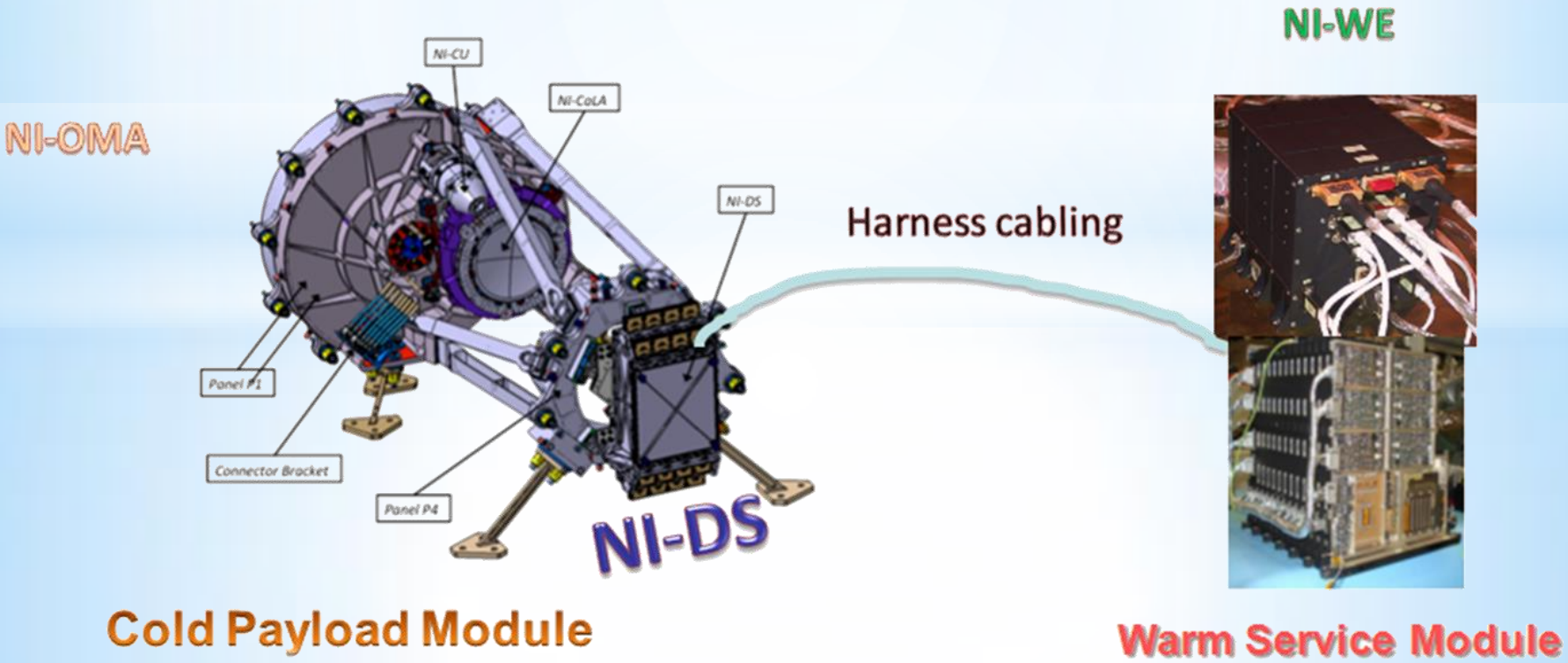
# Assembly Integration and Verification (AIV) of the Near Infrared Spectro-Photometer's (NISP) Warm Electronics (WE) in the EUCLID mission




Fulvio Laudisio

16/09/2016

# Layout

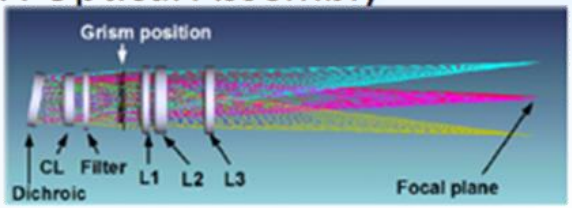
- Euclid Mission
- NISP – WE AIV
- My activity during first year
- Foreseen activities in Second year
- Publications

