

# Euclid Cosmic Visions Assessment Phase

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# Cosmic Vision

Space Science for Europe 2015-2025



## Selection of ESAs Dark Energy Mission

**Dark energy** is recognized by the ESA Advisory Structure as the most timely and important science topic among the M mission proposals and is therefore recommended as the top priority (Nov 2007).

**Dark energy** was addressed by two Cosmic Visions M proposals:

- *DUNE (PI: A. Refregier-CEA Saclay)* – All sky visible and NIR imaging to observe weak gravitational lensing
- *SPACE (PI: A. Cimatti – Bologna Univ.)* – All sky NIR imaging and slit spectroscopy to detect baryonic acoustic oscillations patterns

# Concept Advisory Team

The CAT was appointed to recommend which mission concept must be adopted for a CV assessment study.

- The CAT convened 3 times in the period Jan-Mar 2008.
- Supported by ESA study team for technical advices
- Malcolm Longair presented the results to the AWG in April 2008

## Composition of the CAT

- **M. Longair** (Chair, Cavendish, UK)
- B. Leibundgut (ESO)
- K. Kuijken (Obs Leiden)
- R. Nichol (ICG Portsmouth)

## DUNE background

- A. Refregier (CEA, FR)
- S. Lilly (ETH, CH)
- J. Peacock (ROE, UK)
- P. Schneider (Bonn)

## SPACE background

- A. Cimatti (Bologna)
- C. Baugh (Durham)
- O. Le Fevre (LAM, FR)
- G. Zamorani (INAF, IT)

# Euclid's Concept

- Named in honour of the pioneer of geometry
- Euclid will survey the entire extra-galactic sky (20 000 deg<sup>2</sup>) to simultaneously measure its two principal dark energy probes:
  - **Weak lensing:**
    - Diffraction limited galaxy shape measurements in one broad visible R/I/Z band, AB=24.5 mag
    - Redshift determination by Photo-z measurements in 3 NIR bands (Y,J,H) to H(AB)=24 mag, 5 $\sigma$  point source
  - **Baryonic Acoustic Oscillations:**
    - Spectroscopic redshift survey for ~33% of all galaxies brighter than H(AB)=22 mag,  $\sigma_z < 0.001$
- With constraints:
  - Aperture: max 1.2 m diameter
  - Limited number of NIR detectors
  - Nominal mission duration: max ~5 years

# Assessment Phase Study Objectives

- Space Segment definition
  - Attractive science case and Affordable design
- Compliance with ESA science programme needs
  - Smooth transition to the definition phase
  - Launch readiness in 2017/2018
- Enable reliable selection process
  - Consolidated requirements and science case
  - Schedule, technology development plan, understood
  - Development risks and costs understood
- Development approach following ESA science programme review team (SPRT) recommendation:
  - Payload AO and development will be advanced, to be ready for early delivery to the system, this means that consortia must already be involved during the assessment phase

# Schedule and implementation constraints

- All M mission studies must progress in parallel
  - Target: dispersion < 2 months
  - Enables a fair selection process
  - Easier involvement of National Agencies for the payloads
- Selection process enabled by end 2009
  - Target: Issue industrial ITTs by mid-April 2008
  - Industrial offers received by mid-July 2008
  - Kick-Off of industrial studies by end July (goal) [Sep 2008 for Euclid]

# Concurrent design Facility Pre-Assessment

## Objectives

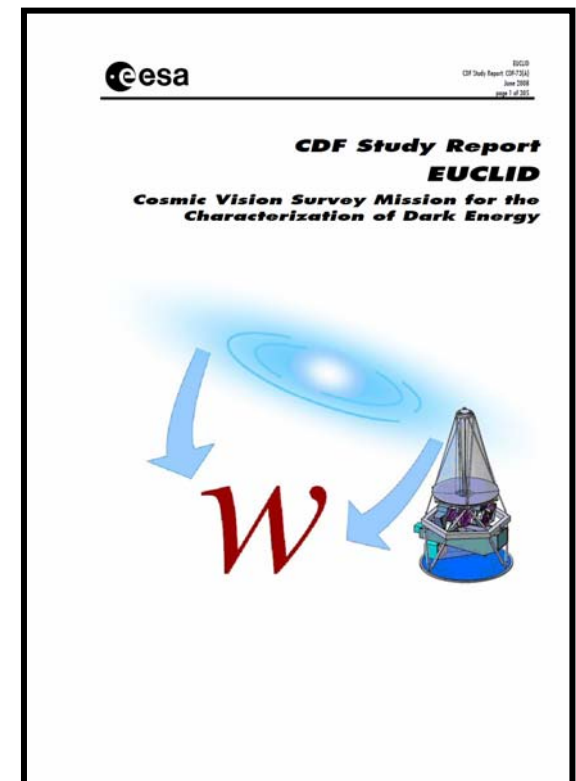
- To assess the mission from technical (orbit, payload, service module configuration, budgets), financial, and programmatic
- To perform system main mission trade offs
- To investigate payload configurations

