CONSTRAINTS FROM COSMIC VOIDS WITH THE EUCLID SATELLITE

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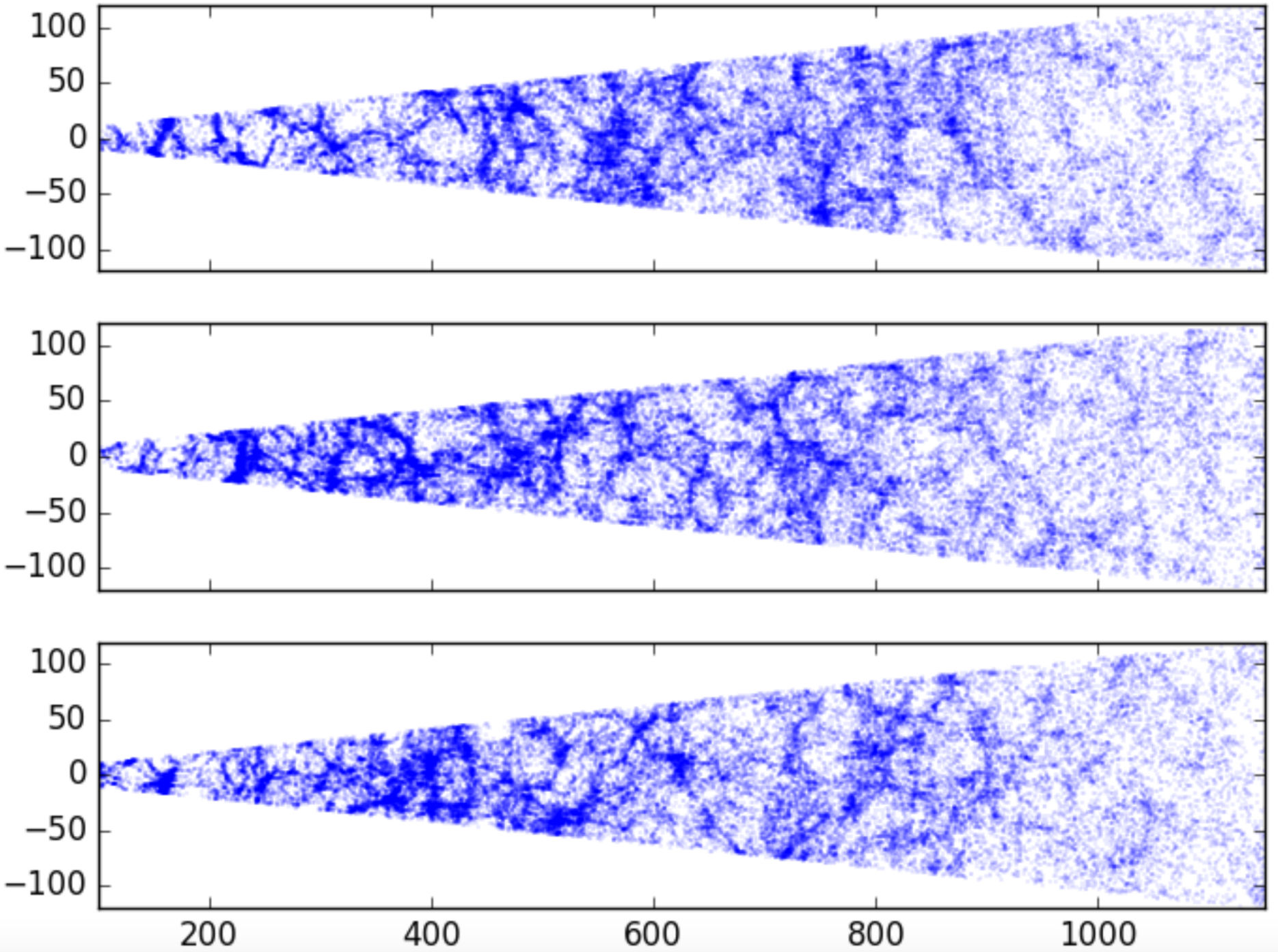
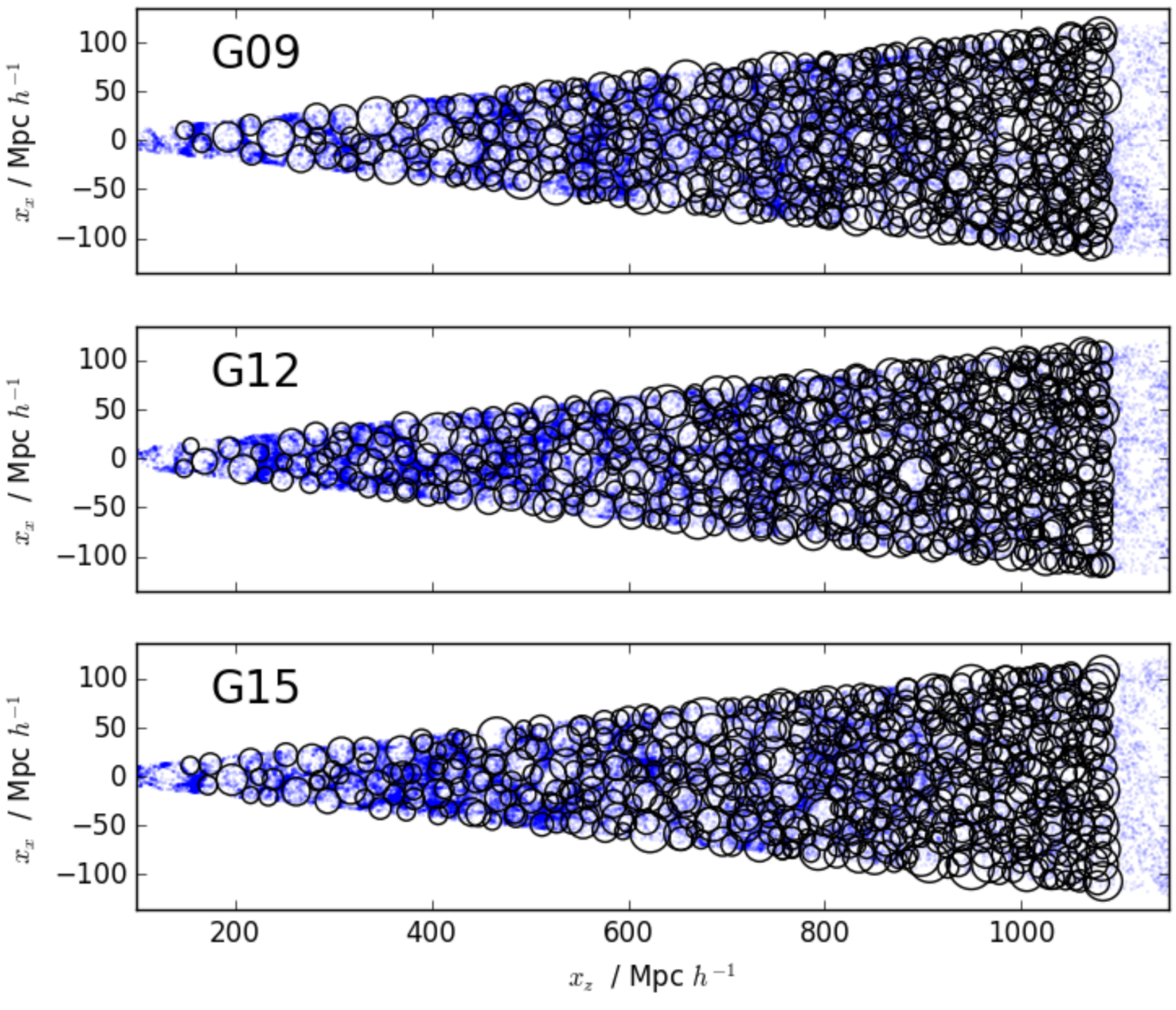
