BOSS
The Baryon Oscillation Spectroscopic Survey

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Outline

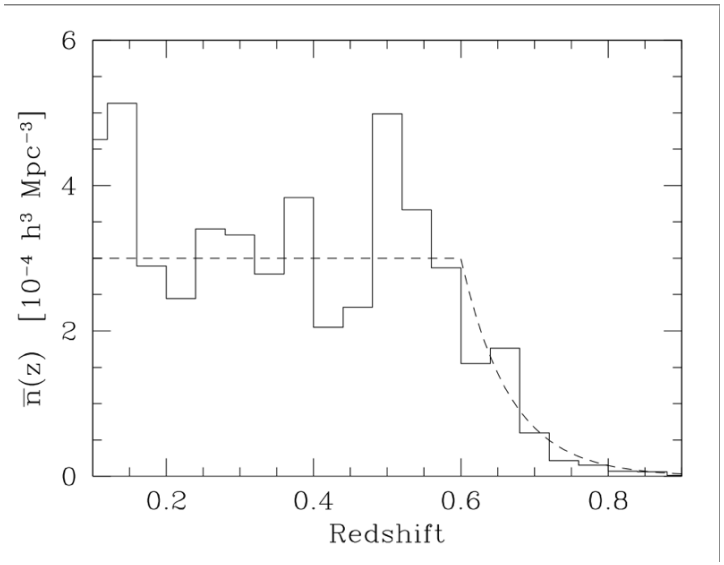
SDSS-III and BOSS

- How to do a precision low-z BAO expt.?
- After SDSS, then what?
- BOSS – part of SDSS-III (all dark time for 5 yrs)
- Scheduled start (contingent on funding) Fall 2008
- Director : Daniel Eisenstein
- BOSS PI : David Schlegel

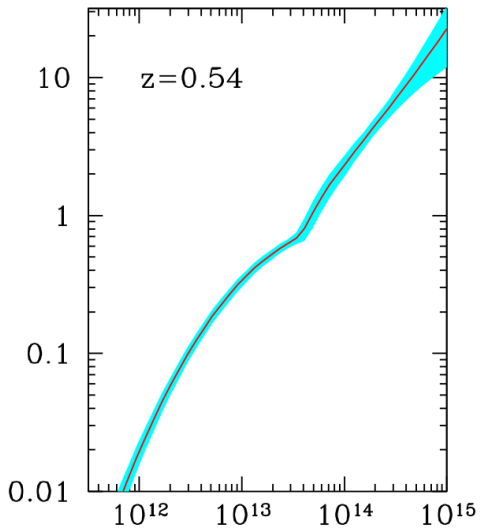
BOSS in overview

- Ω = 10,000 deg^2
- LRGs : $z \sim 0.1 - 0.7$
- QSOs (Lyman-α forest) : $z \sim 2.3 - 3.3$
- 1% d_A, 2% H at $z \sim 0.35, 0.6$
- 1.5% d_A, H at $z \sim 2.5$
- Fill in SDSS stripes in the south
- Leverage existing hardware where possible
  - LBL red-optimized CCds
  - E2V/Fairchild blue CCDs
  - VPH gratings
  - 1000 fibers

