
esa
ARIEL Science, Mission & Community Conference 2020
ARIEL mission status
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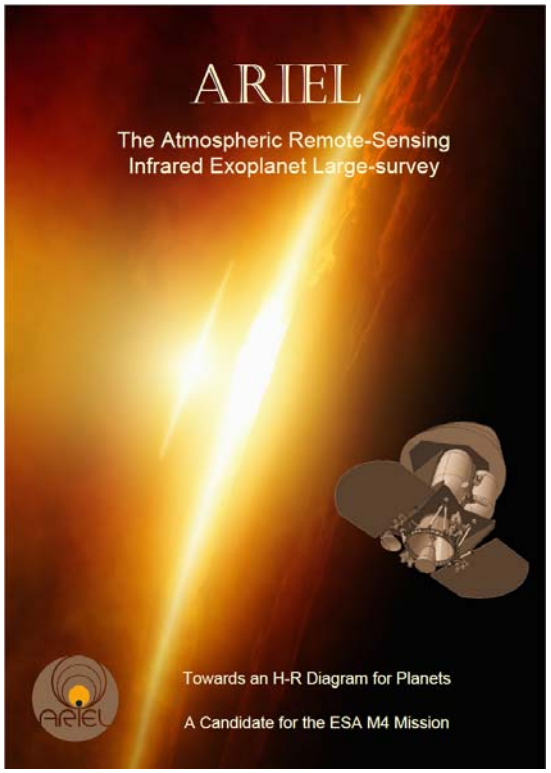
European Space Agency

WELCOME.

INTRODUCING…

M4 background and chronology



27 proposals received
Jan 2015

M4 call
Aug 2014

ARIEL, THOR & XIPE selected
Jun 2015

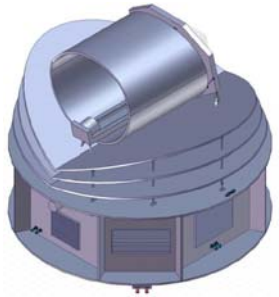
CDF

Phase A

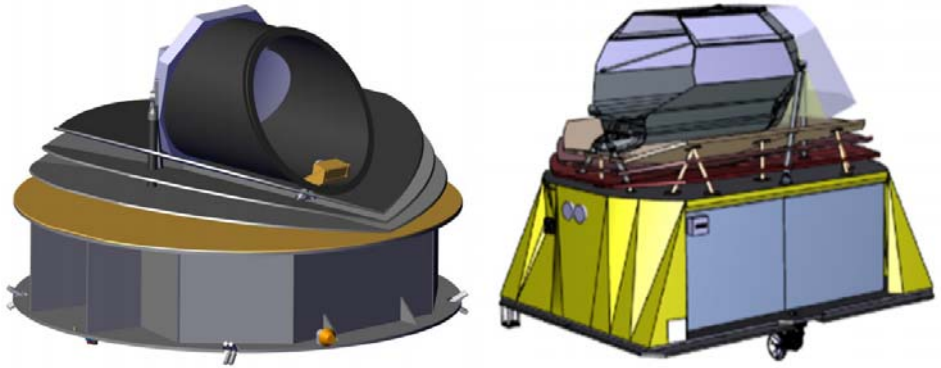
ARIEL selection by SPC
Mar 2018

Phase B1 (on-going)

