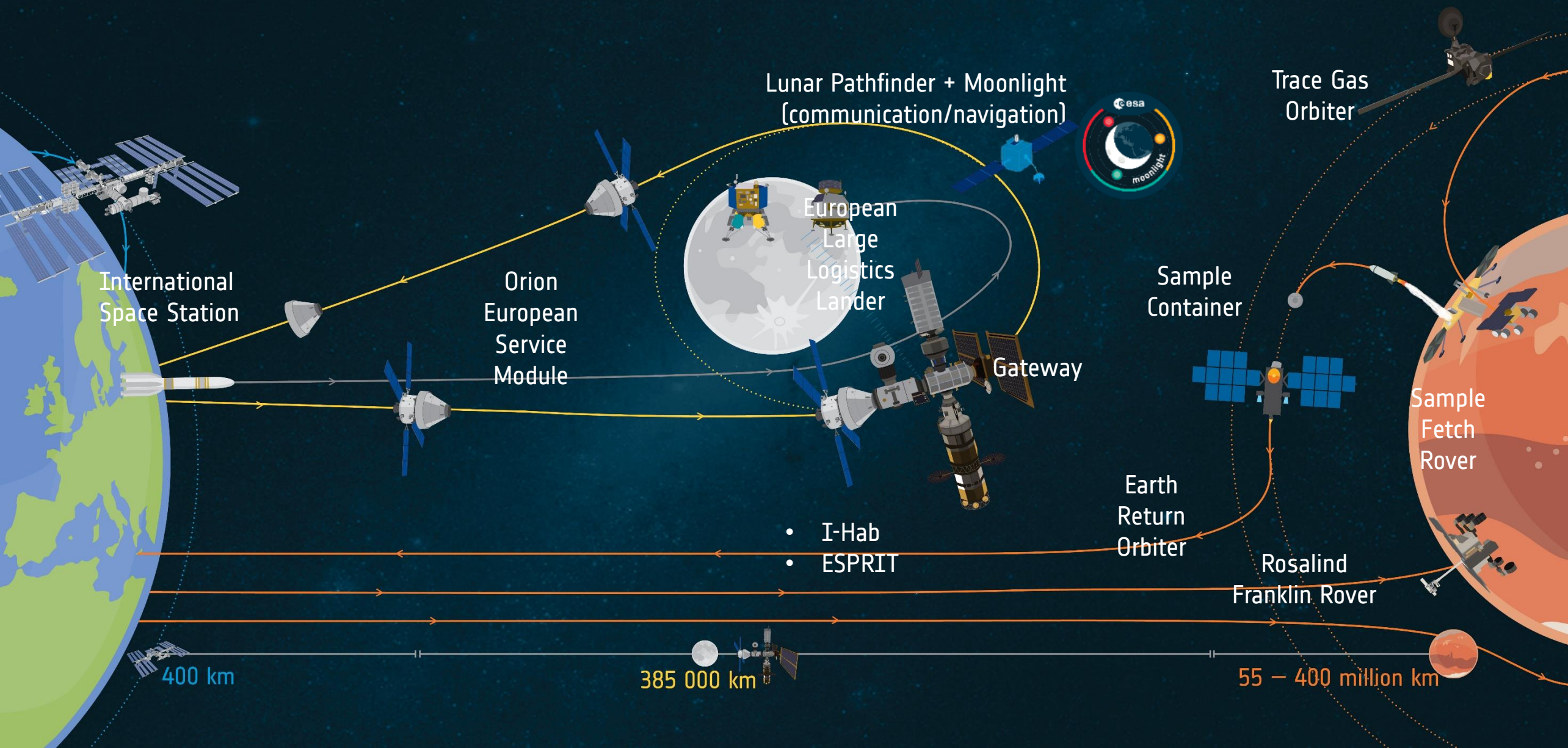


ESA's SciSpacE research programme

Sebastien Vincent-Bonnieu on behalf of the SciSpacE team
Human and Robotic Exploration
ESA ESTEC
GdR MFA, 02/11/2022

ESA's Human And Robotic Exploration Destinations



TERRAE NOVAE 2030+



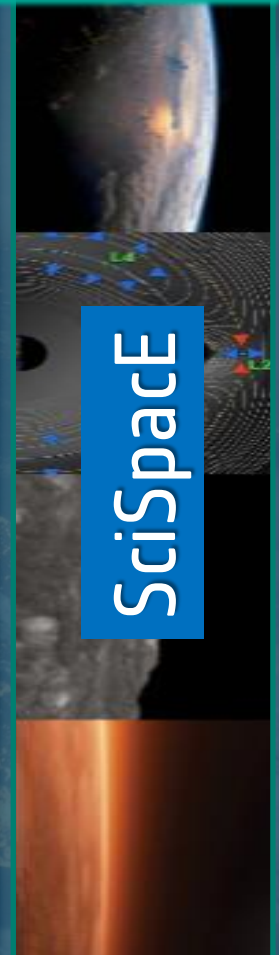
- Create new opportunities in low Earth Orbit for a sustained European presence after the International Space Station,
- Enable the first European to explore the Moon's surface by 2030 as a step towards sustainable lunar exploration in the 2030's,
- to prepare the horizon goal of Europe being part of the first human mission to Mars.



