

# EXPLORING GALAXY CLUSTERING WITH THE DARK ENERGY SURVEY DATASET

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On behalf of the DES Collaboration



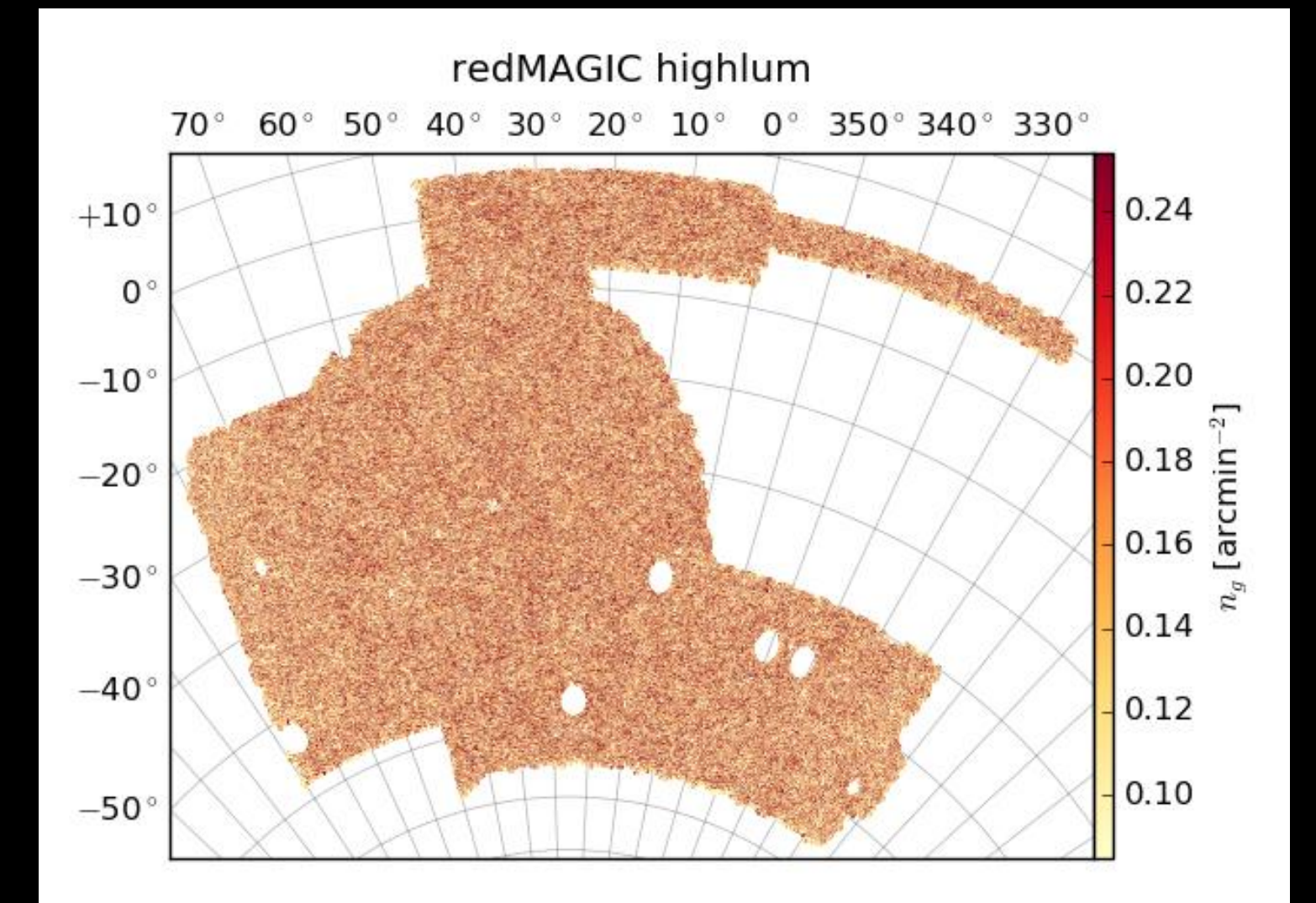
## INTRODUCTION

The Dark Energy Survey is an international collaboration whose main goal is to understand the nature of the dark energy. To achieve this, it is performing a 5-year photometric survey from Cerro Tololo (Chile), covering around 5000 square degrees of the southern sky up to magnitude  $i=23.7$  or redshifts of about 1.2. One of the main cosmological probes used by DES is the angular galaxy clustering in photometric redshift shells.

