OHB Planetary Exploration Enabling Technologies

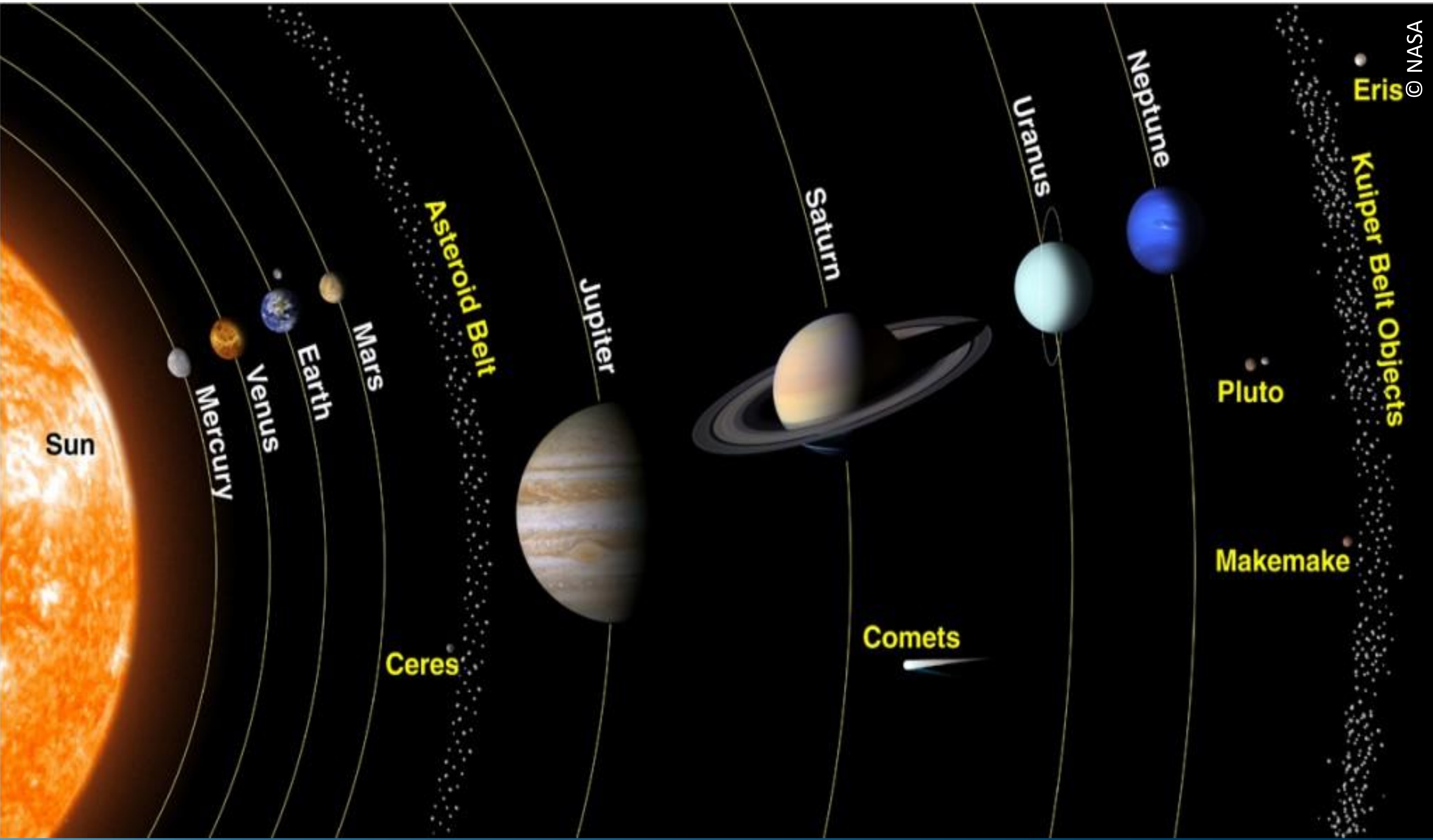
Planetary Exploration, Horizon 2061 Synthesis Workshop

September 11-13 2019, Toulouse

We. Create. Space.

Scope of activities

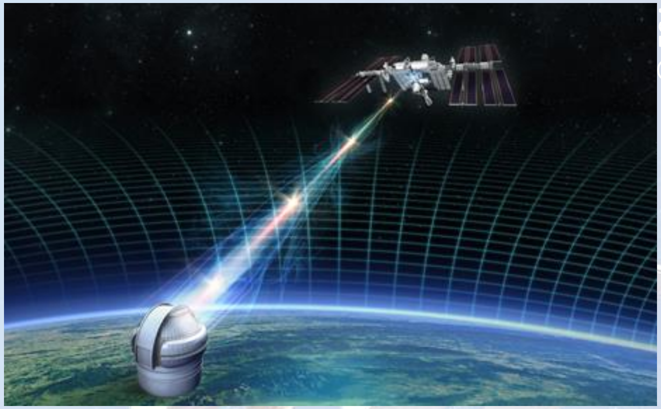
“A space odyssey…”



Low-Earth Orbit, selected technology involvements

© ESA

SpaceQuest – Quantum Technologies

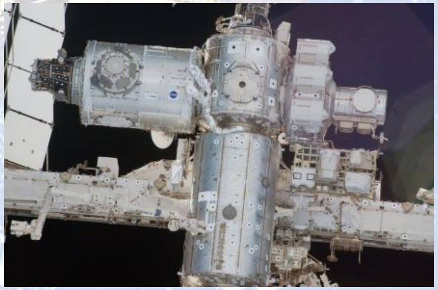


Objectives

- Observing a relativistic quantum effect
- Quantum Key Distribution (Quantum Cryptography)

