

Euclid: les dernières nouvelles

<http://www.euclid-ec.org>

La mission Euclid

Understand the origin of the Universe's accelerating expansion

- Constrain parameters that characterise properties of a broad range of dark energy (DE) and modified gravity (MG) models
- Design surveys that can distinguish DE, MG, DM effects by... :
 - using at least 2 independent, complementary probes (**5 probes**)
 - tracking their observational signatures on the
 - geometry of the Universe:
 - Weak Lensing (WL), Baryon Acoustic Oscillations(BAO),
 - cosmic history of structure formation:
 - WL, Redshift-Space Distortion, Clusters of Galaxies
 - controlling systematic residuals to a very high level of accuracy.

SURVEYS In ~5.5 years					
	Area (deg ²)	Description			
Wide Survey	15,000 deg²	Step and stare with 4 dither pointings per step.			
Deep Survey	40 deg²	In at least 2 patches of > 10 deg ² 2 magnitudes deeper than wide survey			
PAYLOAD					
Telescope	1.2 m Korsch, 3 mirror anastigmat, f=24.5 m				
Instrument	VIS	NISP			
Field-of-View	0.787×0.709 deg ²	0.763×0.722 deg ²			
Capability	Visual Imaging	NIR Imaging Photometry			NIR Spectroscopy
Wavelength range	550– 900 nm	Y (920-1146nm),	J (1146-1372 nm)	H (1372-2000nm)	1100-2000 nm
Sensitivity	24.5 mag 10σ extended source	24 mag 5σ point source	24 mag 5σ point source	24 mag 5σ point source	3 10 ⁻¹⁶ erg cm ⁻² s ⁻¹ 3.5σ unresolved line flux
	Shapes + Photo-z of $n = 1.5 \times 10^9$ galaxies			z of $n = 5 \times 10^7$ galaxies	
Detector Technology	36 arrays 4k×4k CCD	16 arrays 2k×2k NIR sensitive HgCdTe detectors			
Pixel Size	0.1 arcsec	0.3 arcsec			0.3 arcsec
Spectral resolution					R=250
Possibility other surveys: SN and/or μ-lens surveys, Milky Way ?					

The Euclid mission... in one slide



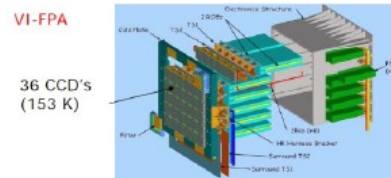
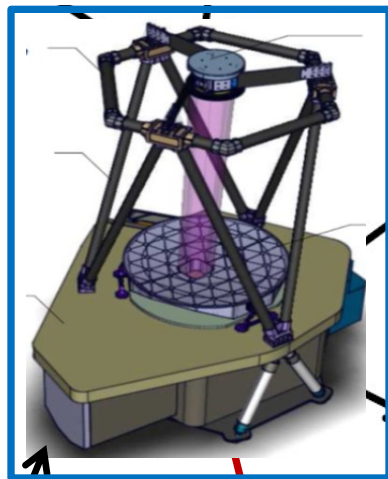
Soyuz@Kourou Q2 2020



ears



PLM+SVM: 2010-2019



VI-FPA
36 CCD's (153 K)



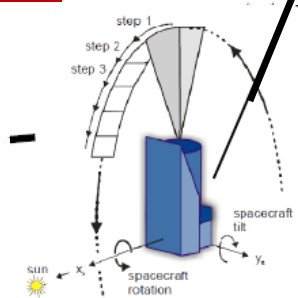
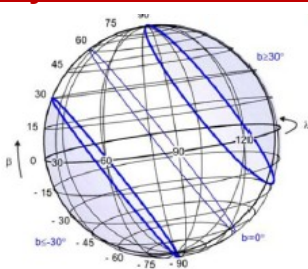
VI-RSU
One leaf shutter
VIS



VI-Cal. Unit

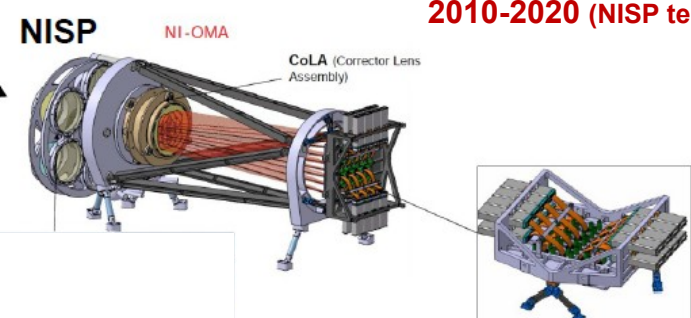
VIS imaging: 2010-2020
(VIS team)

Surveys: 2010-2028 (Survey WG)



6 yrs mission

- Commissioning – Sc. Verif.
- Euclid nominal in operation: 5.5 yrs of Euclid Wide+Deep
- Euclid+: Additional surveys: SNIa, mu-lens, Milky Way?

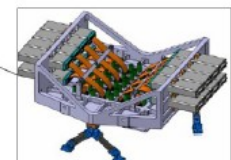


NISP

NI-OMA

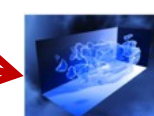
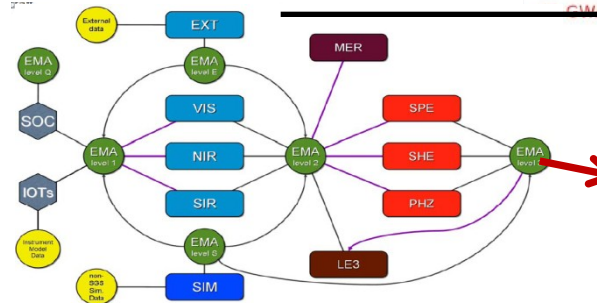
CoLA (Corrector Lens Assembly)

NIR spectro-imaging 2010-2020
(NISP team)

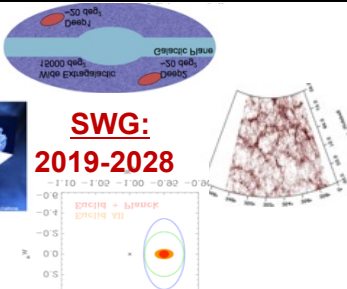


NI-FPA (16 detectors)

SGS: 2010-2028



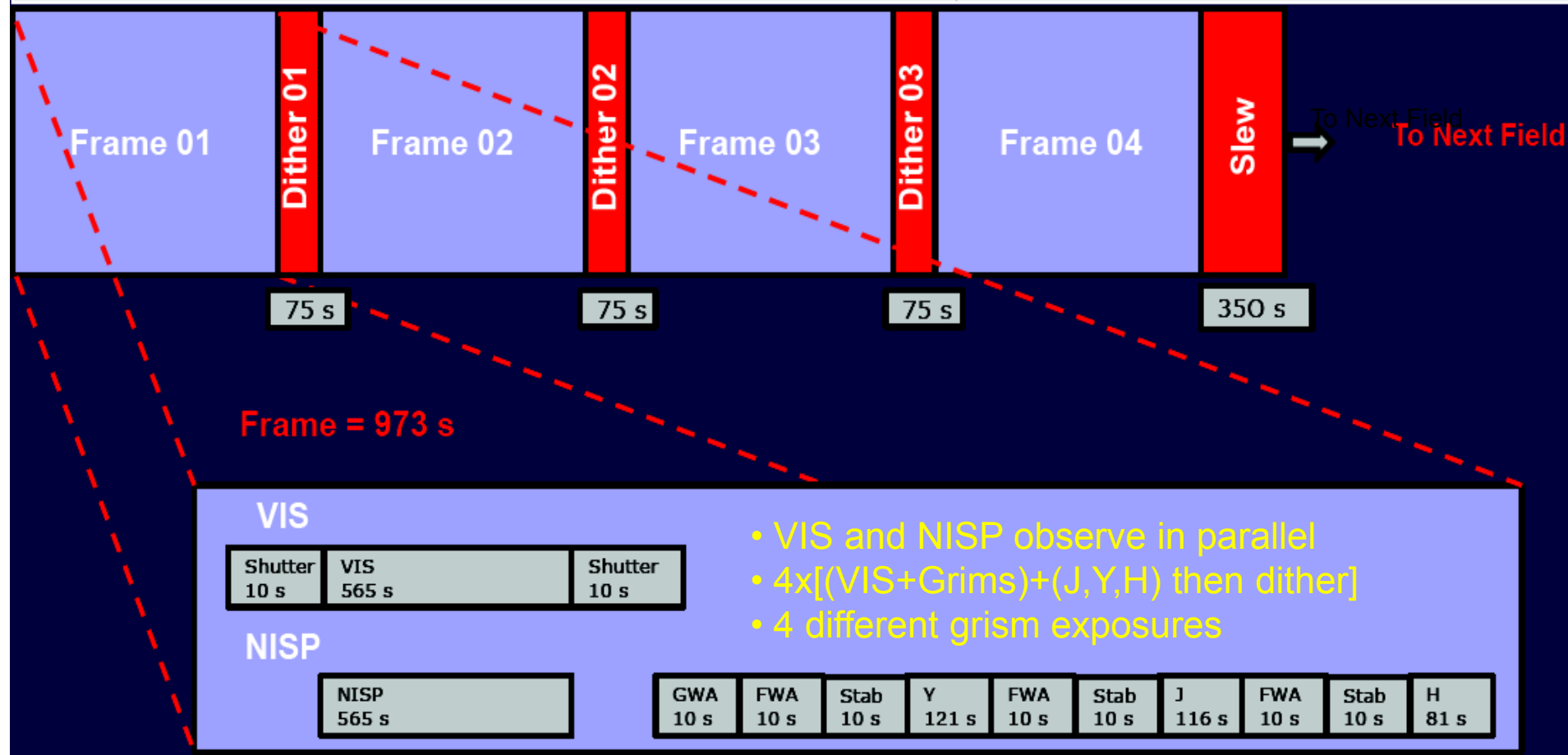
SWG: 2019-2028



20-30 PB data processing (EC-SGS team) – Science analyses

Total Field of View observation time (time between 2 fields observations):

• Reference Case = $4 \times 973 \text{ s} + 3 \times 75 \text{ s} + 350 \text{ s} = 4467 \text{ s}$ ➔ Reference Field Sequence = 4500 s

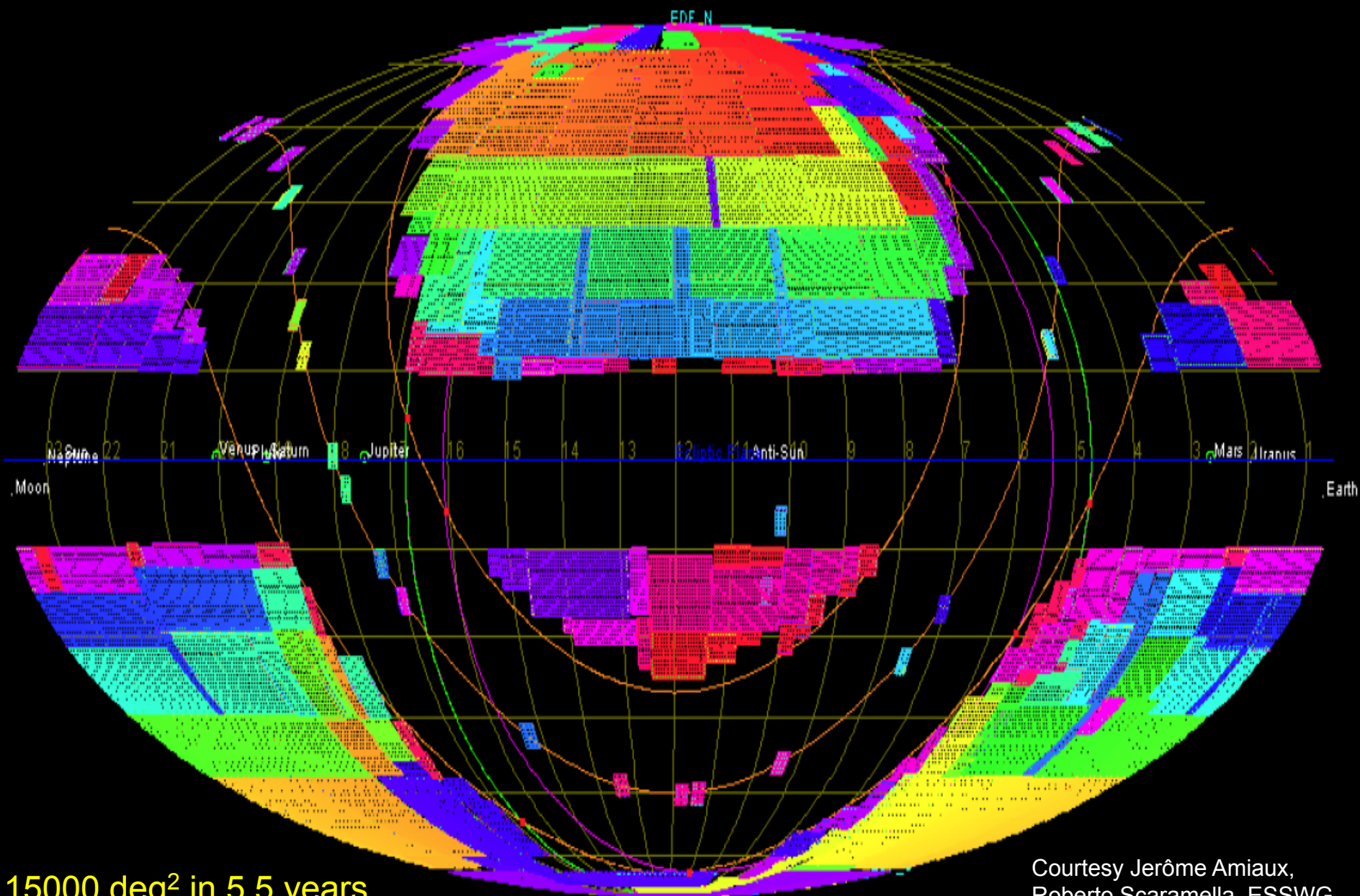


Courtesy Jérôme Amiaux, ESSWG

Data transfer to Earth: 4 hours/day

Euclid Deep+Wide survey model (MOCD-B)

