Testing cosmological models with WiggleZ

Chris Blake , Swinburne

Testing cosmological models with WiggleZ

The WiggleZ Survey (core) Team

Swinburne : Chris Blake , Carlos Contreras , Warrick Couch , Karl Glazebrook , Tornado Li , Greg Poole , Emily Wisnioski

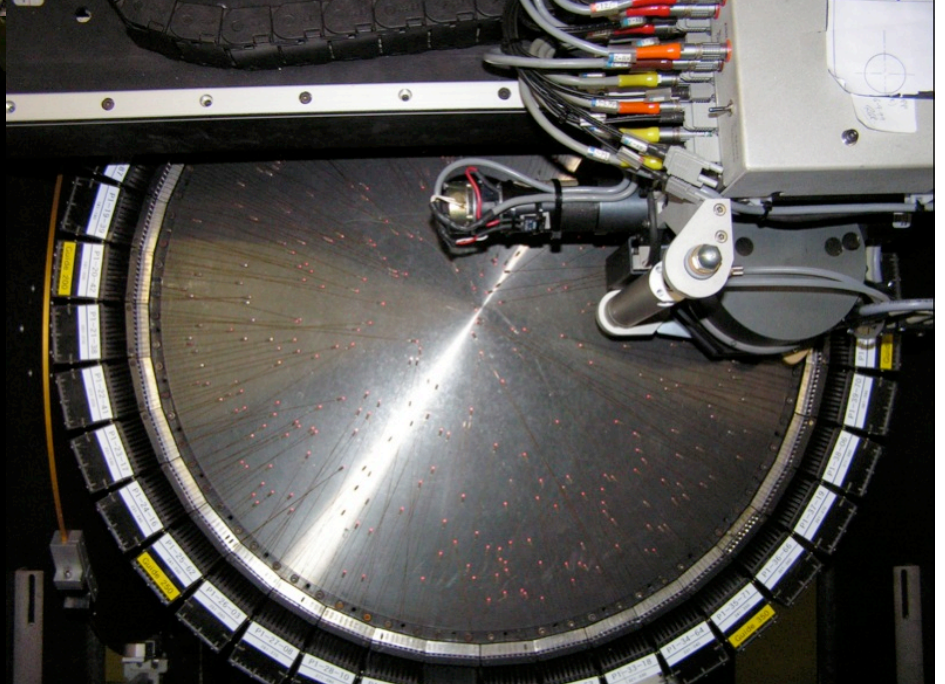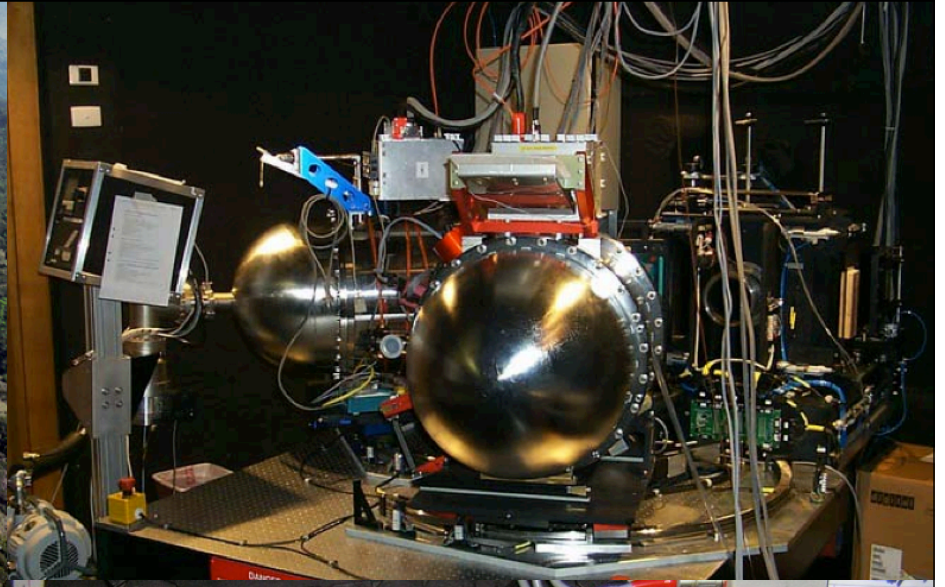University of Queensland : Tamara Davis , Michael Drinkwater

AAO : Sarah Brough , Matthew Colless , Mike Pracy , Rob Sharp

Scott Croom (U.Syd.) , Ben Jelliffe (U.Syd.) , David Woods (UBC) , Kevin Pimbblet (Monash) , Russell Jurek (ATNF)

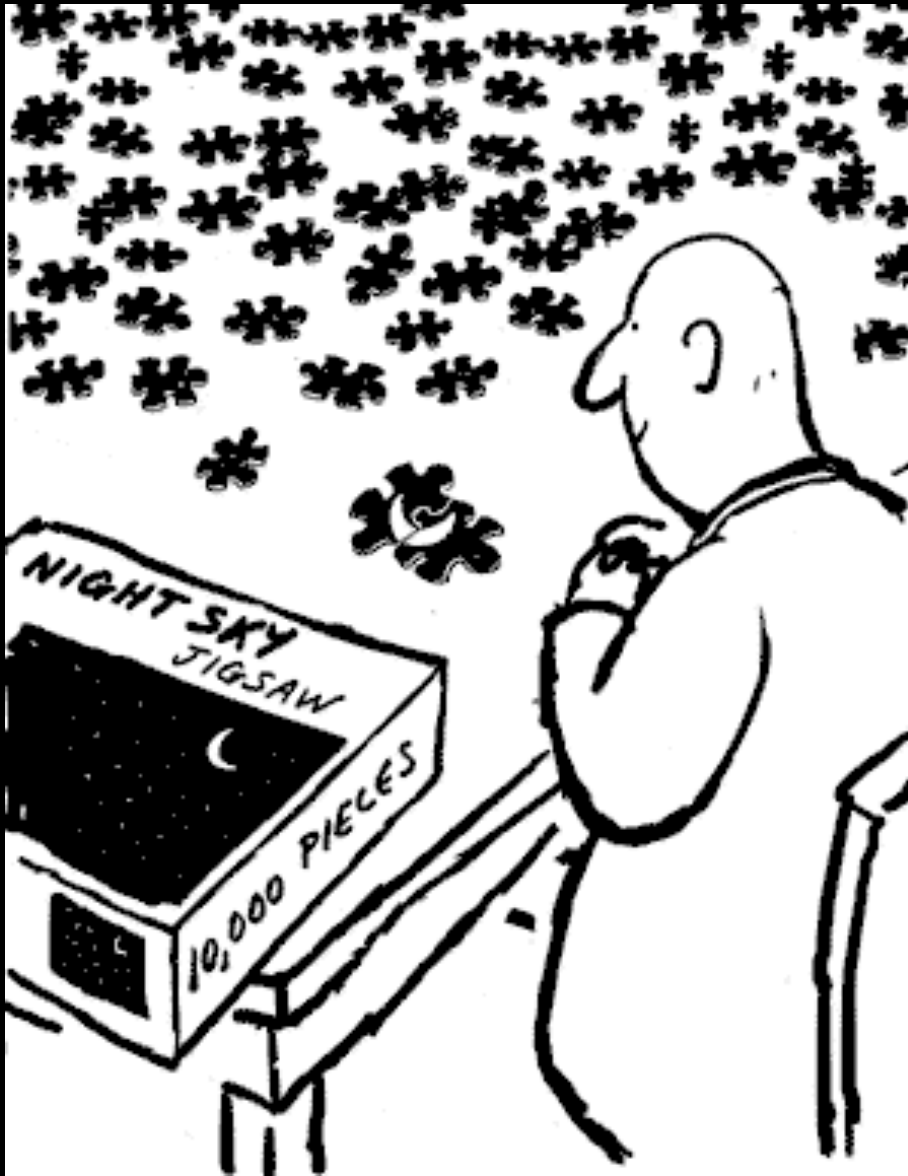GALEX team : Karl Forster , Barry Madore , Chris Martin , Ted Wyder

RCS2 team : David Gilbank , Mike Gladders , Howard Yee

The WiggleZ Dark Energy Survey

- 1000 sq deg , 0.2 < z < 1.0
- 200,000 redshifts
- blue star-forming galaxies
- 2006-2010
- 50% of data analyzed here

The dark energy puzzle

What is "dark energy" ?

