

The background of the slide is a deep space image featuring a complex network of pinkish-purple filaments and several bright, multi-colored galaxies (blue, white, and red) scattered across a dark, star-filled field. The text is centered in the upper half of the image.

**Cosmic Vision cycle 1  
Presentation to Industry  
Science Directorate, ESA/ESTEC**



**ESTEC, 26 Feb 08**

# Agenda

**9:30- Welcome**

**9:35- ESA presentation on Cosmic Vision plan**

1. Cosmic Vision Cycle 1
2. Selected Missions
3. Assessment Studies
4. National Activities Parallel to Cosmic Vision studies
5. Technology Developments
6. Schedule

**11:45- Questions**

**13:00- End**

# 1- Cosmic Vision Cycle 1

## Call for CV planning cycle 1 Mission Proposals

- First CV planning cycle (CV 1) covers 2015–2018 period  
**Current Call released March 2007.**
- Aims at final selection of
  - 1 “medium M” mission, ESA cost < 300 ME**
  - 1 “large L” mission, ESA cost < 650 ME**
- Launch in mid 2017 & late 2018.
- Total available envelope for first cycle: ~ 950 M€.

# Cosmic Vision cycle 1

## Overall schedule

<b>5 March 07</b>	<b>Call for Mission Proposals</b>
<b>29 June 07</b>	<b>Proposals due</b>
<b>2007 - 2009</b>	<b>Assessments (competitive)</b>
<b>end 2009</b>	<b>Down selection (2M, 2L)</b>
<b>2010 - 2011</b>	<b>Definition (competitive)</b>
<b>end 2011</b>	<b>Final Selection and Approval</b>
<b>2012 - 2017</b>	<b>Implementation</b>
<b>Mid 2017 &amp; late 2018</b>	<b>M1-L1 Launches</b>

**Total budget envelope 950 M€**



# Proposals Overview

- ❑ **Total of 50 proposals, often of high quality**
- ❑ **Astrophysics: 19 proposals**
  - 4 'L' and 15 'M' class.
- ❑ **Fundamental Physics: 12 proposals**
  - 1 'L' and 11 'M' class.
- ❑ **Solar System: 19 proposals**
  - 5 'L' and 14 'M' class.
- ❑ **About half include potential collaboration with NASA, JAXA, CNSA, Roscomos.**



## Selection process

- Evaluation carried out by ad-hoc Peer Review Teams (as necessary) under responsibility of ESA advisory bodies.
- Recommendation for selection by discipline Working Groups (i.e. AWG, FPAG & SSWG).
- Final recommendation for selection across disciplines by SSAC.
- PIs of proposals excluded from selection process.
- Agreed rules of conduct for members of advisory bodies involved as Co-Is in proposals

# Selection criteria

- **Scientific excellence** **WG/SSAC**
- **Scientific return** **WG/SSAC**
- **Compatibility with CV scientific priorities** **WG/SSAC**
- **Timeliness of the mission** **WG/SSAC**
- **Need to go to space** **WG/SSAC**
- **“Science value for money” rating** **WG/SSAC-ESA**
- **Technology maturity and technical feasibility** **ESA**
- **Compatibility with Class M or L envelopes** **ESA**
- **Cost to Member States (payload, etc.)** **ESA**
- **Overall project risk** **ESA**
- **Status of international cooperation** **ESA**
- **Communication potential** **WG/SSAC-ESA**





## CV selection outcome

### Seven missions selected for assessment over 2008-2009

- **Five M-class missions (ESA cost < 300 ME)**
  - ✓ **Goal: Down-selection end 2009, launch 2017**
- **Two L-class missions (ESA cost < 650 ME)**
  - ✓ **Compete with LISA**
  - ✓ **Goal: Down-selection end 2009, launch 2018**
- **A number of science mission themes (~ 10) highly ranked, requiring technology developments for enabling readiness for the next Call for Missions**

## 2- Selected missions

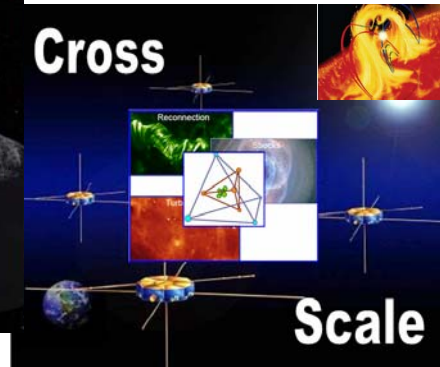
# SSAC SELECTION

Fields	M Class	L Class	Mission of Opportunity
<b>Solar System</b>	Space Plasmas (CROSS-SCALE)	Giant planets (TANDEM – Saturn)/ LAPLACE – Jupiter)	
	Neo sample return (MARCO POLO)		
<b>Astrophysics</b>	Dark Energy (DUNE/SPACE)	X-ray astronomy (XEUS)	IR astronomy (SPICA)
	Astero- seismology/ Exoplanets (PLATO) 		

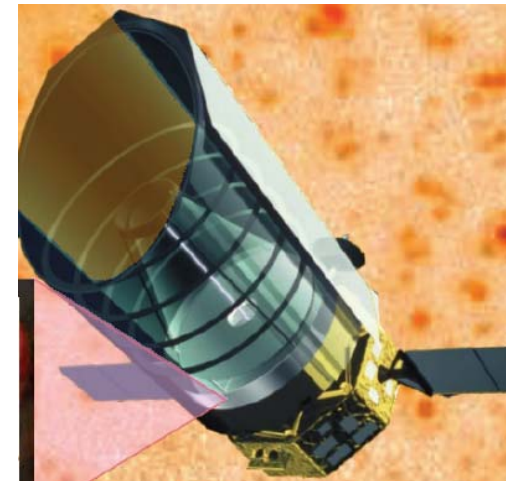
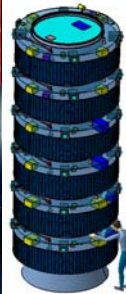
# M class missions