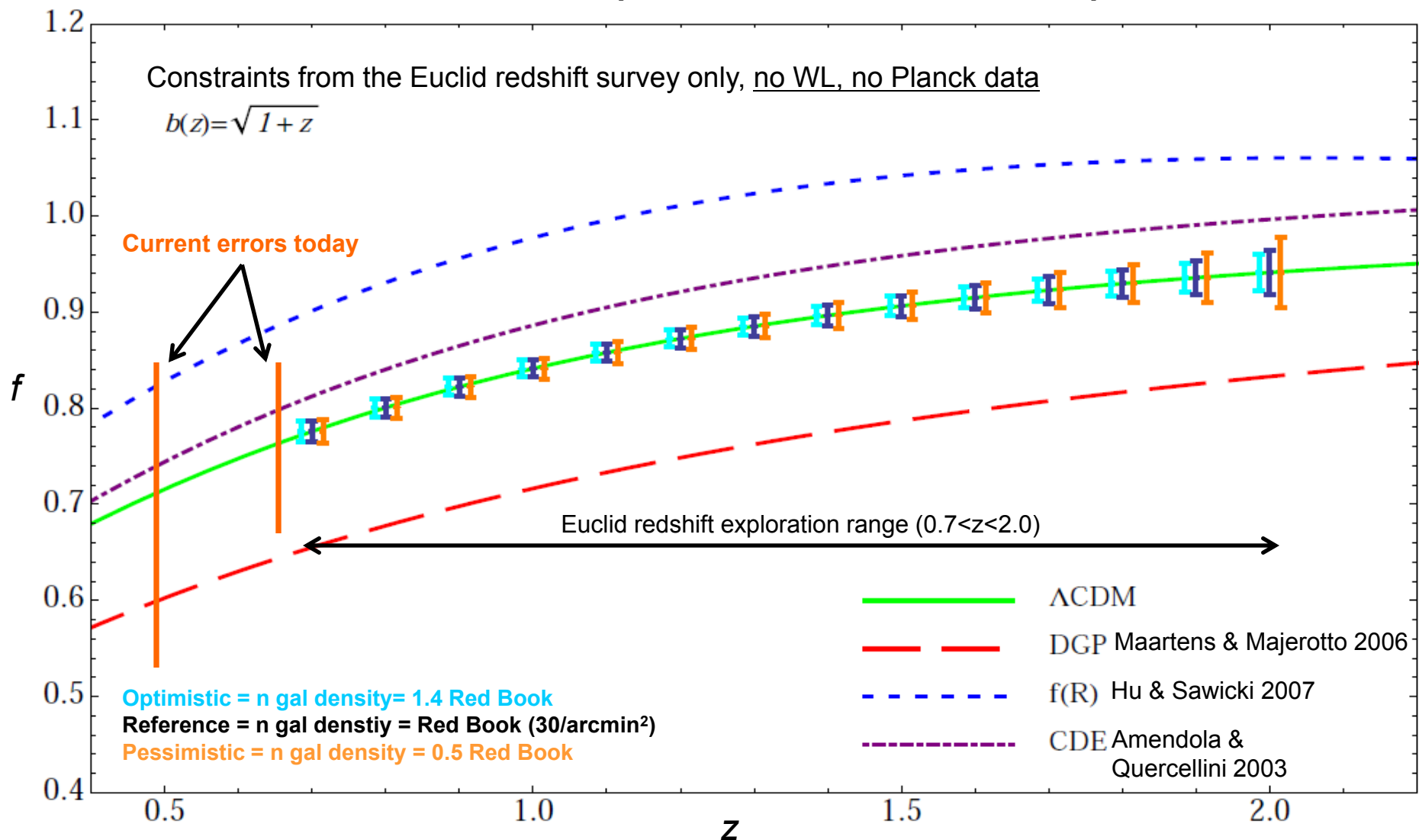
Euclid Consortium



15000 deg² in 5.5 years

Courtesy Jérôme Amiaux,
Roberto Scaramella, ESSWG

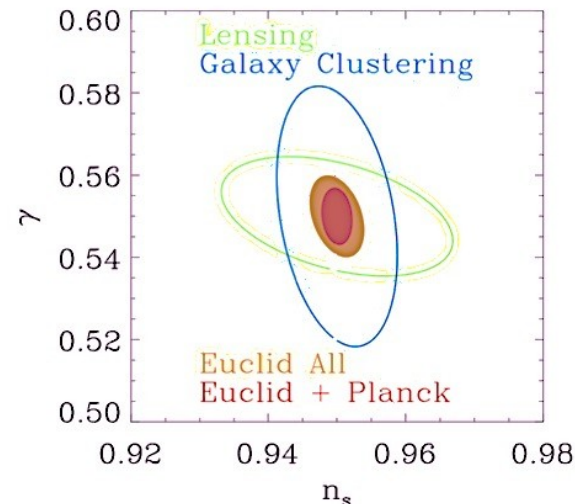
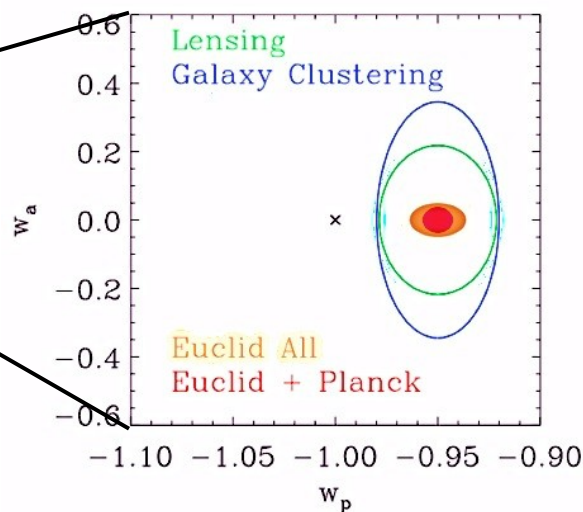
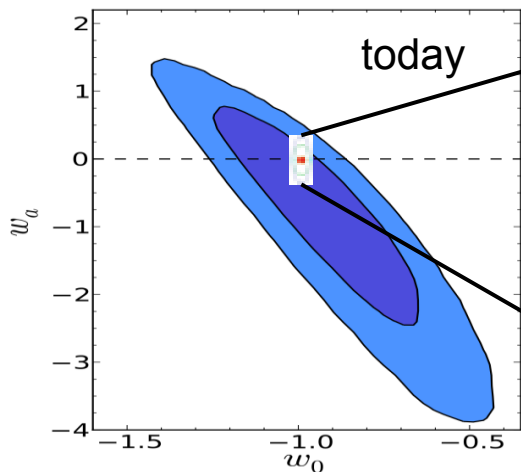
See Amendola et al 2012 for a comprehensive review of model exploration with Euclid



Amendola et al arXiv:1206.1225

DE constraints from Euclid:
68% confidence contours in (w_p, w_a) .

Constraints on γ and n_s . Errors marginalised over all other parameters.



	Modified Gravity	Dark Matter	Initial Conditions	Dark Energy		
Parameter	γ	m_ν / eV	f_{NL}	w_p	w_a	FoM
Euclid primary (WL+GC)	0.010	0.027	5.5	0.015	0.150	430
Euclid All	0.009	0.020	2.0	0.013	0.048	1540
Euclid+Planck	0.007	0.019	2.0	0.007	0.035	4020
Current (2009)	0.200	0.580	100	0.100	1.500	~10
Improvement Factor	30	30	50	>10	>40	>400

Laureijs et al 2011, Euclid RB arXiv:1110.3193 from Euclid SWG
Amendola et al arXiv:1206.1225

Assume systematic errors are under control

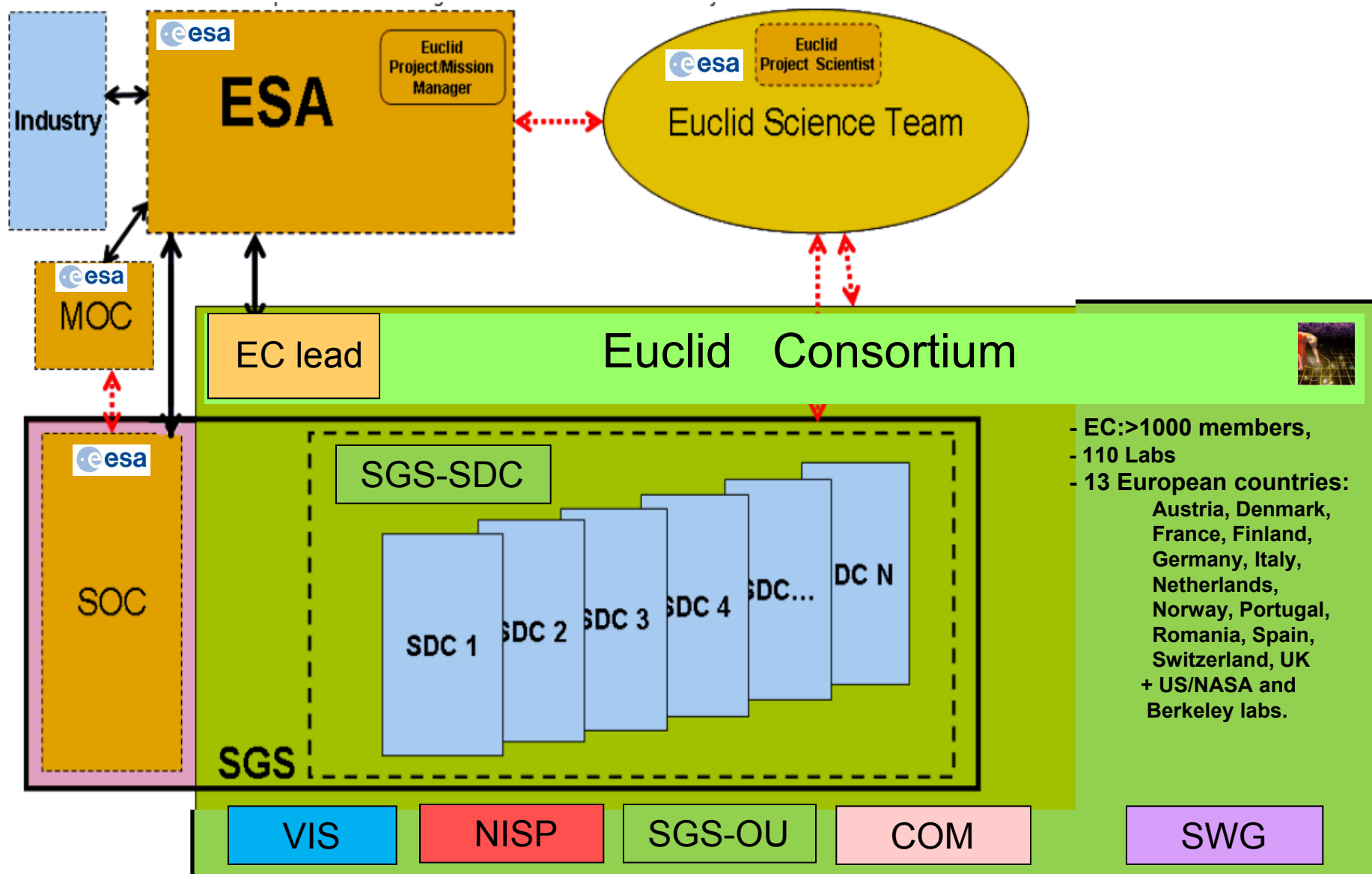
Dernières nouvelles

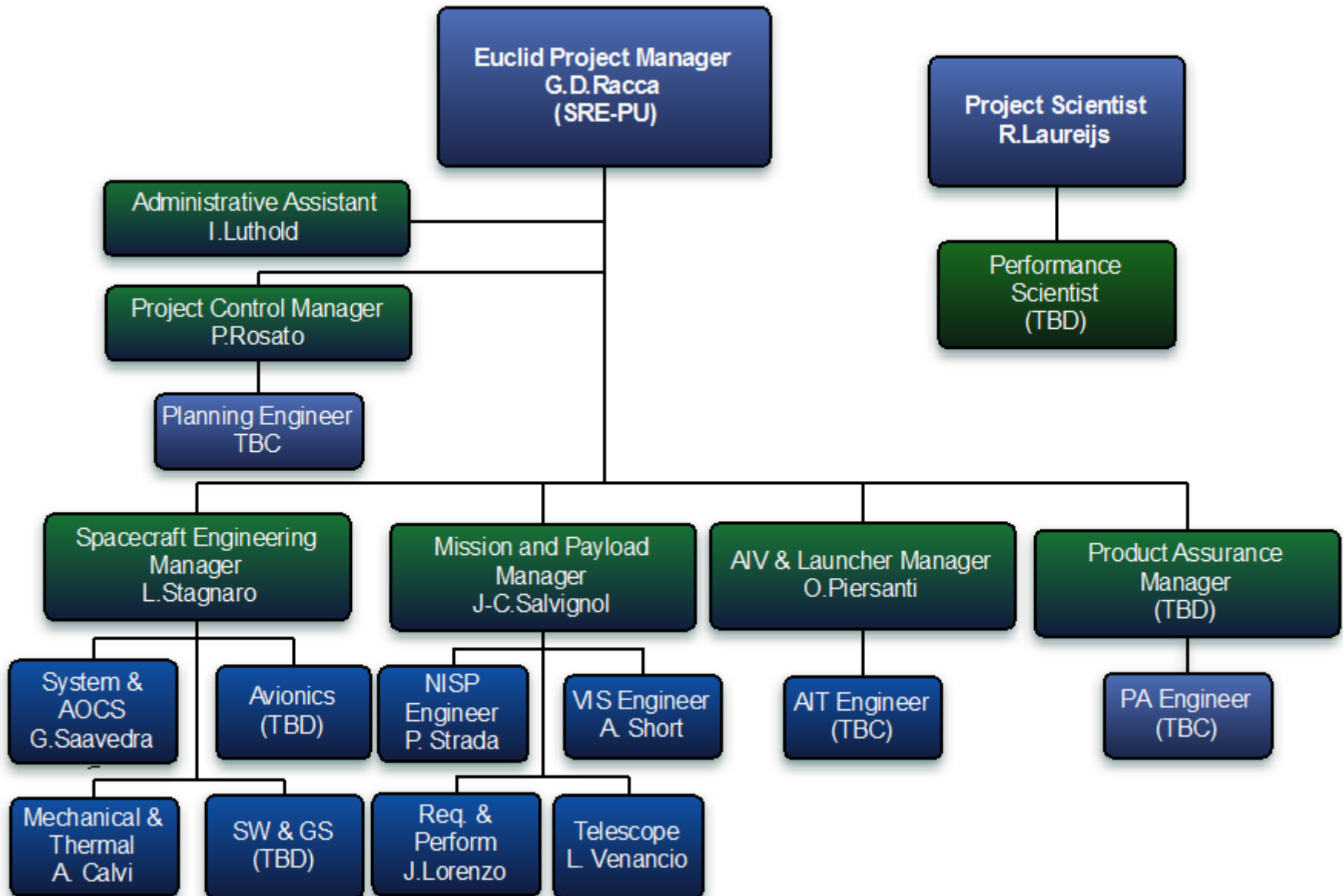
- **Adoption en juin 2012**, ... lancement en Q2 2020
- Mise en place de l'équipe projet Euclid-ESA
- Mise en place du Steering Committee
- EC continue à grandir → Euclid Consortium Membership Committee
- ESA-EC WGs: NISP detector, Survey, Système mission, Calibration

- Importante activité de documentation (EID-A, SPBD, GDPRD, SciRD, MOCD-A/B, CalCD-A/B, SAID, SWG-OU interface documents, etc...)
- Avancement ITTs : détecteurs NIR et VIS, PLM, SVM
- Avancement des instruments VIS et NISP
- **Préparation de la PRR SGS** (voir présentations SGS)
- **Sélection du PLM en cours**