2014 2015 2016 2017 2018 2019 2020

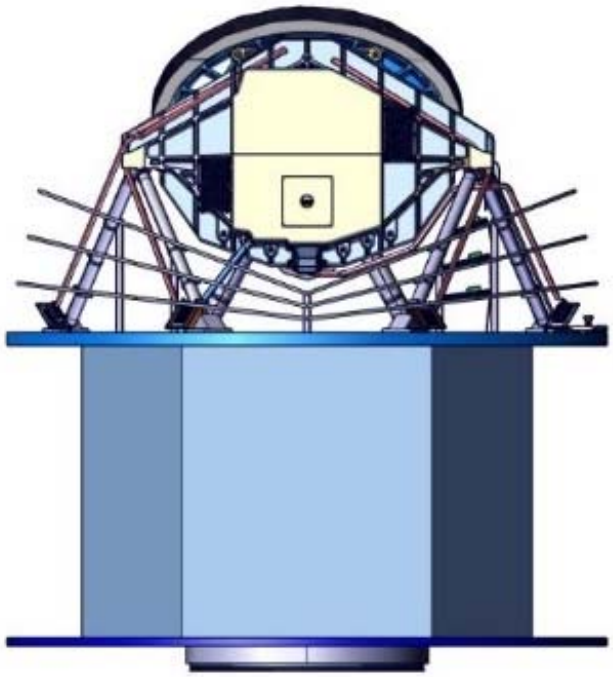


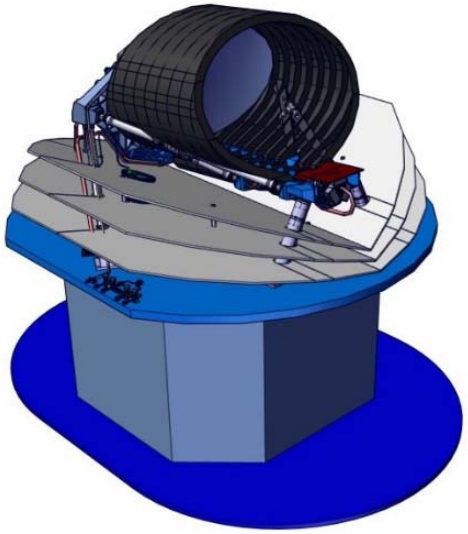
ARIEL CDF S/C design

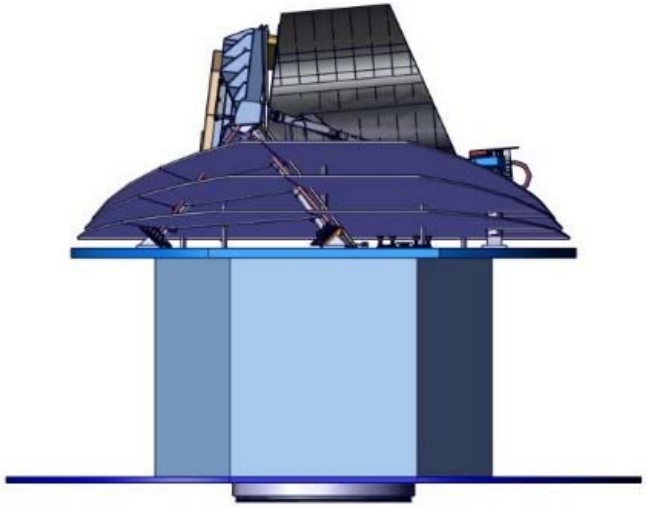


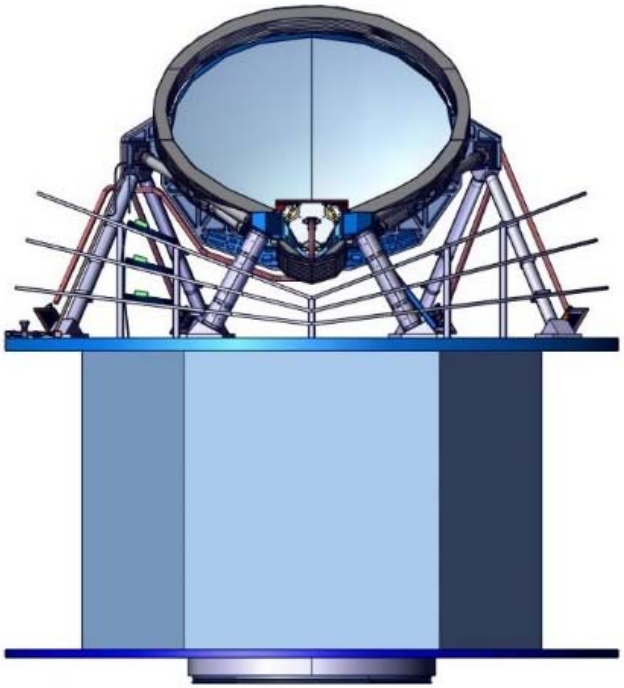
ARIEL S/C design at the end of phase A (Courtesy TAS & ADS) as found in the ARIEL Yellow Book

ARIEL S/C overview









ARIEL S/C design at the end of B1, with Consortium PLM and dummy SVM (competitive studies on-going)

ARIEL in rough numbers

Spacecraft wet mass: 1335 kg allocation

- Includes 453 kg for the payload

Power budget: ≤1 kW

- Includes ≤190 W for the payload

Payload data budget: 236 Gbits/week

Pointing requirements: see table

- All @ 99.7% confidence level
- "Across LoS" refers to the error around any axis normal to the LoS (i.e. 2D cone radius)

