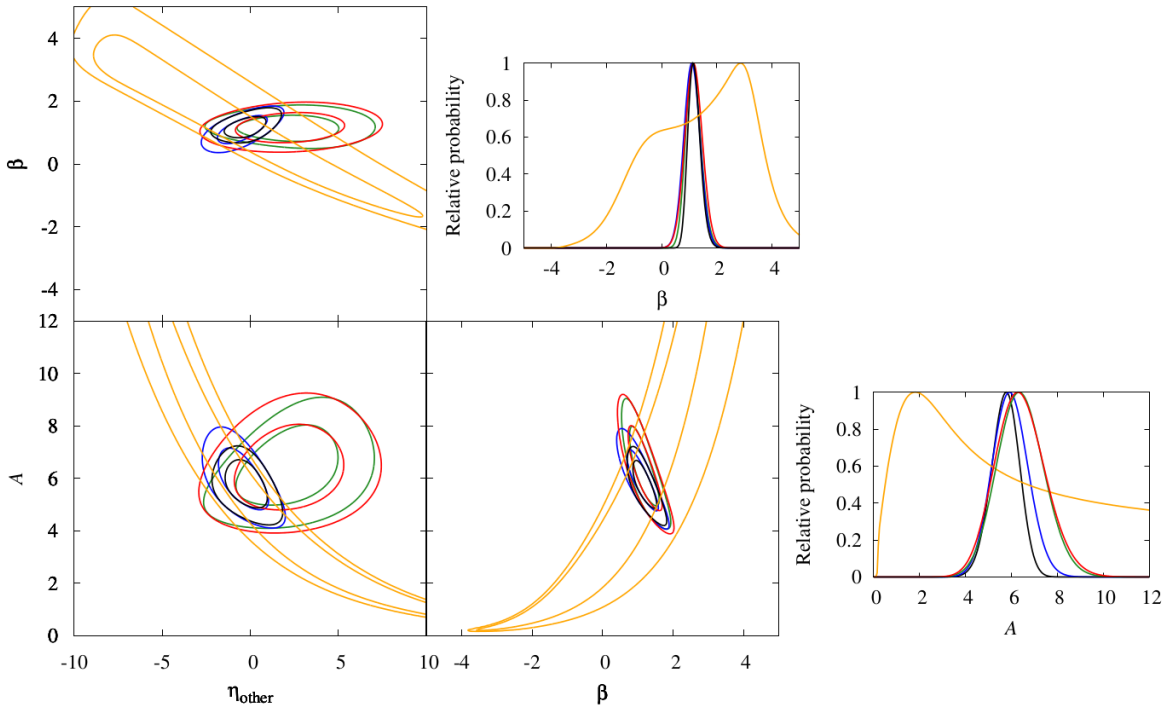
$$C_{nn}^{(ij)}(l) = C_{gg}^{(ij)}(l) + C_{gm}^{(ij)}(l) + C_{mg}^{(ij)}(l) + C_{mm}^{(ij)}(l)$$

$$C_{n\epsilon}^{(ij)}(l) = C_{gG}^{(ij)}(l) + C_{gI}^{(ij)}(l) + C_{mG}^{(ij)}(l) + C_{mI}^{(ij)}(l)$$

Joachimi & Bridle, 2010

Joachimi+, 2011

$$P_{gI}^{\text{model}}(k,z,L) = Ab_g P_{\delta I}(k,z)\left(\frac{1+z}{1+z_0}\right)^{\eta_{\text{other}}}\left(\frac{L}{L_0}\right)^{\beta}$$

