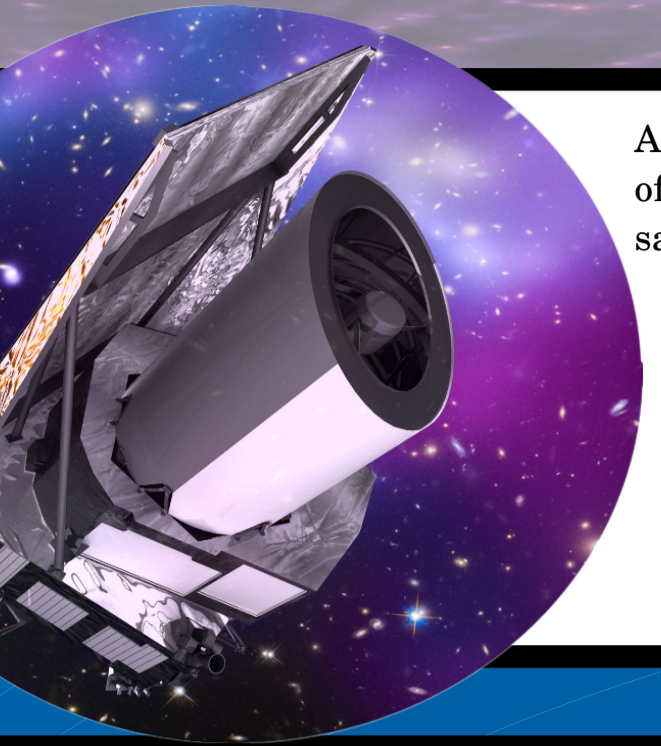


Euclid Detector System Demonstrator Model : A first demonstration of the NISP detector system

J.C. Clémens^a, B.Serra^a, M.Niclas^a, A.Ealet^a, W.Gillard^a, A.Secroun^a, R.Barbier^b,
B.Kubik^b, S.Ferriol^b, G.Smadja^b, E.Prieto^c, F.Beaumont^c, C.Fabron^c, J.Garcia^c,
E.Grassi^c, T.Maciaszek^c

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An artist view of the Euclid satellite - © ESA

