Unleashing the Power of Clustering Redshifts

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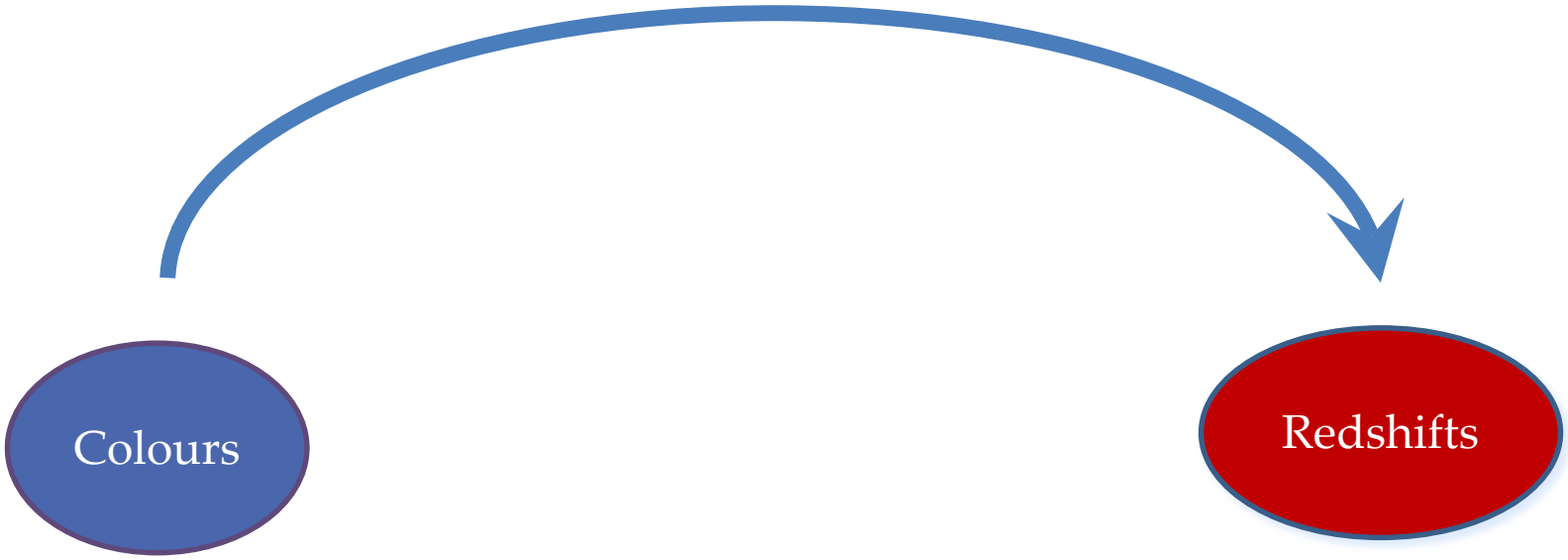
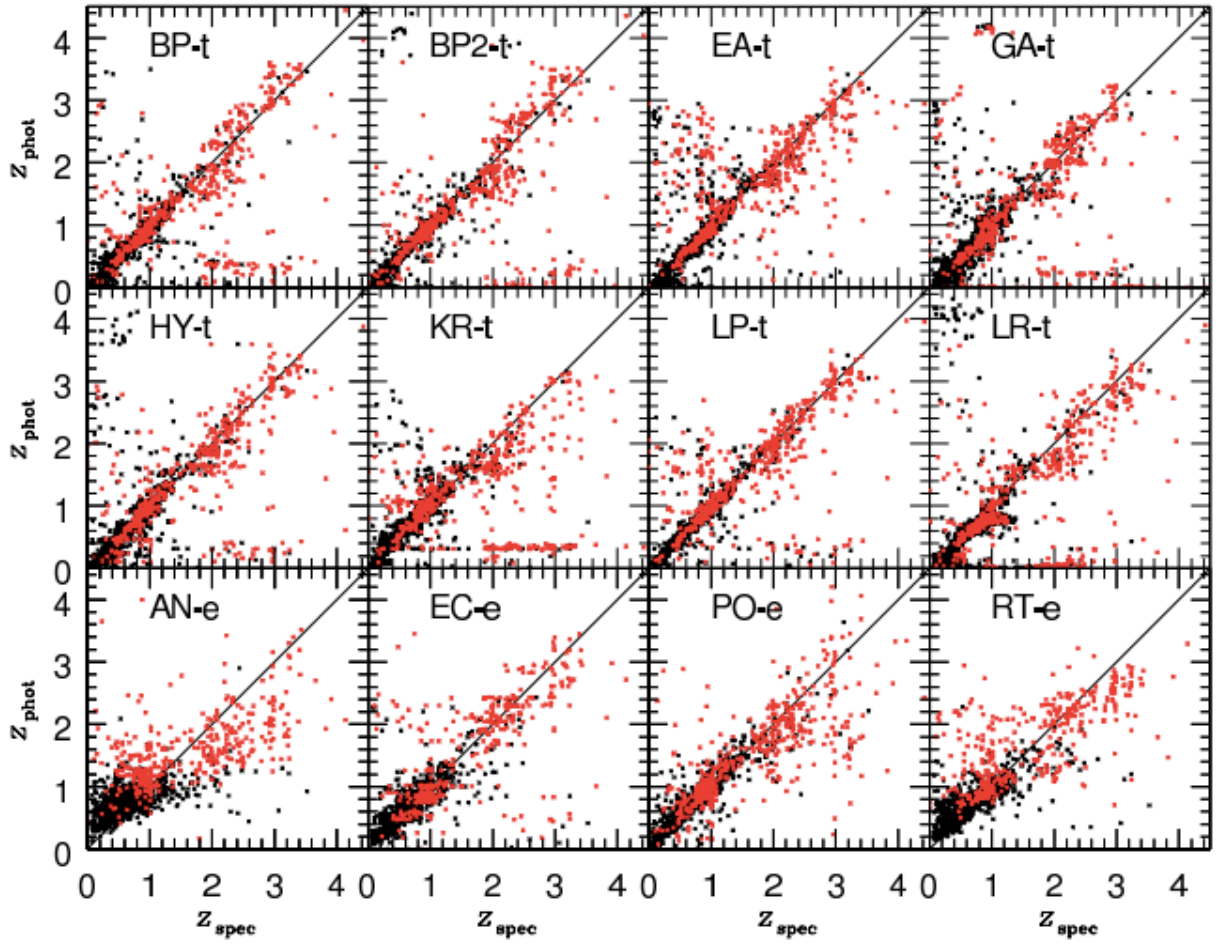
Photometric Redshifts

