Observing the high redshift Universe with Euclid

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on behalf of the Euclid Collaboration

IAUS333 - 05/10/2017

What if you have….

- An *additional* spectroscopic mode in the range 0.92-1.30 micron
- R~260 or better
- Slitless spectroscopy
- Supporting near-infrared Photometry in Y[0.92-1.19], J[1.19-1.54], H[1.54-2.0] bands down to $m_{AB} < 26$

- Area of 40 deg^2 well sampled
- Space based → PSF <0.2 arcsec, no atmosphere

Answer by the Euclid Science Team:

Great! Use it!

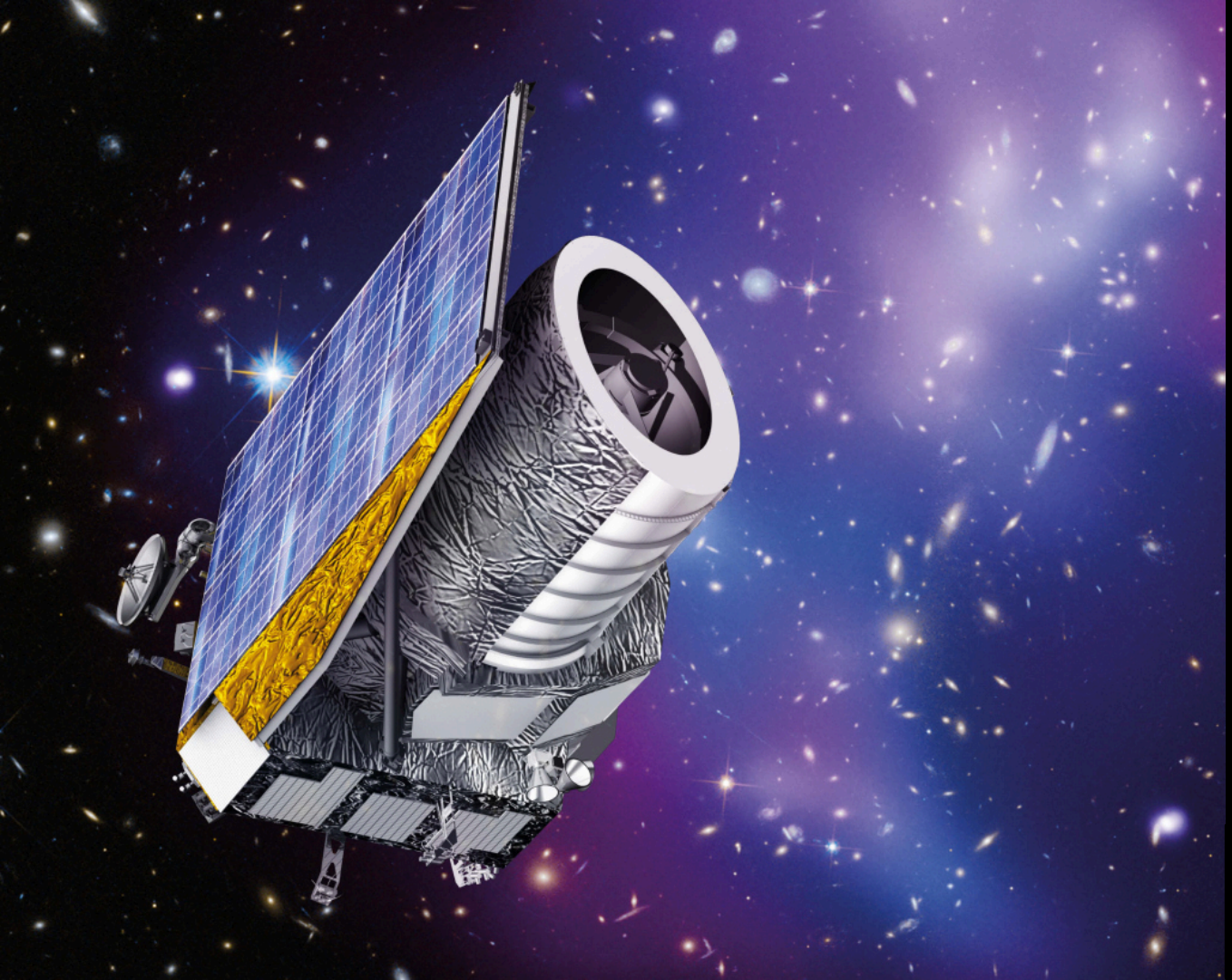
The leading science case must be “the high redshift Universe”.

….now we have to make it happen…..

→ The observing mode will be optimised for this science case

Outline

- Brief description of Euclid
- Preparing Euclid science
- Estimating detections rates for LAEs and QSOs
- Other facilities in 2020+
- Conclusions



