Galaxy clustering

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Outline of the talk

- Status of the OU-LE3 PFs.
- Status of the spectroscopic visibility mask and sample selection PFs.
- Summary of the BOSS-DR12 data release.
  - BOSS dataset
  - BAO constraints
  - RSD constraints
  - Cosmological implications

Status of the OU-LE3 PFs

- Correlation function, power spectrum, their covariance matrices, three-point function and bispectrum PFs developed by OU-LE3 WP galaxy clustering.
- The correlation function has reached maturity level 1A. On its way to ML1B. The power spectrum will also reach ML1A early next year. Covariance matrices codes will soon follow.
- The bispectrum and three-point functions are in an earlier stage. C++ prototype code ready (ML0).
- The Bispectrum code has been developed by Jennifer Pollack, Portsmouth and a C++ and Fortran version now exists. Jun Koda is starting a postdoc in Rom next month (with Enzo Branchini) to migrate the Bispectrum code into the Euclid environment.
- The three-point function code (developer is Michele Moresco): direct tripled counting code vs. FFT based method by Harvard group).
- Science performance review 2017 + Design review at the end of 2017.

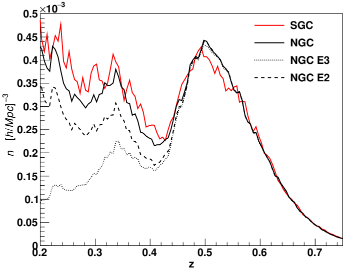
Spectroscopic Visibility Mask (VMSP-ID) + Sample Selection (SS-ID)

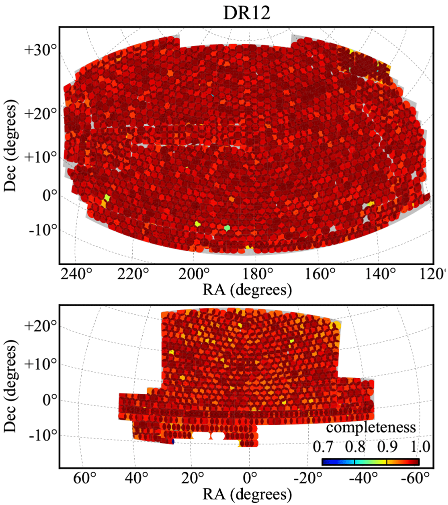
- VMSP: Random catalogue which specifies the Euclid survey in RA, DEC and redshift (stellar density, sky brighness etc).
- Currently developed together with the E2E simulation pipeline (pypelid, main developers Ben Granett and Dida Markovic).
- Soon to be migrated into a Euclid-compliant code in collaboration with SDC-Romania.
- The sample selection PF is meant to (1) apply different cuts (based on the parameters defining the mask) and (2) calculate the completeness and purity of that sample. The reference sample for the completeness calculation is the deep sample (developer of that PF is Lado Samushia). We expect to reach ML1 by mid 2017.

The BOSS galaxy survey

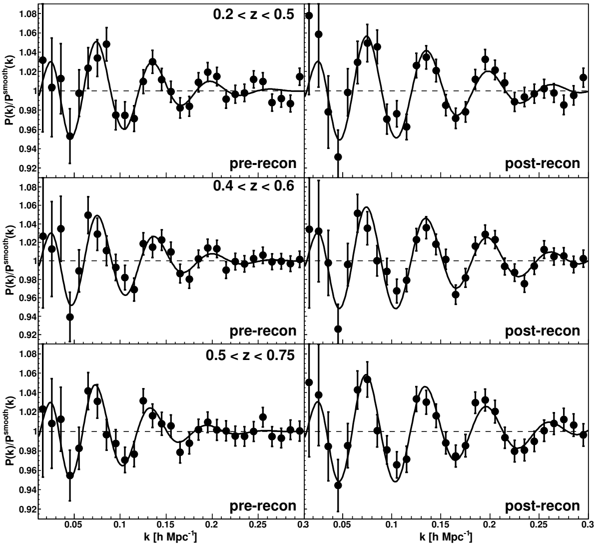
- Third version of the Sloan Digital Sky Survey (SDSS-III).
- Spectroscopic survey optimized for the measurement of Baryon Acoustic Oscillations (BAO).
- The galaxy sample includes 1 100 000 galaxy redshifts in the range $0.2 < z < 0.75$.
- The effective volume is $\sim 6\,\mathrm{Gpc}^3$.
- 1000 fibres/redshifts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

