High-redshift LRG clustering evolution in SDSS Stripe 82

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Durham University
MARIE CURIE ACTIONS
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Outline

- Motivation
- Existing work on LRGs clustering
- LRGs selection on SDSS Stripe 82
- Angular correlation function of z~1 LRGs
- Comparison with previous studies
- Summary-Conclusions

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Motivation

- Extending the existing studies from SDSS, 2SLAQ & AAΩ LRG surveys to z ~ 1
- n(z) calibration from colour selected LRGs
  LRGs expected to be primary tracers of LSS in future z~1 galaxy surveys :
  VST, VISTA, DES, Pan-STARRS

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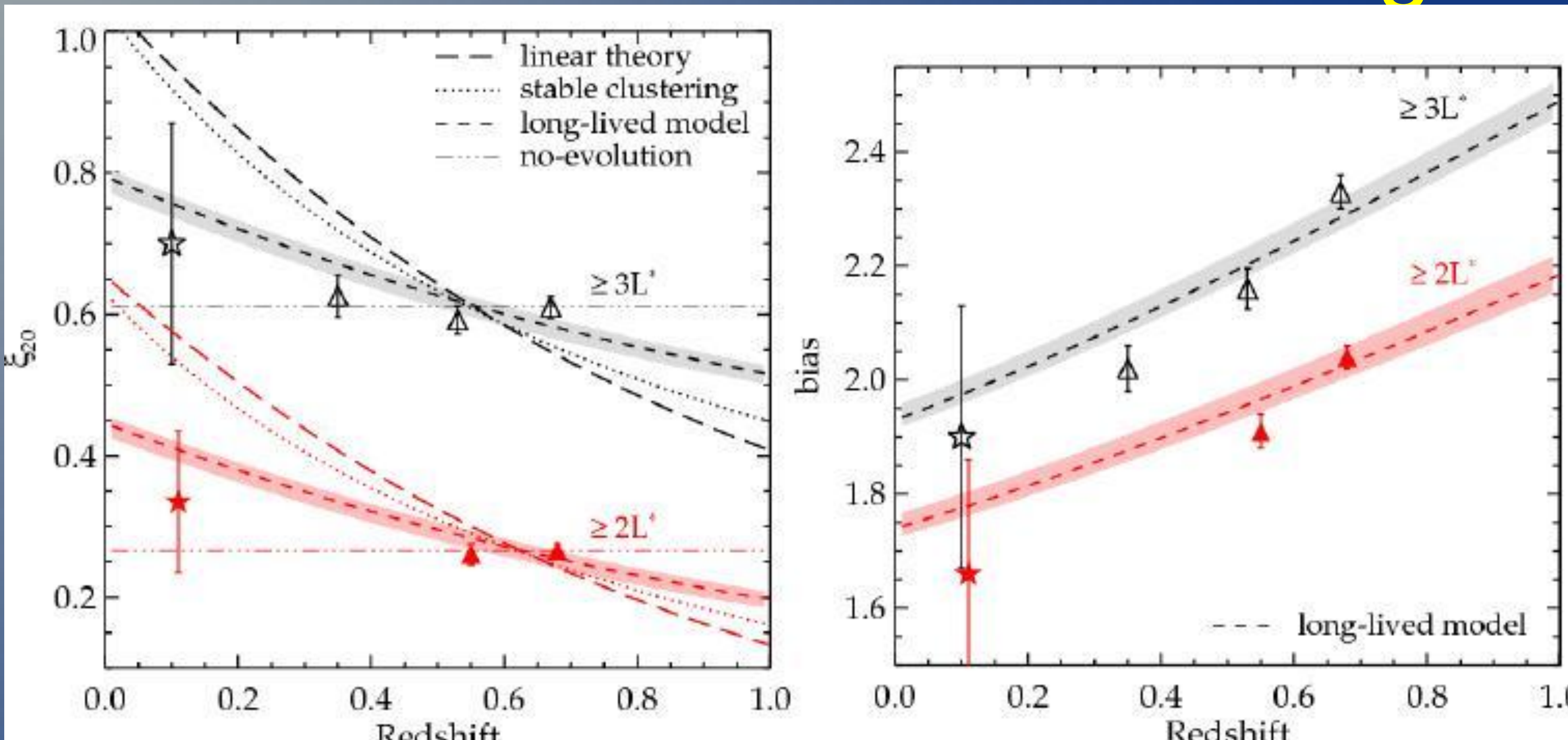
Evolution of LRG clustering



AAΩ LRGs at z ~0.68

Sawangwit et al. 2011

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Luminous Red Galaxies

High luminosities

- Easy to observe out to greater distances
- High linear bias good for BAO detection

Uniform SED

- Homogeneous strong candidates sample for photometry/spectroscopy
- Colour-magnitude selection becomes easier