LRGs



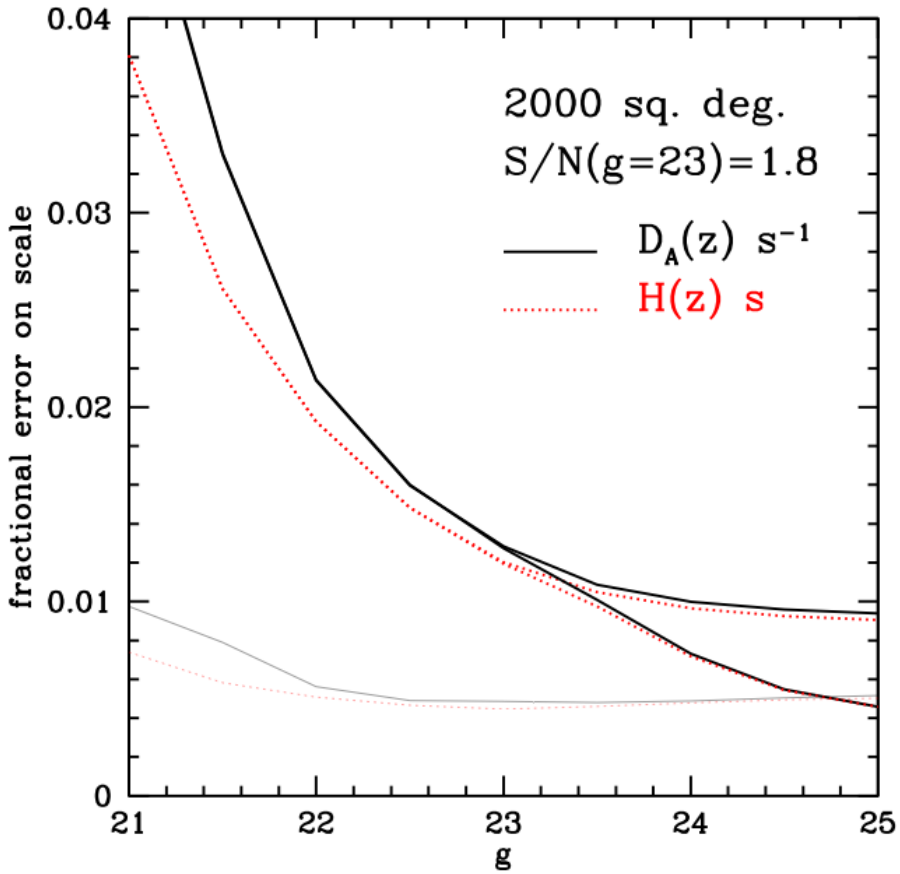
- Targeting based on SDSS *gri* photometry
  - $i < 20$
  - Experience from SDSS, 2SLAQ, AGES
- $\sim 150/\mathrm{deg}^2$, $\bar{n} \sim 3 \times 10^{-4}(h/\mathrm{Mpc})^3$
- Sample similar to photometric samples analyzed in NP et al (2007), Blake et al (2007).
- Bias passively evolving; $b(z)D(z) \sim 1.7$ ($\sigma_8 = 0.8$)
- Small-scale clustering well understood in terms of HODs.



NP, White, Norberg, Porciani in prep.

QSOs

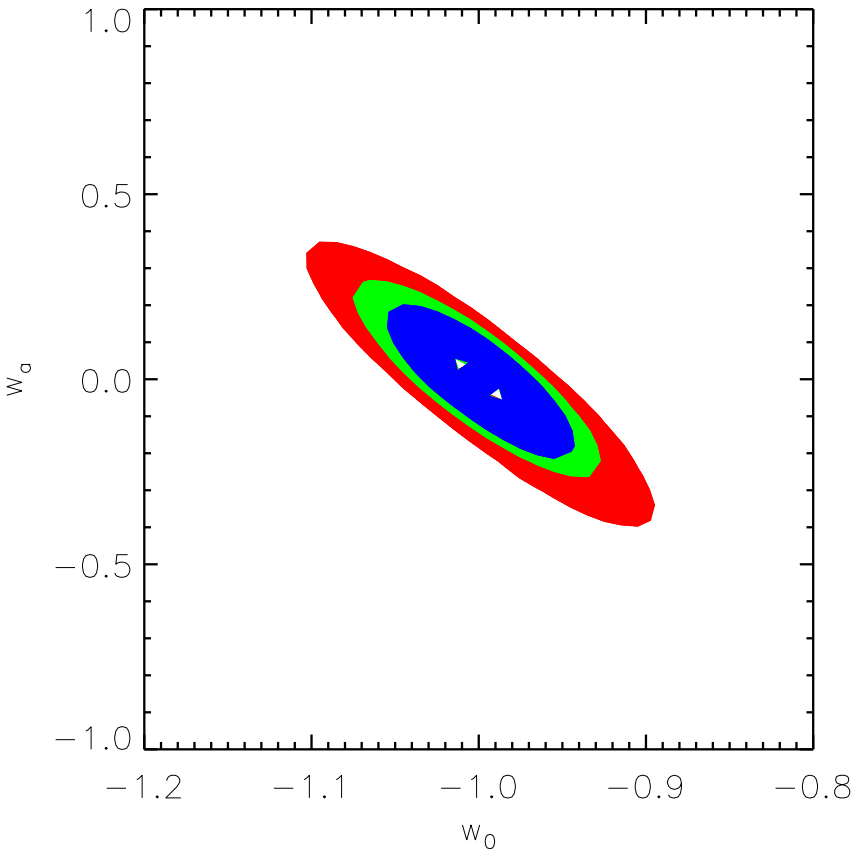
- 8000 deg^2
- $g = 22$
- 20/deg^2
- 1.5% in d_A, H
- Comparable to other high-redshift surveys, but with 2.5m telescope

