OU-NIR Pipeline
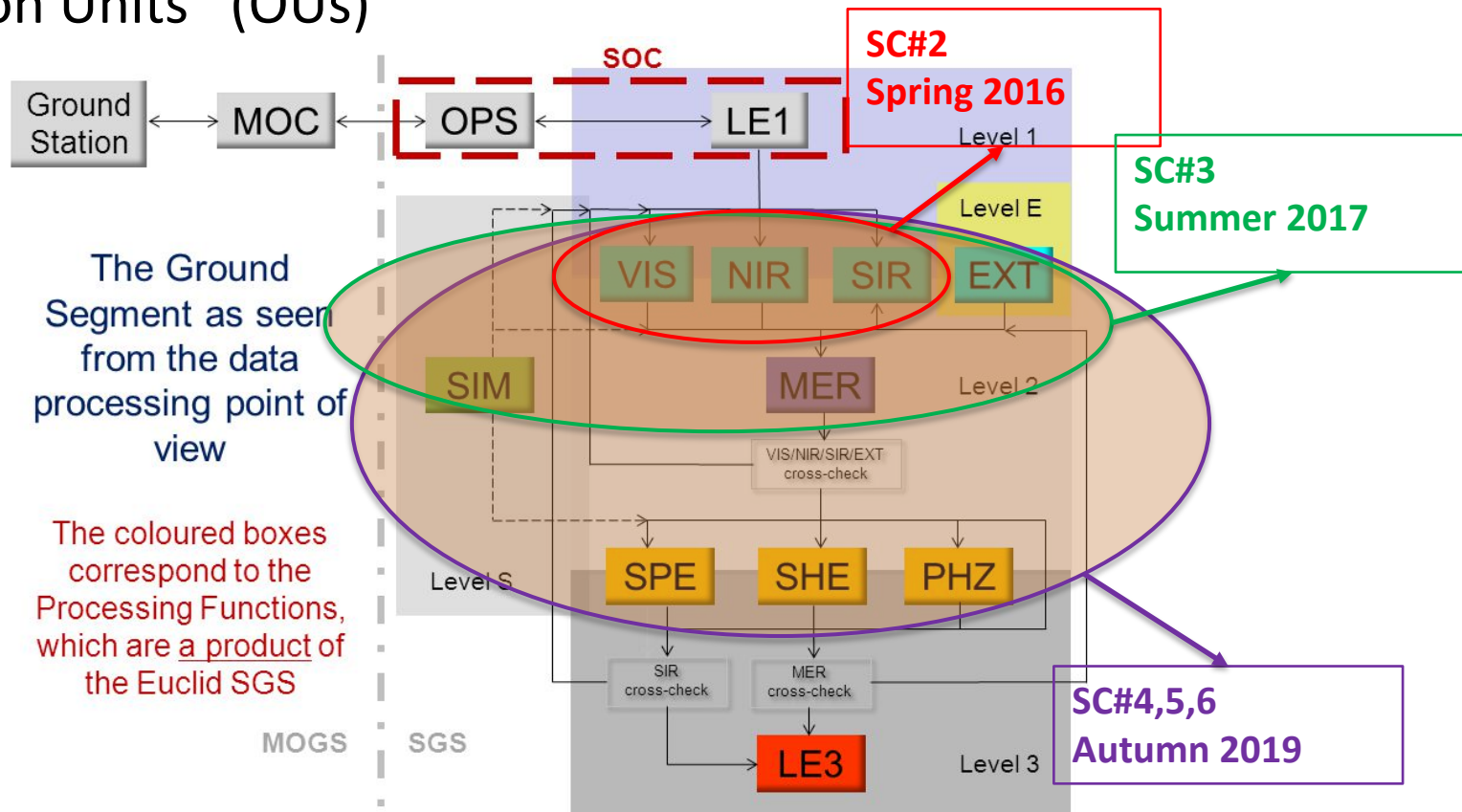
F. Faustini

A. Bonchi, R. da Silva, G. Polenta

on behalf of OU-NIR collaboration

INAF Science Archives and the Big Data Challenge

Challenge-driven Development

The development of Euclid pipelines is organized in Challenges that provides an incremental involvement of the various Organitation Units   (OUs)

SOC

Ground Station ↔ MOC ↔ OPS ↔ LE1

SC#2
Spring 2016

SC#3
Summer 2017

Level 1

Level E

The Ground Segment as seen from the data processing point of view

VIS NIR SIR EXT

SIM   MER   Level 2

VIS/NIR/SIR/EXT cross-check

The coloured boxes correspond to the Processing Functions, which are a product of the Euclid SGS

Level S   SPE SHE PHZ

SIR cross-check   MER cross-check

SC#4,5,6
Autumn 2019

MOGS   SGS   LE3   Level 3

This is an functional view of the SGS

OU-NIR

OU-NIR is the Organization Unit responsible for reducing all the NISP imaging data and for pre-reducing the NISP spectral data in common with the OU-SIR Processing Function.