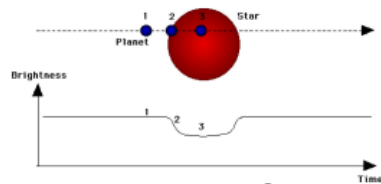
**Marco-Polo**  
NEO sample return  
in collaboration with JAXA



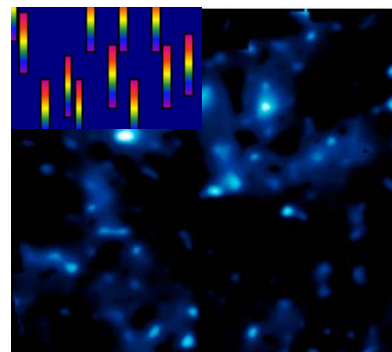
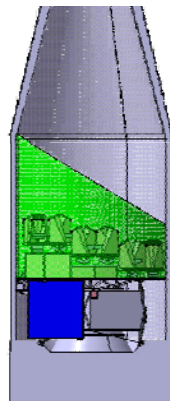
**Cross-Scale**  
Plasma physics



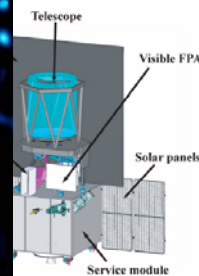
**SPICA**  
3.5 m IR observatory  
in collaboration with JAXA



**PLATO**  
Exoplanet detection  
& star characterization



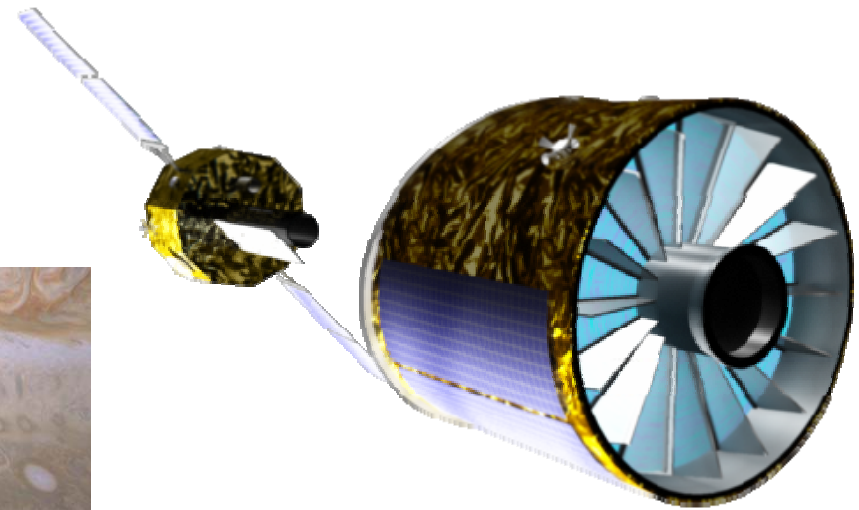
**Dark Energy**  
Deep space survey



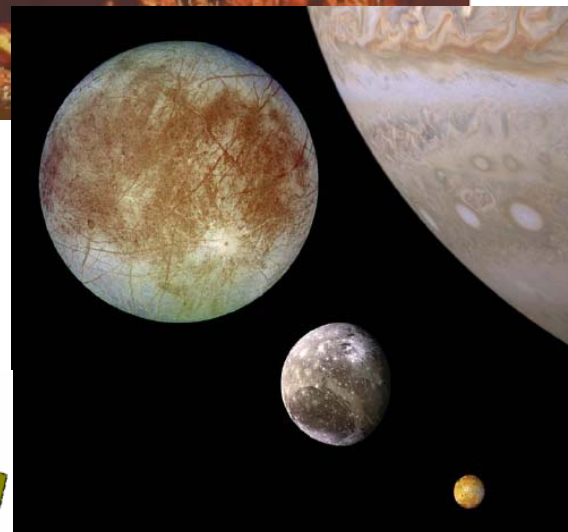
# L class missions



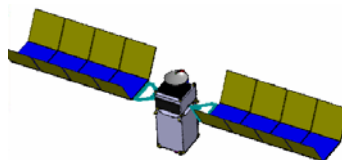
**Tandem**  
*mission to Saturn/Titan*



**Xeus**  
*X rays observatory*



**Laplace**  
*mission to the Jupiter system*



# Characteristics of L & M missions

## □ L missions

- ✓ Ambitious long term missions, down-selection of two L missions end 2009
- ✓ Mission budget requires international collaboration, to be defined during the assessment phase
- ✓ Technology developments to be implemented as soon as possible. Coordination between ESA/national agencies for technology development activities (SPC workshop in June)

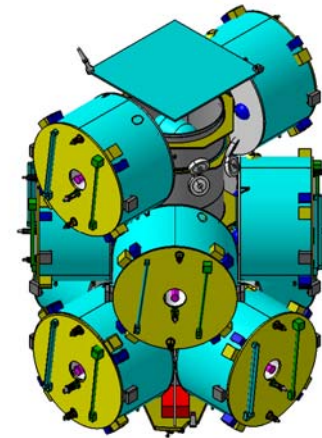
## • M missions

- ✓ High technology readiness level (supposed  $TRL \geq 5$ )
- ✓ No technology developments before down-selection end 2009
- ✓ Pre-developments can be envisaged in the development phase, if justified by the mission schedule risk minimisation

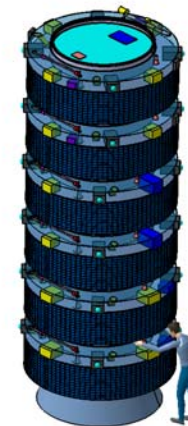
## Cross Scale - Status of assessment study activities

- ❑ Study Science Team in place, Sci-RD and PDD are being reviewed (all instrument data sheets are in)
- ❑ System level CDF completed in Dec 2007
- ❑ Industrial ITT documentation under preparation.
- ❑ JAXA and NASA included in Study Science Team
  