SEDs or Training Sets



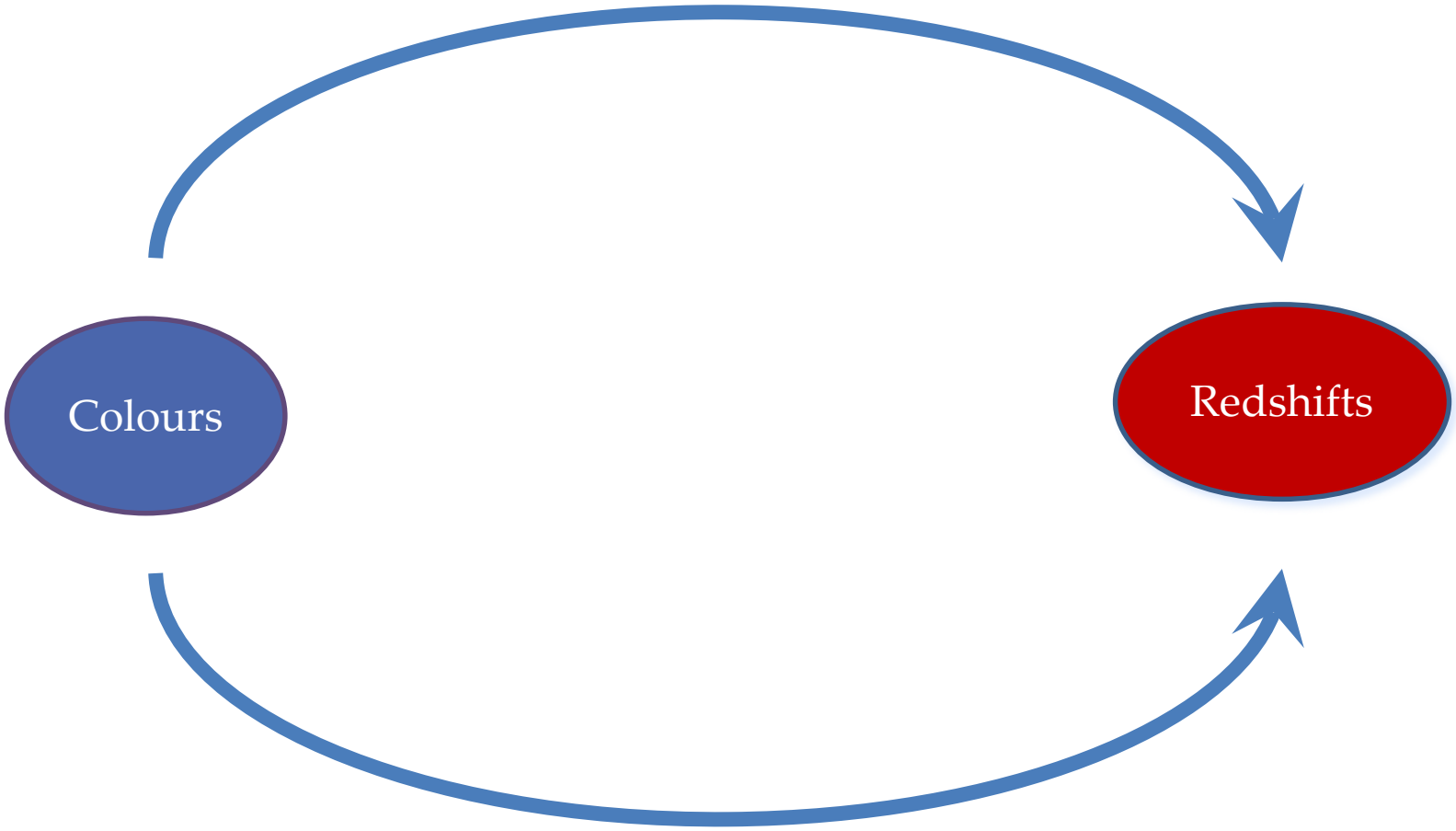
Photometric redshifts

- They rely on templates (theoretical or observed)
- They require training sets. The answer is not unique.



PHAT: PHoto-z Accuracy Testing ★ Hildebrandt et al.

Photometric Redshifts
SEDs or Training Sets

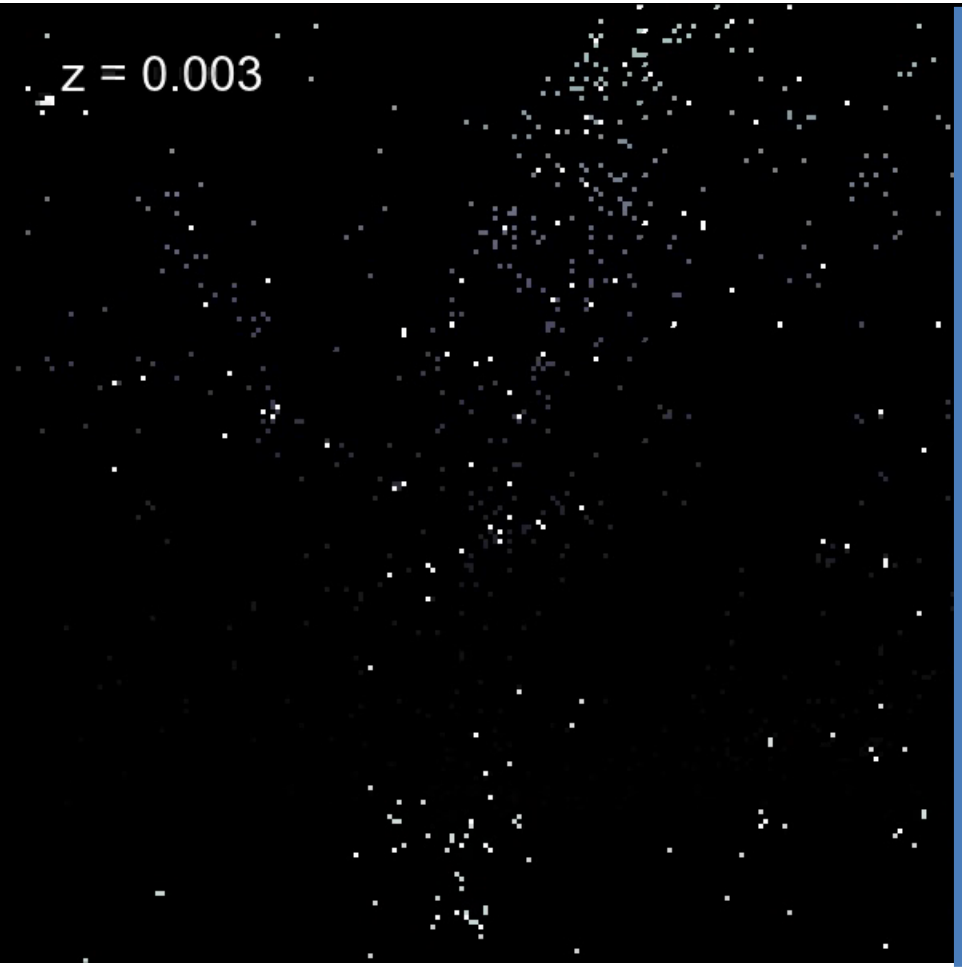


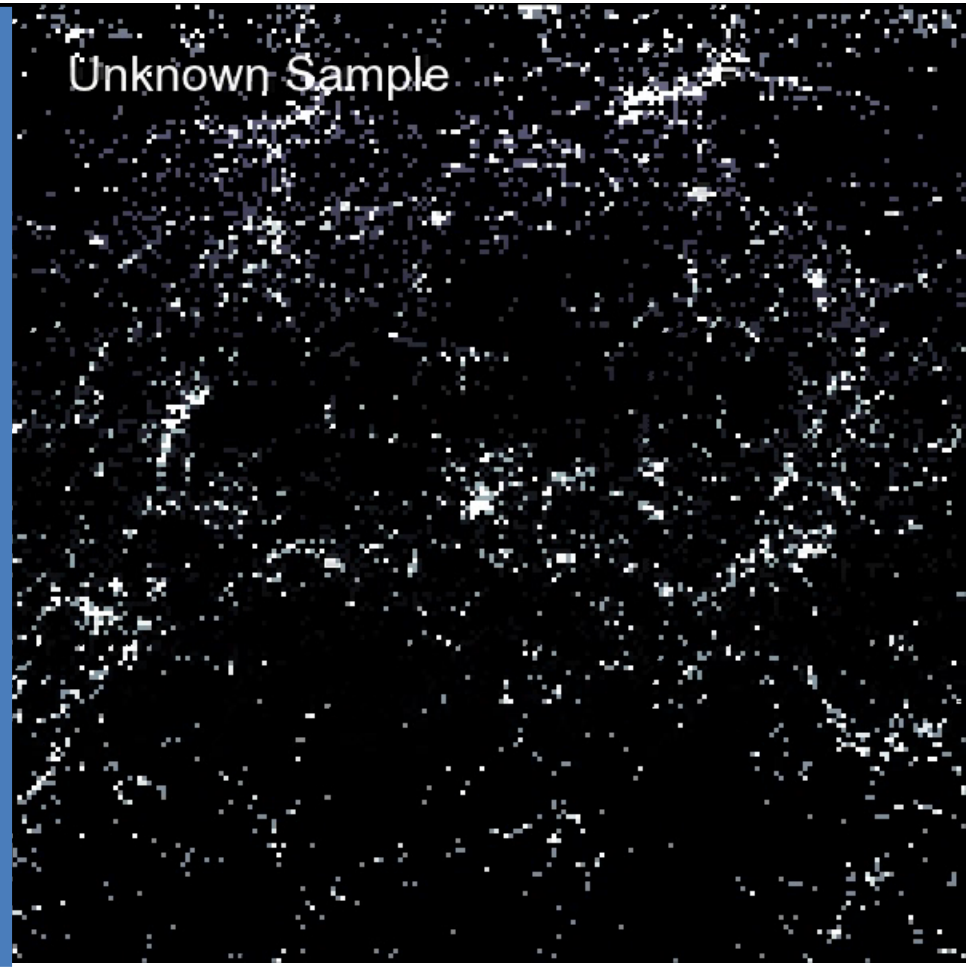
Clustering Redshifts
Spatial Correlation with Reference Set