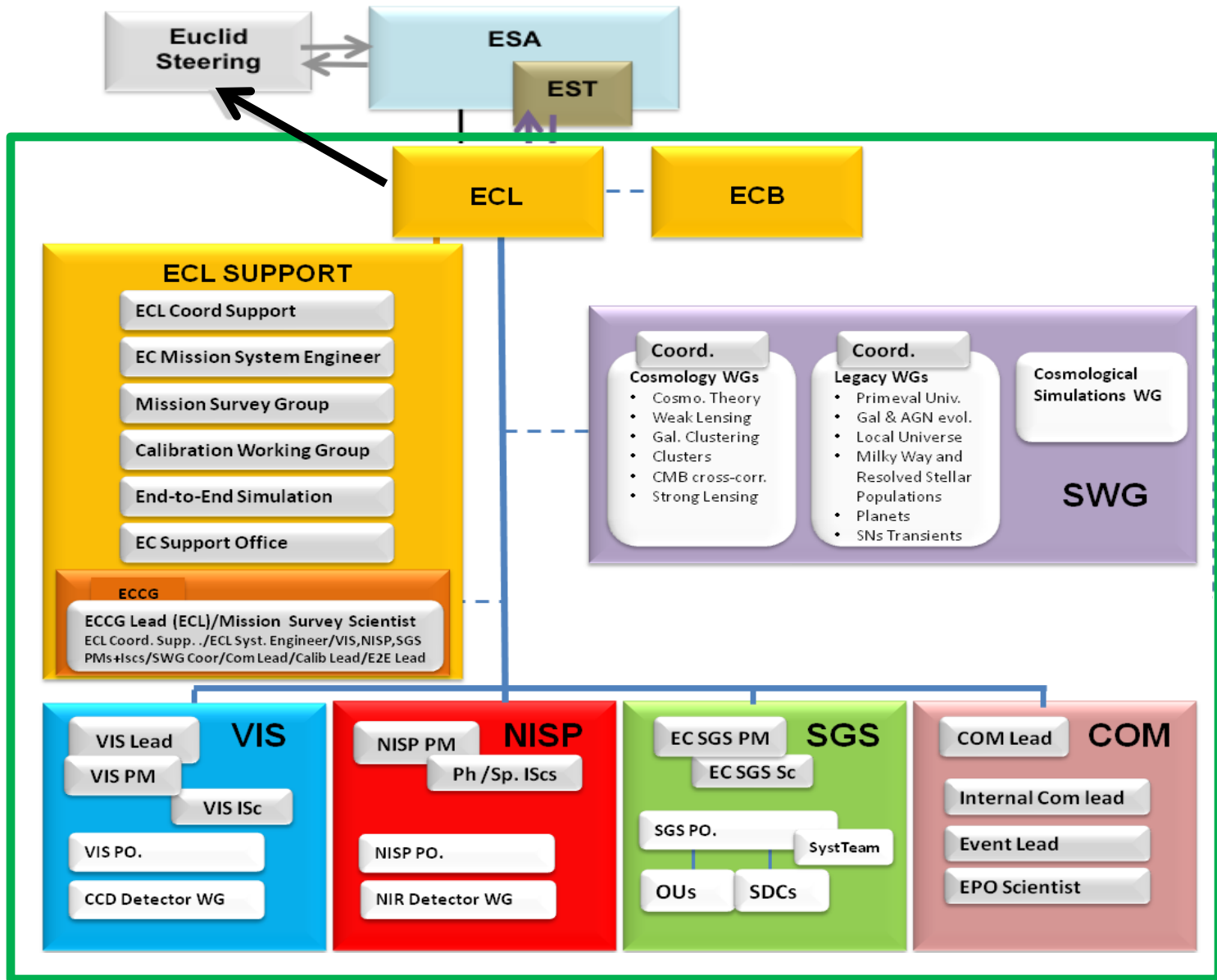
- Données externes imagerie visible sol et spectroscopie
- **Nouveaux partenaires: NASA**, possible : Canada/CSA, CSL-Belgique
- Data Level-Q et releases Euclid,

- Organisation des E2E simulations/performance en cours
- Préparation des règles de publications

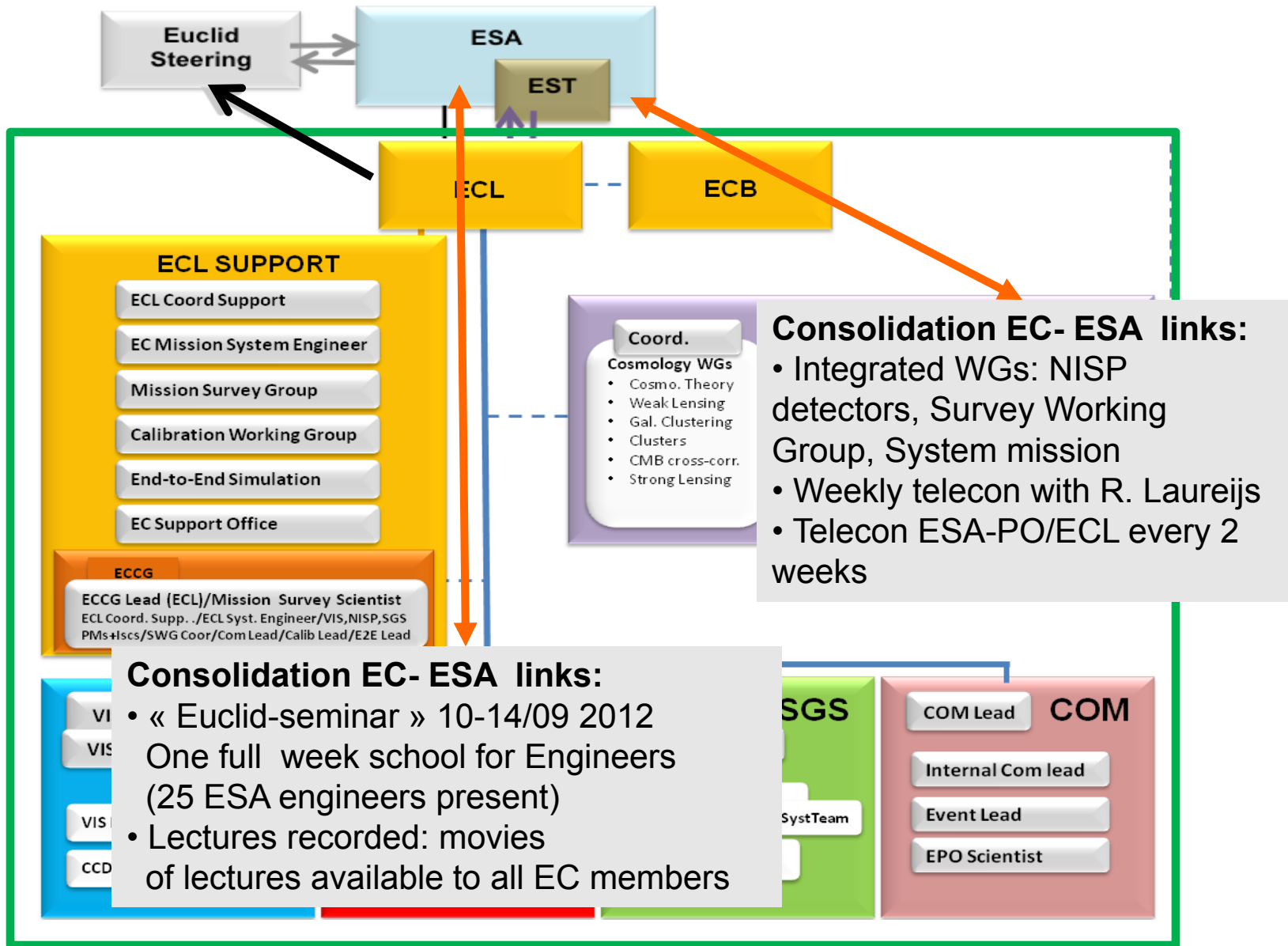




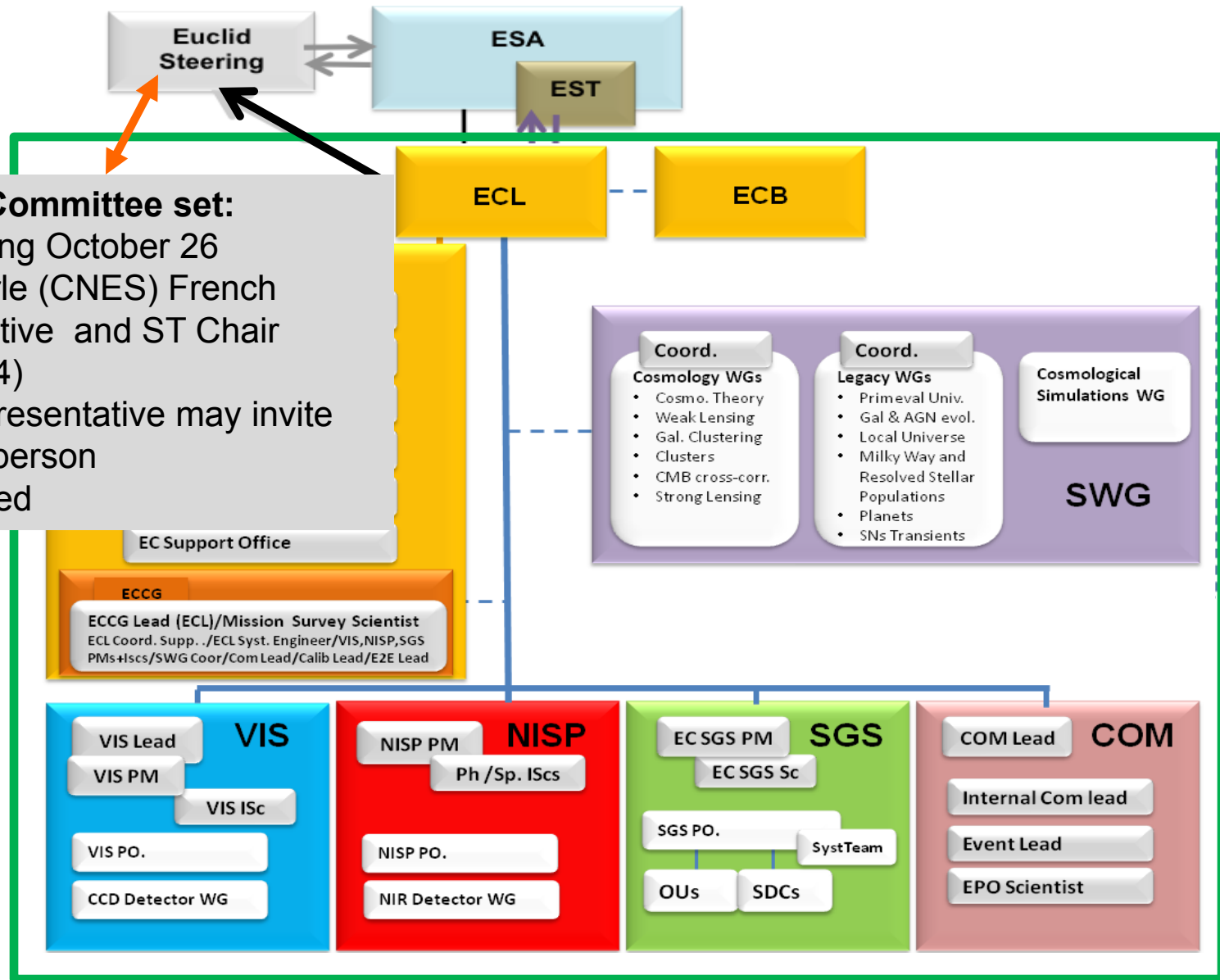
Euclid Consortium: organisation



Euclid Consortium: organisation



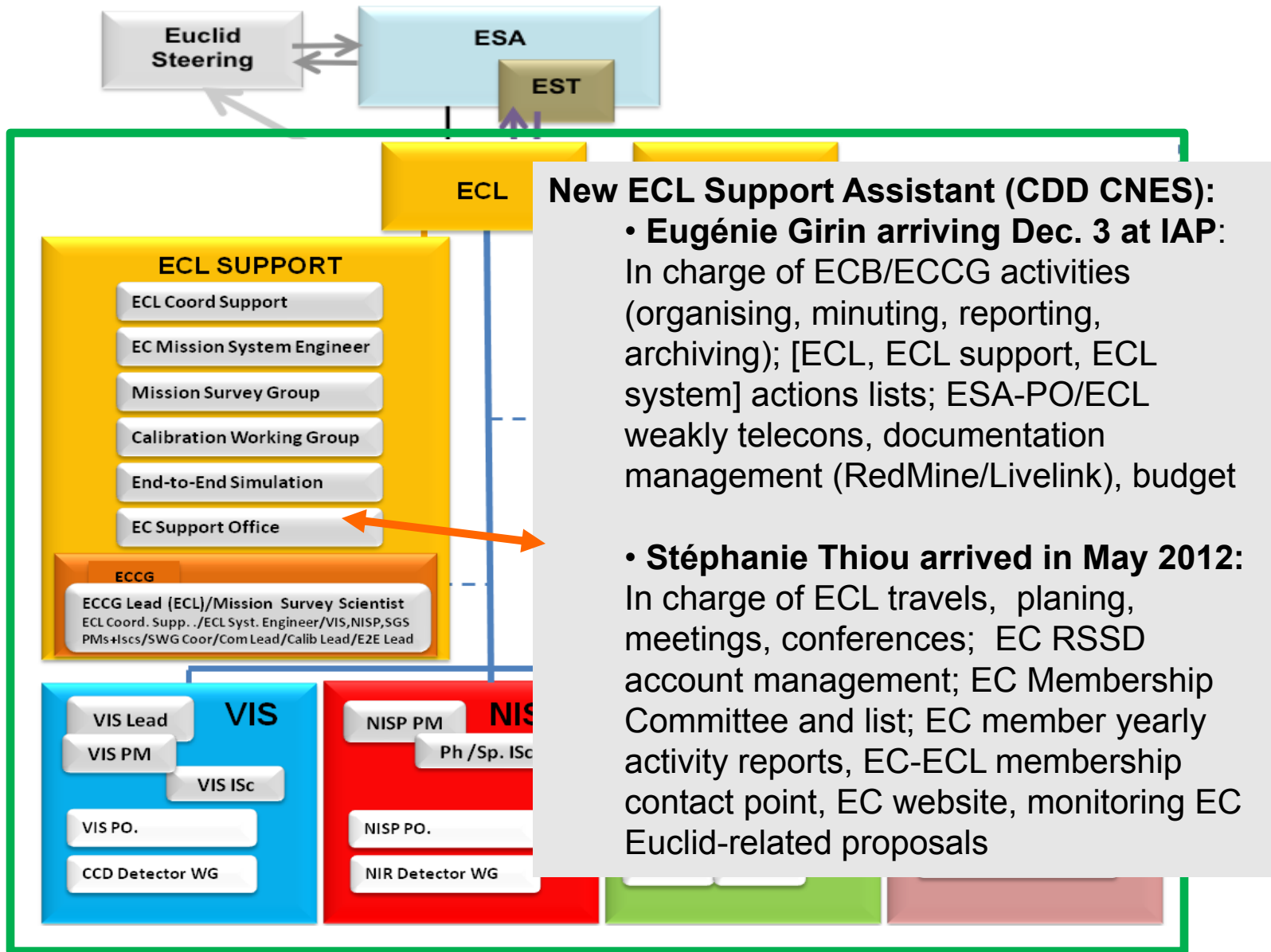
Euclid Consortium: organisation



Steering Committee set:

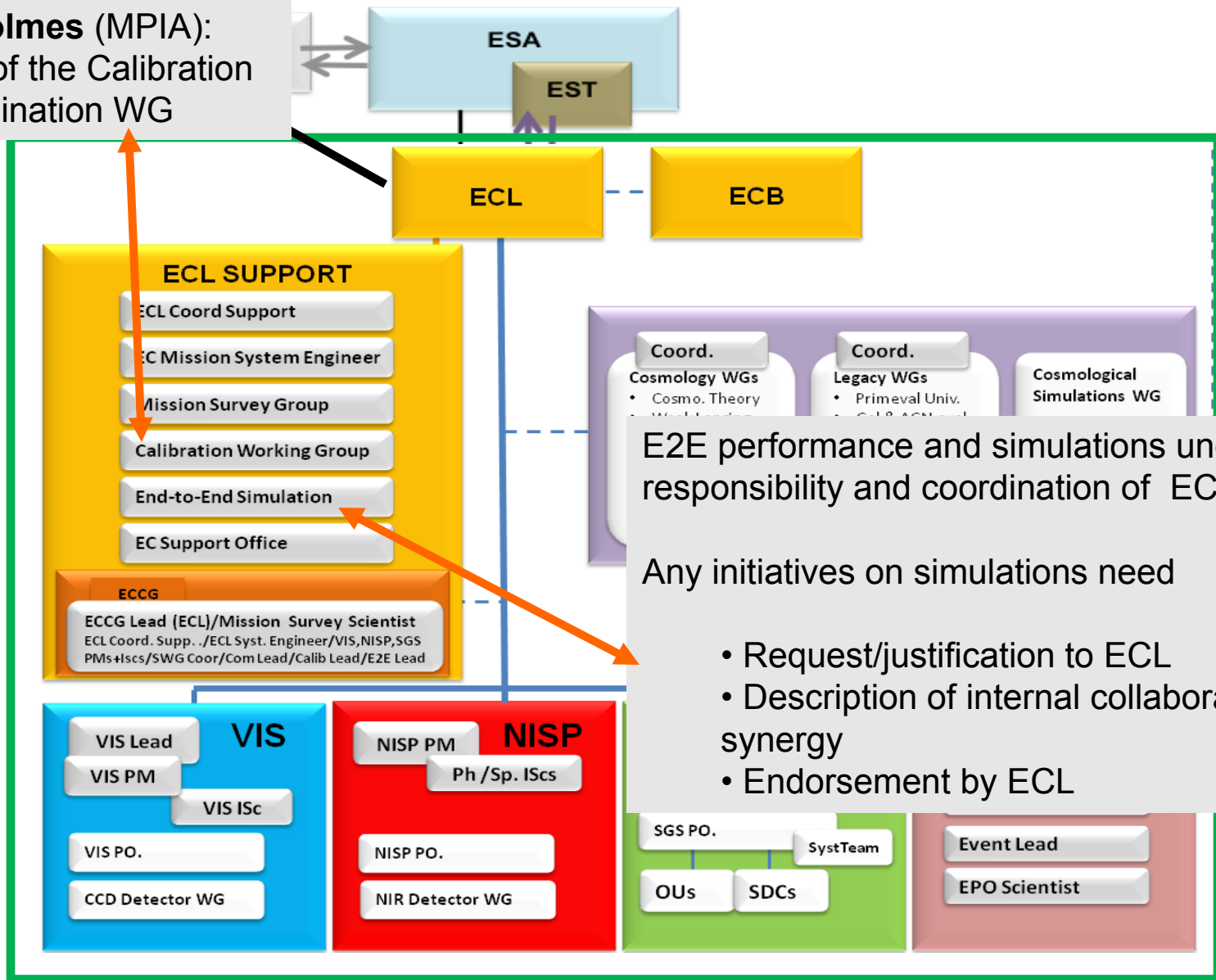
- 1st meeting October 26
- O. Lamarle (CNES) French representative and ST Chair (2012-2014)
- Each representative may invite one extra-person
- ECL invited

- **EC: ~1015 membres enregistrés (03/12/12):**
 - ~650 chercheurs
 - ~110 laboratoires/départements
 - Liste mise à jours tous les 4 mois (Octobre, Février, Juin): ECMC
 - Monitoring et rapport de chaque membre EC tous les 2 ans
- **13 +1 pays contributeurs:**
 - Autriche, Danemark, France, Finlande, Allemagne, Italie, Pays-Bas, Norvège, Portugal, Roumanie, Espagne, Suisse, UK
+ Contributions de labos de Berkeley.
 - (+1)=NASA en cours
 - Discussions (lentes): Canada/CSA, Belgique, Suède, Japon
 - Expression d'intérêt: Corée du Sud, Brésil, Chine
- **Conférences annuelles:**
 - 2010: Paris
 - 2011: Bologna
 - 2012 : Copenhague
 - **2013 : Leiden**
 - 2014 : Marseille ? (TBC)
 - 2015 : Lausanne



Euclid Consortium: organisation

R. Holmes (MPIA):
lead of the Calibration
coordination WG

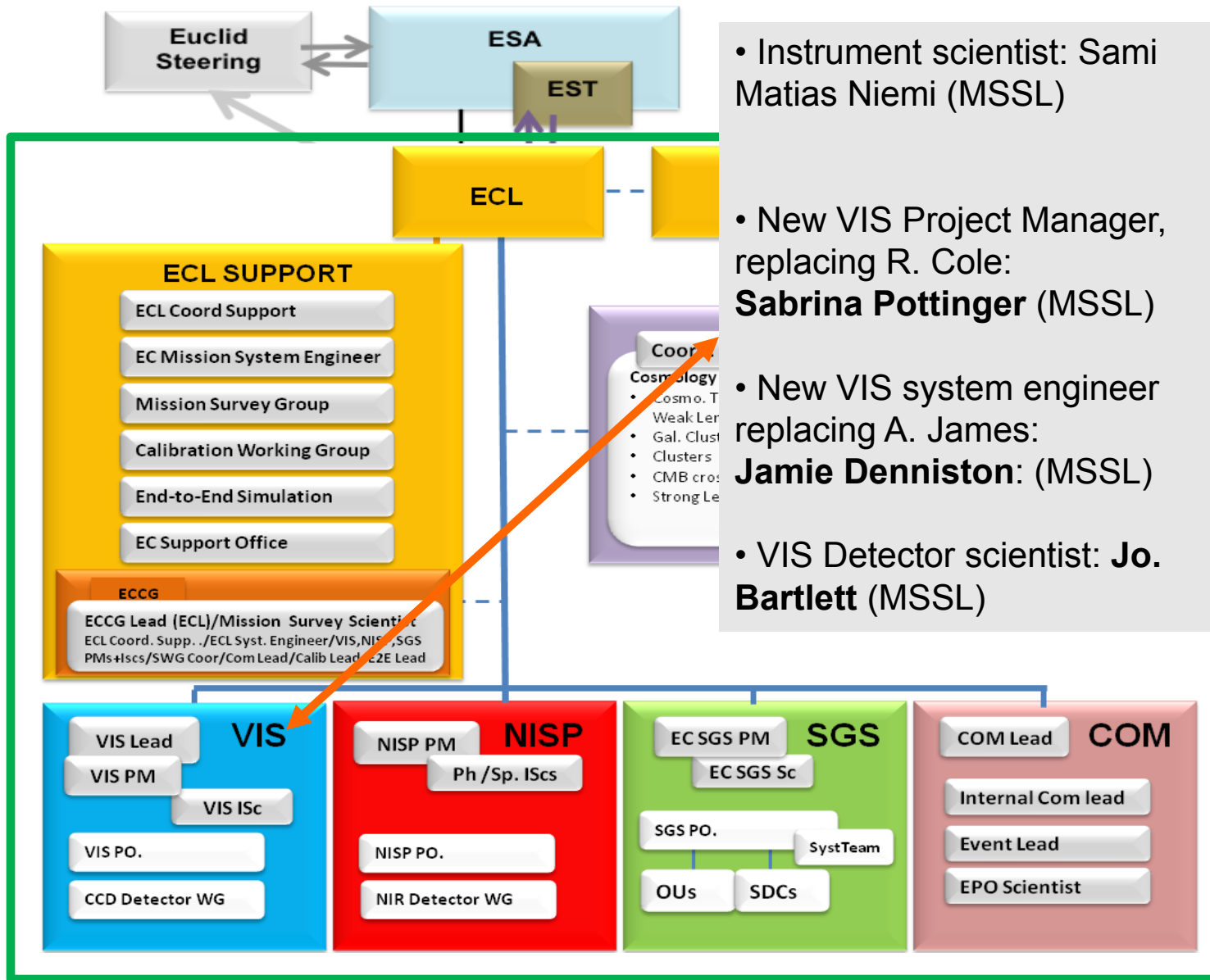


E2E performance and simulations under the responsibility and coordination of ECL

Any initiatives on simulations need

- Request/justification to ECL
- Description of internal collaborations/synergy
- Endorsement by ECL

Euclid Consortium: organisation



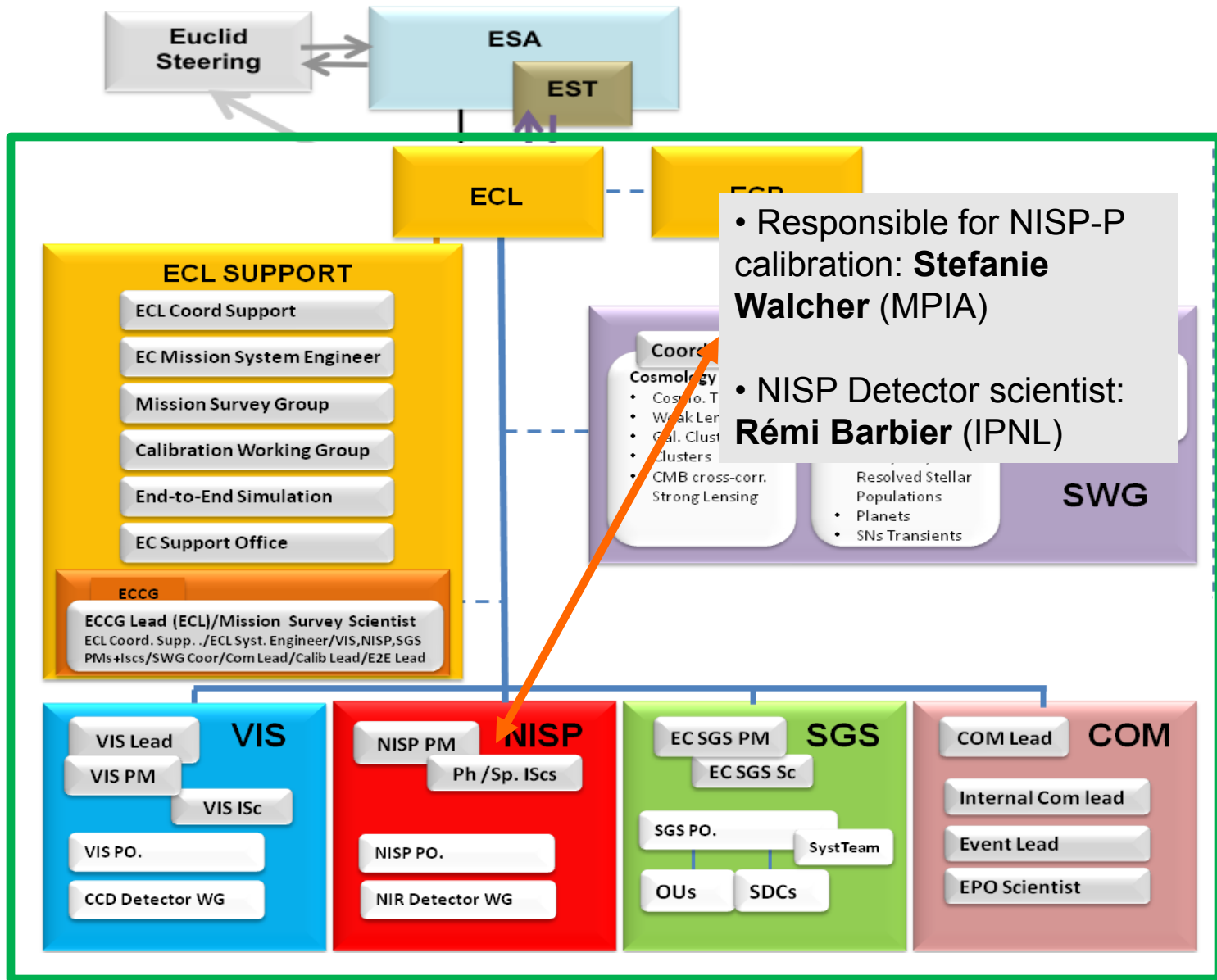
- Instrument scientist: Sami Matias Niemi (MSSL)

- New VIS Project Manager, replacing R. Cole: **Sabrina Pottinger** (MSSL)

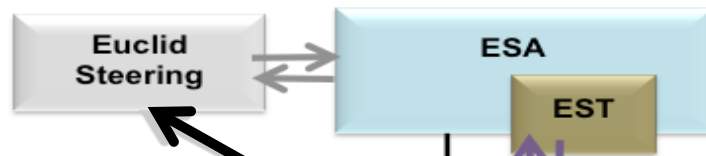
- New VIS system engineer replacing A. James: **Jamie Denniston**: (MSSL)

- VIS Detector scientist: **Jo. Bartlett** (MSSL)

