

Redshift-space distortions & galaxy-galaxy Lensing in VIPERS/BOSS/eBOSS

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zSurvey meeting

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Clustering and g-g lensing

- Combine 3D clustering and lensing measurements using estimators such as:

$$E_G \equiv \frac{\nabla^2(\psi - \phi)}{3H_0^2 a^{-1} \beta \delta} = \frac{Y_{gm}}{\beta Y_{gg}} \propto \frac{b}{f} \frac{\Omega_{M_0}}{b} \approx \frac{\Omega_{M_0}}{f}$$

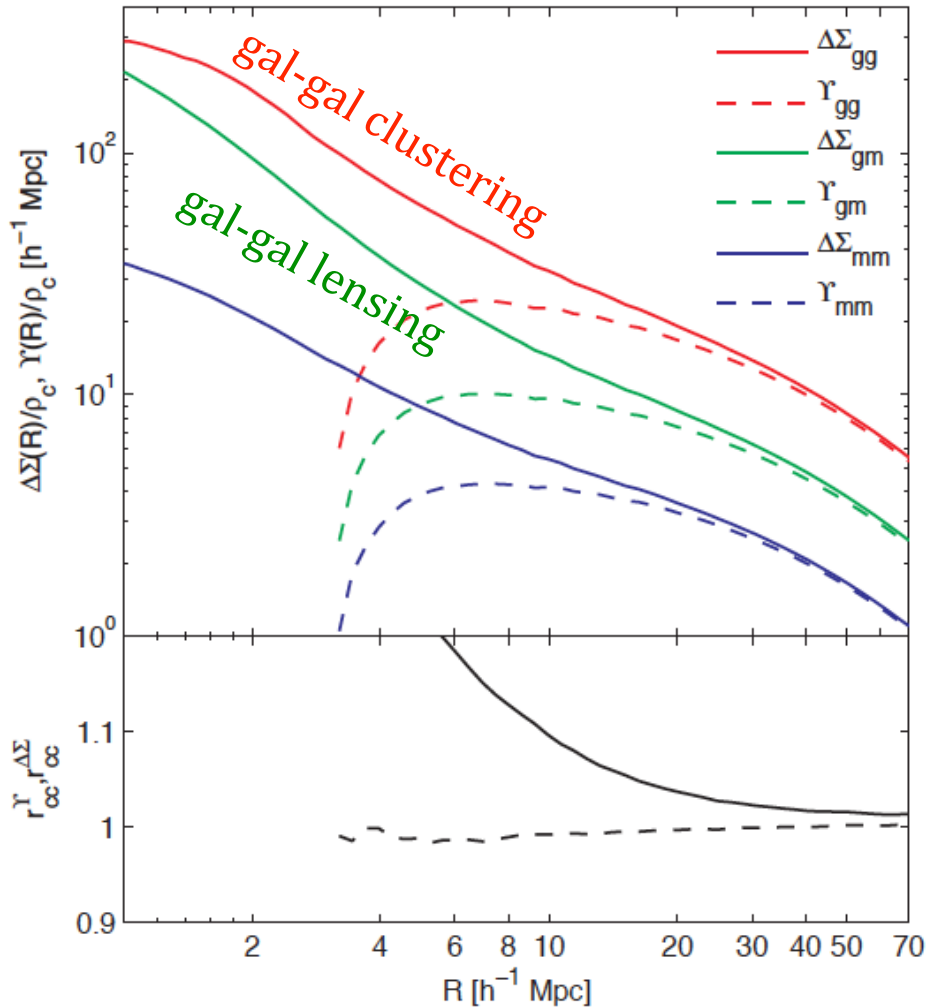
Lensing: sensitive to galaxy bias and matter density

Clustering: sensitive to redshift-space distortions and galaxy bias

- Cosmological interpretation :

- Galaxy-galaxy clustering $\rightarrow P_{gg}(k)$ proportional to $b^2 \sigma_8^2$
- Galaxy-galaxy lensing $\rightarrow P_{gm}(k)$ proportional to $b \sigma_8^2 \Omega_m$

Predicted g-g lensing

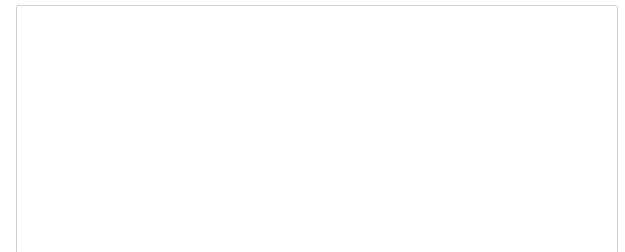


Excess surface mass density:

$$\Sigma_{\text{gm}}(R) = \Omega_m \rho_{\text{crit}} \int_{-\infty}^{+\infty} g_1(\chi) \left[1 + \xi_{\text{gm}}(\sqrt{R^2 + \chi^2}) \right] d\chi$$