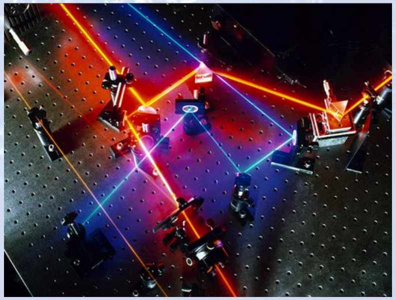
Space Segment

- Installed in the WORF compartment (pressurized)
- autonomously established optical link with OGSs during transit (Tracking, Beaconing)
- single photons detection sent from OGS towards the ISS
- Arrival times recording of all photons
- Detection of single photons' polarization with four single-photon detectors using a passive basis choice setup



Optical Ground Segment (OGS)

- Tracking of the ISS within a FoV of ±35° off-zenith
- Send and receive beacon laser light to/from the ISS
- Generation of pairs of entangled photons, send one to the ISS and detect one locally



ANITA – Air Quality Monitoring for the ISS

Analysing Interferometer for Ambient Air (ANITA)

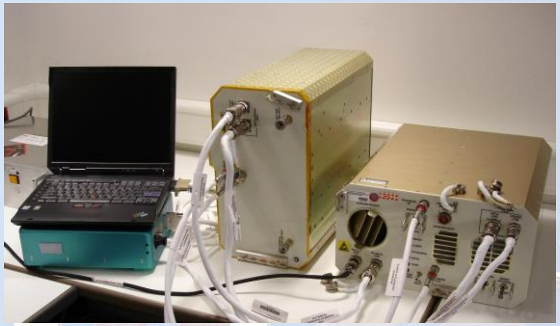
- **Monitor the cabin air for contaminants at concentrations down to the low parts per million (ppm) or high parts per billion (ppb)**
- **Fast measurement cycle using Fourier Transform Infrared (FTIR) interferometer allows the trend in air quality to be analysed in near real-time**

ANITA-1 (from Sept. 2007 to Aug. 2008 on ISS)

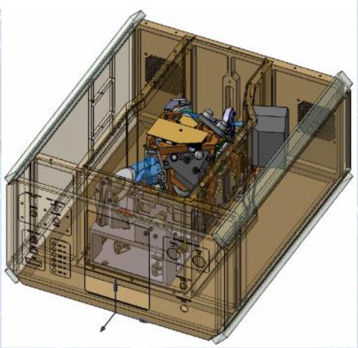
- **Simultaneously identify and quantify 32 gaseous air contaminants including formaldehyde, ammonia and carbon monoxide**
- **ANITA automatically monitors the local air or crew can also collect air samples at remote locations using a hand pump and sample bags**

ANITA-2 (upload to ISS in 2020)

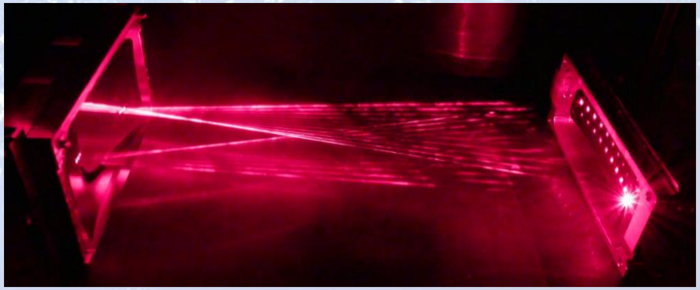
- **Second-generation technology demonstrator for a permanent atmosphere monitoring system for the ISS**
- **Increased robustness and sensitivity**
- **Mass and volume reduction of around 50 %**



