france for euclid 6 symposium

Galaxy Clustering SWG activity report

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Galaxy Clustering SWG

Leads: Will Percival, Luigi Guzzo, Yun Wang (deputy)

SWG weekly telecon on Monday 5pm

SWG yearly meeting joint with LE3-GC Jan-Feb

- Reorganisation of the WPs (on-going)
  - **WP 1**. Observational Systematics. Merging current “Sample Selection”, “Mask/Slitless”, and “Liaison with Sims” WPs
  - **WP 2**. Likelihood Fitting, link to future IST: likelihood
  - **WP 3**. Non-linear effects. (including current “Reconstruction” WP), link to future IST: non-linear
  - **WP 4**. Higher-order statistics
  - **WP 5**. Additional GC probes (a.k.a. current “New Probes”)
  - **WP 6**. Photo-z Clustering

- **Open call for new WP leads: consider applying!**
- Currently 2/16 French WP leads

Summary

- *Galaxy clustering systematics* tiger team work
- Synergies with CS-SWG, SPV2, OU-LE3-GC

Galaxy Clustering Systematics

- Set up in March of a *tiger team* dedicated to study and budget systematic error affecting the GC probe
- Based on current knowledge of Euclid characteristics
- The team worked for about 9 months (until October) and produced a **60 page-long document**
- Not intended to give the definitive systematic error budget but perform **a first overview** and **provide recommendations** to improve on its estimation

Galaxy Clustering Systematics

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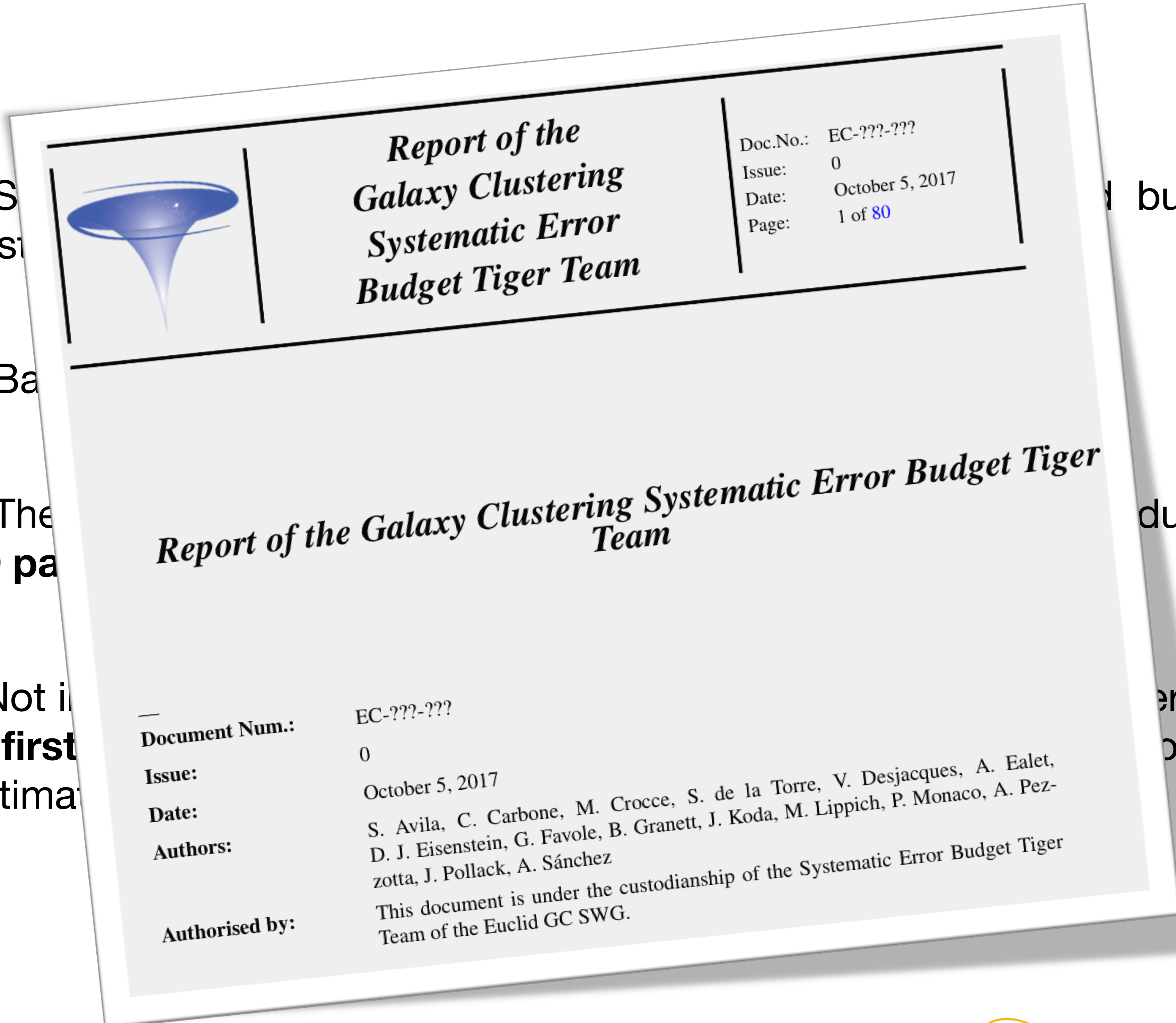


	Report of the Galaxy Clustering Systematic Error Budget Tiger Team	Doc.No.: EC-???-??? Issue: 0 Date: October 5, 2017 Page: 1 of 80

Report of the Galaxy Clustering Systematic Error Budget Tiger Team

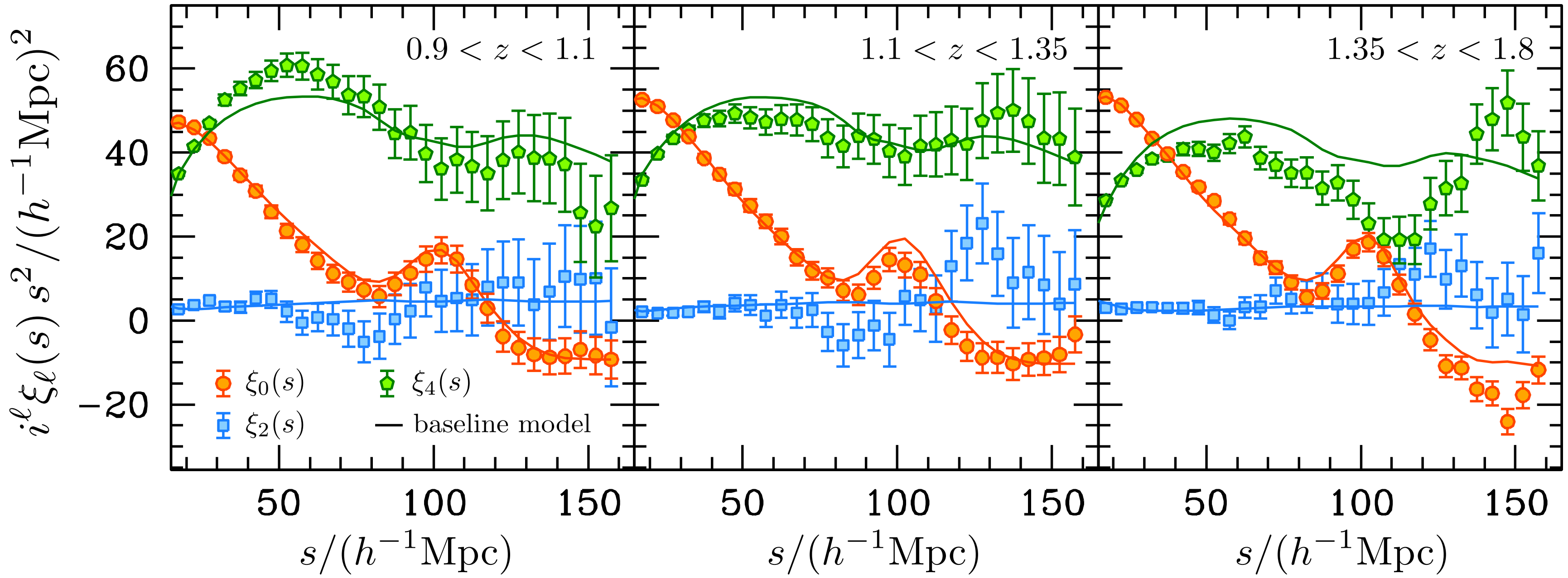
Document Num.:	EC-???-???
Issue:	0
Date:	October 5, 2017
Authors:	S. Avila, C. Carbone, M. Crocce, S. de la Torre, V. Desjacques, A. Ealet, D. J. Eisenstein, G. Favole, B. Granett, J. Koda, M. Lippich, P. Monaco, A. Pezzotta, J. Pollack, A. Sánchez
Authorised by:	This document is under the custodianship of the Systematic Error Budget Tiger Team of the Euclid GC SWG.