- ❑ Two baselines studied:
  - SF2-1b launch to LEO or GTO
  - 1.4 x 25 Re or 10 x 25 Re target orbit ( $i = 14^\circ$ )
  - Option 1: 10 S/C on a dispenser, cost and mass critical
  - Option 2: 6 S/C in stacked configuration, cost critical

Convergence on going towards 7 S/C, stacked configuration



*Option 1: 10 S/C + dispenser, launch and transfer configuration*



*Option 2: 6 stacked S/C, no dispenser, launch and transfer configuration*



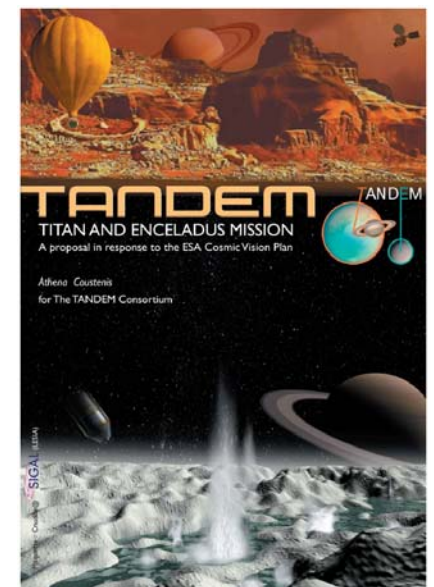
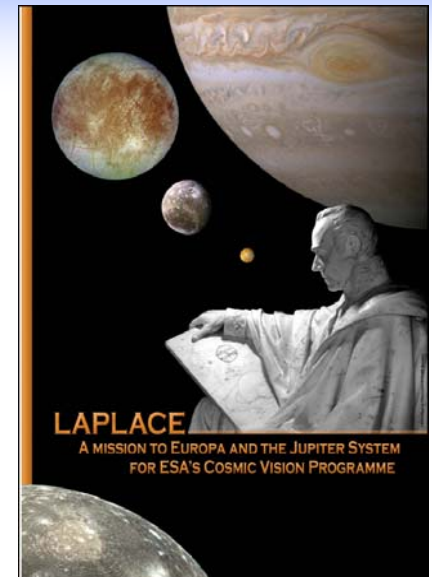
# Marco Polo – Status of assessment study activities

- ❑ Study science team in place, Sci-RD drafted, PDD work on-going
- ❑ Mission in collaboration with JAXA
  - Collaboration scheme not yet frozen
  - JAXA lead
  - ESA lead scenario with JAXA as junior partner also considered
- ❑ System level CDF study planned in Mar08
  - Investigation of simplest possible mission
- ❑ Industrial study scope: whole spacecraft
- ❑ Planetary Protection Working Group initiated



# Outer planet mission – Status of assessment study activities

- ❑ Cooperation scenario with NASA as baseline – discussions ongoing; JAXA expressed also interest for Laplace/Tandem
- ❑ NASA milestone: 3 to 1 down-selection of outer planets Flagship mission in October 2008
  - Organisation and cross-participation for the near future work under discussion
- ❑ Work focused on critical mission aspects through dedicated working groups
- ❑ Two CDF studies planned for Laplace/Tandem, to be completed by July 08
- ❑ ITT planned for end 08

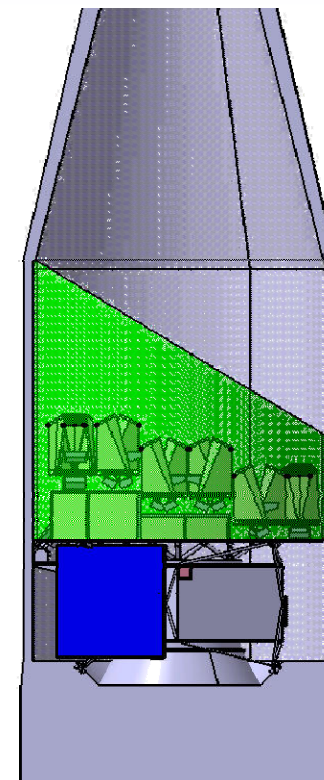


# PLATO - Status of assessment study activities

- ❑ SST in place, Sci-RD and PDD are being reviewed
- ❑ Dedicated payload module study made by ESA
  - ✓ Viable staring option elaborated in Dec07,
  - ✓ Adopted as baseline by SST
- ❑ ESA system study (CDF) is completed
- ❑ Industrial ITT documentation in preparation

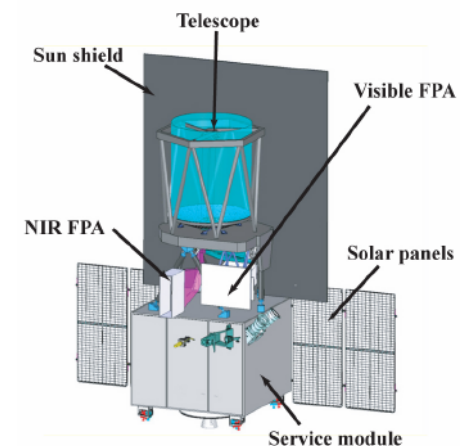
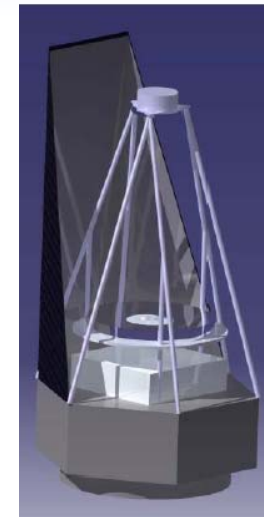
## 'Staring mode' baseline:

- SF2-1b launch to L2 (direct transfer)
- ~ 30 identical telescopes
- Total collecting area ~0.3 m<sup>2</sup>, FOV > 400 deg<sup>2</sup>
- 4 CCD's / focal plane (compatible with realistic detector procurement constraints), 3k x 3k, 18 um pixel
- Options to improve science performance: larger CCD/FOV (~ 530 deg<sup>2</sup>), modified operations scenario (2<sup>nd</sup> field + longer lifetime).



