

## Galaxy clustering

New requirements  
NISP-OUSIR-OUSPE  
specifications

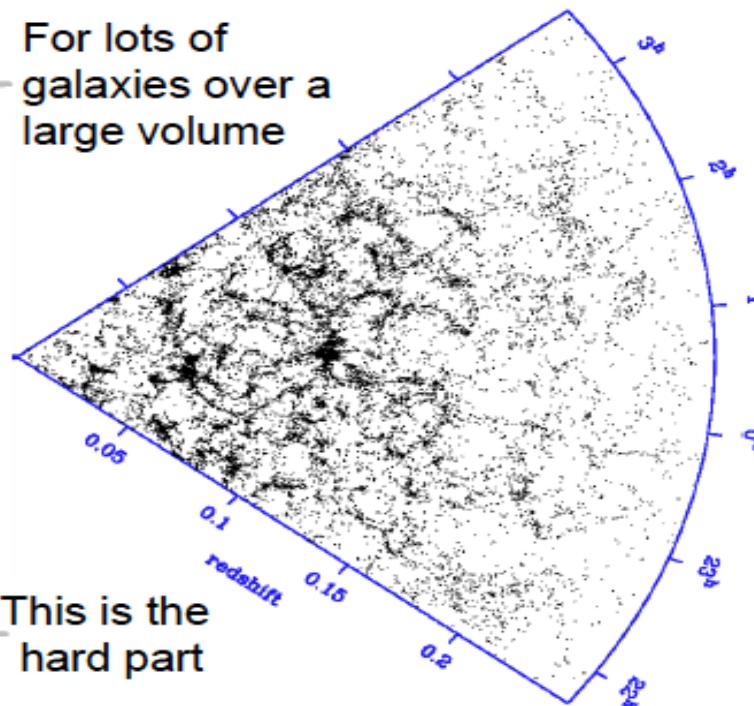
A.Ealet

- Need angular galaxy positions
- Need galaxy redshifts

For lots of galaxies over a large volume

- Need to understand population
  - angular completeness
  - radial completeness
  - radial/angular fluctuations

This is the hard part



Design need to limit errors on:

1. The precision and accuracy in the measurement of galaxy redshifts (including catastrophic redshift failures)
2. The impact of unobserved sky regions in the survey (i.e. “holes”)
3. The knowledge of the (a) redshift and (b) angular selection function (including slitless spectroscopy effects)

- Area >15000 deg<sup>2</sup>
- Density >3500 gal/deg<sup>2</sup>
- Coverage 0,7<z < 2

Accuracy:

- Precise redshifts  $s(z) < 0.001(1+z)$
- Catastrophic redshift < 20%

-Selection function:

- Completeness > 45 %
- Purity > 80 %

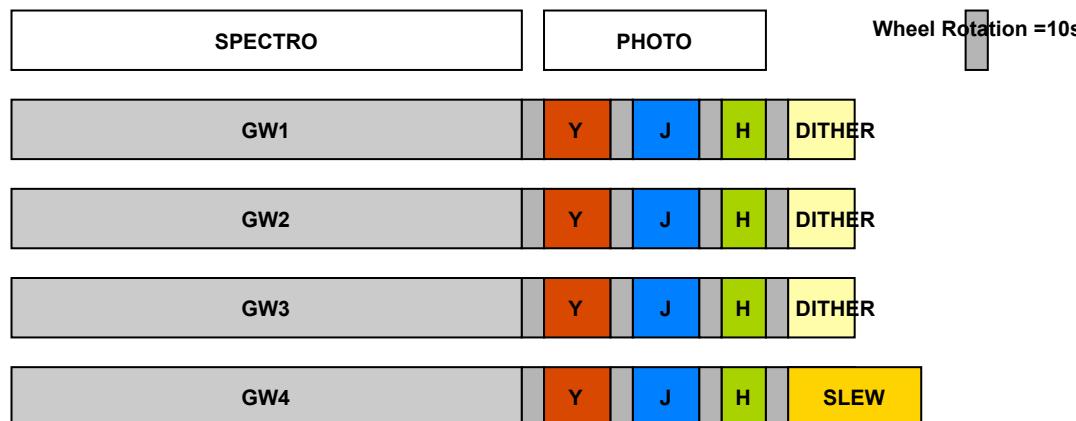
-Systematics

- offset of redshift distribution < 1/5 redshift accuracy
- Purity knowledge ~ 1 % -> 140000 galaxies with purity of 99%

# Observational strategy

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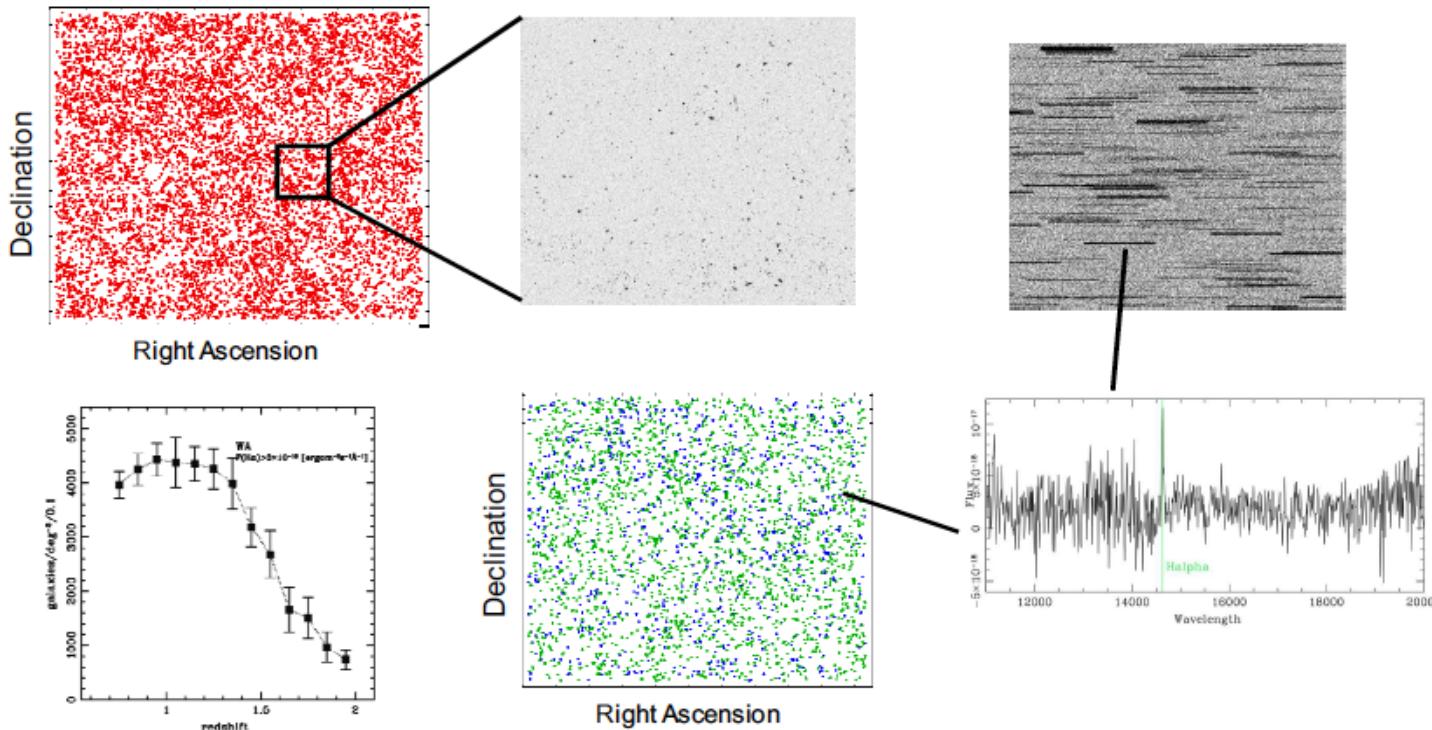
- Wide/Deep surveys
- Use emission line H $\alpha$  to measure redshift
- Sensitivity >  $3 \cdot 10^{-16}$  erg/cm $^2$ /s
- 4 Observations with 4 grisms (2 blues, 2 reds), with 0 and 90degree of rotation to reduce confusion + dithering
- $\sim 4 \times 10$  mn of observation
- Slitless, Resolution > 250
- Accurate wavelength calibration < 1 pixel



# End to end simulation chain

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- FULL END TO END simulations from observation to final products



- Areas of the order of 1 square degree (1.3 sq. deg. presented here)
- Statistically evaluate level 1 (2) requirements

