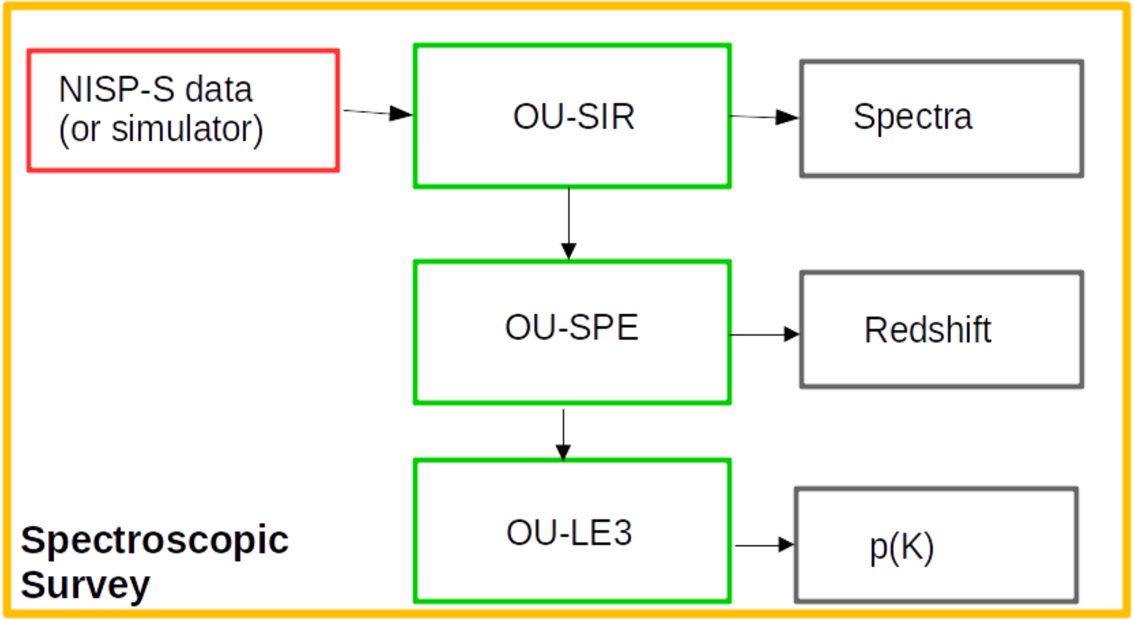
OUs activity: Spectroscopy.

Part I: OU SIR.

Marco Scodeggio
INAF – IASF Milano

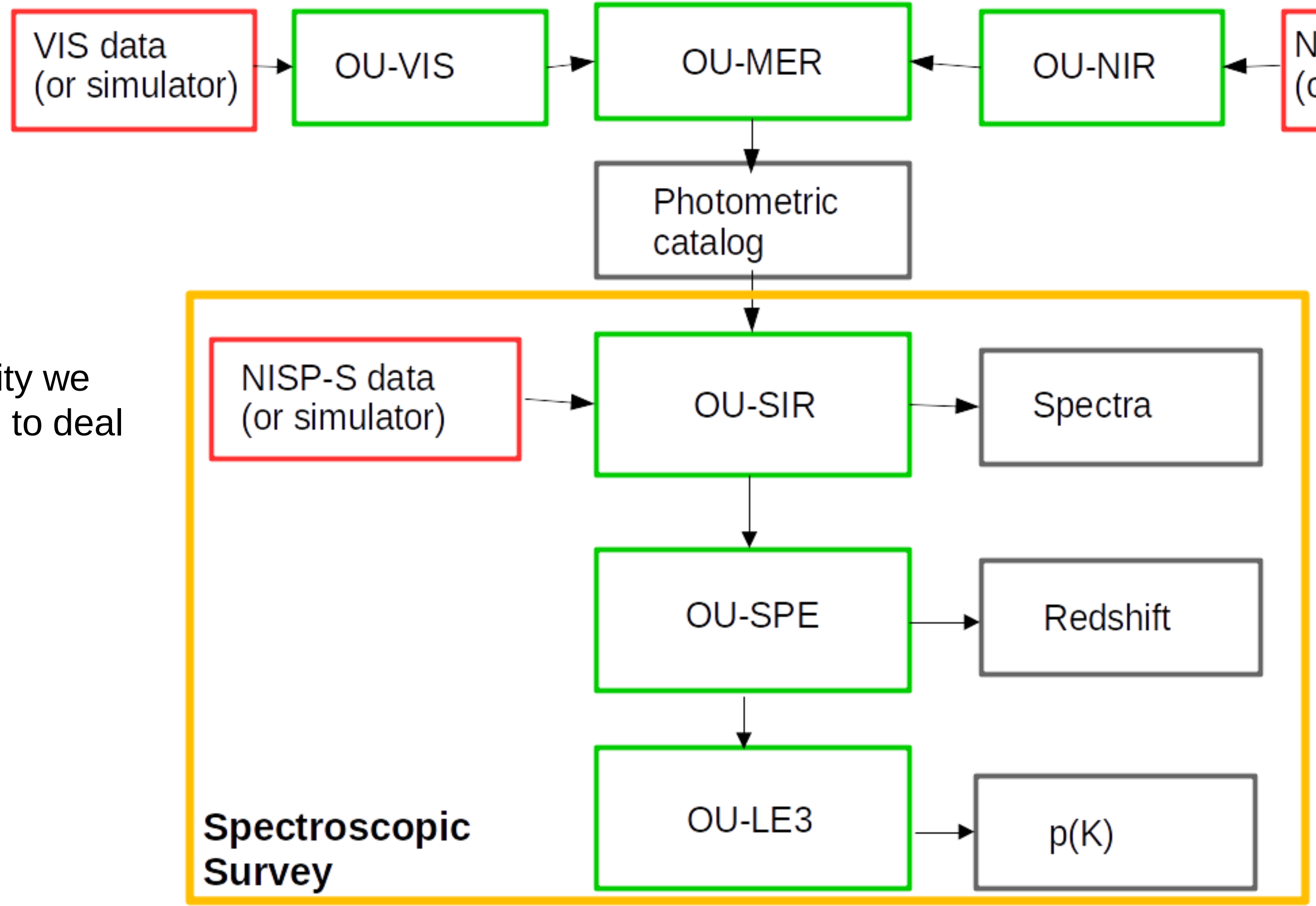
OUs activity: Spectroscopy.

General perception about the Spectroscopic Survey



OUs activity: Spectroscopy.

Reality we need to deal with



OUs activity: Spectroscopy.

SIR Status @ the Ground Segment Readiness Review:

- NO major RIDs
- A few minor RIDs (some improvements to the Software Design Document)

PF maturity:

- All PEs close to reach ML-3A (pre-production stage), but we still need to improve on some details

PF main problems:

- SIR is still a tiny group, and any perturbation to the development activities will immediately result in significant delays in the agreed upon schedule
- The spectroscopic data-set is an extremely complicated one, and we do not have yet all the needed tools to speed-up development and validation activities

OUs activity: Spectroscopy.

OU-SIR tasks today.

- OU-SIR development and validation for the PV phase pipeline release is almost over

- **But significant major uncertainties still persist, mostly because of lack of information about instrument properties** (never had any info available about instrument response variations across the field of view, detailed layout of detectors in the field of view, optical ghosts, detector persistence effects)

OU-SIR tasks after launch.

- Learn as much as possible about NISP instrument properties
- Code changes / update / upgrade resulting from this learning process
- Technical and scientific validations of modified codes
- Contribute to the IOT activities to monitor the Spectroscopic Data Quality (see Chiara Mancini's talk)
- Continue the production of simulated NISP data required to support the continued SIR development activities (see Francesca Passalacqua's talk)
- Support to SWG for scientific exploitation, as part of the end-to-end scientific validation of the Spectroscopic Survey

OUs activity: Spectroscopy.

OU-SIR: what's next

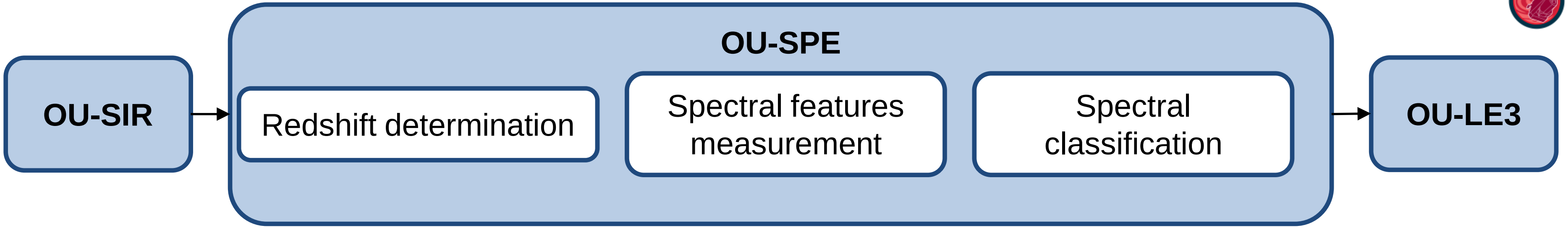
- Complete the re-reduction of PV Rehearsal #1 data with the latest version of the Pipeline, to provide SPE a good set of spectra for their internal testing
- Complete preparation for PV Rehearsal #2
- Improve a couple of PEs that need some updating (background subtraction, optimal extraction)
- Clean up the calibration pipelines
- Continue working with the group defining the details of the end-to-end scientific validation of the Spectroscopic Survey, to make sure all info that might be needed will be readily available
- Continue working on a Euclid-specific spectroscopic data plotting tool

OUs activity: Spectroscopy.

Part II: OU SPE.

Michele Moresco
University of Bologna

OUs activity: Spectroscopy.



INPUT

- 1D decontaminated combined spectra and associated information;
- *1D spectra for each single roll observation;*
- Associated noise: variance (covariance matrix);
- Mask (1D and combined).

