



# Euclid

Stefano Dusini (INFN Padova)



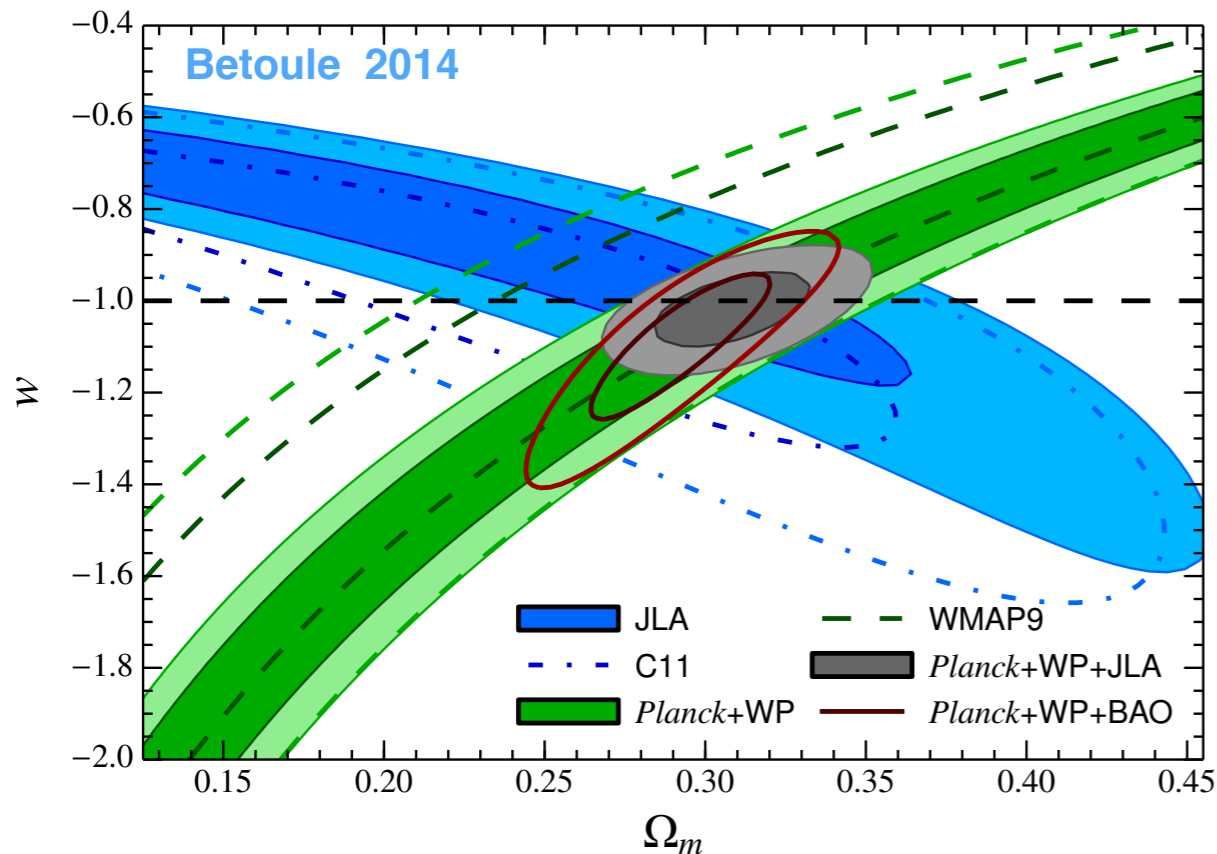
# Dark Energy questions

- What is the equation of state of **DE**: **constant?** or **change with time?**
- New **energy component** or **breakdown of GR** at large scale ?

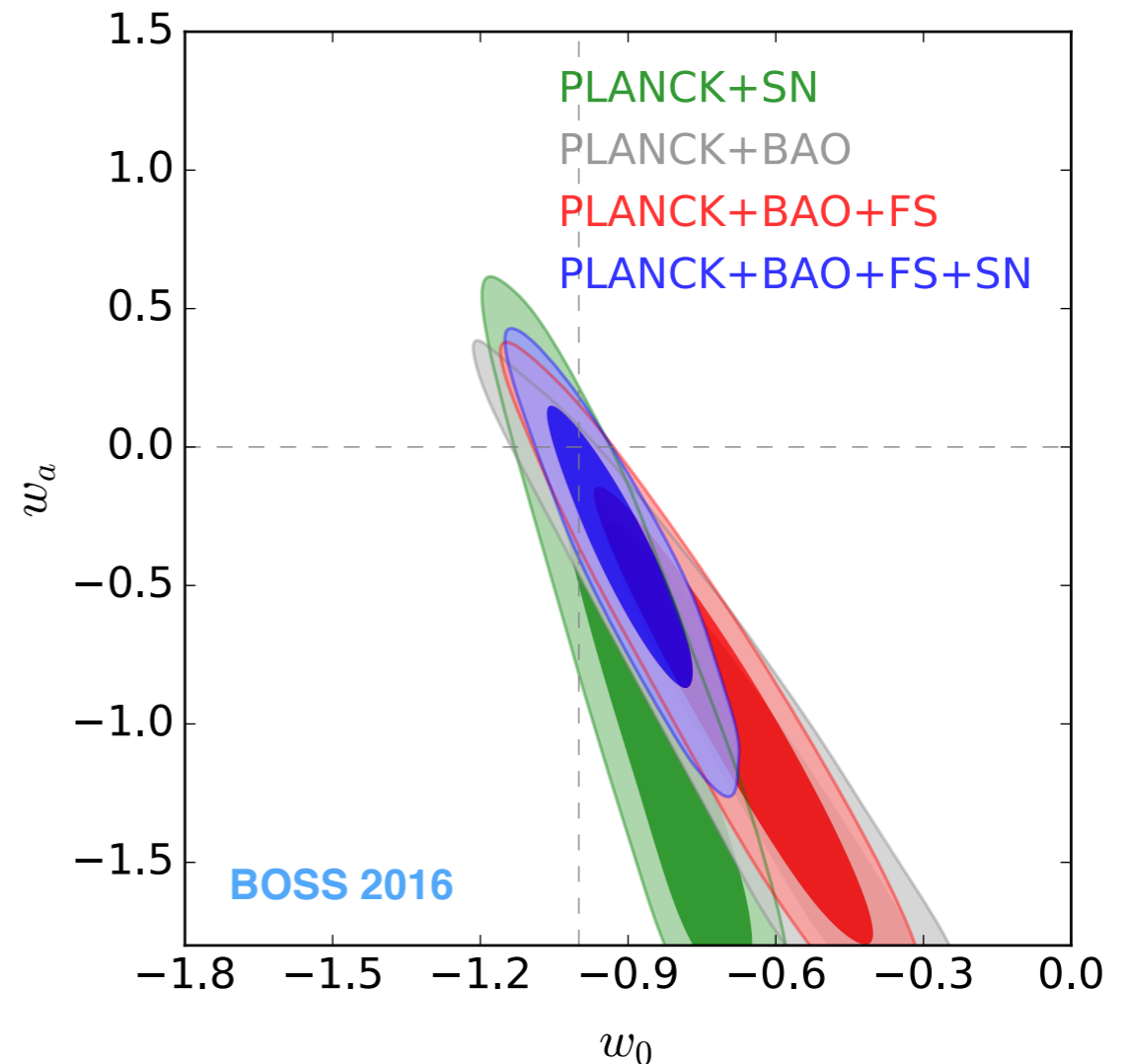
➤ *Observe the expansion rate  $\mathcal{H}(z)$  and growth of structure  $f(z)$  at different epoch.*

