

# Acoustic Oscillations

*in simulated galaxy surveys*

*the BASICC*

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- **astro-ph/0702543, MNRAS in press**

Using numerical simulations of structure formation plus semi-analytical models of galaxy formation we have investigated how reliable the measurements of the acoustic oscillations are. We have also made forecasts for future galaxy surveys

Edinburgh, 26<sup>th</sup> October 2007

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## Introduction

- Nature of Dark Energy:
  - Standard candles. e.g. Supernovae Type Ia
  - Multiplicity function of clusters
  - Weak lensing
  - **Baryonic Acoustic Oscillations**

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## Introduction

- Measurements of BAO are aimed with even less than 1% of error
    - SPACE, WFMOS, Pan-STARRS, PAU-BAO, SDSS-II, WiggleZ, DES, FastSound, BOSS, ADEPT, DUNE
- Accurate observations demand an accurate modelling of the experiment**

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## Modelling the BAO experiment

- Model the Universe
- Extract the signal in a realistic way
- Model the details of the observations

# BASICC

*baryon acoustic simulation at the ICC*

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## Modelling the Universe in a Supercomputer

- N-Body Simulations:

**Basicc, L-Basicc**

1 Cube of 1340 Mpc/h

3 billion particles

Halos of  $5e11$  Mo/h at  $z=0$

50 low resolution cubes

1000 x Millennium Volume

- GALFORM

Magnitudes, colours,  
emission lines strength

1,200,000 galaxies at  $z=1$

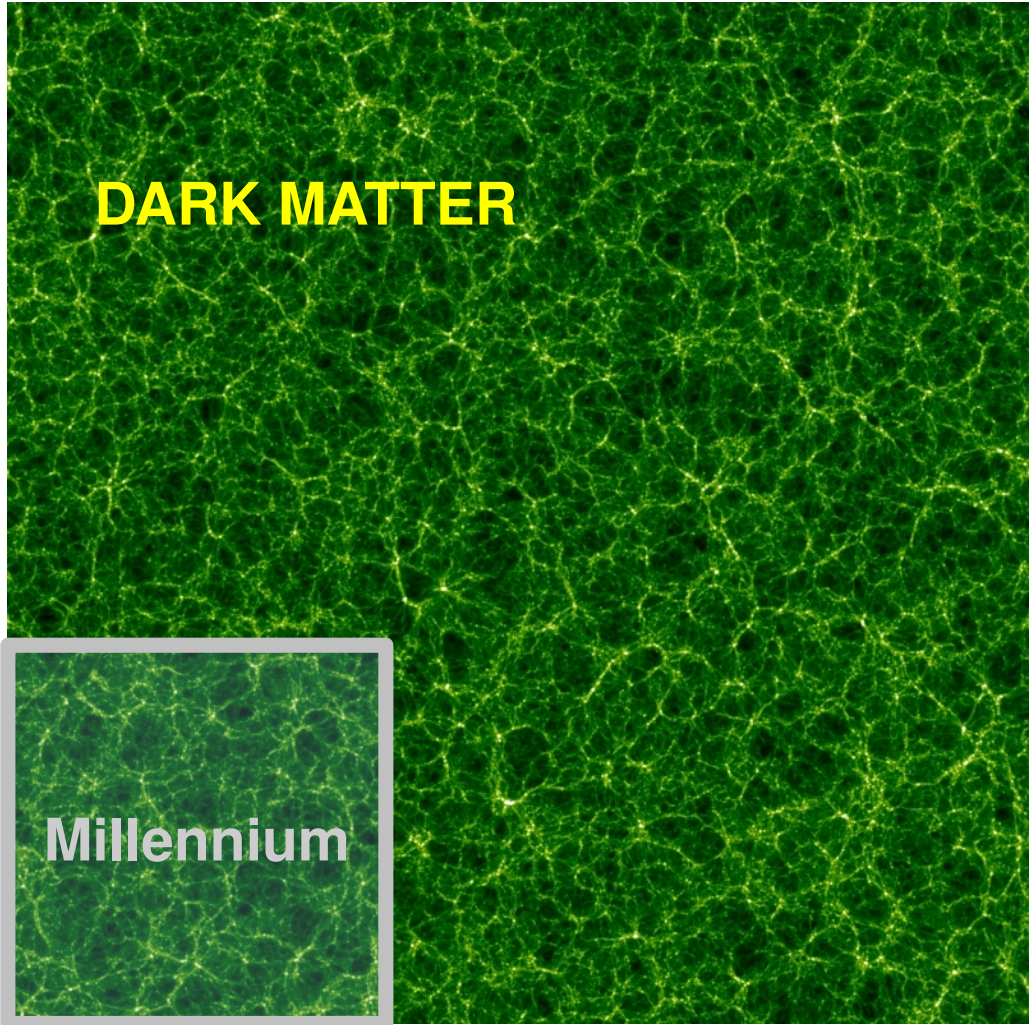
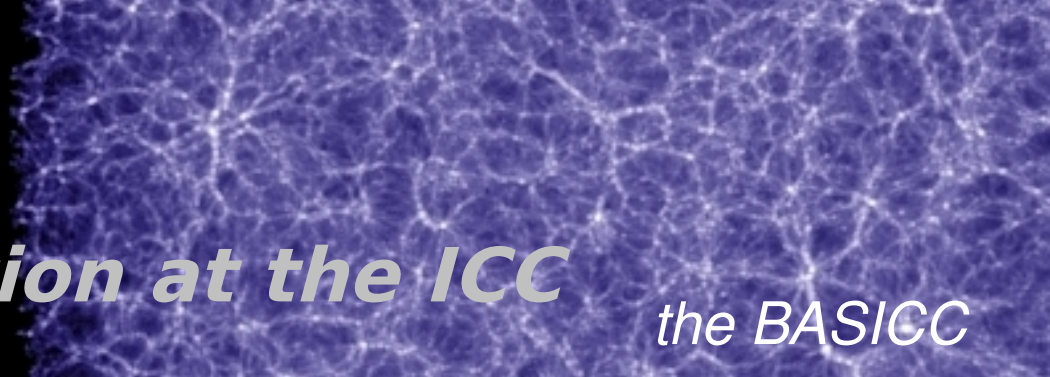
brighter than  $R_{ab} = -22.5$