The NIR PF development plane is studied to take into account the interaction with the other OU involved in each challenge.

| Processing Element	Institution		SC#2	SC#3	SC#4,5,6	SC#7
Initialize Image	SSDC		X			
Bad Pixel Masking	IPAC		X			
Non–linearity and saturation fl	IPAC			X		
Dark and Bias Subtraction	IPAC			X		
Cosmic Ray rejection (single fr non aggressive)	Leiden		X			
Persistence masking	IPNL				X	
Ghosts and scattered light	Leiden					X
Moving object masking	Leiden					X
Flat field correction – small sca	Leiden			X		
Superflat correction	Leiden			X		
Flat field correction – large sca	Leiden				X	
Background subtraction	Leiden		X			
Astrometric calibration	INAF–OAPd		X			
Relative Photometric calibratio	Leiden			X		
Absolute Photometric calibrati	IPAC				X	
Image Resampling	SSDC		X			
Cosmic ray rejection on multip frames	SSDC			X		
Image stacking	SSDC		X			
PSF derivation	SSDC			X		
Catalog Production	SSDC		X			
Transient identification	SSDC					X

For this new challenge the NIR processing function will run almost complete, with some calibration pipelines. **For SC#4,5,6 we have more realistic simulations where many 'simplified and modeled' effects will be replaced by instrumental effects.**

OU-NIR Processing Function

The NIR PF is studied and designed to satisfy NIR requirements listed in the NIR Requirements Specification Document.

The NIR PF starts from NISP Level 1 (raw science and telemetry) data:
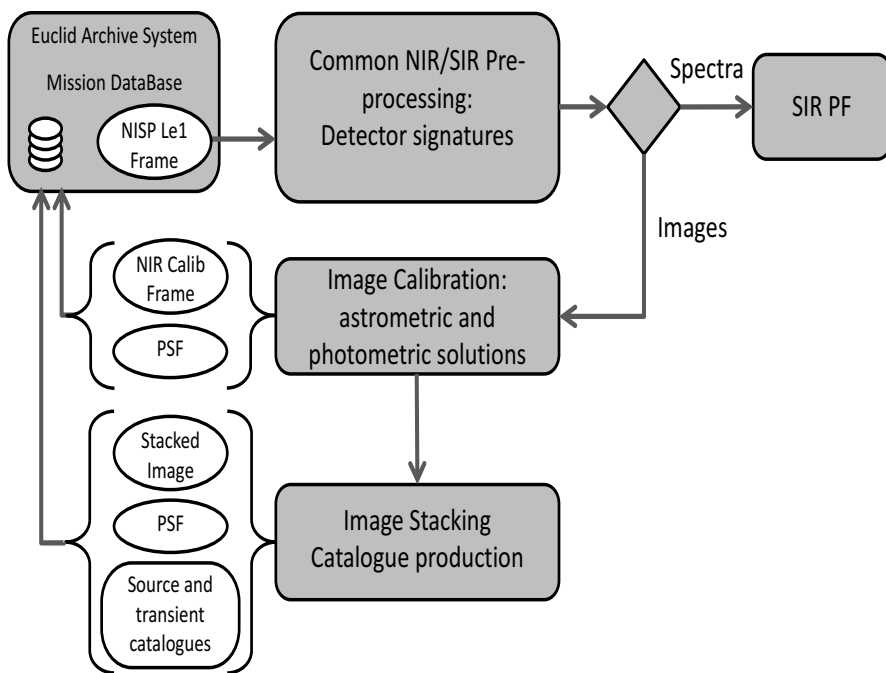
- The data must be corrected for all relevant instrumental effects (bad pixel masking, saturation, non-linearity, persistence, dark current, cosmic ray hits, ghosts, scattered light, flat field)
- The sky background is estimated and the data are calibrated for astrometric and photometric correction

These steps expect a good knowledge of NISP instrument and a close collaboration with the Instrument Team

OU-NIR Processing Function Calibration pipelines

The architectural design of NIR PF has been modified to optimize its workflow and results.

NIR calibration pipelines have been introduced to analyse the instrumental effects, they process the exposure data acquired by the instrument in calibration mode or through specific calibration observations and produce the calibration data needed by the NIR science pipeline.

In the NIR PF the calibration pipelines are in a number comparable to the processing elements of scientific pipeline, this is to obtain a more reliable result and satisfy all the requirements.

OU-NIR Processing Function Outputs

The outputs of the NIR Processing Function are (in Y, J, and H bands):