Galaxy Clustering Systematics
The menu

- Sources of systematic errors classified in three parts: **data**, **theory**, **likelihood**

Galaxy Clustering Systematics
Baseline

- For data and likelihood parts define a baseline galaxy clustering model based on Flagship (1.3.1)

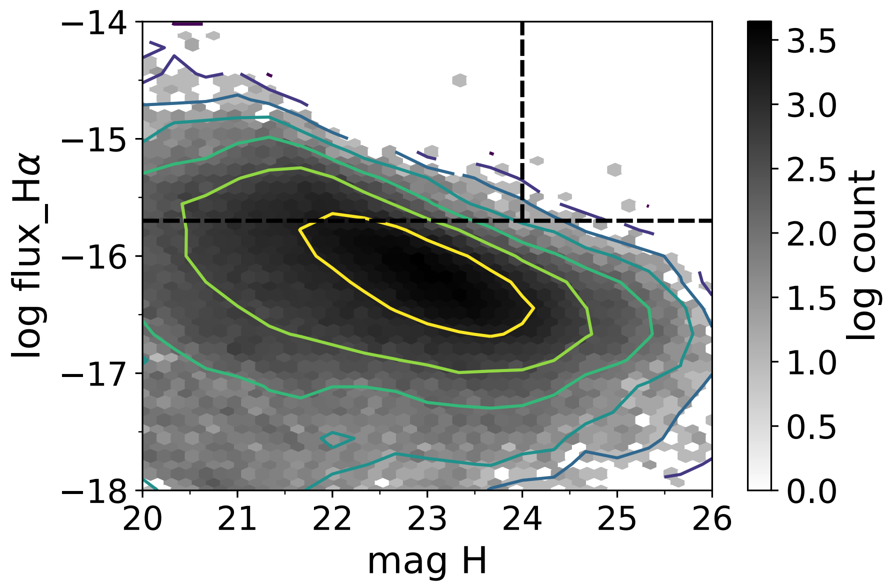


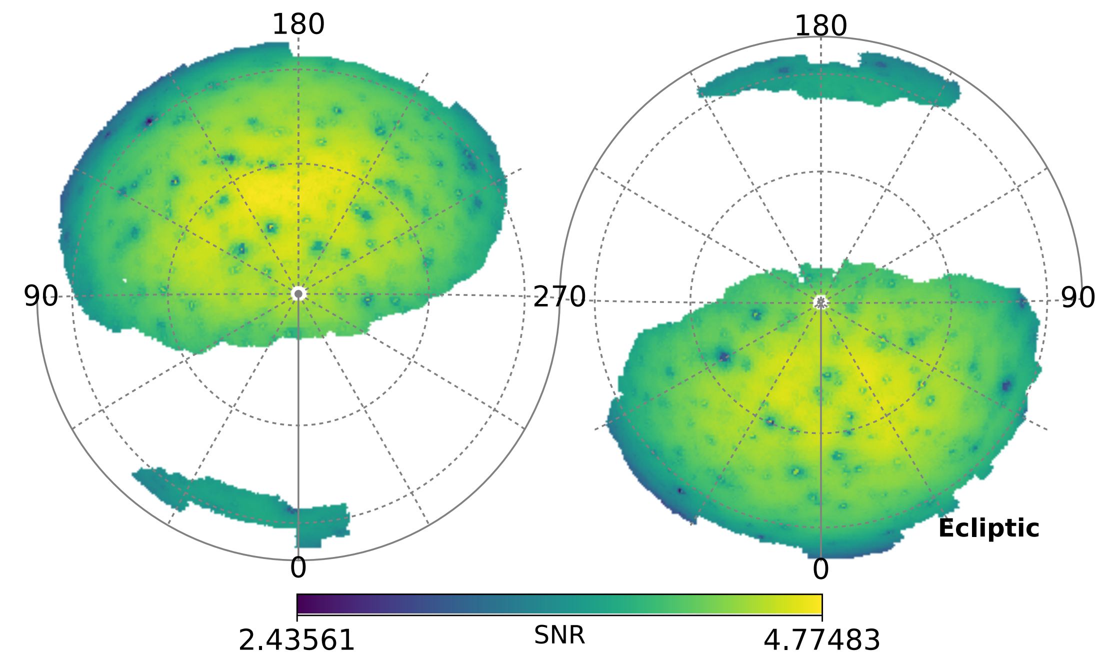
Redshift range	Volume/$(h^{-3}\mathrm{Mpc}^3)$	$n(z)/(h^3\mathrm{Mpc}^{-3})$
0.9–1.1	2.73	1.35×10^{-3}
1.1–1.35	3.99	8.58×10^{-4}
1.35–1.8	8.21	7.42×10^{-4}