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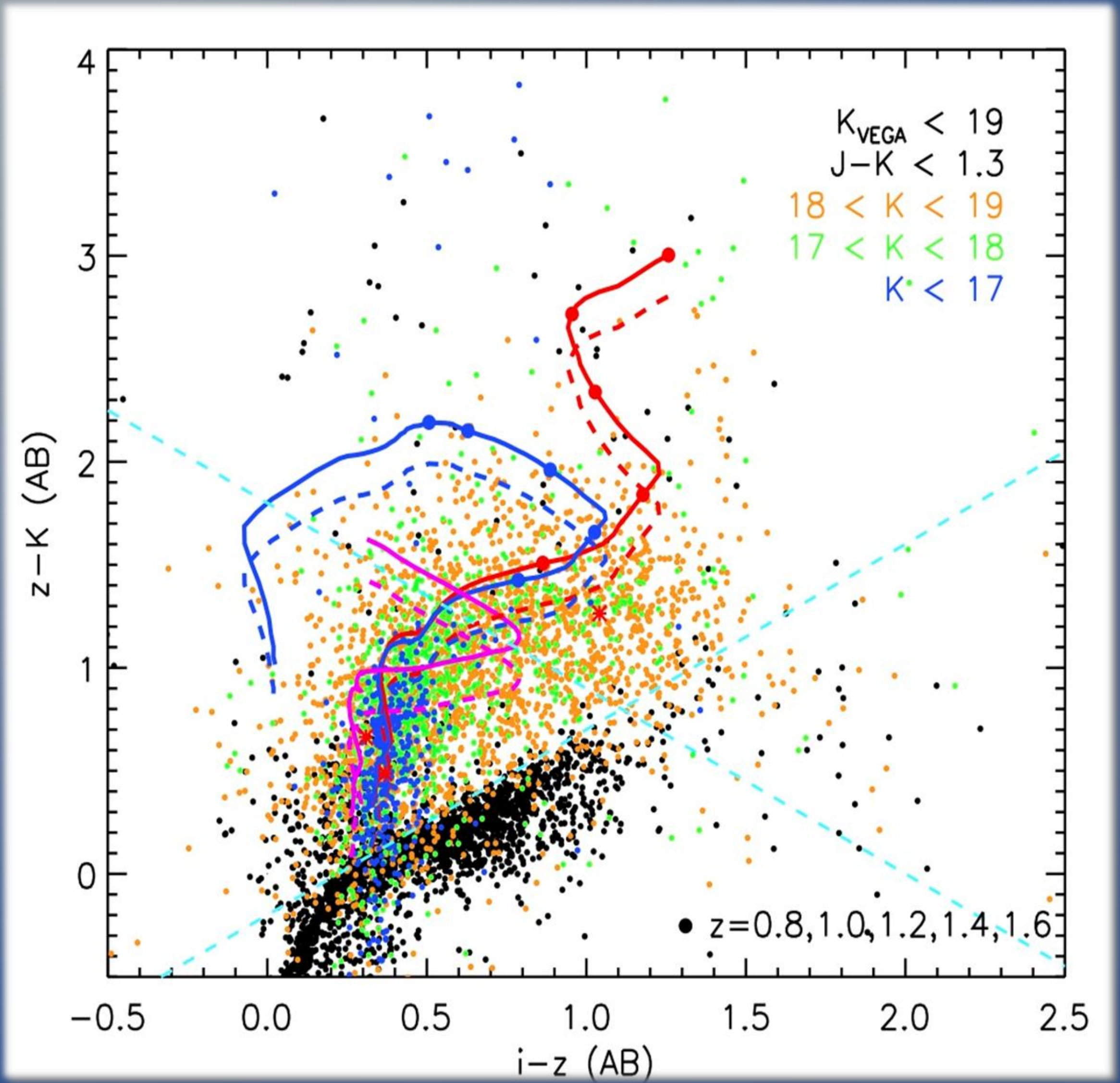
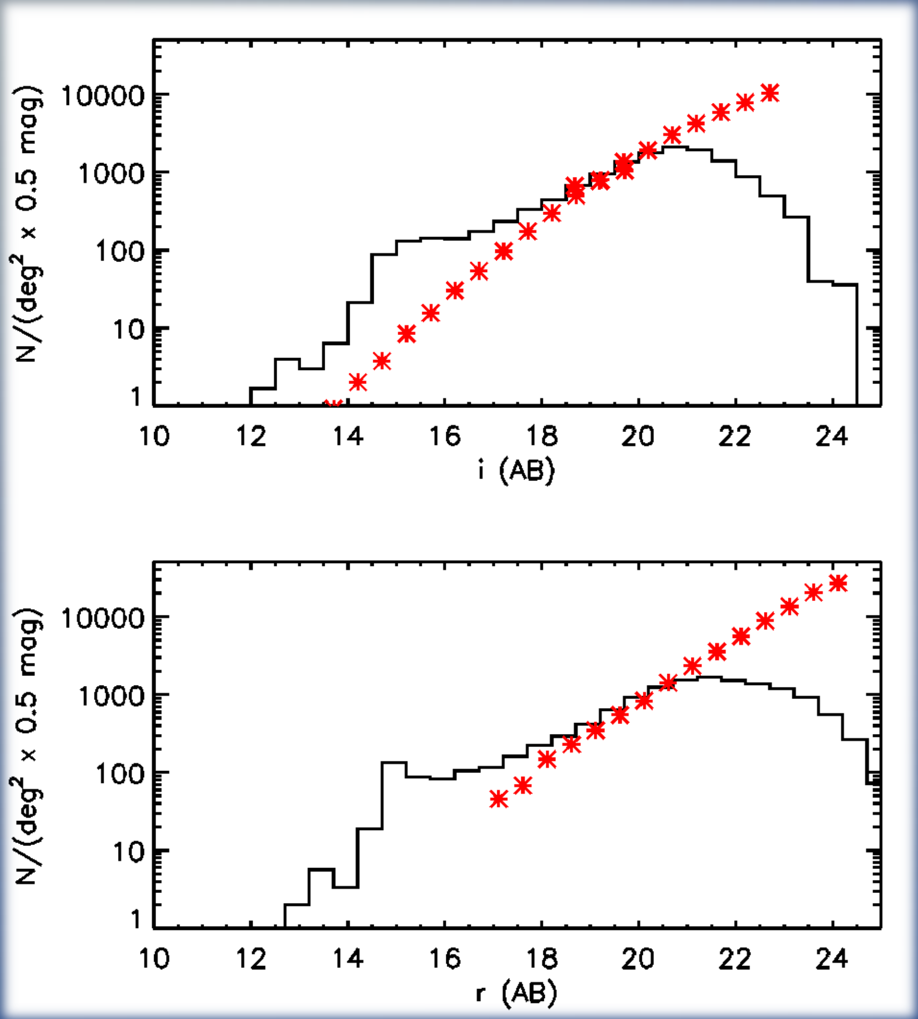
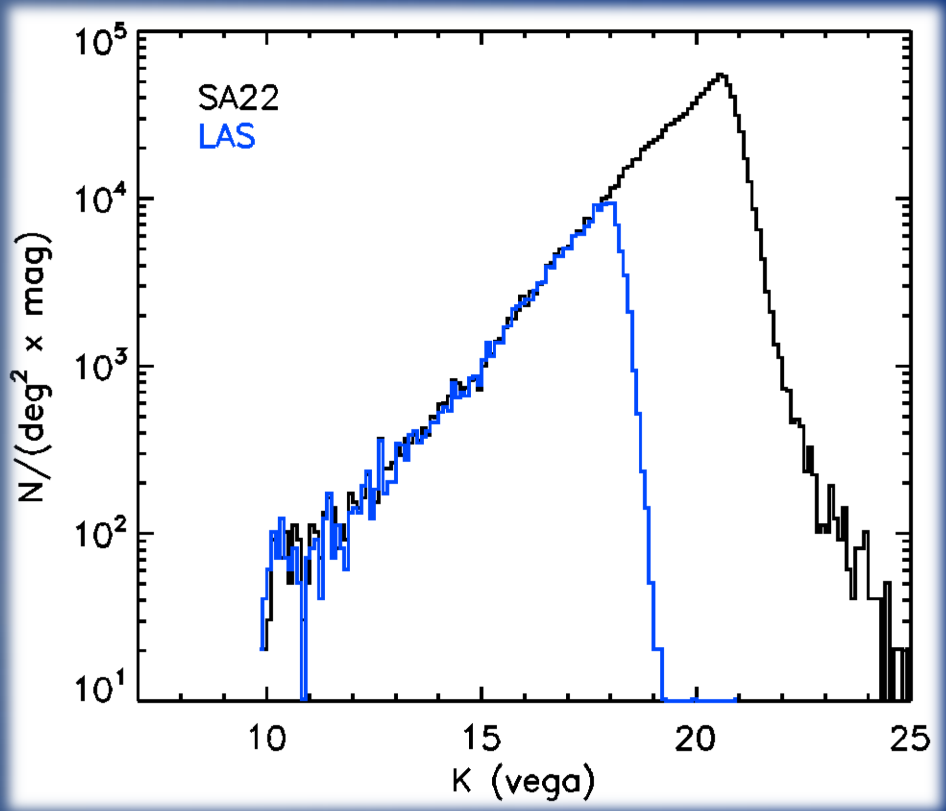
LRG selection in Stripe82



- Optical & NIR photometry
- UKIDSS LAS & DXS JHK
- SDSS ugriz $i_{AB} \leq 22.5$
- $K_{vega} \leq 18$
- LRGs > 4L*

Number counts in Stripe82





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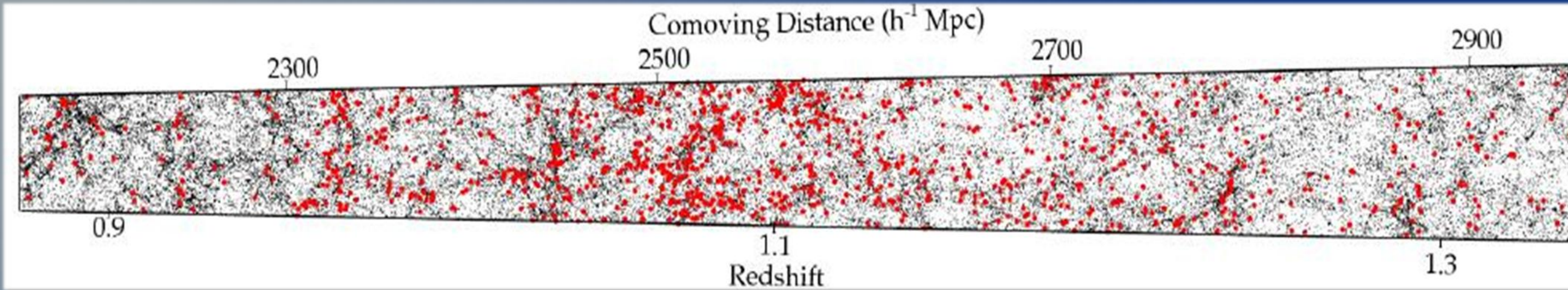

