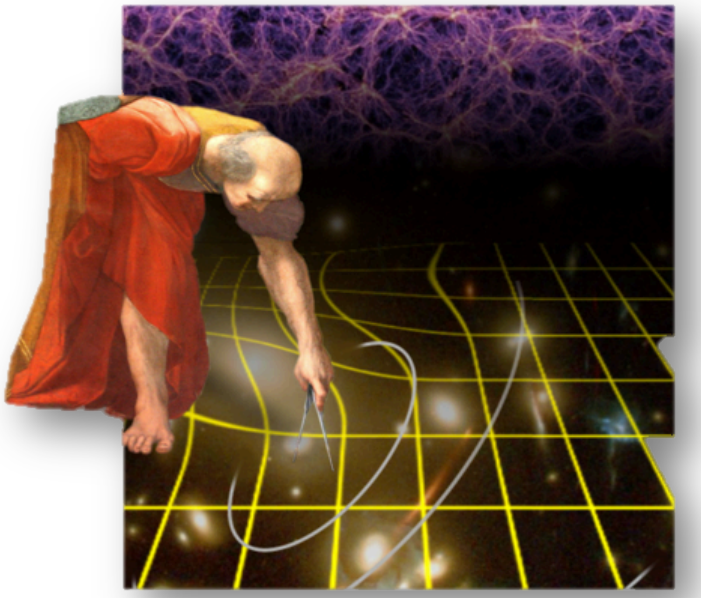


Galaxy Clustering SWG

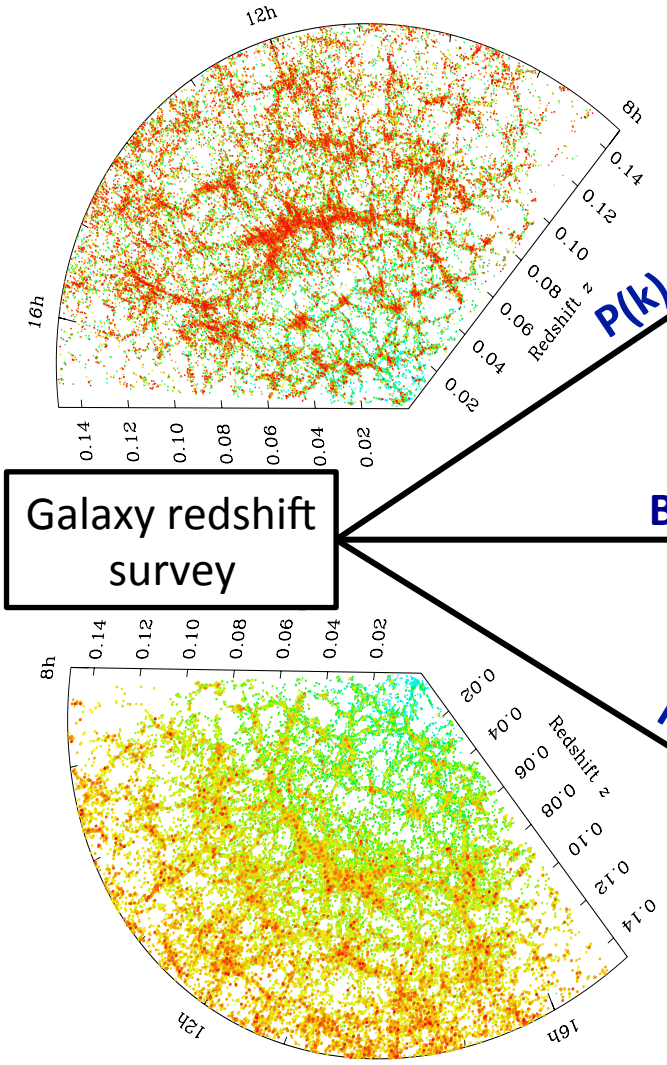
Euclid-France meeting

Toulouse 3/12/2012

Sylvain de la Torre

GC-SWG lead: Luigi Guzzo & Will Percival

Galaxy clustering



Galaxy redshift survey

P(k) shape

What are the constituents of matter?
e.g. neutrino mass
Is the Universe homogeneous on large scales?
e.g. spectral index, non-gaussianity

BAO

What is the expansion rate of the Universe?
e.g. quintessence, Λ

RSD

How does structure form and grow within this background?
e.g. GR, modified gravity

Understanding acceleration

Euclid key questions

1. Is cosmic acceleration produced by a cosmological constant or by an evolving scalar field?

- Measure expansion history H(z) to unprecedented accuracy, as to detect percent variations of w(z) with full control of systematic effects

➔ Using Baryonic Acoustic Oscillations (BAO) in the clustering pattern

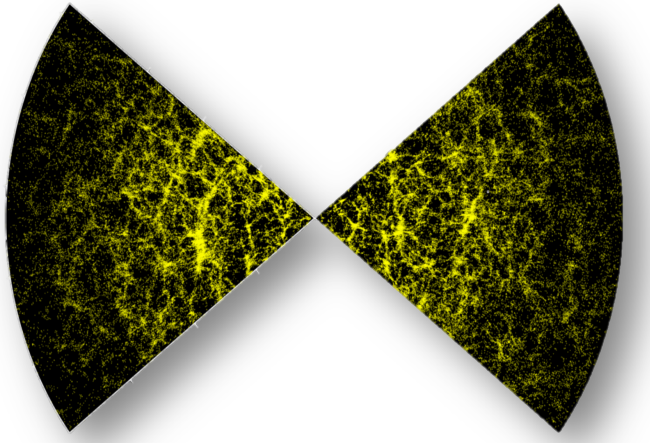
2. Does General Relativity need to be modified on cosmological scales?

