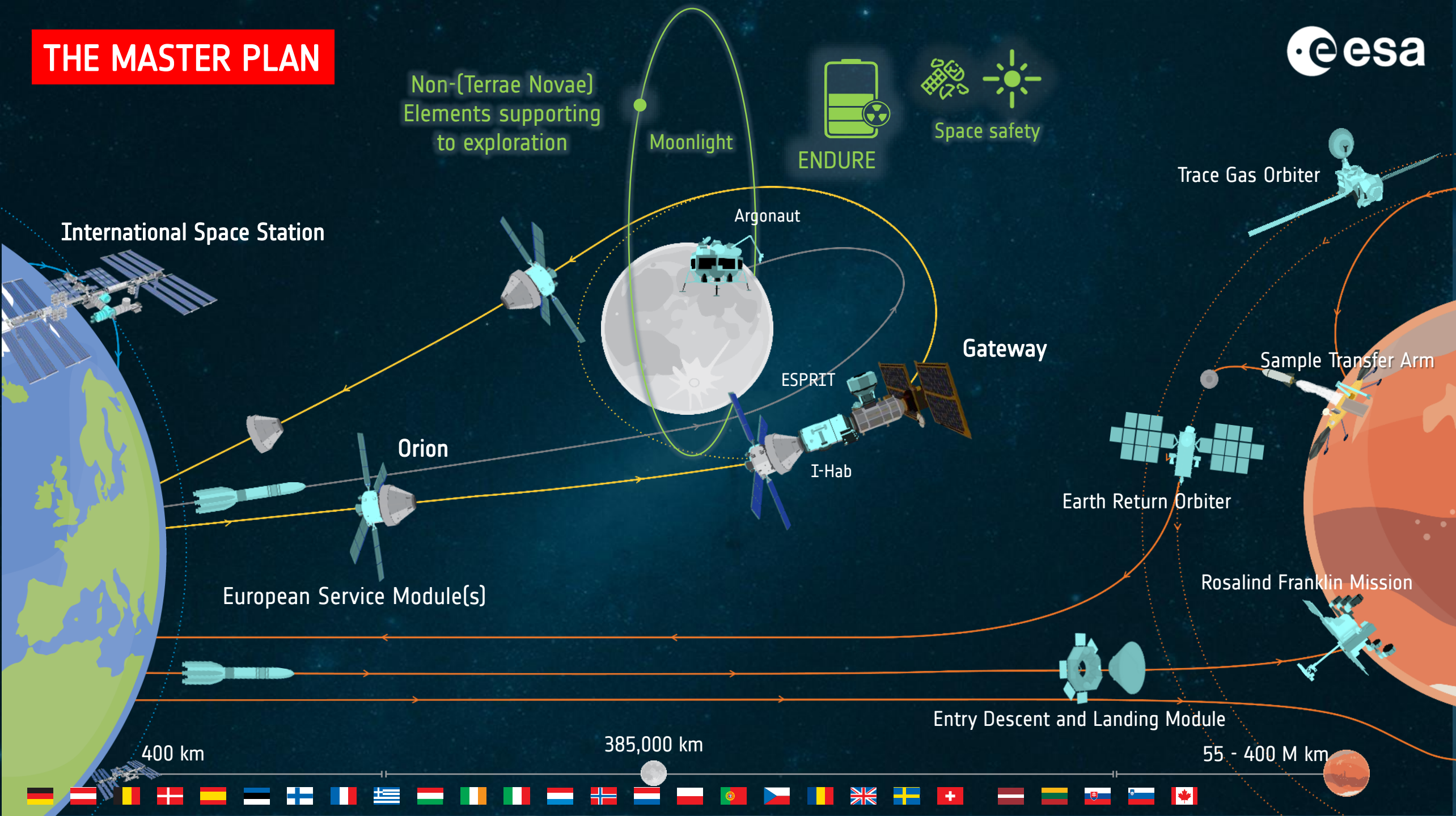


ESA's HRE SciSpacE research

James Carpenter, Francesca McDonald, Sebastien Vincent-Bonnieu (HRE-RS),
Berengere Houdou (HRE-LL), Matt Taylor (SCI-SCP)
Heliophysics in Europe, ESA/ESTEC, 30/10/2023

THE MASTER PLAN



Non-(Terra Novae)
Elements supporting
to exploration

ENDURE

Space safety

International Space Station

Moonlight

Argonaut

Trace Gas Orbiter

Gateway

ESPRIT

I-Hab

Sample Transfer Arm

Orion

Earth Return Orbiter

European Service Module(s)

Rosalind Franklin Mission

Entry Descent and Landing Module

400 km

385,000 km

55 - 400 M km



OUR NEXT GENERATION EXPLORERS



5

Career Astronauts

1

Parastronaut
Feasibility Study
Member

11

Members of the
Astronaut Reserve



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.

E3P Period 3 (2023-2025)