- Calibrated frame (OU-VIS or GAIA source catalogue is used for astrometric calibration) includes: (→OU-MER)
  - Scientific image Fits
  - Background Fits
  - PSF Fits
- Stacked Frame includes: (→OU-MER)
  - Scientific image Fits
  - PSF Fits
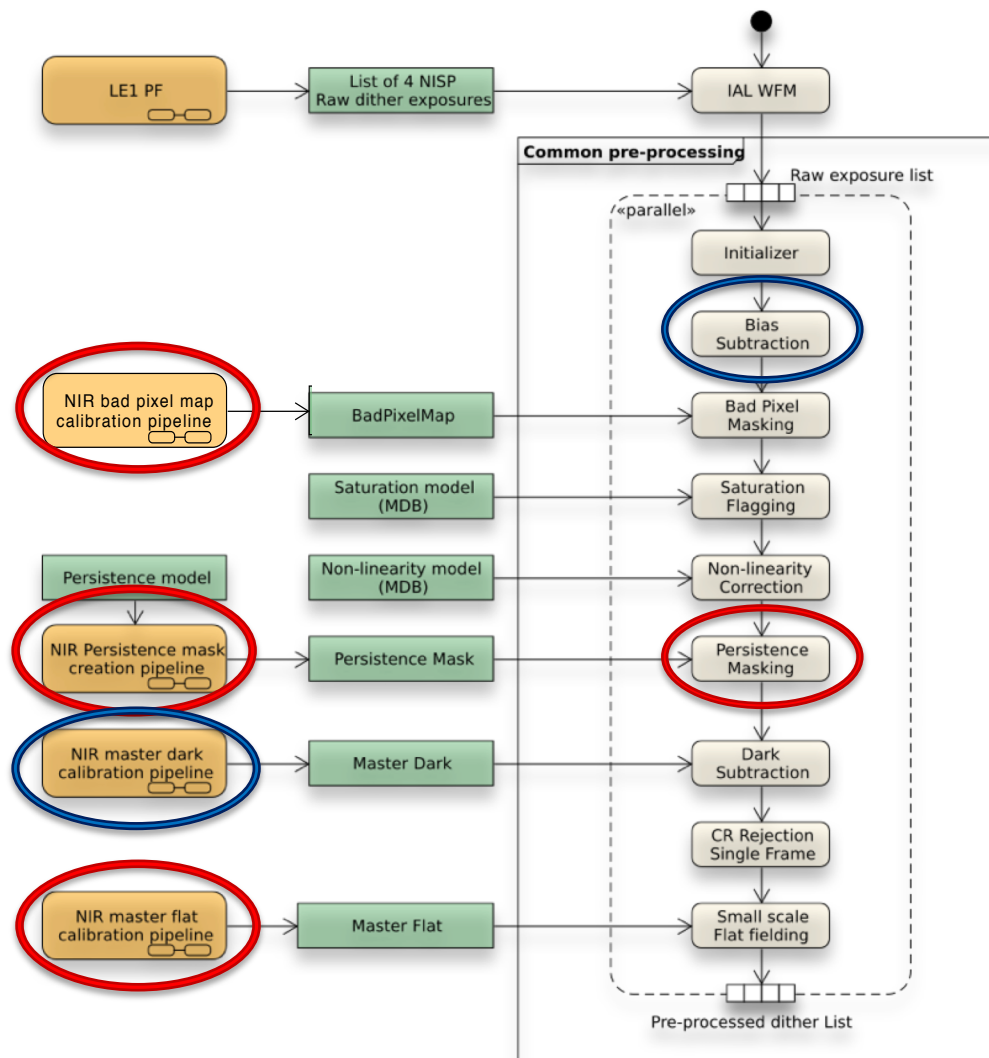- Catalogs
- Transient Object (→LE3)

All OU-NIR product must be validated and the respective requirements must be met.