1) new, missing matter-energy component

2) failure of the laws of gravity

3) failure of the laws of quantum theory

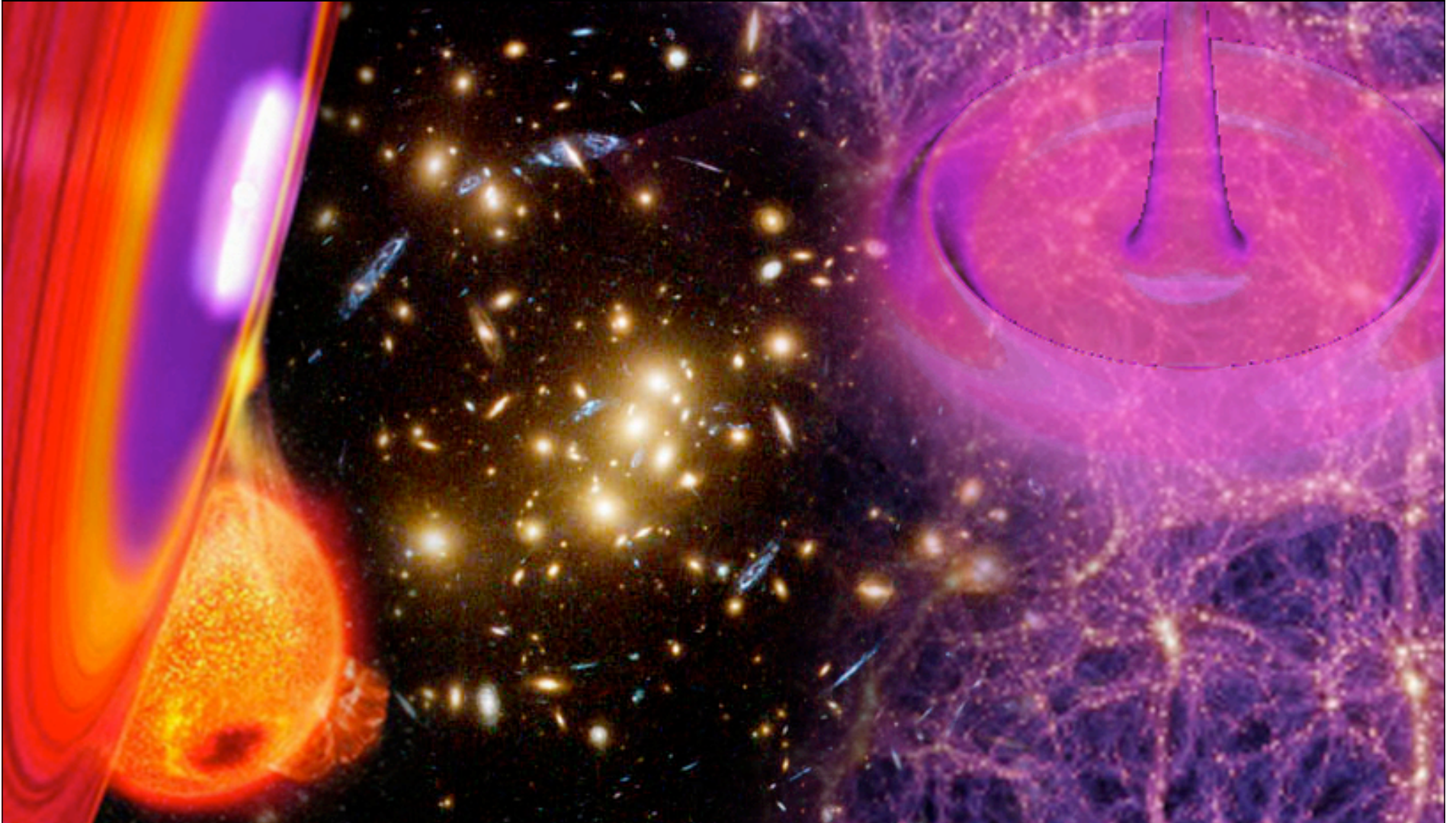4) systematic errors in our observations?

The dark energy puzzle

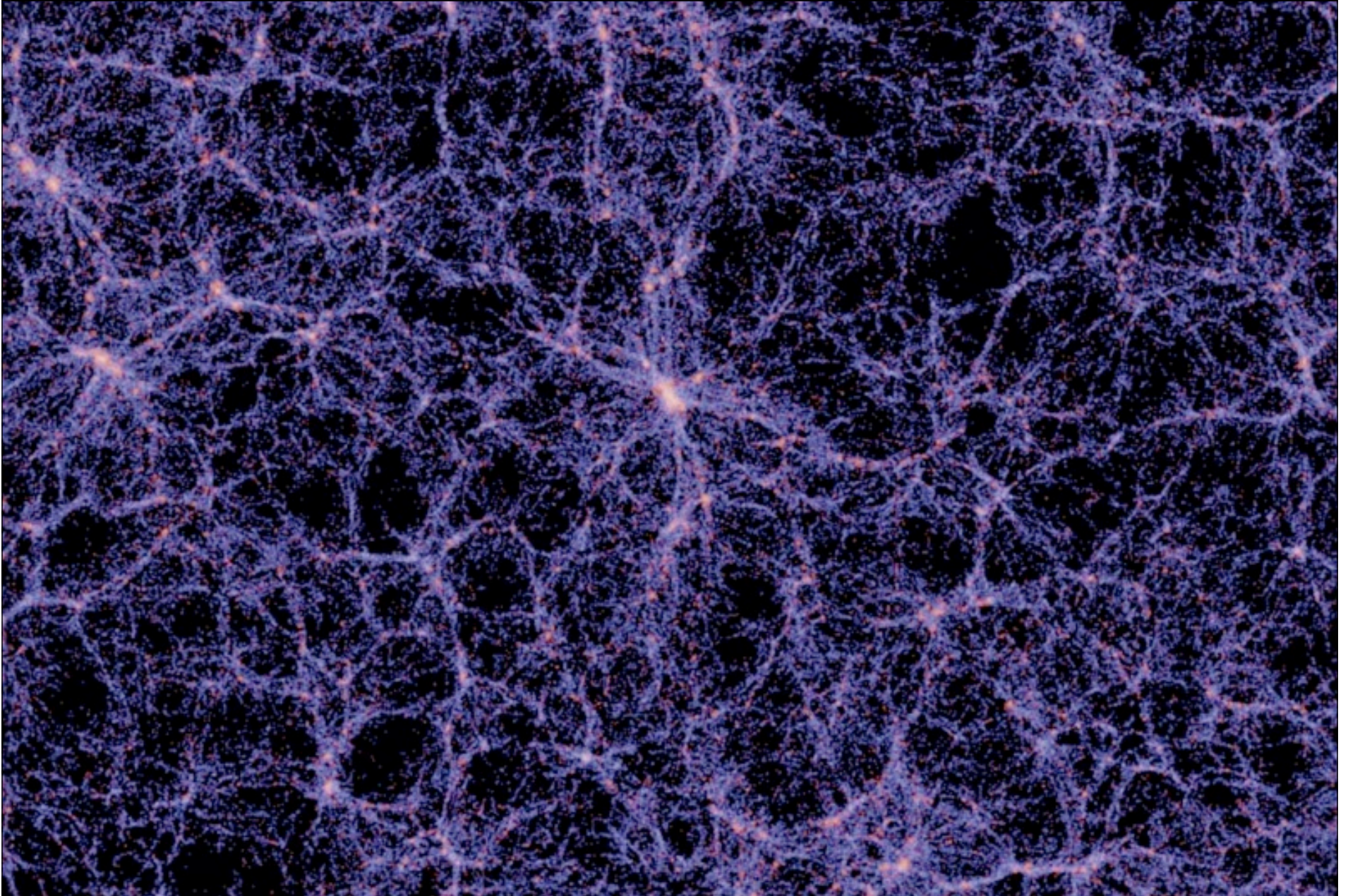Image credit : Lawrence Berkeley National Laboratory
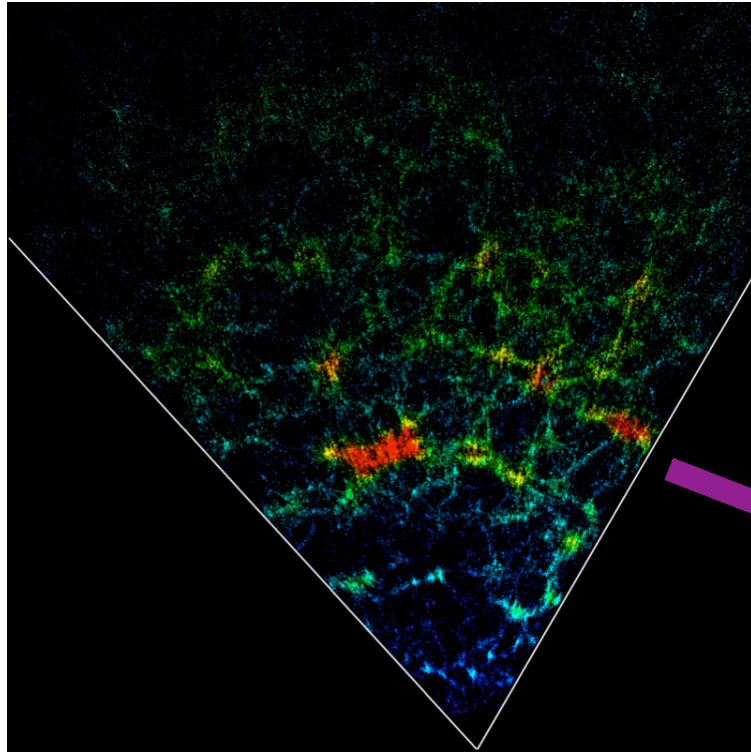
The dark energy puzzle