- Measure growth history of structure to unprecedented accuracy

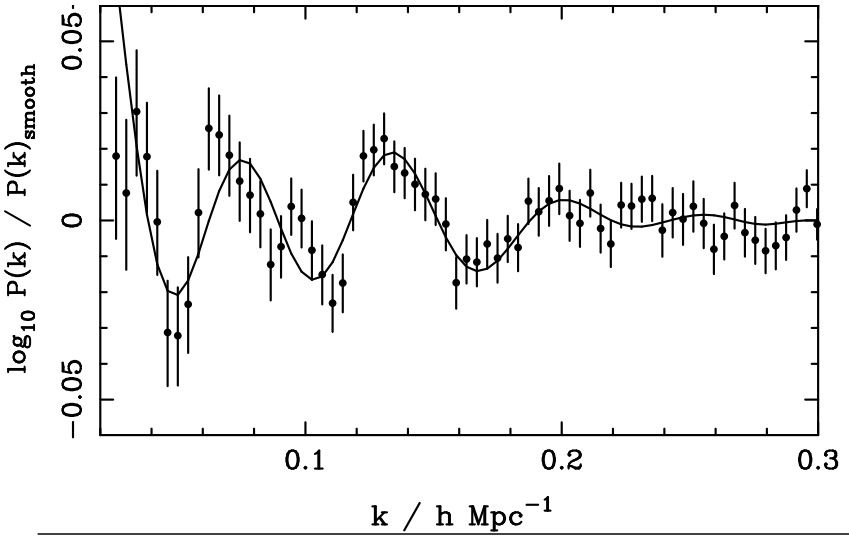
➔ Using anisotropy of galaxy clustering in redshift-space (Redshift-Space Distortions, RSD)

Baryonic Acoustic Oscillations

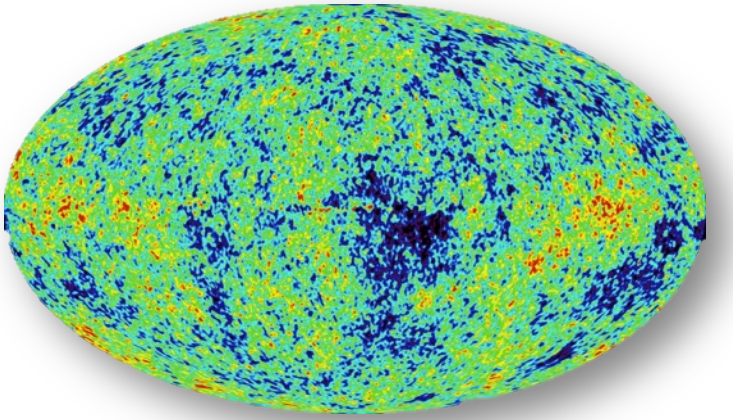
Galaxies



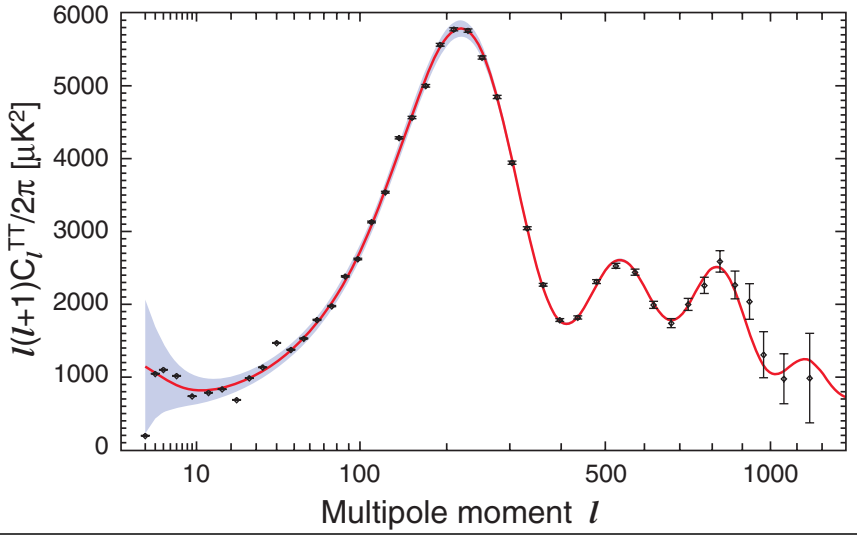
(BOSS, Anderson et al. (2012)



Cosmic Microwave background



(WMAP, Komatsu et al. 2009)

