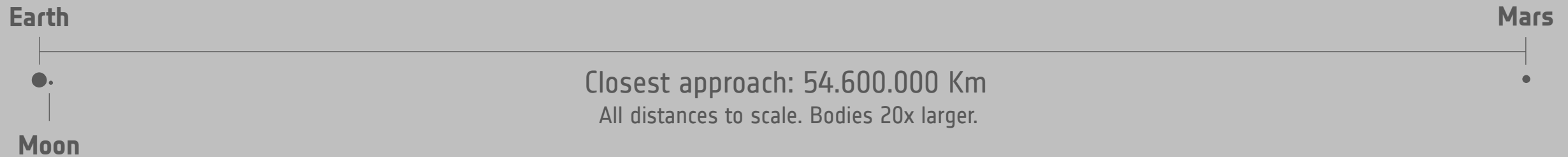


# TERRAE NOVAE PROGRAMME



“ESA UNCLASSIFIED – Releasable to the Public”



2020 > 2030

ESA in mutual inter-dependence



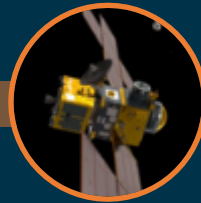
ExoMars 2016



ExoMars 2022



Mars Sample Return



Orion - European Service Module



Gateway – permanent habitation in deep space



Core ISS Partner



Post-ISS Commercial stations

2030 > 2040

European-led capabilities



Preparing to send humans to Mars



Living and working on the Moon



Cargo launch and return



Independent human transport

## The right stuff

## Benefits

National ambitions

Science & Knowledge

Realistic and resilient shared strategy

Competitiveness & growth of industry

Essential capabilities for sustainable exploration

International cooperation

Stimulating the development of commercial services

Inspiration

Autonomy in selected areas for resilience and to become an even stronger partner

Leader in exploration

Earth

Mars



Moon

Closest approach: 54.600.000 Km

All distances to scale. Bodies 20x larger.

WITH A GOAL IN MIND



### Continuity

Sustained presence in, and utilisation of low Earth orbit

Strategic resilience

### Ambition

Europeans on the Moon by 2030

### Vision

Europeans on Mars by 2043

### Inspiration

Cargo / crew transportation and sample return mission



European autonomy



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→ THE EUROPEAN SPACE AGENCY

# PROPELLING EUROPE INTO THE NEW ERA OF SPACE EXPLORATION



Extend ISS operations until 2030:  
new science benefits - first flights of  
new astronauts - first astronaut with  
disability

Promote commercial exploration services  
Prepare future science, missions & technology

Deliver Mars science & communications:  
ExoMars Trace Gas Orbiter

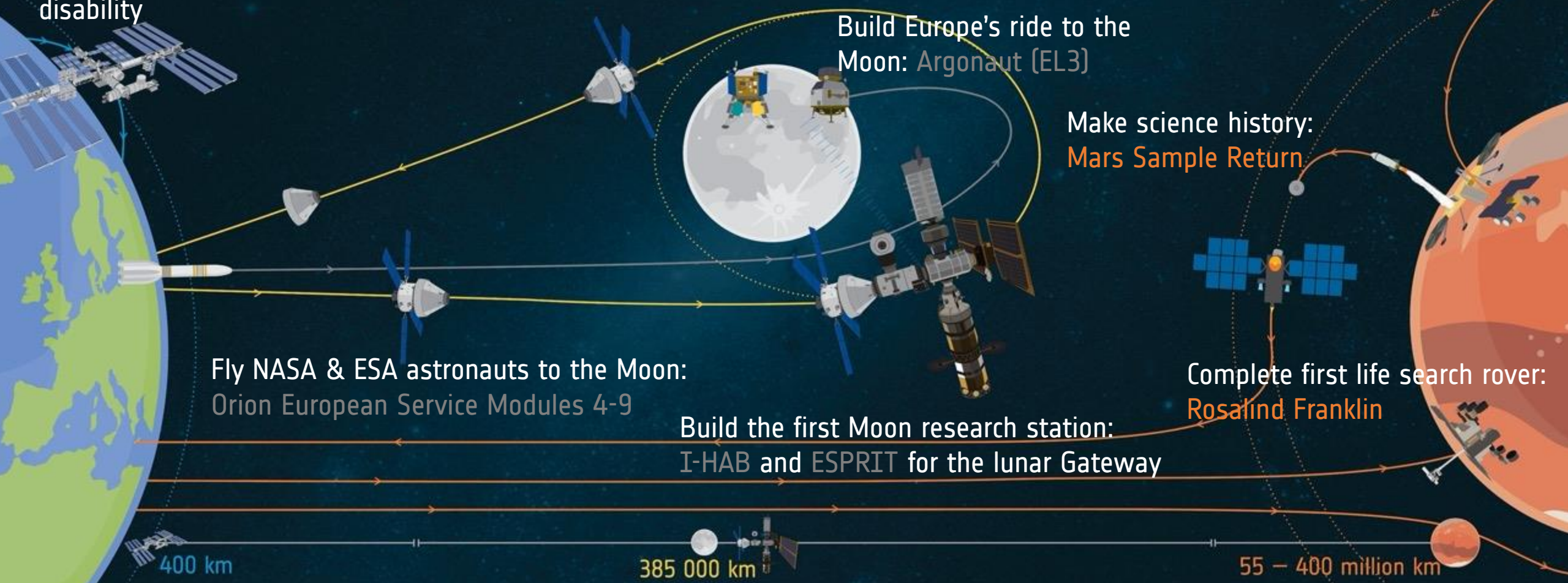
Build Europe's ride to the  
Moon: Argonaut (EL3)