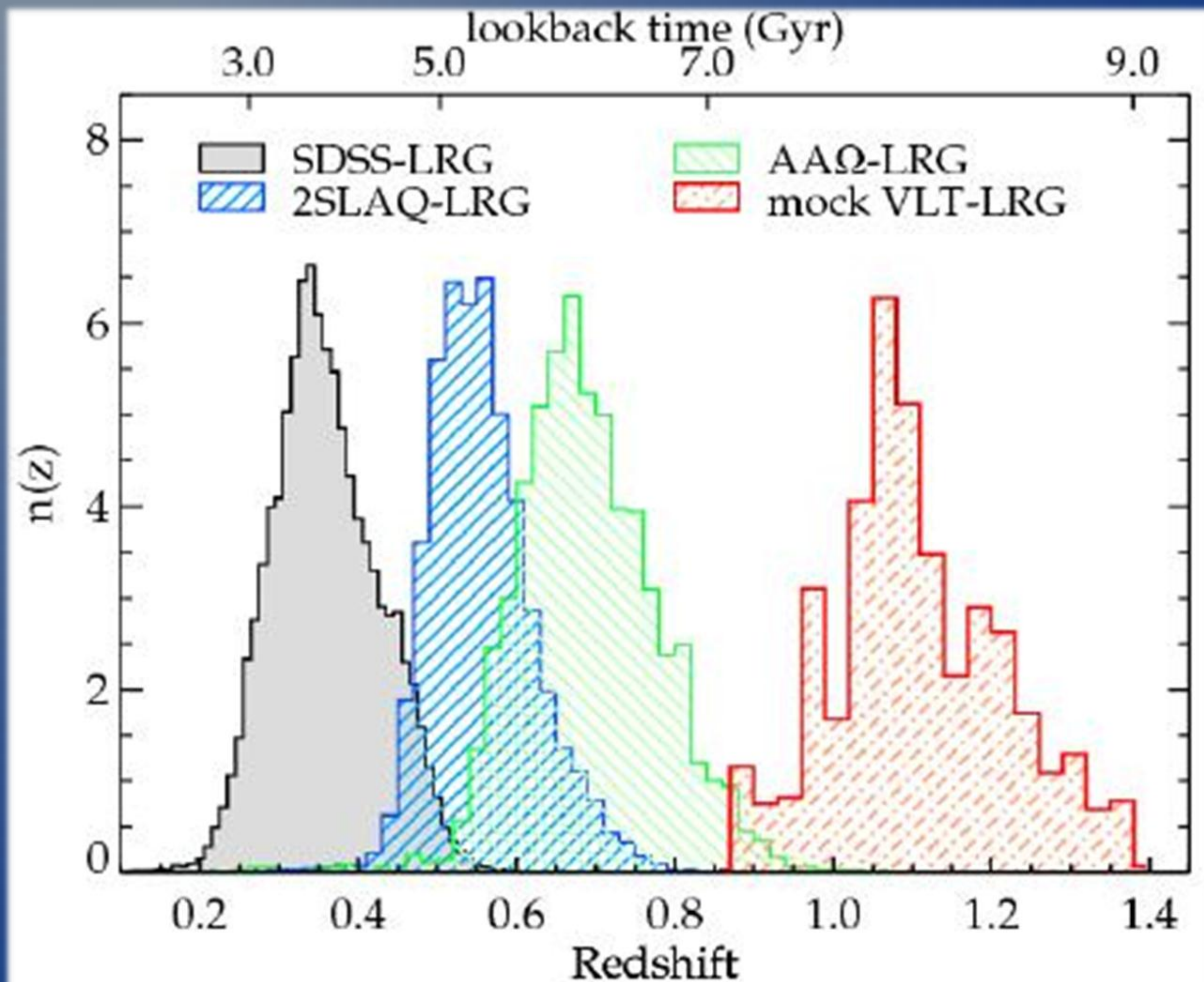

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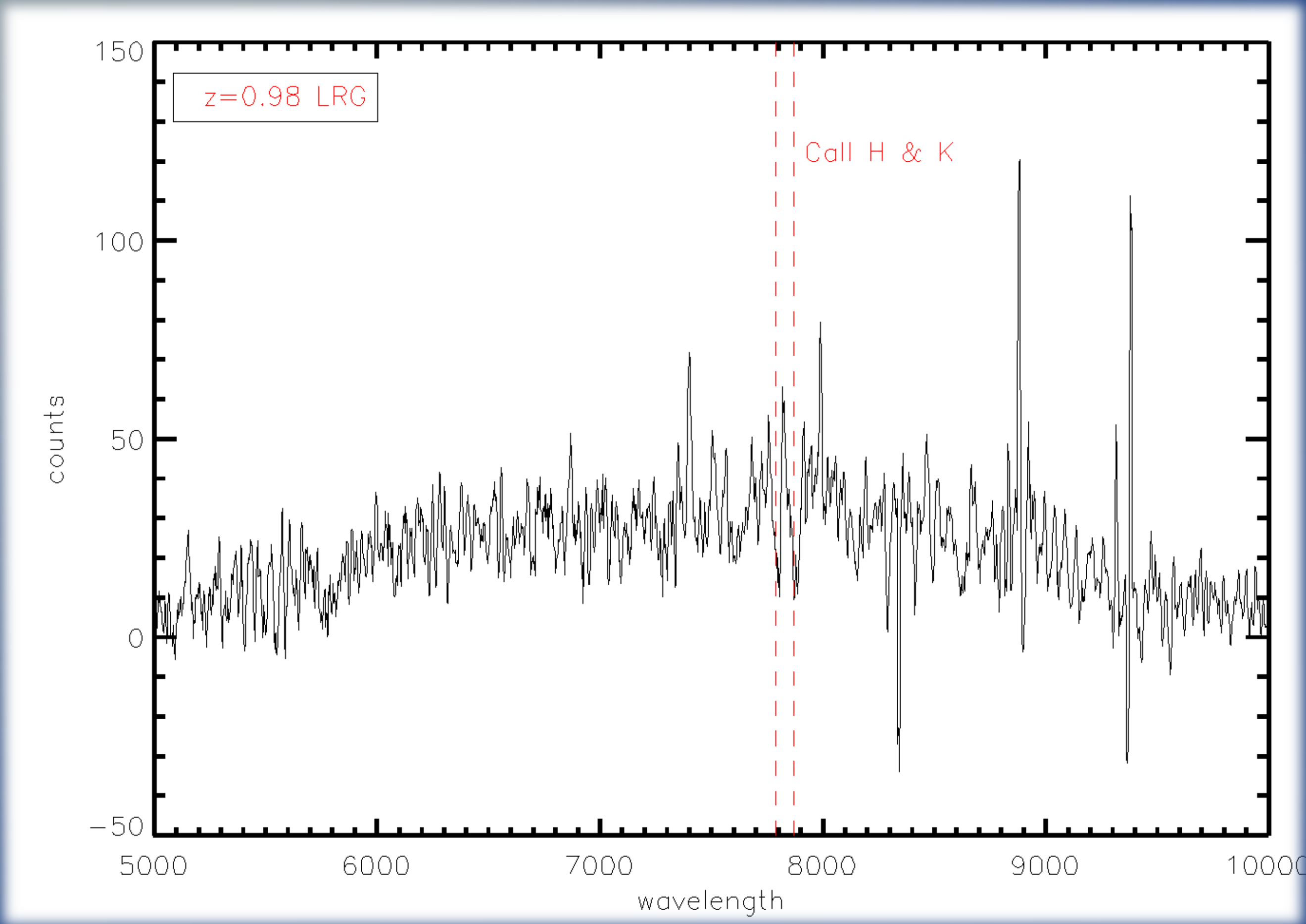
VLT LRG
600 LRGs in 1.8deg^2 of SDSS Stripe82



- Red arm CCD problem in VLT
- After completion, LRGs can be used as training sample for photo-z estimations

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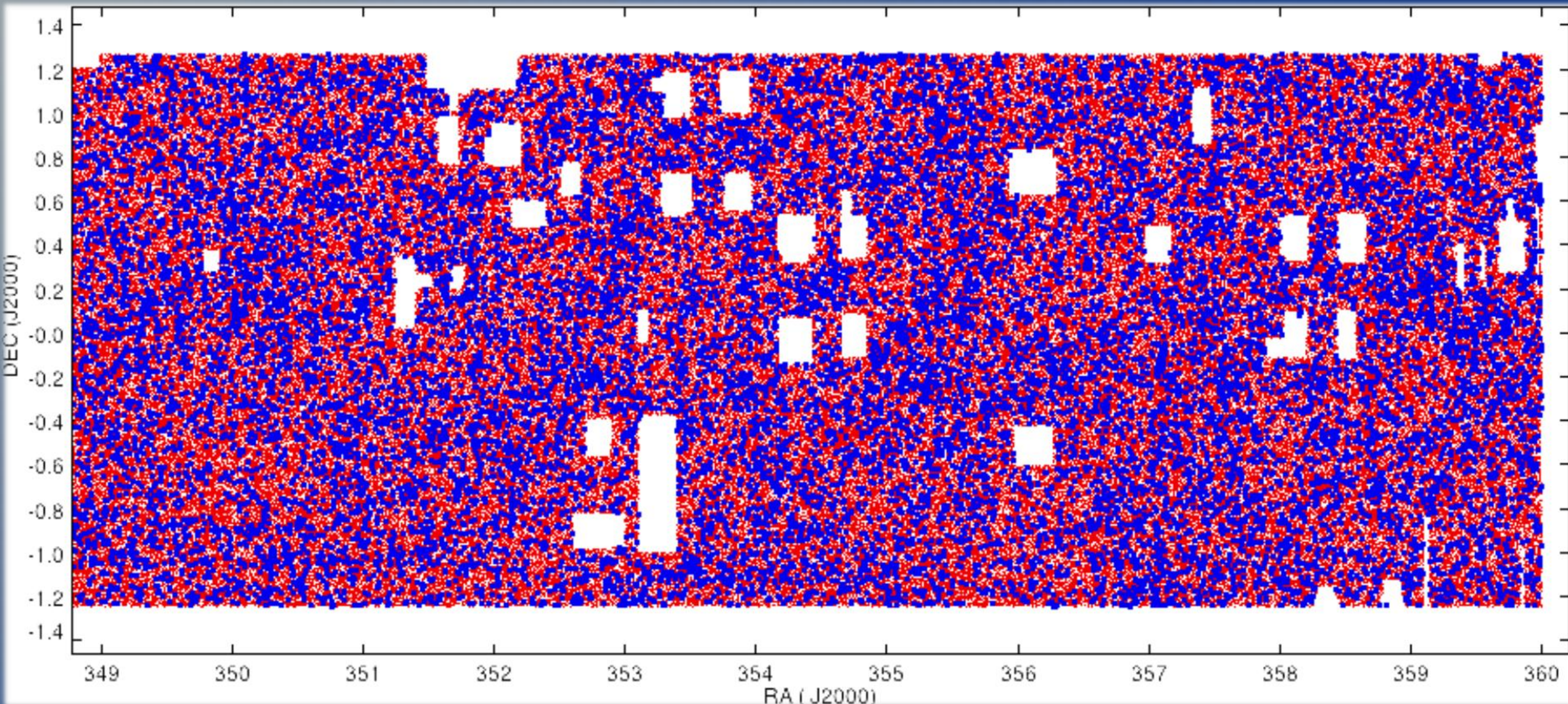
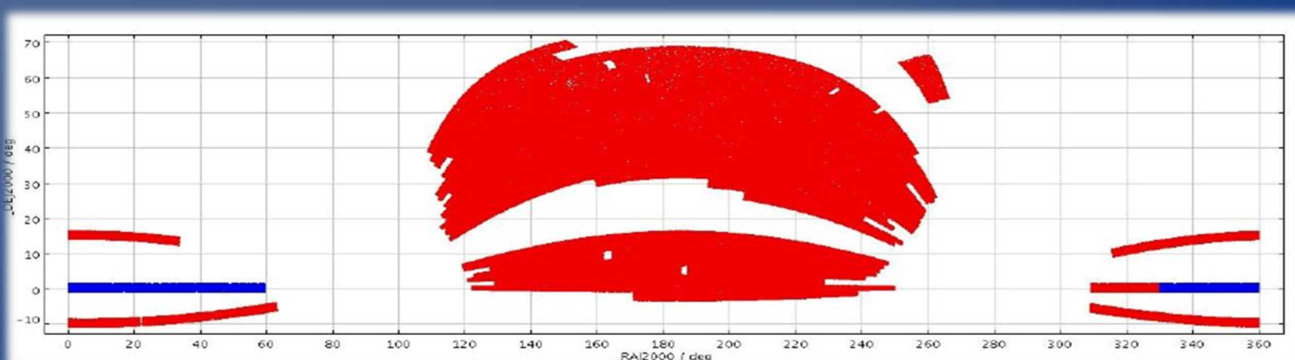
LRGs in Stripe 82