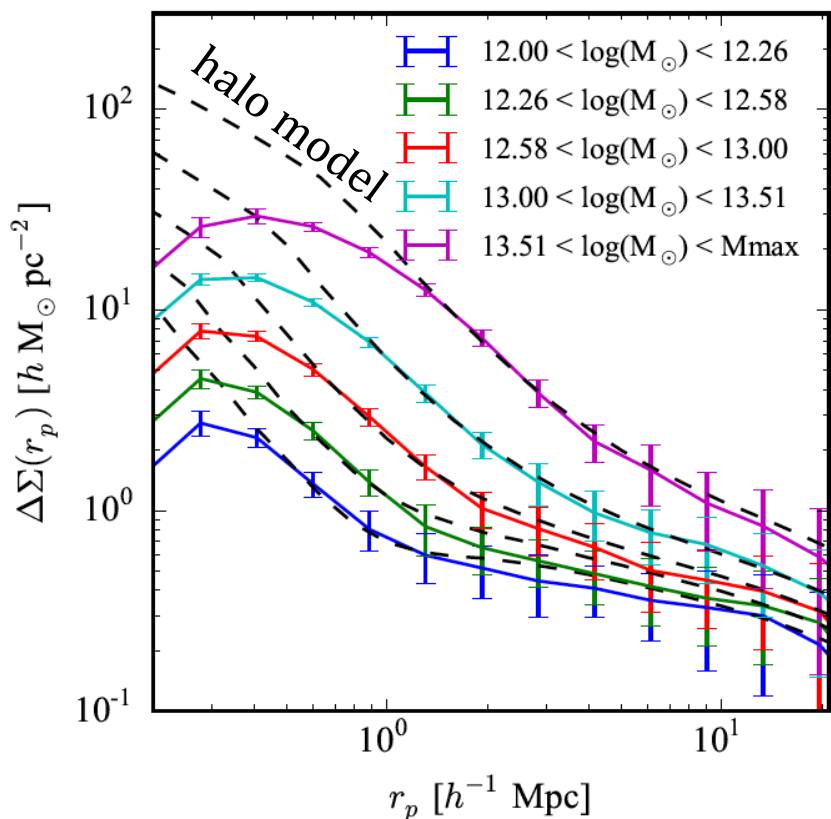
Annular differential surface density:

$$\Upsilon(R; R_0) \equiv \Delta\Sigma(R) - \frac{R_0^2}{R^2} \Delta\Sigma(R_0) ;$$

