ESA Future Projects and Missions

Opportunity for Slovenia

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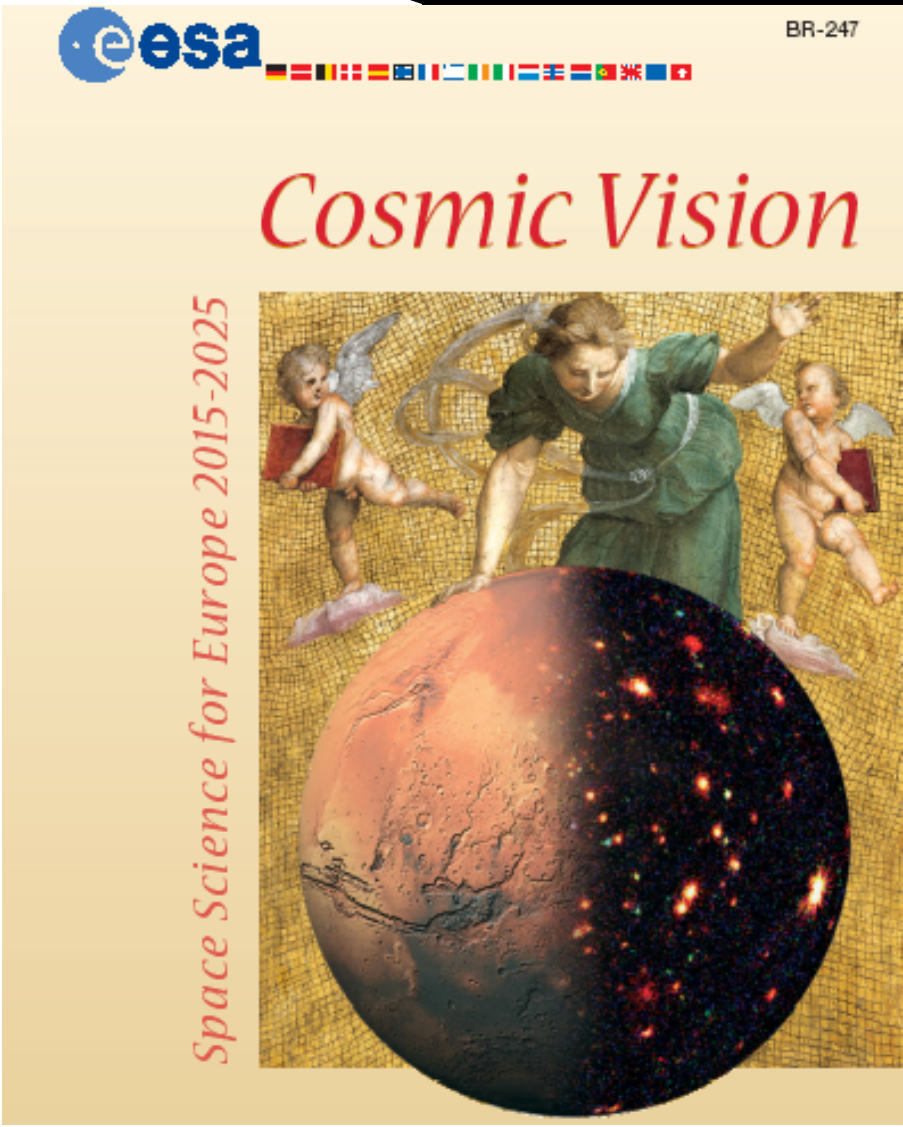
Four Questions:

What are the conditions for life and planetary formation?

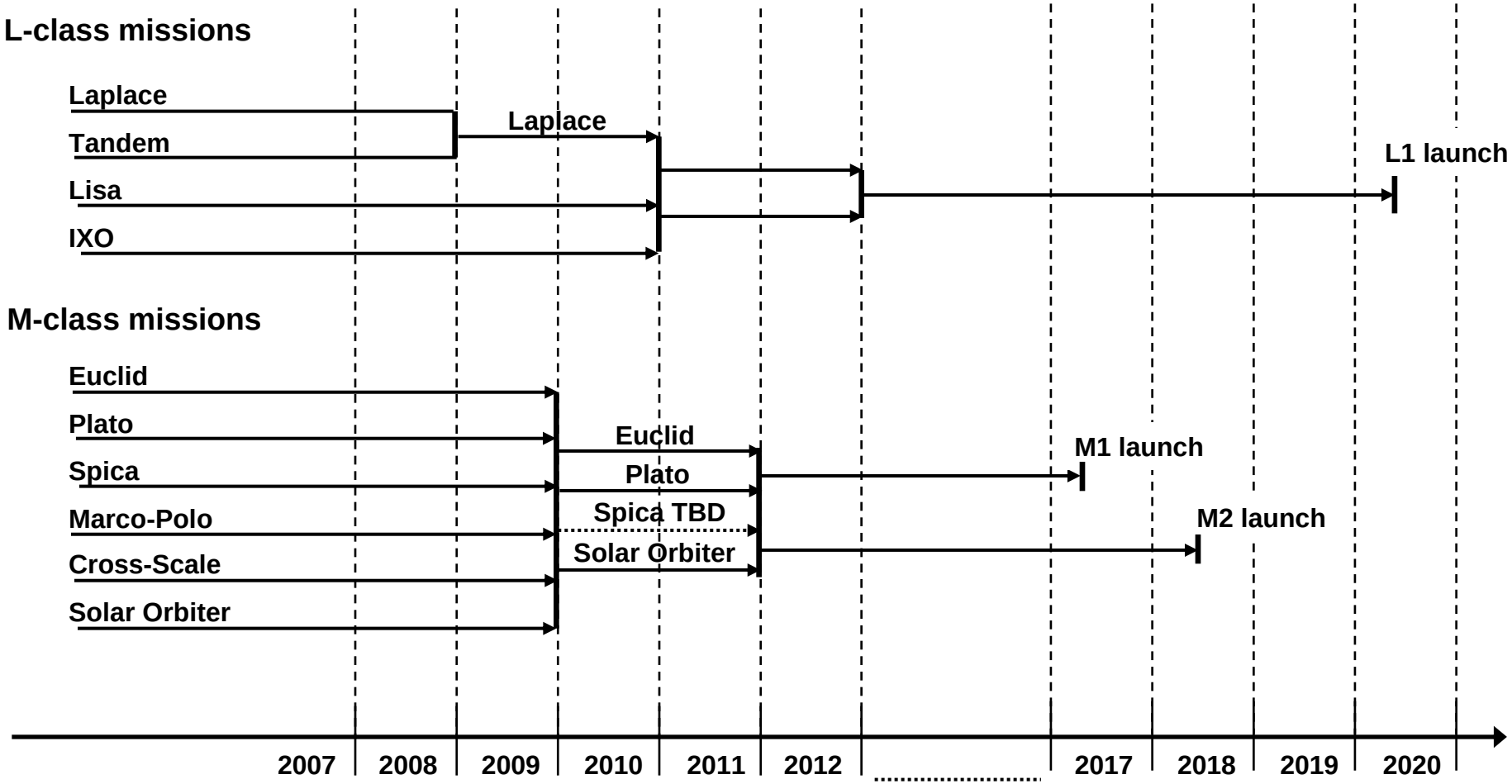
How does the Solar System work?