ANITA-1 System



ANITA-2

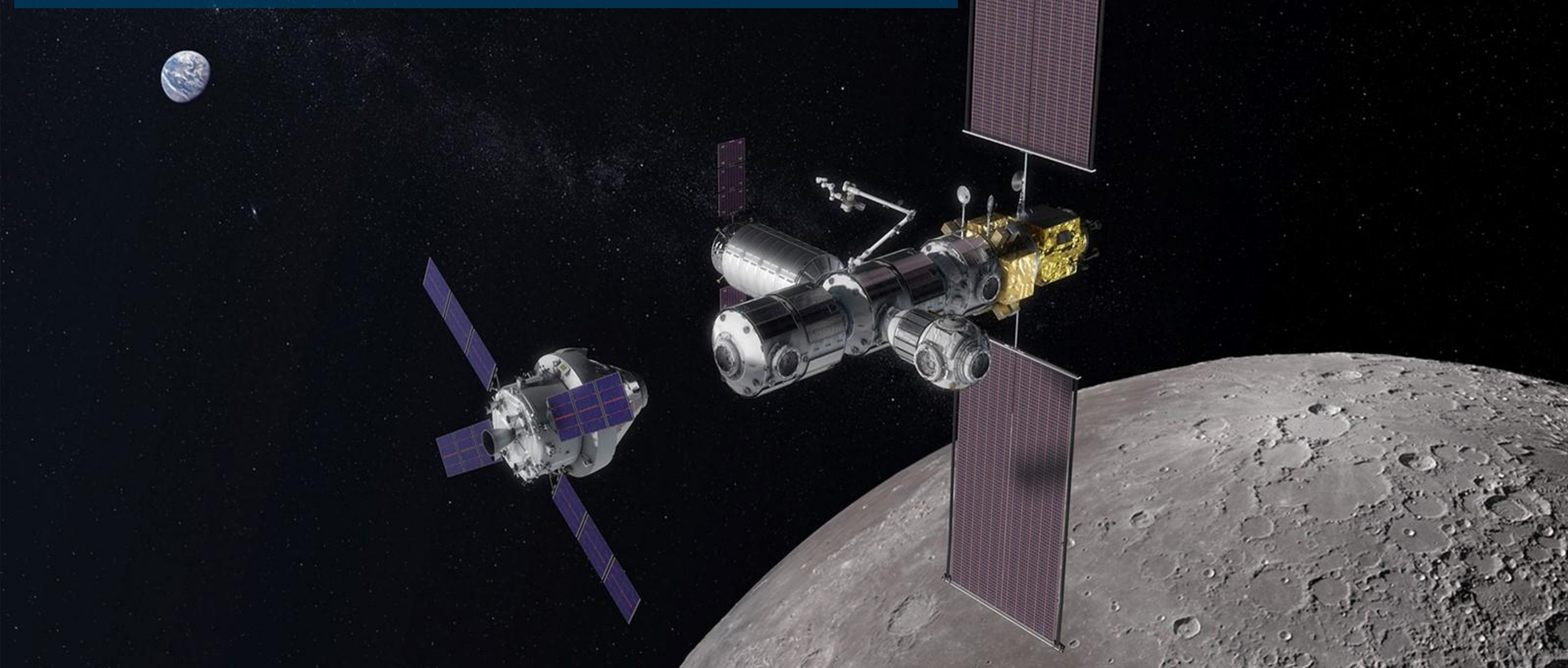


OHB and the Moon, selected technology involvements

Xenon Refuelling on Gateway

ESPRIT for Gateway

- → 2026: Gateway Refuelling with Xenon and Hydrazine
- → First demonstration and use of Xe Refuelling in space
- → OHB responsible for Xe Refuelling in one of two parallel Phase B1 projects



Xenon Refuelling in Space

Refuelling of electric propulsion systems is a key building block to enable reusable and affordable systems for sustainable human exploration missions. It will also be useful to enable lifetime extension of Earth orbiting satellites.

Xenon has many inherent characteristics that make its transfer between spacecraft very complex and challenging. Complex fluid transfer and thermal control systems are needed during spacecraft filling operations on ground.

Xenon refuelling has never been attempted in space and presents a novel capability to be demonstrated in orbit. Within the Gateway program, ESA decided to develop this capability in Europe

AM in Space

Critical point in space exploration: provision of systems ensuring long-term survival of crew and technological assets in harsh space environment

Key for sustainable presence in space is the capability of Earth-independence (as far as possible…)

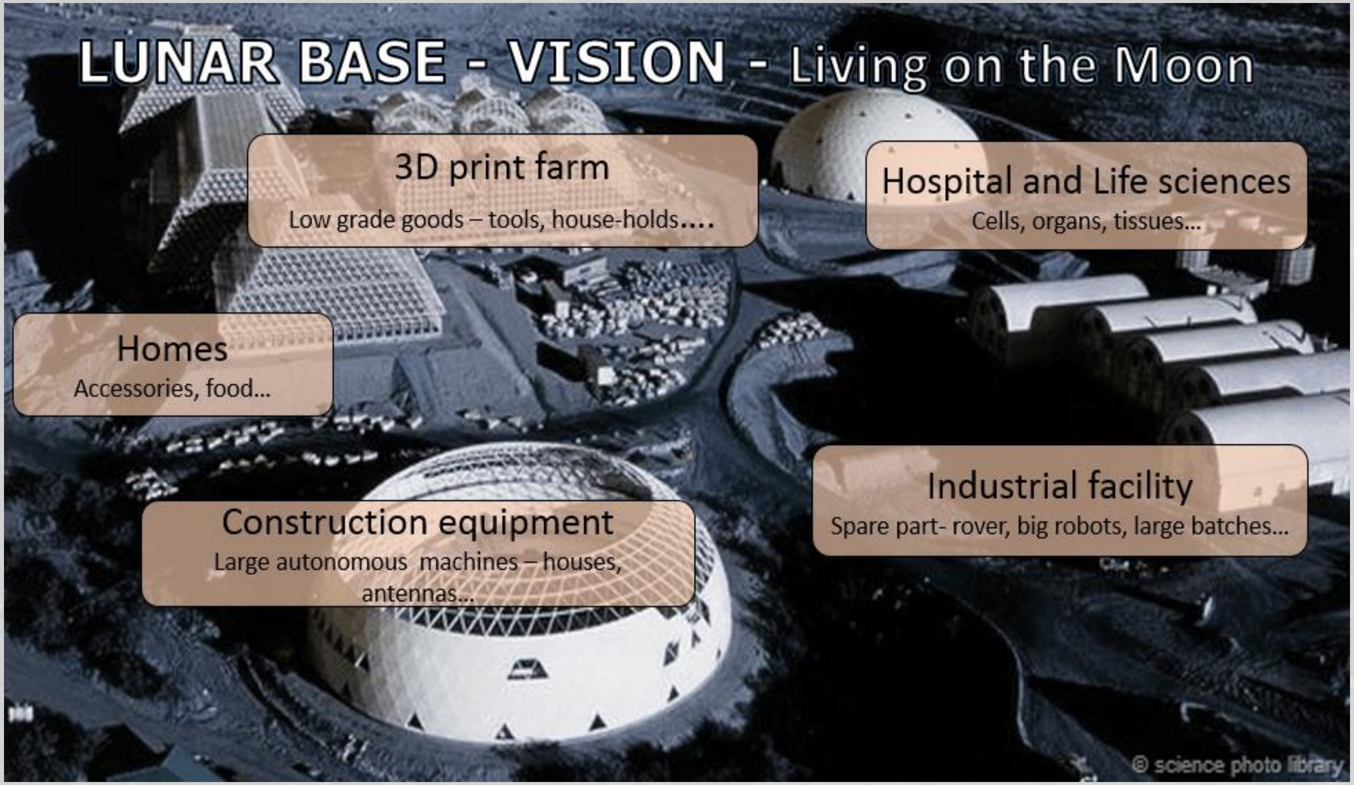
Additive manufacturing has potential to provide sustainability advantages by printing necessary structures/spares/in-situ and on-demand reducing cost, volume, and up-mass constraints