Key Systems

Wide-field telescope with 1.2 diameter primary mirror
FoV: 0.69x0.74 deg^2

Diffraction limited

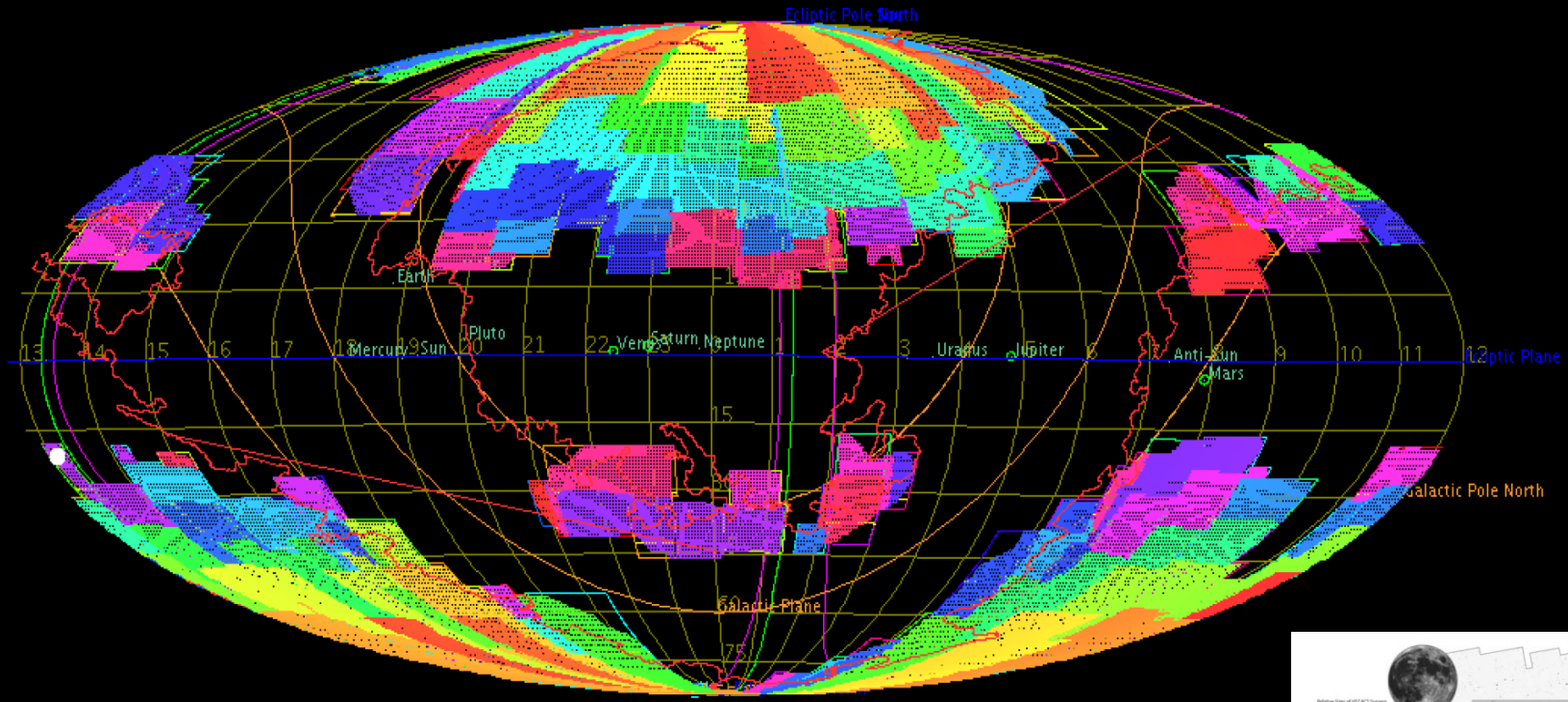
Visual Imager
0.55-0.9 micron band

Near-Infrared
Grism Spectrometer
0.9-1.3, 1.25-1.85 micron
Photometric Imager
Y, J, H

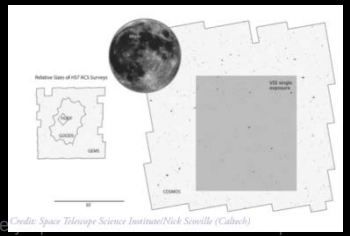
Low noise AOCS providing very stable pointing
~100 GB compressed data/day

Launch: 2021

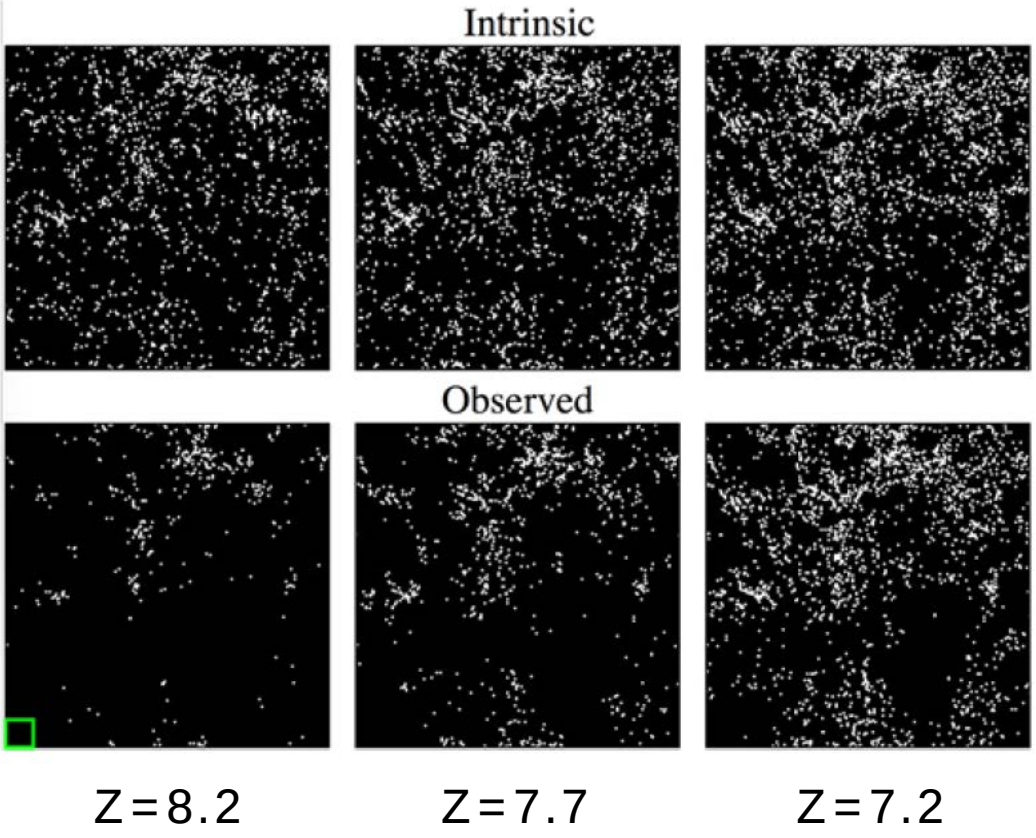
Euclid Reference Survey (2015)



Total area 15,000 deg2 in 6 years



Credit: Space Telescope Science Institute/Nick Scoville (Caltech)