$$p = w\rho$$

Not yet enough precision to distinguish among various scenarios.



$$w = w_0 + (1 - a)w_a$$



# Euclid Primary Objectives

- ◉ **Euclid is a M-class ESA Space Mission dedicated to understand :**
  - The origin of the Universe's accelerating expansion
  - The properties and nature of Dark Energy and Gravity on large scale.
- ◉ **Probe the effects of Dark Energy, Dark Matter and Gravity by:**
  - The expansion history of the universe
  - The history of structure formation
  - Tracking their observational signatures on the
    - ✓ Galaxy Clustering (GC), Baryonic Acoustic Oscillation (BAO), Redshift-Space Distortion (RDS)
    - ✓ Weak Lensing (WL), Cluster of Galaxies (CL)
  - Multi-probes approach to address different models ( $\Lambda$ CDM, wCDM, mod-GR...)
  - Large statistics = large survey to reduce statistical error
  - Controlling systematics to an unprecedented level of accuracy



# Italy in Euclid



## “Euclid-Italy” Team

- ~320 members
- Financial support from ASI, partly from MIUR (PRIN), INFN
- Universities : Bo, Mi, Na, Pd, RM1, RM2, RM3, TS, SISSA, SNS
- INAF : OABo, OABrera, OACt, OAA, OANa, OAPd, OARM, OATo, OATs, IASFBO, IASFMII, IAPS
- **INFN**: Bologna, Genova, Lecce, Milano, Padova, Roma1

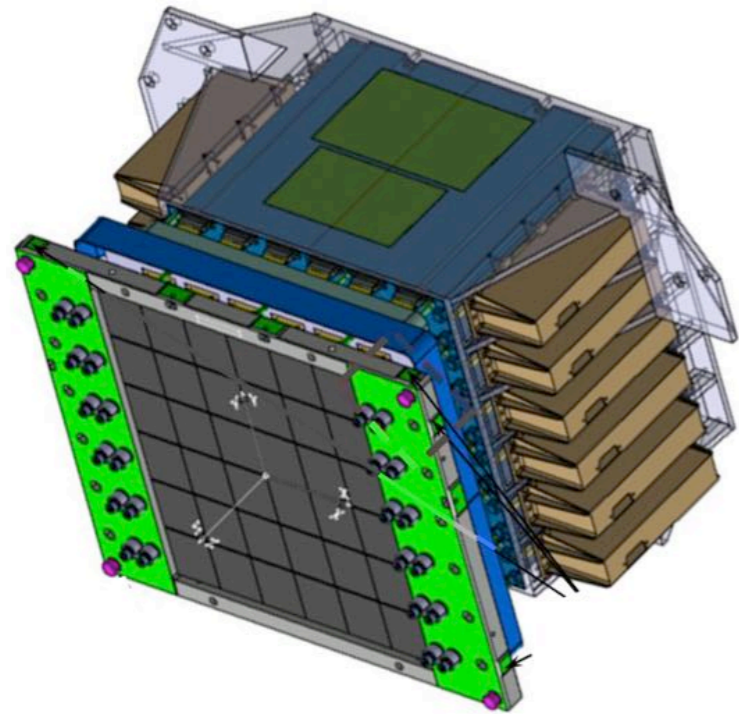
## “Euclid-INFN” Team

- ~44+7 members
- Bologna: 16 members
- Genova:  $\approx 7$
- Lecce: 5
- Milano: 3
- Padova: 11
- Roma1: 9