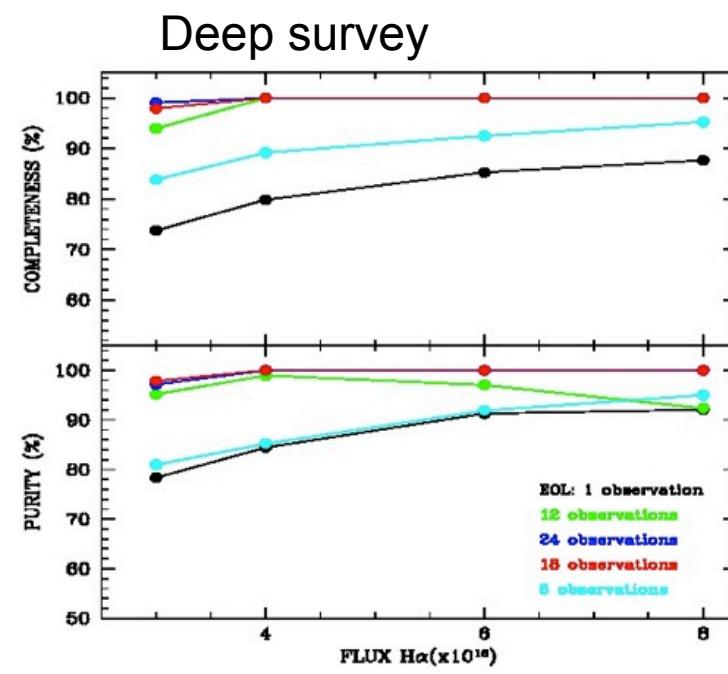
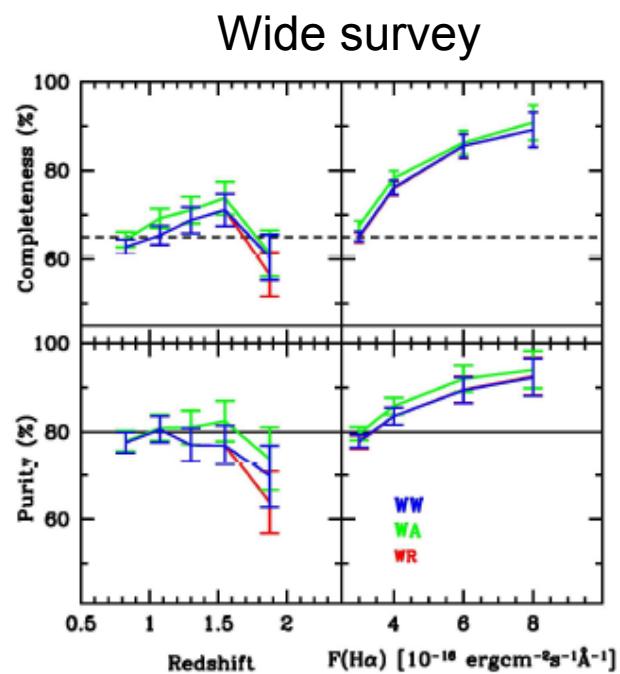
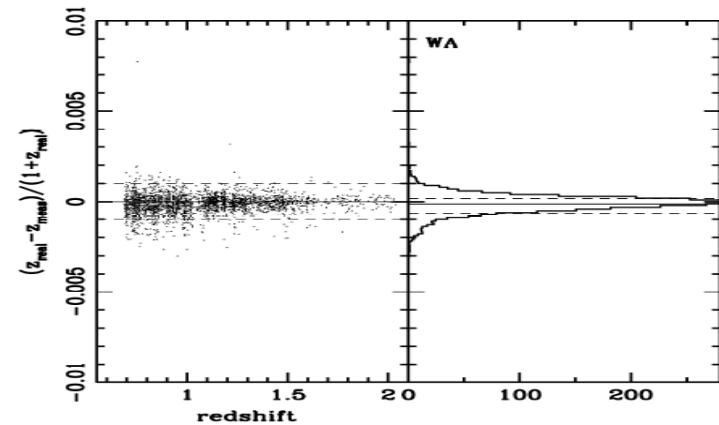
Tool used for verification in previous reviews – all requirements fulfilled

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# Clustering performance evaluation

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- Control of offset
- 70 % galaxies have  $\sigma(z) < 0.001(1+z)$
- Offset  $< 6 \cdot 10^{-5}$
- Control of the selection function



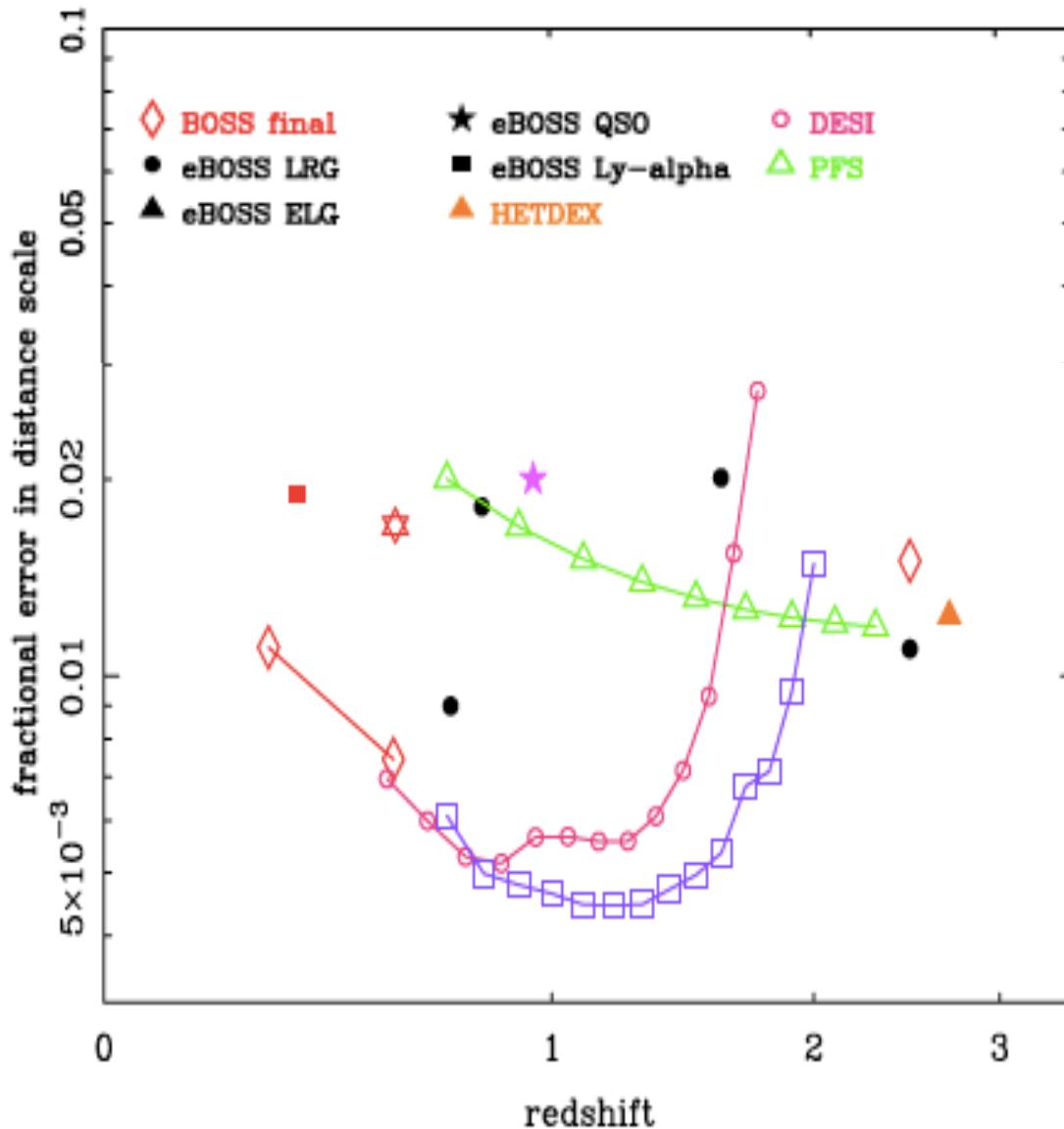
- Discussion started at Leiden
- Propose to review Euclid baseline because
  - New estimation on space density Halpha emitters
  - New bias evaluation
  - New forthcoming experiments
- Propose to study an optimisation of the observational strategy
- Should stay compatible with PDR of NISP instrument

# see SWG report ...

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Authors:	Function:	Signature & date :
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W. Percival	Galaxy Clustering SWG chair	
Contributors:	Function:	Signature & date :
R. Bean	Science predictions	
A. Cimatti	H-alpha luminosity function analysis	
A. Ealet	Instrument simulations	
P. Franzetti	Slitless simulations	
B. Garilli	Slitless simulations	
J. Geach	H-alpha luminosity function analysis	
C. Hirata	H-alpha luminosity function analysis	
T. Kitching + WL SWG	WL Fisher Matrix prediction and combination	
M. Magliocchetti	Observational bias measurements	
E.-M. Mueller	Science predictions	
L. Pozzetti	H-alpha luminosity function analysis	
Y. Wang	Science predictions	
+other GC SWG members	Discussions, comments, etc.	