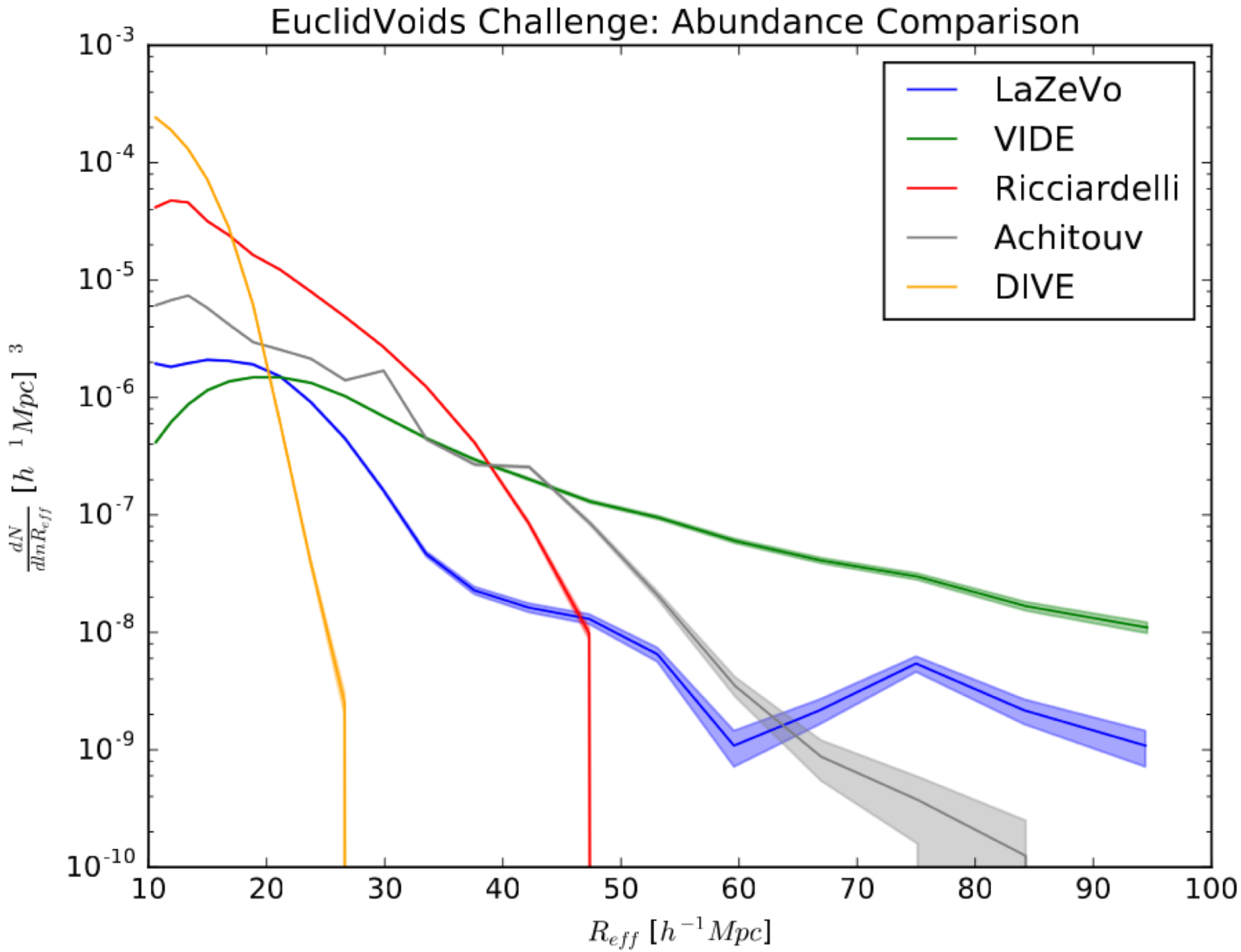
- Voids (along with clusters and filaments) are one of the principal components of the cosmic web.
- The cosmic web is visible here in GAMA data.