URBAN: conceiving a lunar base using 3D printing technologies
General Study for esa

AM in Space

URBAN: ESA General Study for evaluation of feasibility and implementation of AM for construction, expansion and maintenance of a lunar base

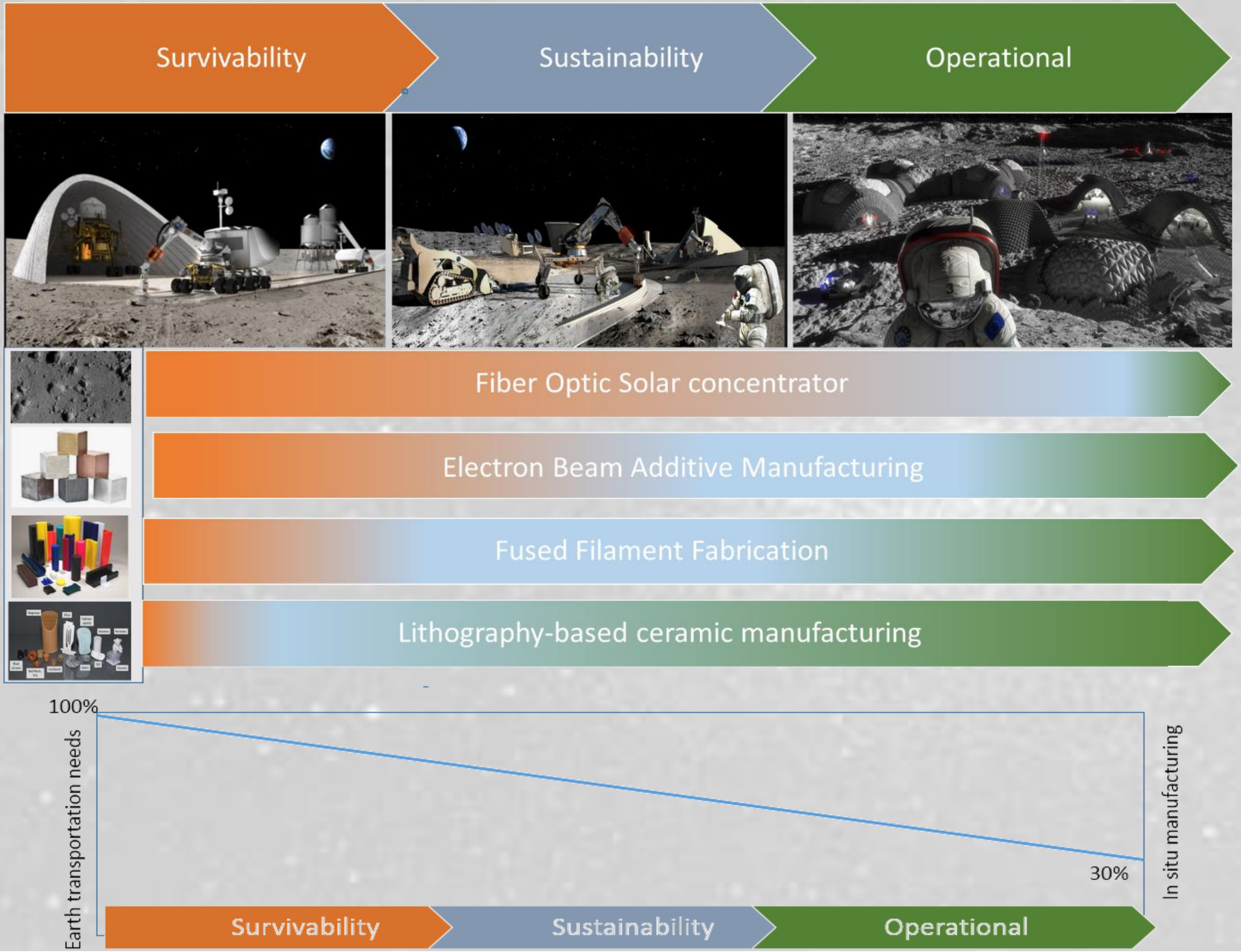
OHB
comex
LIQUIFER SYSTEMS GROUP
sonaca space
SONACA GROUP



Experts: ATG europe | BEEVERYCREATIVE | LITHOZ | TNO innovation for life | Advanced Polymer Technology AB | Fraunhofer ENAS | CELLINK