When studying galaxy clustering, the impact of systematics and observing conditions must be taken into account, since they can introduce an artificial clustering. In order to mitigate the influence of these conditions, Survey Property maps (SPs) are created, allowing to characterize their magnitude. The aim of this contribution is to showcase how the influence of these SPs on the clustering is identified and to explain the procedure that is followed to reduce their impact.

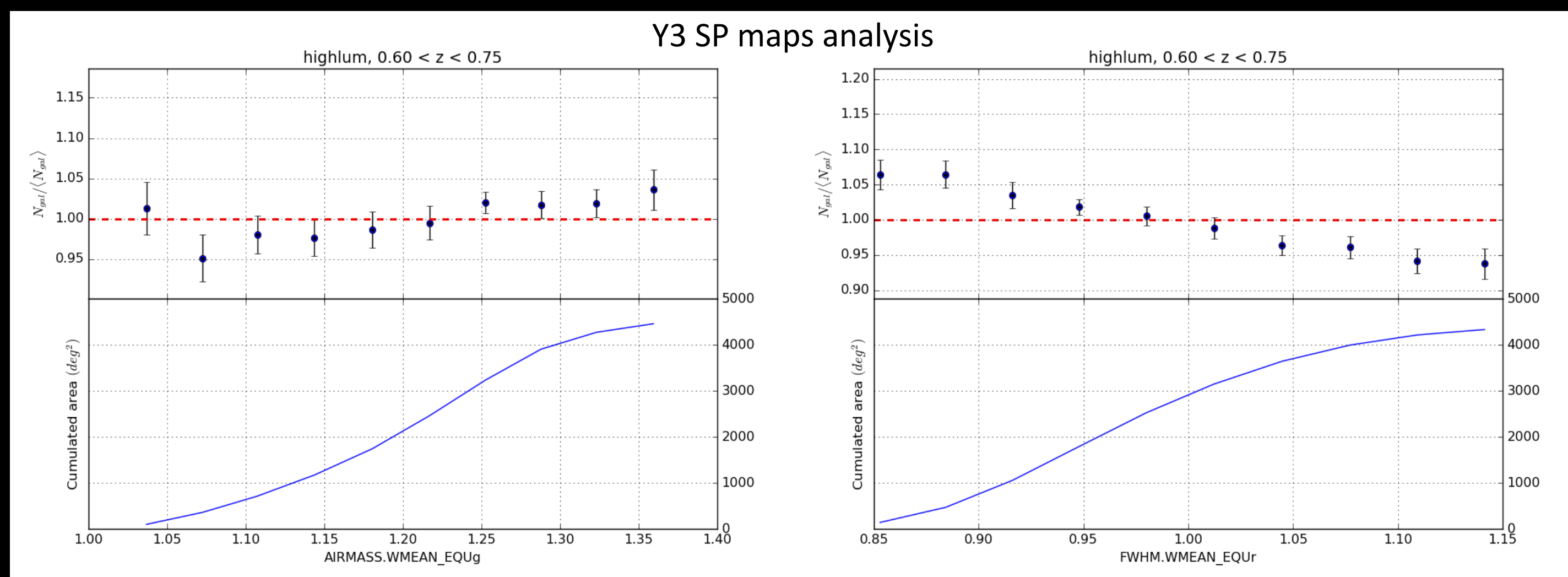
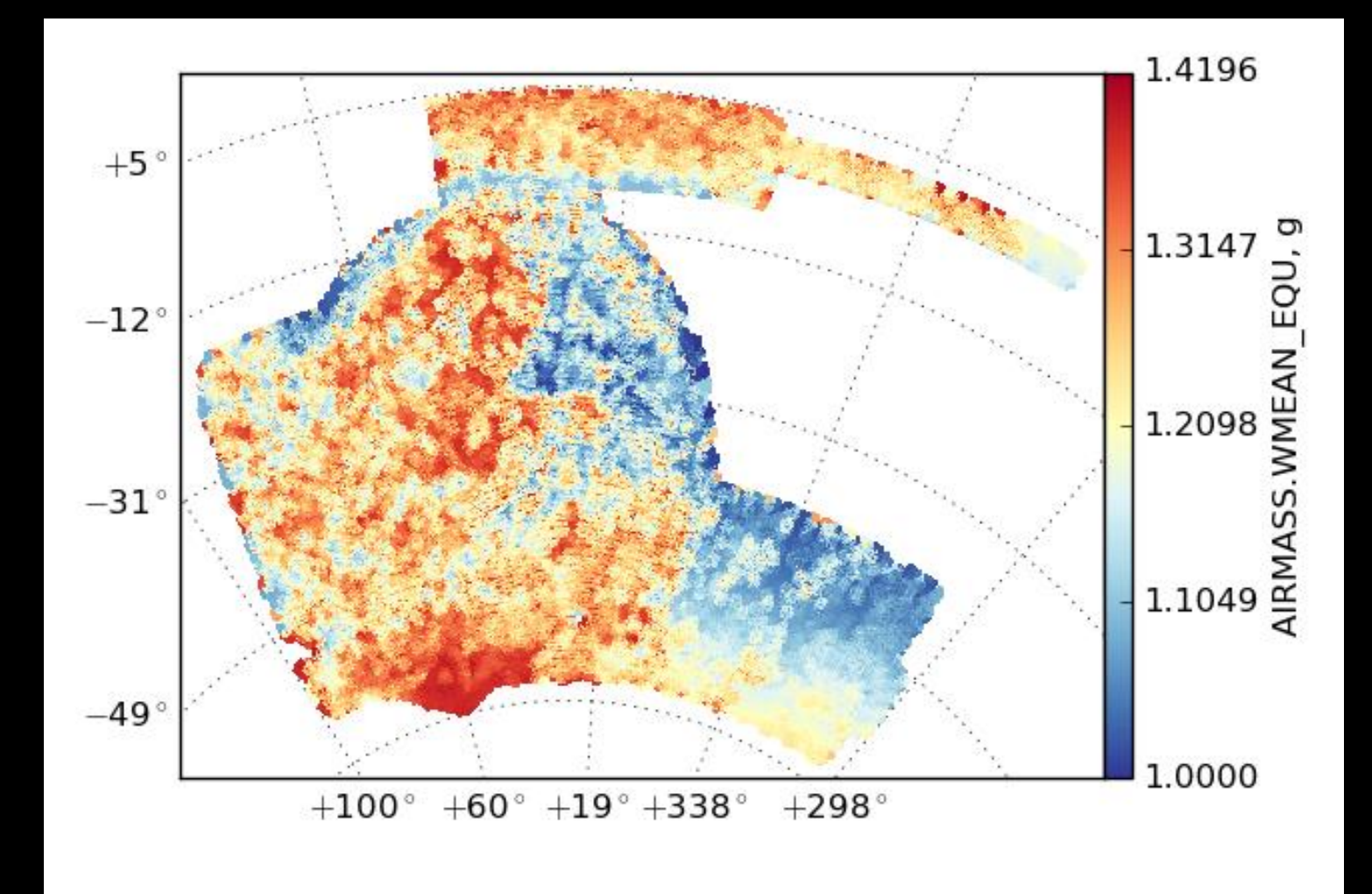
## REDMAGIC SAMPLES

