Status report

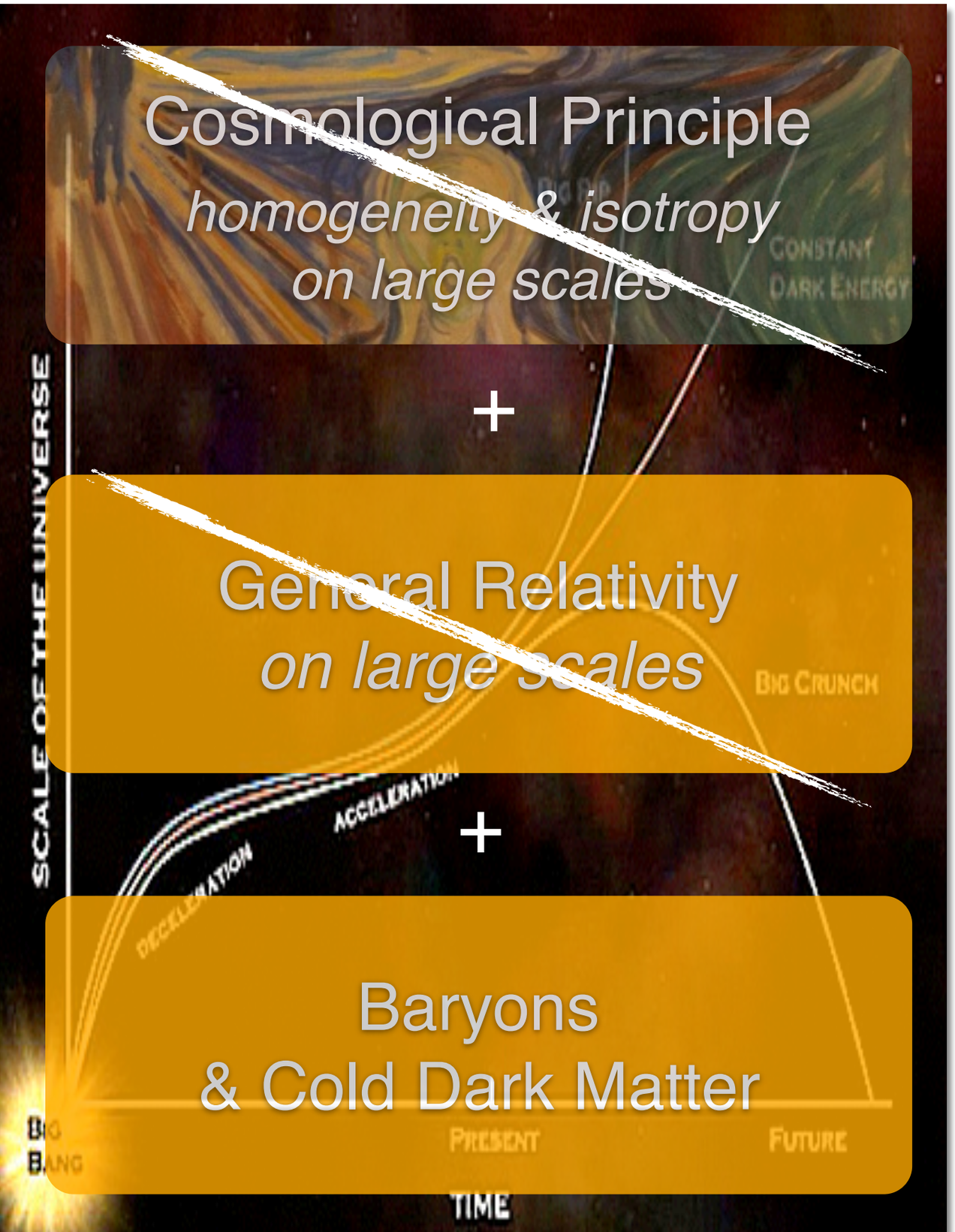
Euclid-France meeting

Paris, 7th of January 2016

Sylvain de la Torre

Laboratoire d'Astrophysique de Marseille
Aix-Marseille University

Galaxy clustering: Main science



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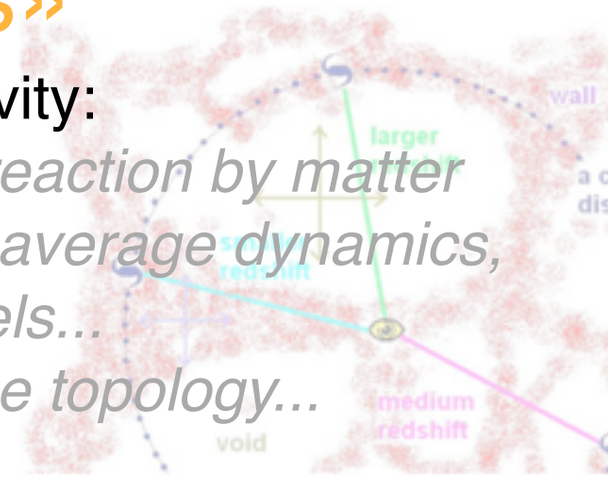
«other probes»

inhomogeneous gravity:
non-linear GR backreaction by matter inhomogeneities on average dynamics, Swiss-Cheese models... non-trivial space-time topology...



RSD

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dark gravity:
[superstring-inspired/justified] scalar-tensor and/or f(R) theories of gravity, 5D gravity, massive gravity, ...

BAO

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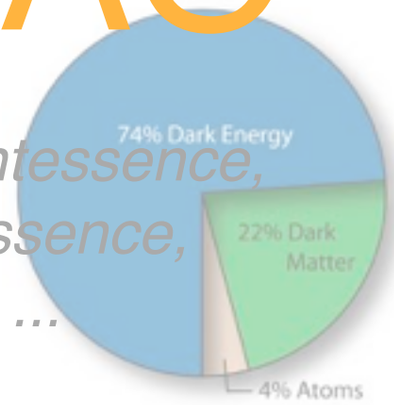
dark energy:
cosmological constant, quintessence, cosmon, k-essence, spintessence, generalized Chaplygin gas, ...

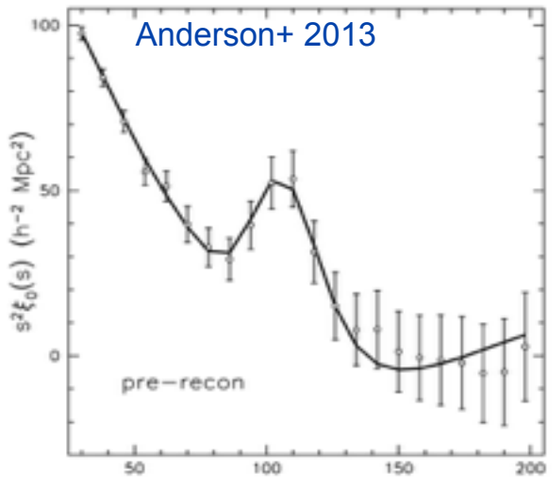


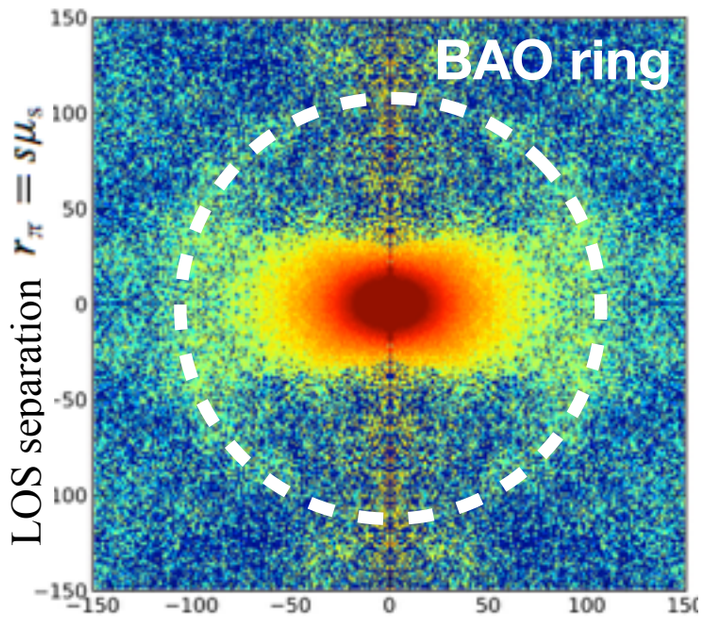
Galaxy clustering: Main observables

#1: Baryonic Acoustic Oscillations (BAO)
in 2-point correlation functions

H(z) (Dv(z) in fact)