SDSS Spectroscopic Galaxies

$158.5° < \alpha < 213.5°$
$5° < \delta < 60°$

Using Spatial Correlations to Measure Redshift



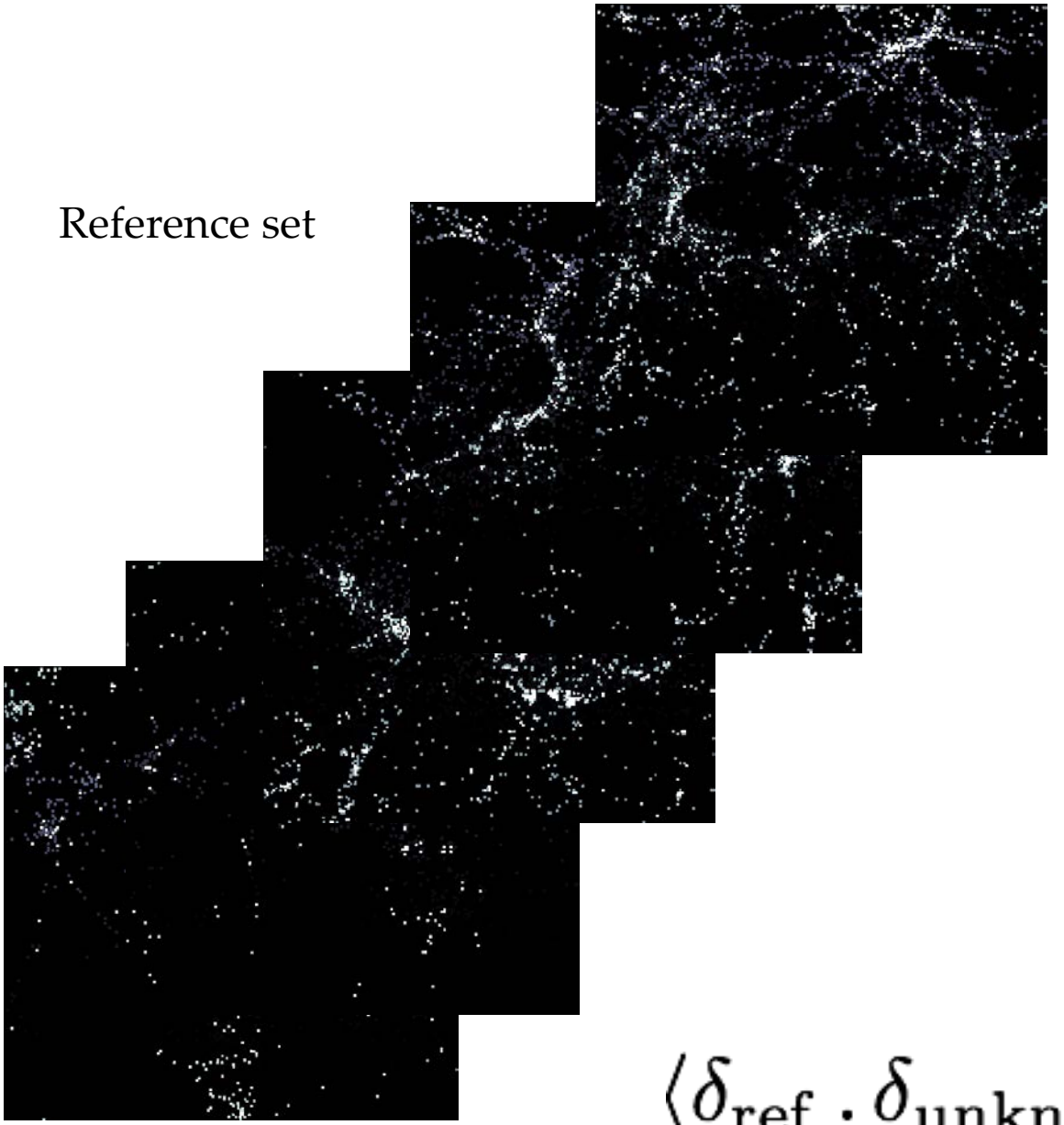


SDSS Spectroscopic Galaxies
158.5° < α < 213.5°
5° < δ < 60°

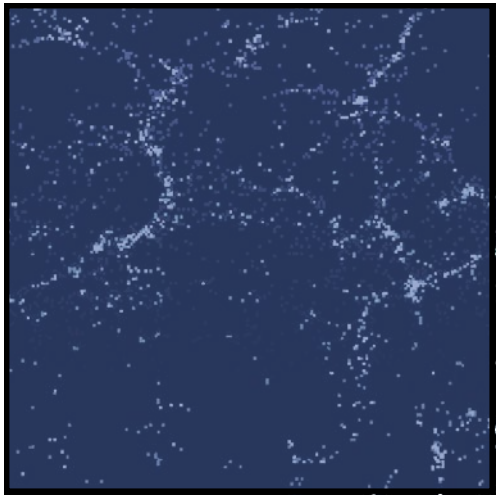
z = 0.03

z = 0.059

Reference set



Sample at unknown redshift



$$\langle \delta_{\mathrm{ref}} \cdot \delta_{\mathrm{unknown}} \rangle$$

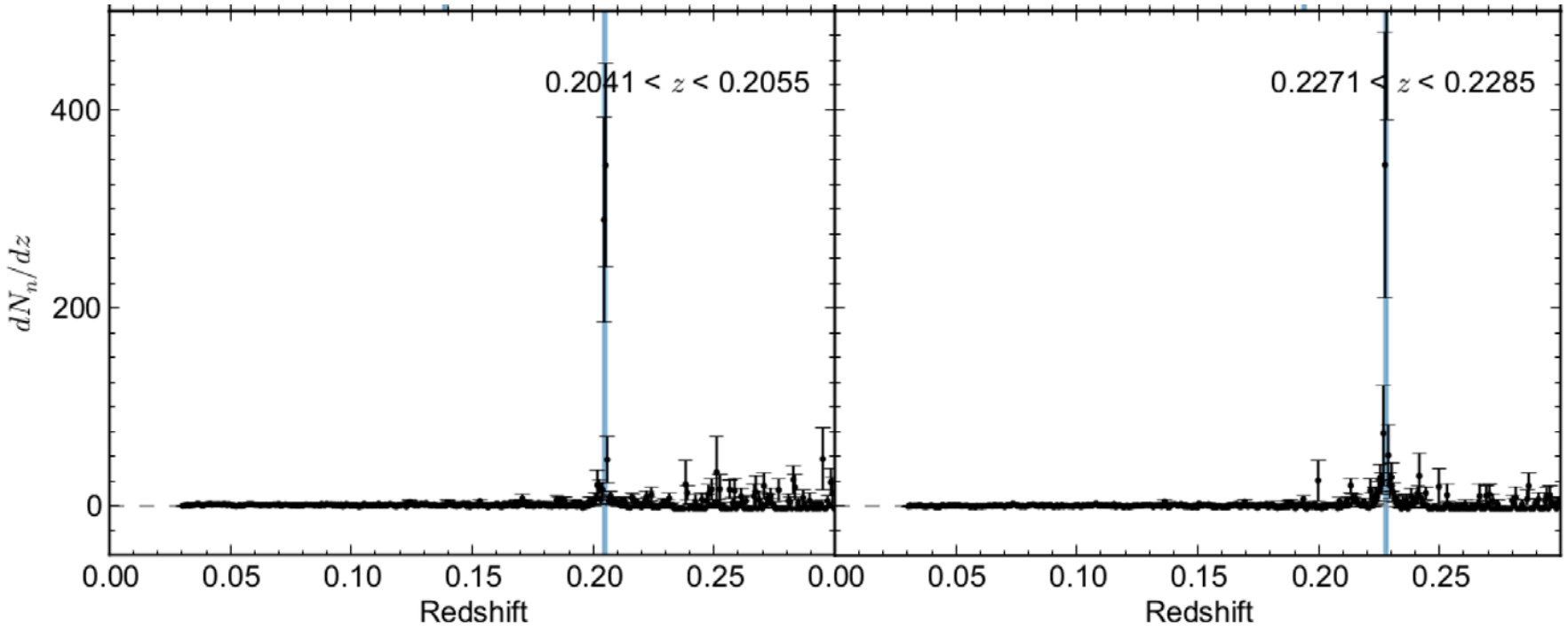
Metric: 2-point correlation function

Long history, now being developed

Peebles 1969	First mention of the idea
Landy, Szalay, & Koo 1996	First use of clustering in data
Newman 2008 **Matthews & Newman 2010** **Matthews & Newman 2012**	Development of the technique on *large spatial scales*, for *precision measurements*
de Putter et al. 2013 **McQuinn & White 2013**	Optimizing the large scale method
Ménard et al. 2013 **Schmidt et al. 2013** **Rahman et al. 2013a,b (forthcoming)**	Developing the technique on *small spatial scales*, development of the tools, and application to data

How accurate are they?

