Technical assessment of M4 candidates

Paris, 3 July 2017

ESA Presentation
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M4 boundaries

- Call issued in August 2014, 27 proposals received
- M4 candidates ARIEL, THOR and XIPE selected following technical screening and scientific peer review
- Specific M-class mission, aiming at a Cost at Completion to ESA below 450 M€ (e.c. 2014, 456 M€ in e.c. 2017)
    - Cost envelope lower than for M2 (Euclid) and M3 (PLATO)
    - Mature missions targeted
    - Faster mission preparation timeline and development schedule. Compressed study phase. Mission adoption planned mid-2019, for a target launch in 2026
- All candidates make use of the new ESA launchers (Ariane 6.2 or Vega-C)

ARIEL – Mission Description

Science objectives

- Study exoplanets through transit/eclipse spectroscopy observations of their atmosphere.
- Survey type mission (>500 targets) with 3 tiers of increasing data quality:
  - SNR~7 @ 10 resolution elements (~30% of time for all planets)
  - SNR~7 @ half R (~60% of time for half of the planets)
  - SNR~7 @ max R (~10% of time for ~10s of planets)

Mission Profile

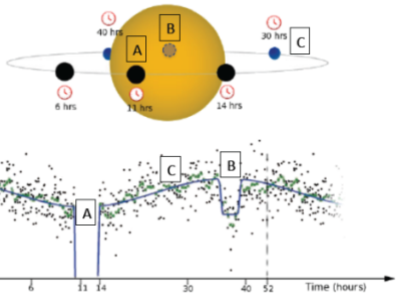
- A62 launch to L2, 4 years lifetime (6 years goal), 85% observation efficiency.
- Dual launch possible.

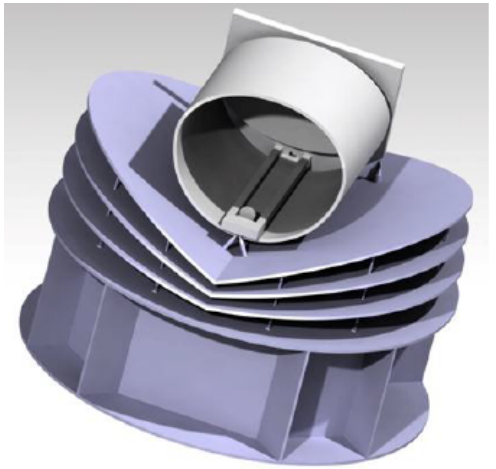
Payload (414 kg PLM + 41 kg warm payload units, 130 W, 175 Gbit/week)

- 4 VNIR channels + AIRS spectrometer.
- PLM passively cooled to ~55 K + active Ne JT cooler for AIRS detectors at 35 K.
- 3 mirror off-axis afocal telescope (Aluminium), 1.1x0.73m M1, diffraction limited at 3µm

Spacecraft (1.2 t wet, 1 kW)

- Fine pointing with FGS and reaction wheels on dampers.
- APE (1''), PDE (100 mas / 10 h) and RPE (200 mas / 90 s).
- X band communications, 15 h downlink every week split in 3 contacts.





THOR - Mission description

Main Science Objectives

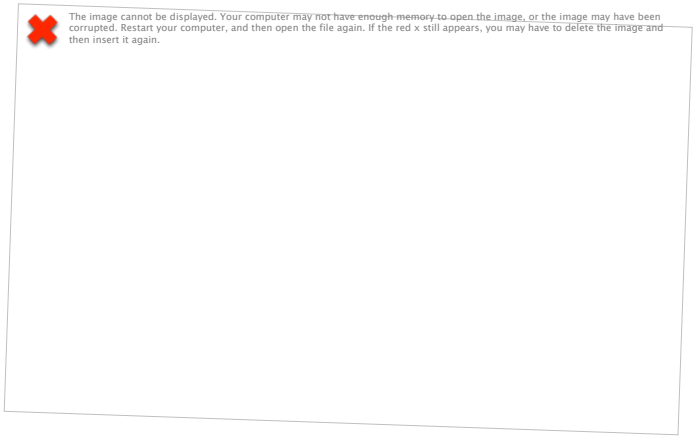
- How are plasma heated & particles accelerated?
- How is the dissipated energy partitioned?
- How dissipation operates in ≠ regimes of turbulence?