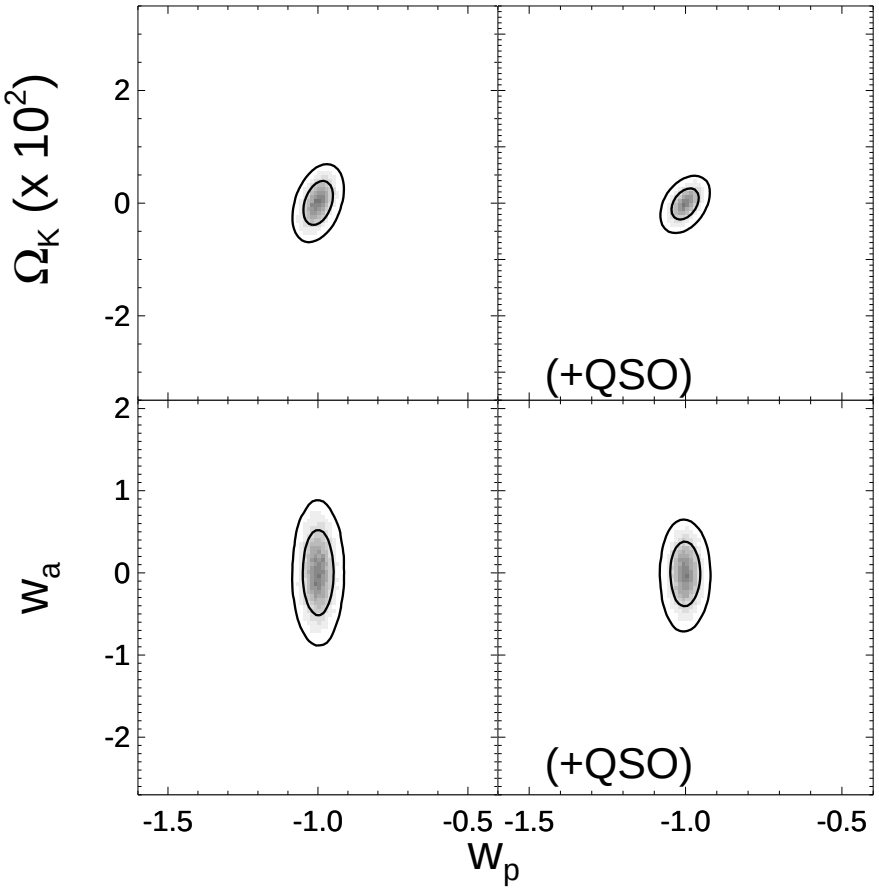


McDonald and Eisenstein, 2006

Dark Energy Constraints

DETF FoM = 122 (BOSS BAO), 257 (+P(k)), 479 (+WL+SN+CL)



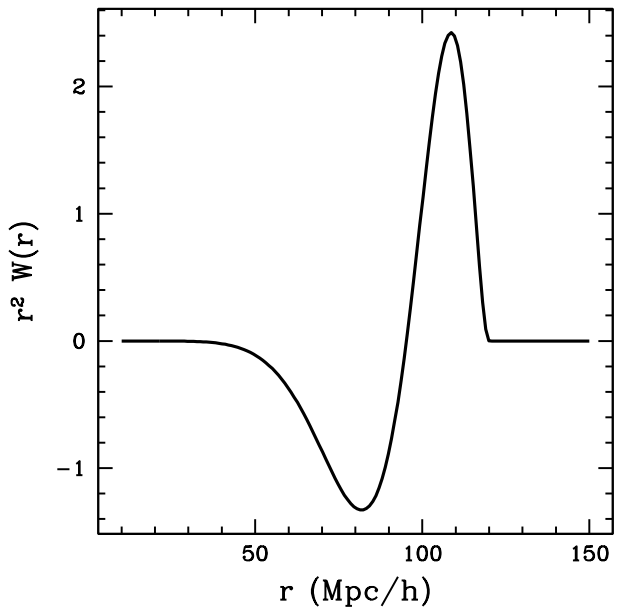


Other Science

- Galaxy $P(k)$, Lyman-α forest
- Evolution of massive galaxies from z=0.7 to z=0
- Improved QSO clustering measurements at moderate to high redshift
- GG lensing (synergy with eg. Pan-STARRS)
- ... and much more.