Sustainable technologies

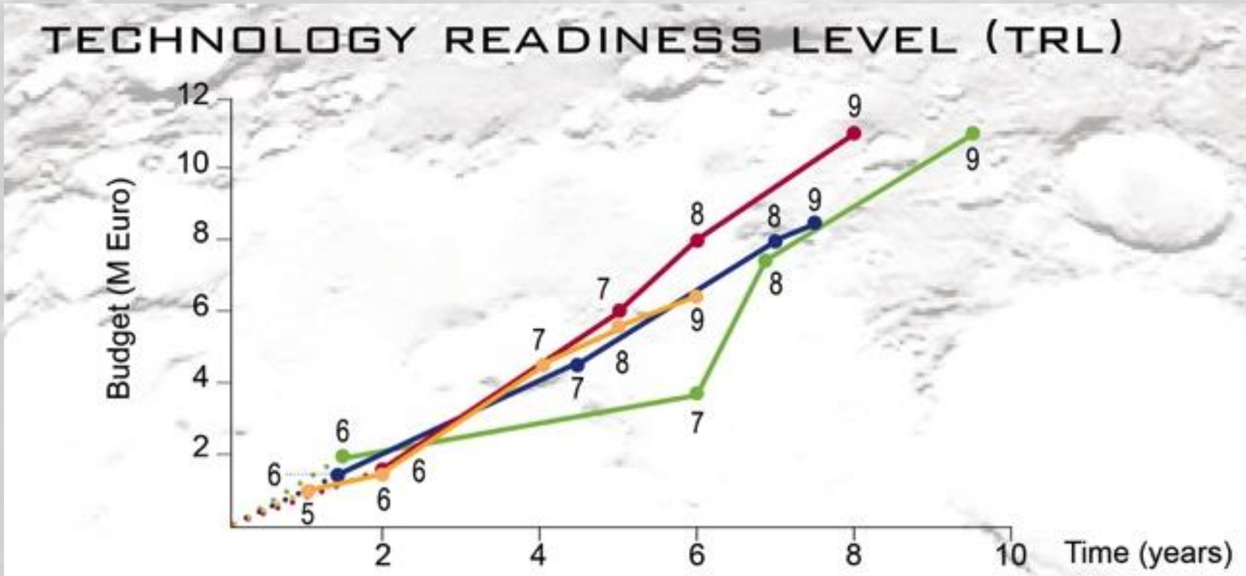
AM in Space



AM in Space

Selected AM technologies (shortlist of 21 over 52 analysed)

- Electron Beam Additive Manufacturing (EBAM)
- Solar Concentrator / Solar Sintering
- Fused Filament Fabrication (FFF)
- Lithography-based Ceramic Manufacturing (LCM)



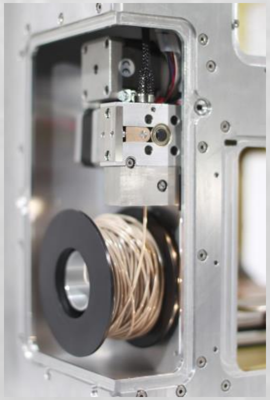
AM in Space

ISS ALM printer for large part production with high performance polymers

Development and manufacturing of AM printer for:

- engineering polymers
- parts exceeding build volume constraints
- compatible to ISS
- gravity independent

- fused deposition modeling (FDM) process
- PEEK filament baseline material



Project Team

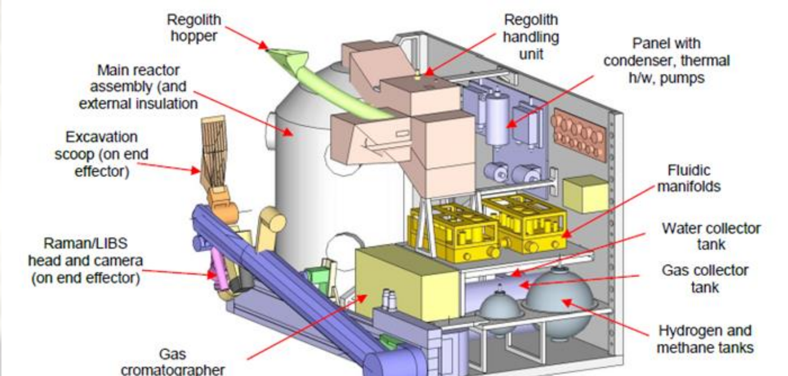
Oxygen and Volatiles Resource Extraction on the Moon (ISRU)

~42 weight-% of oxygen mineralogically bound in the lunar regolith

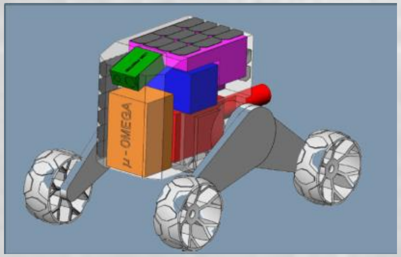
OHB involved in several ESA-funded studies to extract this oxygen: *carbothermal reduction* to obtain H2O and from it H2 and O2 -> rocket propellant, breathing air, potable water

- **Studies of a sequence of missions to demonstrate practicality**
- **Studies of thermochemical reactor design and prototyping**

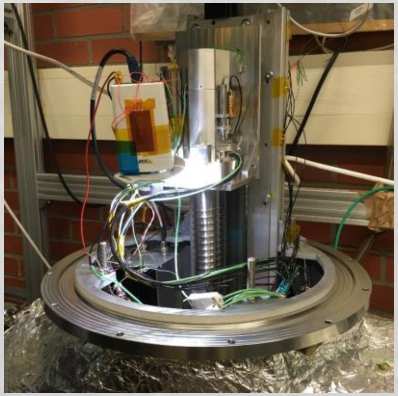
LUVMI-LVS: instrumented drill for volatiles detection and extraction from the regolith: funded through Horizon 2020 -> at TRL 5



Oxygen extraction system (OHB Italia)