European Exploration Envelope Programme Period 2 (2020-2022)



Commercialisation as a cross-cutting theme



ExPeRT = Mission studies and mid-TRL technology

SciSpace = Science in the Space Environment



Publication of SciSpacE white papers :



SCIENCE & EXPLORATION

The SciSpacE White Papers

1956 VIEWS 12 LIKES

ESA / Science & Exploration / Human and Robotic Exploration / Research

In brief

The science community's recommendations on future research focus areas: a key input to the definition of the Terrae Novae research strategy



Special issue in NPJ
microgravity
(End of 2022)

https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Research/The_SciSpacE_White_Papers



- The SciSpacE landscape has changed
 - Destinations have multiplied with active and planned missions in LEO, Moon and Mars
 - Commercial ventures are increasingly sharing space with government space agencies
 - The number of nations with space agencies and/or interests has increased
- Entering a new ministerial process, an overarching strategy is being developed, therefore, a complementary SciSpacE strategy and implementation plan makes sense
- Natural extension of the science community white paper exercise and ESA strategy TERRAE NOVAE

Elements of the HRE Science Strategy



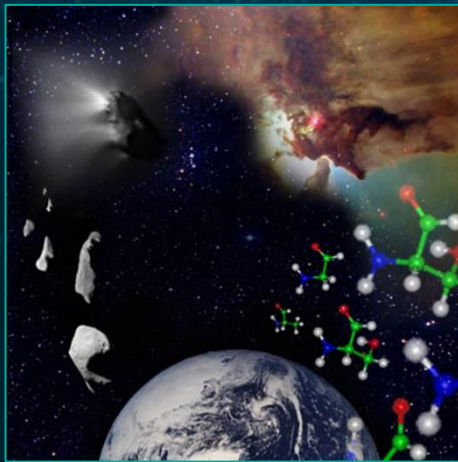
Humans living on other worlds



Astronaut 2.0



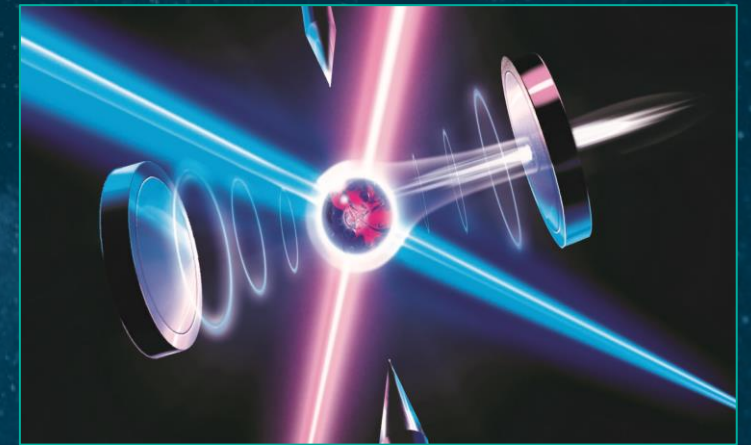
Space Travel



Origin, Evolution, and Protection of Extra-Terrestrial Life



Nature of Exploration Destinations



Exploring the Principles of Nature

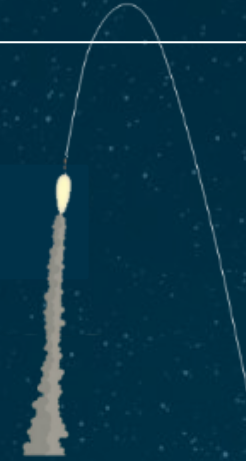
SciSpacE - Research Ground and Sub-Orbital Platforms



Bedrest



Dry Immersion



Sounding Rockets



Drop Tower



Concordia, Antarctica
Isolation and Confinement



Parabolic Flight

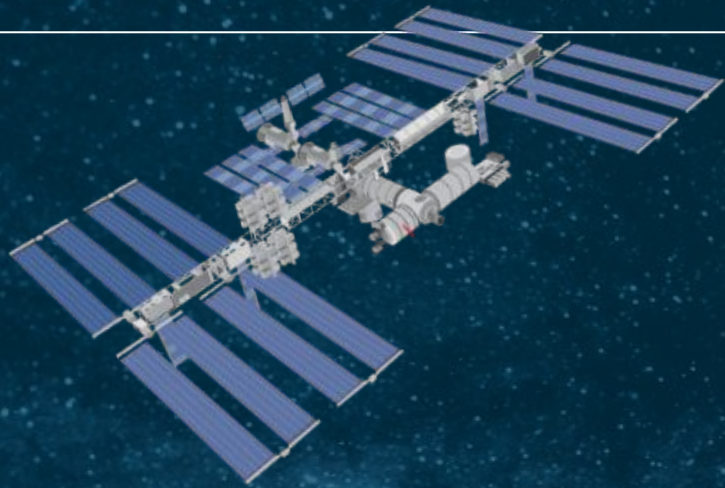


Ground-based
facilities

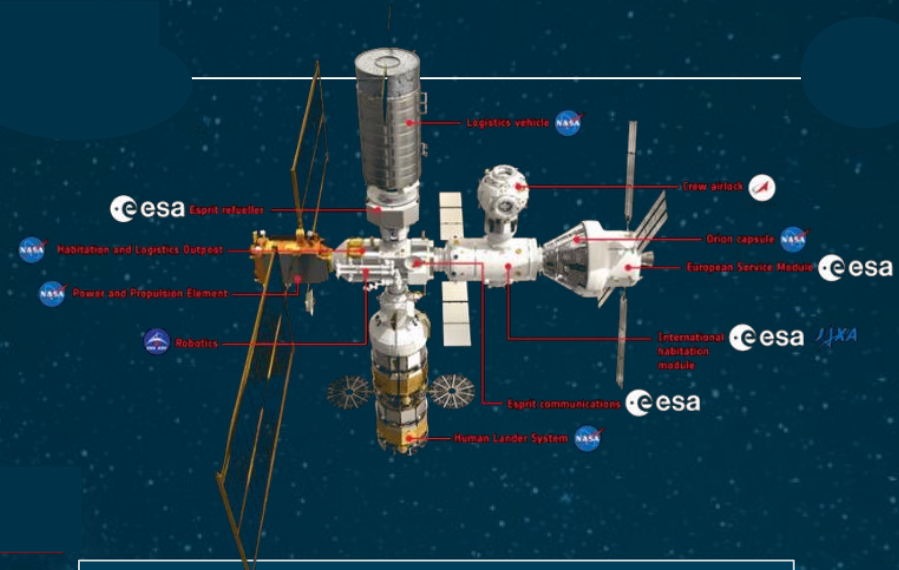


Radiation

SciSpaceE - Research Platforms



International Space Station (ISS)