# The Euclid Mission

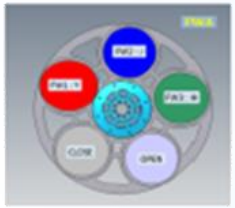
- **ESA mission**
- Selected in Oct. 2011 - Fully funded
- Partners: ESA, TAS, Airbus DS, Euclid Consortium (EC)
- Overall mass: ~2020 kg, Power : 1920 W (E0L)
- Data rate: 850 Gbit/day
- Telescope (T=125K, passive):
  - 1.2m aperture primary, 3 mirror Korsch anastigmat
- 2 Instruments (VIS, NISP) – T = 100-140 K (passive)
  - Wide field instrument, VIS: 36 e2v 4kx4k CCDs $0.55<\lambda<0.92$ µm, 576 M pixels, 0.11 arcsec/pix, 0.53 deg² FoV
  - Photom. (Y, J, H) +spectrom.: 16 H2GR HgCdTe detectors;
  - 64 Mpixels, 0.30 arcsec/pix, 0.53 deg² FoV (=VIS)
  - Grism slitless spectro (1B + 3R grisms) $0.92<\lambda<2.05$ µm, R>250
- Downlink Rate: X/X + K-band to Ground Station 55 Mbits/s. 850 Gbit/day to transfer 4hr/day.
- Ground Segment: ESA (50%,) EC (50%, EC leads science and external data): 1.5 billion galaxies for WL, 30 million redshifts, 12 billion sources (3sigma)
- L2 orbit
- Launch Vehicle – Soyuz-Fregat
- Launch date 2020, from Kourou space port
- 6.25 years mission + additional surveys (exopl, SN)
- Main surveys: 15,000 deg²+40 deg² 2 mag. deeper
- Science drivers: DE
- Science leads: Euclid Consortium

# NISP (Opto Mechanincal Assembly) T ≈ 140K

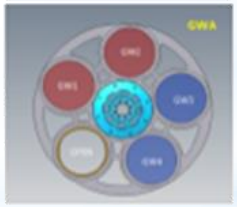
- NI-SA : Structure Assembly ; SiC Structure
- NI-OA : Optical Assembly



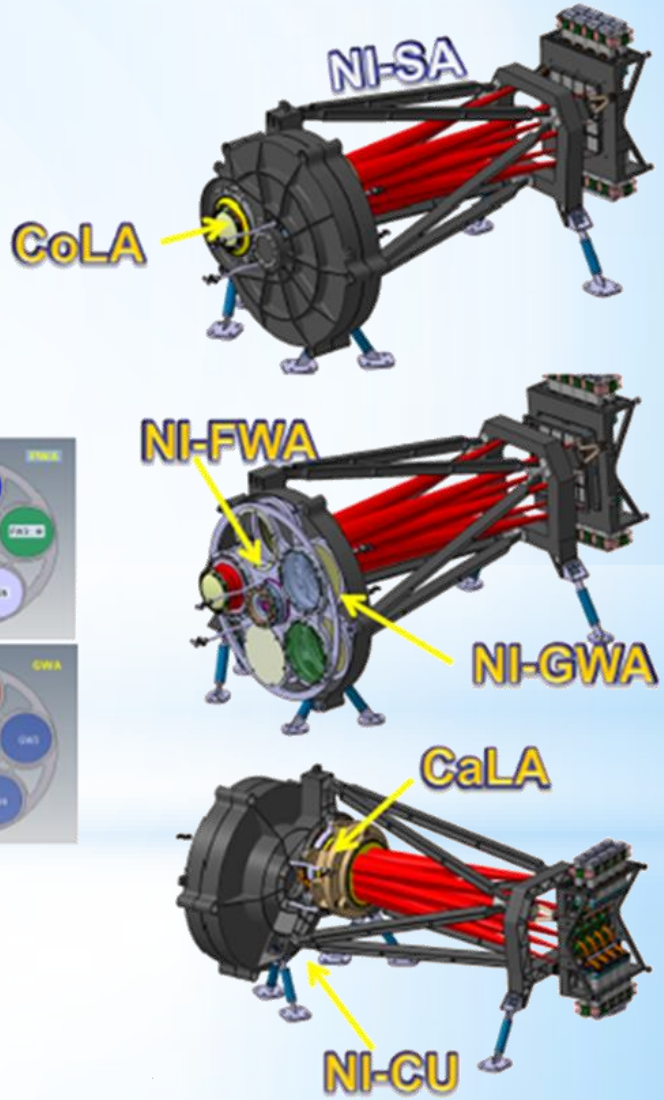

  - CoLA : Corrector Lens Assembly
  - CaLA : Camera lens Assembly
- NI-FWA : Filter Wheel Assembly
  - 3 Filters + CLOSE + OPEN