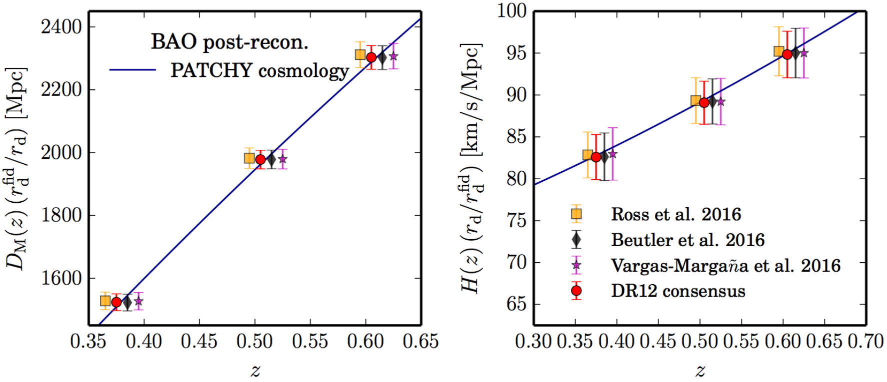




BOSS & BAO

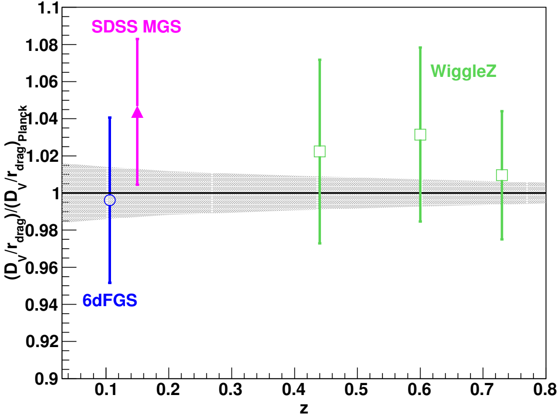


Beutler et al. (2016)



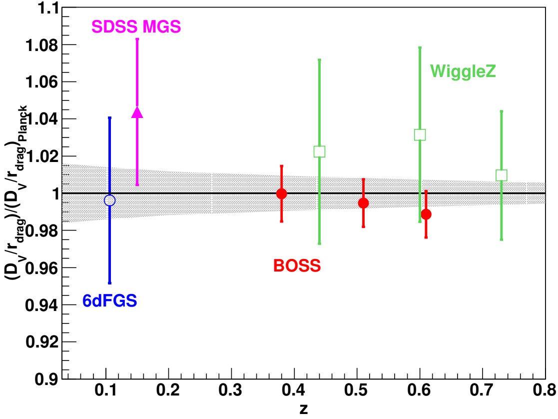
Alam et al. (2016)

BAO constraints before BOSS



$$D_V(z) = \left[(1+z)^2 D_A^2(z) \frac{cz}{H(z)}\right]^{1/3}$$

BAO constraints including BOSS



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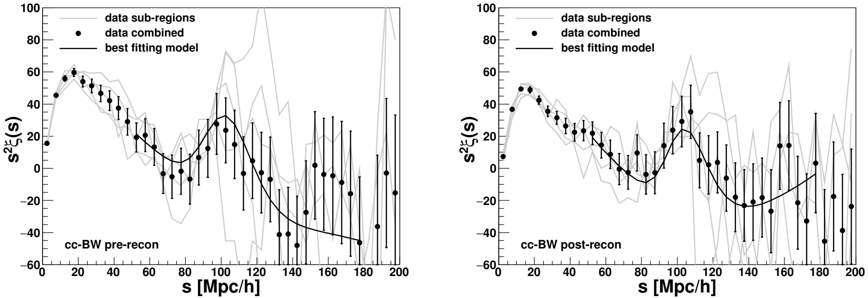
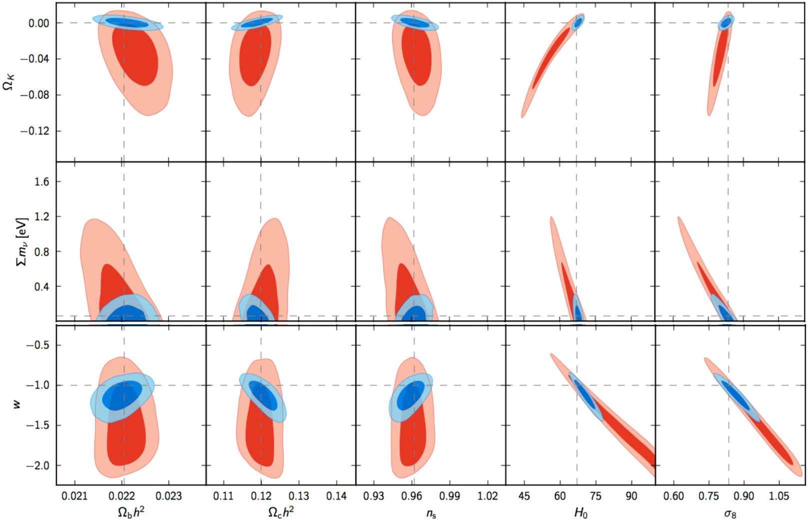