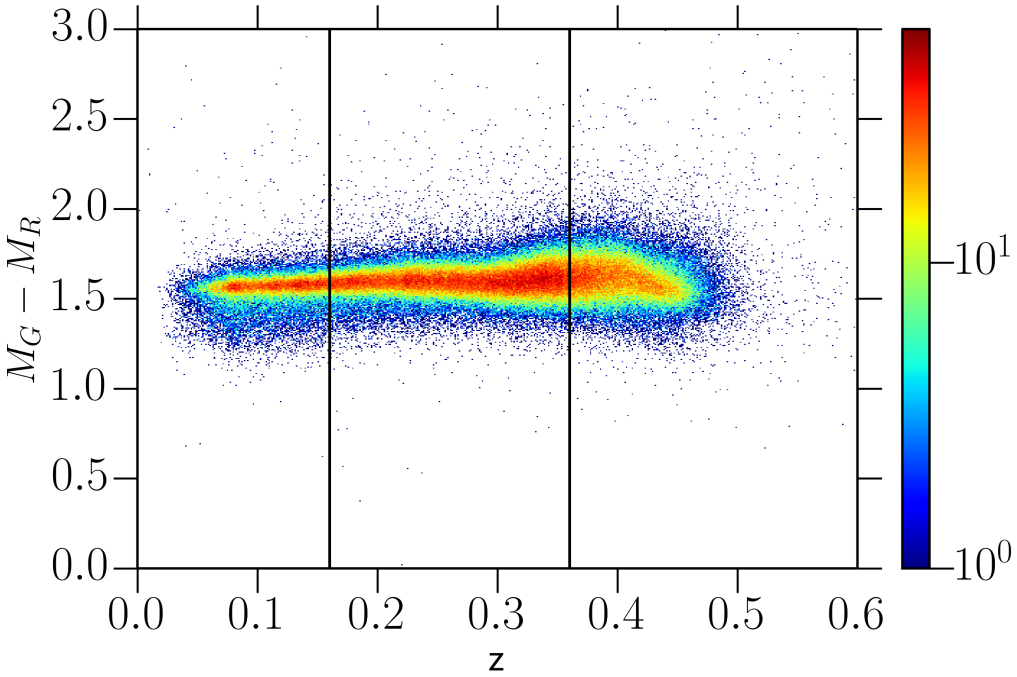


Our Goals:

- Extend IA measurements and contraints to lower luminositites.
- Study environment dependence of IA.

Data

Sample: Spectroscopic LRGs from SDSS-III BOSS LOWZ sample.
Shape measurements: From Reyes+ 2012. For $\sim 90\%$ of the sample.
k-corrections: Magnitudes k-corrected to $z = 0.3$, using k-correct v4.2. *(Blanton+ 2007)*.



k-corrected G-R color

Galaxy-Galaxy correlation

$$\xi_{gg}(r_P, \Pi) = \frac{SD}{SR} - 1 \qquad SD = \sum_{i,j|r_P,\Pi} \langle \delta(r_P, 0)\delta(r_P, \Pi) \rangle$$

Shape-Galaxy correlation

$$\xi_{g+}(r_P, \Pi) = \frac{S_+D}{SR} - \frac{S_+R}{SR} \qquad S_+D = \sum_{i,j|r_P,\Pi} \frac{e_+(j|i)}{2R}$$

Shape-Shape correlation

$$\xi_{++}(r_P, \Pi) = \frac{S_+S_+}{RR} \qquad S_+S_+ = \sum_{i,j|r_P,\Pi} \frac{e_+(j|i)e_+(i|j)}{(2R)^2}$$