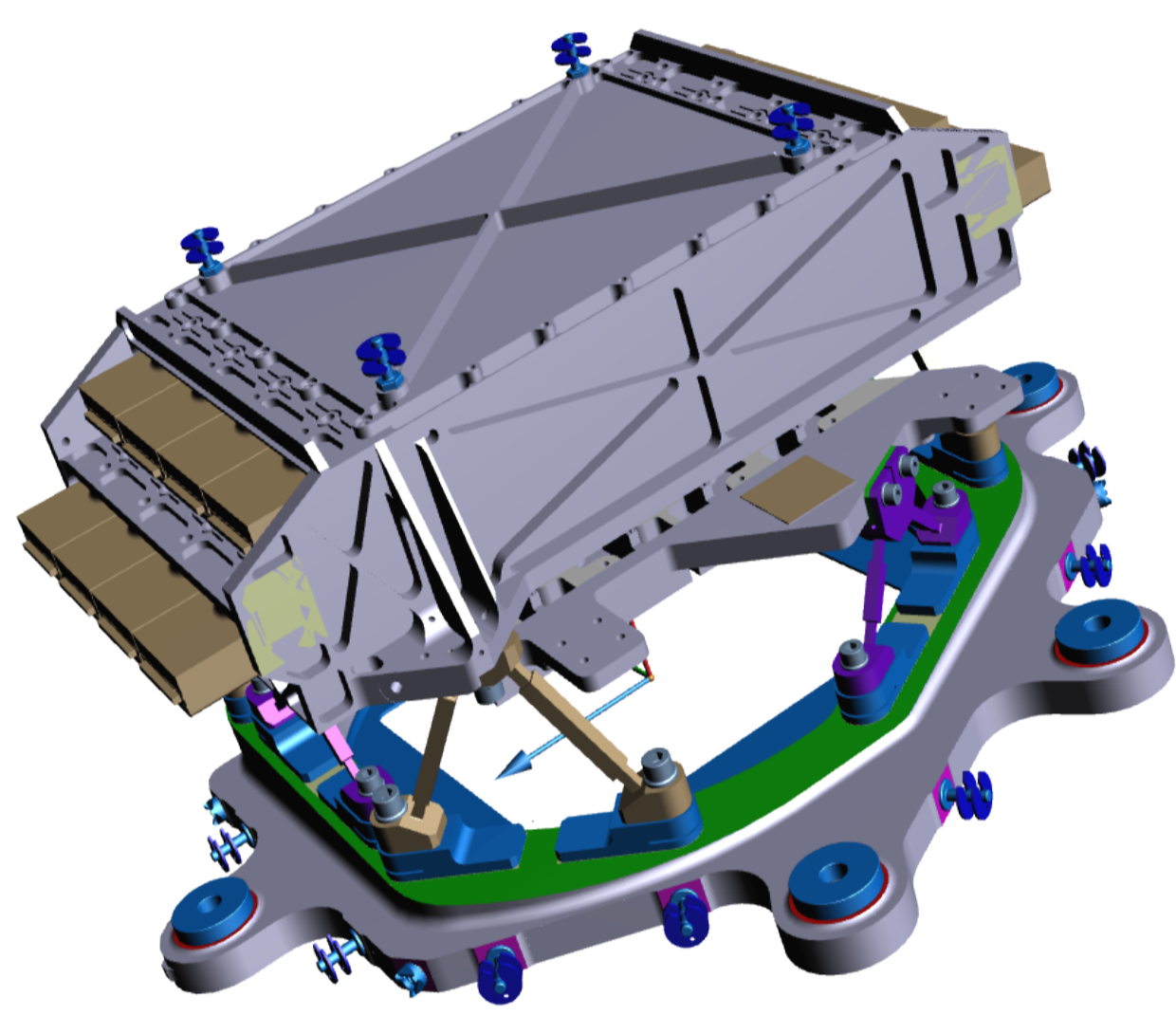
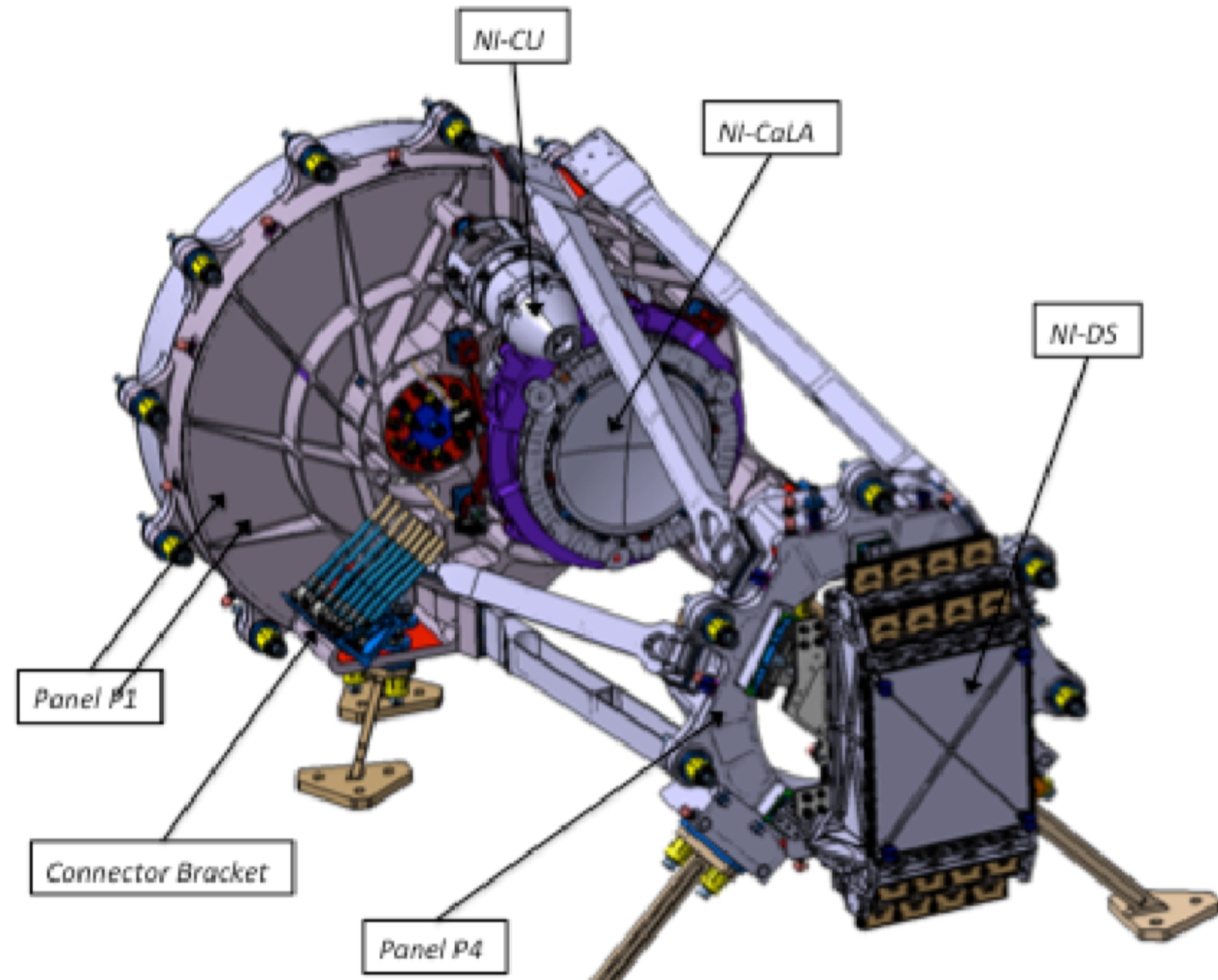
A demonstrator model (DM) of the Euclid's focal plane array (FPA) has been integrated at CPPM and tested at LAM facilities in Marseille (France). The aim of this first model of the NI-DS is to demonstrate the validity of the integration procedure foreseen for Euclid FPA, to check the behavior of the Sensor Chip System in a multi-detector configuration and to demonstrate the system ability to support thermal cycles and vibration tests.

