Gregory Horndeski, 'Horndeski Scalar Theory, Past, Present and Future'

Steps Towards Cosmology With Void Lensing

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CENTRE DE PHYSIQUE DES PARTICULES DE MARSEILLE CPPM

LAM LABORATOIRE D'ASTROPHYSIQUE DE MARSEILLE

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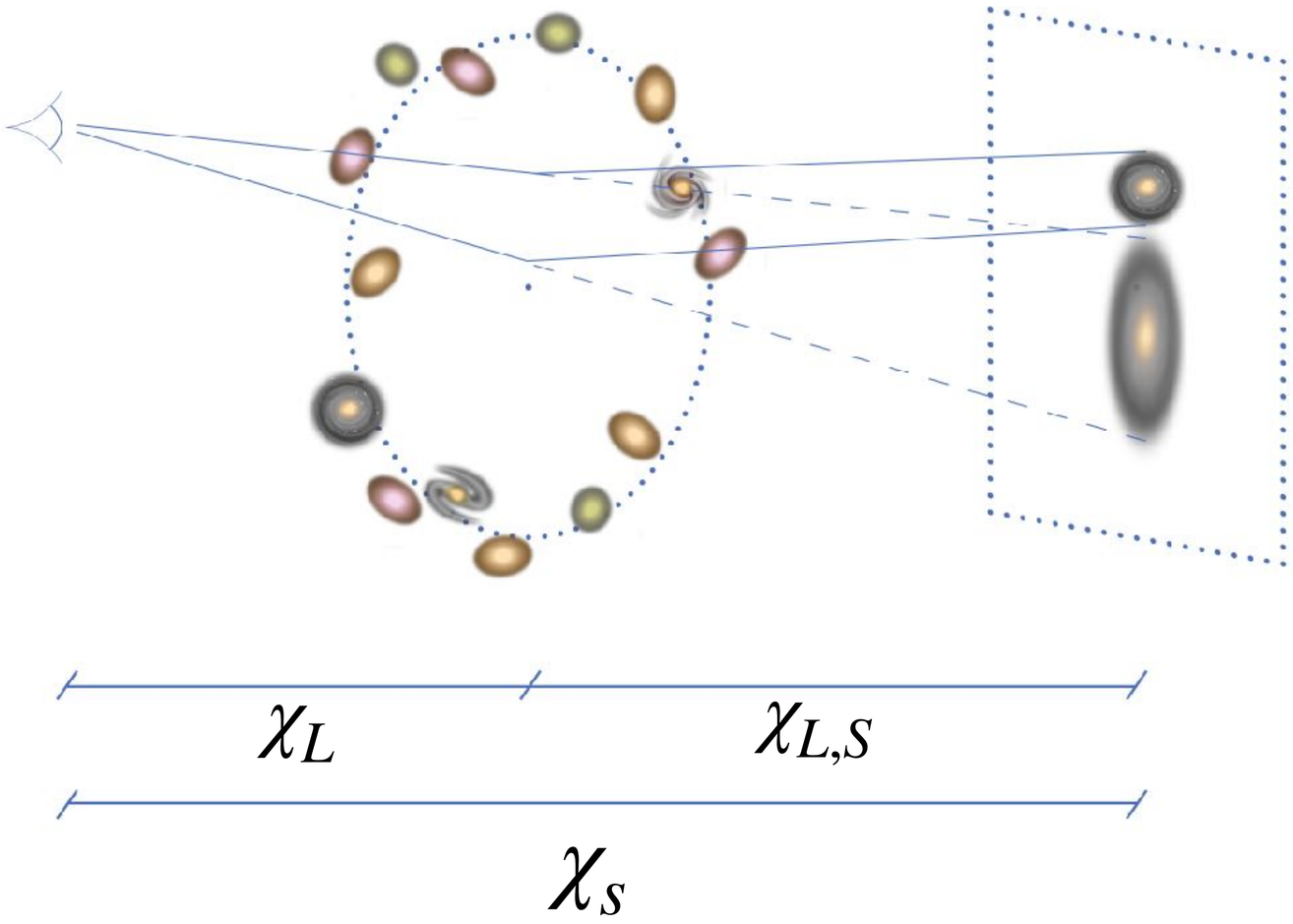
WL Voids



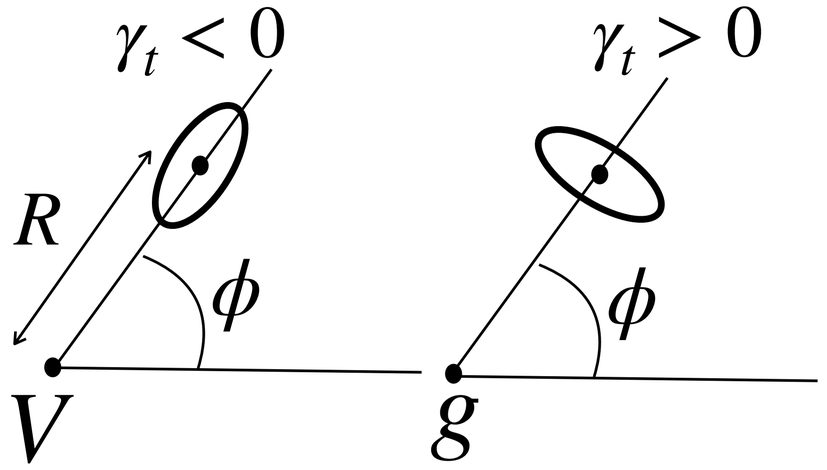
Differential surface mass density:

