Mission Status Update

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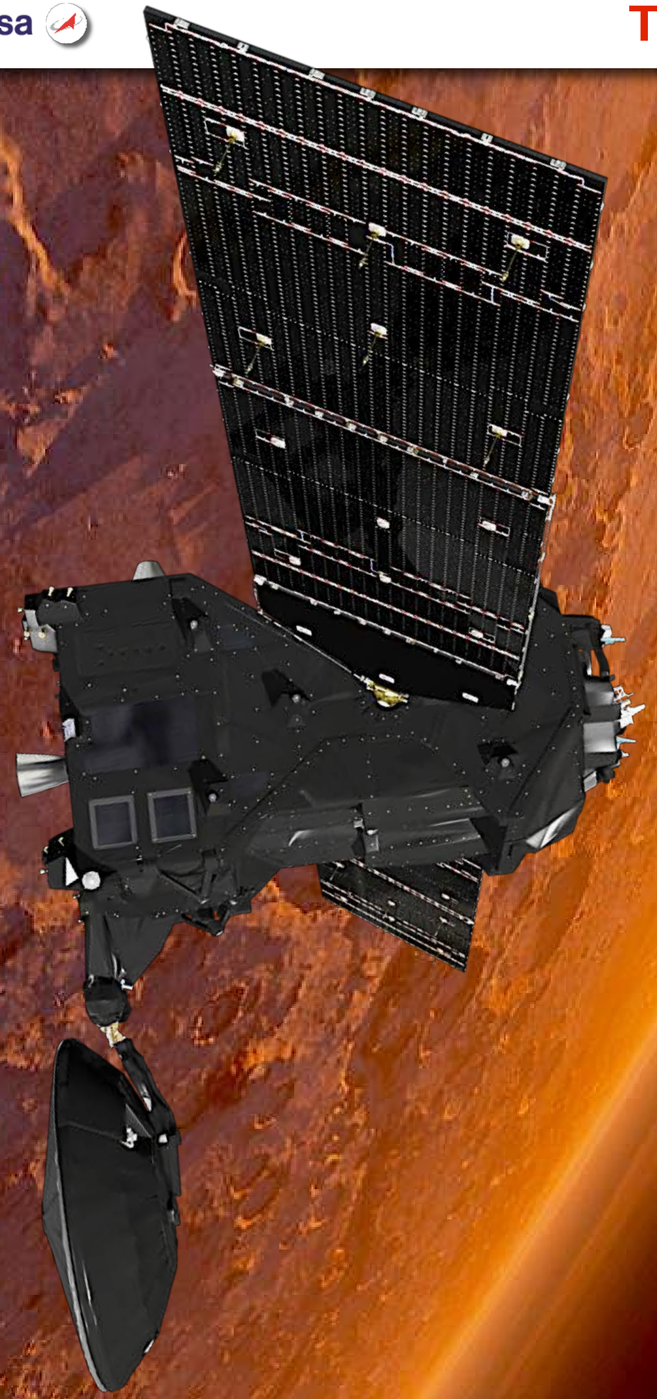
ExoMars project and ExoMars science working teams

MEPAG #38 Telecon
17 Apr 2020

TGO Status



The spacecraft is healthy.

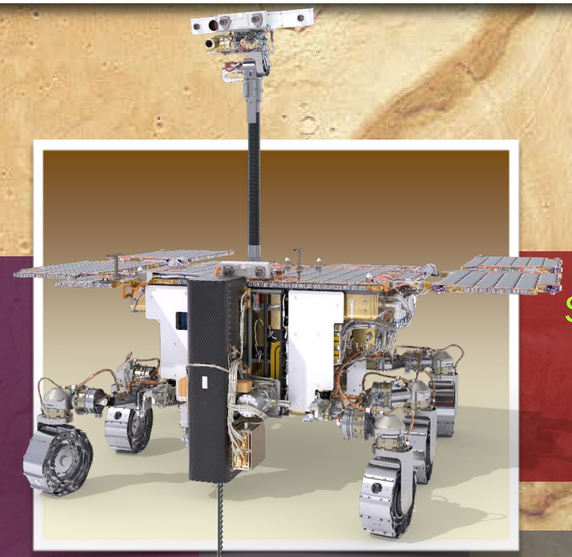
All instruments are working well, with the exception of the ACS TIRVIM channel, whose cryocooler can no longer bring the IR detector to working temperature.

Normal operations started again on 11 Apr 2020.

2022 Mission Objectives

E X O M A R S

2022



SCIENTIFIC OBJECTIVES

- To search for signs of past and present life on Mars;
- To investigate the water/subsurface environment as a function of depth.

TECHNOLOGY OBJECTIVES

- Surface mobility with a rover (having several kilometres range);
- Access to the subsurface to collect samples (with a drill, down to 2-m depth);
- Sample acquisition, preparation, distribution, and analysis.

- To characterise the surface environment.

- Throttled braking engines for planetary landing;
- Russian deep-space communications stations working in combination with ESA's ESTRACK.