Make science history:  
Mars Sample Return

Fly NASA & ESA astronauts to the Moon:  
Orion European Service Modules 4-9

Build the first Moon research station:  
I-HAB and ESPRIT for the Lunar Gateway

Complete first life search rover:  
Rosalind Franklin



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# International Space Station

YOU ARE DOWN THERE



Operations and Utilisation up to 2030  
Astronauts  
Commercialisation



...

Regular ESA astronauts missions

2022 2023 2024 2025



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# ISS LONG-DURATION MISSIONS

Thomas Pesquet



2021

Mathias Maurer



2021

Samantha Cristoforetti



2022

Andreas Mogensen



2023



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# CONTRIBUTIONS TO ISS

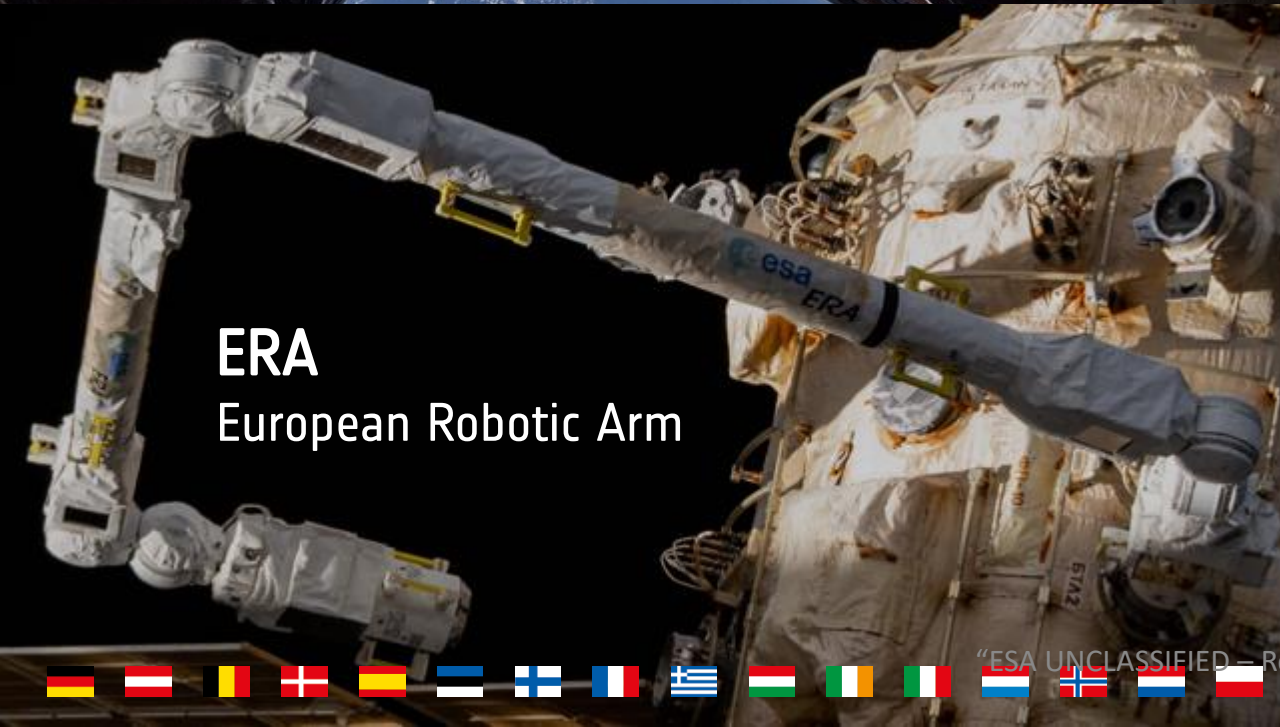
## Structural and logistics elements

Columbus, Cupola, Node 2 & 3, ATVs, DMS-R



## Outfitting

MELFI -80degree freezers, Life support rack, Air quality monitor



## ERA

European Robotic Arm



## Bartolomeo

Commercial platform



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# IN-ORBIT OPERATIONS AT THE SERVICE OF SCIENCE



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# SciSpacE Research and Platforms