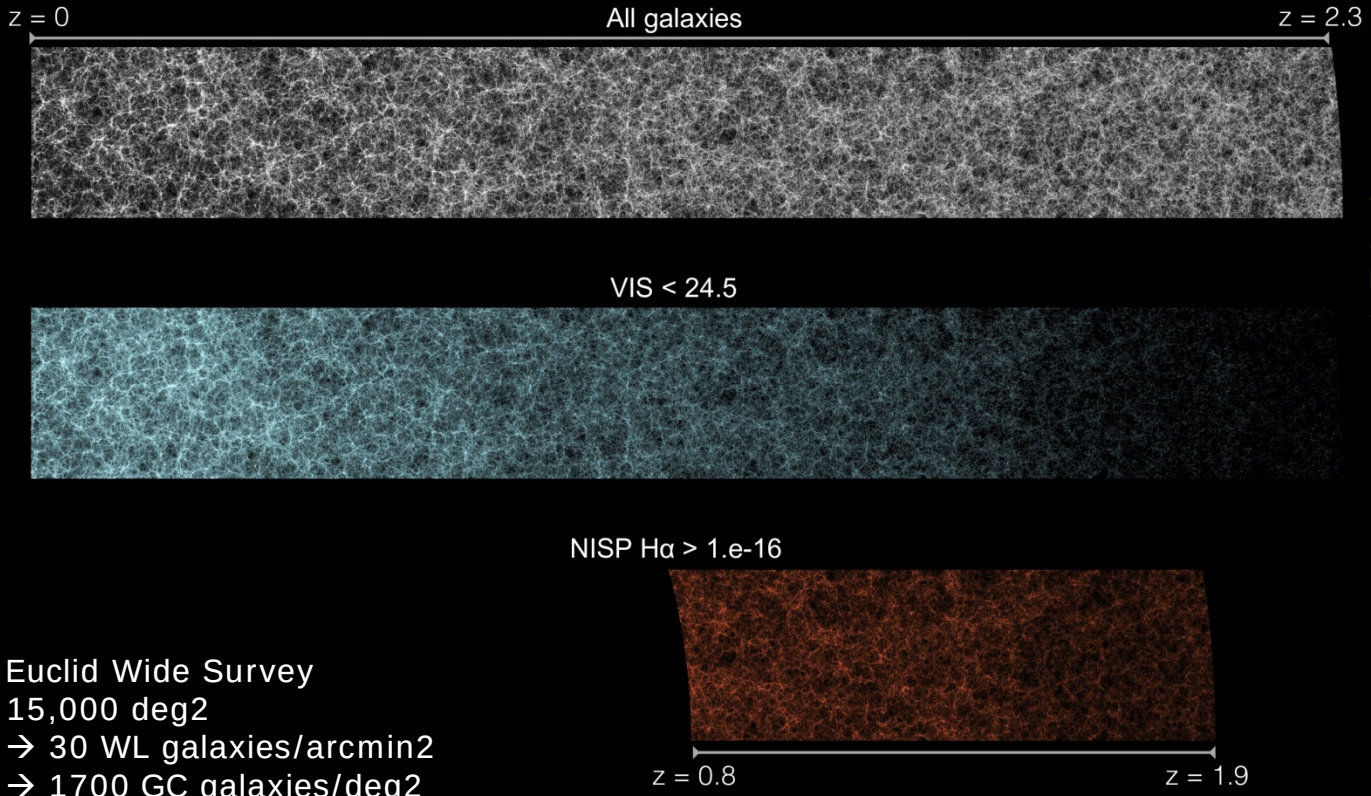


the intrinsic distribution of Lyα emitters within a 94 Mpc box taken from simulations