Expansion history

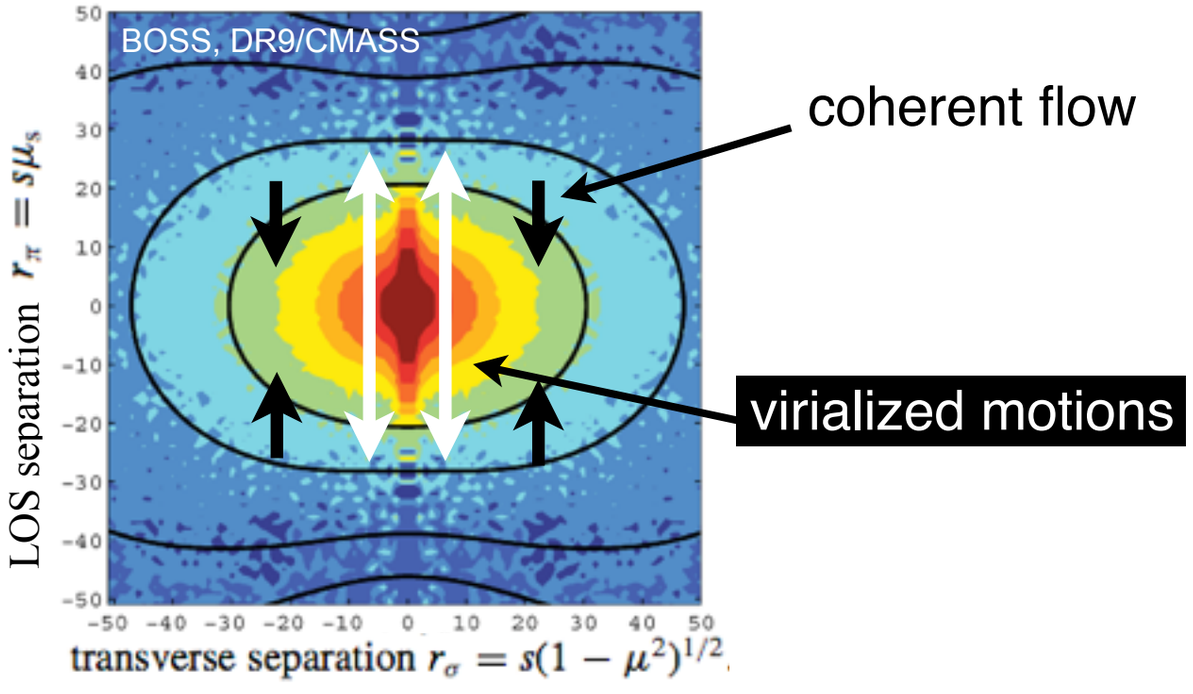




#2: Redshift Space Distortions (RSD)
in 2-point correlation functions

f(z)

