Characterization of EUCLID infrared detectors

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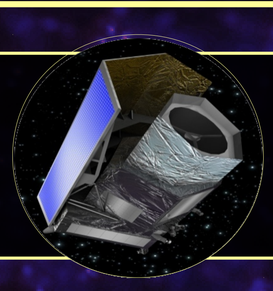
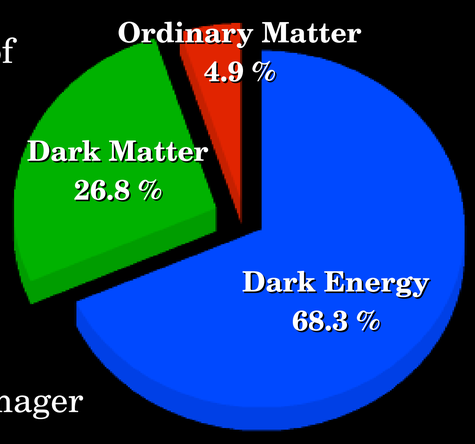


Euclid is a wide-field mission for the cartography of the dark Universe lead by European Space Agency (ESA) and the Euclid Consortium that is to launch on 2020. This mission was selected within the Cosmic Vision program and aims at bringing more understanding on the nature of the recent acceleration of the expansion of the Universe and the possible related nature of dark matter and dark energy.

Euclid & Cosmology

Dark Matter

- Heavier mass of galaxies than observed
- Weak Lensing (WL) - shape of galaxies
- High quality Imager & Photometry



Dark Energy

- Present acceleration of the expansion of the Universe
- Baryonic Acoustic Oscillations (BAO) - distribution of galaxies
- Spectroscopy : detection of Hα line

Method - Multi cosmological probes
- High precision measurements <1%

Euclid survey
- 15.000 deg² over 6 years
- 10s of millions of galaxies
- z between 0.9 and 2.0

Control of systematics
- Frequent calibration
- Detailed *a priori* knowledge of instruments

NISP instrument

Near
Infrared
Spectrometer
Photometer

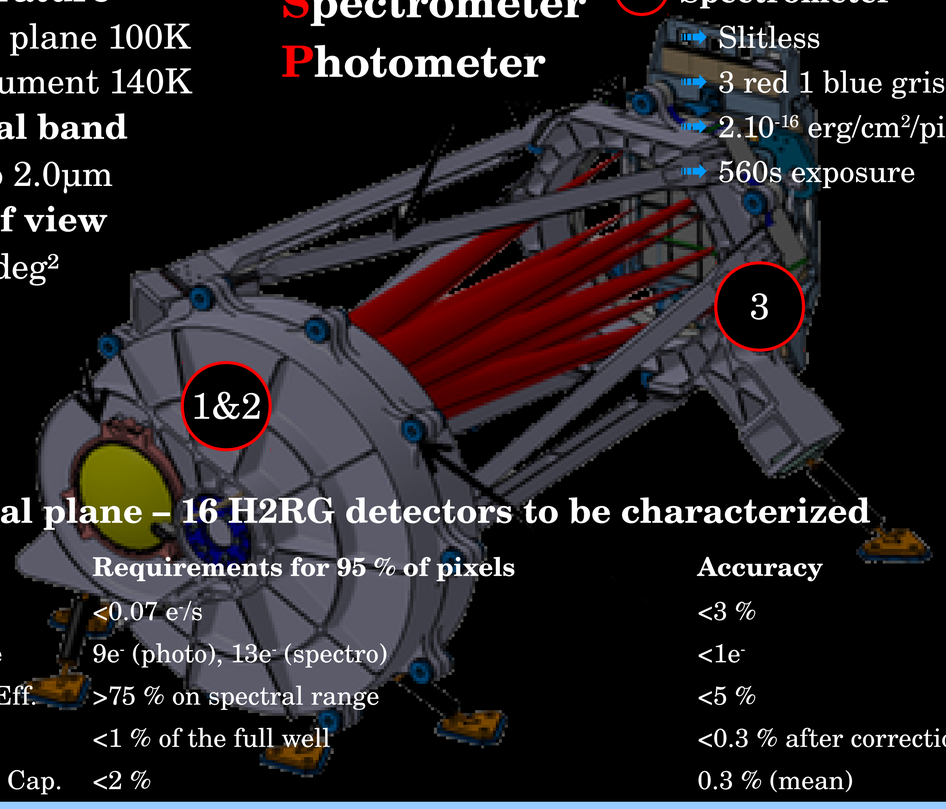
Temperature
- Focal plane 100K
- Instrument 140K

Spectral band
- 0.9 to 2.0µm

Field of view
- 0.55 deg²

1 **Photometer**
- Y,J, H bands
- 0.3 arcsec/pixel
- 100s exposure

2 **Spectrometer**
- Slitless
- 3 red 1 blue grisms
- 2.10^{-16} erg/cm²/pix
- 560s exposure



3 **Focal plane – 16 H2RG detectors to be characterized**

Name	Requirements for 95 % of pixels	Accuracy
Dark	<0.07 e⁻/s	<3 %
Total noise	9e⁻ (photo), 13e⁻ (spectro)	<1e⁻
Quantum Eff.	>75 % on spectral range	<5 %
Linearity	<1 % of the full well	<0.3 % after correction
Inter-Pixel Cap.	<2 %	0.3 % (mean)
Persistence	**<10 % of the dark mean value after 5 hours**	**<0.5 % after correction**

No persistance model – need of a model for **calibration** and **simulation** purposes

Study of persistence

Theory

Sensitive part - HgCdTe crystal
- Defaults in the crystal
- While acquiring signal from a source photo generated charges can be captured by those defaults
- **Trapped charges released on next acquisitions**
  Persistent image !