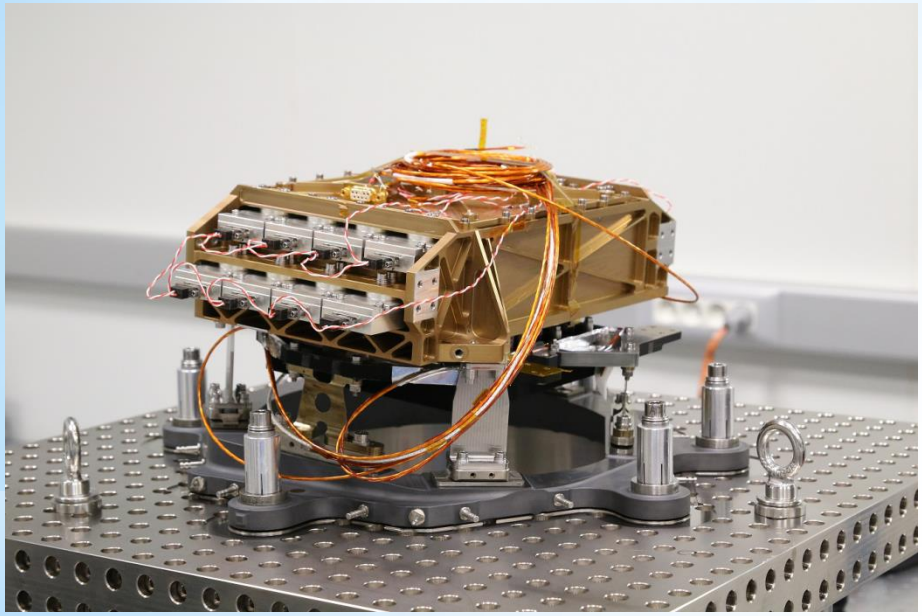
- NI-GWA : Grism Wheel Assembly
  - 4 Grisms + OPEN



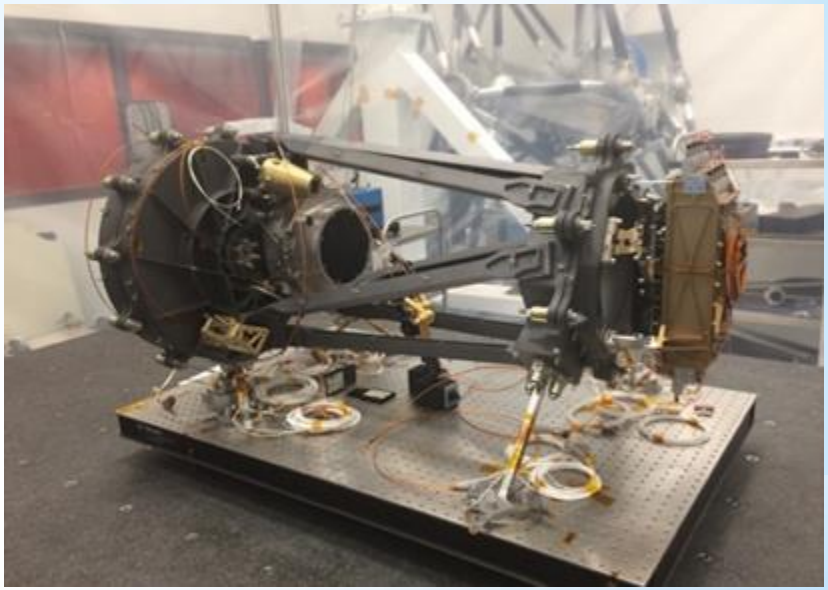
- NI-CU : Calibration Unit
  - 3 wavelength
- NI-TC : Thermal Control
  - To control the optics at +/-0.3K all life (≈140K)