Commercialisation as a cross-cutting theme

space robotics

ExPeRT

ESA

- Orbit
- Control
- Light
- Antenna
- Power

Cornerstone #1:
Humans in LEO

Cornerstone #4:
Mars robotic exploration

SciSpace

Cornerstone #2:
Humans beyond LEO

Cornerstone #3:
Moon robotic exploration

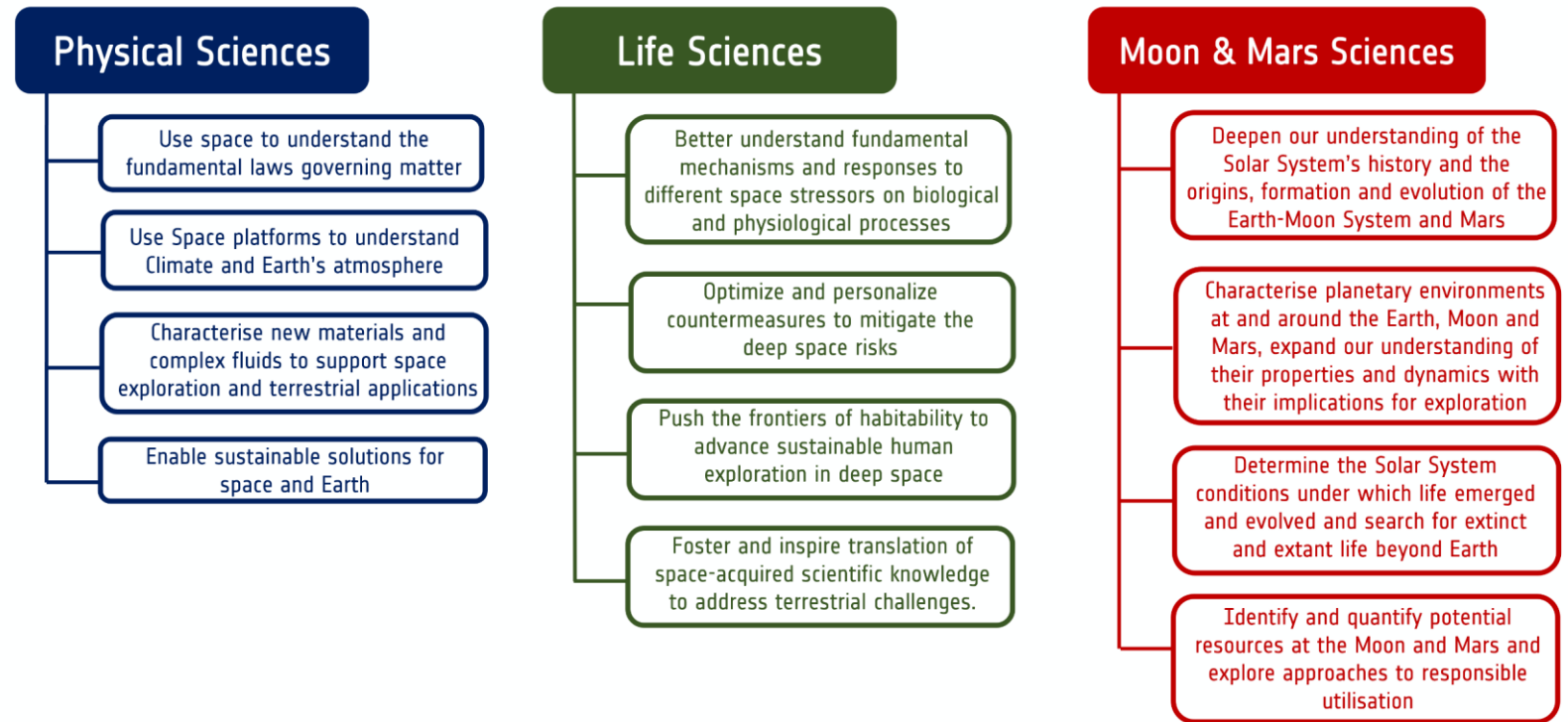
ExPeRT = Mission studies and mid-TRL technology

SciSpace = Science in the Space Environment

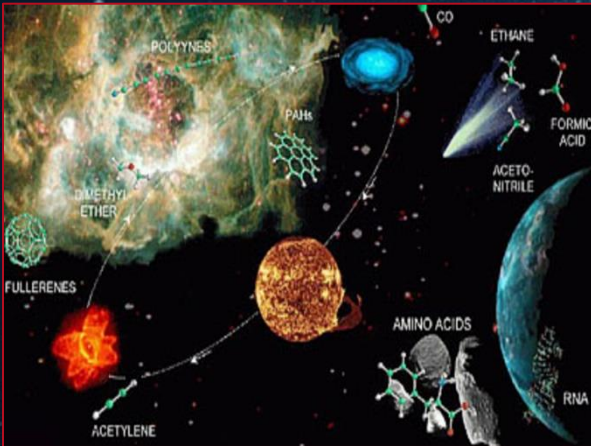
SciSpacE structure

SciSpacE prepares and delivers multidisciplinary science activities utilising varied research platforms including ground-based analogues; micro-gravity and LEO facilities, and is expanding to Moon and Mars destinations

- Fosters innovative, world-class, science research
- Helps to deliver solutions to challenges on Earth
- Supports European economy
- Prepares responsible sustained human and robotic exploration

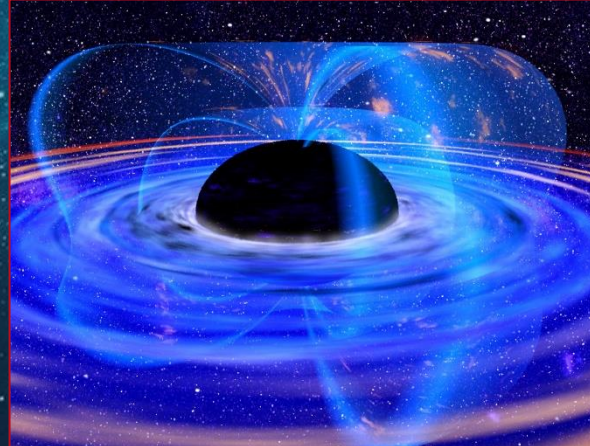


HUMANS LIVING ON MOON & MARS



EXTRATERRESTRIAL LIFE

ASTRONAUT 2.0



FUNDAMENTALS OF NATURE

SPACE TRAVEL AND TRANSPORT



NATURE OF EXPLORATION DESTINATIONS

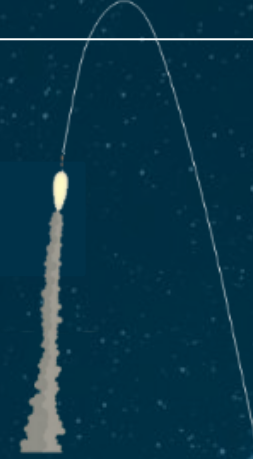
RESEARCH USING Ground and Sub-Orbital PLATFORMS