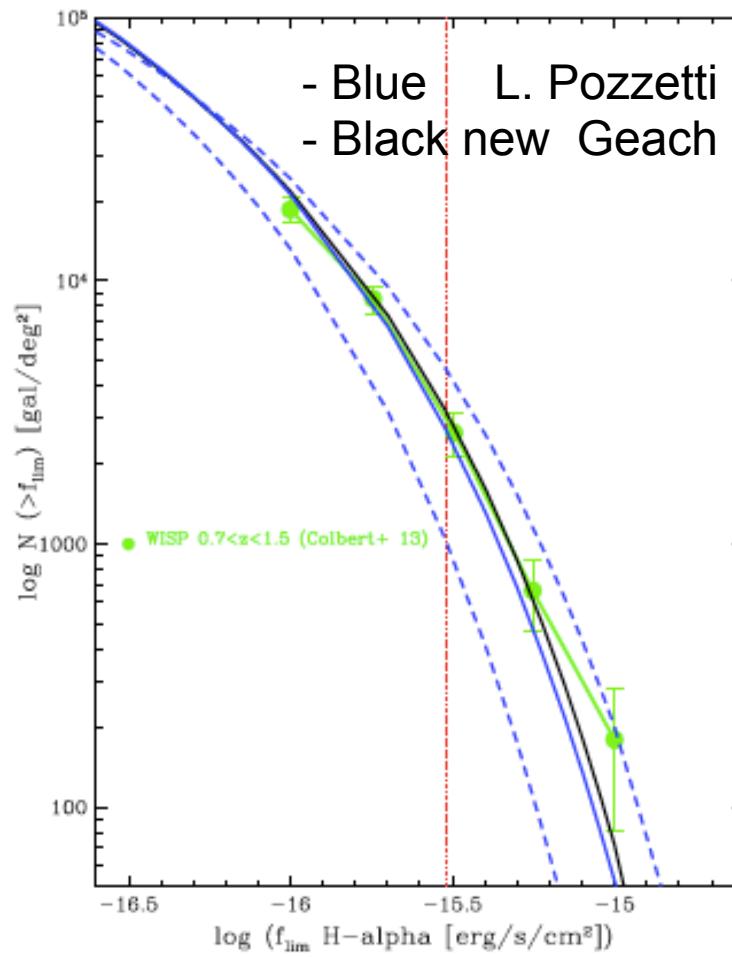
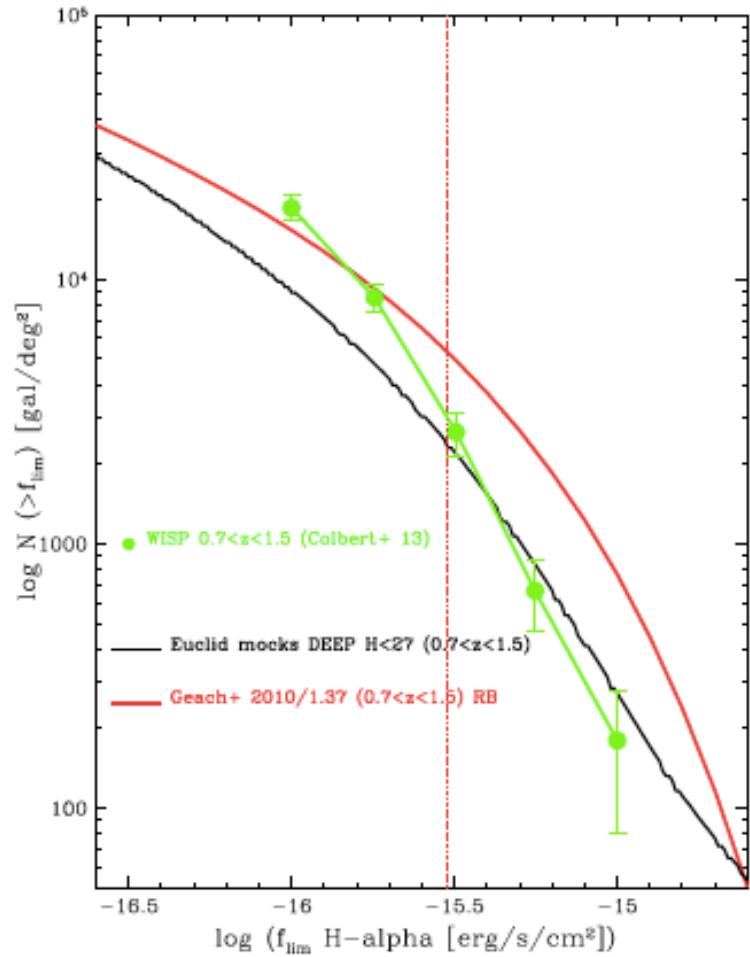
- Dark Energy Spectroscopic instrument (DESI)
  - 5000 fibers multi object on  $14\ 000\ \text{deg}^2$
  - Observe  $\sim 20\ \text{M}\ \text{LRG}, \text{ELG}, \text{QSO}$
  - $\text{zmax} \sim 1.2$
- Subaru Telescope Prime Focus Spectrograph (PFS)
  - 2400 fibers on  $\sim 1500\ \text{deg}^2$ , 3 M redshifts
  - $0.6 < z < 2.4$



# New Data for Halpha emitters

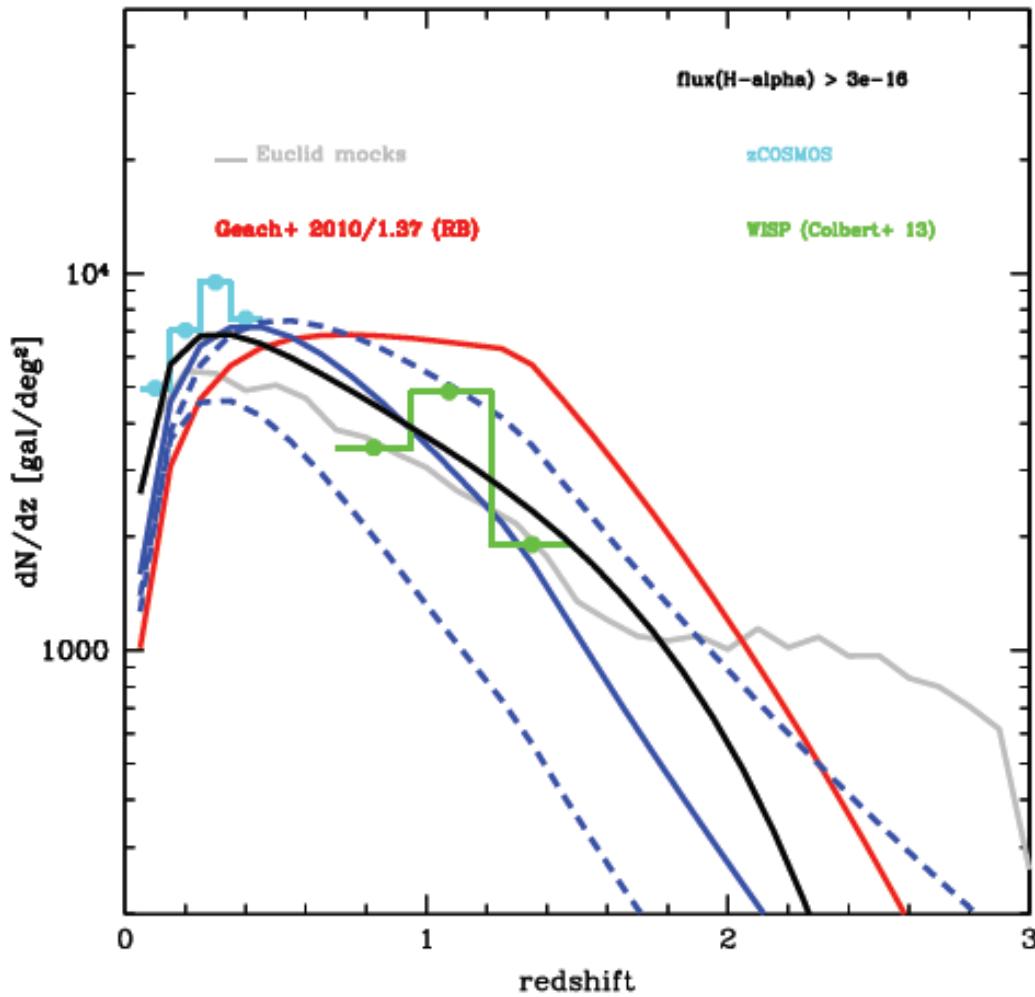
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- New data from the WFC3 Infrared Spectroscopic Parallel (WISP) Survey



# Density H-alpha emitters

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Previous Euclid evaluation  
use red Geach (2010)

-30% decrease in data with arXiv

-> Updated models (2013):

-Lucia Pozzetti in blue

- Jim Geach in black

=> Significantly lower

- For the definition study report, SWG use semi analytic models of [Orsi et al\(2010\)](#)  $b=0,9+0,4 z$   
(Same in PFS, DESI use  $b=0,84$  at  $z=0$  to  $2$  at  $z=2$ )
- Latest models ([Gonzalez-Perez \(2013\)](#) ) predicts slightly higher biases ( $1.1$  at  $z\sim0,5$  rising to  $2.2$  at  $z=2.2$ )
- These two predictions are almost consistent
- Some evidence of very high biases but small sample and not enough robust results today
- [Use Gonzalez-Perez \(2013\) in the report](#)