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Angular correlation function w(θ)

- The galaxy two-point correlation function, ξ(r), measures the excess probability of finding a pair of objects separated be distance *r* relative to that expected from a randomly distributed process.

- It's a powerful statistical tool for studying the Large-Scale Structure (LSS) of the Universe (Peebles 1980).

In an isotropic and homogeneous Universe, if the density fluctuations arises from a Gaussian random process, the 2PT and P(k) can completely describe these fluctuations

$$w_{LS}(\theta) = 1 + \left(\frac{N_{rd}}{N}\right)^2 \frac{DD(\theta)}{RR(\theta)} - 2\left(\frac{N_{rd}}{N}\right)\frac{DR(\theta)}{RR(\theta)}$$

$$w_{HM}(\theta) = \frac{DD(\theta)RR(\theta)}{DR(\theta)^2} - 1$$

$$w(\theta) = \frac{DD(\theta)}{DR(\theta)^2}\left(\frac{N_{rd}}{N}\right) - 1$$

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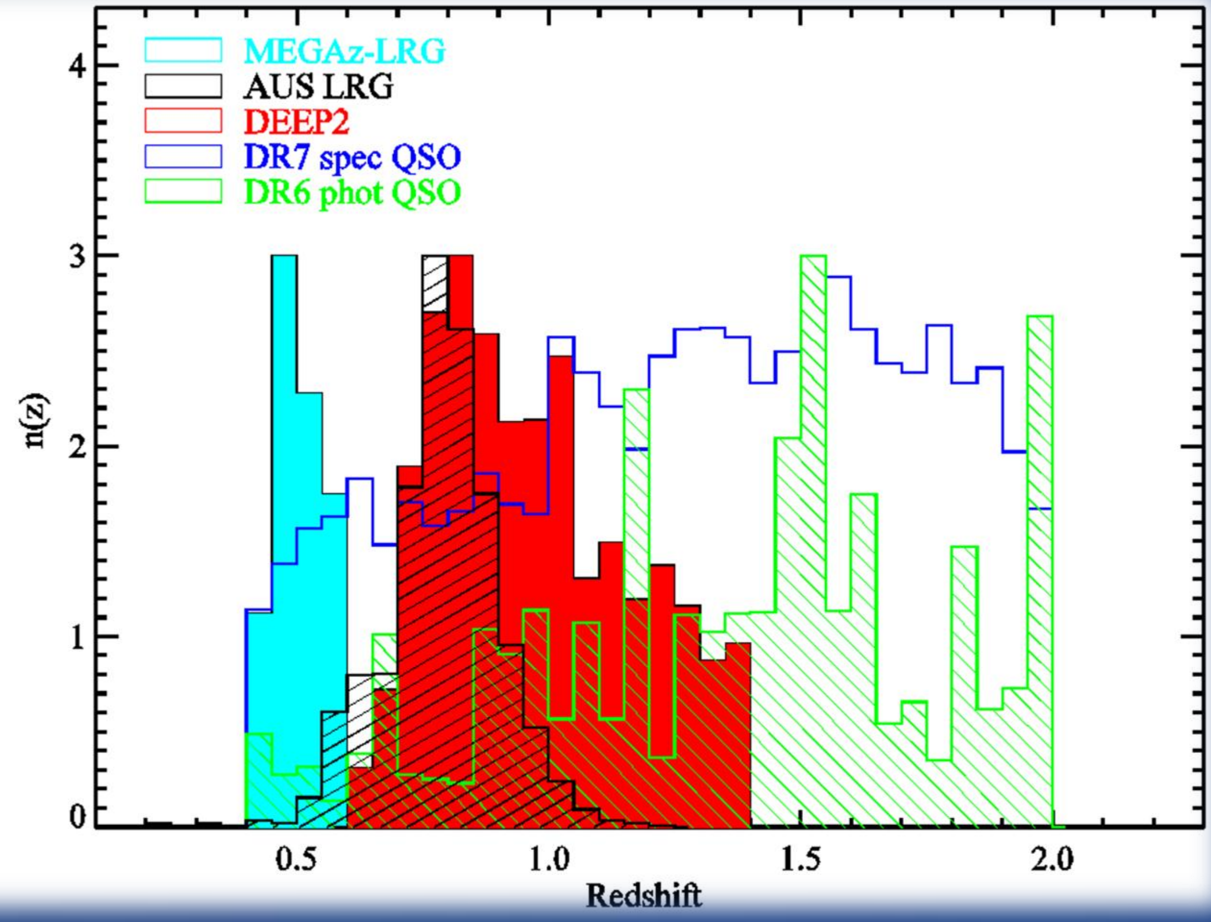
'Calibrating Redshfit Distributions Beyond Spectroscopic Limits With Cross-Correlations' Newman 2008