$$D_V/r_s = 2180^{+110}_{-140}\,Mpc \qquad \text{(pre-recon)}$$
$$D_V/r_s = 2132 \pm 65\,Mpc \qquad \text{(post-recon)}$$

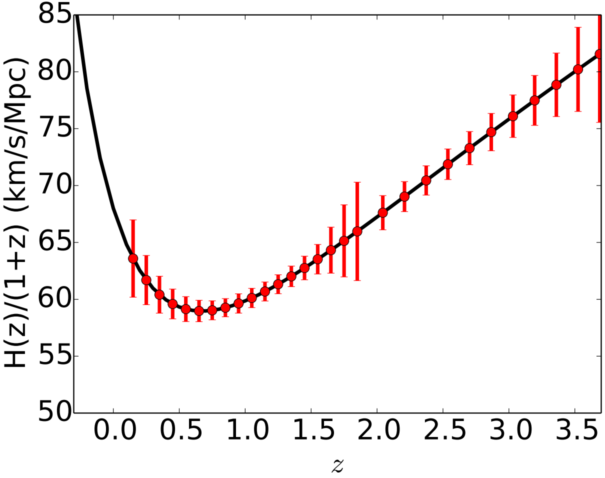
Beutler et al. (2015)

Planck 2015

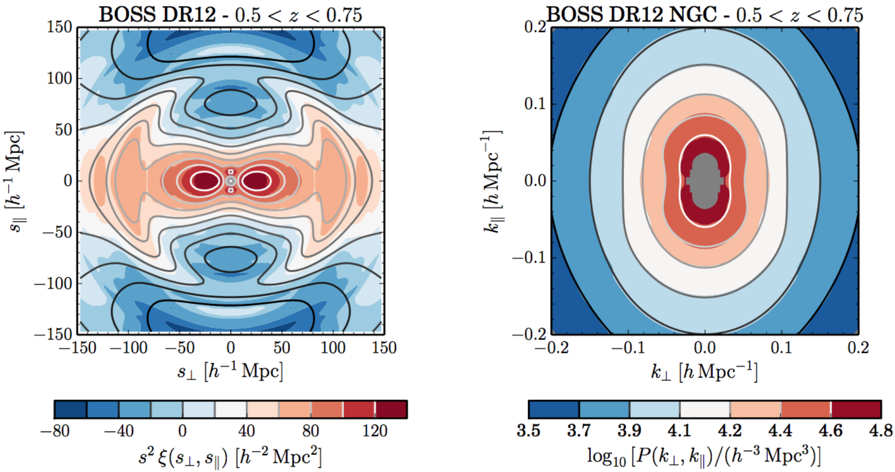


Ade et al. (2015)

Next generation BAO (DESI)



Patrick McDonald



Alam et al. (2016)