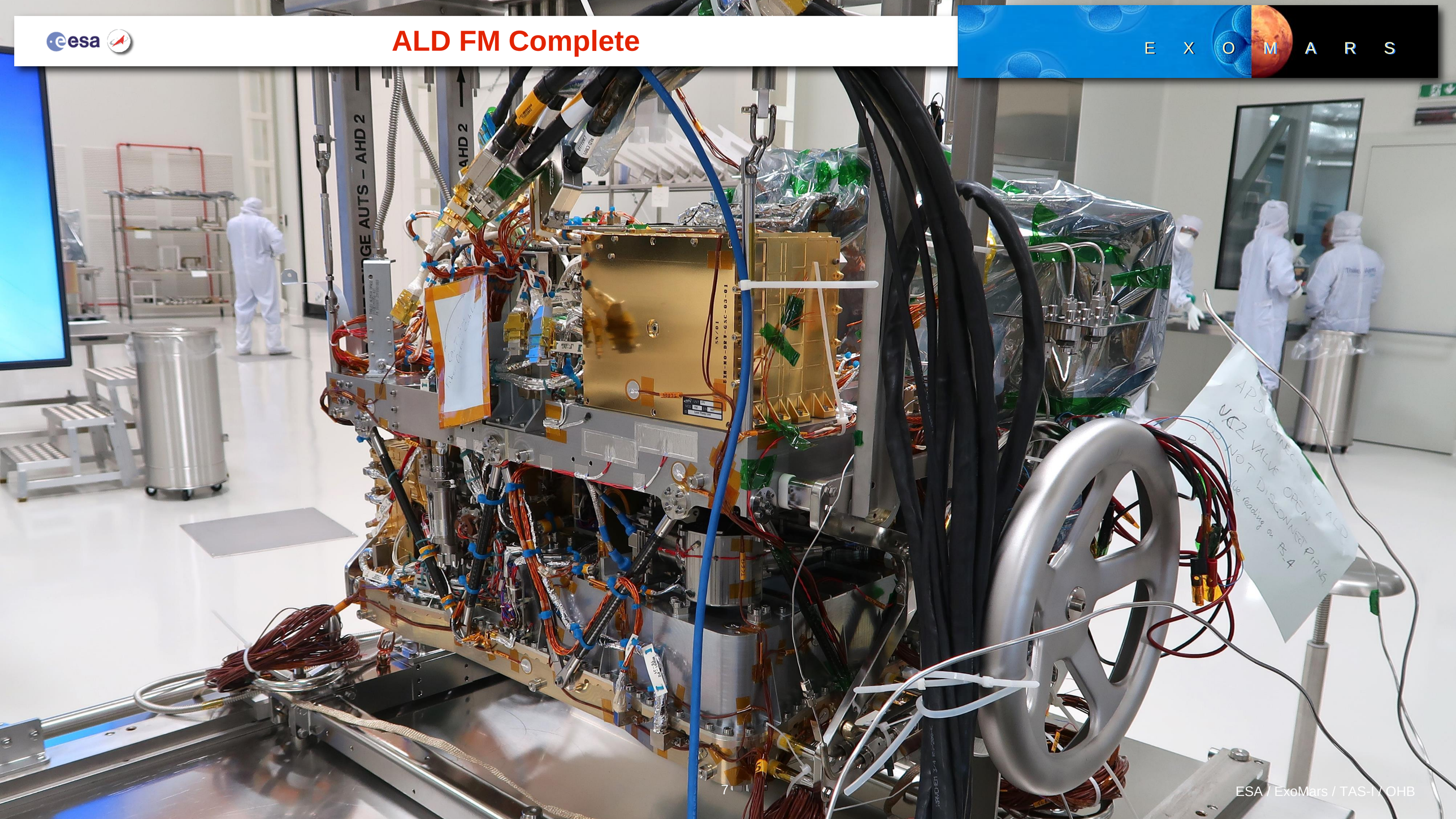
Mamers Valles, ESA / MEX / HRSC

Analytical Laboratory Drawer

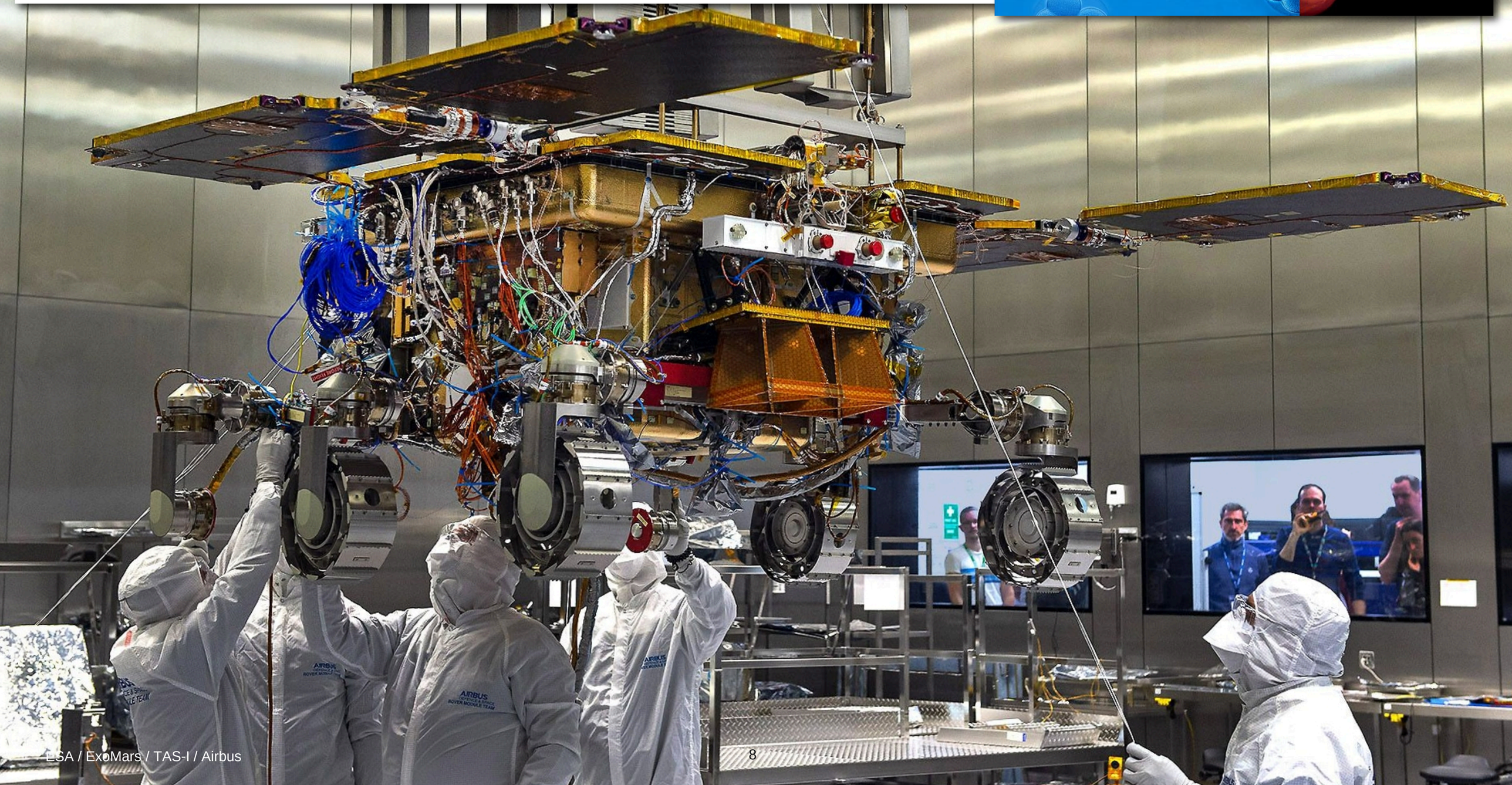
Refillable Container

