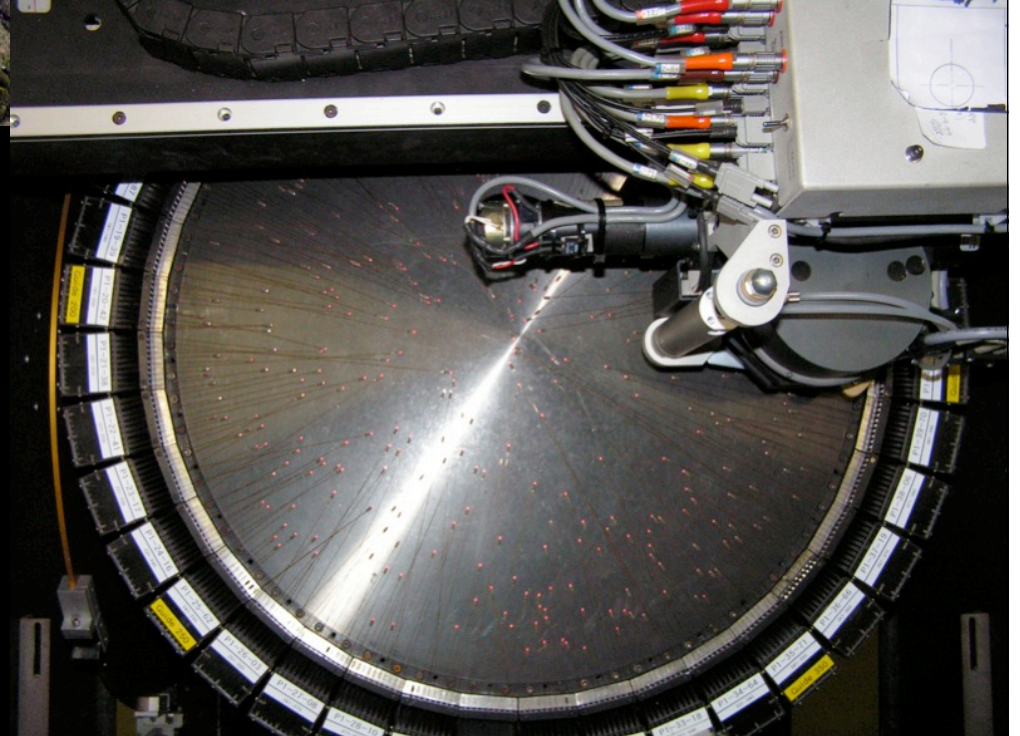
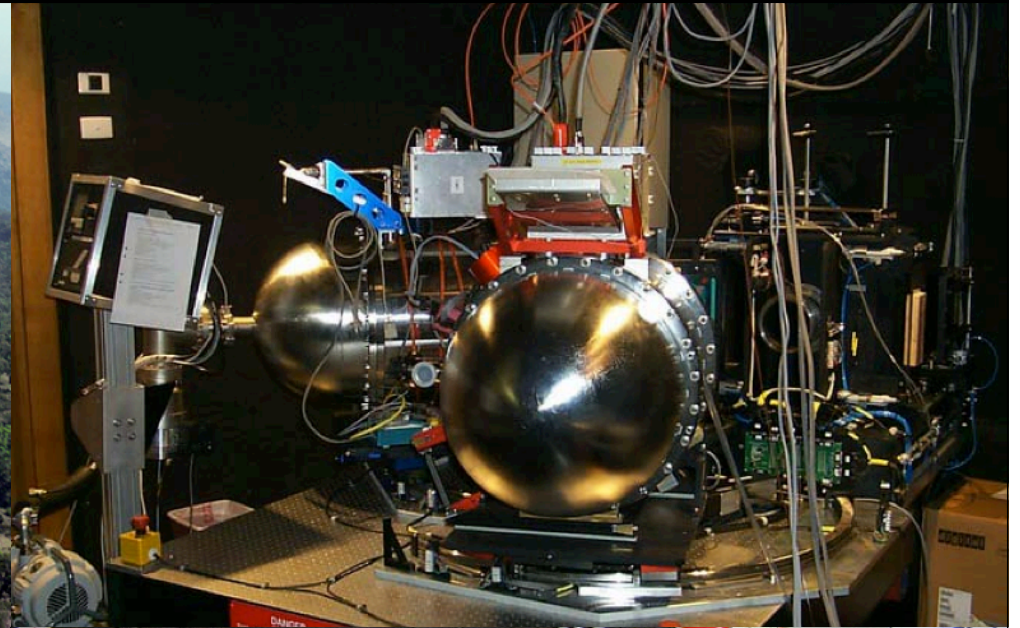




Baryon acoustic peak reconstruction in WiggleZ

Chris Blake (Swinburne)

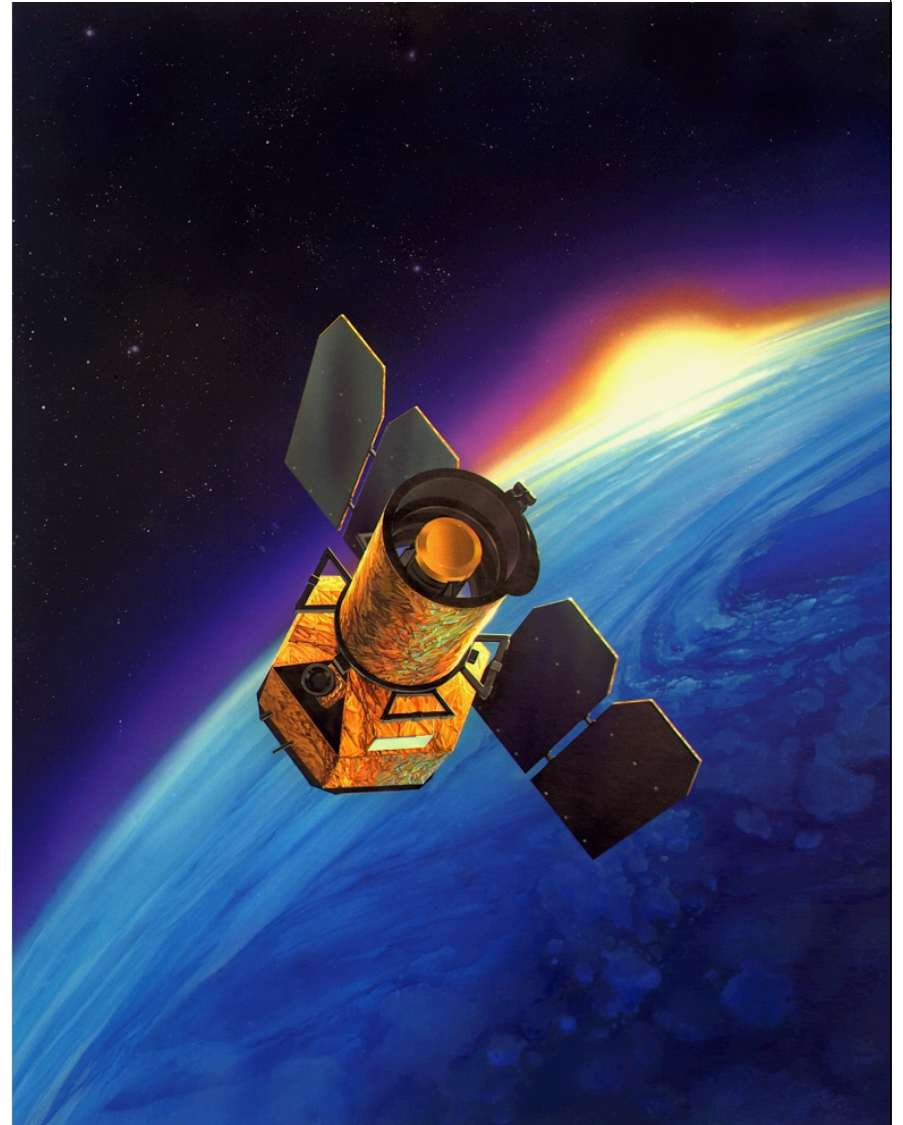
The WiggleZ Dark Energy Survey



- 1000 sq deg , $0.2 < z < 1.0$
- 200,000 redshifts
- blue star-forming galaxies
- Aug 2006 - Jan 2011