Blue color indicates products or features available from the next challanges

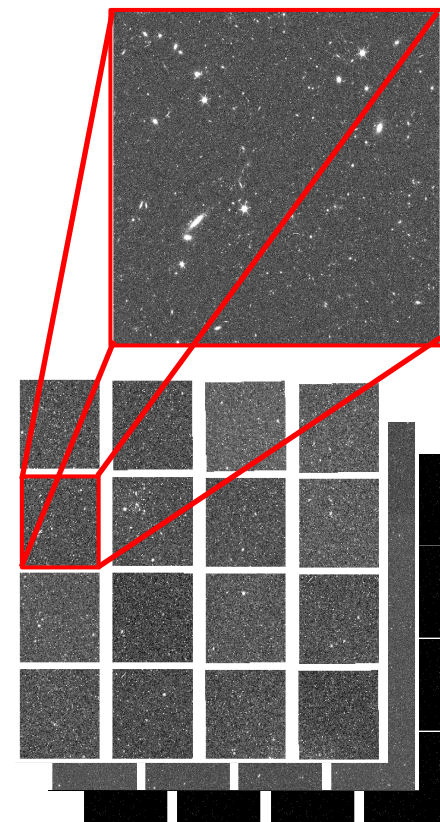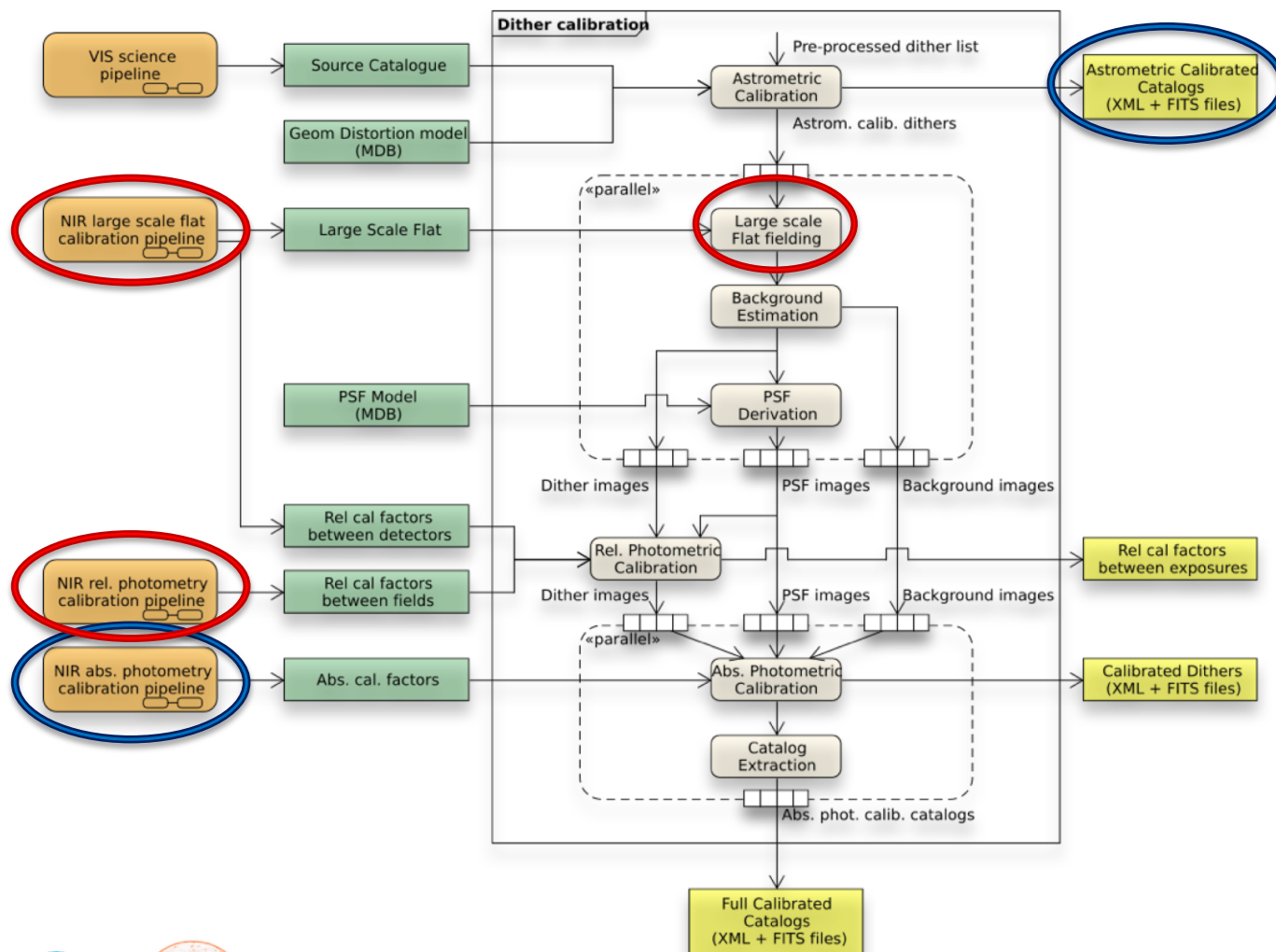# NIR-Processing Function (SC 4,5,6)
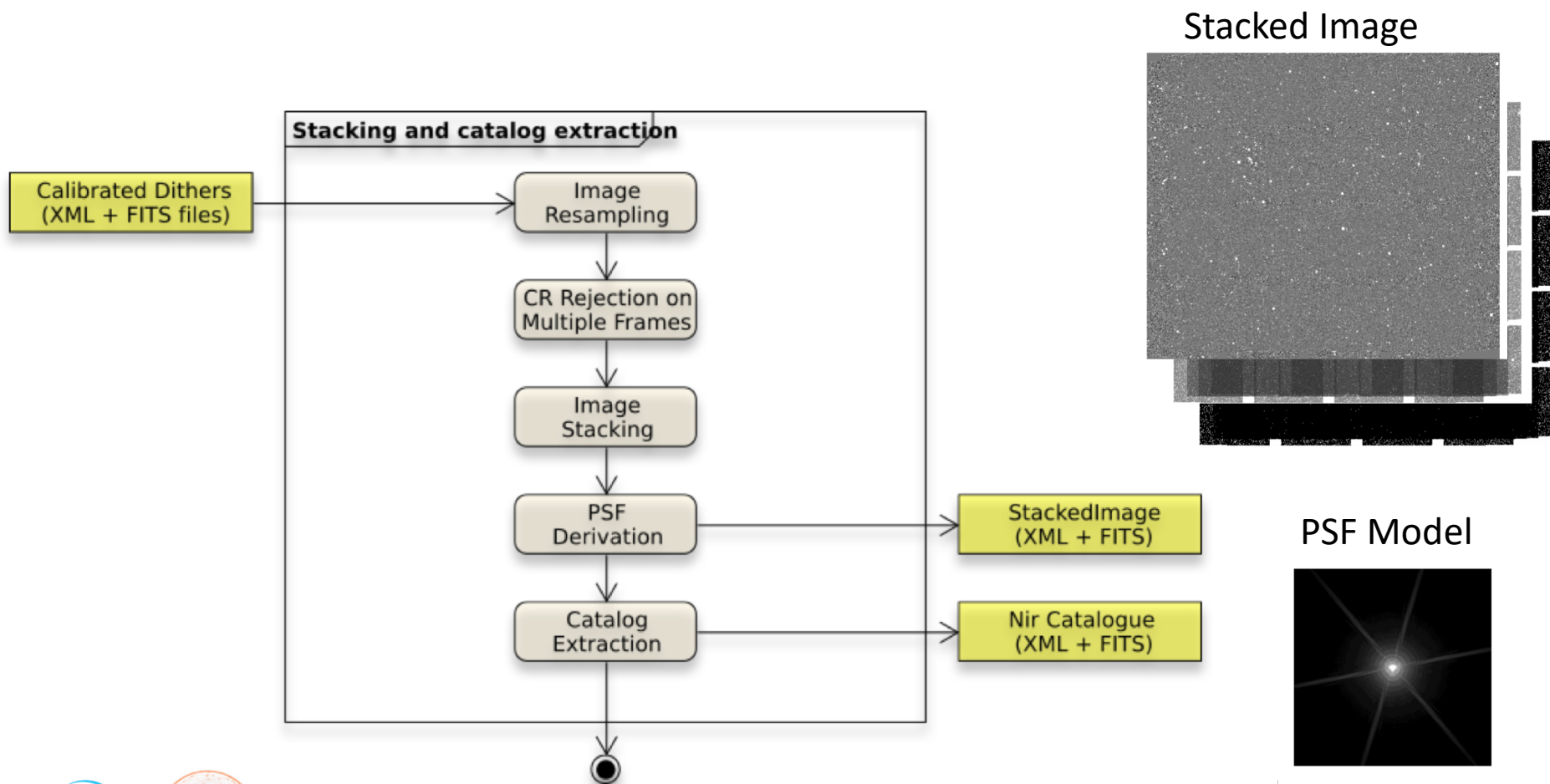## Common Pre-Processing with OU-SIR