Gateway

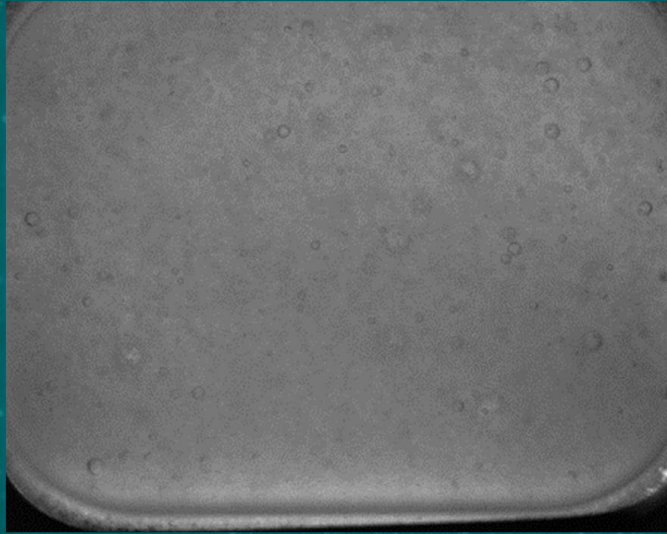


Space Rider



European Large Logistics Lander (EL3)

SciSpacE – Upcoming research



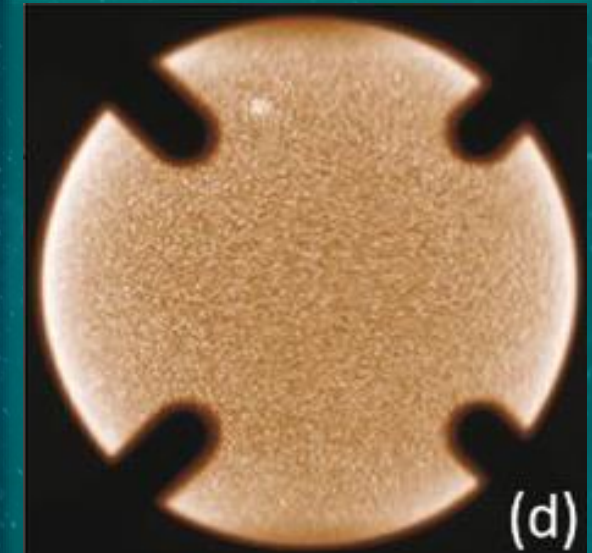
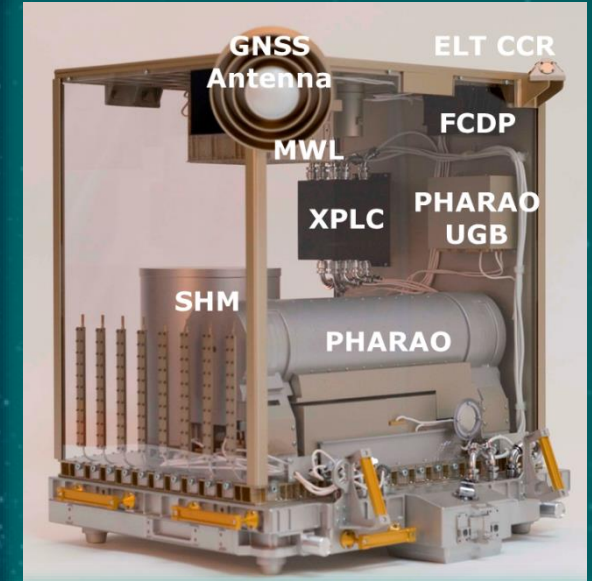
◀ **Soft Matter research:** Emulsions [PASTA] and Foam coarsening [FOAMC] onboard the ISS. Continuation in 2023-2025.

▶ **Physical sciences:** Atomic clock ACES, Measurement of the gravitational red shift, Search for time drifts of fundamental constants, violations of special relativity