# NISP Present Status



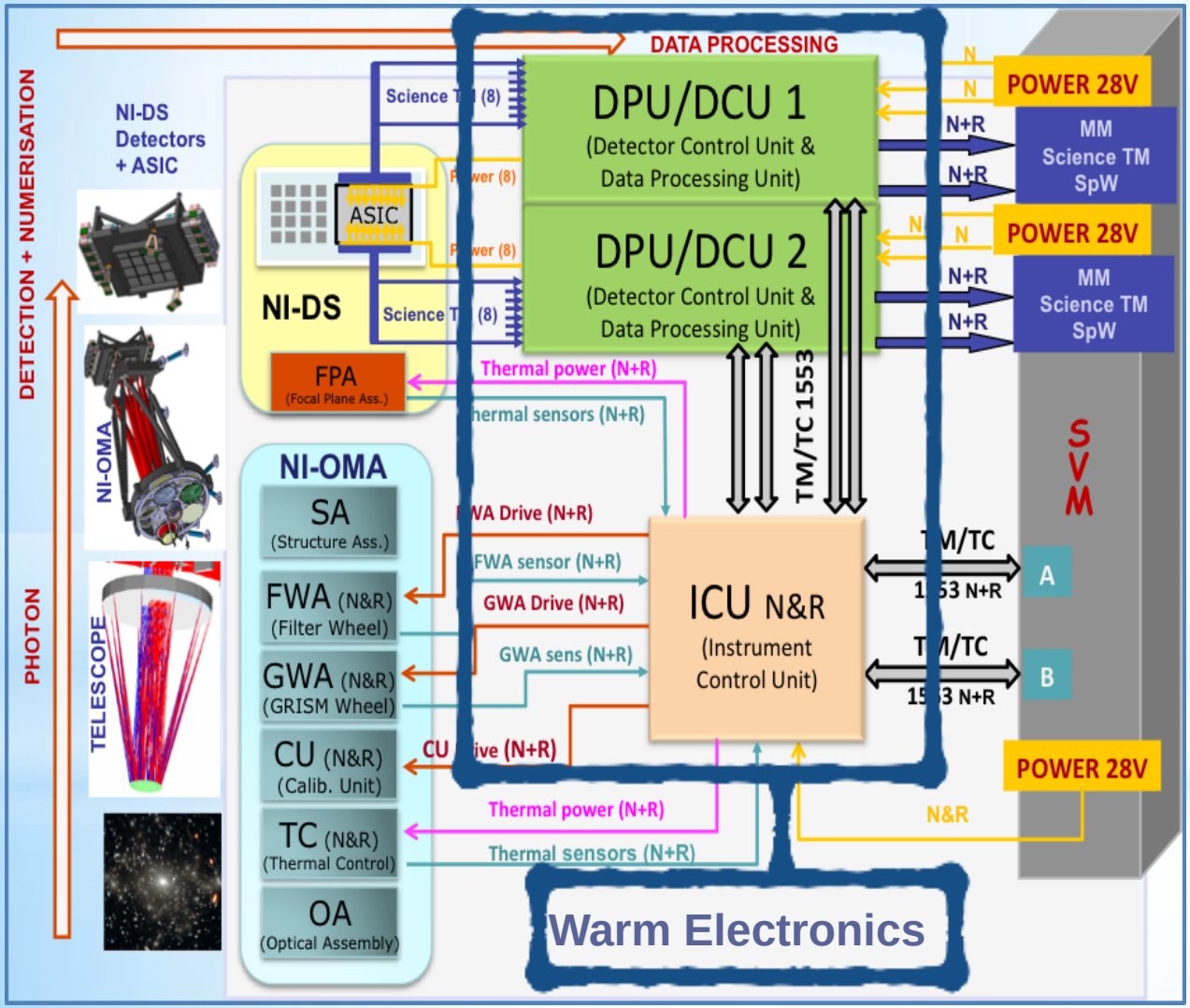
Focal Plane Assembly



NISP Opto Mecchanical Assembly

Mechanical Parts are under development
Structural parts made in SiC
Working Temperature 100 K
Fully functional by 2018

# NISP Warm Electronics




DPU/DCU

- Data acquisition
- Data processing
- Data compression
- Data transfer to satellite memory

ICU

- Filter wheel & grism wheel control
- Telecommands dispatching
- Telemetry acquisition and transfer to SVM

# NISP Warm Electronics AIV

Aim WE-AIV:

- Verify DPU & ICU ASW integration in the HW (unit level)
- Test end-to-end science data
- Test TC/TM flow (DPU+ICU)
- Documentation and test-plan preparation
- To be performed on EQM, AVM and FM models