Growth rate of structure history

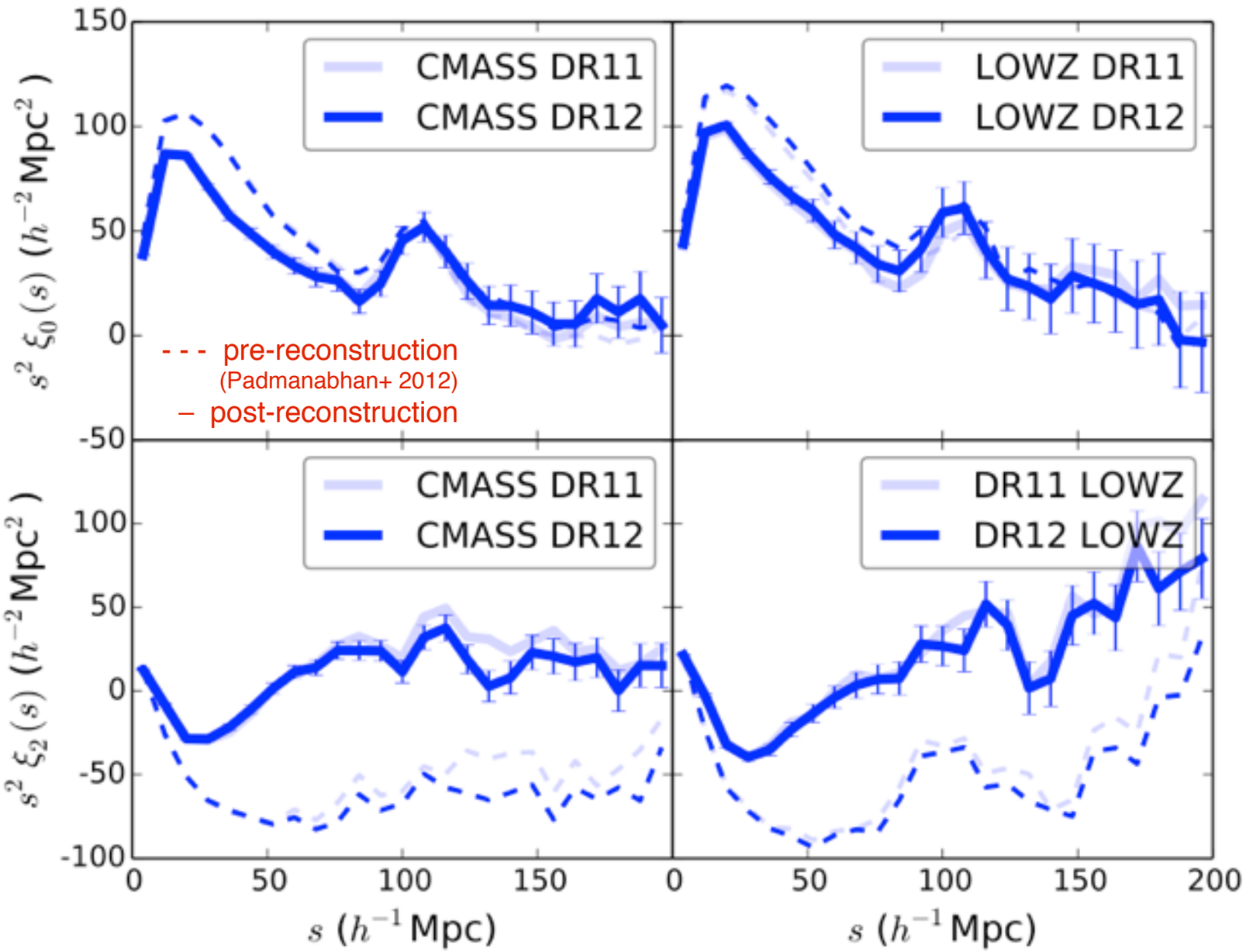


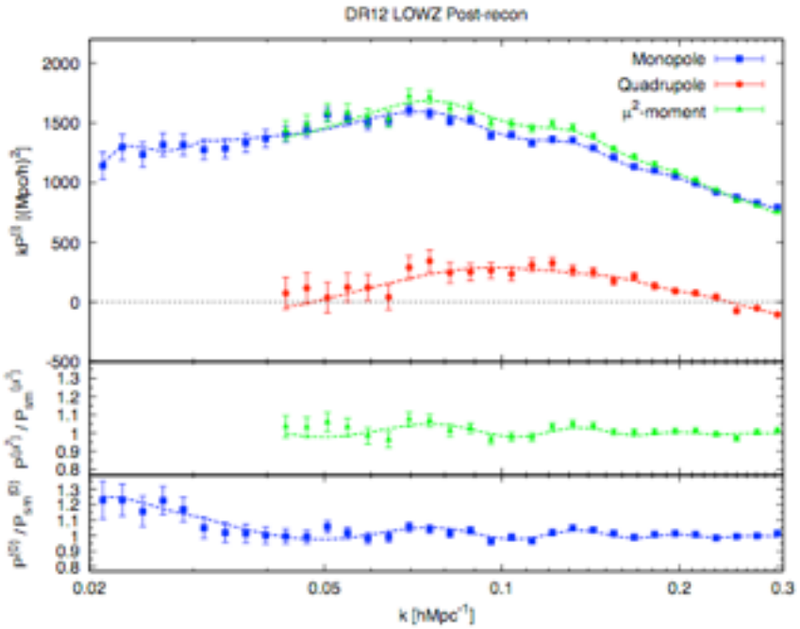
Galaxy clustering: News / BAO

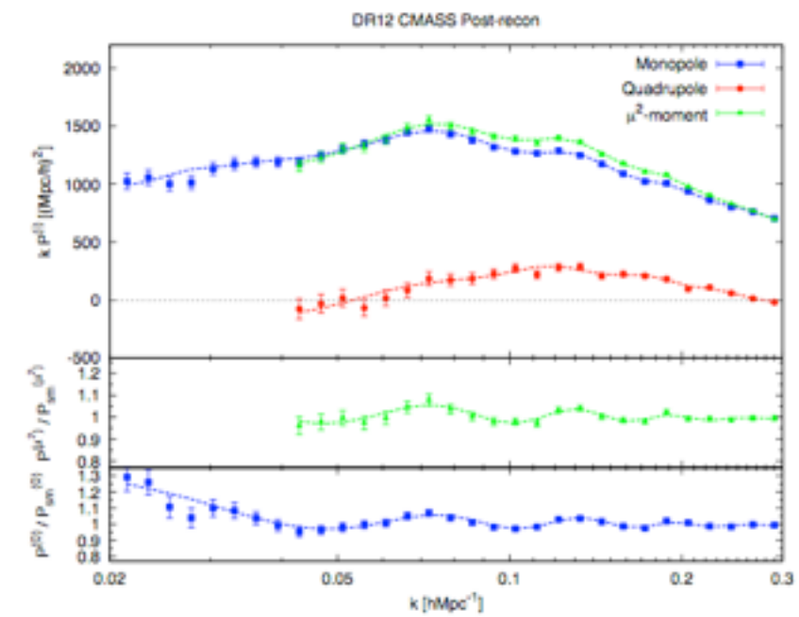
SDSS-III/BOSS [DR12]

Cuesta+ 2015
Gil Marín+ 2015

- volume = 14.5 Gpc^3 = 1.10 volume DR11
- LOWZ ($0.15 < z < 0.43$): ~360,000 gals; CMASS ($0.43 < z < 0.70$): 780,000 gals
- (1) spherically averaged and anisotropic 2-PCF
  (2) power spectrum: monopole, dipole, μ^2-moment
- $D_V(z)$, $D_A(z)$, $H(z)$ @ z=0.32, z=0.57; excellent agreement with LCDM@Planck 2015





