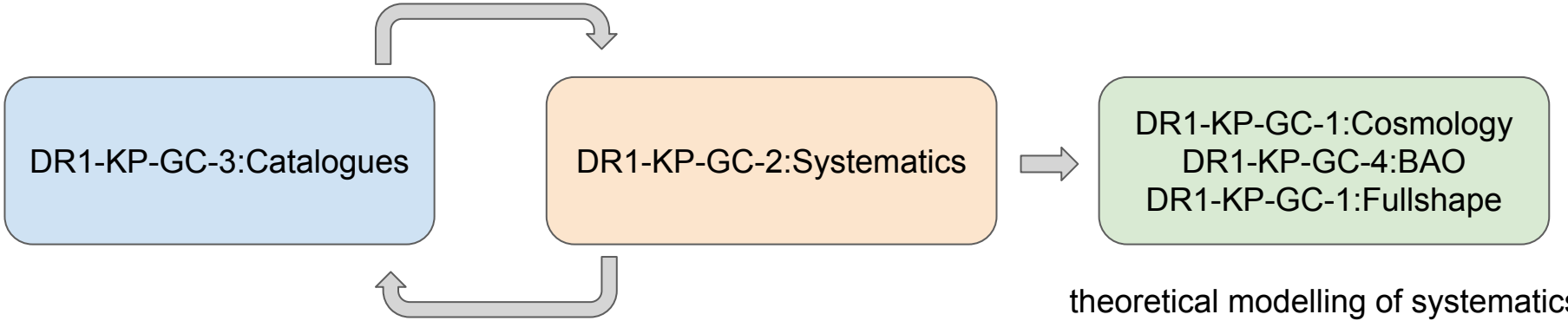
Systematics in spectroscopic clustering

DR1-KP-GC-2:Systematics

Coordinators: Pierluigi Monaco, Ilaria Risso

Goal and synergies

We aim to assess the impact of systematic effects on the galaxy clustering measurements, characterizing and mitigating all residual errors which are not accounted for in the selection function of the spectroscopic catalogue.



early tests on real data, validation and checkpoints of the spectroscopic pipelines, identification and mitigation of systematics

theoretical modelling of systematics and impact on cosmological parameters

Data systematics in the spectroscopic sample

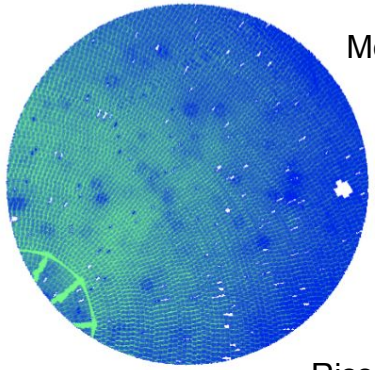
We can identify two broad classes of systematics:

1. **angular systematics**

   modulation of the galaxy number density across the sky due to fluctuations of the survey depth
   (DR1-KP-GC3, see B. Granett's talk)

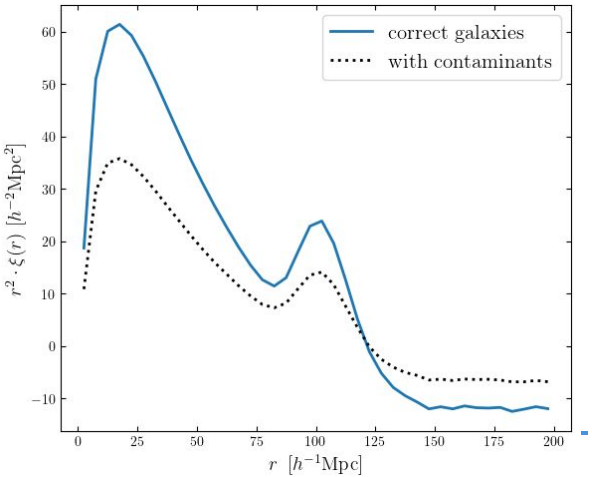
2. **redshift errors**

   introduction of contaminants (line and noise interlopers) in the spectroscopic sample which dilute the clustering signal



Monaco et al., in prep.

