Cosmological constraints using BAO

From spectroscopic to photometric catalogues

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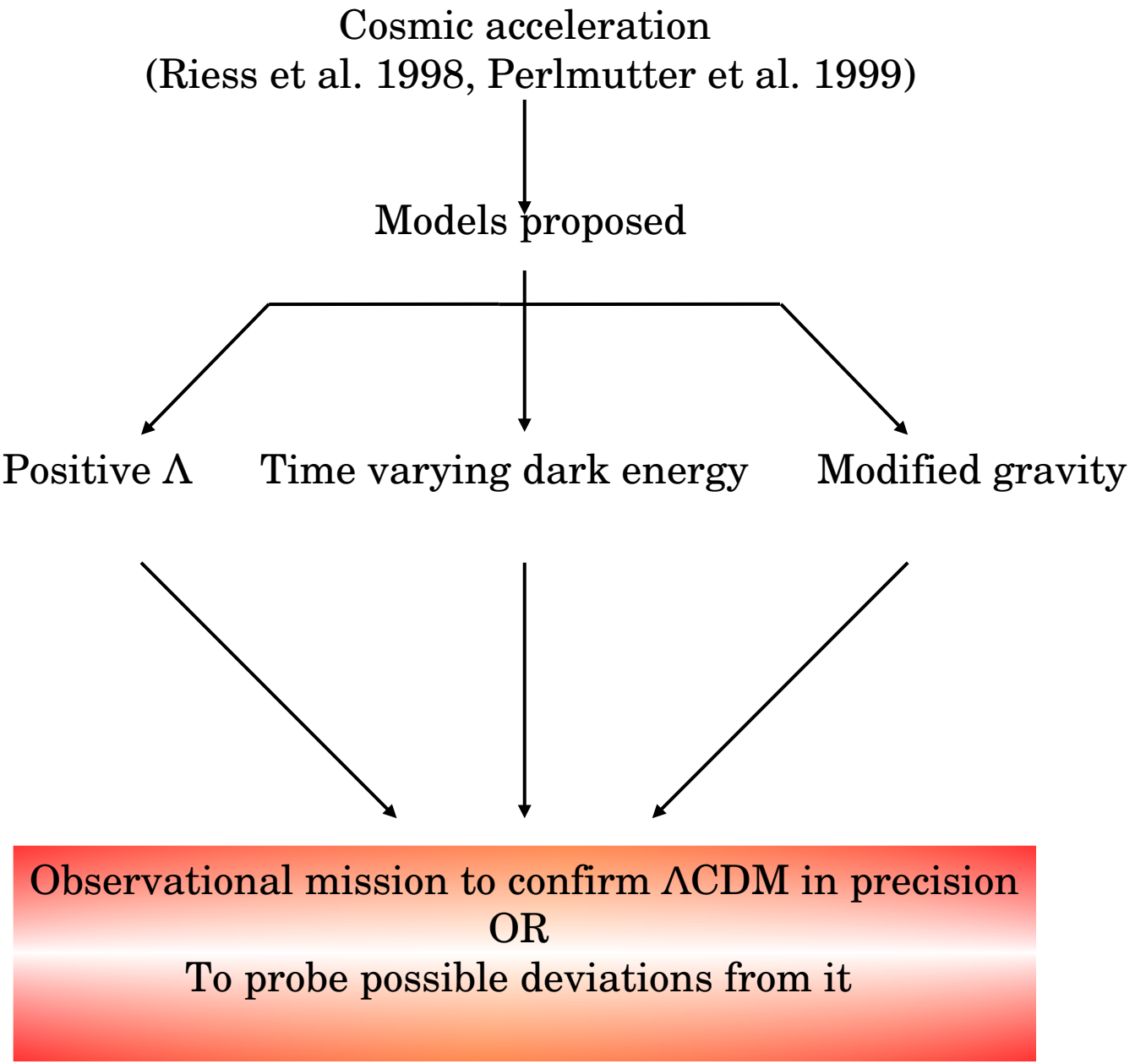
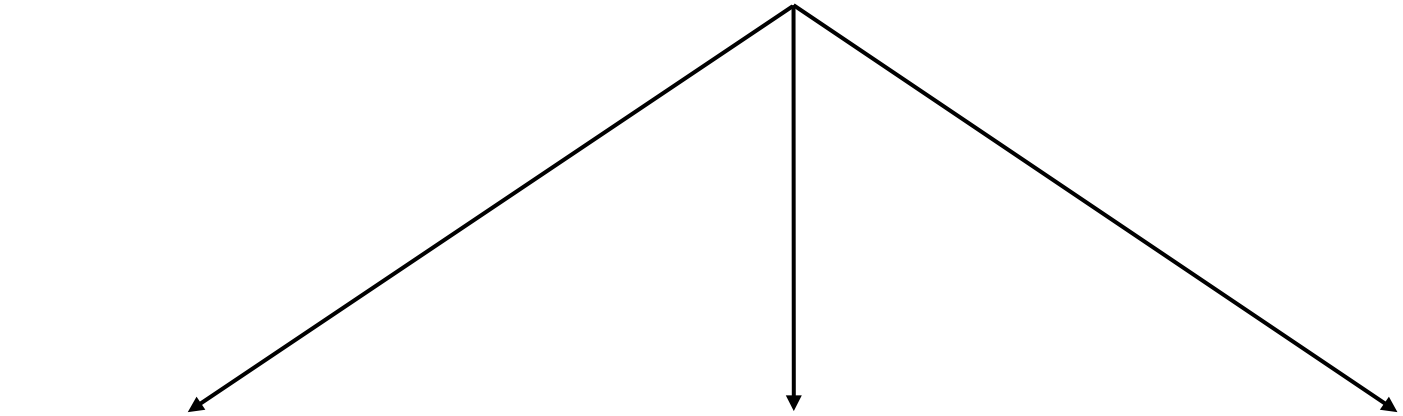
Working with Dr. Yong-Seon Song