$$\Delta\Sigma(R, z_L) = \Sigma_{crit}(\bar{\kappa}(<R) - \kappa(R))$$

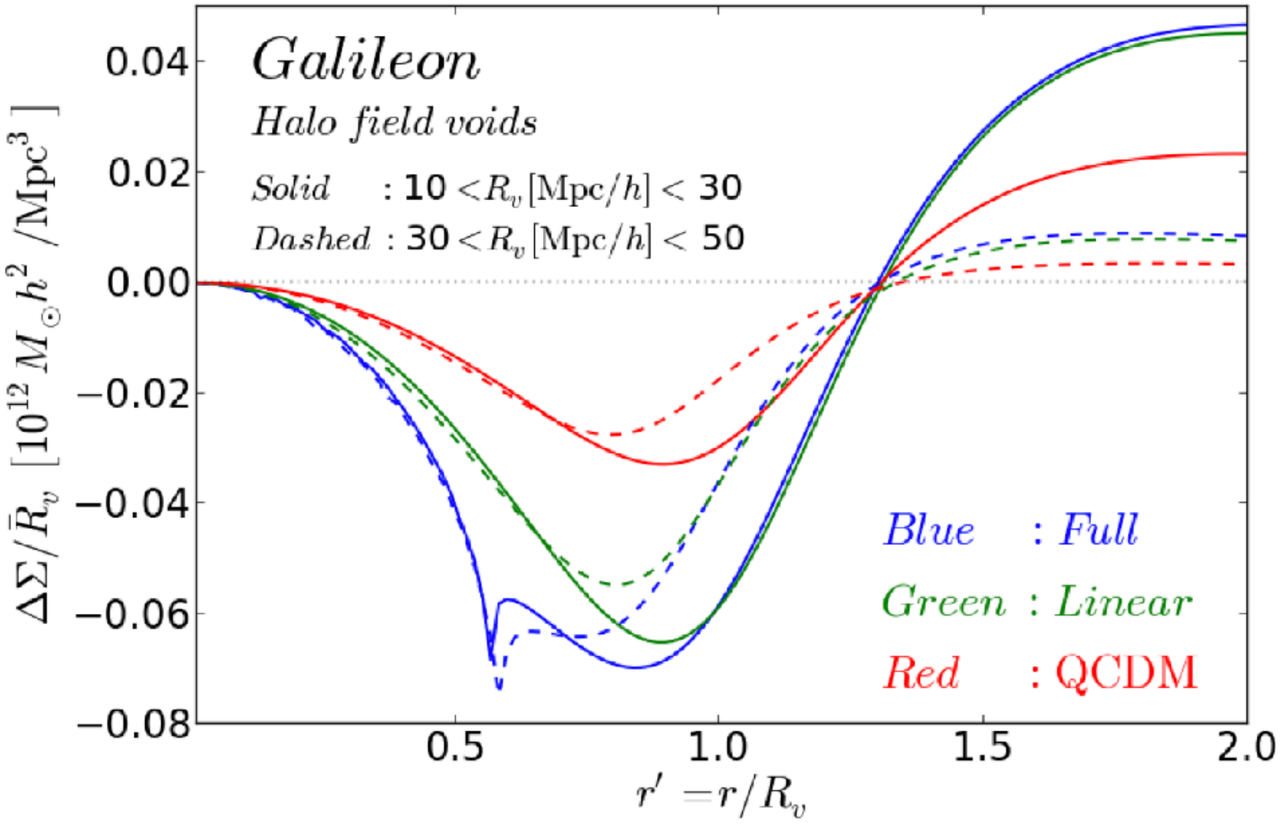
$$= \Sigma_{crit} \times \gamma_t(R)$$

$$\kappa(R) = \Sigma_{crit}^{-1} \int d\chi \rho(\chi, R)$$

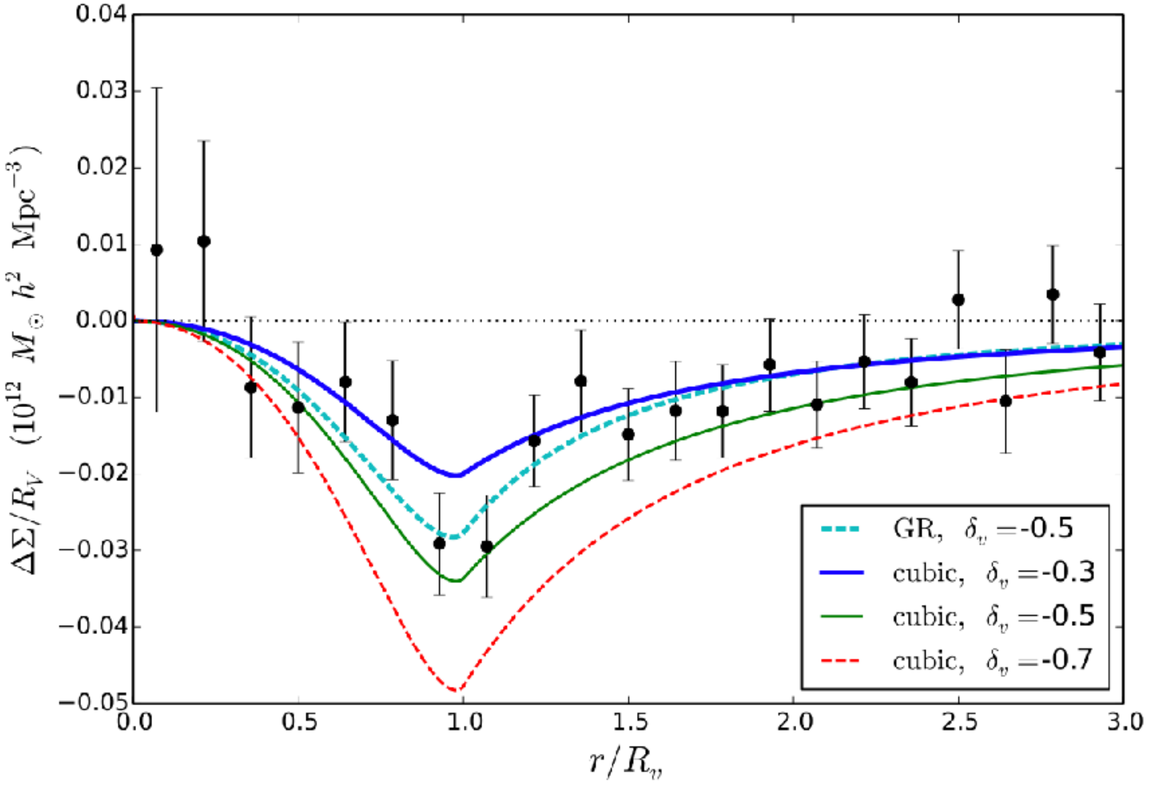
$$\gamma_t = -Re\{(\gamma_1 + i\gamma_2)e^{-2i\phi}\}$$



Void-Lensing Predictions

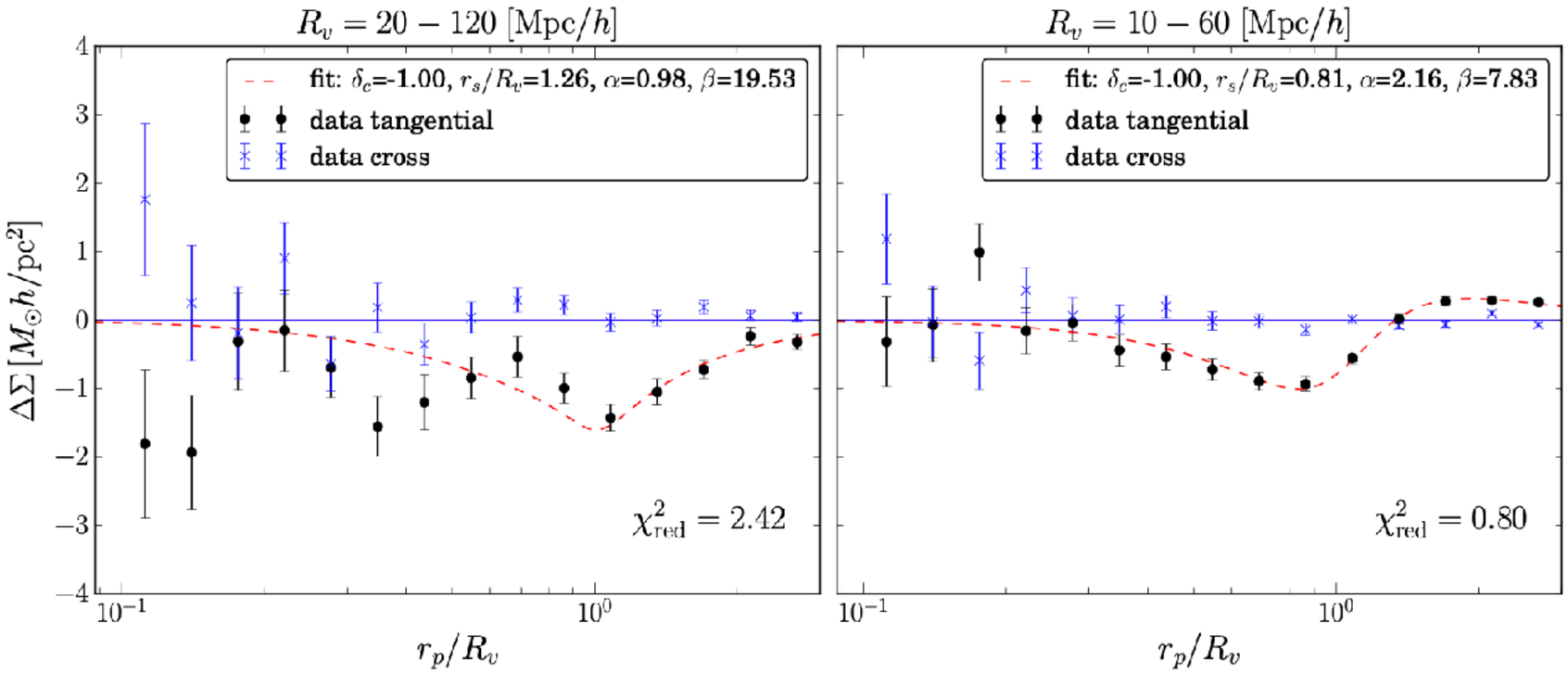


Alexandre Barreira et al. (2015)

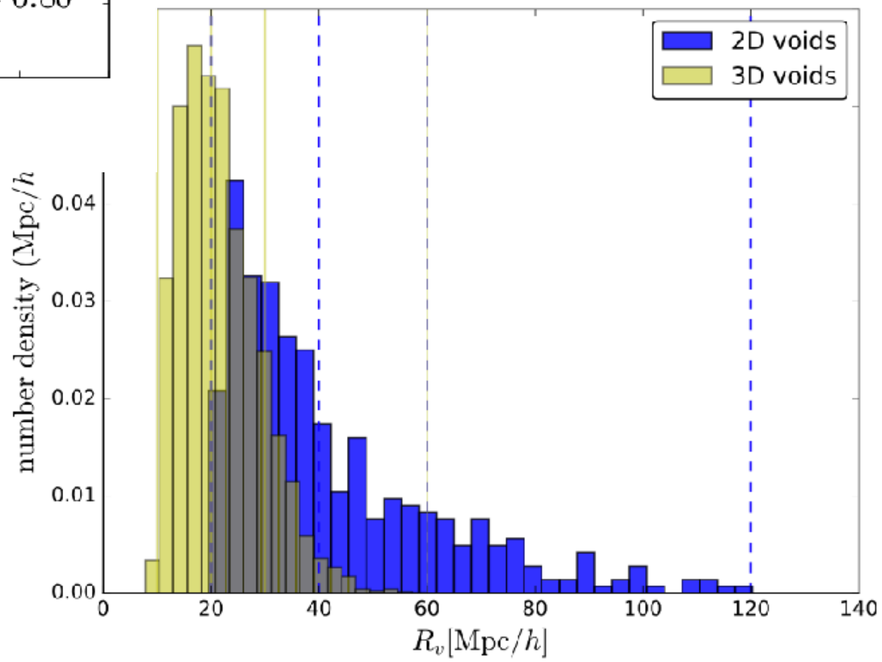


Tessa Baker et al. (2018)

Void Lensing (DES)

