# Cosmic Vision 2015-2025
# Technology Plan

## Industry day, Estec 21 November 2008

**This file corresponds to one of a series of presentations made during this meeting. The complete set of presentations is available to download from:**

**http://sci.esa.int/CVIndustryDay2008**

Directorate of Science
and Robotic Exploration

# Overview of M-class missions

# Cross Scale (M-class)

## Science

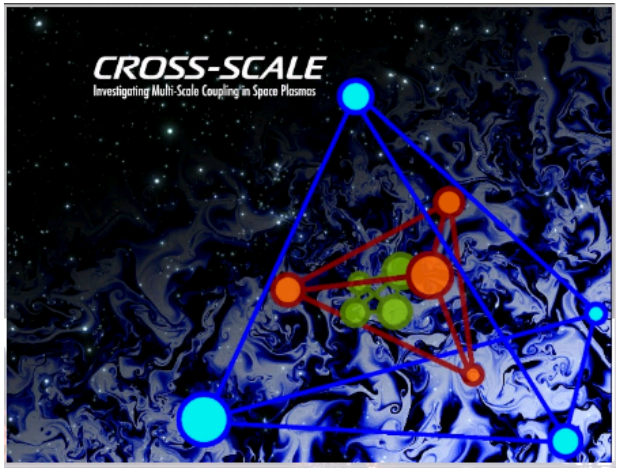
- To study plasma processes (turbulence, reconnection, shocks) on multiple scales simultaneously

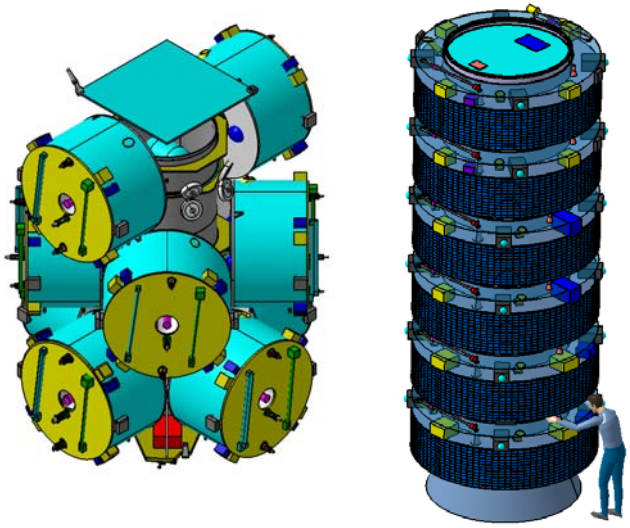
## Space Segment

- 7 S/C in nested tetrahedra, optimum 12 S/C on 3 scales:

  (1) Electron scale (2-100km), (2) Ion scale (50-2.000km), (3) Fluid scale (3.000-15.000km)
- Launch on Soyouz-2b (single launch)
- Slightly adopted payload per scale (~25 kg per S/C)
- Spinning S/C with ~15 rpm
- Orbit: 10 $R_E$ x 25 $R_E$ (optimum science, low radiation, no debris problem) constellation passes through bow shock, magnetotail and magnetopause
- Orbital period: 104 h, Orbit Inclination: 14 degree, multiple visit of "Tailbox"
- S/C design identical for all scales to minimise non-recurring costs
- Main trade-off: dispenser / stacked configuration

## Payload: provided by Member States



Trade: Dispenser or Stacked configuration

**Directorate of Science and Robotic Exploration**

# Cross Scale (M-Class)

## Technology

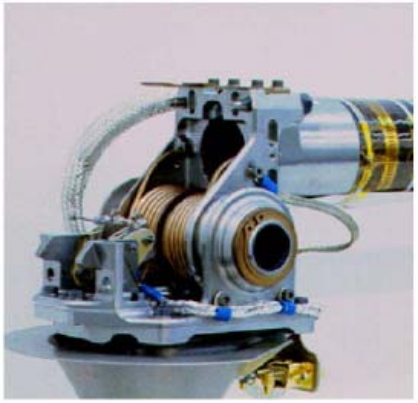
- No major critical technology development required