Note: partial overlap between INFN-INAF-UNI

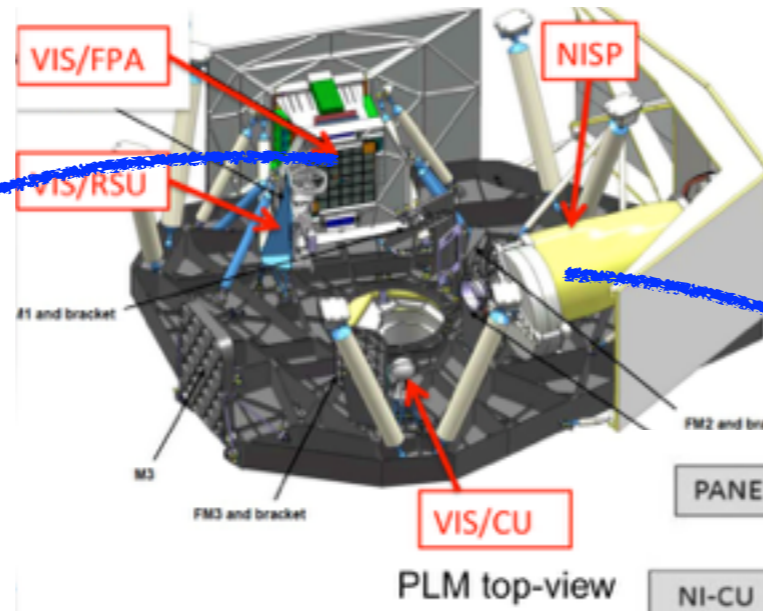


**VIS**

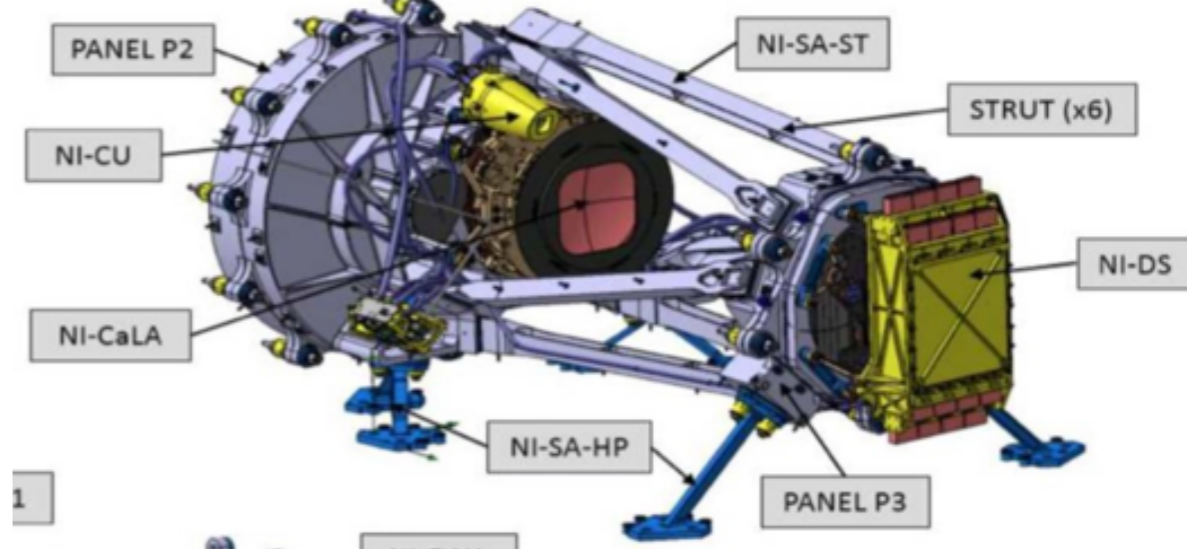


Focal Plane Array (FPA)

- 36 CCDs, **604 Mpixel**, 12  $\mu\text{m}$  pixels
- 0.1 arcsec pixel on sky, **0.54 deg<sup>2</sup> per field**
- 1 filter Y (R+I+Y)
- Bandpass 550-900 nm
- Data volume 520 Gbit/day
- Mass 135 Kg

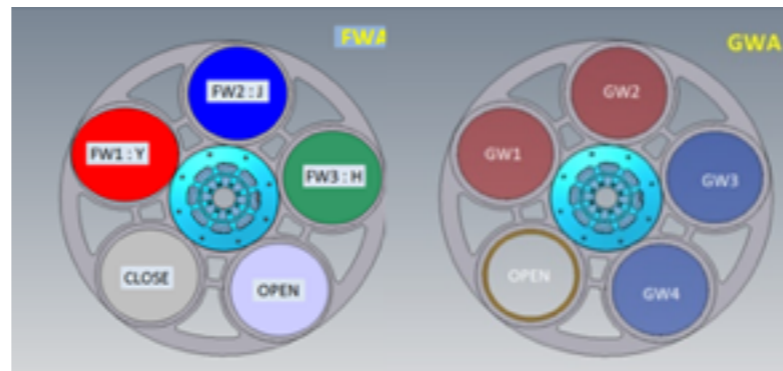


PLM top-view

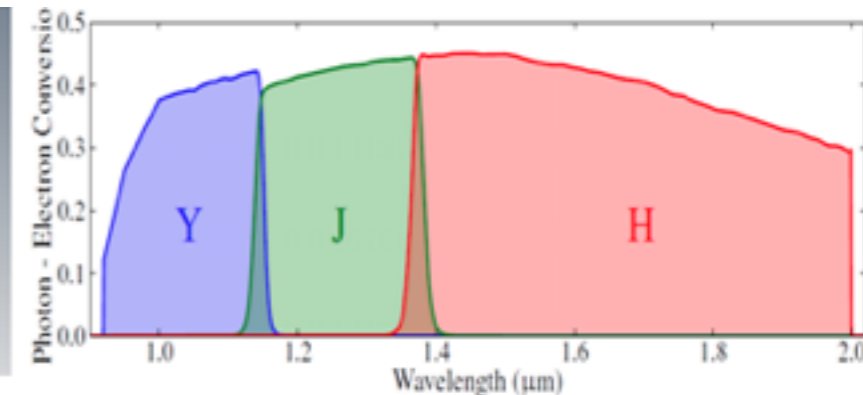


**NISP**

- 16 H2RG (HgCdTe), **67 Mpixel**, 18  $\mu\text{m}$  pixel
- 0.3 arcsec pixel on sky, **0.55 deg<sup>2</sup> per field**
- 3 filter **Y, J, H**
- 4 grims: **1xB(920-1350 nm), 3xR(1250-1850)**
- Data volume 290 Gbit/day
- Mass 159 Kg