NIR-Processing Function (SC 4,5,6)
Astrometric e Photometric Calibration

NIR-Processing Function (SC 4,5,6)
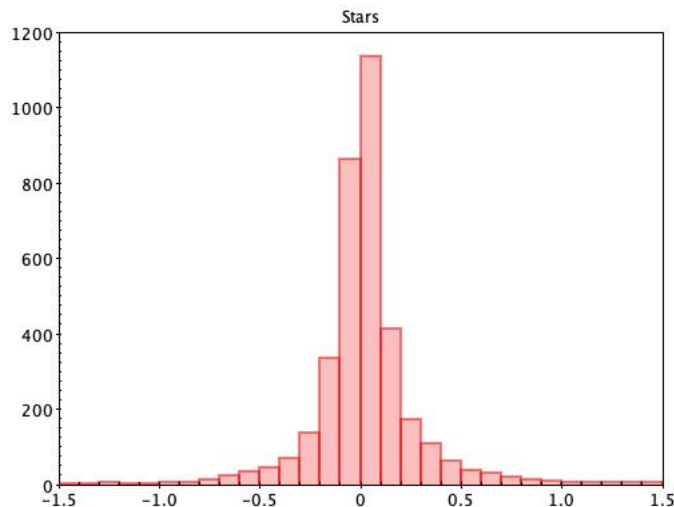## Stacking and Catalog Extraction