Cross-Correlations

➡ QSOs x LRGs

➡ GALs x LRGs



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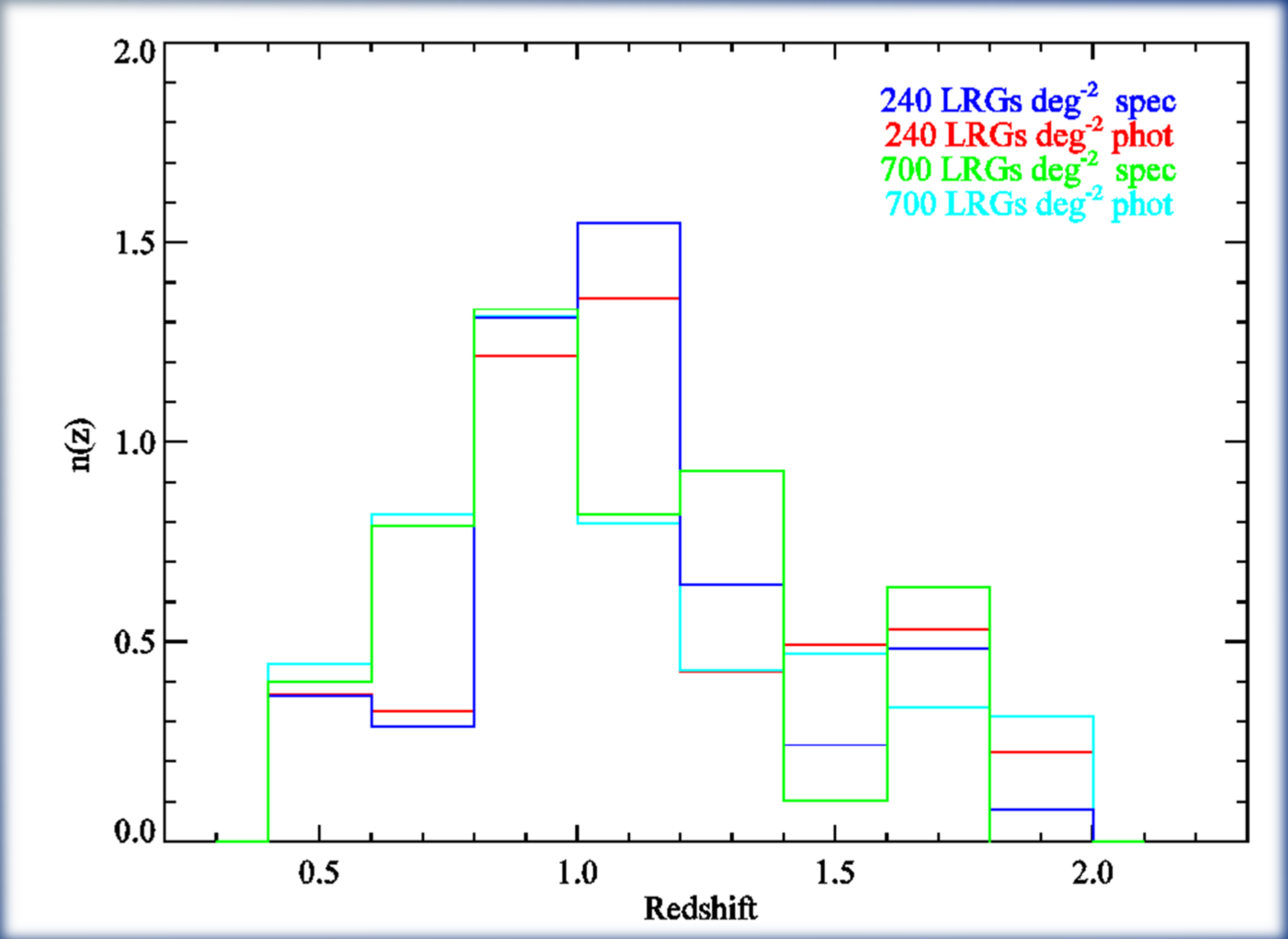
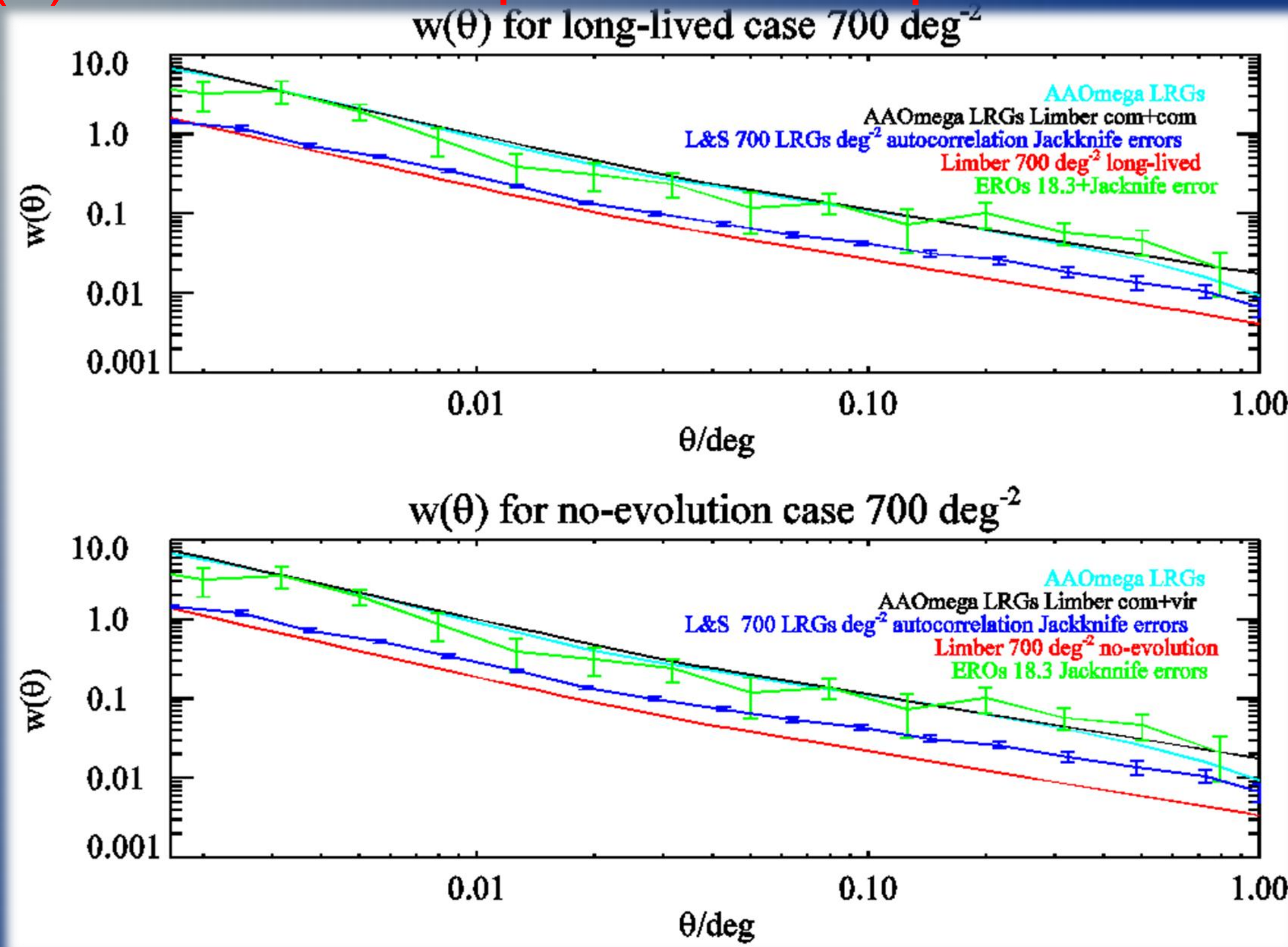
LRGs n(z) from x-correlations



w(θ) results & comparisons with previous studies



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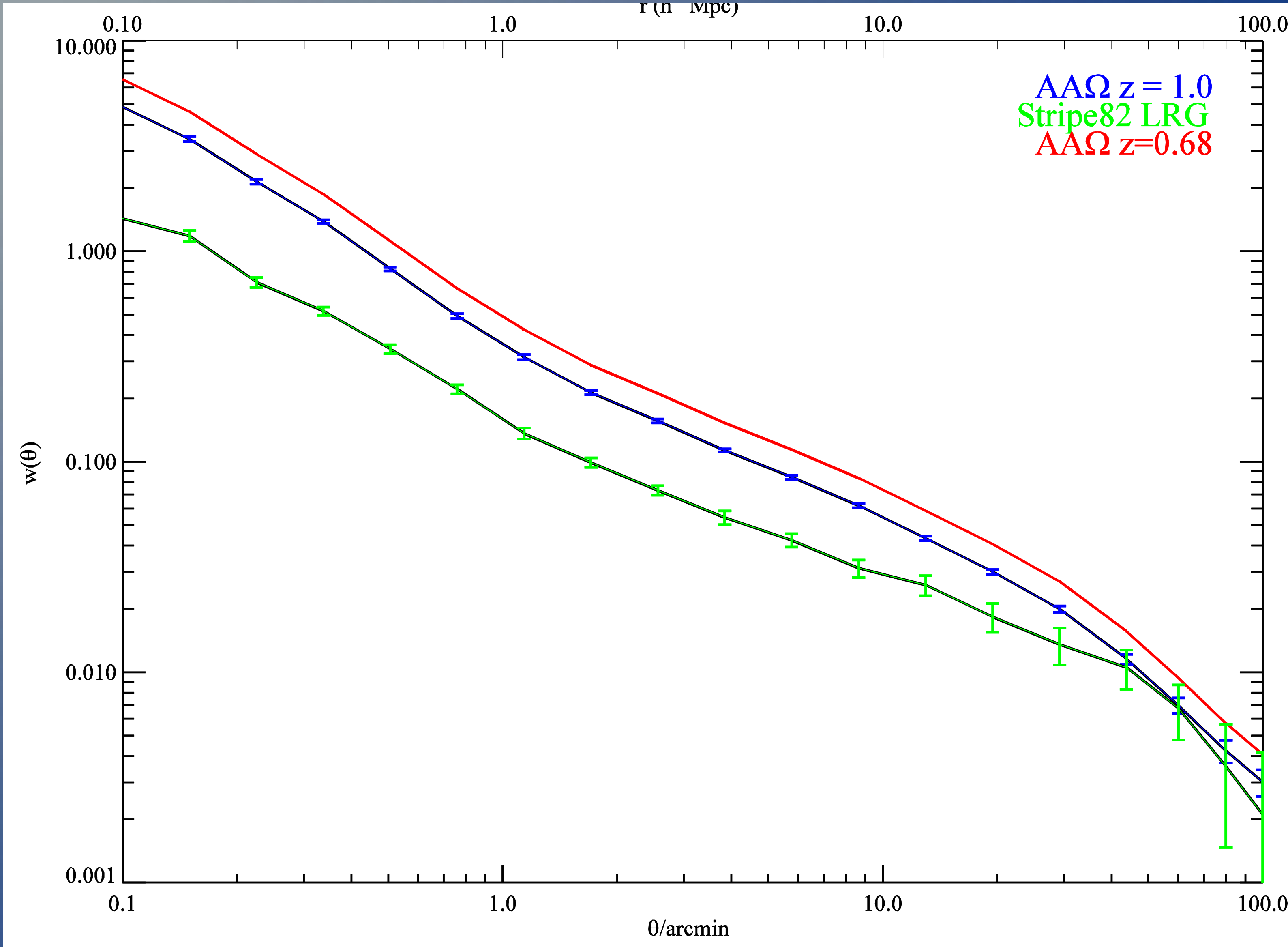