ALD FM Ultra Clean Zone

ALD FM Complete

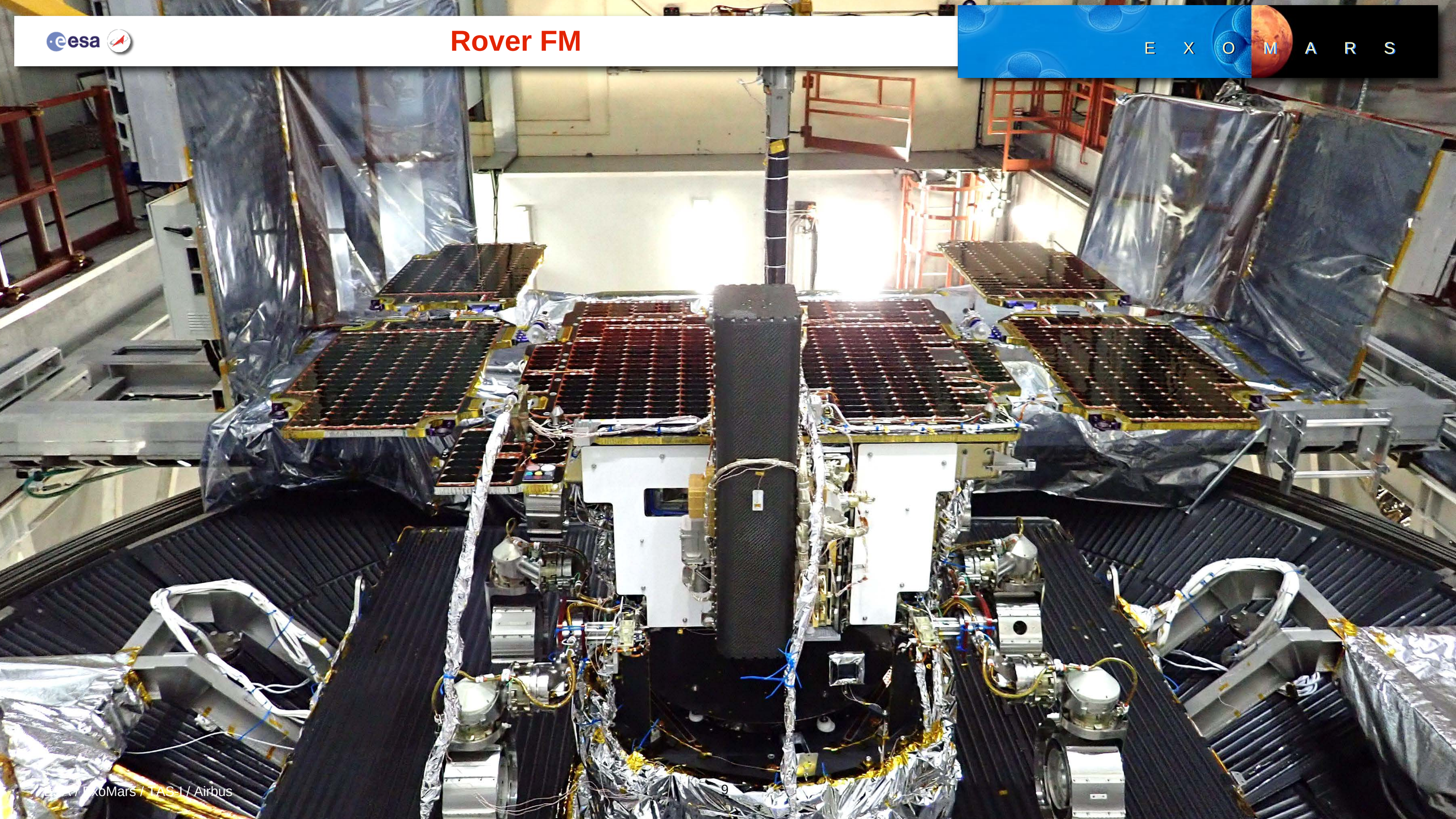


Rover FM

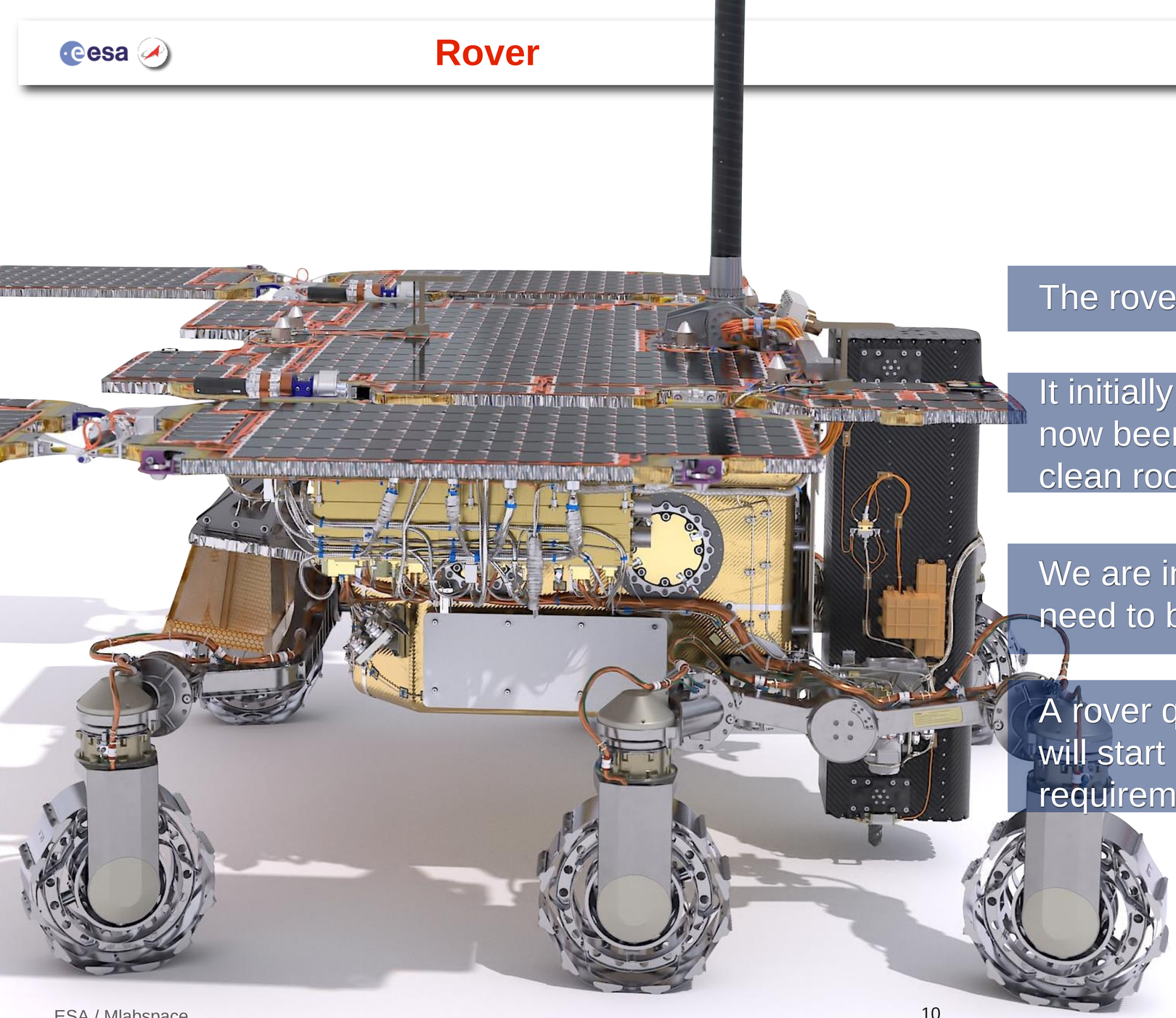


ESA / ExoMars / TAS-I / Airbus

Rover FM



Rover



The rover arrived at TAS-I on 20 Mar 2020.

It initially remained stored in its container. It has now been unpacked and installed in the ISO 7 clean room.