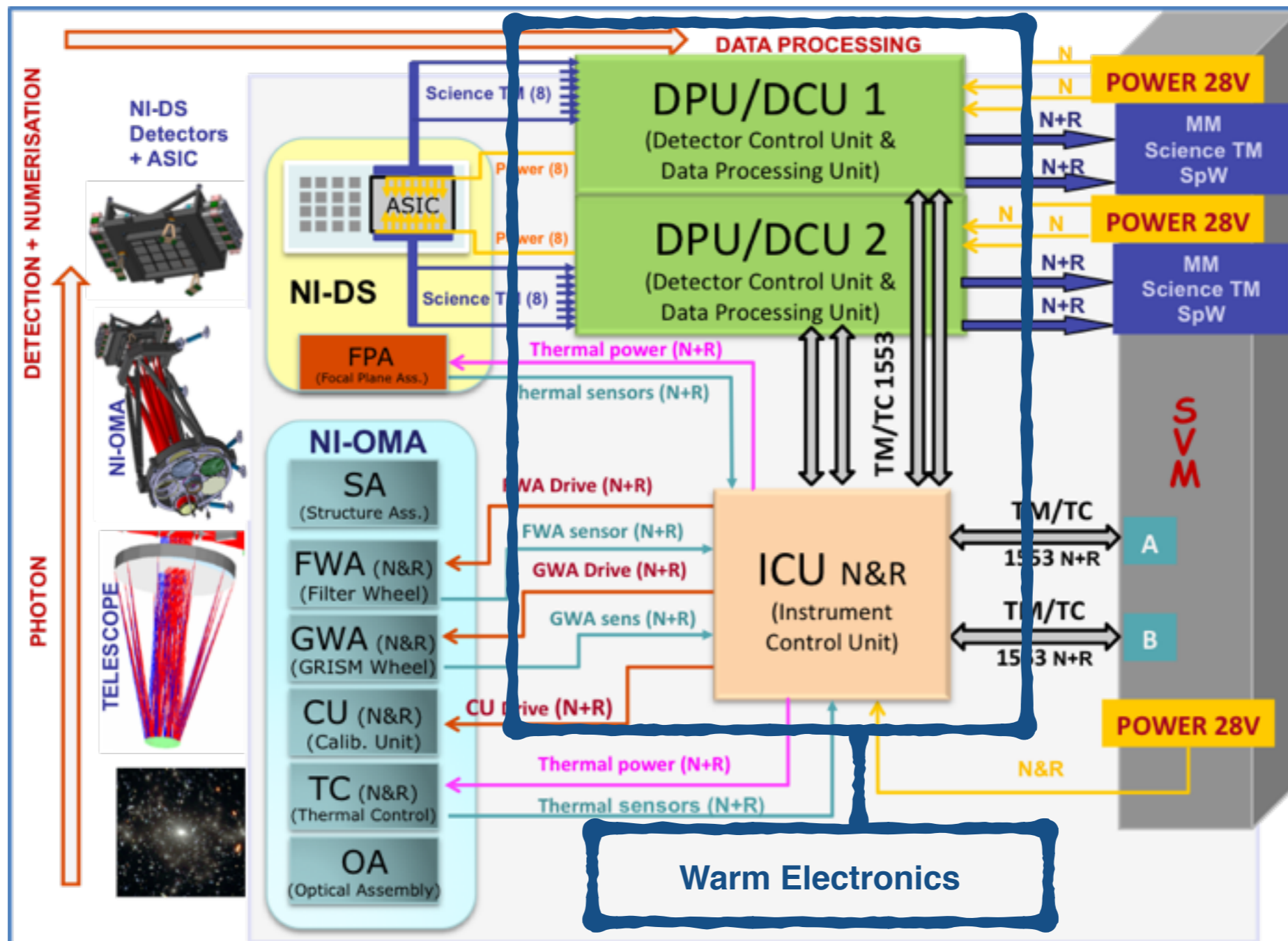


Filters and grisms positions in wheels

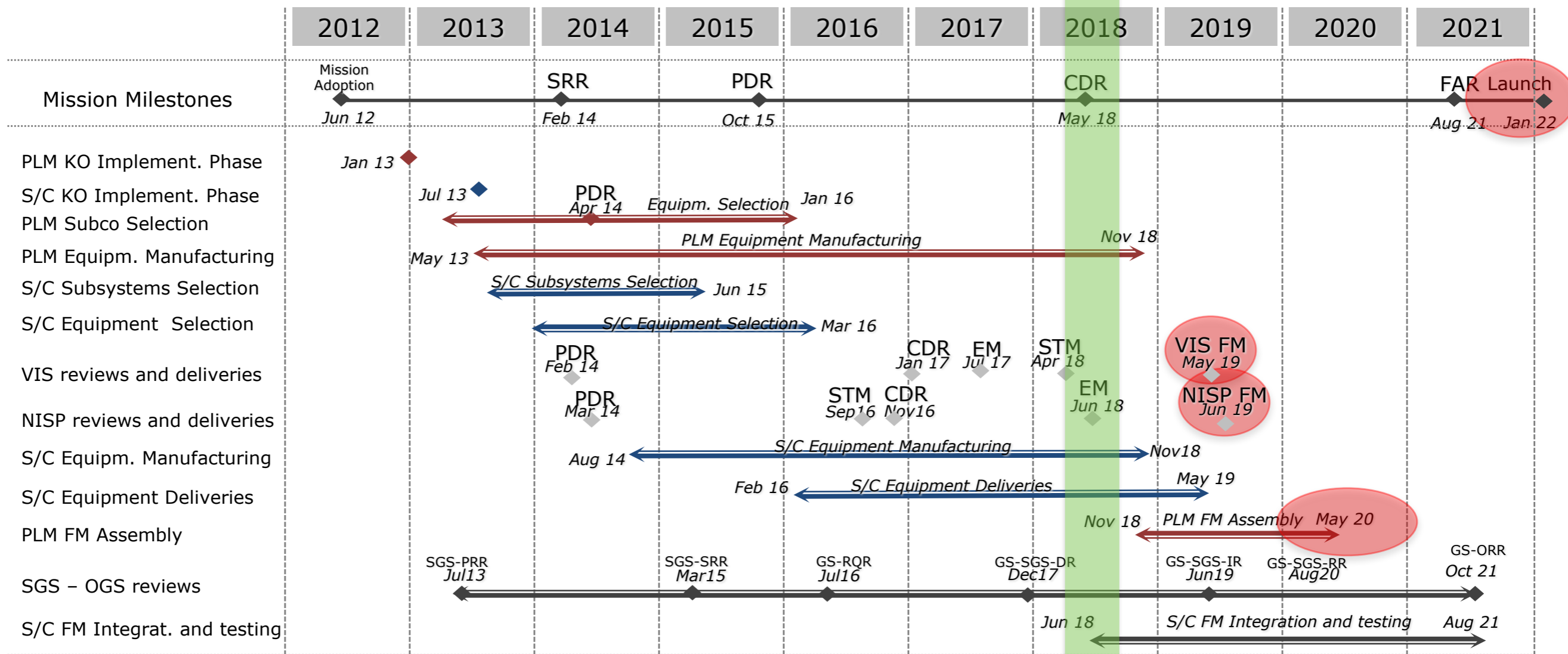


NISP throughputs through the Y, J and H filters

- INFN ha la responsabilita del “Assembly Integration and Verification (AIV)” della [Warm Electronics](#) dello strumento [NISP](#)
- Contratto ASI 2015-18 con finanziamento 259 keuro (~2 RtD)
- Nuovo contratto (2018-21) in fase di definizione con richieste simili al precedente



# Euclid Schedule: Bonn 2018



ESA UNCLASSIFIED - For Official Use

Euclid Consortium meeting 2018 | Project Status | G.D.Racca | Bonn, 11<sup>th</sup> June 2018 | | Slide 36



## Consegna NISP: second meta 2019

- + 6-12 mesi rispetto ad un anno fa (package ASIC Teledyne, ICU PCB...)
- Impatto sulle attività di AIV della WE e NISP: slittamento e aumento del carico