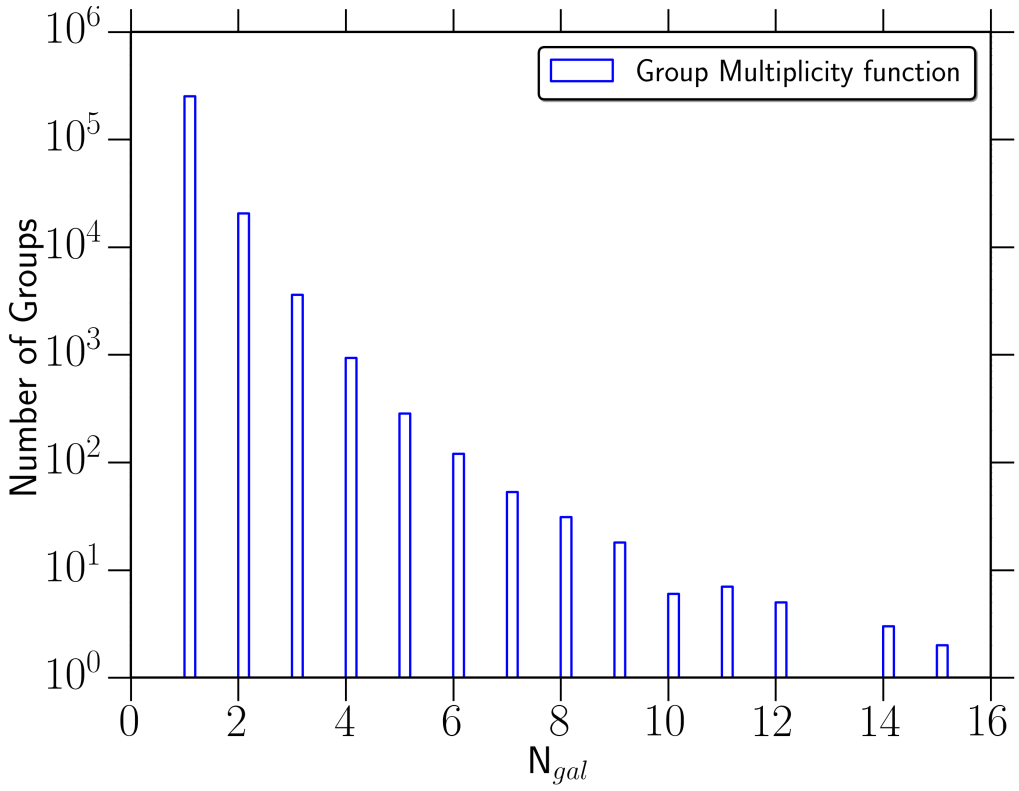
Projected correlation estimator

$$w_{ab}(r_P) = \int_{-\Pi_{\max}}^{\Pi_{\max}} \xi_{ab} d\Pi$$

Mandelbaum+, 2006

Counts in Cylinders (CiC) Method (*Reid & Spergel, 2009*)

- One-halo pairs: $\Delta r_{\perp} \leq 0.8h^{-1}$Mpc, $\Delta r_{\parallel} \leq 20h^{-1}$Mpc
- Group pairs using FoF algorithm.
- Satellite fraction, $f_{\mathrm{sat}} = 0.107$