Bedrest



Dry Immersion



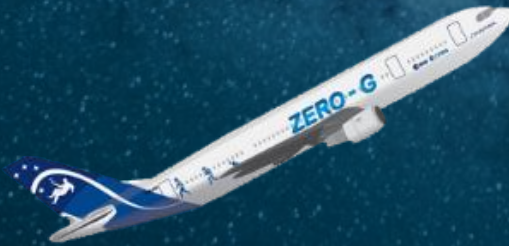
Sounding Rockets



Drop Tower



Concordia, Antarctica
Isolation and Confinement



Parabolic Flight

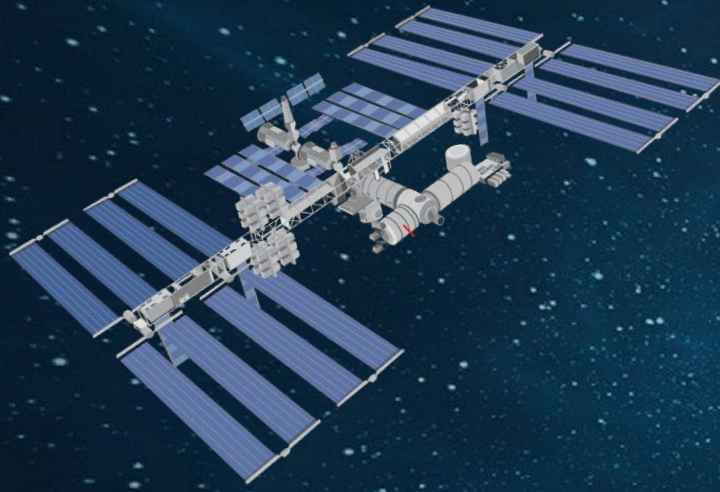


Ground-based
facilities

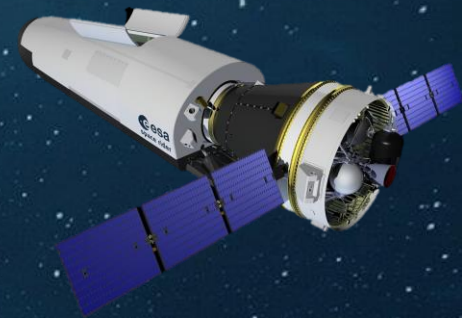


Radiation

RESEARCH USING SPACE PLATFORMS



International Space Station (ISS)

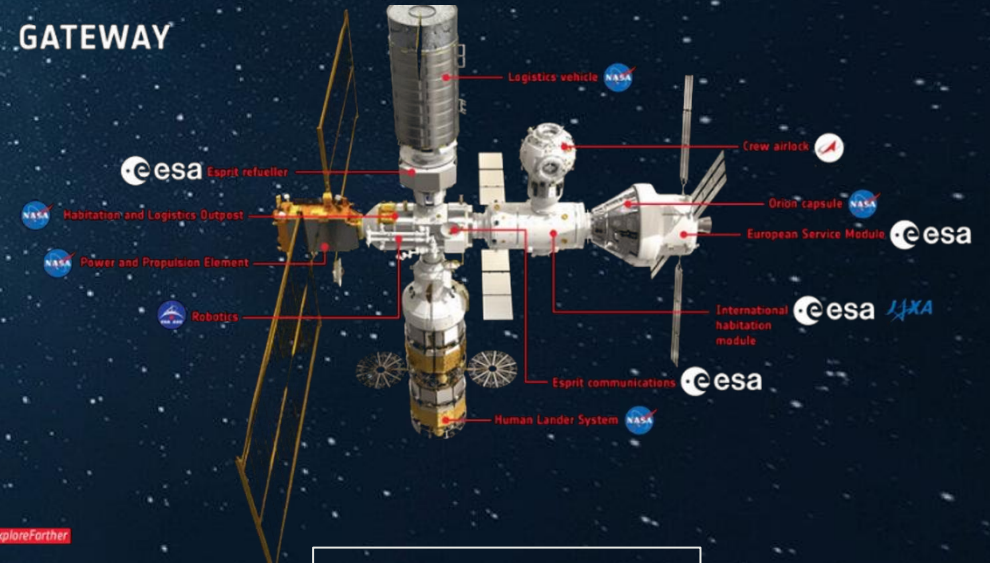


Space Rider



Argonaut

GATEWAY



Gateway



LOW EARTH ORBIT



Europe needs LEO for utilisation and exploration preparation, also post-ISS

Preparing the post-ISS era has already started with international trend of commercialisation