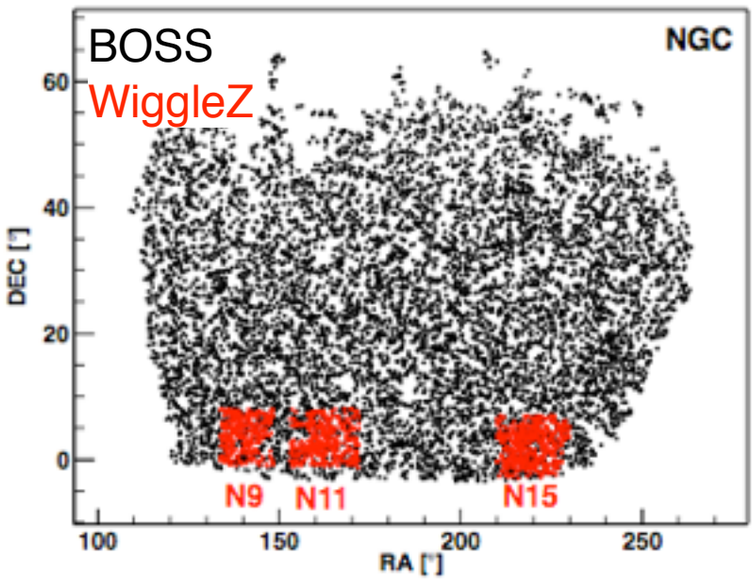


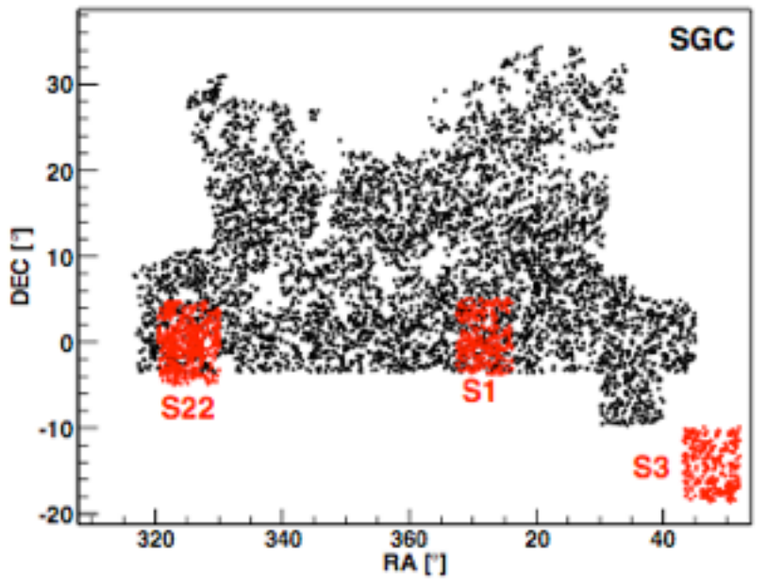
Galaxy clustering: News / BAO

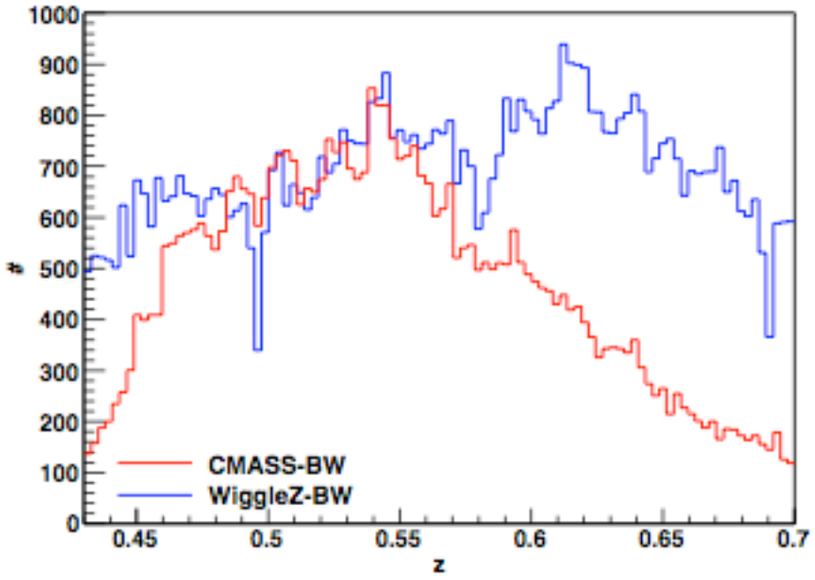
BOSS_CMASS .vs. WiggleZ (overlap)

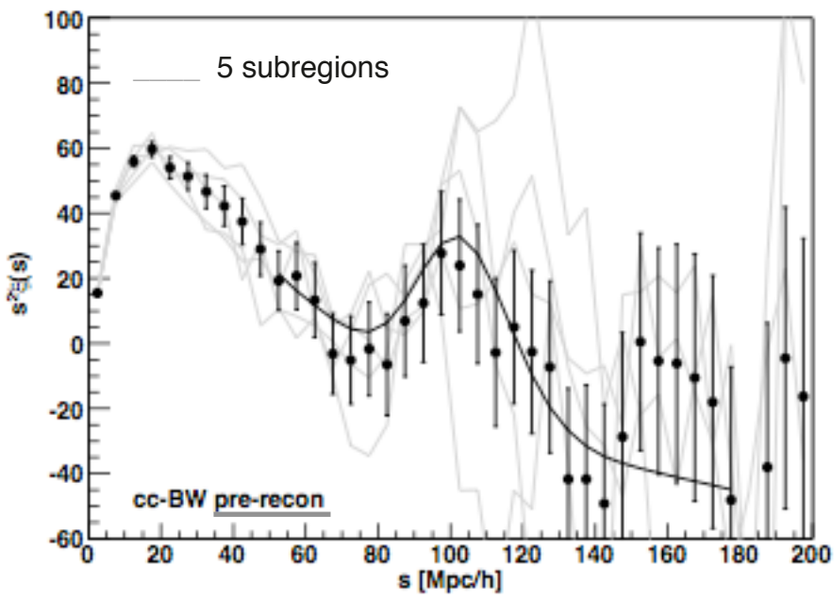
Beutler+ 2015

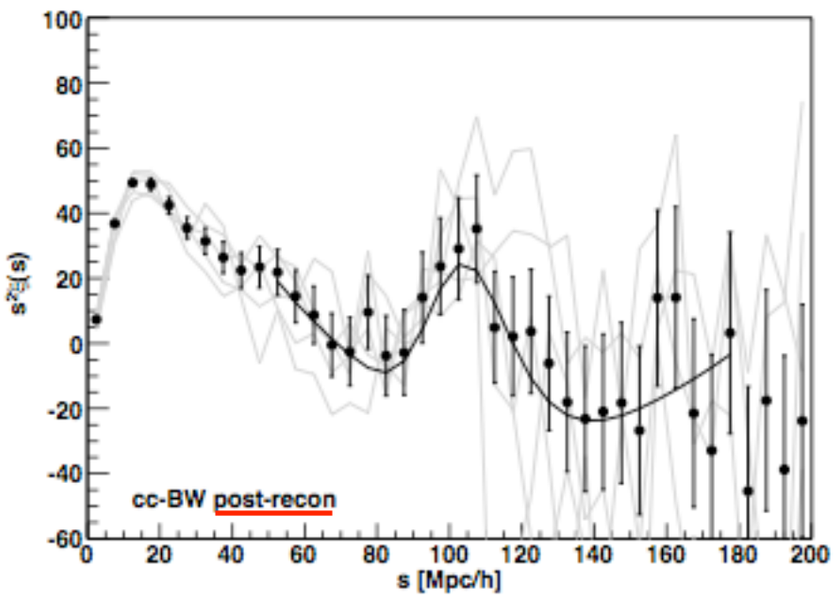
- CMASS ($0.43 < z < 0.70$): mainly LRG, bias $b \sim 2$
- WiggleZ ($0.1 < z < 1.0$): mainly ELG, bias $b \sim 1$
- cross-correlation of sources (LS estimator)
- possible source of systematic uncertainty for BAO measurement: relative velocity effect
  (...old galaxies still carry the selection of the relative velocity effect, while young galaxies do not)









