ESA
MREP-2 & Cosmic Vision
Future Missions

P. Falkner, D. Rebuffat
Future Missions Office
Science & Robotic Exploration (SRE), European Space Agency

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Mars Robotic Exploration Preparation (MREP-2)

- MREP-2 is an optional programme following MREP-1

Mars Robotic Exploration Programme Slice 2:

- Prepare post-ExoMars missions and enable decisions at next C-Min (2016)
- Mars Sample Return mission is confirmed as long term objective

Post ExoMars MREP activities are focused on two categories:

1. Technology Development
   - Mission preparation: Phobos-SR (Phootprint), MSR
   - Long term: strategic and enabling technologies for European Robotic Exploration

2. Mission Studies

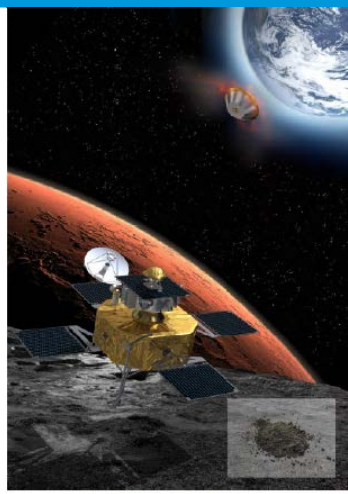
MREP-2 status

MREP-1

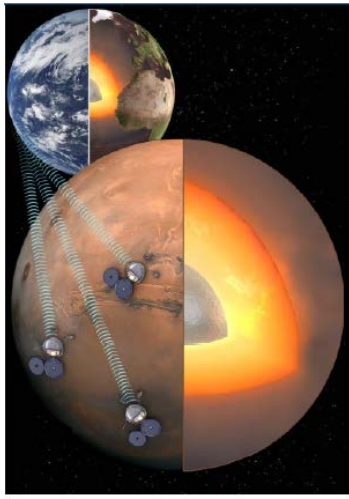
- 5 mission studies done – presented at ASTRA 2011
  - ⇨ 2 candidate missions proposed at MC-12
    - Phootprint & Inspire
    - Mars Sample Return confirmed as long term objective
  - ⇨ Many Technology Activities initiated

MREP-2

- presented at ASTRA 2013
- Nov 2012: MREP-2 subscribed at C-Min 2012
- Initiation of PB-HME working group on future robotic exploration missions
- Initiated co-operation with ROSCOSMOS ⇨ joint Phobos SR
- Many Technology Activities initiated under MREP-2 (see online technology plans)