Galaxy Clustering Systematics
Data

- Impact of Ha emitter number density and variation of flux limit

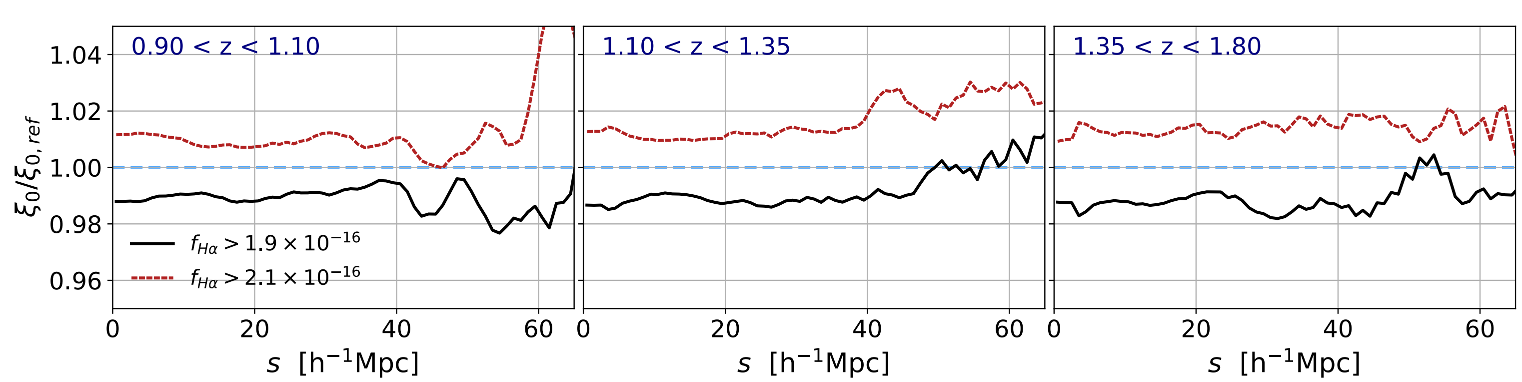
Ha emitters selection in Flagship





4-exposure Ha SNR

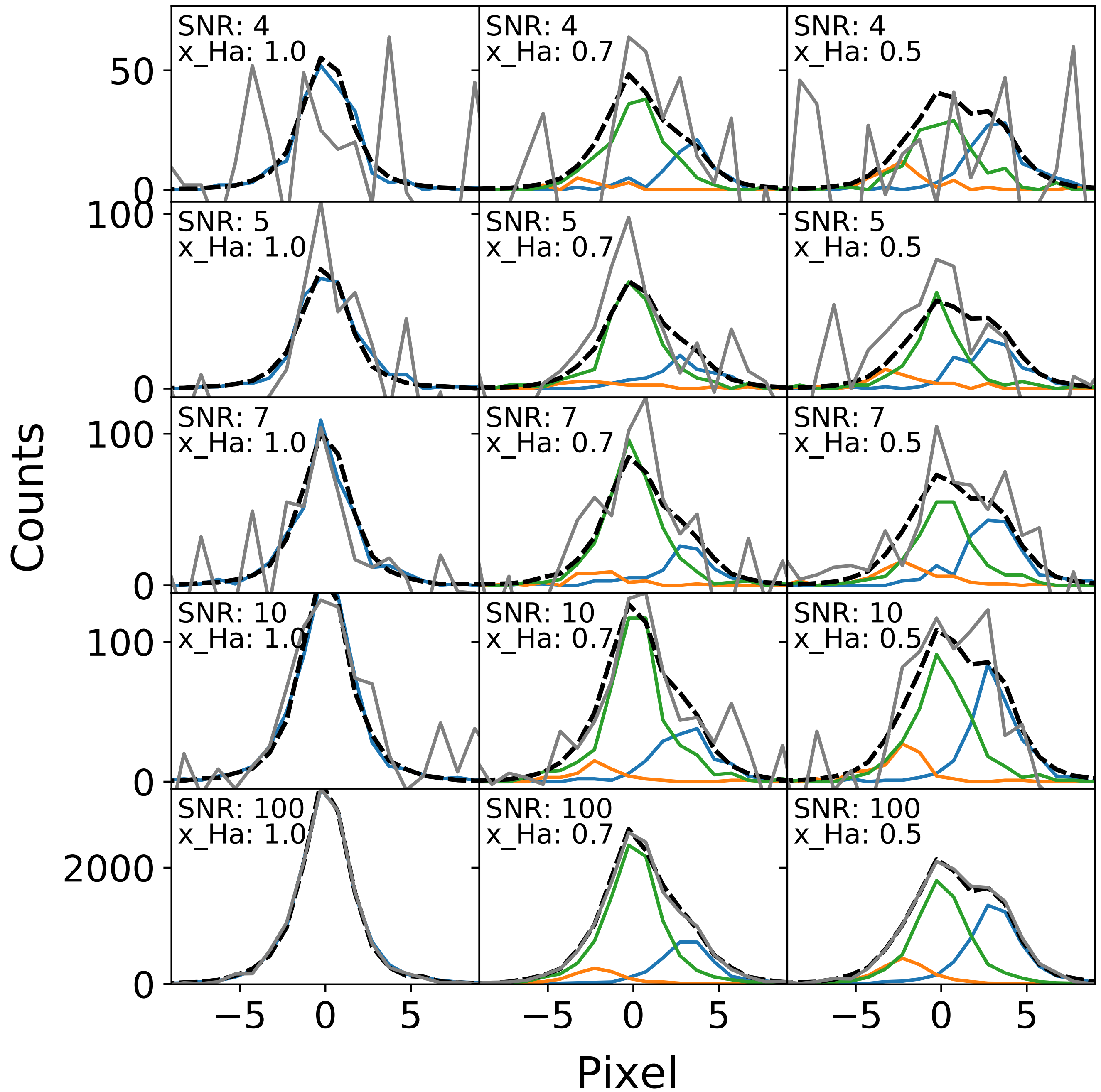
5% variation of the Ha flux limit

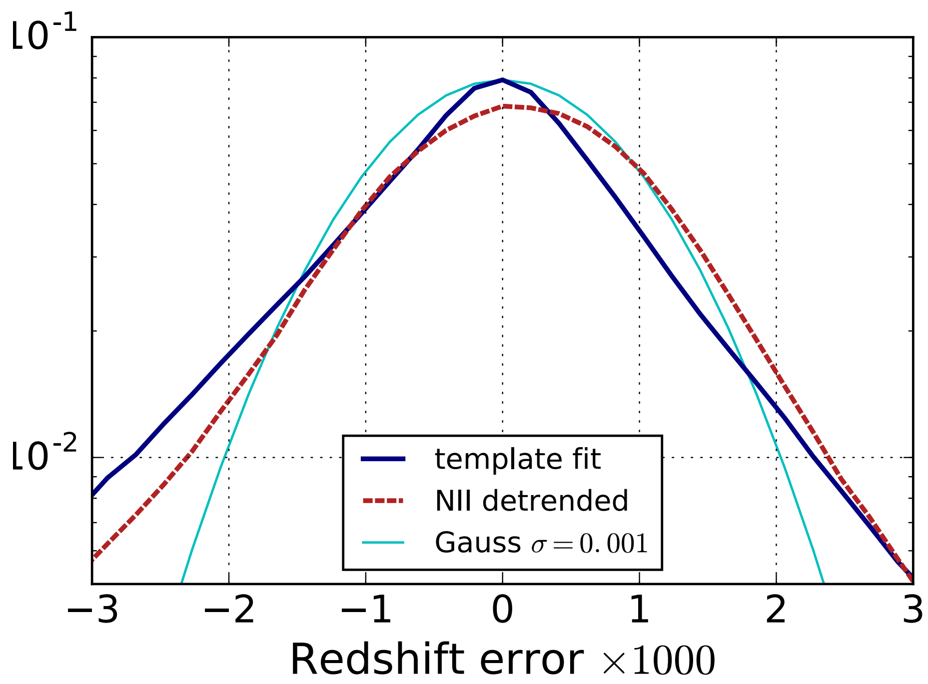


Galaxy Clustering Systematics

Data

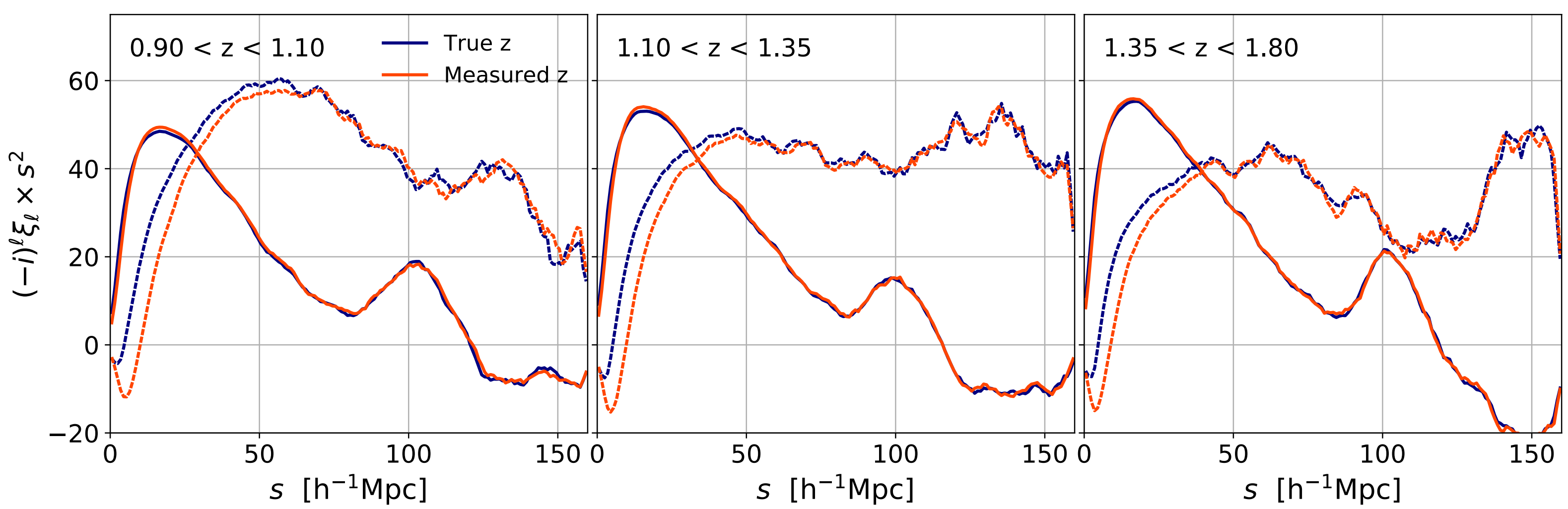
- Estimation of random redshift errors in Flagship