Euclid-NISP Near Infrared Spectrometer Photometer

The spectro-photometer of the EUCLID mission contains several subsystems (calibration unit, filter/grisms wheels, mechanical assembly, optical alignment and focal plane).

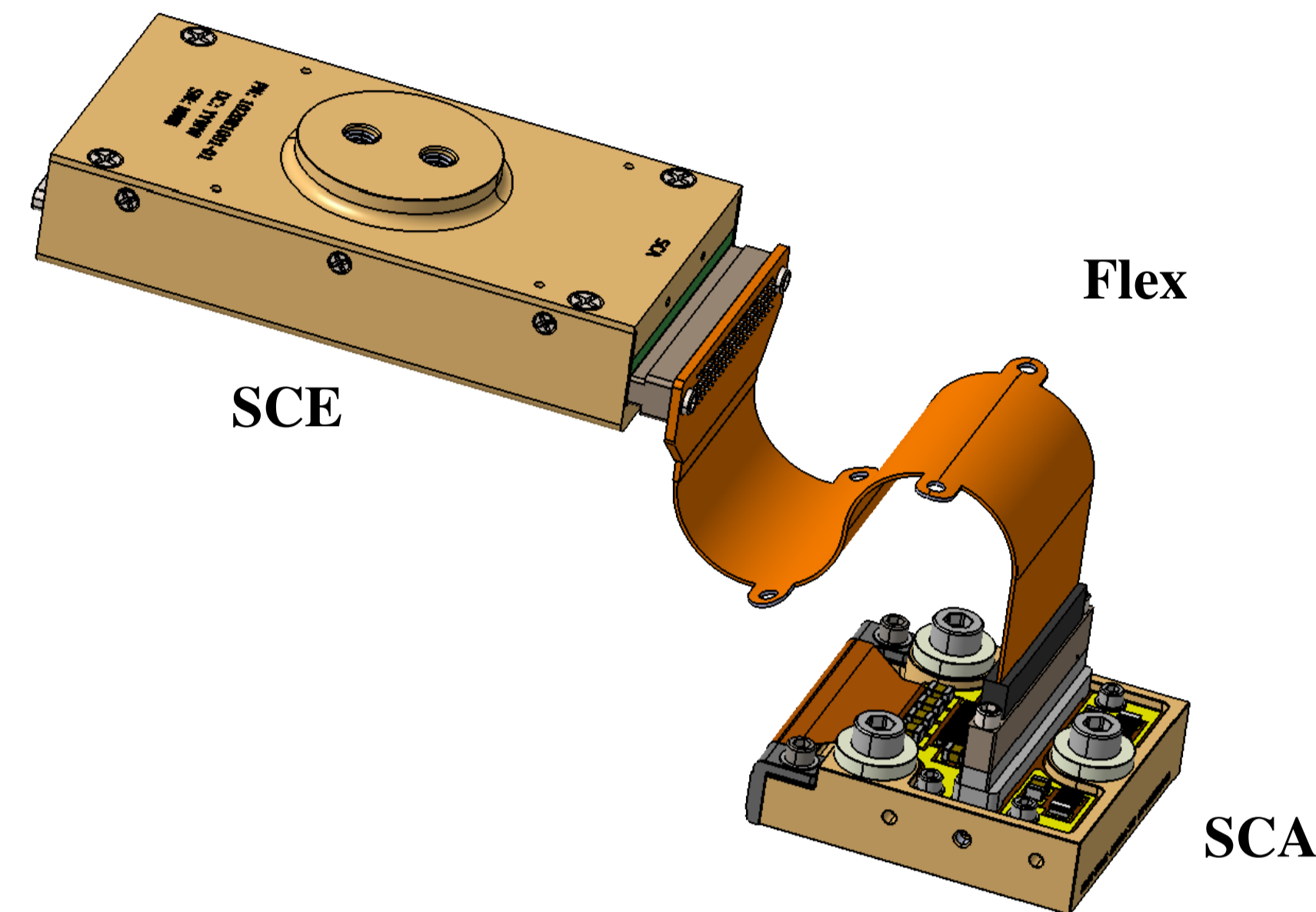
The focal plane array of the NISP (NISP-FPA) is the mechanical support of the detector system (NI-DS).