## • Micro-/Partial Gravity

## Radiation

## Isolation/Confinement

## Other

Bedrest  
 Dry Immersion  
 Parabolic Flight  
 Drop Tower  
 Sounding Rockets  
 Ground-Based Facilities  
 International Space Station (ISS)  
 Gateway

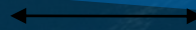
Ground-based Radiation  
 GSI Radiation  
 ISS  
 Gateway

MARS500 / SIRIUS  
 ESA-led isolation studies - future  
 Concordia, Antarctica  
 Gateway

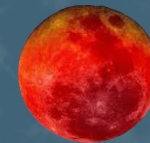
Ground-Based  
 Facilities



LEO: International Space Station (ISS), Space Rider, Commercial Platforms



BLEO: Gateway, Moon, and Mars



# SciSpacE - Research Ground and Sub-Orbital Platforms



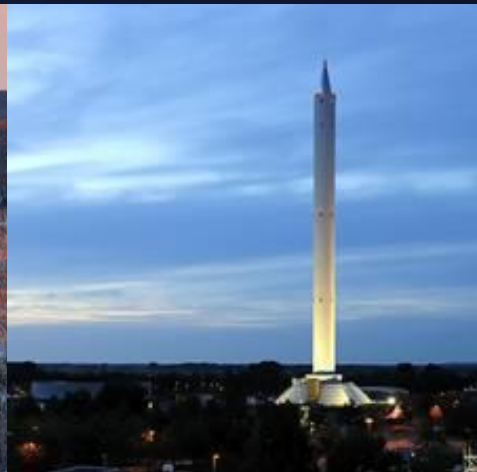
Bedrest



Dry Immersion



Sounding Rockets



Drop Tower



Concordia, Antarctica  
Isolation and Confinement



Parabolic Flight



Ground-based  
facilities



Radiation



# NEXT GENERATION EXPLORERS



New ESA astronauts and parastronaut feasibility study



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# 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

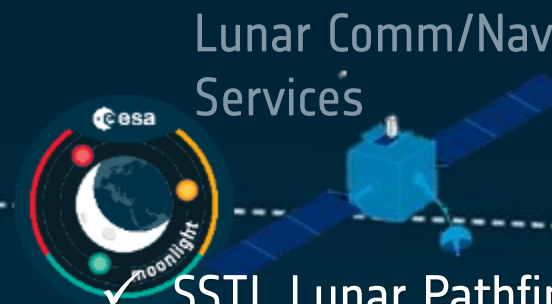
Transportation model is fundamental

**TERRAE NOVAE 2030+**



# Europe's new era of lunar exploration

- ✓ ESM1 launch preparations
- ✓ ESM2 delivered in October 21
- ✓ ESM3 and 4 in manufacture