We need to make simultaneous measurements of the cosmic expansion and growth histories

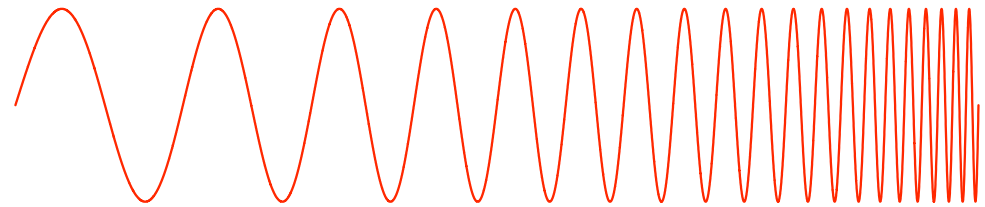Image credit : Lawrence Berkeley National Laboratory

Clustering pattern

Clustering pattern

Amplitude of long-wavelength structure modes
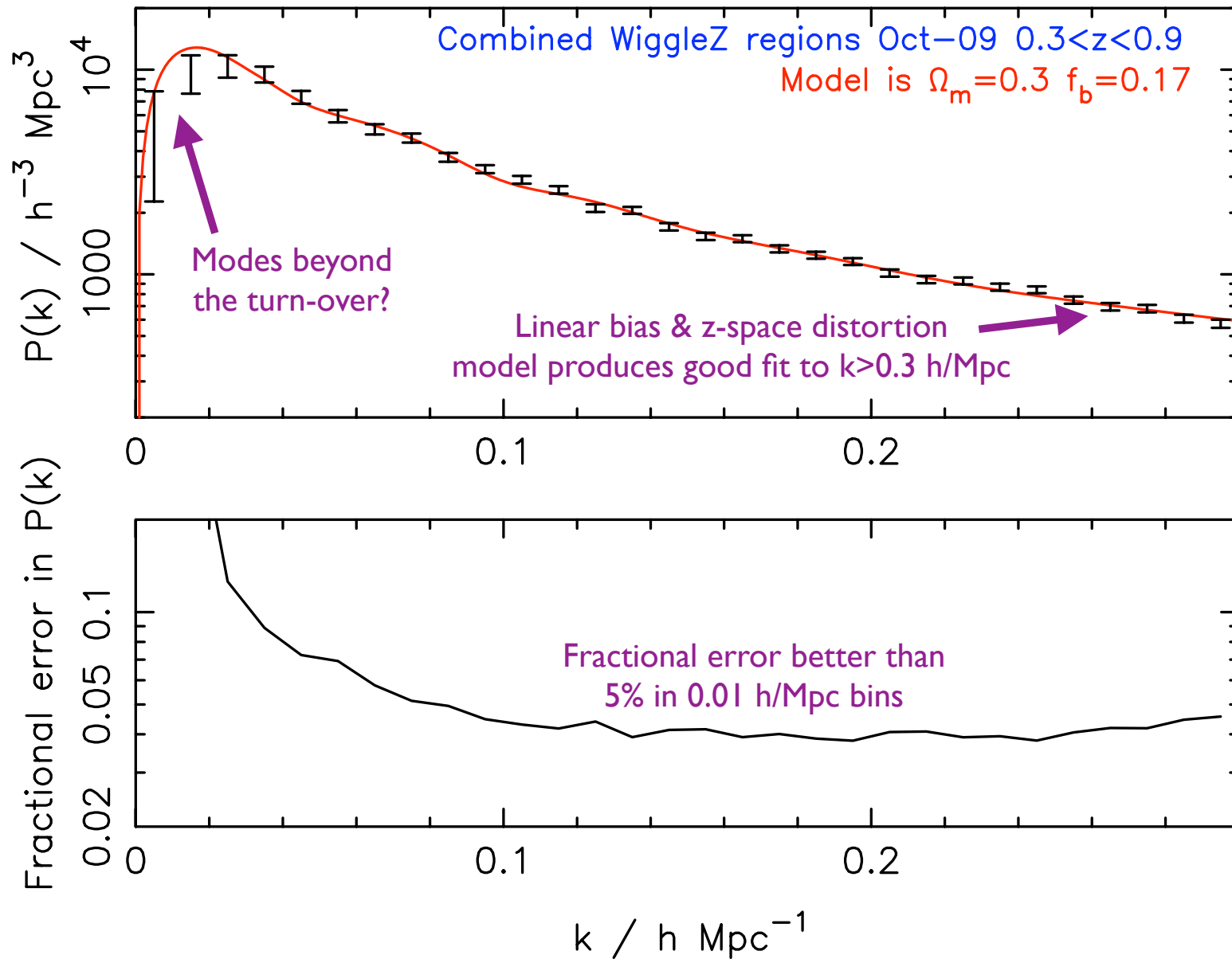
Amplitude of short-wavelength structure modes