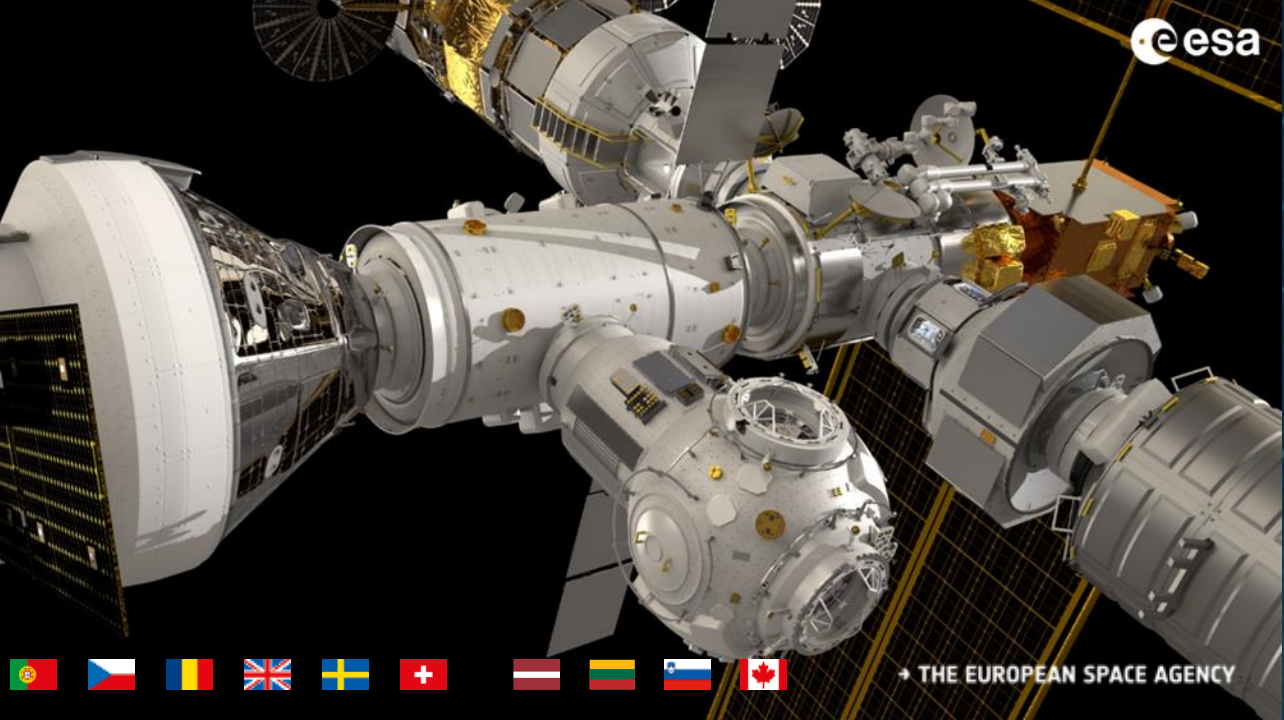
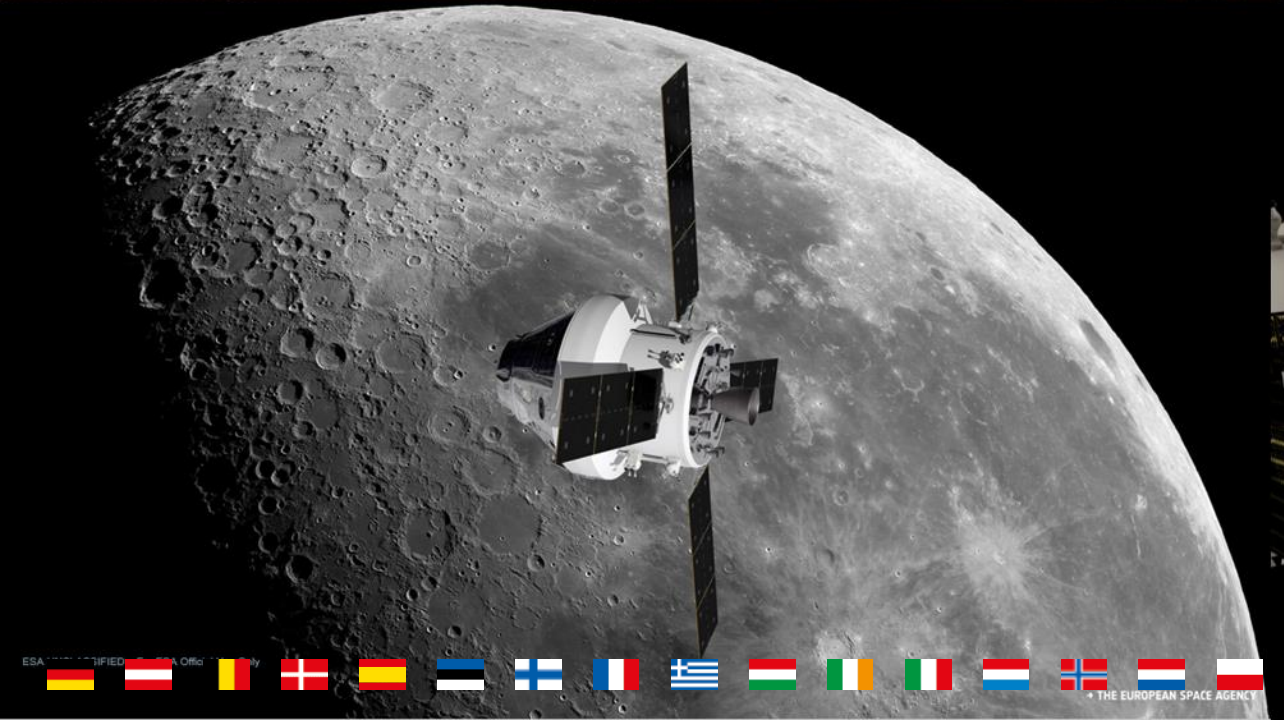
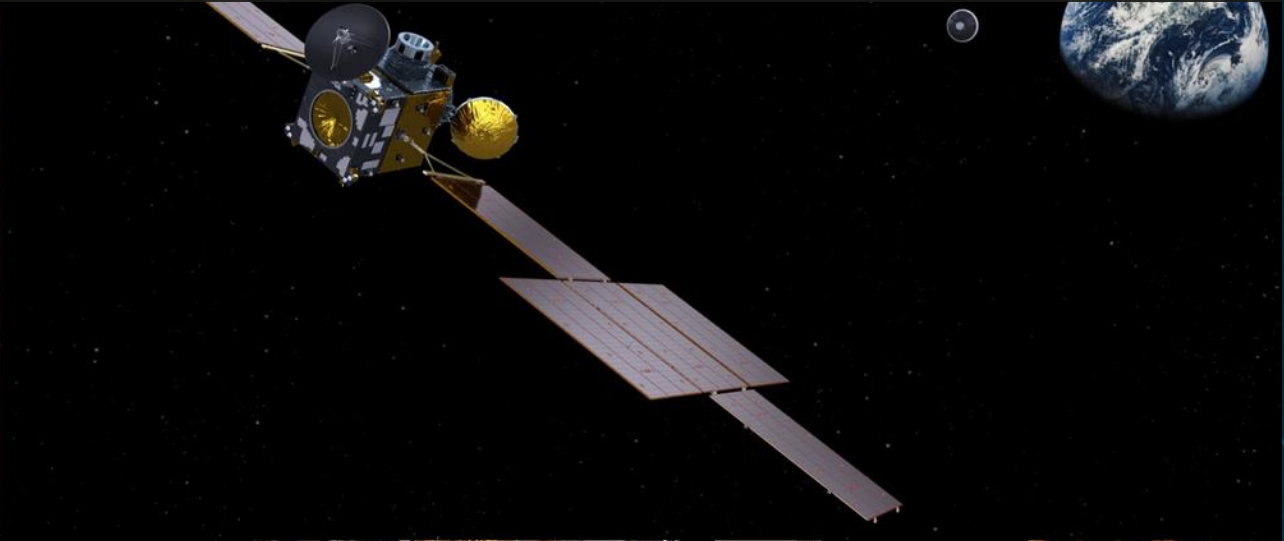