## Joint efforts

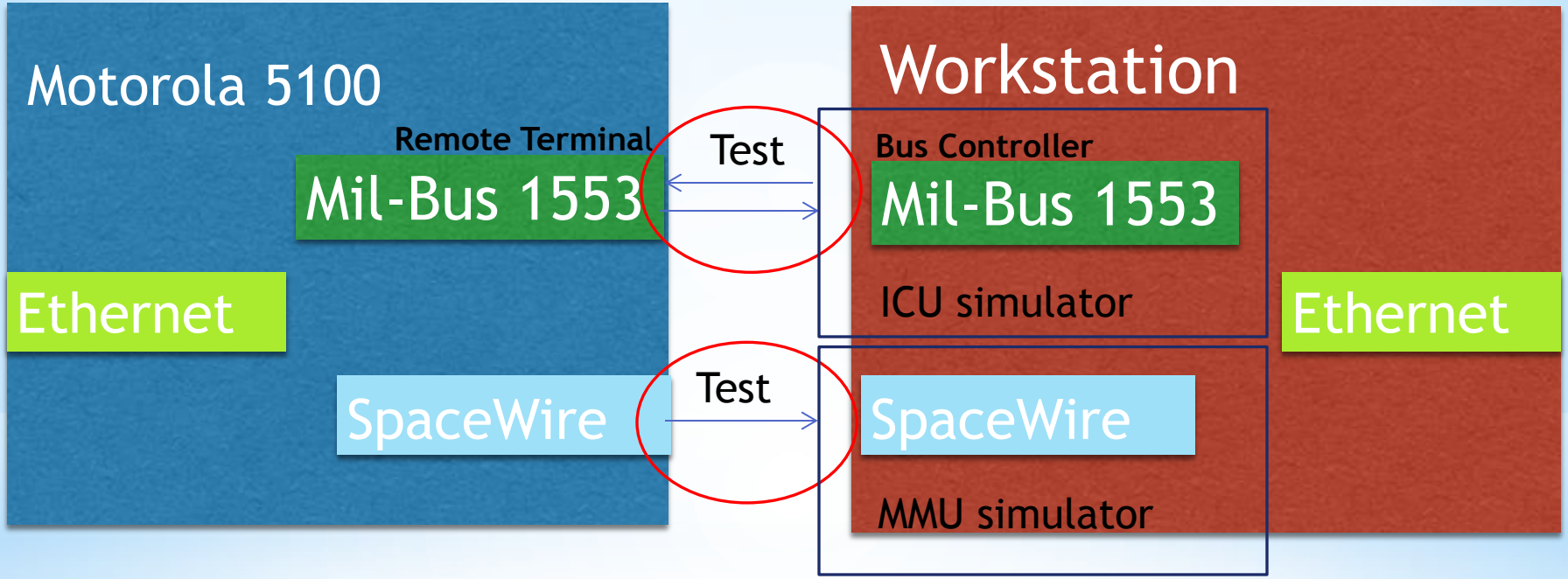
* INAF (Padua Observatory) – DPU/DCU ASW development
* INAF (Turin Observatory) – ICU ASW development
* Department of Physics UNIPD - WE - AIV
* CISAS - WE - AIV
* INFN (Padua and Bologna) - WE - AIV

my institution

* LAM (Marseille Astrophysics Laboratory) – NISP instrument validation
* Euclid Consortium- Scientific validation

# DPU test set-up @ INFN Padova

In order to have AIV tools ready when FM is delivered a bread board has been prepared based on commercial hardware as well as SW simulators of the remaining hardware




- Motorola 5100 VME board + VxWorks 5.5.1 emulating a Maxwell 750 CPU board
- Ballard MILBUS 1553 PMC -> Ballard MILBUS 1553 USB emulating ICU-DPU communication
- DynEng SpaceWire PMC -> DynEng SpaceWire PCI emulating DPU-SVM Mass Memory data transfer

# My Work in 2015-2016

- Getting acquainted with MIL-STD-1553 and SpaceWire protocols and developing software simulators
  - ICU Simulator :Software emulating the board controlling the the NISP camera reciving TeleCommands from the spacecraft
  - Mass Memory Simulator : The scientific data transfer is emulated via a SpaceWire link, the stability of this link was extensively tested with transfers of $10^{12}$ bits