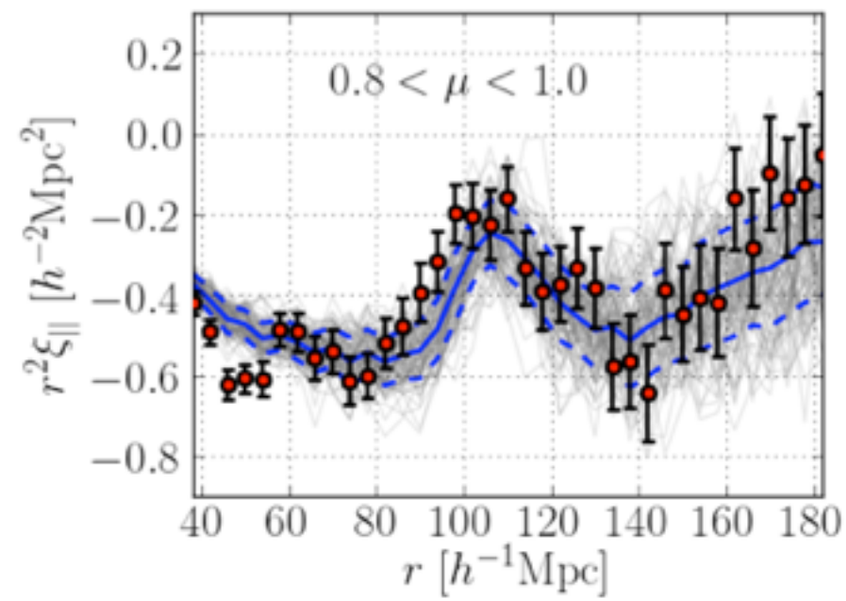


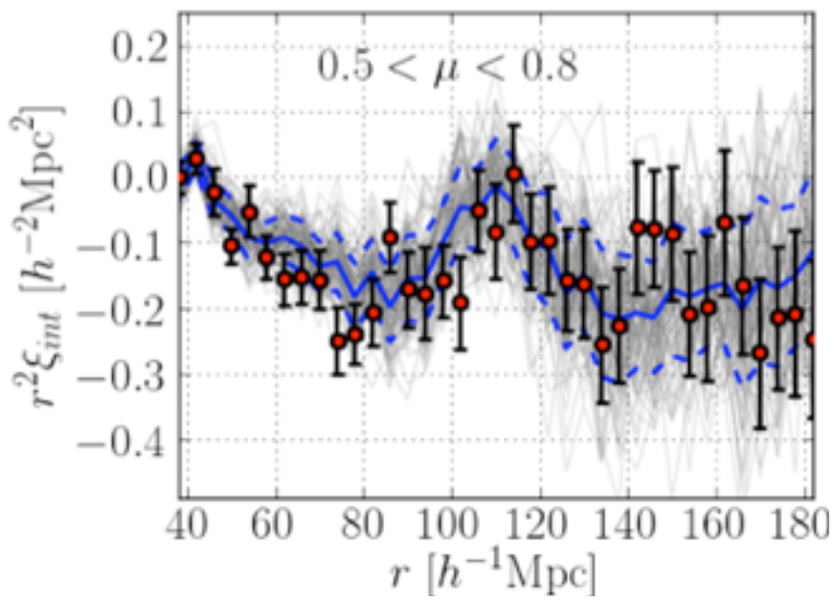
Galaxy clustering: News / BAO

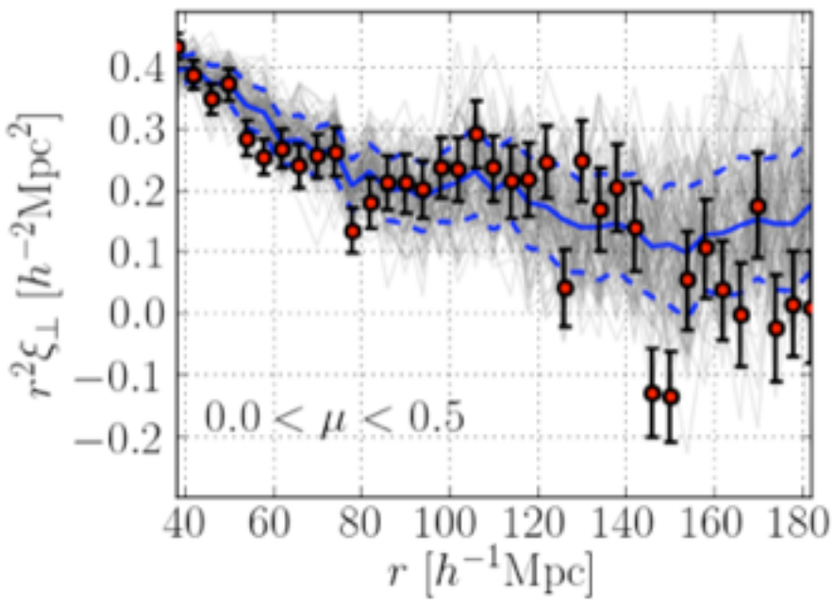
SDSS-III/BOSS [DR11]: BAO in LyA forest

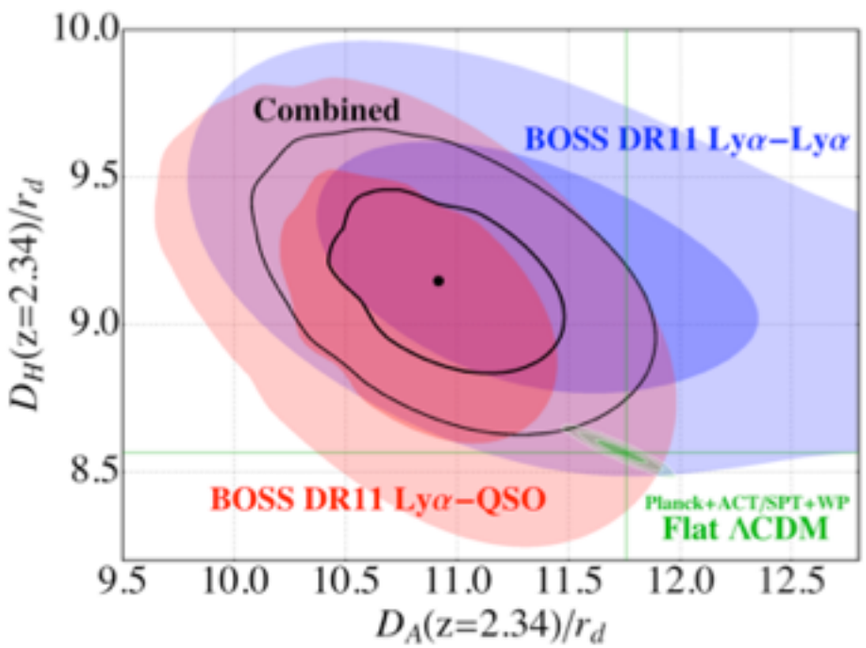
Delubac+ 2015

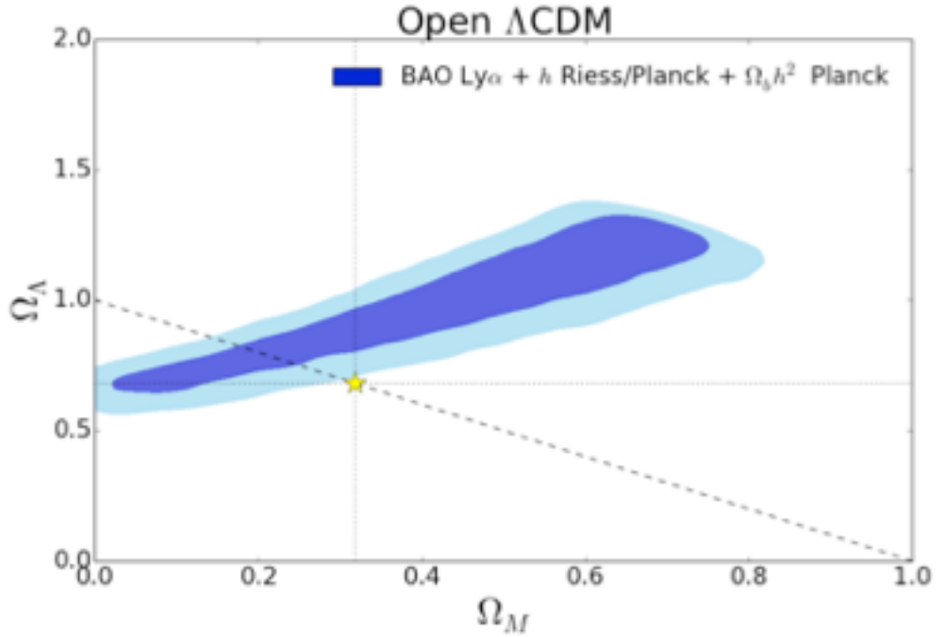
- 8400 deg^2 ~ 0.84% ultimate BOSS
- QSO (2.1 < z < 3.5): ~140,000 QSO
- flux correlation function of QSO
- $D_A(z)$, H(z) @ z=2.34; consistent with LCDM@Planck 2015











«our values differ by 1.8σ from those of the Planck+WP model. They differ from the WMAP9+ACT+SPT model by 1.6σ»