What are the fundamental laws of the Universe?

How did the Universe begin and what is it made of?

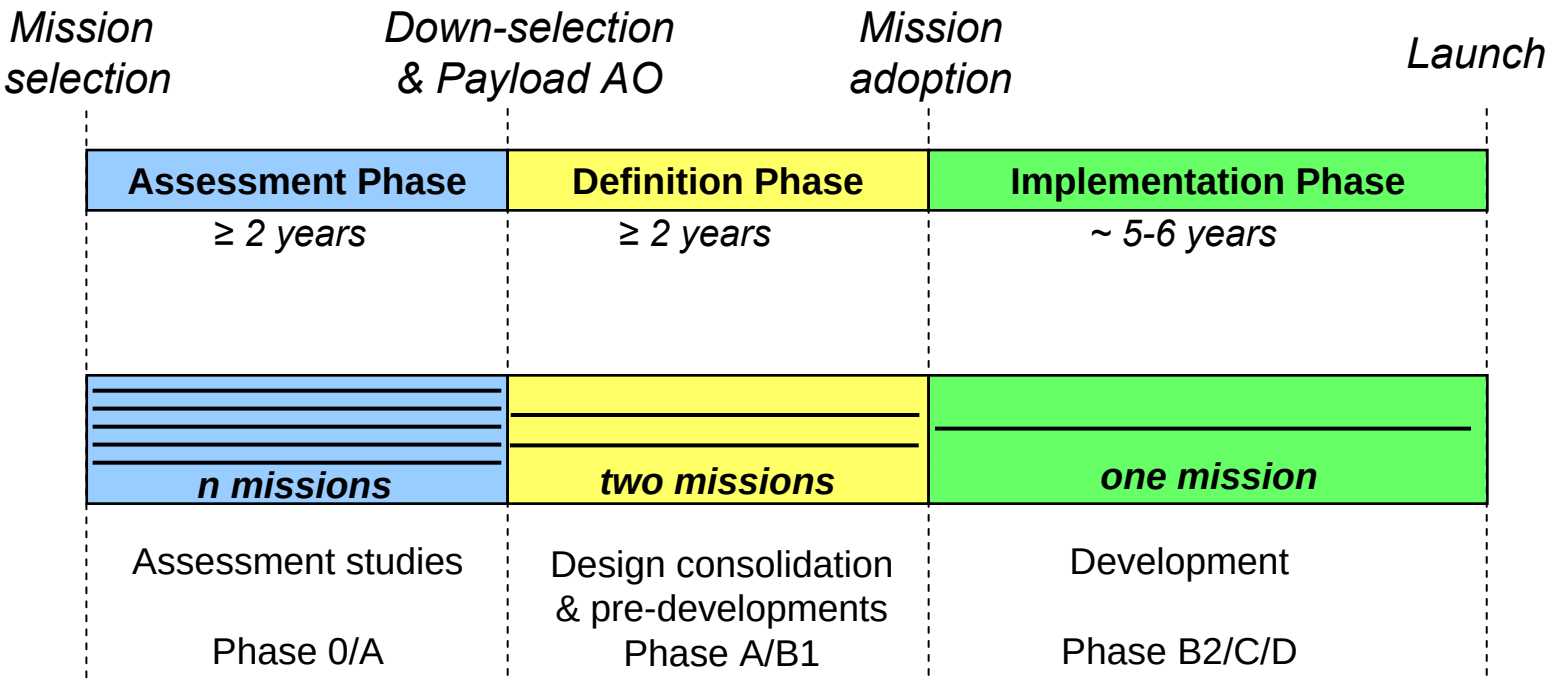


Cosmic Vision timeline summary



Mission Phases

First slice of Cosmic Vision Plan: Three M-Class in definition and three L-Class missions in assessment



more on cosmic vision: http://sci.esa.int/science-e/www/area/index.cfm?fareaid=100