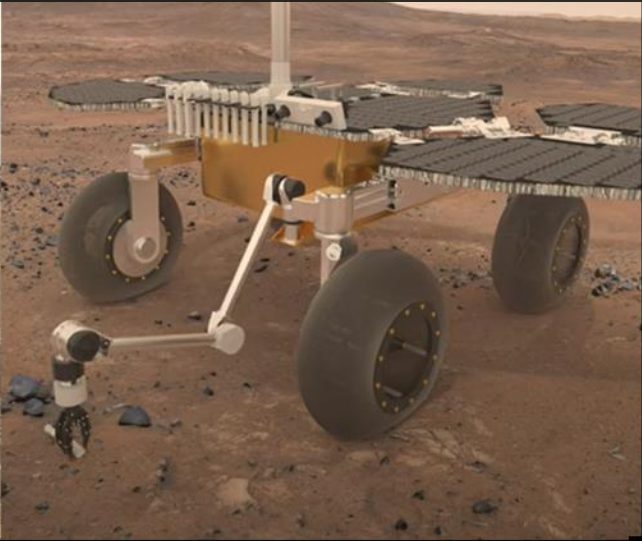
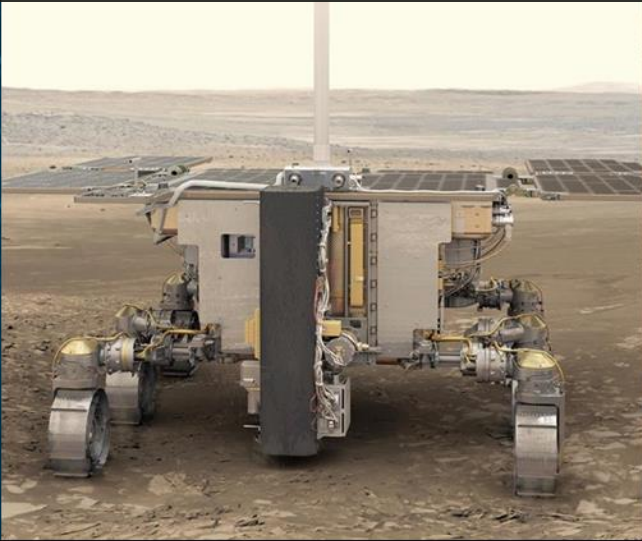