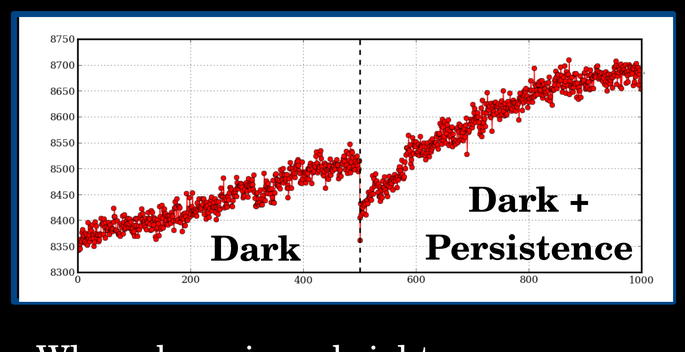
Effects impacting persistence signal
- Exposure time
- Previous source amplitude
- Operational temperature
- Shape of the source

Objectives

- Determine calibration procedure of the detectors for persistence
- Provide detector simulations with realistic models of persistence

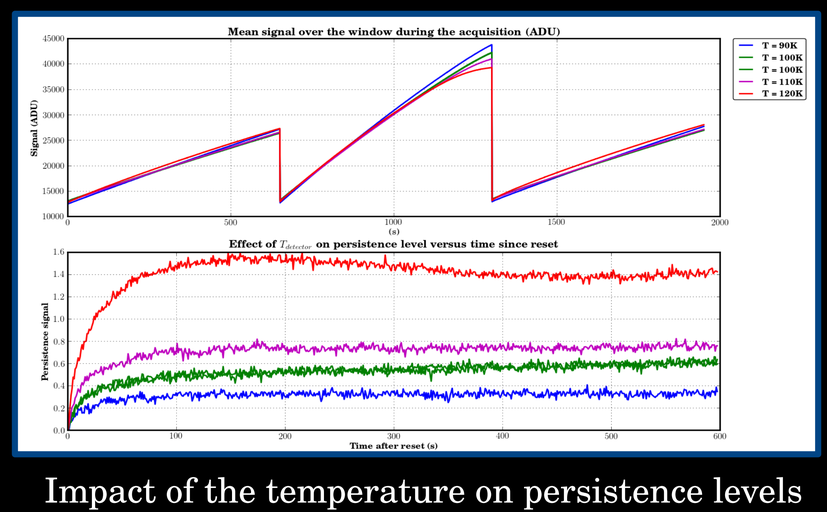
First results of image persistence

Confirmed effect of persistence on engineering grade detectors



When observing a bright source, followed by dark measurements. The dark measurement shows an excess of signal – which is caused by persistence.

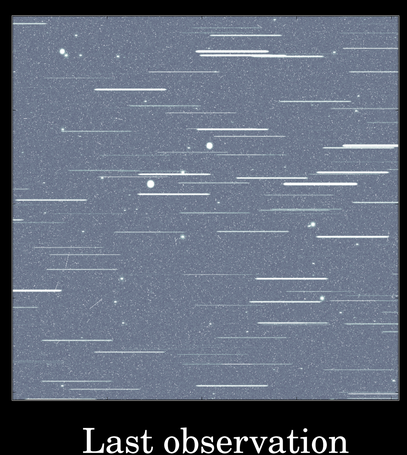
Ongoing collaboration with ESA and NASA-GSFC for persistence study



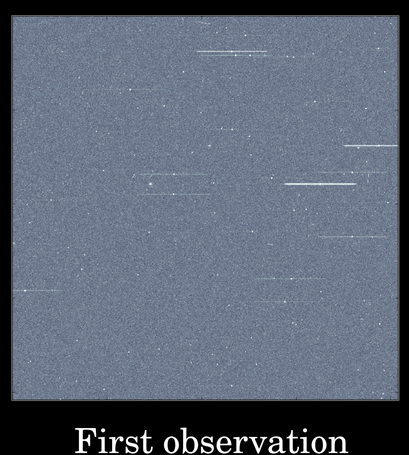
Impact of the temperature on persistence levels (acquired at ESA test bench)
Higher temperature > higher persistence signal

Perspectives

Realistic simulations with decay law
- **Evaluate impact on Euclid**



Last observation spectrometry



First observation photometry

Impact of persistence signal on following exposures

Further work

Further collaboration with ESA
- Relation between optically and electrically induced persistence

Collaboration with NASA-GSFC
- Study the impact of the source amplitude on persistence levels

Provide the simulator with a realistic model and maps of persistence parameters
- Quantify the impact of persistence on Euclid science

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