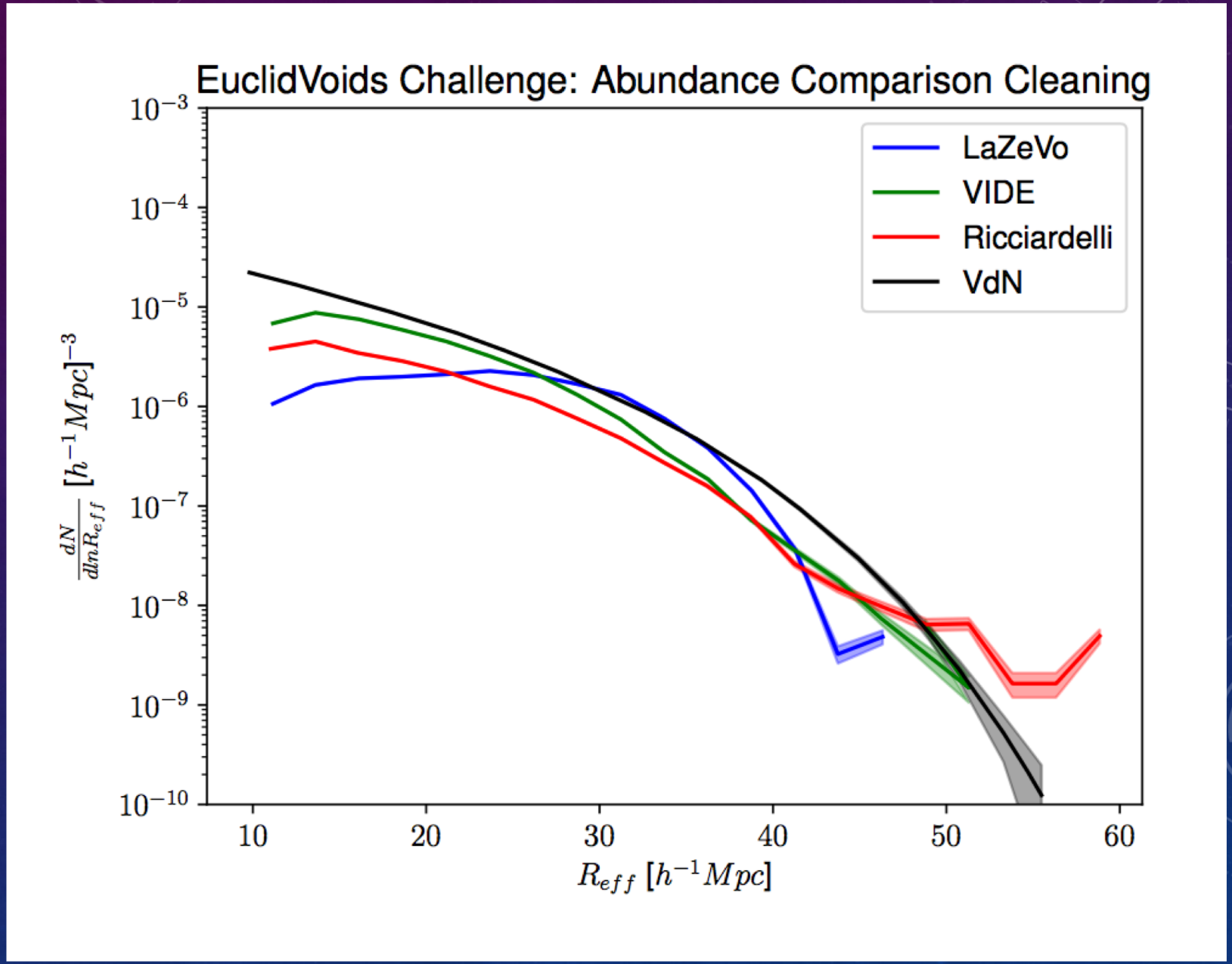
- There are many different algorithms to identify voids.
- Here voids have been identified using a spherical void finder.