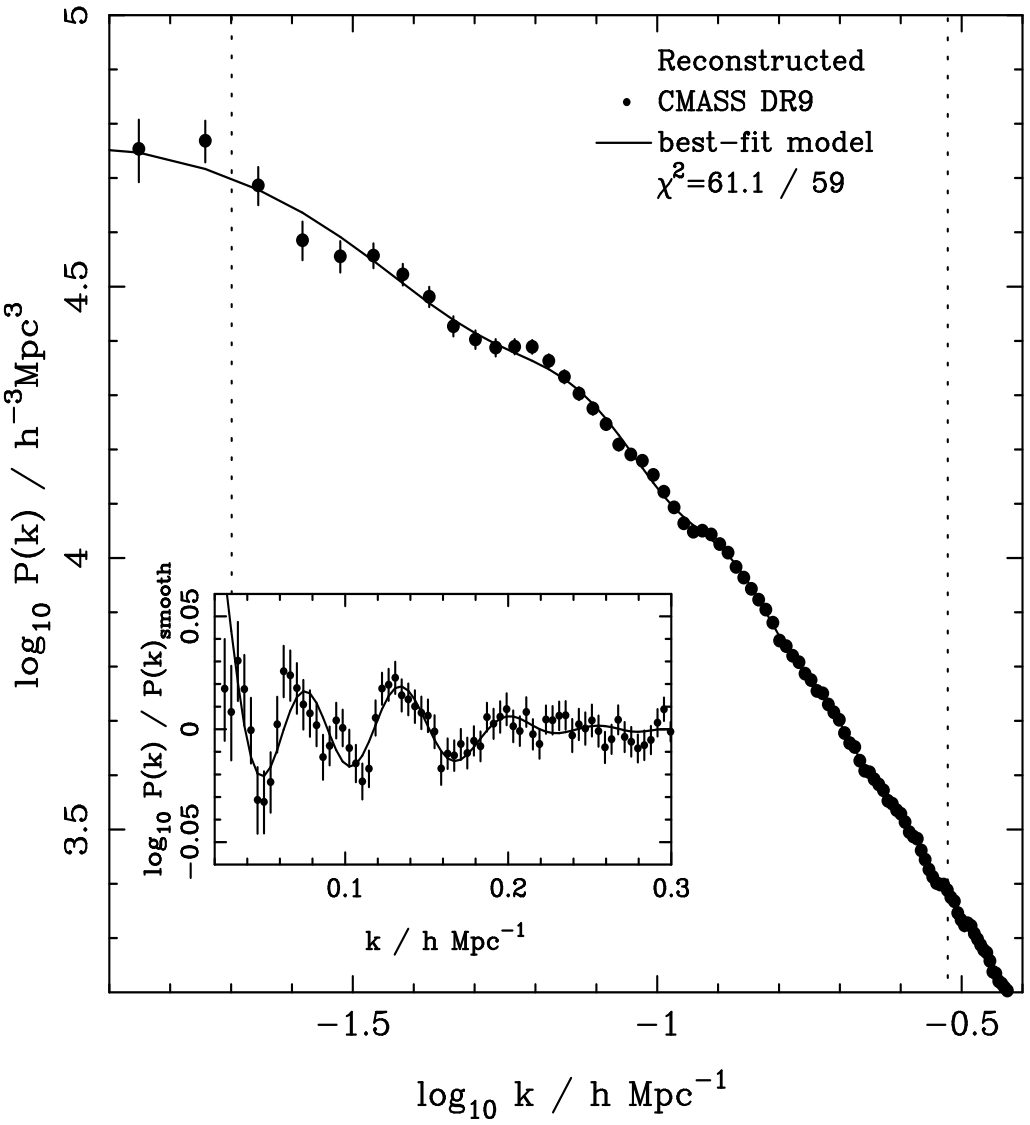


P(k) and BAO: current

BOSS CMASS at z=0.57

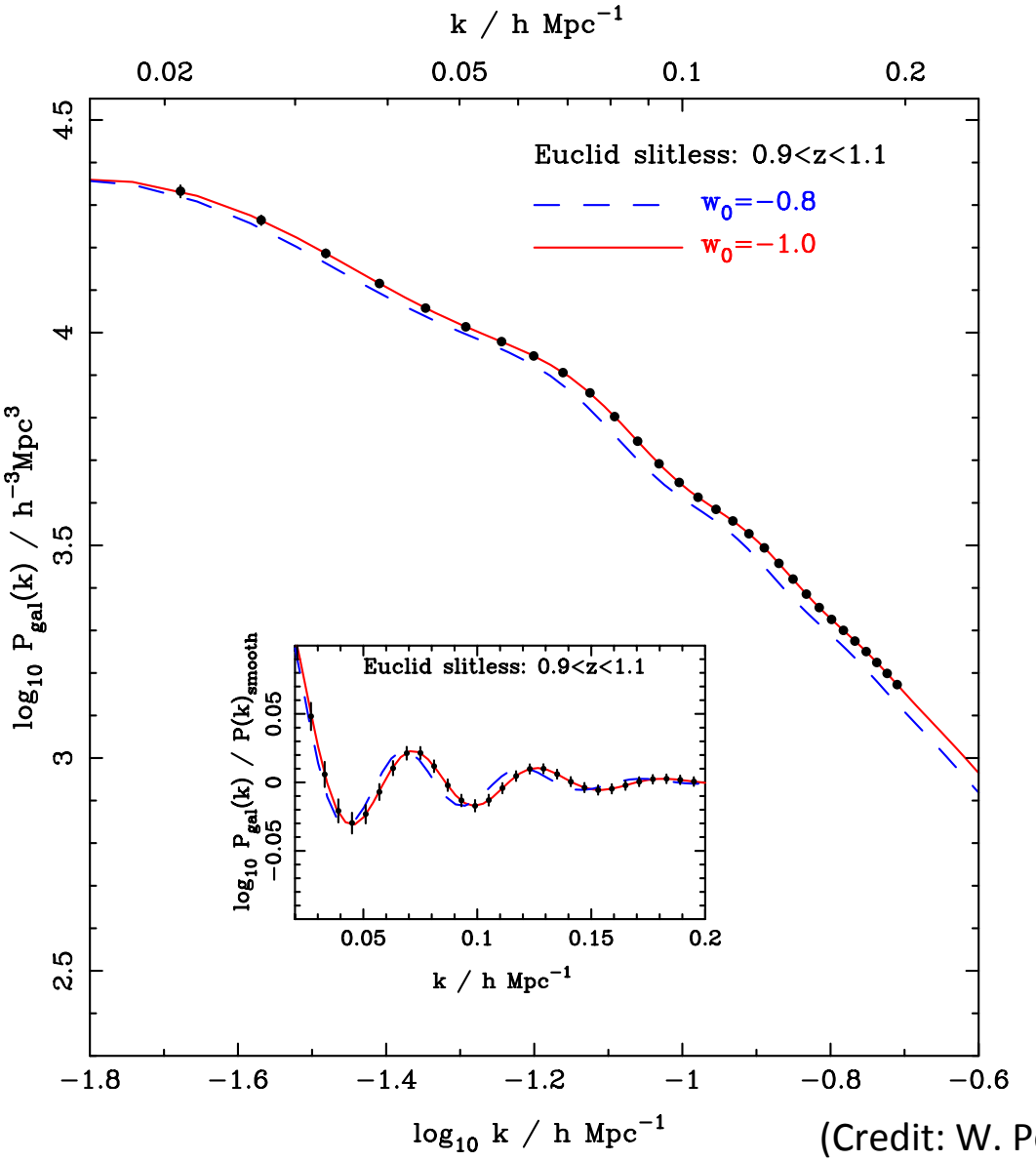
Largest volume of the Universe currently mapped

(Anderson et al. 2012)