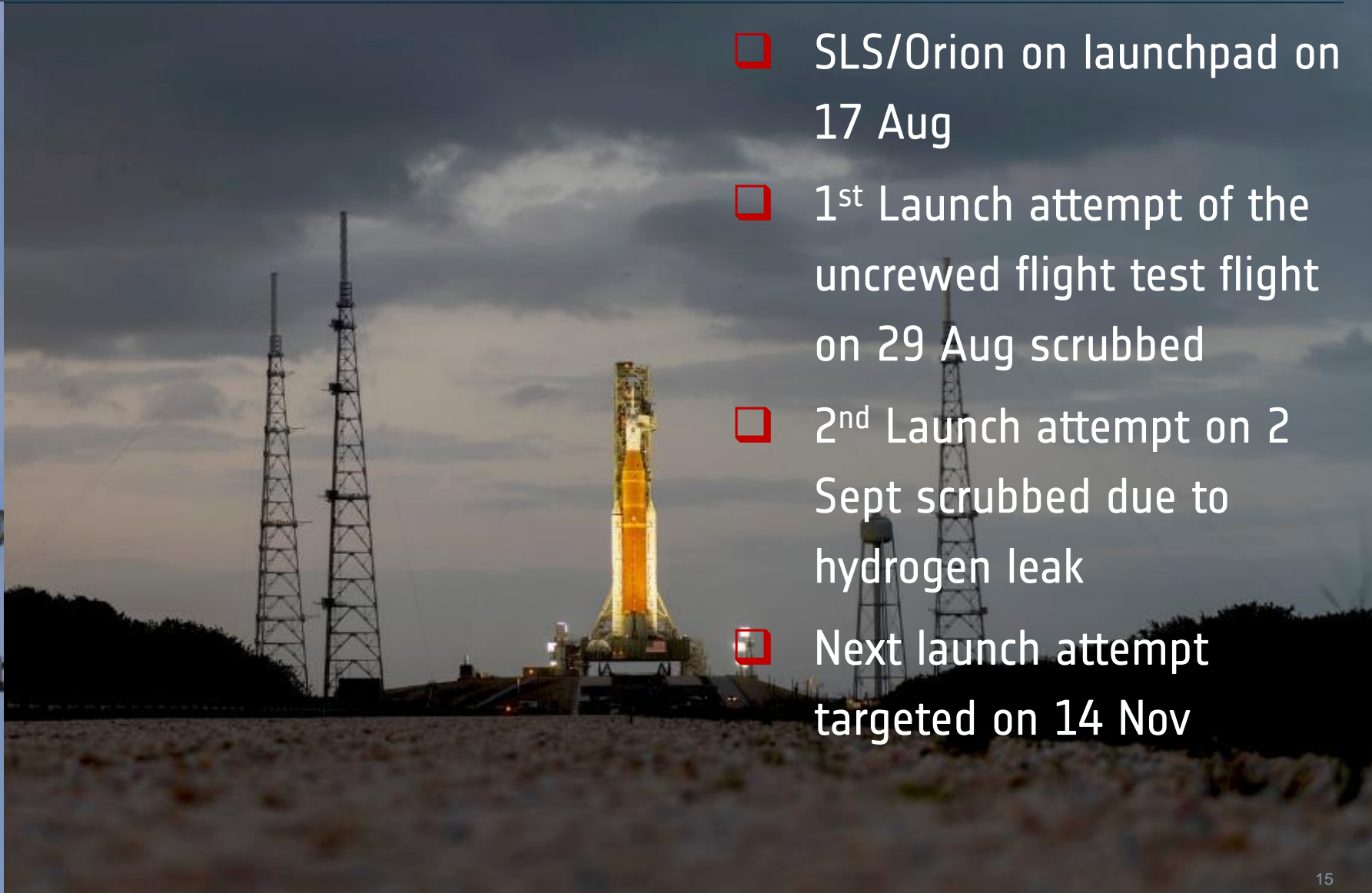


- ✓ Completion of Preliminary Requirement Review
- Redirection of next phase to focus on LEO applications based on commercial LEO RFI and on overall exploration transportation architecture

- ✓ Luna cooperation with Roscosmos discontinued
- ✓ Landcam-X commercial flight demo in negotiation



- ✓ EL3 iSRR kicked off in 05/2022
- ✓ EL3 to be decided at CM22

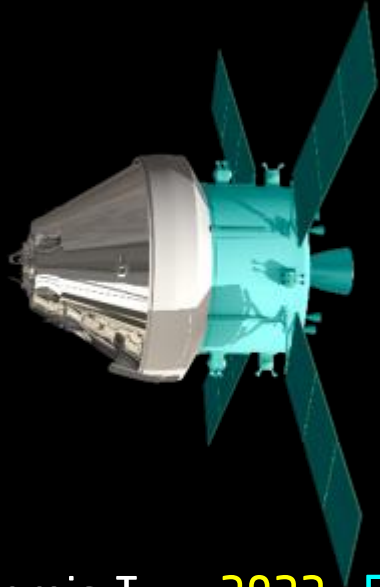


- ❑ SLS/Orion on launchpad on 17 Aug
- ❑ 1<sup>st</sup> Launch attempt of the uncrewed flight test flight on 29 Aug scrubbed
- ❑ 2<sup>nd</sup> Launch attempt on 2 Sept scrubbed due to hydrogen leak
- ❑ Next launch attempt targeted on 14 Nov

# AT THE HEART OF MOON EXPLORATION



## Orion and Lunar Gateway



European Service Module  
**ESM**

European System Providing Refuelling, Infrastructure and Telecommunications

**ESPRIT**

International Habitation Module  
**I-HAB**

> 50% of the modules

YOU ARE HERE

Artemis I	2022	ESM-1	Uncrewed flight test
Artemis II	2024	ESM-2	Crewed flight test
Artemis III	2025	ESM-3	Moon landing
Artemis IV	2027	ESM-4	I-HAB delivered to Gateway
Artemis V	2028	ESM-5	ESPRIT delivered to Gateway
Artemis VI	2029	ESM-6	

3 ESA astronauts flight opportunities to Gateway

...

...

...

...