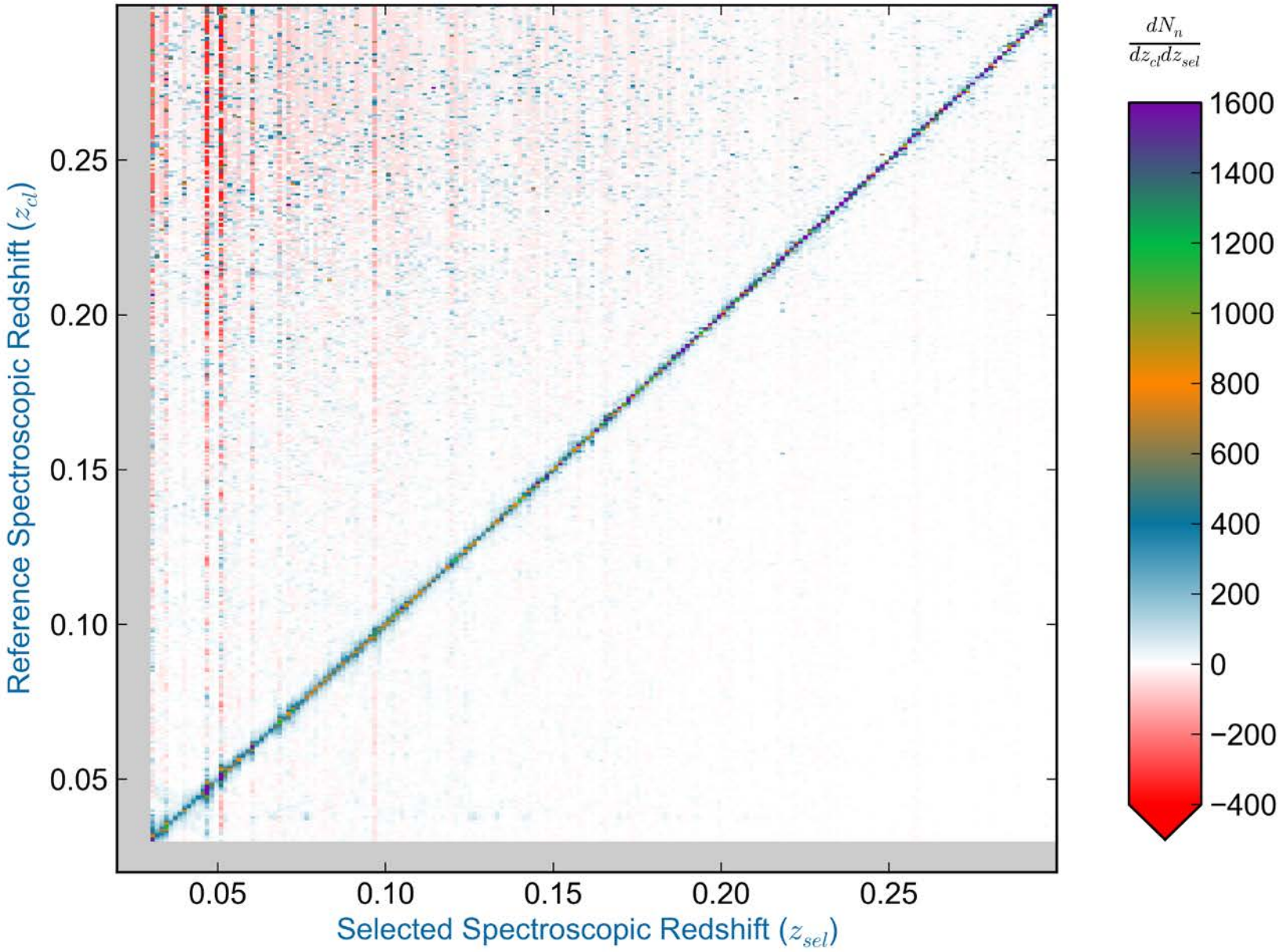
Using the SDSS Spectroscopic Galaxies:



Accuracies: $\Delta z < 10^{-3}$

How accurate are they?