Cosmic acceleration
(Riess et al. 1998, Perlmutter et al. 1999)
Models proposed
Positive Λ
Time varying dark energy
Modified gravity
Observational mission to confirm ΛCDM in precision
OR
To probe possible deviations from it

Expansion history of the Universe revealed by cosmic distance measures



Cosmic parallax

Standard rulers
(BAO)

Standard candles
(Supernovae)

Expansion history of the Universe revealed by cosmic distance measures

Cosmic parallax

Standard rulers (BAO)

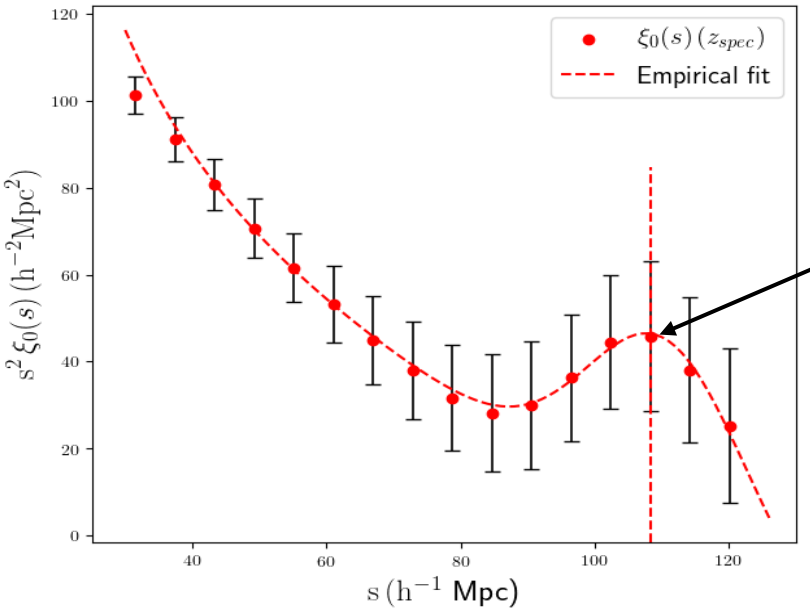
Standard candles (Supernovae)