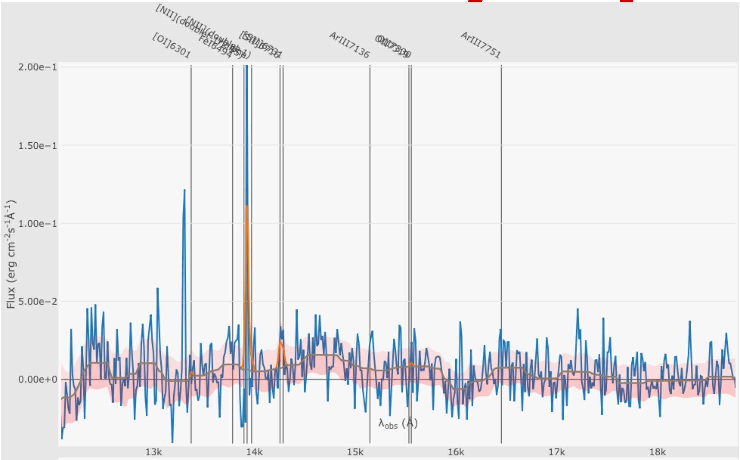
OUTPUT

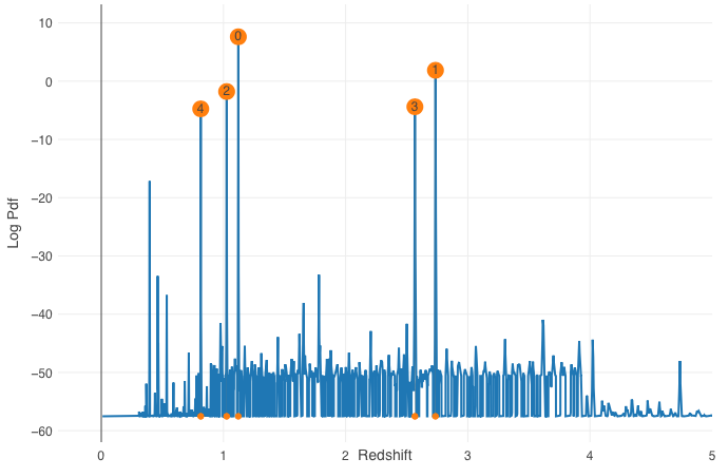
- Best 5 redshifts for each galaxy/QSO, with reliability flags (redshift quality);
- PDF for redshift measurement;
- Measurements (flux, EW, position, FWHM, RF params+…) of spectral features (emission lines, absorption lines, spectral breaks, continuum) and their associated errors;
- Spectral classification for each object.

STATUS

- ML3A
- Code correctly run during SC8 and following phases, improvement ongoing

OUs activity: Spectroscopy.





REDSHIFT DETERMINATION

Two main methods:

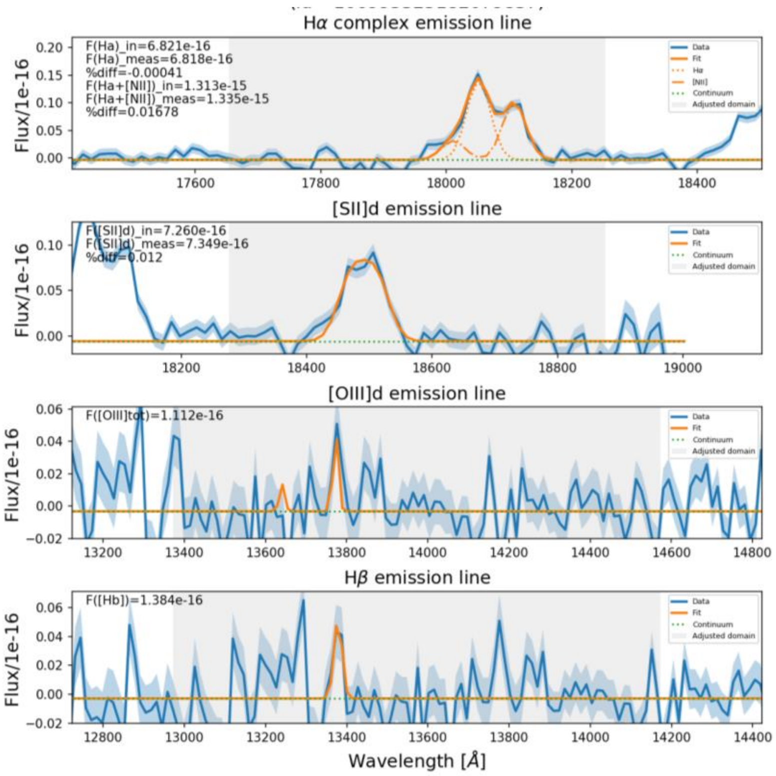
- ***line model***: continuum subtracted with median filtering, fit lines
- ***full model***: fit lines+continuum (requires a good background subtraction and decontamination)

PDF from each model are combined
- Marginalization (over all model parameters);
- final PDF delivered.

The best redshift is taken at the maximum of integrated probability
- error on redshift estimated via Gaussian fit;
- integral value under the PDF peak as reliability level;
- being improved with ML/DL techniques, using the full PDF.

Different priors can be adopted:
- Strong lines: greater probability for “Main Strong lines” (Hα, OII, OIII)
- Hα : greater probability to be an Hα line
- N(z) : an a-priori redshift distribution of Ha emitters

OUs activity: Spectroscopy.



SPECTRAL FEATURES MEASUREMENTS

Two main methods for **emission lines**:
- ***direct integration***: model independent, provides a measurement of the total flux (e.g. blended Hα+[NII])
- ***multi-Gaussian fit***: line-ratios free, provides deblended fluxes (may depend on SNR)

Measurements performed for each galaxy at the 5 redshift solutions provided by PE5200

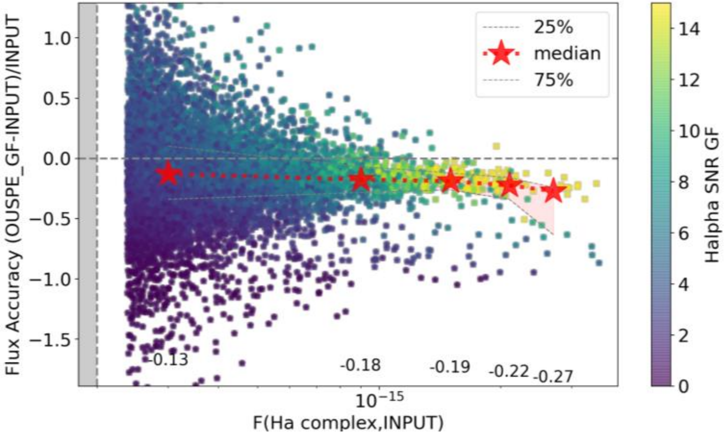
Emission lines divided between main (e.g. Hα+[NII], [OIII]d, Hβ) that will be always measured, and secondary that will be measured above a threshold

Absorption lines (Lick indices) and continuum features measured above a continuum SNR threshold

For each line and for each redshift solution, it will be provided a measurement of flux, EW, position, FWHM, RF parameters
The emission lines list and absorption line list can be found at the relevant wiki

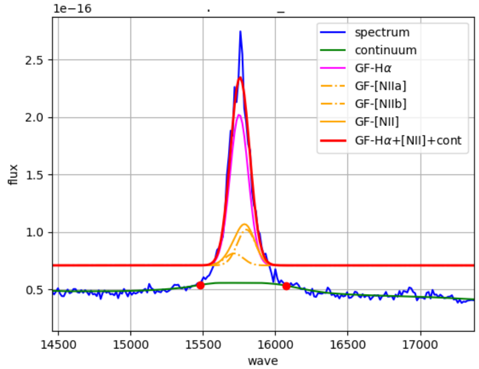
OUs activity: Spectroscopy.

VALIDATION (spectral features, for redshift performance, see Ben's slides)

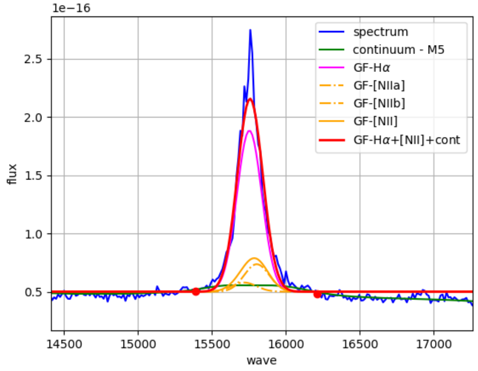


broad line AGN

before



after



- Good agreement between SPE measurements and independent estimates (IRAF, AMAZED, slinefit, …)
- Full test campaigns here
- Results within requirements for the target sample in the SC8 pilot run
- -30% offset w.r.t. Input flux in SC8 full results (under investigation, feedback given to SIR)
- Further performance assessment on EL-COSMOS, pypelid, WP2 and WP9 SWG-GAE simulations (contact point: D. Vergani): similar trends
- Size dependence to be taken into account (expected performance are for a sample with size<0.5 arcsec): extraction-loss effect?
- First analysis of QSO and improvement of the pypeline

OUs activity: Spectroscopy.

IMPROVEMENTS, CHALLENGES, and OPEN ISSUES

EXPECTED IMPROVEMENTS

- Improved quality flags for redshift (ML) and lines ⟶ significant impact on P/C already tested
- Inclusion of QSO analysis and more general validation of measurements (Vergani, Palazzi, Maiorano, Zamorani, Pozzetti, Talia, Moresco, Rossetti)
- Revision of the analysis of RG+BG spectra
- Possible improvements in the pipelines before SPE

CHALLENGES

- Incoming SELFCAL analysis
- SPV3 exercise (including several features: cosmic rays, persistence, RG+BG, …): new assessment of P/C in coordination with LE3 and SWG
- need for dedicated simulations for QSO and passive galaxies: work ongoing to create them with bypass (+ …)

OPEN ISSUES

- Offset in flux measurement: impact on flux (redshift?)
- Assess SPE performances on SPV3 data ⟶ work already ongoing in several WP and SWG
- Impact of z-priors on the analysis
- Any bypass code we have need to be validated: need for pixel-level simulations and analysis
- for spectral features, we are available to analyze and validate (Vergani, Palazzi, Maiorano, Moresco, Rossetti, …) simulations

OUs activity: Spectroscopy.

Part III: OU LE3.

Enzo Branchini
University of Genova

OUs activity: Spectroscopy.

OU-LE3 is really at the interface between SGS and SWGs.
The two interfaces are very different.

General Consideration for the whole LE3-IT

- **Status @ the Ground Segment Readiness Review:**
  Only 1 major RID (Cluster Detection)
  A few minor RIDs (Closed)
  LE3+SDC-IT members really did a good job !!!
- **PFs maturity.**
  All P1 and P2 PF expected to reach ML-3B (production stage) by April 2023 (one possible exception: Photometric mask).

Let us now focus on LE3-for spectroscopy

OUs activity: Spectroscopy.

OU-LE3 development, implementation and validation phase before launch is almost over. No major issues detected. Several lessons learned. And warnings on the role of LE3 and management of its PFs during operation.

OU-LE3 tasks after launch.

- Code running and maintenance. Support to SDCs.
- Code changes / update / upgrade (from OUs or SWG inputs).
- Technical and scientific validations of modified codes.
- Data quality check.
- Support to SWG for scientific exploitation.

OUs activity: Spectroscopy.

CHALLENGES and OPEN ISSUES

Running codes. What and when.

- Making Catalogs. What is the cadence with which LE3 generates catalogs using LE2 data products ? What are the characteristics of the minimal building block (different requirements for the Deep, the Wide and the Cluster catalogs) ? Some of this in B. Granett talk.
- Clustering statistics. Same question on cadence. Different statistics to be estimated with different frequency.
- Covariance. DR1 spectroscopic mocks will need to be in the SAS well before science analysis starts to estimate their 2-point statistics.

IN-FLIGHT PROCEDURES FOR LE3 ARE TO BE DEFINED

OUs activity: Spectroscopy.

CHALLENGES and OPEN ISSUES

LE3 PFs for data quality check.