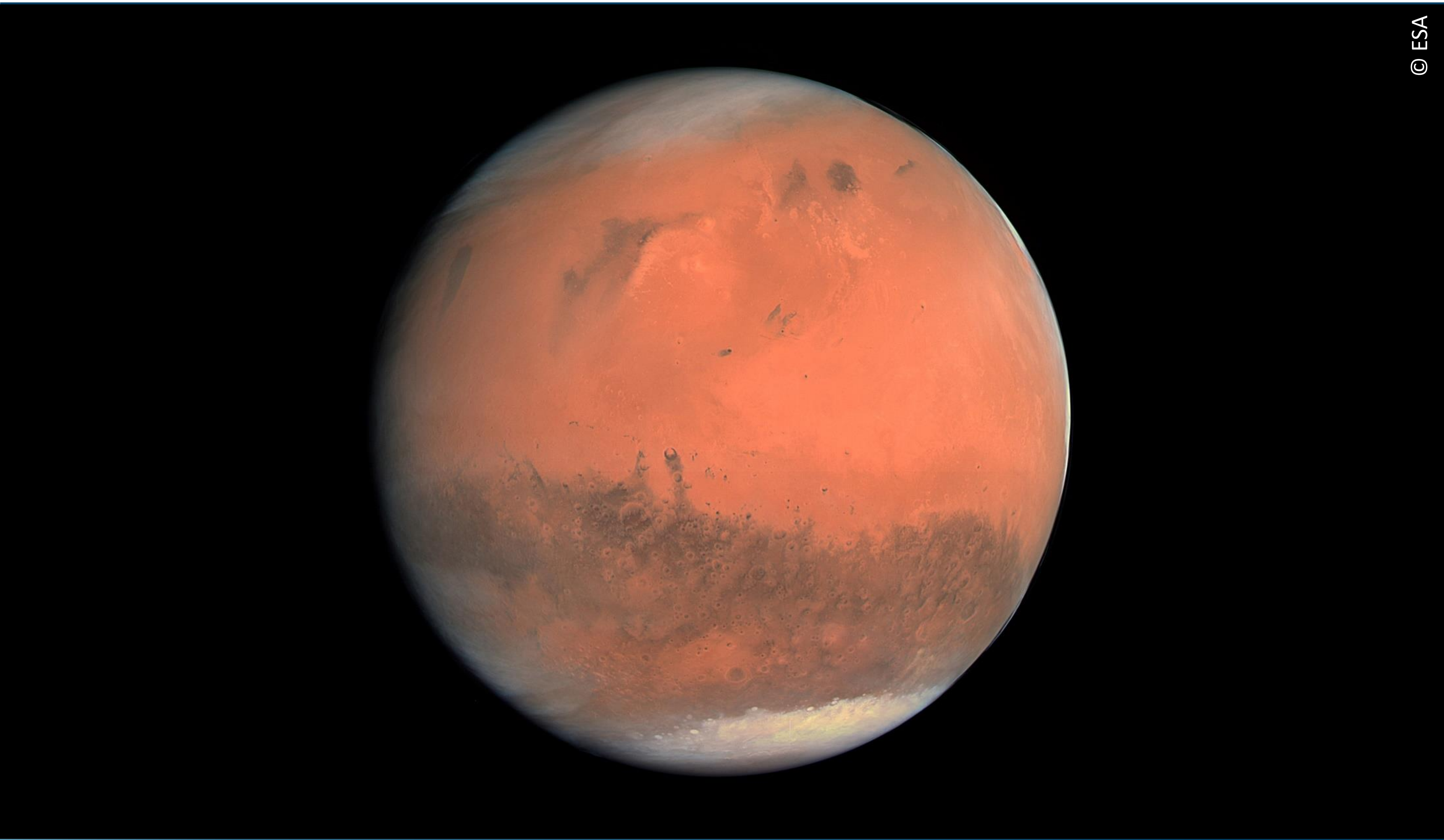


CHAR „scouting“ rover with 4 science instruments (OHB with Stellar Space Industries)