**Table 8.1:** ~~Grism~~ combination and redshift ranges for the configurations tested here

	Grism 1		Grism 2		Grism 3		Grism 4	
<b>Baseline</b>	0.68<z<1.21	0	0.68<z<1.21	90	1.21<z<2.05	0	1.21<z<2.05	90
<b>high-z start</b>	0.9<z<1.44	0	0.9<z<1.44	90	1.4<z<2.05	0	1.4<z<2.05	90
<b>4-red, z0.8 start</b>	0.8<z<1.67	0	0.8<z<1.67	90	0.8<z<1.67	180	0.8<z<1.67	270
<b>4-red, z0.9 start</b>	0.9<z<1.80	0	0.9<z<1.80	90	0.9<z<1.80	180	0.9<z<1.80	270
<b>4-red, z1.0 start</b>	1.0<z<2.05	0	1.0<z<2.05	90	1.0<z<2.05	180	1.0<z<2.05	270
<b>4-red, z1.2 start</b>	1.2<z<2.05	0	1.2<z<2.05	90	1.2<z<2.05	180	1.2<z<2.05	270

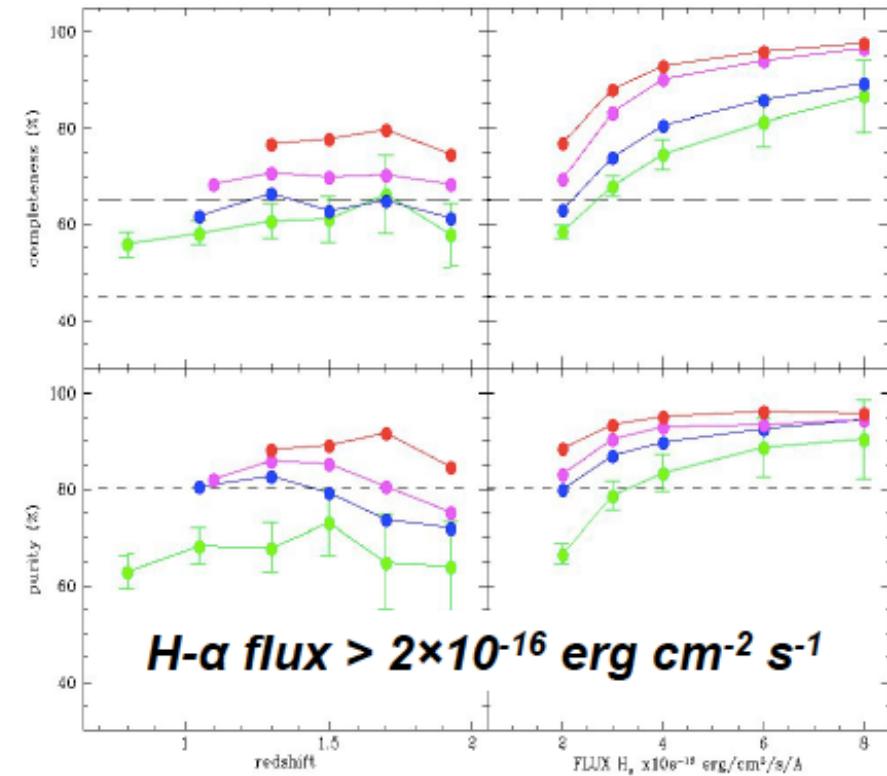
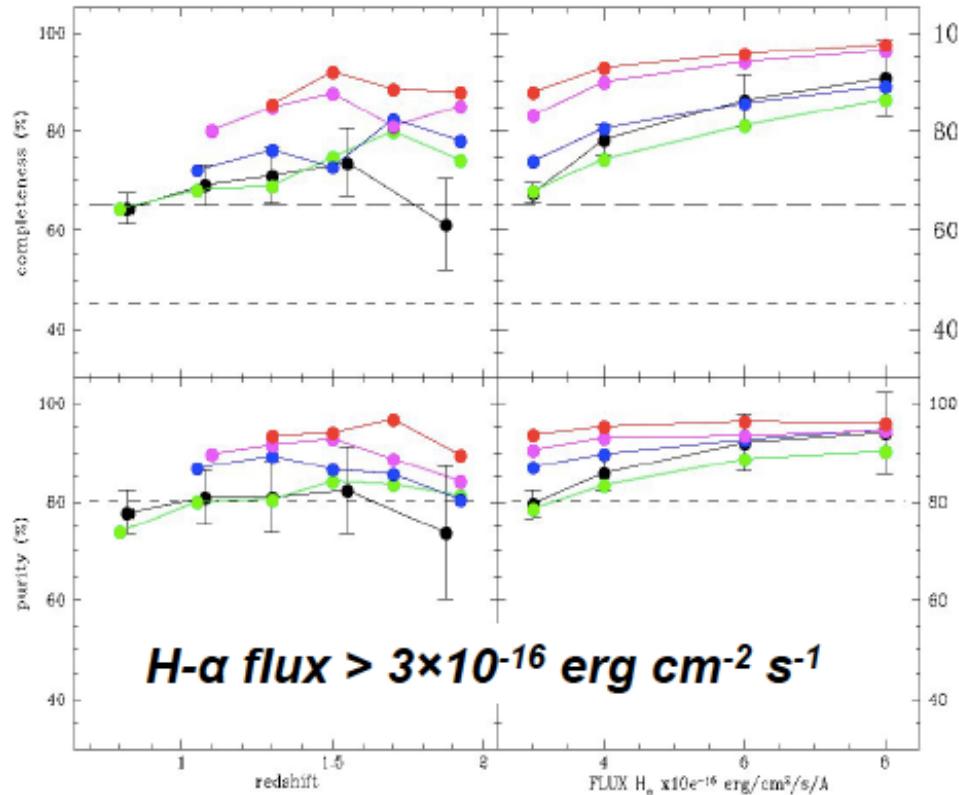
**Table 8.2:** As table 8.1, but converted to wavelengths

	Grism 1		Grism 2		Grism 3		Grism 4	
<b>Baseline</b>	1.1< $\lambda$ <1.45	0	1.1< $\lambda$ <1.45	90	1.45< $\lambda$ <2.0	0	1.45< $\lambda$ <2.0	90
<b>high-z start</b>	1.25< $\lambda$ <1.6	0	1.25< $\lambda$ <1.6	90	1.57< $\lambda$ <2.0	0	1.57< $\lambda$ <2.0	90
<b>4-red, z0.8 start</b>	1.2< $\lambda$ <1.75	0	1.2< $\lambda$ <1.75	90	1.2< $\lambda$ <1.75	180	1.2< $\lambda$ <1.75	270
<b>4-red, z0.9 start</b>	1.25< $\lambda$ <1.83	0	1.25< $\lambda$ <1.83	90	1.25< $\lambda$ <1.83	180	1.25< $\lambda$ <1.83	270
<b>4-red, z1.0 start</b>	1.3< $\lambda$ <2.0	0	1.3< $\lambda$ <2.0	90	1.3< $\lambda$ <2.0	180	1.3< $\lambda$ <2.0	270
<b>4-red, z1.2 start</b>	1.44< $\lambda$ <2.0	0	1.44< $\lambda$ <2.0	90	1.44< $\lambda$ <2.0	180	1.44< $\lambda$ <2.0	270

$$0.65628 (1+z_{\text{lim}}) = \lambda_{\text{lim}}/\mu\text{m}.$$

# E2E predictions on completeness/purity

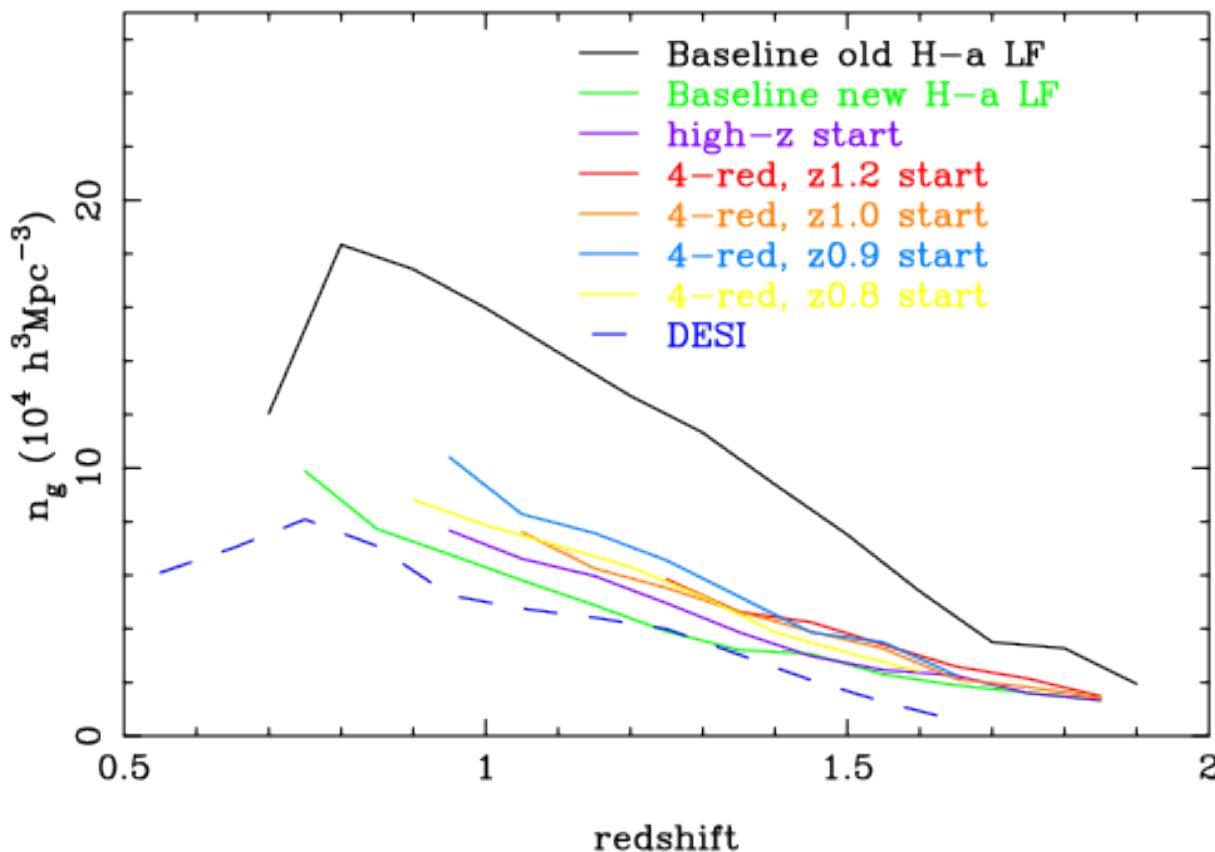
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BLACK – Baseline (old H- $\alpha$  lum func)  
 GREEN – Baseline (new H- $\alpha$  lum func)  
 BLUE - high-z start  
 RED - 4-red, z1.2 start  
 MAGENTA - 4-red, z1.0 start