We can model this function from theory
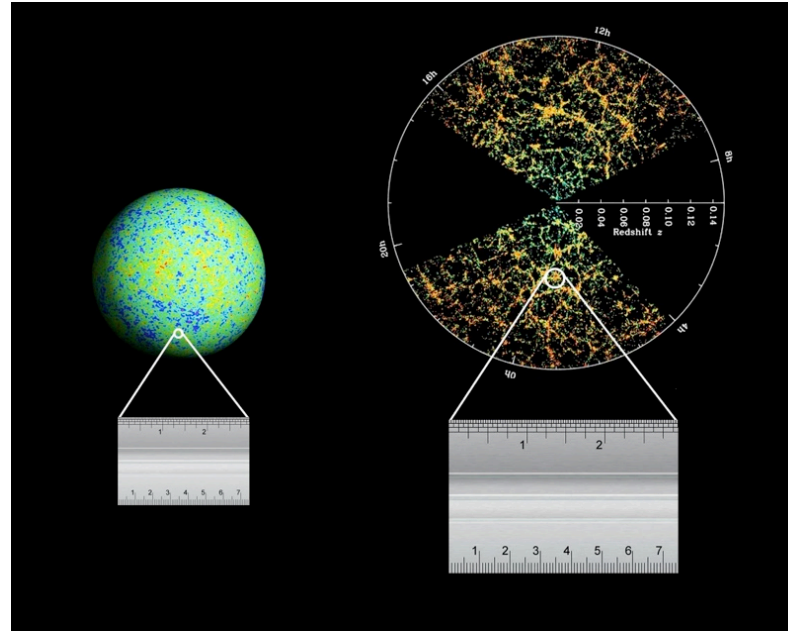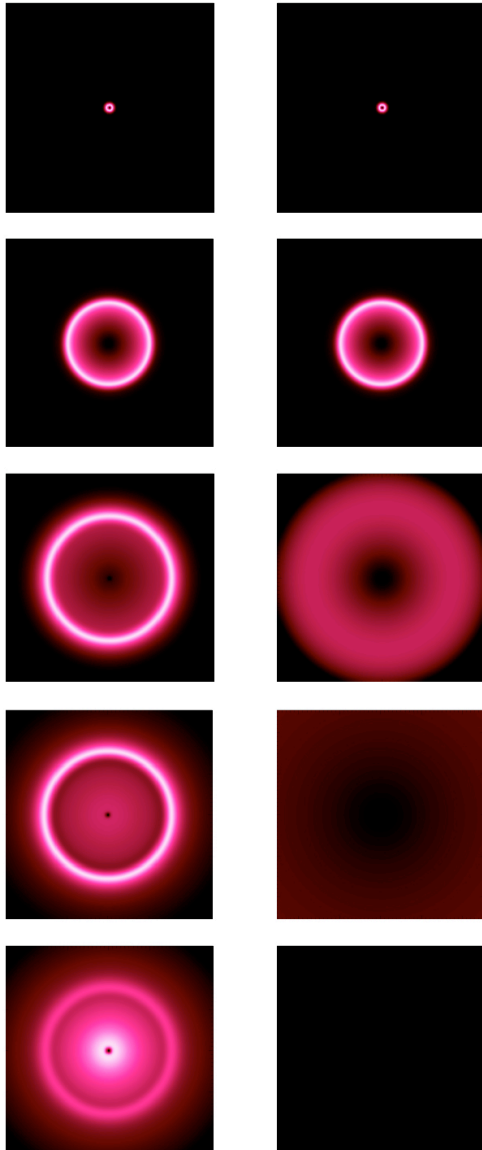
Power spectrum P(k)

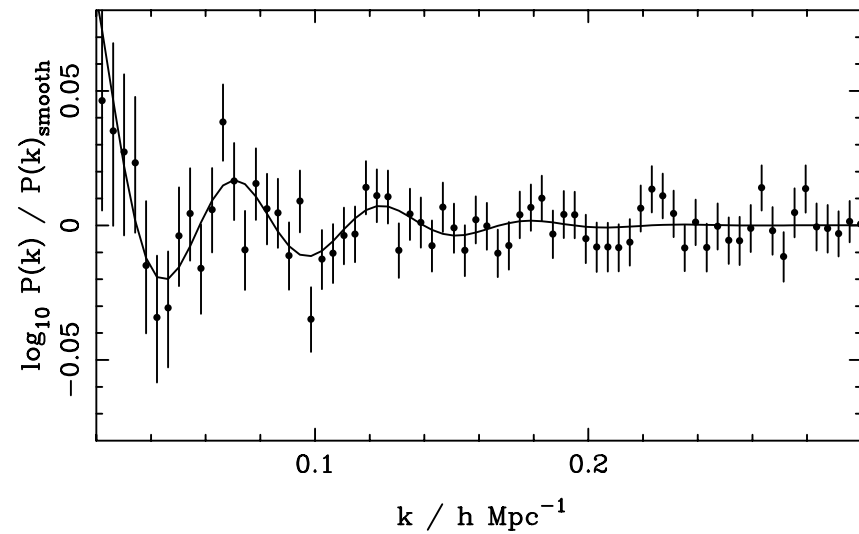Fourier wavescale k

Clustering pattern

Expansion history : baryon oscillations

BARYONS   PHOTONS
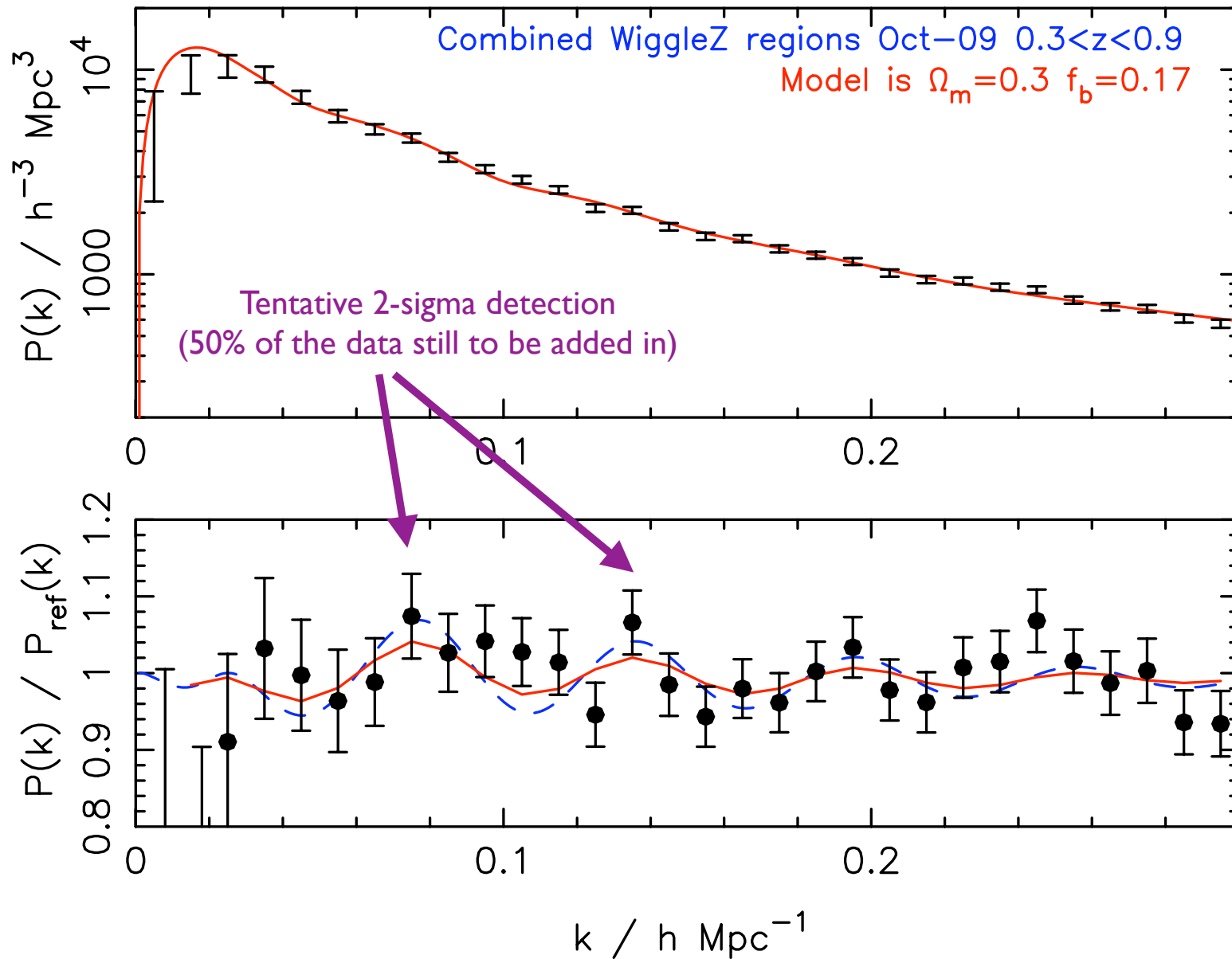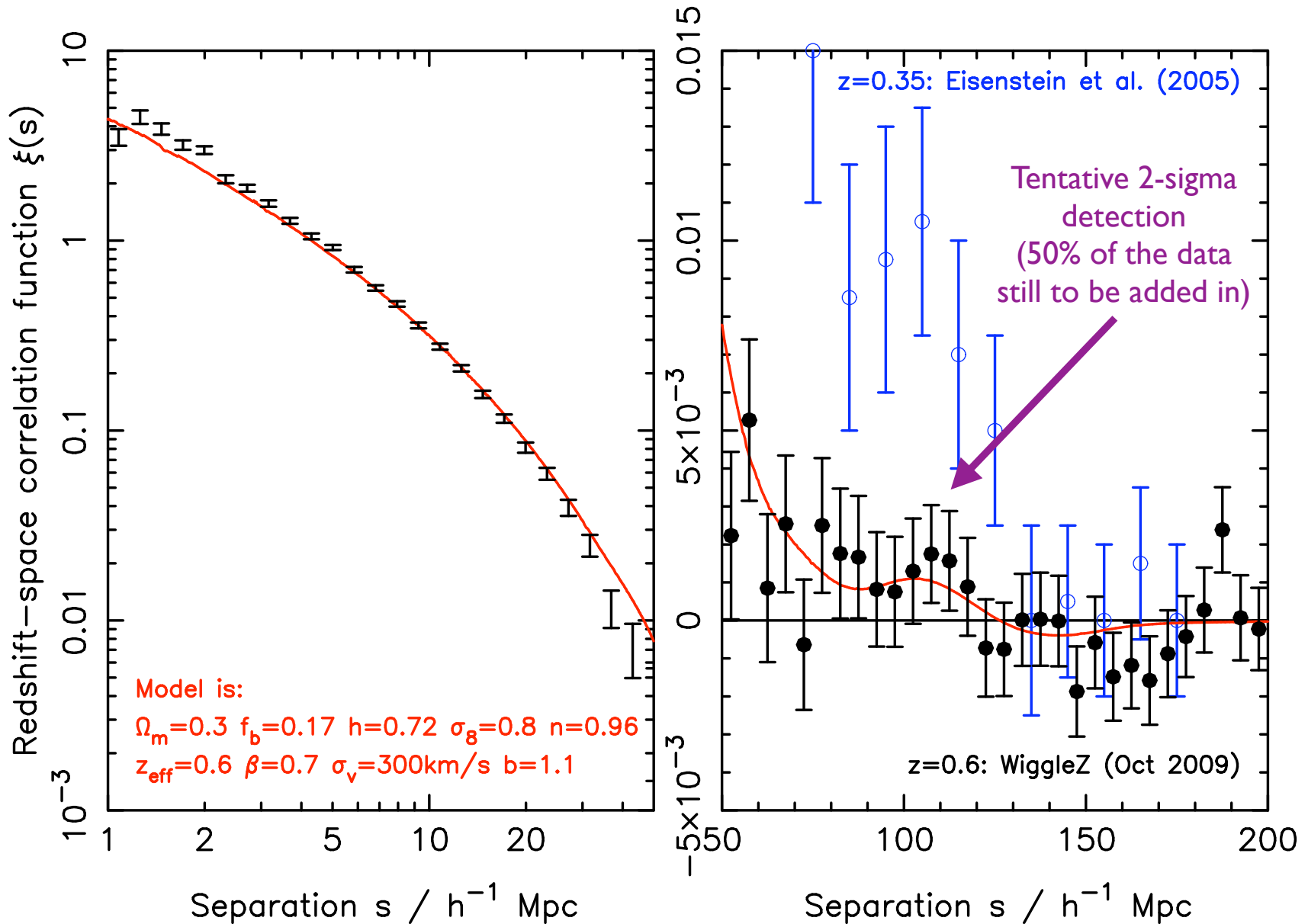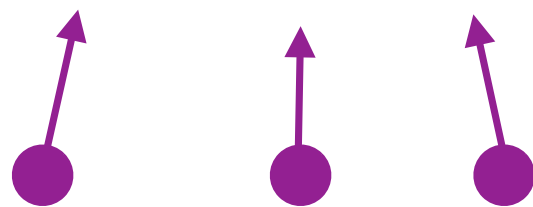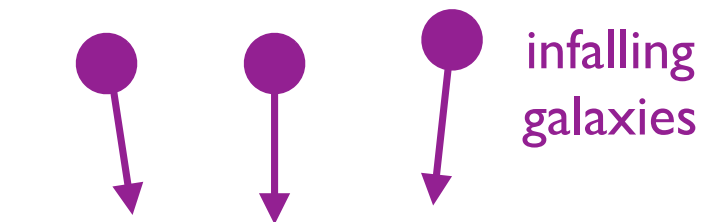
SDSS
Percival et al.
(2007)