## Activity

- Study performed in 8 sessions (02/04/08-22/05/08)
- Interdisciplinary team of ESTEC and ESOC specialists
- Support provided by Euclid scientists from WL and BAO Spectroscopy

## Outcome has been used

- For better understanding of the Science and Mission requirements, and payload design
- to write the ITT for the industrial studies

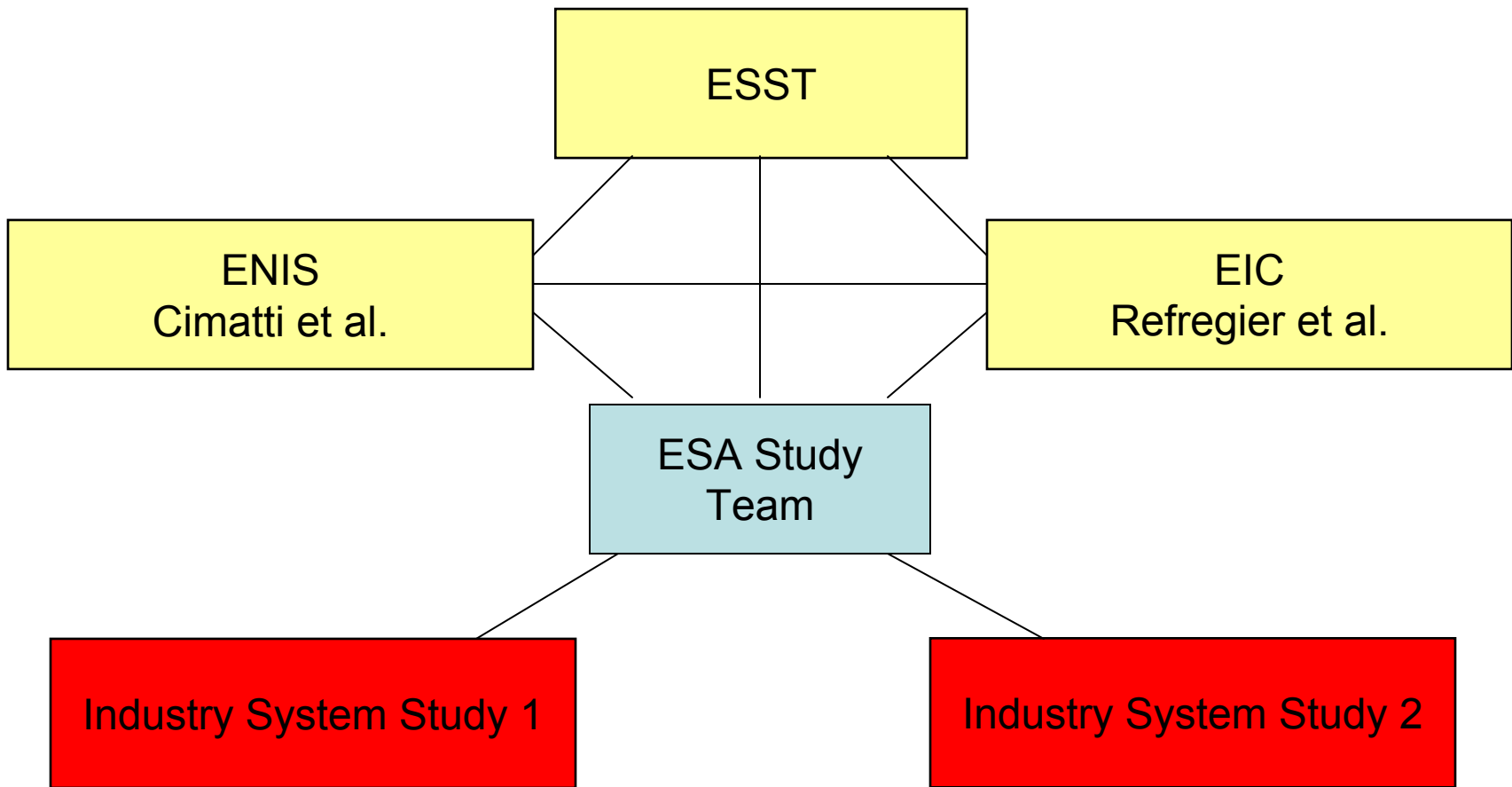


# Assessment Study Set up

- Invitation to Tender (ITT) for industrial system study including payload
  - Selection of two industrial teams
    - Thales Alenia Space – Torino