No Agency owned platforms, instead buying services

Transportation model is fundamental

TERRAE NOVAE 2030+

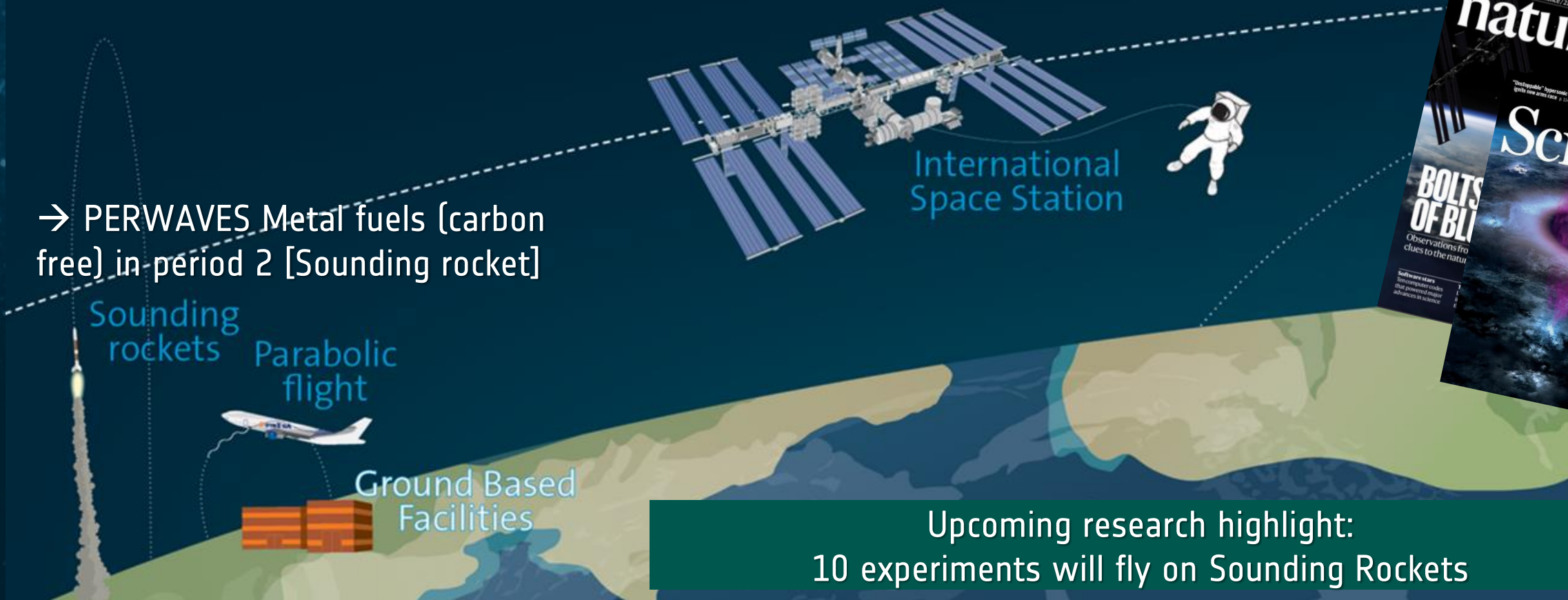


RESEARCH HIGHLIGHTS

- Understanding of cell ageing - DNAmAge
- Musculoskeletal deconditioning in long spaceflight
- Complex Plasmas effect on ISS
- Metallic alloys properties measurements EML and MSL

→ ASIM observed the genesis of blue lightning into the stratosphere

→ PERWAVES Metal fuels (carbon free) in period 2 [Sounding rocket]



Upcoming research highlight:
10 experiments will fly on Sounding Rockets

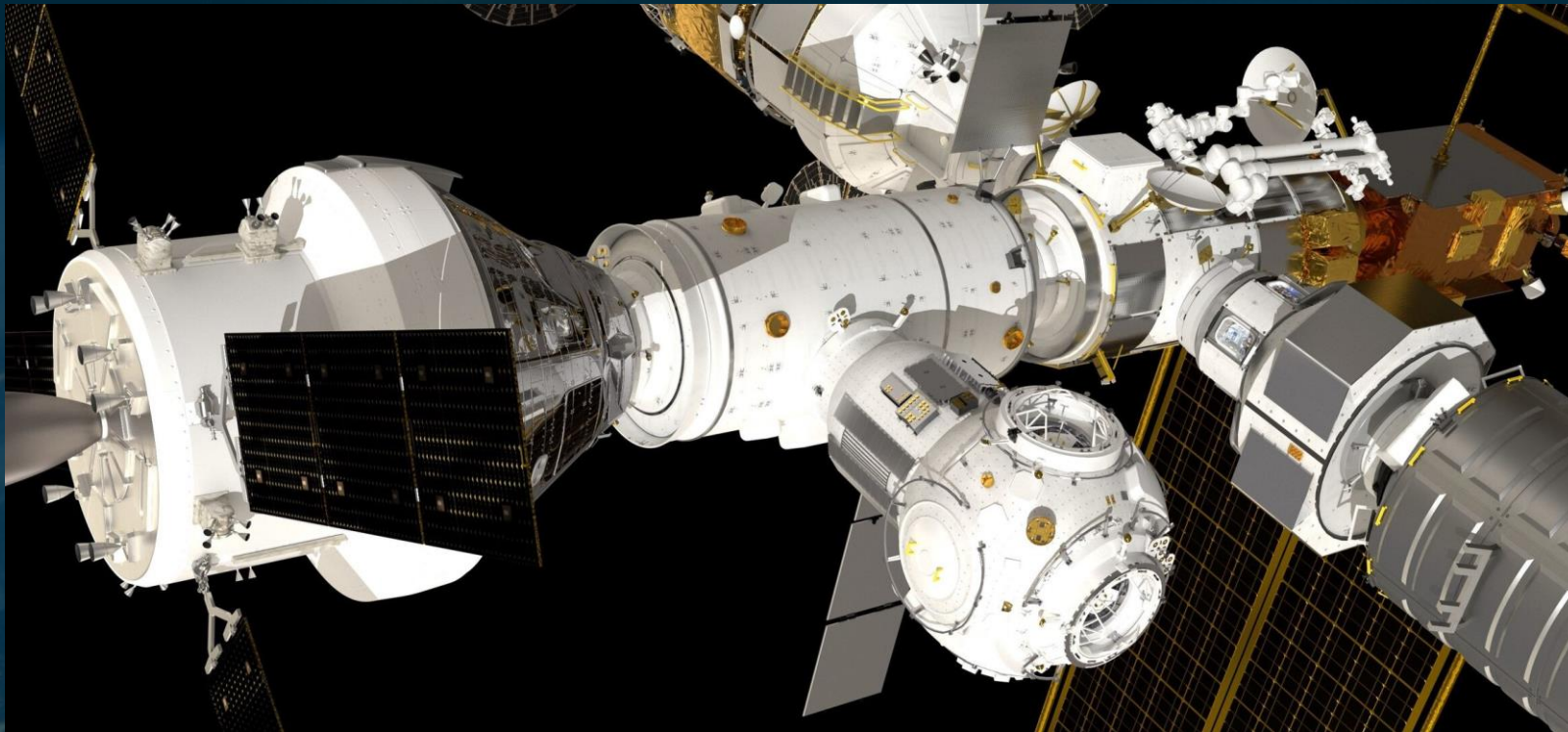
Regular and substantial robotic access during the 2030s enabling European-led scientific and logistic activities

