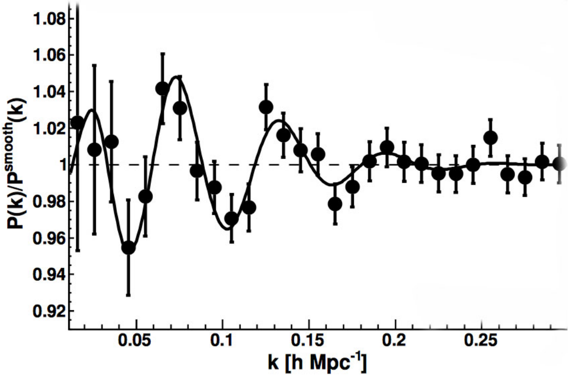
Cosmology with the Baryon Oscillation Spectroscopic Survey

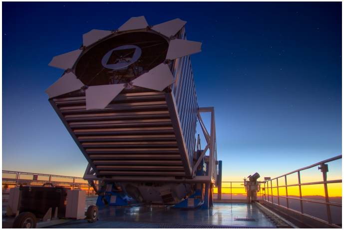
Florian Beutler

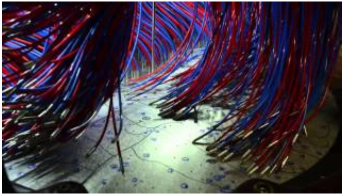


ICG, University of Portsmouth

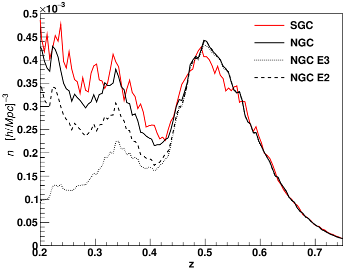
The BOSS galaxy survey

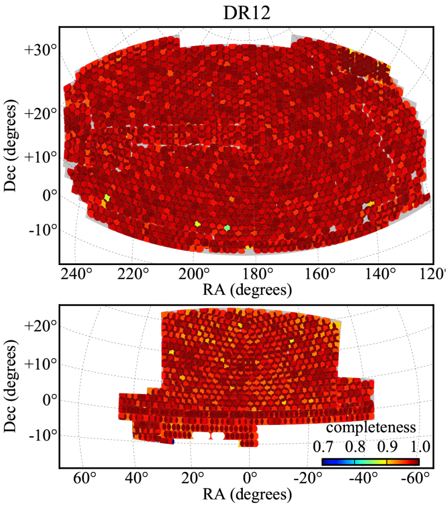
- Third version of the Sloan Digital Sky Survey (SDSS-III).
- Spectroscopic survey optimized for the measurement of Baryon Acoustic Oscillations (BAO).
- The galaxy sample includes 1 100 000 galaxy redshifts in the range $0.2 < z < 0.75$.
- The effective volume is $\sim 6\,\text{Gpc}^3$.
- 1000 fibres/redshifts per pointing



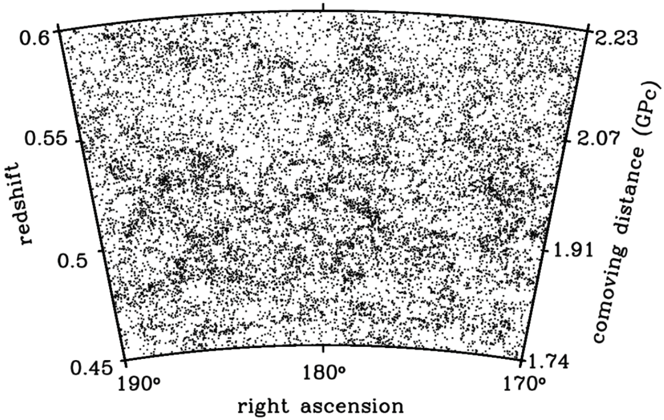


- The final data release (DR12) coveres about 10 000 deg^2.
- The survey is divided in a north galactic patch (NGC) and a south galactic patch (SGC).