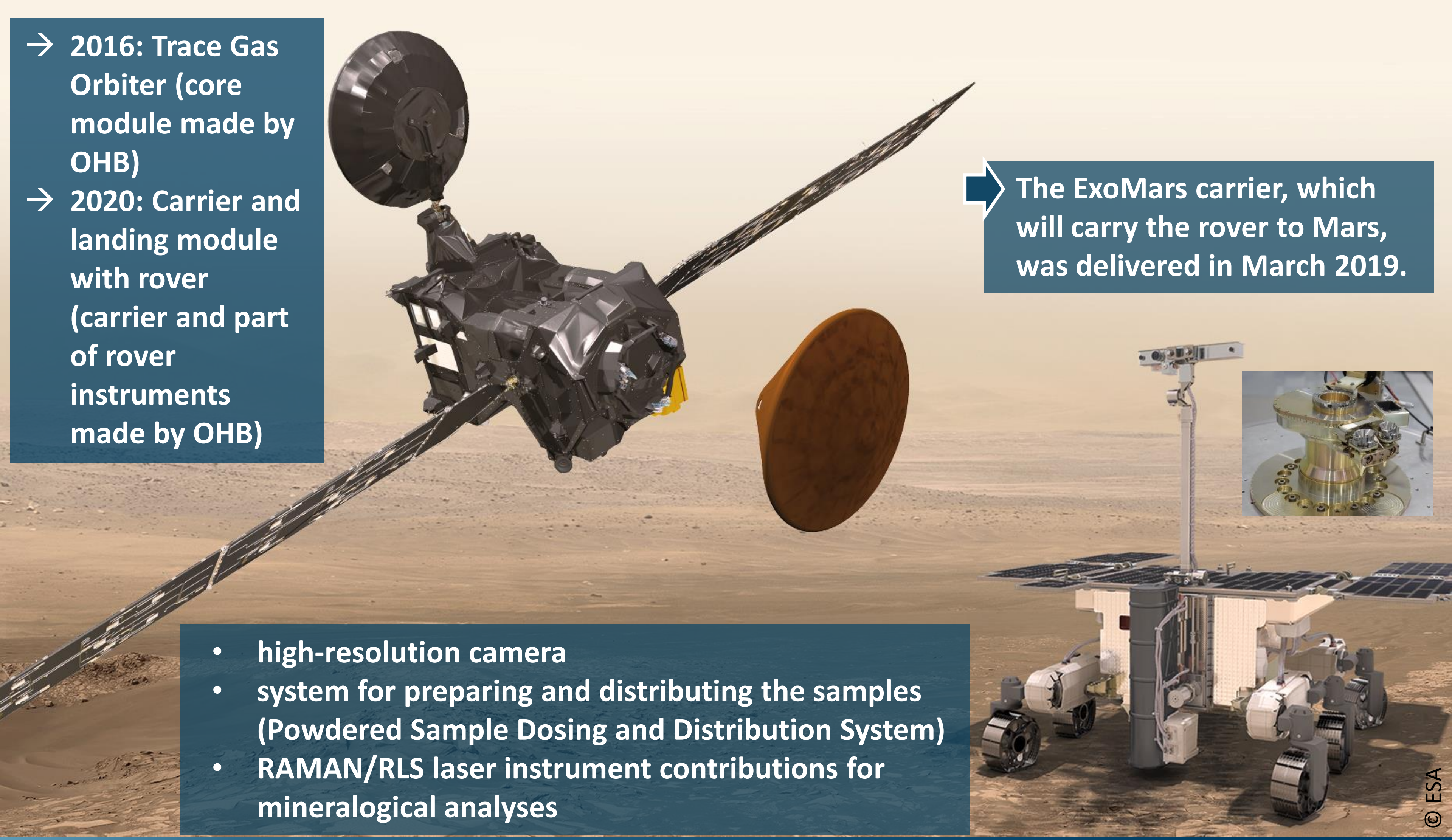


LUVMI-LVS prototype

OHB and the red planet, selected technology involvements



ExoMars



- → 2016: Trace Gas Orbiter (core module made by OHB)
- → 2020: Carrier and landing module with rover (carrier and part of rover instruments made by OHB)

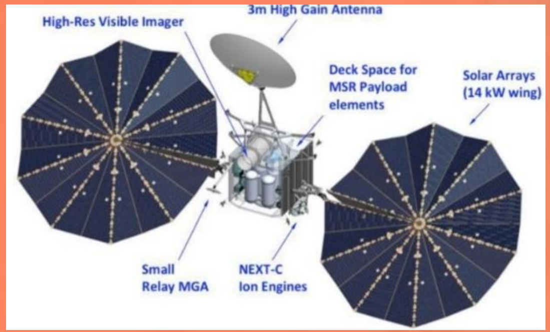
The ExoMars carrier, which will carry the rover to Mars, was delivered in March 2019.

- high-resolution camera
- system for preparing and distributing the samples (Powdered Sample Dosing and Distribution System)
- RAMAN/RLS laser instrument contributions for mineralogical analyses

MARS Mission Technologies (e.g. robotics and mechanisms)

Mars Sample Return (ESA)