Stacked Image

PSF Model

NIR Absolute photometry – calibration pipeline

Mean IS

0.369 ± 0.015

0.406 ± 0.020

0.390 ± 0.027

0.353 ± 0.013

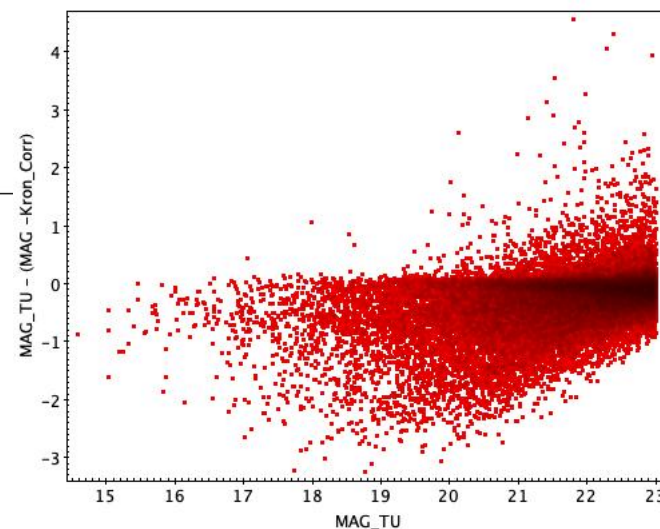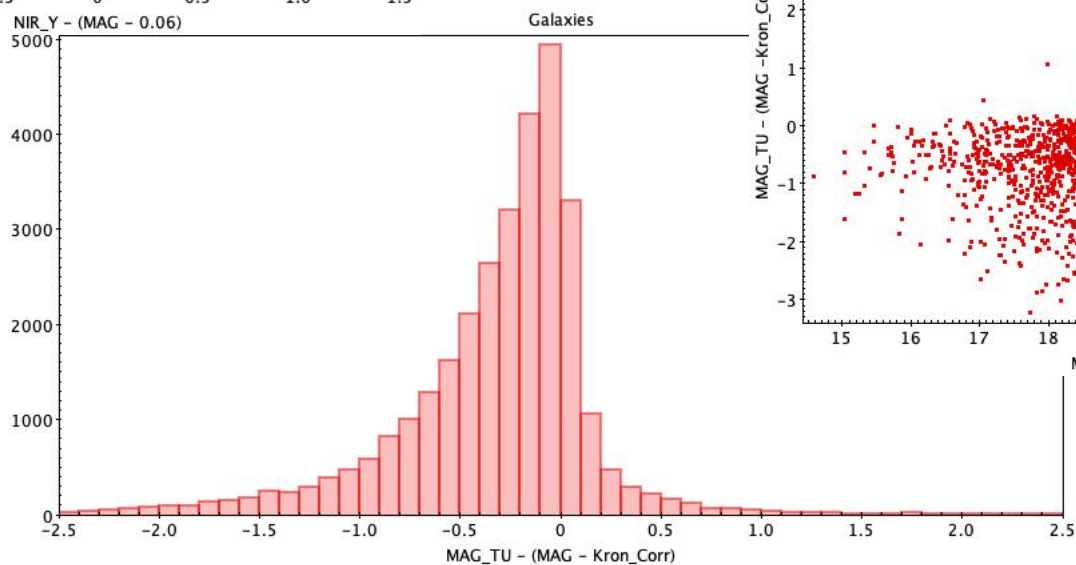Euclid NISP-P H-band Inverse Sensitivity
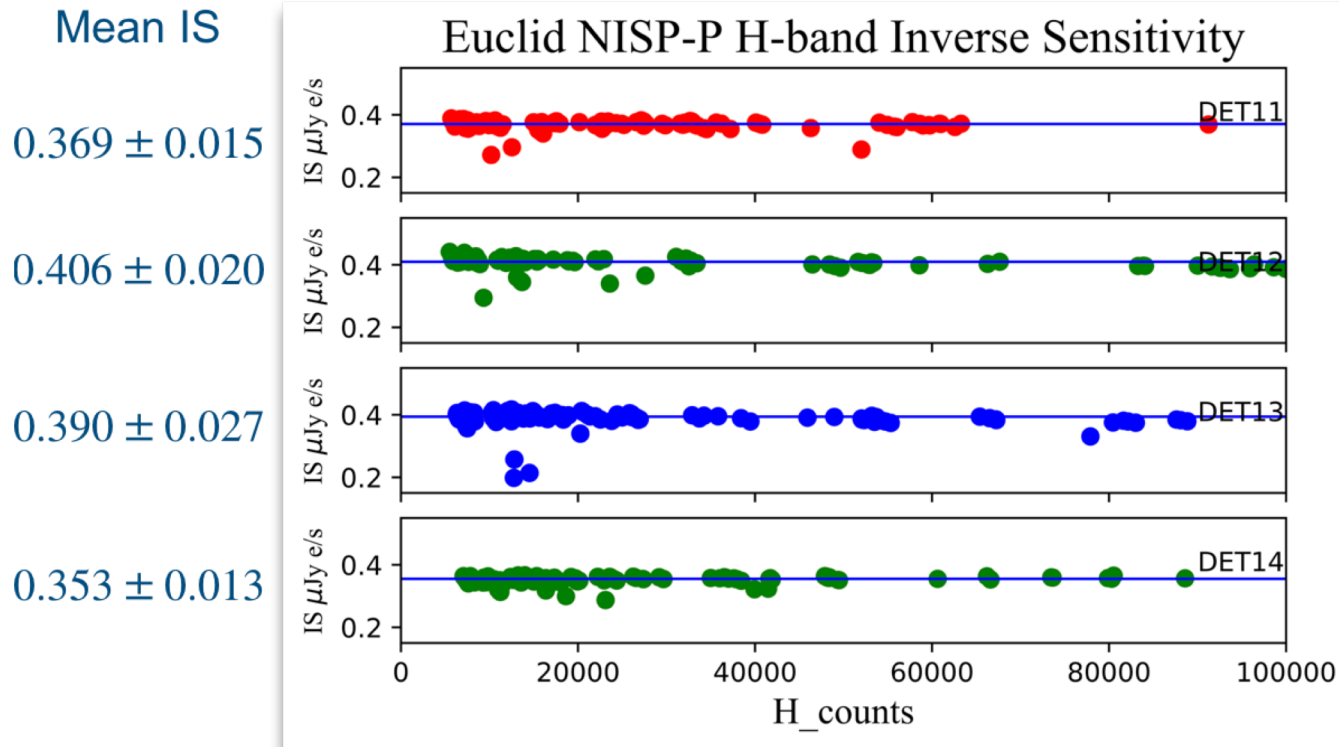
Mean value (16 detectors): 0.367 ± 0.028