Constraints on

$$D_V(z) = \left[(1+z)^2 D_A(z)^2 \frac{cz}{H(z)}\right]^{1/3}$$

Angular diameter distance

Hubble parameter



Appears as a bump in the two-point correlation function

Photometric error dispersion

$$\sigma_z = \sigma_0 \times (1 + z_{spec})$$

Spectroscopic redshift surveys

- Precise redshift information
  $\sigma_0 \approx 0.001$

BUT

- Time consuming
- Difficult at high redshifts

Photometric redshift surveys

- Lower redshift precision
  $0.02 < \sigma_0 < 0.05$

BUT

- Covers more galaxies
- Can extend to large redshifts

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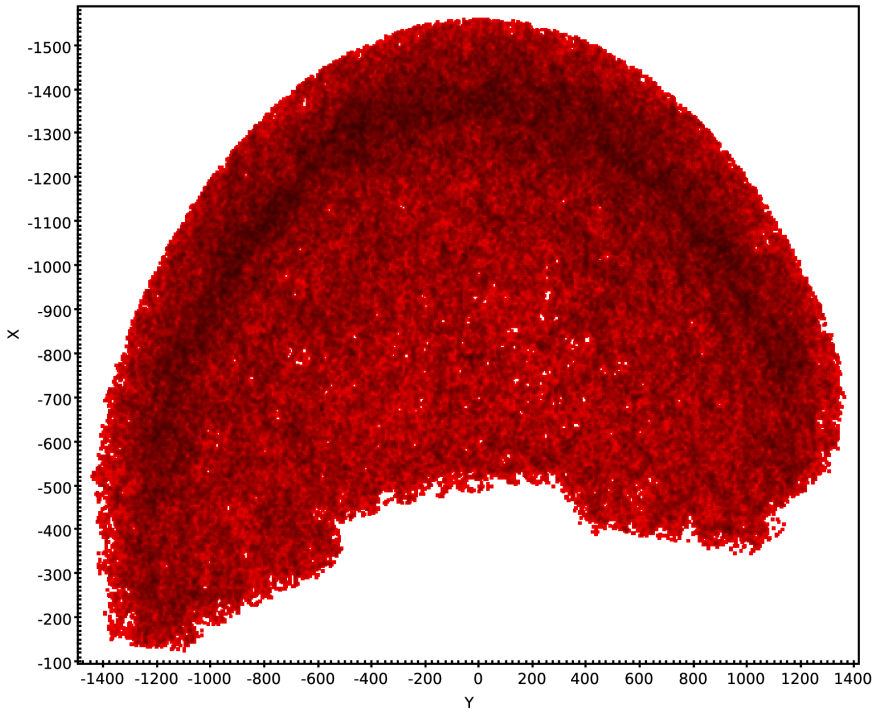
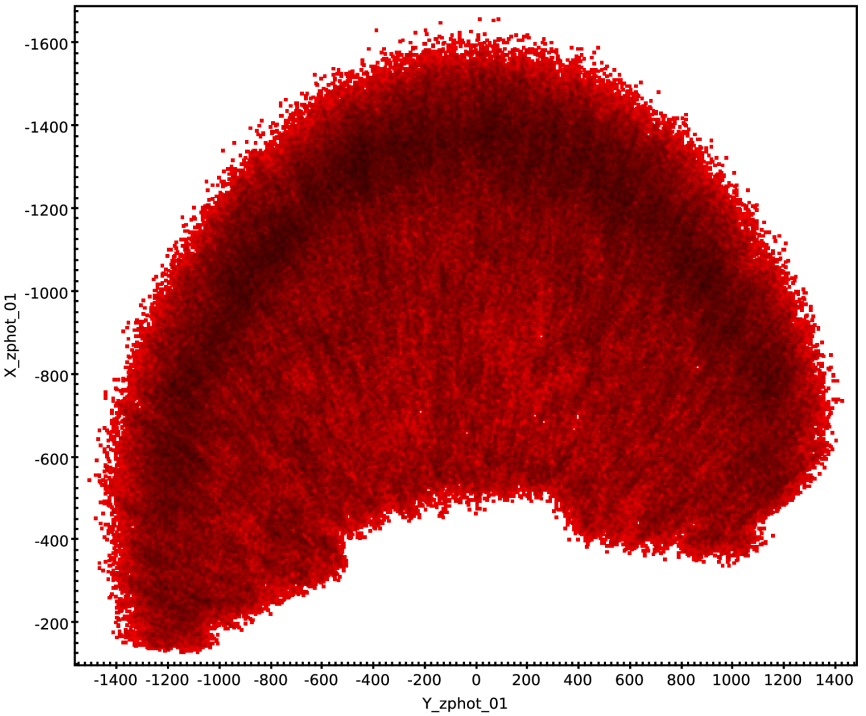
Ongoing and upcoming surveys will have photometric redshift measurements