# BASICC

*baryon acoustic simulation at the ICC*

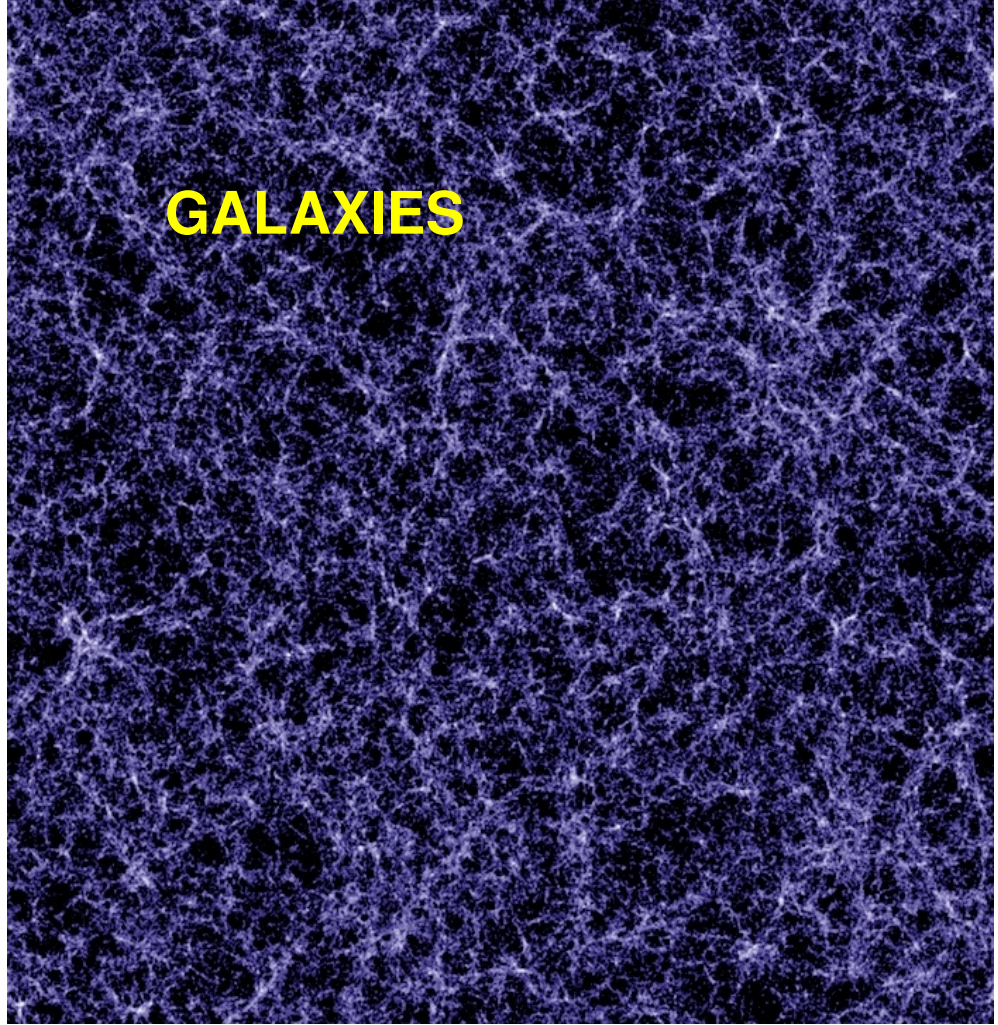
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**DARK MATTER**