Angular correlation function comparison of scaled AAΩ LRGs at redshift z~1 with our Stripe82 LRGs.

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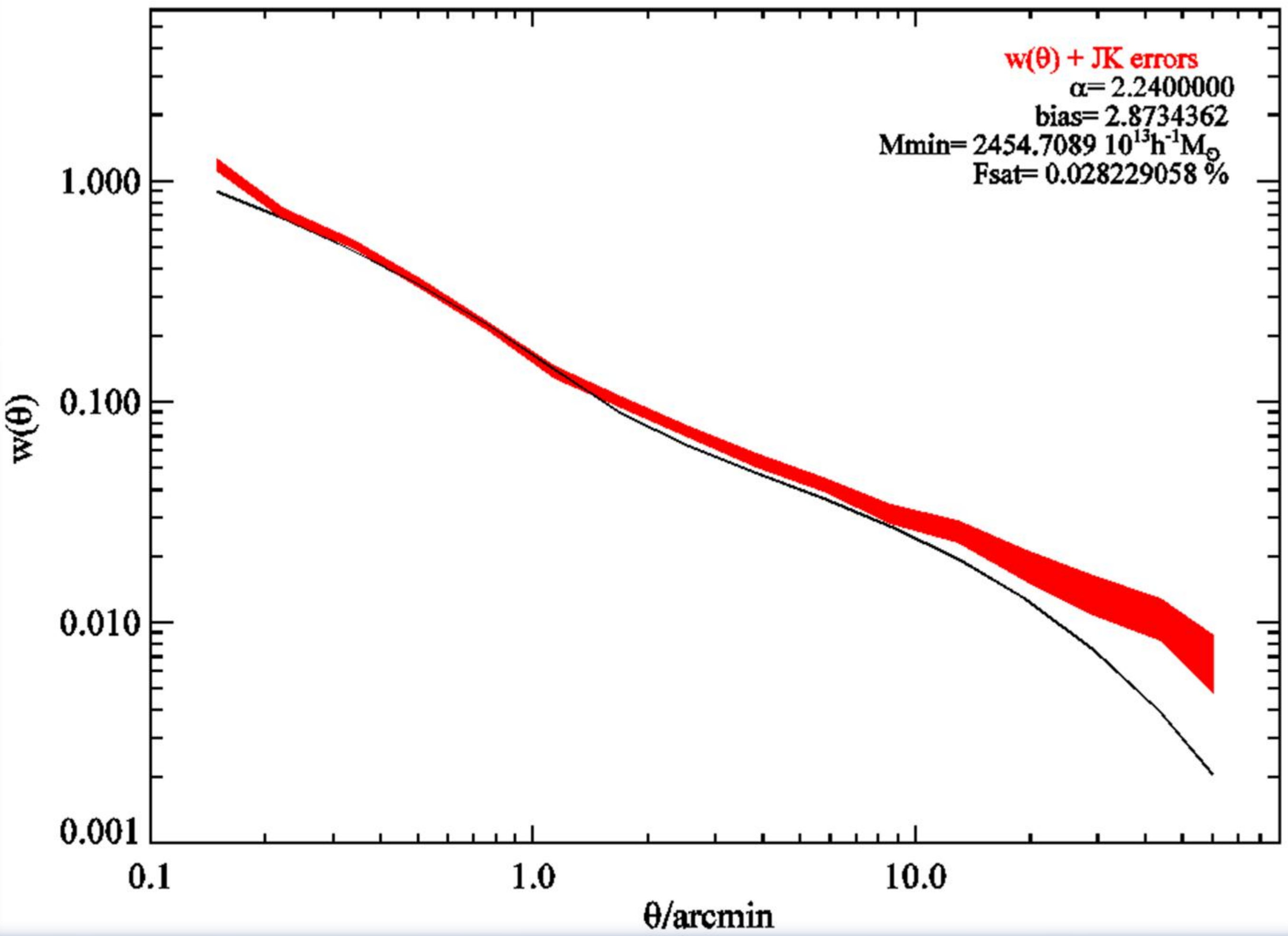
Halo Model & Halo Occupation Distribution (HOD)



- HOD : how galaxies populate dark matter haloes as a function of halo mass.

We use a three-parameter HOD model (Seo et al. 2008), which distinguishes between the central and satellite galaxies in a halo (Kratsov et al. 2004)

LRGs at z~1 are highly biased objects, b~ 2.8, in our case.

LRGs are hosted in most massive haloes, as our best χ^2/def results indicate.