- Clustering statistics for quality check. Estimating clustering statistics is a powerful tool to spot observational systematic errors. See example in I. Risso talk.
- And should be used. However, the soon-to-be adopted "Medusa" blinding strategy makes the use of these tools very risky. In fact, the potential risk of looking at cosmologically-sensitive data will make LE3 operators drop LE3 activities to SWG tasks (LE3 people are also SWG members).

POSSIBLE HUGE MANPOWER ISSUE AFTER LAUNCH

OUs activity: Spectroscopy.

CHALLENGES and OPEN ISSUES

Validating new/updated LE3 codes.

- Code validation procedure during flight operations must change. Current procedures to modify, implement and validate codes is rigorous but far too slow to be effective in flight. We need to re-think the whole procedure to be able to efficiently: 1) adopt/define new scientific requirements (with SWG), 2) turn them into validation tests, 3) update codes and submit DM change requests (with SDC), 4) Run validation (with SDC) 5) check results (with SWG). Documentation needs to be kept at minimum.

THE IN FLIGHT PROCEDURES ARE TO BE DEFINED

OUs activity: Spectroscopy.

OU-LE3 activities and goals will change significantly after launch.

For the specific case of galaxy clustering (but similar considerations apply to Weak Lensing and Galaxy Clusters) OU-LE3 cannot be regarded anymore as the final step of the data analysis pipeline. It will be one of the blocks of a pipeline that runs from LE2 all the way down to the parameter estimate in the likelihood analyses. Feedback from other OUS and SWG will be of essence to effectively tackle the problems that we will face after launch.

Efficient procedures need to be defined and implemented SOON to get this done.

Bejond OUs activity…

OUs activity: Spectroscopy.

Topical talk #1: Data Quality and Validation for the Spectroscopic Data

Chiara Mancini
INAF - IASF Milano
For the OU-SIR team

OUs activity: Spectroscopy.

Monitoring the quality of the spectroscopic data

Data Quality

- Parameters computed for all data products, for every run of the SIR Pipeline
- Summary statistics about the data, to detect significant problems in a pipeline run
- Should anything go wrong, then we need to go for an in-depth analysis (Validation)
- DQ parameters available by default to IOT

Validation

- Parameters computed on demand, for a new pipeline version, or when DQ results signal the presence of a problem
- Detailed statistics about the data, used to understand most of the details of a pipeline run
- Should we still fail to understand what went wrong, then we need to look at the data interactively
- Might require some manual info transfer to IOT

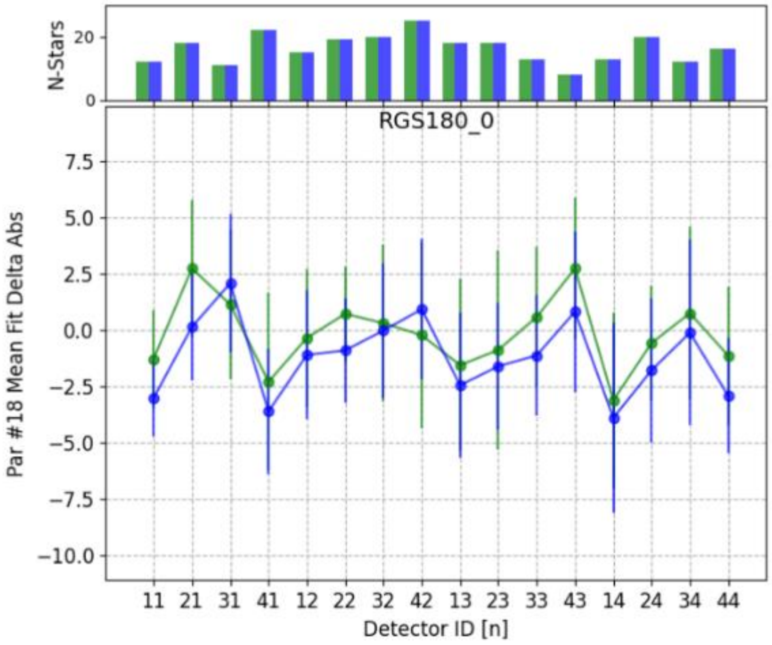
Debugging

- Step-by-step interactive analysis of the data reduction procedure, and of the relative data-products
- Dedicated tools for the interactive analysis (not an SDC-Prod environment)
- Definitely an activity lead by OU people

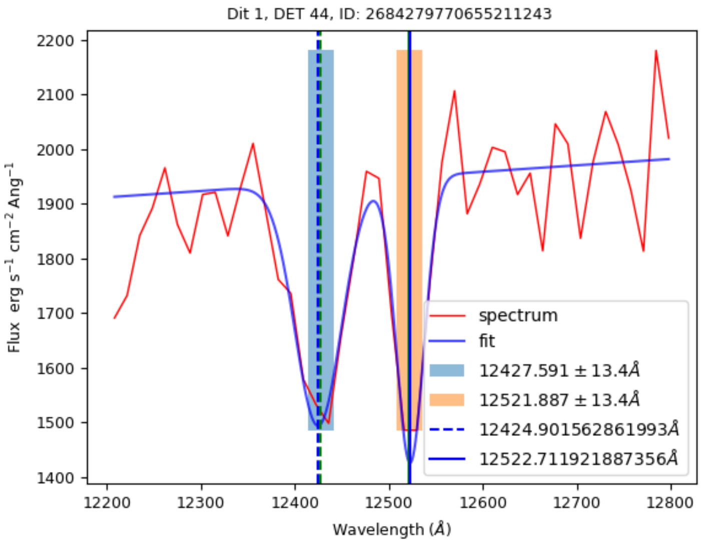
OUs activity: Spectroscopy.

Monitoring the quality of the spectroscopic data

Data Quality Wavelength Calibration **Validation**



Summary stats, grouping data by detector



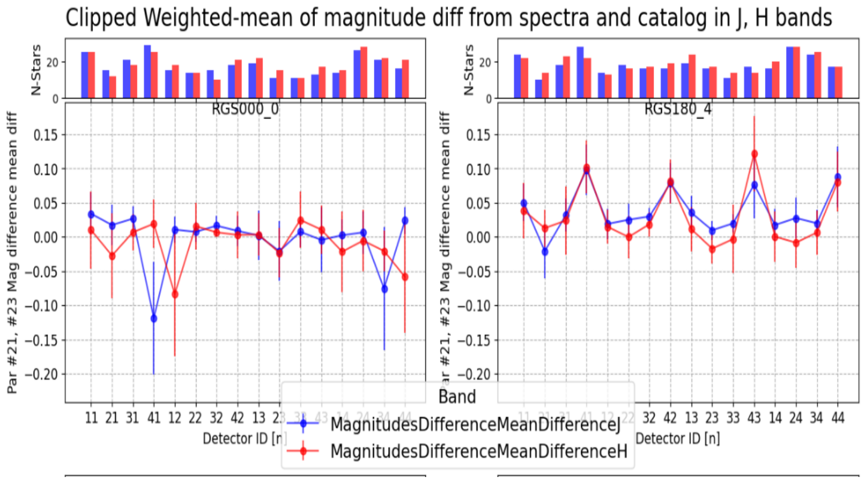
Detailed info for every single object
(bright stars only, to be able to detect the lines)

OUs activity: Spectroscopy.

Monitoring the quality of the spectroscopic data

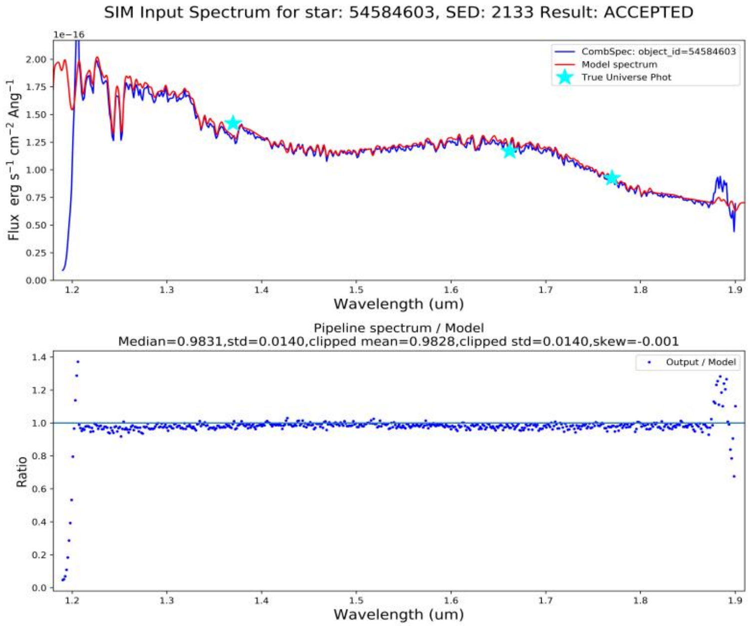
Data Quality

Flux Calibration



Summary stats, grouping data by detector

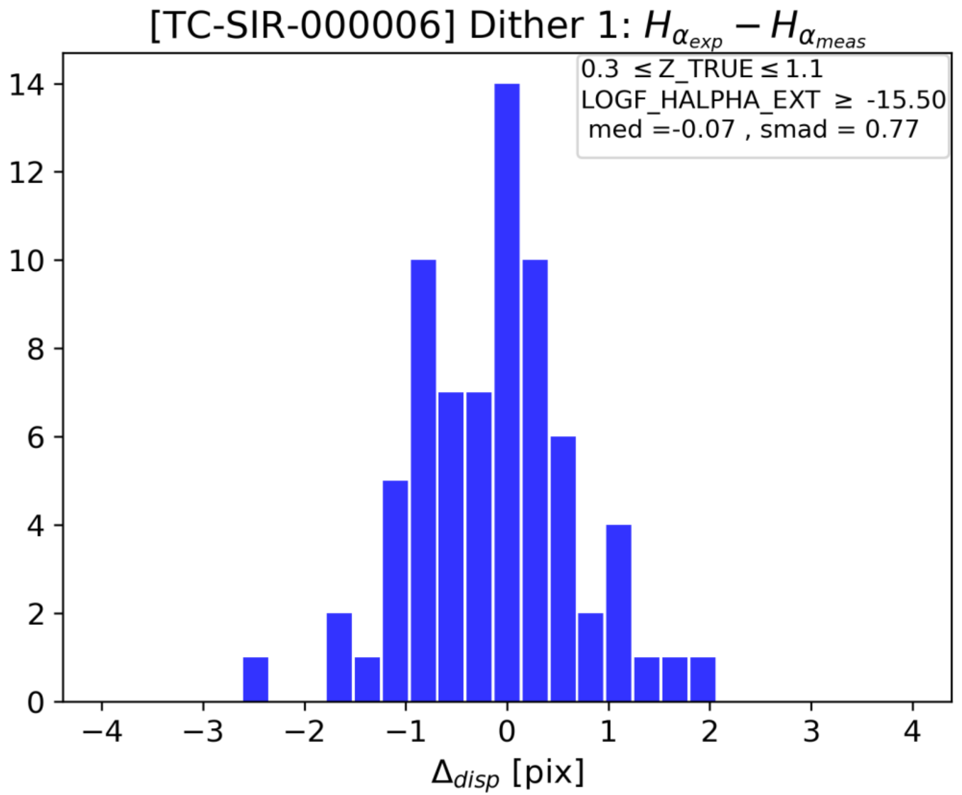
Validation



Detailed info for every single object
(bright stars only, to have robust flux measurement)

OUs activity: Spectroscopy.