## Assessment Status

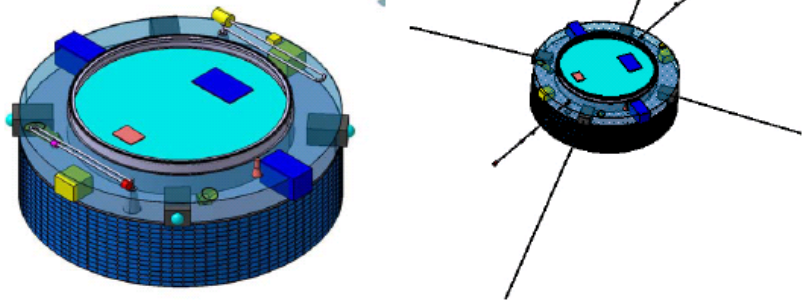
- ESA Phase 0 study completed.
- Industrial Studies – 2 parallel contracts running (TAS-F and Astrium-UK, Final Review Jun. 2009)
- In parallel: National funded Instrument Studies (10) by instrument proposers

## International Collaboration

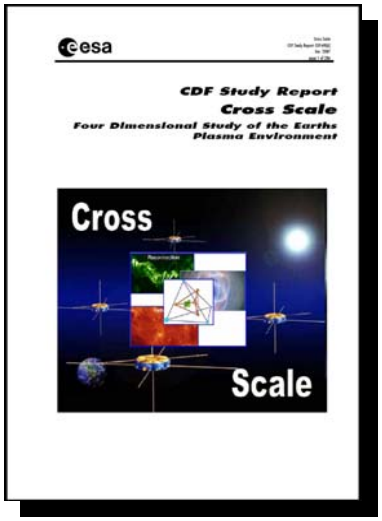
- JAXA (Scope), NASA and CSA

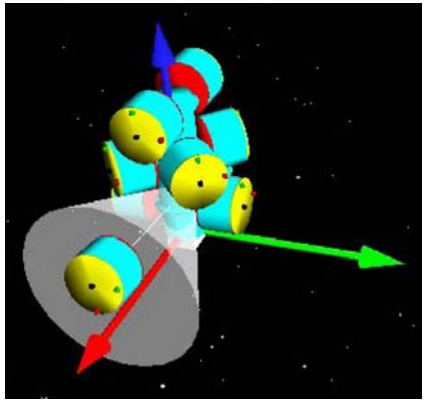


Wire-boom deployment unit



Spacecraft in stowed and deployed configuration



S/C deployment simulation (dispenser based)

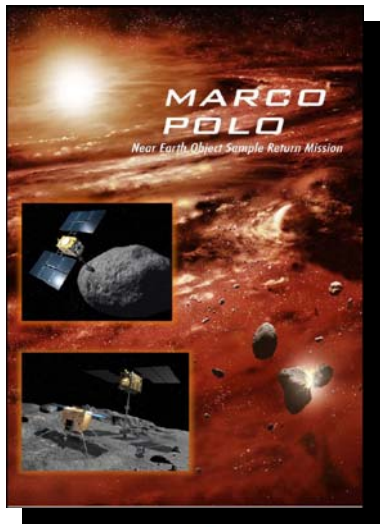
# Marco Polo (M-class)

## Science

- ~30 gram Sample Return from primitive Asteroid (C or D-type)
  e.g.: UQ 1989 (C-type), ~760m diameter, 0.67 AU x 1.16 AU

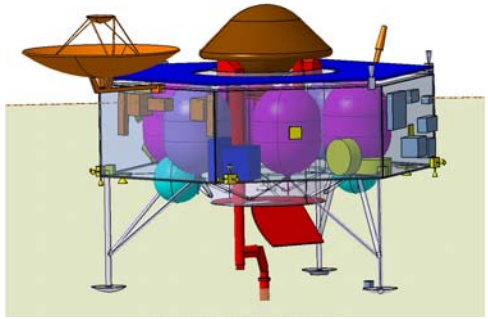
## Space Segment

- Goal: Minimum possible space segment
- Launch with Soyuz -1B (Aug. 2017)
- Chemical Transfer (typ. 3.2 year), Δv = 482 m/s, Earth-Venus GA-transfer
- Arrival: Dec. 2020 – 1.6 year stay time (observation, sampling)
- Landing on target at full daylight
- Return: Nov. 2023, Δv = 529 m/s, Venus GA
- Entry: v = 11.8 km/s, 11 MW/m2, ~76 kg entry capsule (ERC)
- 3 axis stabilized S/C, mass = 1.191 kg (wet)
- Sampling based on coring principle (some ExoMars heritage)