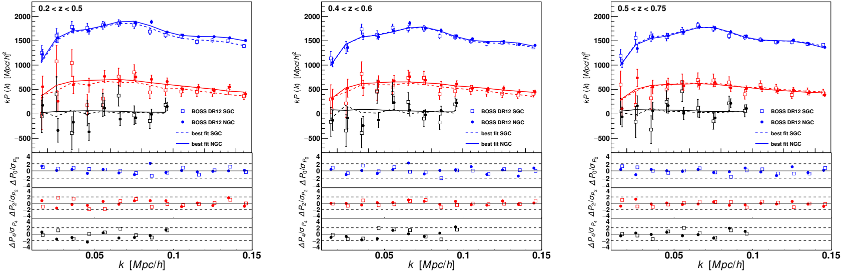
Power spectrum modeling

Our power spectrum model is based on renormalized perturbation theory (Taruya et al. 2011, McDonald & Roy 2009)

$$
\begin{aligned}
P_{\rm g}(k,\mu) = \exp\left\{-(fk\mu\sigma_v)^2\right\}\big[&P_{{\rm g},\delta\delta}(k) \\
&+ 2f\mu^2 P_{{\rm g},\delta\theta}(k) + f^2\mu^4 P_{\theta\theta}(k) \\
&+ b_1^3 A(k,\mu,\beta) + b_1^4 B(k,\mu,\beta)\big],
\end{aligned}
$$

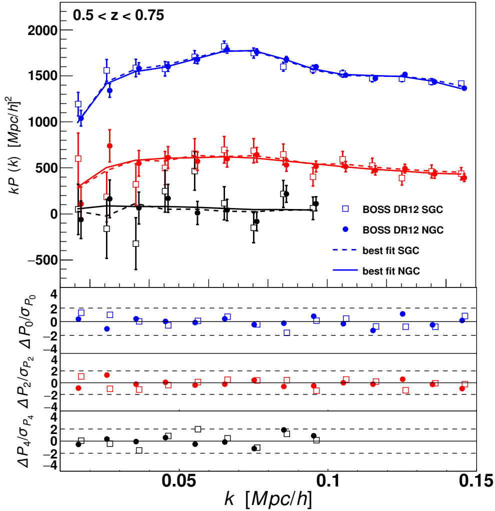
with

$$
\begin{aligned}
P_{{\rm g},\delta\delta}(k) &= b_1^2 P_{\delta\delta}(k) + 2b_2 b_1 P_{b2,\delta}(k) + 2b_{s2} b_1 P_{bs2,\delta}(k) \\
&+ 2b_{\rm 3nl} b_1 \sigma_3^2(k) P_{\rm m}^{\rm L}(k) + b_2^2 P_{b22}(k) \\
&+ 2b_2 b_{s2} P_{b2s2}(k) + b_{s2}^2 P_{bs22}(k) + N, \\
P_{{\rm g},\delta\theta}(k) &= b_1 P_{\delta\theta}(k) + b_2 P_{b2,\theta}(k) + b_{s2} P_{bs2,\theta}(k) \\
&+ b_{\rm 3nl}\sigma_3^2(k) P_{\rm m}^{\rm lin}(k),
\end{aligned}
$$

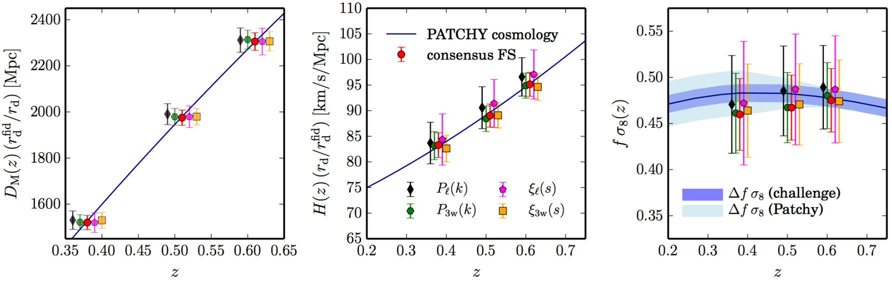


Beutler et al. (2016)

Power spectrum measurement

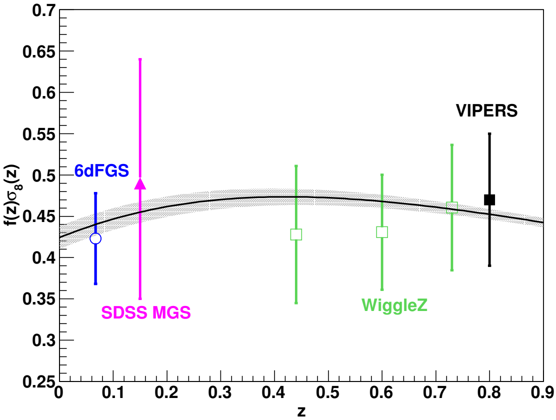


Beutler et al. (2016)