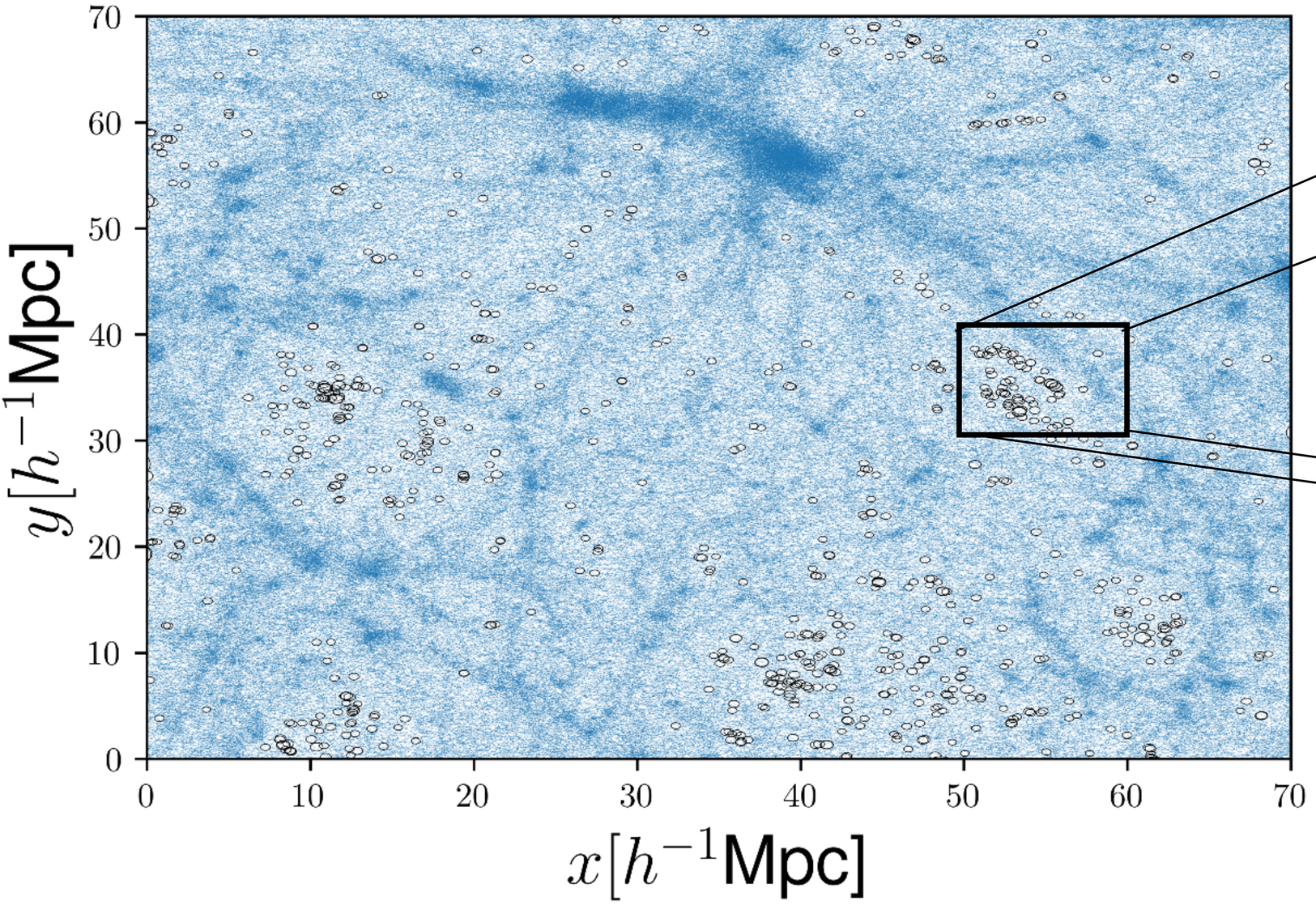


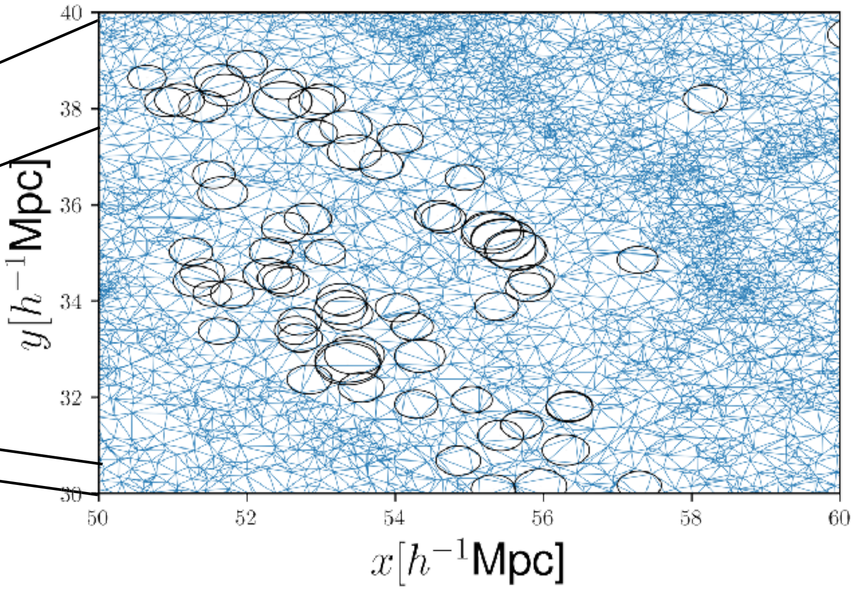
$$S/N_{2D} = 10 \quad S/N_{3D} = 14$$



Y. Fang et al. (2019)

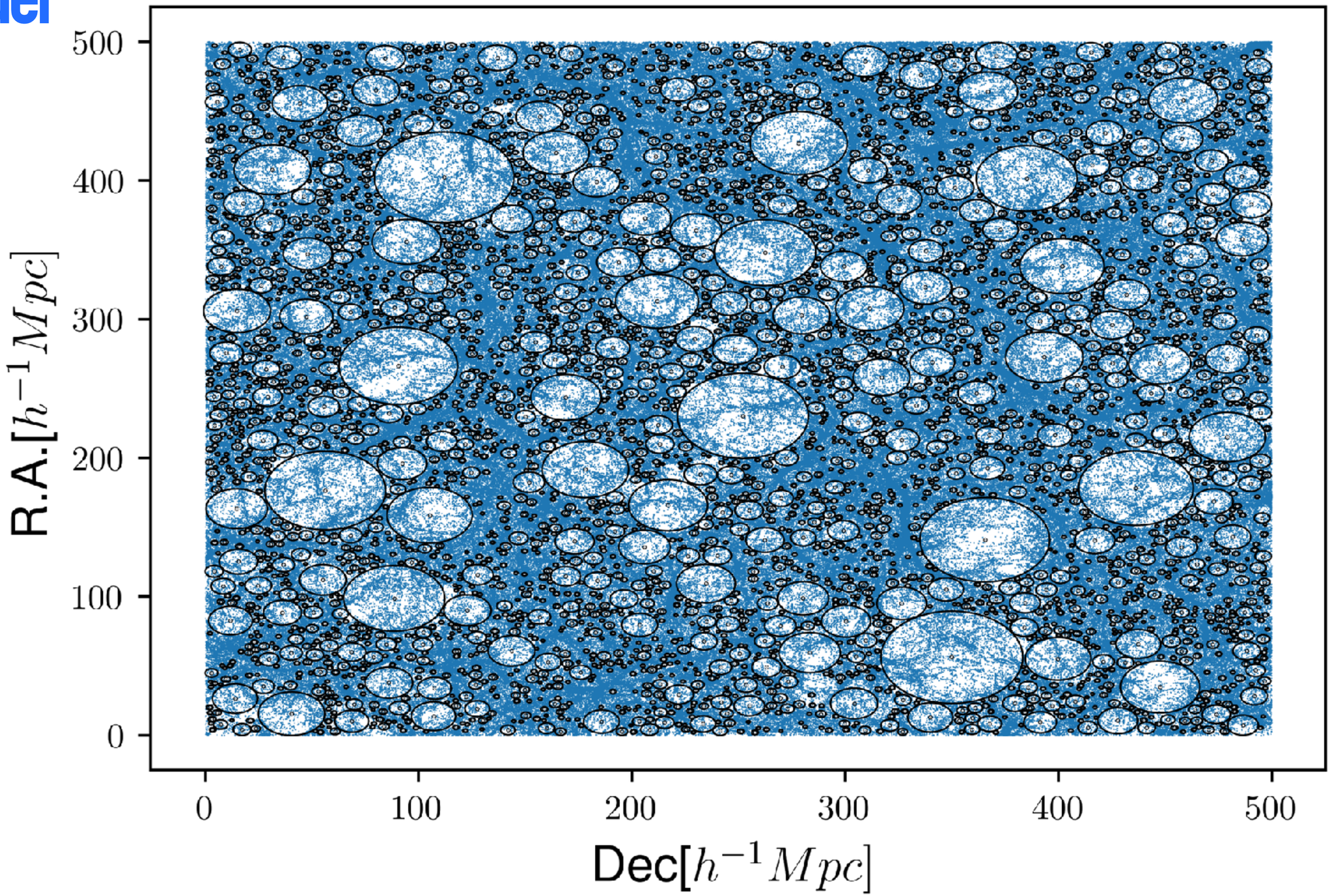
Void Finder



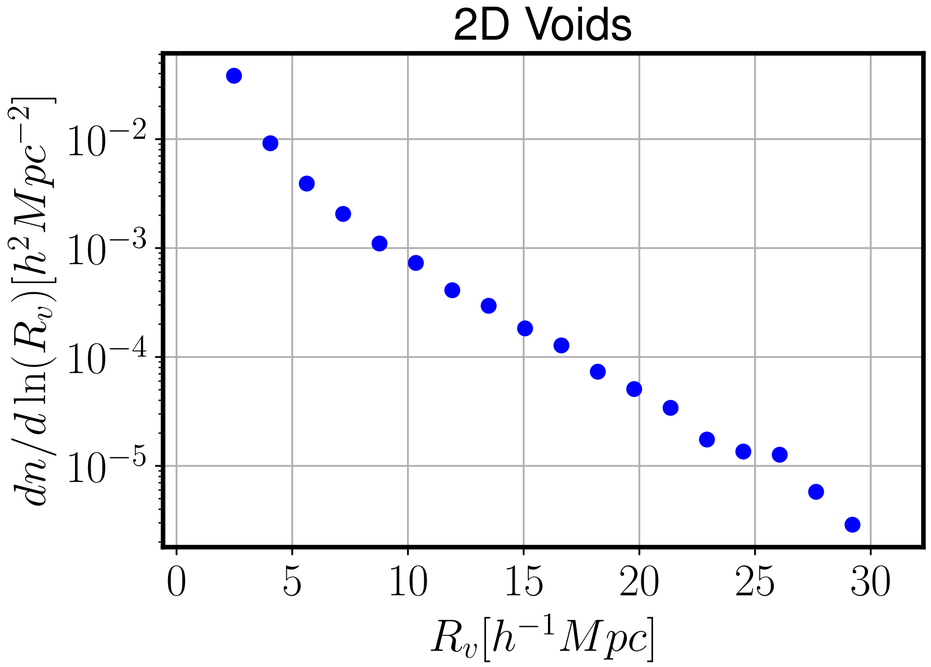


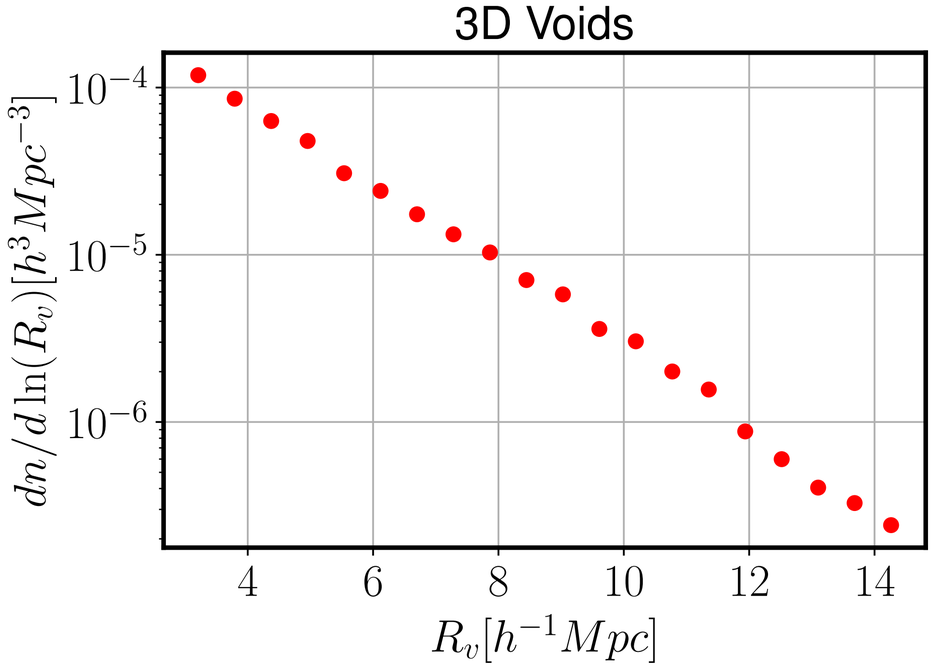
1) **Perform Delaunay triangulation**
2) **Sort by circumcircle radius**
3) **Grow the circle around the N largest circles and stop when the density reaches Δ**
4) **If candidates intercept each other, keep the largest.**