1)Is there a possible way to recover the BAO information from photo-z's ?

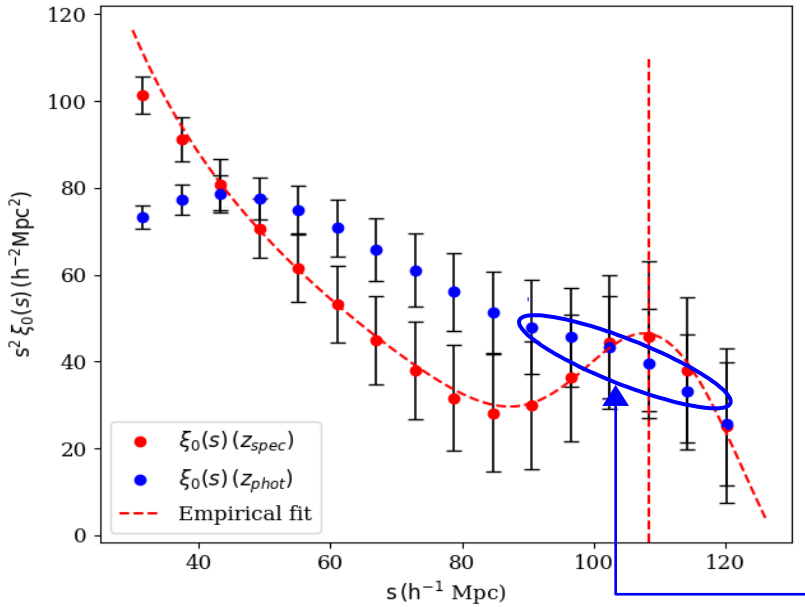
2)Is the recovered BAO peak usable for cosmic distance measures ?