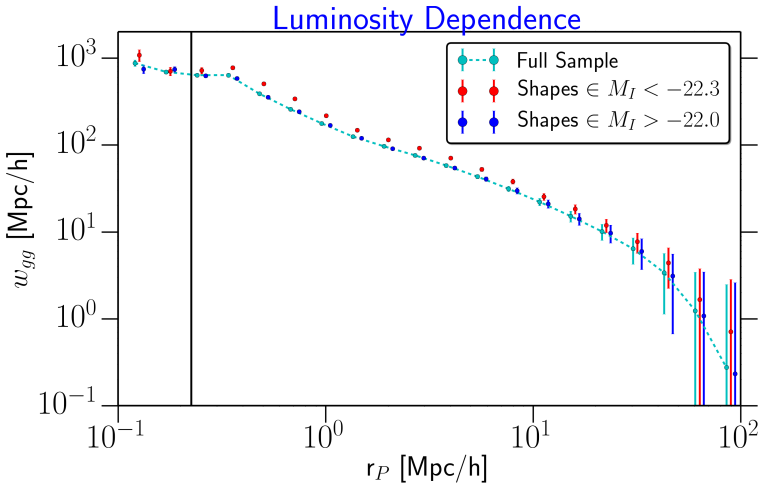


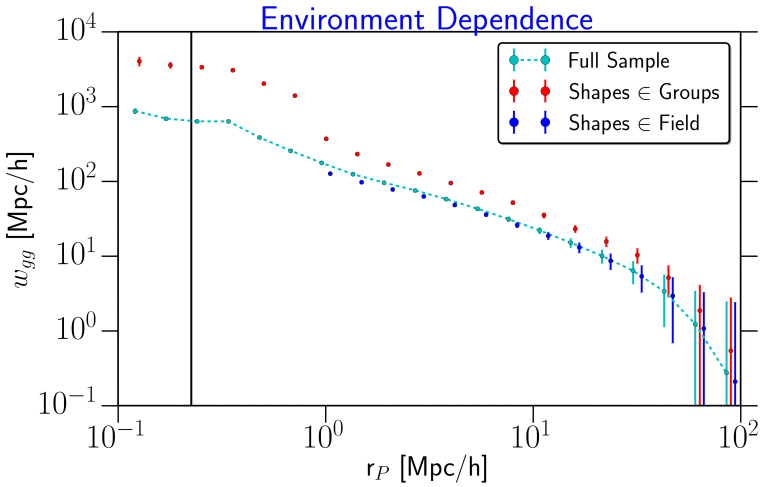
CiC Group-Multiplicity function

Results

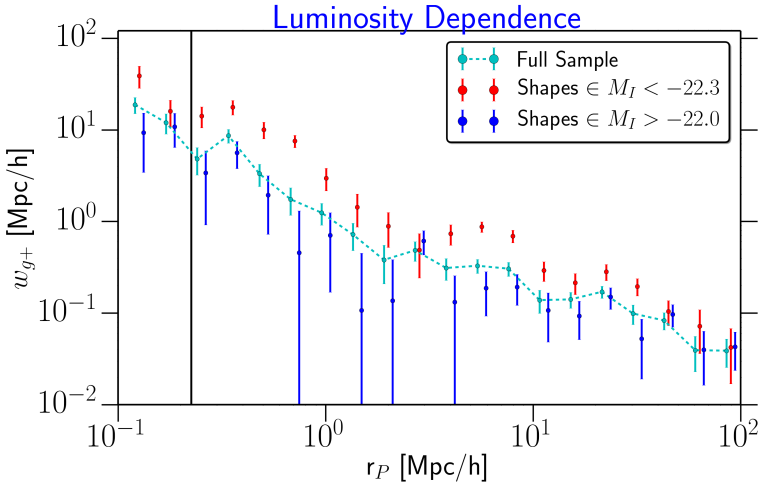
w_{gg}

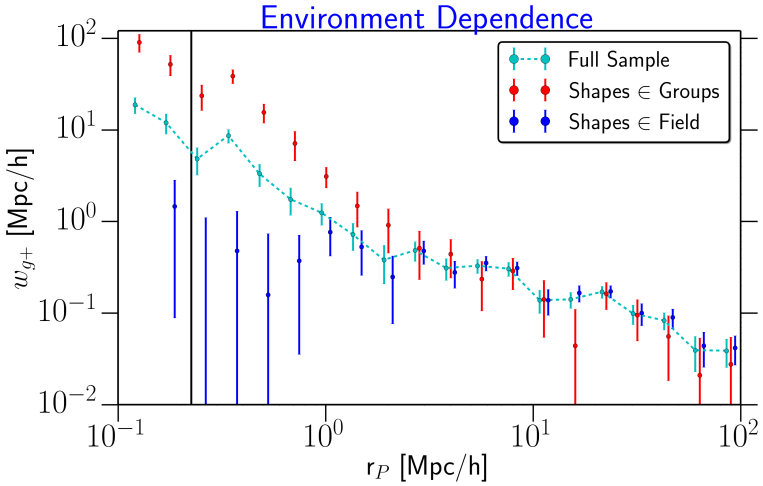
Density $\in$ Full Sample



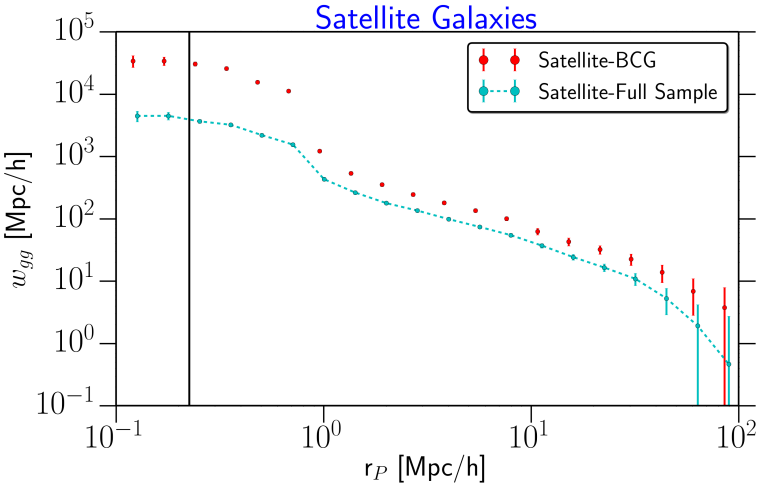


