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

Void-Lensing as a Test of Gravity:

1. How To Measure WL by Voids

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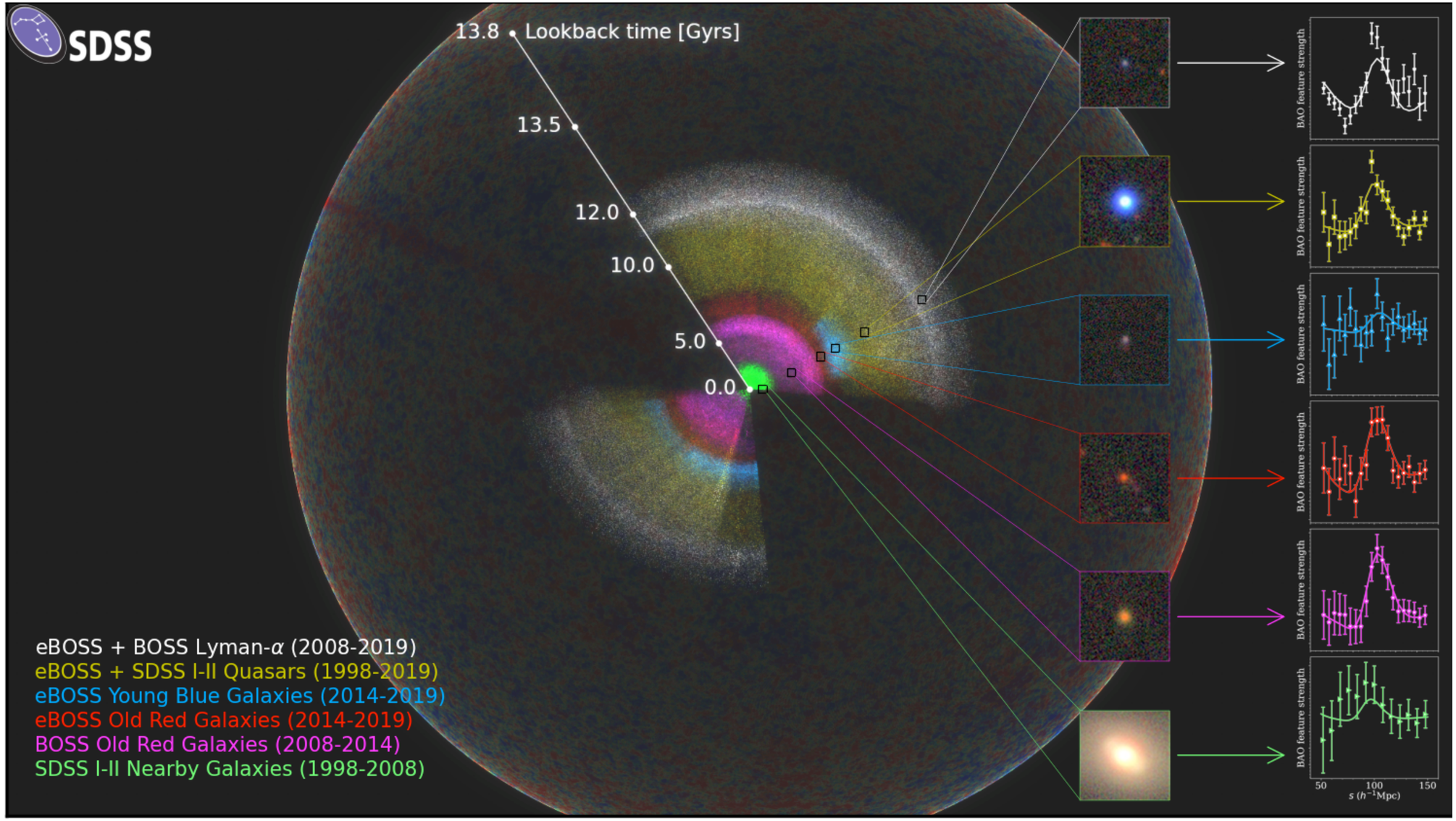
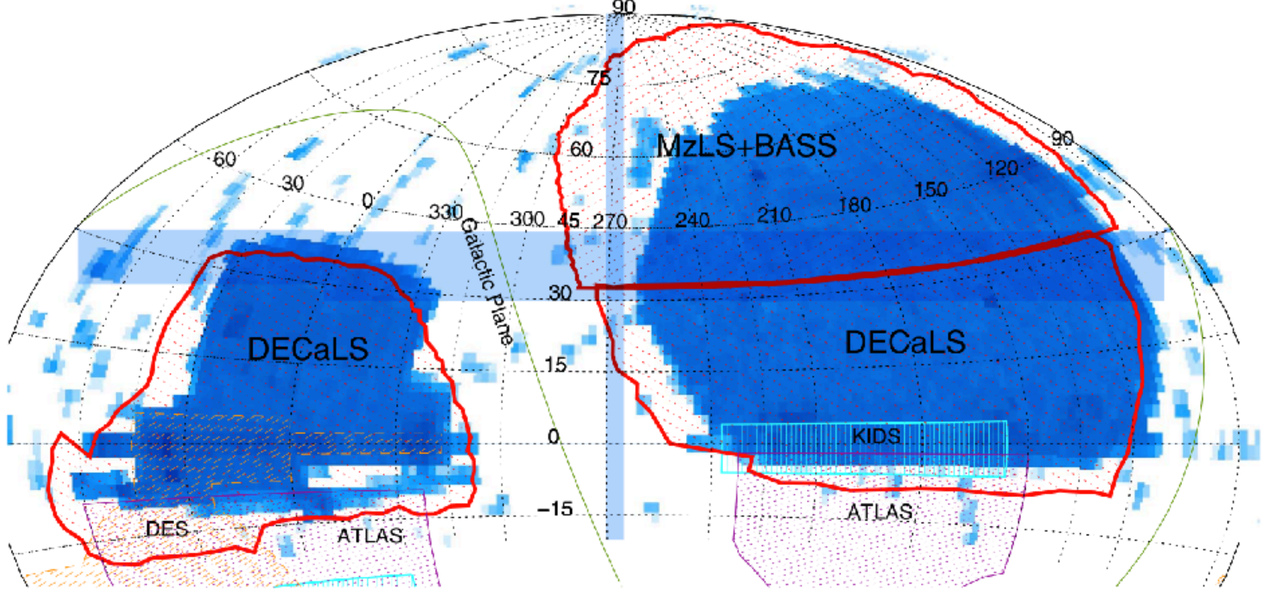
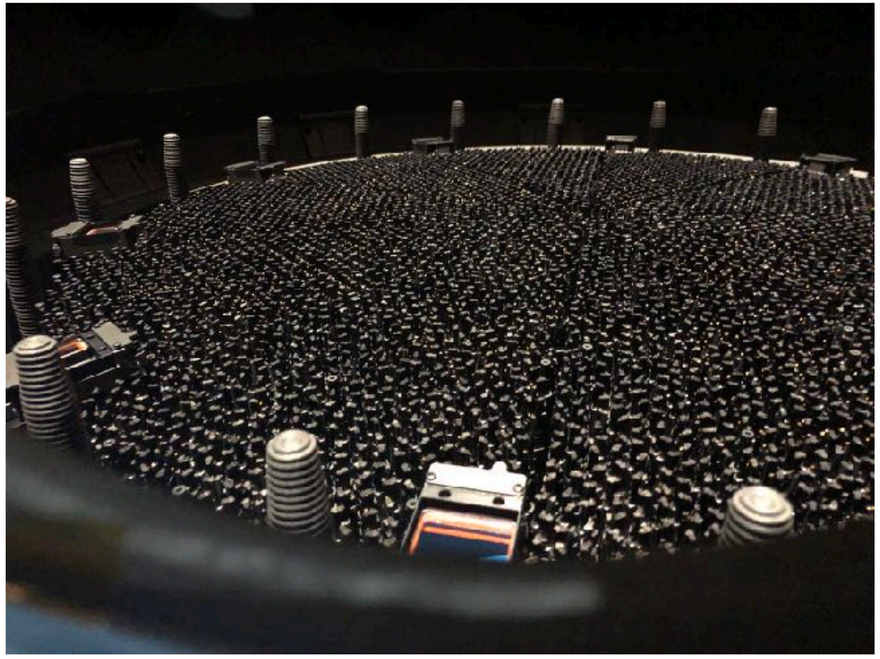
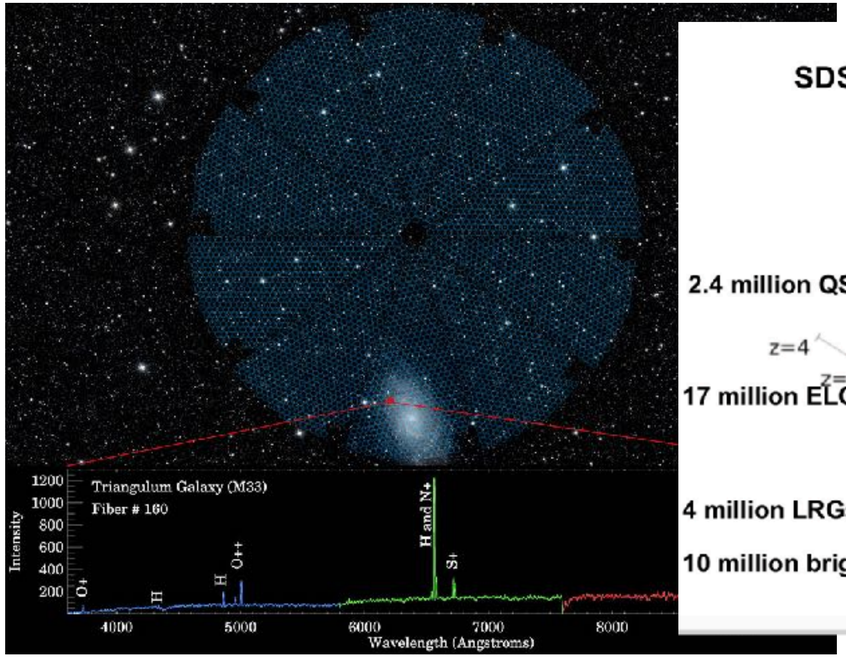
Motivations