Expansion history : baryon oscillations

Combined WiggleZ regions Oct−09 0.3<z<0.9
Model is Ω_m=0.3 f_b=0.17

Tentative 2-sigma detection
(50% of the data still to be added in)

Expansion history : baryon oscillations

Model is:
$\Omega_m=0.3$ $f_b=0.17$ $h=0.72$ $\sigma_8=0.8$ $n=0.96$
$z_{eff}=0.6$ $\beta=0.7$ $\sigma_v=300km/s$ $b=1.1$

z=0.35: Eisenstein et al. (2005)

Tentative 2-sigma detection
(50% of the data still to be added in)

z=0.6: WiggleZ (Oct 2009)

Growth history : redshift-space distortions
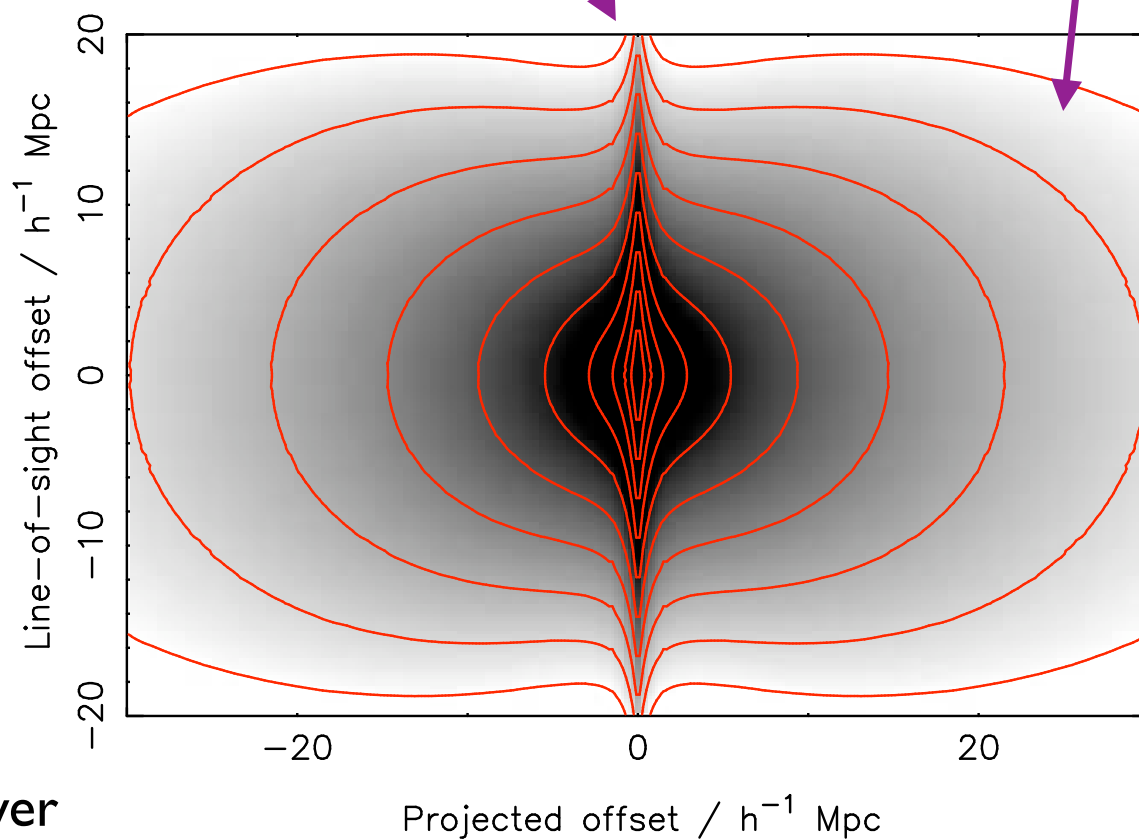
Growth history : redshift-space distortions
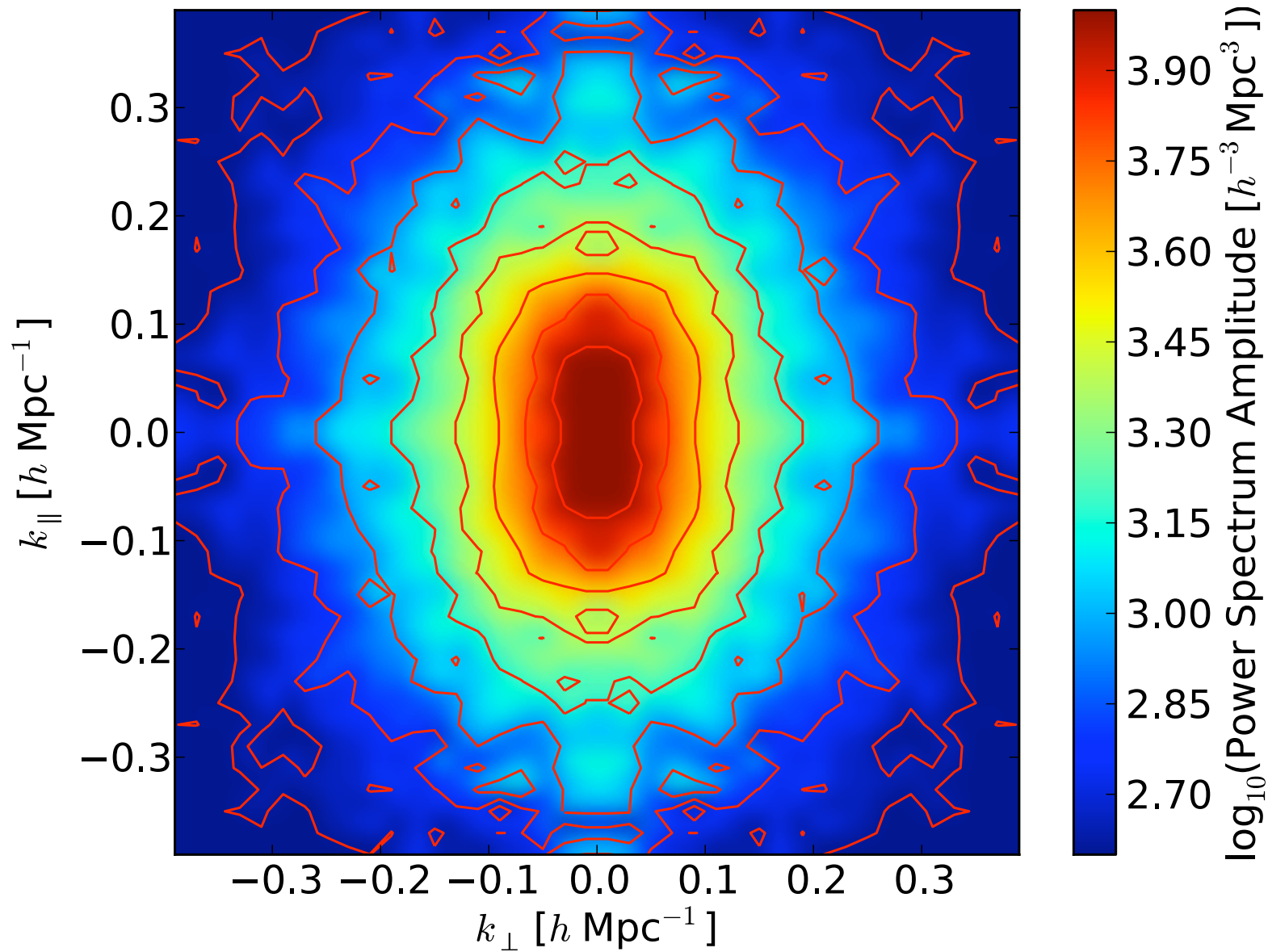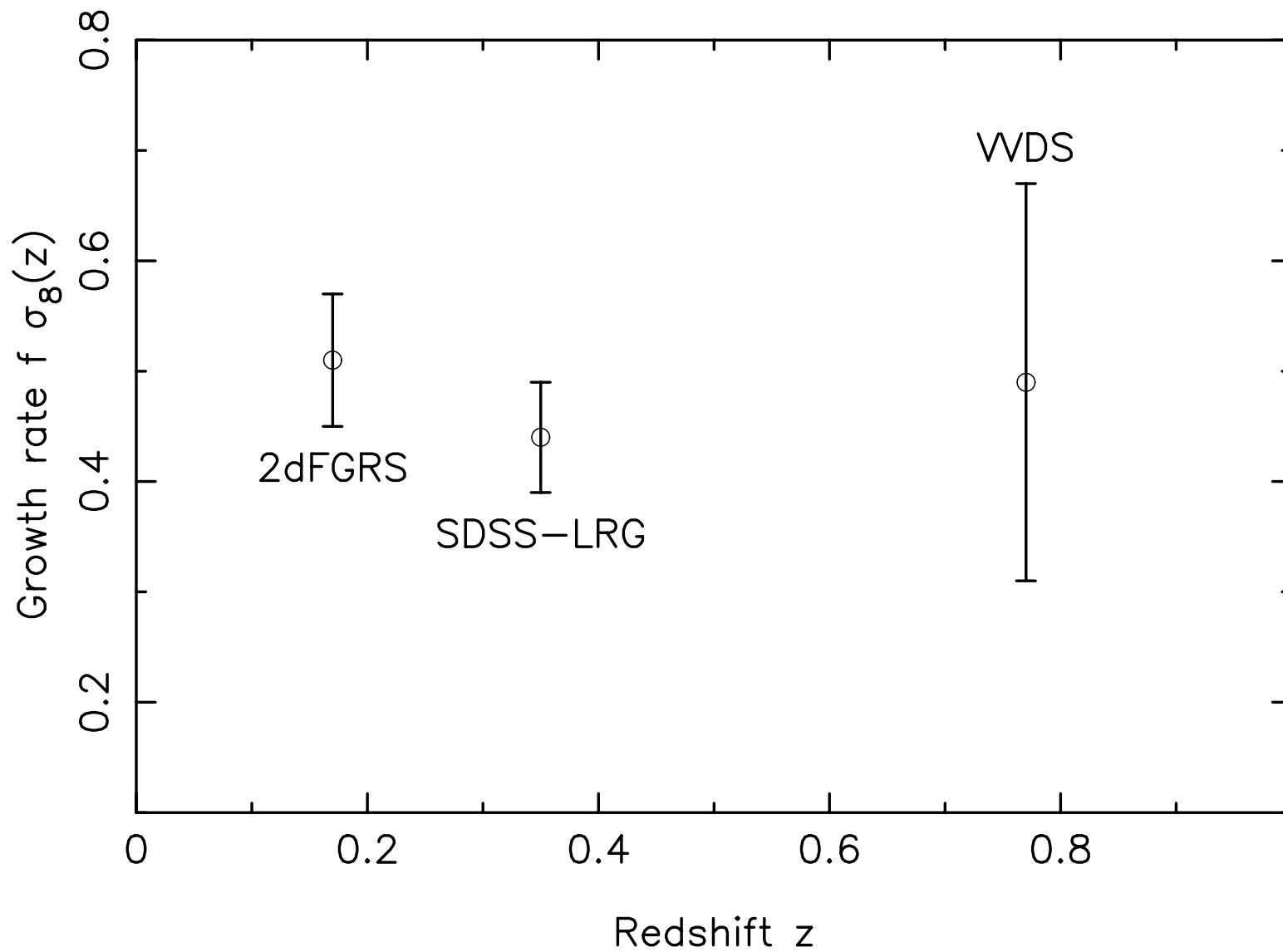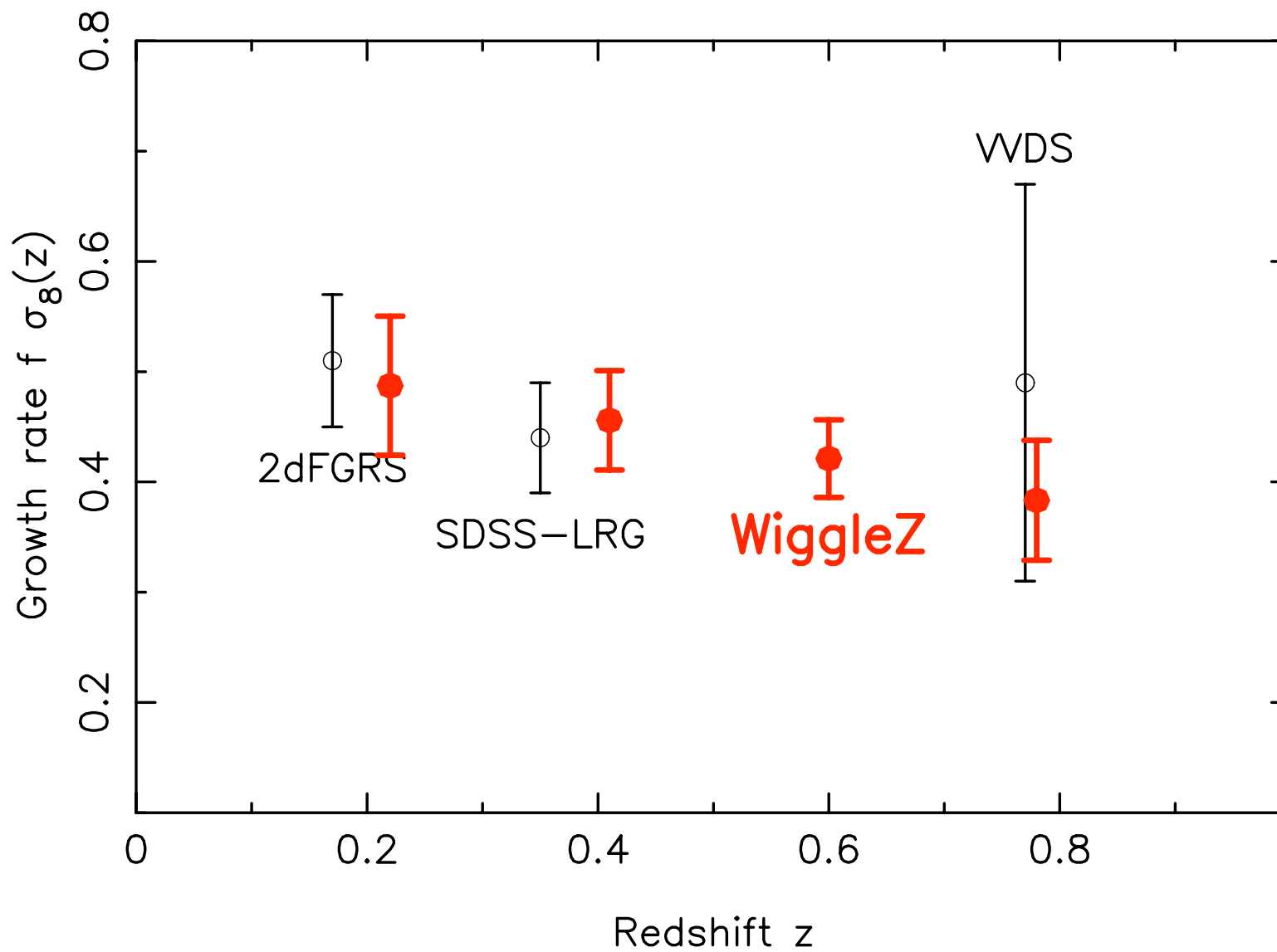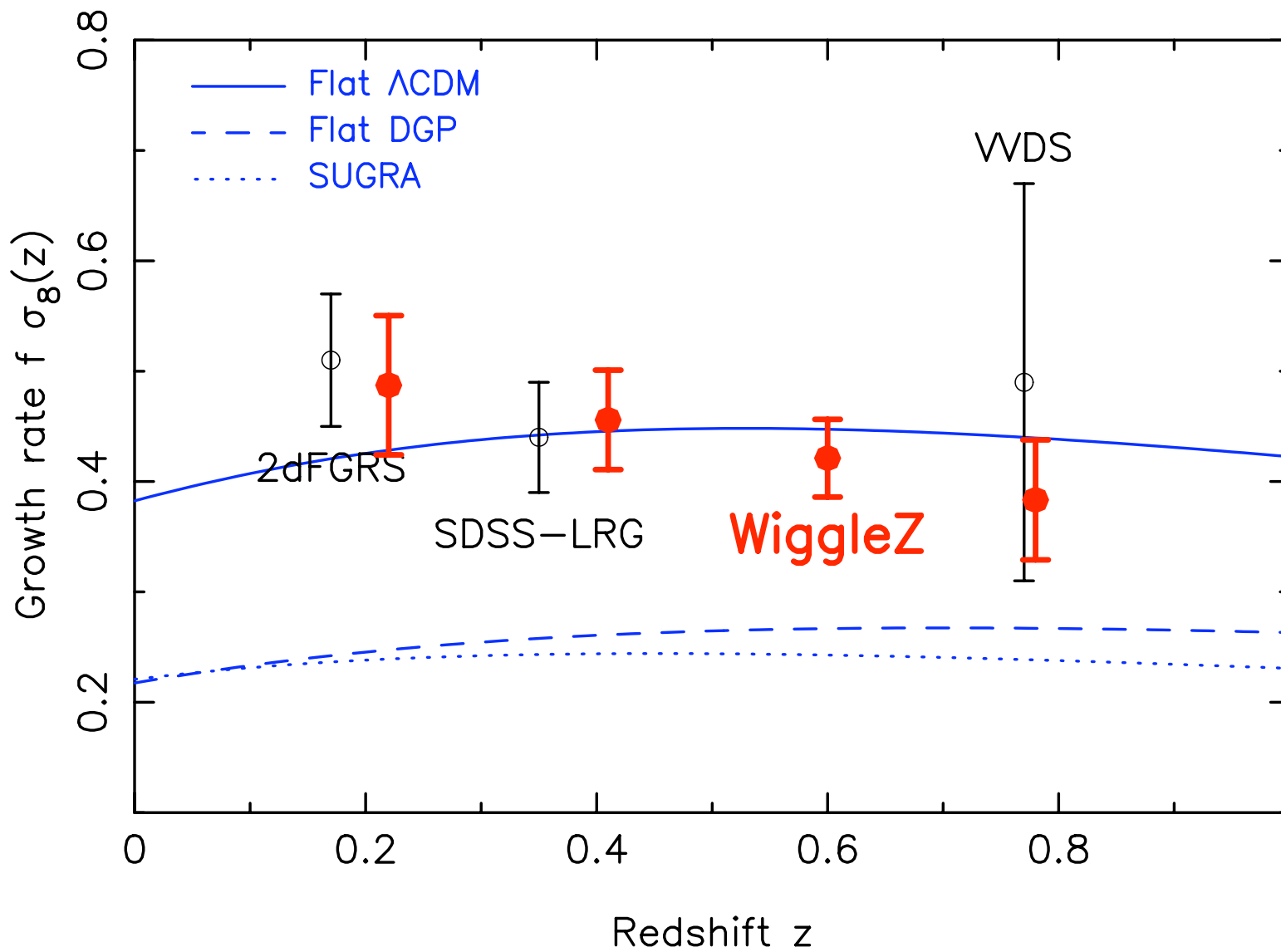
Growth history : redshift-space distortions