# Prediction n(z)

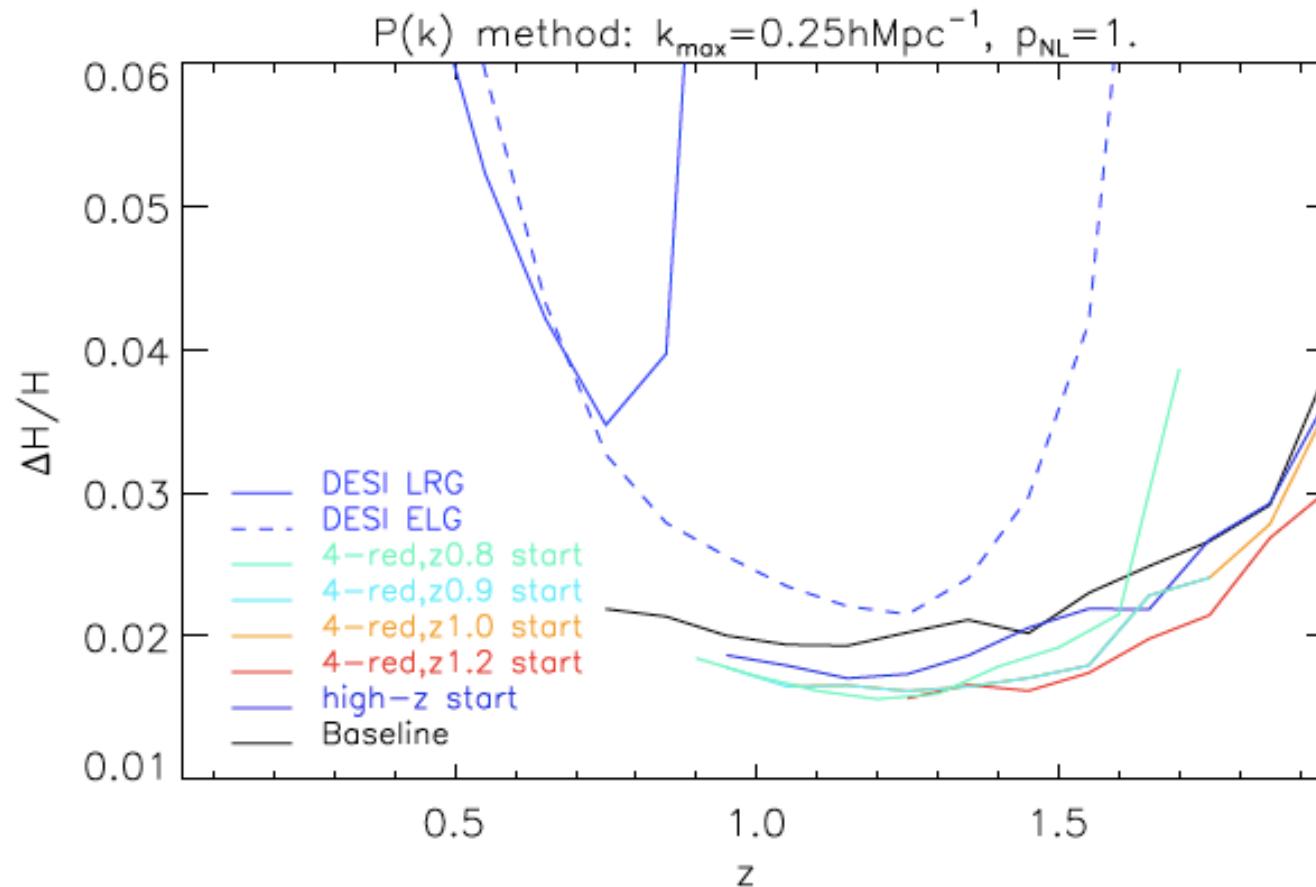
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**$H\text{-}\alpha$  flux >  $3 \times 10^{-16}$  erg cm $^{-2}$**

# Prediction BAO distance

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**$H-\alpha$  flux  $> 3 \times 10^{-16} \text{ erg cm}^{-2}$**

# Predicted FOM

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## Galaxy clustering alone

	FoM ( $\gamma$ fixed)		FoM ( $\gamma$ varied)	$\sigma_v$	FoM ( $\gamma$ varied)	$\sigma_v$
	alone	+BOSS	alone		+BOSS	
Baseline	74	146	38	0.052	80	0.035
high-z start	35	120	16	0.100	65	0.041
4-red, z0.8 start	35	107	16	0.084	56	0.041
4-red, z0.9 start	35	117	16	0.088	62	0.040
4-red, z1.0 start	30	126	14	0.104	67	0.040
4-red, z1.2 start	13	114	6	0.178	59	0.042

## With weak-lensing

	$N_{\text{gal}} / 10^6$	FoM ( $\gamma$ fixed)	FoM ( $\gamma$ varied)	$\sigma_v$
Baseline	25.8	488	404	0.019
>1 exposure	19.4	439	370	0.020
high-z start	21.9	443	382	0.021
>1 exposure	16.4	406	353	0.022
4-red, z0.8 start	24.3	418	362	0.021
4-red, z0.9 start	23.2	444	383	0.021
4-red, z1.0 start	21.1	462	399	0.021
4-red, z1.2 start	15.4	450	387	0.021

- Report conclusion

- New H $\alpha$  density predicts less redshift (2000/ deg $^2$  instead 3500 / deg $^2$ )
- An option with 4 identical grisms and 4 orientations is agreed as a more robust option for observation
- the SWG report suggests to cover the range  $1 < z < 1.8$
- With the same flux limit, this meet the FOM (WL+GC) requirement

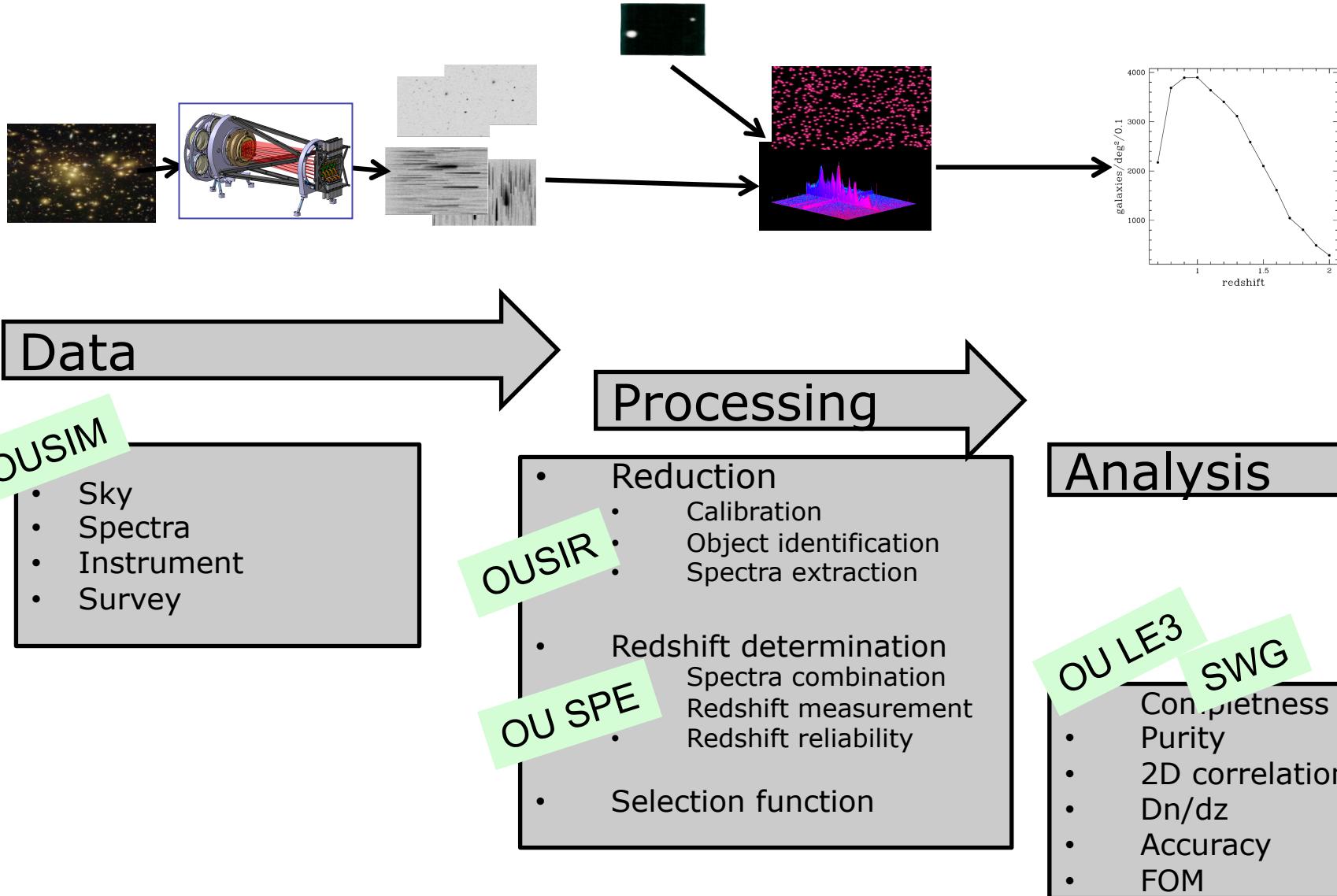
This is translated in a NISP new baseline