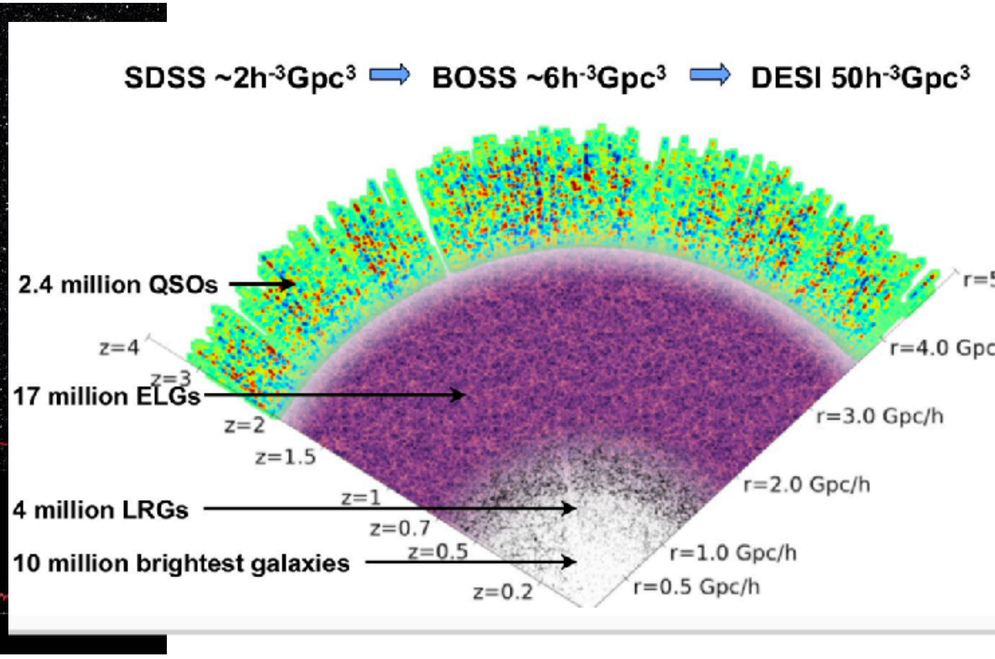


DESI Survey

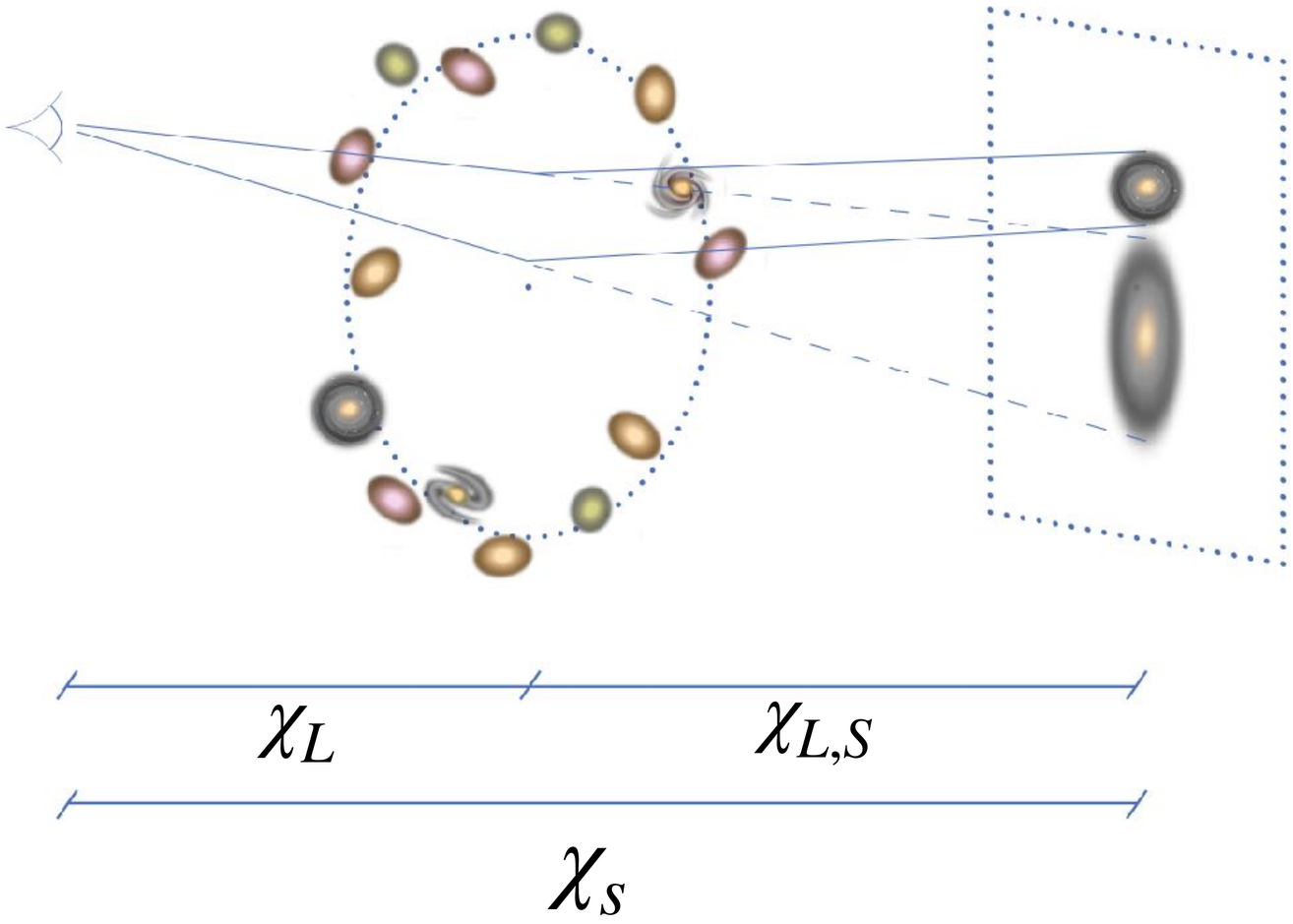

MzLS+BASS
DECaLS
DECaLS
KIDS
DES
ATLAS
ATLAS
Galactic Plane
90
75
60
30
0
330
300
45
270
240
210
180
150
120
90
60
30
0
−15




Triangulum Galaxy (M33)
Fiber # 160
Intensity
Wavelength (Angstroms)
O+
H
H
O++
H and N+
S+
1200
1000
800
600
400
200
4000
5000
6000
7000
8000


SDSS ~2h-3Gpc3
BOSS ~6h-3Gpc3
DESI 50h-3Gpc3
2.4 million QSOs
17 million ELGs
4 million LRGs
10 million brightest galaxies
z=4
z=3
z=2
z=1.5
z=1
z=0.7
z=0.5
z=0.2
r=4.0 Gpc
r=3.0 Gpc/h
r=2.0 Gpc/h
r=1.0 Gpc/h
r=0.5 Gpc/h

WL Voids



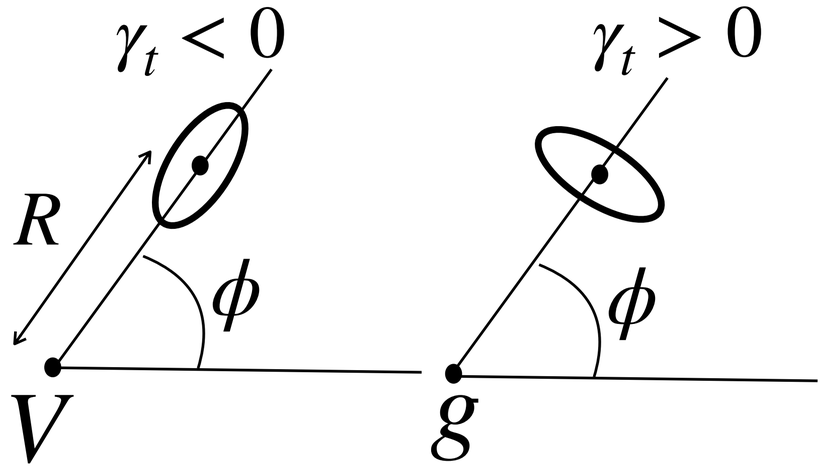
Differential surface mass density:

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

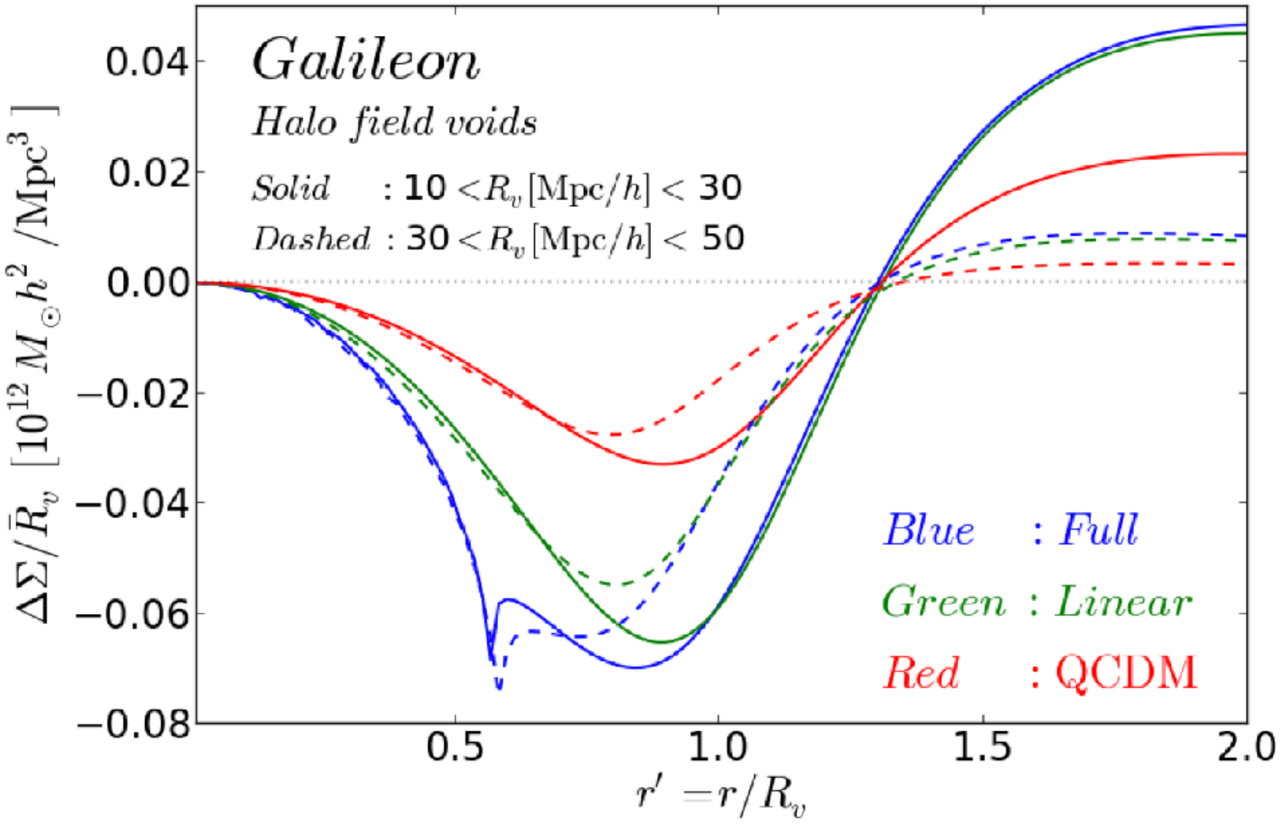
$$= \Sigma_{crit} \times \gamma_t(R)$$

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

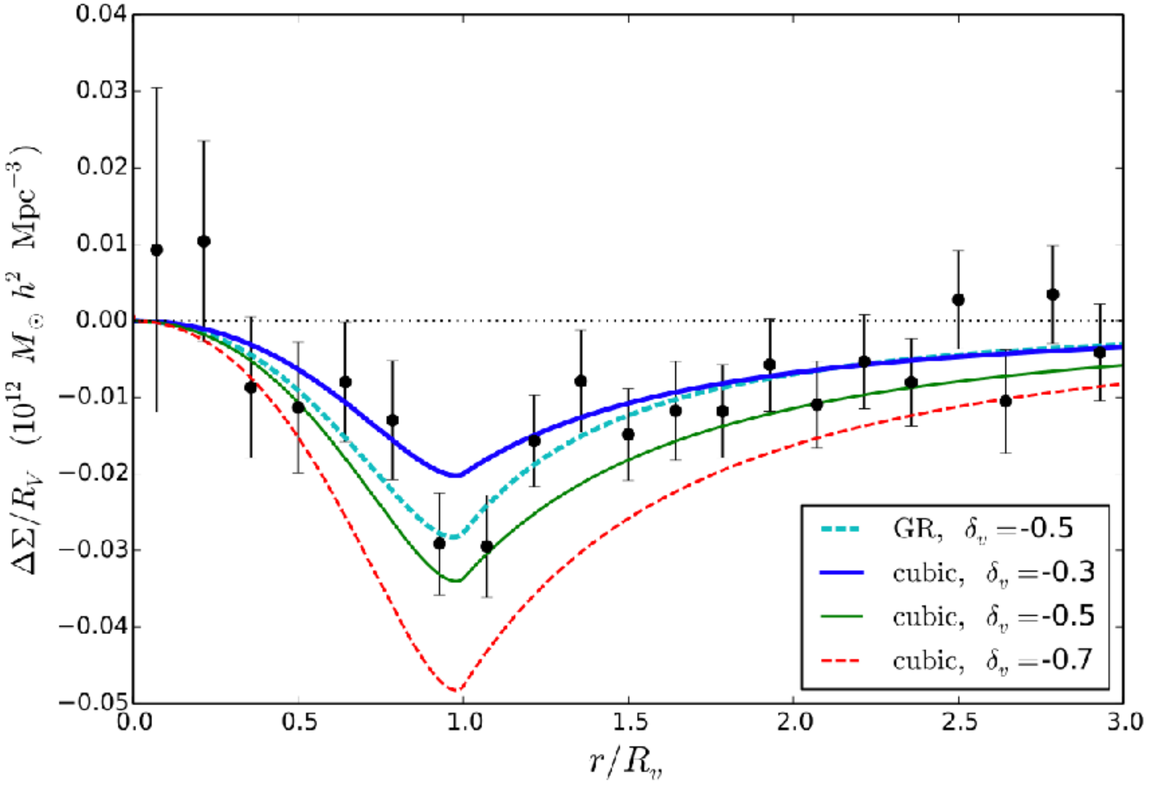
$$\gamma_t = -Re\{(\gamma_1 + i\gamma_2)e^{-2i\phi}\}$$



Void-Lensing Predictions

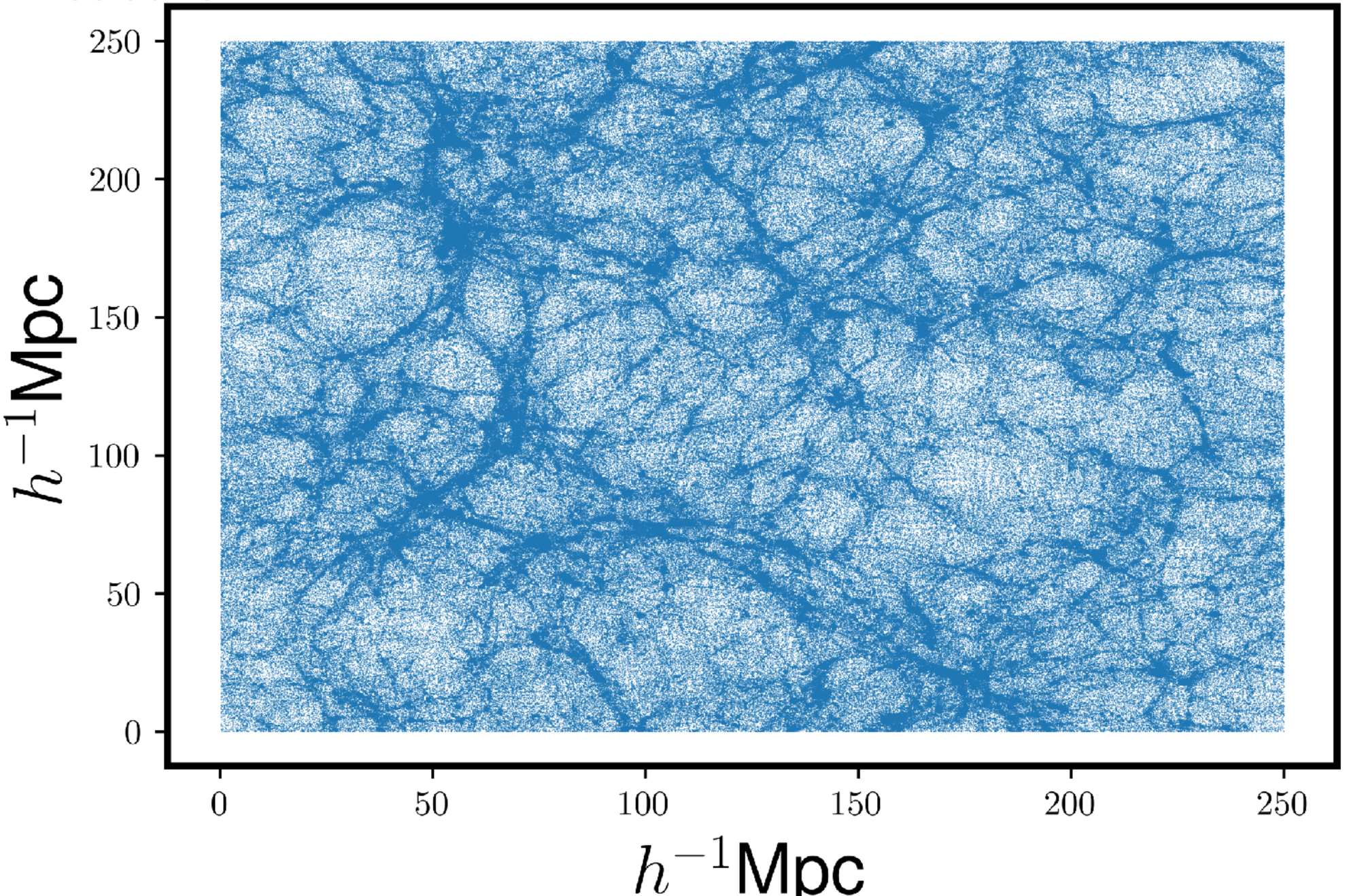


Alexandre Barreira et al. (2015)



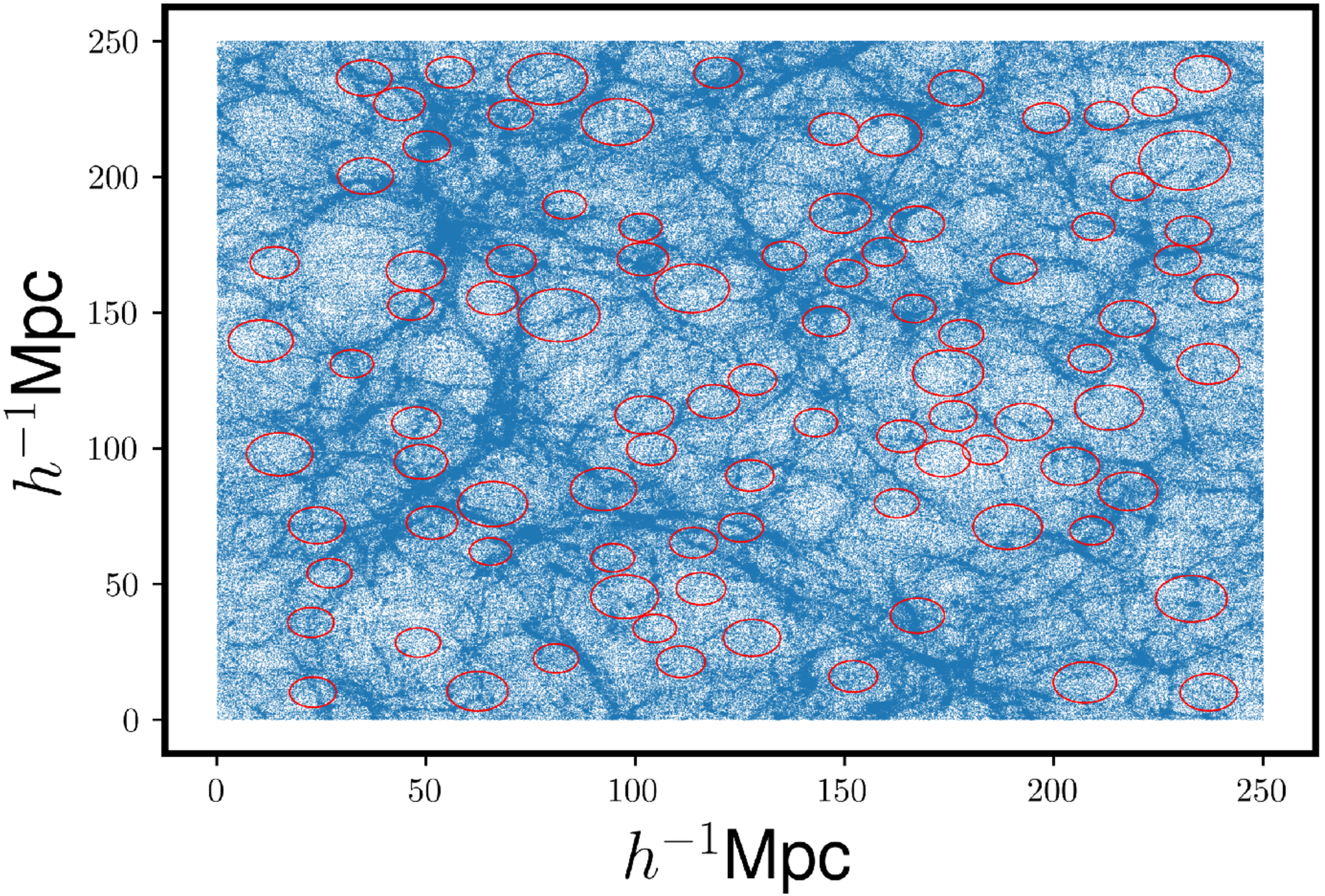
Tessa Baker et al. (2018)