PHOOTPRINT,
Phobos sample return



INSPIRE,
Mars Network of landers

Overview

Phobos SR
Phootprint

Mars Precision Lander
with Sample Fetch Rover

MREP Technology Development

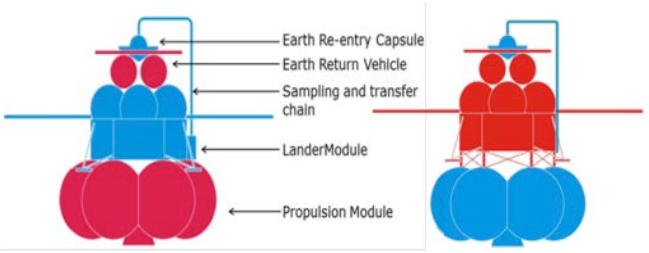
INSPIRE
Mars Network Mission

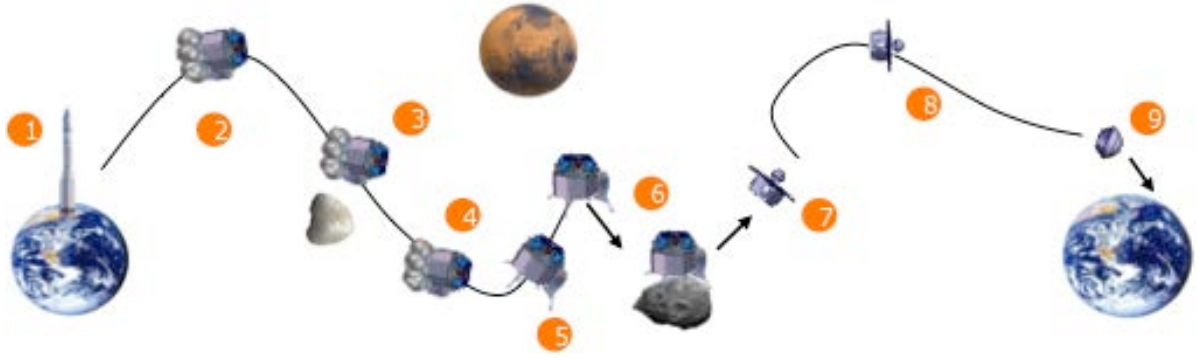
Mars Sample Return

Phobos Sample Return Phase-A

1. Building on successful joint CDF and Phootprint pre-phase A outcomes, an Phobos Sample Return Phase A is under preparation
2. Study will address the two joint Roscosmos / ESA scenarios as per CDF, as well as an ESA standalone scenario
3. Study will contemplate the modular architecture as designed during joint CDF (4 elements : PM,LM,ERV,ERC)
4. Kick-Off end of May 2015, and 12 months study to provide results in due time for CMIN 16

Baseline joint scenario *Back-up joint scenario*



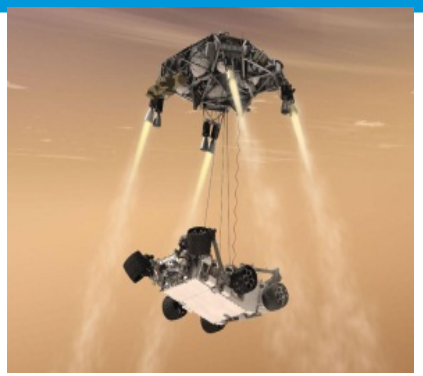


1. Launch and Direct Escape with Proton and Breeze-M in 2024
2. Transfer Earth-Mars
3. Transfer to Deimos and Deimos Close Proximity Operations
4. Deimos-Phobos Transfer and Release of PM (baseline scenario)
5. Phobos Close Proximity Operations
6. Descent and Landing and Surface Operations
7. Ascent by ERV
8. Departure and Transfer Mars-Earth
9. Reentry with ERC, landing in Kazakhstan or Woomera

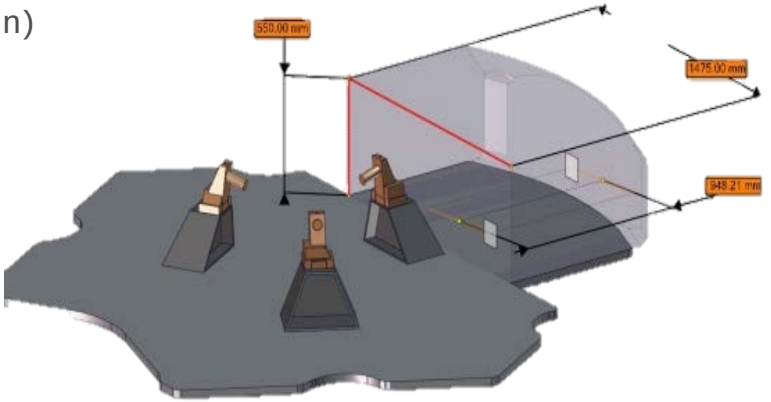
- Proton launch (joint scenarios) or Ariane 5or 6 (ESA-standalone)
- Direct escape in 2024
- Transfer to Mars (11 months)
- 9 months around Deimos / Phobos
- Departure from Mars in 2026
- Return to Earth (8 months)
- Return Capsule release and recovery in 2027 in Kazakhstan or Australia
- Mission lifetime ~ 3 years

MarsFAST: ESA / NASA joint mission study

- **Joint mission based on the NASA Skycrane and ESA rover technologies**
  - **NASA:** EDL System and static platform
  - **ESA:** Fast mobility rover & egress system
- **Main requirements for ESA rover:**
  - Mass allocation (rover + egress) 200 kg
  - Fast mobility demonstration for MSR Fetching Rover (~290 m/sol average)
  - Science payload allowing for remote & in situ science, sample acquisition/transfer/analysis (no life detection)
  - Minimum 180 sols life time
- **ESA CDF study focused on the rover**
  - Performed in Sept-Oct 2014
  - Preliminary design & programmatics
  - Iterations with JPL on interfaces to the platform



MSL Skycrane concept (credit NASA)