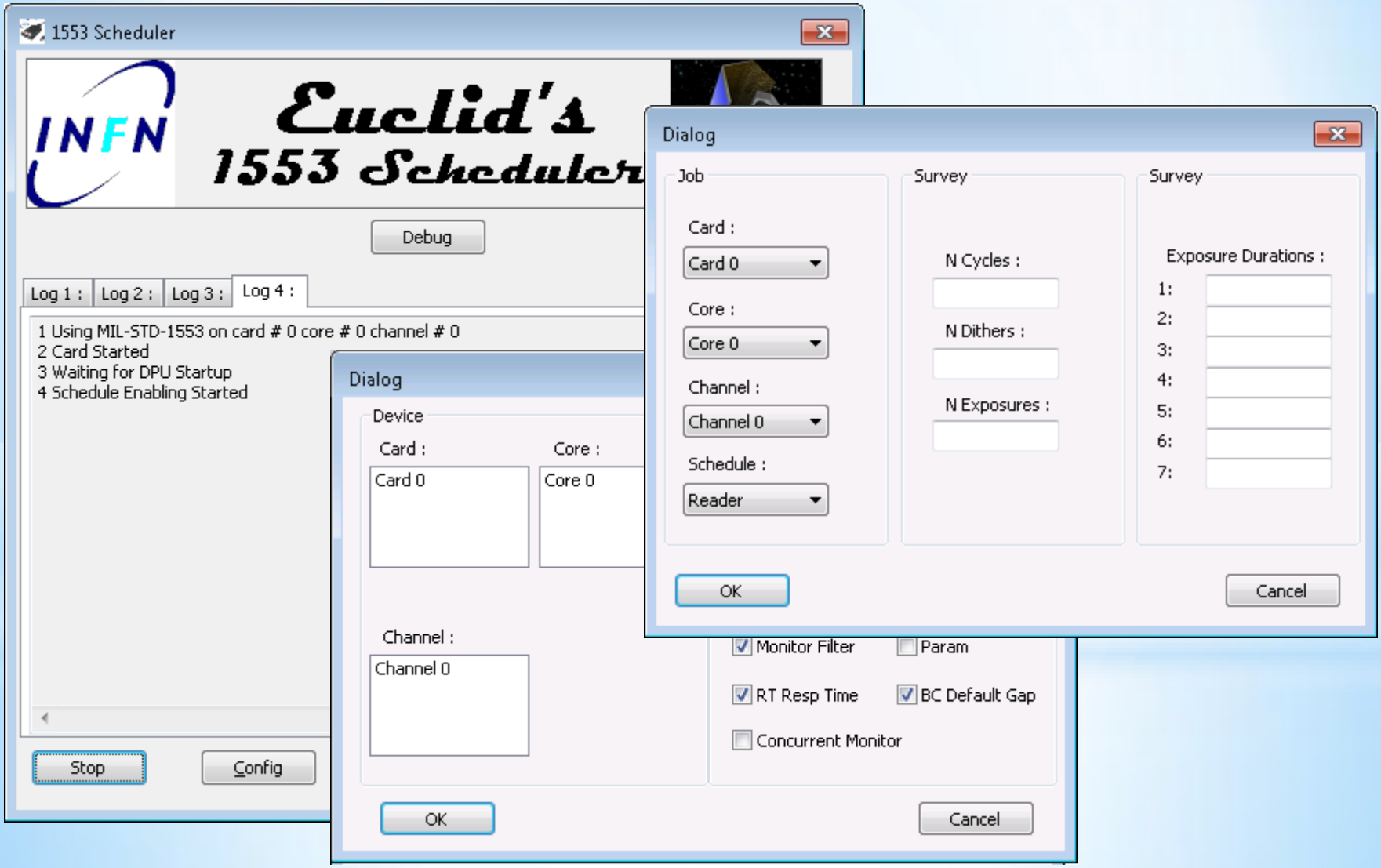
- Integration of the DPU ASW (VxWorks code) on the INFN set-up