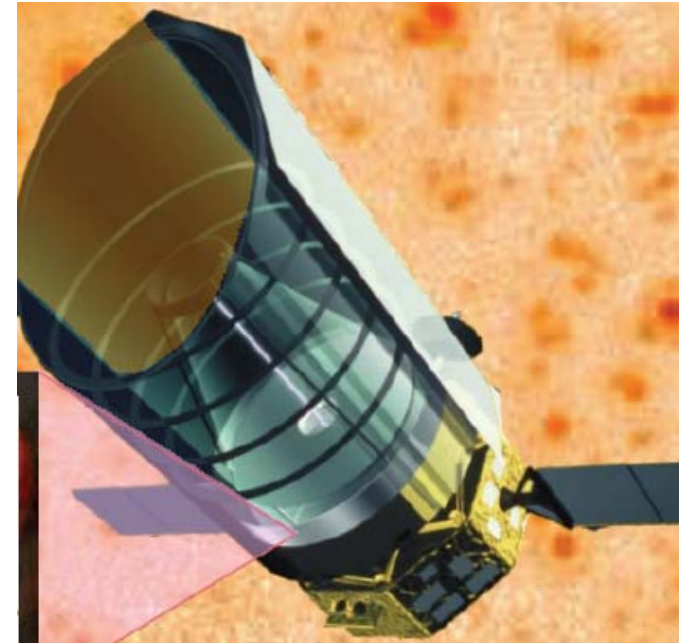
# Dark Energy Mission - Status of assessment study activities

- ❑ Concept Advisory Team in place for convergence on Dark Energy Mission payload concept
  - ✓ Achieve a robust dark energy measurement and consolidate technical feasibility
  
- ❑ Convergence concept
  - Telescope aperture diameter of 1.2 m
  - VIS focal plane for weak lensing
  - NIR focal plane shared by photometry and spectroscopy
  - Limit design to 1 spectrometer (+ no DMD back-up)
  
- ❑ CDF study planned for April 2008
  
- ❑ ITT in May 2008



# SPICA - Status of assessment study activities

- ❑ JAXA-ESA mission
  - ✓ JAXA led mission
  - ✓ ESA contribution
    - Cryogenic 3.5 m Telescope
    - SAFARI science instrument (through Member States funding, MIRI-like scheme)
  - ✓ ESA-JAXA letter of agreement drafted, for defining respective responsibilities during assessment study
  
- ❑ SAFARI (European instrument) PDD on going
  
- ❑ CDF activities (Telescope Assembly & SAFARI) planned in April/May



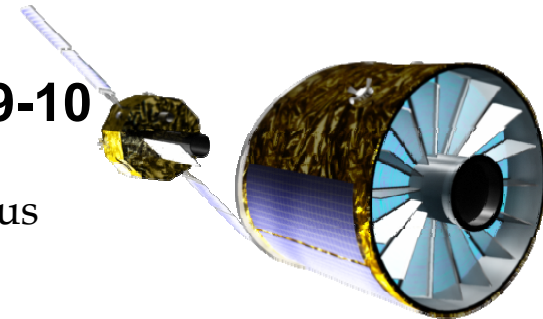
# XEUS - Status of assessment study activities

**Internal critical review performed in Dec 07**

- ✓ take stock of work performed to date,
- ✓ identify critical areas requiring for attention

**First meeting of XEUS Study Science Team (9-10 Jan 08):**

- ✓ presentation on study process and objectives, study status and criticalities, and technology development,
- ✓ discussion on alternative design solutions.



**XEUS workshop being organised (ESTEC, 5-6 March 08):**

- ✓ Science topics and science drivers
- ✓ Required technology developments
- ✓ Recent progress on X-ray instrumentation and optics
- ✓ Evaluation of International collaboration potential

• **System CDF study planned in June 08**





## 3- Assessment studies



# Key elements of Cosmic Vision implementation plan

## ❑ **Spacecraft Assessment Studies**

- ✓ ESA internal studies & industrial studies
- ✓ Programmatic inputs for down-selection process

## ❑ **Science Instrument Assessment Studies**

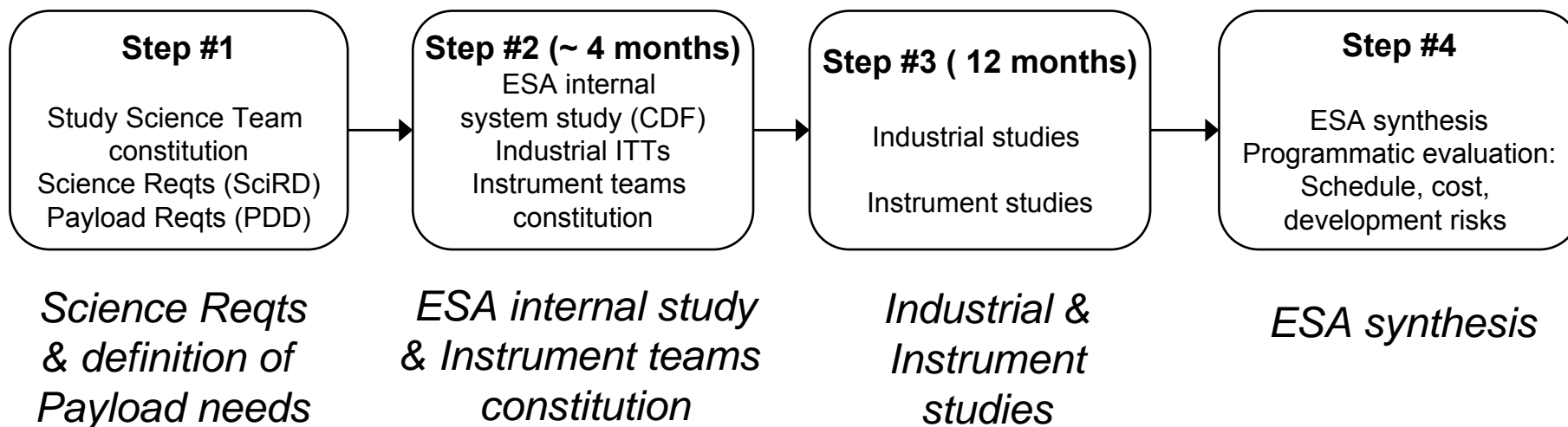
- ✓ National activities conducted in parallel to ESA system studies
- ✓ Enable robust spacecraft definition and instrument selection (AO) at the beginning of the Definition Phase