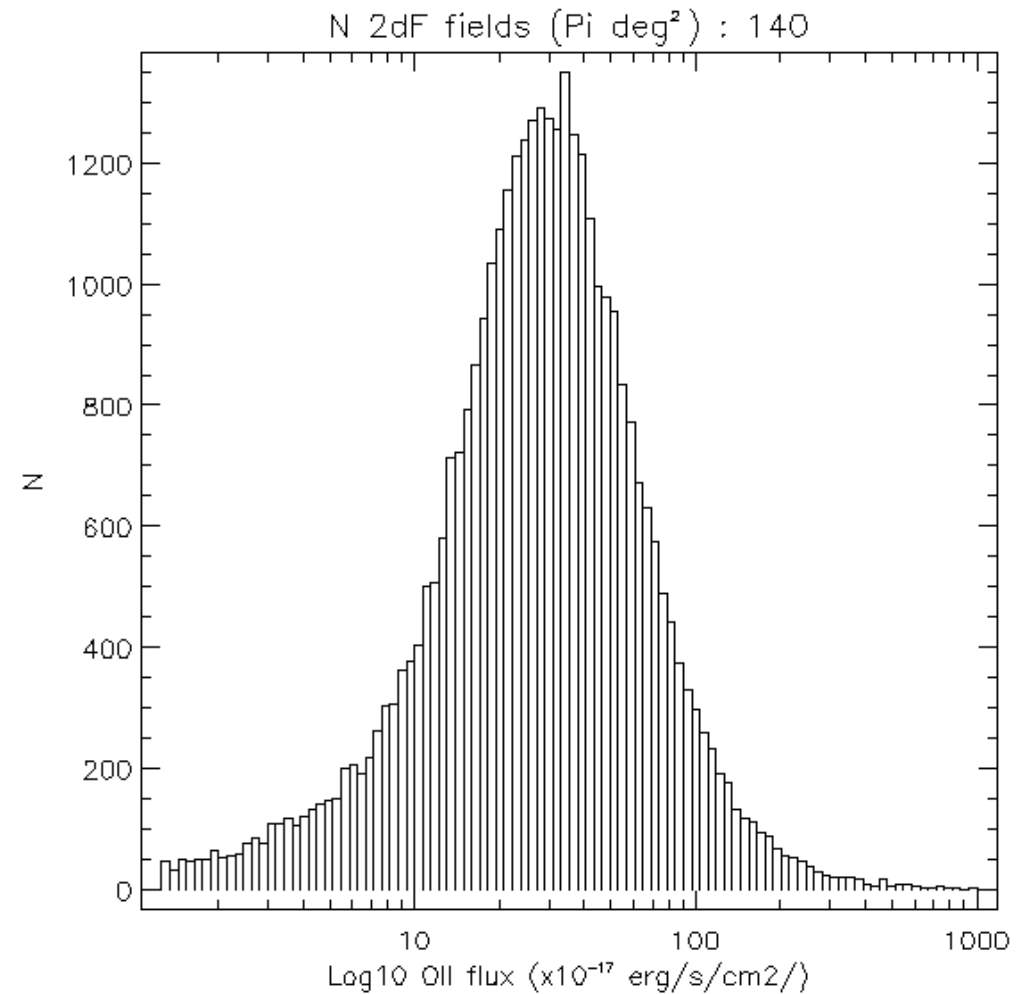
Survey design

- Follow up **UV-selected** sources from GALEX imaging
- **Colour cuts** select high-redshift galaxies
- **Star-forming galaxies** : redshifts from emission lines, SFR
10-100 solar masses per year
- **Short 1-hr exposures** - maximize numbers with 70% redshift completeness



Line fluxes

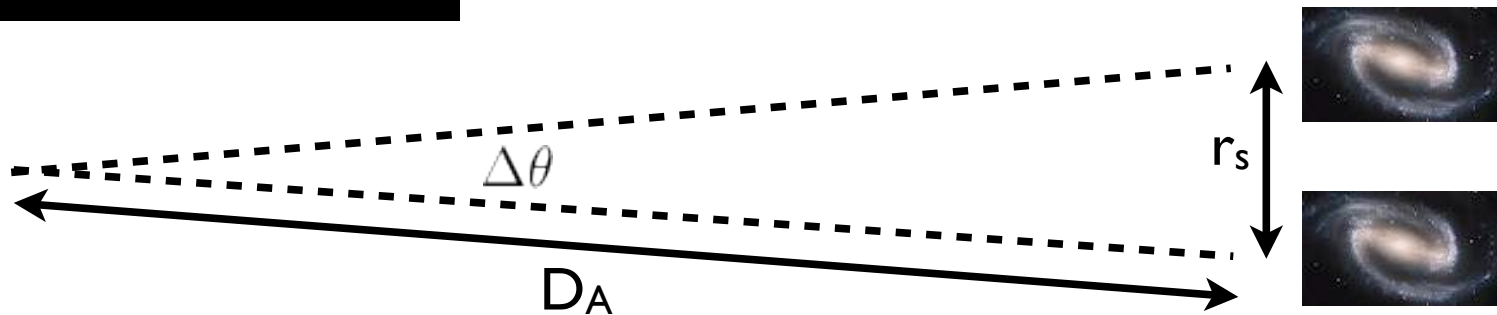
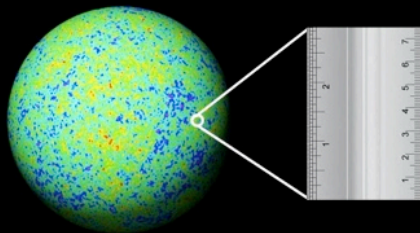
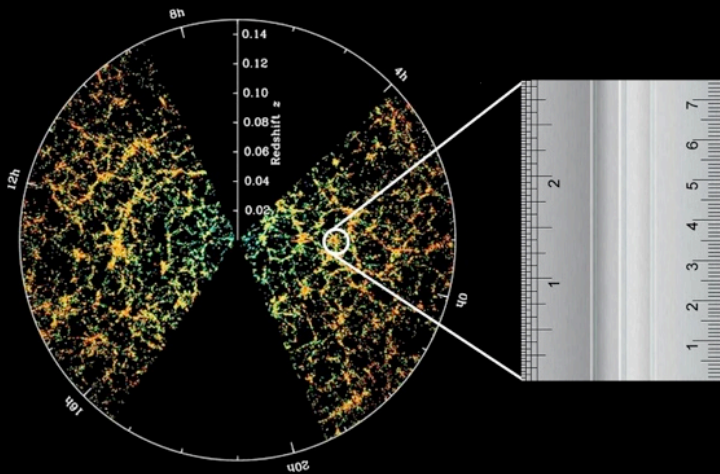
- Mean [OII] line flux
= 3×10^{-16} erg/s/cm²
- Detect some at the
 1×10^{-16} level