Euclid Consortium: organisation

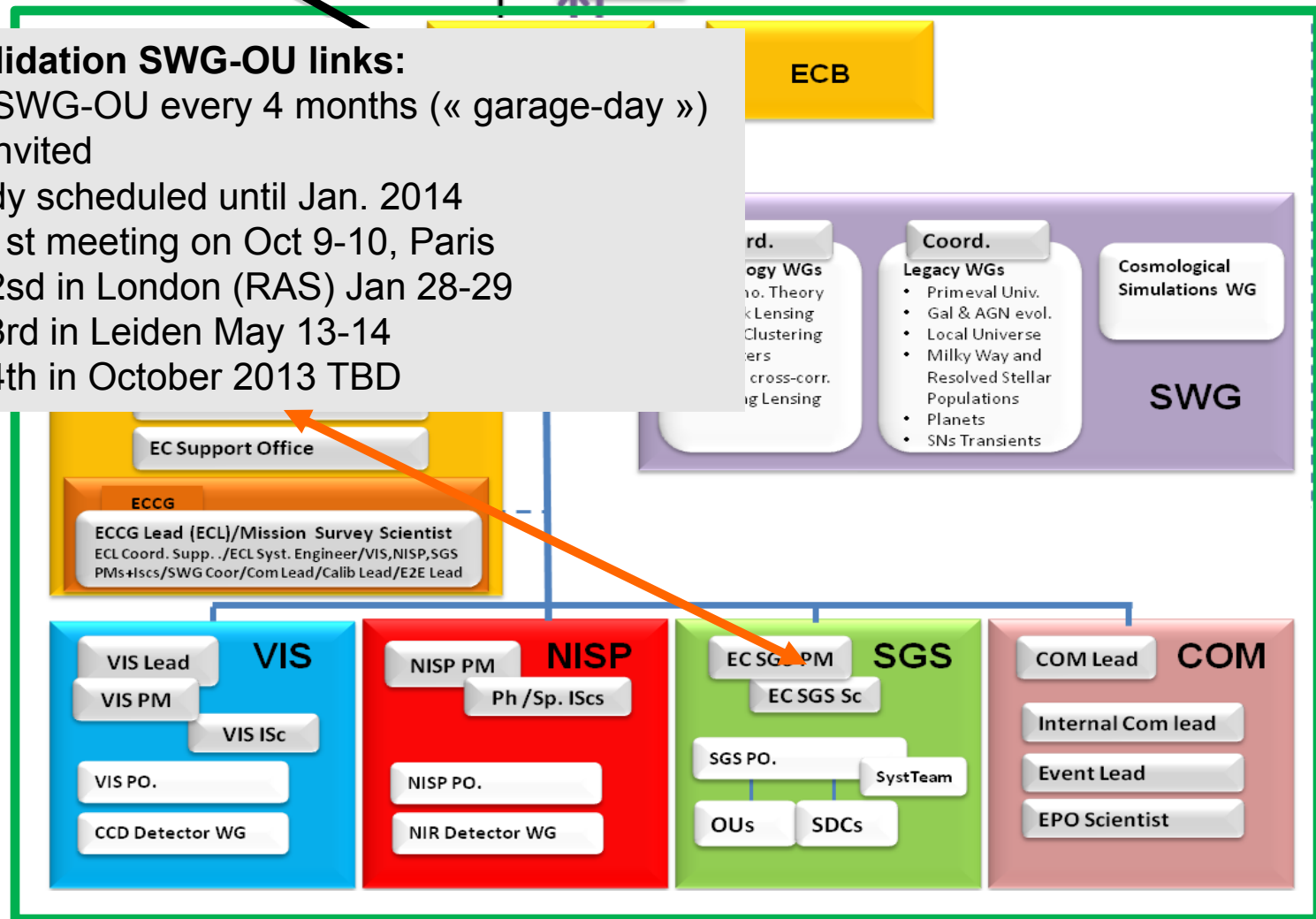


Euclid Consortium: organisation

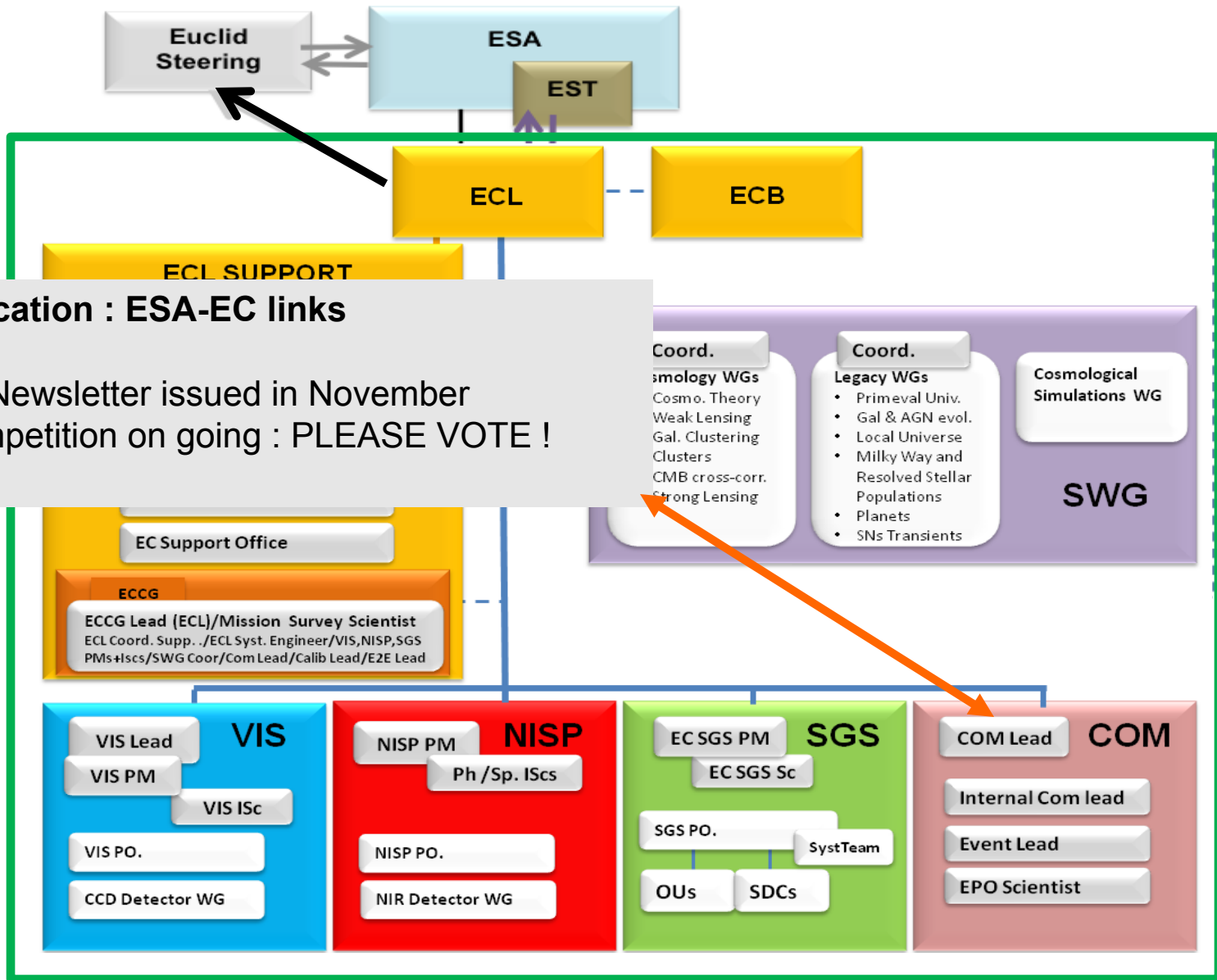


Consolidation SWG-OU links:

- Joint SWG-OU every 4 months (« garage-day »)
- ESA invited
- Already scheduled until Jan. 2014
 - 1st meeting on Oct 9-10, Paris
 - 2nd in London (RAS) Jan 28-29
 - 3rd in Leiden May 13-14
 - 4th in October 2013 TBD



Euclid Consortium: organisation



Communication : ESA-EC links

- 2nd EC Newsletter issued in November
- Logo competition on going : PLEASE VOTE !

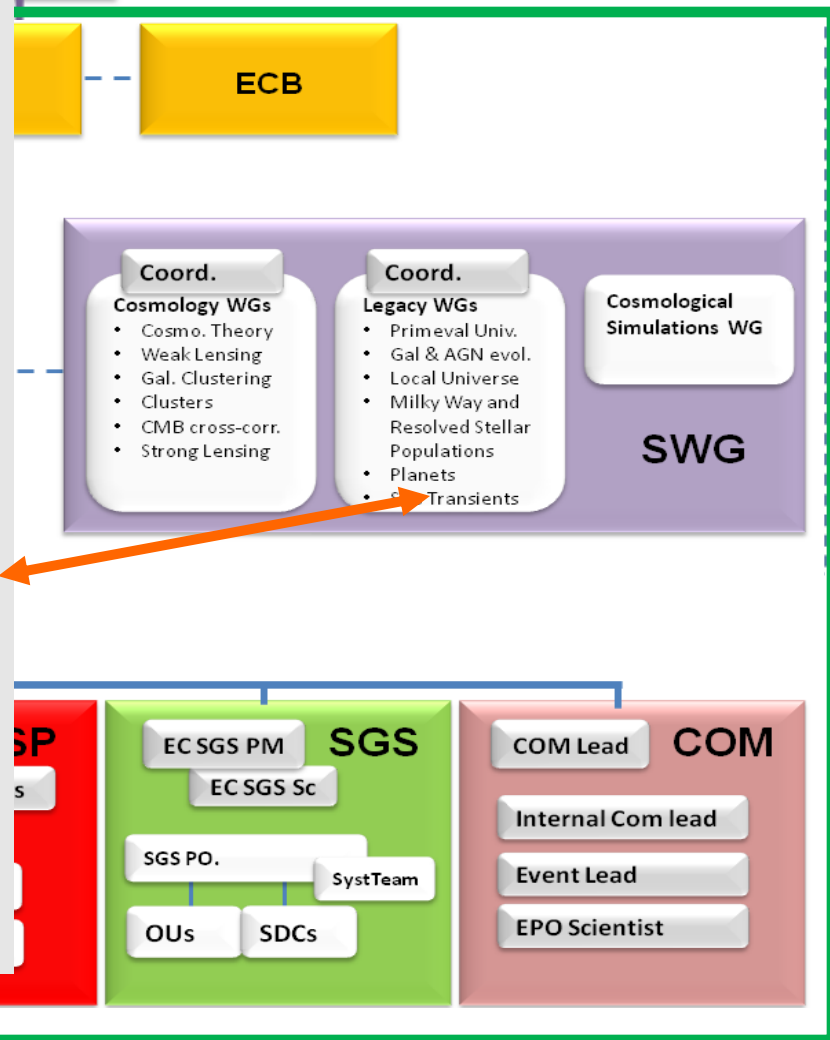
Euclid Consortium: coordinating proposals



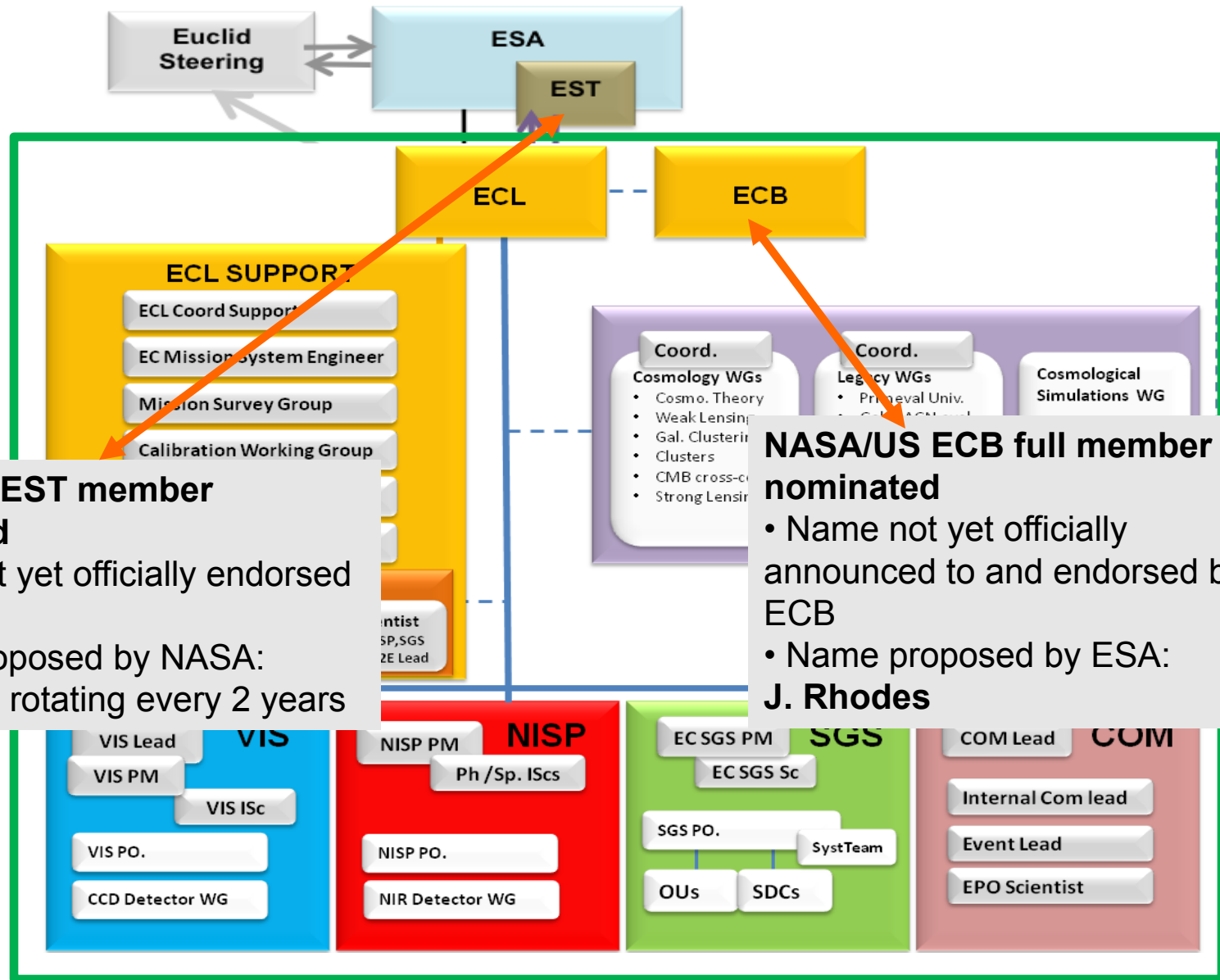
Important contributions to documentation activity and organisation of SWG WPs and SWG-OU organisation

European projects:
ERC and ITN in Nov. 22

- At least 5 ERC Euclid-related submitted
- At least 4 INT/SPACE Euclid-related submitted
- Only one officially supported by EC: letter of support endorsed by ECB from ECL joined to the proposal (cosmo simulations)
- Not controlled despite request: unknown number of Euclid-related proposals
- **Next year: EC will provide official letter of support to all proposals that will be sent to ECL/ECB.**



Euclid Consortium: organisation



NASA/US EST member nominated

- Name not yet officially endorsed by ESA
- Name proposed by NASA: **J. Rhodes** rotating every 2 years