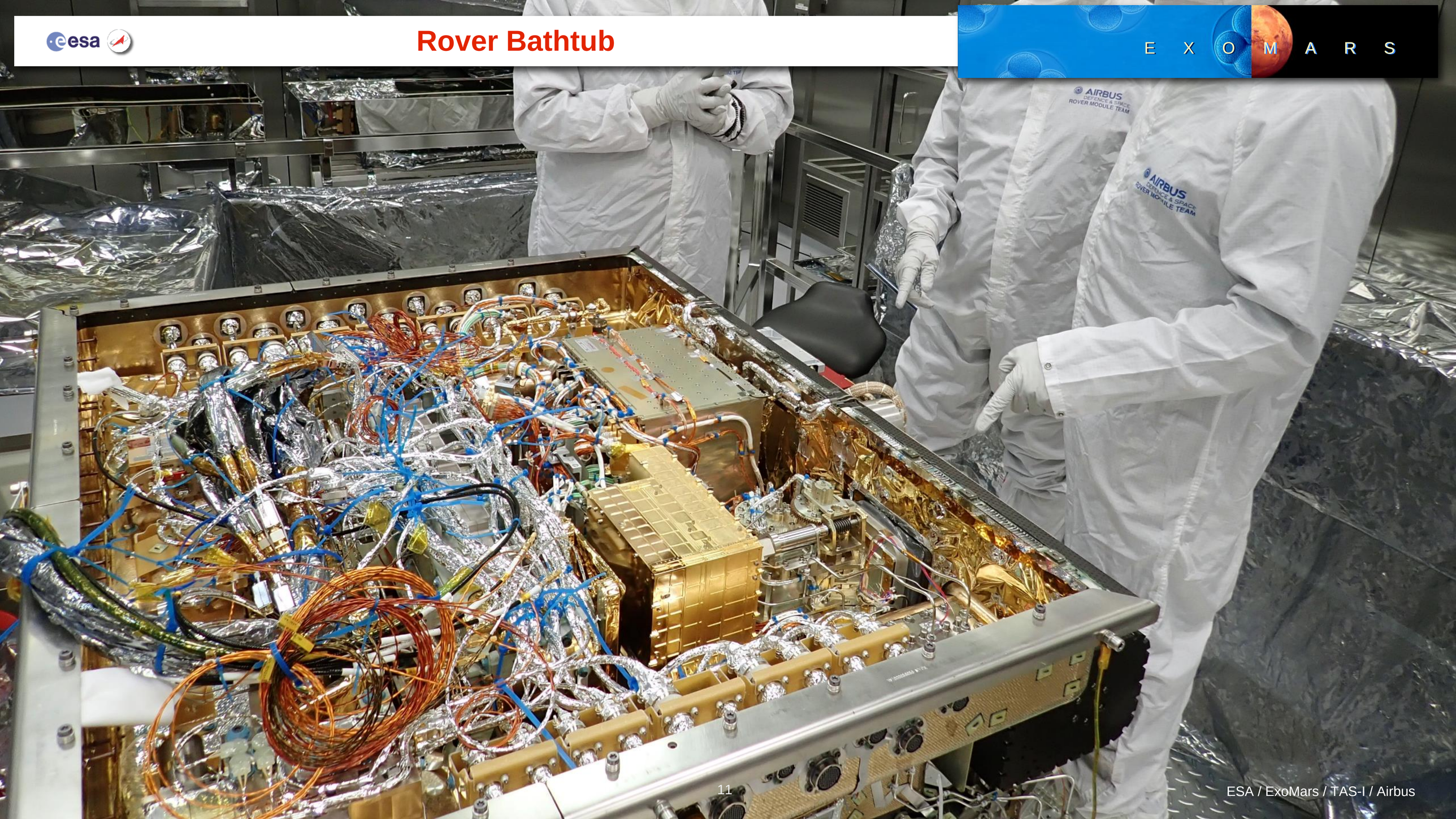
We are in the process of evaluating what items need to be maintained, replaced, or repaired.

A rover qualification acceptance review (QAR) will start soon to assess the verification of requirements.

ESA / Mlabspace

Rover locomotion system, TAS-I / Airbus / MDA

Rover Bathtub



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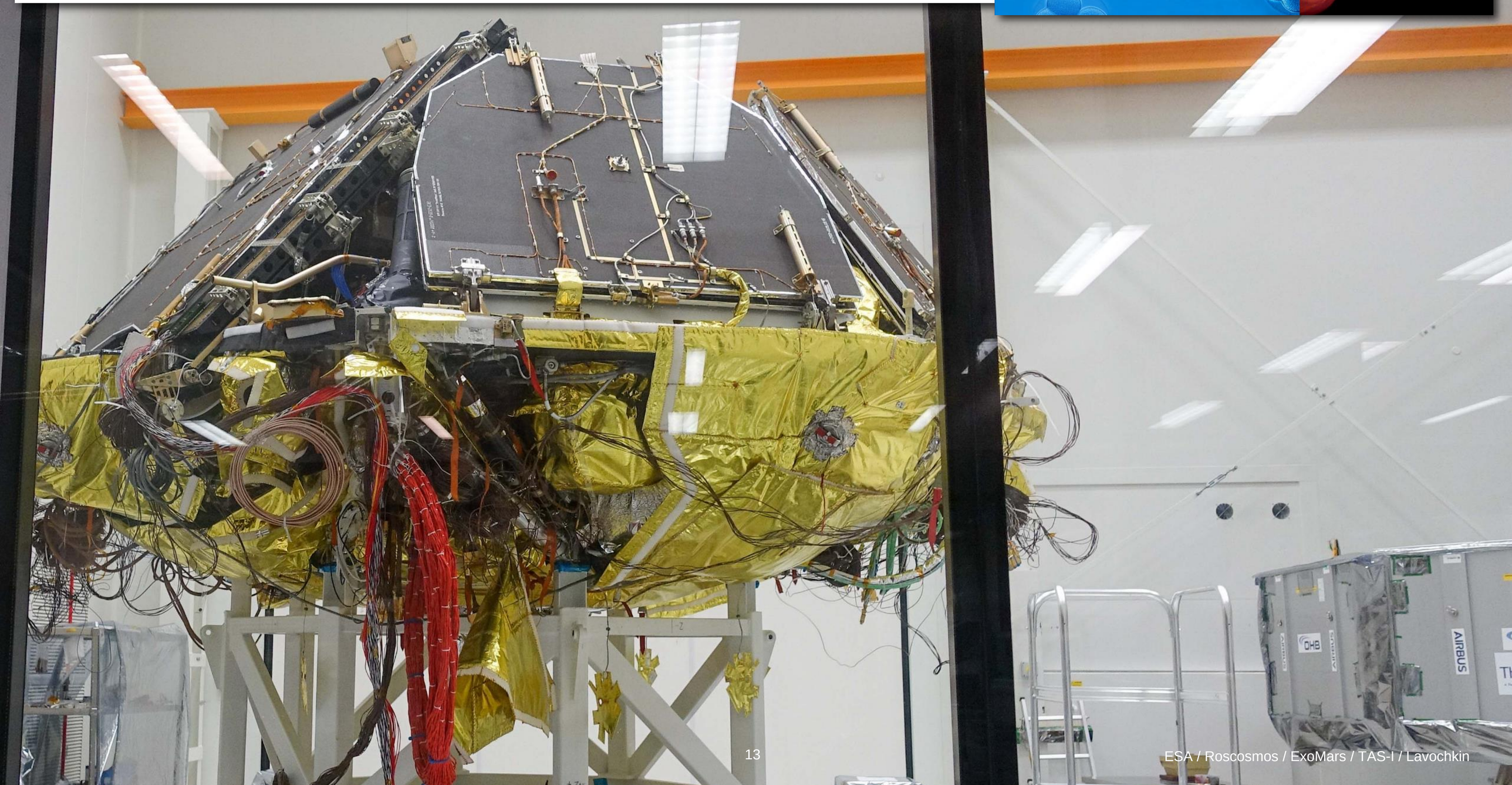
Carrier Module FM