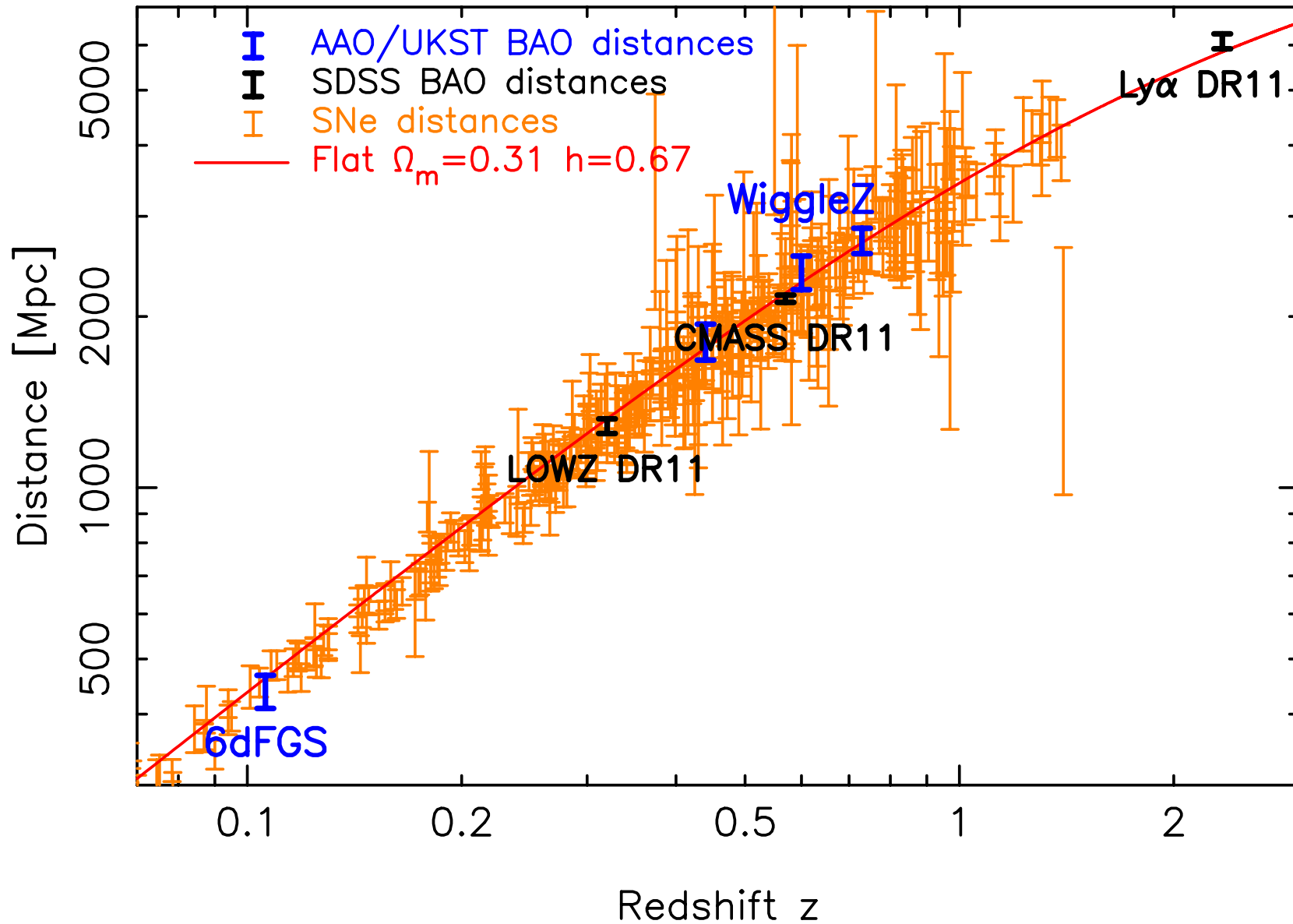
Credit : Rob Sharp

Standard ruler : baryon acoustic peak

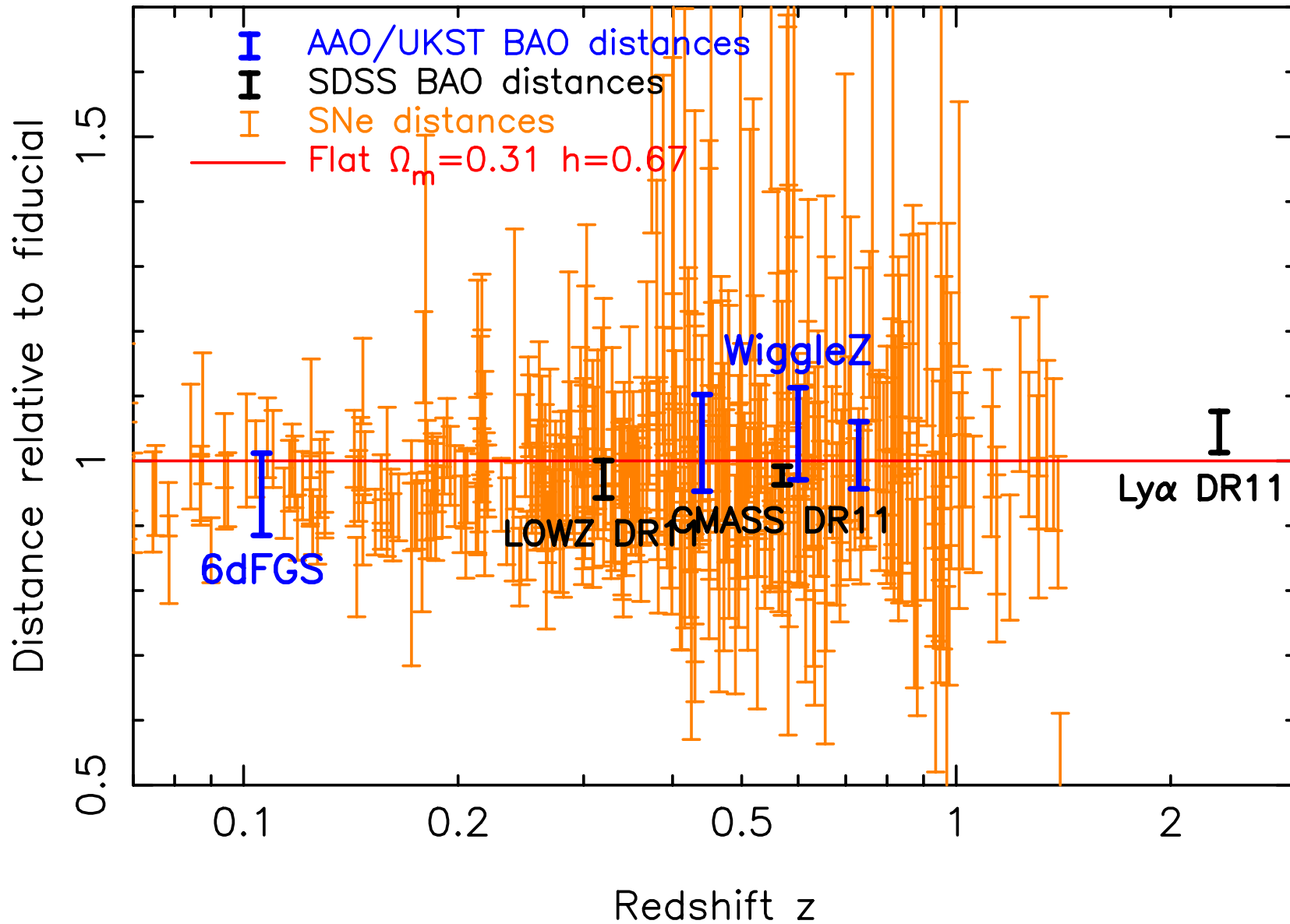
- Preferred co-moving separation of $105 h^{-1}$ Mpc between clumps imprinted at recombination
- We observe a preferred angular separation between galaxies at some redshift
- Allows distance determination by simple geometry