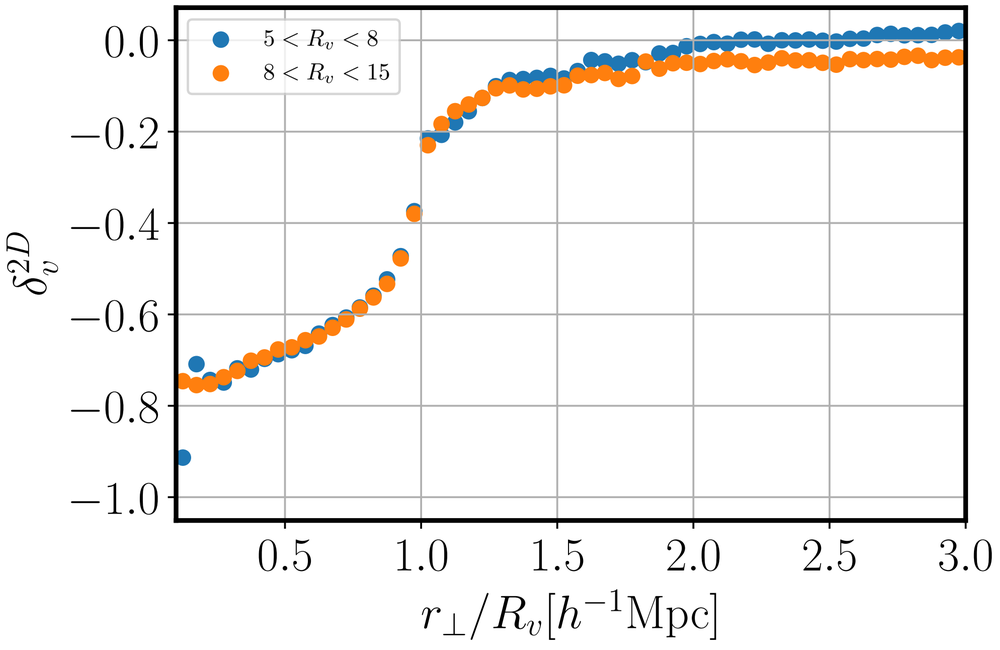
Void Finder

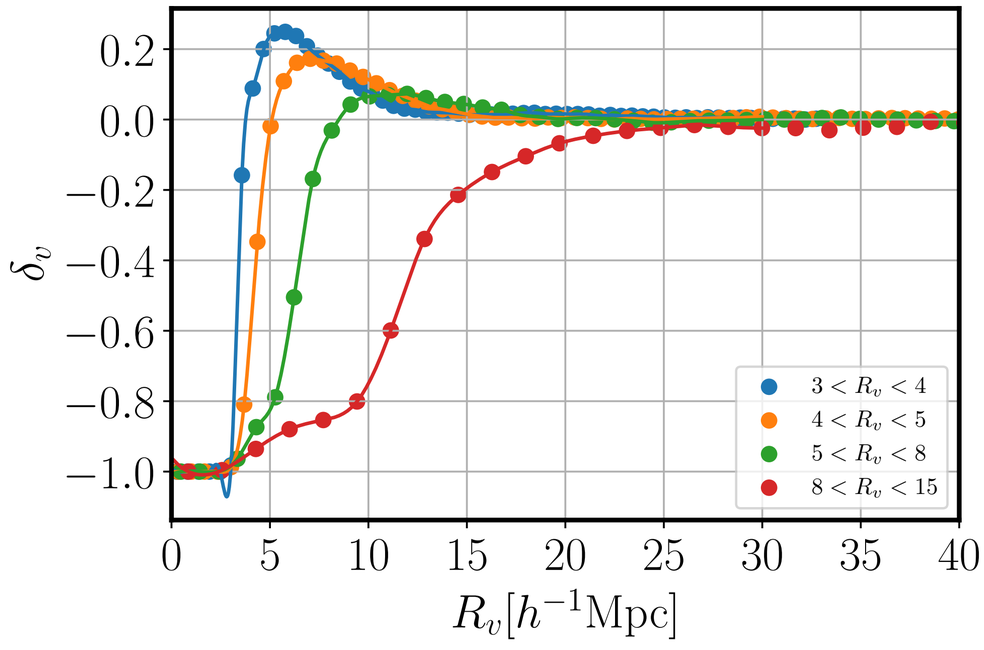


Void Profile and Abundance

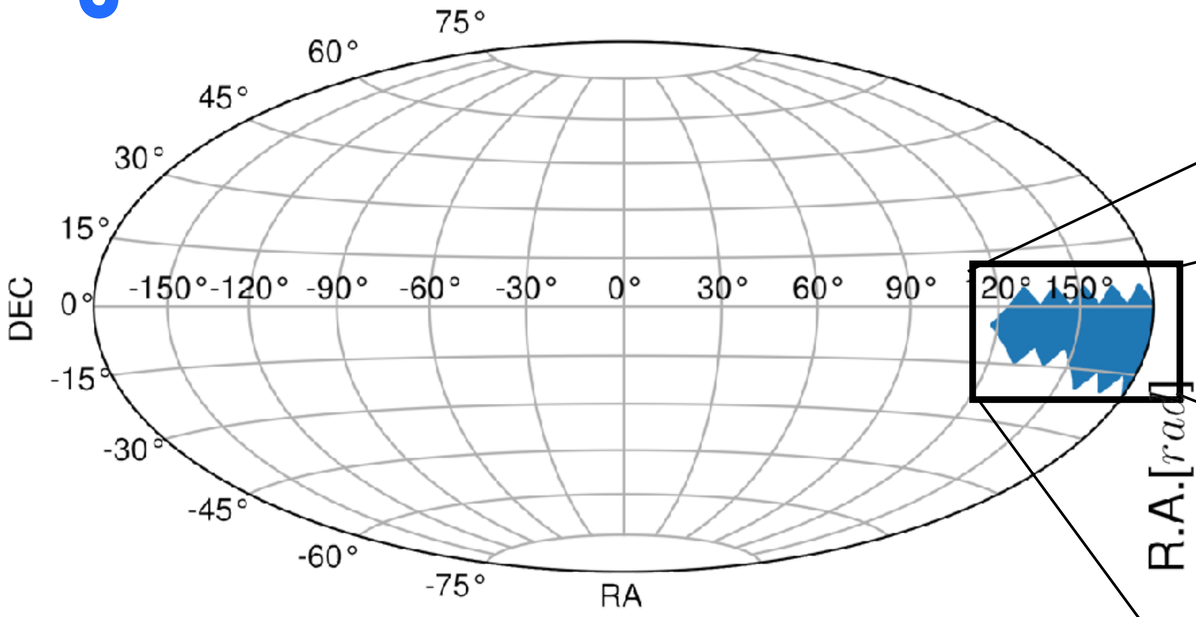


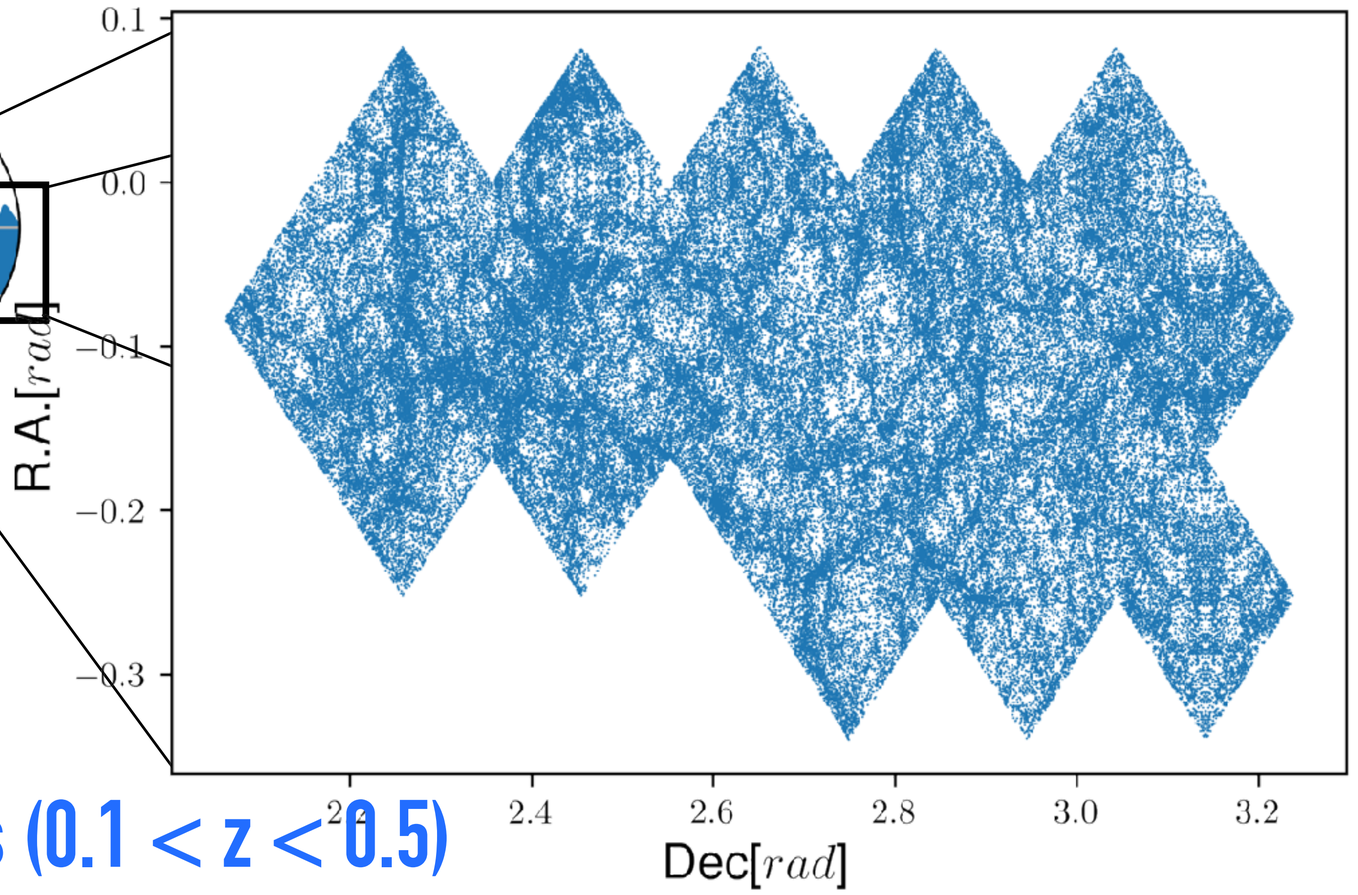