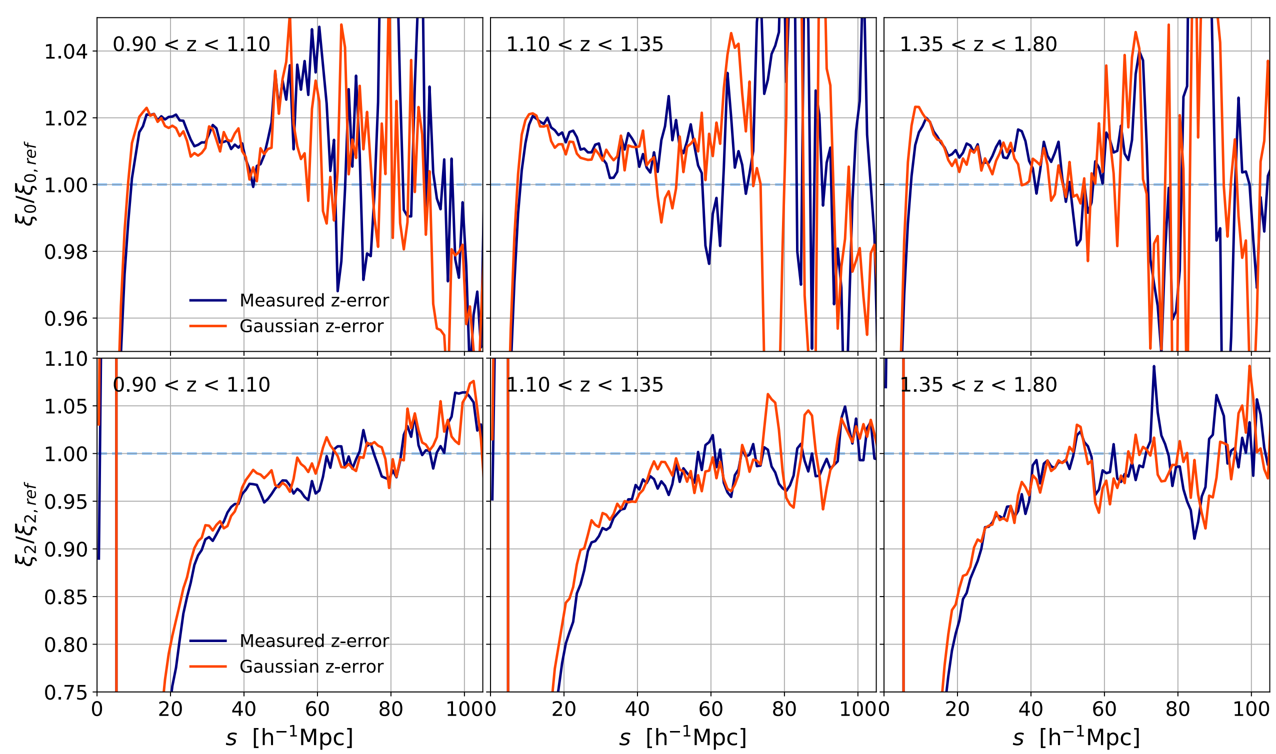


Galaxy Clustering Systematics
Data

- Impact of redshift random errors on two-point statistics



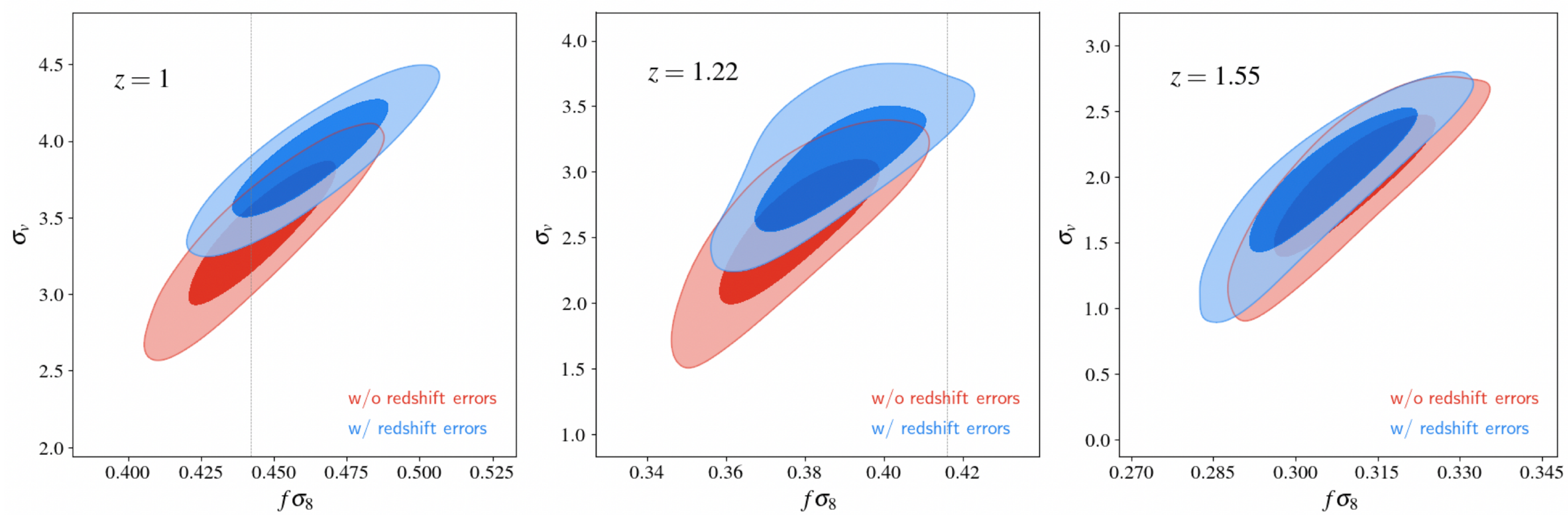
Redshift error vs no redshift error



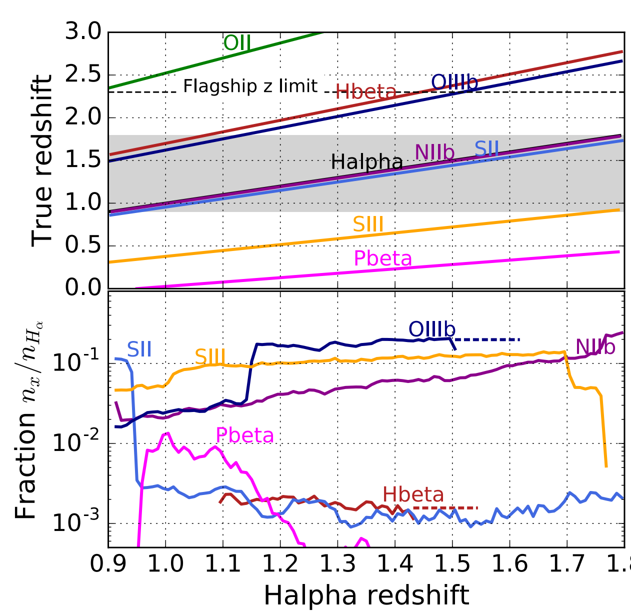
Gaussian z-error PDF vs true z-error PDF

Galaxy Clustering Systematics
Data

- Impact of redshift random error — *baseline error: 0.0016*



- Redshift systematic error (overlapping spectra, line misidentification)
  - Mitigation by forward modelling spectra overlaps in the random sample or pairwise weights: still to be studied in detail!



Galaxy Clustering Systematics
Theory

- Non-linear dark matter clustering
  - Perturbation Theory allows reaching 1-2% level accuracy up to k_{max} = 0.2-0.25: e.g. MPTbreeze, RegPT, gRPT, …