NI-DS host 16 H2RG infrared detectors, each one will be integrated in this subsystem at CPPM before delivery to ESA in 2017



- NI-SSS supports the SCEs. It is made of aluminum and fixed onto the P4 panel by 3 Invar blades. Composed of a main body and removable lid for integration purposes.
- The NI-CSS (Cold Support Structure) supports the SCAs and ensures their co-planarity. Made of Molybdenum in order to ensure the best thermo-mechanical behavior given the structure of the SCAs. Fixed to P4 by 3 Titanium blades
- The NI-P4 interfaces the full NI-FPA with the NISP instrument. This panel, SiC made, is screwed directly onto the instrument and supports all the remaining parts of the NI-FPA

Euclid infrared detectors



NISP IR H2RG detectors

- 16 detectors in the FPA
- 2048x2048 hybrid pixels each
- 18µm pitch / 2.3µm cut-off
- Provided by Teledyne Imaging Sensors under ESA/NASA contract

NISP Infra-red detectors and their Front End Read Out electronics will be provided to the Euclid consortium by the Teledyne Company. These SCS (Sensor chip System) consist of 3 sub-systems :

- The SCA (Sensor Chip Array) is a 2K x 2K pixels of 18 µm pitch substrate removed, HgCdTe detector hybridized to an H2RG readout integrated circuit (ROIC).
- The SCE (Sensor Chip Electronics) is a Sidecar based Front-End Electronics, which provides all the needed biases for one SCA and digitizes, at 100 kHz and in parallel, 33 video signals coming from it. It is enclosed in a Titanium/CE9 package for thermal purposes and compatibility with Aluminum support structure
- Finally, the CFC (Cold Flex Circuit) connects the SCA to the SCE.

Once integrated, these detectors will be tested for dark, noise performances and EMC

Demonstrator model

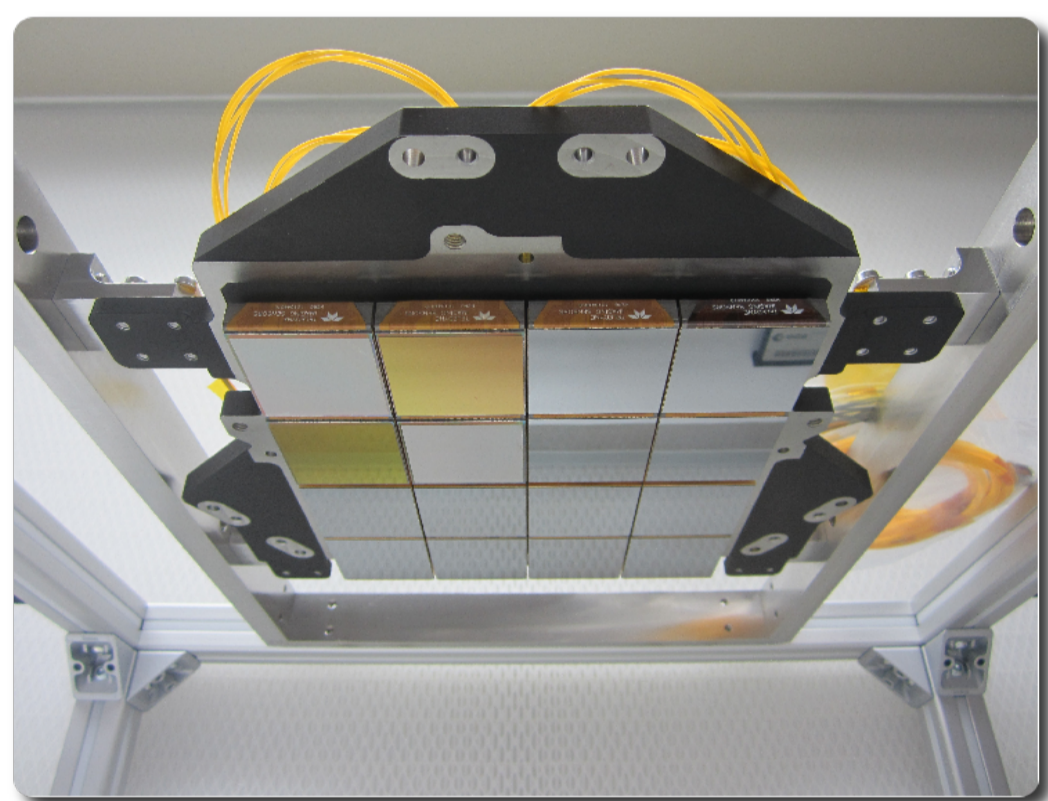
The Demonstrator Model consisted on two separate periods :