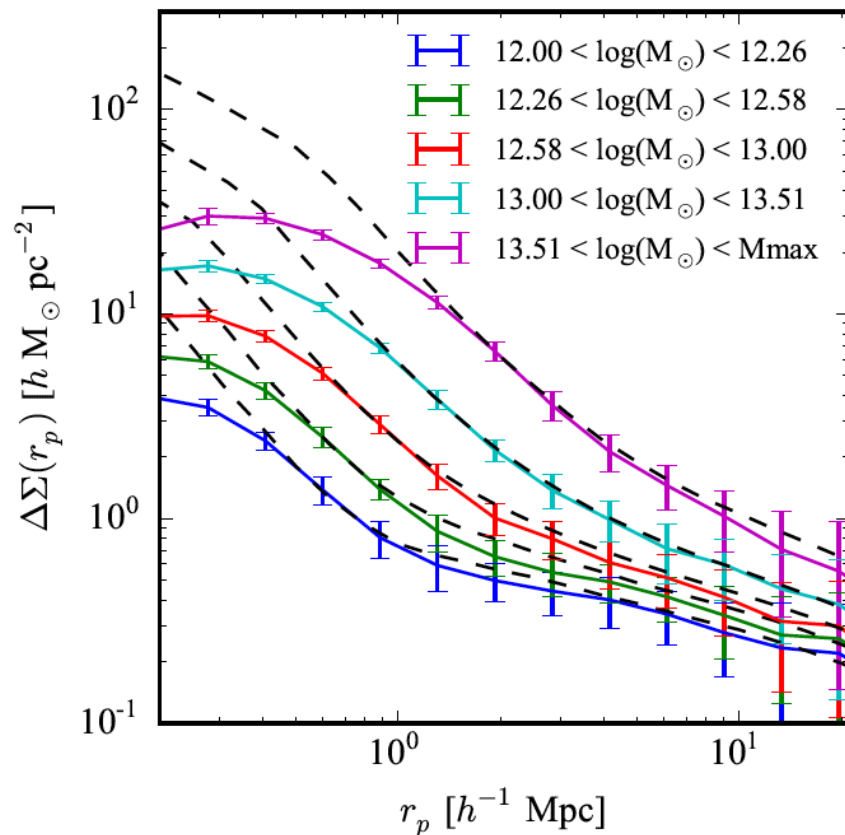


Simulation: BigMultiDark lensing

Excess surface mass density



$z=0.5$



$z=0.8$

Modelling: RSD and bias

- Eulerian non-local bias (*McDonald & Roy, 2009*):

$$\delta_h(\mathbf{x}) = b_1\delta(\mathbf{x}) + \frac{1}{2}b_2[\delta(\mathbf{x})^2 - \sigma_2] + \frac{1}{2}b_{s^2}[s(\mathbf{x})^2 - \langle s^2 \rangle] + \text{higher order terms}$$

Non-linearities

Tidal tensor → Non-localities

- RSD model (*Taruya et al. 2010, Beutler et al. 2014*):

$$P^{(s)}(k, \mu) = D_{\text{FoG}}(k, \mu; \sigma_{\text{FoG}}) [P_{g,\delta\delta}(k) + 2f\mu^2 P_{g,\delta\theta}(k) + f^2\mu^4 P_{\theta\theta}(k) + b_1^3 A(k, \mu, f/b_1) + b_1^4 B(k, \mu, f/b_1)],$$

$$P_{g,\delta\delta}(k) = b_1^2 P_{\delta\delta}(k) + 2b_2 b_1 P_{b_2,\delta}(k) + 2b_{s^2} b_1 P_{b_{s^2},\delta}(k) + 2b_{3nl} b_1 \sigma_3^2(k) P_m^L(k) + b_2^2 P_{b_2^2}(k) + 2b_2 b_{s^2} P_{b_2 s^2}(k) + b_{s^2}^2 P_{b_{s^2}^2}(k) + N,$$

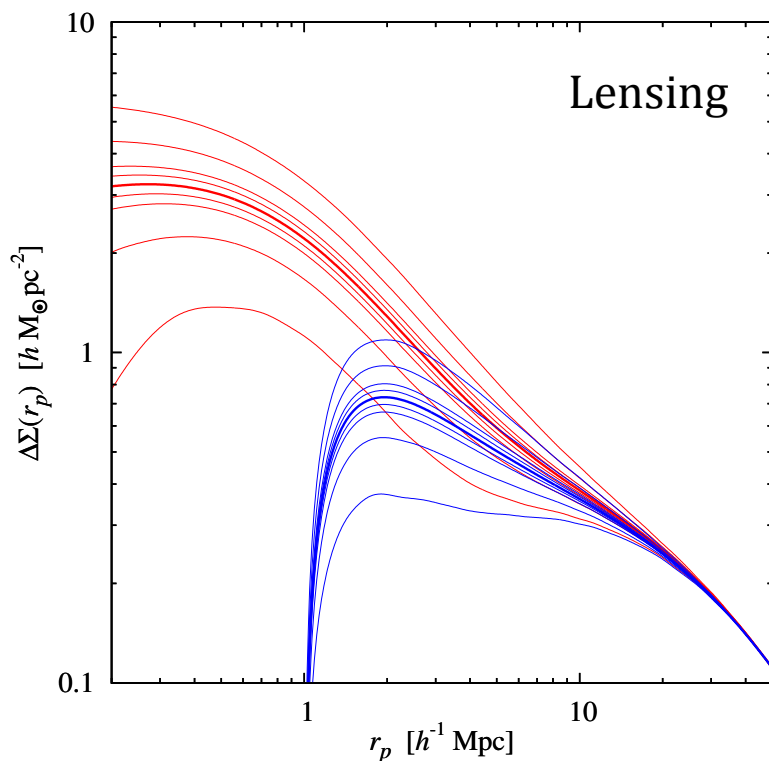
$$P_{g,\delta\theta}(k) = b_1 P_{\delta\theta}(k) + b_2 P_{b_2,\theta}(k) + b_{s^2} P_{b_{s^2},\theta}(k) + b_{3nl} \sigma_3^2(k) P_m^{\text{lin}}(k),$$