Reliable and visible partner for sustainable exploration of the Moon

Ambition of the first European on the surface by 2030

TERRAE NOVAE 2030+





◀ **Radiation** European Radiation Sensor Array (ERSA) – External deep space radiation environment and space weather

◀ **Radiation** Internal Dosimeter Array (IDA) – Internal radiation as experienced by crew

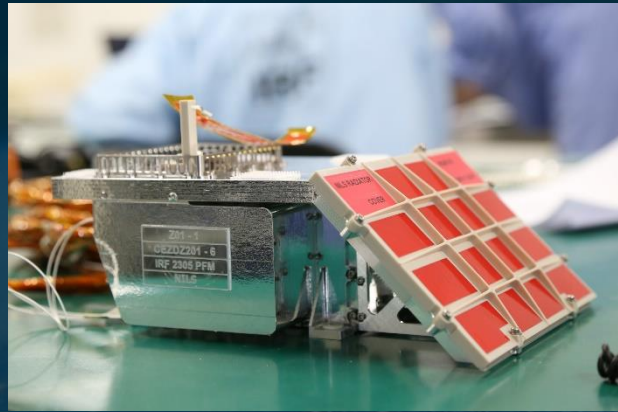
◀ **Human Health**
In-situ assessment of immune parameters, Health...

Future prospects :

Active Sensors for Telemetry of Extraterrestrial Impactors At Gateway (ASTERIA) is a package of instrumentation which aims to characterise and monitor the environment at Gateway

Partner led heliophysics next generation package expected to follow HERMES with European Science participation

Science and technology on the Moon

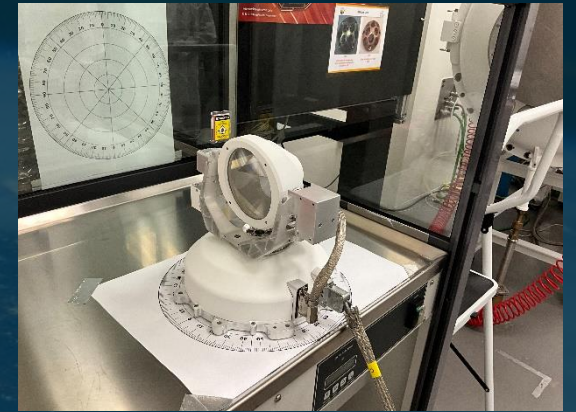


◀ Lunar environment

Negative Ions at the Lunar Surface (NILS) on Chang'e 6 examining the interaction of the solar wind with airless bodies

Geophysics ▶

MoonLIGHT laser retroreflector on Intuitive Machines mission IM3, ranging from Earth to probe the interior of the Moon and relativistic physics

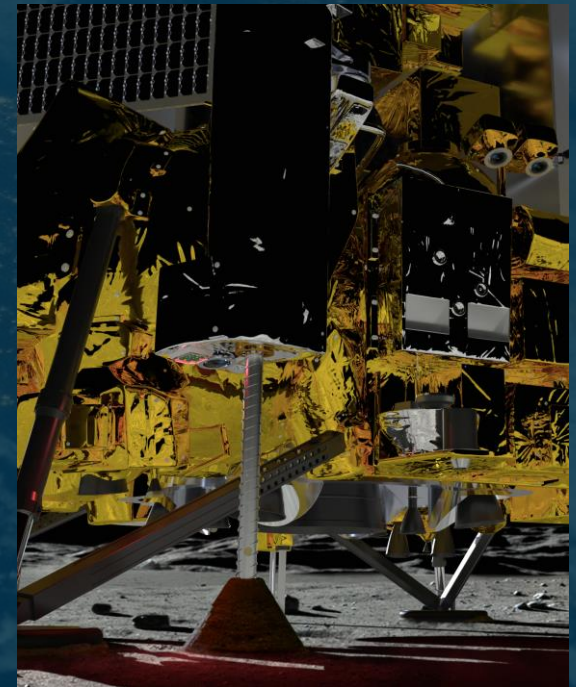


◀ Resources / exosphere

Exospheric Mass spectrometer (EMS) on Astrobotic mission 1 and JAXA LUPEX rover looking for water ice near the surface