Alam et al. (2016)

Growth of structure constraints



$$f(z) = \frac{\partial \ln D(a)}{\partial \ln a}$$

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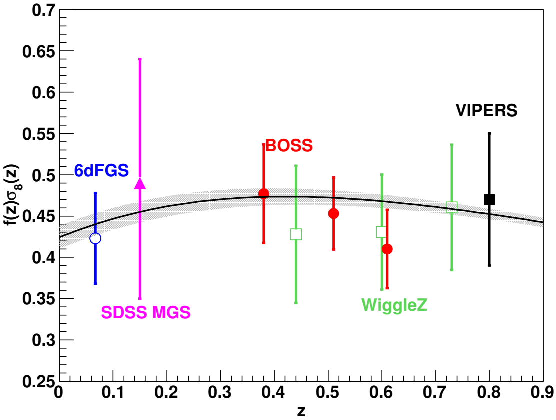

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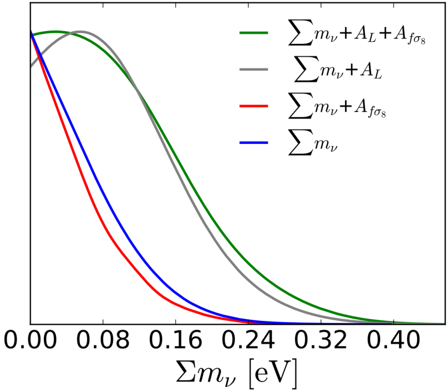
Constraining the neutrino mass



Alam et al (2016)

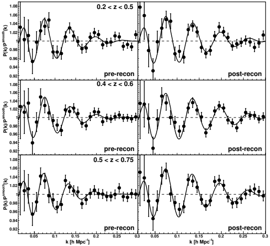
$$\Lambda CDM + \sum m_\nu < 0.16\, eV$$

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

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

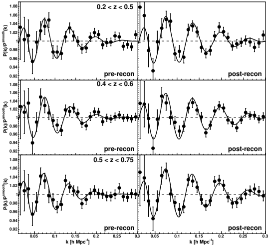
$$\Lambda CDM + \sum m_\nu + A_L + A_{\mathrm{fsig8}} < 0.25\, eV$$

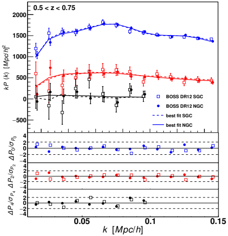
Summary



1. In BOSS we were able to measure the BAO scale in two independent redshift bins ($z = 0.38$ and $z = 0.61$) with an error of 1%, representing the best BAO scale measurements to date.

Summary





1. In BOSS we were able to measure the BAO scale in two independent redshift bins ($z = 0.38$ and $z = 0.61$) with an error of 1%, representing the best BAO scale measurements to date.
2. We achieved the best constraint to date on the growth of structure through $f\sigma_8$ with an uncertainty of 11% in two independent redshift bins.

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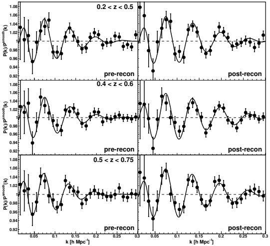

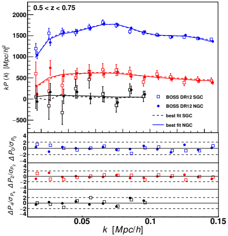

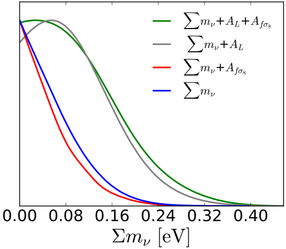

1. In BOSS we were able to measure the BAO scale in two independent redshift bins ($z = 0.38$ and $z = 0.61$) with an error of 1%, representing the best BAO scale measurements to date.
2. We achieved the best constraint to date on the growth of structure through $f\sigma_8$ with an uncertainty of 11% in two independent redshift bins.
3. These measurements lead to a neutrino mass constraint of < 0.16 eV when combining with Planck.