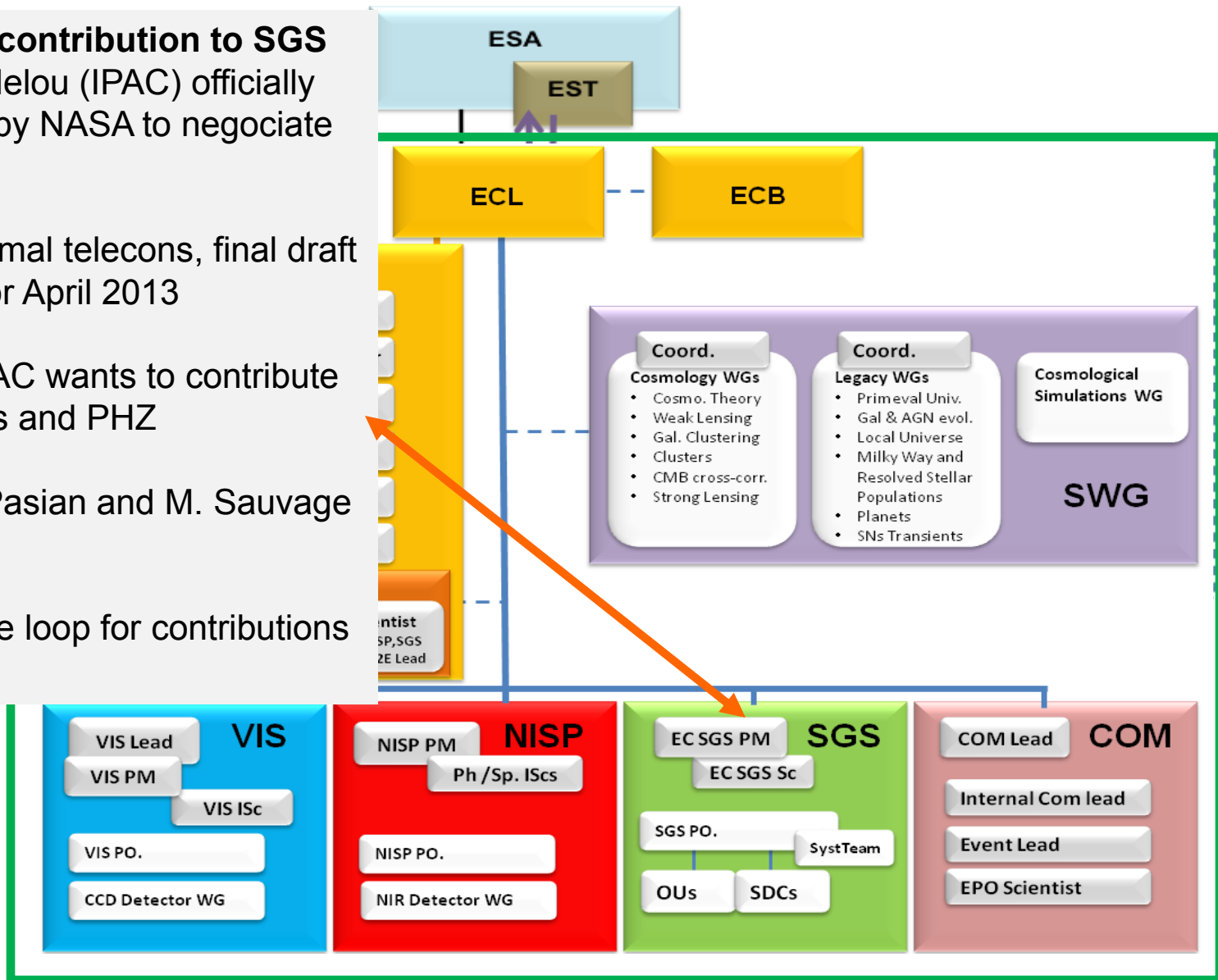
NASA/US ECB full member nominated

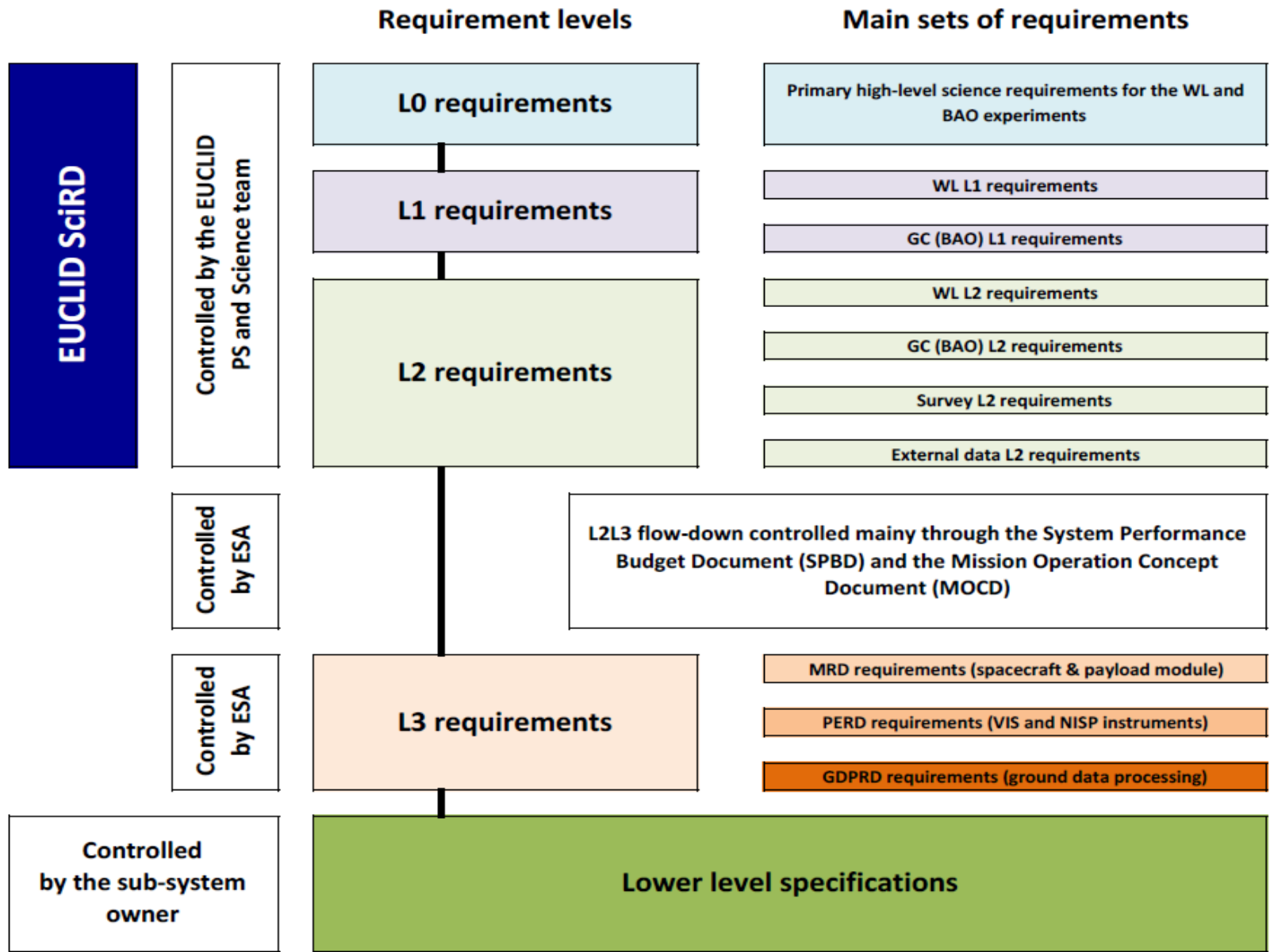
- Name not yet officially announced to and endorsed by ECB
- Name proposed by ESA: **J. Rhodes**

Euclid Consortium: organisation

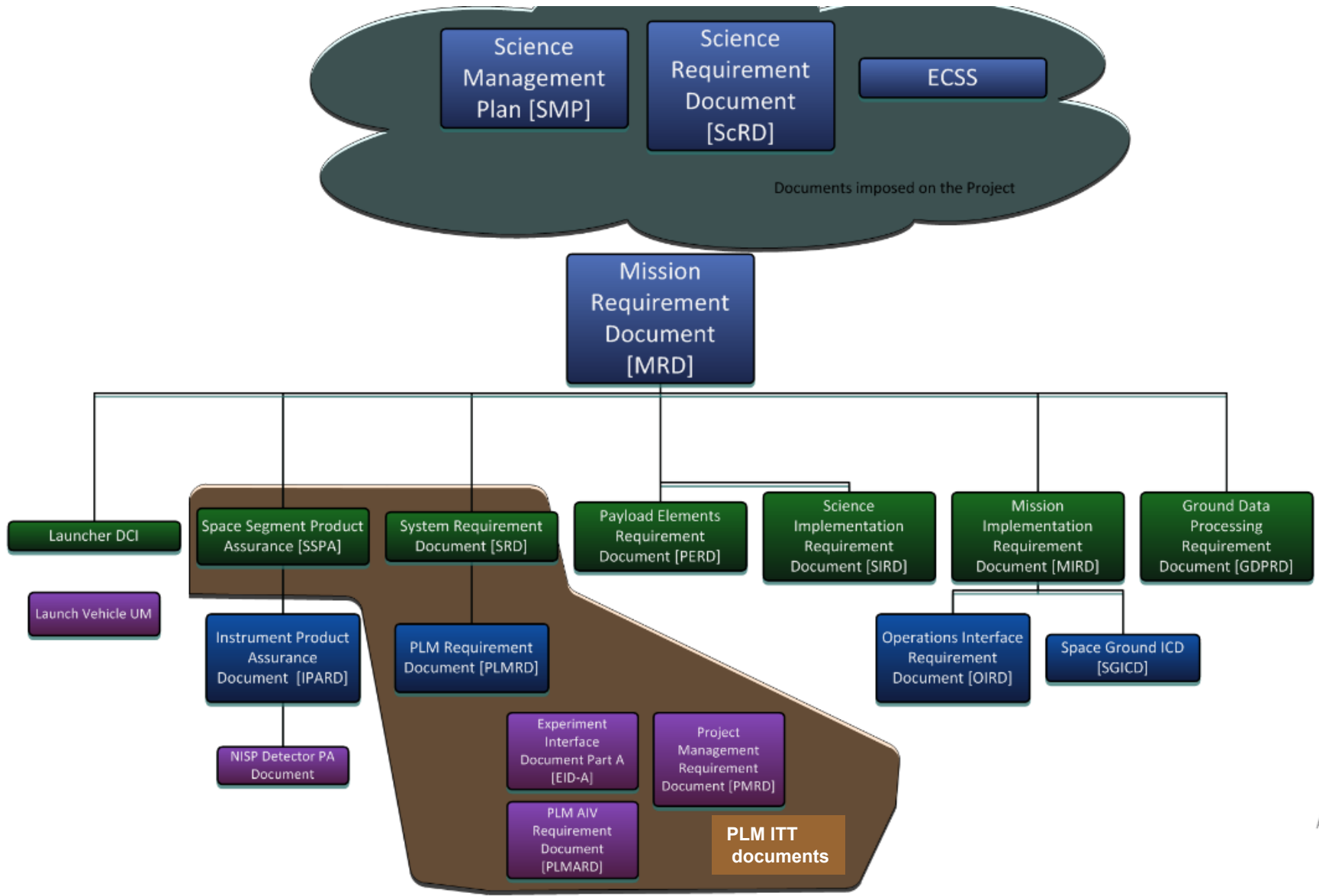
NASA/US contribution to SGS

- George Helou (IPAC) officially appointed by NASA to negotiate with ECL.
- Still unformal telecons, final draft proposal for April 2013
- NASA/IPAC wants to contribute to NIR OUs and PHZ
- ECB, F. Pasian and M. Sauvage in the loop
- ESA in the loop for contributions to SOC

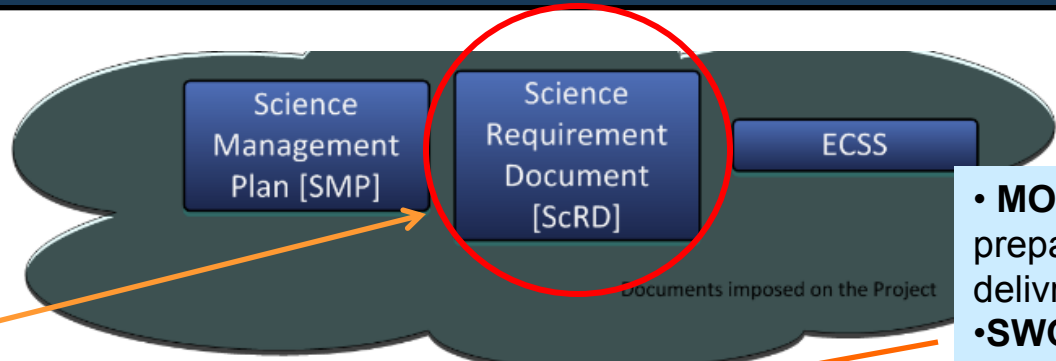




New organisation of documentation

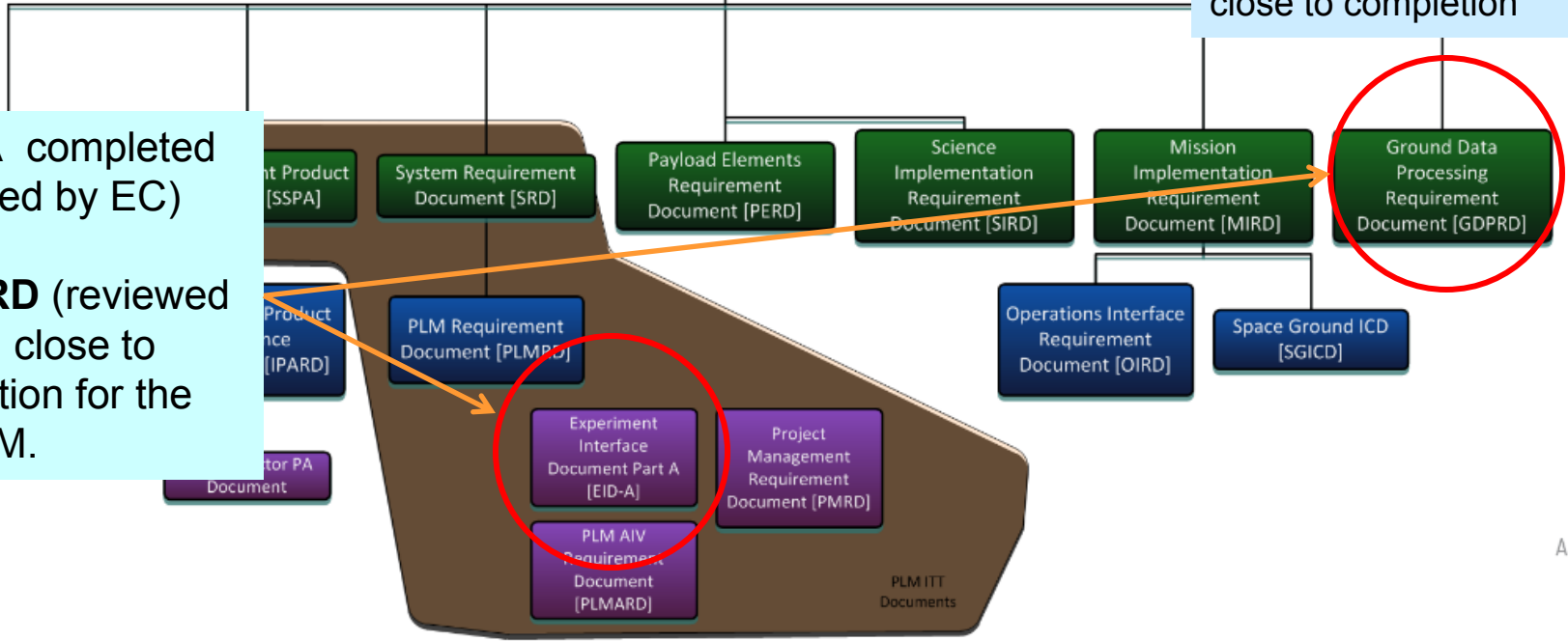


On going activities on documentation



• **SciRD**: Version 6.2 → 7.0 for ITT SVM, after endorsement by EST (on going)

- **MODC-B + CaICD-B** prepared by EC and delivered to ESA
- **SWG-OU** : interface document produced by SGS checked approved by ECL
- **SPBD** reviewed by EC close to completion



- **EID-A** completed (reviewed by EC)
- **GDPRD** (reviewed by EC) close to completion for the ITT SVM.