$$b_{s^2} = -\frac{4}{7}(b_1 - 1),$$

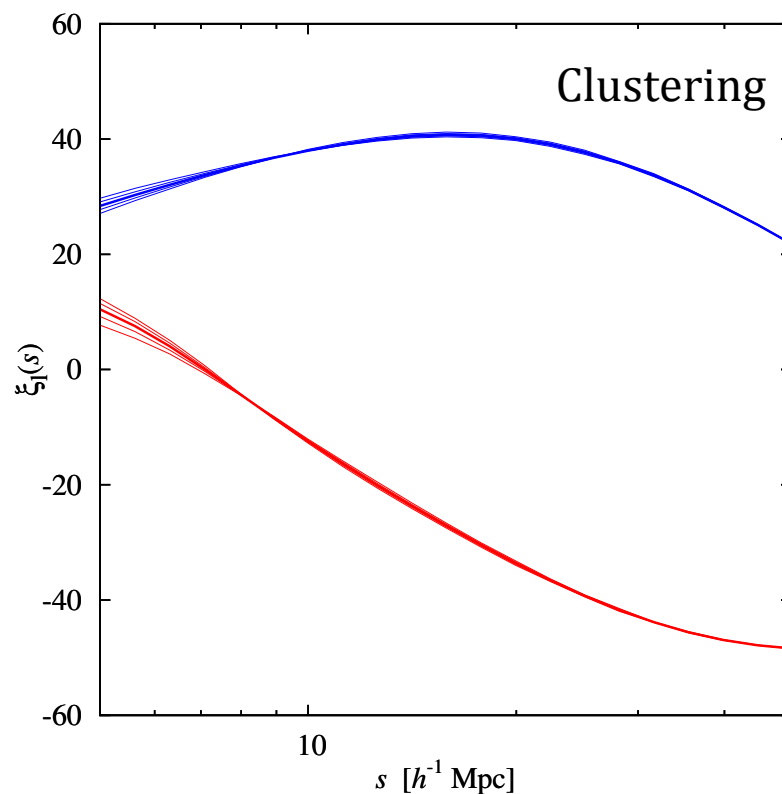
$$b_{3nl} = \frac{32}{315}(b_1 - 1),$$

Modelling: bias non-linearities

Excess surface mass density

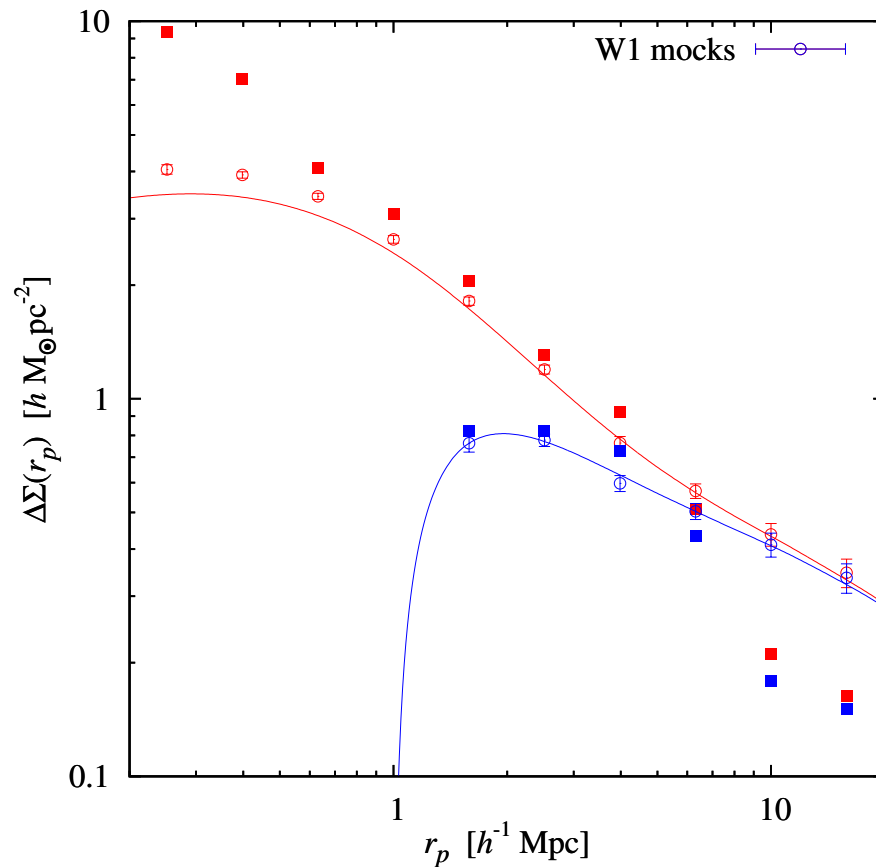
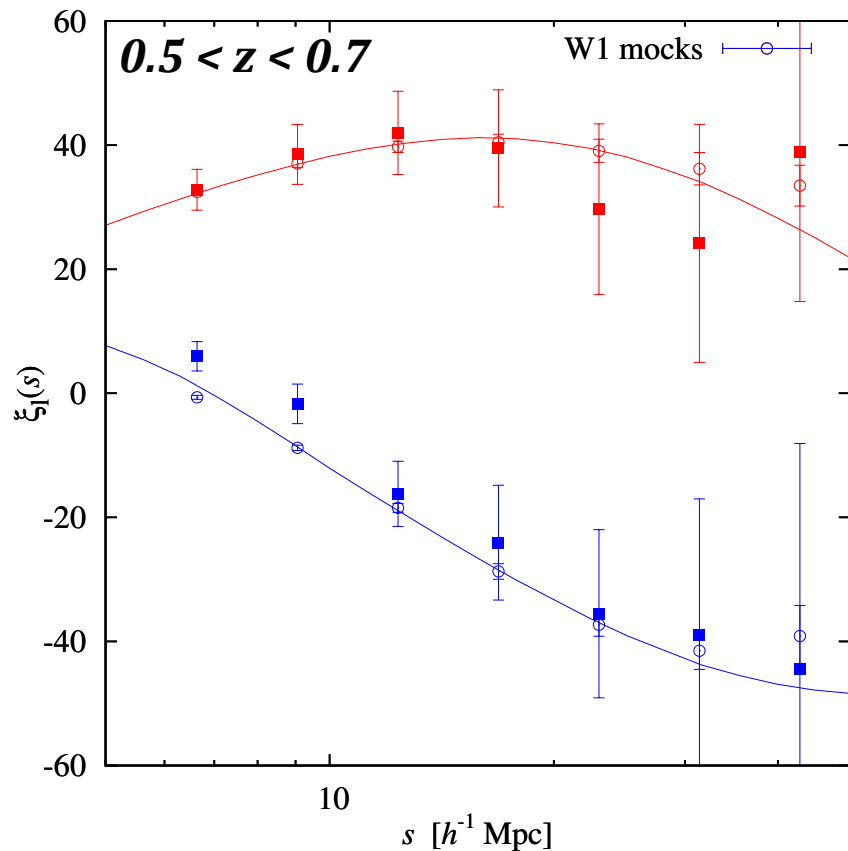