the resulting observed distribution of Lyα emitters

McQuinn et al, 2007

Flagship mock galaxy catalog

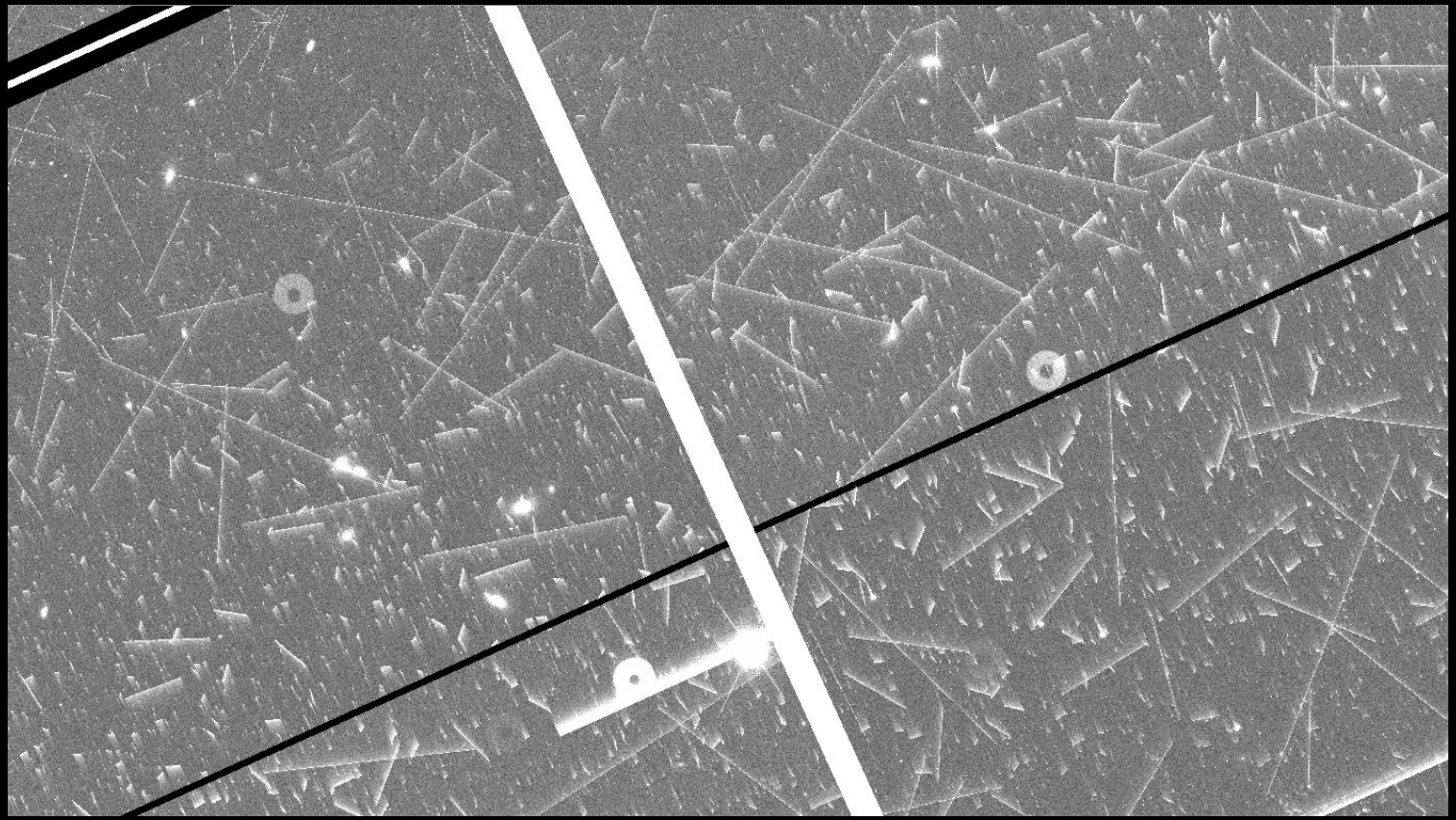


HOD pipeline developed by the Institut de Ciències de l'Espai (ICE) and Port d'Informació Científica (PIC) in Barcelona, and is based on the 2 trillion dark-matter particle Flagship run produced by Univ. Zurich.

Euclid Wide Survey
15,000 deg2
→ 30 WL galaxies/arcmin2
→ 1700 GC galaxies/deg2

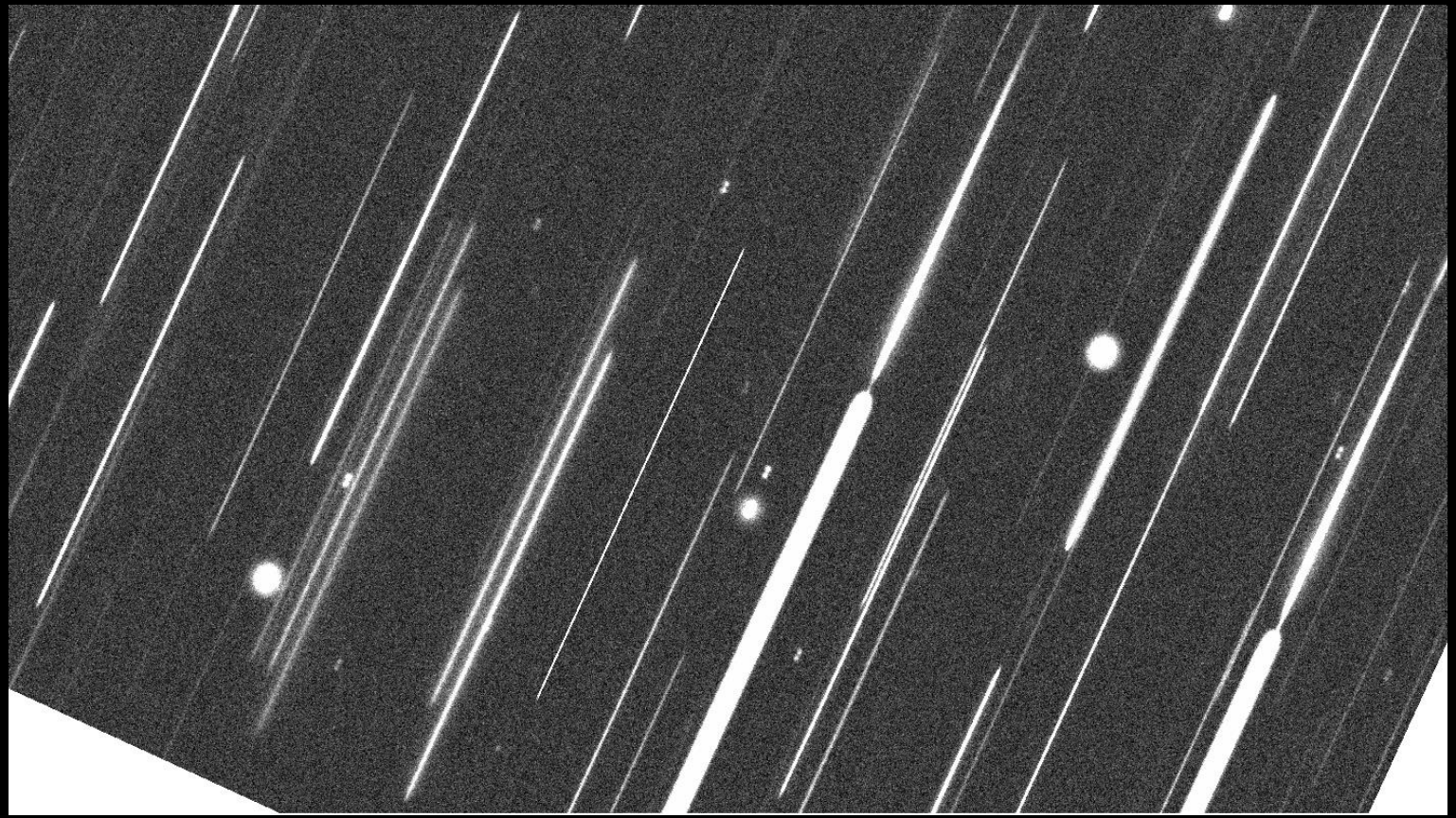
Part of a End-to-End Simulation programme (Science Performance Verification 2)

VIS SC3 (CCDs)