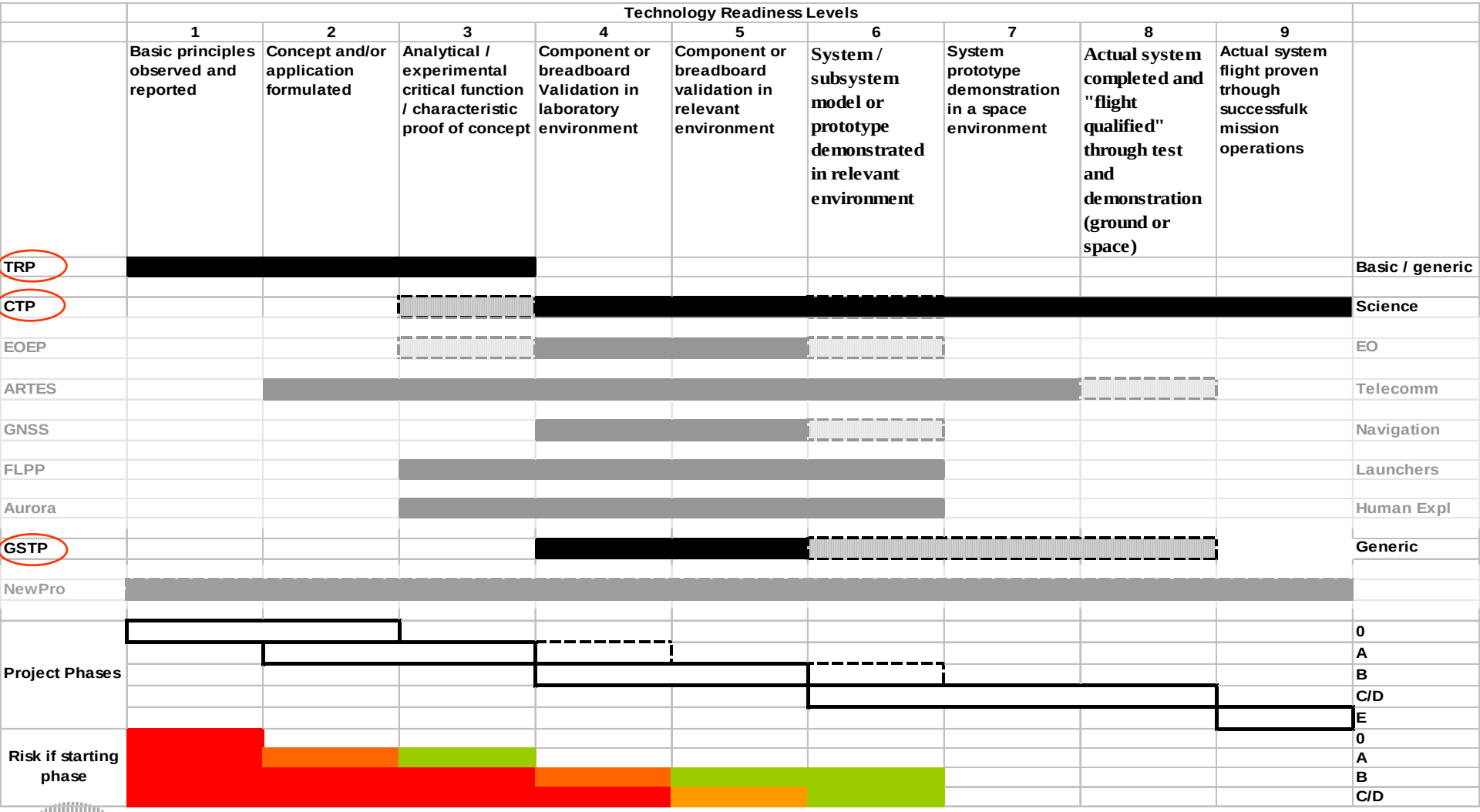
Key elements of Cosmic Vision implementation plan

- **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 Preparation**
  - For spacecraft and science instruments
  - Harmonisation with Member States required for payload related activities

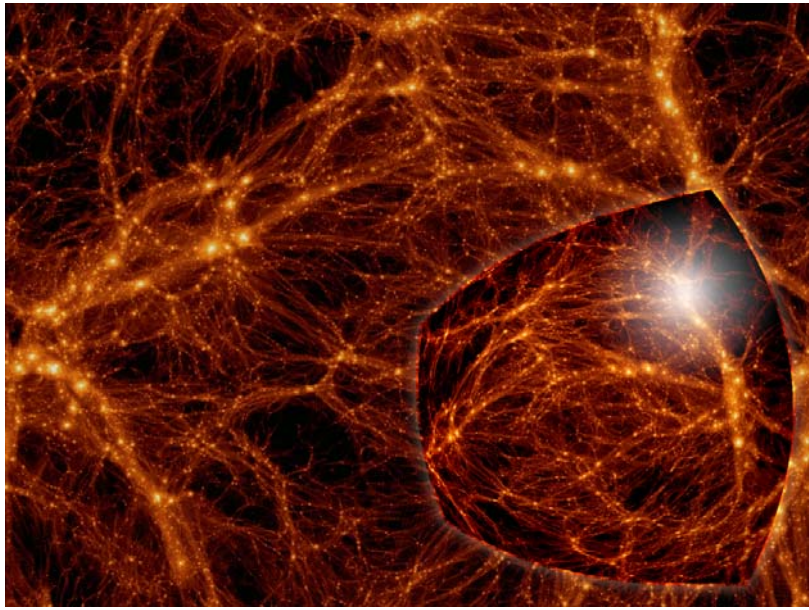
Technology development: programmes, project phases and risks



EUCLID overview

Science Objective:

>10000 deg^2 sky survey to characterize dark energy and dark matter

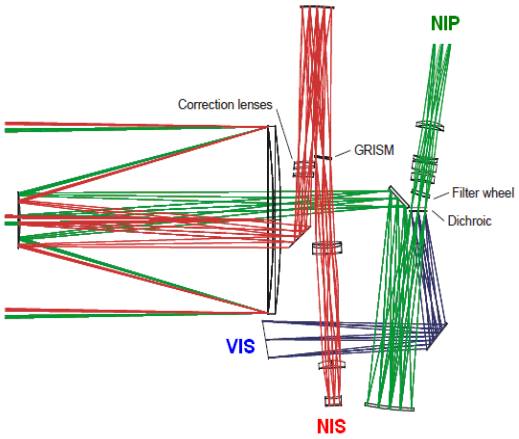


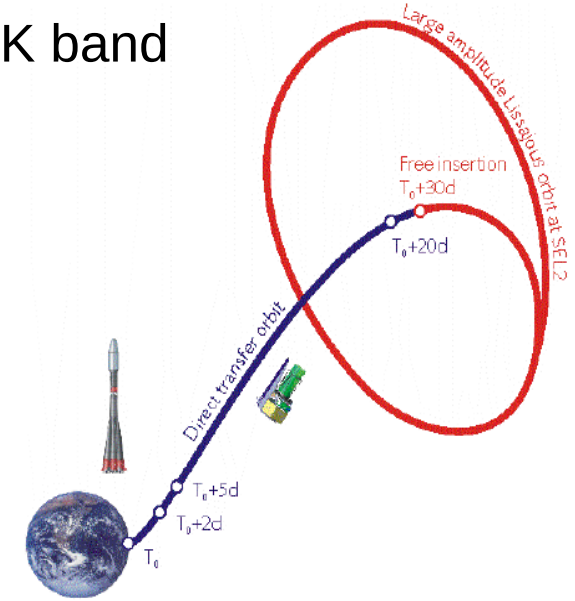
Payload:

- 1.2 m telescope
- Visible imager (weak lensing)
- Near IR photometer (weak lensing)
- Near IR spectrometer (BAO)

EUCLID: Key Aspects driving technology:

- Large area focal planes (VIS & NIR) – state of art + radiation resistance
- Exceptional requirements on PSF stability and low ellipticity (0.1 arcsec)
- Step and stare sky scanning strategy – duty cycle efficiency and Line of Sight Stability
- Very high data rate – K band





PLATO: “PLAnetary Transits and Oscillations of stars”

Main science objectives

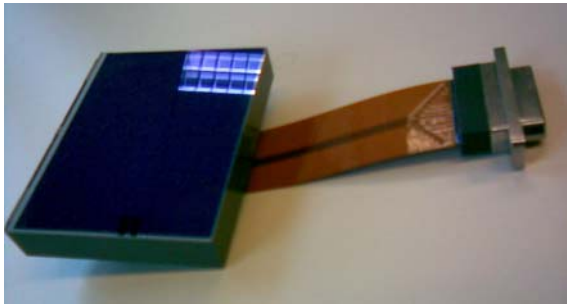
- To search for exoplanetary transits (occultations) in front of stars
- To characterize the parent stars in terms of fundamental physical parameters via asteroseismology
- Accomplished through high time-resolution, high precision, and high duty-cycle visible photometry

Mission concept:

- Direct insertion into Large amplitude orbit around L2 using Souyz 2-1b LV
- 6 year mission, 3-axis stabilized
- Multi-aperture approach to allow for large FoV
- Optics and detectors (CCD) operating at cold temp. (~170K)
- ~0.2” pointing and stability req. (P/L → FGS)

PLATO Technology

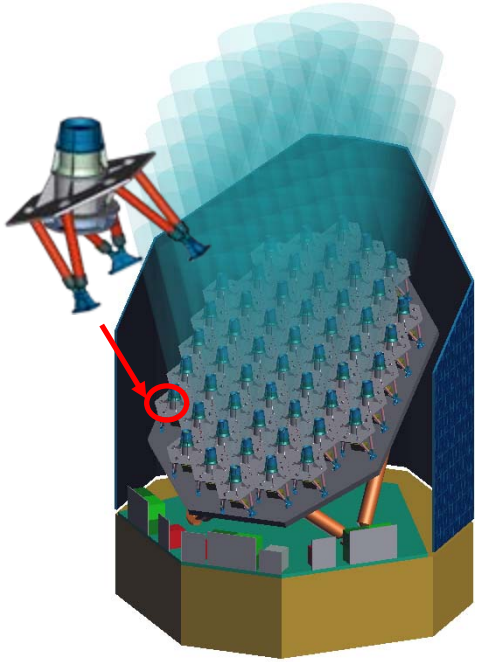
Pre-developments required:



CCD prototyping

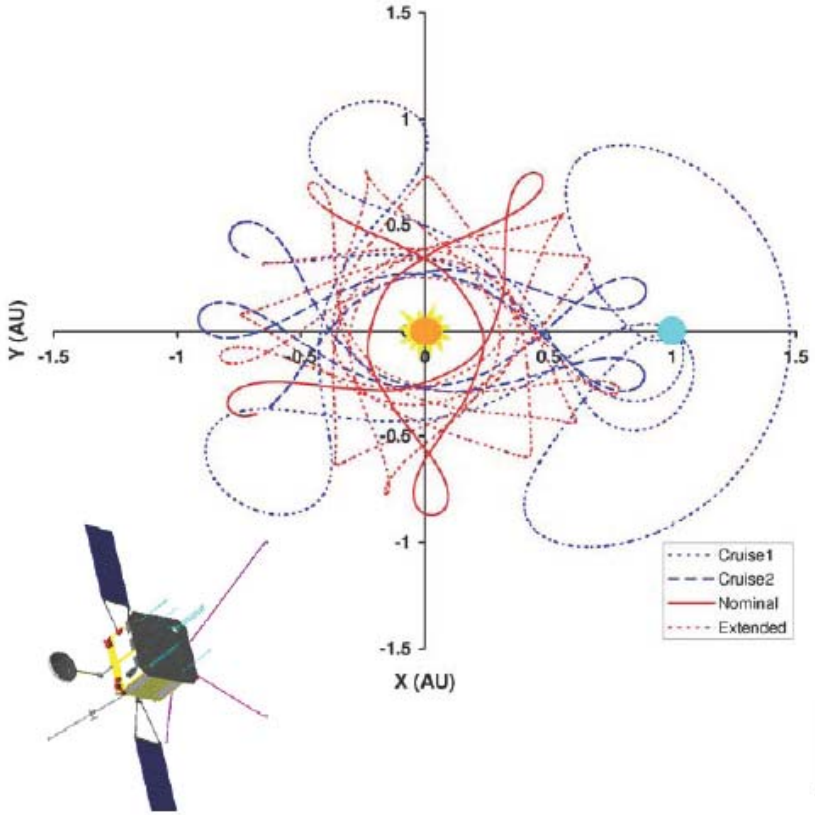
- **Optimized high speed, high dynamic range CCD**
- **Multi-aperture approach: many CCDs need to be produced in short time frame**