P(k) and BAO: Euclid

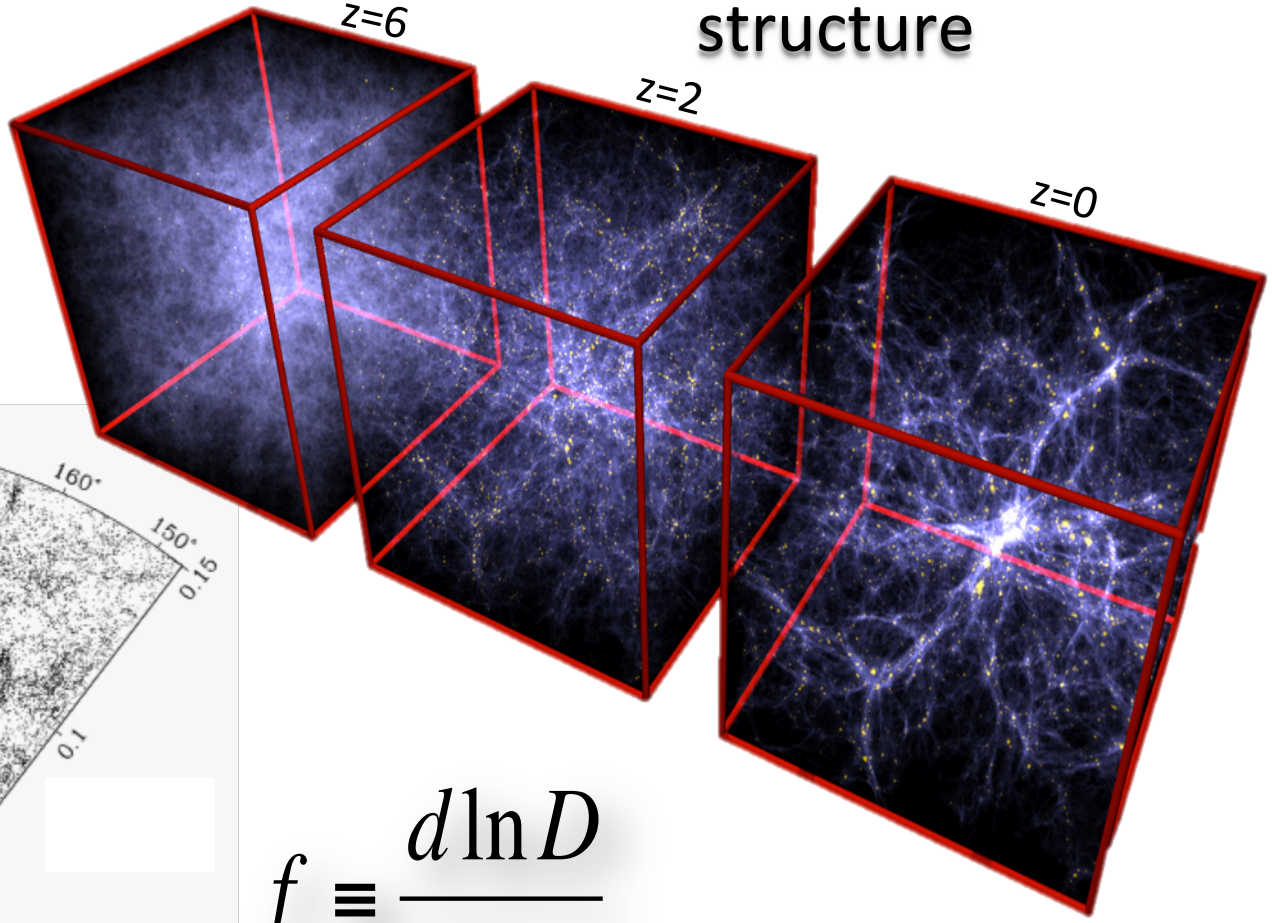
EUCLID forecast: 20% of the data at z=1



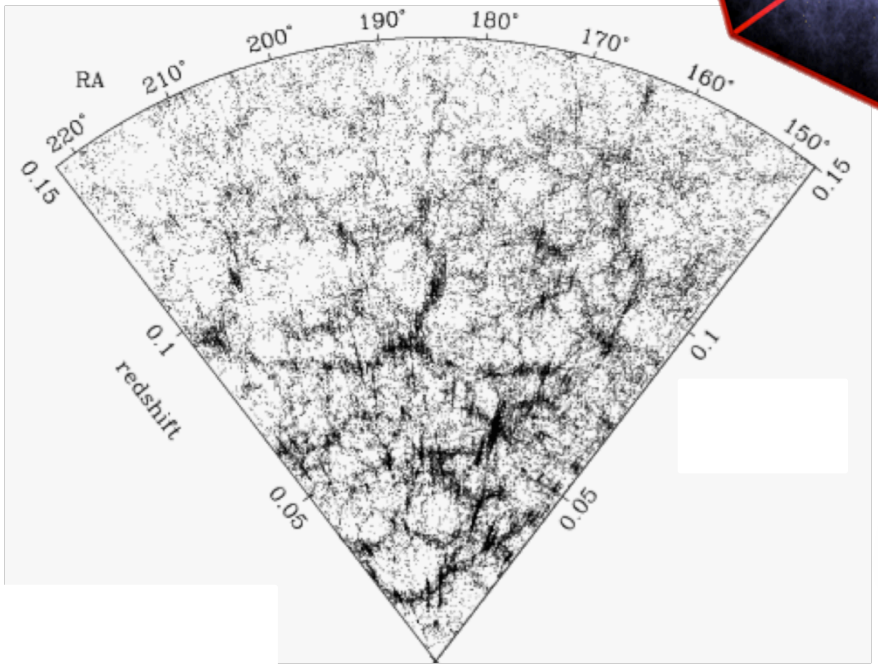
(Credit: W. Percival)