- **Earth Return Orbiter Phase A/B1 Study**
  - TASI Core Team Support

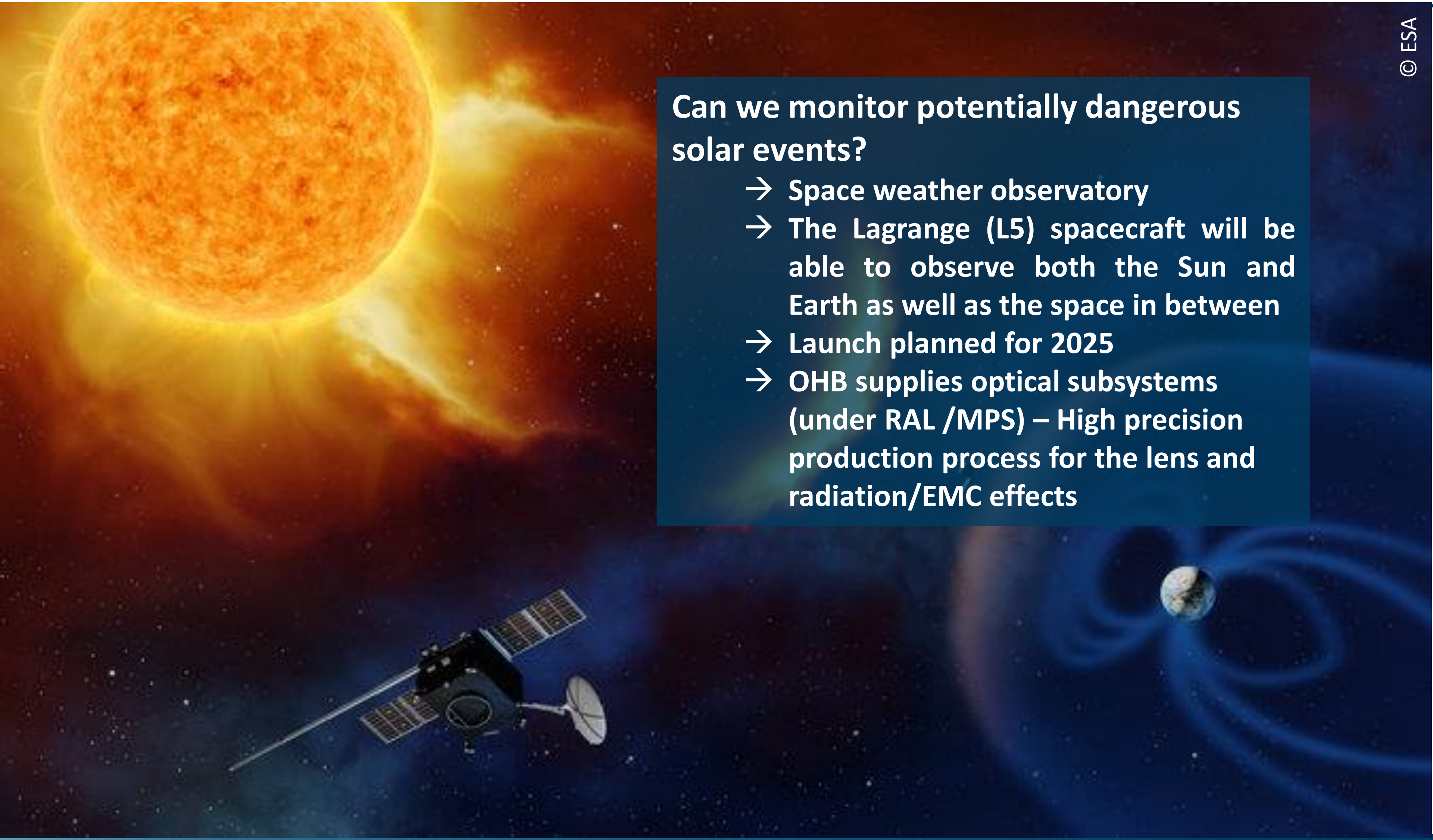


- **Fetching Rover Phase A/B1 Study**
  - Returnable Sample Tube Assembly (RSTA) - Manipulation and Storage System incl. visual Sensors
  - Cooperation between OHB and ADS (UK) for Extended B1 – RSTA Subsystem

- **STABLE (Sample Transfer Robotic Arm) Phase 1/2 Study**
  - OHB Consortium:
    - OHB Prime
    - Piap
    - DLR (RMC)

Planetary protection, sample collection, visual based detection, sealings

PMI Lagrange (Photospheric Magnetic Field Imager) Instrument



Can we monitor potentially dangerous solar events?

- → Space weather observatory
- → The Lagrange (L5) spacecraft will be able to observe both the Sun and Earth as well as the space in between
- → Launch planned for 2025
- → OHB supplies optical subsystems (under RAL /MPS) – High precision production process for the lens and radiation/EMC effects

PLATO (PLAnetary Transits and Oscillations of Stars)

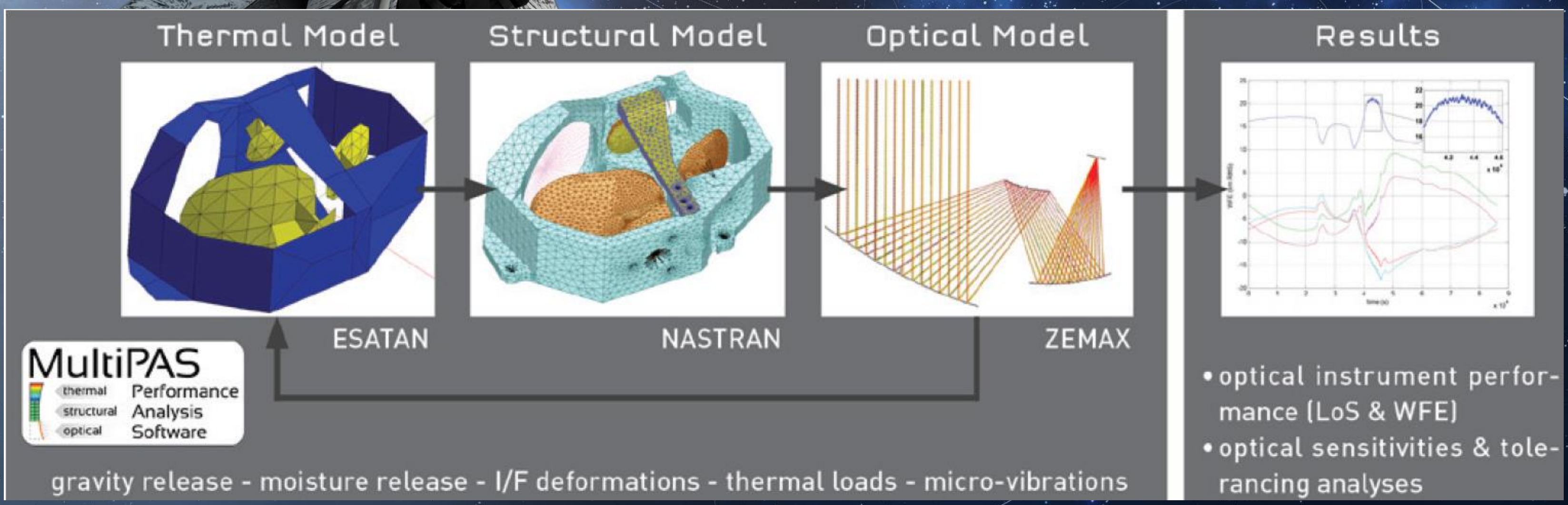
Is there a second Earth?

- → Space observatory to be positioned 1.5 million kilometers from Earth in L2
- → 26 telescopes to search for Earth-like planets in the habitable zone of other stars
- → Launch planned for 2026
- → OHB is prime contractor for PLATO mission, leads industrial consortium and supplies payload components

PLATO (PLAnetary Transits and Oscillations of Stars)

Ultra Stable Structures for Future Giant Space Observatories

- → PLATO poses state of the art pointing requirements
  - → High stability
  - → Long term
- → Future Giant Space Observatories will push the boundaries (microarcseconds)
- → OHB developed technology will predict and verify in-orbit thermo-structural-optical behavior for large ultra stable structures



Q & A

THANK YOU FOR YOUR ATTENTION