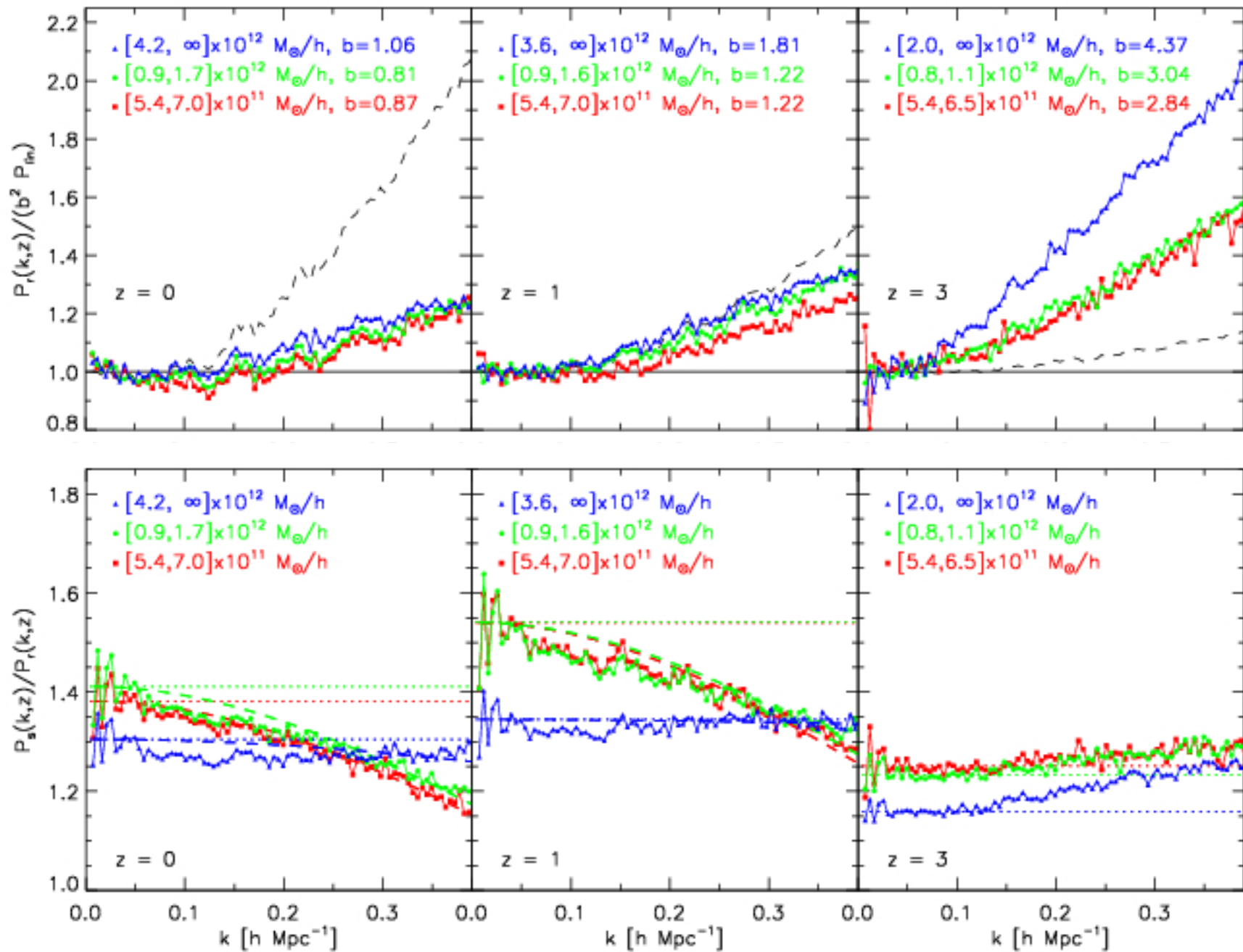
**Millennium**



**GALAXIES**



# Halo clustering in the BASICC



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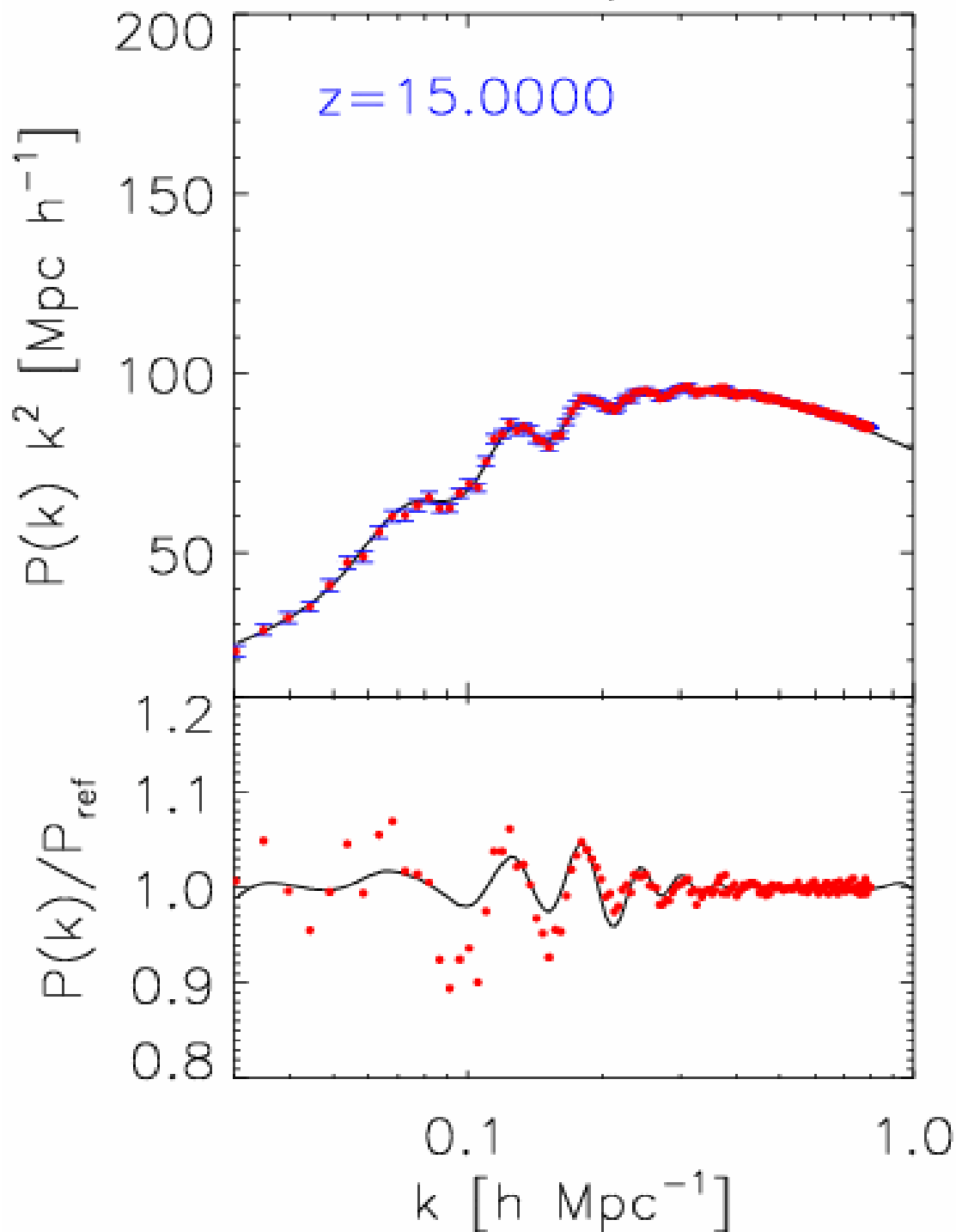
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## Modelling the BAO experiment