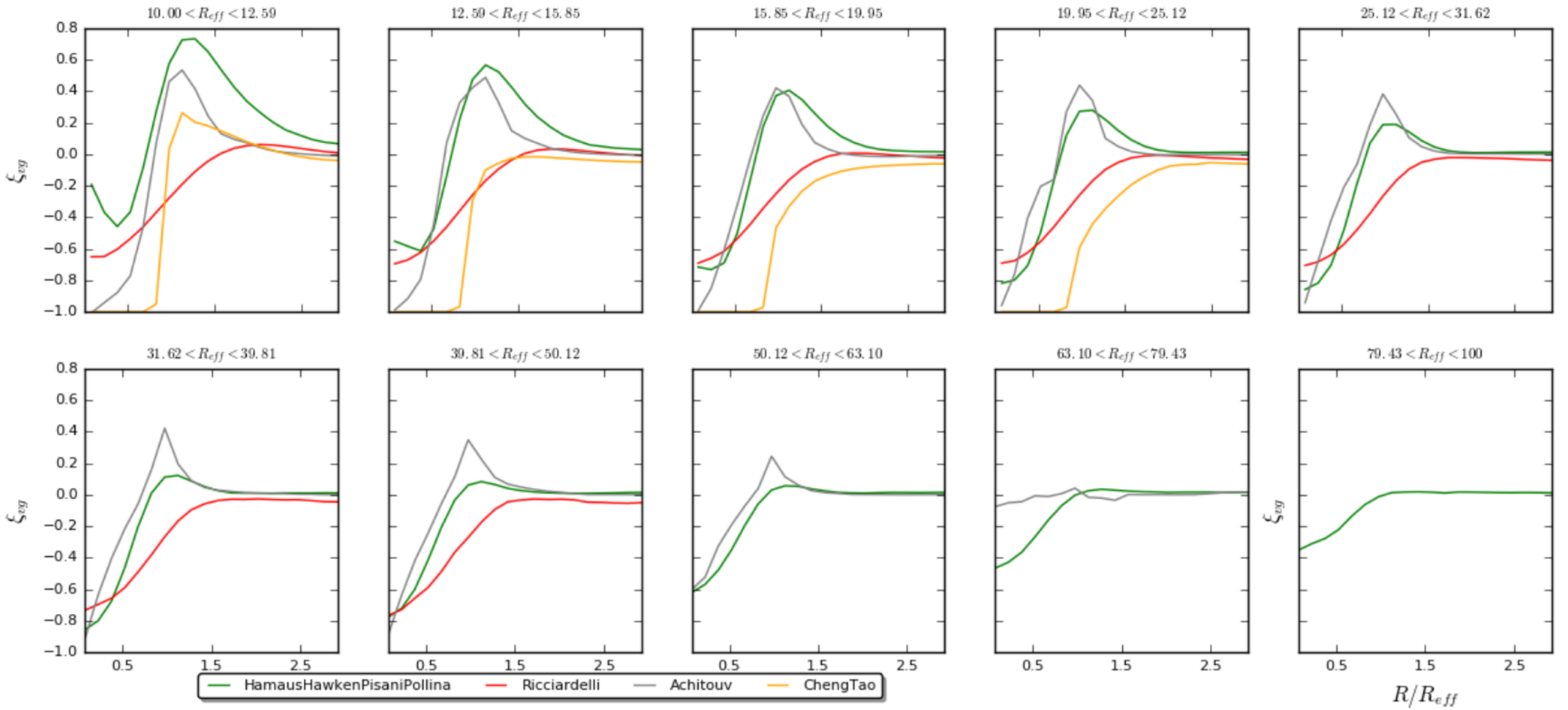


- We launched a challenge (using data from DEMNUni) to compare outputs from different void finders.
- Two key statistics of interest:
  - The abundance of voids as a function of radius.
  - The density profile (void-galaxy cross correlation function).



- We can post-process void catalogues in such a way as to normalise the abundance.
- There is an increasing agreement with theoretical models.
- See Ronconi et al ‘17 for details on how this works.