## ❑ **Technology Development Plan**

- ✓ For spacecraft and science instruments
- ✓ Harmonisation with Member States requested (June 08 SPC workshop)

# Assessment Phase Logic:

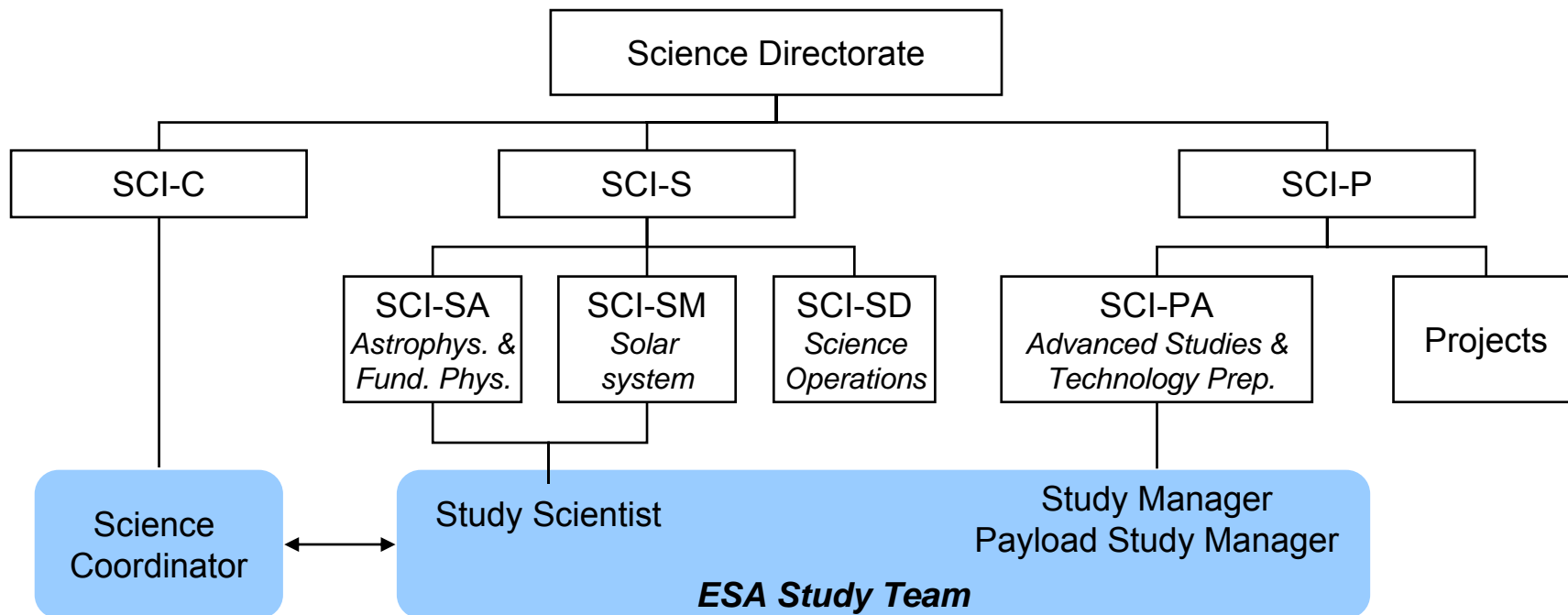
## Four major steps



# Assessment study actors

- ❑ Study Science Team
  - ✓ Represents the science community for the study field
  
- ❑ ESA study team
  - ✓ **Study scientist:** Responsible for all Science aspects related to the study needs. Chairs the Study science team
  - ✓ **Study manager:** Overall study management, including technical management and programmatic aspects
  - ✓ **Payload study manager:** Responsible for payload aspects, in support to the study manager
  - ✓ **ESA technical experts**
  
- ❑ Industrial study teams
  - ✓ Selected through open competition
  
- ❑ Instrument teams
  - ✓ Phase A level study of non recurring science instruments
  - ✓ Funded by Member States

# CV Implementation in ESA



**The Science Coordinators are in charge of the overall implementation and coordination of the Cosmic Vision Plan**

# Industrial studies: ITTs

## Competitive Invitation To Tenders

- ✓ Parallel contracts envisaged for each study, provided good offers are received
- ✓ Documentation inputs: SOW, Science Requirements, Payload Definition Document
- ✓ ESA internal studies outcome will be made available the latest at the study kick-off
- ✓ 6-7 weeks for offer preparation

# Industrial studies: Objectives

## ❑ Space segment definition

- Spacecraft concept and definition, meeting science objectives and programmatic requirements
- Payload definition (ESA part)
- Consolidation of technical requirements

## ❑ Mission Technology Readiness Evaluation

- Requirement: TRL  $\geq 5$  at the beginning of Implementation Phase.  
Applicable to the whole spacecraft, including science payload

## ❑ Spacecraft programmatic evaluation

- Spacecraft development plan
- Technology development plan, if relevant
- Risk assessment and cost estimate

# Industrial studies: Structure

## □ Three major phases

- Concept review and trade-offs ~ 4-5 months
- Detailed design ~ 6-7 months
- Programmatic evaluation ~ 1 month