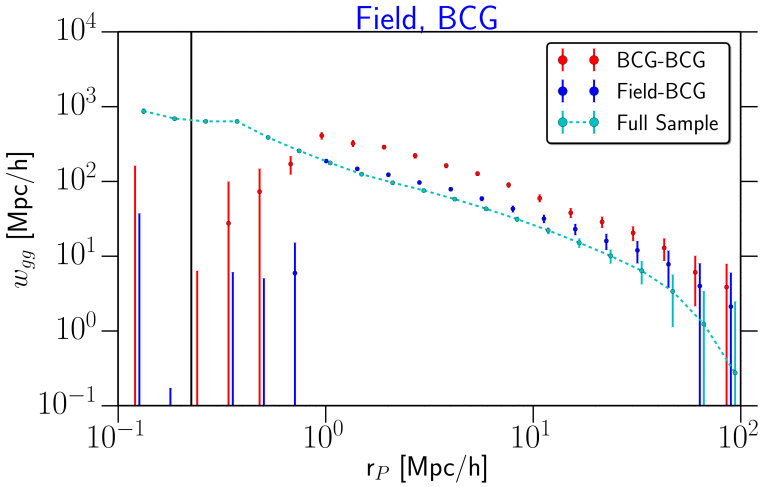
w_{g+}



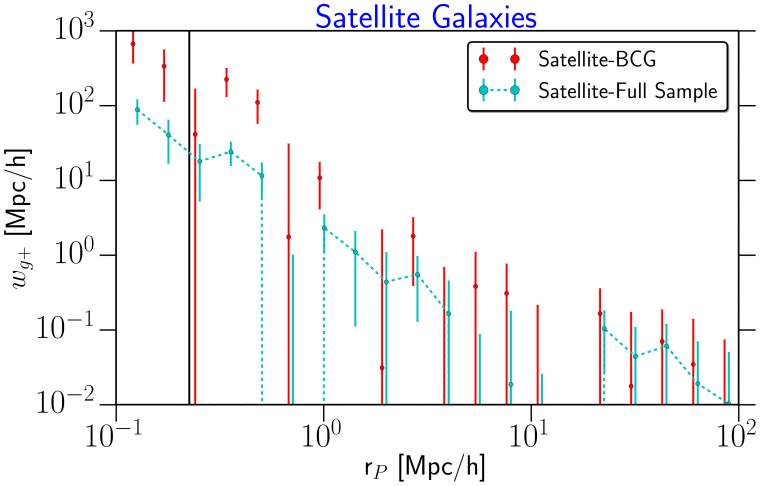


w_{gg}


Satellite Galaxies
Satellite-BCG
Satellite-Full Sample
w_{gg} [Mpc/h]
r_P [Mpc/h]


Field, BCG
BCG-BCG
Field-BCG
Full Sample
w_{gg} [Mpc/h]
r_P [Mpc/h]