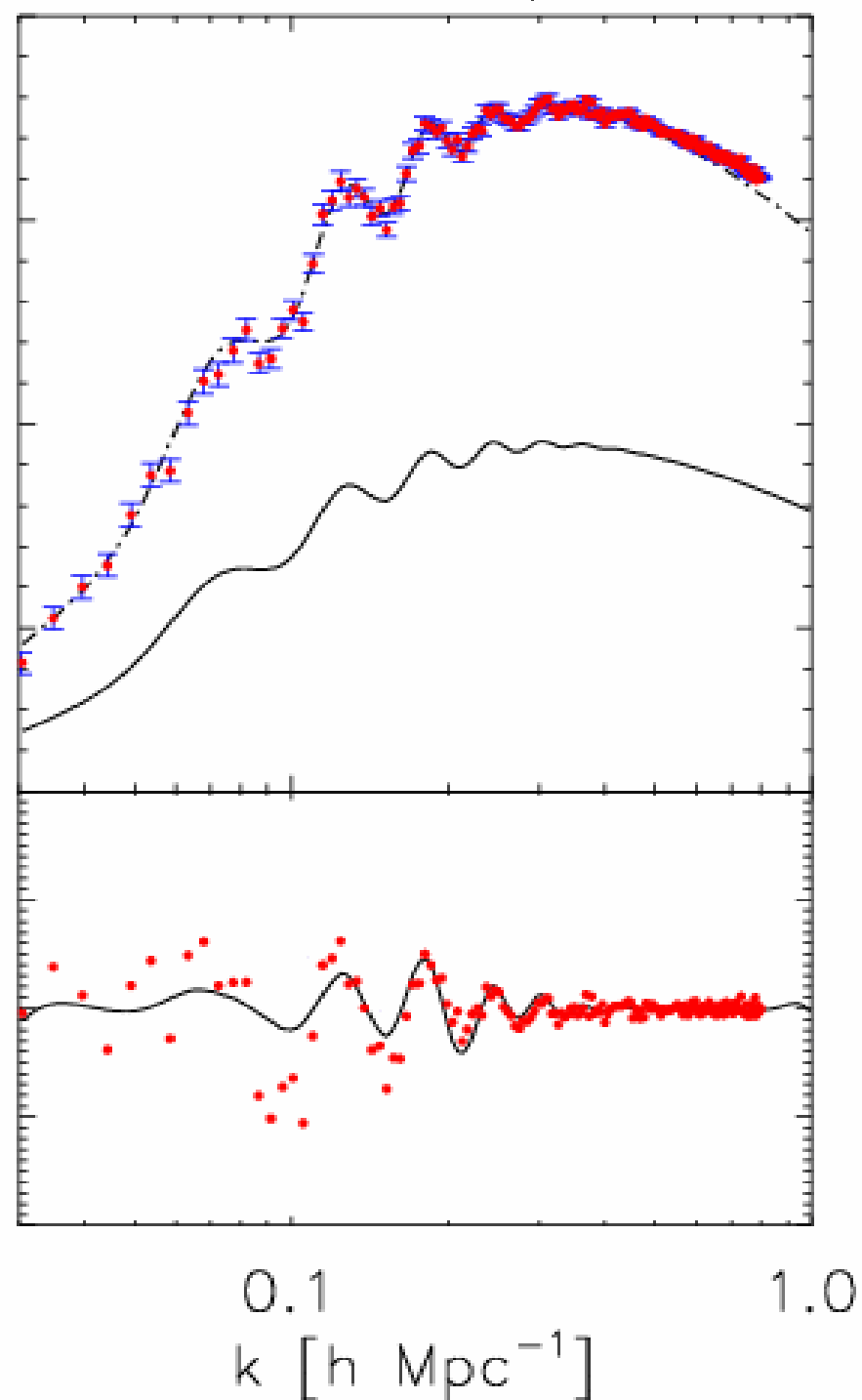
- Model the Universe
- Extract the signal in a realistic way
- Model the details of the observations