  - EFT can improve on accuracy but with more nuisance parameters
  - Semi-analytical models calibrated on simulations (Halofit, HM code, emulators) can potentially reach smaller scales

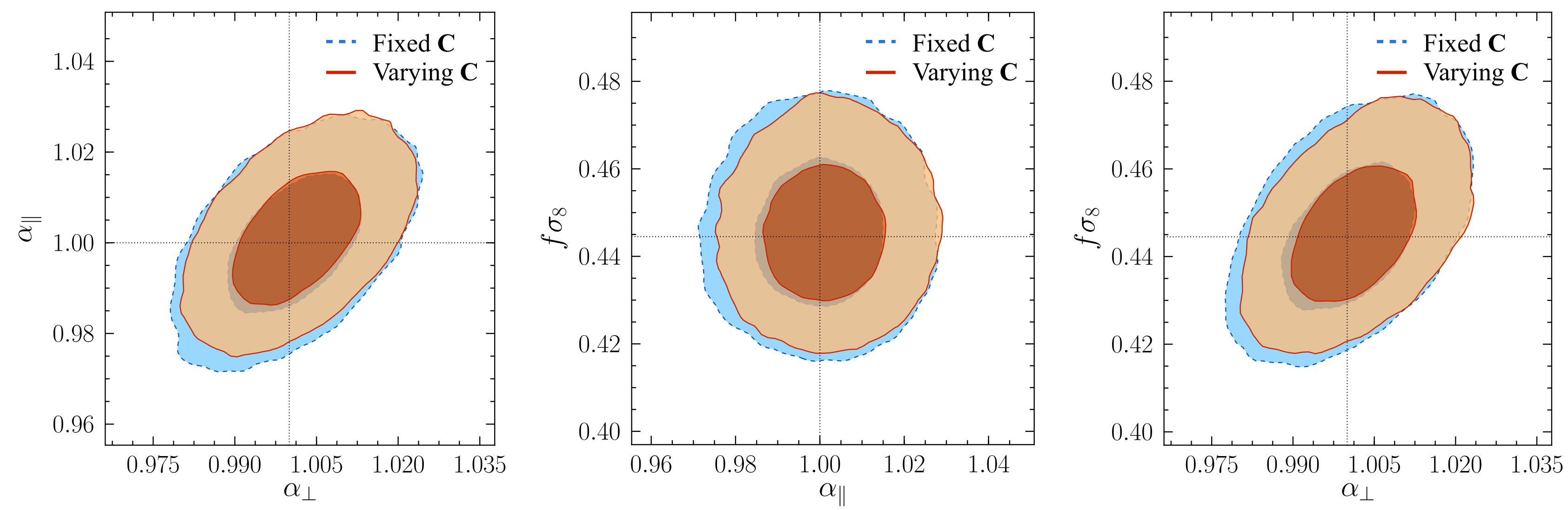
- Relative velocity/density between baryons and dark matter
  - Secondary effect: 1%? change on amplitude and position of BAO peak

- Galaxy biases
  - Detailed non-linear and non-local bias models (4 parameters) can be used, but unclear how these nuisance parameters affect final constraints
  - Velocity bias: include as an additional nuisance parameter?
  - Assembly bias?

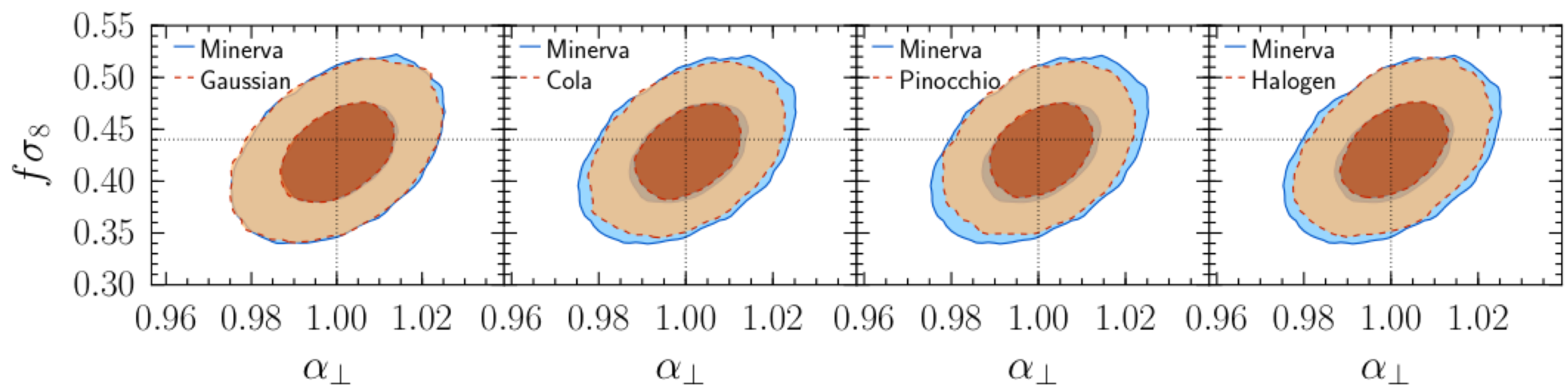
Galaxy Clustering Systematics

Likelihood

- Impact of cosmology-dependent data covariances



- Impact of biased data covariances (approx. methods to build mocks)