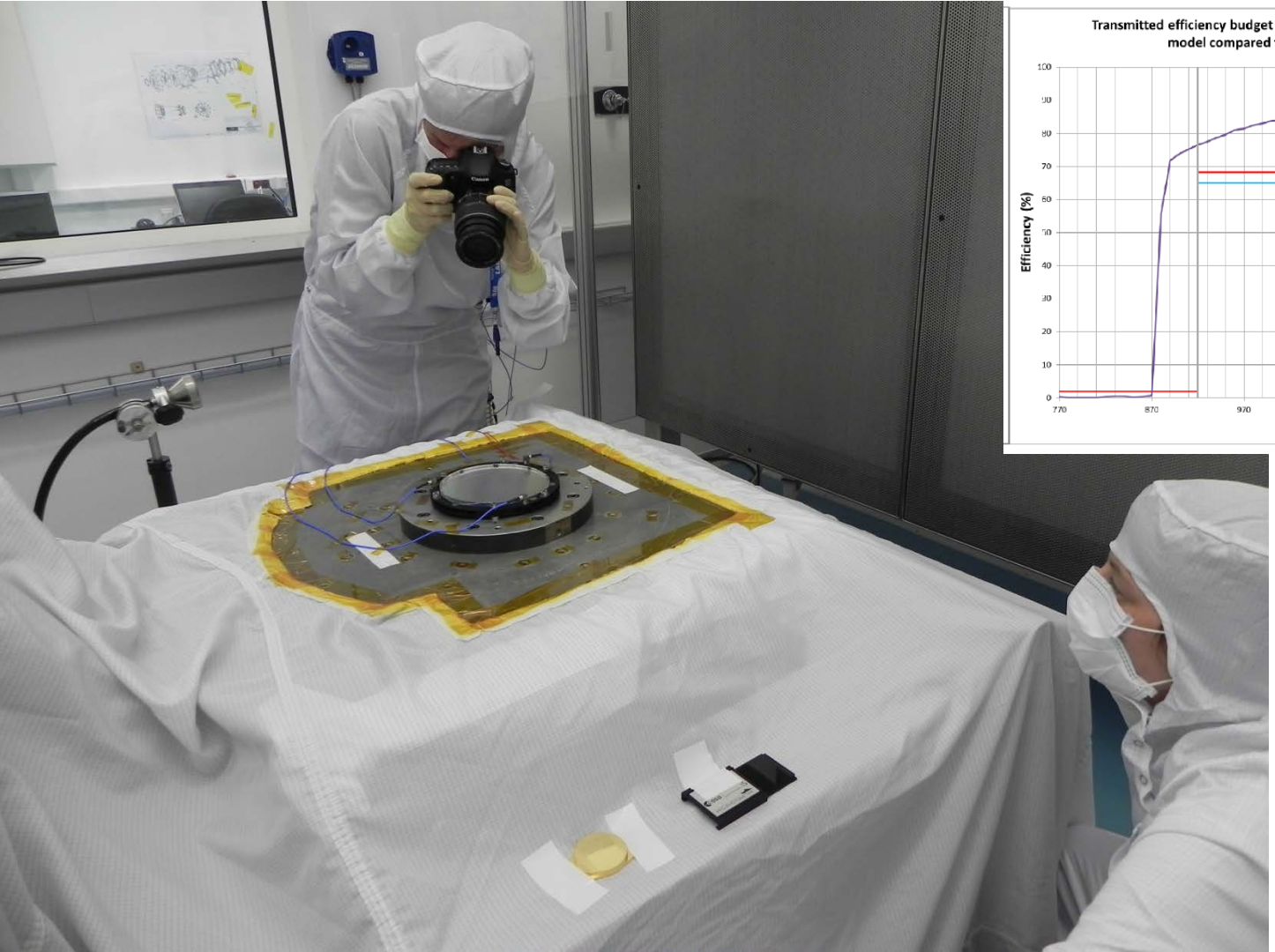


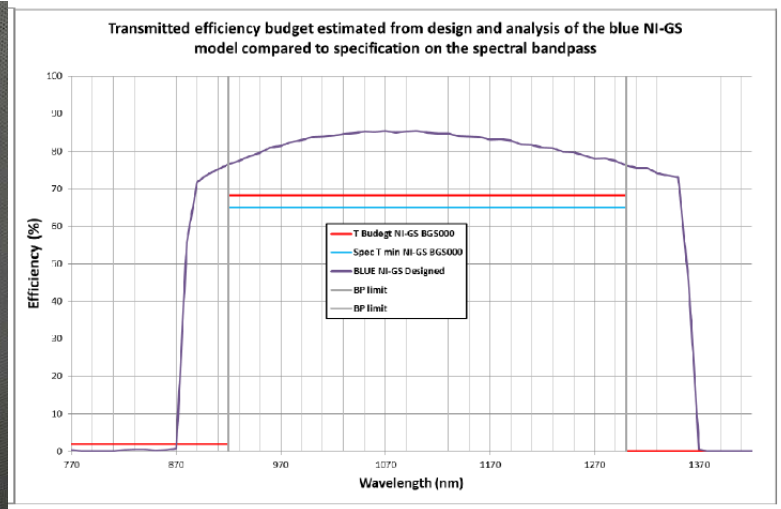
Courtesy of Euclid Consortium / Science Challenge 3

NISP-S SC3 (H2RG)



Courtesy of Euclid Consortium / Science Challenge 3





Costille et al. SPIE (2016)

Red Grism Flight Model on the shaker horizontal configuration.