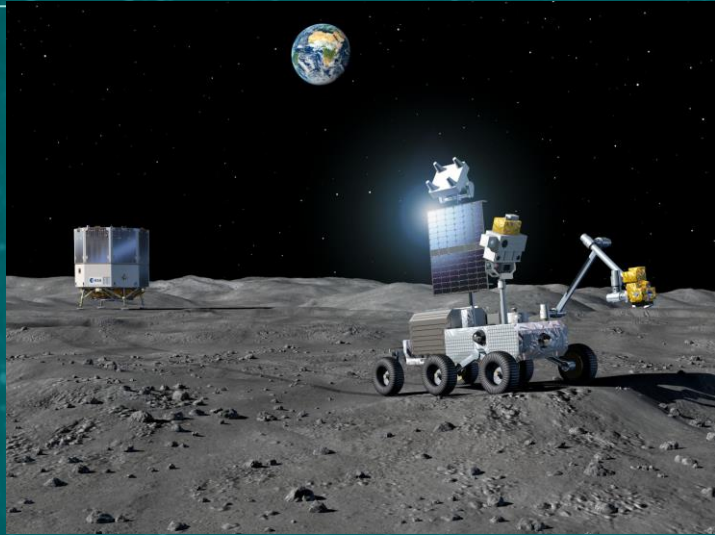
Resources characterisation ▶

PROSPECT drill and chemical laboratory: drilling at the lunar South Pole for ice and volatile chemistry. Resource utilisation experiment



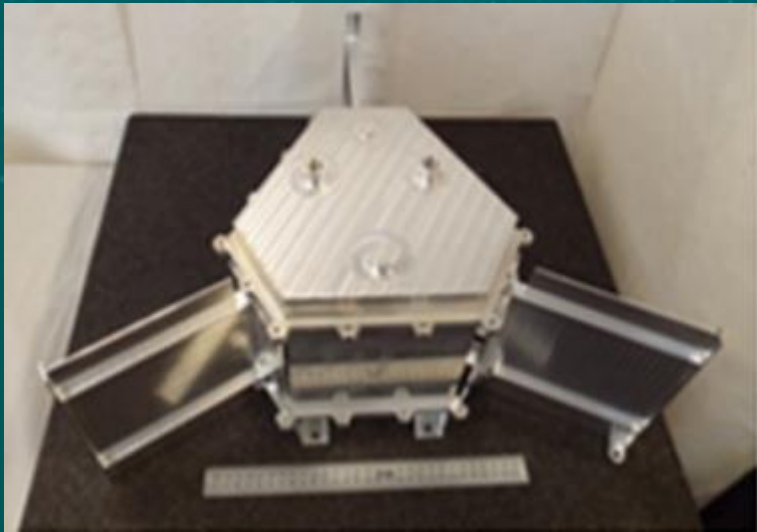
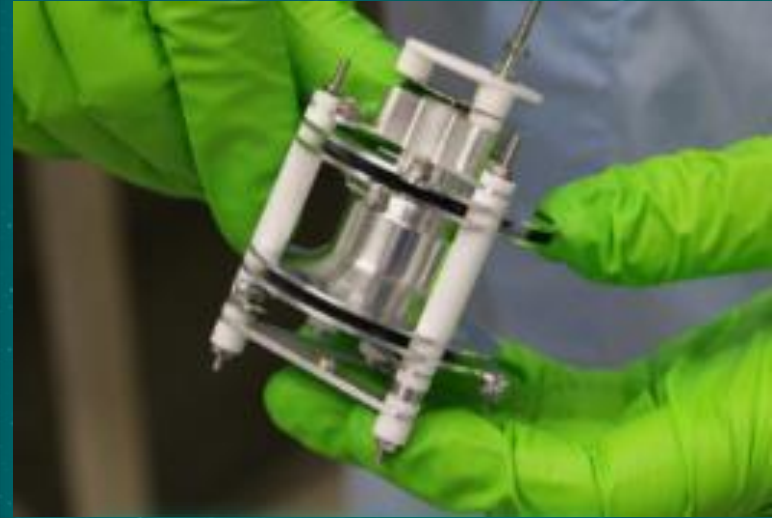
Future prospects: Exploration driven activities, environment monitoring, resources characterisation, sample selection and return, space biology, human health research, physics and astrophysics (longer term)

Science and technology on the Moon



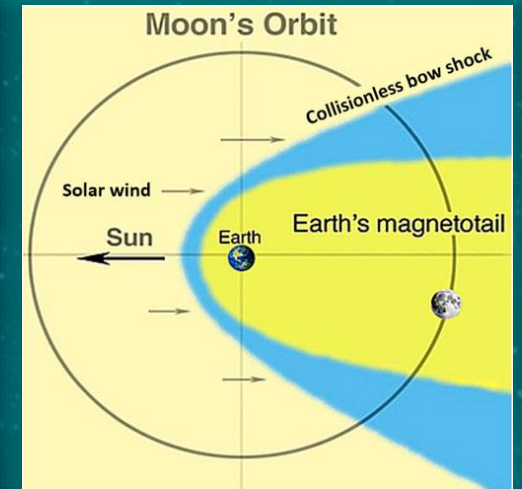
◀ **Lunar science** missions of opportunity with NASA, JAXA/ ISRO, CNSA – up to 6 missions by 2026

▶ **Study of payload servicing module [HADES]:** to enable long duration measurement on the surface [opportunities for Heliophysics activities]



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

▶ **ESA Topical Team:** Article: "Space Plasma Physics Science Opportunities for the Lunar Orbital Platform – Gateway " in **Frontiers**