Descent Module FM



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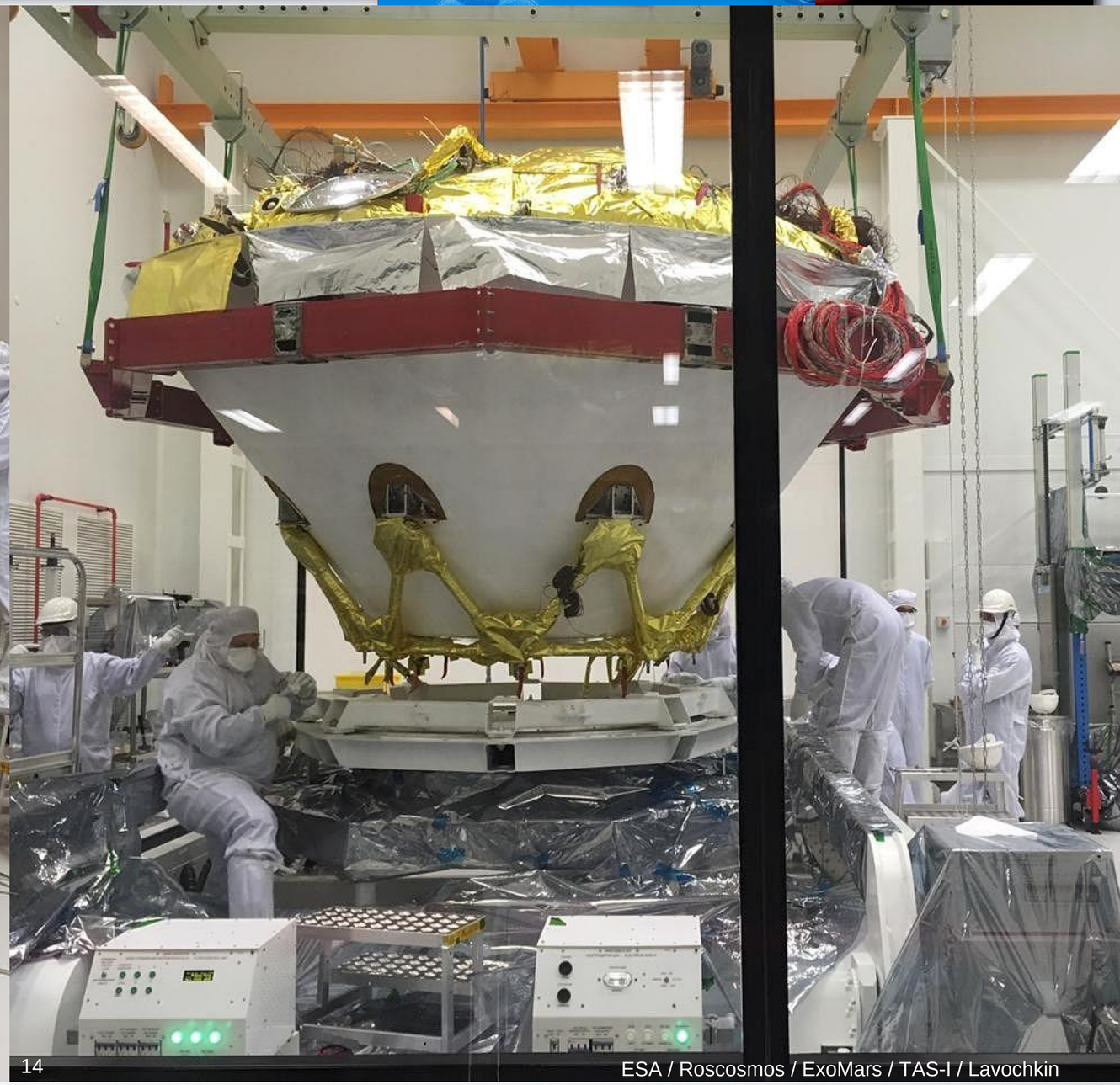
Descent Module FM