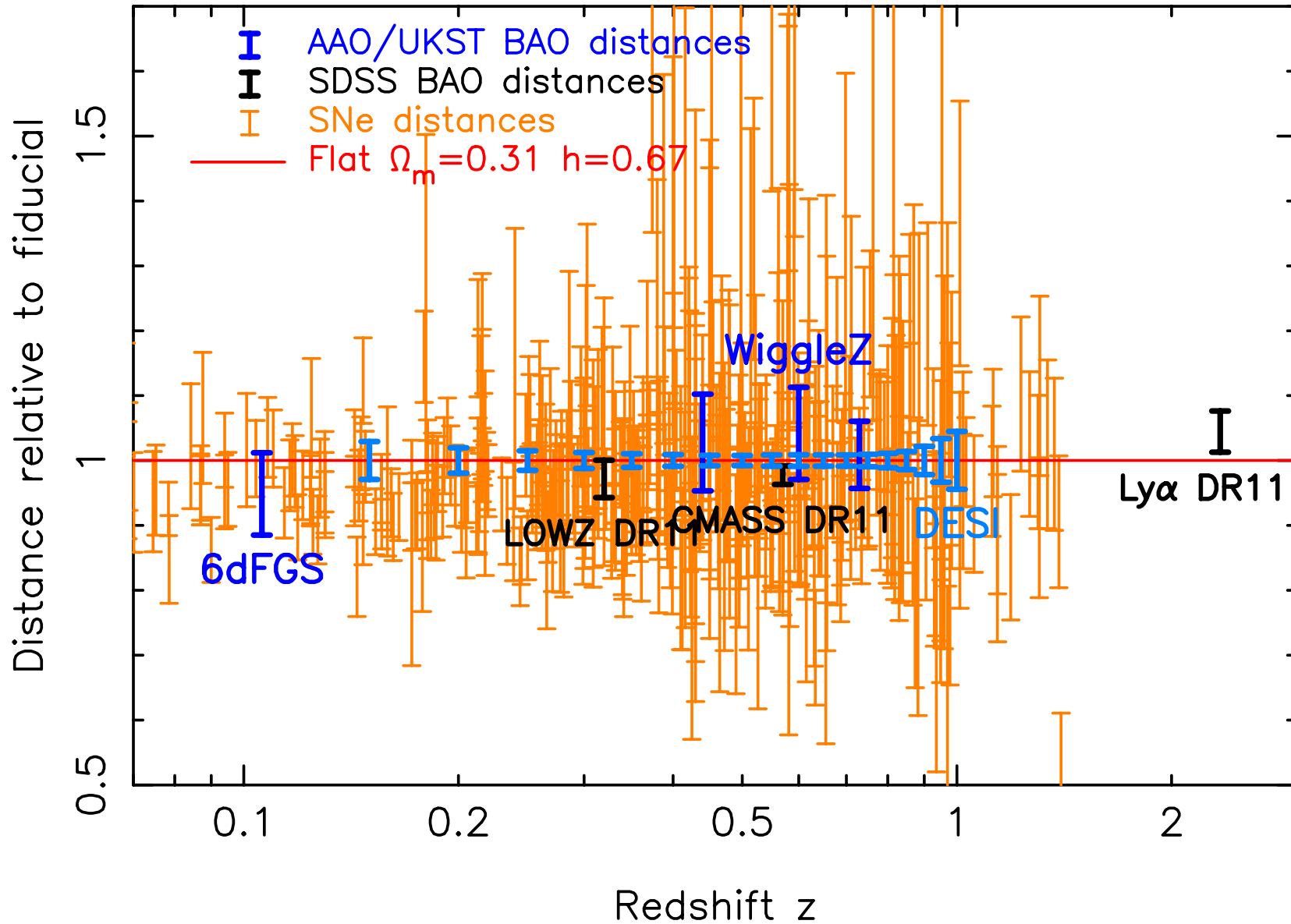
BAO Hubble diagram



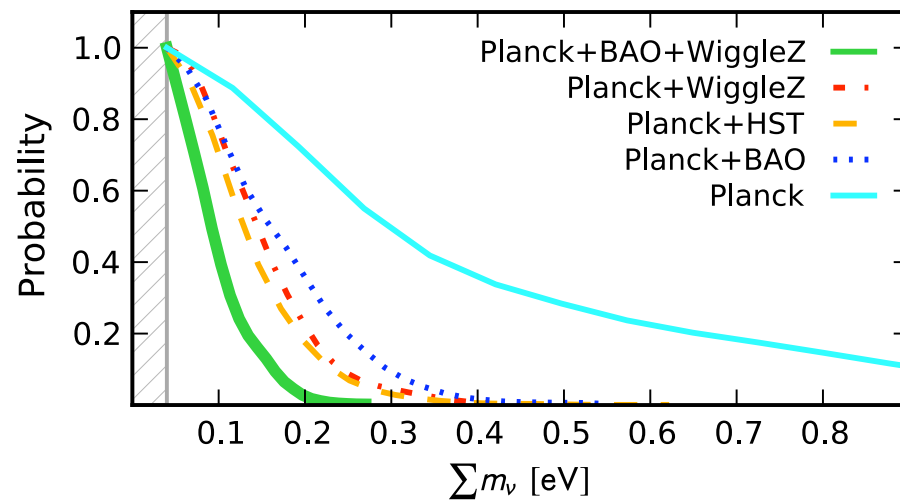
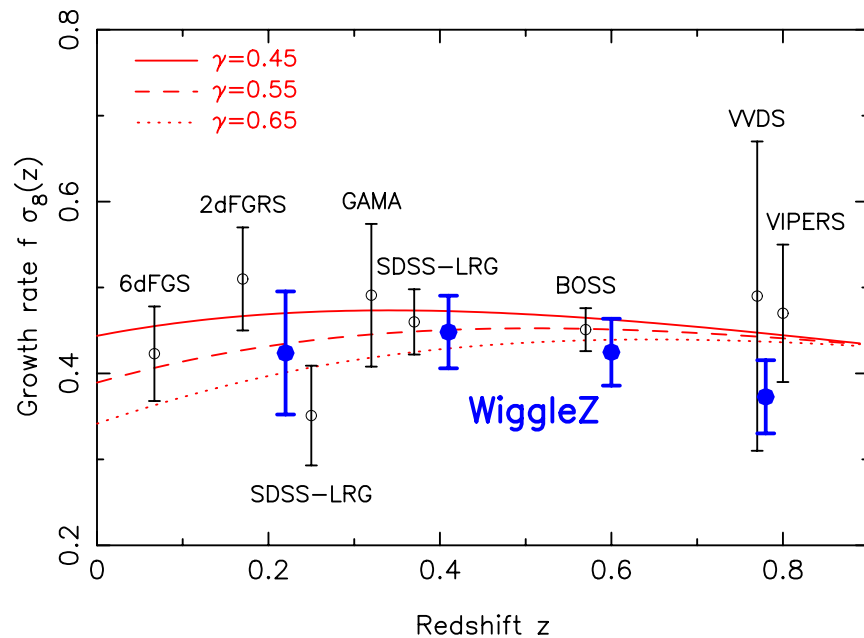
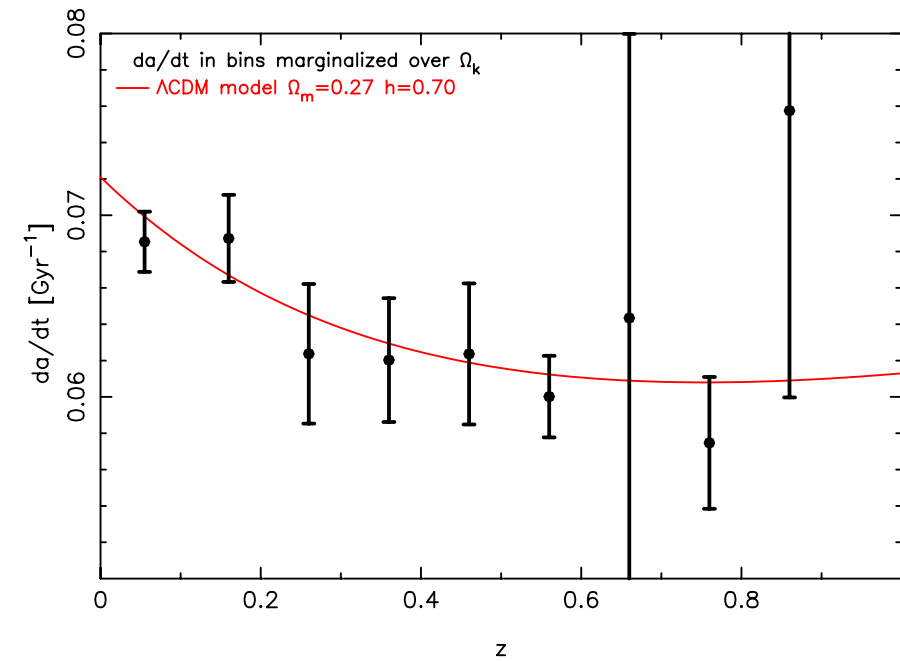
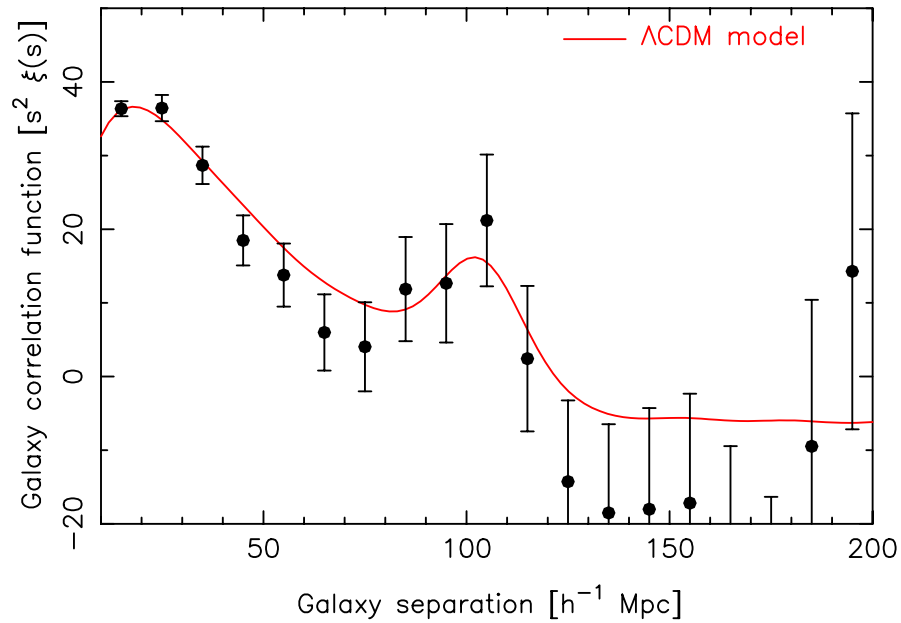
BAO Hubble diagram