Monopole & quadrupole correlation function



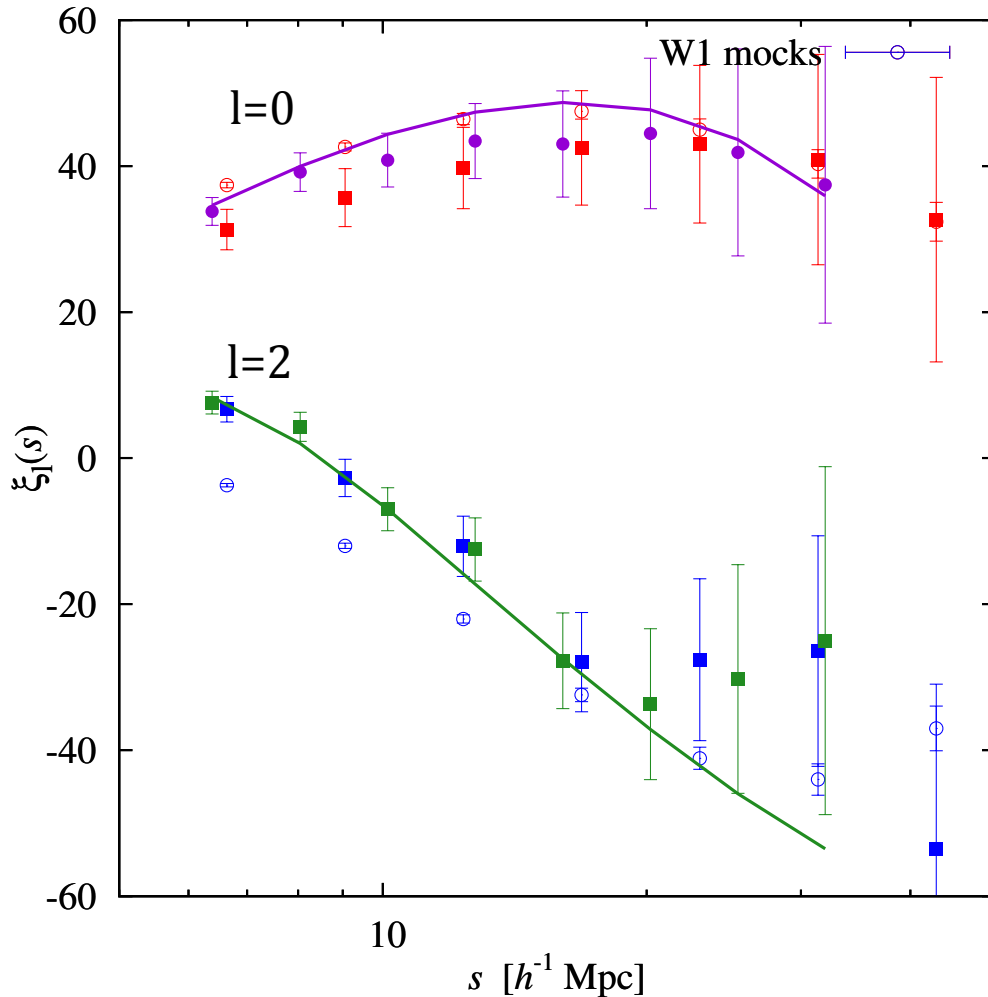
- Effect of varying galaxy bias non-linearity (b_2)