Dandouras et al Front. Astron. Space Sci., Mar. 2023

Recent and future Cis-Lunar and Lunar activities

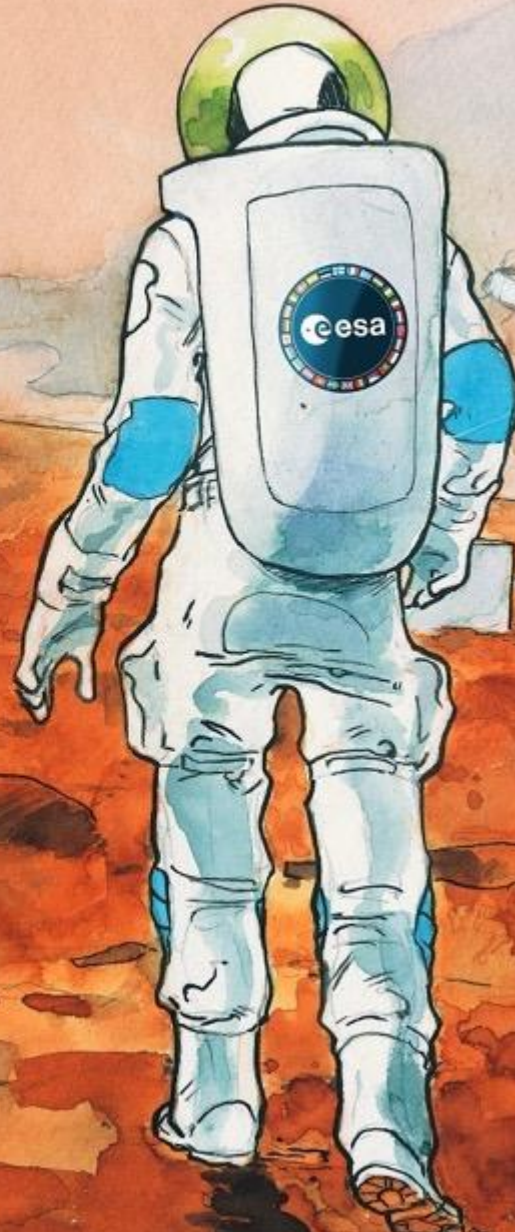
- Gateway: European Radiation Sensor Array (ERSA) and Internal Dosimeter Array (IDA)
- Moon surface: Reserve pool of science activities (AO closed in 2022)
- Facility Definition Team (call recently closed):
 - ASTERIA - Active Sensors for Telemetry of Extraterrestrial Impactors At Gateway
 - HADES - Human Artemis Deployed Environment System
 - METIS - Multifunctional Exposure Testbed In deep Space

- Call for Small Lunar Mission [open]

- Future calls expected for ESA and international partner activities at Gateway and Moon

14 December 2023





Robotic missions to consolidate key capabilities to

- Continue the search for life
- Secure Europe's independence of action at Mars

Future possible missions studies as part of ExPeRT

In synergy with LEO and Moon, position Europe for a strong contribution to the Human journey in the 2040s

TERRAE NOVAE 2030+

Cornerstone 4: Ambitious decade of Mars exploration

Trace Gas Orbiter

- TGO science continuing
- Data relay for Curiosity, Insight, Perseverance continues

→ ERO is in phase C development (readiness for launch is 2027)

ExoMars Rover

- Mission to land Rosalind Franklin proposal in cooperation with NASA decided at CM22

Earth Return Orbiter

→ **Discontinued**

→ STA Contract signed in July 2022

Sample Fetch Rover

Sample Transfer Arm



ESA's SciSpacE Research Opportunities



Announcements of Opportunity (AO)

Human research (Concordia,
isolation...)
Sounding Rockets
ISS
Gateway
Moon ...

Continuously Open Research Announcements

(CORA)