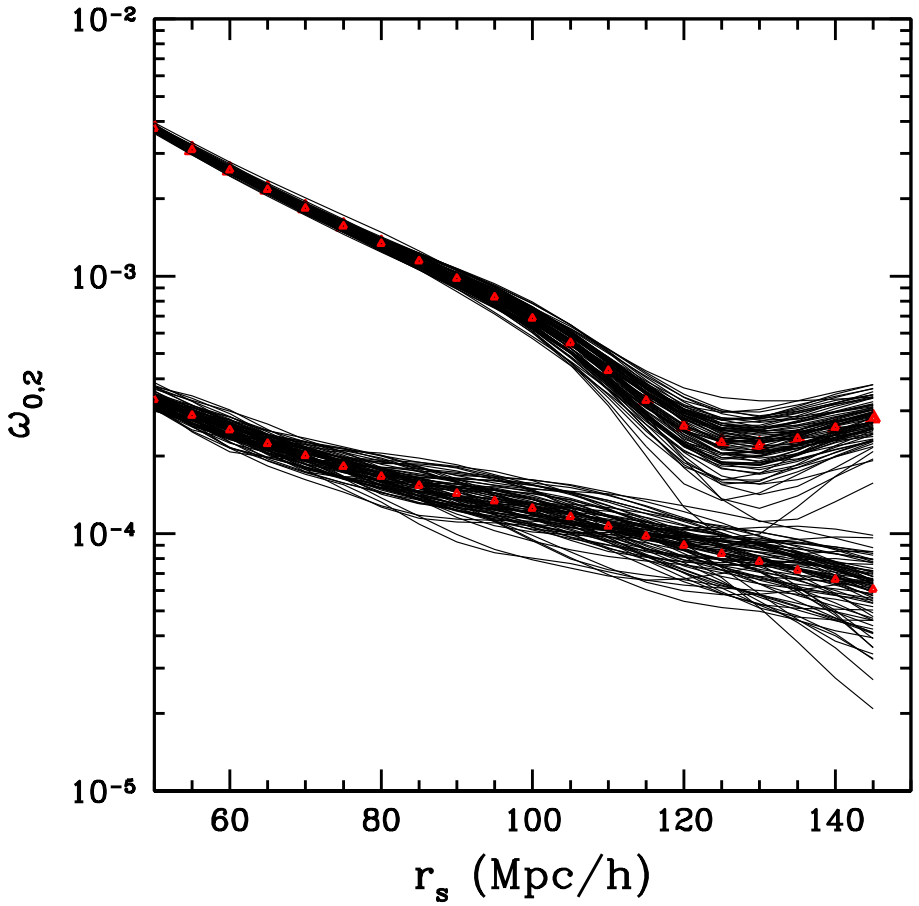
ω_ℓ

- A real space, band-power, unbinned estimator
- Generalize ideas in NP, White, Eisenstein 2007
- $\omega_\ell \equiv 2\pi \int dr\, d\mu \xi(r,\mu) W(r, r_s) P_\ell(\mu)$
- Use $W(x) = (2x)^2(1-x)^2(0.5-x)$ where $x = (r/r_s)^3$
- Asymptotics : k^2, k^{-4}
- Insensitive to large scale modes (PBC, integral constraints etc.)
- Gaussian correlation matrix is a good approximation



BOSS with ω_ℓ

- 40×8 (Gpc/h)^3 simulations
- $80 \times$ BOSS
- Low resolution simulations
- galaxies populated according to density to match large scale clustering of LRGs