Redshift-space distortions

Probing the growth rate of structure



Redshift space

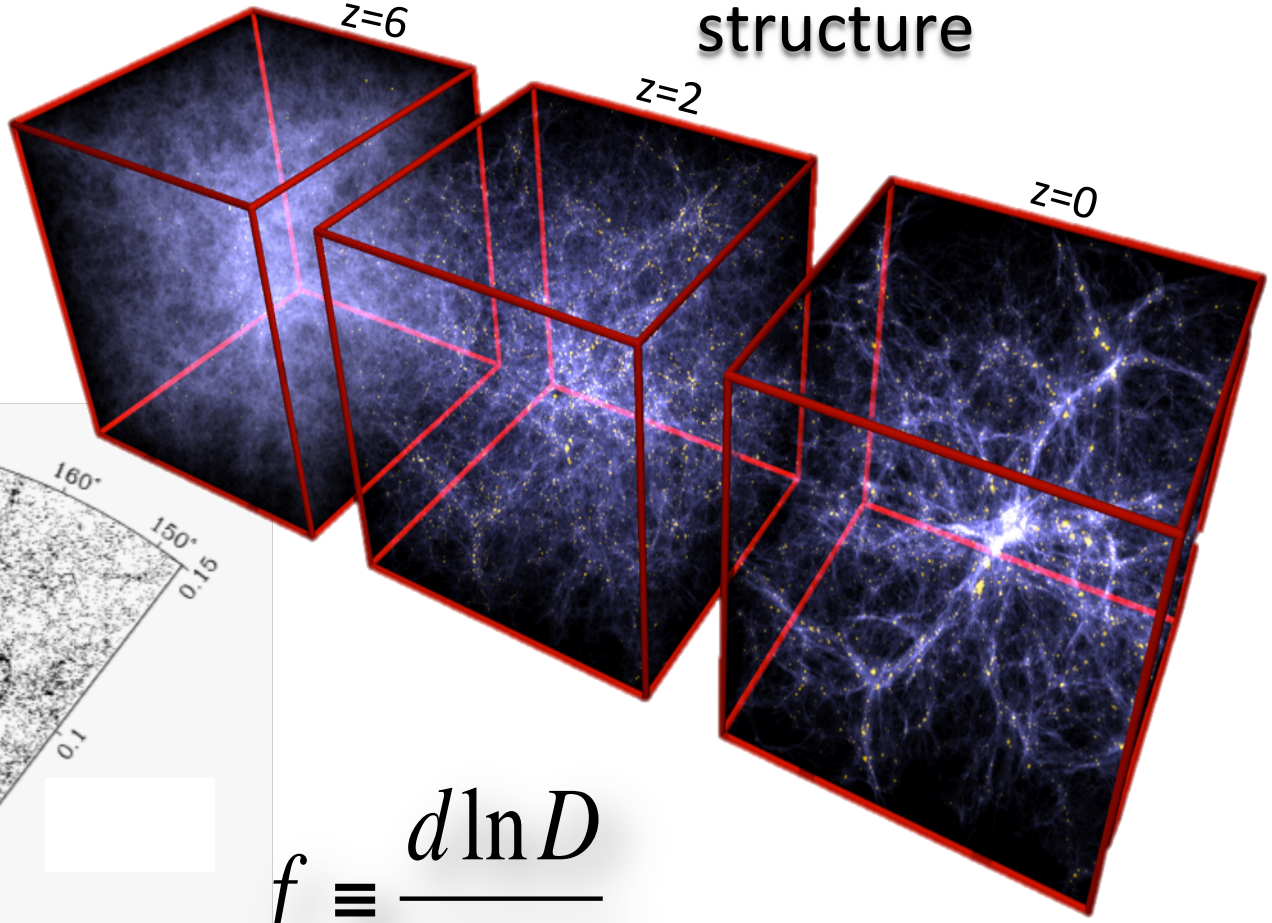


$$f \equiv \frac{d\ln D}{d\ln a}$$

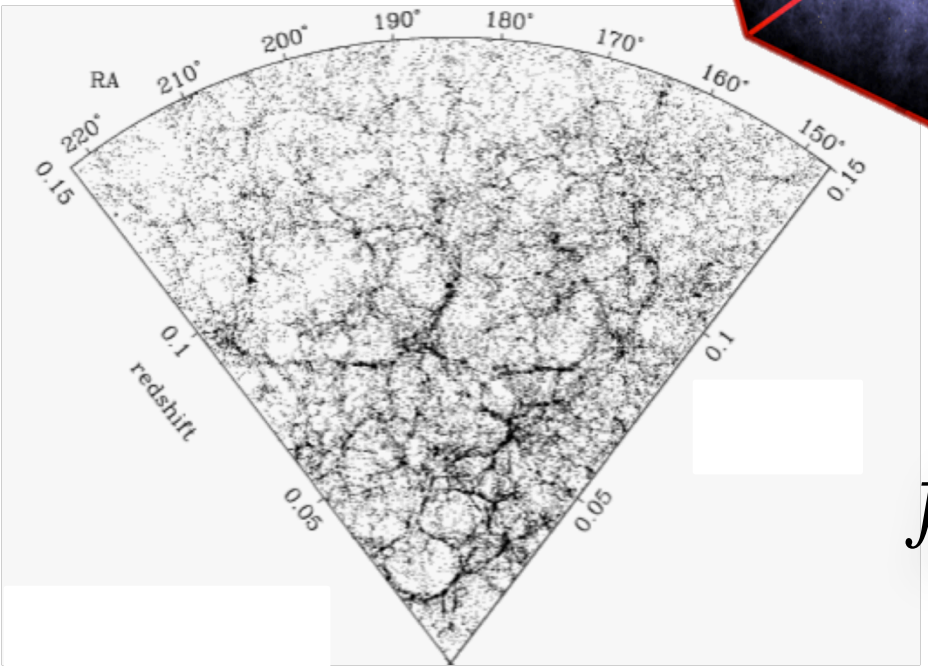
(Credit: V. Springel)

Redshift-space distortions

Probing the growth rate of structure



Real space

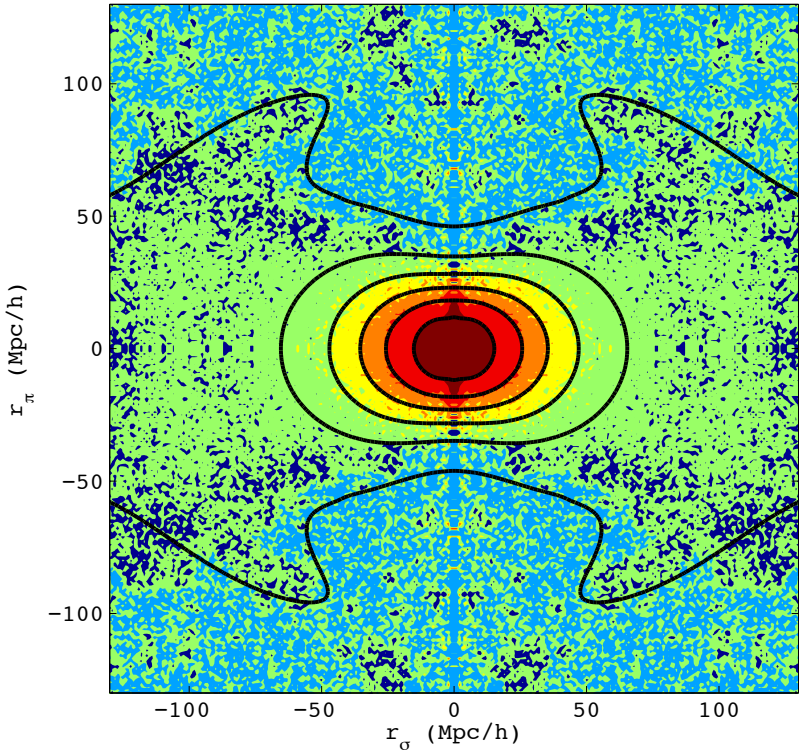


$$f \equiv \frac{d\ln D}{d\ln a}$$

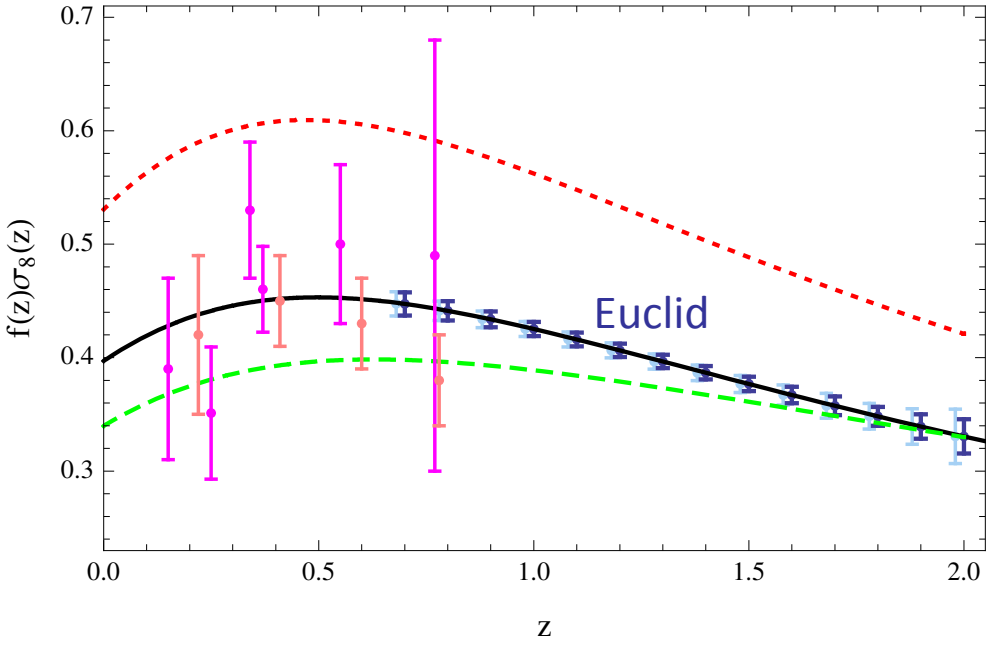
(Credit: V. Springel)