BAO Hubble diagram



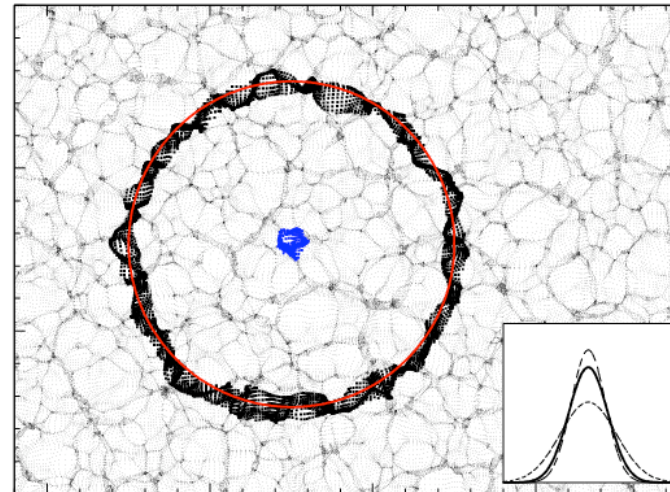
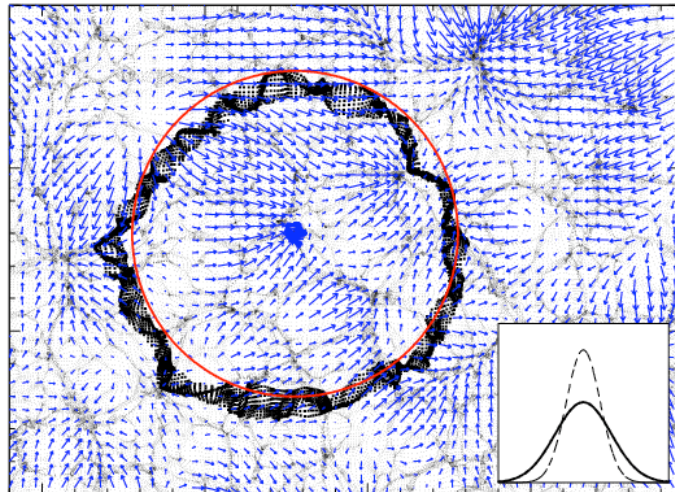
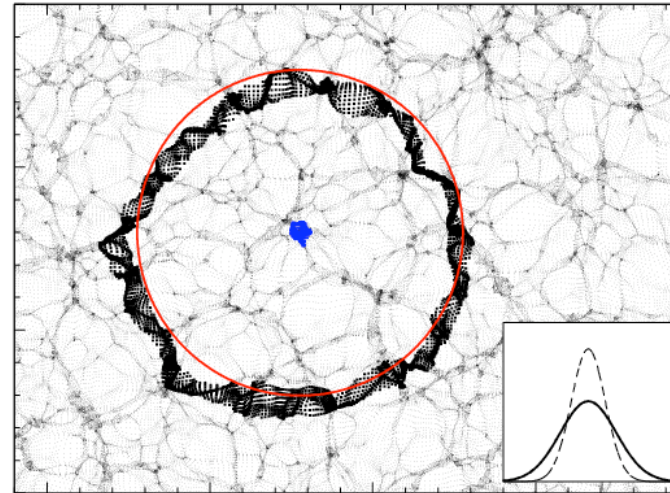
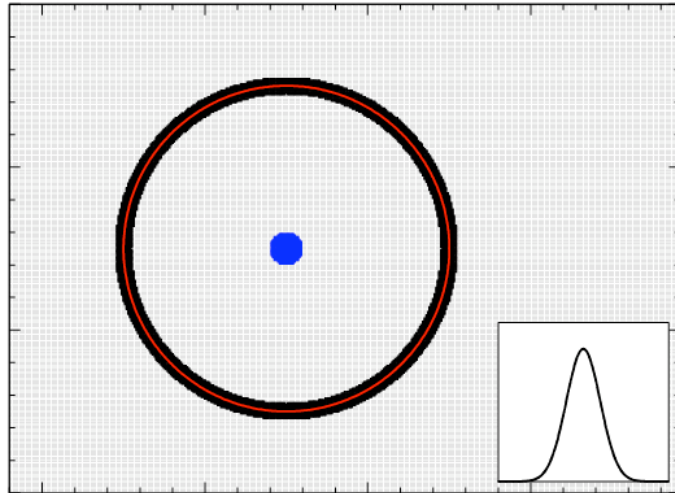
WiggleZ cosmology results



Reconstruction of the acoustic peak

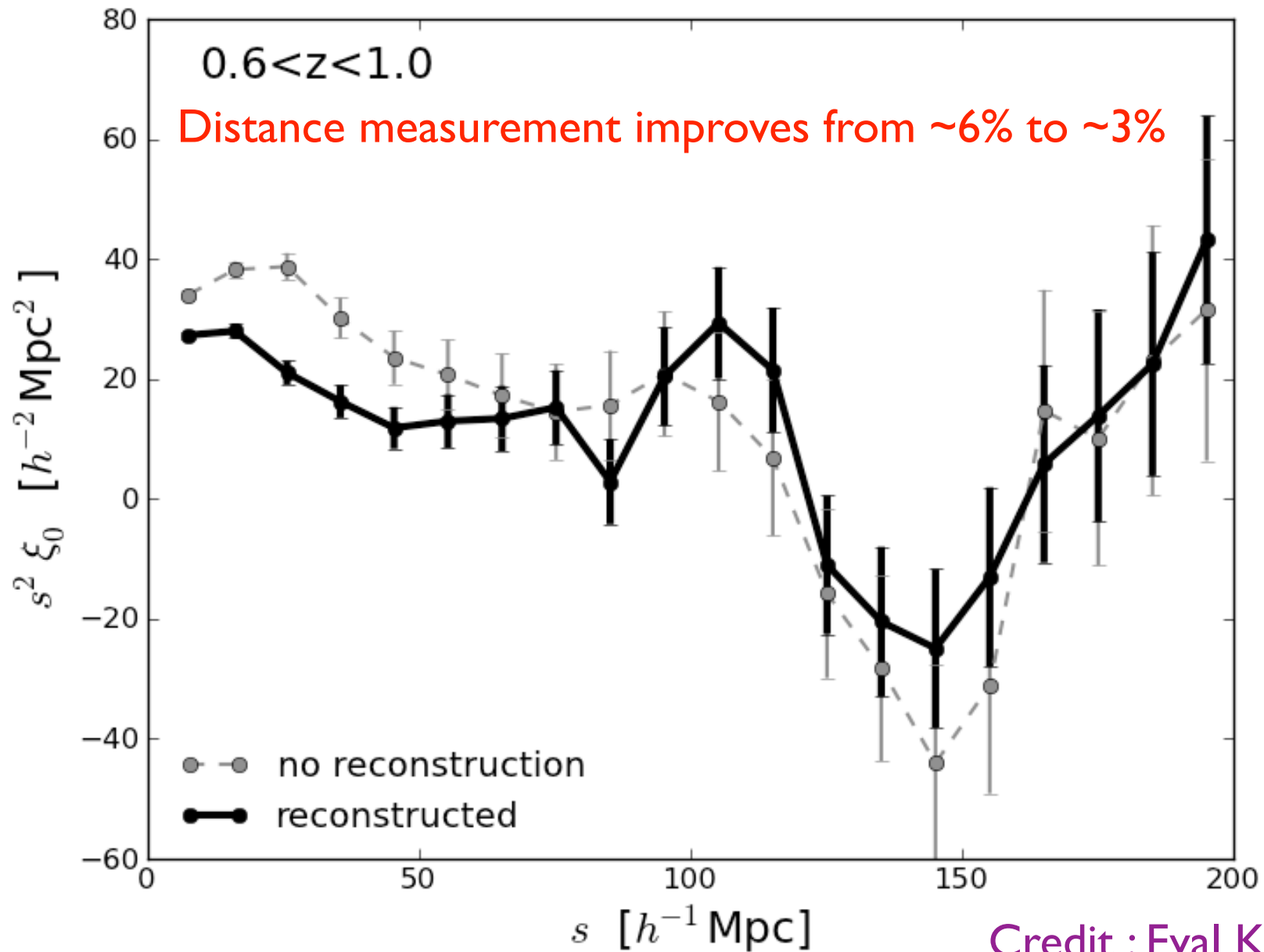
- Baryon acoustic peak is **blurred** by movement of galaxies over the age of the Universe
- **Reconstruction** uses the observed density field to approximately compute these motions
- Galaxies are shifted to their near-original positions, **sharpening peak** and improving standard ruler accuracy
- WiggleZ dataset provides an application with relatively low completeness and high shot noise