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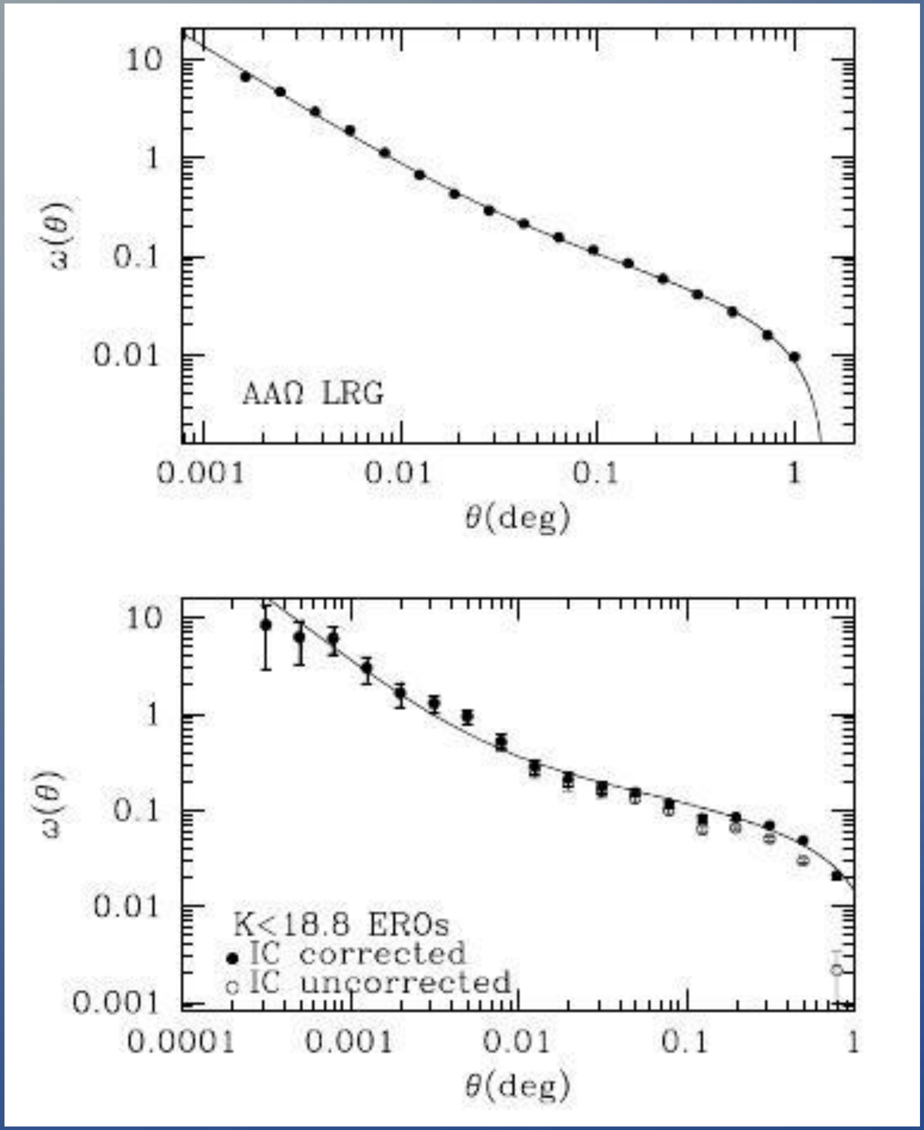
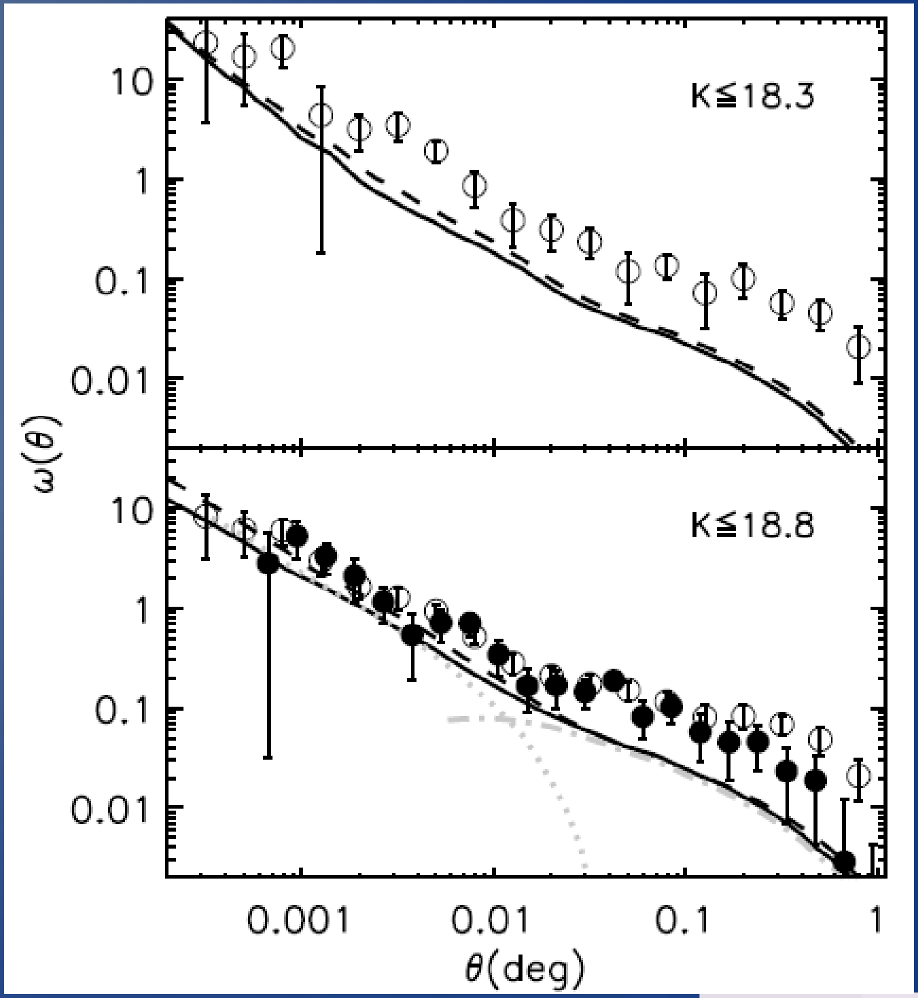
Clustering studies with similar behaviors

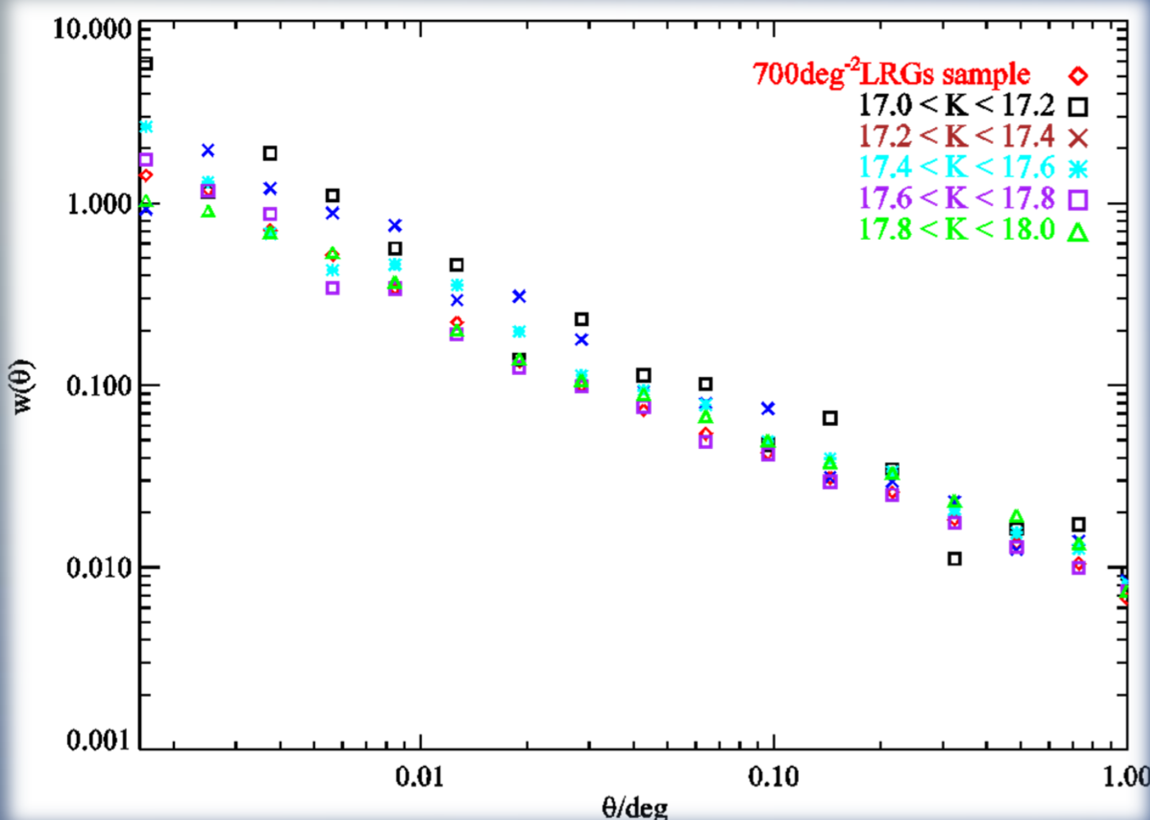


Kim et al. 2011 used *i*-K>4.5 EROs at 1<z<2.