At first the integration of the full instrument in both CPPM and LAM laboratories (three weeks), testing integration procedures of the whole system.

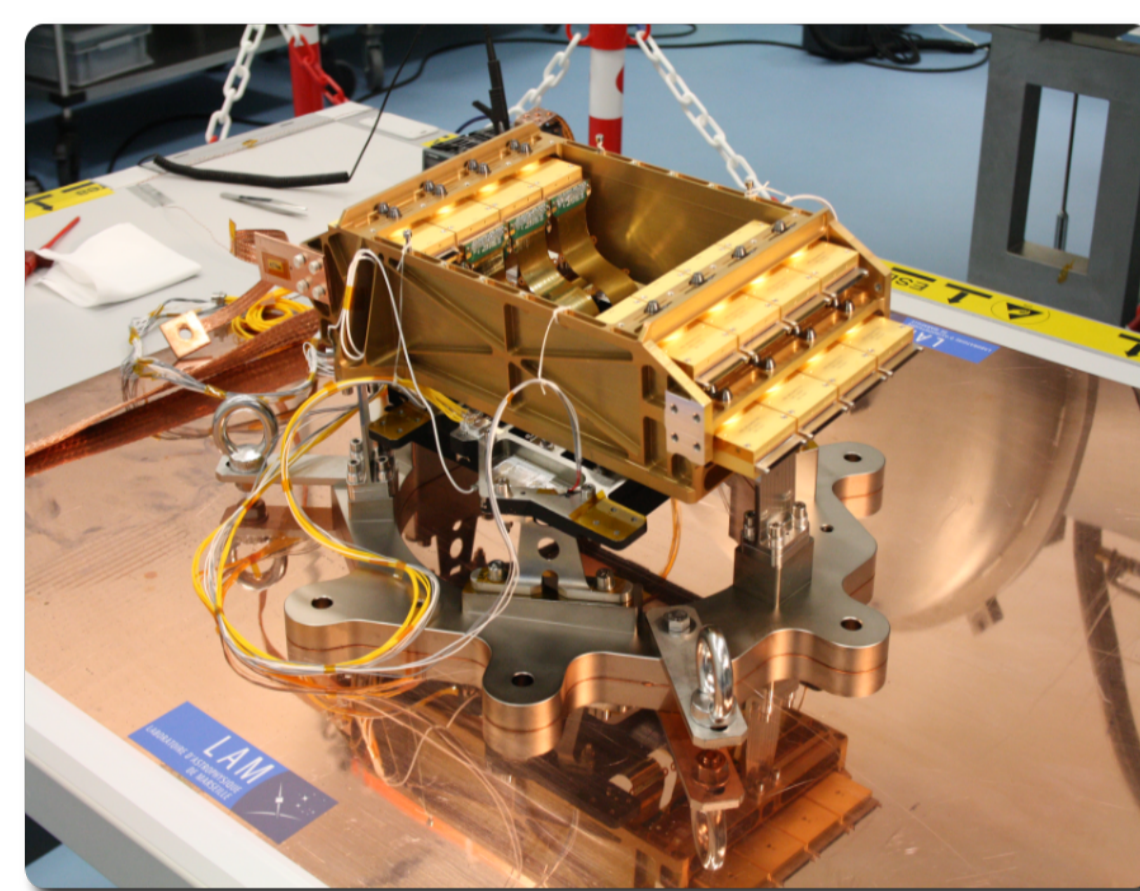
Secondly, the test of the detectors on the DM, acquiring continuous data over the period to evaluate stability of the acquisition system and performances achievable.