Reconstruction of the acoustic peak



Padmanabhan et al. (2012)

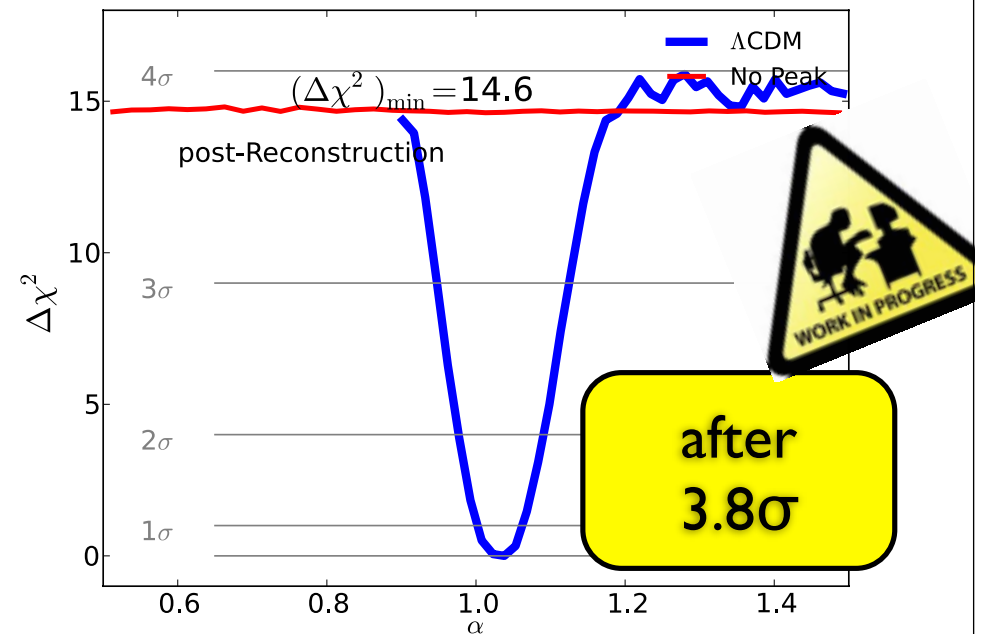
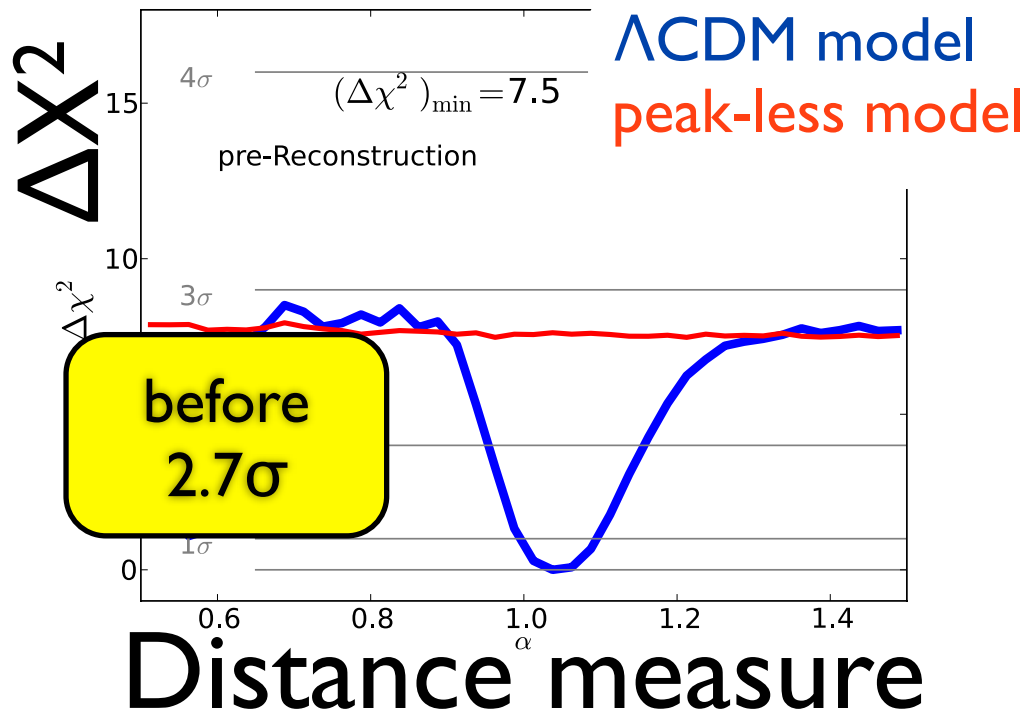
Reconstruction works for WiggleZ !



Credit : Eyal Kazin

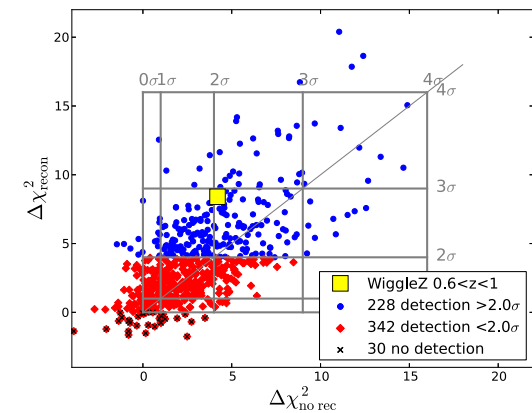
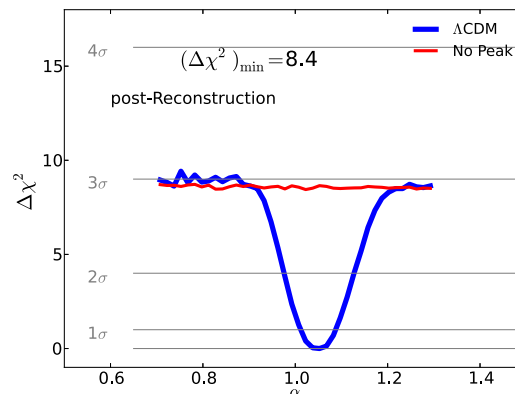
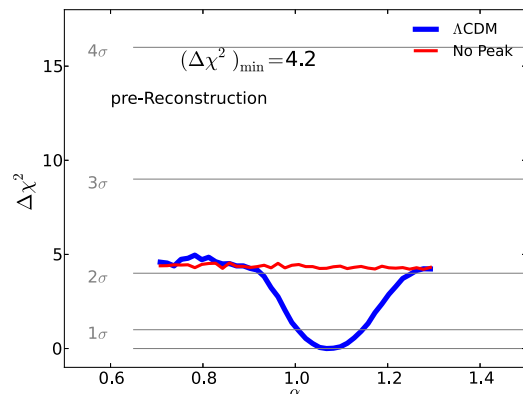
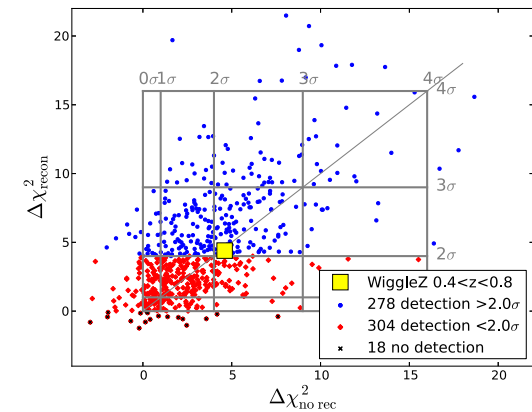
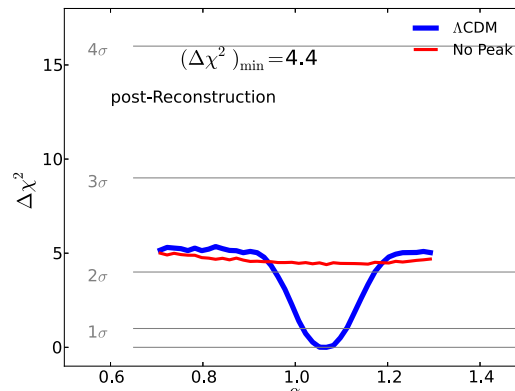
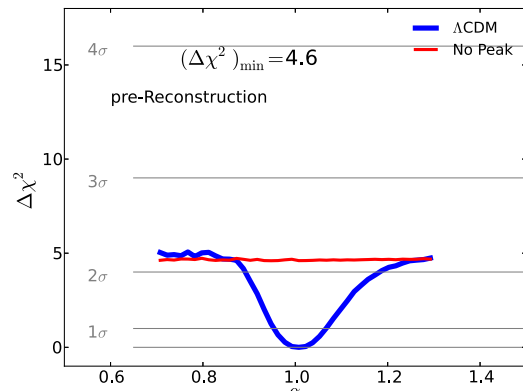
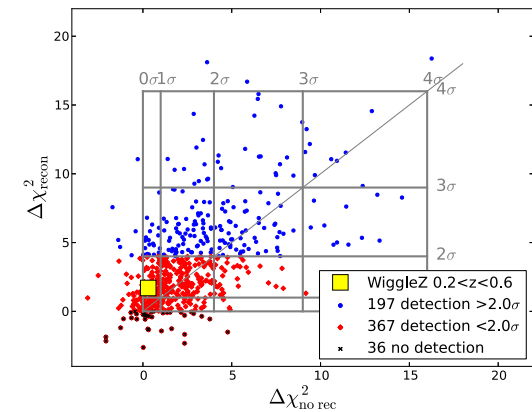
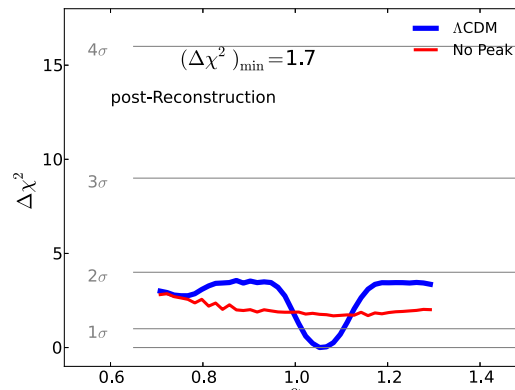
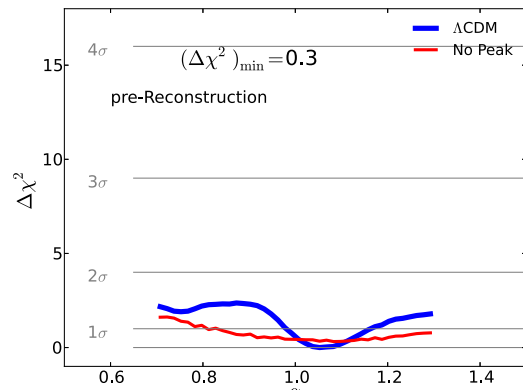
Reconstruction works for WiggleZ !