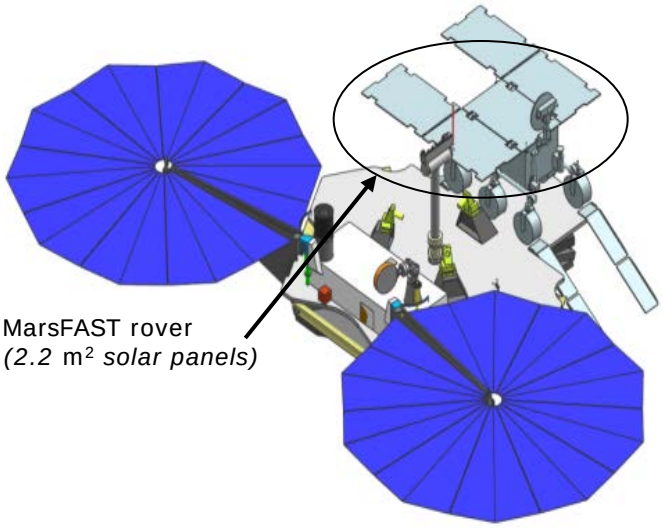


Volume allocation for the stowed rover (from JPL)

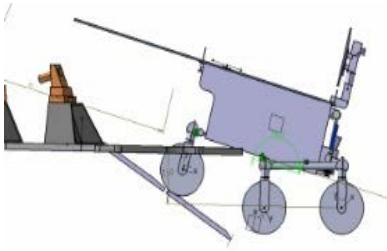
MarsFAST: ESA / NASA joint mission study

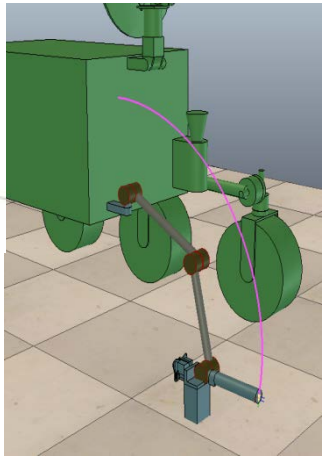
MarsFAST rover main features

- Strawman payload: stereo camera, meteo package, Mössbauer spectrometer, close-up imager, luminescence dating (requires sample acquisition)
- Robotic arm & sampling tool to perform in situ analyses and sampling operations
- Total rover mass: 156kg including margins