Agency

- **New documentation naming/numbering (ESA) convention**

- Coding system made of 5 elements separated by a dash symbol:
 - EUCL-XXX-XX-X-XXXX
 1. Project identifier
 2. Originator (e.g. AE = ARIANESPACE, EST=ESTEC, MSSL)
 3. Document Code (e.g. DP=Data Package, PR=Procedure)
 4. Project Element
 5. Numbering System
 - About 4. Project elements: 8
 - 1 : Management and mission/system engineering/PA/AIV
 - 2 : Service Module
 - 3 : Payload Module
 - 4 : Launcher
 - 5 : Ground Segment (MOC)
 - 6 : VIS Instrument
 - 7 : NISP Instrument
 - 8 : Science and Science Ground Segment

Example: EUCL-ESAC-PR-8-0001_vissue.version_Title(abbreviated).pdf

- **Signature:** Installation of a document signature procedure: **Abobe Pro Selected**
- **Access:** One single access point to official documents: RSSD Livelink: **managed by ECL assistant supports and Catherine Grenet, with help from COMS**

- **NASA: voir précédentes viewgraphs**
 - Réponses à l'AO soumis fin aout
 - NRA évaluation/sélection à Washington 2-4 octobre
 - Les équipes US ne formeront pas des groupes indépendants, seront intégrés dans les SWG du Consortium
 - Premières sollicitations pour un SDC à IPAC:
 - Discussions des participations aux OUs: début dès annonce officielle de l'équipe sélectionnée puis après signature MoU ESA-NASA.
 - Le PI NASA sélectionné sera à l'ECB et l'EST
- **Belgique:**
 - Visite à CSL en mai 2012. Offre en cours:
 - Mesures déformations FPA VIS et NISP pendant refroidissement
 - Mesures déformations de structure du NISP pendant refroidissement
 - Mesures de vibrations du FPA VIS et des unités NI-OMA et NI-DS
 - Tâches des chercheurs belges définies
 - Proposition faite à CSL, en cours
- **Canada:**
 - voir Pan-STARRS

- **Japon/SUBARU HSC:**
 - Visite au Japon en juin 2012,
 - Lol pour 194 nuits HSC: 6000 deg² + 1500 deg² du projet HSC
 - Retour 20-30 japonais dans EC
 - Offre pour collaboration spectro avec PFS
 - Très bien reçu au Japon. Visite en février pour convaincre.
 - Collision avec HSC puis PFS surveys
 - Échéance : juin 2012
- **Canada/Pan-STARRS:**
 - CSA prêt à soutenir le suivi sol Euclid avec PS1/2
 - 20-25 M USD
 - Si ok alors 20 chercheurs canadiens invités dans EC
 - Lettre approuvée par l'ECB, l'ESA, et N. Kaiser envoyée à CSA
 - Échéance: juin 2012
- **WHT:** peu d'évolution
- **CFHT new WFC 4 deg²:** attractive, serait la plus indépendante des approches mais backup pour le moment. Attendre CFHT Users meeting, Campbell River, May 2013

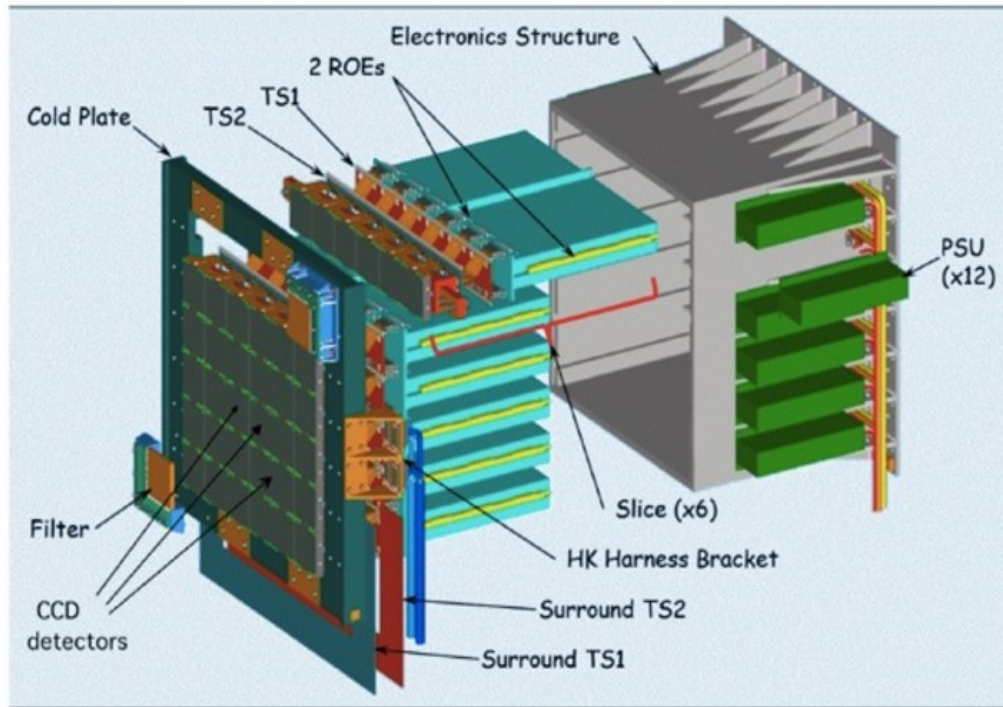
- **ESO/VST:**
 - Possible de couvrir 1500 deg^2 : = KIDS/VIKING + profond
 - Equipes KIDS/VIKING déjà dans EC
 - Pas d'échéance pour augmenter la profondeur actuelle
- **DES+e-DES:**
 - 5000 deg^2 , 4 filtres, 1^{ère} image = $0.7''$
 - Négociations en cours
 - Visite DES meeting à Houston en décembre
 - MoU + discussion pour une extension e-DES = DES+ 2500 deg^2
 - Proposal e-DES au printemps 2013 (en discussion: avec EC)
- **LSST:**
 - 20000 deg^2 , 4 filtres
 - Négociations stoppées officiellement jusqu'en 2014
 - tout ce qui se rapporte à LSST dans Euclid est stoppé... mais
 - Discussions LSST-Euclid toujours en cours, processus lent

VIS Instrument

- Large area imager: a « shape measurement machine »
- 36 4kx4k E2V CCDs, 12 micron pixels,
- CCD e2V #273 very good
- 0.1 arcsec/pixel on sky
- Bandpass 550-900 nm
- Limiting magn.for wide survey : AB 24.5, 10 σ extended

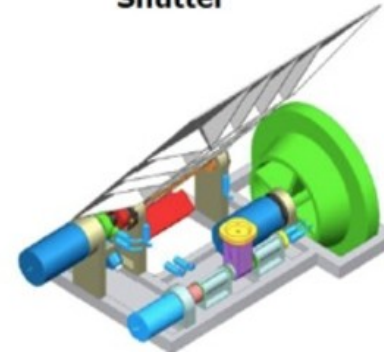
Name	Unit	Nation
VI-FPA	VIS Focal Plane Assembly	UK F
VI-RSU	VIS Shutter	CH
VI-CU	VIS Calibration Unit	F
VI-CDPU	Control and Data Processing Unit	I
VI-PMCU	Power and Mechanism Control Unit	F

COLD

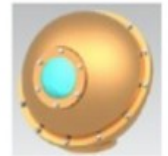


Focal Plane Assembly

Shutter

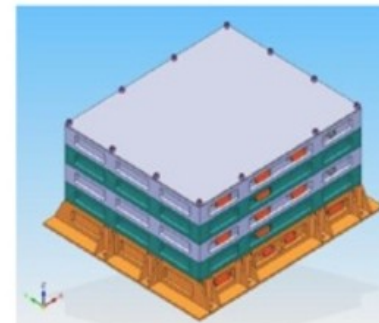


Cal Unit



WARM

Power and Mechanisms Control Unit

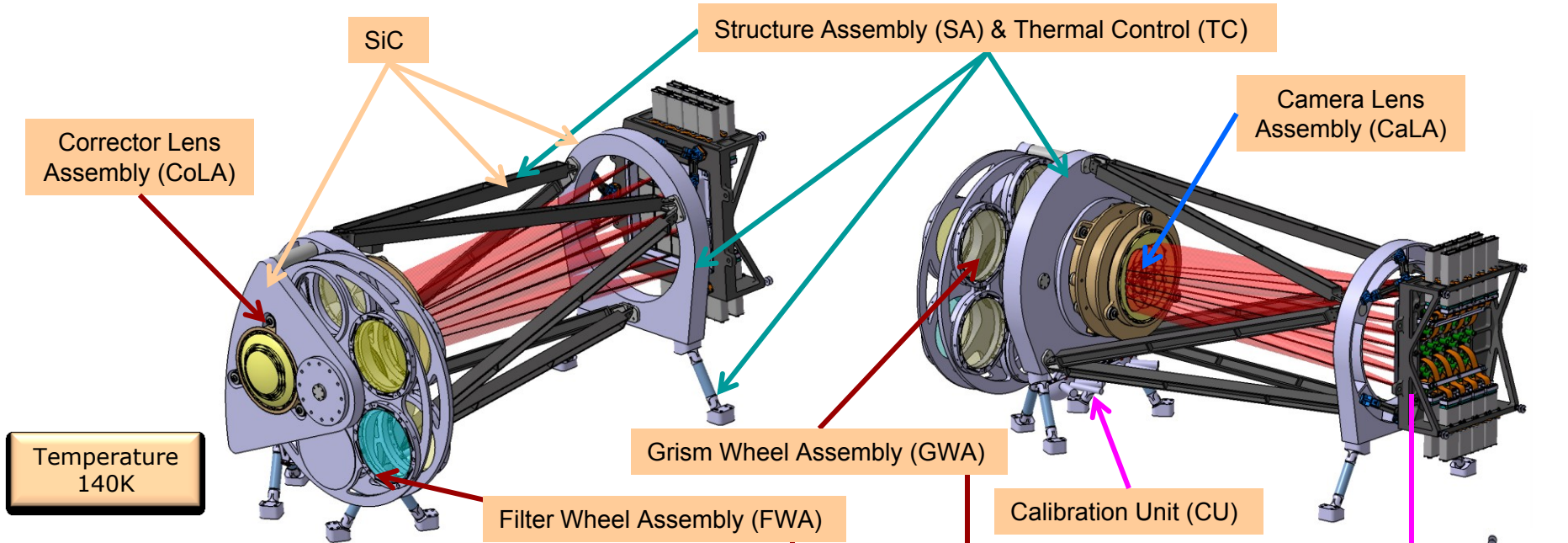


Command and Data Processing Unit

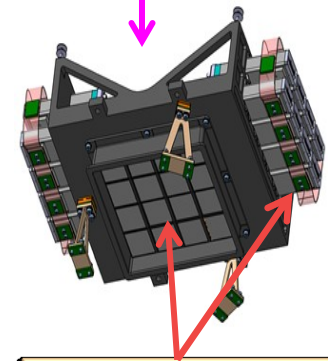
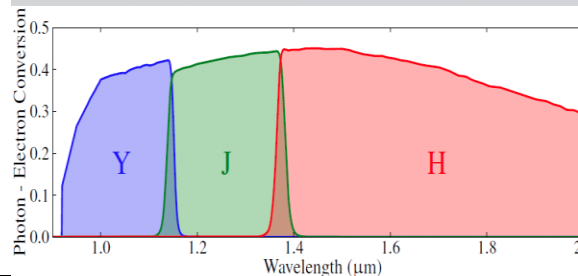
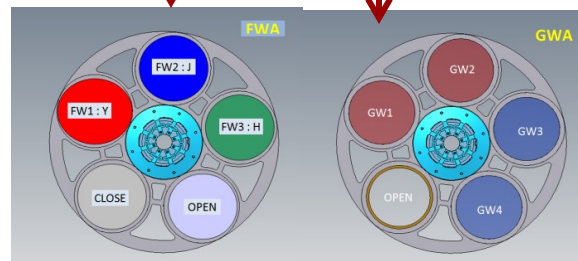


- Different progress made in each sub-system development:
 - Late signatures of contracts with industry: October 2012 for the CDPU (I) and December 2012 for the shutter (CH)
 - Impact on the PMCU development (shutter design needed)
 - FPA design need PLM selection (Q4 2012) for completion
 - completion during Industry/instrument optimisation phase (Q1-Q2 2013)
- Completion of e2V CCD pre-development phase in November 2012
 - CTI measurement of irradiated CCDs: compliant with specification → meet the requirements on precision on ellipticity measurement.
- e2V CCD pre-development phase extended for mechanical and thermal modelings and tests

- FPA / telescope interface: almost no margin on the current FPA flatness budget:
 - Design ,PLM/FPA interface optimisation after PLM selection
- Risk of direct solar illumination after launch: need input from ESA
- Verification/qualification plan will have to be revised according the outcome of model studies (in particular EM)
- VIS is an unusual instrument: composed of separated units mounted in the PLM, no VIS no optical bench as such.
 - Final performances difficult to validate until its full integration on the PLM
 - Need to define a performance verification plan at PLM level with industry



- Large area NIR imager and slitless spectrograph
- 16 2kx2k H2GR NIR detectors
- 0.3 arcsec/pixel on sky
- 3 NIR filters: H, J, I,
- 4 Grisms (2 « blue », 2 « red »)
- Limiting magn. for wide survey : AB 24.0, 5 σ point source
- Data volume 180 Gbit/day

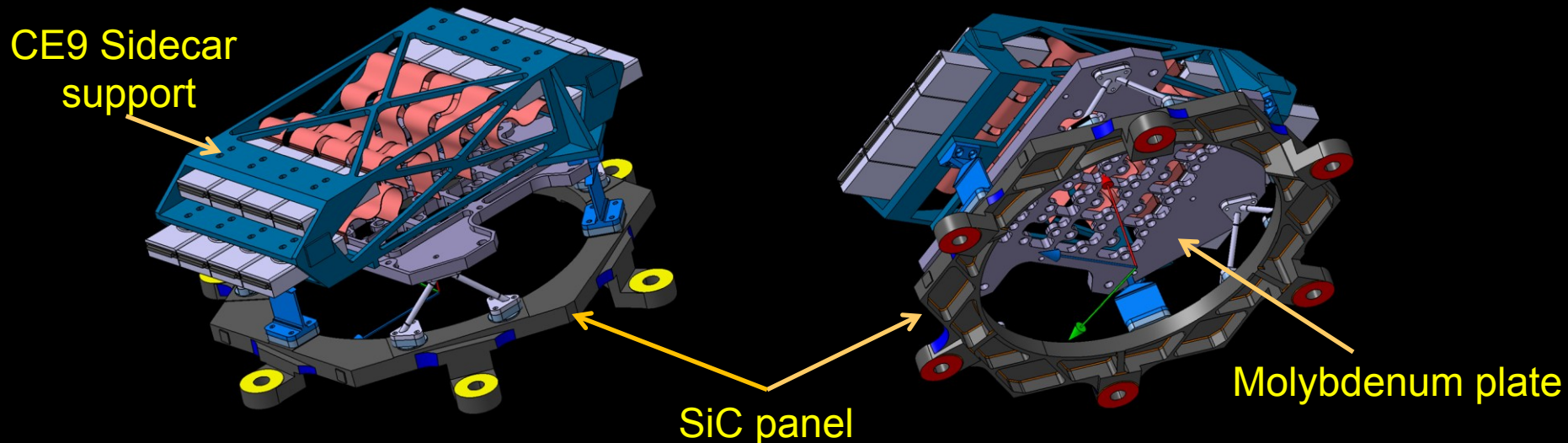


16 H2RG DETECTORS (provided by ESA/NASA)



Focal Plane

- Teledyne discovered cracks on the HgCdTe sensitive layers of the detectors with SiC package due to thermoelastic constraints at operational temperature
- Small impact (few %) on detectors but the reason is not well understood
→ decision to move to Molybdenum detector package as JWST