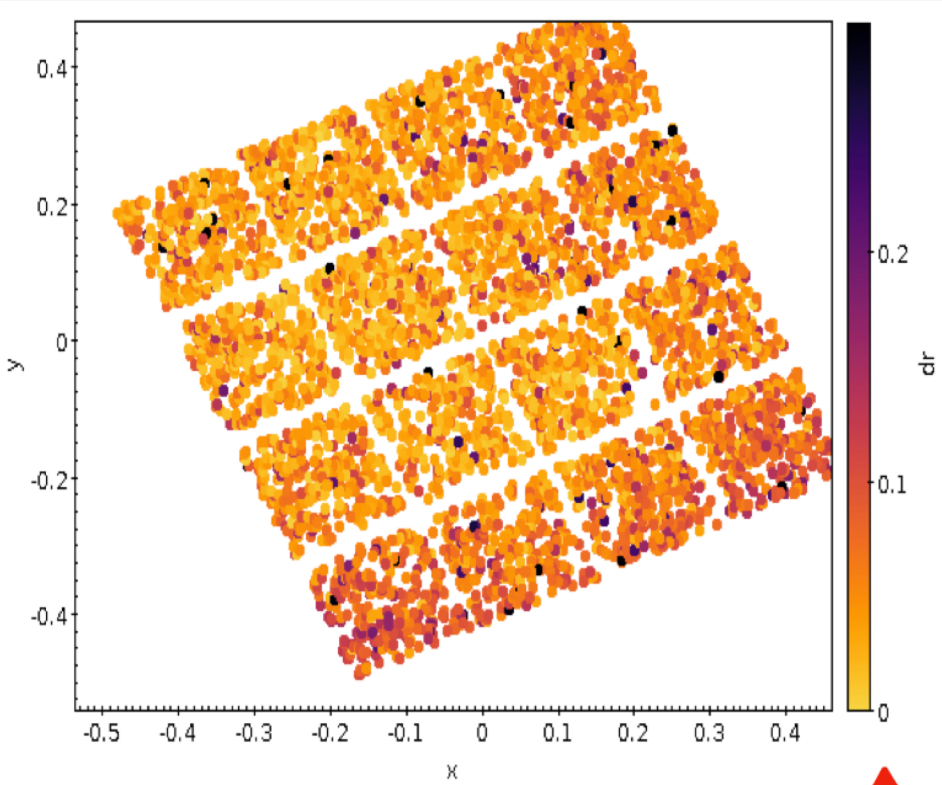Expected value from SIM: 0.372 ± 0.013

NIR photometry

Stars photometry is in good agreement with the true universe, while the galaxies magnitudes are underestimate for a lot of objects, especially for the bright sources.
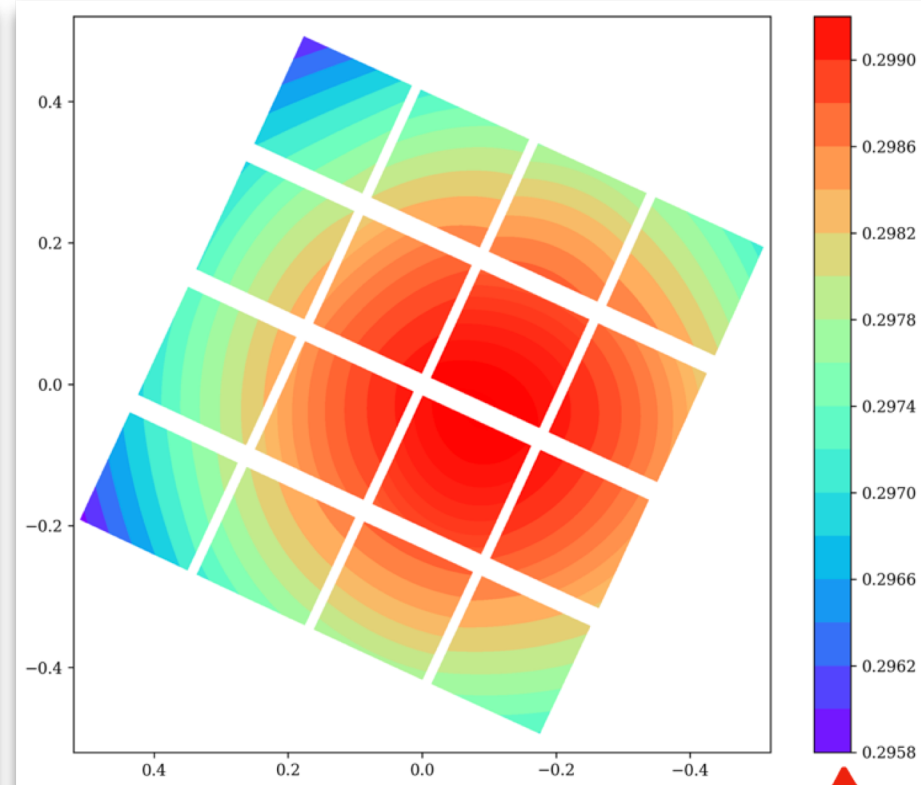
NIR Astrometric Calibration