- Fast mobility using high performance vision based navigation algorithms under development at ESA
- Communications based on UHF relay Orbiter, and X-band Direct to Earth link (low data rate) for reactive operations and mission robustness
- Ability to hibernate for 14 sols during a local dust storm
- Egress system (22 kg) sized to cope with hazards and platform attitude after landing



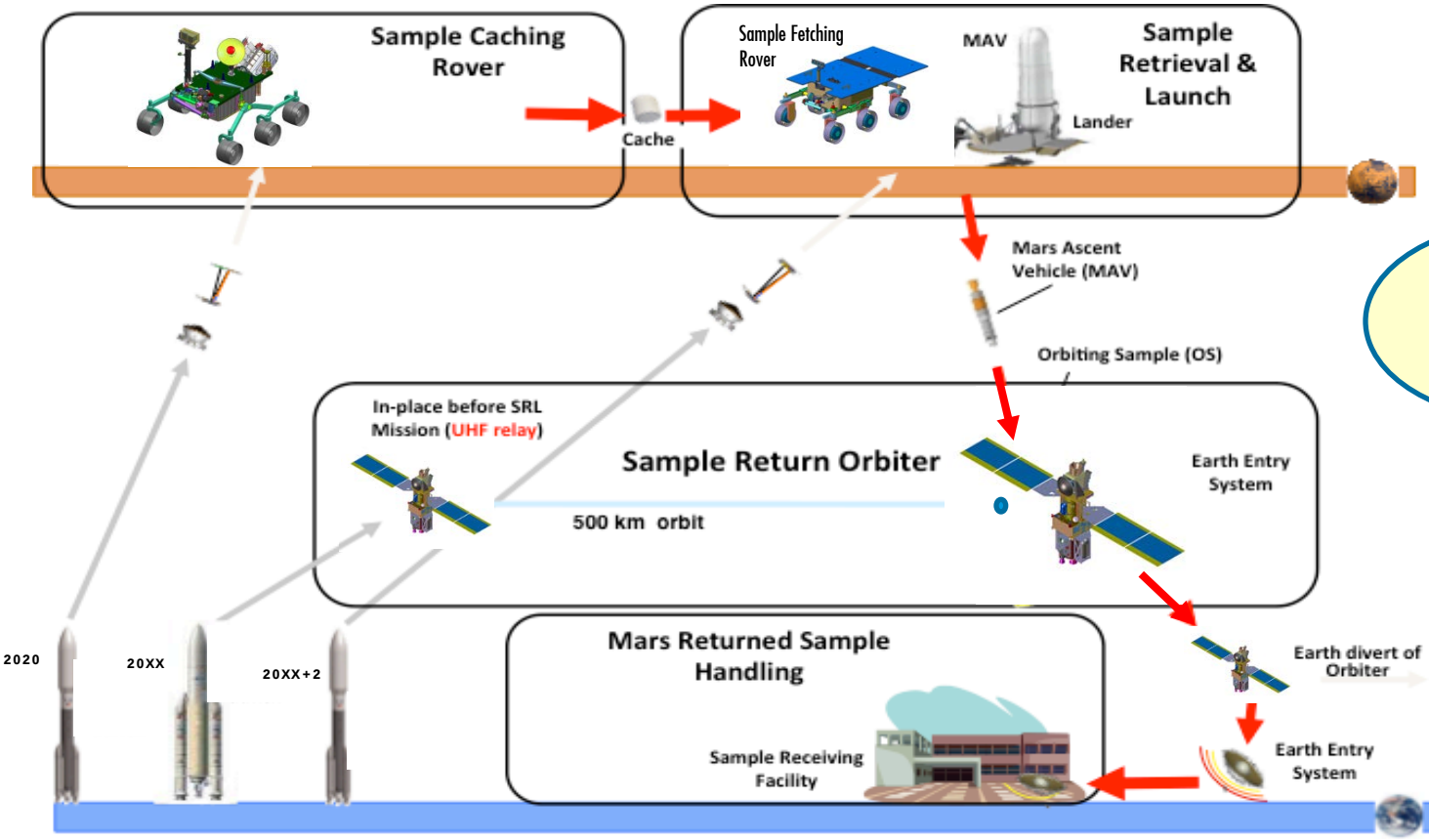
MarsFAST rover
(2.2 m^2 solar panels)