## □ Overall study duration: $\leq 1$ year (must)

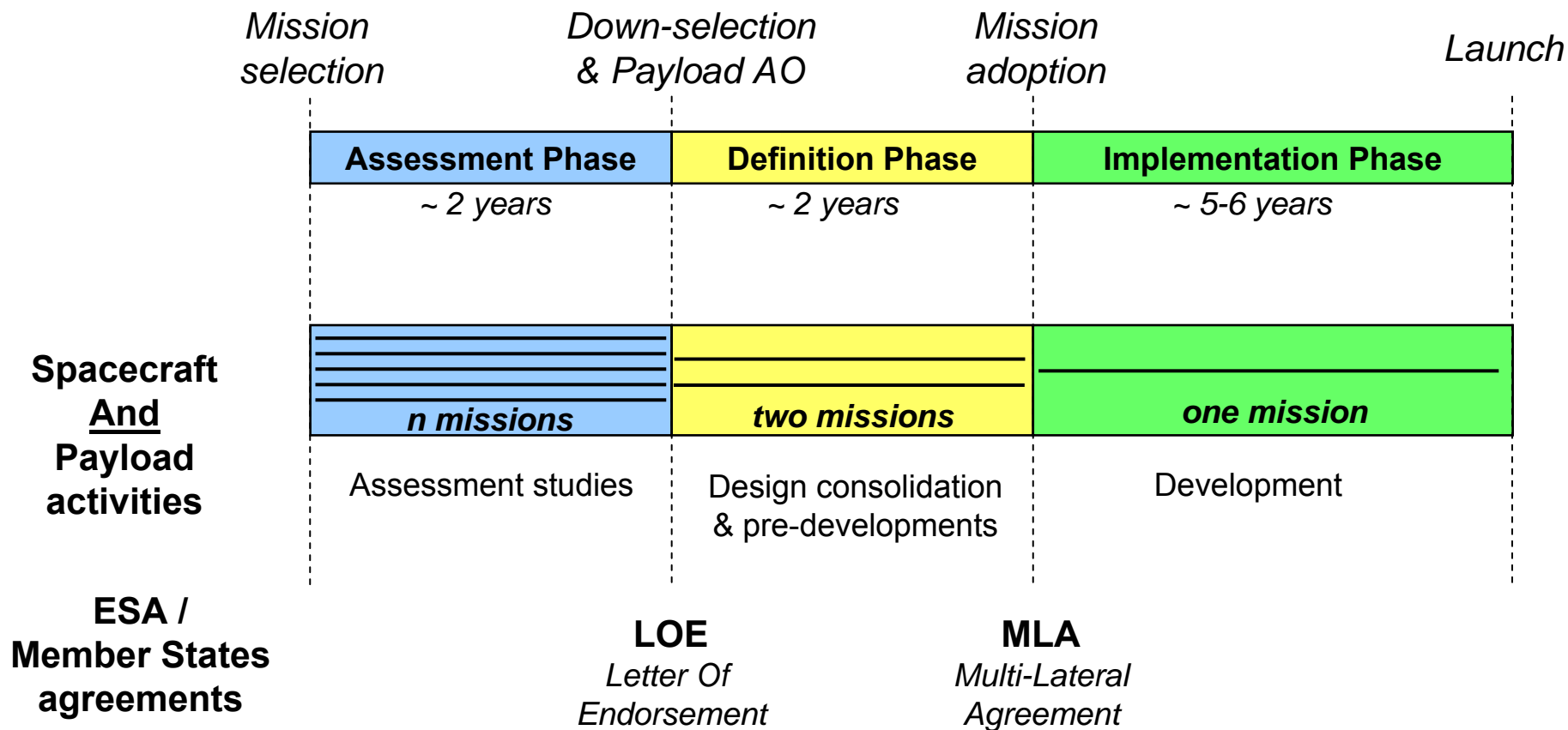


# 4- National Activities Parallel to Cosmic Vision Studies

## ESA approach on Payloads, resulting from SPRT/SPC recommendations

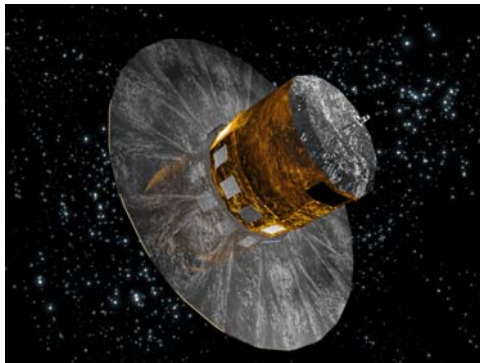
- ❑ Science Payload Phase A/B1 to be completed before entering the implementation phase
  
- ❑ Payload AO is moved at the beginning of the Definition Phase
  
- ❑ Perform Instrument assessment studies before entering the Definition Phase

# Consequences of SPRT/SPC: Illustration for M missions



# Payload categories

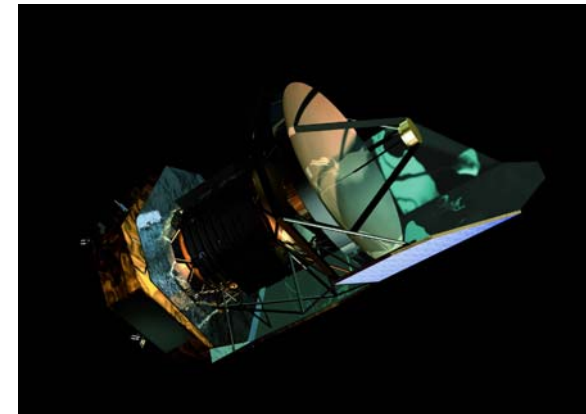
**Payload = Instrument or instrument suite.  
Hardware from useful signal collection/detection device to digital output signal**