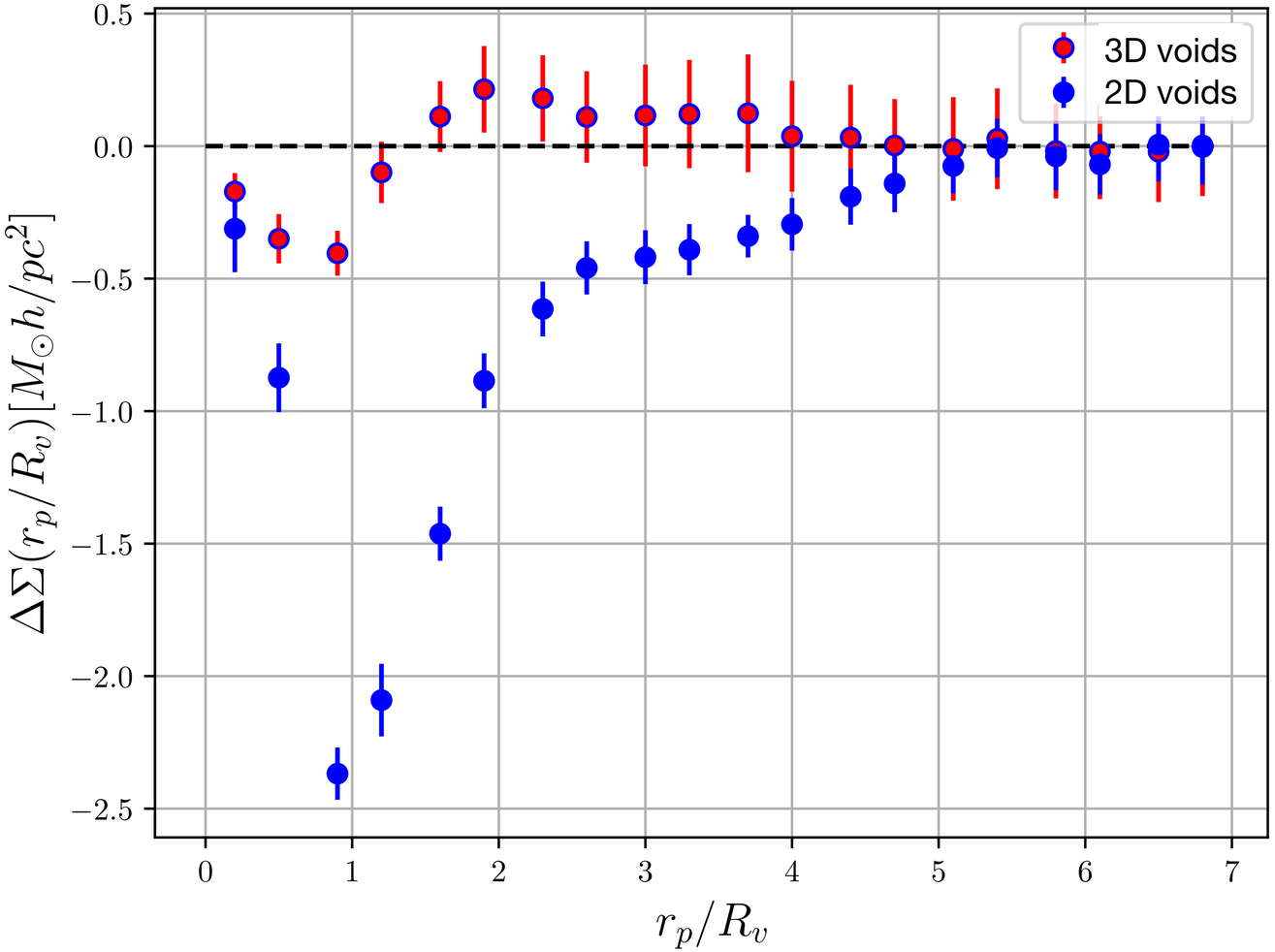
Stage1mocks

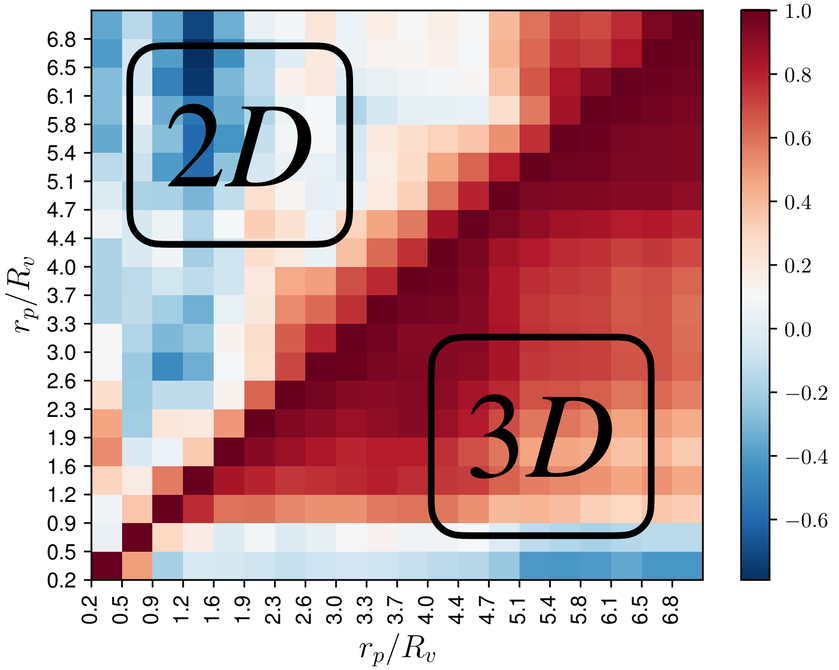


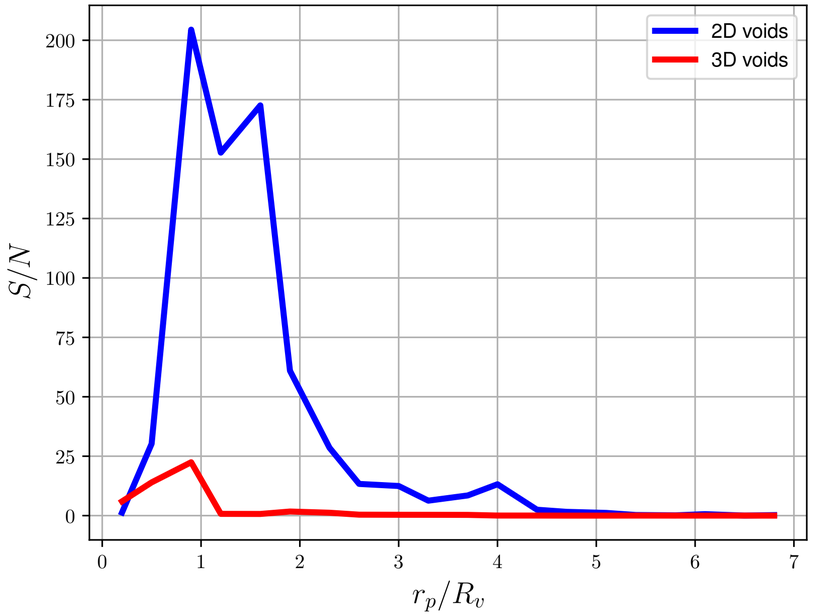


- 1000 deg sq
- ~ 1M BGS spectroscopic galaxies (0.1 < z < 0.5)
- ~ 65M photometric HSC sources (0.3 < z < 1.5)