Mode	Submode	Pointing metric	Bright targets	Faint targets	Time scale
Coarse Pointing Mode	Acquisition	cAPE across LoS	10 ''		
		cAPE around LoS	1 '		
		cRPE across LoS	200 mas		FGS integration time
		cRPE around LoS	20 ''		
		Coarse rate across LoS	2 ''/s		
		Coarse rate around LoS	200 ''/s		
	Tracking	cAPE across LoS (FGS)	3.5 ''		
		cAPE around LoS (FGS)	1.5 '		
		cRPE across LoS	200 mas		FGS integration time
		cRPE around LoS	20 ''		
Fine Pointing Mode		fAPE across LoS (AIRS)	1 ''		
		fAPE across LoS (VNIR)	5 ''		
		fAPE across LoS (FGS)	3.5 ''		
		fAPE around LoS	1 '		
		fRPE across LoS (FGS)	200 mas		FGS integration time
		fRPE acround LoS (FGS)	20 ''		
		fRPE across LoS	140 mas	280 mas	0.1 s
		FRPE around LoS	14 ''	28 ''	
		fRPE_MPE across LoS	140 mas	280 mas	0.1 s to 90 s / 300 s
		fRPE_MPE around LoS	14 ''	28 ''	
		fPDE across LoS	70 mas	300 mas	90 s / 300 s to 10 hrs
		Single-sided ASD for PDE	0.58 ''/√Hz	4.5 ''/√Hz	
		fPDE around LoS	10 ''	30 ''	

ARIEL design approach

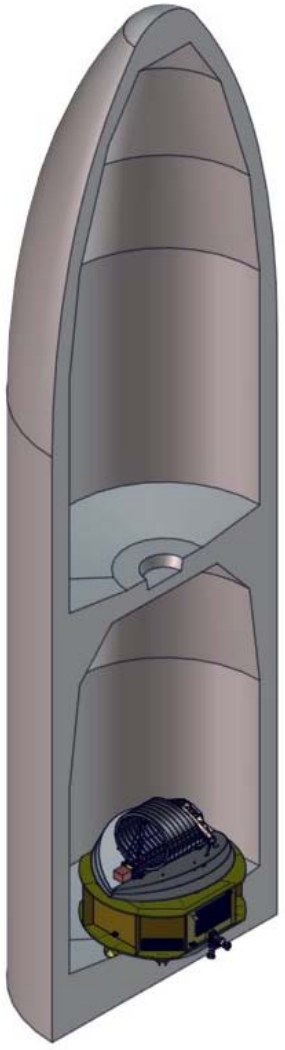
Engineering budgets are limited, following a design to cost approach with respect to the M4 programmatic constraints, with measures such as:

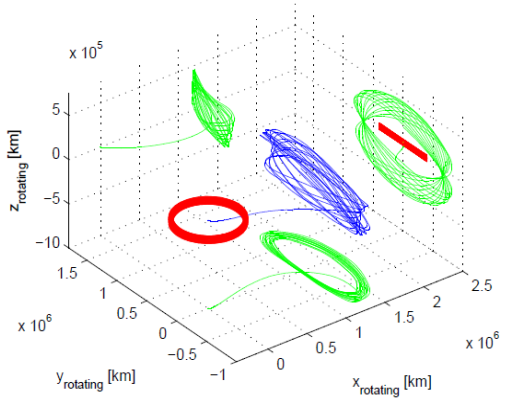
- Pointing stability requirements to enable an AOCS system based on reaction wheels only (no other fine pointing actuator)
- Modest data budget to enable a communications system based on X-band only, with minimal ground contact time (15 hrs/week split in only 3 contacts, no week ends)
- Mass limitation despite A62 high performance (dual launch with Comet-I)
- Power limitation for body mounted Solar cells only
- Lifetime limited to 4 yrs (6 yrs goal)

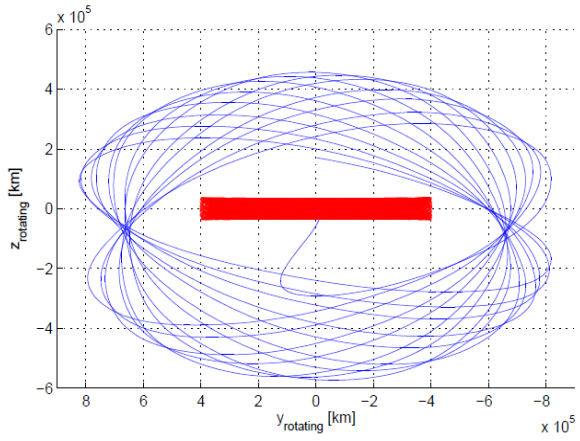
Albeit aiming for transformative, ground breaking science.