***CM-2PCF-GC:** about 5000-10000 runs required*

Galaxy Clustering Systematics
Summary

Systematic effect	Responsible WP or group	impact on BAO	impact on RSD	Maturity of mitigation
Photometric calibration	WP2	small	small	high
Milky Way extinction	WP2	small	small	high
Redshift measurement error	WP1	small	medium?	high
Confusion from overlapping spectra	WP2	unknown	unknown	low
Deep field	WP2	small?	small?	low
Clustering estimators: power spectrum	OU-LE3	small	small	high
Clustering estimators: two-point correlation function	OU-LE3	small	small	high
Clustering estimators: wide-angle effects	WPX	small	small	high
Reconstruction	WP4	large	none	medium
Nonlinear evolution of dark-matter	none	medium	large	medium
Redshift-space distortions	none	low	large	low
Galaxy density bias	none	low	large	low
Massive neutrinos	none	low	large	medium
Galaxy velocity bias	none	low	large	low
Variations of model template with cosmology	WP4?	low	unknown	low
Lightcone & projection effects	WPX	low?	low?	low
Relative velocity and density perturbations between baryons and dark matter	none	small?	small?	small?
Noise in the covariance matrix	WP3	small	small	high
Biased estimates of the covariance matrix	WP3	small-med?	small-med	high
Cosmology dependence of the covariance matrix	WP3	small?	small	low
Incorrect shape of the likelihood function	WP3	unknown	unknown	low
Combination of results from multiple statistics	WP3	small	small	high

Redshift error
Spectra confusion

Non-linear evolution of dark matter

Rel. vel. baryons & dark matter

Bias & cosmology-dep. in cov. matrix

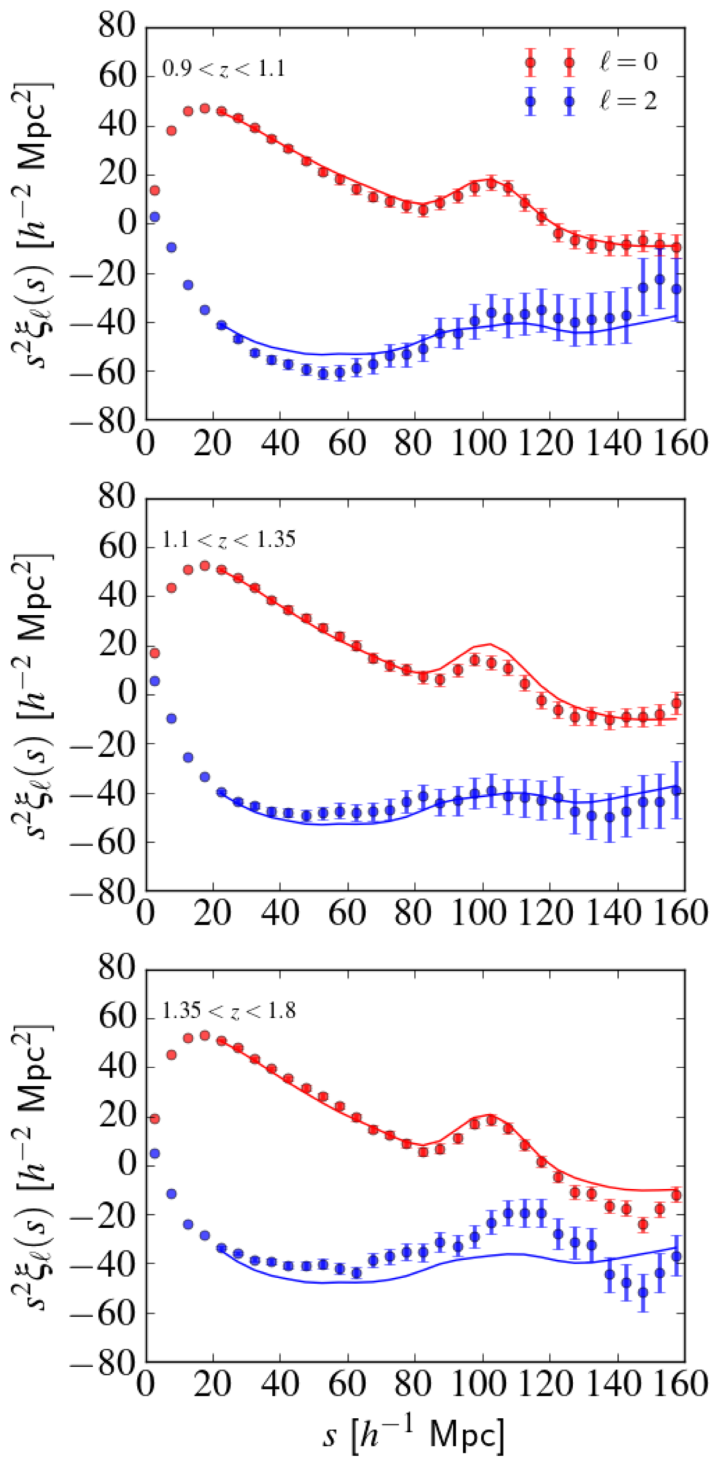
- Small components: $\sigma_{\rm sys}/\sigma_{\rm stat} < 0.2$.
- Medium components: $0.2 < \sigma_{\rm sys}/\sigma_{\rm stat} < 0.45$
- Large components: $\sigma_{\rm sys}/\sigma_{\rm stat} > 0.45$.

Summary

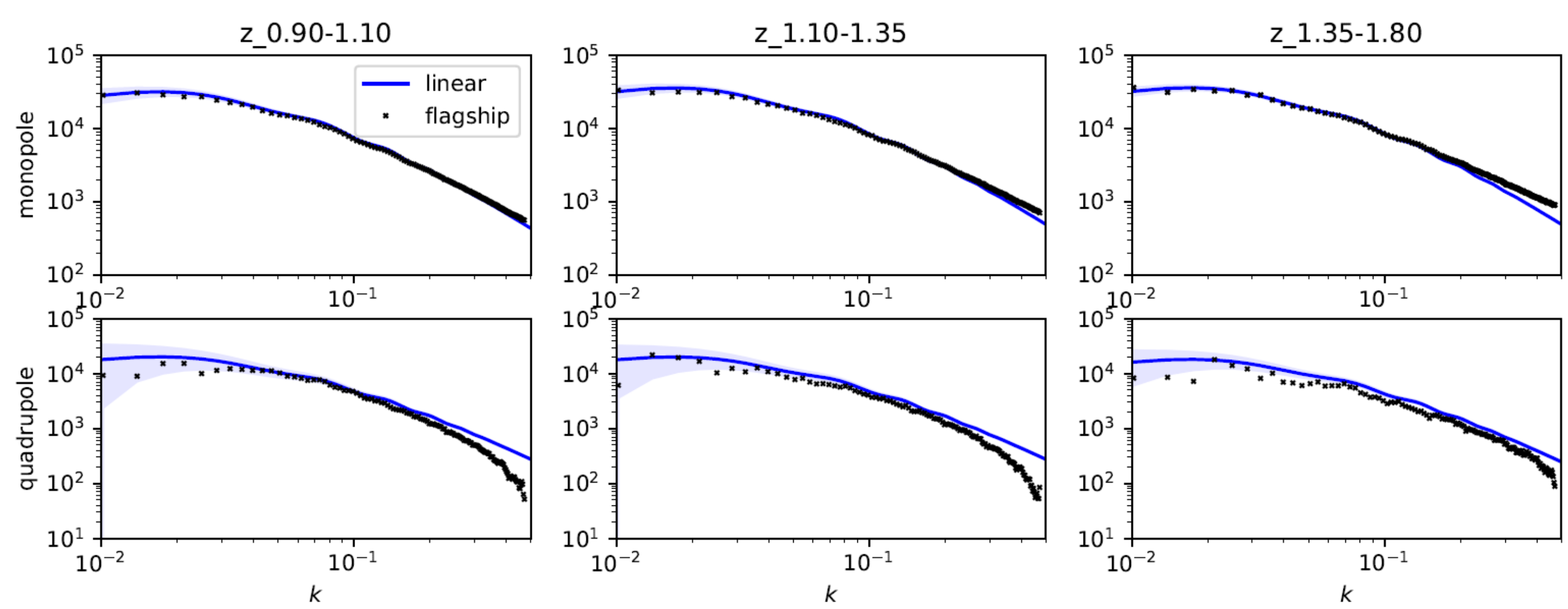
- *Galaxy clustering systematics* tiger team work
- Synergies with CS-SWG, SPV2, OU-LE3-GC