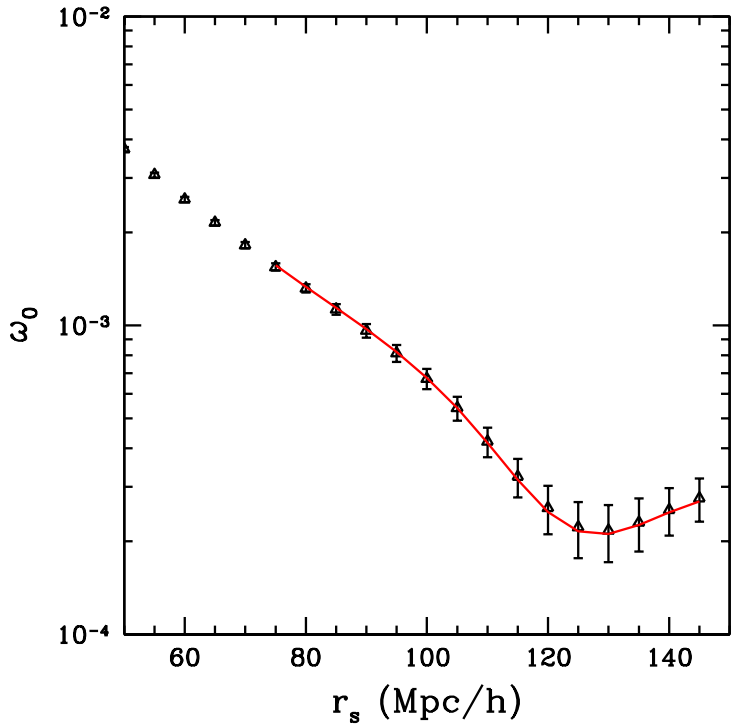
A $P(k)$ model

$$P_{ESW}(k) = P_{lin}(k)e^{-k^2\sigma^2} + P_{nw}(k)(1 - e^{-k^2\sigma^2})$$

$$P_g(k) = \frac{B(k)}{C(k)} P_{ESW}(\alpha k)$$

$$B(k) = \sum_{i=0}^{3} b_i k^i$$

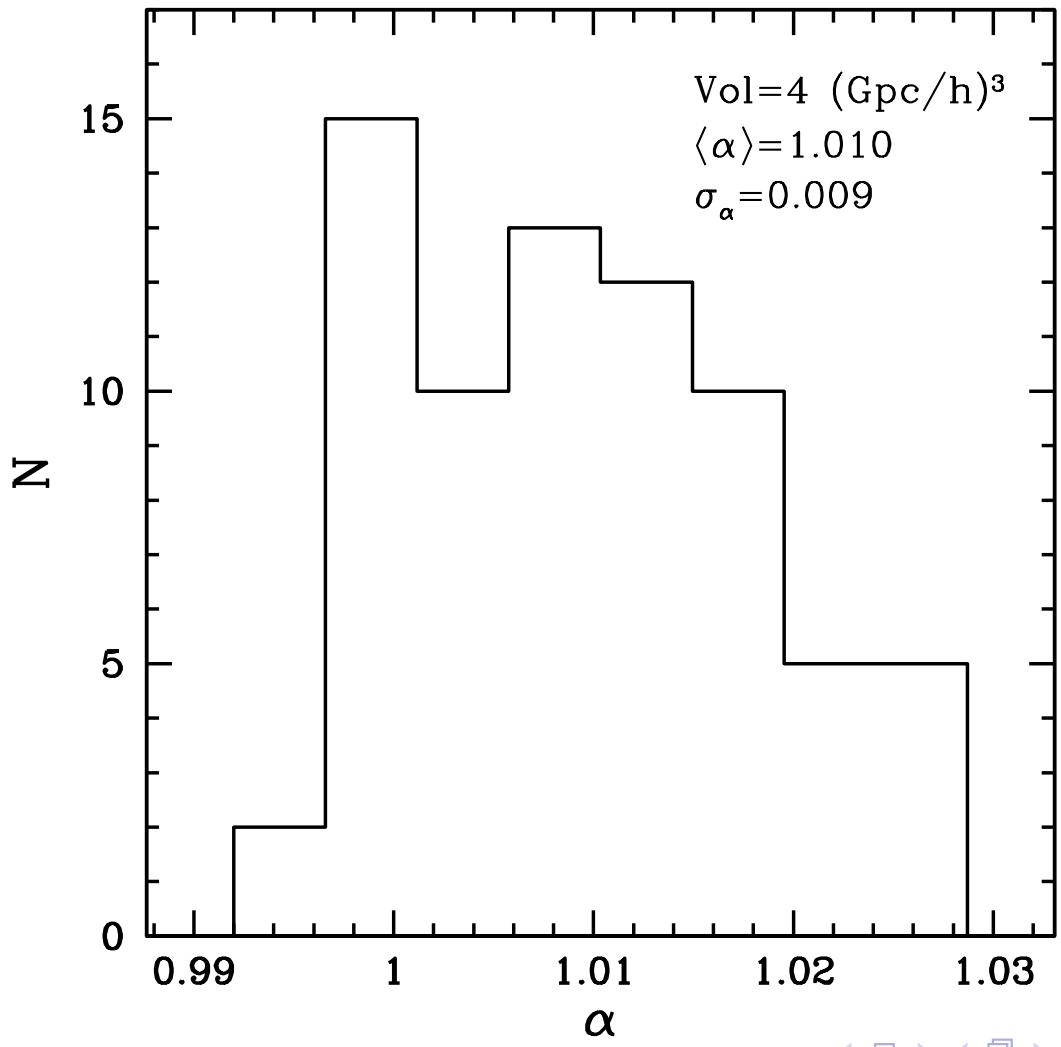
$$C(k) = 1 + \sum_{i=1}^{2} c_i k^i$$



Eisenstein, Seo, White 2006

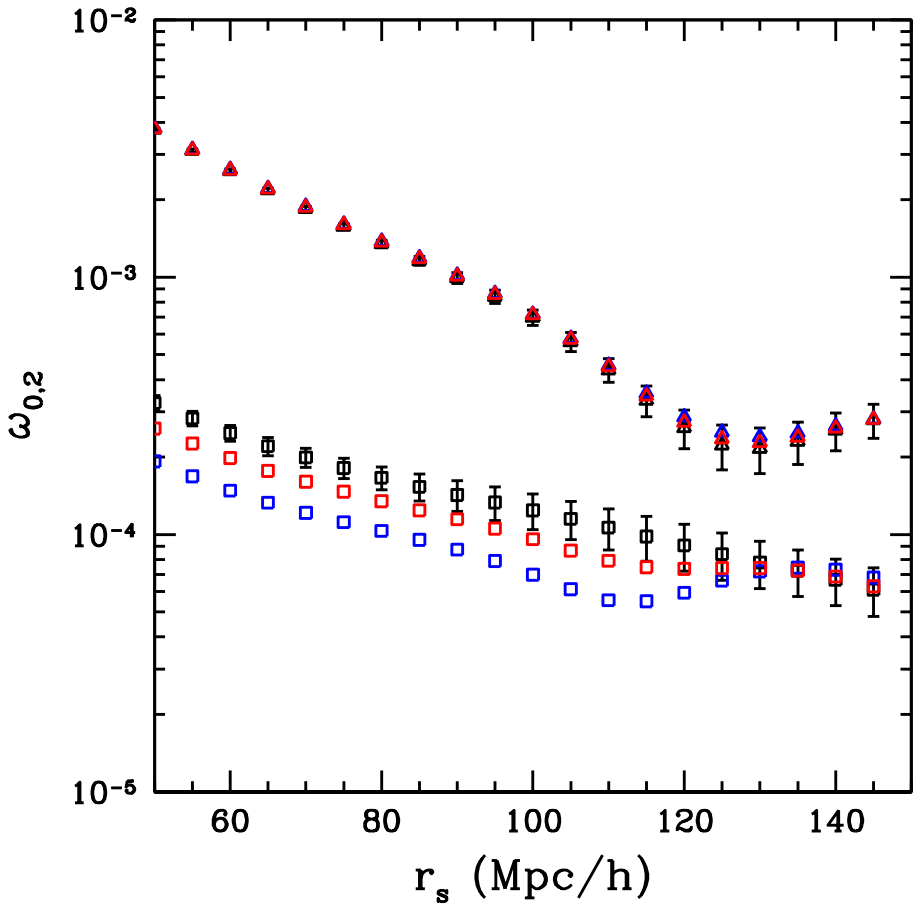
Isotropic Shifts

PRELIMINARY!



Anisotropic Clustering

- Isotropic clustering constrains $D_V \equiv d_A^{2/3}/H^{1/3}$
- Warp box holding D_V constant; consider 5,10% warps
- Amplitude change, not shift



Summary

BOSS :

- On the SDSS 2.5m telescope
- Using LRGs between z=0 to 0.7, 1% distance constraints
- Using the Lyman-α forest, z=2.3 to 3.3, 1.5% distance constraints
- Within a factor of 2 of a low-z cosmic-variance BAO measurement

Analyzing BAO surveys :

- A band-power configuration space estimator
- Isotropic shifts – need more work
- Anisotropic clustering