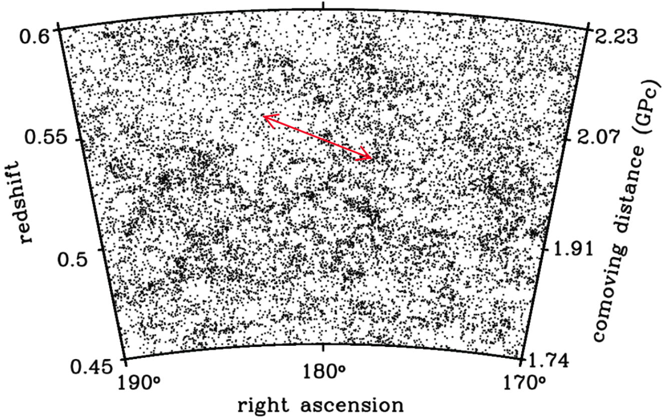




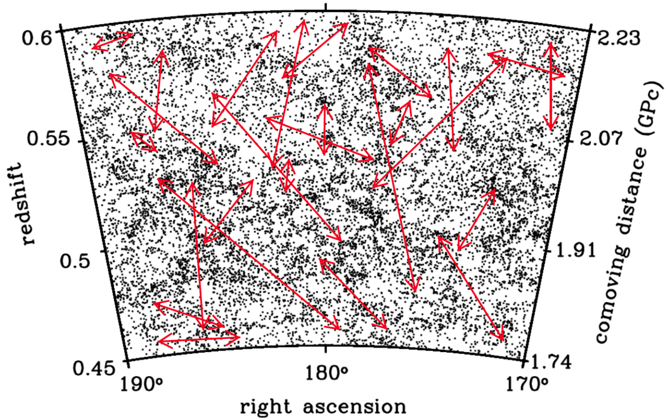
Two point statistics



Two point statistics



Two point statistics



Two point statistics

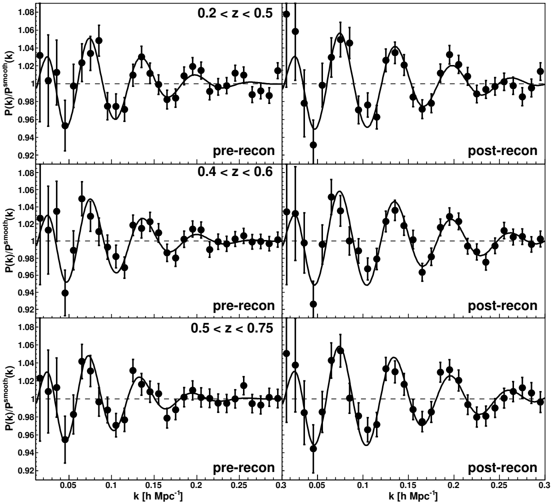
The correlation function is defined via the excess probability of finding a galaxy pair at separation r

$$dP = \overline{n}^2 \left[1 + \xi(r)\right] dV_1 dV_2.$$

The correlation function and the power spectrum are just Fourier transforms of each other

$$P(k) = \int \xi(r) \exp(ik \cdot r) d^3 r = \langle \delta^2(k) \rangle$$
$$\xi(r) = \frac{1}{(2\pi)^3} \int P(k) \exp(-ik \cdot r) d^3 k.$$

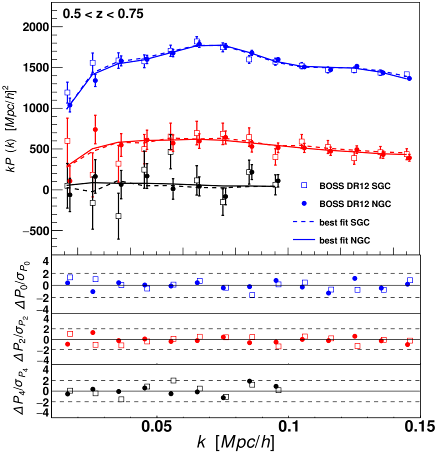
Isotropic two-point measurements



Beutler et al. (2016)

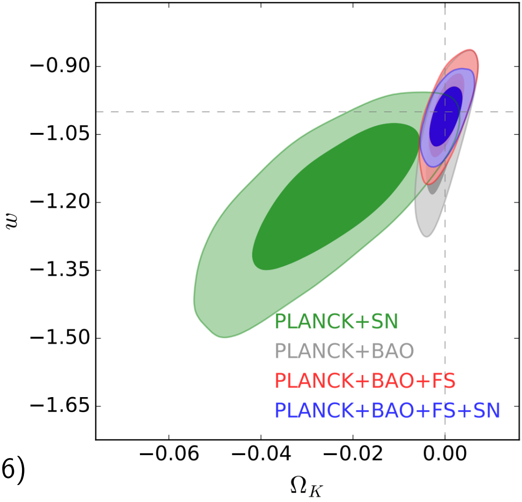
Anisotropic two-point measurements

$$P_\ell(k) = \frac{2\ell+1}{2}\int_{-1}^{1} d\mu\, P(k,\mu)\mathcal{L}_\ell(\mu)$$



Beutler et al. (2016)

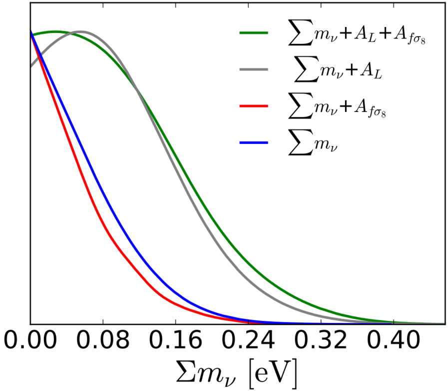
Constraining cosmological parameters



Alam et al (2016)

$$\Omega_k = 0.0002 \pm 0.0023$$

$$w = -1.01 \pm 0.04$$



Alam et al (2016)