$\xi(r_\sigma, r_\pi)$ and redshift-space distortions

Current and EUCLID measurements of the growth rate *f*



(BOSS, Reid et al. 2012)



(EUCLID forecast, Majerotto et al. 2012)

The long way from raw data to cosmology

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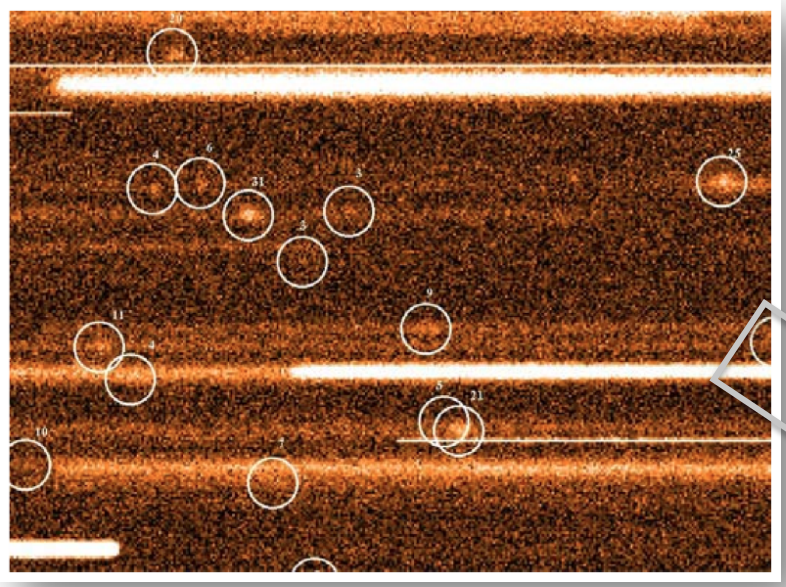
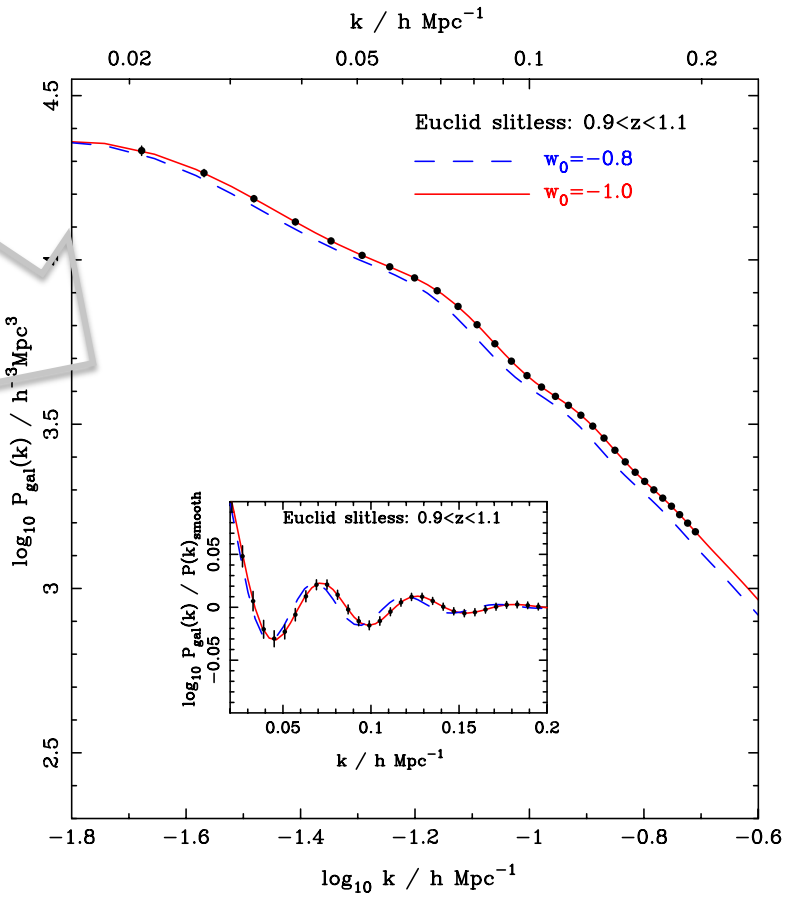