Monitoring the quality of the spectroscopic data



Validation results on the overall accuracy of the wavelength calibration (based on spectra with bright Halpha line)

Requirement: scatter < 1 pix

Results: scatter = 0.77 pix

These are Blue Grism data

OUs activity: Spectroscopy.

Open points about data monitoring

Data Quality

- Parameters computed by the SIR Pipeline
- We just need to interface with IOT, and make sure IODA can handle the info

Validation (1)

- Some of the Validation procedures require intermediate data products that are not stored in the EAS
- Can we run them in an SDC environment (not the Prod one) ?
- Do we need a Validation Lite pipeline that can be run inside the SDC Prod environment ?
- Who will have the authority to request / run a Validation Pipeline run ?

Validation (2)

- At the moment the Validation Pipeline is producing a report, which is a collection of plots and data tables, uploaded to an EC Redmine page
- Will that be an OK operation mode during the real survey ?
- If not, how do we disseminate the report data to the OU scientists in the most efficient way ?

OUs activity: Spectroscopy.

Open points about data monitoring

Validation (3) / Debugging

- Detailed analysis of the Validation results, or detailed debugging, is still a rather slow process (something measured in weeks, instead of days / hours)
- These activities require tools that are 100% aware of the SIR Data Model, which means that no pre-existing tool can be efficiently used for these taks
- An embryo of an interactive SIR data visualization tool has been created (work by N. Stickley at IPAC and M. Scodeggio at IASF Milano), but it was created when the Euclid Data Model was still at version 3, and never really updated to current versions of the DM.
- It would be fundamental to update and expand this tool for all SIR activities
- It would be valuable to integrate such a tool into a more general Spectroscopic Survey Validation tool. Could that be proposed as part of an HORIZON 2023-2034 proposal ?

OUs activity: Spectroscopy.

About the Validation of SIR Calibrations

Validation (4)

- A special point about the validation of SIR Calibrations: the complete validation of a Calibration data-product involves using the calibration within the standard data reduction process of one (or more) science exposures

- Will it be possible to use a non-validated calibration data-product within a run of the standard pipeline ?

Bonvi
Sturmtruppen
1970

OUs activity: Spectroscopy.

Topical talk #2: NISP-S Simulations

Francesca Passalacqua
With L. Gabarra, C. Sirignano, A. Troja
and Padova Group
University & INFN of Padova

OUs activity: Spectroscopy.

SPECTROSCOPIC SIMULATIONS

- What? → NISP-S simulations
- How? → Specific simulations with SIM-TIPS + reconstruction with NIR and SIR pipelines:
  - 2019: INFN-GE and M. Scodeggio started the work (development for EDEN-2.1)
  - 2022: INFN-PD updated the code for EDEN-3.0
  - Now: effort to run the official IAL pipeline and use the files in the archive
- Why? → To study NISP systematic effects on the measured data

OUs activity: Spectroscopy.

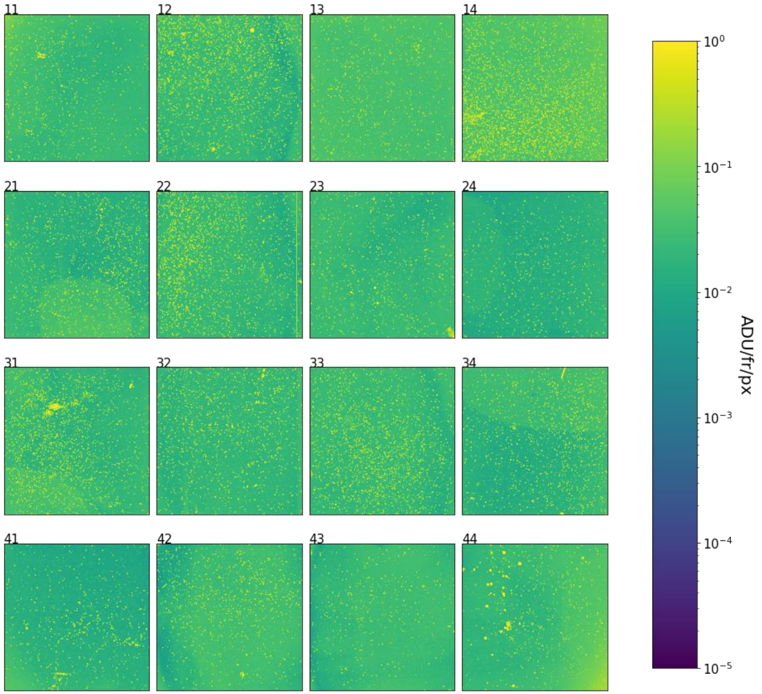
SYSTEMATIC EFFECTS

Instrument:
(characterization from ground tests)

- Readout Noise
- Dark Current
- Bad Pixels
- Quantum Efficiency
- Non Linearity
- Persistence
- Vignetting
- Astrometric & Spectral Distortions

In-Flight Effects:
(simulated from models)

- Cosmic Rays
- Sky Background

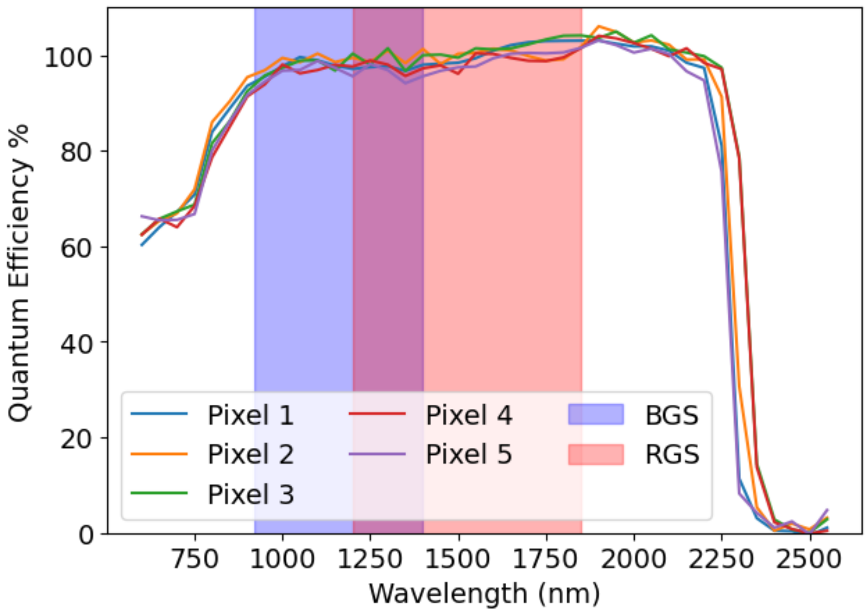


NISP Thermal Background.

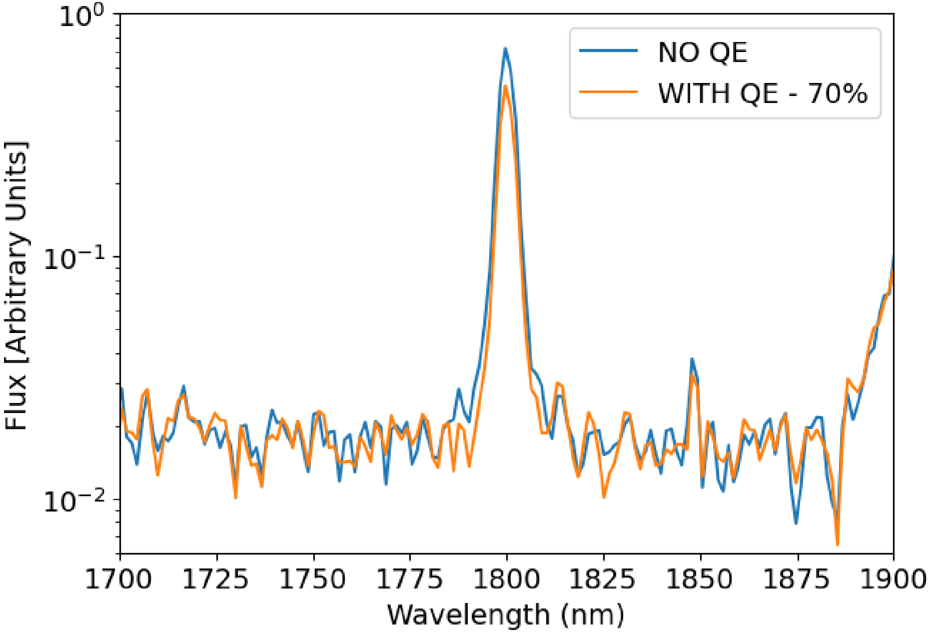
OUs activity: Spectroscopy.

QUANTUM EFFICIENCY AS A FUNCTION OF λ

QE of single pixels as a function of the wavelength



Measured spectra



OUs activity: Spectroscopy.

OUR ACTIVITIES

1. SIM-TIPS modification to take QE into account

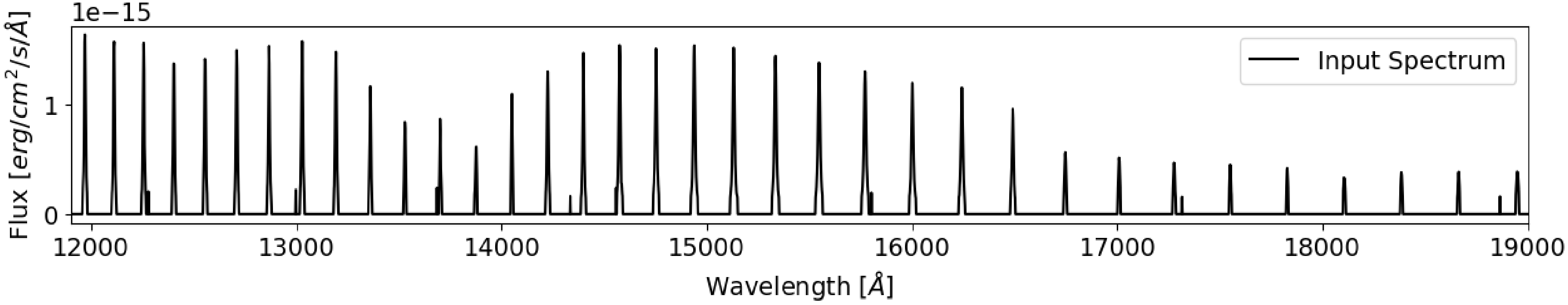
2. Creation of specific input catalogs and spectra:

   - Performance assessment of NISP (Louis Gabarra et al., *in prep.*)
   - Comparison between simulations and ground test campaigns (TV3, CSL, etc…)

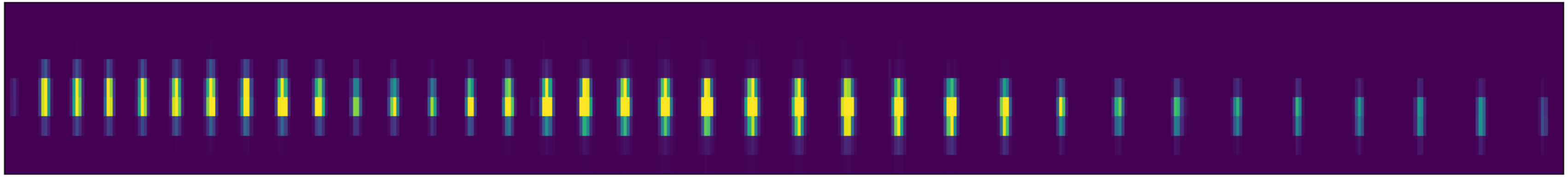
OUs activity: Spectroscopy.