spectro-z



p h o t o - z



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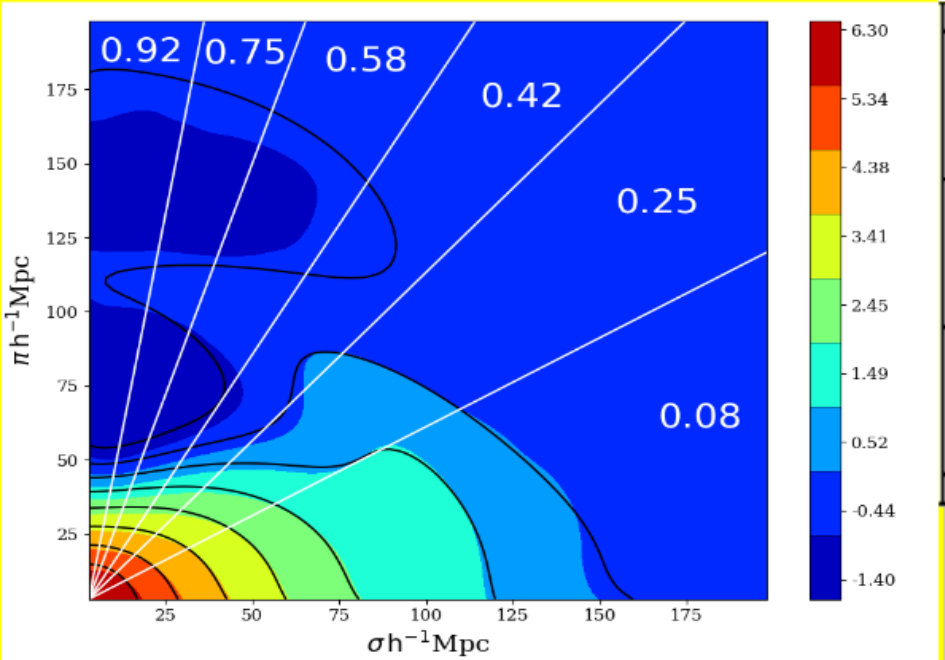
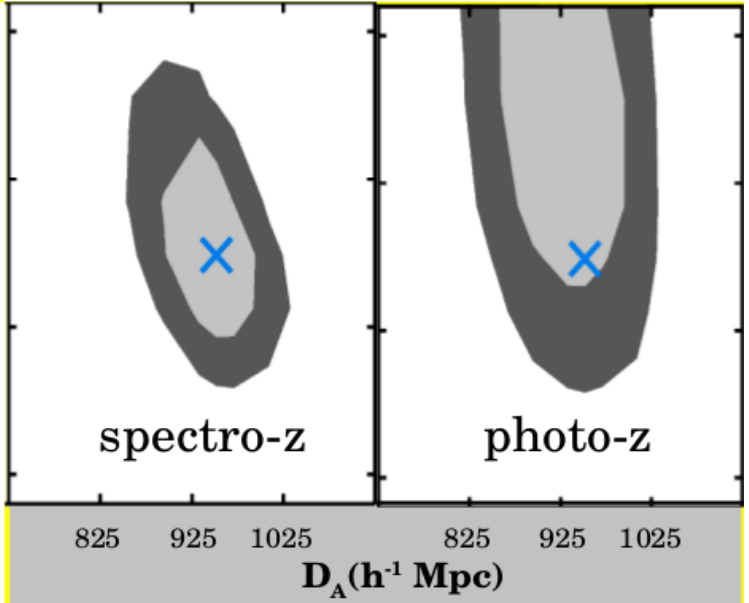
Structures are

S T R E T C H E D

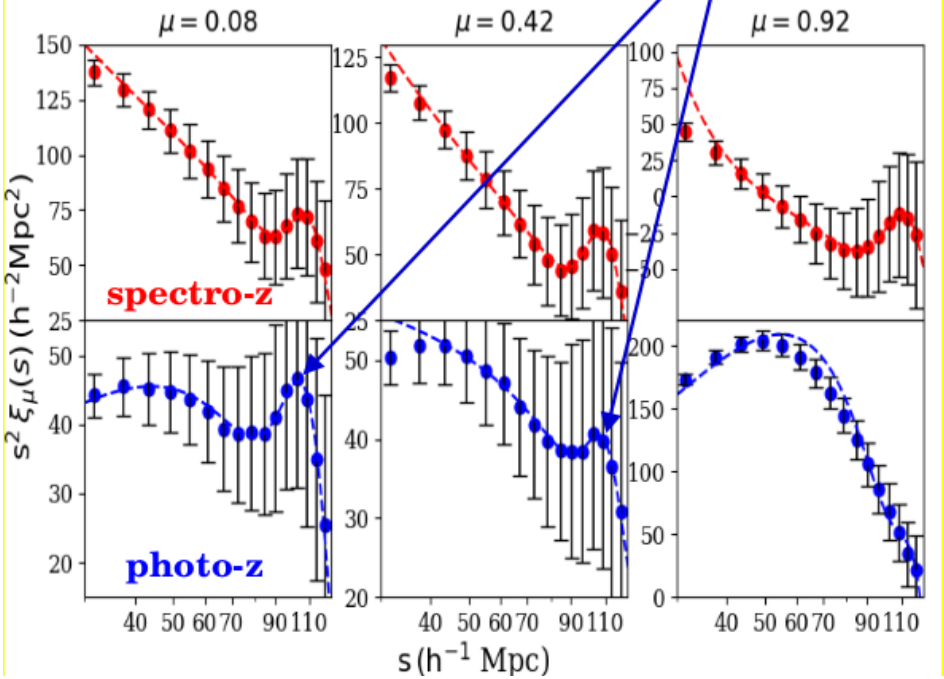
in photometric redshift space

BAO peak smeared out in photo-z space





Photometric redshift –> BAO peak smeared
Analysis using wedge approach is promising!