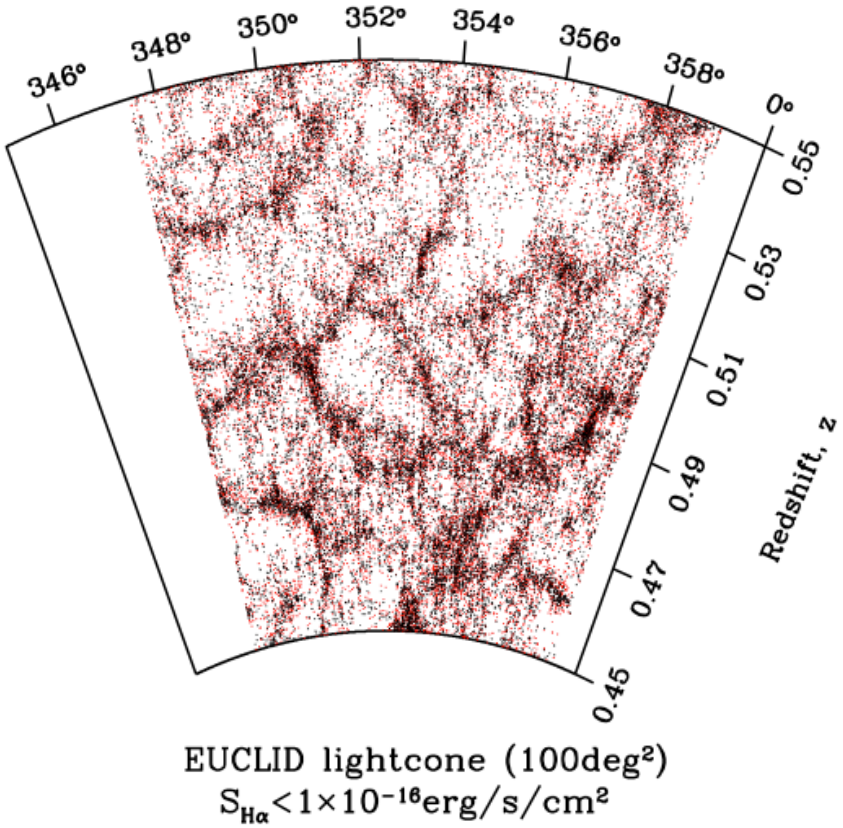


Galaxy clustering: requirements

- Need:
  - angular galaxy positions
  - galaxy redshifts

- Need to understand the population:
  - angular completeness
  - radial completeness
  - radial/angular density variations

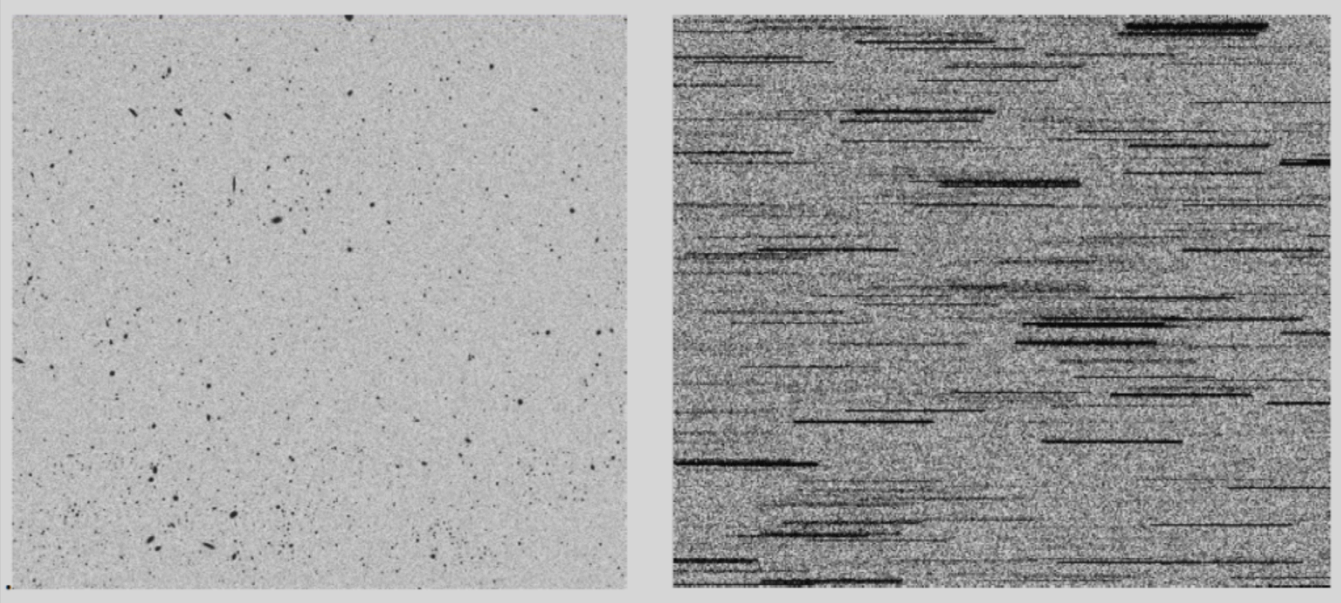
→ **This is the hard part**



(Credit: A. Merson & C. Baugh)

- Then measure n-point statistics: *P(k), ξ(s), ξ(s,v), P(k,μ), etc...*

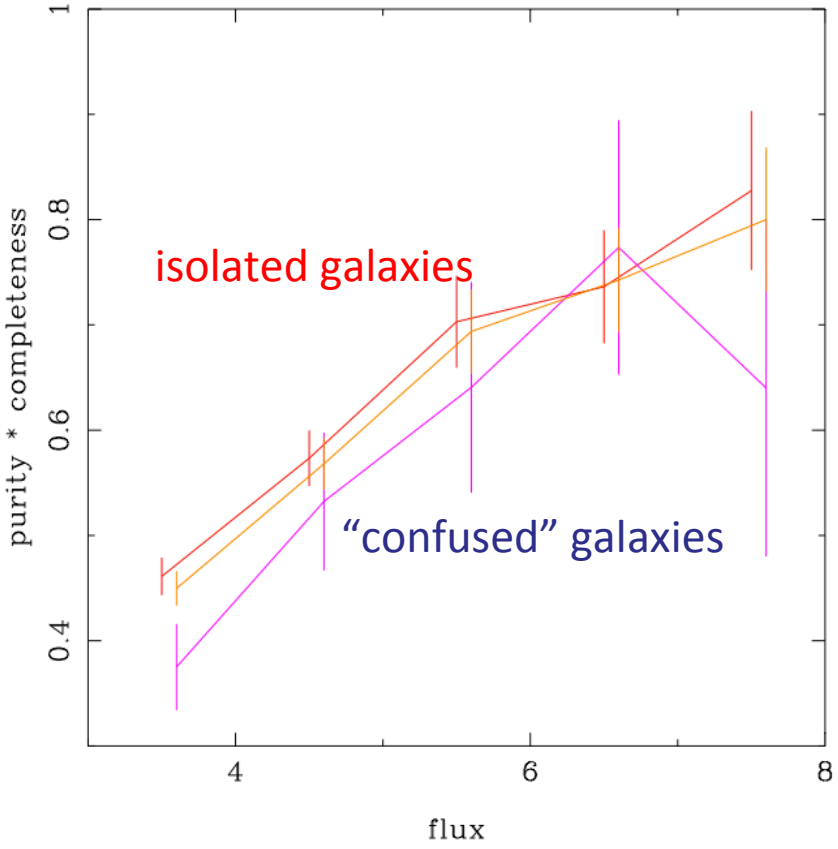
Redshifts from Euclid slitless spectroscopy