- > 4 identical red grisms  $1.25 < \lambda < 1.8 \mu\text{m}$
- > 4 orientations P.A. = (0, 90, 180, 270),

And a best effort to enlarge the red coverage to  $1.85 \mu\text{m}$

# Scientific analysis chain

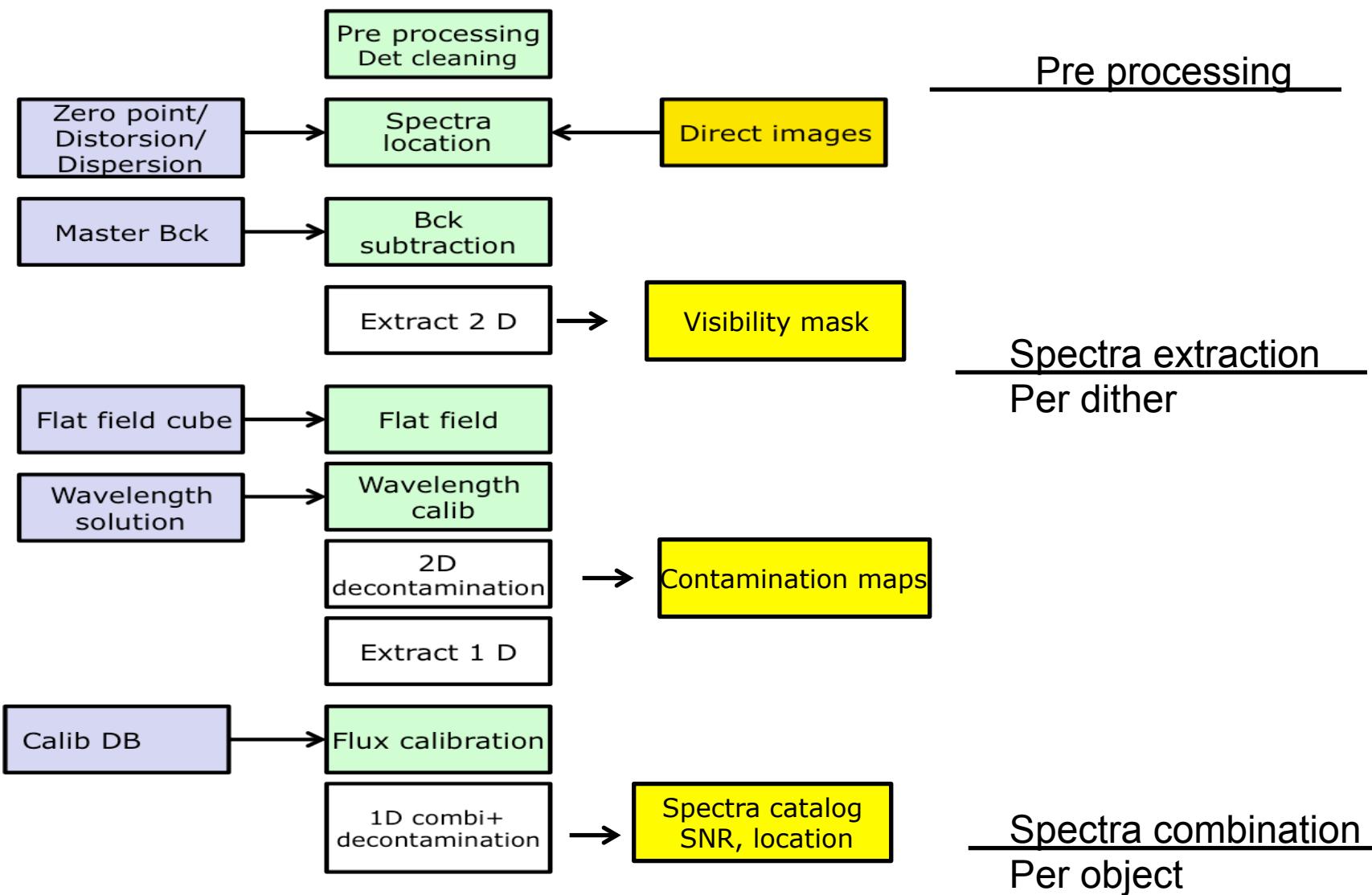
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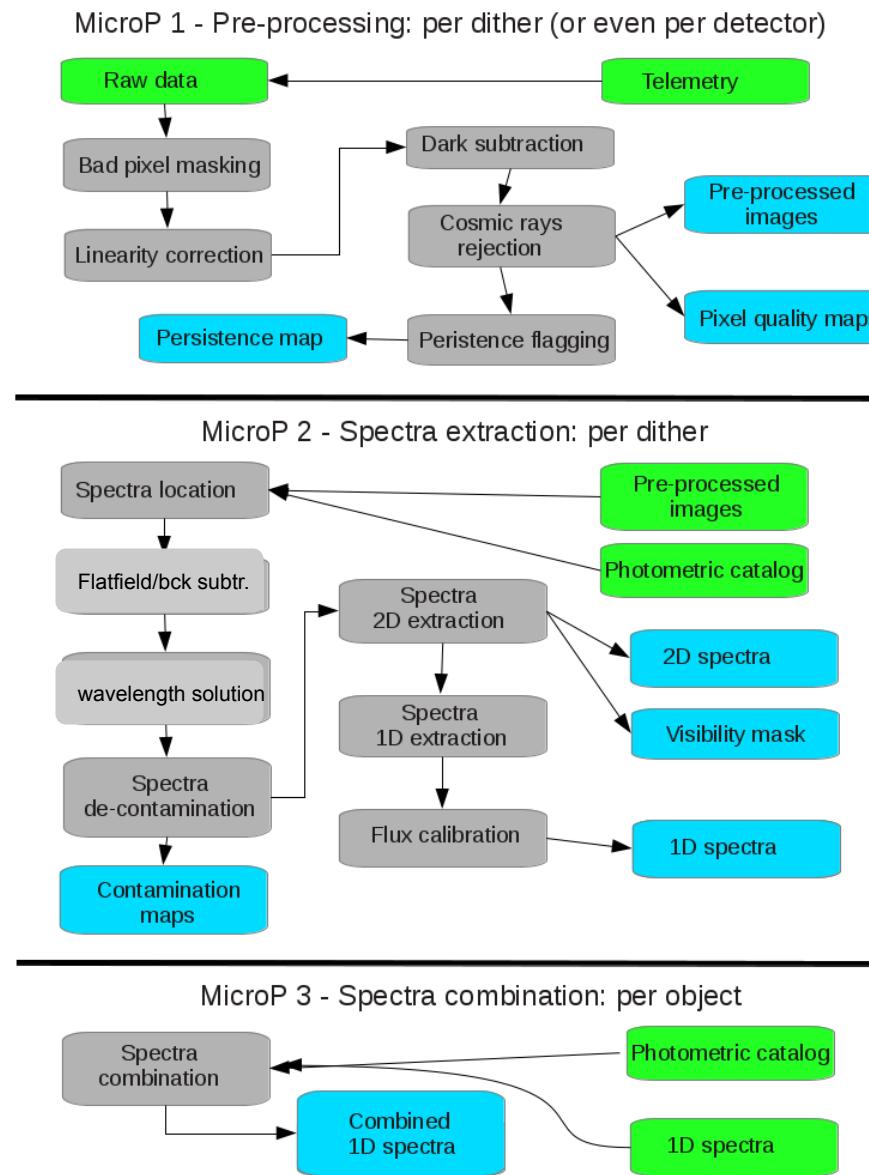
Goals: Produce methods and algorithms for spectro photometric measurements from NISP spectroscopy data:

- Develop the algorithms necessary to produce
  - 2D/1D Calibration
  - Spectra extraction
  - Redshift measurements
  - Spectral features measurements
  - Quality assessment
- Performances vs. Requirements
  - Control measurement uncertainties -> SNR vs.  $\lambda$
  - Control confusion /decontamination (slitless)->completeness/purity
  - Define and estimate the 3D selection function ->mask, weights
  - Develop verification tools

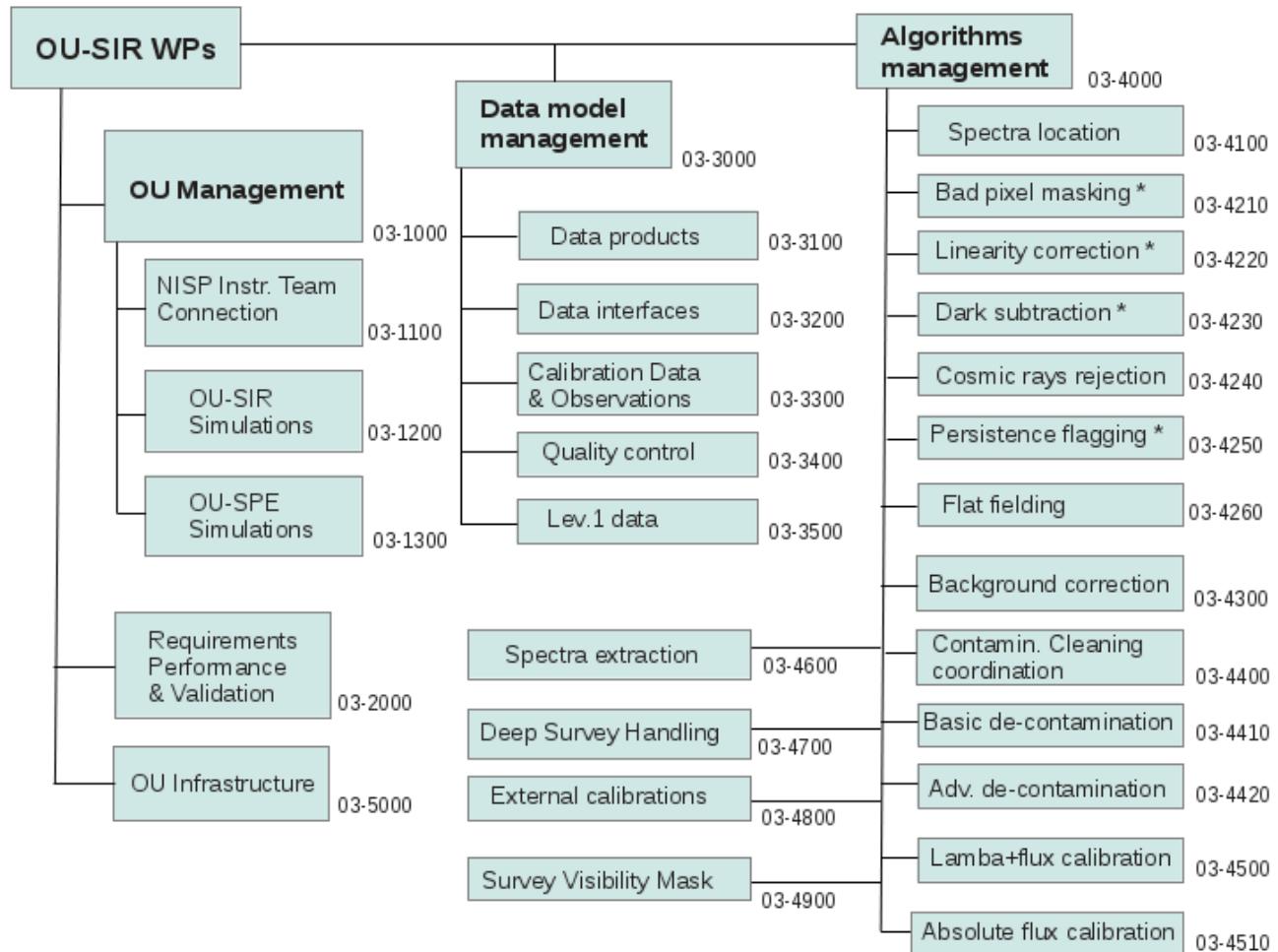
# Calibration/ extraction



# OUSIR tasks



Lead: M.Scodeggio  
Co-lead:C.Surace



- Wavelength solution
  - calibration procedure as HST slitless with Planetary nebulae on board + zero order extraction
  - same accuracy (<1 pixel) but:  
Larger FOV, no exact direct image, larger pointing error  
=> simulation plan with instrument team/OU SIM for procedure verification
- De-contamination/confusion methods under evaluation
- Spectra extraction (AXE, as HST ?)
- 2D simulated images will be produced by OUSIM (TIPS)

Plan is to have mainMicroP prototypes working for the SRR 2014

Develop the algorithms necessary to produce

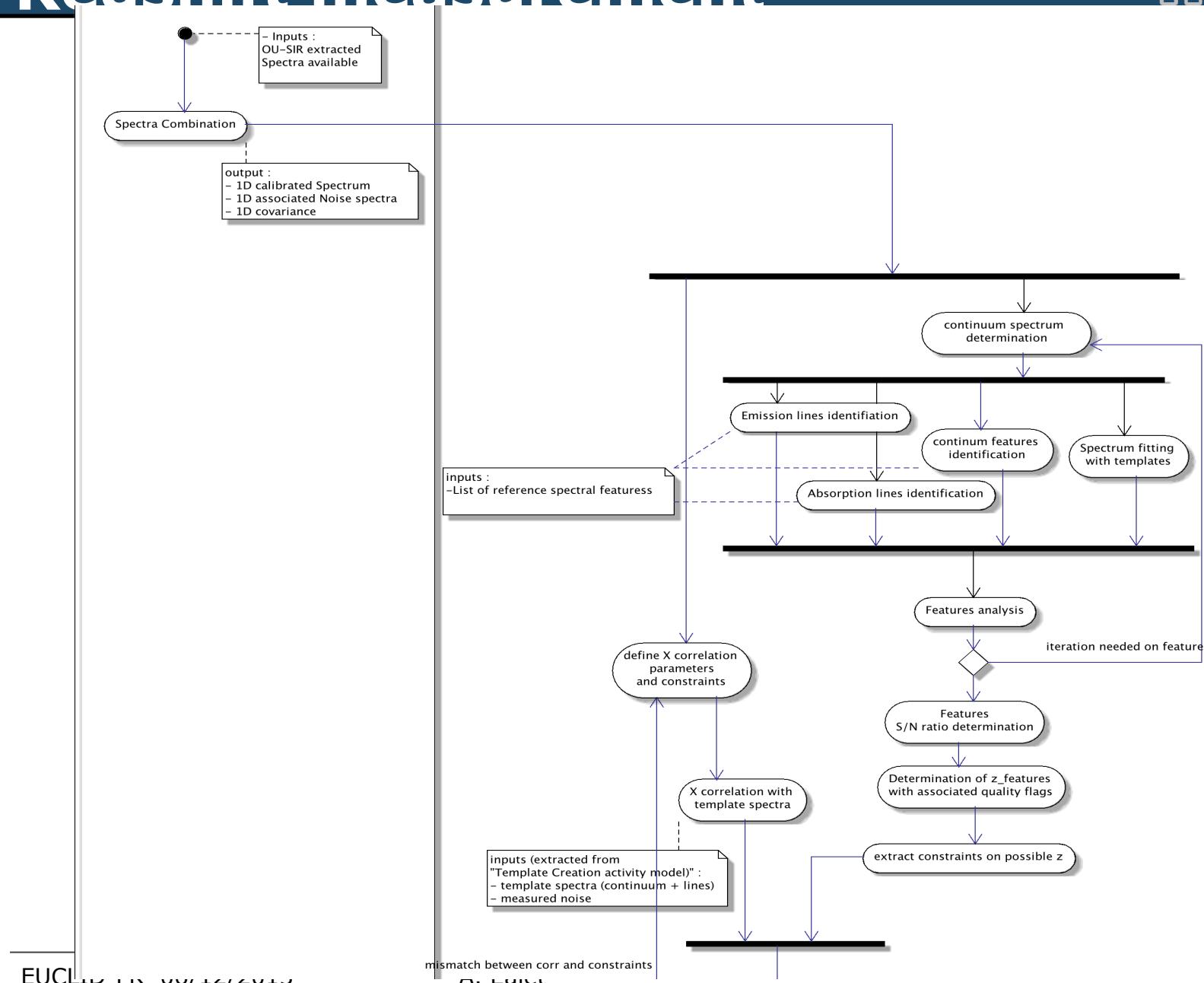
- Redshift measurements
- Spectral features measurements
- Quality assessment
- Measure and control uncertainties

3D mask construction .. OUSPE-OULE3?