Risso et al., arxiv



Redshift errors: preparatory work

End-to-end simulations were run to determine the expected types and fractions of interlopers in the spectroscopic sample (Granett et al. in prep., M. Béthermin).

Reference pre-launch catalogues: *EuclidLargeMocks*

→ 1000 simulated catalogues representative of the expected Euclid galaxy types, number density and DR1 area (Monaco et al, in prep.)

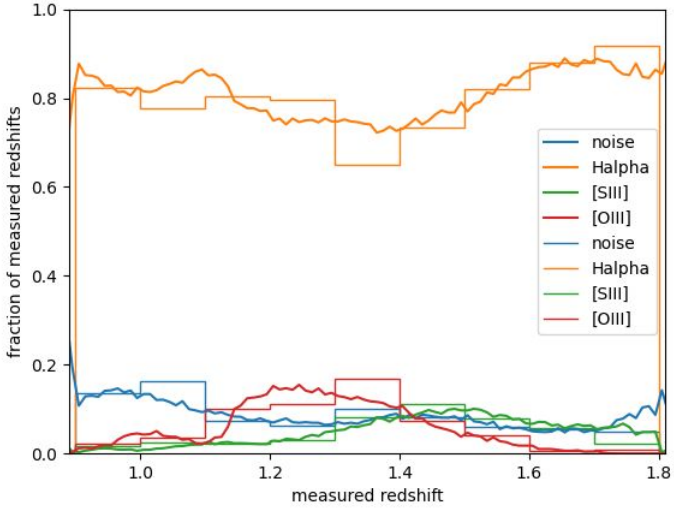


Table 2. Mean fractions of the different interloper types in the four spectroscopic redshift bins in the contaminated *EuclidLargeMocks*.

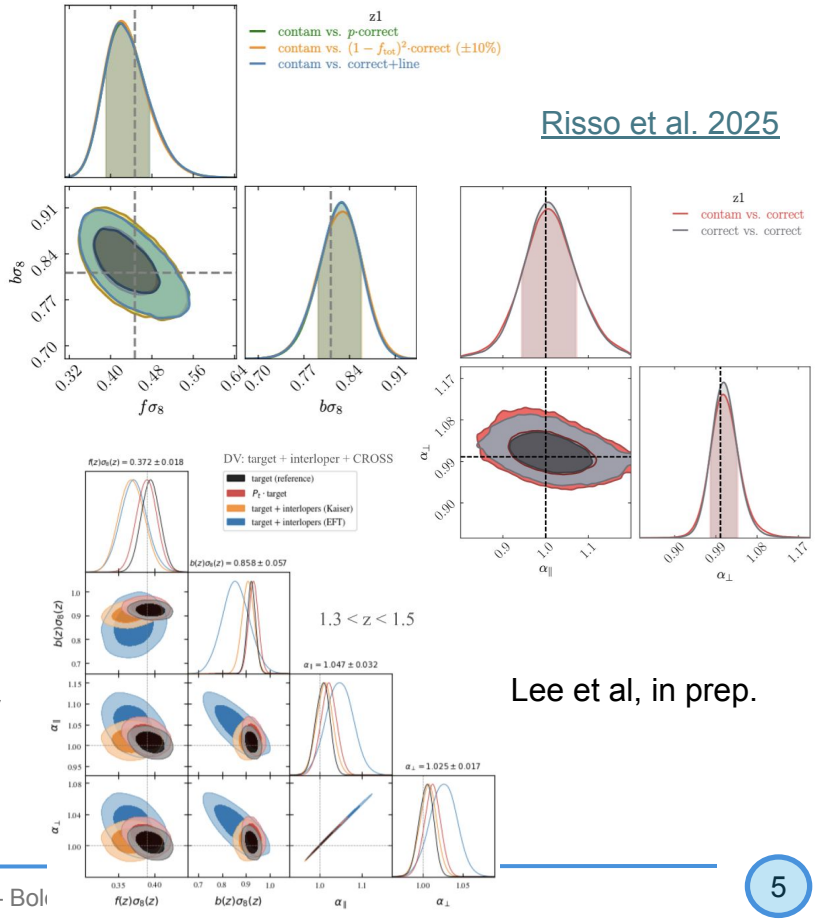
	$z \in [0.9, 1.1]$	$z \in [1.1, 1.3]$	$z \in [1.3, 1.5]$	$z \in [1.5, 1.8]$
O III	0.03	0.12	0.09	0.01
S III	0.01	0.03	0.08	0.07
noise	0.12	0.08	0.08	0.06