Selecting based on spectroscopic redshift



SDSS Photometric Redshifts

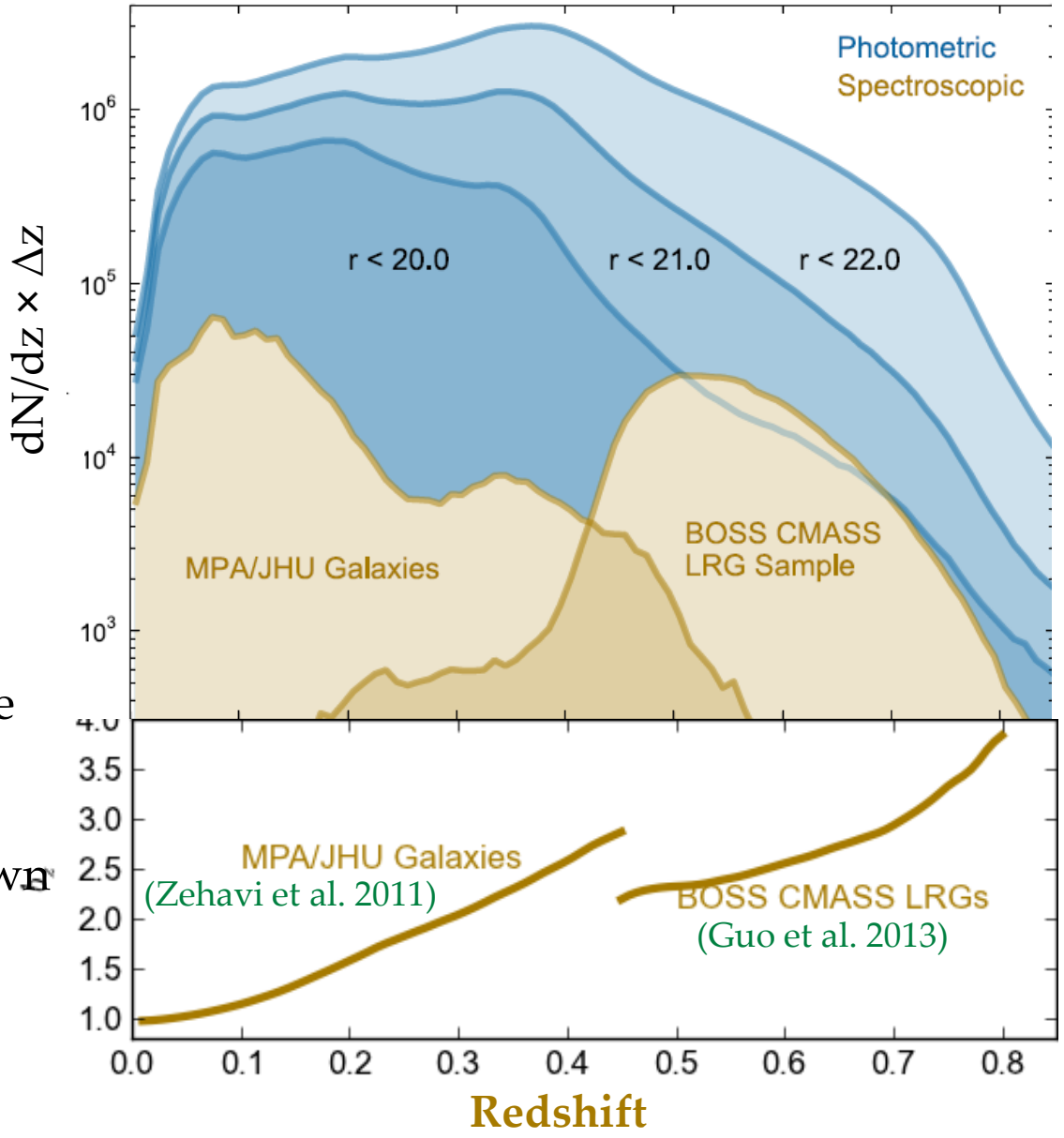
UNKNOWN SAMPLE

SDSS Photometric Galaxies

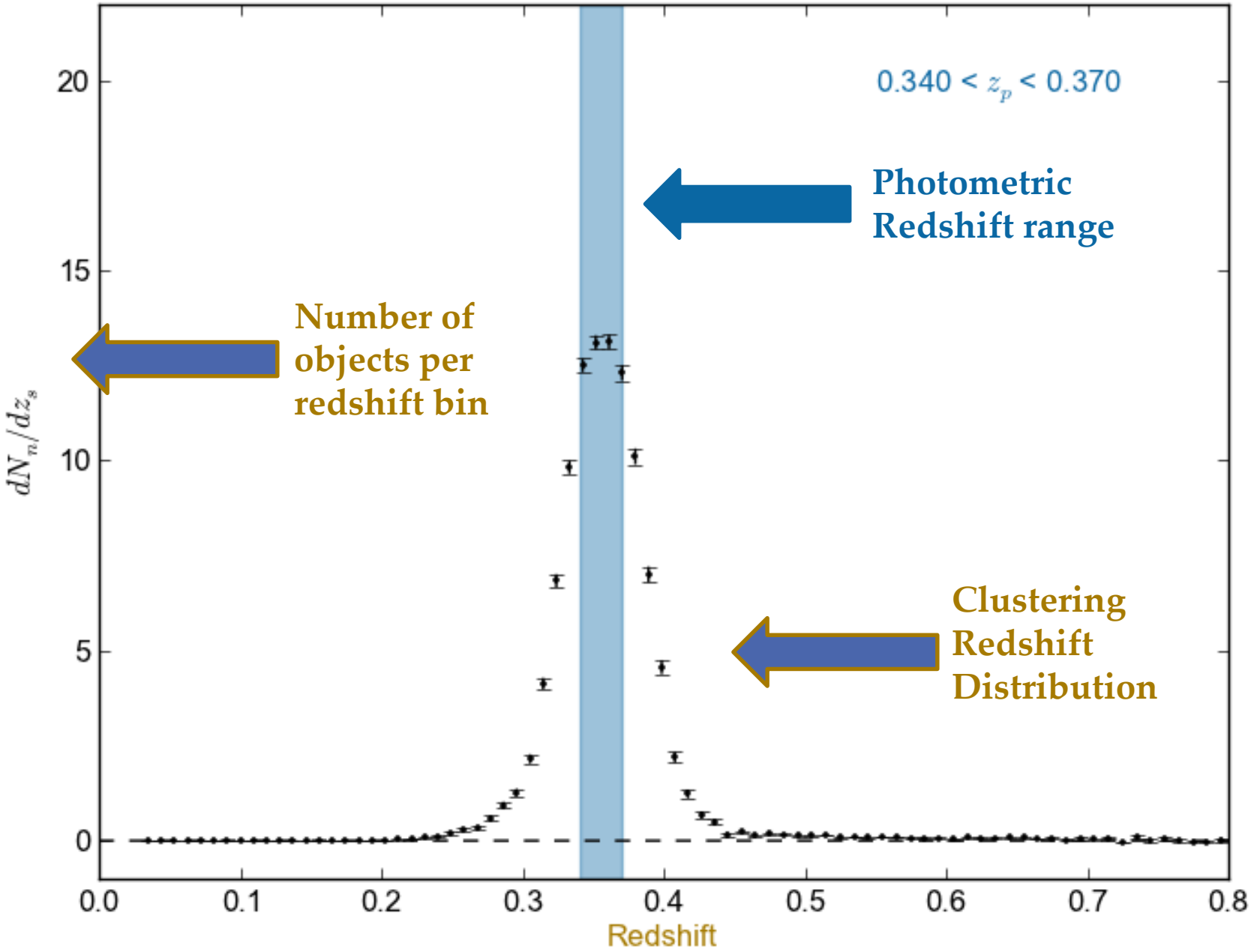
REFERENCE SAMPLE

SDSS main spec sample & BOSS LRGs

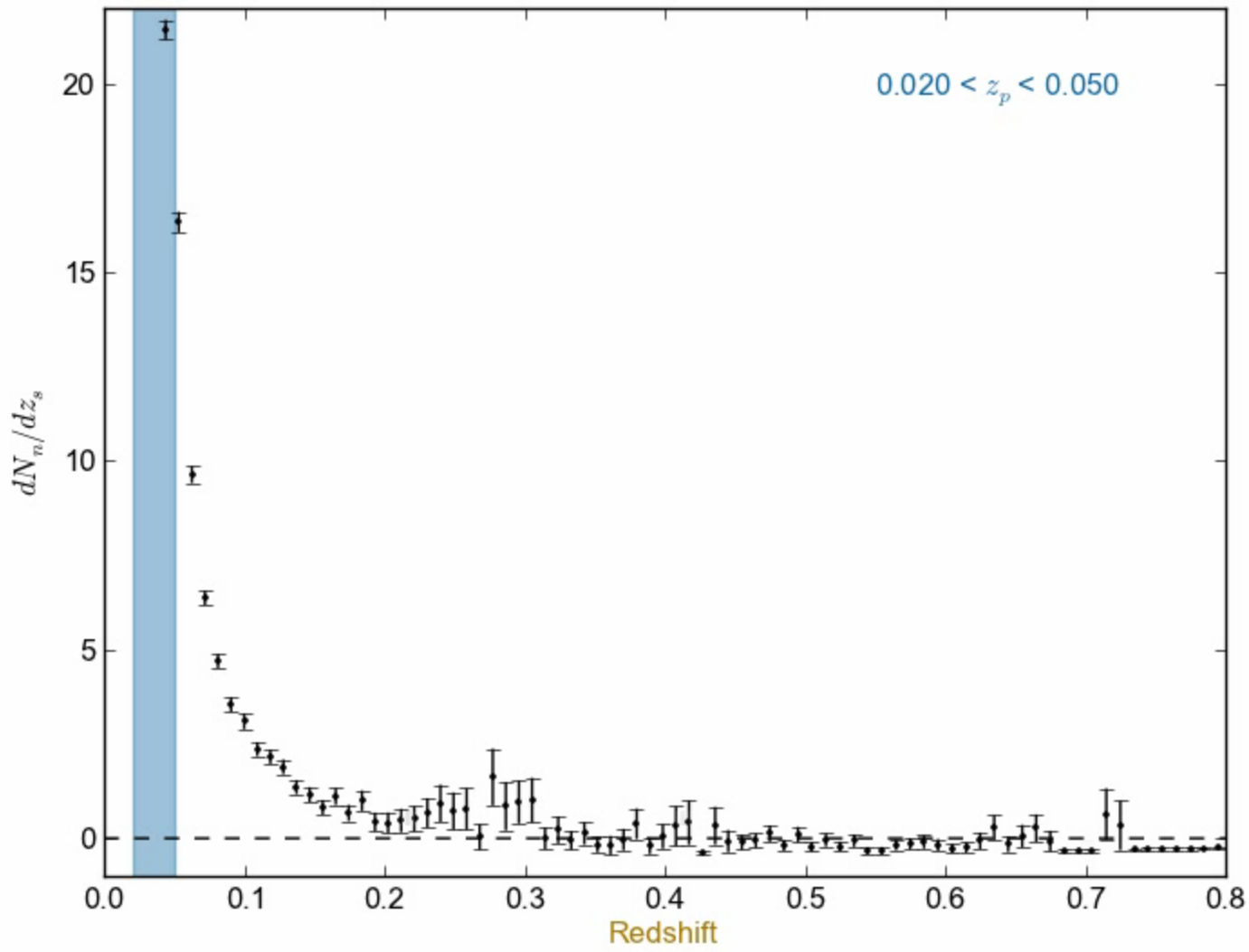
- The (spectroscopic) reference sample is much smaller and does not need to be representative of the unknown galaxies