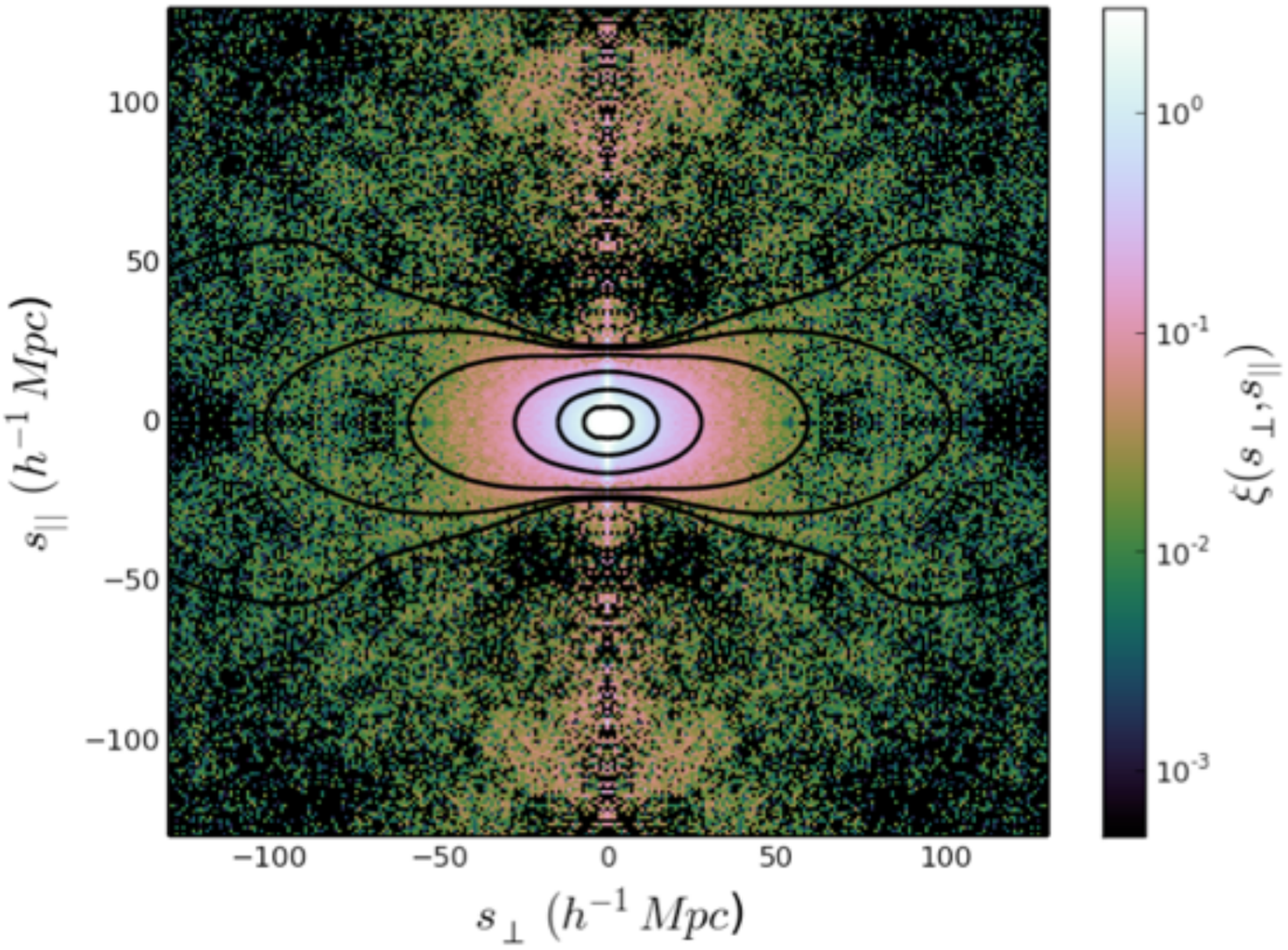
---> continuum subtraction method?

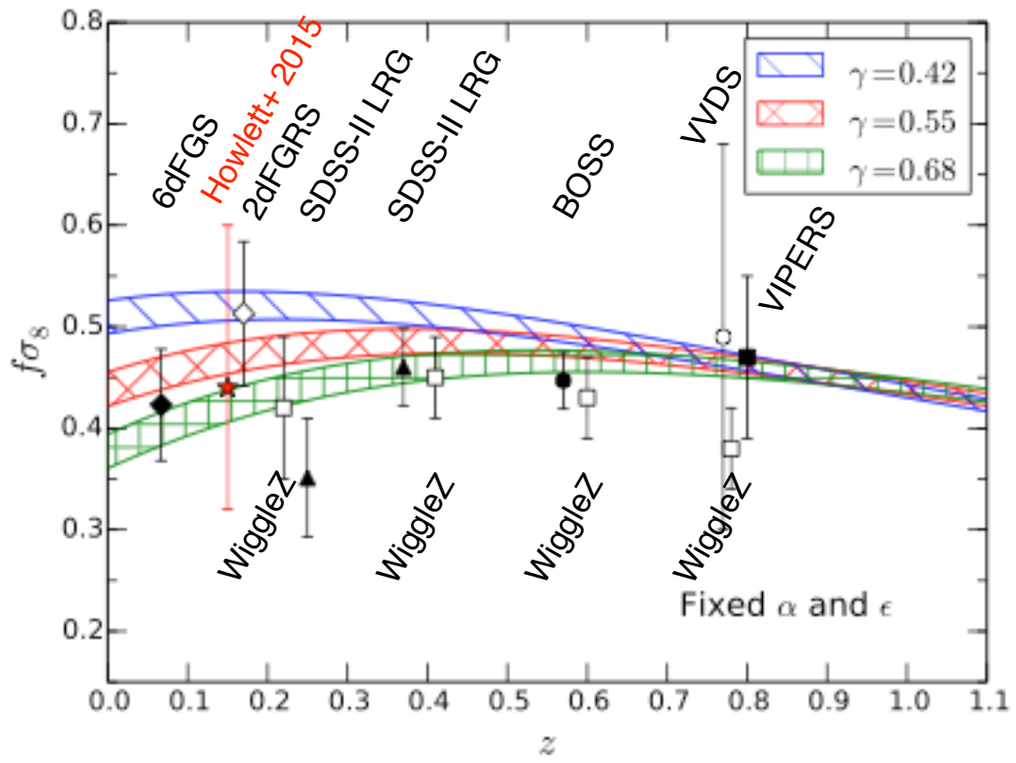
Galaxy clustering: News / RSD

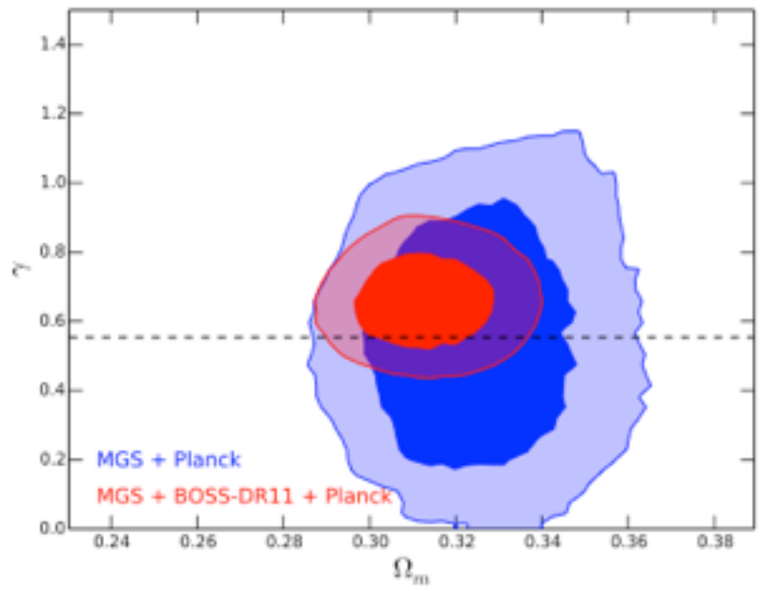
SDSS [DR7]

Howlett, Ross, Samushia, Percival & Manera 2015

- 6800 deg^2
- Main Galaxy Sample (z ~ 0.15): ~ 63,000 galaxies
- monopole & quadrupole 2-PCF
- γ consistent with GR but tendency to slightly larger value