And integration with the two simulators

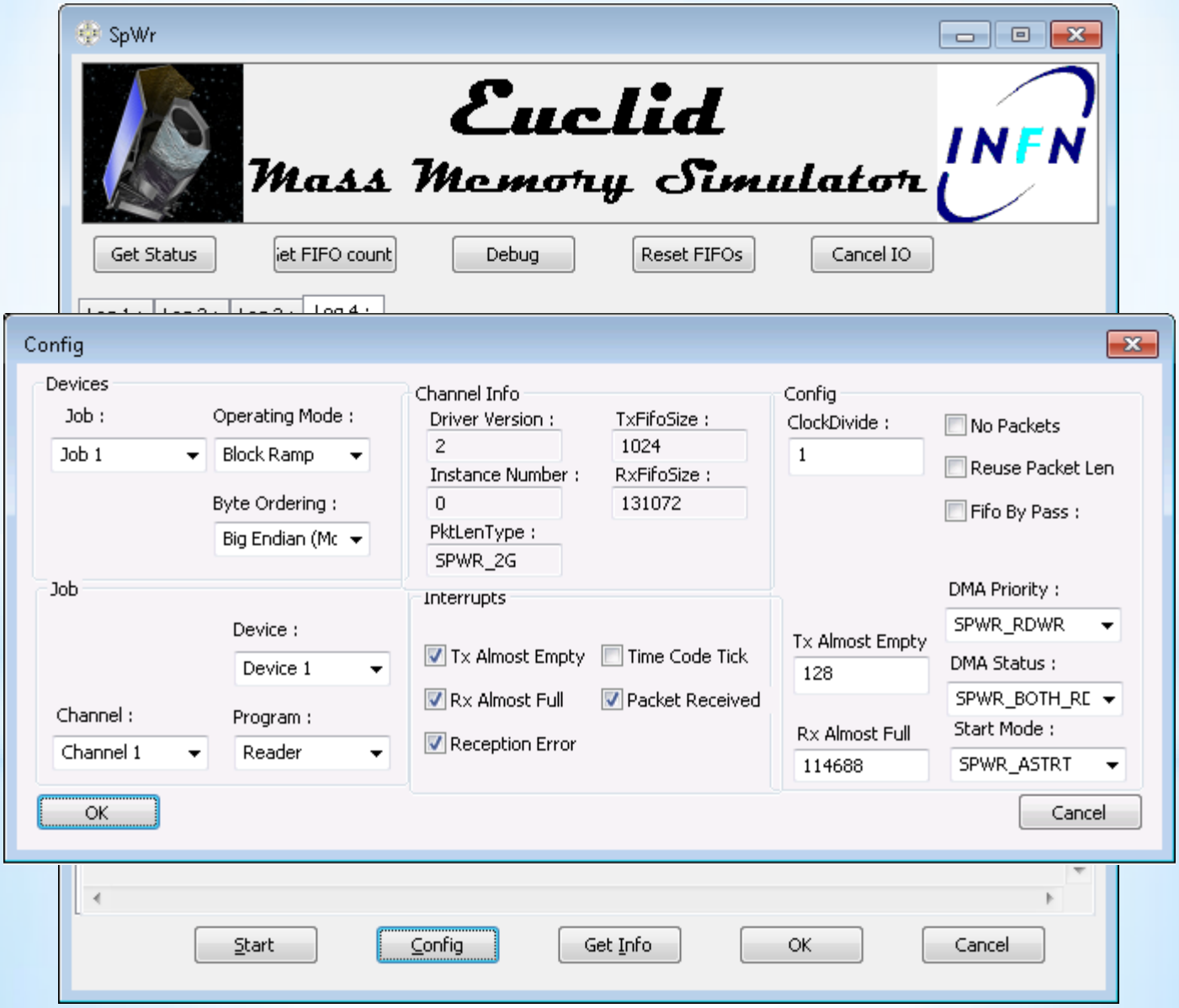
- Development of a DPU simulator

Such tool will be used by the groups working on the development and AIV of the ICU ASW