# Integrazione NISP Flight Model (FM)



## NISP MANAGEMENT

### □ NISP SCHEDULE

#### ➤ NISP FM:

- ❖ **Option 3 is considered as the only one viable (see Rémi talk)**
- ❖ Stable delivery for NI-SA, NI-TC, NI-CU, NI-GWA, NI-DPU and GSE's
- ❖ Slight delay announced for NI-FWA, NI-OA, and NI-ICU, but covered by SCS delay and compliant with the NISP first TV test in June 2018
- ❖ The NISP FM new sequence is then the following :
  - Integration of the NI-OMA FM from October 2017 to April 2018
  - CPPM characterization of SCA's with "4 good already produced non flyable SCE's". Expected to be completed for end of January 2018
  - Integration of the NI-DS "FM" with FM SCA's but non flight SCE's; April 2018
  - Integration of the NI-DS "FM" on the NI-OMA FM; April / May 2018
  - NISP "FM" first TV test (focus, functional) with ALL NISP subsystem and GSE; June / July 2018
  - Replacement of the non flight SCE's by SCE's FM after the first TV test; August 2018
  - Second NISP TV dedicated to SCS's characterization and SCS's tuning with Markury EGSE; September 2018
  - NISP vibration; October 2018
  - Third NISP TV tests (performances and calibration) test with NISP in its final FM configuration; November/December 2018

1

→ Fine 2018

2

→ Meta 2019

3

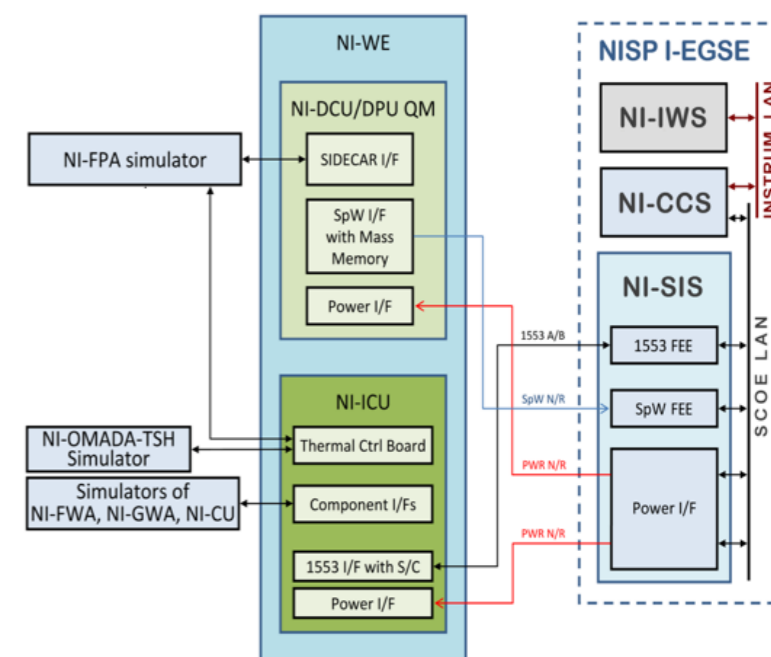
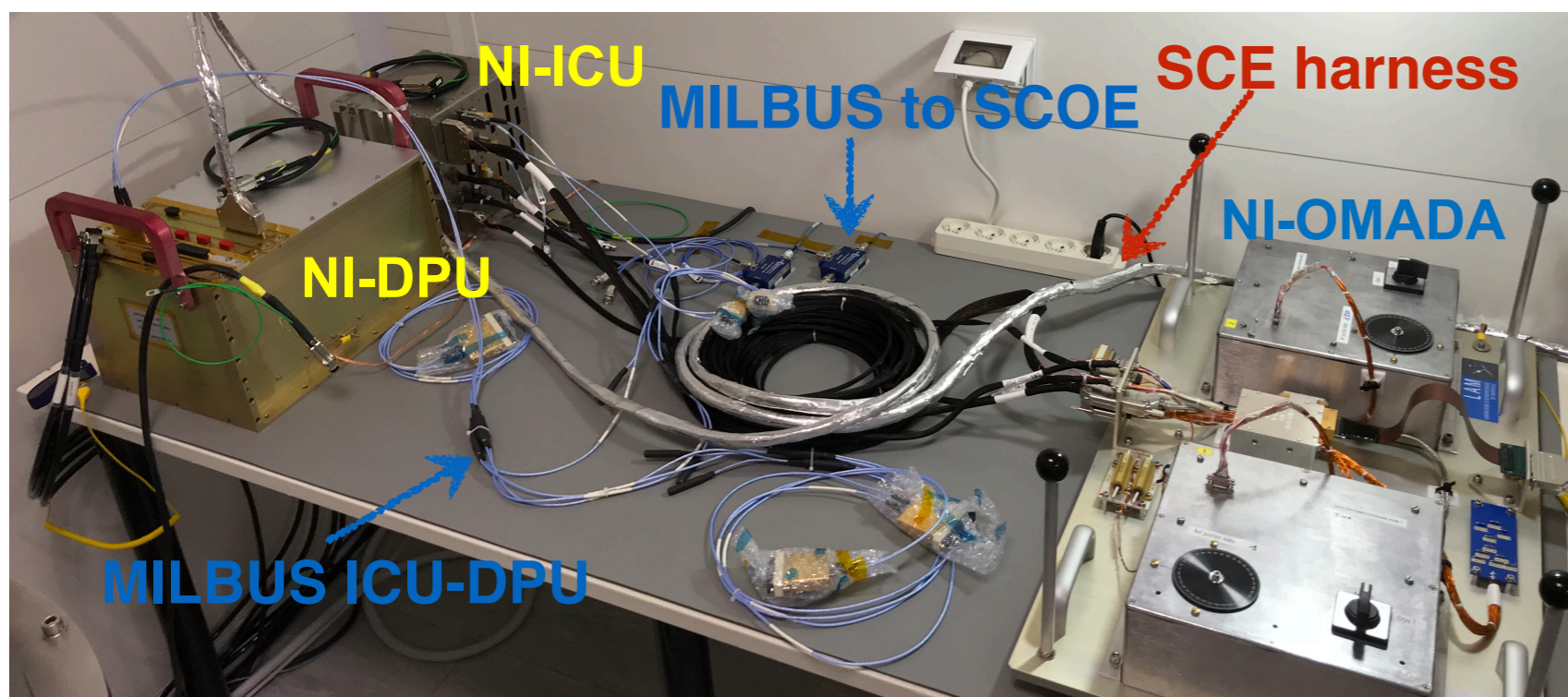
→ Fine 2019