Real Space



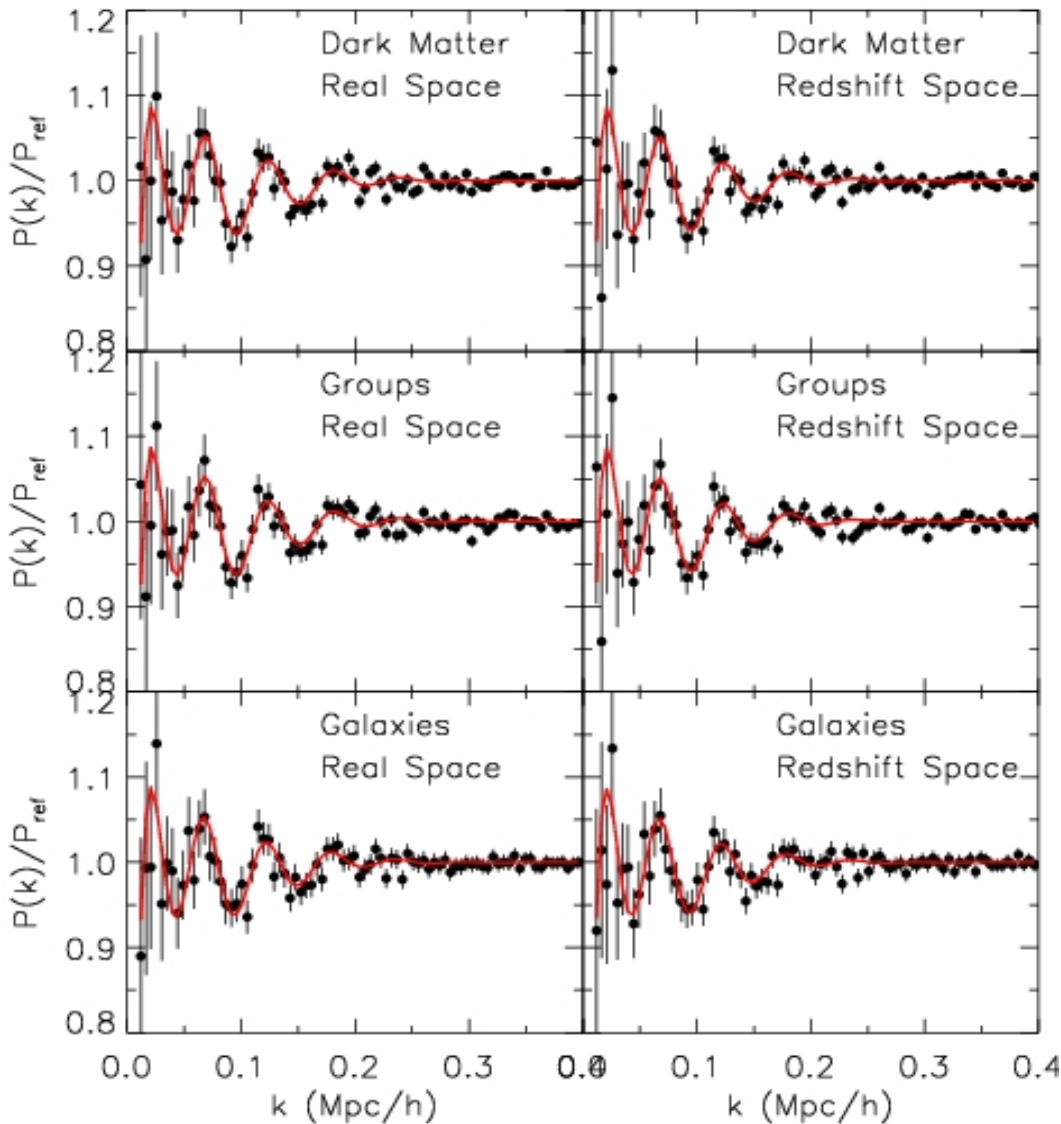
Redshift Space



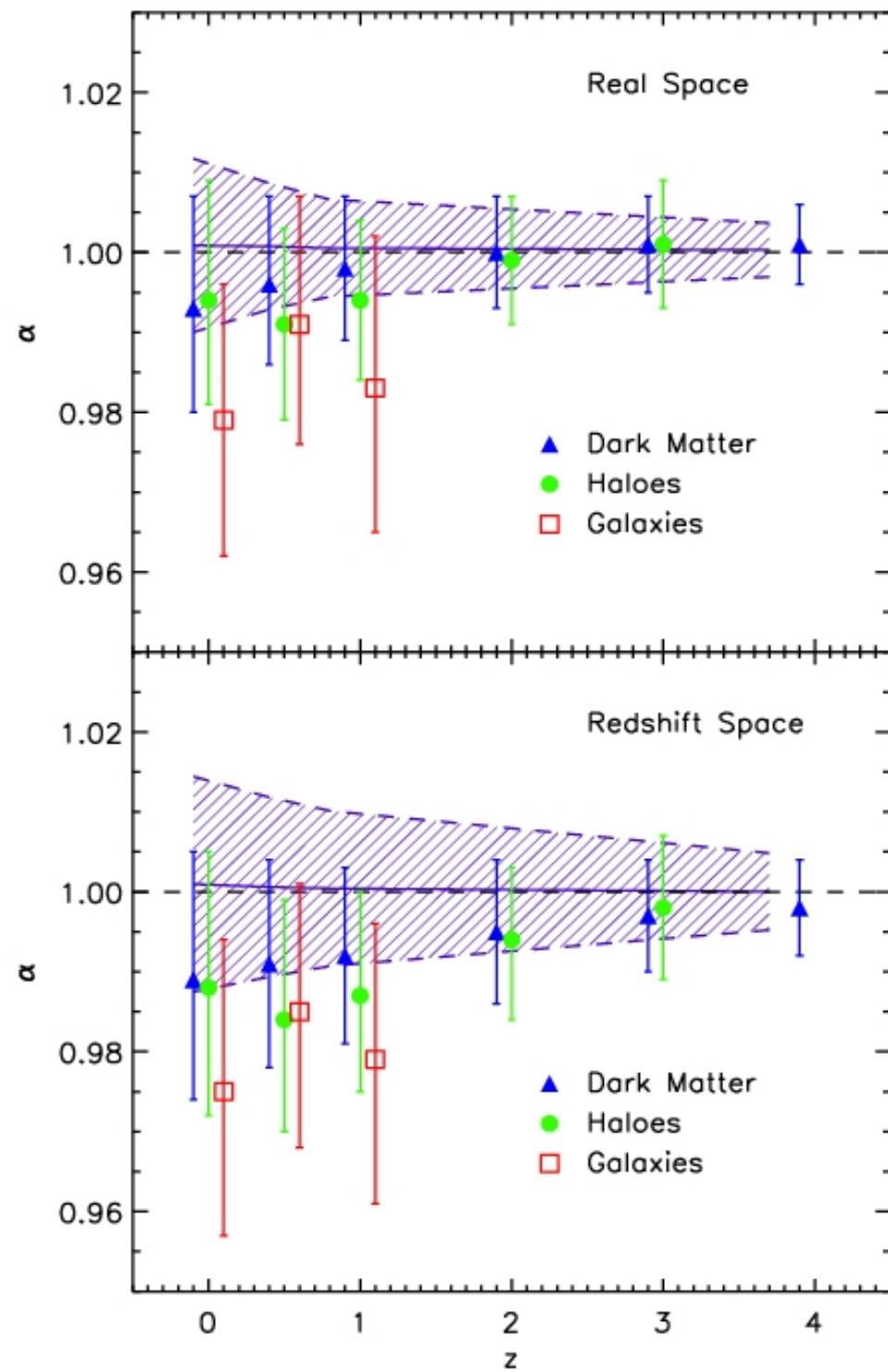
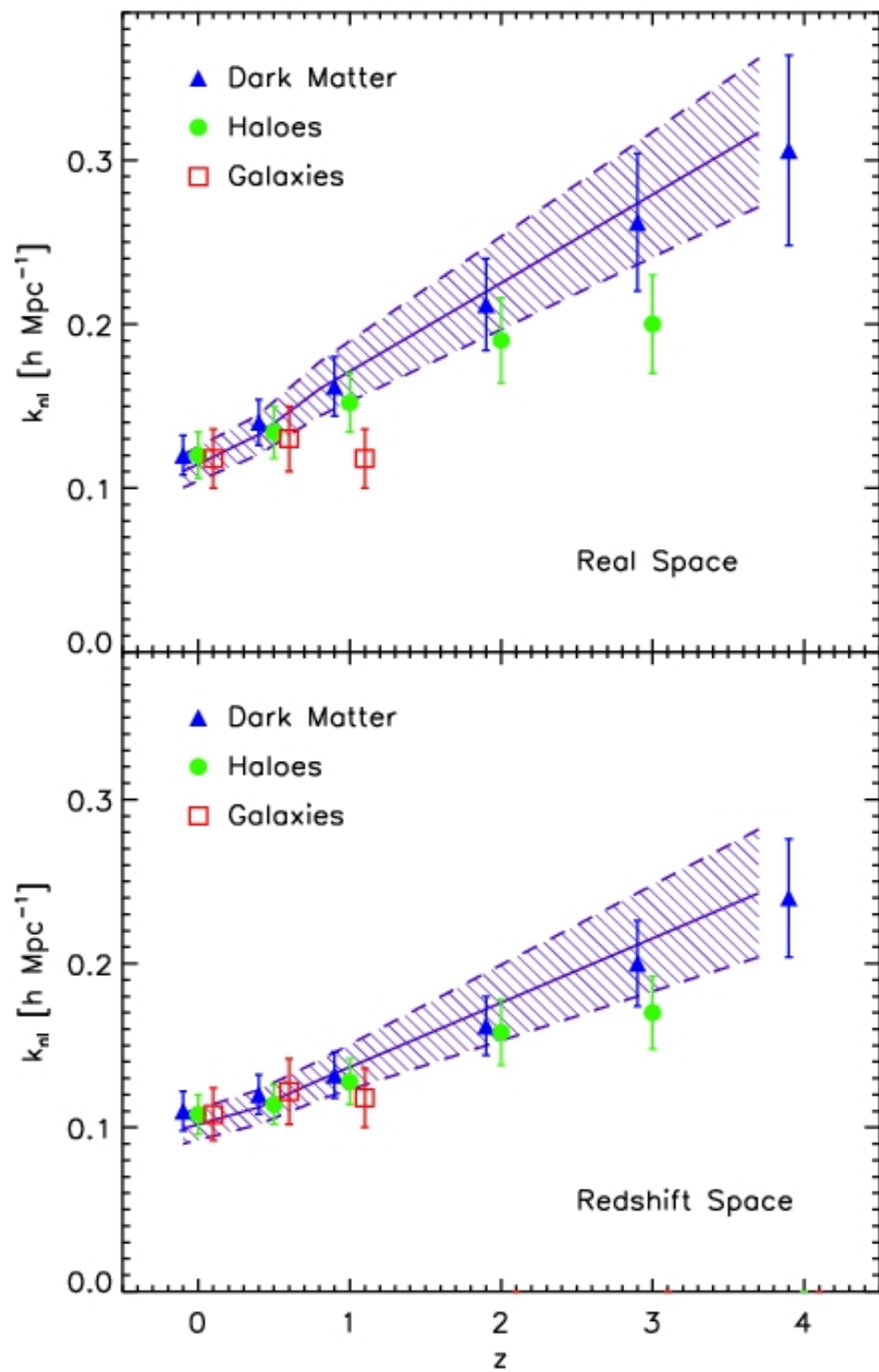
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- Fitting  $P(k)$  divided by a cubic spline
- Linear theory + nonlinear damping ( $k_{nl}$ ) + stretch factor ( $\alpha$ )