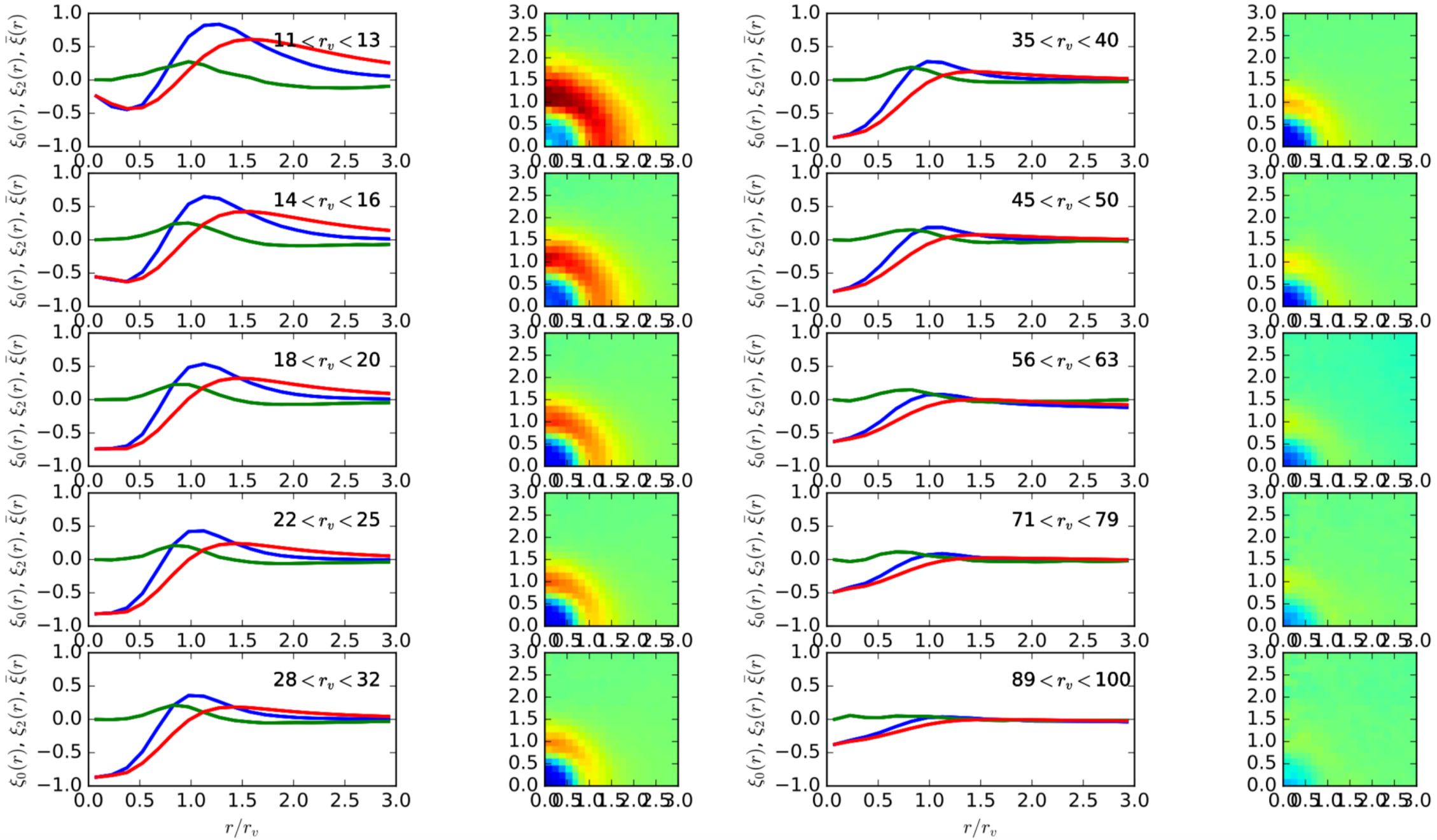
- The density profiles of voids can look quite different with the different void finders.

- We want to measure the growth rate in low density regions because we believe that this might help us rule out modified gravity scenarios.
- One method to do this is to look at the multipoles of the density profile.

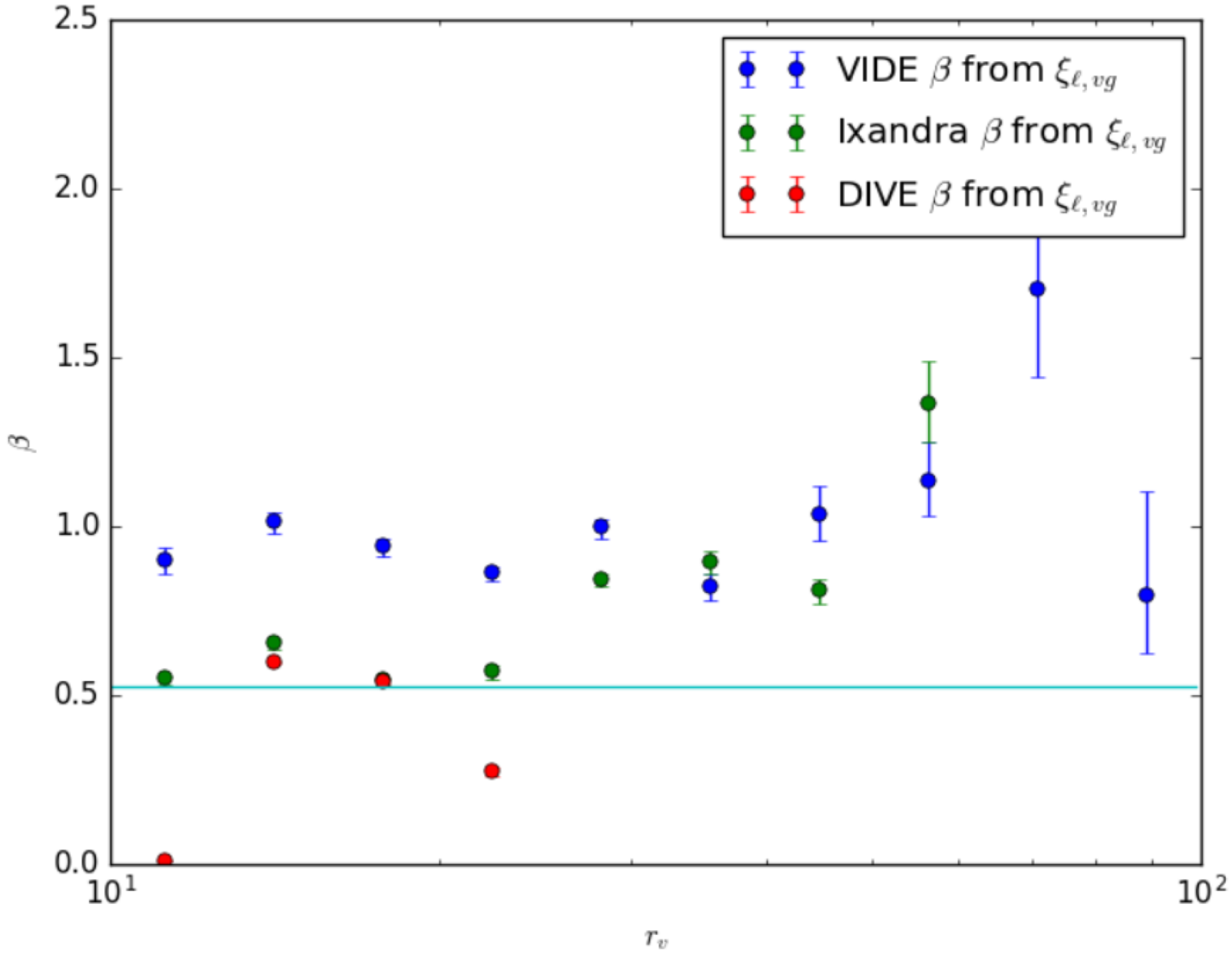
$$\begin{aligned}
\xi_0(r) &= \left(1 + \frac{1}{3}(\beta_g + \beta_v) + \frac{1}{5}\beta_g\beta_v\right)\xi_{vg}(r), \\
\xi_2(r) &= \left(\frac{2}{3}(\beta_g + \beta_v) + \frac{4}{7}\beta_g\beta_v\right)[\xi_{vg} - \bar{\xi}_{vg}(r)], \\
\xi_4(r) &= \left(\frac{8}{35}\beta_g\beta_v\right)[\xi_{vg}(r) + \frac{5}{2}\bar{\xi}_{vg}(r) - \frac{7}{2}\bar{\bar{\xi}}_{vg}(r)],
\end{aligned}$$