ETALON SIMULATIONS

- Creation of the input **spectrum**
  (from the source used in the ground tests)



- 2D simulated image

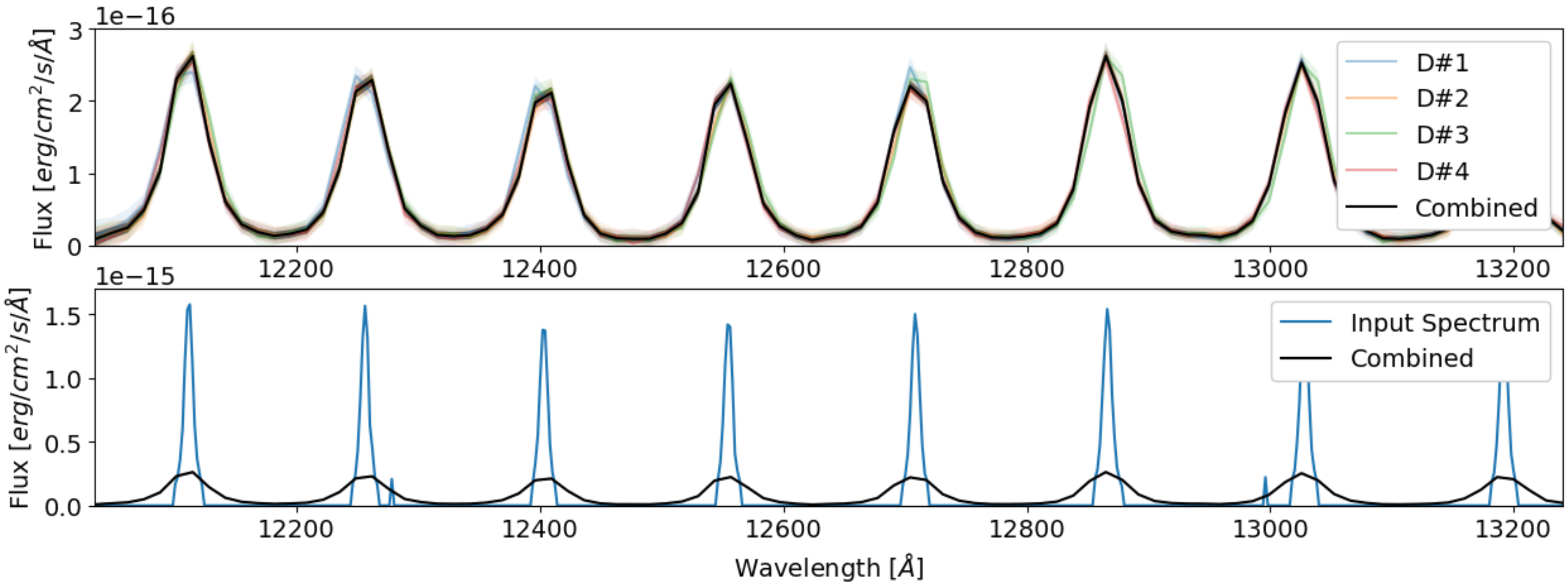


→ Consistent with the images from the tests

OUs activity: Spectroscopy.

ETALON SIMULATIONS

- Measured spectrum



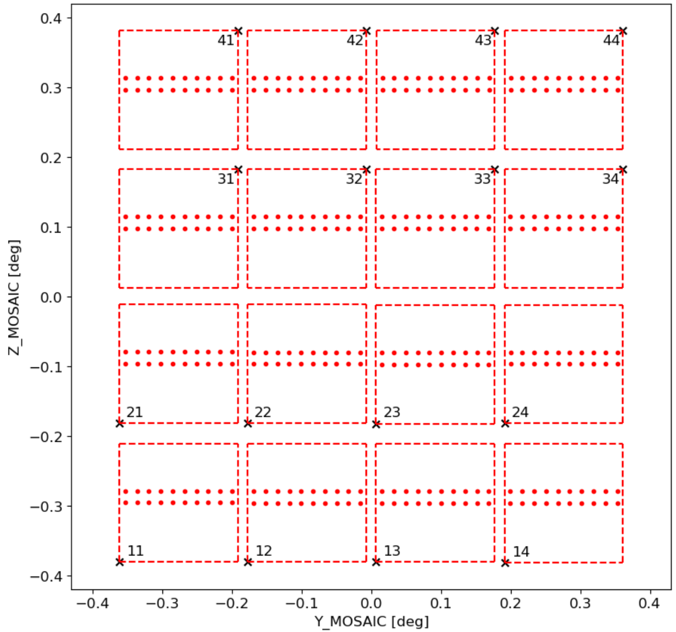
→ Consistent spectral resolution between SIM-TIPS & test campaign

OUs activity: Spectroscopy.

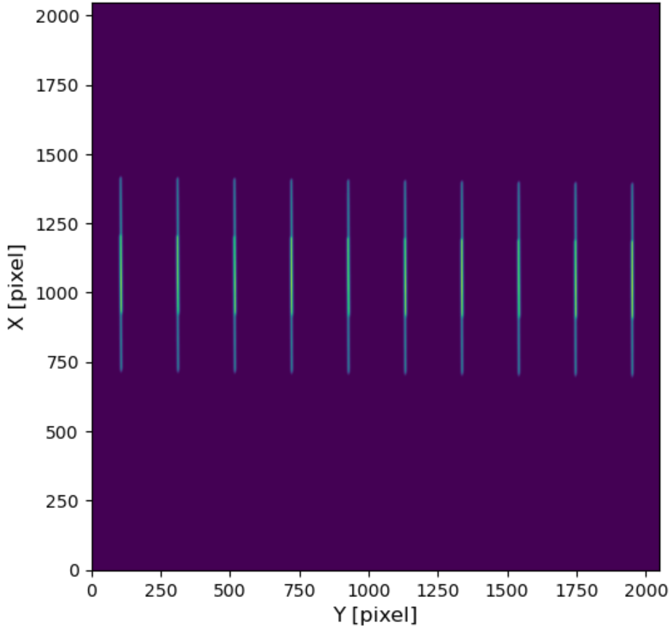
DECONTAMINATION

We added the decontamination module to the simulation framework

- Creation of the input **catalog** for validation



Position of the sources on the focal plane.

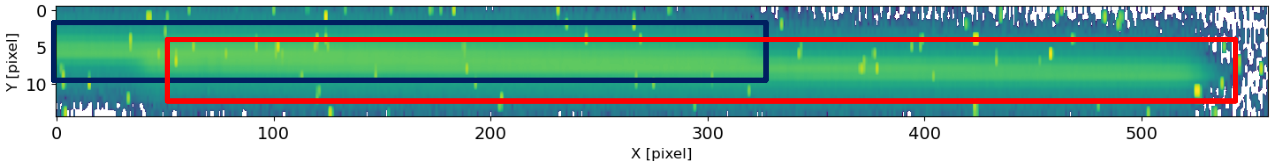


Simulated spectra in one detector.

OUs activity: Spectroscopy.

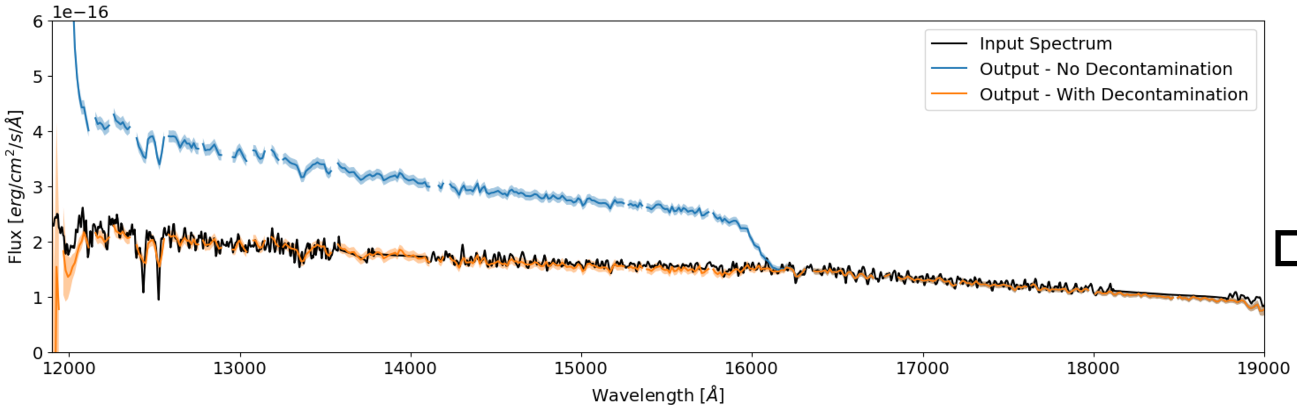
DECONTAMINATION

- Measured spectrum of one source



Zoom of the **processed image**: identification of bad pixels, master dark subtraction, sky background subtraction, etc…

Red = selected source
Blue = contaminant source



Extracted spectra from the dispersed images

We successfully implemented the decontamination task.

This is a preliminary result → test on more representative images are needed to assess decontamination performances

OUs activity: Spectroscopy.

CONCLUSIONS AND OUTLOOKS

- We simulated the data from the test campaigns and compared them to the real ones
- We can create specific input configurations to study the systematics
- We are now reproducing PVRH1 data to validate the simulation framework with the latest version of the pipelines
- We could produce simulations with blue and red grisms to study the performance of NISP

OUs activity: Spectroscopy.