- The galaxy samples employed are sets of Luminous Red Galaxies (LRGs) selected by the redMaGiC algorithm (E. Rozo, *et al.*, arXiv:150705460).
- These samples are built by fitting every galaxy to a red sequence template, obtaining the best fit  $z_{photo}$  and the  $\chi^2$  of the template fit. With this  $z_{photo}$ , the luminosity is computed. The galaxies belonging the sample are those that satisfy  $L \leq L_{min}$  and  $\chi^2 \leq \chi^2_{max}$ .
- The samples used range in redshift from 0.10 to 0.95.



## SURVEY PROPERTY MAPS

- To determine to the impact of observing conditions on the galaxy clustering, DES uses Survey Property Maps (SPs).
- SPs are pixelated maps of the sky with a resolution of 0.74 arcsec<sup>2</sup>, that contain the value of a given observing condition (e.g., airmass, seeing, ...) at each pixel over the DES footprint.
- Initially, there are 23 SPs for each photometric band ( $g, r, i, z$ ), as well as galactic extinction and stellar density maps. In order to avoid over-correction due to correlation between maps, firstly a correlation matrix test is conducted to identify SP families and reduce their number.



## PRELIMINARY TESTS

- The galaxy number density is computed as a function of the binned values of each SP,  $N_{gal}(s)$ .
- To ensure the quality of the data, a  $\chi^2$  test of  $N_{gal}(s)$  is performed, using different  $f(s)$ .
- This allows to identify possible regions on the footprint that should be masked (preliminary analyses show that this is unlikely to be necessary).
- It also helps to further exclude SPs that do not affect  $N_{gal}$ .

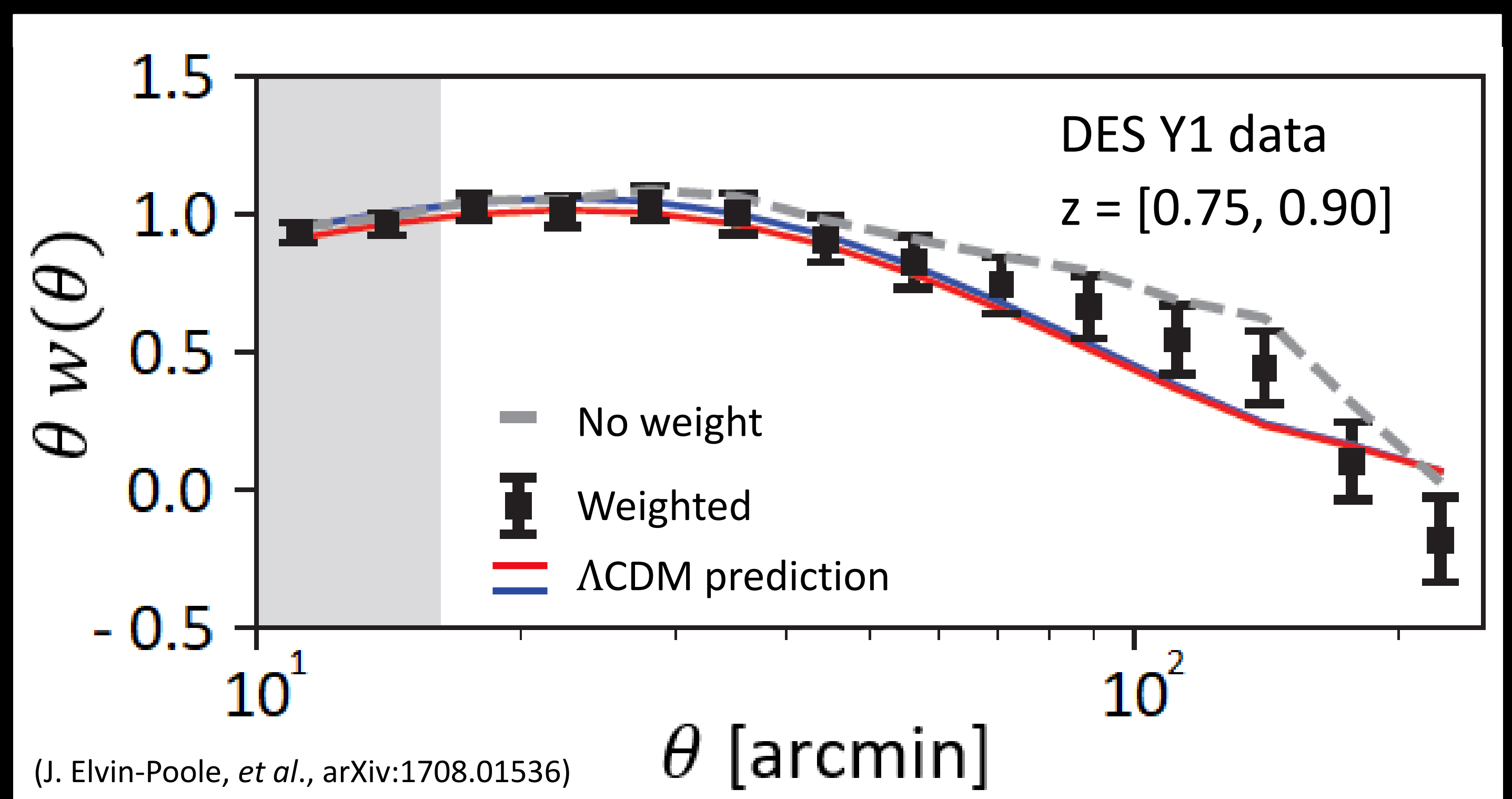
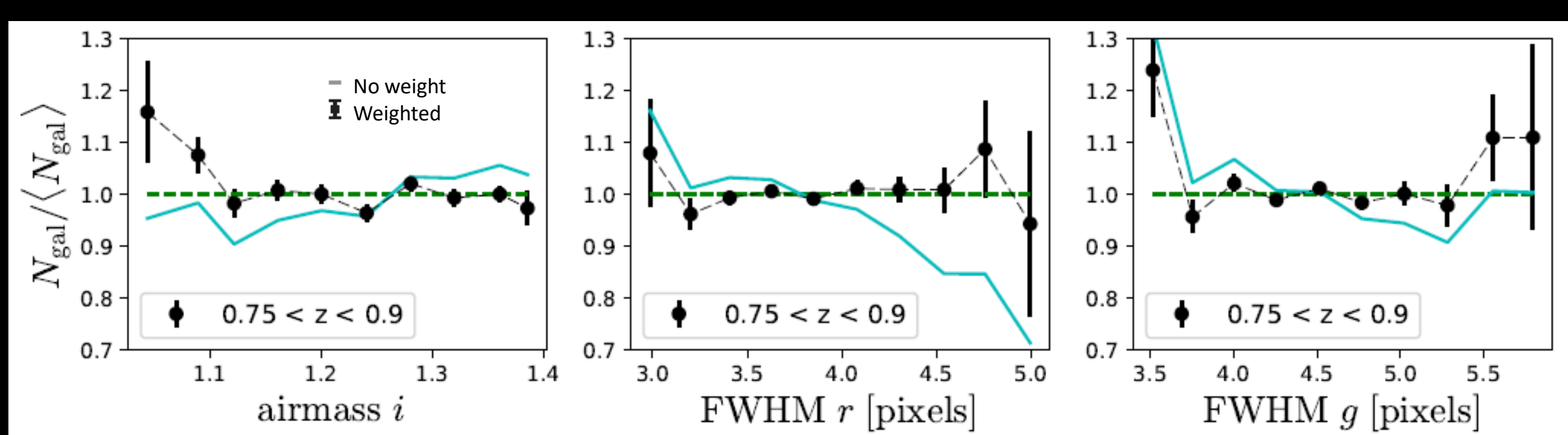
## SYSTEMATICS TREATMENT