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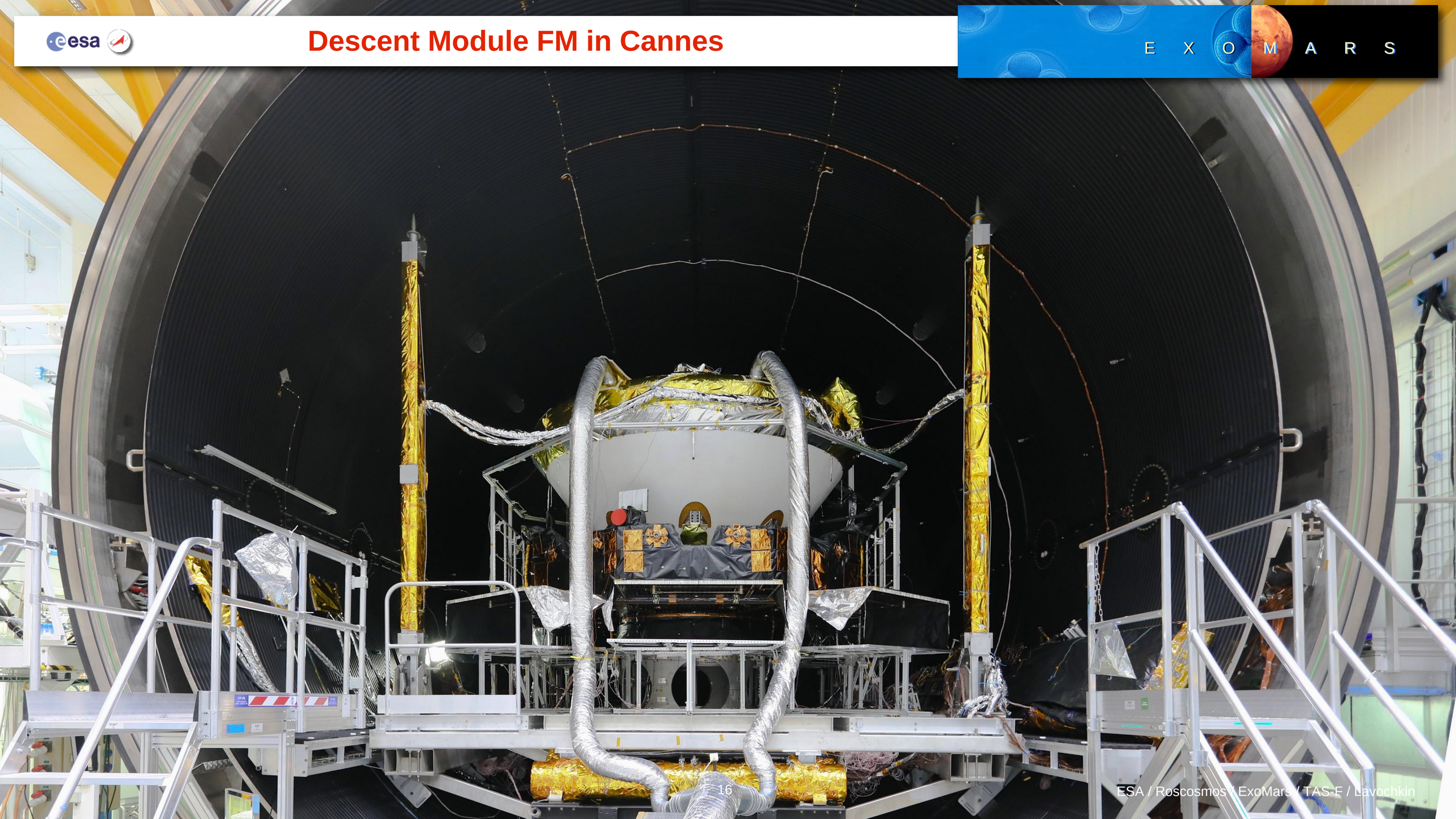
Spacecraft Composite

The project team is working on the statement of work (SOW) for the delta work to make 2022.

On 8 Apr 2020, the spacecraft arrived from Cannes (FR) to Torino (IT) in an Antonov.