Redshift errors: preparatory work

End-to-end simulations were run to determine the expected types and fractions of interlopers in the spectroscopic sample (Granett et al. in prep., M. Béthermin).

Reference pre-launch catalogues: *EuclidLargeMocks*
→ 1000 simulated catalogues representative of the expected Euclid galaxy types, number density and DR1 area (Monaco et al, in prep.)

Results: both in configuration and Fourier space, a simple model accounting only for the total contamination fraction (without modelling the different interlopers' populations) is sufficient to recover unbiased cosmological parameters for DR1 with the pre-launch contamination fractions

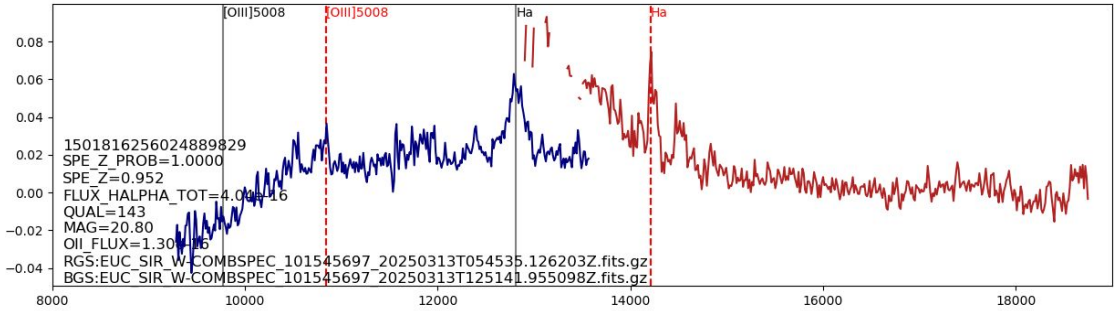


Redshift errors: real data

The error budget is currently dominated by systematics effects, and in fact real data are much more complicated than mock catalogues:

- the fraction of catastrophic redshift errors looks higher than expected
- the same estimation of the interlopers' fraction is not straightforward
- underestimated effects (i.e spectra overlap, 0th order masking, persistence…)
- bugs/flaws in the pipelines

→ targeted actions and modifications to the pipelines tested on the COSMOS field to maximize purity and completeness in view of DR1



B. Granett

The need for new mocks for DR1

The parameters for the selection are:

selection	density	purity	f_OIII	f_SIII	f_noise	PDFc	mean	sigma	gamma	trunc	PDFl	mean	sigma	footprint	real.
pre-launch	1255	0.7999	0.0668	0.0497	0.0836	G	0	0.001		remove	G	0	0.001	30degCircle	10
high density 1	2000	0.6	0.05	0.05	0.3	V	0	0.0005	0.0004	remove	G	0	0.001	30degCircle	50
high density 2	2000	0.6	0.05	0.05	0.3	V	0	0.0006	0.001	noise	G	0	0.001	30degCircle	50
high purity	600	0.8	0.05	0.05	0.1	V	0	0.0005	0.0004	remove	G	0	0.001	4D-30degCircle	50
worst case	400	0.4	0.05	0.05	0.5	V	0	0.0006	0.001	noise	G	0	0.001	4D-30degCircle	50