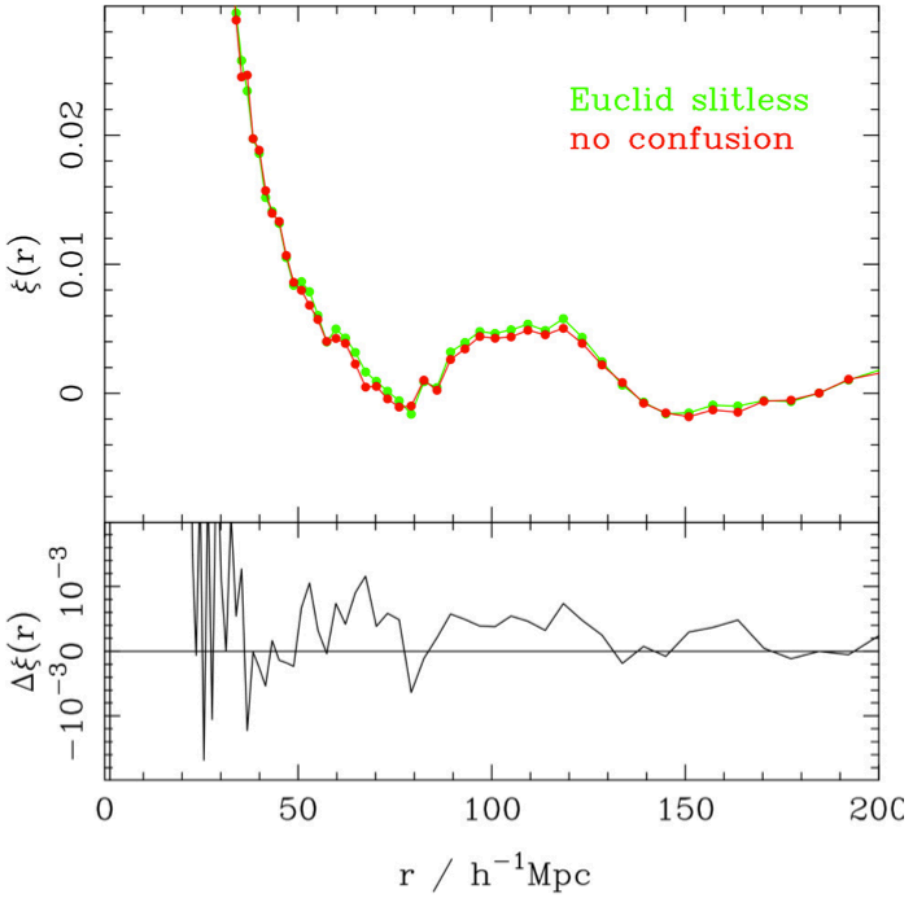
1 deg^2 of the sky simulated and propagated through end-to-end Euclid spectroscopic simulation (Garilli, Franzetti, Ealet, Roche, Rossetti et al.)

- Slitless provides an *a priori* uniform sample (no target sample)
- Slitless spec. means that almost all spectra are contaminated: contamination is the largest source of redshift failures
- Uniformity, completeness, purity are the key issues to be kept under control → Simulations and Deep survey are crucial

Spectroscopic confusion problem



Completeness and purity



Effect on clustering over 100 deg²

(Euclid Red Book, Laurejis et al. 2011)

Work-packages: high priority

Work-package	Input product	Output product	Notes	Priority
[[Sample selection]]	list of ra, dec, redshift PDF (+ other galaxy properties?) for mocks	Sample weighting, or inclusion/exclusion (might be angle dependent), sample mask	Development work with mocks, then application. Liaise with OU-SIM, input for OU-LE3	High
[[Survey Mask]]	Information on data	Mask	Led by OU-LE3 internal work package, liaise with OU-SIR, OU-SPE, OU-SIM, SWGs on science	High
[[Deep field analysis]]	deep field mocks, standard simulations	analysis of slitless spectroscopy effects. Estimation of depths and angular distortions. Estimate science potential of clustering in deep fields	Liaise with OU-SIM, SWG-SIM (simulations), OU-LE3 (masks), Legacy SWG	High
[[Angle dependent clustering]]	standard simulations, information from deep field	Algorithm to remove slitless effects	led by OU-LE3 GC work package, but with SWG input	High

Work-packages: medium priority

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[[Reconstruction algorithms]]	list of ra, dec, redshift PDF (+ other galaxy properties?) for mocks	Algorithms and estimate of induced error	Development work with mocks, then application. Joint OU-LE3 galaxy clustering task. Final algorithm development and testing in OU-LE3	Medium
[[Covariance matrices]] and likelihood techniques for 2-pt correlation functions and power spectra	spectro-z and photo-z(?) mock galaxy catalogs	covariance matrices	Cosmic variance and shot-noise, model dependency required. Joint group with OU-LE3 GC work-package (data expertise and issues). SIM-SWG task 5 group working on simulations required: need input on what to run.	Medium
[[3-pt covariance matrices]] and likelihood techniques	spectro-z and photo-z(?) mock galaxy catalogs	covariance matrices	Cosmic variance and shot-noise, model dependency required. Joint group with OU-LE3 GC work-package (data expertise and issues). SIM-SWG task 5 group working on simulations required: need input on what to run.	Medium
[[3-pt calculation]]	simulations	Algorithms for determining cosmology-dependent 3-pt statistics, and dependencies therein.	Led by OU-LE3 GC work package task, but close interaction required with GC-SWG on cosmological model issues	Medium

[[joint GC-WL field calculation]]	simulations	best-fit matter, galaxy density fields	development work could increase importance. Work with WL-SWG.	Medium
[[joint GC-WL field analysis]]	matter, galaxy fields recovered from simulations	parameter estimates	development work could increase importance, and	*Medium*
[[Photo-z sample selection]]	list of ra, dec, redshift PDF (+ other galaxy properties?) for mocks	Sample weighting, or inclusion/exclusion (might be angle dependent), sample mask	Development work with mocks, then application. Liase with OU-SIM, OU-PHZ, input for OU-LE3	Medium
[[2-pt photo-z calculation]]	photo-z mock galaxy catalogs	Algorithms for 2-pt statistics, and dependencies therein	Led by OU-LE3 GC work package task, but close interaction required with GC-SWG	Medium
[[Photo-z covariance matrices and likelihood techniques]] for 2-pt correlation functions and power spectra for photo-z samples	photo-z mock galaxy catalogs	covariance matrices	Cosmic variance and shot-noise, model dependency required. Joint group with OU-LE3 GC work-package (data expertise and issues). SIM-SWG	Medium
[[joint GC-clusters analysis]]	simulations with cluster positions, mass estimates from OU-LE3 clusters work-package	algorithm for including this data	An extension of catalogue selection. Work with clusters-SWG, OU-LE3 clusters work-package.	Medium