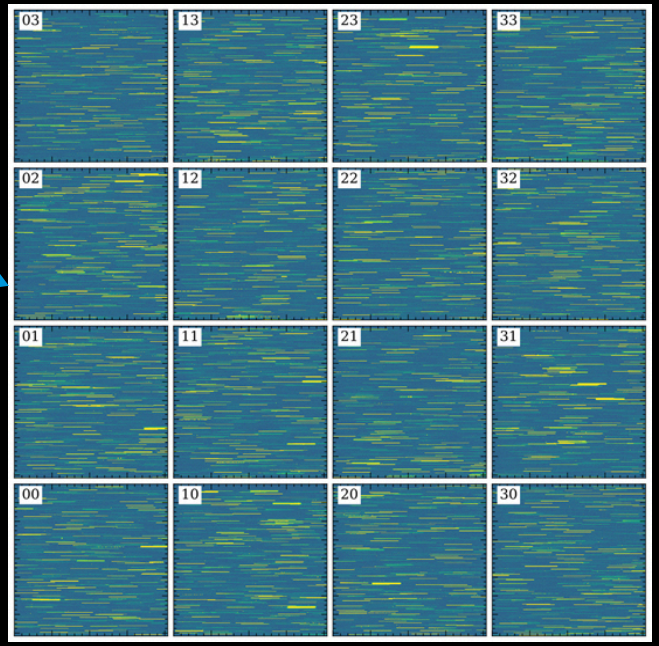
Photo from: A. Costille (LAM)

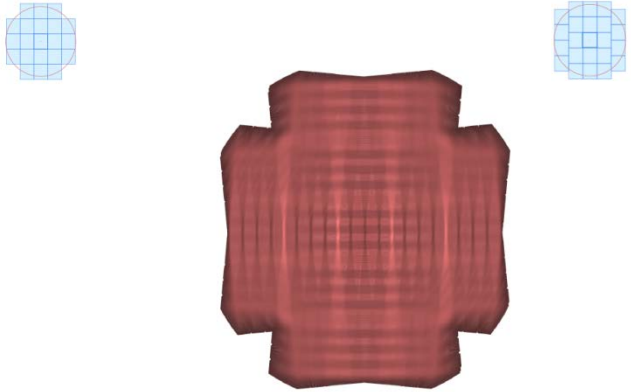
Short wavelength (blue) Grism programme

- Wavelength range: 0.92-1.3 micron
- Line Detection limit *≤6 10^{-17} erg cm^{-2} s^{-1} (3.5 sigma point source)*

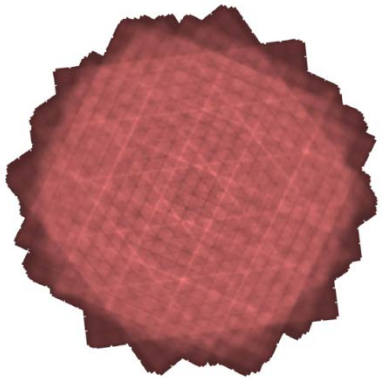
Is part of the Deep Survey

- Field of view: 0.76×0.72 deg^2
- 40 coverages
- 40 deg^2 total area

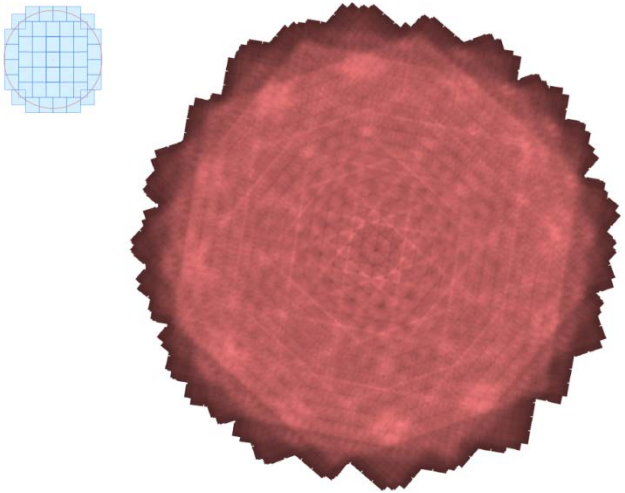




Deep Fornax (10 deg2)



Deep Field North (10 deg2)
Centred on the NEP



Deep Field South (20 deg2)
Close to SEP

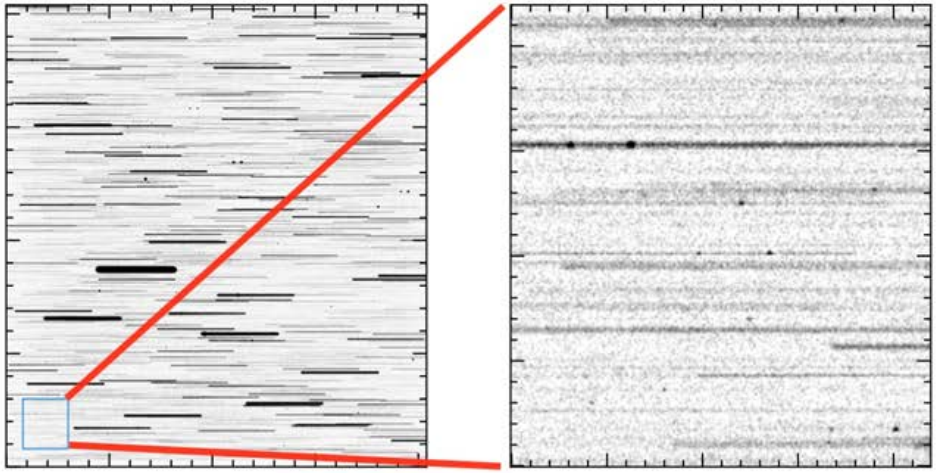
Scheduling and coverage forecast by João Dinis (Lisbon Univ.)

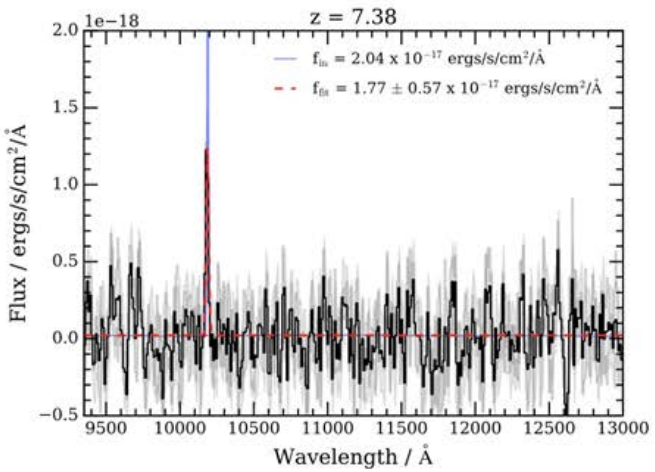
Euclid Deep Survey: estimating Lyα emitters number counts