$$\begin{aligned}
\xi_0(r) &= \left(1 + \frac{\beta}{3}\right)\xi_{vg}(r), \\
\xi_2(r) &= \frac{2\beta}{3}[\xi_{vg}(r) - \bar{\xi}(r)].
\end{aligned}$$

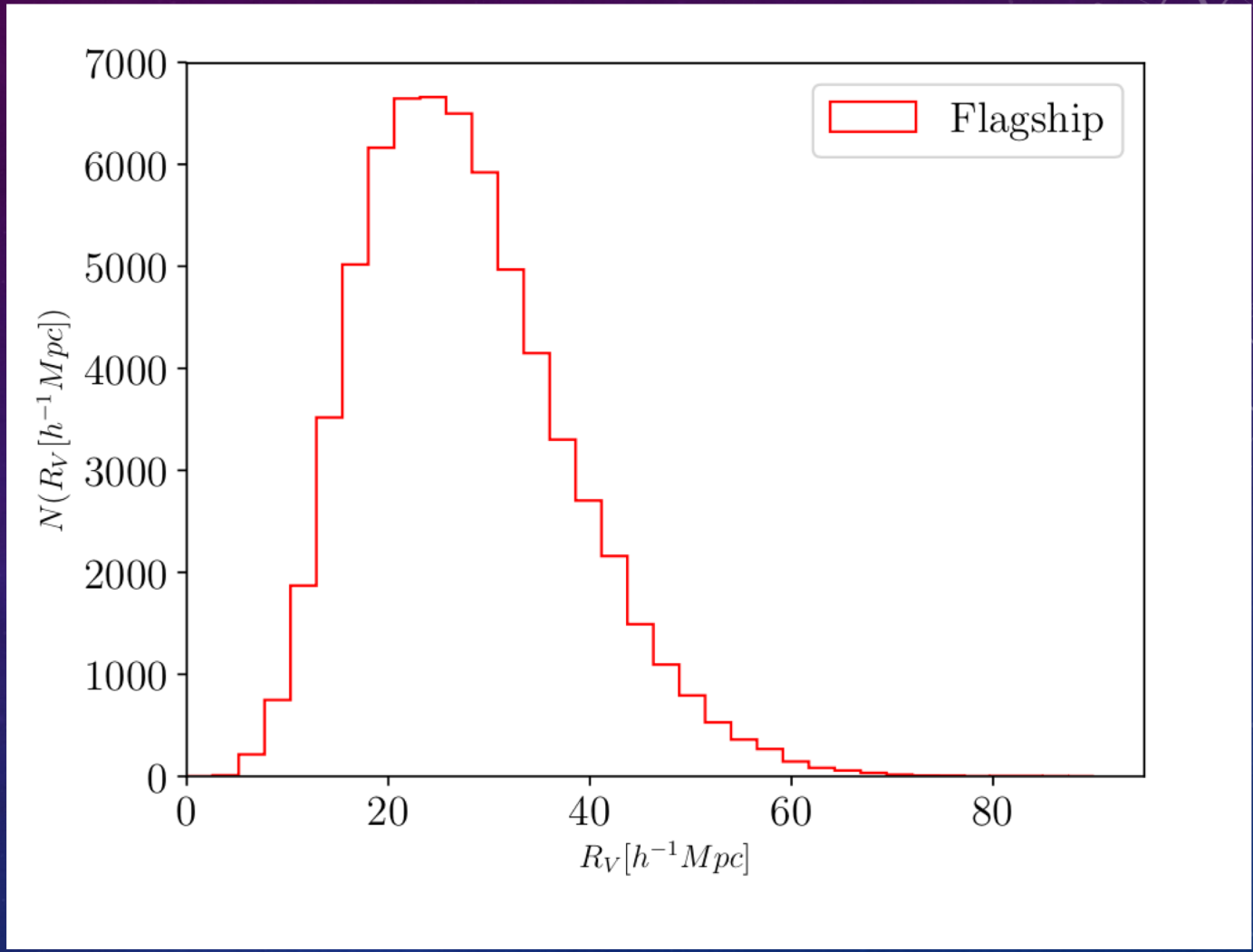
$$\epsilon_i = \xi_2(r_i) - \frac{2\beta}{3+\beta}[\xi_0(r_i) - \bar{\xi}_0(r_i)].$$