# ICU-DPU simulator



# Mass Memory simulator



# Foreseen activites for NISP-WE AIV in 2017-2018

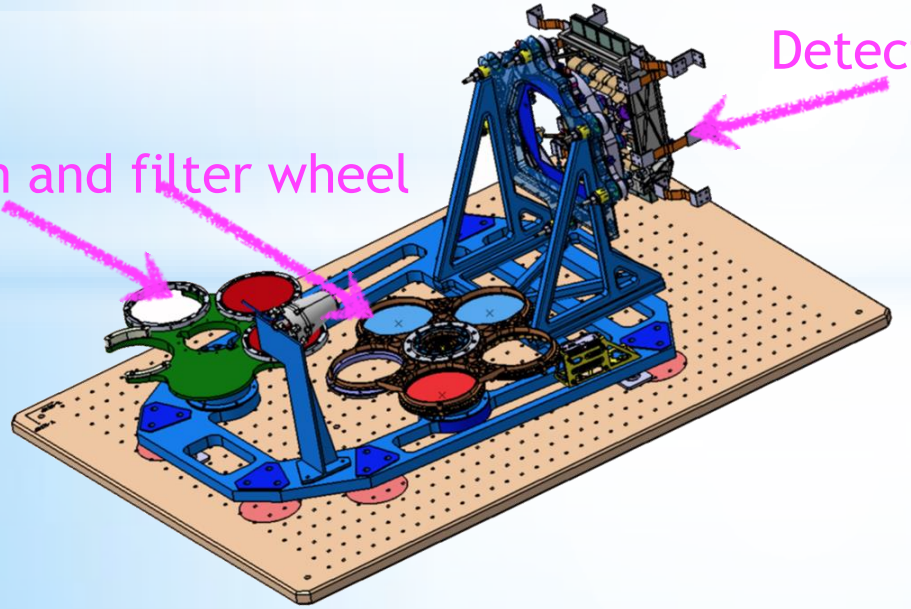
- ASW (v1) integration in DPU & ICU EQM models, DPU+ICU integration and validation @ INFN Padova (ISO 8 clean room in preparation)
- WE integration with NISP instrument @ LAM ( Marseille)
- TC/TM procedures for AIV test @ LAM (EQM model)
- TC/TM for AIV test @ Thales Alenia Space (TAS-I), Turin (AVM model)
- ASW (v2) integration in DPU & ICU FM models, DPU+ICU integration and validation @ INFN Padova

- January - June: AIV test of DPU, ICU and WE (ICU+DPU)
- June - September: AIV test NISP @ LAM
- September - November: AVM test @ TAS-I

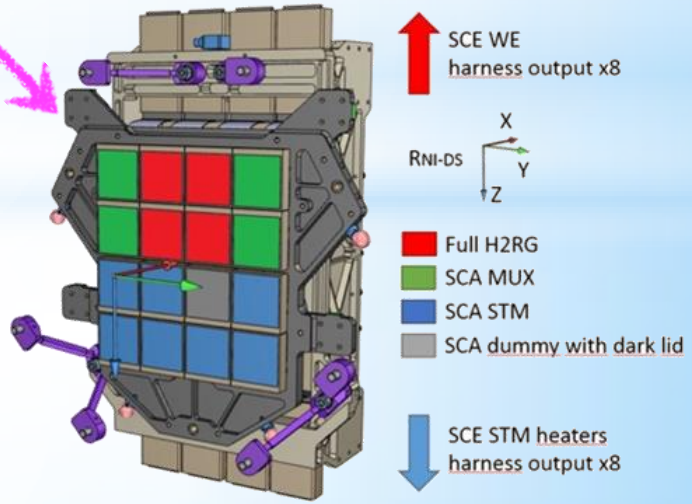
## NISP-EM AIV test @ LAM

- allow at unit level, electrical, mechanical and thermal qualification
- allow the development of the ground checkout systems
- Validation of the, thermal, electrical, command & control test procedures for the FM
- test the NISP performances (limited to dark and flat field to 4 engineering detectors)

45 $m^3$ cryo-vacuum chamber
77K and $10^{-6}$ mbar
Large integration room (100tn seismic mass to provide high stability (< $10^{-7}$g at 5 - 100 Hz))




Detector system



## Courses:

1. CCS 5 training @ TERMA – Leiden
2. IDEAS DB tools @ TASI - Torino

## Publications:

Proceedings of SPIE Space Telescopes and Instrumentation 2016

1. "Euclid Near Infrared Spectrometer and Photometer instrument concept and first test results obtained for different breadboards models at the end of phase C"
2. **"On-board data processing for the near infrared spectrograph and photometer instrument (NISP) of the EUCLID mission" - POSTER Presentation**
3. "EGSE customization for the Euclid NISP Instrument AIV/AIT activities"
4. "Detailed design and first tests of the application software for the instrument control unit of Euclid-NISP"
5. "Instrument Workstation for the EGSE of the Near Infrared Spectro-Photometer instrument (NISP) of the EUCLID mission"

**Thank you for your attention**

**Questions are welcome**