Blue grism 0.92-1.3 micron, corresponds to : 6.5 < z(Lyα) < 9.7

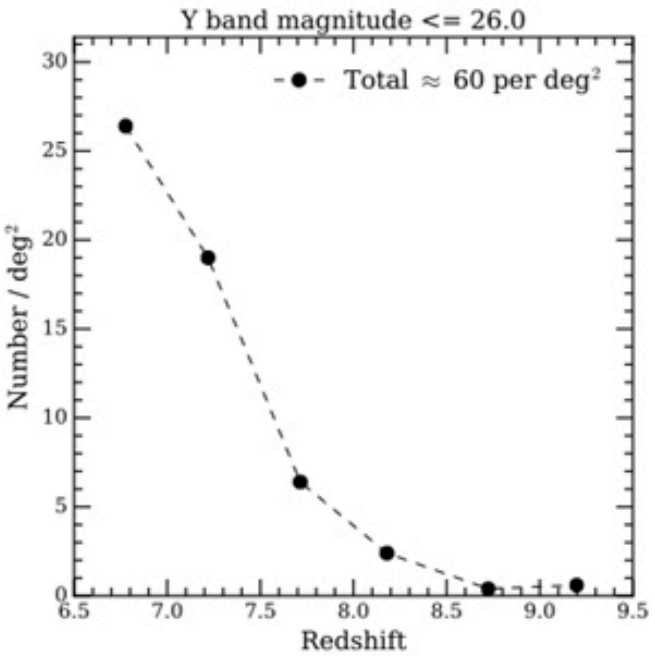
Method:

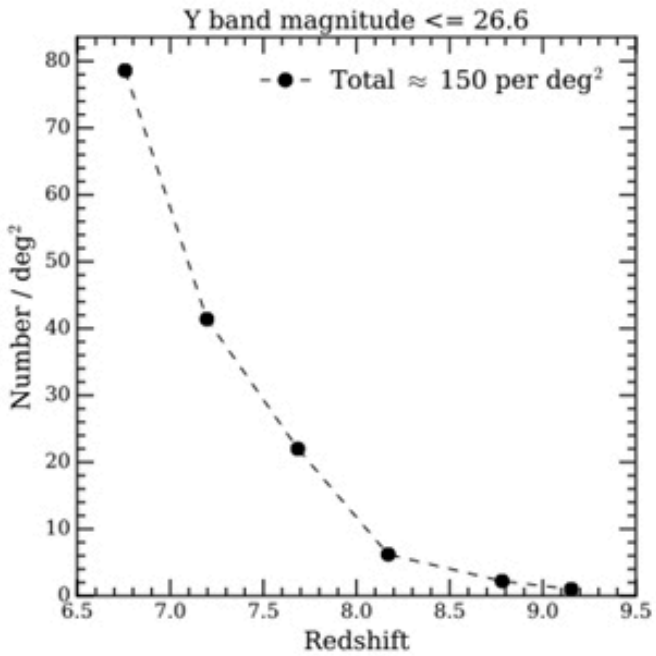
- run a deep survey simulation using empirical galaxy catalog generator (EGG, Schreiber et al 2016) + aXeSIM
- Extrapolate EGG to z>6 + Lyα emitters, consisitent with Matthee et al 2015, f_{esc} = constant = 30%
- Simulated a full 10h exposure with Euclid grisms over 0.5 deg2





Predicted number of LAEs in the deep fields with Y band detection





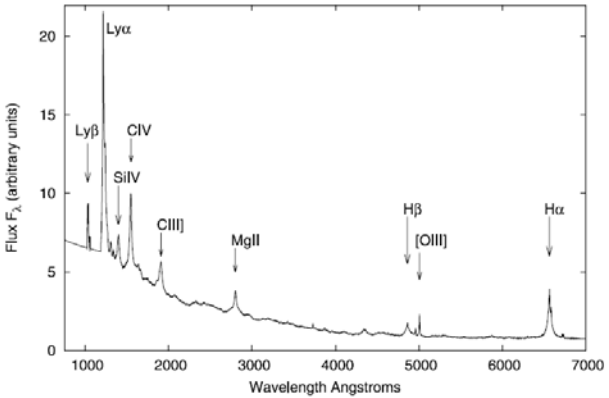
Note we assume that we can retrieve spectra only if there is a detection in the photometry bands.

Bagley et al (2017) estimate 70 per deg^2

→ **Caveat**: Marchetti, Serjeant & Vaccari MNRAS(2017) find 0.85-1.82 deg^{-2}, this number includes lensed Lya emitters.