Refractive telescope breadboard/EM



- **Bread-boarding of a 6 lens telescope, with large diameter lenses and operating at low working temperature**
- **34 telescopes to be produced: heritage from a bread-board telescope is needed**

Top level scientific goals of Solar Orbiter

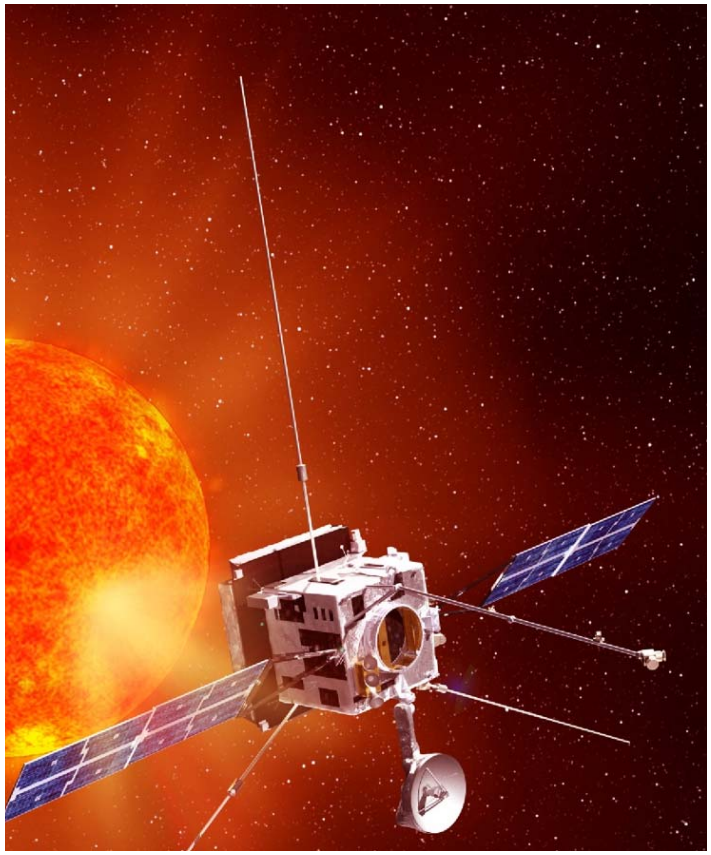


- Determine the properties, dynamics and interactions of plasma, fields and particles in the near-Sun heliosphere
- Investigate the links between the solar surface, corona and inner heliosphere
- Explore, at all latitudes, the energetics, dynamics and fine-scale structure of the Sun's magnetized atmosphere
- Probe the solar dynamo by observing the Sun's high-latitude field, flows and seismic waves

Combination of Remote Sensing + In-Situ science

Solar Orbiter technologies:

- Rely on Bepi-Colombo (Mission to the planet Mercury) technology and equipments wherever possible
- Double-sided solar array based on Bepi-colombo cell technology
- High flux solar testing
- Heat shield
- Heat rejecting filters

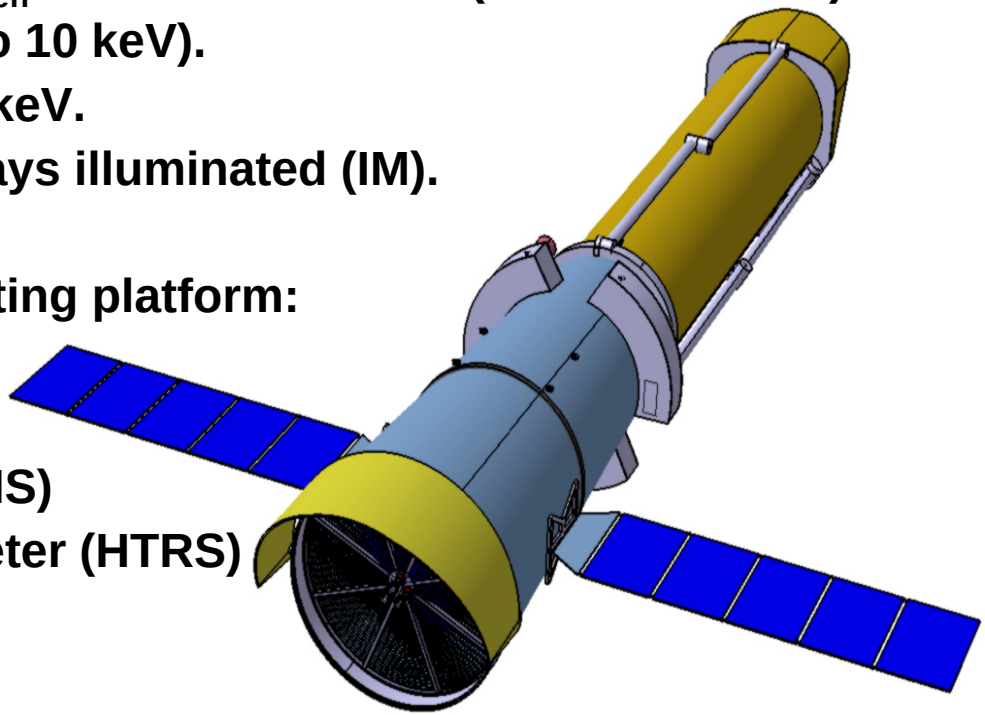


IXO – International X-ray Observatory

- International ESA-JAXA-NASA collaboration scheme in 2008, XEUS & Constellation X merged → International X-Ray Observatory.