w_{g+}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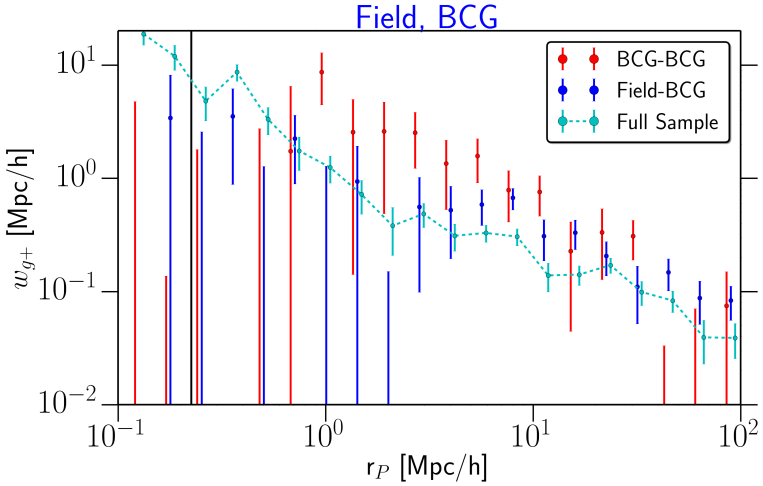
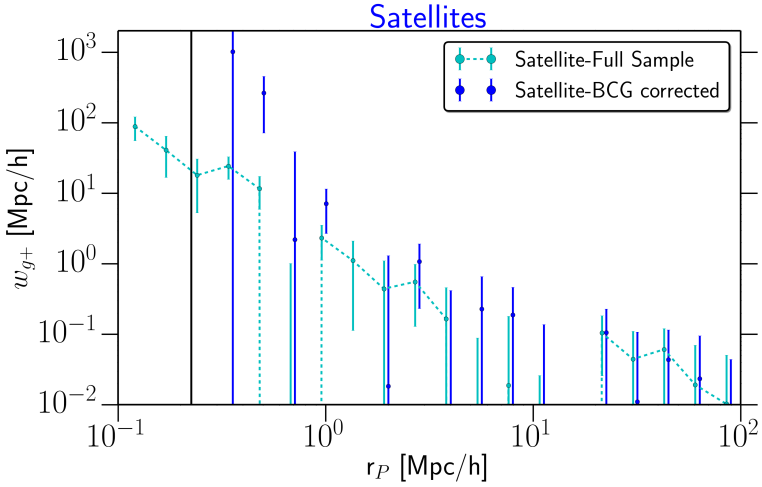

Field, BCG
BCG-BCG
Field-BCG
Full Sample
w_{g+} [Mpc/h]
r_P [Mpc/h]

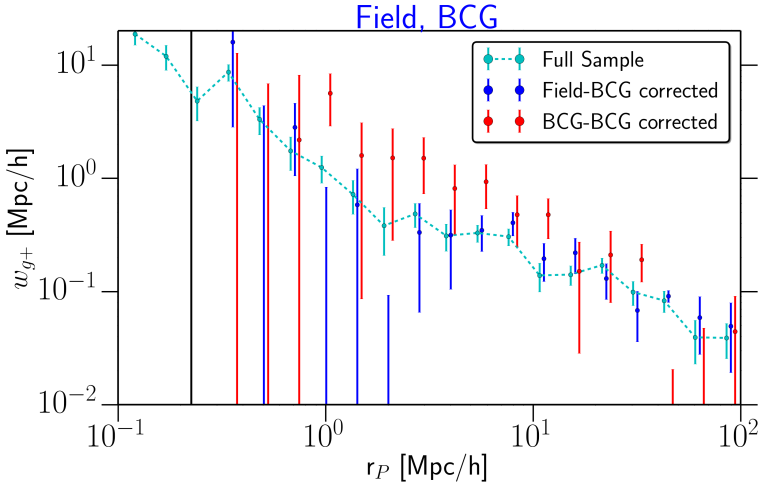
Bias Correction

$$w_{g+}^{(DS)} = b_D\, w_{\delta+}^{(S)}$$
$$w_{gg}^{(DD)} = b_D^2\, w_{\delta\delta}$$

$$w_{g+}^{(D'S)} = w_{g+}^{(DS)} \sqrt{\frac{w_{gg}^{(D'D')}}{w_{gg}^{(DD)}}}$$

Valid only for linear bias, large scales.





Summary

- IA detection at high S/N
- Luminosity Dependence: Brighter galaxies have stronger IA.
- Environment Dependence: Environment effects important at small scales $\sim$ 1Mpc. At larger scales, $\geq$ 10Mpc, environment effects appear to be important for BCGs.

Future work:

- Model Fitting: Fit models to quantify detections and also test for validity of models.
- Model the bias dependence to better understand environment effects at small scales.
- Test Halo model for IA.