How To Measure VL



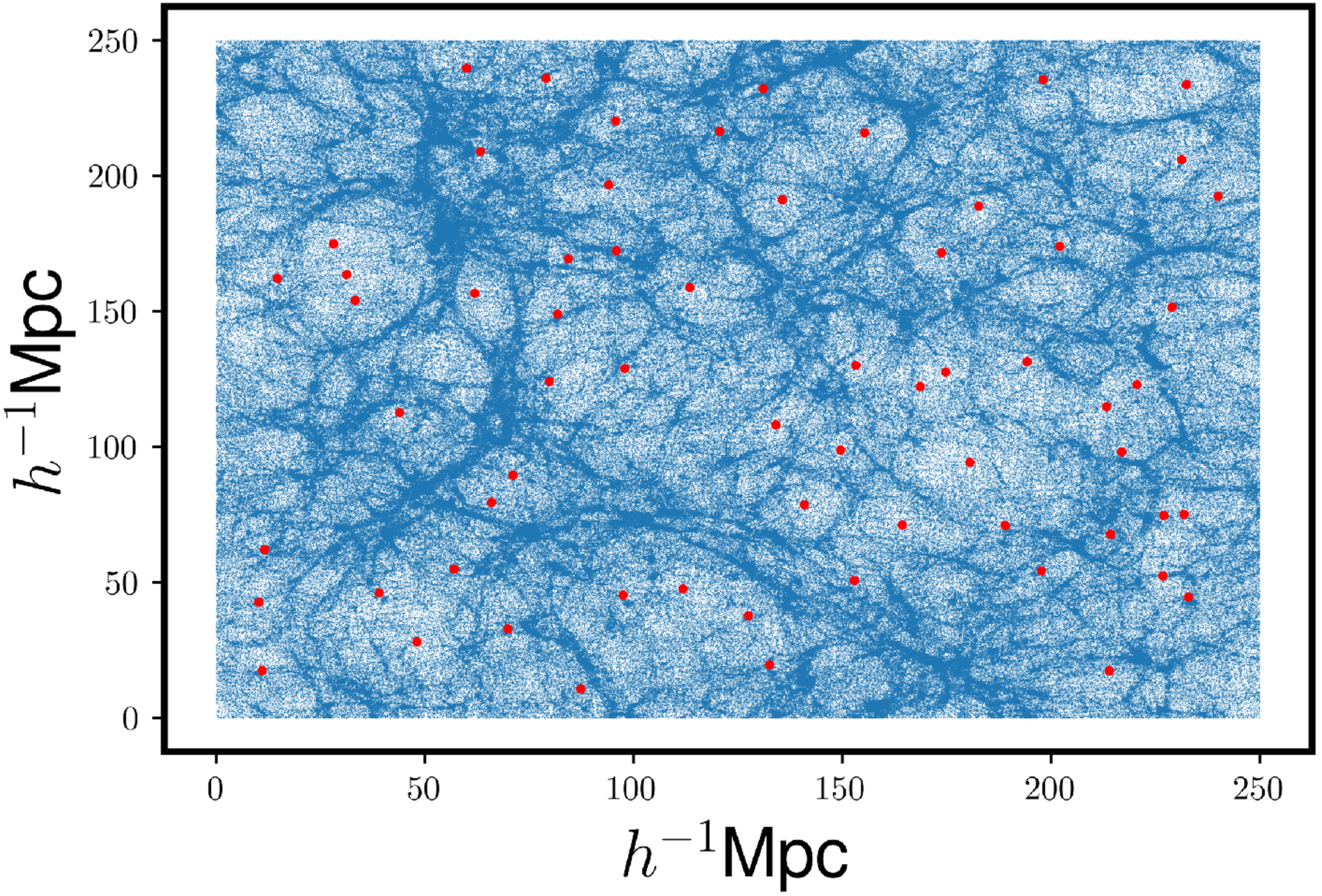
How To Measure VL

3D Voids



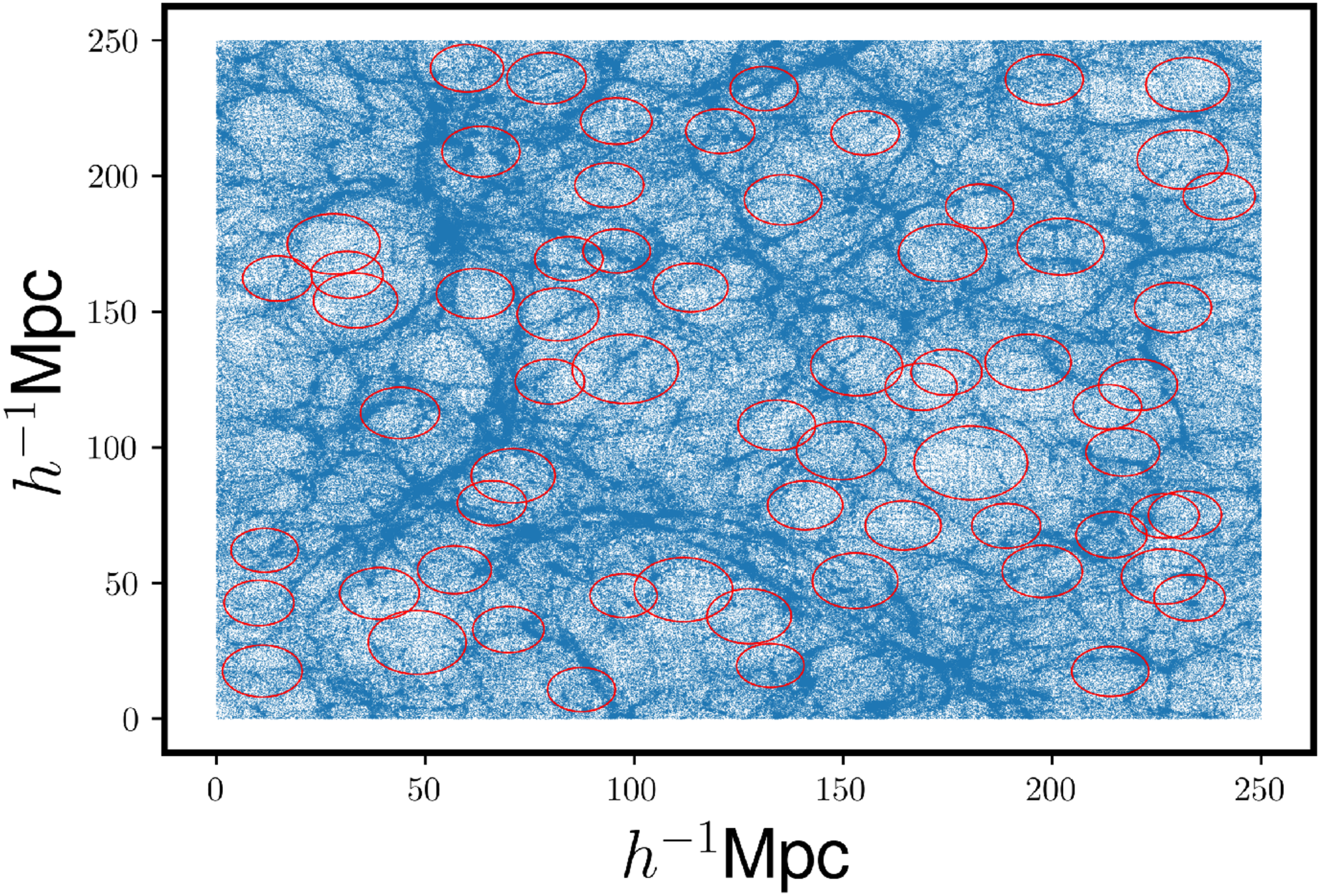
How To Measure VL

3D Voids centers ($8 < R_v < 15[h^{-1}\text{Mpc}]$)



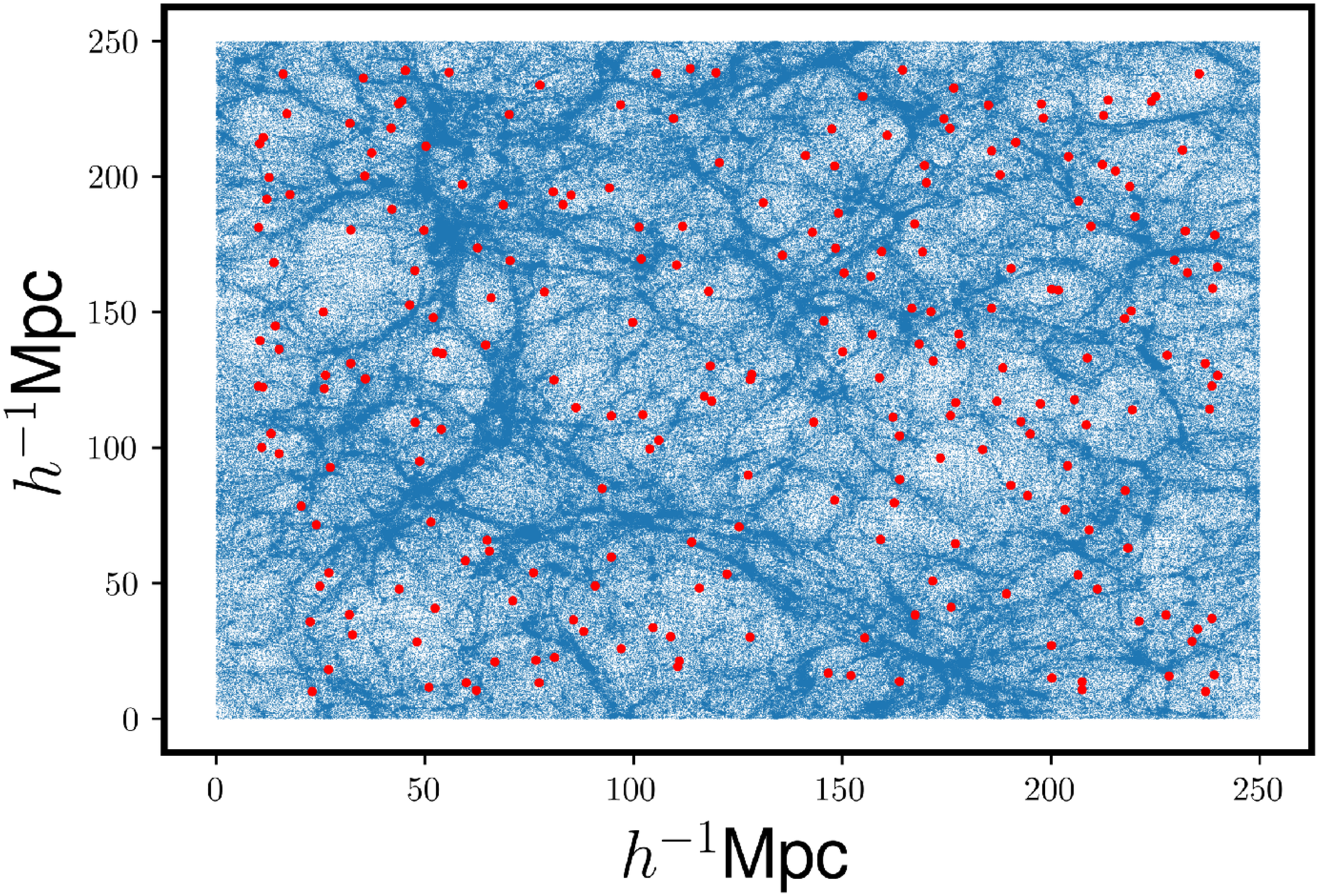
How To Measure VL

3D Voids centers ($8 < R_v < 15[h^{-1}\text{Mpc}]$)