Mission analysis

- A62 launch with a direct transfer to Sun-Earth L2, in a dual launch configuration with Comet-I in the top position and ARIEL below.
- Eclipse-free (Earth and Moon) high-amplitude L2 orbit throughout the entire lifetime to ensure thermal and power stability.
- 4 years lifetime (6 years goal).
- ≥ 85% observation efficiency.
- De-orbiting manoeuvre at EoL to ensure low probability of Earth return, and minimum casualty risk on ground, complying with space debris regulations.





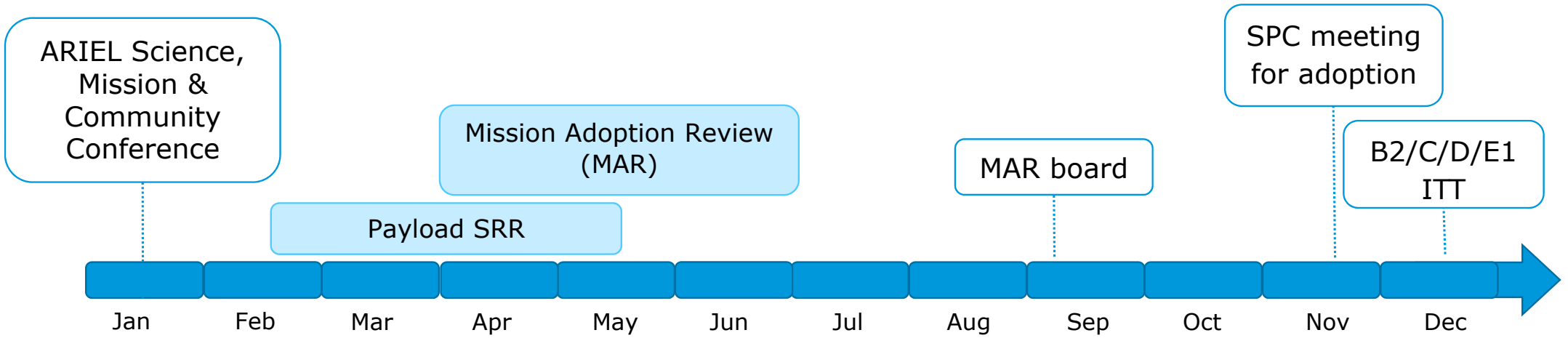


Technology developments activities

- No technology developments required at SVM level.
- All technology development activities concern the payload complement:
  - Aluminium cryogenic telescope with Silver coating
  - Ne JT cooler
  - Cryogenic M2 re-focussing mechanism
  - Detection chain (detectors and electronics)
  - And a few smaller items (e.g. dichroics, calibration unit etc.)
- These are currently on-going, with many tests happening now, with the aim to reach a Technology Readiness Level (TRL) of 6 for adoption.

See further details in the payload presentation(s).

Short/medium term plan (2020)



The main objective of the MAR is to support the adoption process and the initiation of the subsequent development phase. With (a few) extra details:

- Requirements completeness, adequacy and flow-down
- Clear and adequate I/Fs between all mission elements
- Feasibility of the baseline design, and adequacy of PA approach
- Adequacy of the development plan, risk assessment, and schedule
- Readiness of technology developments to support adoption

Development schedule (anticipated)

- Main milestones:

Milestone	Schedule
MAR	Q2 2020
Phase B2/C/D Kick-Off	Q3 2021
System PDR	Q4 2022
System SM Mechanical Test Campaign	Q3 2023
System CDR	Q1 2025
FAR	Q2 2027
Launch (L)	2028
LEOP	L + few hours
Start of Satellite and Payload Commissioning	L + few days
Start of nominal in-orbit science operation Phase	L + < 6 months
End of nominal in-orbit operation Phase	L + 4 years

- Detailed schedule will include reviews for all elements (mission, S/C, payload, subsystems, ground segment). Payload reviews indicated here as an example:

Review	Schedule
Payload development and consolidation Review **(pDCR)**	Q2 2019
Payload System Requirement Review **(pSRR)**	Q2 2020
Payload Preliminary Design Review **(pPDR)**	Q2 2022
Payload Critical Design Review **(pCDR)**	Q4 2024
Payload Qualification and Acceptance Review **(pQAR)**	Q4 2026
Payload Flight Acceptance Review **(pFAR)**	TBD

Mission organisation & responsibilities