◀ **Exobiology and Material Research:** Exobiology facility and Euro Materials Ageing (EMA-CNES/ESA) outside the ISS.

▶ **Materials Science:** New campaign of EML and Transparent alloy, X-Ray Facility

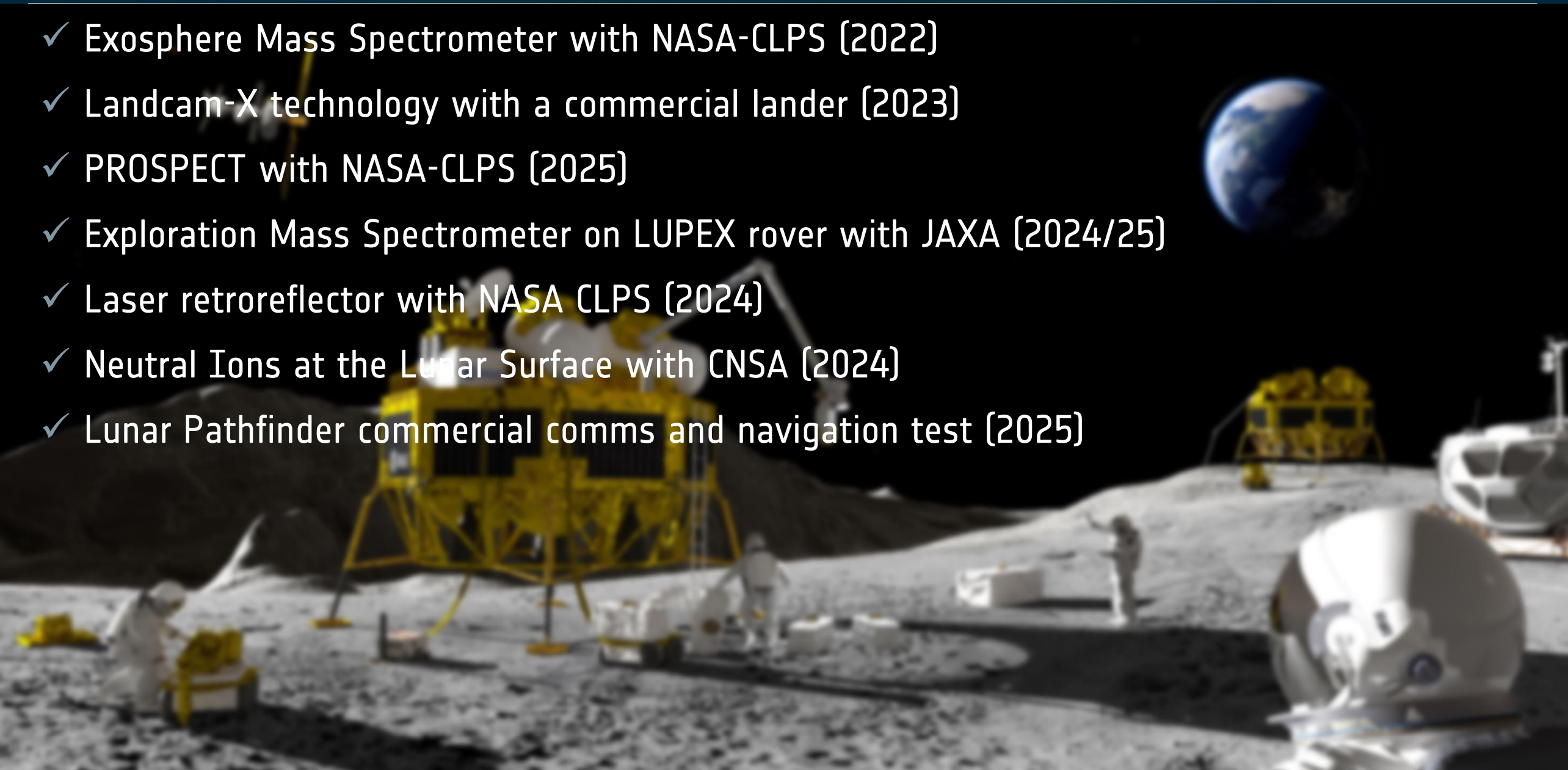


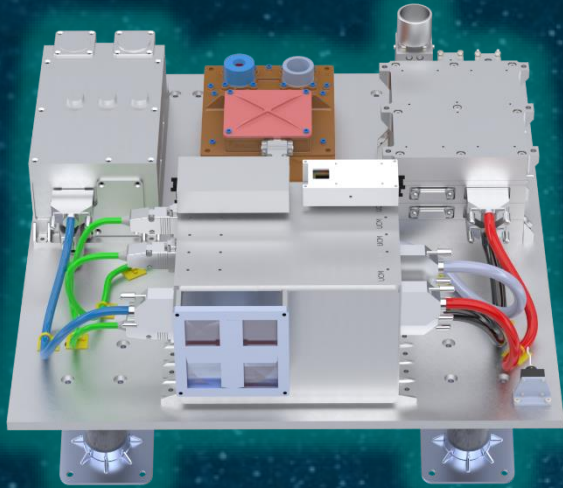
Getting started: Moon orbit/lunar surface and Mars surface



First ESA Science and technology on the Moon 2022-2025

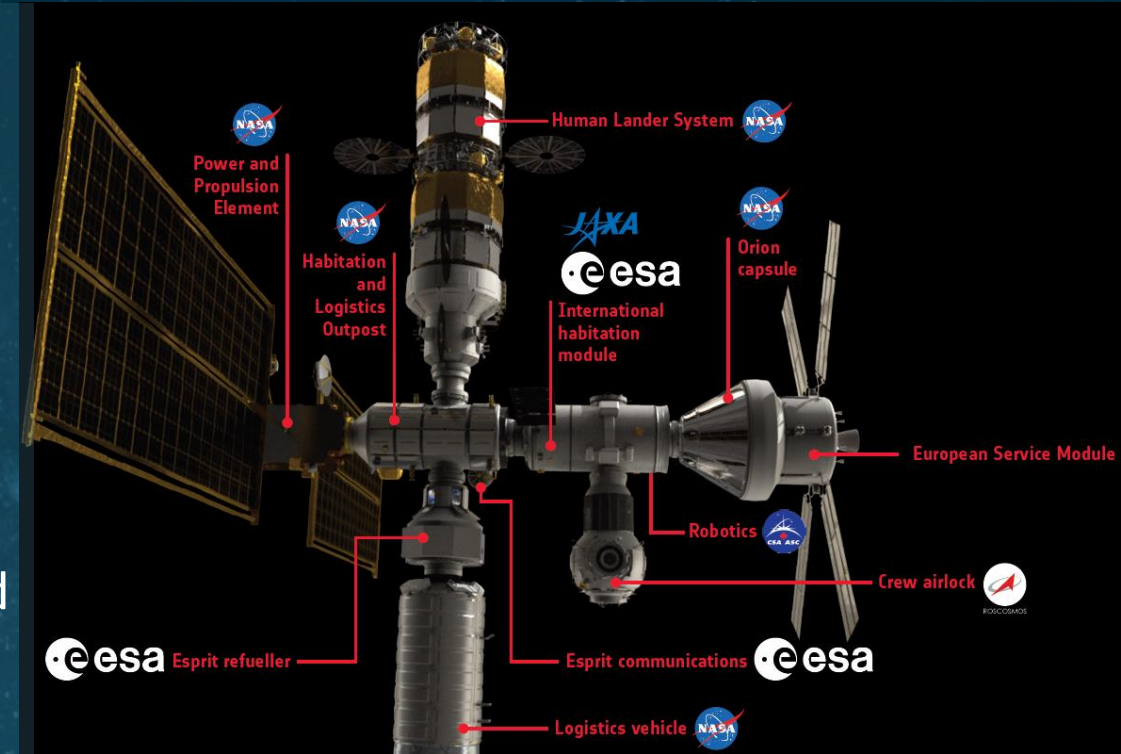
- ✓ Exosphere Mass Spectrometer with NASA-CLPS (2022)
- ✓ Landcam-X technology with a commercial lander (2023)
- ✓ PROSPECT with NASA-CLPS (2025)
- ✓ Exploration Mass Spectrometer on LUPEX rover with JAXA (2024/25)
- ✓ Laser retroreflector with NASA CLPS (2024)
- ✓ Neutral Ions at the Lunar Surface with CNSA (2024)
- ✓ Lunar Pathfinder commercial comms and navigation test (2025)





