Mission Selection Review summary

M5 Public presentation, 29 April 2021

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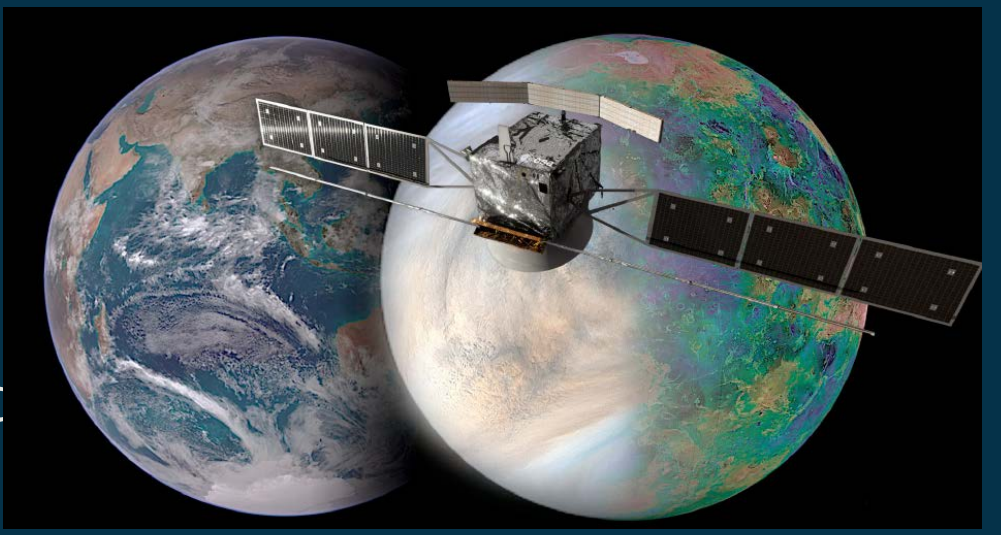
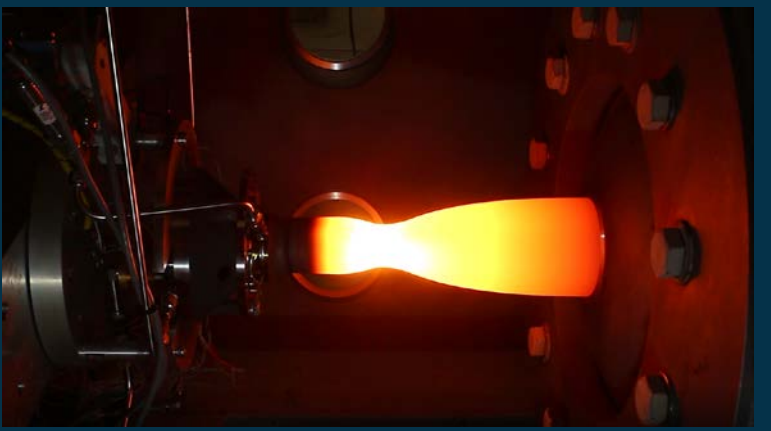
M5 Mission Selection Review

- ESA Independent Review concluding the Phase A, organised in two Panels, Technical and Programmatic, for each mission
- Objectives: Confirm the candidate missions feasibility and enable the SPC to make an informed decision for the M5 mission selection
- Review inputs produced by the Phase A studies
  - ✓ For ESA provision: Data packages produced by the two parallel industrial contracts for the spacecraft definition, for each mission candidate
  - ✓ For nationally provided payload elements: Data packages produced by the instrument teams (I-PRR)
- NASA provision to Envision was subject to NASA internal reviews, with visibility provided to ESA, and positive outcome

EnVision Technical Assessment: Spacecraft

- Good design maturity achieved
  - ✓ SC 1,400 kg (dry)/ 3 kW, incl. P/L 240 kg / 1,600 W
- Compatibility with Ariane 6.2 confirmed
- Critical functions designed with robust margins and within heritage, e.g. Venus Orbit Insertion, Aerobraking, and thermal management.
- Overall, medium development risk
  - ✓ Available heritage & know-how in Europe for both the SC development and operations
  - ✓ High Thrust (1 kN) engine early qualification recommended