Growth history : redshift-space distortions
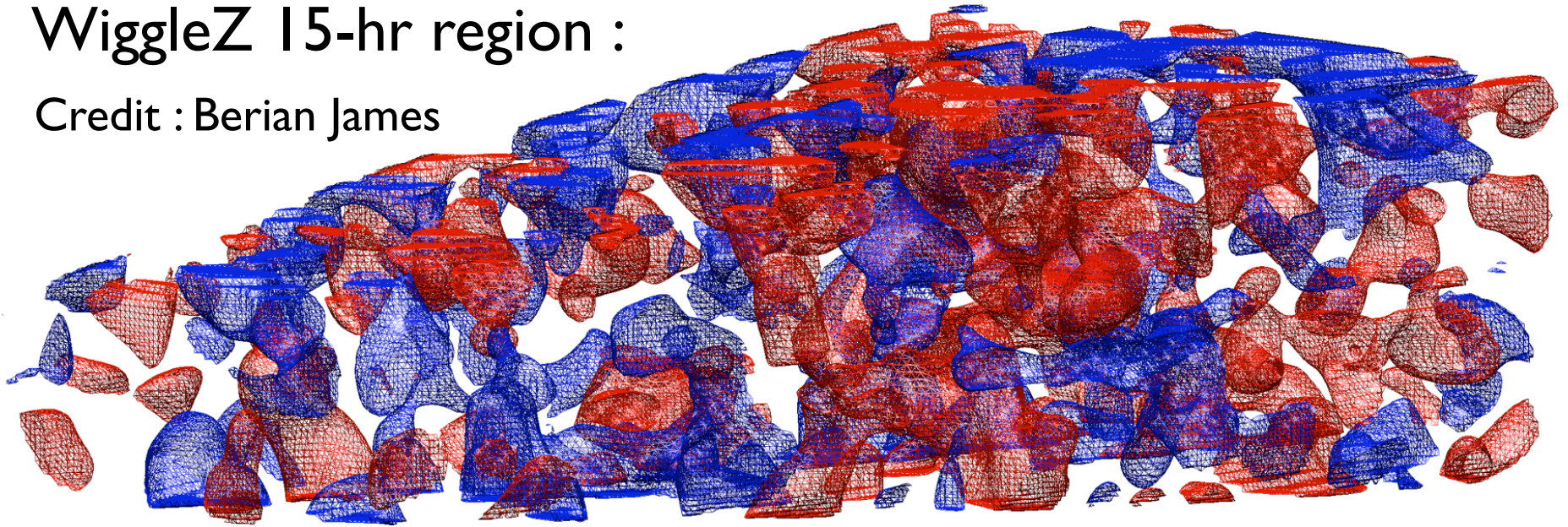
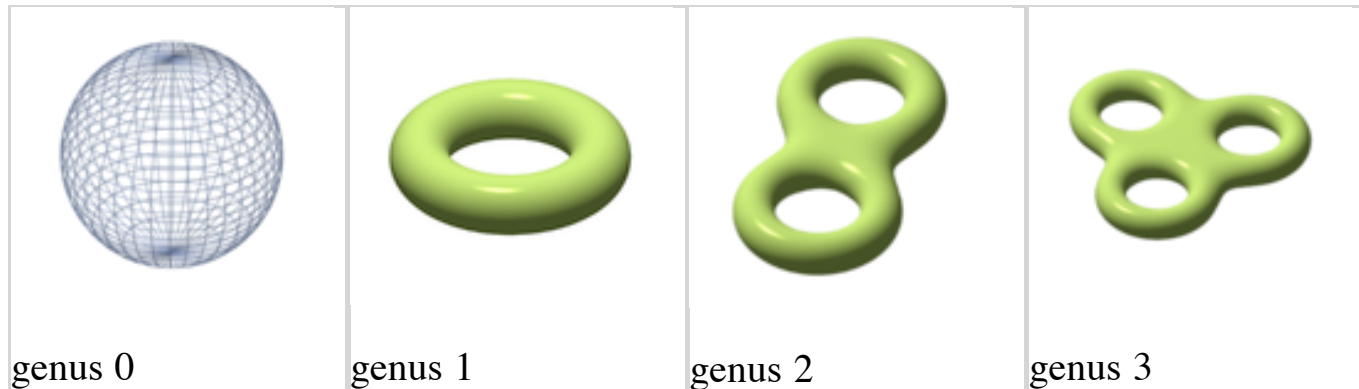# Growth history : redshift-space distortions