$11 < r_v < 13$
$14 < r_v < 16$
$18 < r_v < 20$
$22 < r_v < 25$
$28 < r_v < 32$
$35 < r_v < 40$
$45 < r_v < 50$
$56 < r_v < 63$
$71 < r_v < 79$
$89 < r_v < 100$
$\xi_0(r), \xi_2(r), \bar{\xi}(r)$
r/r_v

- There appears to be bias in the measurements that is not understood.
- This bias in dependent upon the void finder used.
- VIDE measurements are consistent over a wide range of scales.

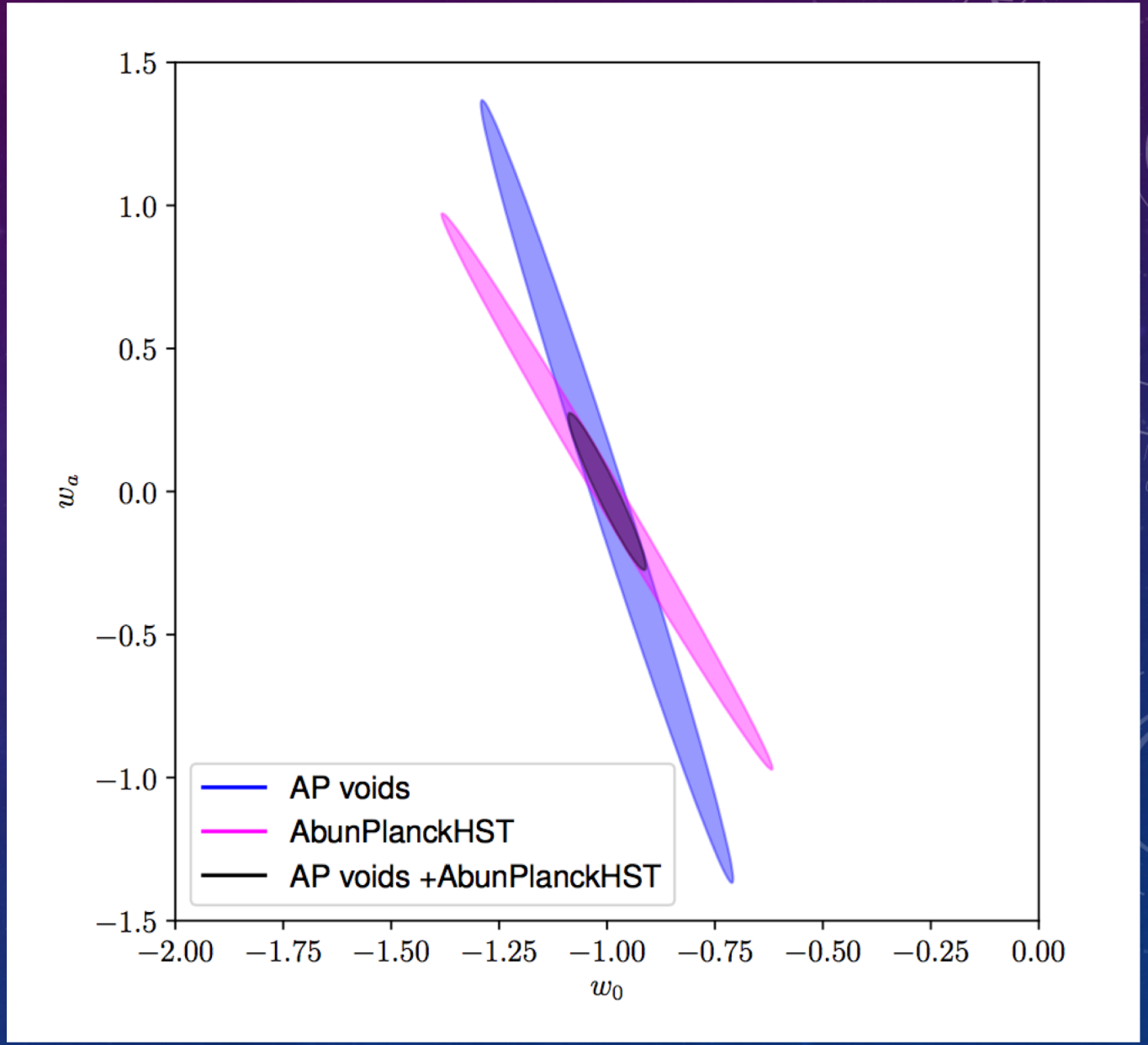


- The flagship simulation does not yet include velocities, so we have been able to test our RSD models on it.
- We have however started to look at the abundance.
- (See also Pierros's talk)