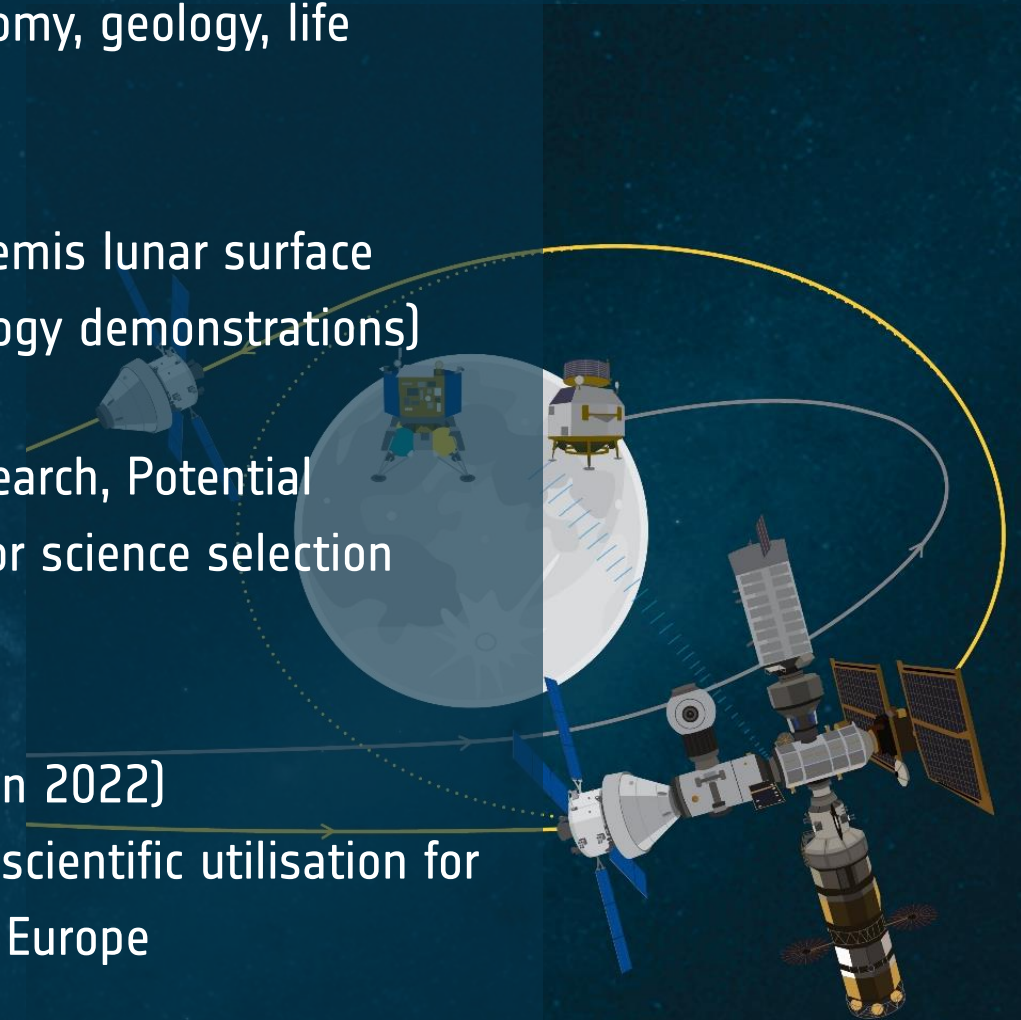
◀ **Radiation environment** The European Radiation Sensor Array (ERSA) will consist of several science instruments on a single platform externally mounted on PPE

◀ **Internal Dosimeter:** Internal Dosimeter Array (IDA) integrated in a payload bank enclosure in the HALO module



Upcoming – Cis-Lunar and Lunar Surface

- Utilisation studies: Exploration of polar resources, radio astronomy, geology, life sciences lab, ISRU...
- European Large Logistic Lander (EL3) to support the NASA Artemis lunar surface programme, including candidate payloads (science and technology demonstrations)
- Gateway: Payloads implemented by ESA to support health research, Potential development of an Exobiology facility with accompanying AO for science selection European Radiation Sensor Array (ERSA),
- Moon surface: Reserve pool of science activities (AO launched in 2022)
Coordination of access to new samples from Artemis missions for scientific utilisation for the European science community and build curation community in Europe