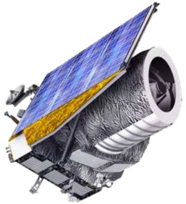
Topical talk #3: Spectroscopic Catalog

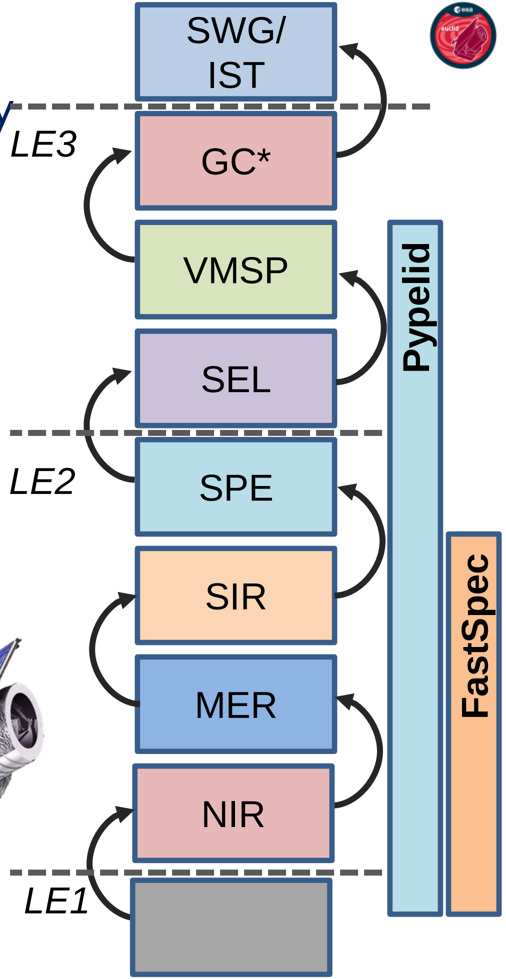
Benjamin Granett
INAF-OABrera

OUs activity: Spectroscopy.

Spectroscopic pipeline end-to-end

- End-to-end sims and in-orbit validation are critical for galaxy clustering science:
  - To run the scientific validation of the pipeline;
  - Test sample selection and forecast redshift purity and number density;
  - Identify systematics and test mitigation strategies.
- Requires coordination between LE2 OUs, LE3 PFs and SWG.
- We are developing complementary simulation approaches:
  - Full pipeline: **OUSIM+SPV3**;
  - Partial: **FastSpec+SPE**;
  - Bypass: **Pypelid.**
- Highlighted work packages/PFs: **SWG GC-E2E, SWG GC-Observational Systematics, LE3-ID-SEL-VMSP**

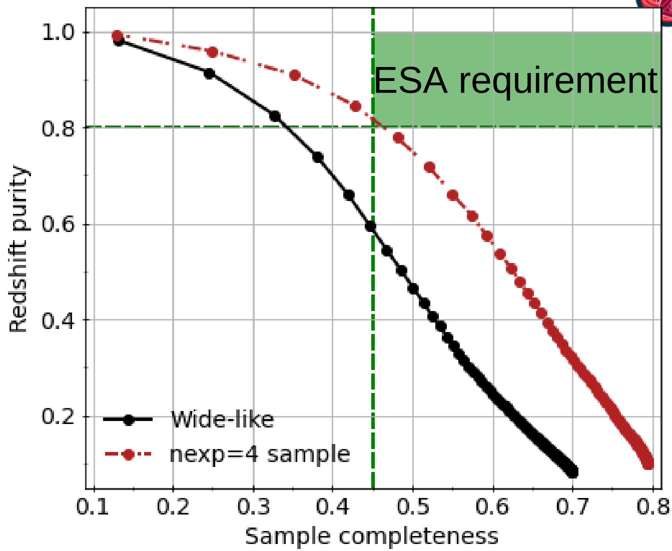




OUs activity: Spectroscopy.

Purity and completeness simulations

- We used EL-COSMOS 1D spectra simulations (FastSpec) to compute the purity and completeness of the SPE pipeline (M. Moresco, B. Granett, S. de la Torre, M. Bethermin, V. Le Brun, OU SPE).
- Consider two samples for computing purity and completeness:
  - **ESA requirements sample** (flux Ha>2e-16 cgs, diameter<0.5”, 4 exposures).
  - **Science LSS sample** (selection criteria set to optimize number count, redshift purity, and science results on Wide simulations).
- For clustering science, **sample size is more important than completeness** (eg we can select on SNR instead of flux to have a larger sample).
- **Redshift purity** (fraction with good redshifts) **is more important than sample purity.**
- Preliminary work started on **SIR simulations** (L. Gabarra), sources placed on a grid without overlapping spectra.



The green box represents the requirement for the ESA sample.

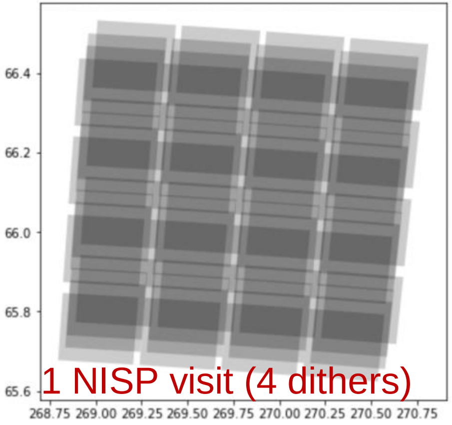
The subsample with 4 exposures reaches the requirement, but covers only a portion of the Wide survey area.

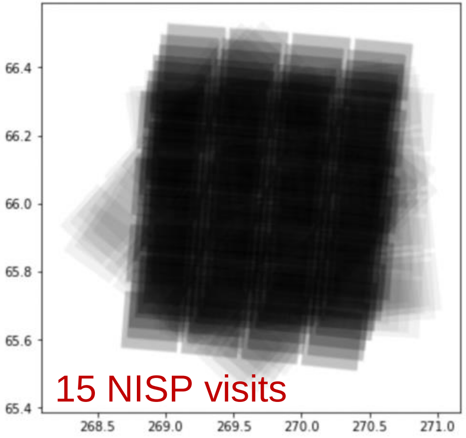
Application of a color selection and the SPE machine learning merit will help to boost the redshift purity.

OUs activity: Spectroscopy.

LE3 selection pipeline

- LE3-Internal Data-SEL PF (B. Granett, E. Branchini, P. Monaco, S. Nadathur, C. Krawczyk, F. Beutler) performs spectroscopic sample selection and estimates purity and completeness.
- Purity and completeness of the Wide are computed using the **Wide-like** and **Full-depth** reductions of the CPC-Deep fields.
- **Purity is computed in the CPC-Deep fields only.**
- Completeness is characterized at any point in the Wide survey through the random catalog (VMSP).
- **Open issues:**
  - Pipeline processing of the Deep-CPC catalogs.
  - Integration of the photometric mask, MW extinction;
  - Possibility of a color selection to improve redshift purity;
  - Propagation of uncertainty;
  - **How to characterize the purity and completeness of the Deep catalog?**



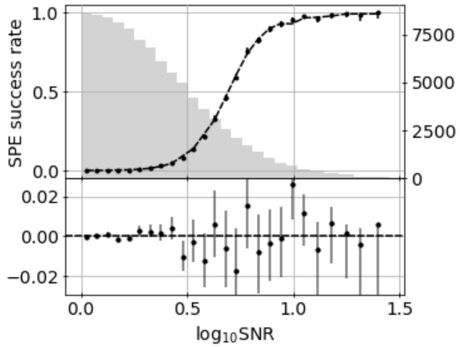


OUs activity: Spectroscopy.

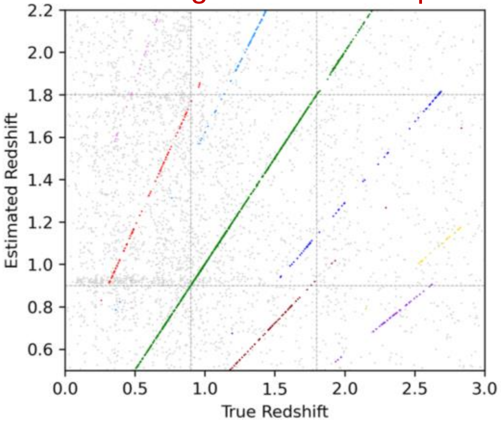
LE3 Spectroscopic visibility mask pipeline

- LE3-Internal Data-VMSP PF (B. Granett, E. Branchini, P. Monaco, S. Nadathur, C. Krawczyk, F. Beutler) characterizes the selection function and builds the **random catalog**.
- VMSP **forward models** the selection with a bypass detection algorithm.
  - Reads the noise in the NISP images at the location of the randoms to compute SNR.
  - Maps the SNR to the probability of a correct redshift measurement.
- **Open issues:**
  - We don't have full pipeline E2E sims for validation; validation was done only on FastSpec-SPE sims;
  - How to calibrate bypass algorithms on real data;
  - How to run VMSP with a small CPC area;
  - Adding noise interlopers to the random catalog (Ilaria's talk) and new bypass model for interlopers.

Bypass calibration: SNR to measurment



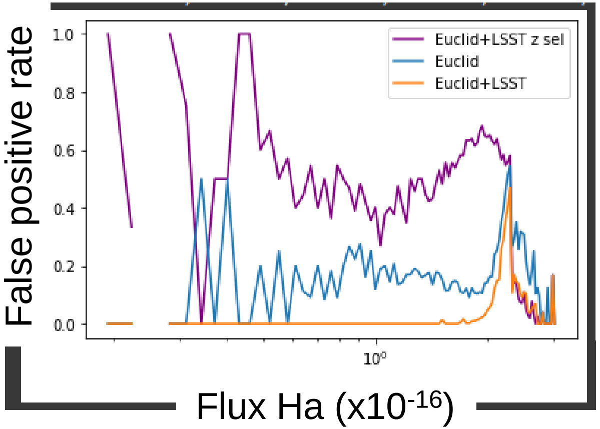
Modelling redshift interlopers

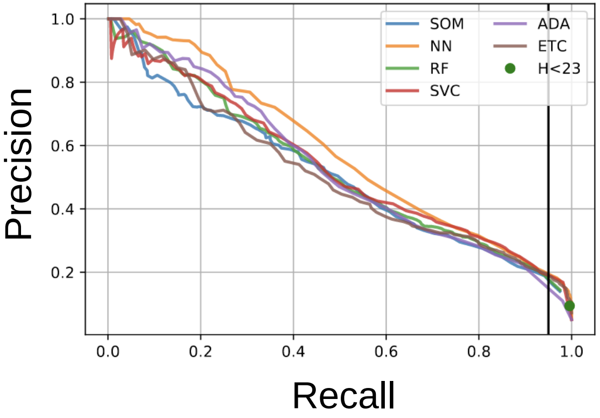


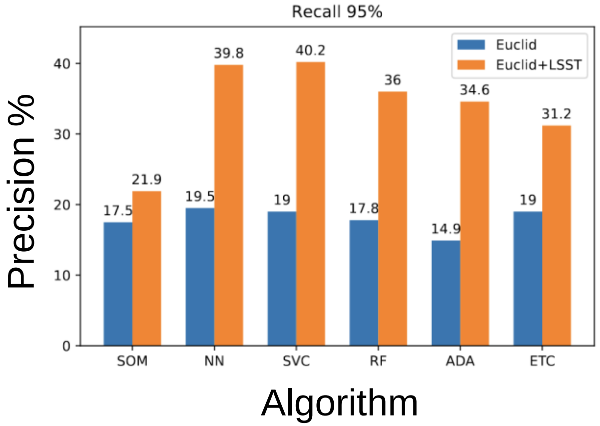
OUs activity: Spectroscopy.