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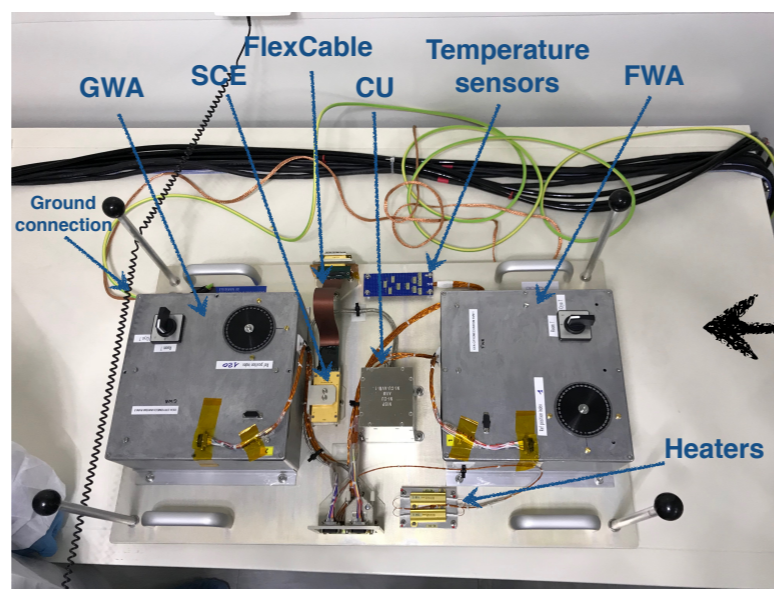
**Effetto: da 1 a 3 sessioni di test @ LAM (Marsiglia)**

# Attività' a Padova 2017-18

- Installazione EGSE (Electrical Ground Support Equipment), SCOE + CCS, per test WE
- Integrazione e test del modello avionico (AVM) dello strumento NISP (nov. 2017 -> giu. 2018), presso INFN Padova, coordinamento INFN.
- Primo modello rappresentativo delle funzionalità di NISP.
- Validazione del SW della WE (DPU + ICU)
- Test formali (ESA+Thales) 22/5 -> 4/6, **successful**
- Modello consegnato a ThalesAlenia Space 15/6.



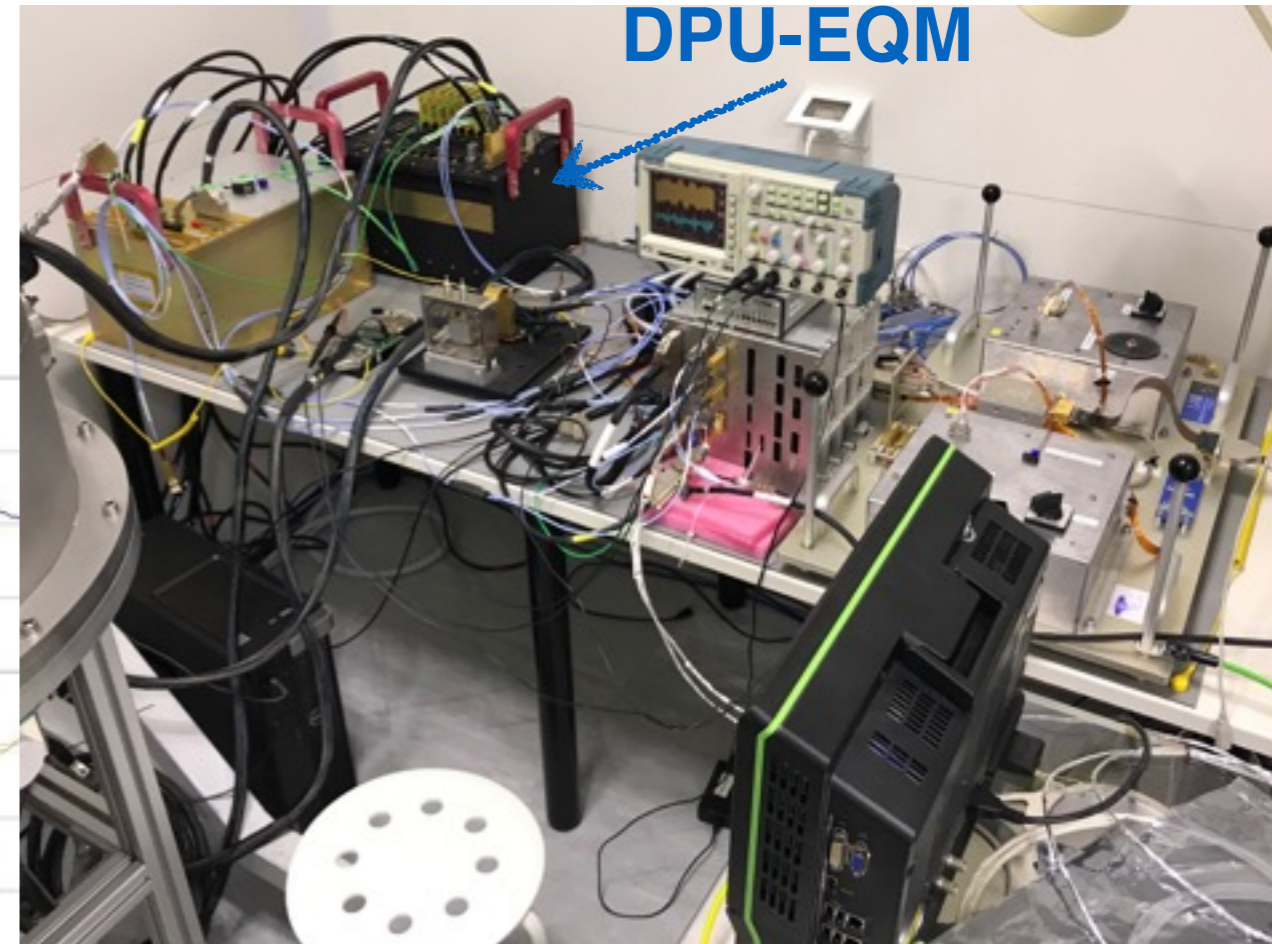
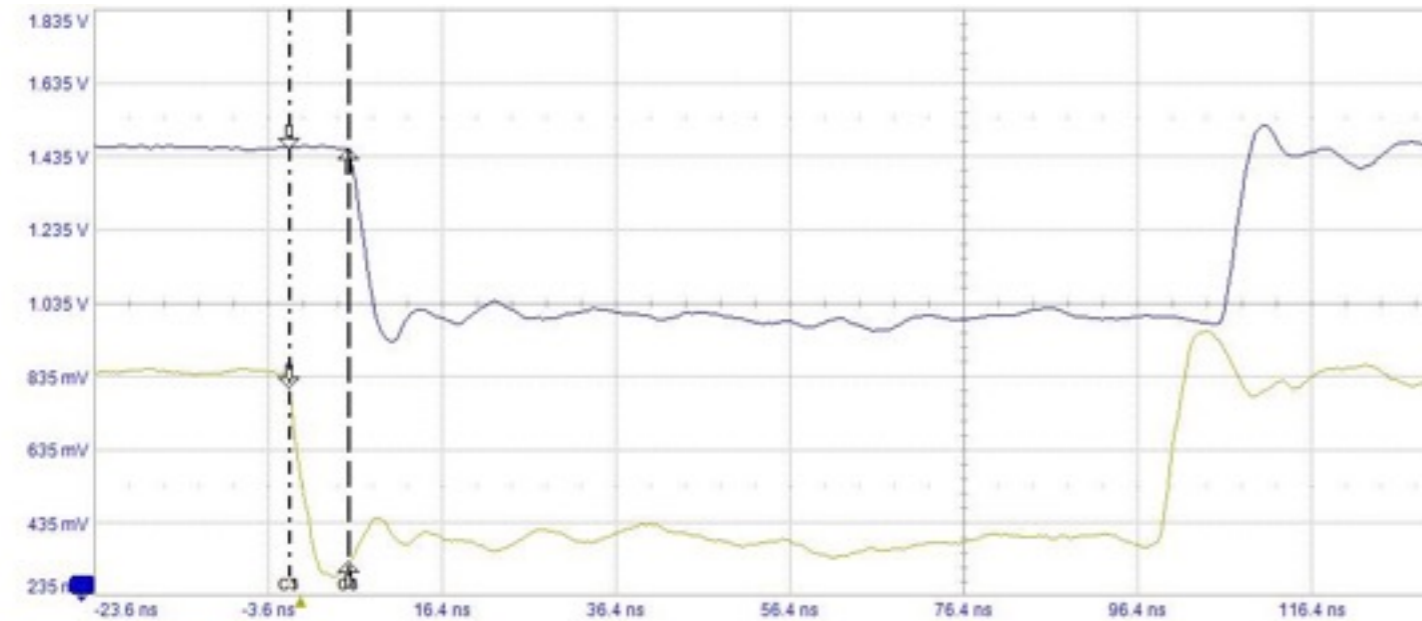
Simulatore funzionale del sistema opto-meccanico di NISP