- Reconstruction improves significance of detection:



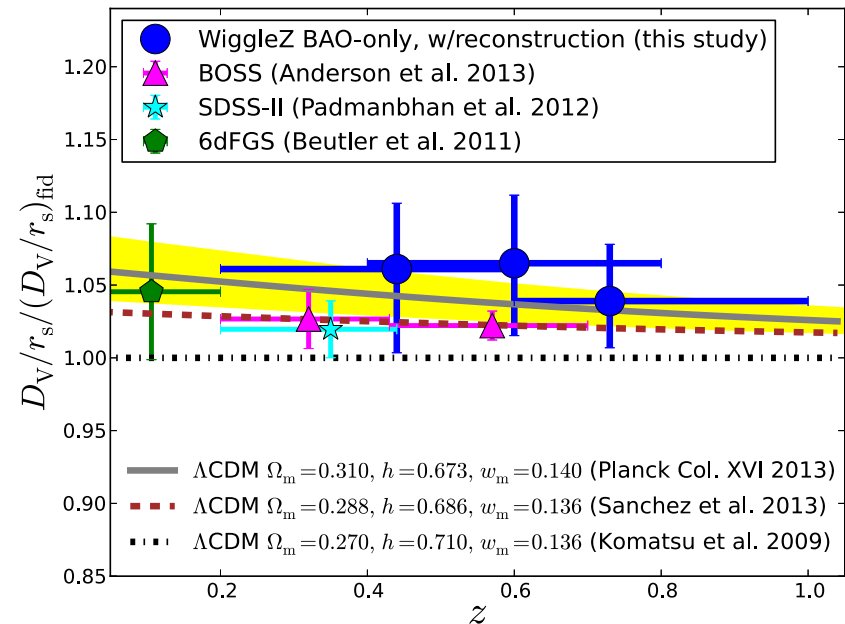
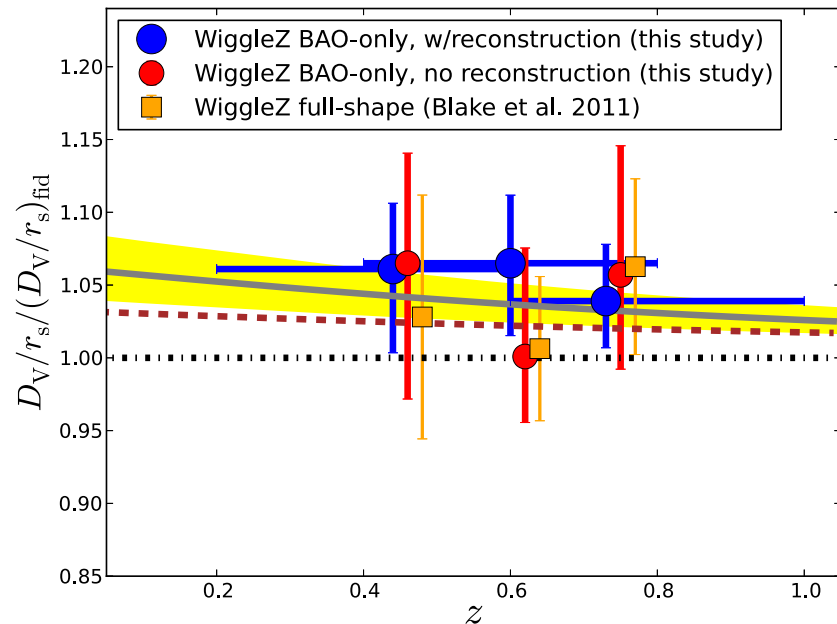
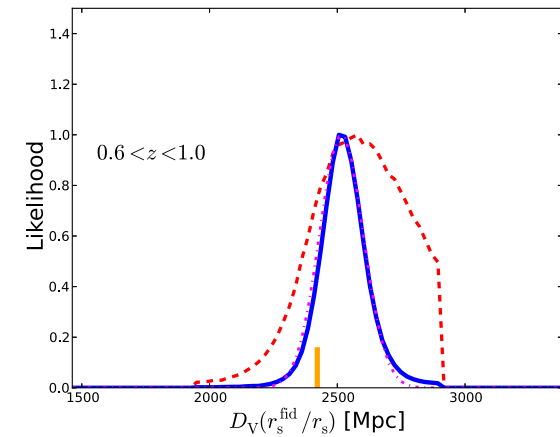
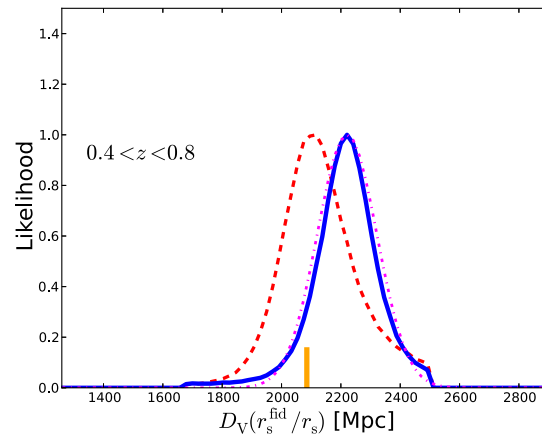
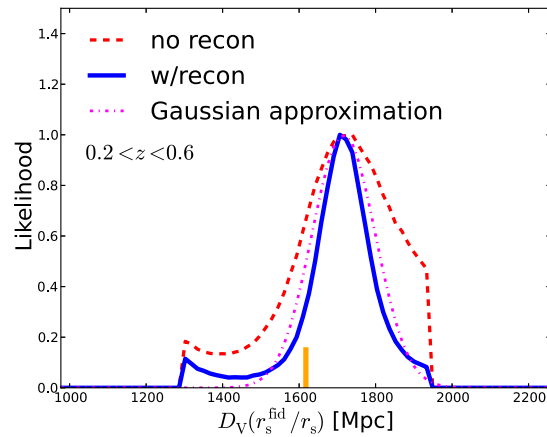
Credit : Eyal Kazin

Reconstruction works for WiggleZ !