    - Astrium GmbH – Friedrichshafen
- Declaration of Interest by payload consortia for payload studies
  - Response from two payload consortia
    - ENIS – Spectrometer (A. Chimatti, Univ. Bologna)
    - EIC – Imaging Channels (A. Refregier, CEA Paris)



# Assessment Study Organisation



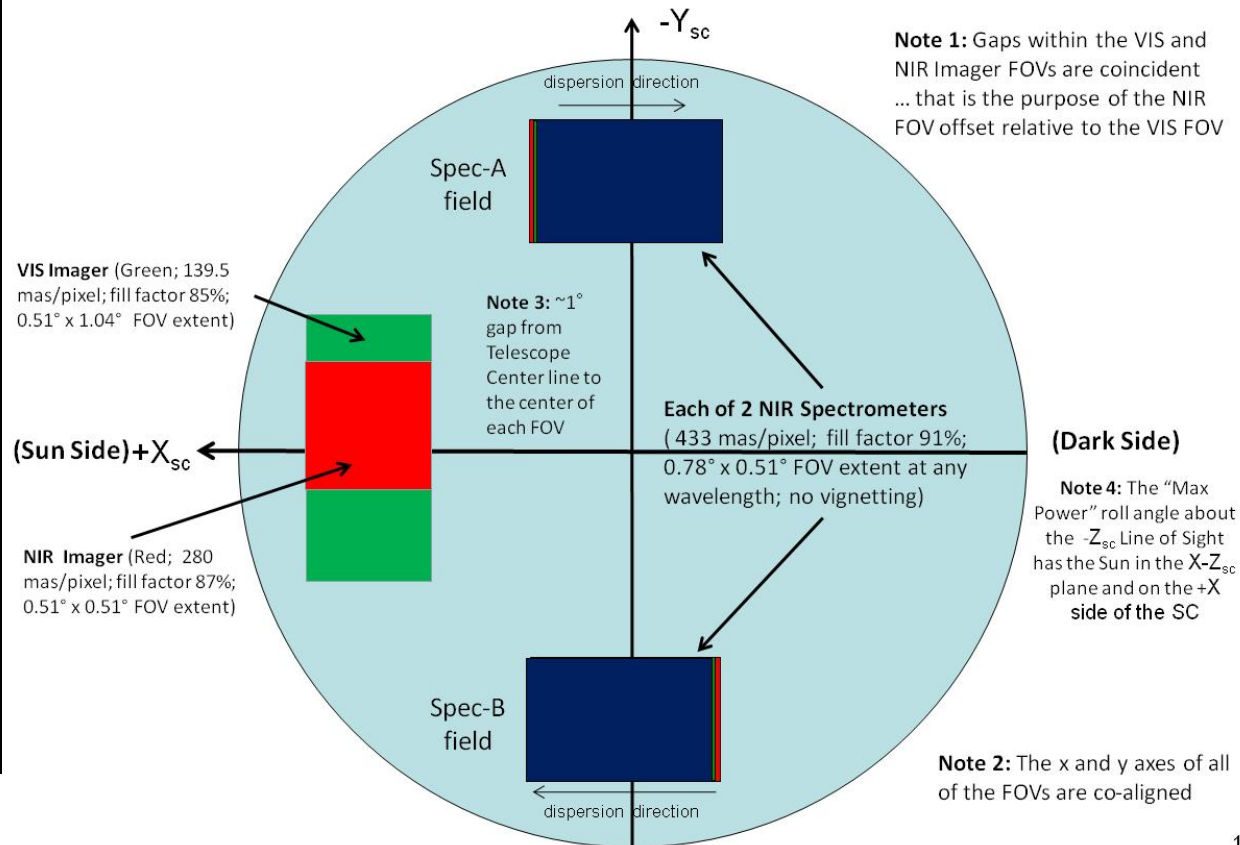
# Trade Offs during Phase 1

- Step and stare adopted as opposed to continuous scanning
- Dithering at spacecraft level
- ESA to provide a telescope system which can feed both the imagers and spectrometer