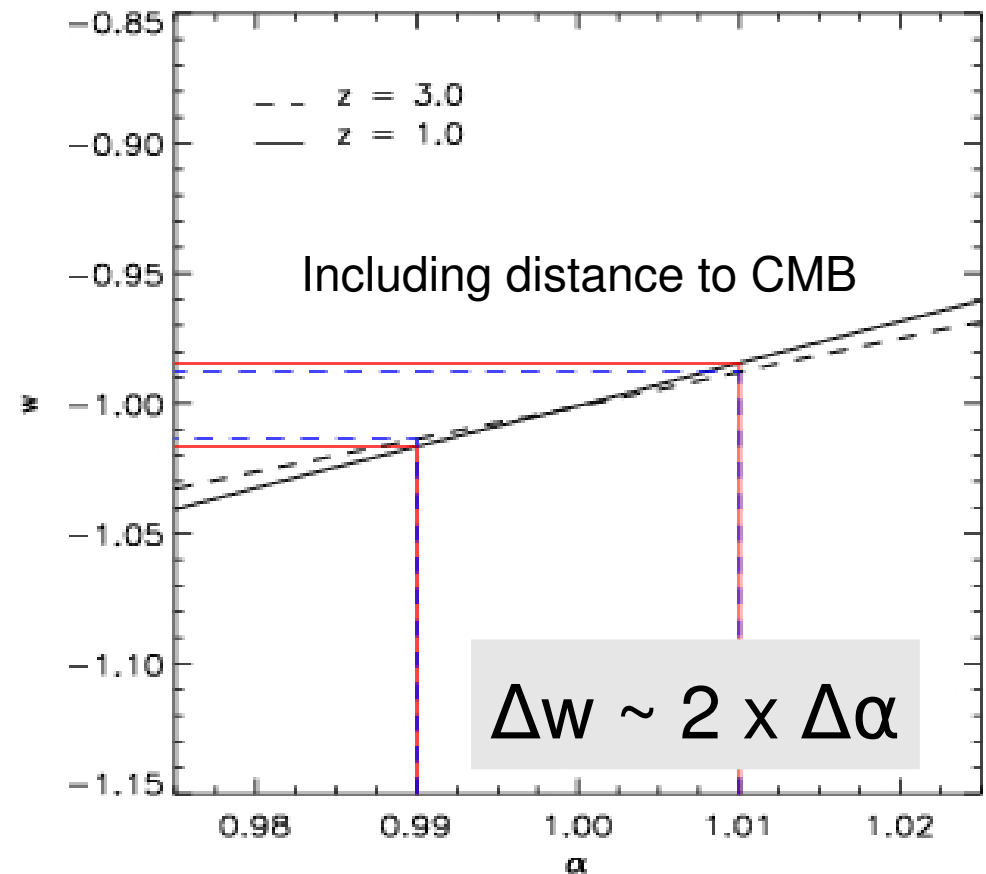
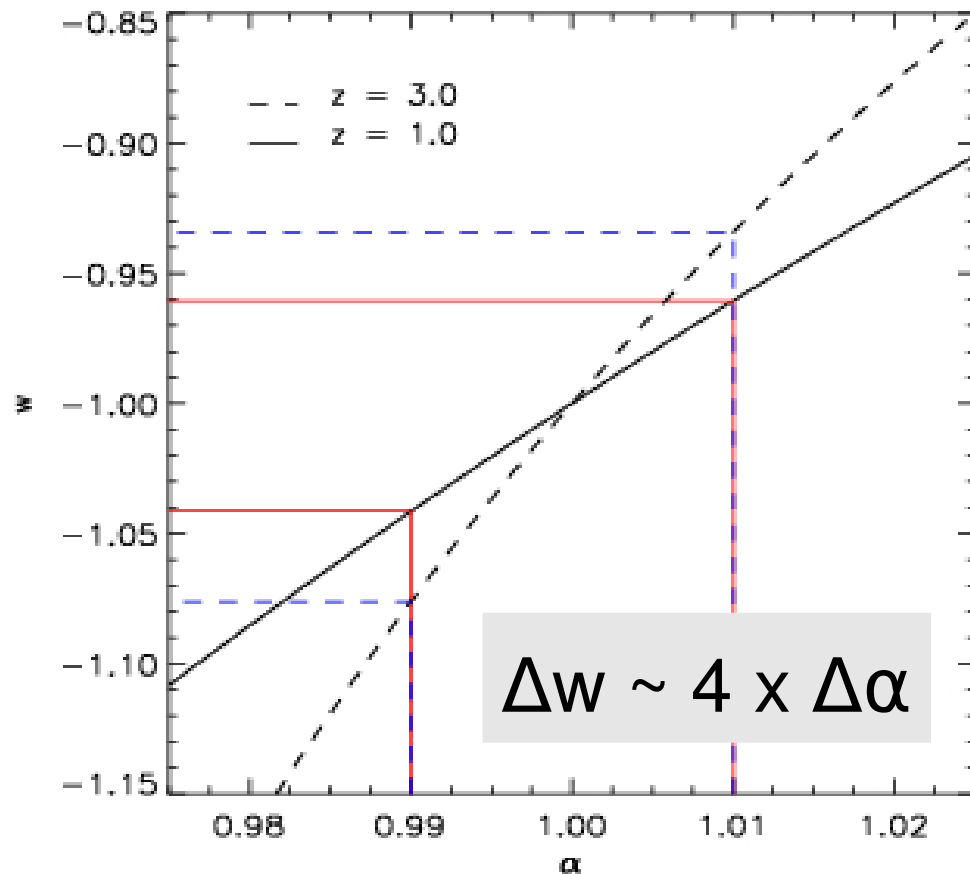