Integration of the NI-DS

First full integration of the NI-DS
First procedural tests between LAM & CPPM
Feedback for future models EQM FM



Detectors and thermal models integrated at CPPM (ISO 5 cleanroom)

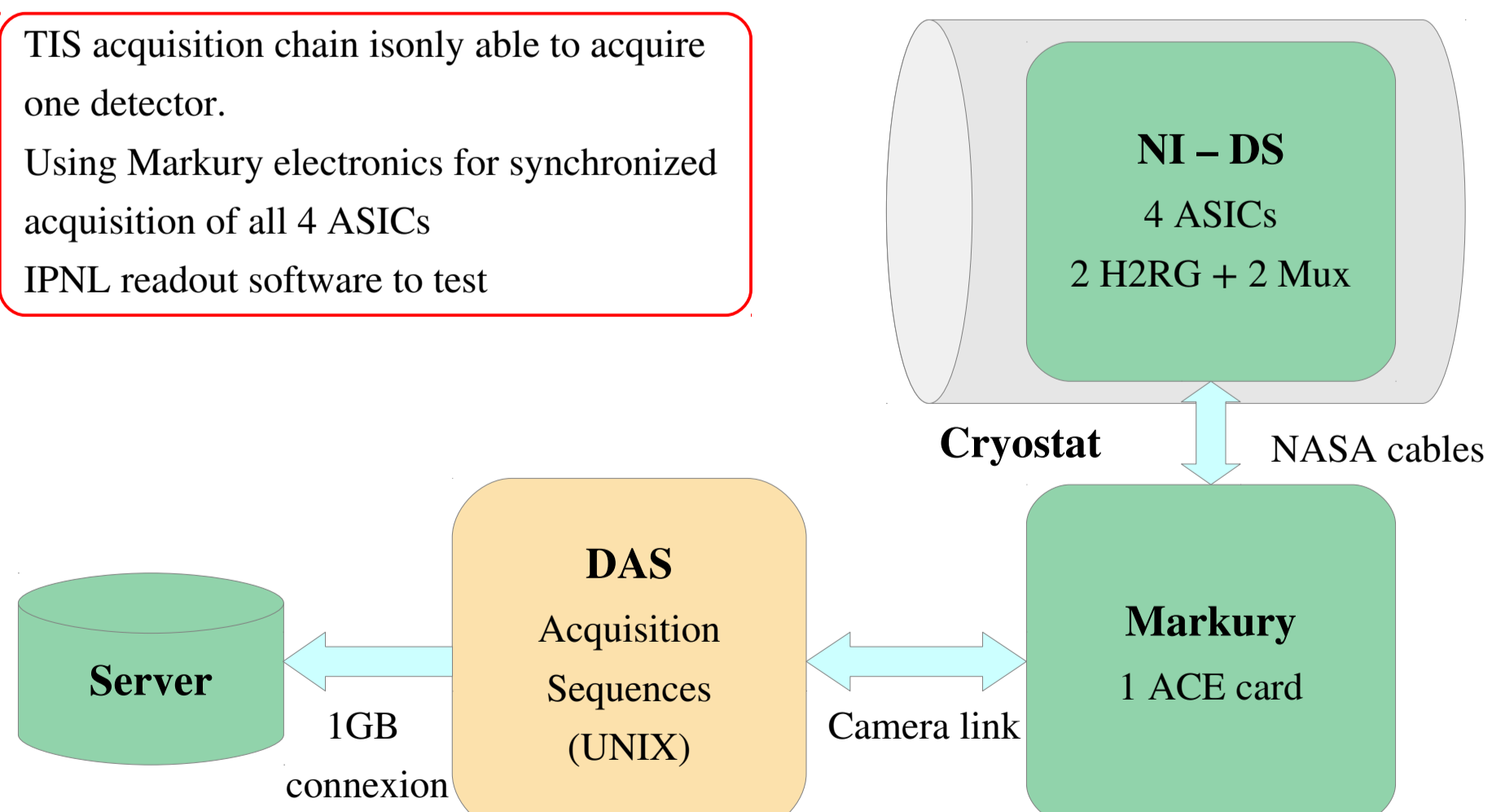


Electronics connected at LAM (ISO 5 cleanroom)

Integration took almost three weeks.

Multi detector acquisition system

TIS acquisition chain is only able to acquire one detector.
Using Markury electronics for synchronized acquisition of all 4 ASICs
IPNL readout software to test



Stable acquisition system acquired more than 7TB of data
During DM run, without critical error during acquisitions.