Synergies with CS-SWG, SPV2, LE3-GC
Flagship validation

- Galaxy clustering measurements in Flagship
- Comparison to theoretical expectations (both state-of-the-art non-linear & linear predictions)
- Issue in the quadrupole moments: unable to reproduce theoretical RSD within stat. error!



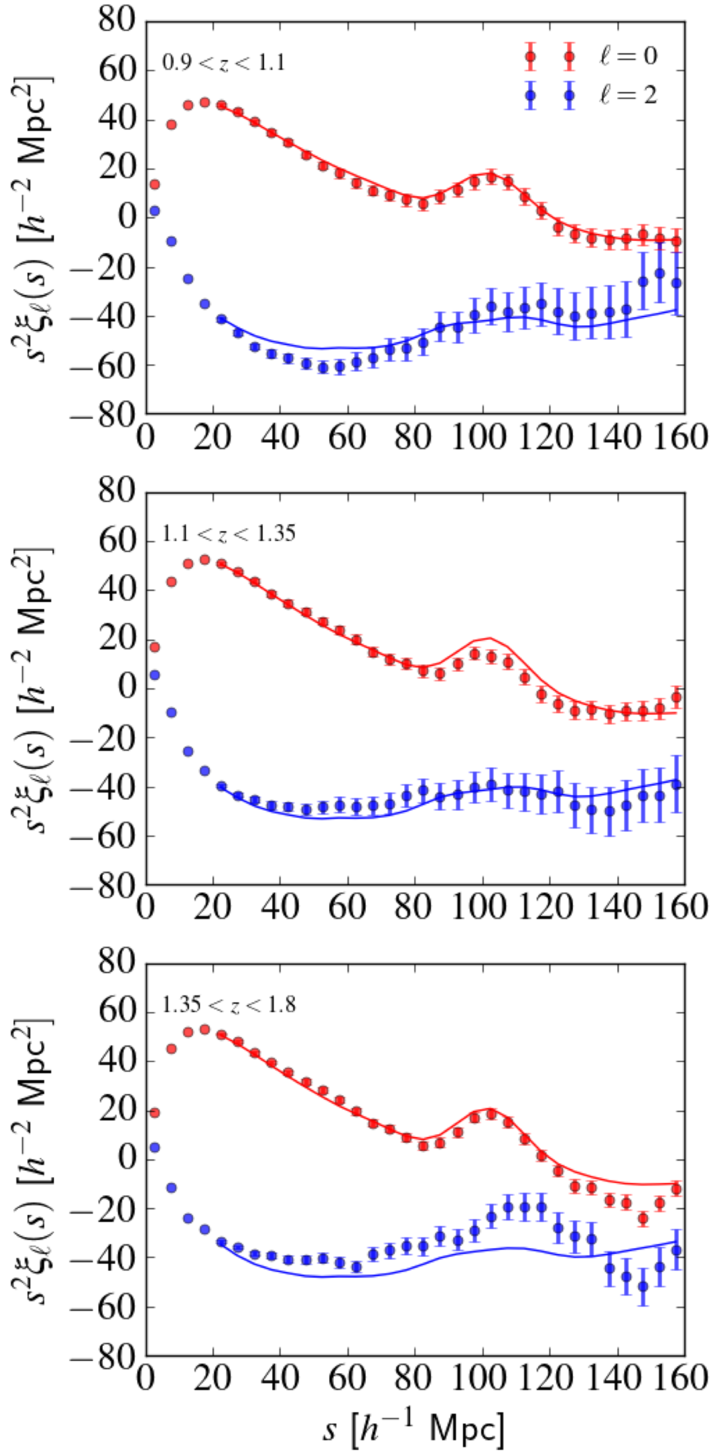
de la Torre et al.



Jun Koda et al.

Synergies with CS-SWG, SPV2, LE3-GC
Flagship validation

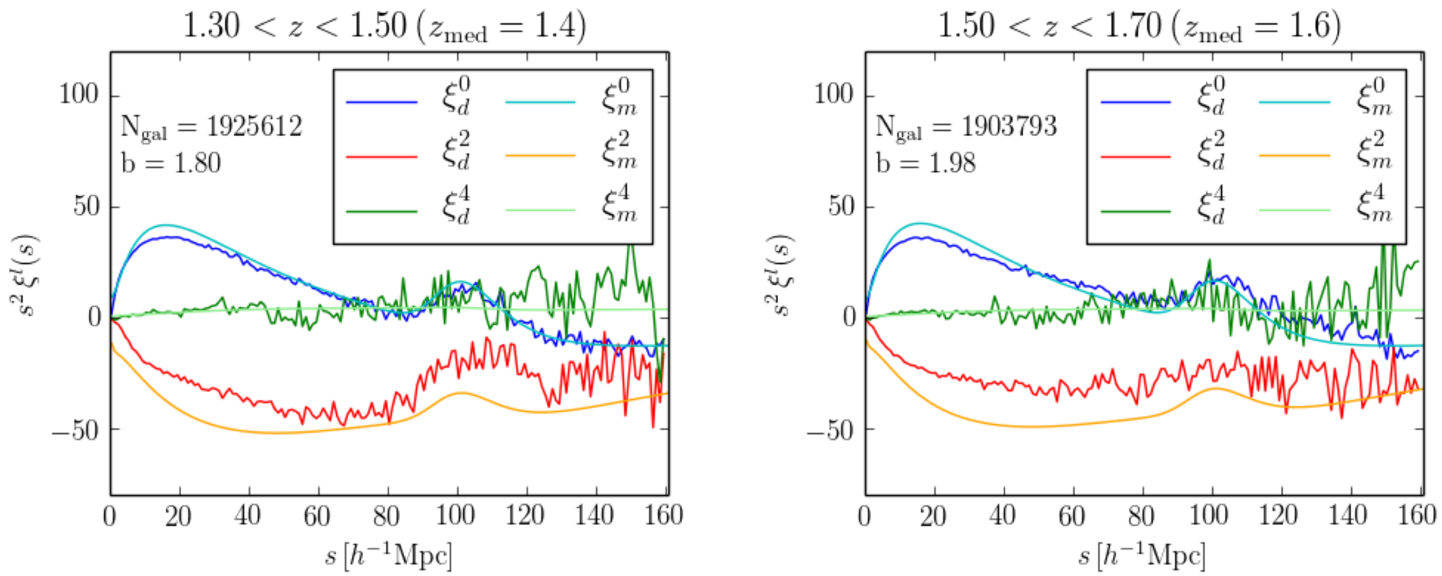
Galaxies



de la Torre et al.