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## Relation $w$ – stretch factor



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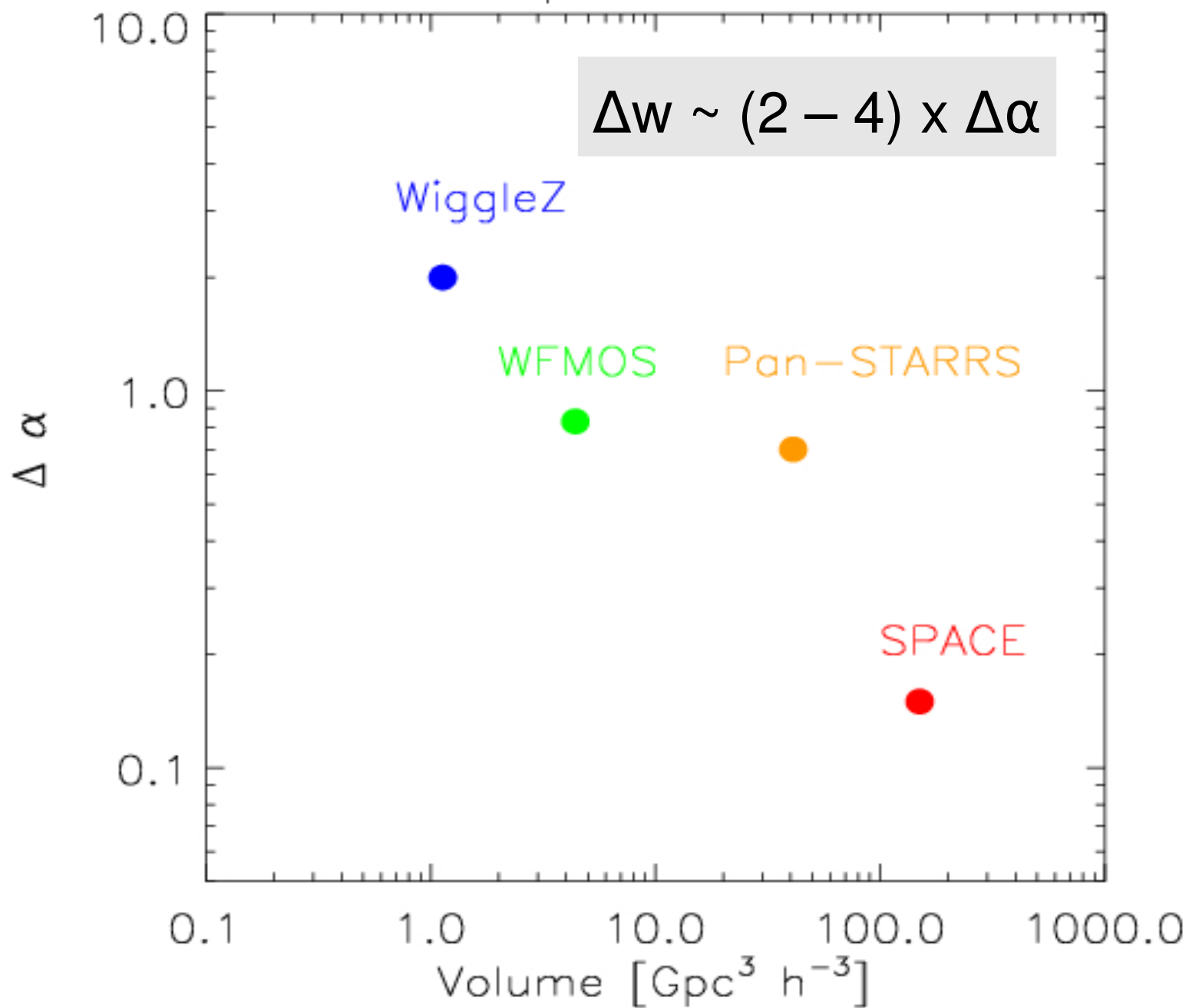
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## Modelling the BAO experiment

- Model the Universe
- Extract the signal in a realistic way
- Model the galaxy selection
  - We select galaxies by magnitude, colors, lines strength, matching the number density of different proposed galaxy surveys

# BAO performance





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## Enhancements

- Evolution of the clustering along the line of sight
- Window functions
- Full covariance matrix
- Bigger volumes

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## Conclusions

- BAO should be an unbiased estimator of  $w$
- Cosmic variance can be a problem
- We have performed the most accurate modelling of the BAO experiment to date
  - WiggleZ: 8%, WFMOS: 4%,
  - PanSTARRS: 3%, SPACE: 0.6 %
- Accurate observations require accurate