Parabolic Flight
Drop Tower
Ground-based facilities

Other

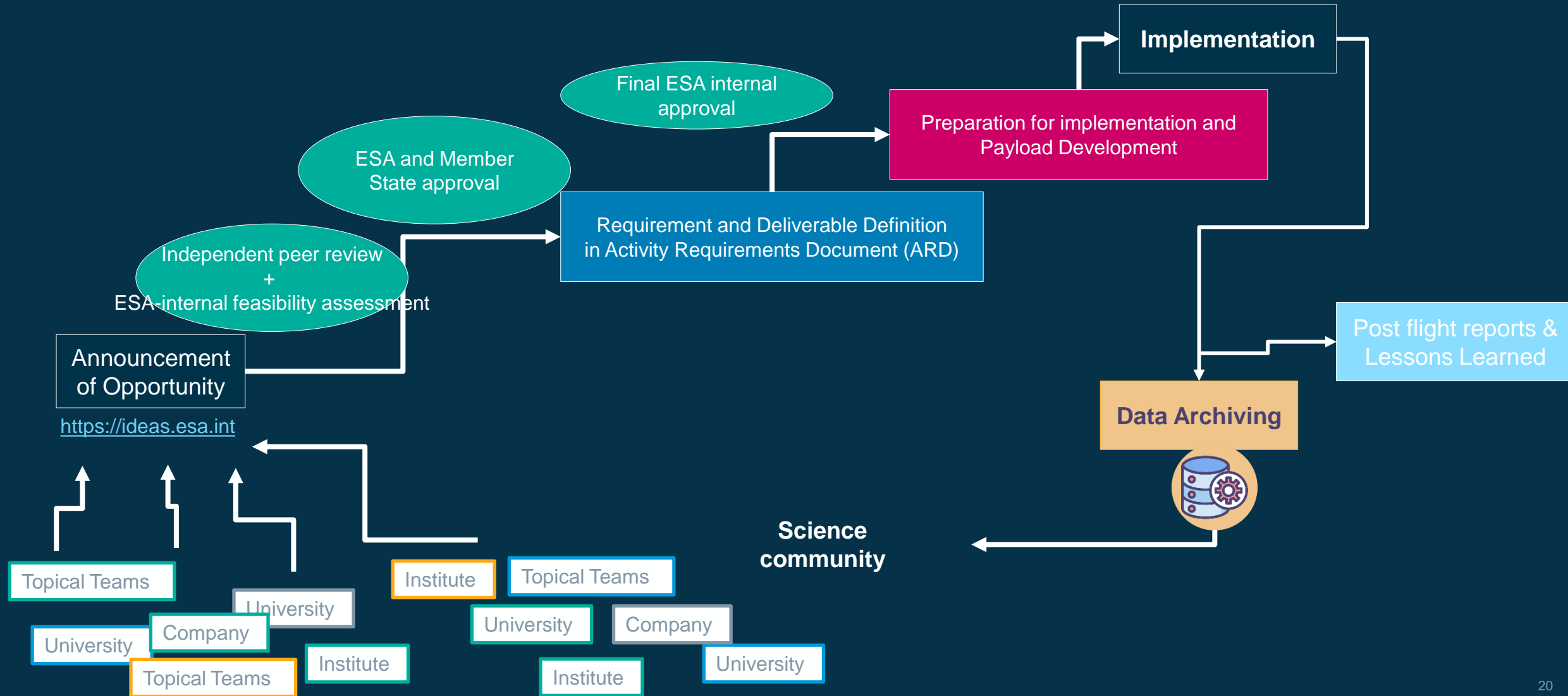
Topical Team

ESA's Open Space Innovation Platform (OSIP) at ideas.esa.int

SciSpacE website at scispace.esa.int



FROM OPPORTUNITY TO IMPLEMENTATION



Announcements of Opportunities

Ground and Sub-Orbital Platforms

- Parabolic Flight (2 campaigns per year) continuously open
- Drop Tower (120 drops/annually) continuously open
- Ground-Based Facilities, incl. radiation via IBPER Radiation continuously open
- Sounding rocket Last call in 2022

ISS

- 3D BioSystem early 2024
- ISS Human research flexible experiments end of 2023
- Call for Low Earth Orbit Facility Definition Teams (FDTs) Membership recently closed
- Reserve pool of activities on ISS closed

Moon

- Call for Small Lunar Mission 14 December 2023
- Call for Lunar Gateway and Moon Surface Facility Definition Teams (FDTs) Membership recently closed
- Reserve pool of activities on Moon closed

Gateway

- AO for health science payloads 2024 (TBC)

Check out SciSpace opportunities on <https://scispace.esa.int/>
ESA's Open Space Innovation Platform (OSIP) at ideas.esa.int

ESA Discovery channel :

<https://ideas.esa.int/>

- co-sponsored research (PhD / Posdoc),
- system studies, and
- early technology development activities

ESA Technology development :

- General Support Technology Programme (GSTP) , development for future mission
- Basic Technology Research Programme (TDE) , early stage tec devolvement
- ExPeRT integrates technologies needed to prepare exploration missions

Commercialisation:

ESA Space Solutions

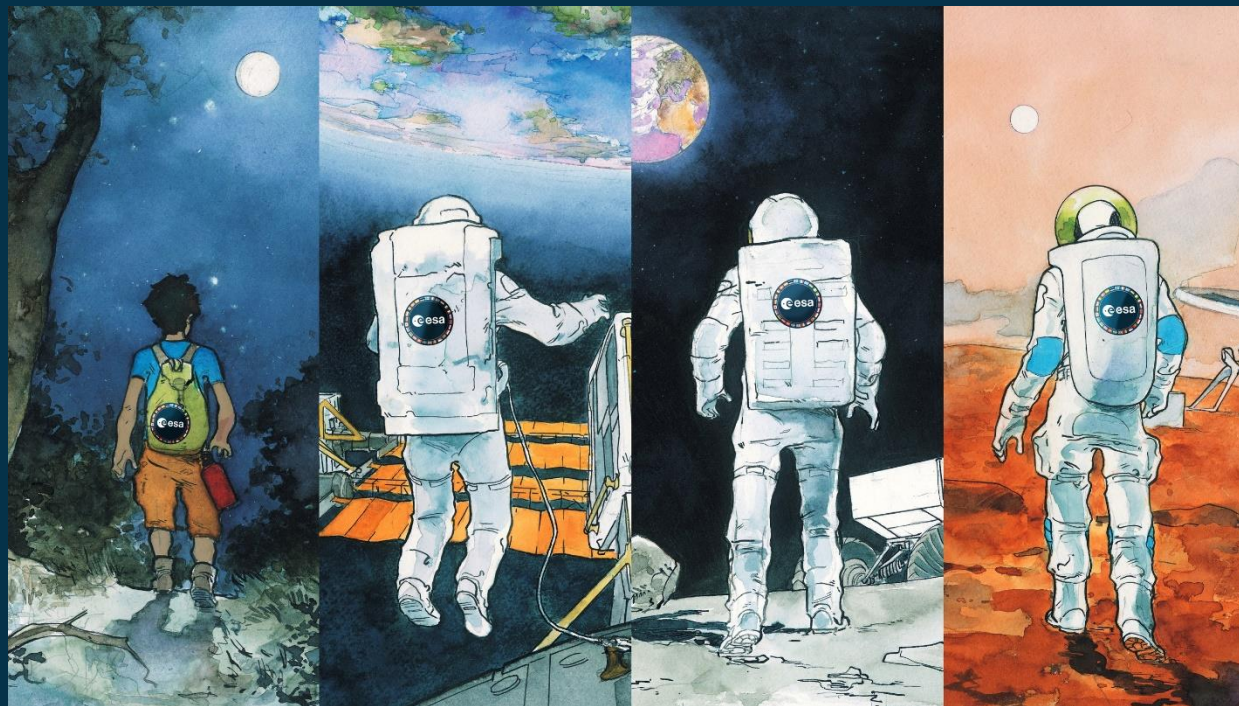
<https://business.esa.int/>

ESA commercialisation gateway

<https://commercialisation.esa.int/>

ESA academy :

- Training sessions (Satellite Communications, ...)
- Fly your Satellite - FYS
- Orbit your thesis - OYT



THANK YOU! – QUESTIONS?



SciSpacE@esa.int



<https://scispace.esa.int>

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