P. Monaco, Y. Elkhashab

High density: maximize the number of sources kept in the sample, thus decreasing purity

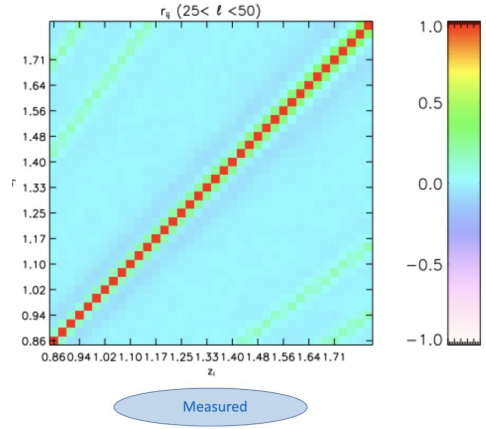
High purity: only very reliable galaxies → low number density due to selection and patchy footprint in the sky

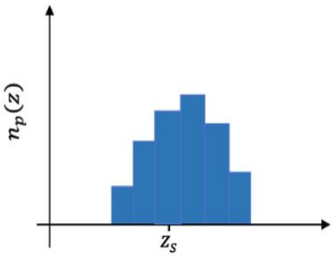
Worst case: both low purity and completeness

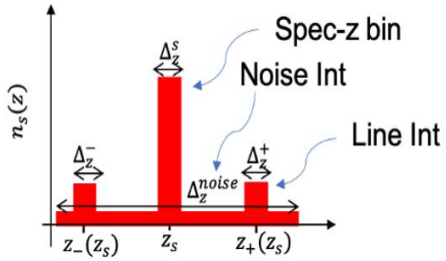
Current efforts to handle real data

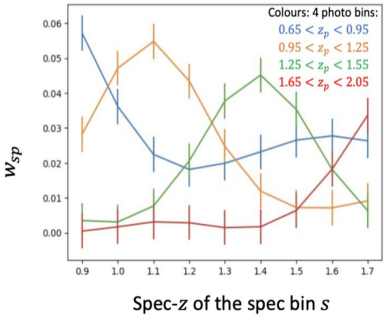
Current efforts to handle real data

- Cross correlations between redshift bins:
  - fractions and types of line interlopers (J. Bell, S. de la Torre)
  - angular systematics and the contribution of lensing (P. Monaco, Y. Elkhashab)
  - spectroscopic contaminants using clustering redshift technique with Euclid photometric sample (W. d'Assignee)