D_A constraints

from spectro-z = **5% precision**

from photo-z = **6% precision**

Why not use angular clustering?

Wedge approach [$\xi(s,\mu)$] has

1) More info
2) 6% more accurate
3) Covariance matrix less complicated !

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Cosmic distance determination from photometric redshift samples using BAO peaks only

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ABSTRACT

The galaxy distributions along the line-of-sight are significantly contaminated by the uncertainty on redshift measurements obtained through multiband photometry, which makes it difficult to get cosmic distance information measured from baryon acoustic oscillations, or growth functions probed by redshift distortions. We investigate the propagation of the uncertainties into large scale clustering by exploiting all known estimators, and propose the wedge approach as a promising analysis tool to extract cosmic distance information still remaining in the photometric galaxy samples. We test our method using simulated galaxy maps with photometric uncertainties of $\sigma_0 = (0.01, 0.02, 0.03)$. The measured anisotropy correlation function ξ is binned into the radial direction of s and the angular direction of μ, and the variations of $\xi(s, \mu)$ with perpendicular and radial cosmic distance measures of D_A and H^{-1} are theoretically estimated by an improved RSD model. Although the radial cosmic distance H^{-1} is unable to be probed from any of the three photometric galaxy samples, the perpendicular component of D_A is verified to be accurately measured even after the full marginalisation of H^{-1}. We measure D_A with approximately 6% precision which is nearly equivalent to what we can expect from spectroscopic DR12 CMASS galaxy samples.

Key words: cosmology: large-scale structure of Universe – cosmological parameters