- Main observatory requirements:
  - Single telescope aperture with A_{eff} = 3 m2 at 1.25 keV (0.6 m2 at 6 keV).
  - Telescope HEW = 5 arcsec (0.1 to 10 keV).
  - DE < 2.5 eV between 0.1 and 6.5 keV.
  - X-ray Grating Spectrometer always illuminated (IM).

- Five focal plane instruments on rotating platform:
  - Wide Field Imager (WFI)
  - Hard X-ray Camera (HXI)
  - X-ray Imaging Spectrometer (XMS)
  - High Time Resolution Spectrometer (HTRS)
  - X-ray Polarimeter (XPOL)

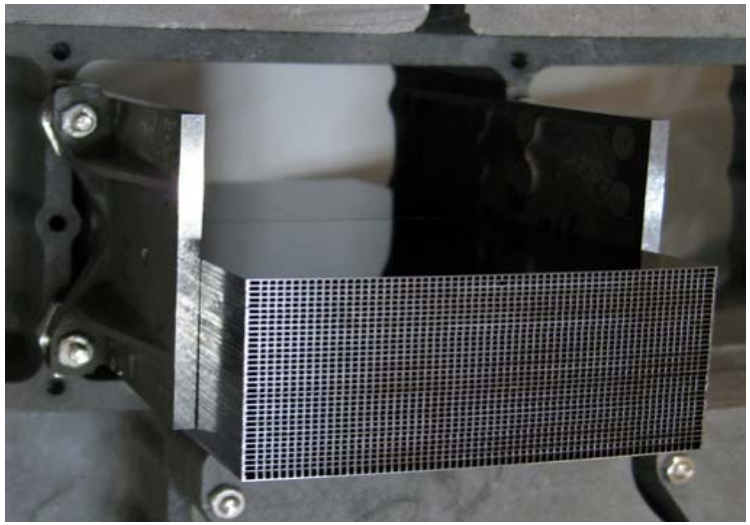


IXO technology activities:

- Low mass X-ray optics (mission enabling): Si pore optics development and validation,
- Alternative optics technology using slumped glass
- Cryogenic coolers (required by Narrow Field Instrument)
- Deployable structure required to increase focal length (extension mechanisms, deployable shroud).

National developments:

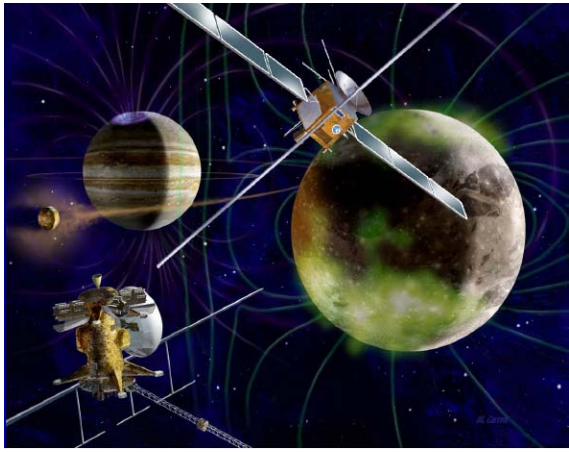
- Detectors
- Associated electronics
- Cooling



Laplace – Europa Jupiter System Mission

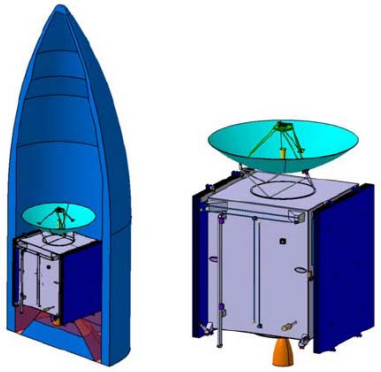
ESA/NASA Outer Planet candidate mission

- ESA: Jupiter Ganymede Orbiter (JGO), Jupiter System Science (atmosphere, magnetosphere) with focus on Callisto and Ganymede
- NASA: Jupiter Europa Orbiter (JEO). Jupiter System Science with focus on Europa, Io (NASA-JEO)



Space Segment (ESA, Jupiter Ganymede Orbiter (JGO))

- Launch: Ariane 5 in 2020, Transfer: VEEGA-type, no deep space manoeuvre, arrival: 2026
- Jupiter tour with multiple fly-bys at Callisto and Ganymede (low altitude, typ. 200 km), then (1) Callisto resonant orbit, (2) Ganymede elliptical orbit, (3) Ganymede circular orbit
- Avoidance of high radiation
- Solar power LILT technology, no concentrators, no RTG or RHU
- Chemical propulsion