Reconstruction works for WiggleZ !

Kazin et al. (2014)

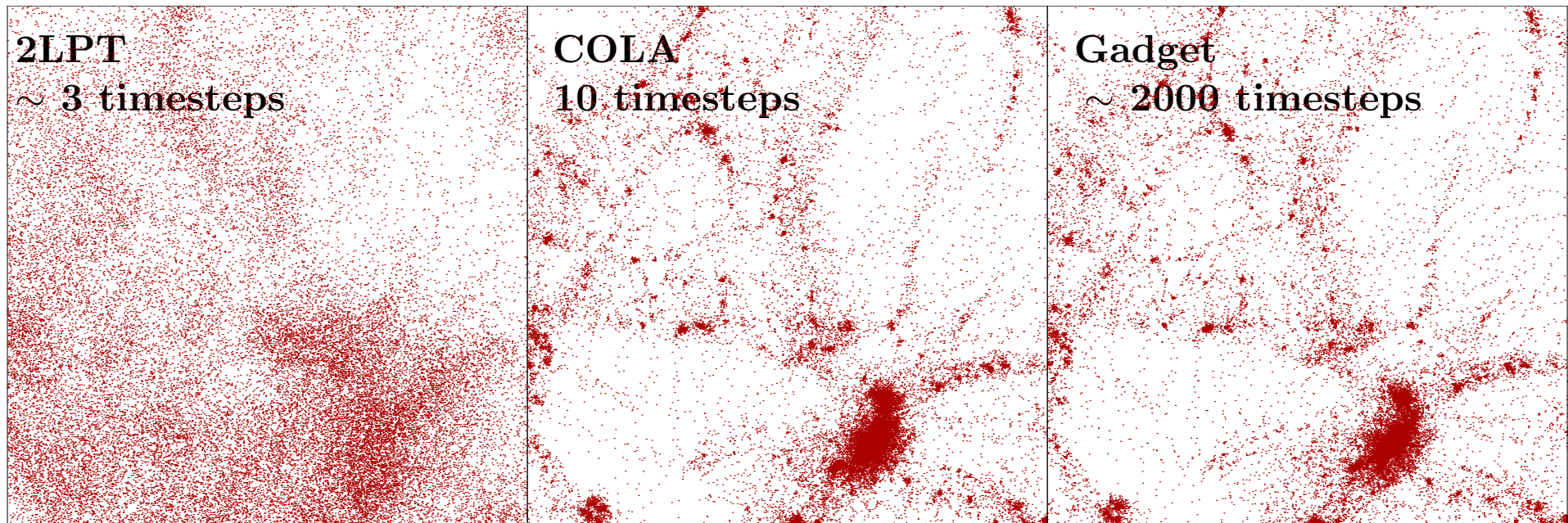


Mock catalogues

- Determine **data covariance** (e.g. after reconstruction) using many (hundreds?) realizations
- **Test model fits** for systematic errors (e.g. due to non-linear effects)
- End-to-end **survey pipelines** to calibrate effects from fibre collisions, redshift blunders, etc.
- Very demanding task for full N-body simulations
- Explore **approximation techniques** (e.g. 2LPT, COLA) for low-mass galaxies

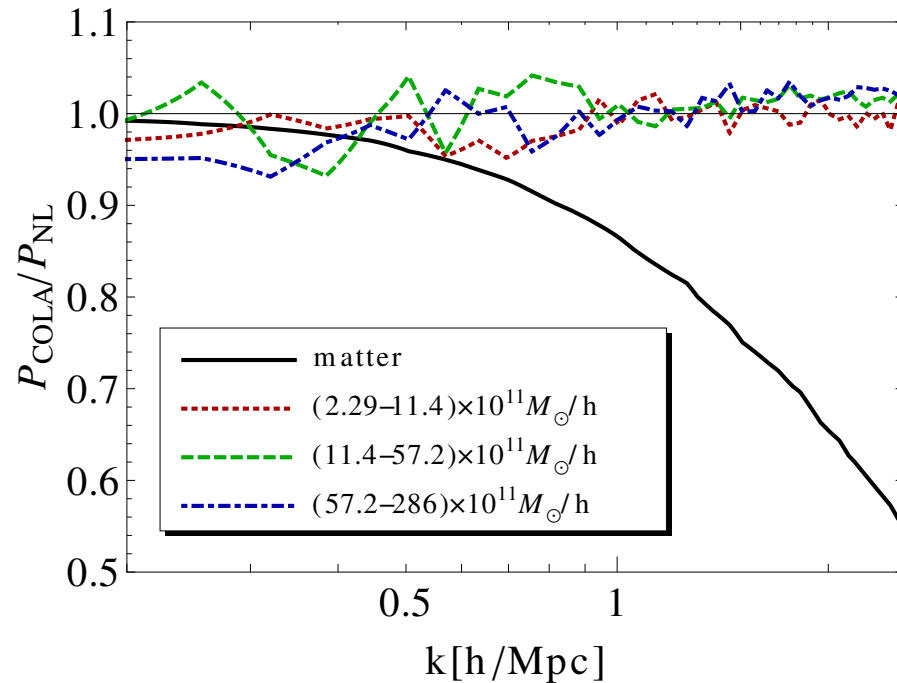
Mock catalogues

Tassev et al. (2013)

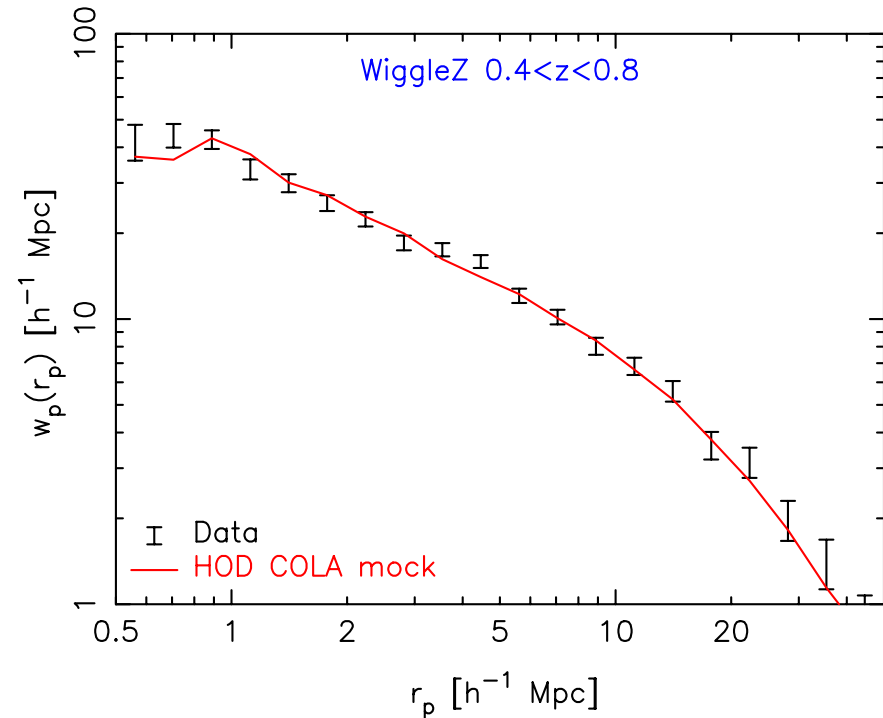


Mock catalogues

- Halo clustering matches full N-body and data



Tassev et al. (2013)



Koda et al. (2014)

Summary

- **Baryon acoustic peak** measurements will continue to be important for testing the cosmological model
- **Reconstruction** is now a mature technique offering significant improvements in the results
- WiggleZ analysis demonstrates that reconstruction can be effective in **sparse / incomplete samples**
- **Emission-line galaxy mocks** can be constructed using Comoving Lagrangian Acceleration (COLA) methods