LEROS-4 1 kN engine fire test

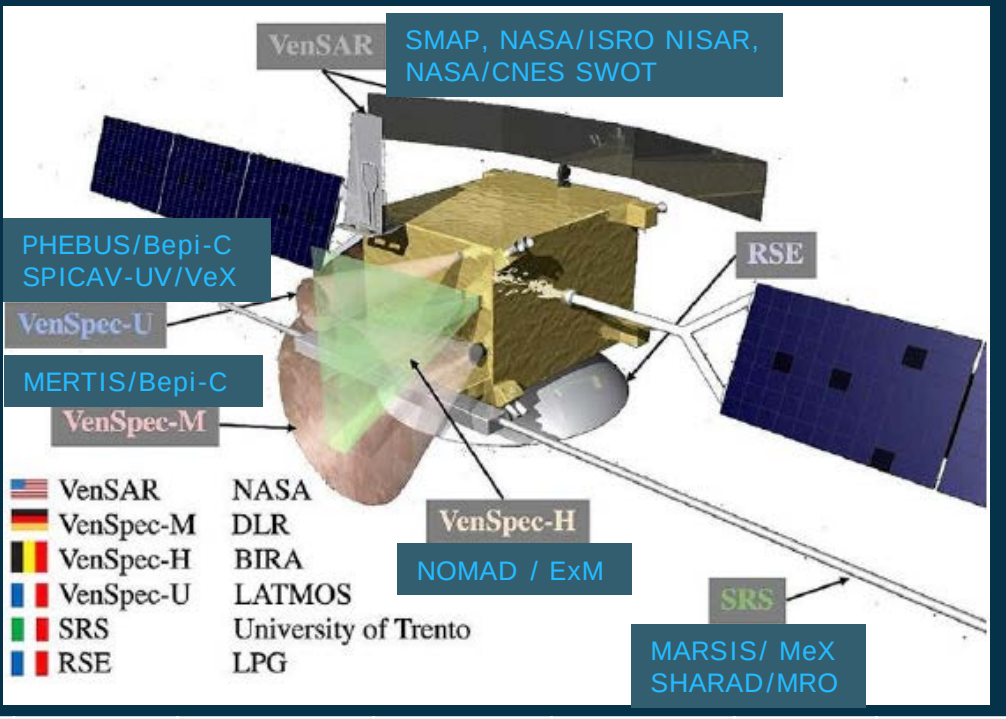
EnVision Technical Assessment: Payload

- All instruments are new HW developments, however with recent relevant heritage

  => Payload-driven development schedule

- NASA VenSAR predevelopments initiated to secure the schedule

- VenSpec-H change of detector assembly with respect to NOMAD (ExoMars): Alternative identified but dedicated activities needed in Phase B1



Instrument	VenSAR	VenSpec-M	VenSpec-H	VenSpec-U	SRS	RSE (USO)
Mass kg, nominal	150	6 (*)	17 (*)	7 (*)	13 (**)	< 1
Peak power W, nominal	1400	15	30	19	200	5