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## PROSPECT on NASA CLPS

Package for Resource Observation and in-Situ Prospecting for Exploration,

## Commercial exploitation and transportation

### Exploration Mass Spectrometer

- EMS launch on NASA/Astrobotics Peregrine lander planned for end 2022
- EMS LUPEX MOU signed with JAXA

## PILOT-D/ LANDCAM-X

**Negative Ions at the Lunar Surface (NILS)**  
for the Chinese Chang'e 6 lunar sample return mission

## Laser Retroreflector

# BRINGING STUFF TO THE MOON



## European Large Logistics Lander

2030 – 2040 once every 2-3 years

TERRAE NOVAE 2030+



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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+**



# 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)



Earth Return Orbiter

ExoMars Rover

- Rosalind Franklin mission proposal in cooperation with NASA to be decided at CM22



→ **Discontinued**

- STA Contract signed in July 2022

Sample Fetch Rover

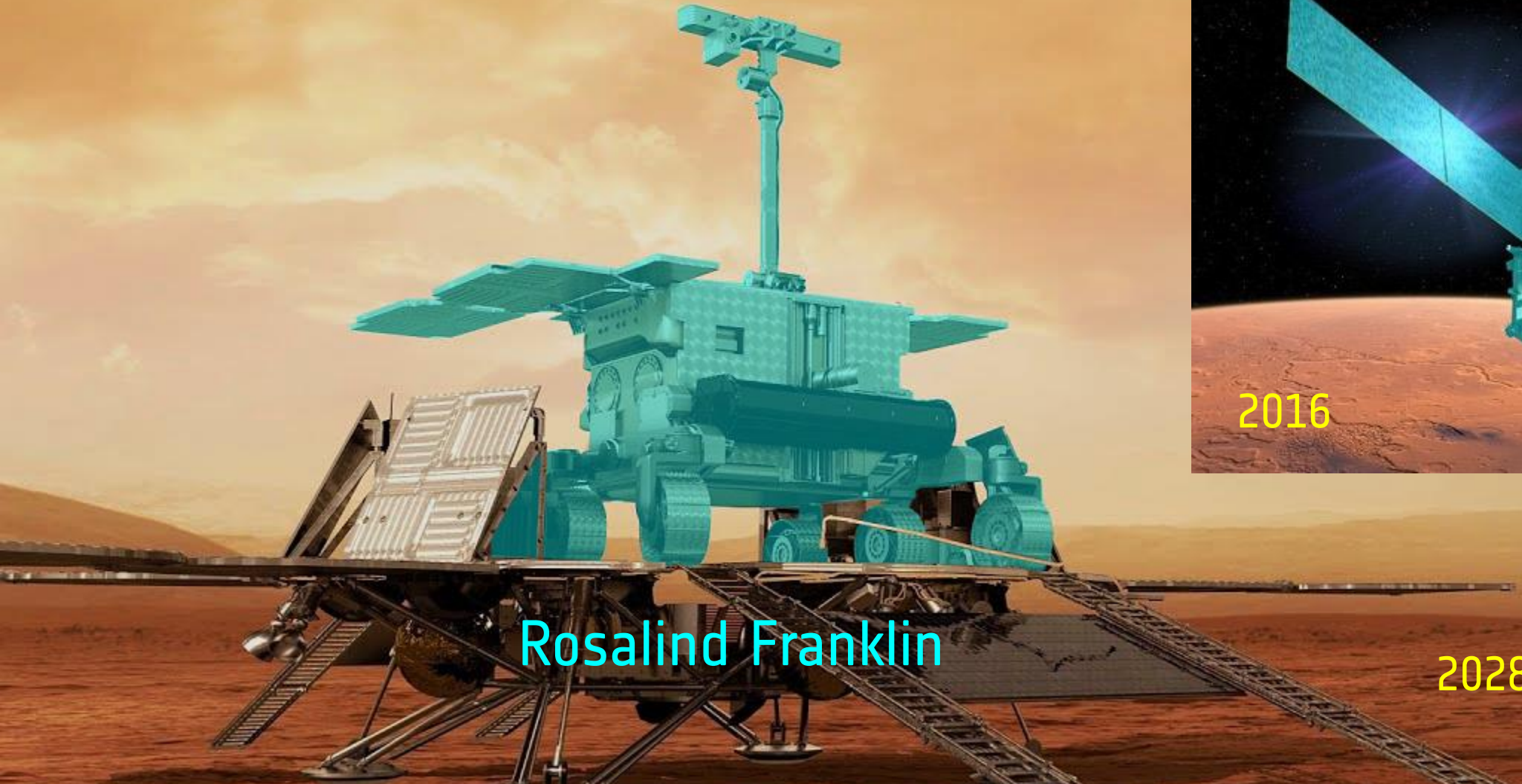


Sample Transfer Arm

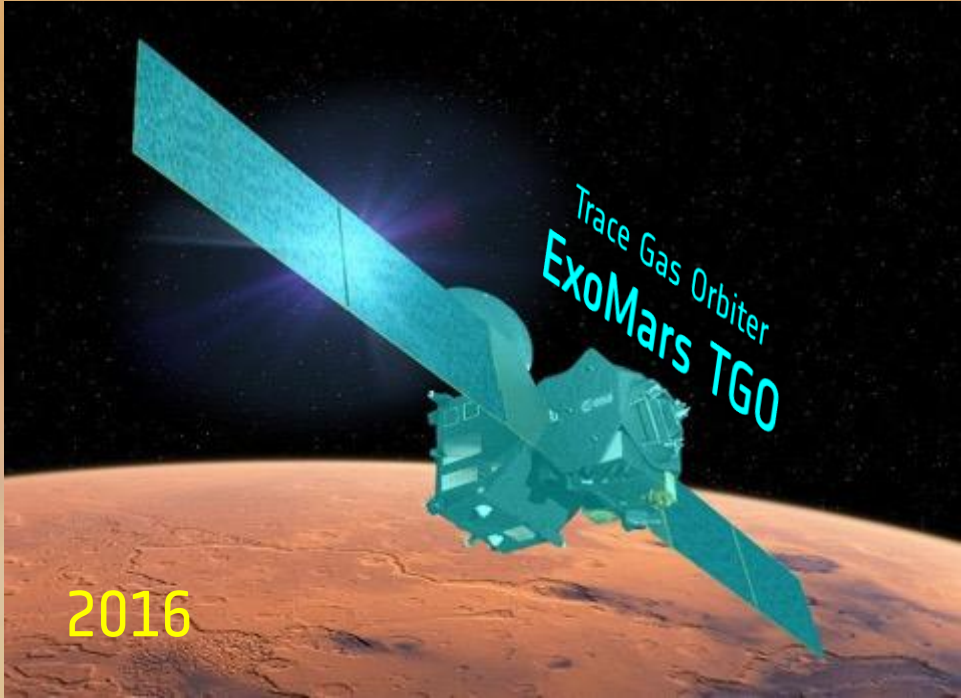


# AT THE RED PLANET

●  
YOU ARE HERE



Rosalind Franklin



2016

Trace Gas Orbiter  
ExoMars TGO

2028 (tbc)

AT THE RED PLANET



ExoMars TGO

Layered terrain in Juventae Chasma

02 October 2018

ESA / Roscosmos / TGO / CaSSIS



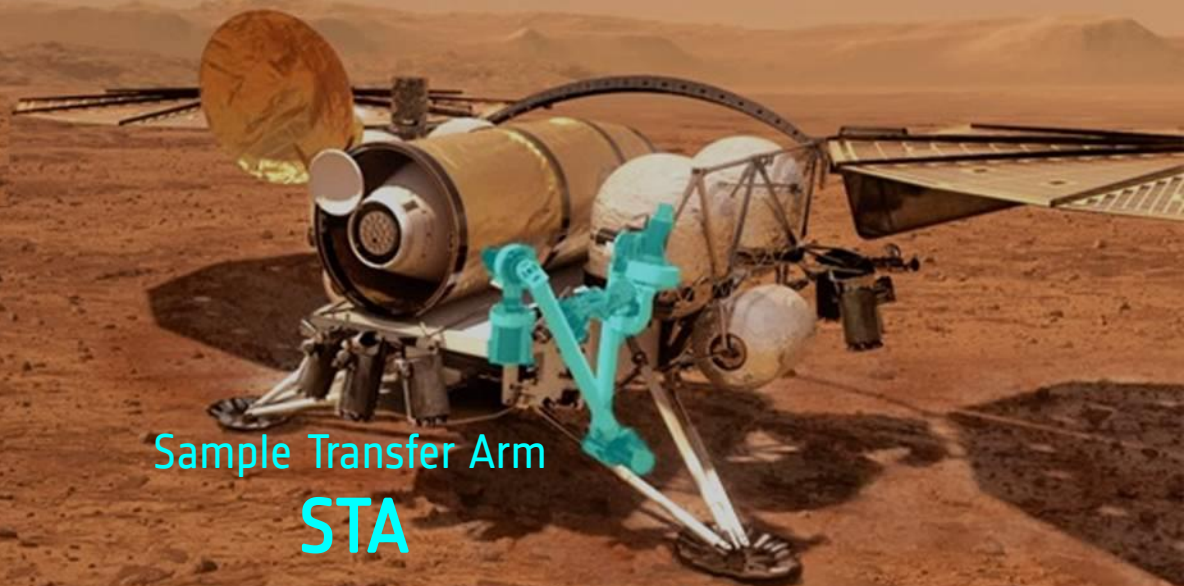
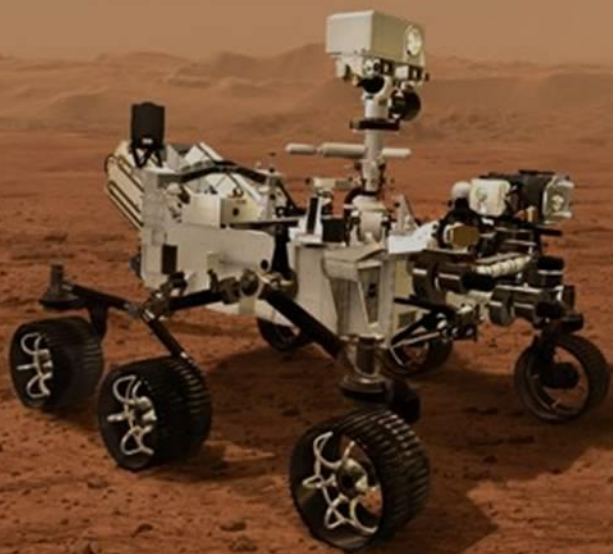
→ THE EUROPEAN SPACE AGENCY