Modelling: theory vs VIPERS mocks



- Symbols:
 - Empty symbols: Mocks v1.7
 - Solid symbols: VIPERS data
 - Curves: theoretical predictions

Data: RSD in VIPERS final dataset



- Symbols:

Empty symbols: Mocks v1.7

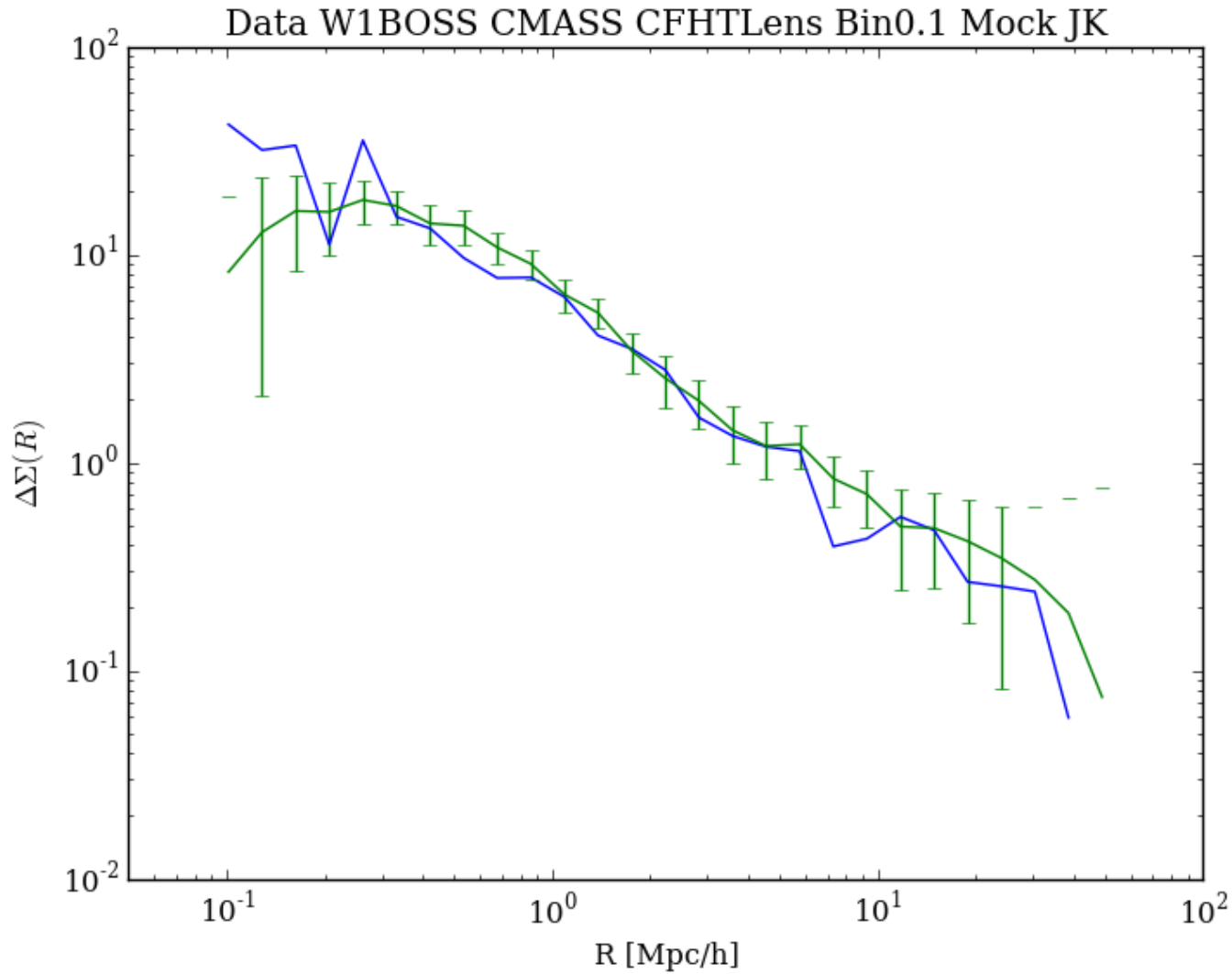
Solid symbols: VIPERS data

Violet/Green: PDR1

Red/Blue: VIPERS v7