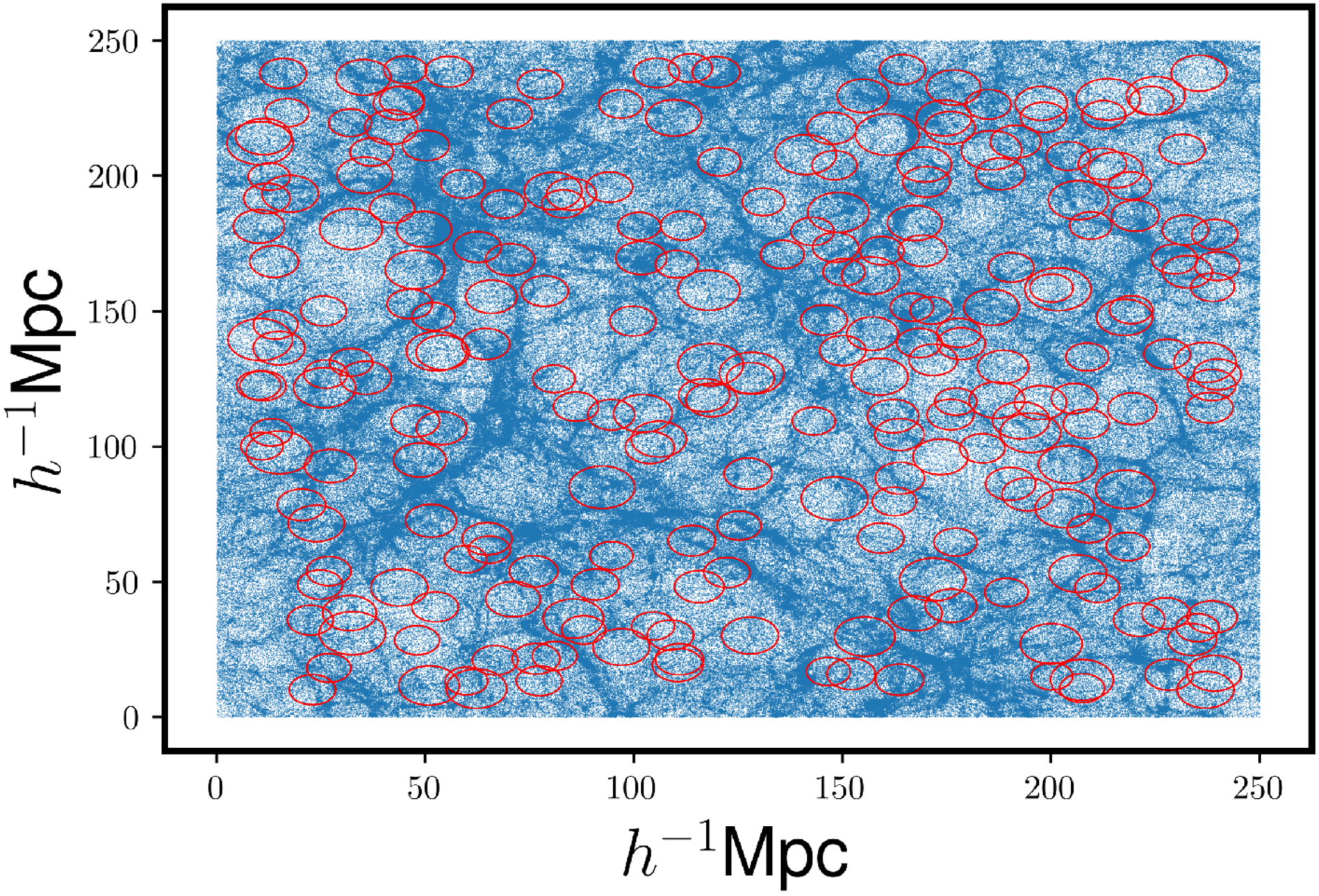
How To Measure VL

3D Voids centers ($5 < R_v < 8[h^{-1}\text{Mpc}]$)

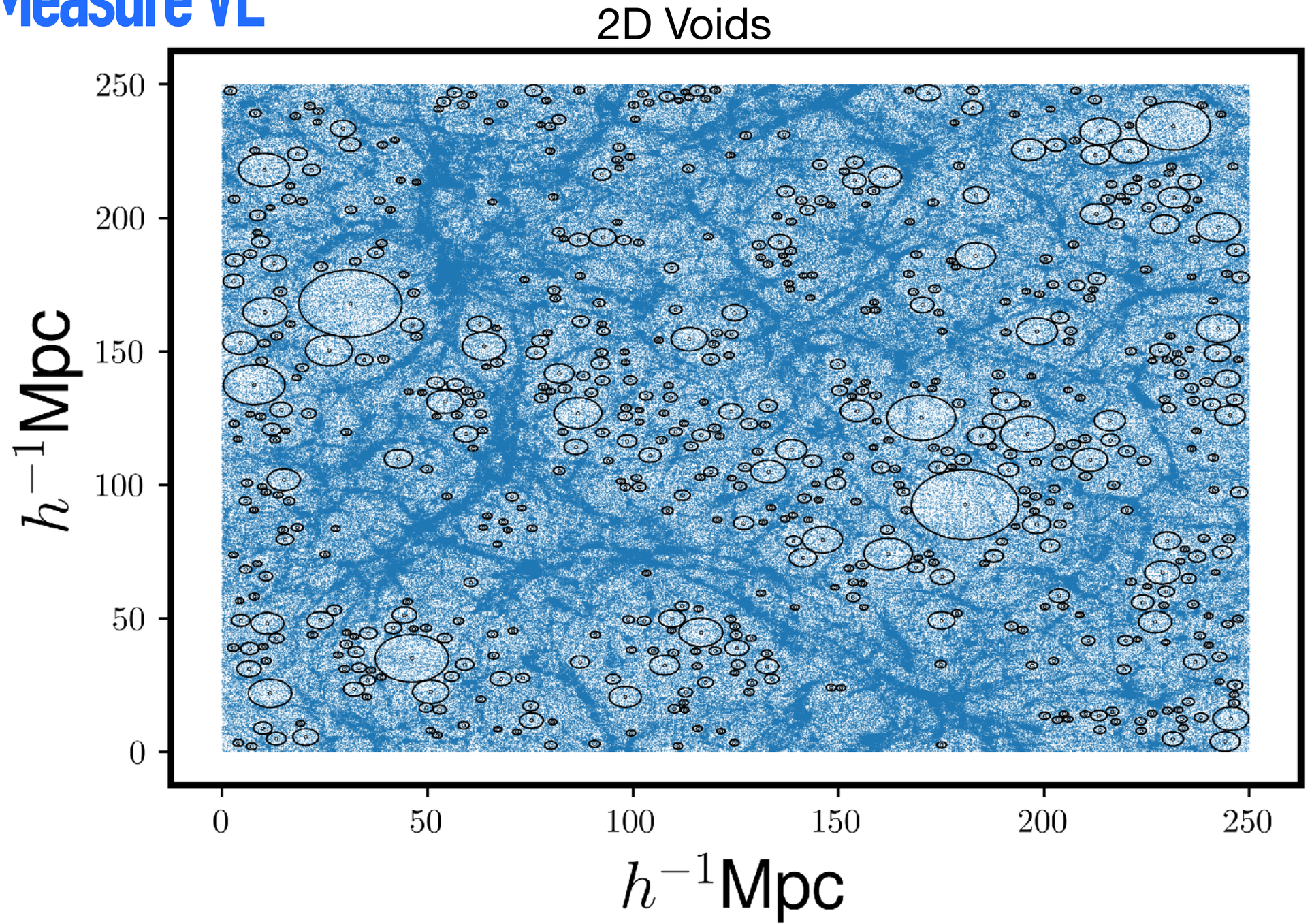


How To Measure VL

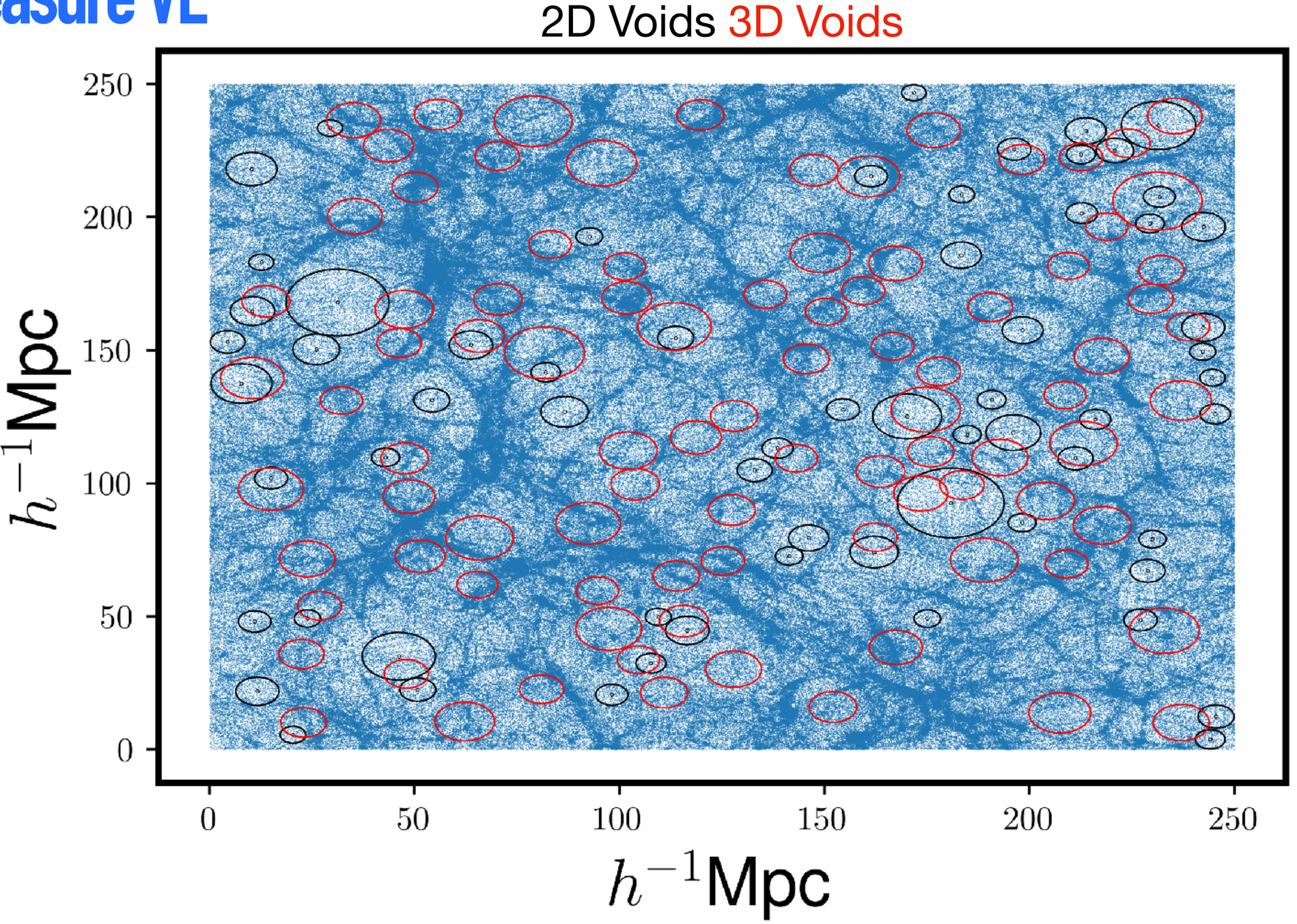
3D Voids centers ($5 < R_v < 8[h^{-1}\text{Mpc}]$)