Highlight: color selection

- Photometric fluxes can help select the Hα emission line galaxy sample to improve redshift purity.
- We investigated with machine learning-based algorithms (M. Cagliari, B. Granett, M. Moresco, L. Guzzo) and paper in prep.
- VIS and NISP YJH selection removes ~20% of potential interlopers (with optical ground based photometry it is ~40%).
- Color selection may prove to be a key ingredient for sample selection when we have real data.







OUs activity: Spectroscopy.

Summary of open issues

- **Sample selection and mask issues cut across the entire pipeline.**
  - We will need to iterate between OUs and SWG to do basic tasks such as developing sample selection criteria and estimating purity and completeness.
  - Hot fixes will be needed to solve problems that arise (eg change in mask area, sample selection criteria, change in calibration).
  - Mitigating systematics can require changes to many PFs (eg accounting for interlopers, introducing a weighting scheme).
- Pipeline elements can no longer be thought of as individual boxes, but as a system that must be tested as a whole.
- Full pipeline end-to-end scientific validation is not ready yet. We risk that we do not see problems until real data arrives.
- In-orbit scientific validation will be needed after launch.
- Processing function development must be sufficiently flexible and rapid to handle unforeseen systematics.

OUs activity: Spectroscopy.

Topical talk #4: Interlopers

Ilaria Risso
Università di Genova

Interlopers

A fraction of the Euclid spectroscopic catalog will be made up of galaxies with wrong measured redshifts, because of (data and pipelines related) systematics → the catalog will not be 100% pure.

$$\text{Purity} = N_{\text{meas, correct z}} / N_{\text{meas}} < 100\%$$

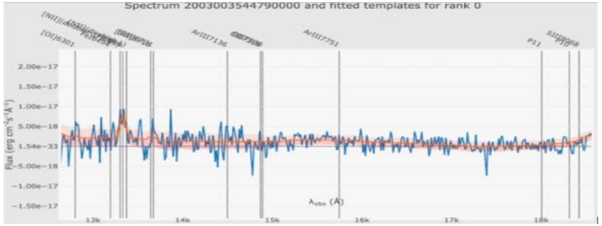
Interlopers == those galaxies whose redshift was not correctly derived because of systematic effects, leading to errors much higher than the precision on the z measurement ("catastrophic redshifts").

- **Noise interlopers**

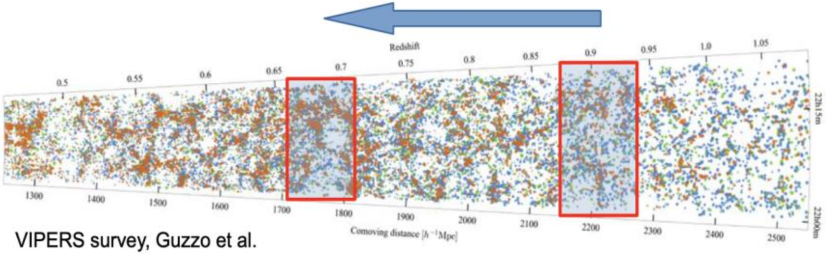
  Galaxies whose emission lines are too faint to be detected. A random spike in the spectrum is mistaken for a Hα line and a completely wrong z within the RGS range is assigned.

- **Line interlopers**

  Galaxies with strong emission lines that have been mistaken for Hα.



Vincent Le Brun, SGS team



VIPERS survey, Guzzo et al.

Outlook of our results

The interlopers impact on Galaxy Clustering measurements was already taken into account during SPV2, although through a simple model in which the effect does not depend on scale.

Proposals have been made to improve the treatment and we are assessing their impact. The main **PRELIMINARY** results are:

1. The scale-independent treatment is accurate enough. There is no need to modify the LE3 PFs for galaxy clustering statistics.
2. The spatial auto and cross correlation properties of the interlopers cannot be neglected and need to be included in the model.
3. Noise and line interlopers have different and sizable clustering signals and both need to be accounted for.

Issue 1: scale dependence.

So far, the effect of the **noise** interlopers has been modelled with a scale independent dilution factor f in the amplitude of the clustering signal:

$$\xi_c = (1 - f)^2 \xi_t$$

Scale dependence → changes in LE3 PF

Do we really need it?

contaminated 2pcf (measured 2pcf): computed on a catalog containing a fraction *f* of noise interlopers

target 2pcf: computed on the uncontaminated part of the catalog

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Scale dependence → changes in LE3 PF

Do we really need it?

NO

A constant f model is sufficient (difference between the two models far below 1%) → no need to modify LE3 PF

Issue 2: clustering of Interlopers

For **each type** of interlopers (noise and line), it is necessary to add two further terms: their auto-correlation signal and their cross-correlation with the spectroscopic sample.

$$\xi_c = (1-f)^2\xi_{\rm t} + f^2\xi_{\rm n} + 2f(1-f)\xi_{\rm tn}$$

contaminated 2pcf (measured 2pcf): computed on a catalog containing a fraction *f* of noise/line interlopers

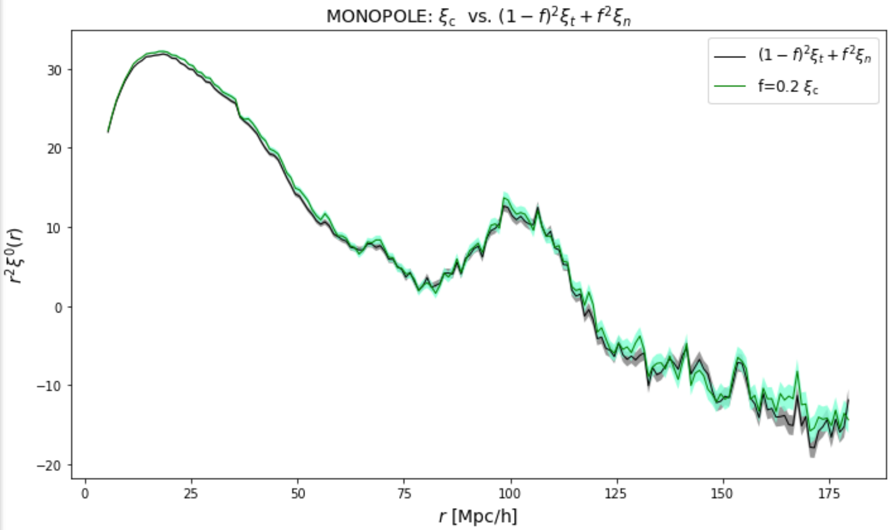
target 2pcf: computed on the uncontaminated part of the catalog

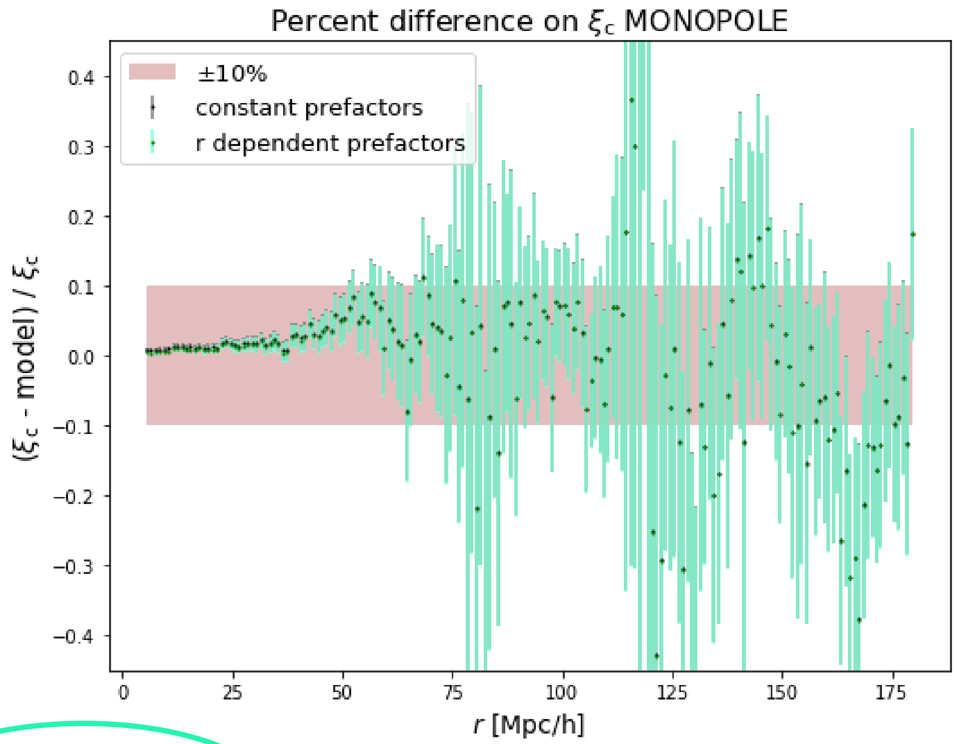
noise 2pcf: computed on the contaminants only