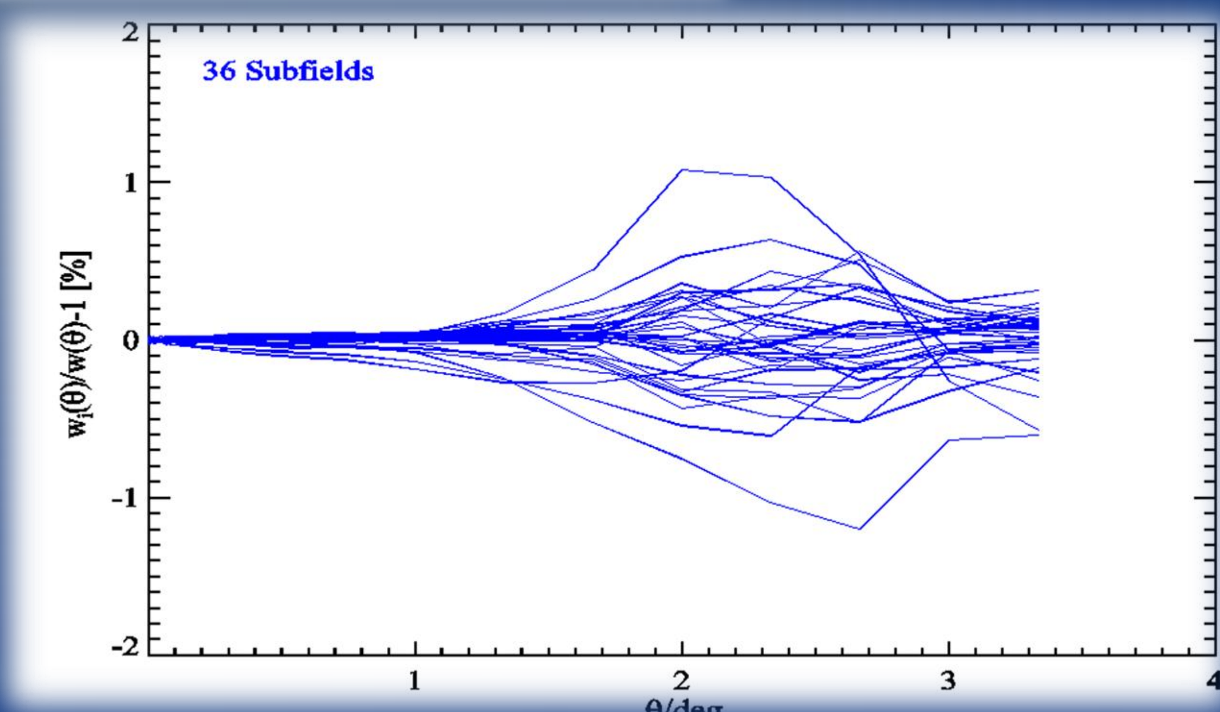
Gonzalez et al. 2011

Test of systematics



K-magnitude bins

Jack-knife resampling fluctuations



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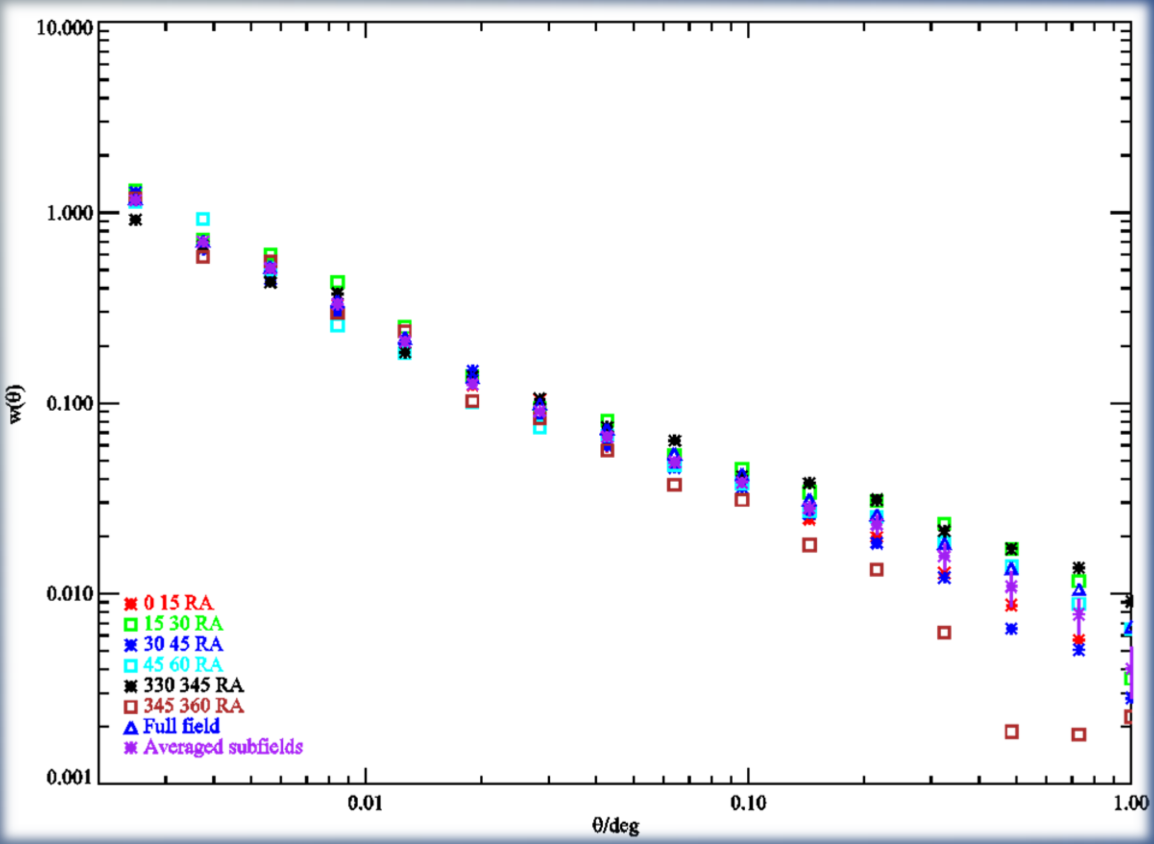
Test of systematics



LS estimator for 6 subfields

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Summary-Conclusions

- izK color selected LRGs from optical & NIR data
- Cross-correlations with AUS LRGS, DEEP2 , MEGAz-LRGs, QSOs at $0.4 \leq z \leq 2.0$
- LRGs at $z \sim 1$
- Angular correlation function measurements of high-redshift LRGs when compared with models show a flatter slope on large scales
- None known artefact in our data, as showed from systematics tests

Something new in our Cosmos again???

THANK YOU!

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Conclusions

- Succesfully *izK* LRGs in Stripe82 at z~1 selection
- Angular correlation function of the LRGs, flatter slope at large scales
- LRGs x-correlations with QSOs, GALs at $0.4 \leq z \leq 2.0$
- Test of systematics
- Mass estimations
- HOD showed that our LRGs have high bias,

are hosted in massive haloes and their clustering at large scales impplies the presence of non-Gaussianity...

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Evolution of LRG clustering

- The form of the small-scale LRG correlation function provides important constraints on the merger rate of LRGs and how this evolves with redshift.
- Masjedi (2006) used the SDSS LRG correlation function to determine an LRG-LRG merger rate of $<0.6 \times 10^{4} Gyr^{-1} Gpc^{-3}$
- Bell (2006) find ~0.3 of all $M > 2.5 \times 10^{10} M_{sun}$ have undergone a major merger to z=1 using the COMBO-17 correlation function

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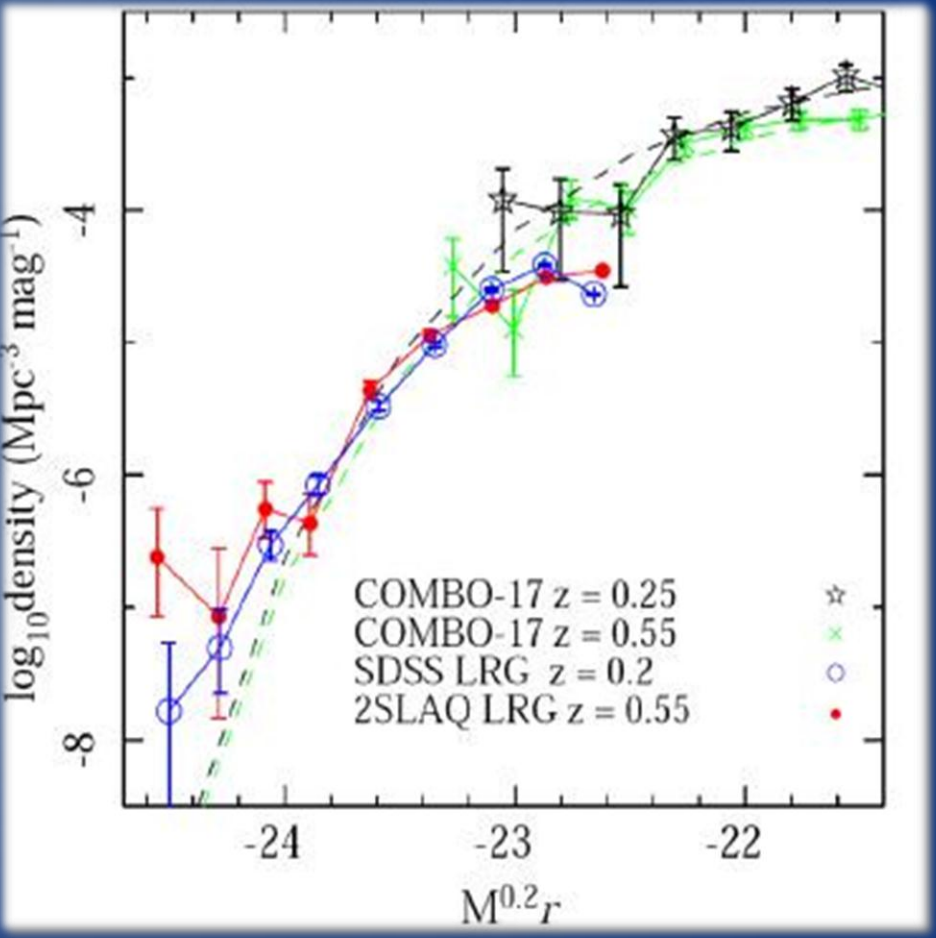
Evolution of LF

- Semi-analytic models (De Lucia 2006) tell us that the most massive galaxies should double their masses between z~1 and z~0.
- Observation of the LRGs LF shows only passive evolution at all observed redshifts.



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Luminosity Function

- It provides a way of testing theories of structure formation and evolution, which, if successful, should correctly predict the observed luminosity function.
- It may be integrated to provide an estimate of the luminosity density of the Universe, thus providing constraints on the star formation history.
- It is needed in order to calculate the correlation function for a flux-limited sample of sources, via the selection function.

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