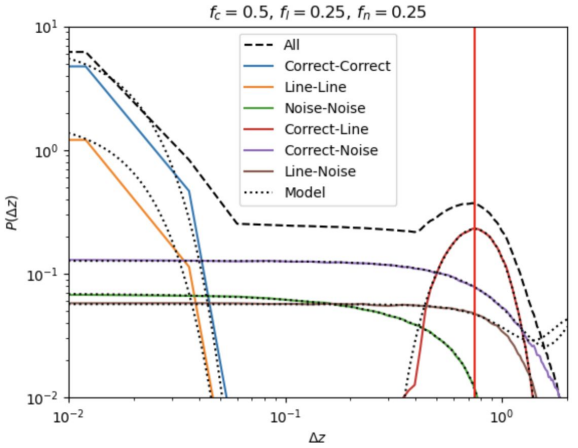




Current efforts to handle real data

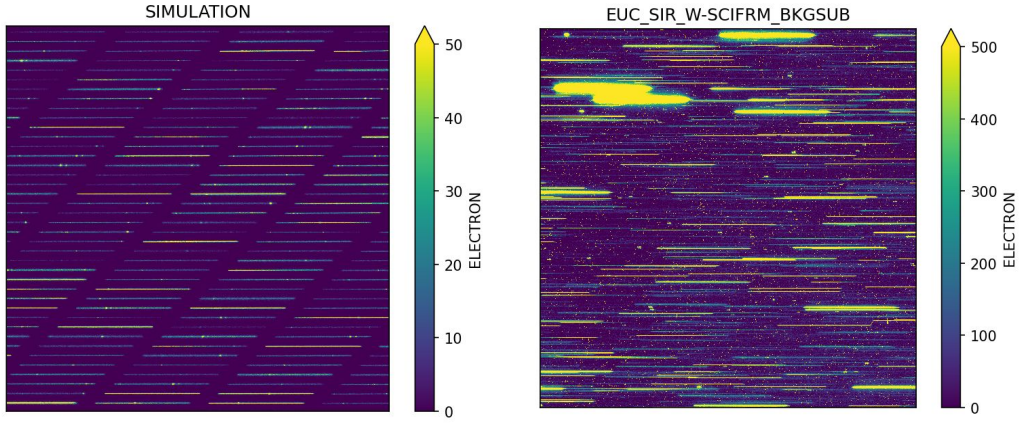
- Cross correlations between redshift bins:
  - fractions and types of line interlopers (J. Bell, S. de la Torre)
  - angular systematics and the contribution of lensing (P. Monaco, Y. Elkhashab)
  - spectroscopic contaminants using clustering redshift technique with Euclid photometric sample (W. d'Assignee)
- Purity through repeated observations in different exposures (S. de la Torre, E. Sarpa, P. Monaco)

$$\begin{aligned}\mathcal{P}(\Delta z) = & f_c^2 H(\Delta z, \sigma') + f_\ell^2 H(\Delta z, \sigma') + f_n^2 M(\Delta z) \\ & + f_c f_l \left(\mathcal{P}_{c\ell}(\Delta z) + \mathcal{P}_{\ell c}(\Delta z)\right) \\ & + f_c f_n \left(\mathcal{P}_{cn}(\Delta z) + \mathcal{P}_{nc}(\Delta z)\right) \\ & + f_\ell f_n \left(\mathcal{P}_{\ell n}(\Delta z) + \mathcal{P}_{n\ell}(\Delta z)\right)\end{aligned}$$