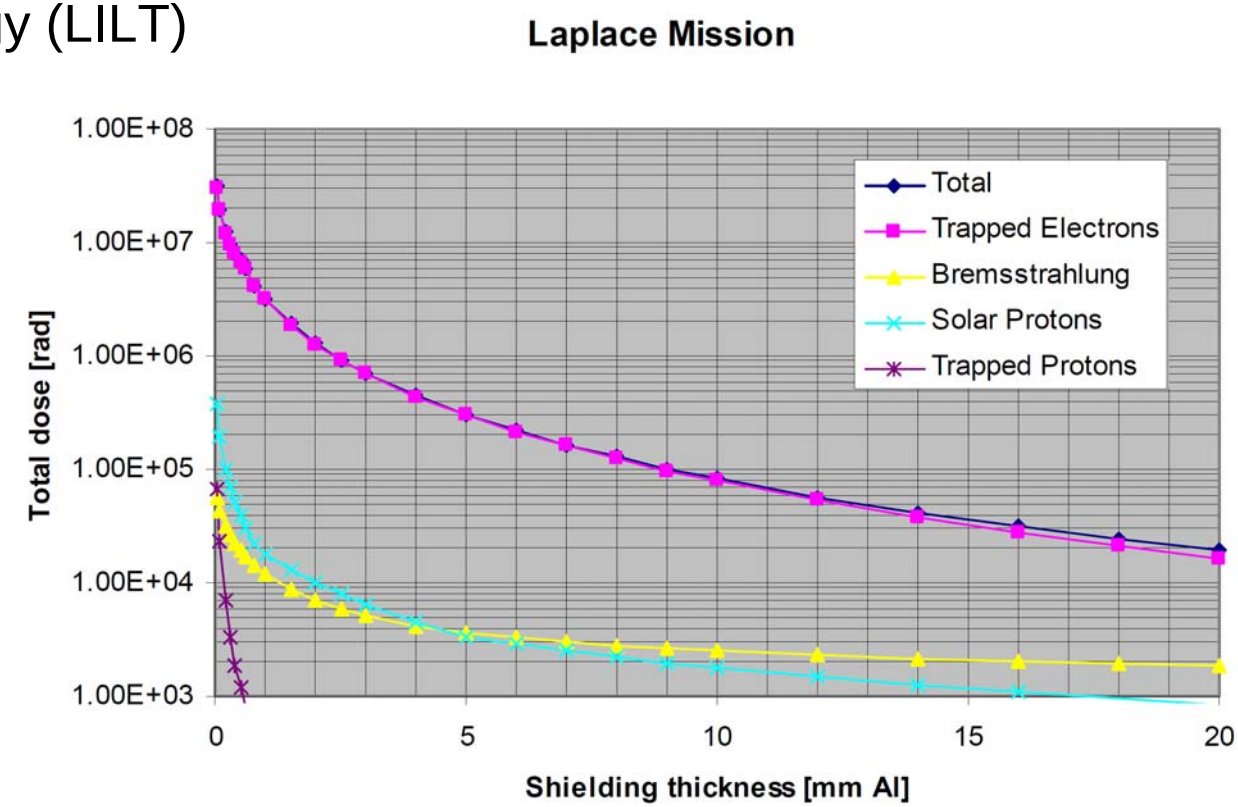


Payload: ~80kg science instruments, nationally provided

JGO = Jupiter Ganymede Orbiter

Laplace Technology developments:

- Radiation hardening and tolerance/tailored shielding,
  Radiation environment; 150 krad (shielded)
- Improved Environmental modelling
- Solar Cell Technology (LILT)

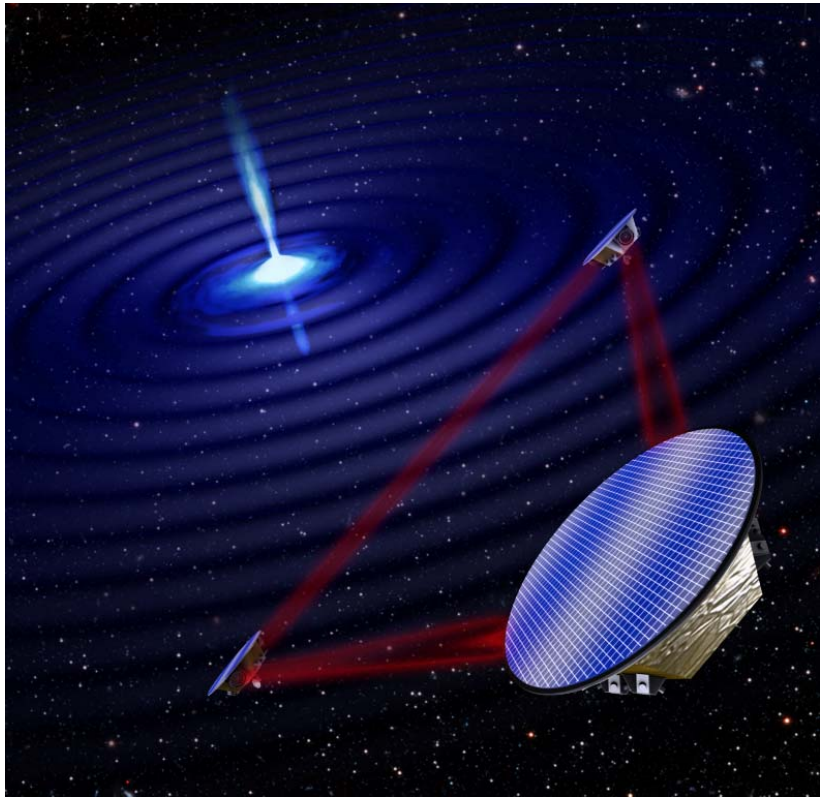


LISA: Laser Interferometer Space Antenna

- ESA/NASA collaboration
- Measurement of gravitational wave using laser interferometry
- Constellation of 3 spacecrafts separated by 5 million km