**Category A**  
“ESA only” Payload  
(Gaia)



**Category B**  
Payload = Instrument suite  
from science institutes  
(Bepi Colombo)



**Category C**  
Shared payload  
ESA + Institutes  
(Herschel)

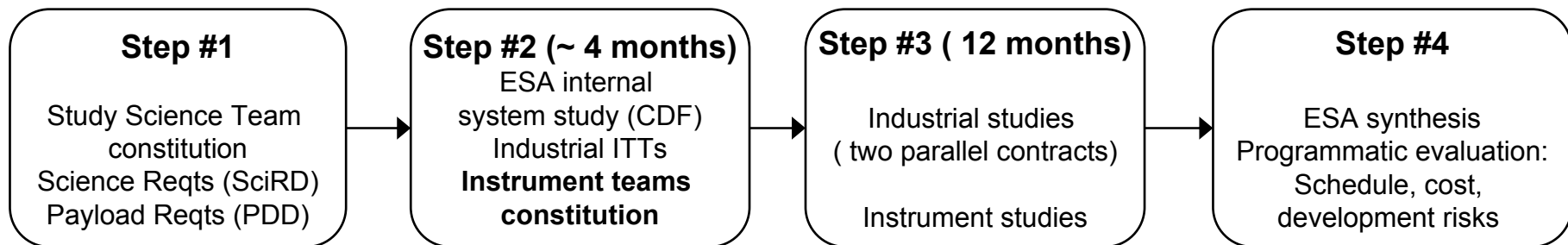
# Instrumentation activities during the assessment phase

- ❑ **Instrument teams expected to be in place at the start of the industrial assessment studies**
- ✓ Phase A type study required during the assessment phase.
- ✓ Work funded by National Agencies, requested for non recurring instruments
- ✓ Work input: Payload Definition Document, elaborated by ESA payload study manager with inputs from the study science team.

Mission	Payload category	Member state provision
Marco-Polo	B	Instrument suite
Cross-scale	B	Instrument suite
Laplace/Tandem	B	Instrument suite
Plato	C	Focal planes, and potentially the whole instruments. The payload will be treated as category A in the industrial studies.
Dark Energy mission	C	Focal planes (IR and VIS). The payload will be treated as category A in the industrial studies.
SPICA	C	Telescope provided by ESA. ESI cryo instrument provided by science institutes under ESA management.
XEUS	C	Optics under ESA responsibility, cryogenic elements TBD, focal plane instruments provided by institutes

# Instrument teams constitution: Procedure

- ❑ Instrumentation requirements are defined in the PDD
  - ✓ Needs established by the Study Science Team,
  - ✓ PDD book captain is the Payload Study Manager
- ❑ Call for “Declaration of Interest”, includes instrumentation requirements (PDD)
- ❑ Instrument teams are requested to respond to the Call within 3 months
  - ✓ Instrument team response: organisation, technical background, study logic, expected funding scheme
  - ✓ Copy is sent to the relevant Member States
  - ✓ ESA will close the loop with the relevant Member States: confirmation of the support, instrument study follow-up, meeting plan details



# Instrument study follow-up

- ❑ **The overall process preserves the future competition for both the spacecraft and instrument developments**
  - ✓ Instrument and industrial teams are independent. Formal interface goes through the ESA Study Team.
  - ✓ Several instrument teams may work on the same instrument
  - ✓ Synthesis of spacecraft and instrument studies to be made by ESA at the end of the assessment phase, with the SST support.
  
- ❑ **Instrument requirements and interfaces visible to all parties**
  - ✓ Instrument teams, industrial study teams, study science team
  - ✓ Instrument science requirements monitored by SST, expressed in PDD
  - ✓ Technical interface requirements monitored by the ESA Payload Study Manager
  
- ❑ **Technical meetings on instrument definition**
  - ✓ Meeting location: ESTEC. Participants: Instrument team, ESA, Member States representatives



# 5- CV Technology Developments

# Technology Developments

## ❑ **Medium Class Missions (M)**

- Proposals based on existing technology, due to launch 2017
- Need TRL 4-5 for down-selection in 2009, and TRL  $\geq 5$  for Implementation in 2011
- Identification of pre-implementation technology activities, but no technology developments foreseen before down-selection in 2009

## ❑ **Large Class Mission Themes (L)**

- Include technologies requiring maturing, target launch date 2018
- Need TRL 4-5 for down-selection in 2009, and TRL  $\geq 5$  for Implementation in 2011
- Determination of required technology developments, to be implemented ASAP
- Coordination with national Agencies required on payload developments

## ❑ **Future Science Programme Themes (F)**

- Important future themes identified by AWG, SSWG, FPAG in Oct 2007
- Need TRL4 by next CV call in 2010/11
- Potential activities identified, need prioritisation by Advisory Structure, and harmonisation with National Agencies' developments

## ❑ **Generic Technologies for Future Science Missions (G)**

- Multiple-use technologies required for future Science Programme
- Technologies related to European Non-dependence

# Technology Programmes

- ❑ **Technology Research Programme (TRP)**
  - ESA wide technology developments (all ESA programmes)
  - Science is Service Domain 2 (SD2)
  - TRL not beyond 3
  
- ❑ **Core Technology Programme (CTP)**
  - Funded by Science Programme
  - Covers all mission stages, from assessment to implementation
  - All TRL levels are supported
  
- ❑ **General Support Technology Programme (GSTP)**
  - Co-funded by ESA and National Funding Agencies
  - Wide range: from basic technologies to in-orbit demonstrations (eg Proba 2)
  - All TRL levels are supported, with emphasis on higher TRL levels
  
- ❑ **National Funding Programmes (National)**
  - Direct national funding
  - Funding of activities managed by ESA

# Technology development: programmes, project phases and risks

	Technology Readiness Levels											
	1	2	3	4	5	6	7	8	9			
	Basic principles observed and reported	Concept and/or application formulated	Analytical / experimental critical function / characteristic proof of concept	Component or breadboard Validation in laboratory environment	Component or breadboard validation in relevant environment	System / subsystem model or prototype demonstrated in relevant environment	System prototype demonstration in a space environment	Actual system completed and "flight qualified" through test and demonstration (ground or space)	Actual system flight proven through successful mission operations			
TRP	■										Basic / generic	
CTP			■	■								Science
EOEP			■	■								EO
ARTES		■									Telecomm	
GNSS				■							Navigation	
FLPP			■								Launchers	
Aurora			■								Human Expi	
GSTP				■			■				Generic	
NewPro	■											
Project Phases	■		■			■					0	
	■			■				■			A	
	■					■					B	
	■							■			C/D	
Risk if starting phase	■		■			■					E	
	■			■				■			0	
	■					■					A	
	■							■			B	
											C/D	