Cosmic topology

WiggleZ 15-hr region :

Credit : Berian James

What is
the genus?

genus 0   genus 1   genus 2   genus 3
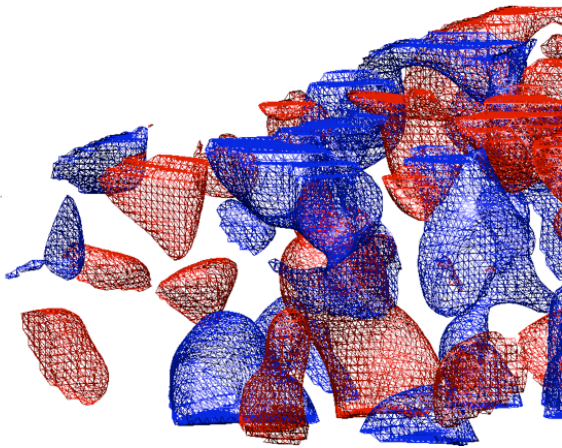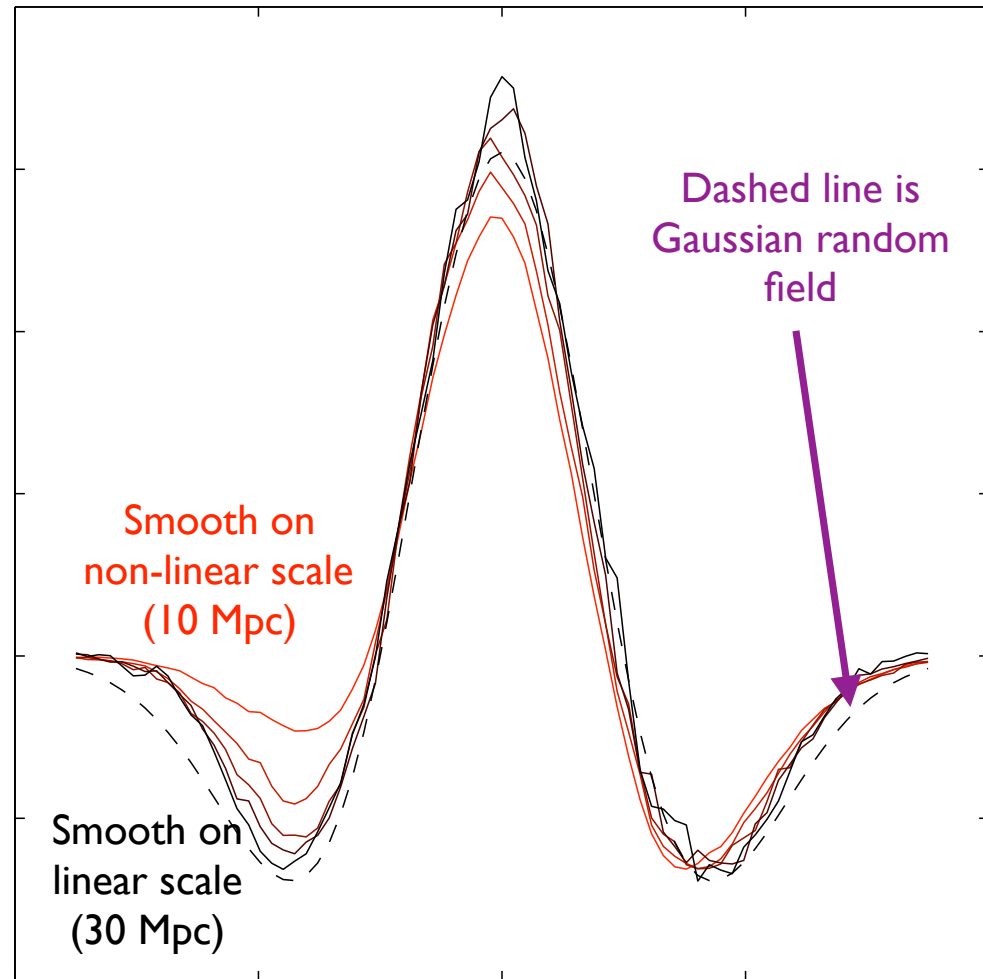
"A topologist is someone who can't tell their doughnut apart from their coffee mug"

Cosmic topology

Credit : Berian James

Genus value

Density value

Dashed line is Gaussian random field

Smooth on non-linear scale (10 Mpc)

Smooth on linear scale (30 Mpc)

Conclusions

- WiggleZ power spectrum is nicely fit by theory with matter/baryon densities consistent with CMB

- Baryon oscillations currently detected at ~2-sigma significance [~3-sigma at survey end]

- WiggleZ gives most accurate growth measurement, extending previous work to higher redshift

- General relativity / cosmological constant models remain a good fit

Thank you !