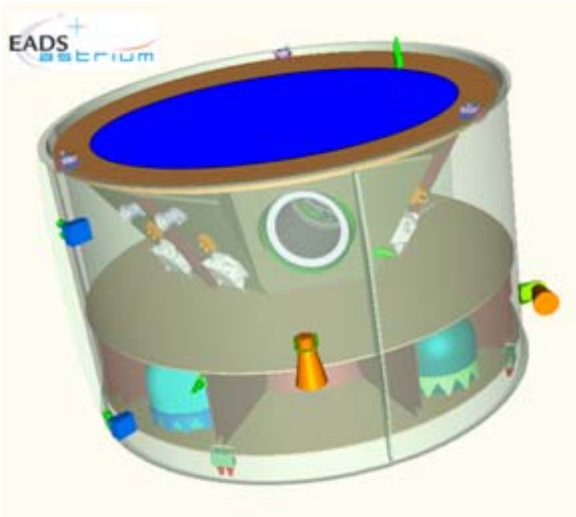
Critical areas

- 6 drag-free test masses
- micropropulsion system
- interferometrically measuring variations in distance between couples of test masses at the picometre level, at 5 million km distance
- LISA Pathfinder technology validation



Technology required by LISA

- Low-noise, high stability mechanisms (point-ahead and optical articulation)
- Highly stable materials for telescope assembly (CFRP, zerodur, inserts …)
- Low-noise electronic components for GRS front-end electronics (voltage references ..)
- Light sources for charge management discharge (LEDs, laser diodes …)
- Metrology system
- High-power laser system (1-2 W EOL, redundant)
- Outgassing & contamination issues
- Micropropulsion (lifetime characterization)

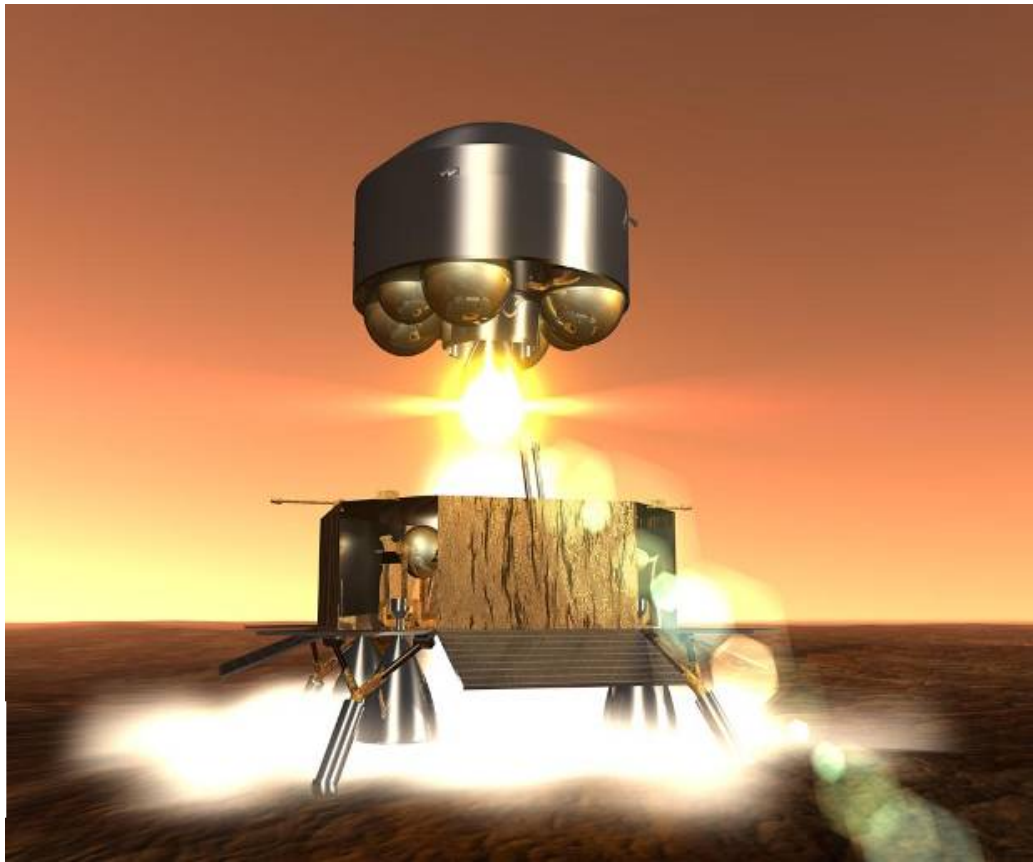


Mars Robotic Exploration Programme

- Foreseen in collaboration with NASA
- Mars Sample Return mission is taken as long term objective
- Target is to contribute to each Mars mission slot (every ~2 years)
- Prepare post-ExoMars missions and enable decisions at next C-Min (2012)

MREP activities:

1. Technology Development
   - Short term: 2020 Network scenario (TRL 5 by end 2011)
   - Mid term: post 2020 intermediate mission (IM)
   - Long term: strategic and enabling technologies for European Robotic Exploration
2. Intermediate Mission Studies
3. MSR architecture studies, in collaboration with NASA/JPL



Future Missions – opportunities for Slovenia

- **Mandatory ESA Programme: Cosmic Visions 1525 Science Programme**
  - Providing a set of carefully selected missions, covering the science priorities of Europe
  - Phased down-selection, considering scientific excellence, technological feasibility and readiness, schedule and affordability
  - Sliced Programme, allowing regular new entries through open Call for Missions (every ~3-4 yrs), ensuring innovation
- **Early involvement facilitates later participation in flight projects**
  - Establish awareness of the programmes and mission candidates
  - Define strategic focus of own interests
  - Identify competitive contribution opportunities
  - Develop relevant capabilities and establish heritage
- **Good investment: early and focused technology preparation**
  - Identify early the technology areas of interest for Slovenia and its industry and institutions
  - Base developments on existing expertise and solid background
  - Ensure strategic relevance and long-term commitment
  - Develop technologies with solid teams working with a well defined focus
  - Build a technological heritage and develop partnerships

Achievement requires Audacity!

esa

European Space Agency is opening the doors to Slovenia
Ljubljana, 31 Mar 2010