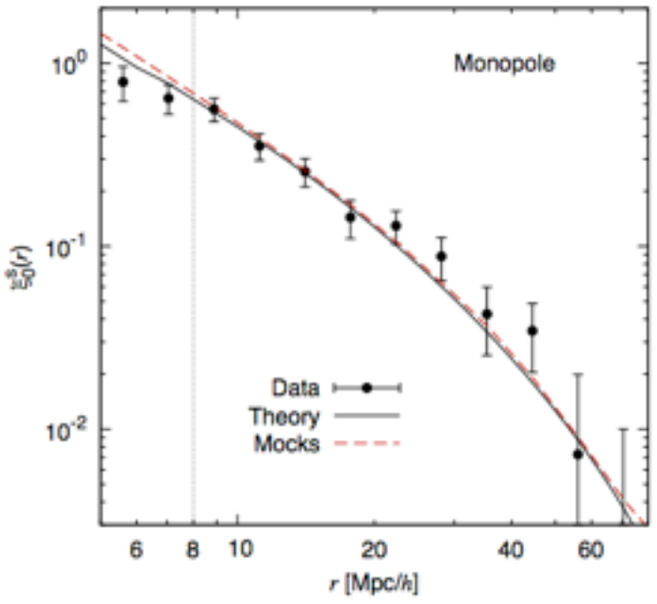


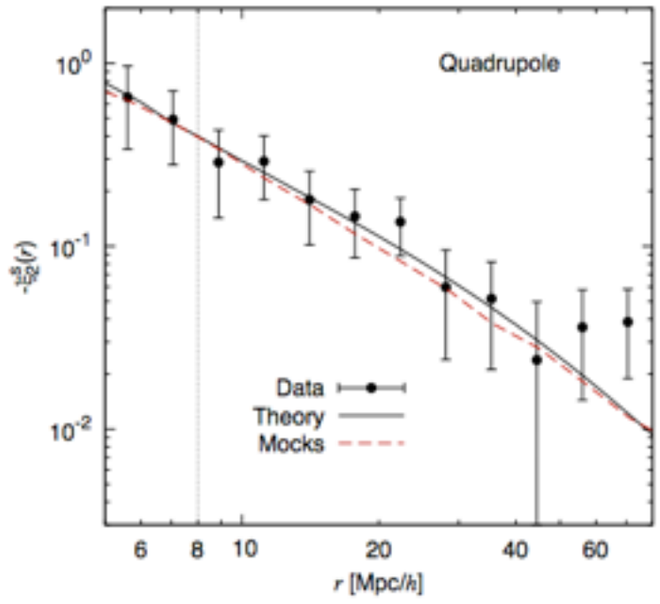
Galaxy clustering: News / RSD

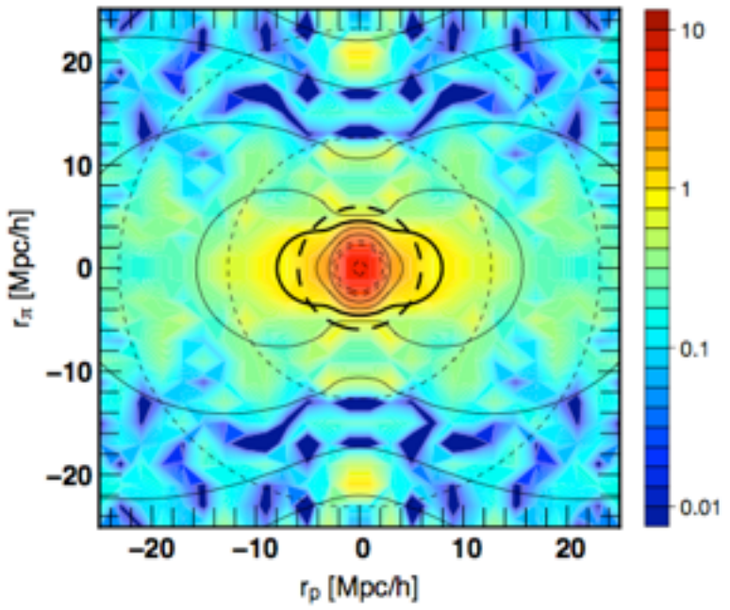
Subaru FMOS galaxy redshift survey (FastSound)

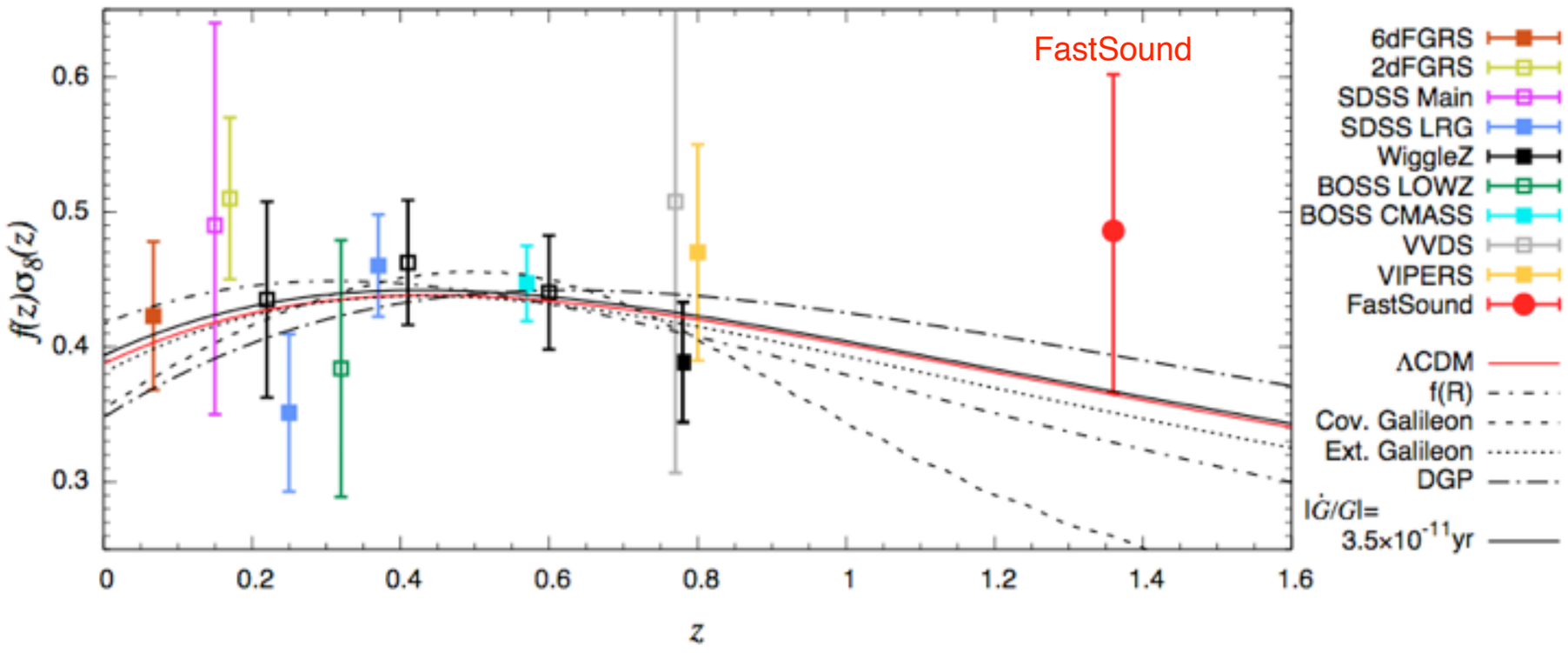
Okumura et al. 2015 (submitted)