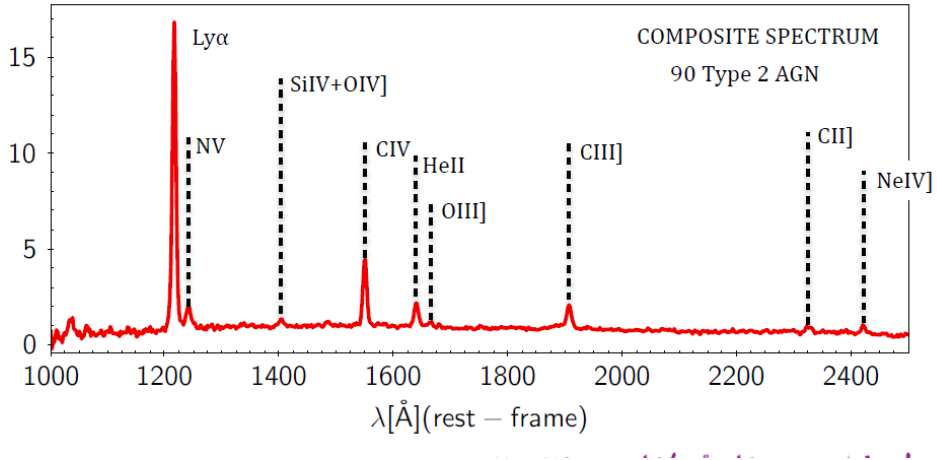
AGNs: stacked spectra

Type 1



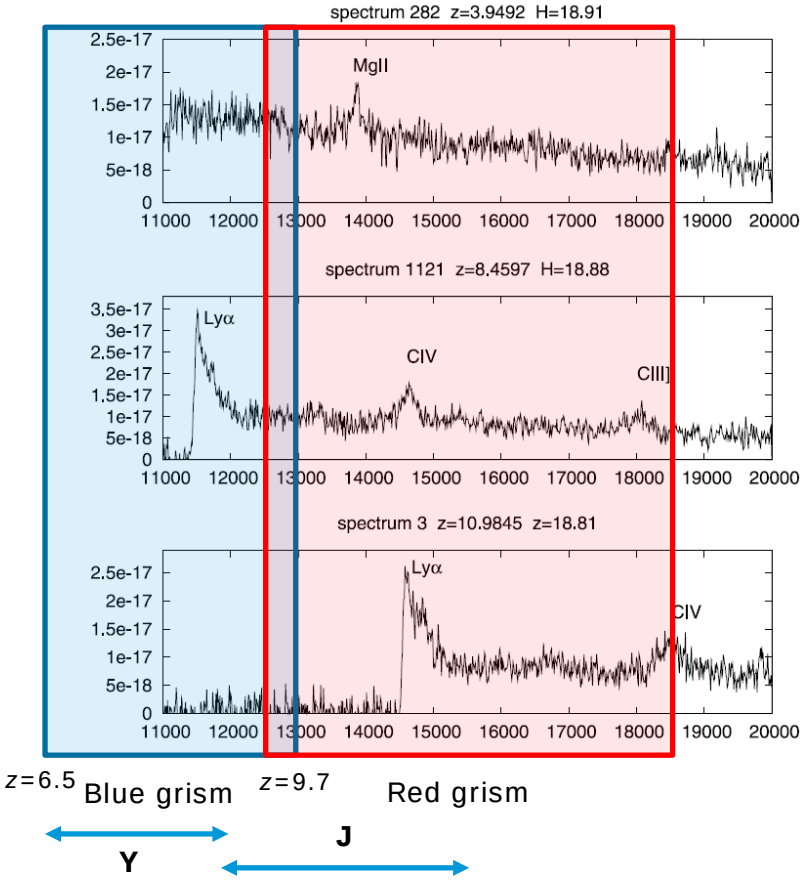
Roche et al. 2012

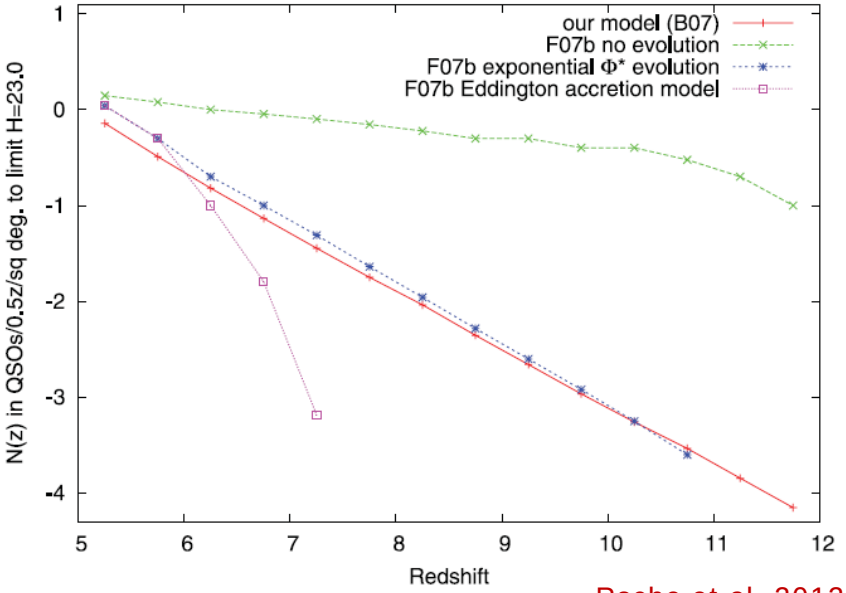
Type 2



Mignoli et al. 2017

Predictions for AGNs



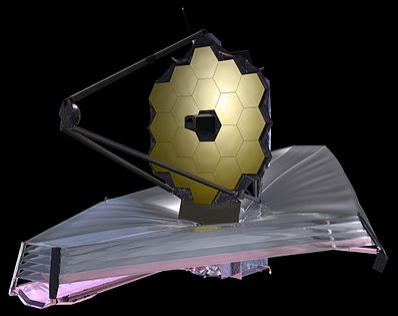


Roche et al, 2012

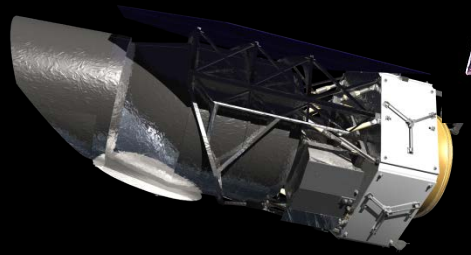
These predictions use old input instrumental parameters. Need further simulations with up-to-date parameters for the grisms.

Other facilities:

- JWST (2019): spectroscopically an order of magnitude more sensitive, but with small field of view (2x2 arcmin)



- WFIRST (2025+): spectrometer > 4-5 times more sensitive
  - Range: 0.95-1.9 micron, R=675
  - FoV 0.281 deg2



- MOONS (2019): multi-object fiber spectrograph
  - Range: 0.64-1.8 micron, R=4000-6000
  - FoV: 500 arcmin2
- Subaru HSC, LSST – see other talks

Summary and Conclusions

- Euclid will perform a 40 deg2 deep field survey
  - Low resolution spectroscopy [0.92-1.3 mum] and [1.25-1.85 μm]
  - Near-IR photometry in the 1-2 micron (m_{AB}<26), VIS imaging (m_{AB}<26.5)

- Euclid will search and provide spectra for high z objects: z>6
  - The effort is just starting
  - Simulations, calibration processes, and processing pipelines have to be developed for the [0.92-1.3 μm] channel

- Catalogue will be made public within “reasonable” timescale after 2021

Thank you!