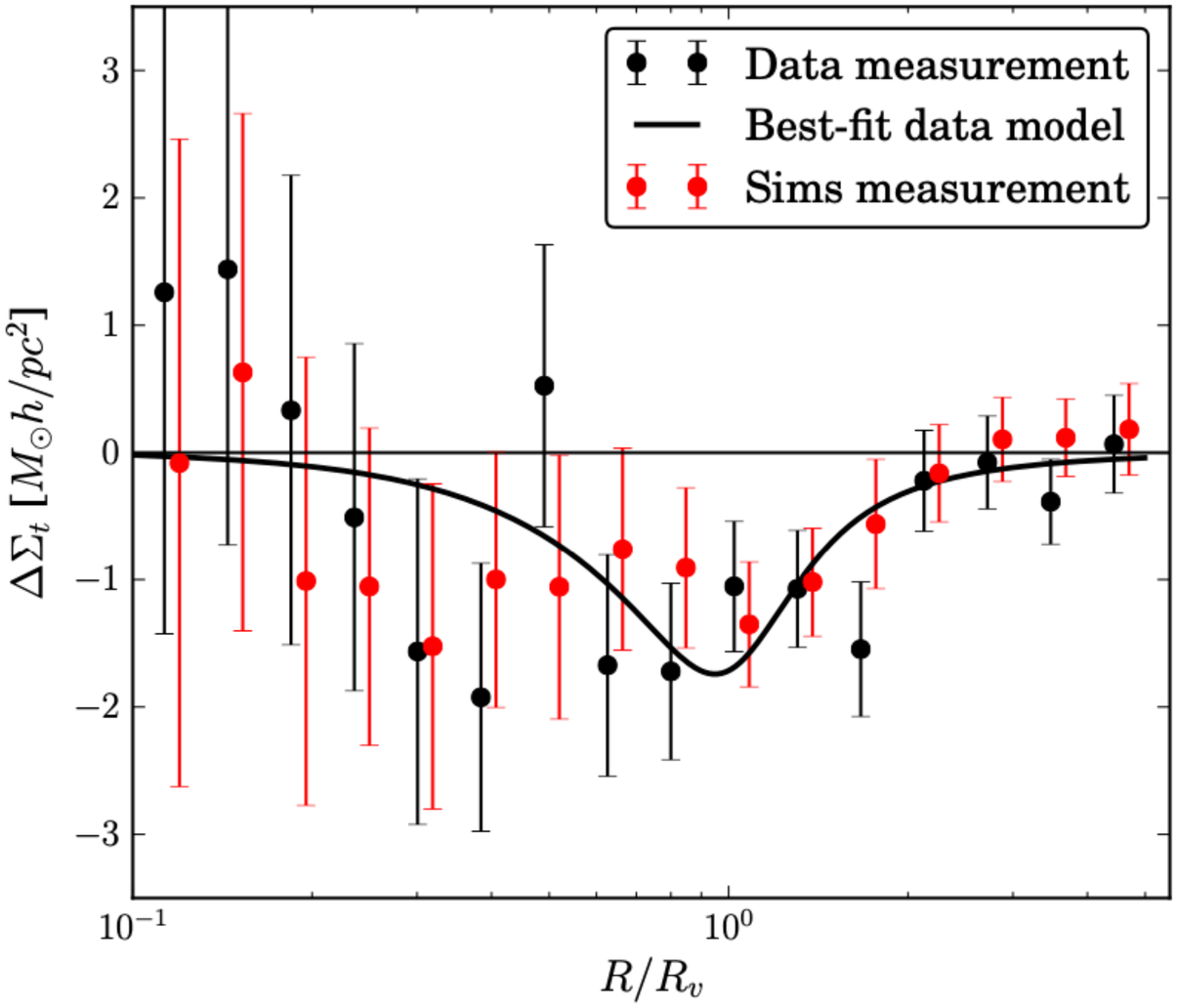
How To Measure VL

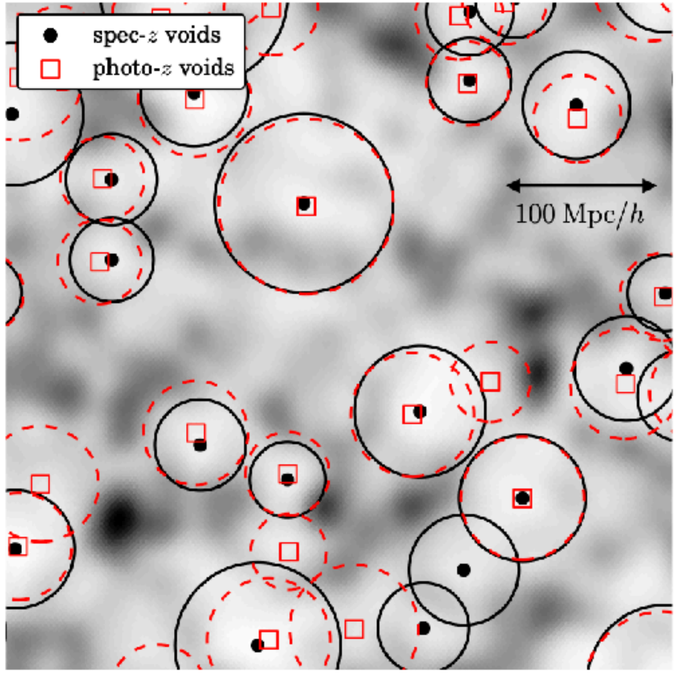


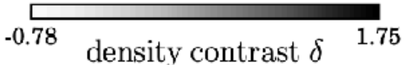
How To Measure VL

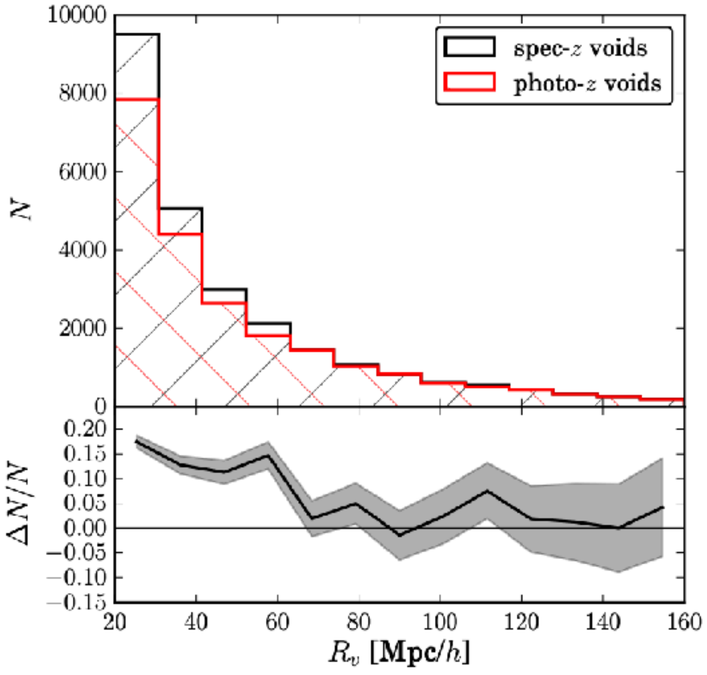


Void-Lensing (DES)



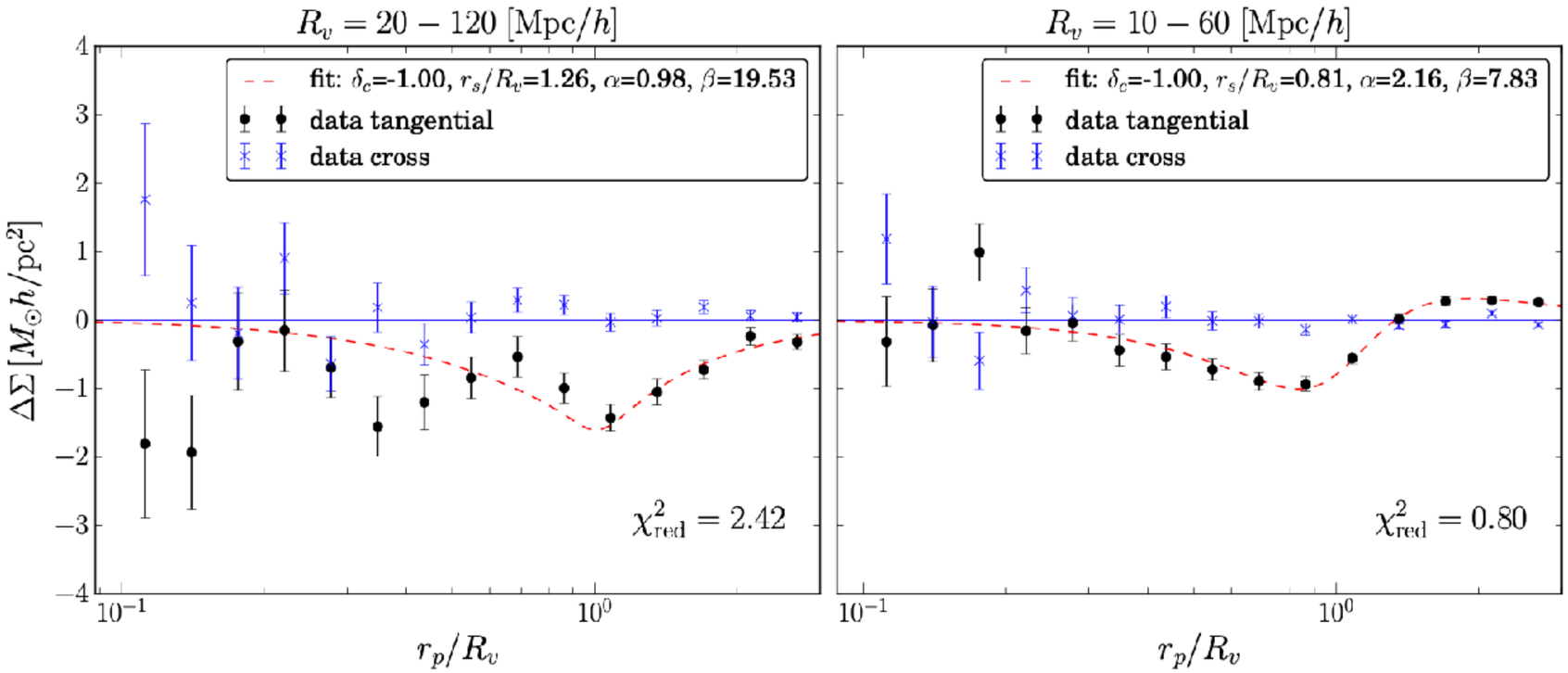




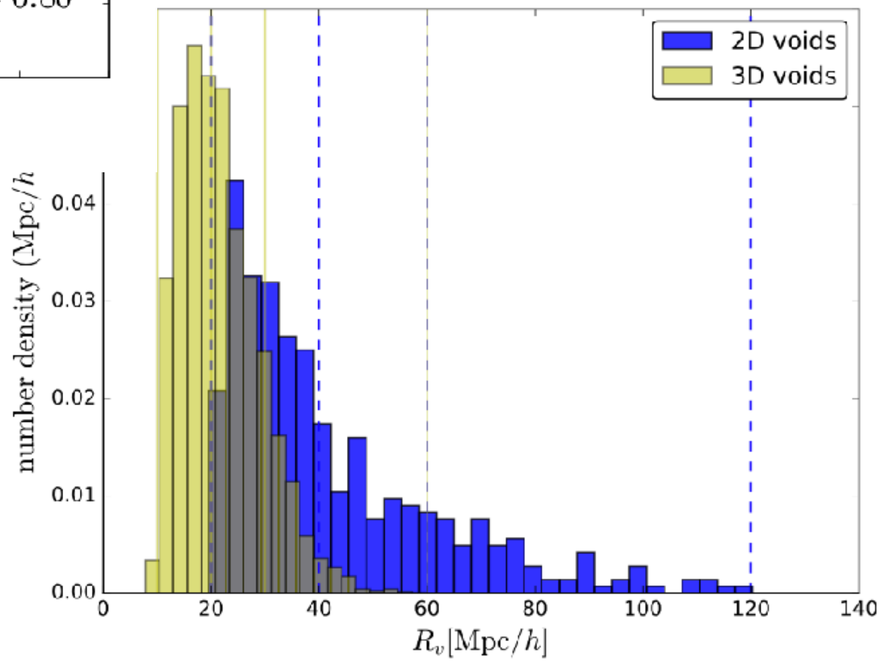


Sánchez et al. (2016)

Void Lensing (DES)