Conclusions on the Demonstrator Model run

Demonstrator Model successfully integrated and tested in April 2015

Multidetector acquisition system with Markury electronics and a homemade DAS proved to be stable during the tests

Dark and noise performances are within the specifications for Euclid's instrument

Conducted EMC tests highlighted quite low sensitivity, except on VDDA and Vrefmain biases to 50MHz injections

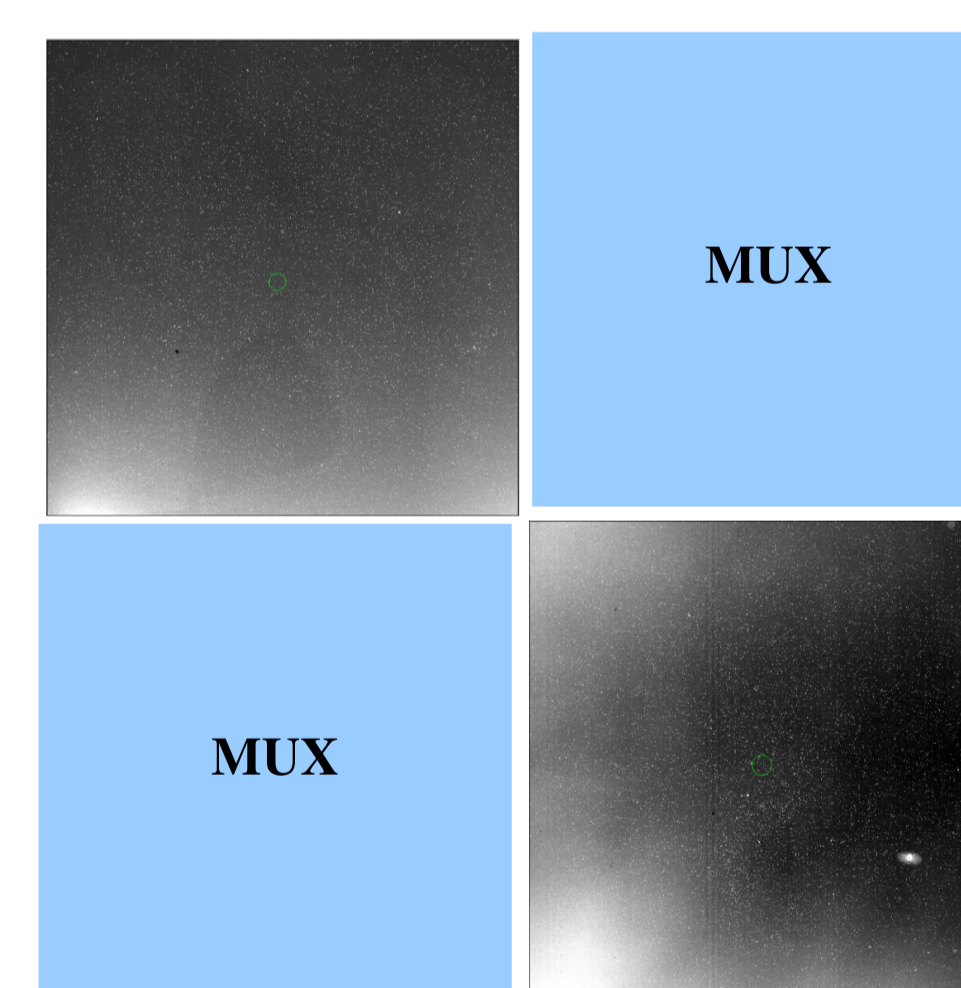
DM Tests

Dark performances

No illumination in DM setup
Only dark and noise available for testing
Full evaluation of performances foreseen at EQM and FM level.

Parameter	Configuration
Bias	500 mV
Gain	18dB

Detector configuration for DM tests using EEf 2.0 firmware



Measured dark current within Euclid's specifications even with the presence of glow within the detector's frame.

Tests conducted

- Acquisition of UTR(5000) for estimation of dark levels and noise

Results

- Good dark value of around 10^{-3} e/s
- Presence of glows within the detector with dark levels twice the median value, not due to light leakage.