Clustering redshift distribution

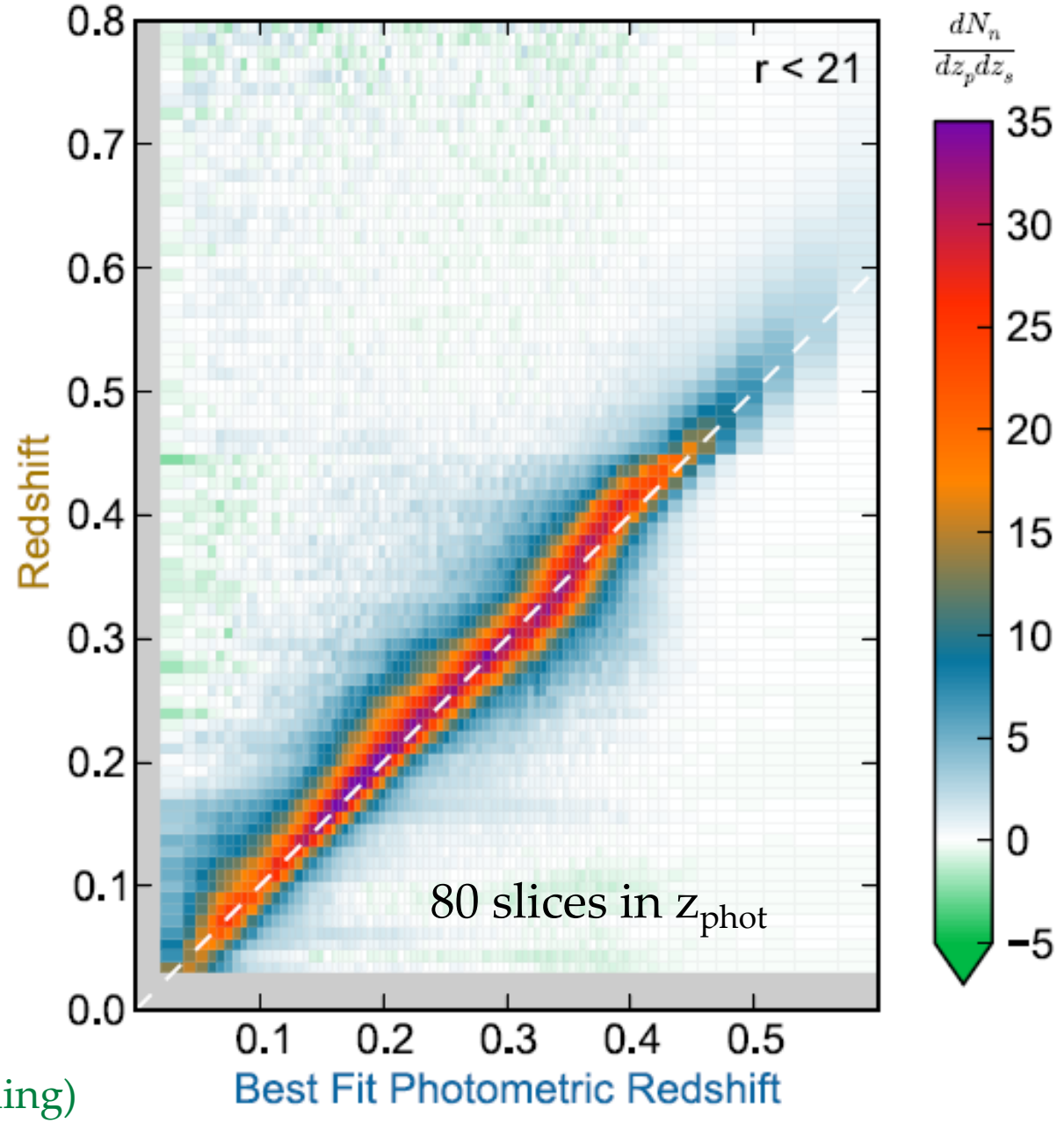


Clustering redshift distribution



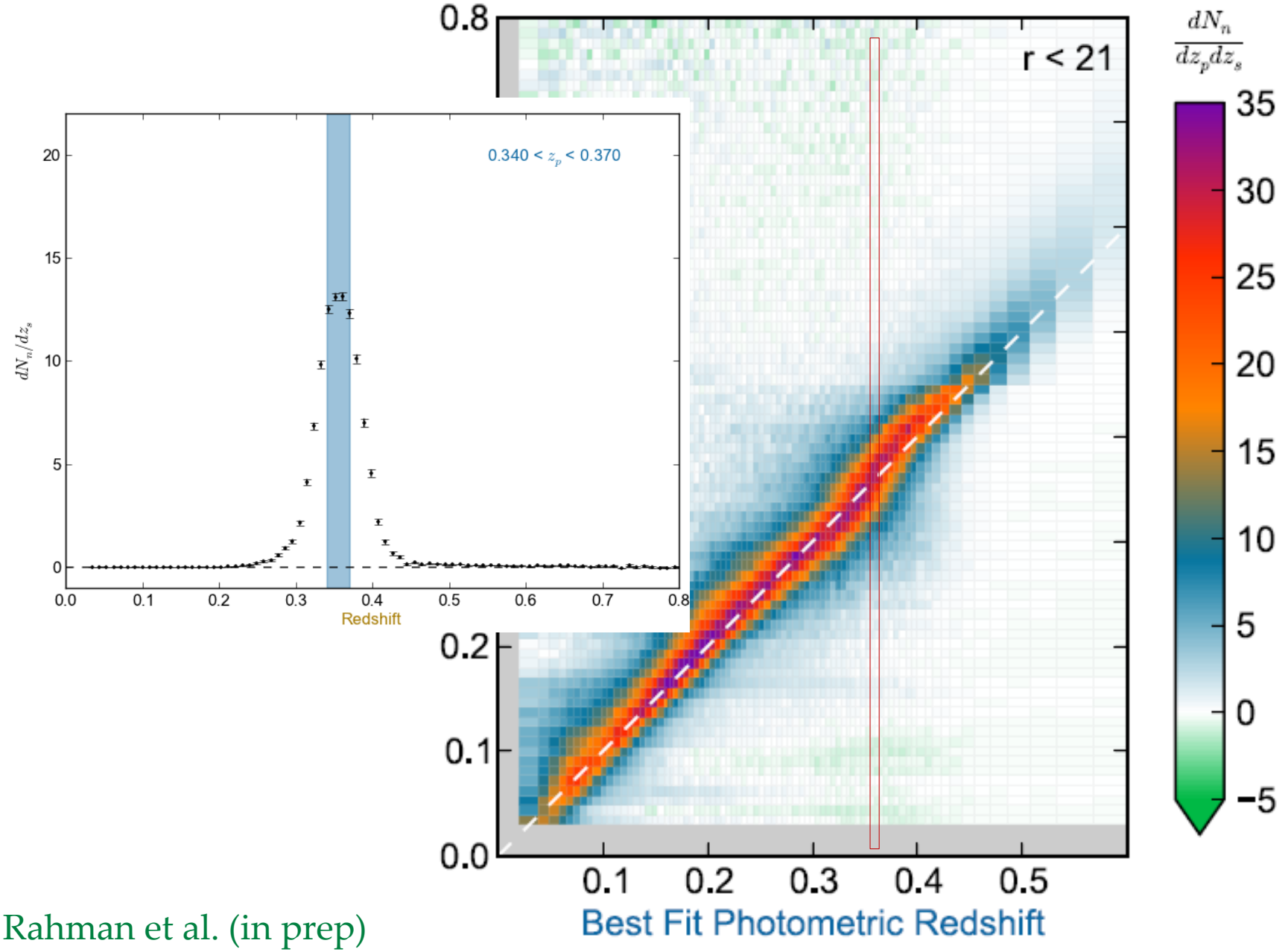
Density map of clustering-z distribution

80 slices in z
($\Delta z \sim 10^{-2}$)



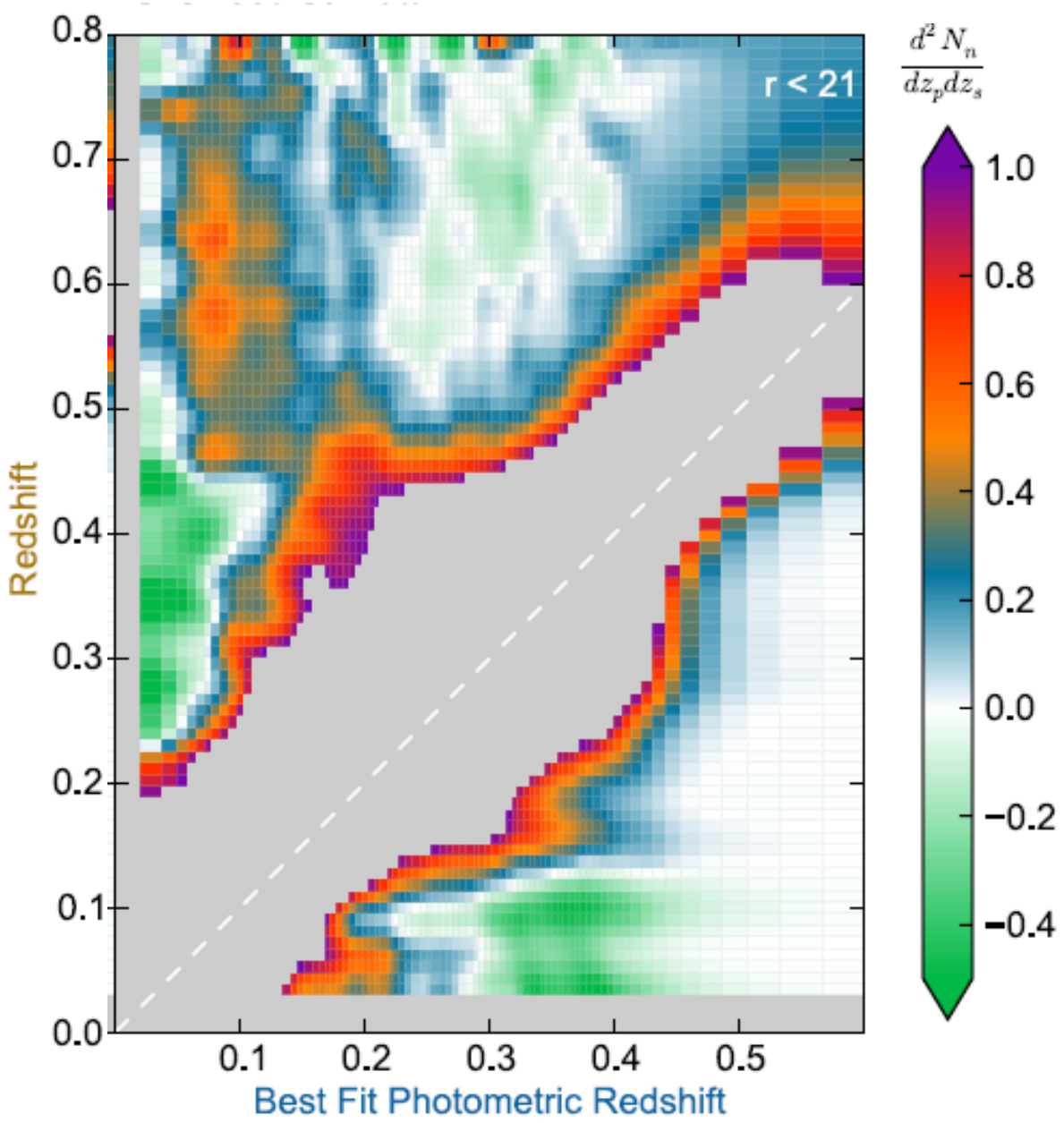
Rahman et al. (forthcoming)