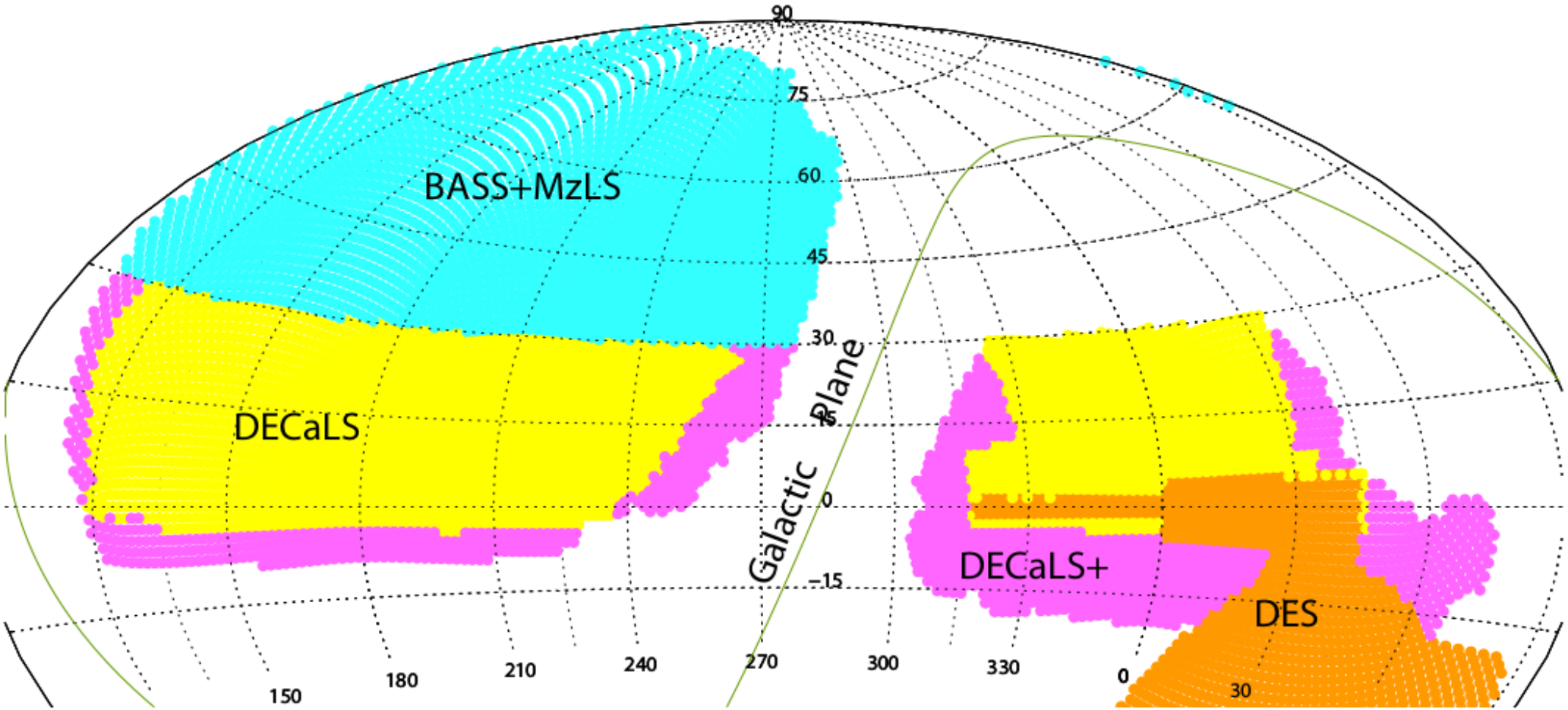
1 INTRODUCTION

Since the discovery of the cosmic acceleration (Riess et al. 1998; Perlmutter et al. 1999), many theoretical models have been proposed to explain the cause of it by introducing a positive cosmological constant, a time varying dark energy component, or a modified theory of gravity. As most ongoing

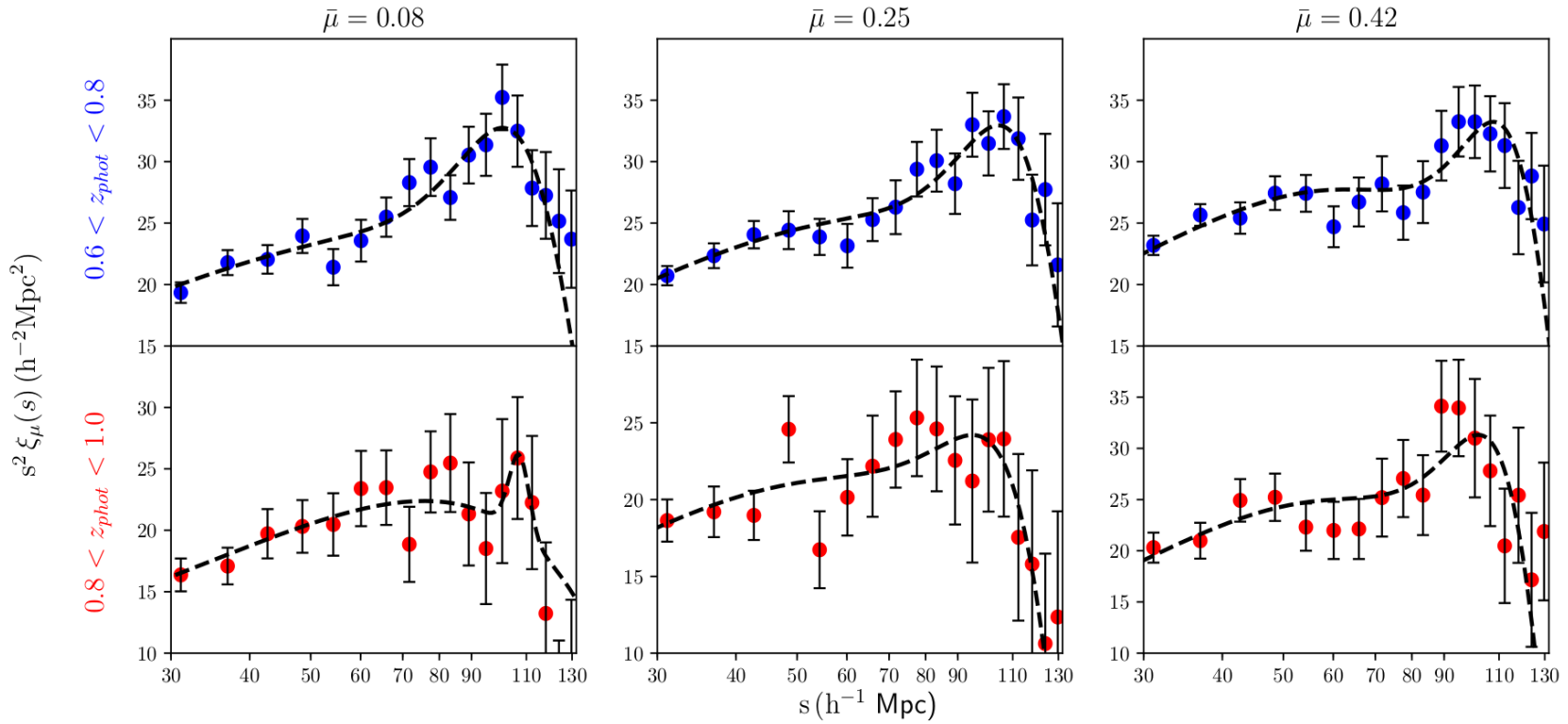
dard ruler technique to probe cosmic distances. The BAO feature has been measured through the correlation function (Blake & Glazebrook 2003; Eisenstein et al. 2005), and the most successful measurements in the clustering of large-scale structure at low redshifts have been obtained using data from SDSS (Eisenstein et al. 2005; Estrada et al. 2009;