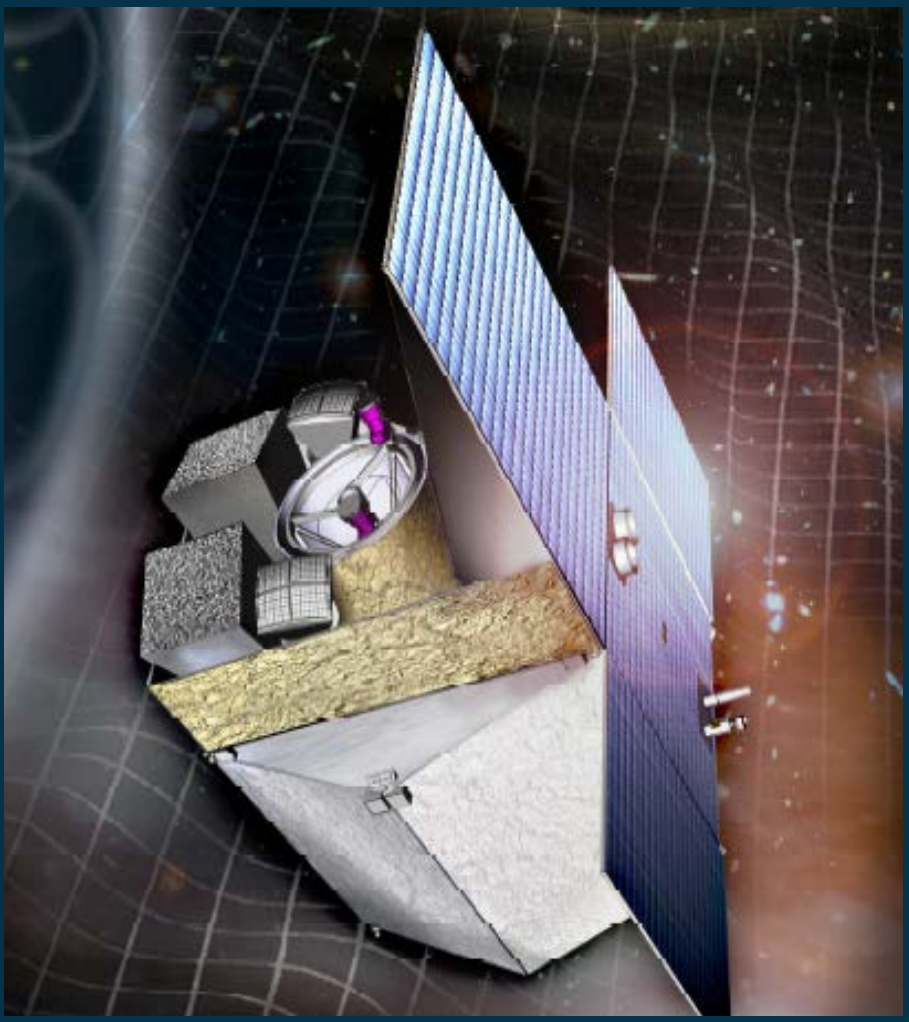
(*) VenSpec Central Control Unit 5 kg on top

(**) Deployable dipole antenna excluded (12 kg) , procured by ESA

THESEUS Technical Assessment: Spacecraft

- Satisfactory design maturity achieved
  - ✓ SC 1,900 kg (dry) / ~ 2 kW, incl. PLM ~ 1,000 kg / 1,000 W
- Compatibility with VEGA-C confirmed
- Spacecraft platform using available technologies and equipment , no predevelopment identified
- Main challenge will be on the development schedule (driven by the payload)

Overall, medium development risk considering the payload I/F and risks



THESEUS Technical Assessment: Payload

- All instruments are new HW developments, however with heritage

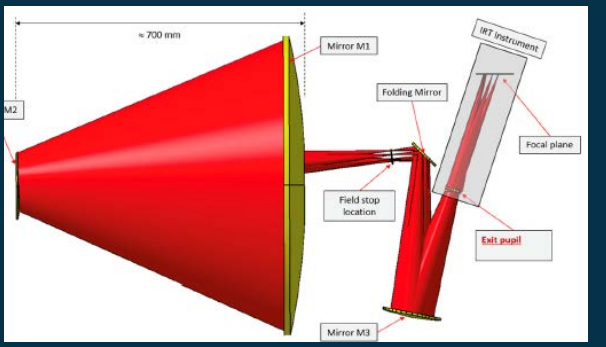
  => Payload-driven development schedule

  ✓ Complex interface management expected at Prime level, to be de-risked through appropriate early models (e.g. STMs & functional models)