Density map of clustering-z distribution



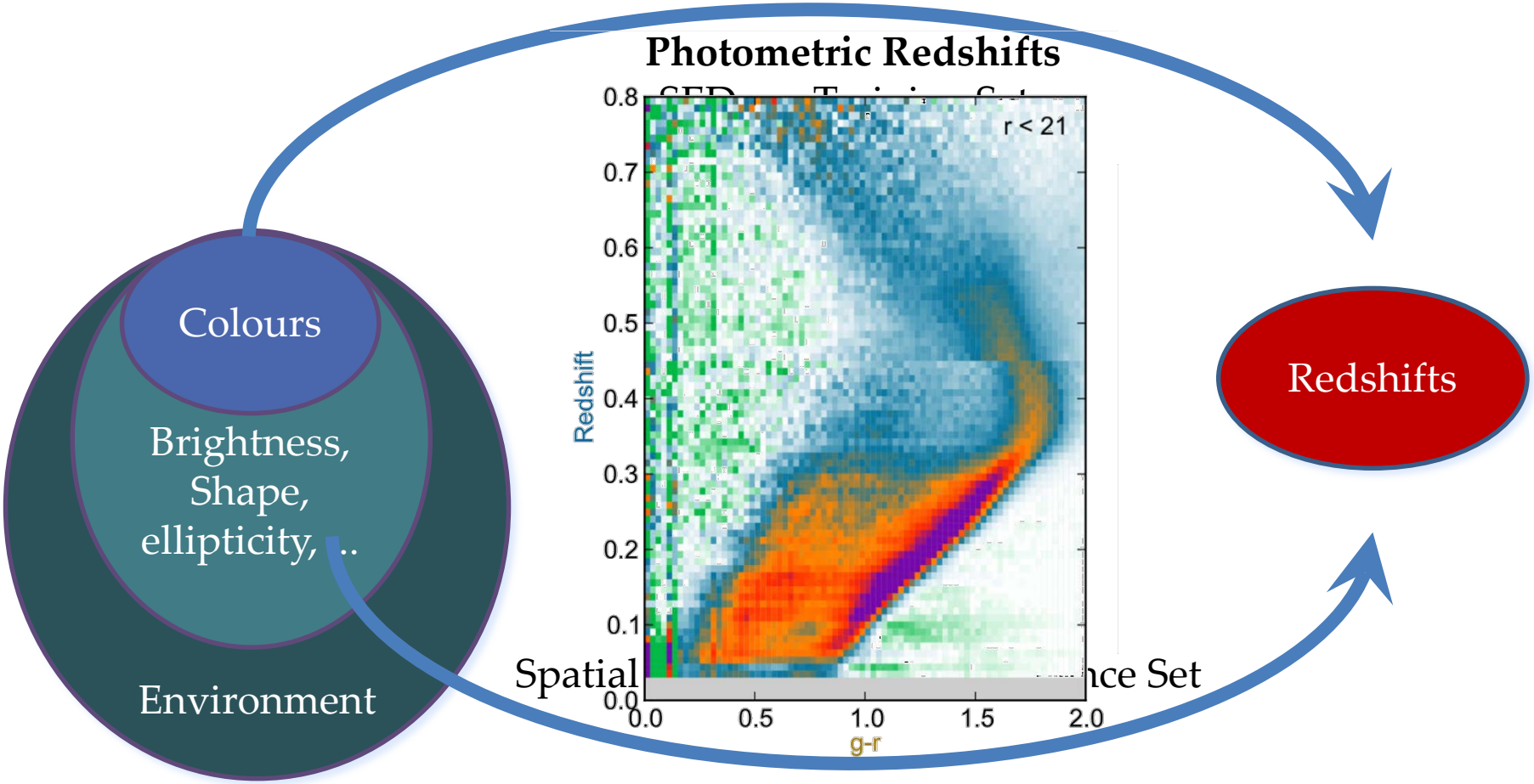
Rahman et al. (in prep)

Density map of clustering-z distribution



Low-level Features

Features smoothed to improve SNR

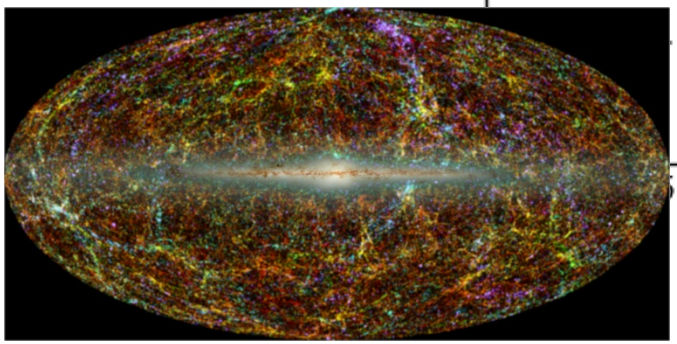


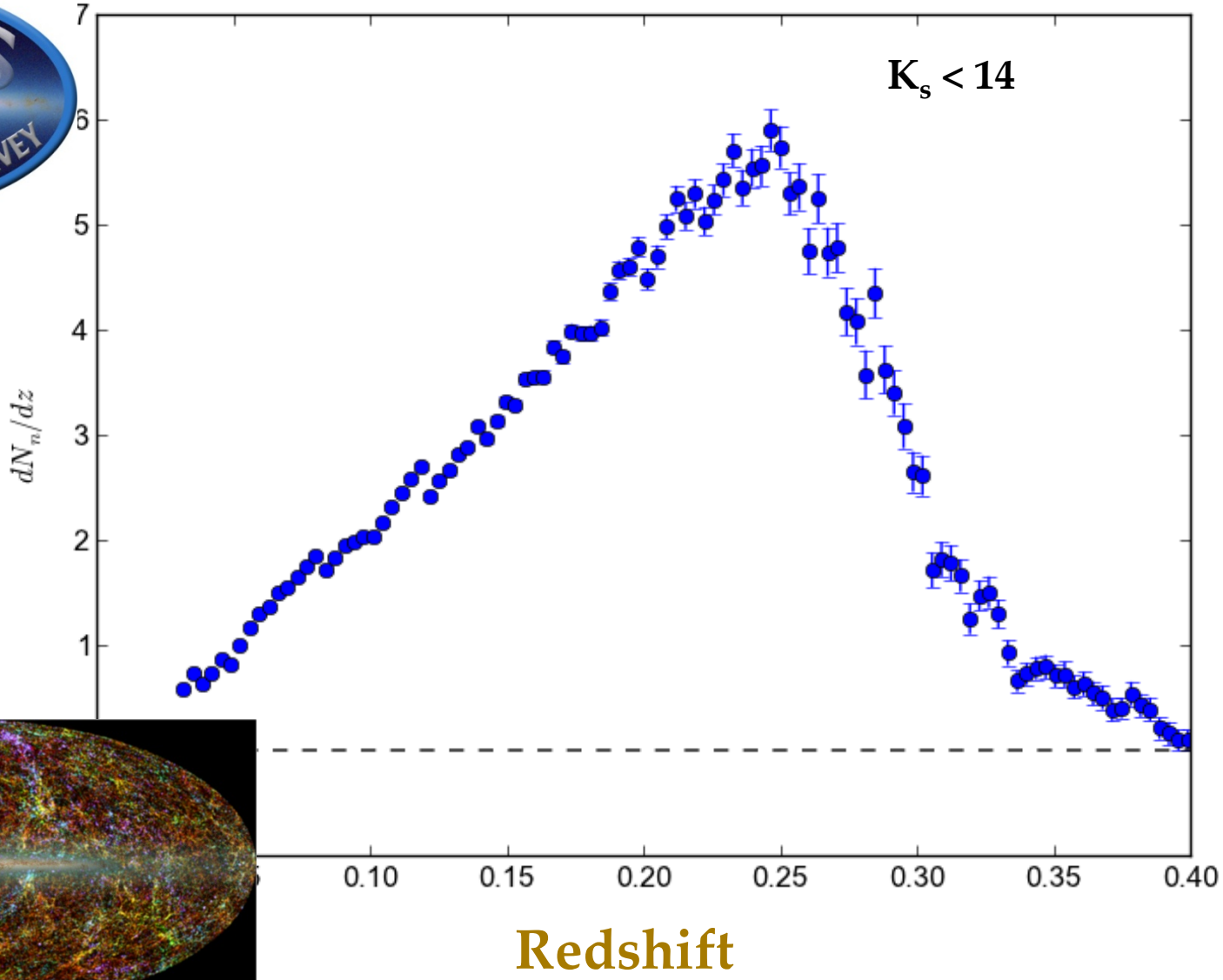
- multidimensional sampling/selection
This will be done without any reference to photo-zs