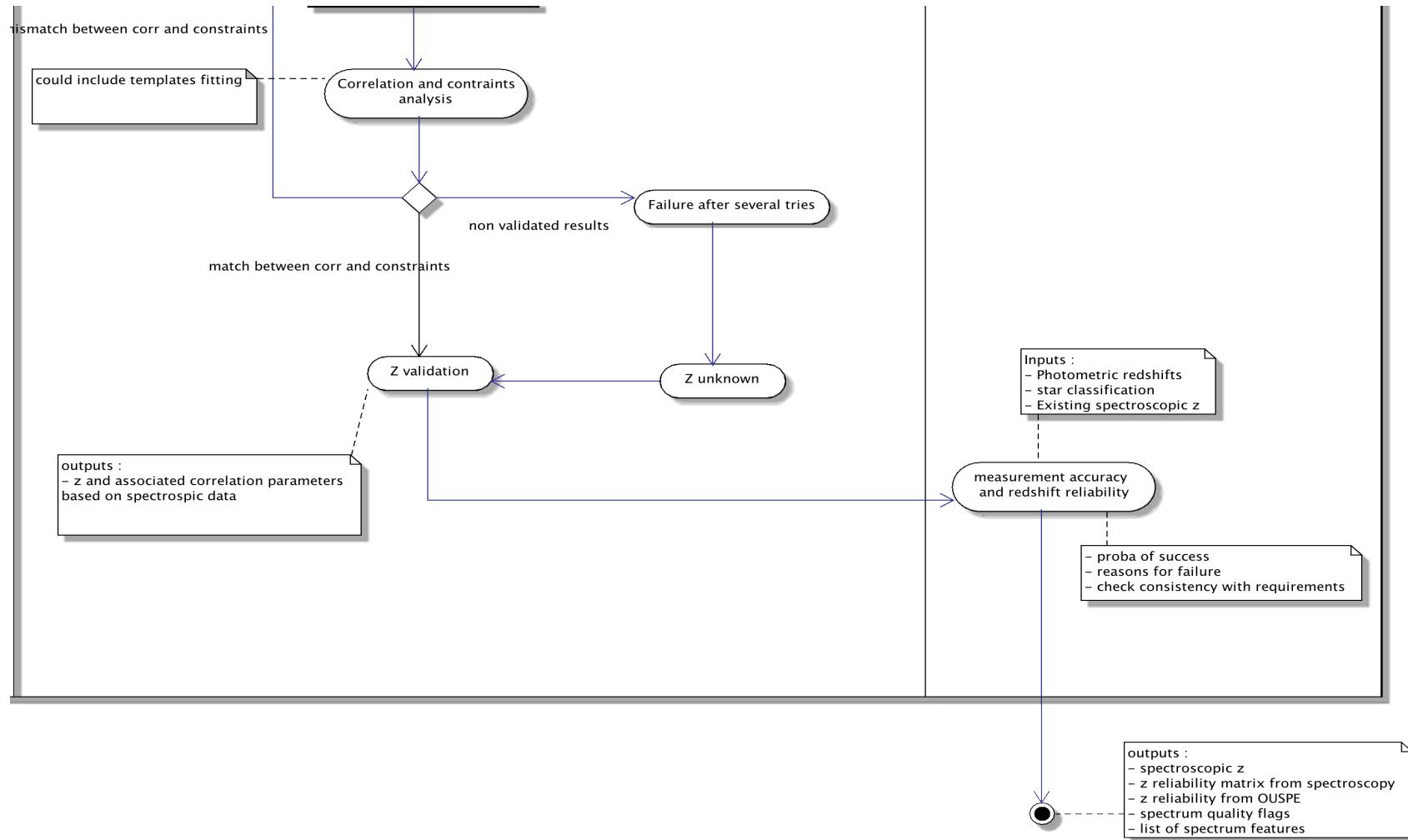
- Key algorithms to measure redshift identified. Baseline is cross-correlation with templates, combined with spectral features detection and continuum fitting.
- Development methodology adopted: Agile environment (CNES) structured with 1 month-long 'sprints', with defined 'stories' and 'tasks'.
- Development plan aims for a first prototype demonstration by the SRR dec. 2014

# Redshift measurement

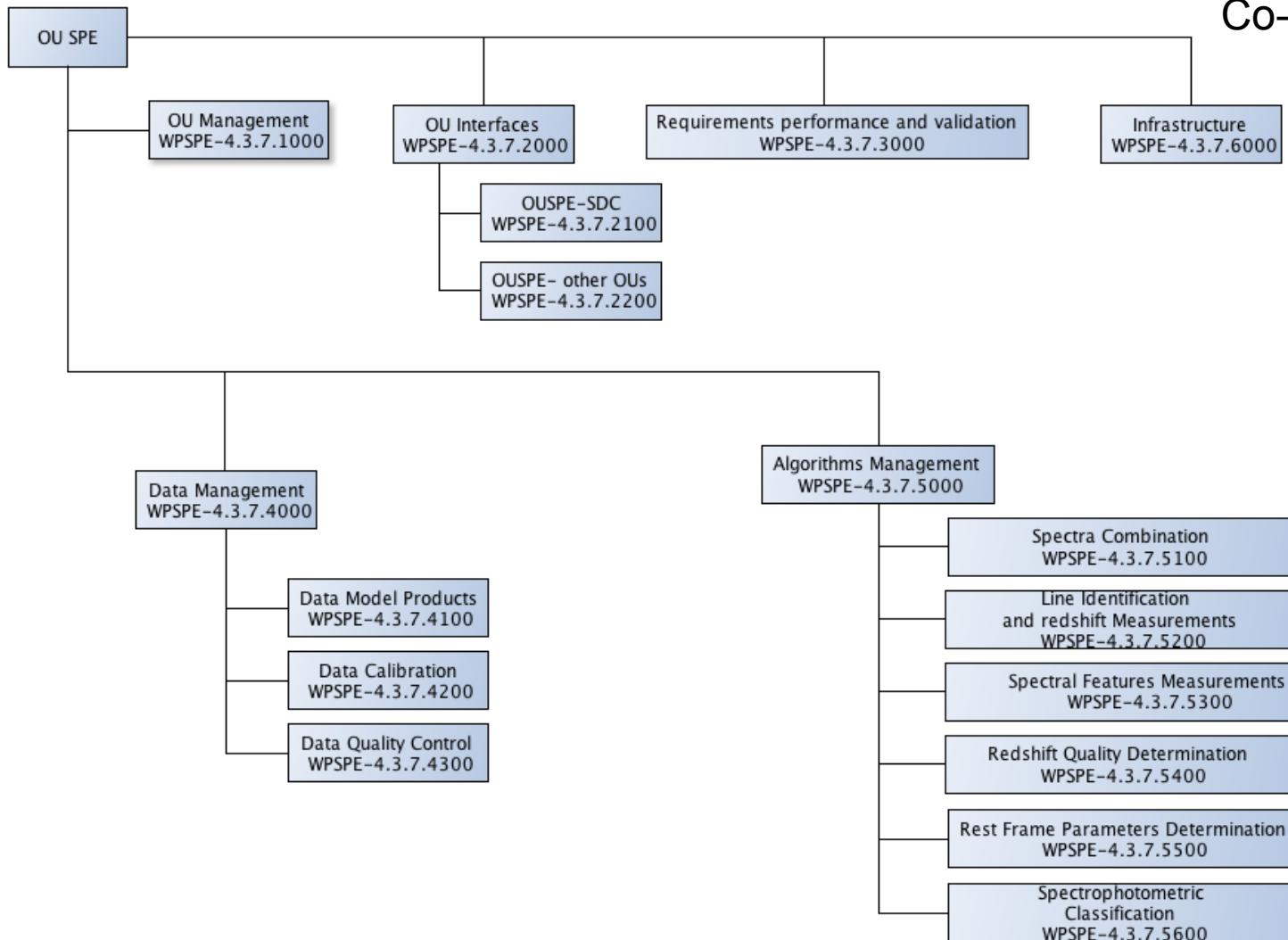
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# Redshift measurement



Lead O.Le Fèvre  
Co-Lead: M Mognoli



# Spectroscopy pipeline: a French Effort

NISP	OUSIR	OUSPE	OUSE3 clustering
OUSIM			
CPPM LAM,IPNL co-lead (A.Ealet)	LAM ,IRAP co-lead (Ch. Surace)	LAM, IRAP,IPNL lead (O.Le Fevre)	LAM,CPPM WP lead (S. De la Torre)
TIPS NIS Image Simulator Fr: 3 FTE	Fr: 9 FTE	Fr: 12 FTE	Fr: 1 FTE

- Clustering science requirements has been reviewed by the SWG
  - > New NISP baseline
    - 4 identical red grisms  $1.25 < \lambda < 1.8 \mu\text{m}$
    - > 4 orientations P.A. = (0, 90, 180, 270)
- Spectroscopy data processing OUSIR/OUSPE in progress
  - Main tasks and algorithms defined
  - Key challenges under work
  - First prototypes for the SRR end 2014

- backup

# instrument simulator

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