- NISP to be completely redesigned at LAM → ~3 month delay
- Mass increase accepted by ESA



NI-OMA

Filter & Grism wheels, torque Compensation Mechanism

- The “high” torque generated at “high” frequency (3Hz) by the wheels is accepted by ESA
- Need for the Torque Compensation Mechanism (CMU). **Answer in the hands of scientists ??**
- Good progress from CEA. Breadbord model to be build and tested in 2013

Structure

- A SiC flight like structure for the demo. model is now designed by LAM
- Structure DM to be build in 2013

Optics, Grism, Filter

- Very good progress from MPE, MPIA, LAM, BCN. Breadboards models to be build and tested in 2013
- **NI-Warn Electronic**
 - Waiting for Italy industry contract (January)
 - Good progress by Spain for Instrument Control Unit

NISP DEVELOPMENT PLAN

- **DM (Demonstration Model)** : Flight like focal plane with 2 detectors grade 4 and 2 MUX + flight like NI-OMA for the structure & thermal control (no optics)

Schedule : NI-DS fully tested for February 2014, NI-OMA integrated for march 2014, NISP DM end of tests for November 2014

- **STM (Structure and Thermal Modem)** : To be negotiated with ESA. Not needed for NISP development as we have the DM & EQM

Schedule : 18/12/2015 delivery to ESA

- **EQM (Engineering & Qualification Model)** : NI-OMA flight structure & Thermal control + EQM of optics, wheels and Calibration unit + Flight focal plane with 4 detectors grade 1

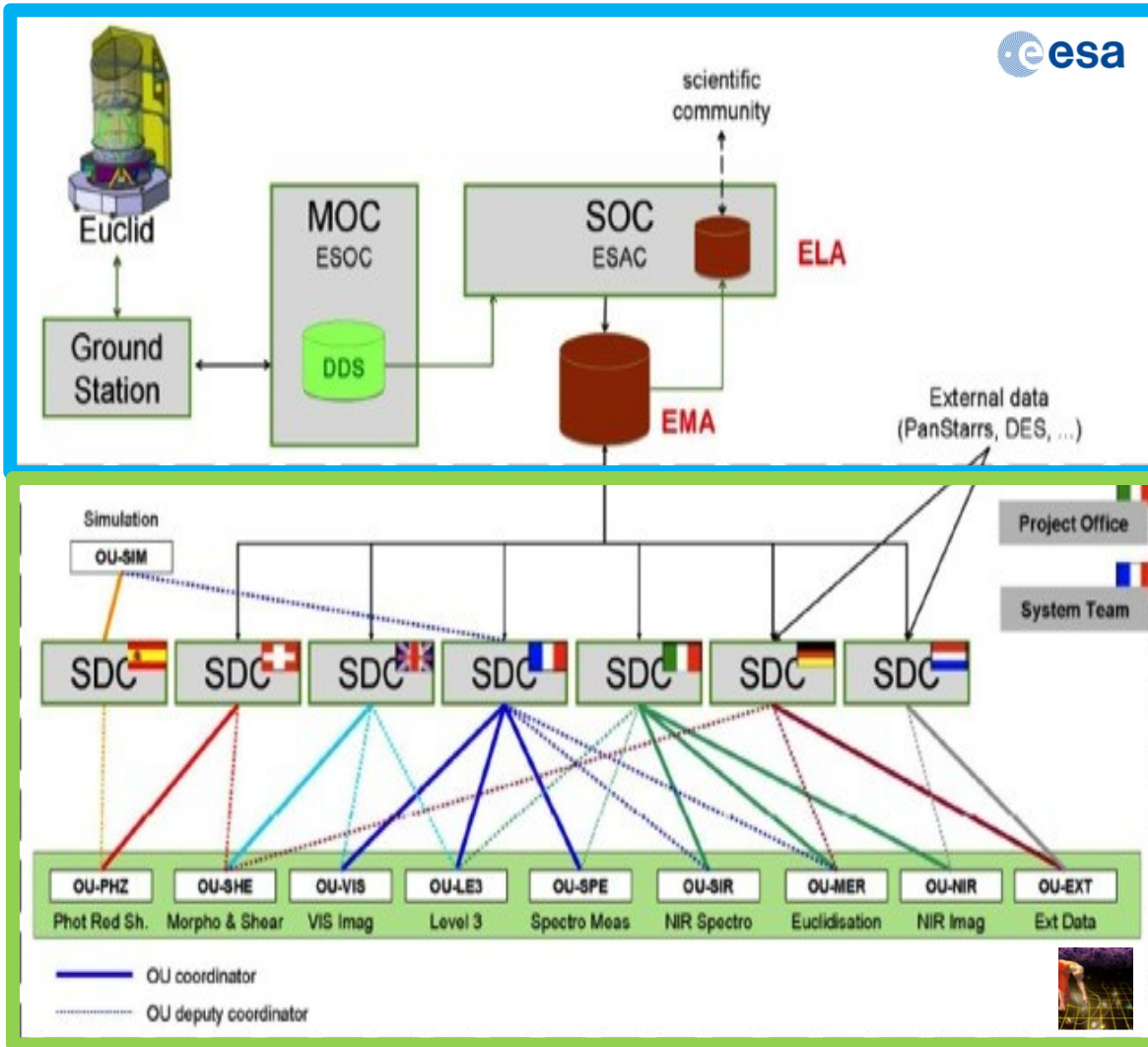
Schedule : End of tests September 2016

- **AVM (Avionic model)** : =NISP Warm electronic EQM:

Schedule : 17/06/2016 delivery to ESA

- **FM:** Schedule : 21/07/2017 delivery to ESA

Ground segment organisation : SDCs and OUs

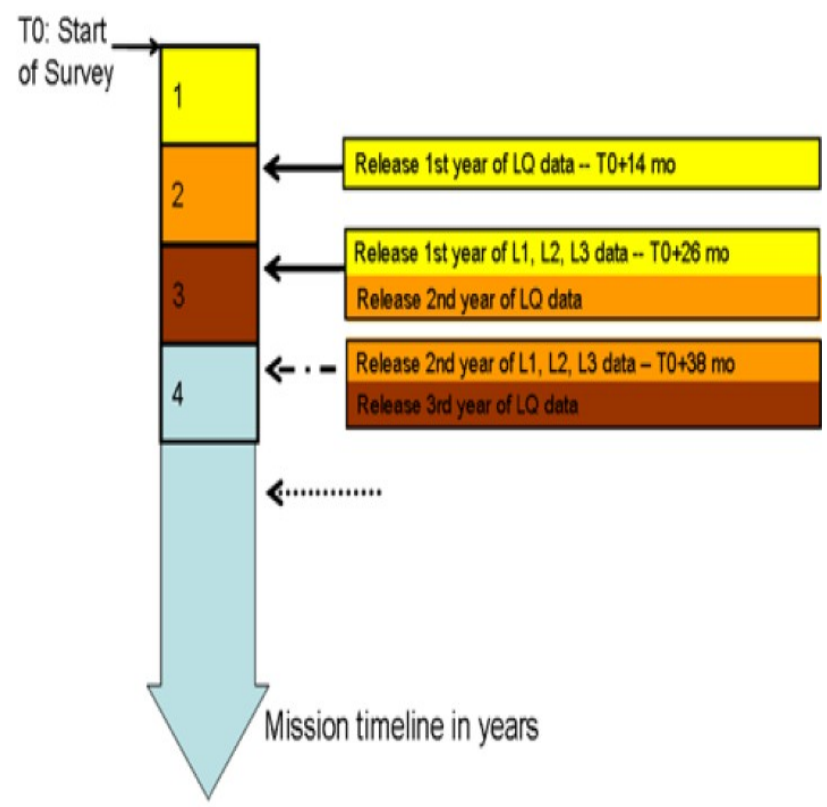


- Complex organisation
- 20-30 Pbytes /cycle/year
- > 10¹⁰ objects (>3-sigmas)

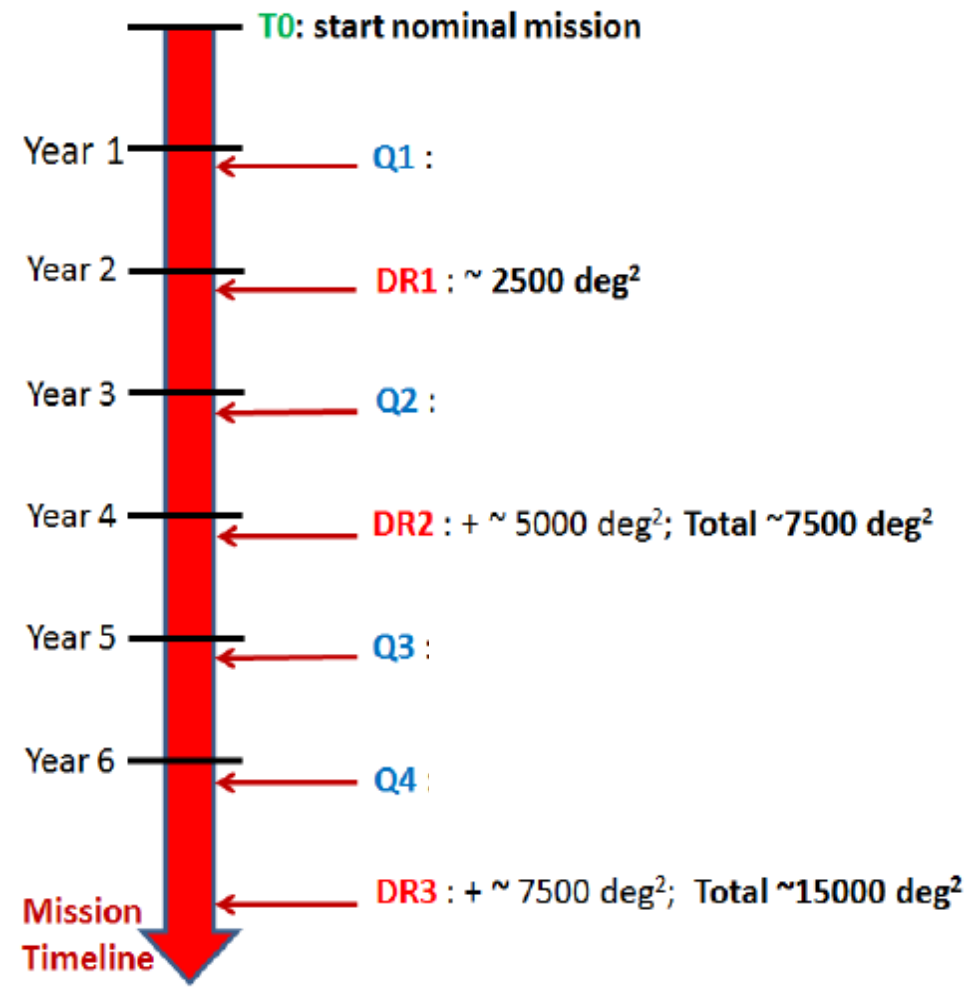
First Level 3 release:
 26 months after the beginning of the surveys .
 Data Releases: see next slides

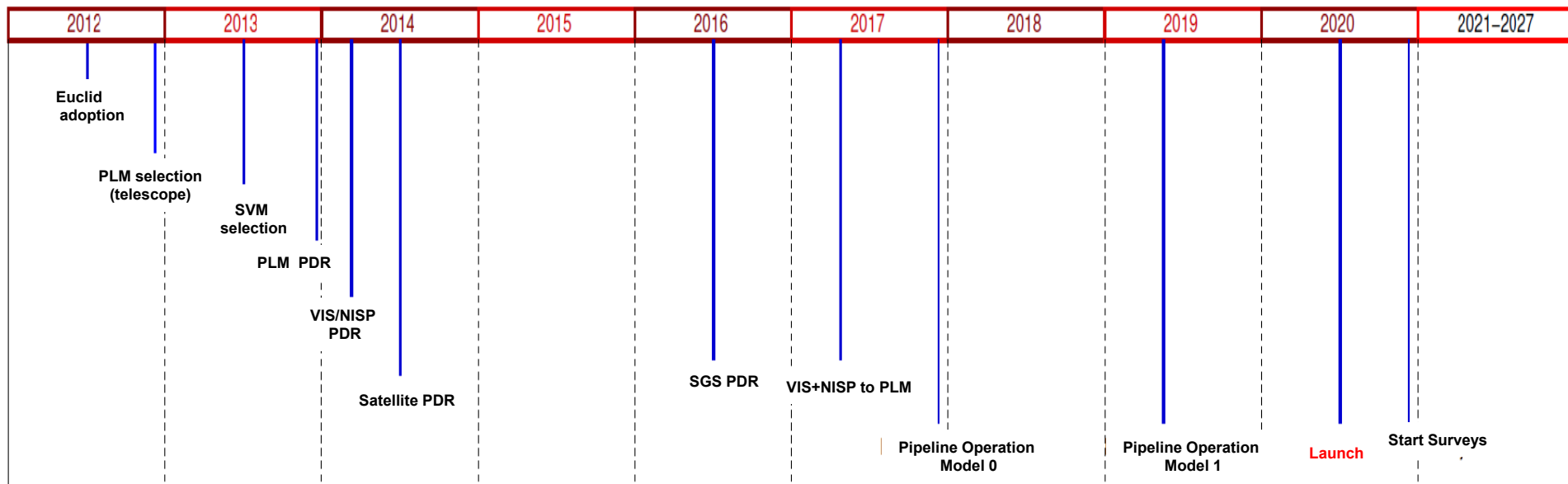
See SGS presentations

Baseline as proposed in SMP June 2012



New baseline very well received in October by AWG → proposal submitted for AWG/SAAC recommendation in Jan. 2013





Launch date: Q2 2020

- Euclid avance « normalement »,
- Les relations ESA-EC sont plutôt très bonnes
- Etat d'esprit général toujours très bon (je pense),
- Bonne consolidation de toutes les équipes,
- Equipes SWG, OUs et et OU-SWGs:
 - consolidées,
 - très actives,
 - très bonnes interactions internes et croisées;
- Nouveaux partenaires attendus : NASA, Belgique, Canada,
- La sélection du télescope est très proche (→ update perf.)
- ITT SVM en très bonne voie pour fin décembre
- La PRR SGS est une étape importante à ne pas manquer
- Quelques points durs: CMU
- Les données sols demandent encore du temps
- Règles de publication bientôt soumises à l'ECB puis EST