Egress & sampling analyses

Mars Sample Return ⇨ iMARS II



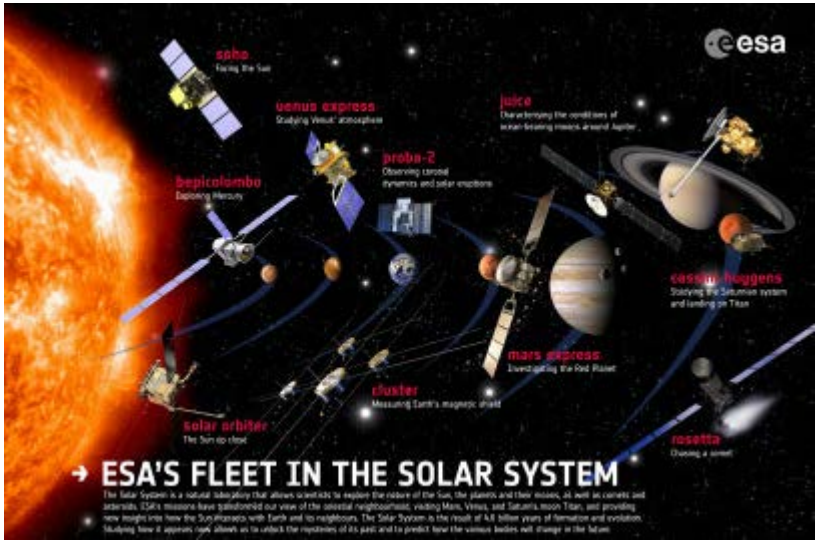
New iMARS II

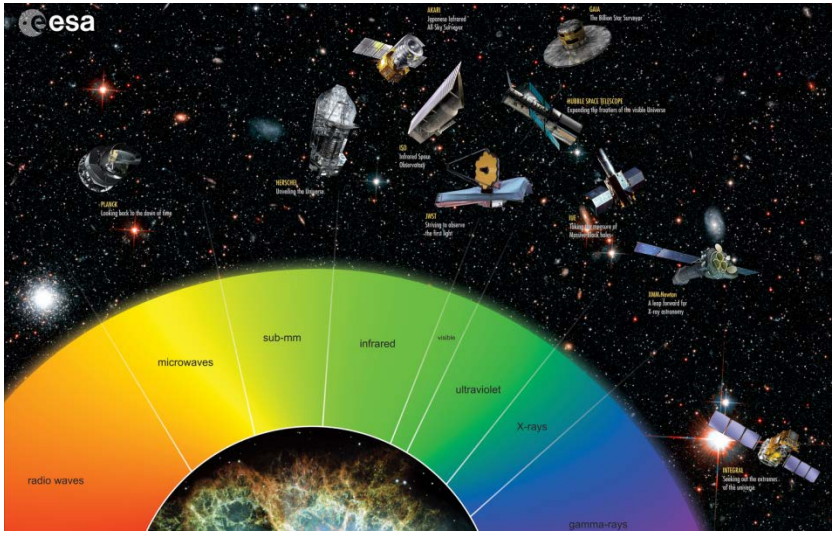
- The Caching Rover mission (SCR) selects and puts the samples in a Cache waiting for retrieval (could be 2020)
- The Sample Retrieval and Launch mission (SRL) retrieves the samples and launches them into Mars orbit
- The MSR Orbiter mission (SRO) rendezvouses and captures the Orbiting Sample (OS) then returns it to the Earth
- The Returned Sample Handling element (MSR-H) performs all the ground-based operations up to samples delivery to laboratories

Summary & Conclusion

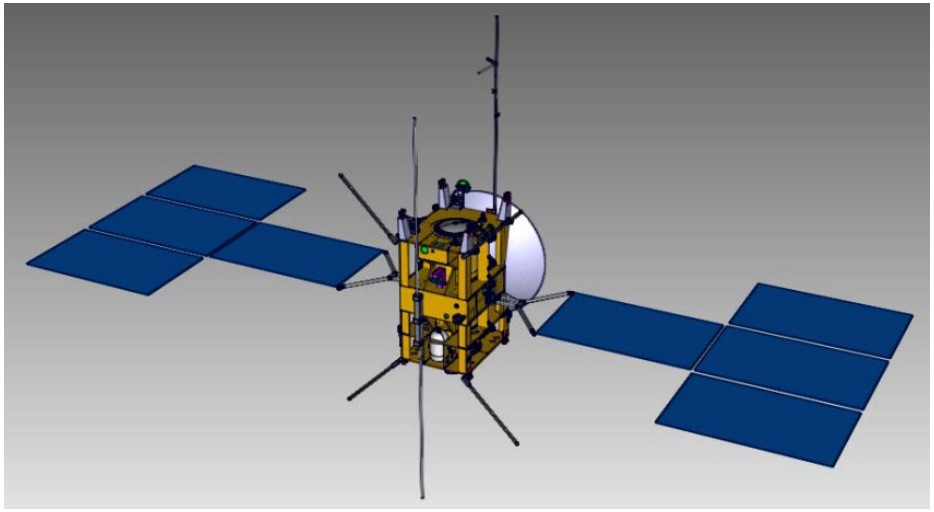
- Joint ESA/NASA/JPL MarsFast CDF Study done
- Preparation of Phobos SR Phase-A study
- MREP-Technology Plan 2015 activities under implementation
- iMars-2 continues – report ready by end June 2015