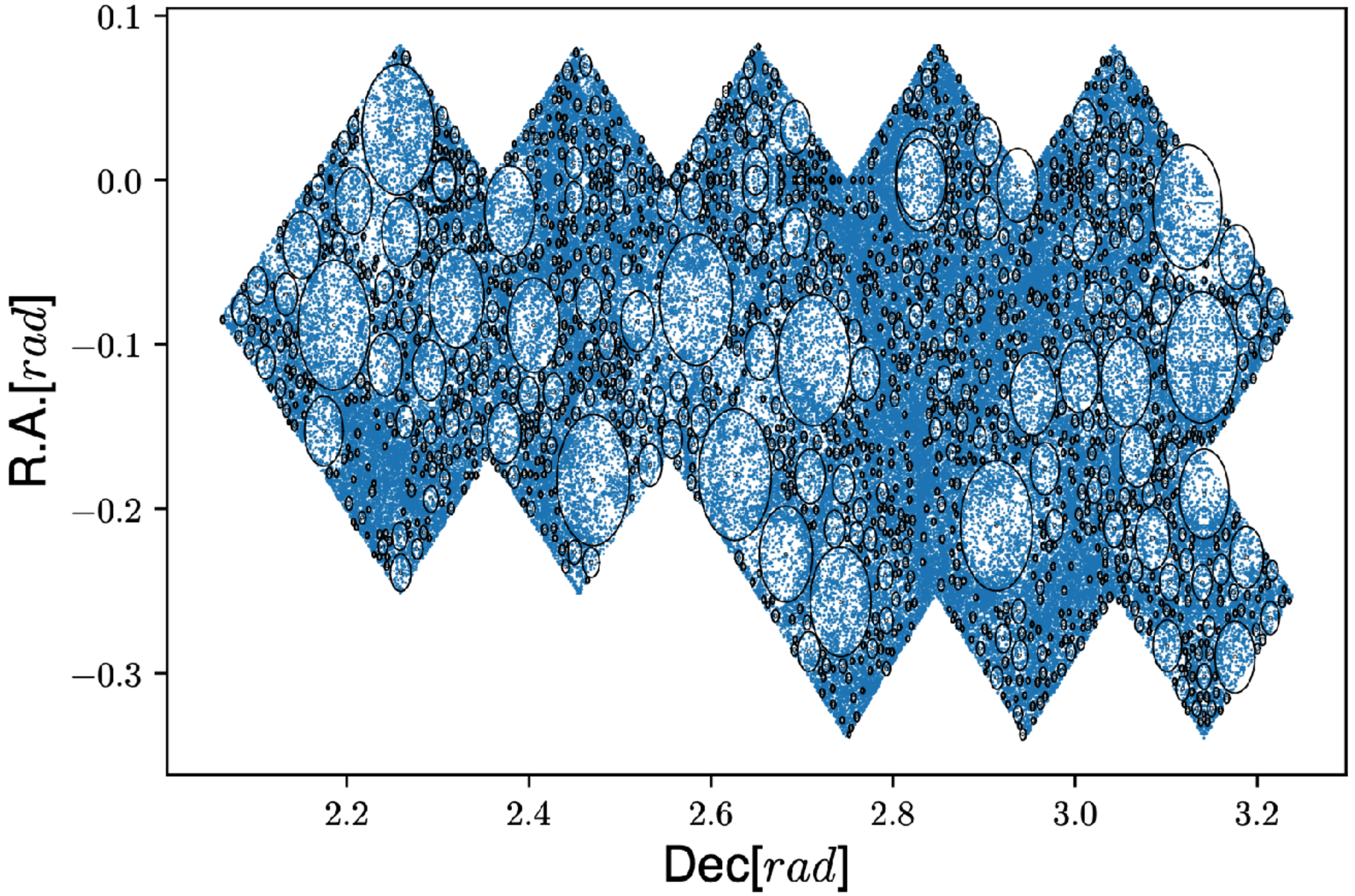


$$S/N_{2D} = 10 \quad S/N_{3D} = 14$$

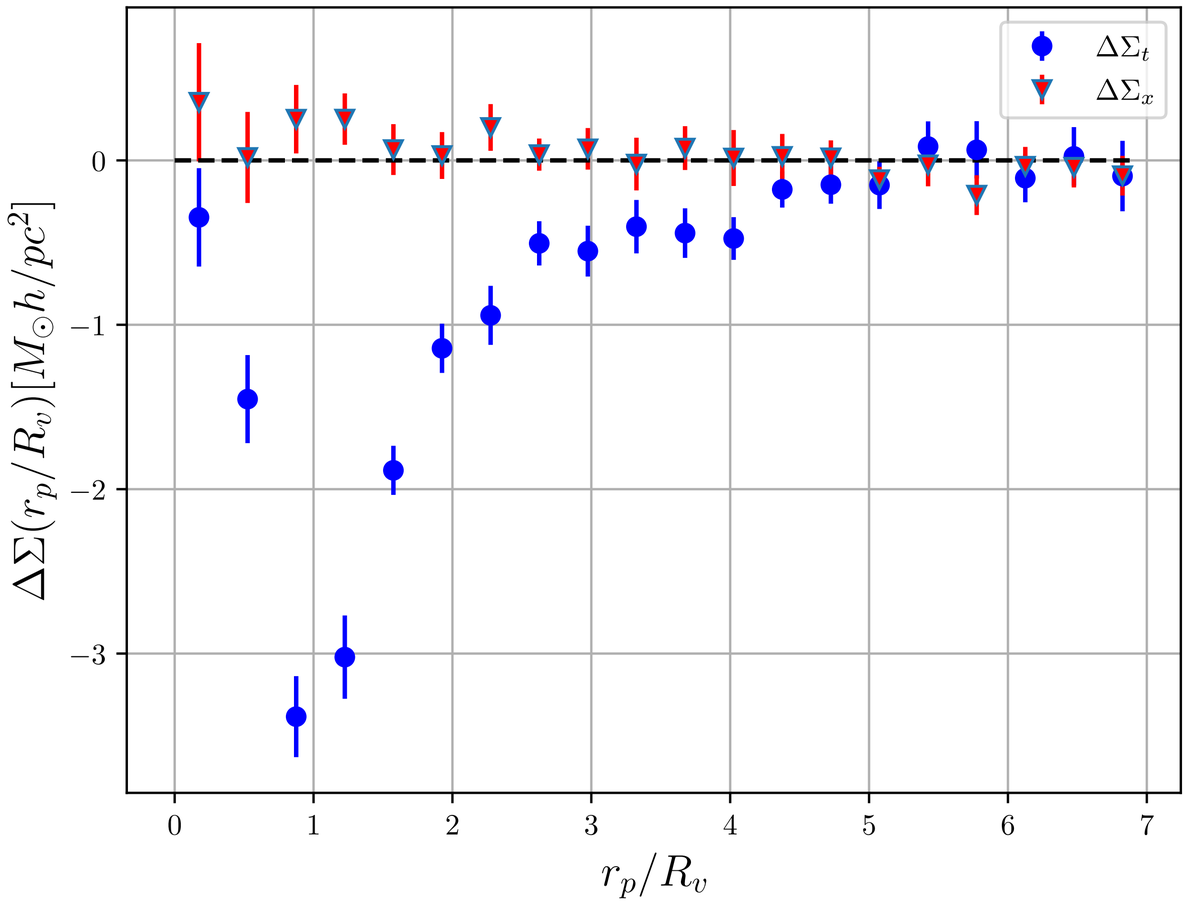


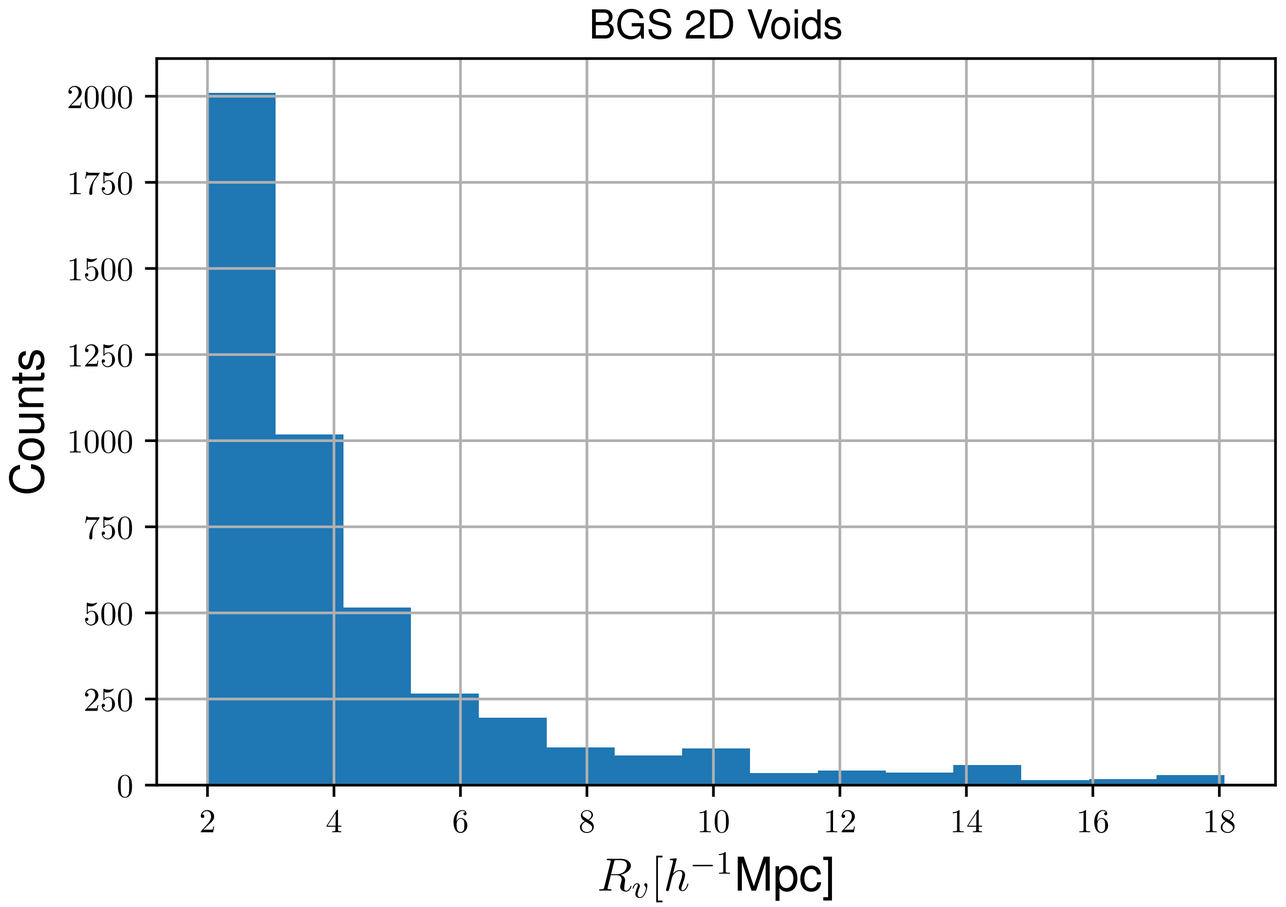
Y. Fang et al. (2019)