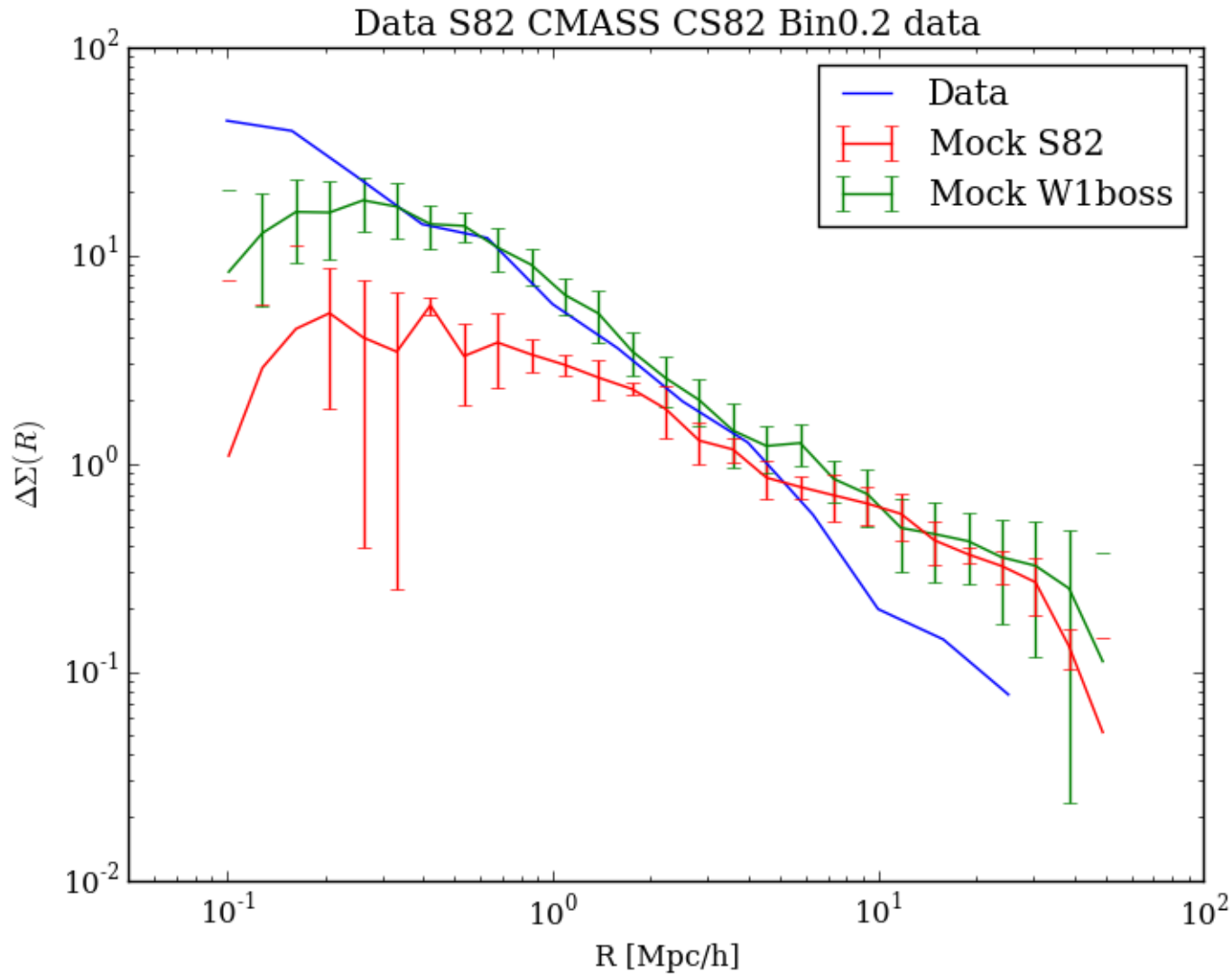
$0.7 < z < 1.2$

Data: Lensing in W1/BOSS field



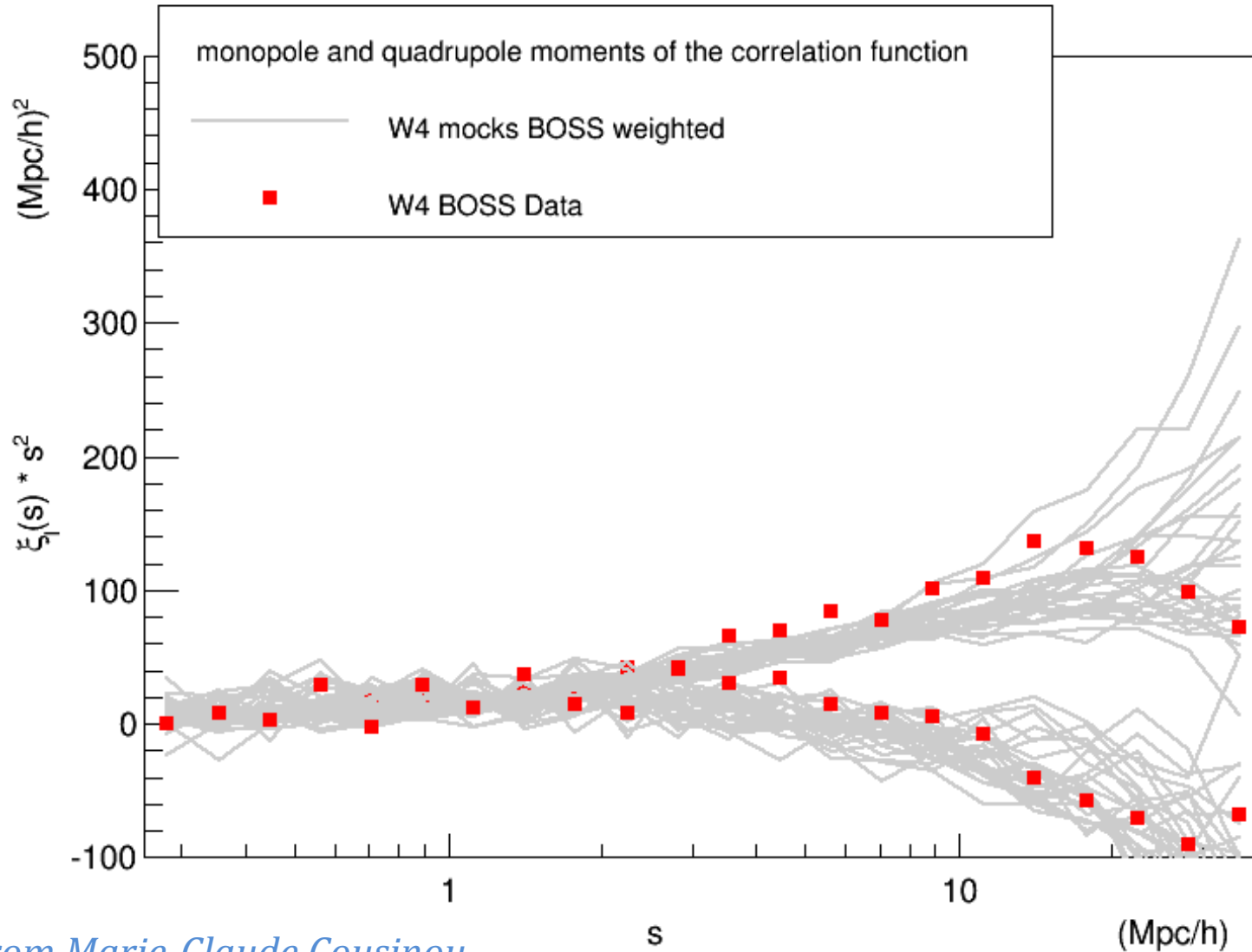
From Eric Jullo

Data: Lensing in S82/BOSS field



From Eric Jullo

Data: RSD in W4/BOSS field



From Marie-Claude Cousinou

Status and roadmap

- Produced several sets of mocks for VIPERS/CFHTLS, BOSS/CFHTLS fields
- Developed a non-linear model to reproduce both g-g lensing and RSD
- Developed a MontePython module to fit lensing+RSD
- Currently running likelihood analysis for VIPERS
- For BOSS, fewer mocks : new Jackknife technique to estimate covariance matrix
- Next step: BOSS likelihood analysis