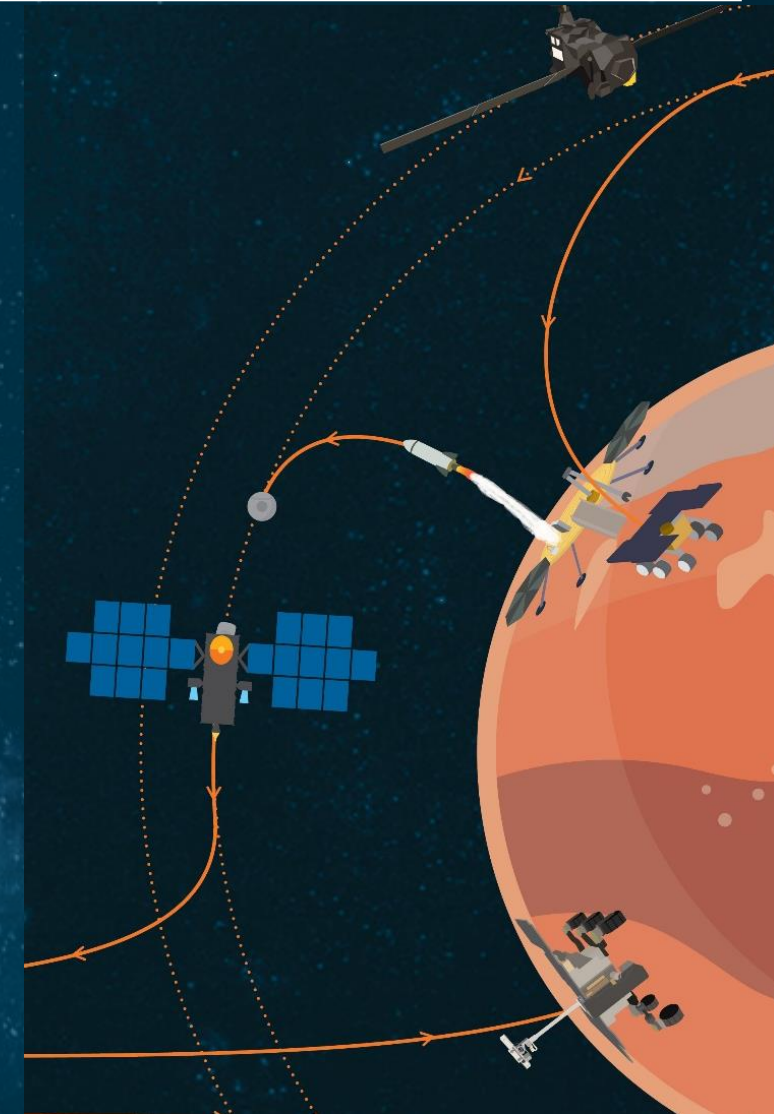
Earth Return Orbiter

- Development of flight instrument, Space Dosimetry Telescope, for integration on ERO

AO for science for Mars payloads to select science instrumentation for future Moon mission candidate studies

Preparation for Mars sample return

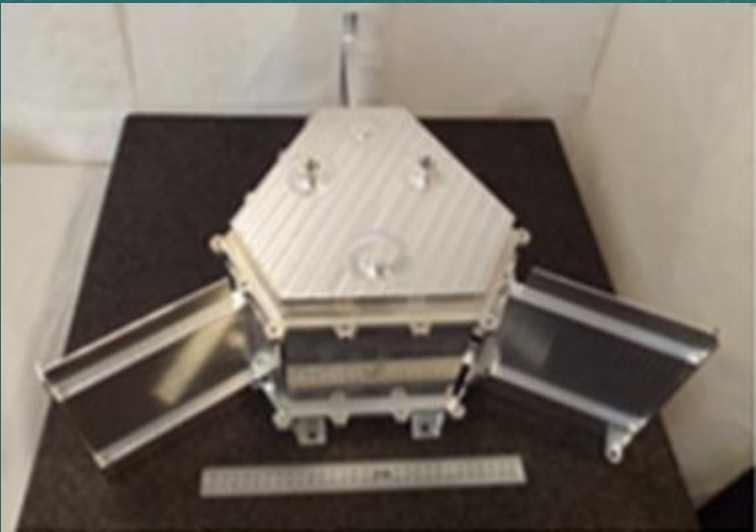
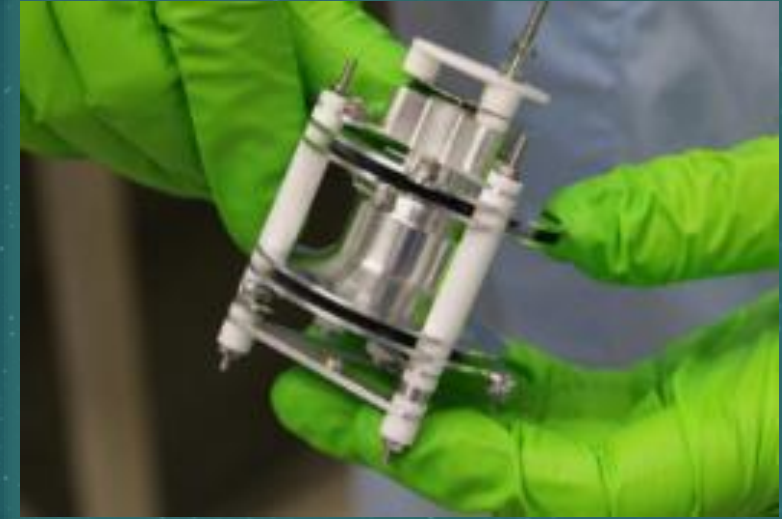
- Prepare for return of Mars samples through NASA collaboration and build an effective and competitive curation community in Europe





◀ **Space Resources:** 'before and after' demonstration of oxygen and titanium extraction from lunar regolith simulant using electrolysis process

▶ **Lunar science** missions of opportunity with NASA, JAXA/ ISRO, CNSA – up to 6 missions by 2025



◀ European **radioisotope** technology based on americium-241 for heat and electrical power generation: essential for future science and exploration

▶ ESA technology in the hands of astronauts for **science, medical and operations support**



Experiments in operation /or completed in 2022

ISS:

ASIM (external platform)	Ongoing
PK4	Ongoing (Campaign #15 in December 2022 - TBC)
FOAM-C #3	In operations, from August 2022 till Dec 2022
PASTA	Operated from March to August 2022
EML	Batch 3 on-going
MSL	Completed Batch 3a (CETSOL & MICAST)
Transparent Alloys	CETSOL-1 campaign (3 cartridges): processing 04–08/2022

New Topical Team on Fire Safety: Coordinator Grunde Jomaas (ZAG, Slovenia)

Other future activities

Projects:

X-Ray Facility on ISS: Payload development phase A/B initiated

ACES: Phase C/D

FLUMIAS: Phase C/D (only 2 Physics experiments)

FLUIDICS-LINEAR: Phase A

Announcement of Opportunities:

ISS

- ISS reserve pool of research activities (deadline Sep 14th)
- Soft Matter on ISS (Soft Matter Dynamics payload) End 2022
- Materials science on ISS (EML Batch) End 2022

Moon

- Reserve pool of science activities (deadline Sep 14th)

Gateway

- AO for science selection European Radiation Sensor Array (ERSA)

SciSpacE research programme



- ESA new research strategy:
 - Continuous utilisation of ground facilities and the ISS
 - Development of Moon and Mars activities
- New opportunities on ISS, Moon and Mars
- Co-funding for PhD and Postdoc

<https://ideas.esa.int/servlet/hype/IMT?documentTableId=45087666723629828&userAction=Browse&templateName=&documentId=8a3636c4e9d0c726514ed4bfe4f14ef0>