arXiv link: www.arXiv.org/abs/1903.09651

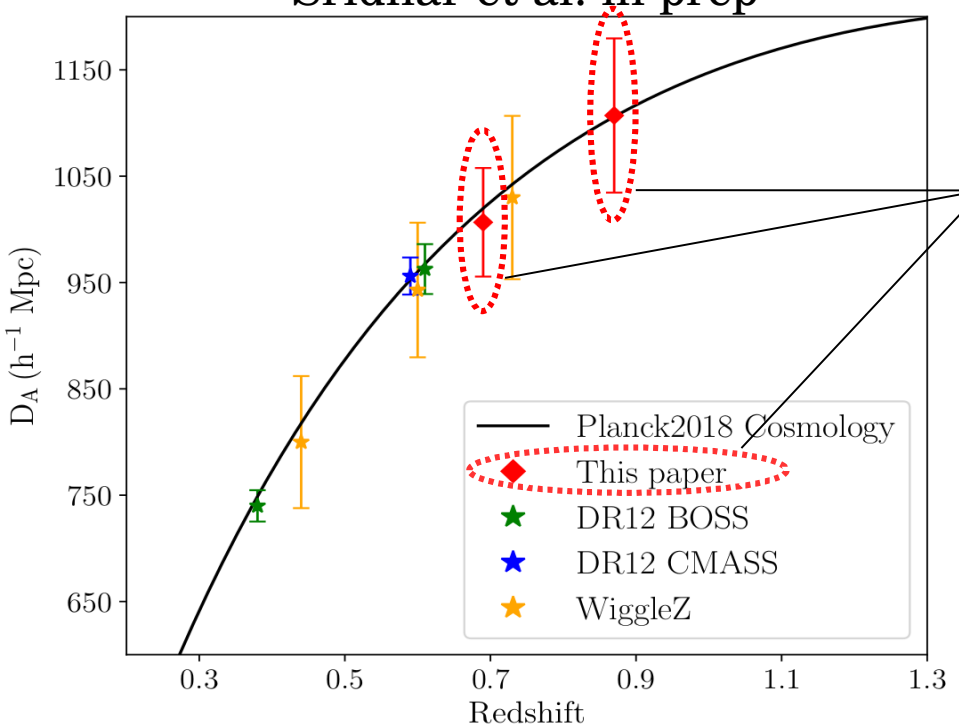
Application to DECaLS DR7 photometric data



DESI collaboration, 2016



Sridhar et al. in prep



Constraints obtained

Thank you – நன்றி (Nandri) – 감사합니다