Filter tilt effect:
J vs. H coordinate differences

Optical distortion map

$dr = (dx^2 + dy^2)^{1/2}$ [arcsec]
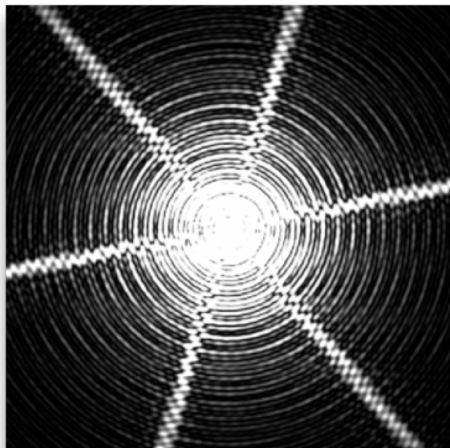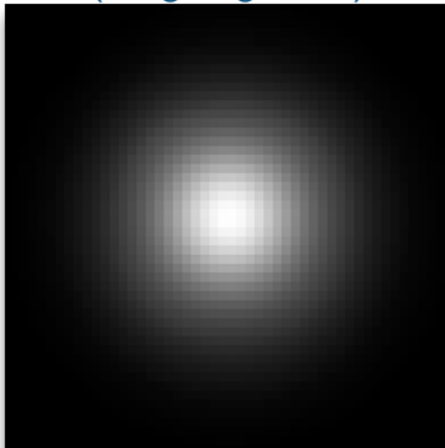
pixel size [arcsec]

NIR Extracted PSF

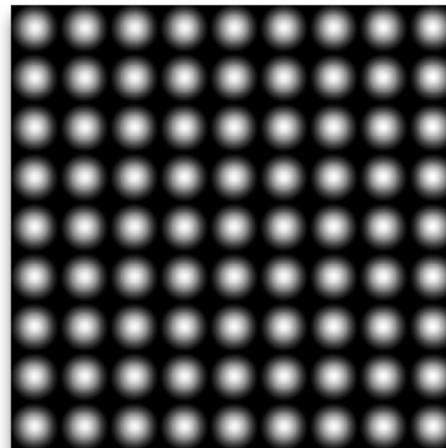

From the MDB

From a calibrated dither
(on-going work)

From a stacked frame

**Extracted PSF
is ~20% larger
than the model**

mean(FWHM) $\sim$ 0.57 arcsec
mean(FWHM) $\sim$ 0.65 arcsec

$\sim$ 2 pixels

Calibrated dither (DET 44)
Stacked frame

FWHM (arcsec)
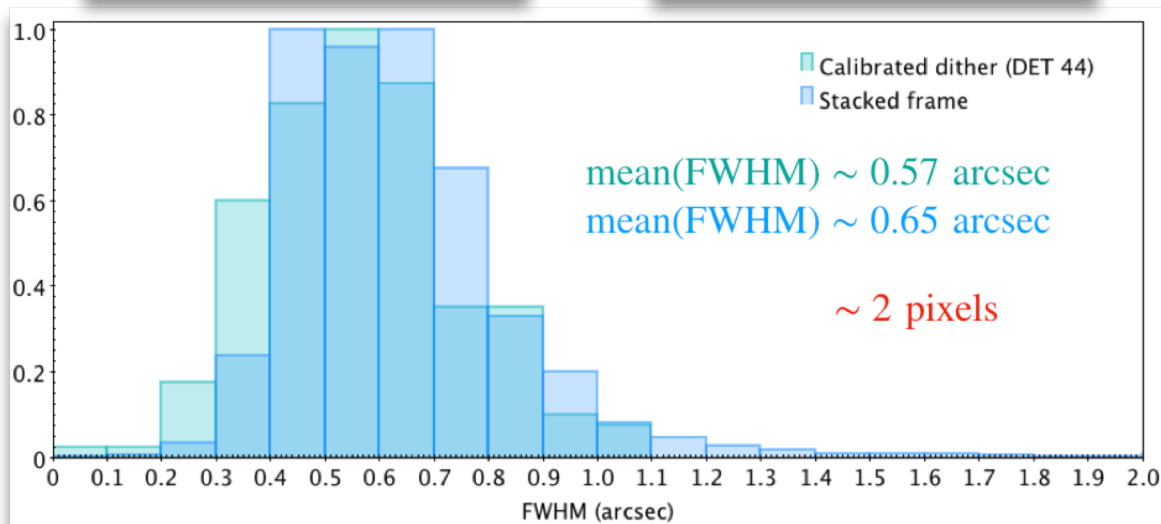
NIR processing and data release for SC4,5,6

- NIR processing function V0.4.3 for SC4,5,6 was released
- NIR product for the run on the first Small Wide Field (SWF1) was released
- The run on the SWF2 is on going
- We are waiting for the simulation of the Large Wide Field (LWF1), the Deep Field and the Self Calibration Field