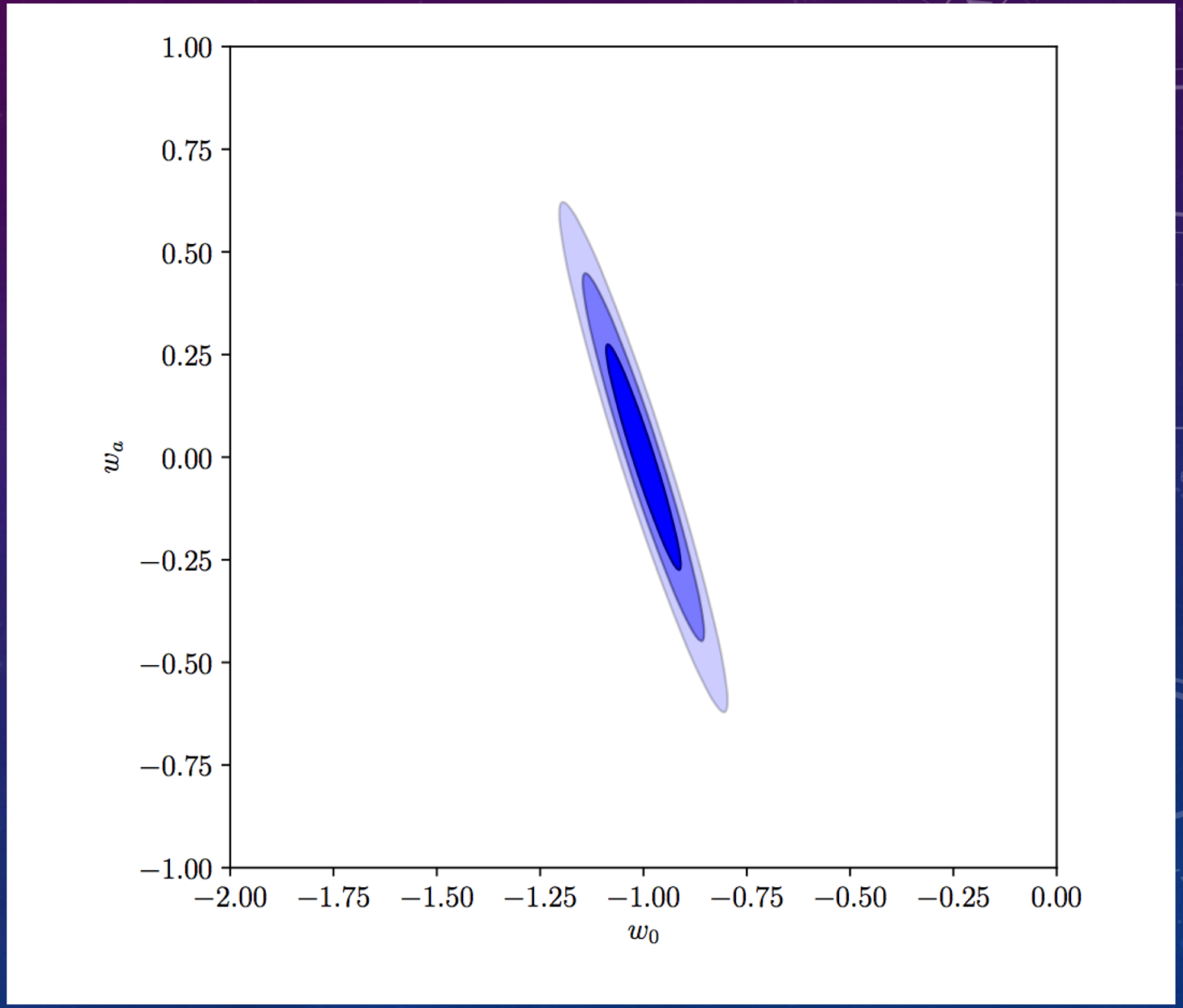


$$w_{CPL}(z) = w_0 + \frac{w_a}{z+1}$$

- We can put constraints on the DE EOS using the abundance of voids, AP test and RSD are also sensitive.
- Calibrating on the Flagship allows us to draw Fisher ellipses in the w0-wa plane.
- We have not yet done this for RSD.



- Our current estimates are that we can get a ~10% constraint on w0 using voids alone.
- (We have not yet included RSD constraints.)



STILL A SHED LOAD OF WORK TO DO

- We have not yet looked at :
  - Void ISW
  - Void lensing
- There is more to the cosmic web than just voids.
- There is currently no one in Euclid looking at filaments!!

ADDITIONAL PROBES WORK PACKAGE

- Work package is very broad and covers all clustering statistics that are not standard two-point or three-point statistics.
- Led by Alkistis Pourtsidou and Adam Hawken

We currently have eight active projects:

- **Cosmological constraints from cosmic voids in Euclid (AJH, Alice Pisani)**
- **21-cm cross-correlations: photometric redshift calibration (**Alkistis Pourtsidou**)**
- **Constraining fNL with Euclid: simulations and systematic effects (**Santiago Avila**)**
- **Cosmological constraints from geometric distortions in the 2D correlation function (**Federico Marulli**)**
- **Cosmological constraints from cosmic homogeneity in Euclid Voids (**Pierros Ntelis**)**
- **Count-in-cells statistics (**Sandrine Codis)
- **Marked correlation functions (**Jon Loveday**)**
- **The Linear Point standard ruler with the Euclid galaxy survey (**Stefano Anselmi)