- Minimise  $\chi^2_{model}$ ,  $N_{gal} \propto A \cdot s + B$
- Minimise  $\chi^2_{null}$ ,  $N_{gal} / \langle N_{gal} \rangle = 1$

$$\Delta\chi^2 = \chi^2_{null} - \chi^2_{model}$$

- Compute  $\Delta\chi^2$  for each SP on the catalogue and on 1000 mocks
- An SP is considered to be significant when  $\Delta\chi^2 / \Delta\chi^2(68) > 2$
- Weights,  $w_{SP}$ , are calculated by fitting  $N_{gal} / \langle N_{gal} \rangle$  to a function  $F_{SP}(s)$ , so  $g_i \rightarrow w_i^{SP} = 1 / F_{SP}(s_i)$
- The SPs are correlated (e.g., depth and seeing)  $\Rightarrow$  Over-corrections may take place
- Iterative process:
  - SPs are ordered from higher to lower  $\Delta\chi^2$  value (on the catalogue)
  - Weights are computed for the first SP and applied to the catalogue
  - $\Delta\chi^2$  is calculated for the remaining SPs and it is checked which ones still fulfill  $\Delta\chi^2 / \Delta\chi^2(68) > 2$
  - The process is repeated until all SPs are below the threshold

- The final weight assigned to a galaxy  $i$ ,  $w_i$ , is the product of all SP weights,  $w_i^{SP}$ , for that galaxy.



## PROSPECTS

- DES Y3 data represents some improvements with respect to Y1:
- More area covered (~5000 square degrees)
  - More depth reached ( $i=23.7$ )
  - Better photometric calibration
  - Better photometric redshift determination
  - New and more precise mock realizations
  - More SPs available
- All these will allow to determine  $w(\theta)$  more accurately.