# IDECS = $f(\text{Euclid}, \text{JDEM})$

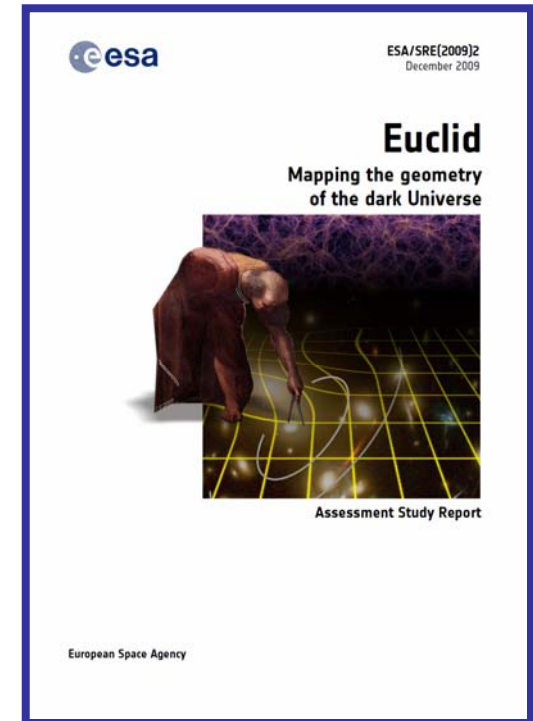
- In the period Jan-Apr 2009, ESA and NASA discussed a reference mission, the International Dark Energy and Cosmology Survey (IDECS)
- European stakeholders meetings were held in Dec 08 and Mar 09
- Reference mission built from
  - Euclid Science and Mission Requirements
  - JDEM Science Coordination Group report
- Features:
  - 1.5 meter telescope
  - Several visible filters for SNe
  - Slitless spectroscopy for BAO
- **Discussion stopped due to NASA internal reasons in early April 09**

IDECS Reference Mission FOVs as Painted on the Sky (view is looking out of the Telescope)



# Back to Euclid

- Return in April 2009 to the 1.2m Euclid concept, an ESA only mission, with:
  - NIR detectors with 2.5 micron cutoff instead of 1.7 micron cutoff
  - Slitless spectroscopy has become the baseline, and DMD slit spectroscopy optional
- Documentation consolidated:
  - Science Requirements Document (SciRD)
  - Mission Requirements Document (MRD)
  - Payload Definition Document (PDD)
- Assessment studies were finalized according to the new baseline
- Work on the Yellow Book (Euclid assessment study report) intensified in Aug-Sep, final delivery to ESA HQ on 16 Nov 2009 – Public Release 1 Dec 2009
- An ESA Baseline Design Review was held in October, giving an evaluation of the assessment studies.



# JDEM Status

- Joint NASA/DoE mission with offices at GSFC and LBNL
- Two Mission Architectures
  - IDECS - Globally similar to Euclid, assuming ESA participation:
    - Optical (CCD) / NIR (HgCdTe)  
All Extragalactic Sky Survey mission, providing precision cosmology and ancillary science
    - WL, BAO, and SNe
    - SEL2 Orbit, 3-5 year mission
  - Omega, NIR detectors only
    - performing WL shape measurement and photometry in NIR
    - photo-z support data from ground
    - Studies ongoing, evaluation of industrial proposals
- Cost goal 650M\$ + launch services
- Direction for JDEM to come from Astro2010 (“ Decadal Survey” ),  
outcome in 2010.

# Conclusion

- Assessment phase has been finalized
  - Yellow Book written and to be presented to community
  - Recommendations provided by Baseline Design Review
- Work on the Definition Phase already started – preparation work for ITT in case of selection
- An ESA only option is being worked out to meet the CV schedule