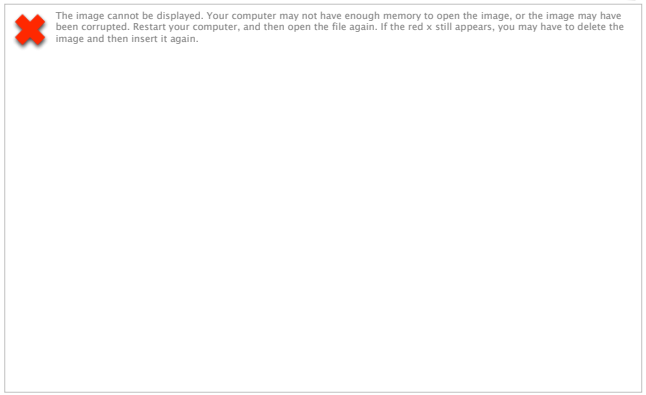
Mission

- Launch June 2026 by Ariane 62
- 3.5y duration, 1y per science orbit (3x)
- 3 science orbits: 6x15, 6x26 and 6x45 R_e
- probing 4 Key Science Regions (KSR)

Spacecraft

- Mass 2.4 tons wet, 1.2 tons dry, 170 kg, 200 W P/L
- 10 instruments for Field (electric, Magnetic), Waves and Particles measurements, including two data processors
- Sun-pointed slow spinner (2 rpm), ~ 4m diameter
- 2 rigid deployable booms of > 6.5m and 4 wire antennas of 50m in spin plane to support the most EMC-sensitive instruments





XIPE – Mission Description

Science objective

- Measurement of the light polarization for a large collection of X-ray sources

Mission Profile

- LEO low inclination (6 deg), 550-600 km, launch with VEGA-C, 3 y operations, controlled re-entry at end of mission to comply with debris regulations

Mirror

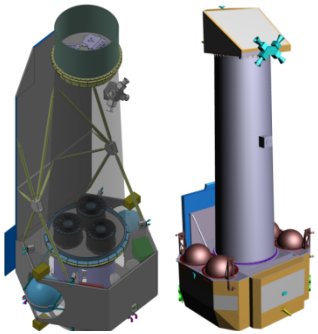
- 3 Wolter-I Mirror Units, 4-m focal length, 30-Ni shell, on-axis total effective area @ 3 kV of 1650 cm^2 (> 1100 cm^2 required for polarimetry sensitivity), 20 arcsec HEW angular resolution

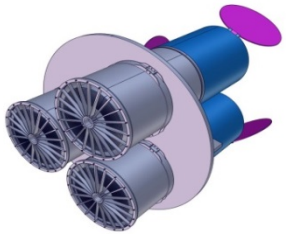
Payload Composition

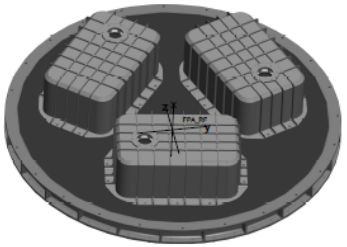
- Focal Plane Assembly with three Detector Units
- Detector Unit includes Gas Pixel Detector (GPD), Back End Electronics and Filter Wheel for Filters and Calibration Sources
- Instrument Control Unit (onboard of SVM)

Spacecraft

- Configuration à la XMM with Mirrors in the SVM and FPA on top of metering tube
- Mass at launch ~1.5 tons







Mission Selection Review

- Phase A completed for the three candidates
- Mission Selection Review (MSR) completed in May 2017, based on the Phase A data package
    - Independent technical and programmatic assessment of the Candidates. The review included for each mission: Technical Panel, Programmatic and Cost Panel, and Review Board
    - The review covered all mission elements, with specific emphasis on the flight segment (platform and payload)
    - High level objective is to assess: technical definition maturity, technology readiness, development plan and cost compatibility with M4 envelope
- MSR Technical Report will be made public

Mission Selection Review conclusions

1. All candidates are confirmed as technically valid for M4 slot
2. ESA estimated Cost at Completion within target for the three candidates
    - The expected Member States contributions are defined for the three missions and have been communicated to the funding agencies.
3. The platform is essentially relying on mature technologies for all candidates, with very few (non critical) or no delta-developments to be initiated in Phase B1 for the selected mission
4. New developments are expected for the payload for the three candidates, however with adequate heritage. Mission-specific payload activities need to be initiated already in Phase B1 for securing the adoption and implementation schedule.

Focus on risks

ARIEL

- Aluminium telescope baseline to be consolidated in Phase B1.
- NeoCam detector TRL (claimed > 6) to be consolidated in Phase B1.
- Ne Joule-Thomson cooler development (with heritage)
- M2 refocussing mechanism development (with heritage)

THOR

- EMC requirements found adequate. Working Group to be maintained in Phase B1
- Payload schedule considered credible, based on CLUSTER/MMS heritage

XIPE

- Mirror relying on available technology (XMM) but may drive the schedule. Development to be initiated in Phase B1 as schedule risk retirement

Next steps

- The scientific assessment of the candidates has started and will drive the mission selection
- The mission selection by the Science Programme Committee (SPC) is planned in November 2017
- For the selected mission, the mission adoption is planned in 2019 (nominally June 2019)
- Phase B1 will be initiated immediately for the selected mission
    - Consolidation of technical baseline and interfaces
    - Pre-developments, for both the payload and platform elements, for securing the implementation schedule
    - Preparation of the industrial implementation phase

The end