- W1-W2-W3-W4 CFHTLS fields, ~1.8-6.6-9.1-3.1 deg^2 (tot ~ 20.6 deg^2)
- $1.19 < z < 1.55$, 2830 ELG (Hα, S/N > 4.5)
- correlation function (monopole & quadrupole) and anisotropic-correlation function









GC-SWG: 2015

Formalization of WP tasks ---> documents on wiki

WP	Lead	Task	Priority
Sample selection	Daniel Eisenstein & Bianca Garilli	Define optimal galaxy selection for galaxy clustering	High
Survey mask	Ben Granett & Marco Scodeggio	Define Euclid spectroscopic masks and random catalogues	High
Slitless spectroscopy effects	Sylvain de la Torre	Define methodology to remove slitless effects on galaxy clustering	High

WP	Lead	Task	Priority
Likelihood fitting	Ariel Sanchez & Will Percival	Define likelihood fitting approach	Medium
Reconstruction	Nikhil Padmanabhan & Francisco Kitaura	Define and test methods for reconstruction (for BAO)	Medium
High-order statistics	Emiliano Sefusatti & Cristiano Porciani	Quantify how high-order stat. can be used to improve cosmological constraints	Medium
Additional probes	Juan Garcia-Bellido & Olivier Doré	Investigate new (non-standard) observational probes	Medium
Photo_z clustering	Shirley Ho	Investigate photo-z clustering as additional probe	Medium

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UPDATE

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GC-SWG: 2015

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Survey mask & Slitless spectroscopy effects	Ben Granett & Sylvain de la Torre	Define (1) Euclid spectroscopic masks and random catalogues; (2) methodology to remove slitless effects on galaxy clustering	High
Liaison with simulations & end-to-end groups	?	Understand spectroscopic sample	*NEW*

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GC-SWG: 2015

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Sample Definition:

1. Estimation of Hα luminosity and size functions from external data.
2. Estimation of OIII luminosity and size functions from external data.
3. Consider the opportunity of AGN clustering.
4. Generate one or more simple figures of merit for n(z) -- *e.g. based on V_eff*
5. Generate quantitative model for the impact of impurities -- *how do incorrect redshifts impact BAO/RSD/LSS results?*
6. Perform a mock LSS computation based on simulated line flux catalogs.
7. Consider the science gain from the selection of multiple samples -- *what colors/line EW selections or secondary line detections are likely to be effective? effects on completeness?*
8. Advise OU-SPE on how to improve sample purity.
9. Advise OU-LE3 on how purity and completeness should be measured in practice *-- number and pdf(z) of failures*
10. Review whether the requirements on purity and completeness are at the proper numerical values.
11. Study how the Euclid Hα sample is likely to relate to OII samples from ground-based surveys.

Observational systematics:

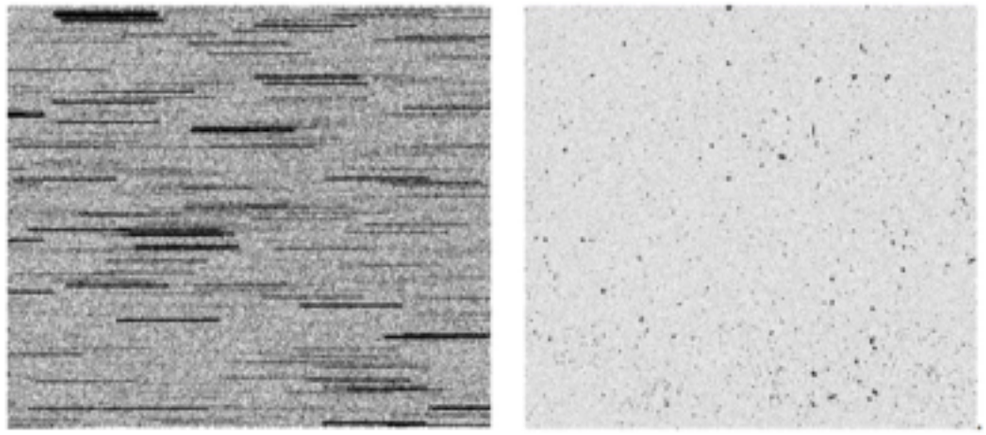
1. Determine how well we need to estimate the anisotropic selection effects?
2. Compute how the small-scale variations in exposure depth will impact the number density of recovered galaxies.
3. How do requirements on secondary lines or photometric colors impact the selection function?
4. What systematics are likely to limit us in the estimation of super-large-scale structure?
5. Investigate the impact of false positives -- *how does their rate depend on time or angle?*

GC-SWG: 2015

WP	Lead	Task	Priority
Survey mask & Slitless spectroscopy effects	Ben Granett & Sylvain de la Torre	Define (1) Euclid spectroscopic masks and random catalogues; (2) methodology to remove slitless effects on galaxy clustering	High

Survey mask:

1. Mock implementation
2. Sample selection
3. Photometric masks and foreground component maps
4. Selection for photometric redshift clustering analysis
5. Selection for spectroscopic redshift clustering analysis
6. Random catalogue construction and uncertainties
7. Covariance matrix



Slitless spectroscopy effects:

1. Produce and validate slitless spectroscopy simulations
2. Identify all potential sources of systematics
3. Quantify radial, angular, and scale-dependent distortions on two-point statistics
4. Estimate the clustering science potential of the Deep Fields
5. Quantify in which measure Deep Fields can be used to calibrate methods to correct for slitless effects
6. Define the survey quantities to be retained to mitigate slitless spectroscopy effect
7. Define optimal correction scheme to remove slitless effects

GC-SWG: 2015

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Short-term tasks: A roadmap for covariance matrix estimation

*In most clustering analyses, c*ovariance *is estimated directly from a set of mock catalogues:*

1. Number of *N*-body simulations and mock catalogues? -- *e.g. Dodelson & Schneider (2013); depends on observable*
2. Size and accuracy of *N*-body simulations and mock catalogues?
3. Are approximate *N*-body methods accurate enough for covariance matrix estimates? -- *Cov from PINOCCHIO, COLA, PATCHY, EZMOCKS will be compared*
4. How to minimize the impact of uncertainties/noise on Cov? -- *shrinkage, covariance tapering, ...*
5. Theoretical models of Cov -- *calibration on mocks could reduce the number of N-body simulations*
6. Same or different Cov for different (cosmological) models?

Mid-term tasks: Likelihood function

7. Correct shape of the likelihood function? (Hamimeche & Lewis 2008, Kalus et al. 2015)
8. How do we combine different methods/2-PCF, e.g. ξ(r) and P(k)? (Anderson et al. 2014)
9. How do we include higher-order statistics?
10. How do we correctly combine systematic and statistical errors?

Long-term tasks: Euclid likelihood modules

1. CosmoMC, MontePython, or a new code?
2. MCMC, nested sampling, HMC...?
3. What is the best way to present results? 1D w/ 2D (3D) marginalized posteriors? more complicated schemes?

GC-SWG: Status

SWG-GC organizational aspects

Weekly telecons joint with LE3-GC on Mondays 5pm

Yearly general meeting (Jan/Feb)

SWG-GC

Reorganization of high-priority WPs

Formalization of WP tasks

Spectroscopic selection function, masks, slitless corrections work on-going

SWG-GC/NISP:

NISP and spectroscopic survey performance study for MPDR (see Anne's talk)