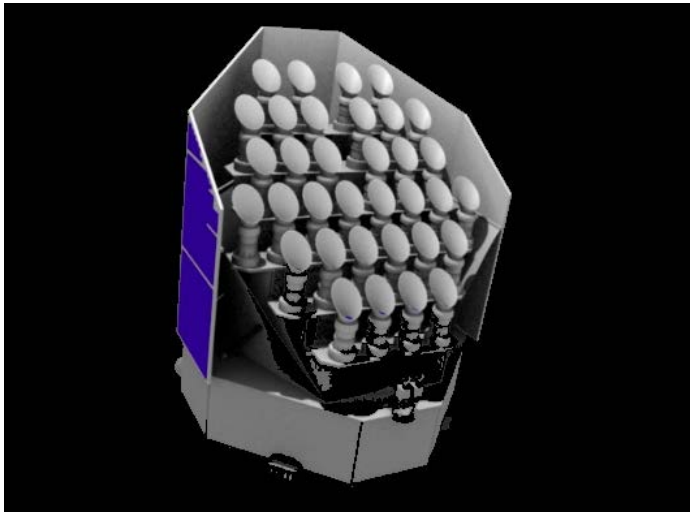
Cosmic Vision
Future Missions





Future Cosmic Vision Missions

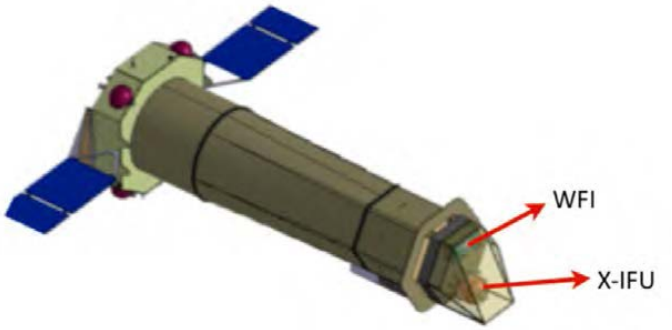


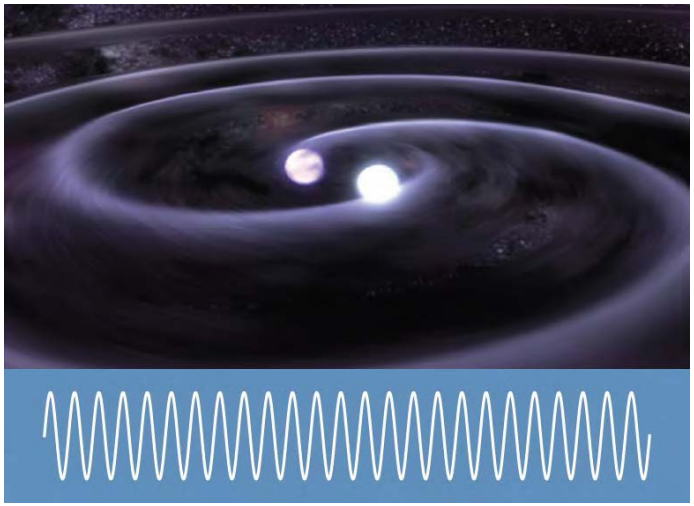


L1: Juice
Jupiter Icy Moons Explorer
Passed SRR end 2014
⇨ Adopted
under implementation

M3: PLATO
Planetary Transit and Oscillations of stars
⇨ Selected by SPC in Feb 2014
for Launch 2024
Currently in Phase B1

Future Cosmic Vision Missions

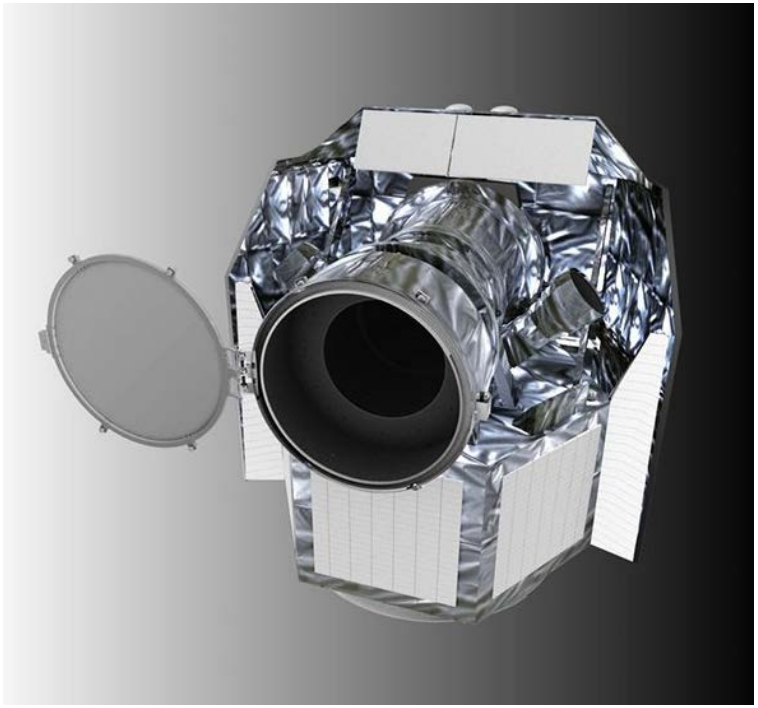




L2: ATHENA
Mission Selected by SPC in June 2014
⇨ Currently in Phase A

L3: Theme Gravitational Universe
⇨ Working group GOAT to investigate alternative detection principles

Future Cosmic Vision Missions



S1: Cheops
In Implementation Phase

M4: Launch 2025/26
- ***Proposals under evaluation***

Joint ESA CAS call: launch 2021
- ***Small joint ESA-China mission***
- ***Proposals under evaluation***

M5: call to come ~ end 2015

Questions ?