cross term*: between uncontaminated galaxies and contaminants

*noise cross term computed by G. Parimbelli using the official *Euclid* code

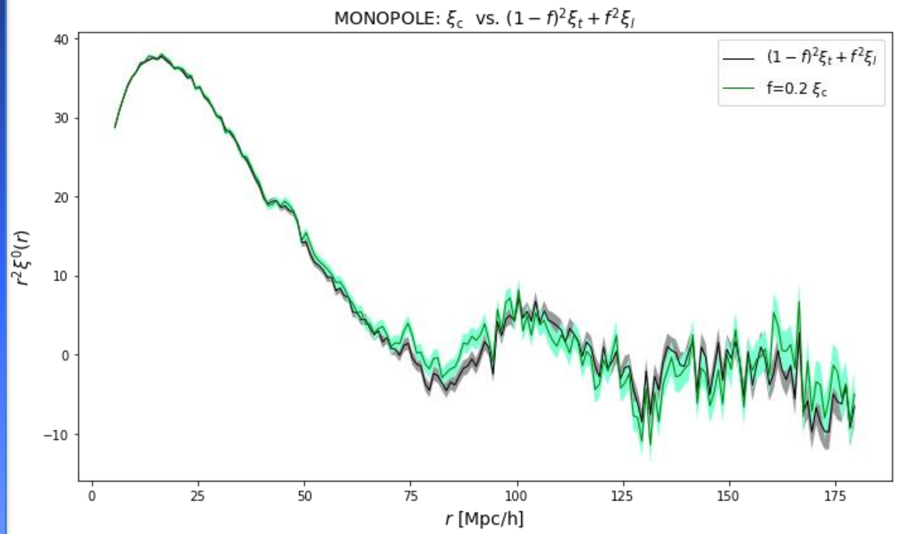
Issue 2: clustering of interlopers

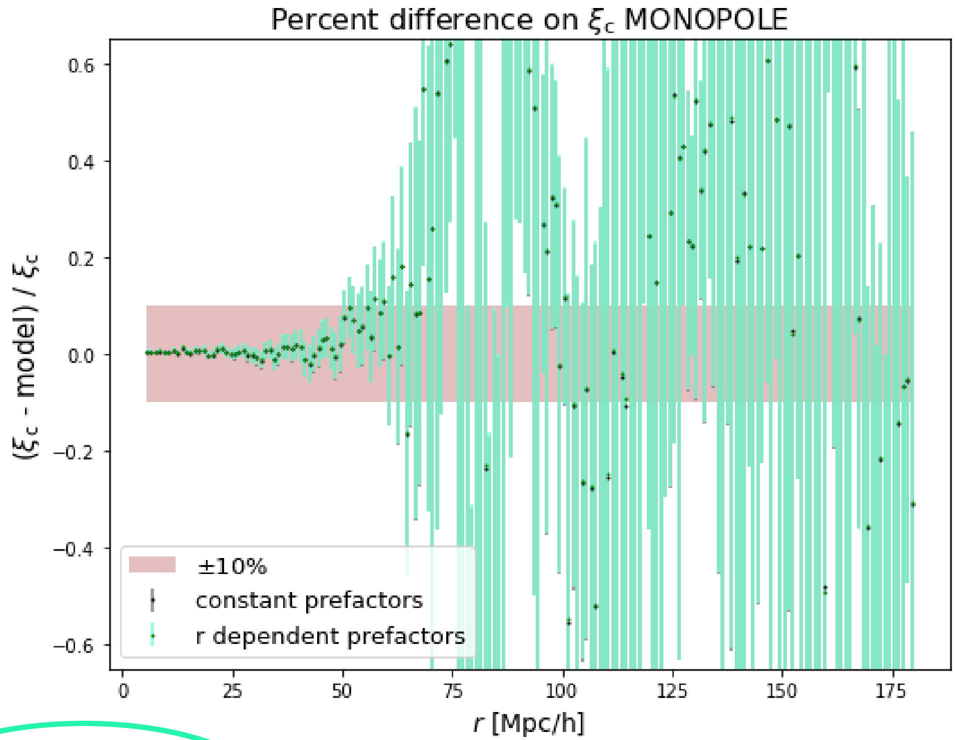




$$\xi_c = (1-f)^2\xi_{\rm t} + f^2\xi_{\rm n} + 2f(1-f)\xi_{\rm tn}$$

Issue 3: noise vs. line interlopers.





$$\xi_c = (1-f)^2\xi_{\rm t} + f^2\xi_\ell + 2f(1-f)\xi_{{\rm t}\ell}$$

Conclusions

Concerning both **noise & line interlopers**:

1. their effect can be modeled by a simple constant term (their fraction *f*), without changing LE3 Processing Functions for clustering statistics.

2. the auto and the cross-correlation properties of both types of interlopers are not negligible and need to be accounted for.

Next steps (ongoing)

1. Include both noise and line interlopers at the same time
2. Find a way to mitigate cross-terms:

- at the *estimator* level (i.e.: using dedicated Random catalogs)
- at the *likelihood* level (i.e. modeling the auto and cross correlation terms)

→ end2end simulations group results needed to gauge interlopers fractions

BACK-UP

Simulation configuration

- **LS** estimator for 2PCF (official *Euclid* code)
- Mock catalogs extracted from **Flagship2**
  1. ~900 deg^2
  2. **0.9 < *z* < 1.1** (*noise interlopers*), **1.2 < *z* < 1.4** (*OIII line interlopers*)

Construction of the contaminated catalog

1. Choose an interlopers fraction (here, **f=0.2)**
2. Remove 20% of sources from the F2 catalog

→ 80% target galaxies left (*target catalog*): galaxies with strong detectable Ha line within the considered z slice

3. Populate the remaining 20% with interlopers (*interlopers catalog*):

contaminated catalog = target catalog + interlopers catalog

Interlopers selection

- *Noise interlopers*:

- they can come from the full photometric catalog

- no strong emission lines detected by NISP (F2 has only Ha and OIII lines)

- pick them randomly among the photometric catalog, within the same field of view and at any redshift (faint lines within their detection range)

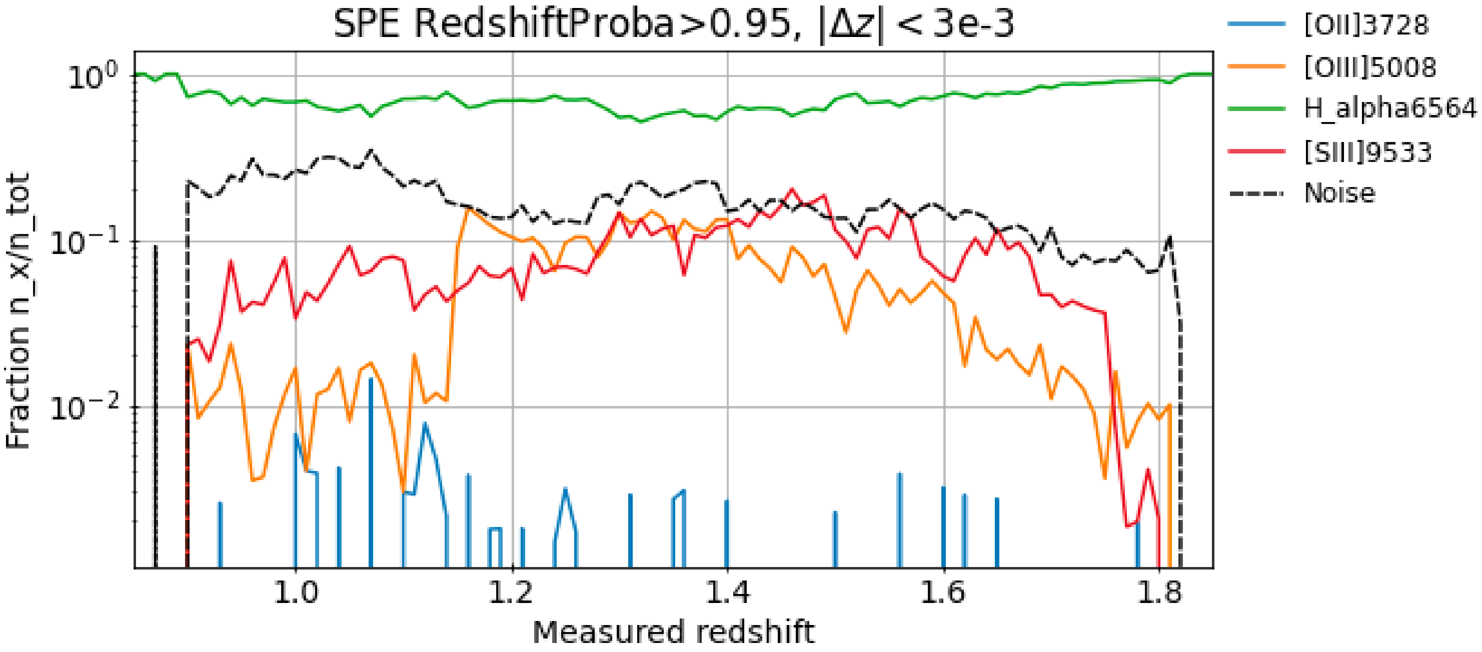
- Assign them a uniform random *z* within the measured redshift bin

- *Line interlopers (OIII in this presentation)*:

- OIII-like emitters, that is Ha emitters within the redshift range from where the OIII interlopers should come

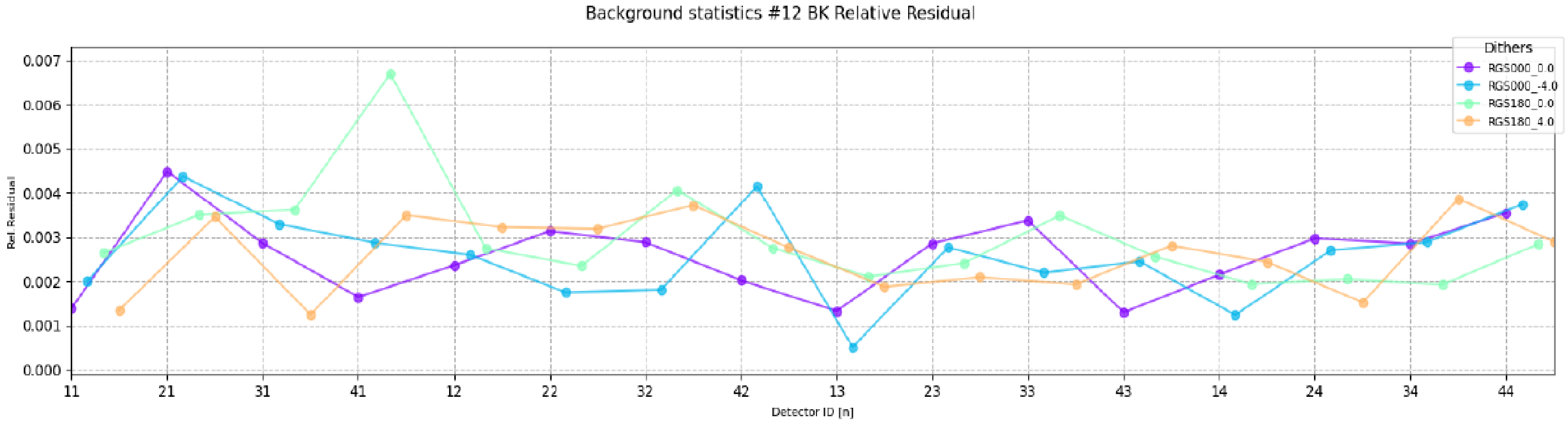
- take their true z and rescale them shifting them to the measured redshift bin

Interlopers fractions

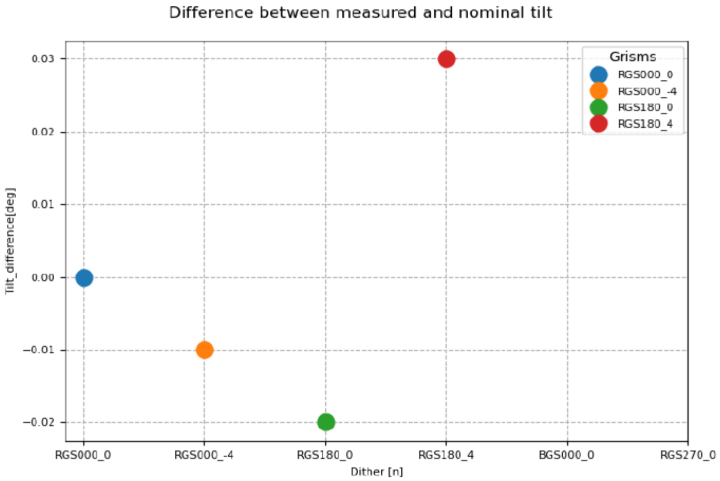


Ben Granett, end2end simulation group

Background subtraction residuals



Grism tilt computation



Spectrophotometric accuracy