2D Void Finder Algorithm

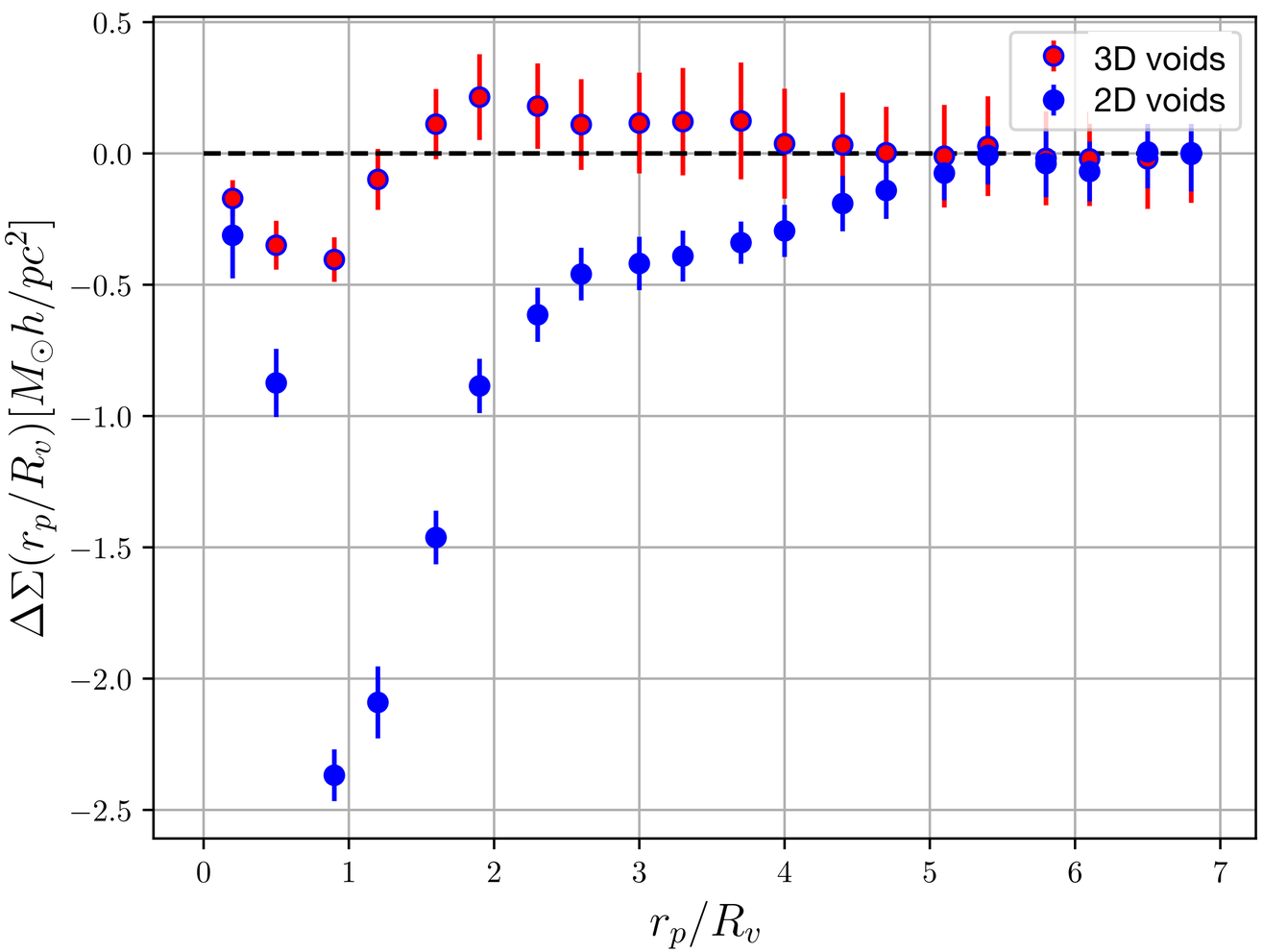


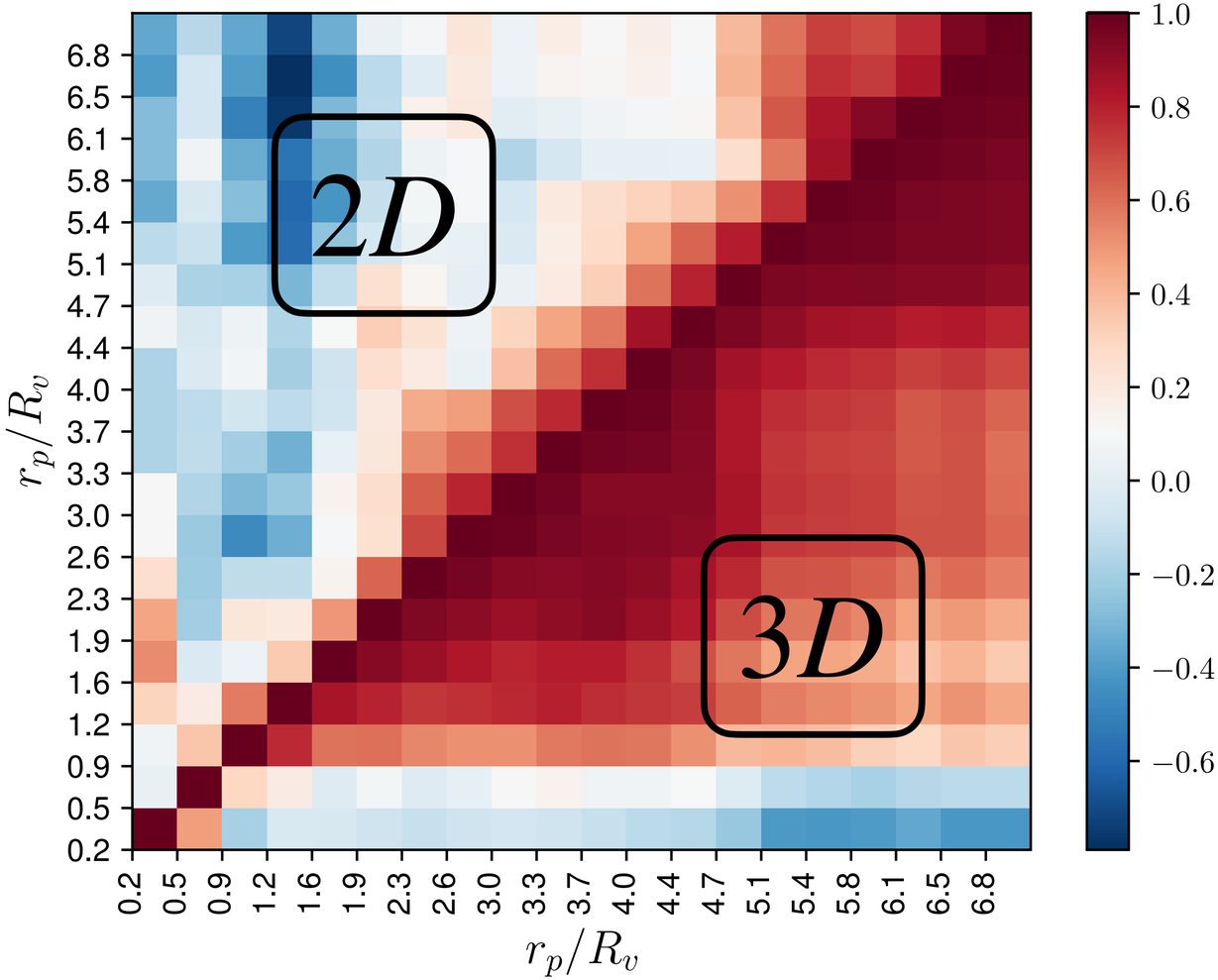
$\Delta\Sigma$ From 2D Voids (4 Bins of Redshift)



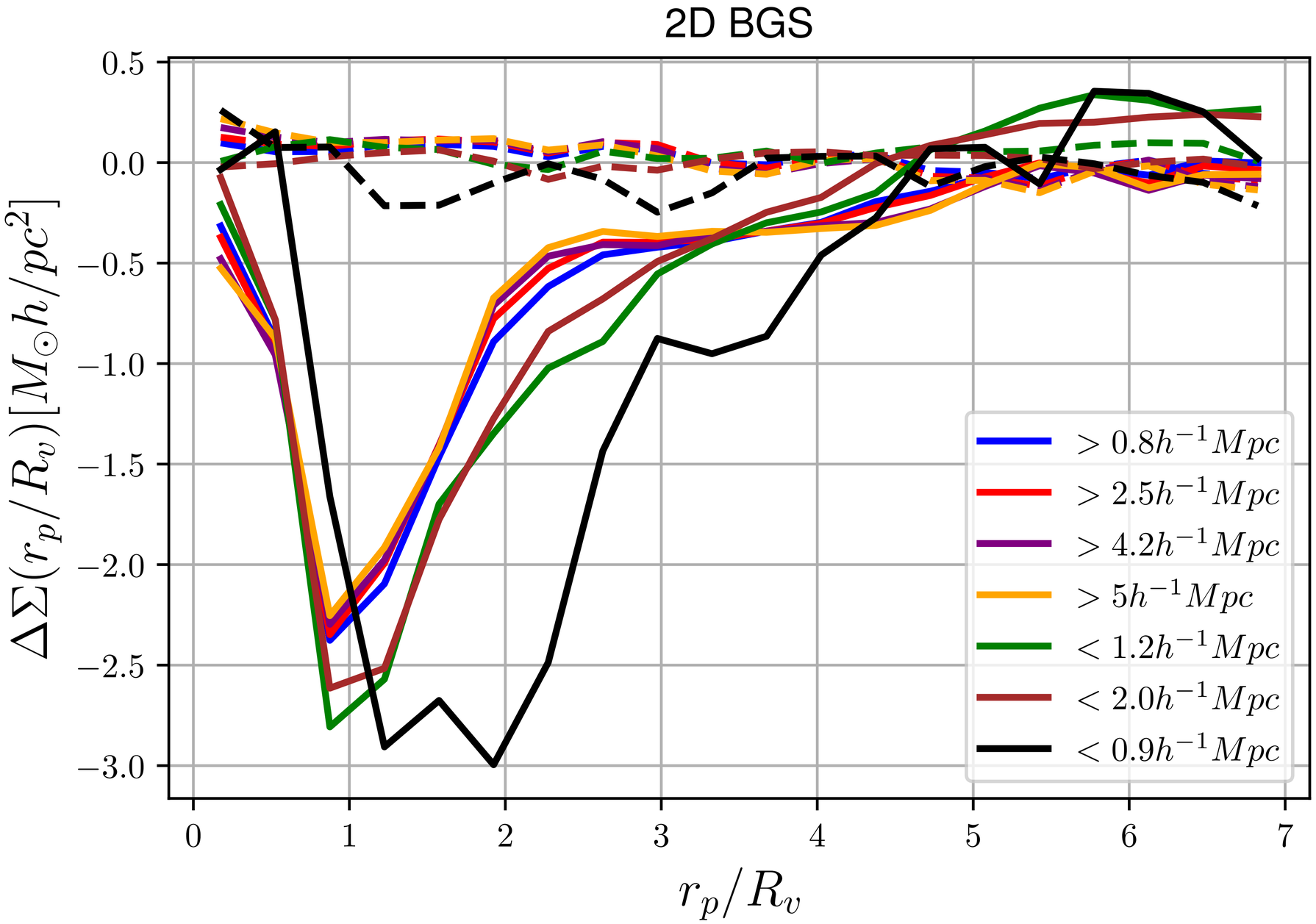


3D Voids X 2D Voids (BGS)





The Role of Void Radius



Conclusion and Next Steps

- DESI survey will open an opportunity for testing gravity with unprecedented precision
- VL lensing is a promising observable
- Don't reject small 2D voids!
- Understand the relation between 2D and 3D voids