# AT THE RED PLANET

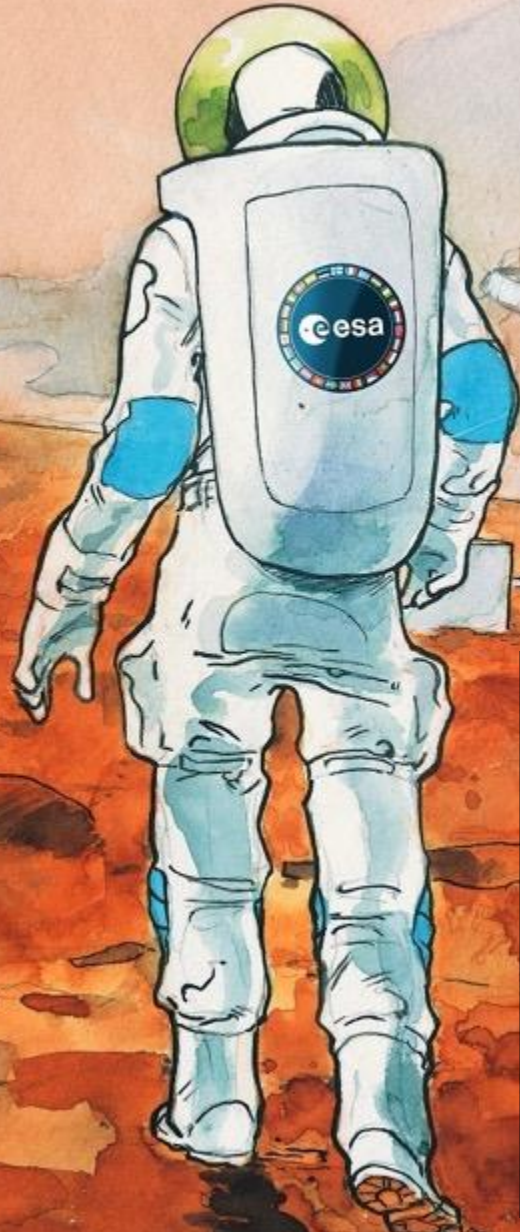
## Mars Sample Return



> 20% of the partnership



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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