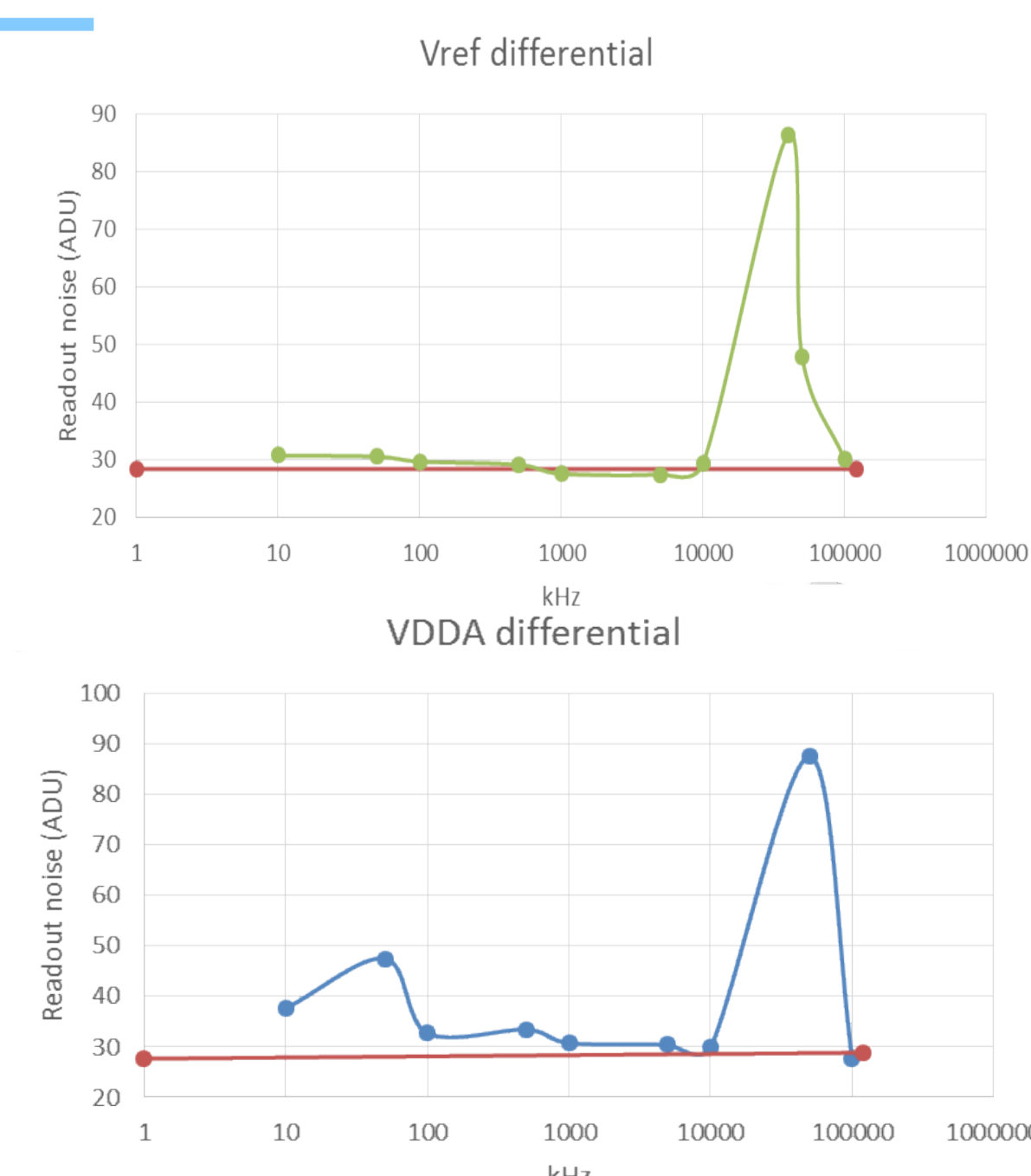
Parameter	SCA 17191	SCA 17244	Euclid specs
Dark	1.3×10^{-2}	4.0×10^{-3}	$< 7 \times 10^{-2}$

Conducted EMC tests

ElectroMagnetic Compatibility conducted tests consist of the injection of noise at a given frequency and power and see how the system reacts

Tests conducted

- Conducted EMC tests done on several biases : VDDA, VREF, VDDIO, VSSIO, VDD and VDD3p3
- Frequencies of injection spanned from 10 kHz to 100 MHz
- Reference noise level of 30 ADU uncorrected
- Results
- Detector's noise mainly sensitive to noise injection in VDDA and VrefMain (around 50MHz)
- Injecting noise on other bias does not modify read noise
- Reference pixels correction method reduce the effect of the noise injection



As expected VDDA and Vrefmain biases are the most sensitive, with a given noise at 50 MHz frequency.

^a Centre de Physique des Particules de Marseille, 163 avenue de Luminy, case 902, 13288 Marseille cedex 9, FRANCE

^b Institut de Physique Nucléaire de Lyon, 4 Rue Enrico Fermi, 69622 Villeurbanne, FRANCE

^c Laboratoire d'Astrophysique de Marseille, Pôle de l'Étoile, Site de Château-Gombert, 38, rue Frédéric Joliot-Curie 13388 Marseille cedex 13, FRANCE