This can be used to infer the redshift pdf of one galaxy

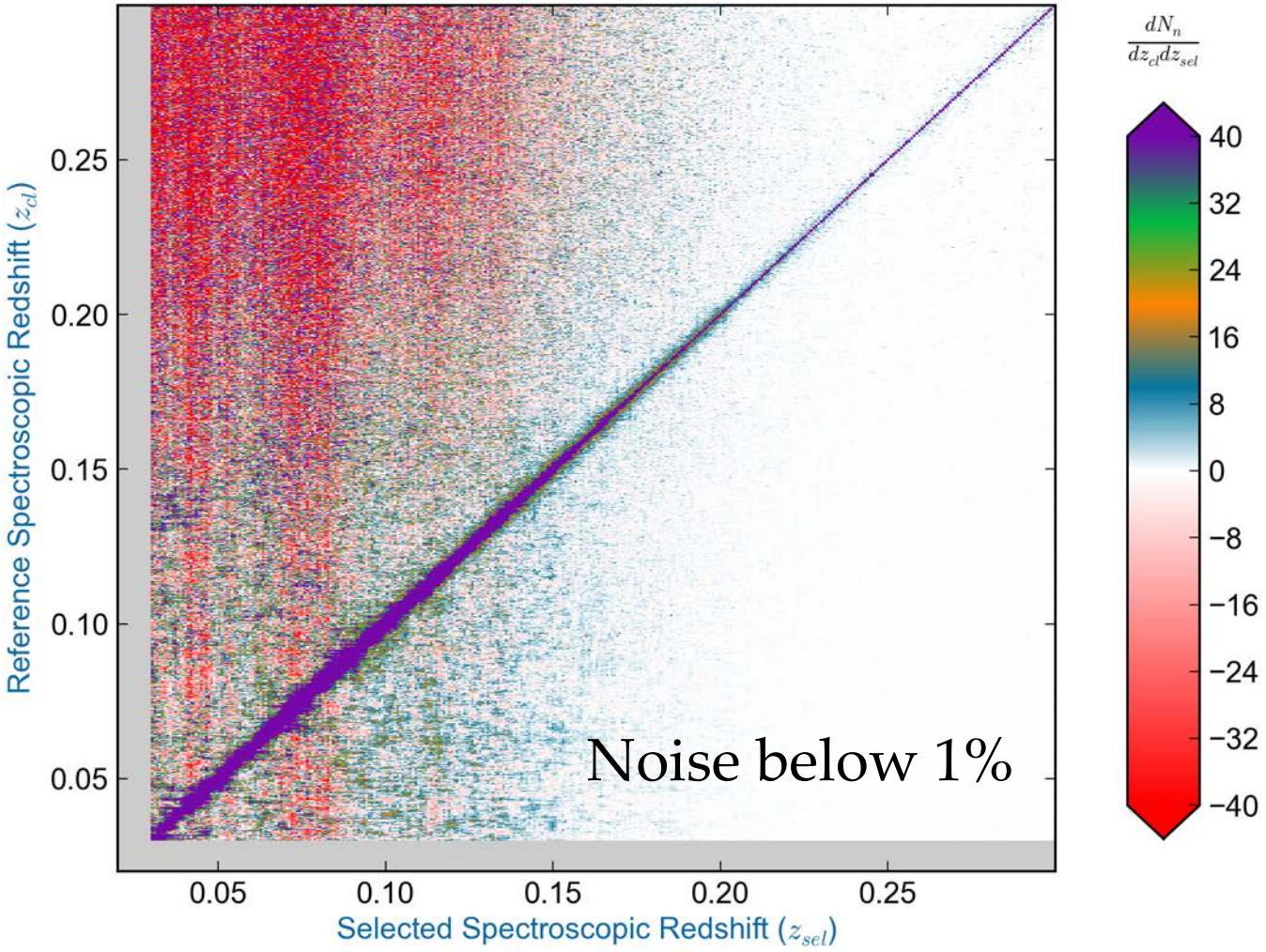
2MASS Clustering Redshift Distribution

Three NIR Filters: 1.2 – 2.4 microns

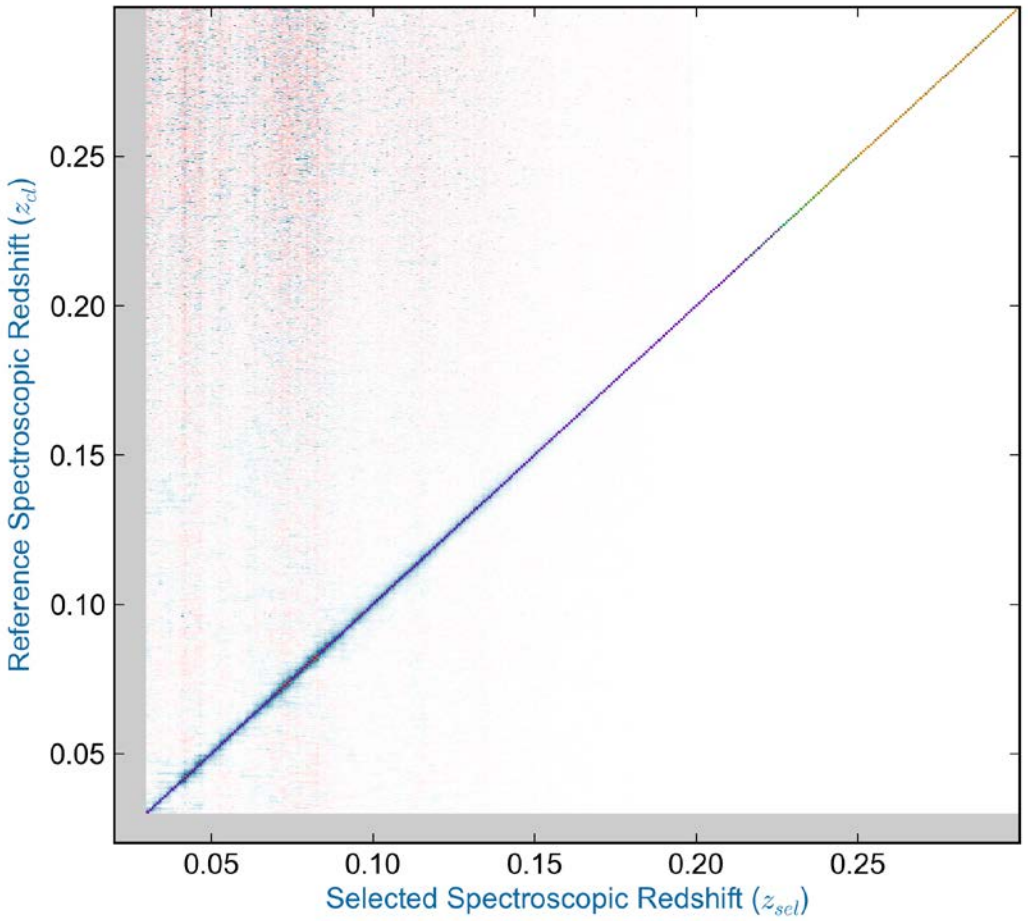




Cleaning Reference Samples



Summary



- New method to deproject sources onto the third dimension
- Requires no a priori knowledge of the source itself
- Redshift accuracy is $\Delta z < 10^{-3}$
- Can be applied to various datasets where distances have been unknown (Radio, High energy)

We are developing the tools and techniques to bring this method to precision cosmology accuracies!