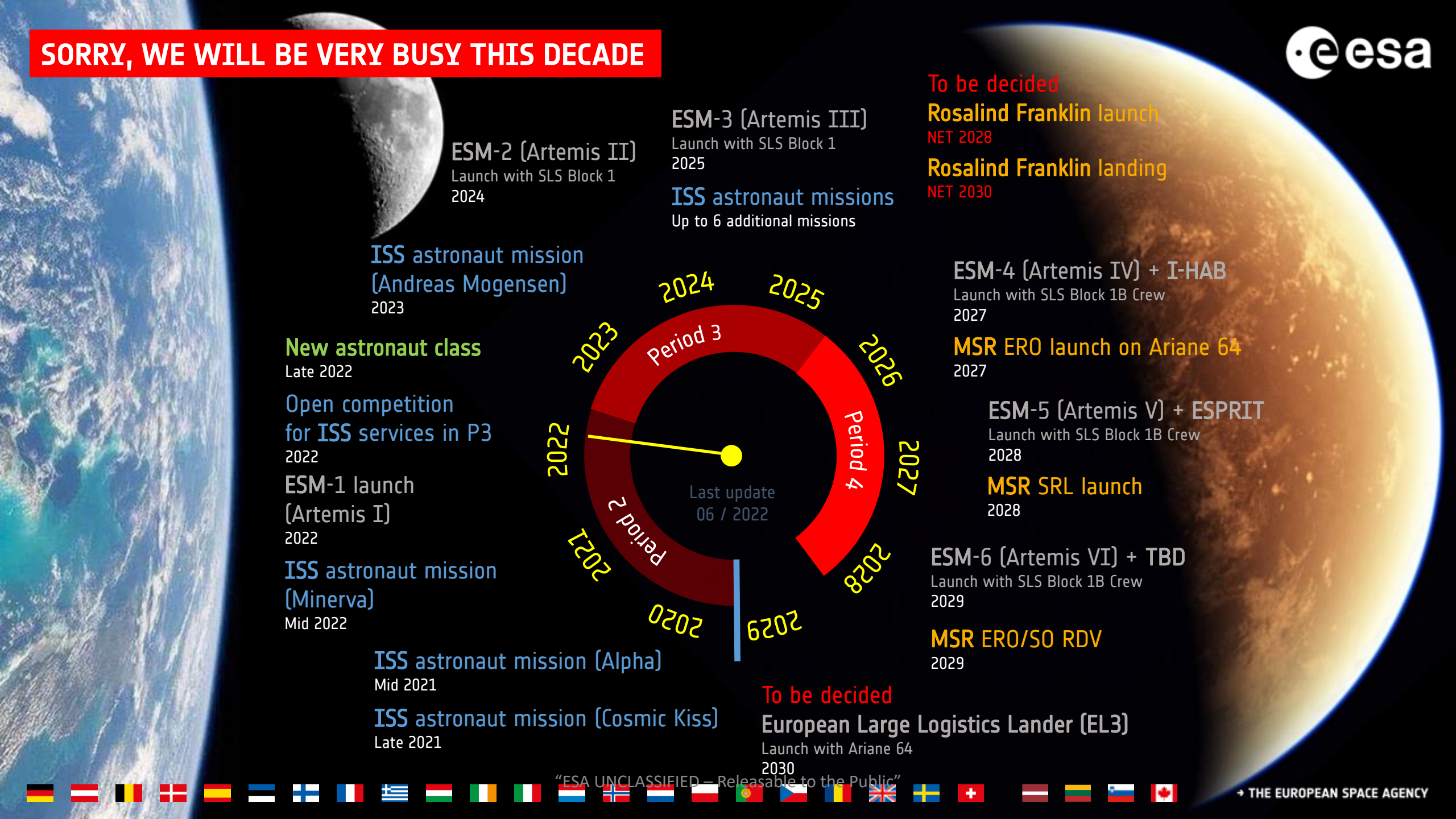
In synergy with LEO and Moon position Europe for a strong contribution to the Human journey in the 2040s

TERRAE NOVAE 2030+





# SORRY, WE WILL BE VERY BUSY THIS DECADE



**ESM-2 (Artemis II)**  
Launch with SLS Block 1  
2024

**ESM-3 (Artemis III)**  
Launch with SLS Block 1  
2025

**To be decided**  
**Rosalind Franklin launch**  
NET 2028

**Rosalind Franklin landing**  
NET 2030

**ISS astronaut mission (Andreas Mogensen)**  
2023

**ISS astronaut missions**  
Up to 6 additional missions

**ESM-4 (Artemis IV) + I-HAB**  
Launch with SLS Block 1B Crew  
2027

**New astronaut class**  
Late 2022



**MSR ERO launch on Ariane 64**  
2027

**Open competition for ISS services in P3**  
2022

**ESM-5 (Artemis V) + ESPRIT**  
Launch with SLS Block 1B Crew  
2028

**ESM-1 launch (Artemis I)**  
2022

**MSR SRL launch**  
2028

**ISS astronaut mission (Minerva)**  
Mid 2022

**ESM-6 (Artemis VI) + TBD**  
Launch with SLS Block 1B Crew  
2029

**ISS astronaut mission (Alpha)**  
Mid 2021

**MSR ERO/SO RDV**  
2029

**ISS astronaut mission (Cosmic Kiss)**  
Late 2021

**To be decided**  
**European Large Logistics Lander (EL3)**  
Launch with Ariane 64  
2030



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WE EXPLORE. YOU BENEFIT.



## Benefiting Europe

- Science and knowledge
- Economic
- Global cooperation
- Exploration preparation
- Societal & Inspirational



[youbenefit.spaceflight.esa.int](http://youbenefit.spaceflight.esa.int)

## Benefits at a glance

- Knowledge and science advancement
- Green and digital commercialisation
- Competitiveness maximises quality and innovation factors

91%

Benefits Realisation Performance  
assessed in 2021



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# Strategy roadmap



2020 > 2030

ESA in mutual inter-dependence



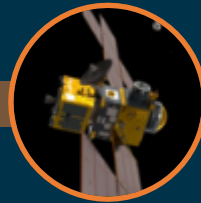
ExoMars  
2016



ExoMars  
2022



Mars Sample Return



Orion - European  
Service Module



Gateway – permanent  
habitation in deep  
space



Core ISS  
Partner



Post-ISS  
Commercial stations



Preparing to send humans to Mars



Living and working on the Moon



Cargo launch  
and return



Independent  
human transport

**EUROPEAN AMBITION**



An ambitious perspective  
for the current and next generations

**TERRAE NOVAE 2030+**



Once explorers, always explorers.



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