# Preparation of ESA Technology Work plan

## ❑ **ESA Technology End-to-End process (E2E)**

- Is organized in service domains (SD)
- facilitating the coordination between corporate multi-domain programmes and specific domain programmes developments (all ESA programmes)

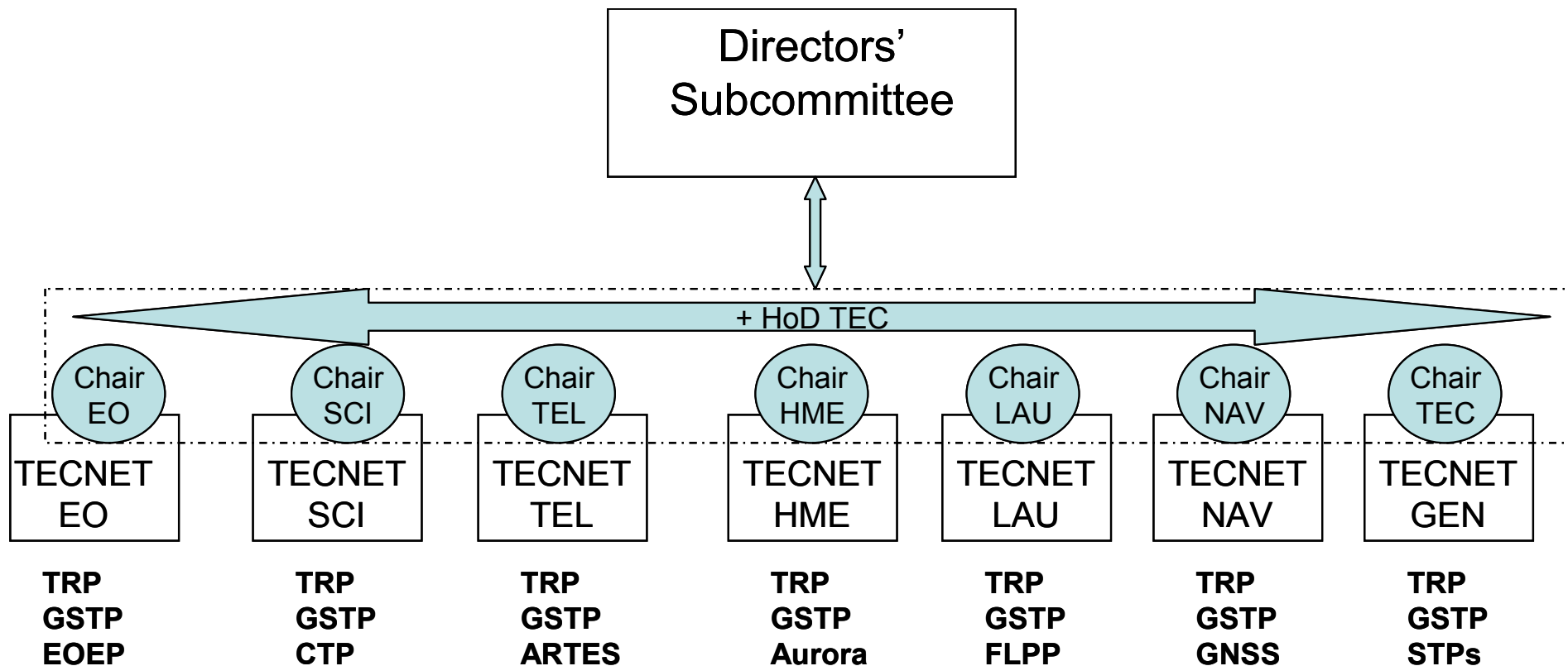
## ❑ **There are six programme driven SDs**

- Earth Observation
- Space Science
- Telecommunications
- Automatic Exploration and Human Space Flight
- Navigation
- Launchers
- Generic SD that covers multi-use technologies and technology push.

## ❑ **TECNET**

- There is a working group (called TECNET) for each SD
- Each TECNET is composed of members of the Programme Directorate as required and including the chairperson, and of D/TEC.
- The Generic SD is chaired by TEC and includes representatives of TEC, OPS and of Programme Directorates as Directorates find appropriate.
- A Directors' Subcommittee for Technology oversees the process

# TECNET and Directors' Subcommittee



## T.D.P. Elaboration

- ❑ **Technology Development Plans will be elaborated in the course of 2008**
  - Starting position: proposals for Missions as submitted
  - System level work (ESA internal) just started, considered only as far as available
  - Planning horizon: 3-4 years
  
- ❑ **ESA TECNET has started Q1/2008**
  - Will provide expert involvement and harmonisation with other service domains
  - Objective is to issue plan as complete as possible for June 2008 SPC workshop, for submission to SPC/IPC for discussion and approval
  - Work will be harmonised with SPC Task Group 2, for June SPC workshop
  
- ❑ **Some activities are not yet defined and require further studies/decisions**
  - GSP activities will complement (partly preceding) technology items
  - Some science mission decisions still open (eg Laplace or Tandem? Exoplanet search approach)



# 6- Schedule

# Milestones

## □ ITTs for industrial studies

- Cross-scale Apr 08
- Plato Apr 08
- Marco-Polo May 08
- Dark energy May 08
- SPICA May 08
- XEUS TBD (before end 08)
- Laplace /Tandem TBD (before end 08)

All industrial studies are expected to be completed by 2009

## □ Technology developments

Prioritisation for future missions from Advisory Bodies:	Mar 08
SPC workshop for Technology development plan:	Jun 08



End