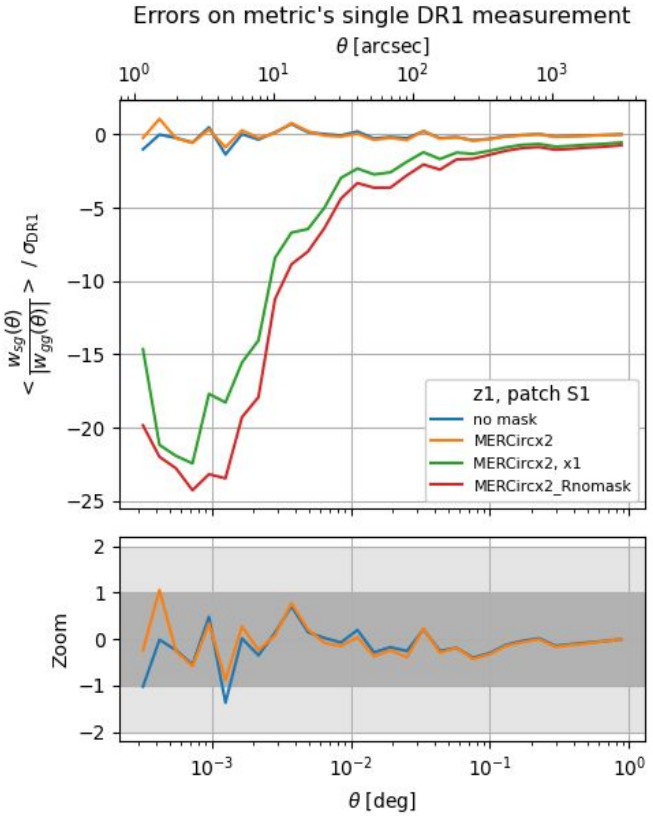
Current efforts to handle real data

- Cross correlations between redshift bins:
  - fractions and types of line interlopers (J. Bell, S. de la Torre)
  - angular systematics and the contribution of lensing (P. Monaco, Y. Elkhashab)
  - spectroscopic contaminants using clustering redshift technique with Euclid photometric sample (W. d'Assignee)
- Purity through repeated observations in different exposures (S. de la Torre, E. Sarpa, P. Monaco)
- Angular mask, purity and completeness through source injection (F. Passalacqua)
- Variations of detection probability in the NISP detector plane (B. Camacho Quevedo)



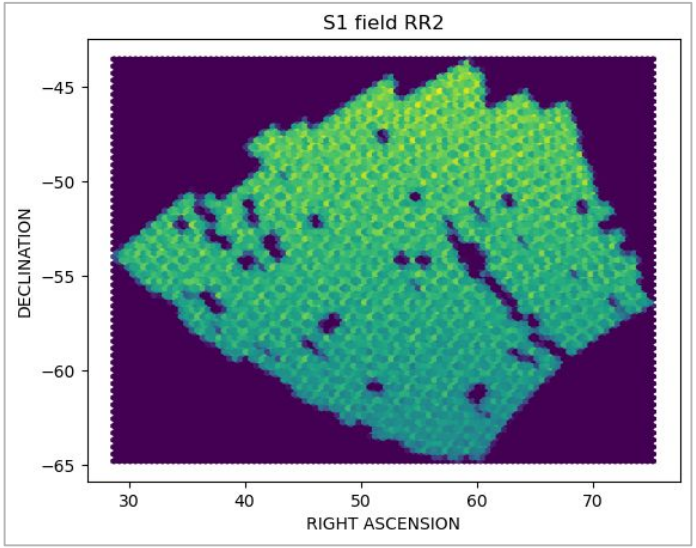
Current efforts to handle real data

- Cross correlations between redshift bins:
  - fractions and types of line interlopers (J. Bell, S. de la Torre)
  - angular systematics and the contribution of lensing (P. M
  - spectroscopic contaminants using clustering redshift te sample (W. d'Assignee)
- Purity through repeated observations in different expo
- Angular mask, purity and completeness through sour
- Variations of detection probability in the NISP detecto (B. Camacho Quevedo)
- Star-related systematics and stellar mask in the random catalogue (I. Risso)



Current efforts to handle real data

- Cross correlations between redshift bins:
  - fractions and types of line interlopers (J. Bell, S. de la Torre)
  - angular systematics and the contribution of lensing (P. M
  - spectroscopic contaminants using clustering redshift te sample (W. d'Assignee)
- Purity through repeated observations in different expo
- Angular mask, purity and completeness through sour
- Variations of detection probability in the NISP detecto (B. Camacho Quevedo)
- Star-related systematics and stellar mask in the ra
- Data selections and random catalogue (A. Farina, B. Granett, I. Risso)



Current efforts to handle real data

- Cross correlations between redshift bins:
  - fractions and types of line interlopers (J. Bell, S. de la Torre)
  - angular systematics and the contribution of lensing (P. Monaco, Y. Elkhashab)
  - spectroscopic contaminants using clustering redshift technique with Euclid photometric sample (W. d'Assignee)
- Purity through repeated observations in different exposures (S. de la Torre, E. Sarpa, P. Monaco)
- Angular mask, purity and completeness through source injection (F. Passalacqua)
- Variations of detection probability in the NISP detector plane

  (B. Camacho Quevedo)
- Star-related systematics and stellar mask in the random catalogue (I. Risso)
- Data selections and random catalogue (A. Farina, B. Granett, I. Risso)
- Galaxy clustering in the Deep field (with GAE: M. Magliocchetti, G. Parimbelli)