- Galaxy clustering measurements in Flagship
- Comparison to theoretical expectations (both state-of-the-art non-linear & linear predictions)
- Issue in the quadrupole moments: unable to reproduce theoretical RSD within stat. error!
- Already present in flagship haloes… velocities?

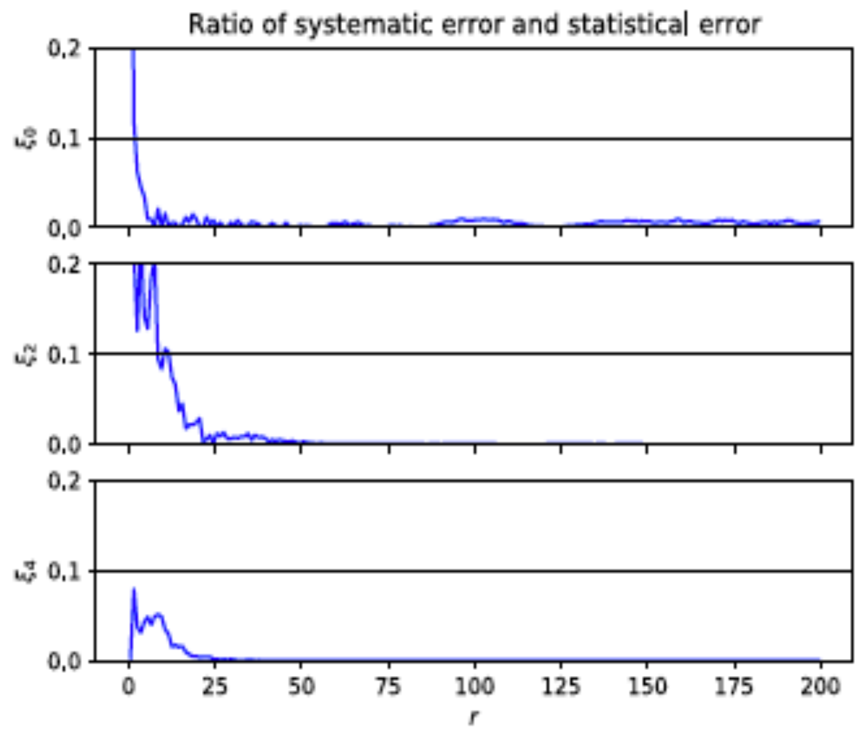
Haloes



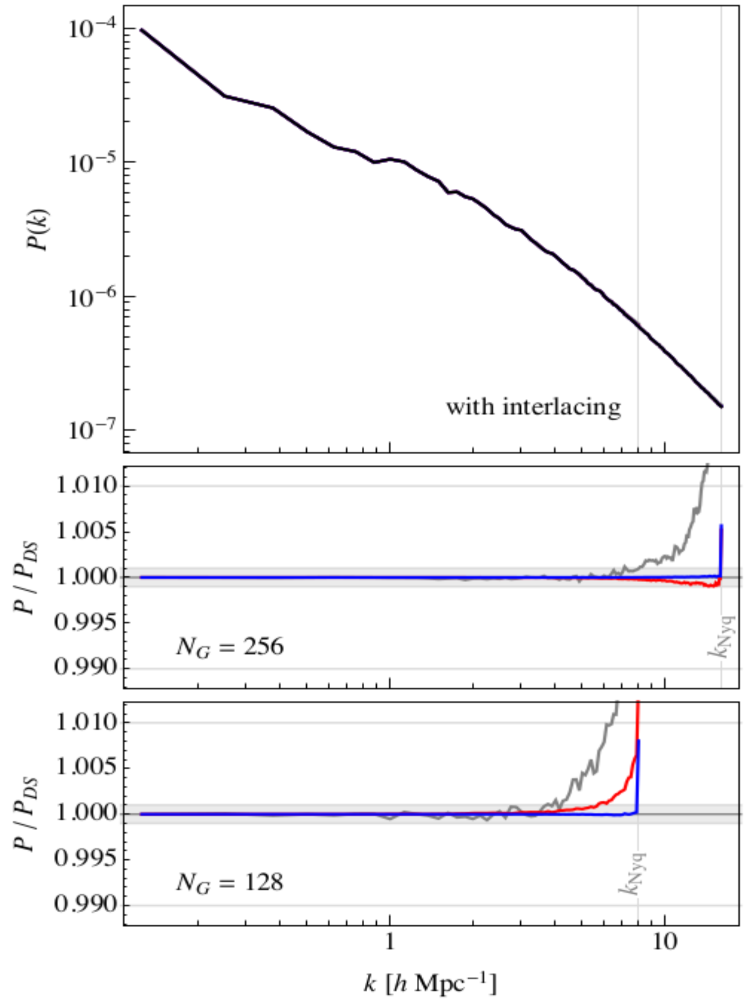
Andrea Pezzotta et al.

Synergies with CS-SWG, SPV2, LE3-GC
LE3-GC validation

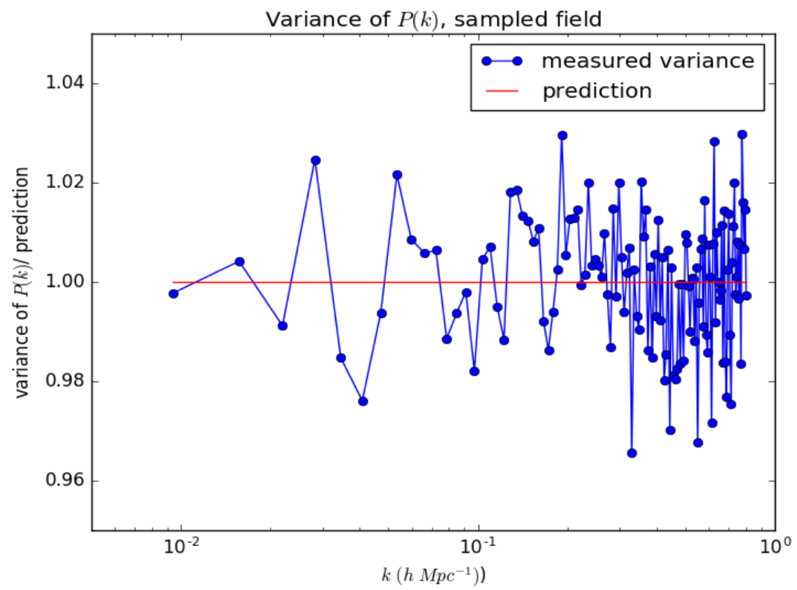
- Last validation of 2PCF-GC, PK-GC, CM-2PCF-GC (first priority)



2PCF-GC



PK-GC



CM-2PCF-GC

Conclusion

- Significant work achieved in the last year
- *Galaxy clustering systematics* document (60 pages) written (now being reviewed)
- New synergies with SPV2, E2E-GC groups
- Reorganisation of the SWG WPs : work more as *Tiger Teams*, more paper oriented
- Need more involvement of the French community