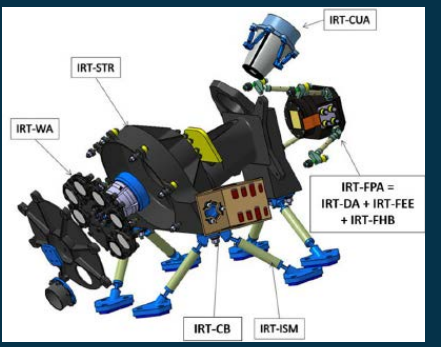
  ✓ No basic technical feasibility issue

  ✓ IRT payload defines the critical path, closely followed by SXI & XGIS

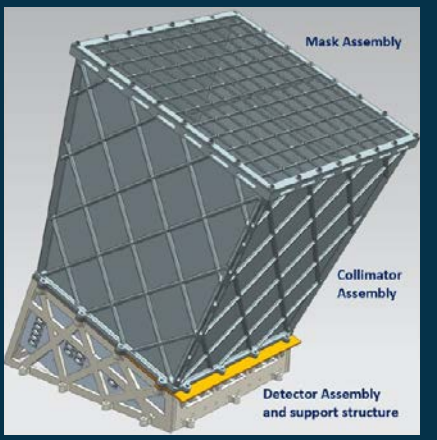
- Effort needed in Phase B1 to consolidate the development approach and schedule, while providing flexibility for the instrument deliveries



700 mm IRT Korsch telescope layout

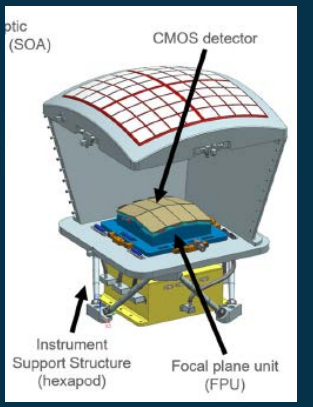


IRT Focal Plane Assembly



XGIS camera

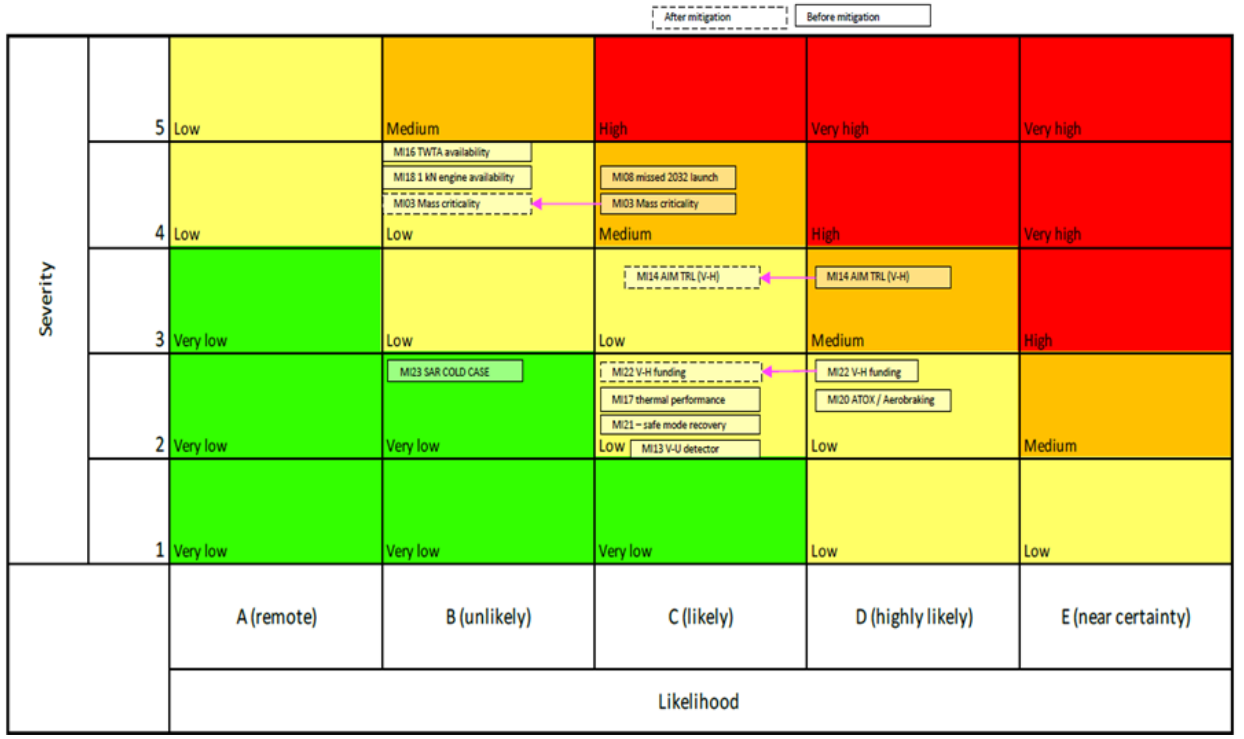
XGIS detector module (10 x 10 needed)