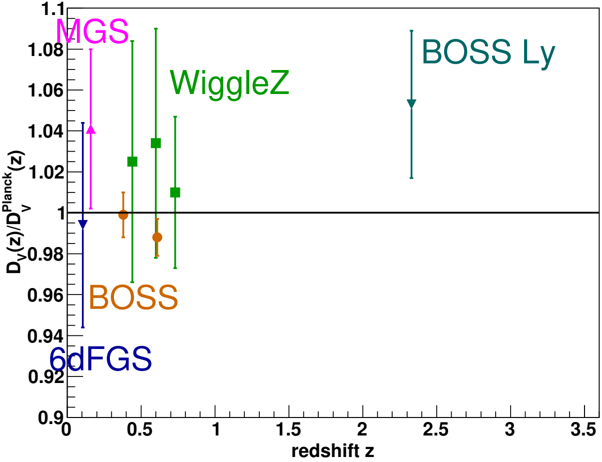
$$\Lambda CDM + \sum m_\nu < 0.16\, eV$$

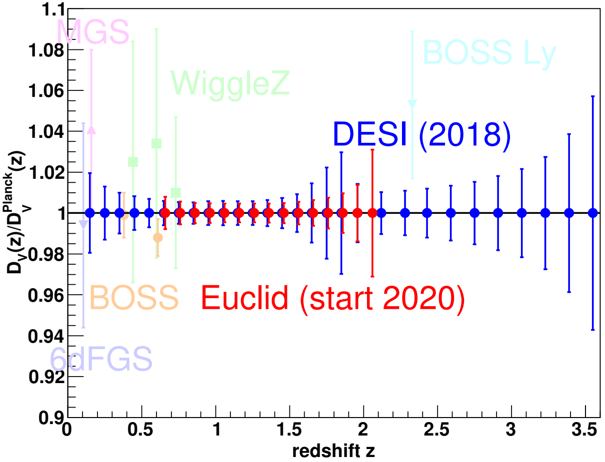
$$\Lambda CDM + \sum m_\nu + A_L < 0.23\, eV$$

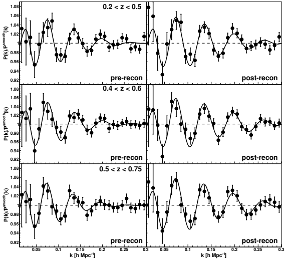
$$\Lambda CDM + \sum m_\nu + A_{\rm fsig8} < 0.15\, eV$$

$$\Lambda CDM + \sum m_\nu + A_L + A_{\rm fsig8} < 0.25\, eV$$

Look into the future

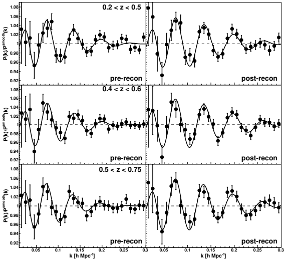


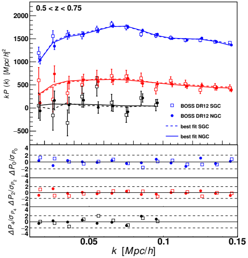

MGS
WiggleZ
BOSS Ly
DESI (2018)
BOSS
Euclid (start 2020)
6dFGS
$D_V(z)/D_V^{Planck}(z)$
redshift z
1.1
1.08
1.06
1.04
1.02
1
0.98
0.96
0.94
0.92
0.9
0
0.5
1
1.5
2
2.5
3
3.5



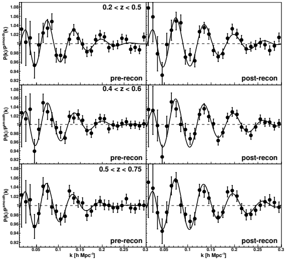
1. BOSS provided two independent 1% constraints on the Baryon Acoustic Oscillation scale at redshift $z = 0.38$ and $z = 0.61$. These constrains substantially improved upon the situation before BOSS.

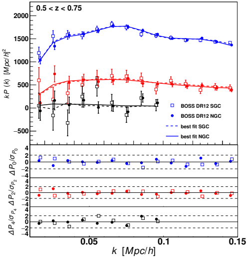
Summary

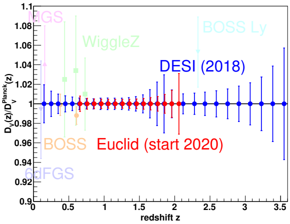




1. BOSS provided two independent 1% constraints on the Baryon Acoustic Oscillation scale at redshift $z = 0.38$ and $z = 0.61$. These constrains substantially improved upon the situation before BOSS.
2. BOSS also provides the currently best constraints on redshift-space distortions. A combined likelihood for BAO + RSD is available.







1. BOSS provided two independent 1% constraints on the Baryon Acoustic Oscillation scale at redshift $z = 0.38$ and $z = 0.61$. These constrains substantially improved upon the situation before BOSS.
2. BOSS also provides the currently best constraints on redshift-space distortions. A combined likelihood for BAO + RSD is available.
3. Future surveys like DESI and Euclid will increase the sample size by more than an order of magnitude.

Thank you very much