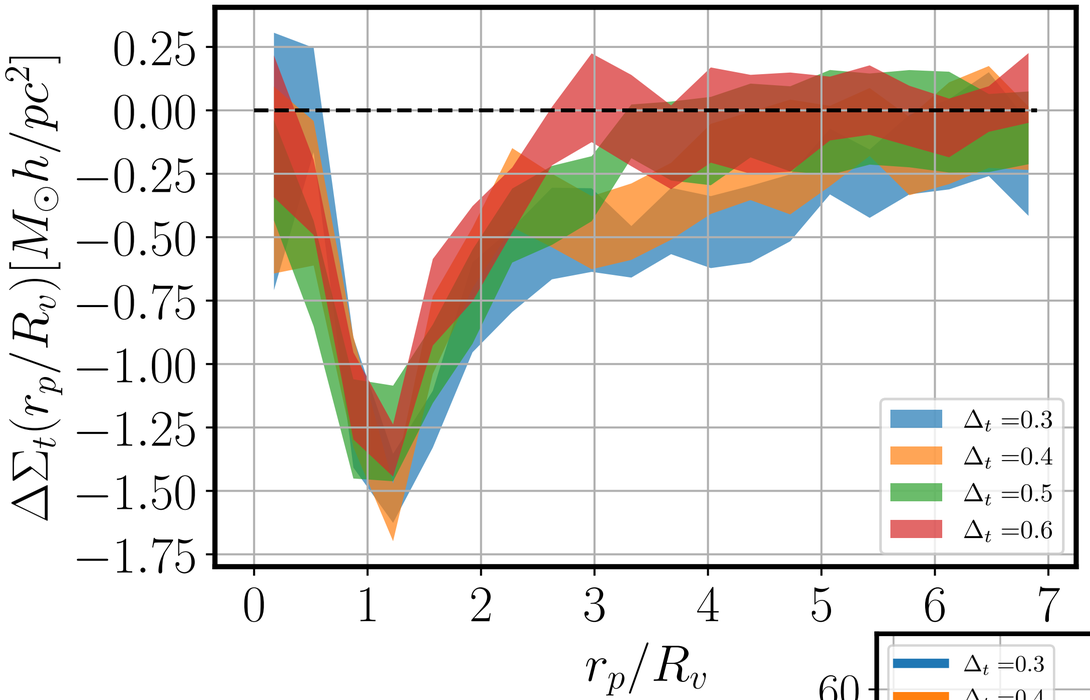
How To Measure VL

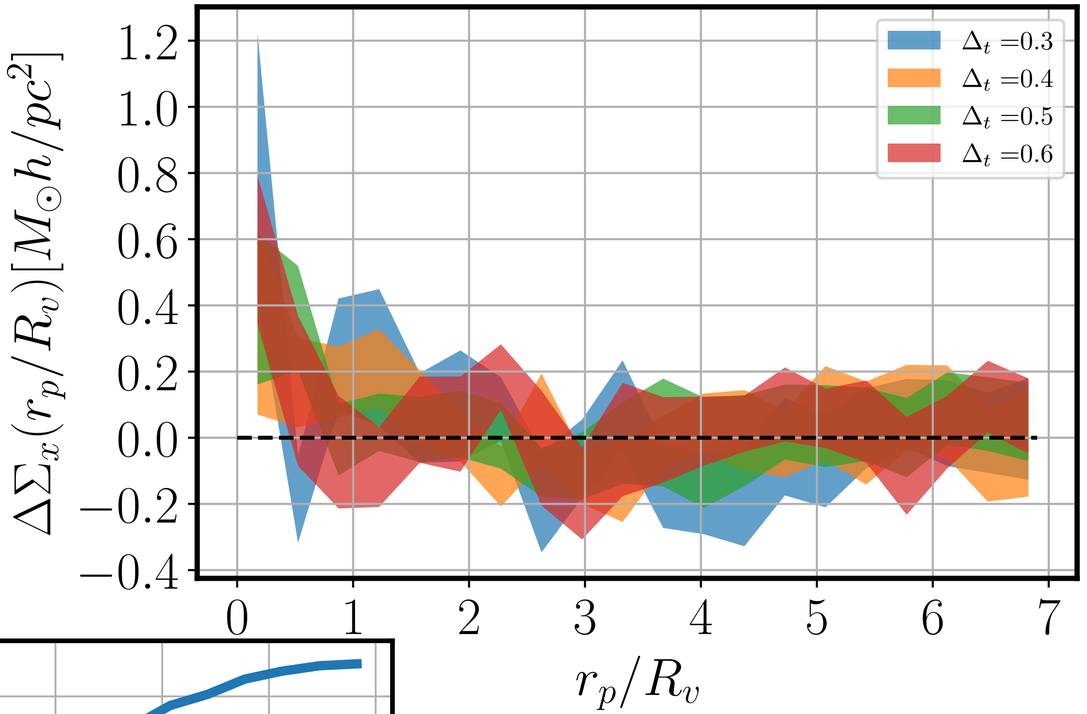


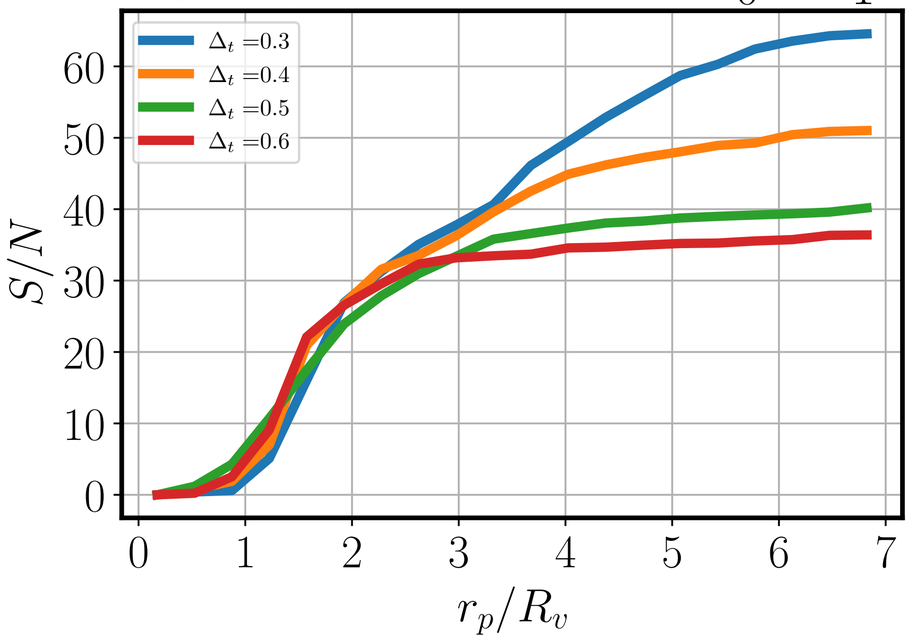




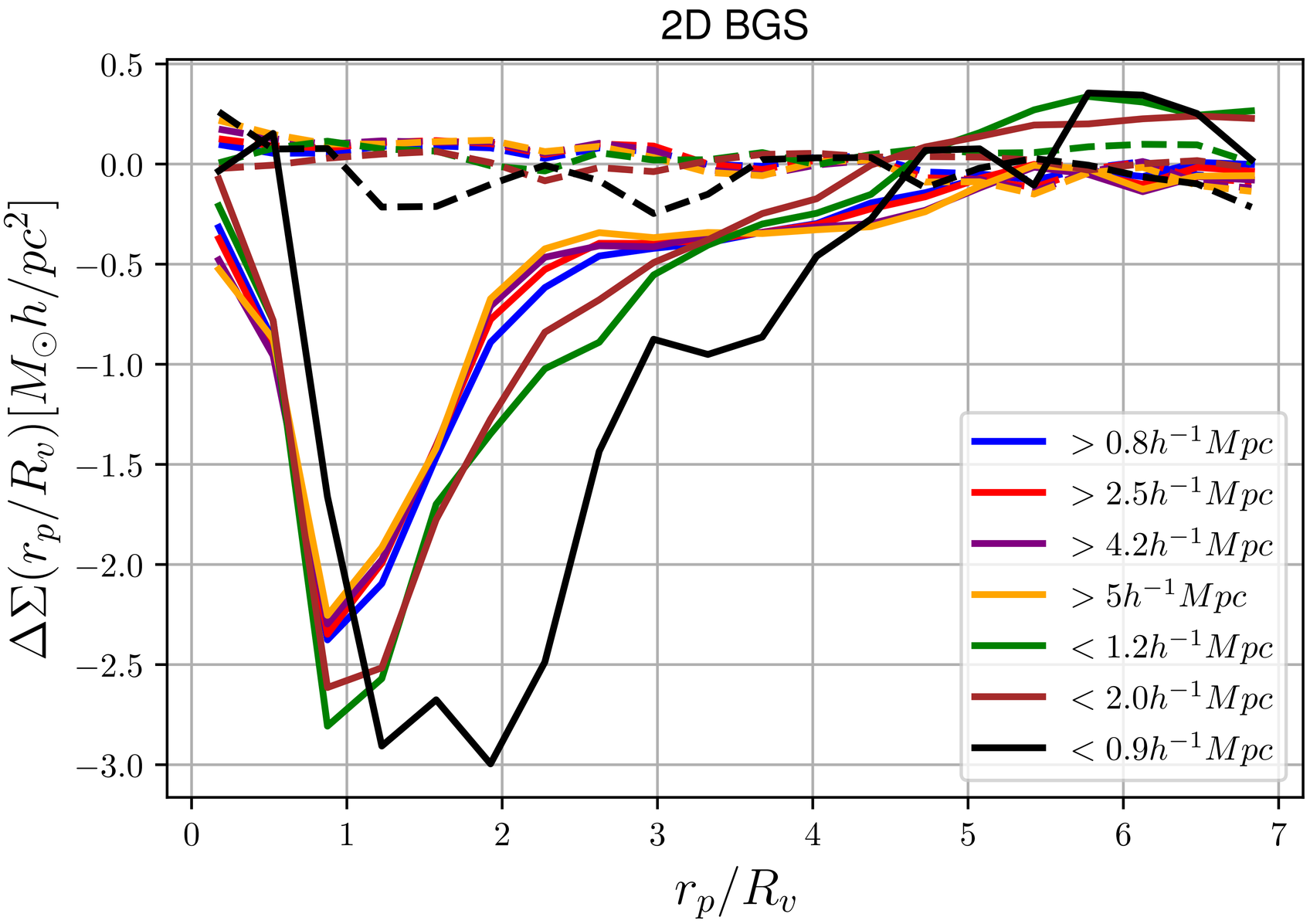
How To Measure VL



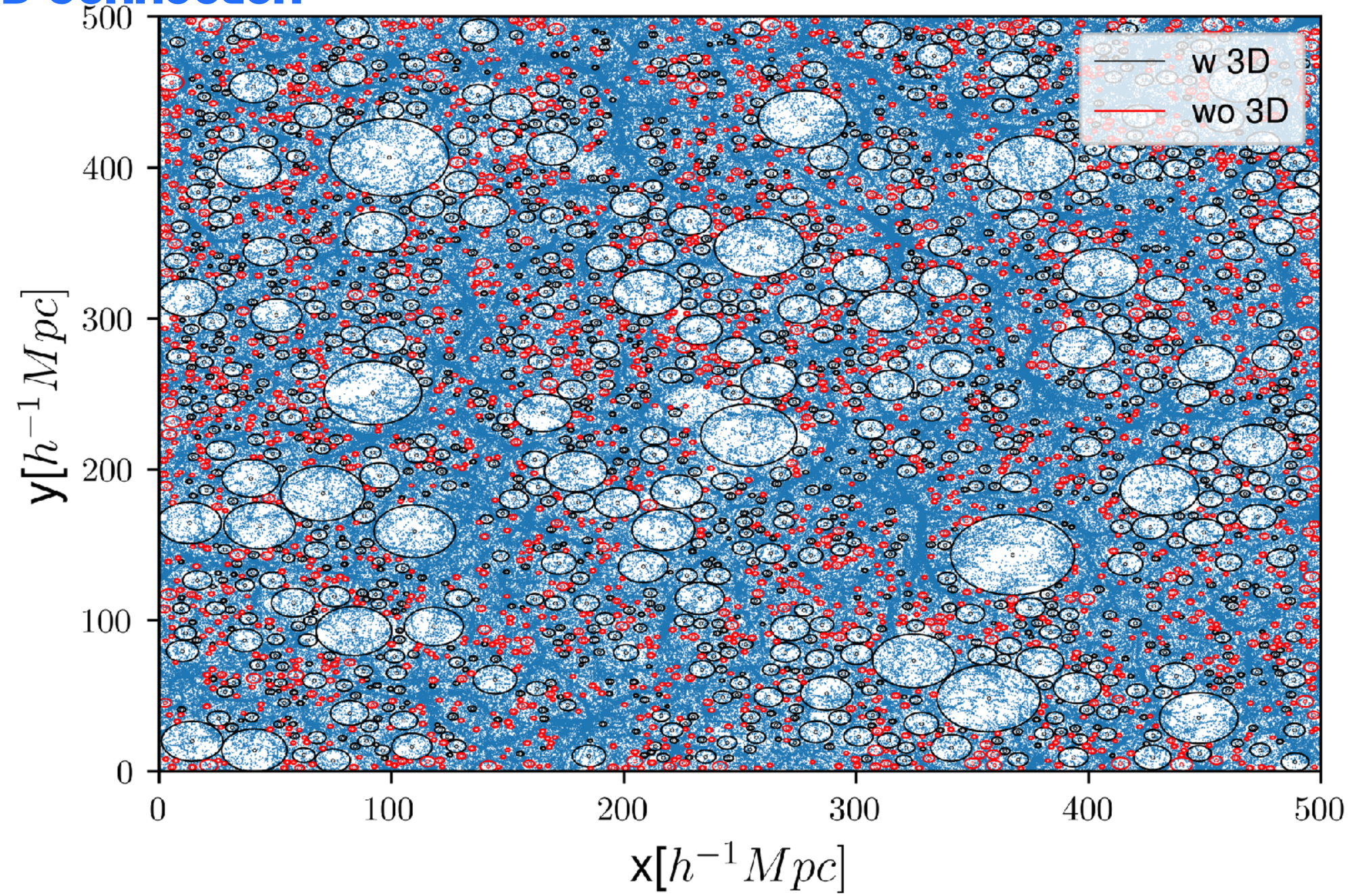




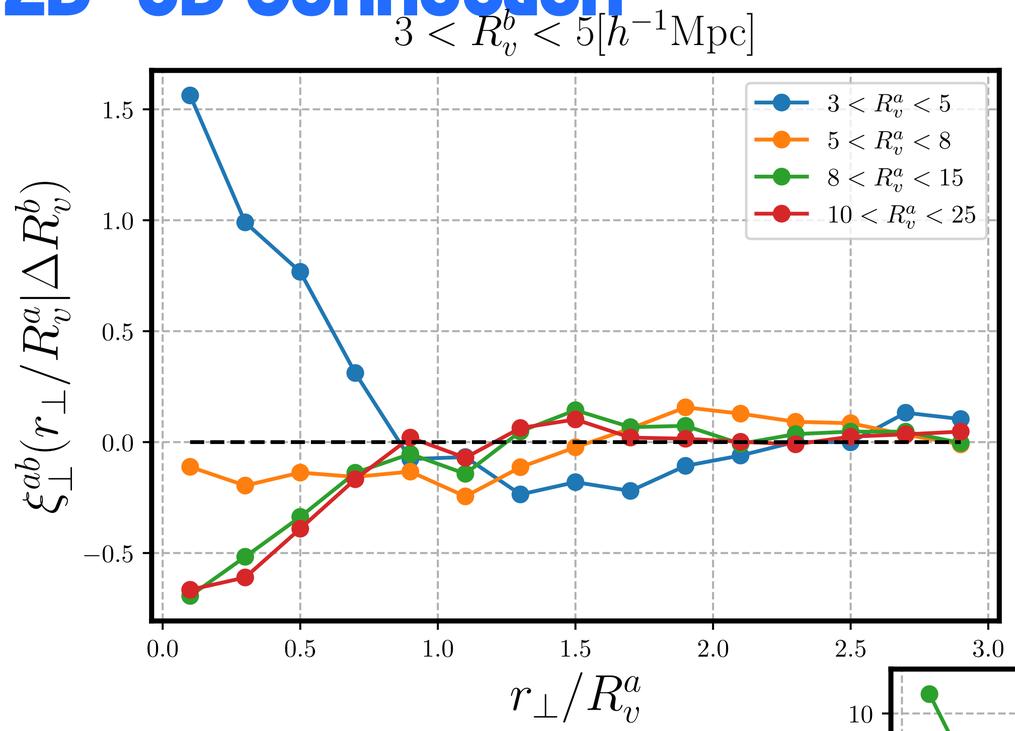
The Role of Void Radius

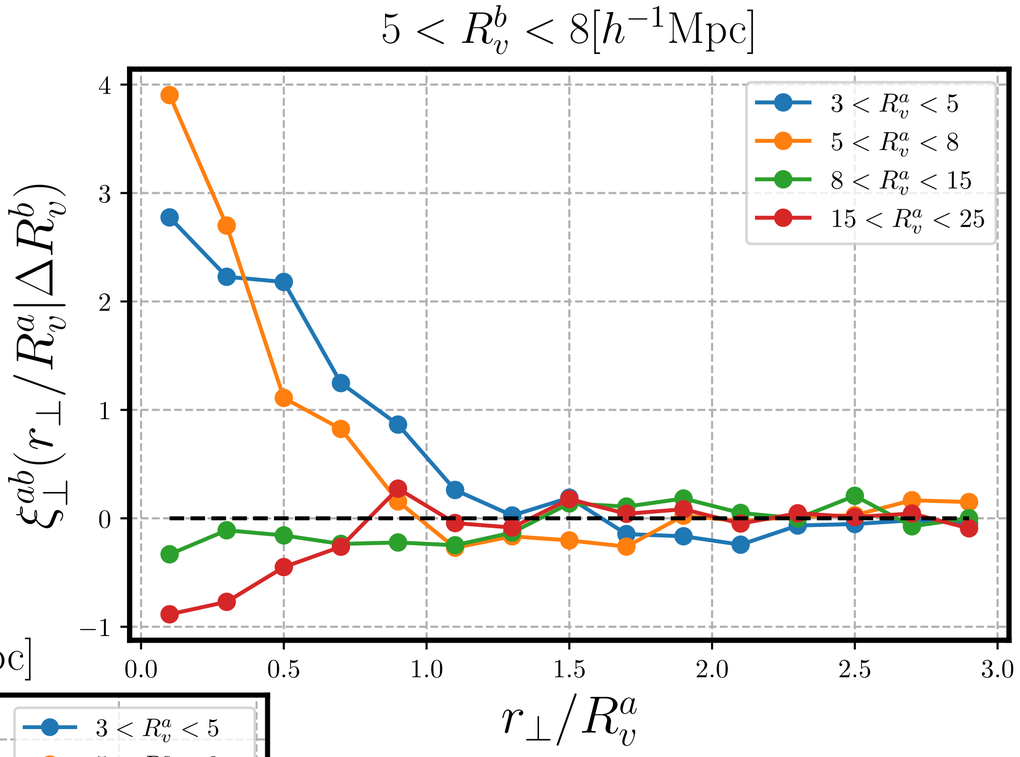


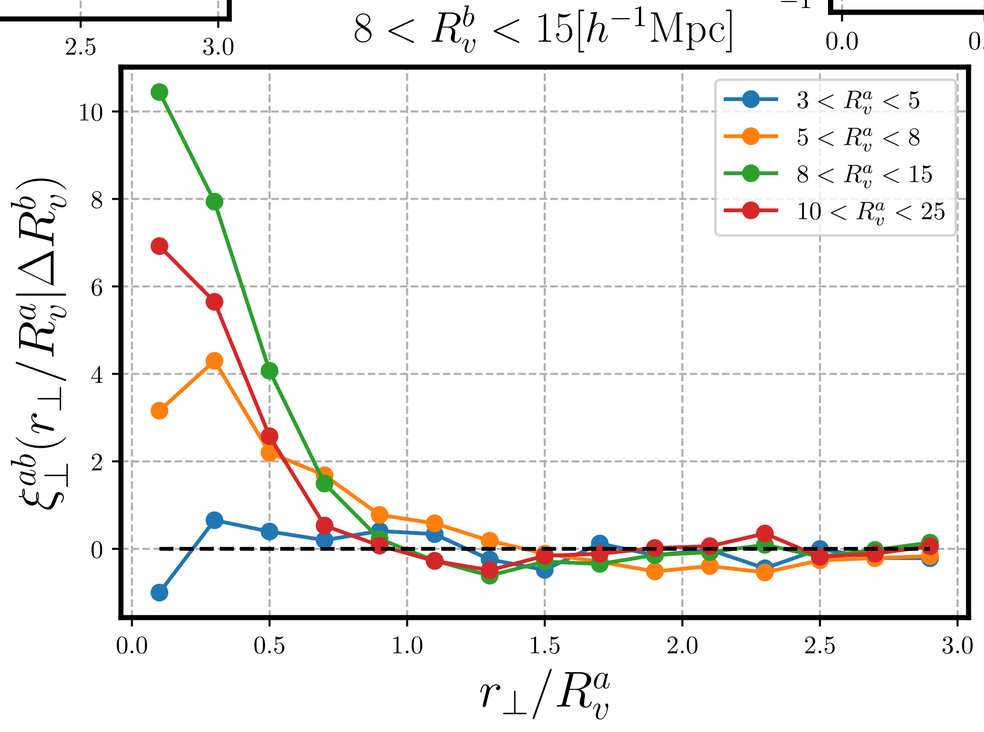
2D-3D Connection



2D-3D Connection







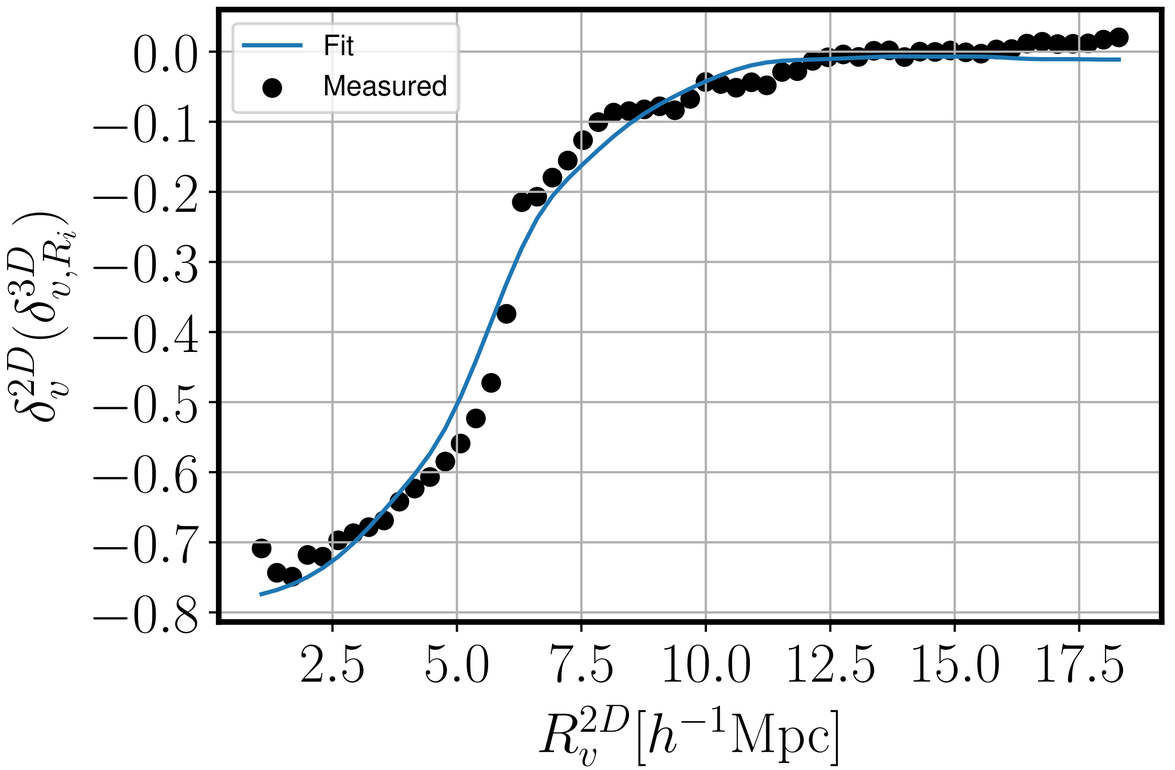
$$a \equiv 2D$$

$$b \equiv 3D$$

2D-3D Connection