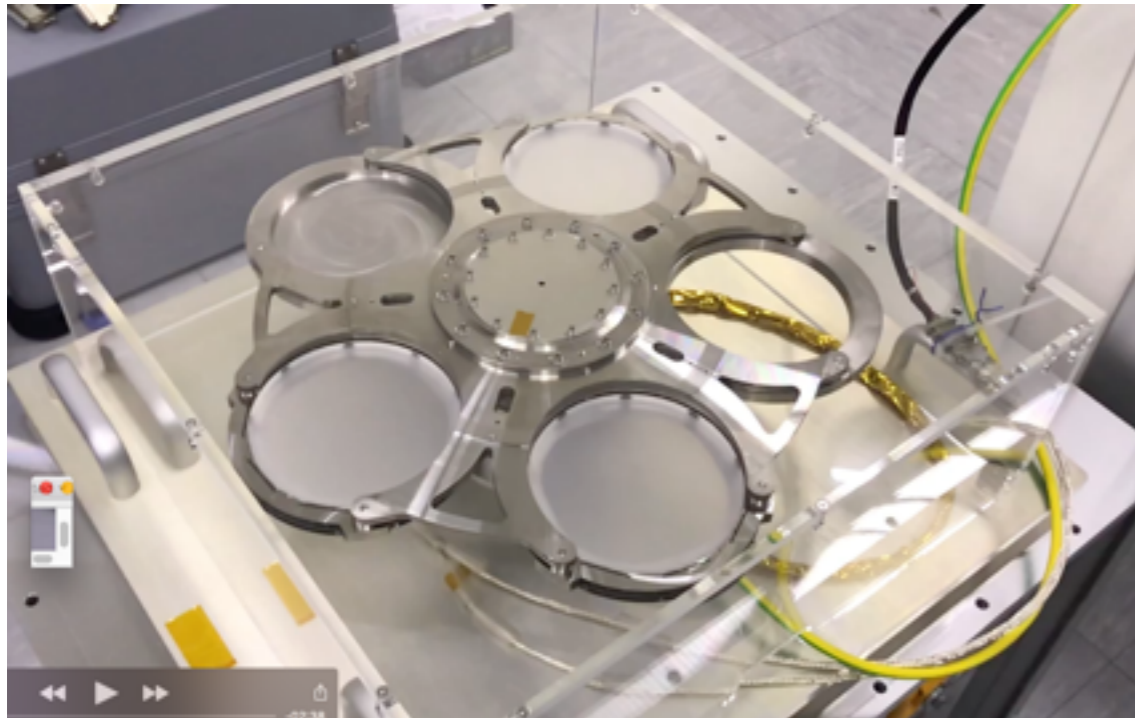
# In aggiunta ai test AVM

- Integrazione ICU + 2 DPUs (EM + EQM) (flight conf.)
  - Verifica e debug SW ICU e DPU
  - Verifica acquisizione sincronizzata 2 DPUs  $\Delta t = 6.8$  ns



Tbase	-76.4 ns	Trigger	UI UC
	20.0 ns/div	Stop	1.238 V
500 S	2.5 GS/s	Edge	Neg
X1=	-1.2 ns	$\Delta X=$	6.8 ns
X2=	5.6 ns	$1/\Delta X=$	147 MHz

Channel	DCIM	DCIM
200 mV/div	200 mV/div	
-1.65500 V	-1.03500 V	
1.42595 V	1.45935 V	
942.22 mV	1.44918 V	
$\Delta y$ -483.72 mV	$\Delta y$ -10.18 mV	



- ### Integrazione NISP WE con Grism Wheel (GWA) EQM
- Verifica telecomando e telemetrie
  - Verifica procedura di home-search e home-check non possibile con simulatori