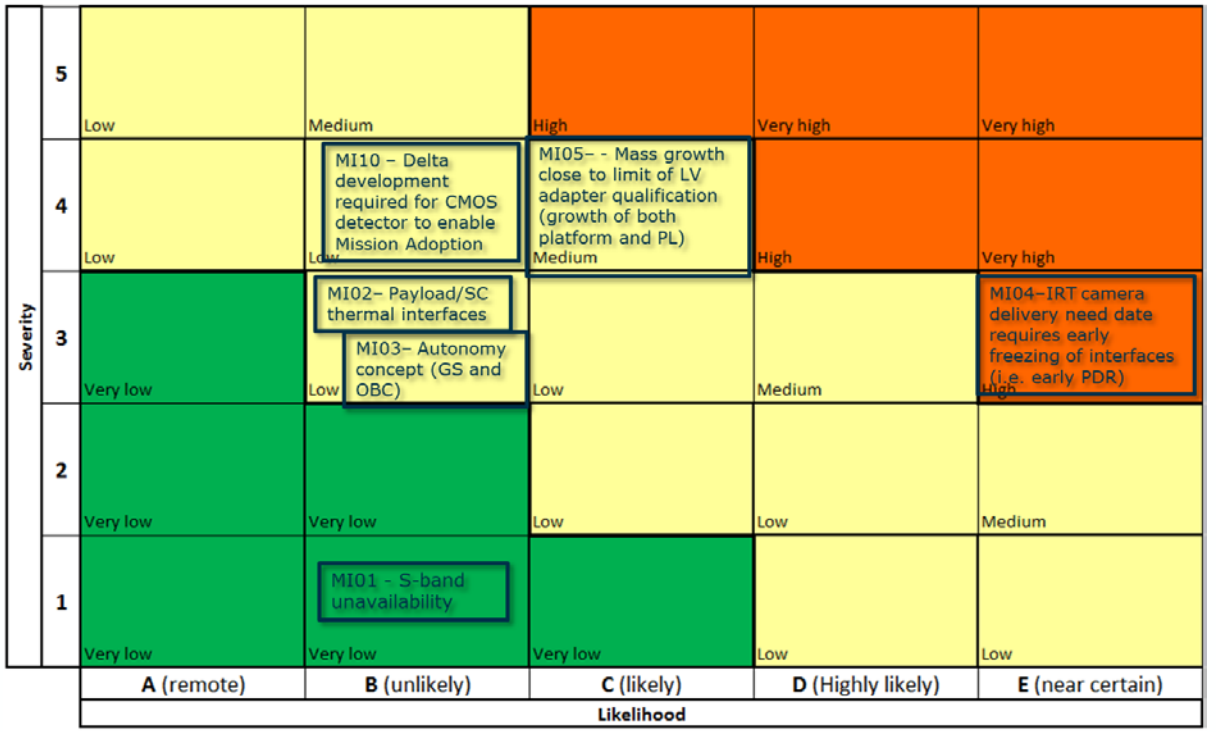
SXI camera

Instrument	IRT telescope	IRT Focal plane	SXI	XGIS	TBU (tbc)
Mass kg, nominal	220	38	77	183	10