$$\delta_v^{2D}(R_v^{2D}) = F[\delta_v(R_v^{3D}), R_v^{2D}] = \int dR_v^{3D} P_R(R_v^{3D}) \int d\xi P_\xi(\xi \,|\, R_v^{3D}) \int dr_{//} \delta_v^{3D} \left(\sqrt{\alpha r_{//}^2 + (r_\perp - \xi)^2} \,|\, R_v^{3D} \right)$$

$$\approx \frac{1}{L} \frac{\sum_i \omega_i \int_0^L dr_{//} \delta_v^{3D} \left(\sqrt{(\alpha_i r_{//} - L/2)^2 + r_\perp^2} \,|\, R_{v,i}^{3D} \right)}{\sum_i \omega_i}$$



$R_v^{2D} \in [5,8](h^{-1}\mathbf{Mpc})$

$R_{v,1}^{3D} \in [5,8](h^{-1}\mathbf{Mpc})$

$R_{v,2}^{3D} \in [8,15](h^{-1}\mathbf{Mpc})$

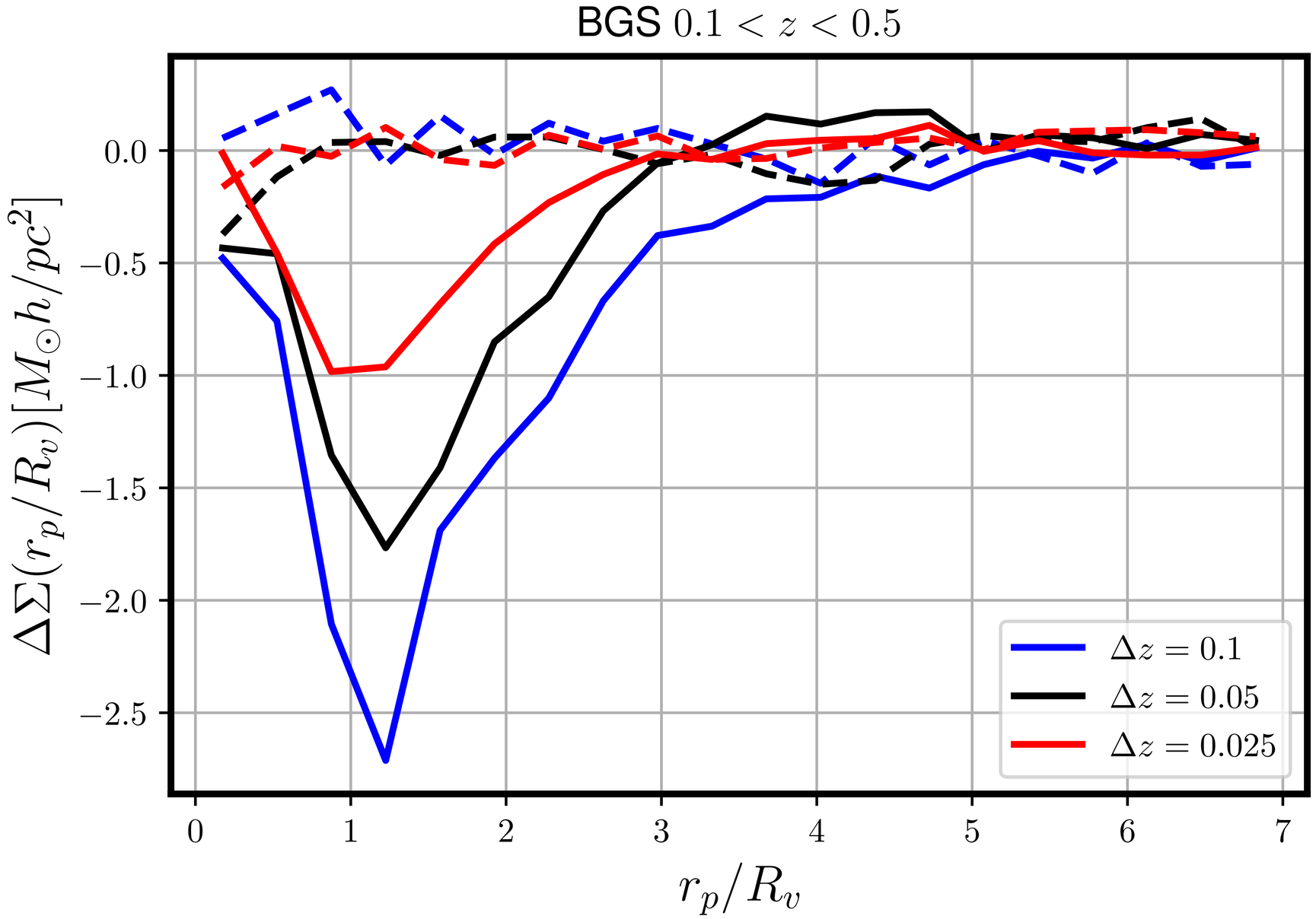
$\omega_1 = 1.11,\ \omega_2 = 0.36,$

$\alpha_1 = 0.59,\ \alpha_2 = 0.78$

Conclusions and Future Steps

- Void-Lensing is an interesting observable in terms of S/N
- Use the freedom of void definition to increase signal!
- Better understand of the connection between 2D and 3D underdensities in order to extract cosmological information

The Role of Bin Size



Investigating the Relation Between 2D and 3D Voids

Starting from the 3D void profile (Voivodic et al., 2020):

$$\frac{\rho_v^{3D}(r_z, r_p \,|\, r_v)}{\bar{\rho}_m^{3D}} \equiv \xi^{1V} + b_v \xi_g$$

Where,

$$\xi^{1V} = \frac{1}{2}\left[1 + \tanh\left(\frac{\ln\left(\sqrt{\left(r_p/r_v\right)^2 + \left(r_z - D_A(z)/r_v\right)^2}\right) - \ln\left(r_0\right)}{s}\right)\right]$$