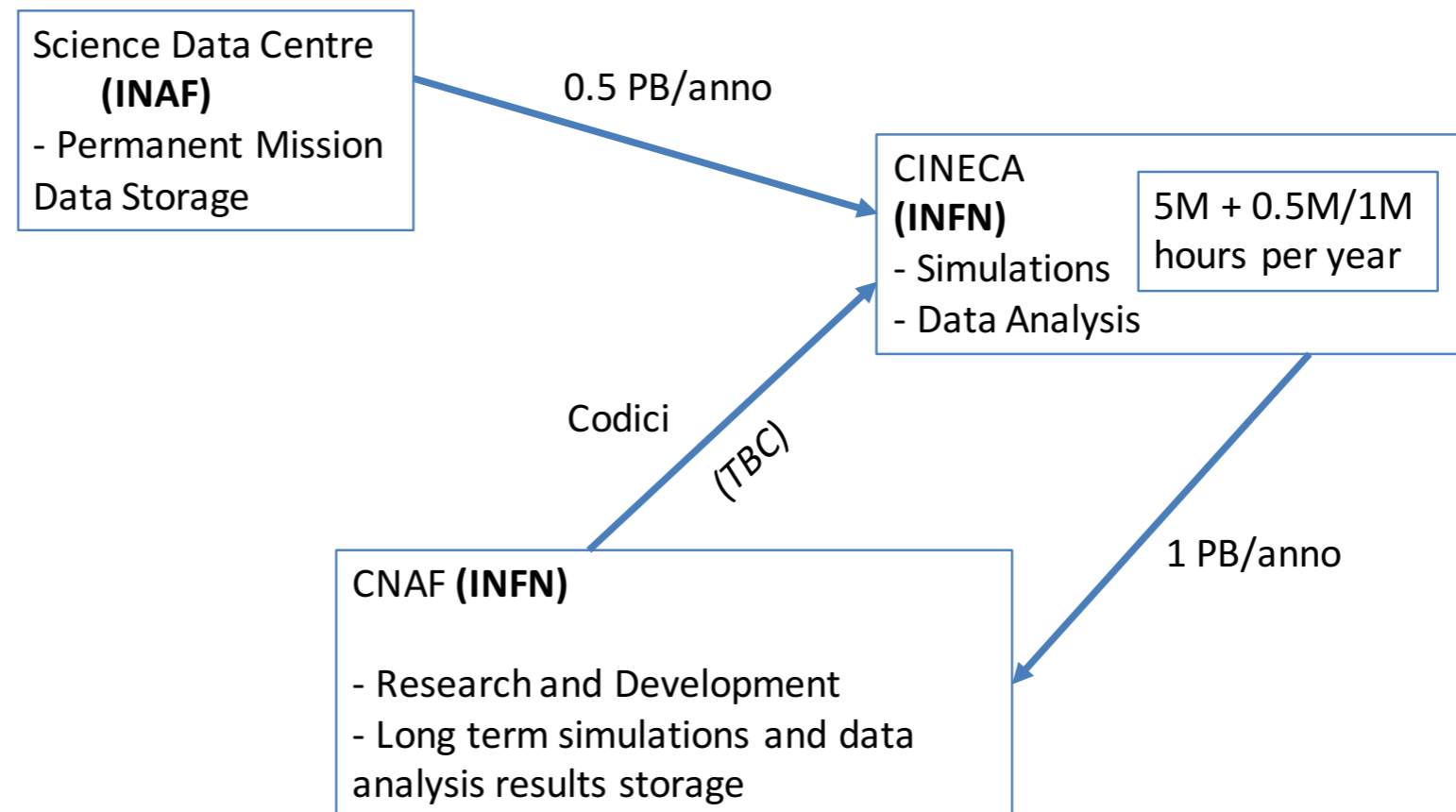


# Attività' di analisi

- Da settembre 2017 il gruppo di e' allargato. **Alessandro Renzi** art.36 INFN su fondi ASI, contratto fino fine 2019.
- Grande esperienza in analisi dati (Planck)
- **Co-leadership** del work package **Euclid WP3**: Correlation of Cosmic Microwave Background lensing with Large Scale Structures Tracers
  - ➔ Sviluppare un estimatore di cross-correlazione tra il lensing della CMB di Planck (o di nuovi CMB dataset suborbitali) e le strutture di grande scala mappate da Euclid (es. cataloghi di redshift di galassie o Euclid weak lensing);
- Validazione algoritmi di calcolo del Power Spectrum

## Calcolo per Euclid

Riunione computing in CSNII il 25 giugno 2018, ai Caprettari.  
Presenti: Lucchesi (presidente CCCS), Zoccoli, Masiero (Giunta), Pallavicini, Ferroni  
Presentato il modello di calcolo per Euclid: **stamped!**  
(con un TBC a breve sulla mini-farm HPC al CNAF e/o a Pisa-Tier2 per development)



# Anagrafica + richieste

Rapp. Nazionale: Luca Stanco  
Rapp. Locale: Stefano Dusini

Responsibilita':

S.Dusini:

NISP AIV deputy Manager

A.Renzi:

Co-lead Euclid WP3

C.Sirignano:

ECDC member

Nome	Contratto	Qualifica	Aff. CSN	Percentuale
Bartolo Nicola	Associato	Prof. Associato	4	10
Benevento Gianpaolo	Associato	Dottorando	4	10
Bertacca Daniele	Associato	Ricercatore DFA	4	10
Dusini Stefano	Dipendente	Ricercatore INFN	2	70
Karagiannis Dionysios	Associato	Assegnista	4	10
Laudisio Fulvio	Associato	Dottorando	2	100
Liguori Michele	Associato	Ricercatore DFA	4	10
Matarrese Sabino	Associato	Prof. Ordinario	4	10
Naletto Giampiero	Associato	Prof. Associato	2	10
Renzi Alessandro	Dipendente	Ricercatore INFN	2	100
Sirignano Chiara	Associato	Ricercatore DFA	2	70
Stanco Luca	Dipendente	Dirigente Ricerca	2	60
Ventura Sandro	Dipendente	Primo Tecnologo	2	10
<b>Totale</b>				<b>4,8</b>

## Richieste finanziarie:

- ~25 k turni/attività LAM (Marsiglia) integrazione FM NISP
- ~ 5k per attività coordinamento/responsabilità
- 10 k collaboration & progress meeting
- 4 k conferenze
- Consumo: 4k
- Trasporti: 3k
- Licenze VxWorks: 13.5K