Risk bubble charts



EnVision



THESEUS

Phase B1 anticipated predevelopments

EnVision

- ESA: 1 kN thruster qualification, ideally to be completed by mission adoption
- ESA: Procurement of VenSpec-H detector assembly, to verify and confirm the baseline compatibility with EnVision
- Member States: Payload preparation activities (design & breadboarding for raising TRLs) in continuation of the Phase A to secure the schedule.

THESEUS

- ESA: SXI CMOS detector EM development and performance verification
- ESA: Activities TBD to support the payload interface freezing before adoption
- Member States: Payload preparation activities (design & breadboarding for raising TRLs) in continuation of the Phase A to secure the schedule

Schedule Analyses

SPC adoption targeted early 2024 for both candidates

- EnVision
  - ✓ Baseline schedule judged realistic: launch in June 2032, science operations at Venus starting in Q1 2035. Back-up launch windows available in Dec 2032 and May 2033.
  - ✓ May 2031 launch window is possibly feasible (subject to compatibility with all instrument schedules, including VenSAR) and is being investigated.

- THESEUS
  - ✓ A launch in 2032 would be possible, subject to overall development approach consolidation and steady progress on instrument preparation activities during the phase B1 .
  - ✓ No stringent launch window constraints for THESEUS

Programmatic assessment: responsibility scheme

ESA have consulted the Member States on the payload funding scheme for the Phase A consolidated baseline.

For THESEUS, the ground VHF network provision is not confirmed.

- ✓ Not mandatory for THESEUS core science objectives
- ✓ Basic mitigation is to use the SC communication system for the trigger alert and ESA ground station(s), with reduced performance

All other elements are supported.

Following the MSR, a second consultation is planned on the funding of payload activities in phase B1.

Phase A baseline responsibility scheme	
EnVision	**THESEUS**
ESA in charge of: SC development; Launch services; In-orbit operations (MOC and SOC);	ESA in charge of: SC development; Launch services; In-orbit operations (MOC and SOC);
<u>EnVision Payload:</u> VenSAR: NASA All other instruments: Member States, with the following ESA contributions: 1- VenSpec-H detector assembly, with integrated cryocooler 2- SRS deployable antenna	<u>THESEUS Payload</u> Member States provision, with the following ESA contributions: 1- IRT telescope assembly 2- IRT cryo-cooling chain 3- IRT focal plane detector and proximity electronics 4- SXI CMOS detectors

Programmatic aspects: ESA cost estimates

ESA CaC estimated by the MSR Programmatic Panel for the Phase A baseline is within **610 M€ (e.c. 2021)** for both missions.

- ✓ Exceeding the target by ~ 5%
- ✓ Launcher costs based on recent consultations of Arianespace for other projects
- ✓ Similar CaC for both missions, but with completely different profiles: Much larger ESA contribution to THESEUS payload, approximately balanced by lower costs for launcher (VEGA-C vs A62) and operations (LEO vs Venus)

ESA and NASA have started their discussion on the implementation details in preparation of the MoU

MSR conclusion

- For both EnVision and THESEUS, the Phase A converged to a feasible baseline by following a design-to-cost approach while preserving the core scientific objectives
- The Member States have been consulted for the funding of nationally provided payload elements. The payload funding scheme is confirmed.
- ESA anticipate a few predevelopment activities for each mission in Phase B1 for securing the implementation schedule and risks
- Predevelopments will also be needed for the nationally provided payload elements, and are expected to be funded in Phase B1
- ESA cost at completion estimates are within **610 M€ e.c. 2021** for both missions

The end