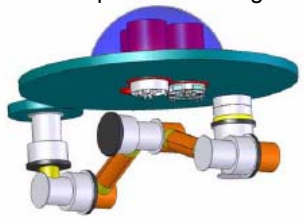

CV-proposal
Marco Polo

Re-entry capsule



Spacecraft Design

## Payload: Focus on sample return



Robotic arm for sampling

**Directorate of Science and Robotic Exploration**

# Marco Polo (M-class)

## Technology

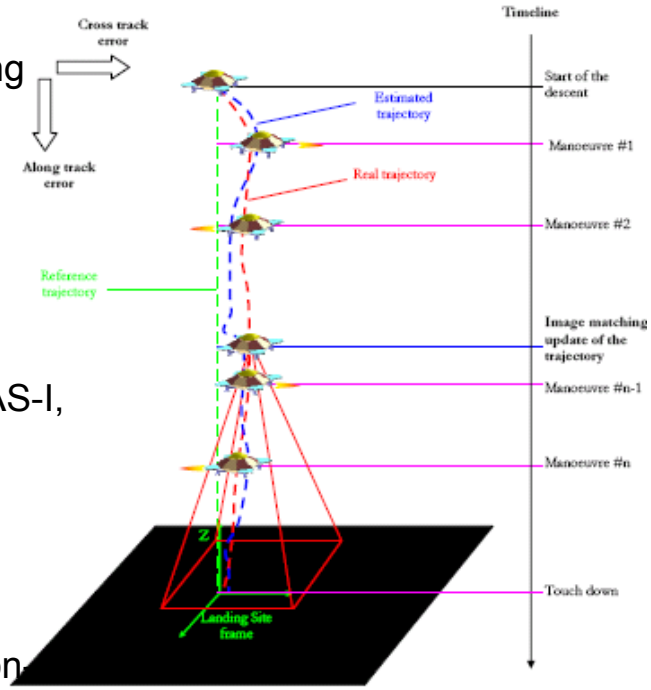
- Guidance and Navigation at small body, including GNC for safe landing
- Landing and operations on surface at low gravity
- Sampling mechanism and transfer system
- Re-entry up to 12.5 km/s

## Status

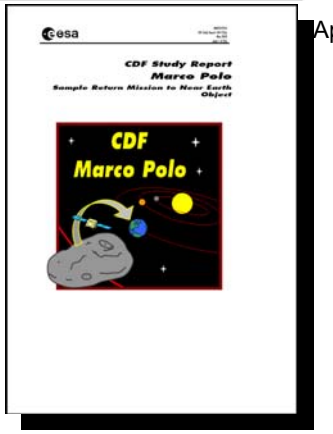
- ESA Phase 0 study completed.
- Industrial Studies – 3 parallel contracts running (Astrium UK, OHB, TAS-I, Final Review ~ Sep. 2009)
- National funded P/L studies in parallel (23 proposals received)

## International collaboration

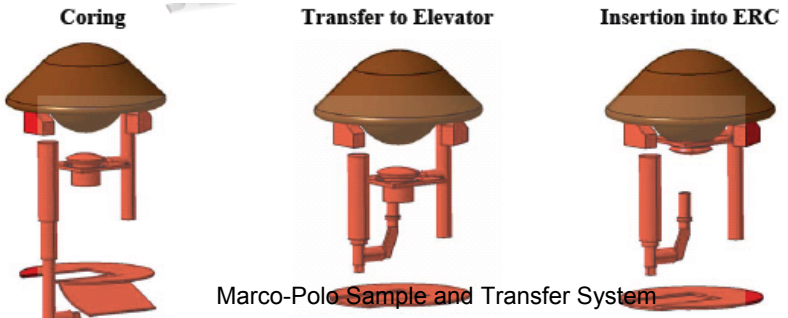
- Under elaboration, could be with JAXA,
- In case of JAXA lead: More challenging target (e.g.2001 SG286/Wilson-Harrington)




Approach and Landing




CDF Report
Marco Polo




Marco-Polo Sample and Transfer System

**Directorate of Science and Robotic Exploration**