ESA / Roscosmos / ExoMars / TAS-I / Lavochkin

Descent Module FM in Cannes



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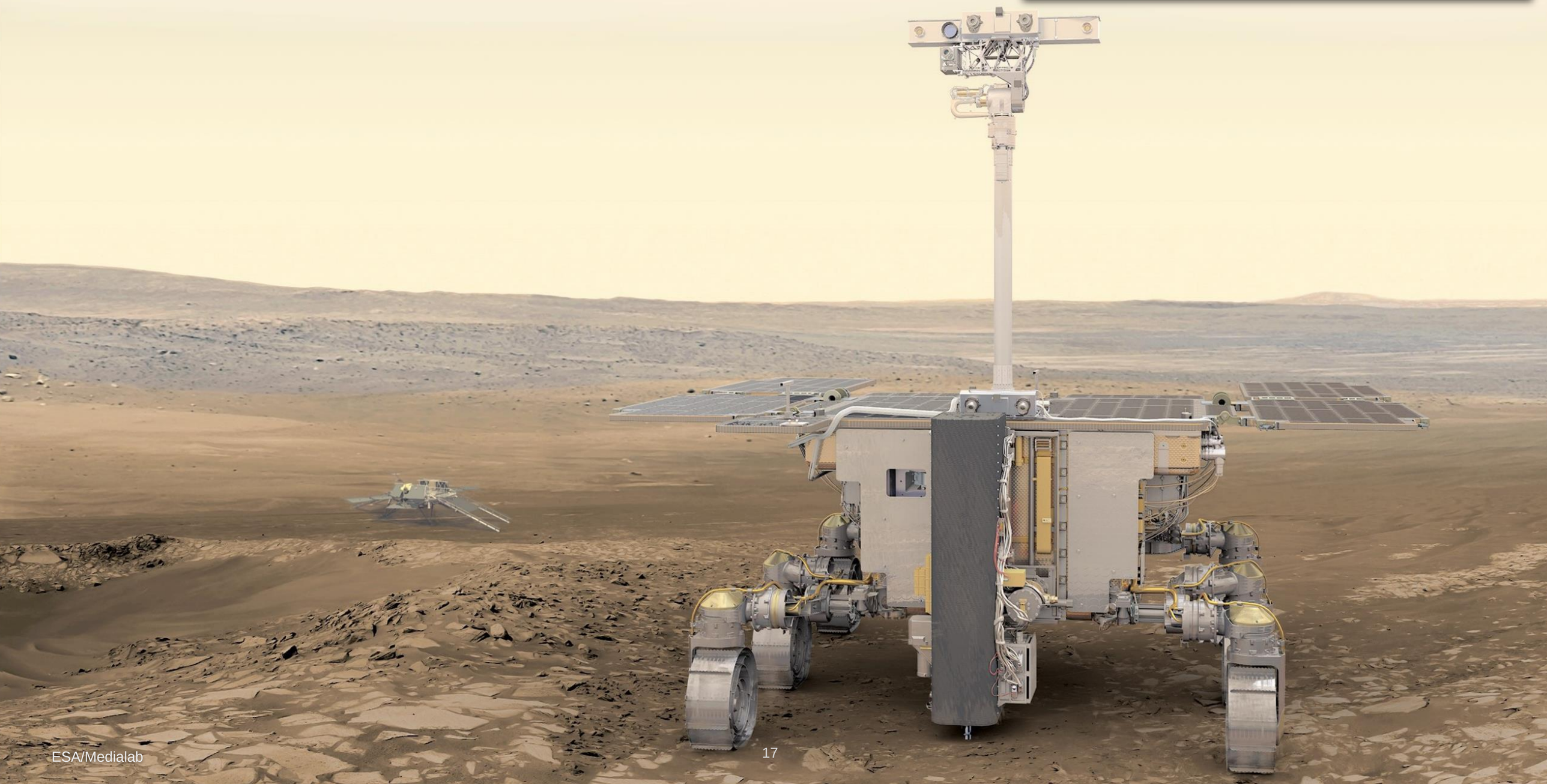
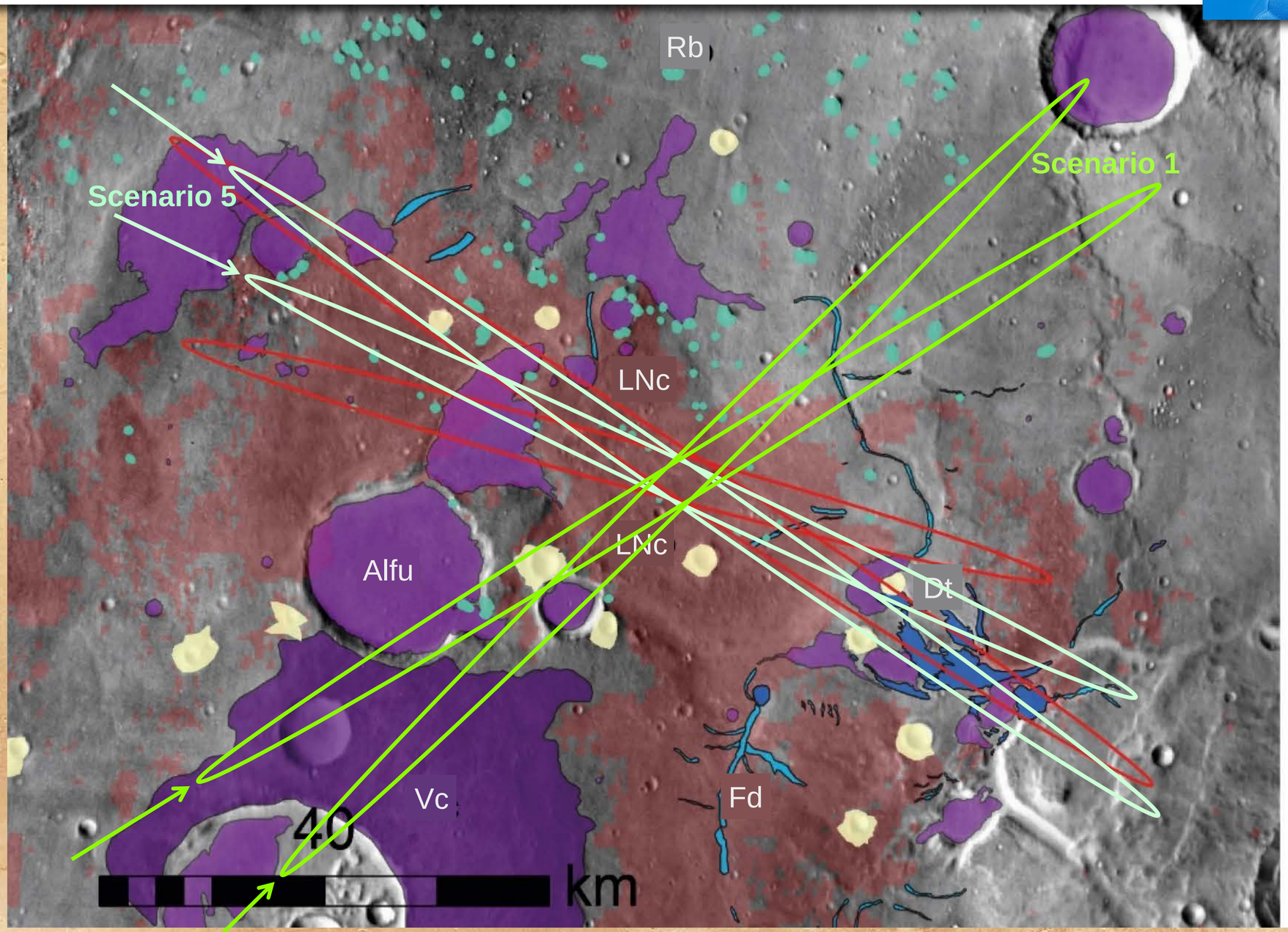
Progress on Trajectory and Landing



ESA/Medialab

Some 2022 Landing Ellipses



ExoMars 2020 dispersion ellipse

Fresh craters

Alfu = Amazonian lava flow unit

Rb = Rounded buttes

Fd = Fluvial deposits

Dd = Deltaic deposits

Vc = Volcanic complex

LNc = Layered Noachian clays

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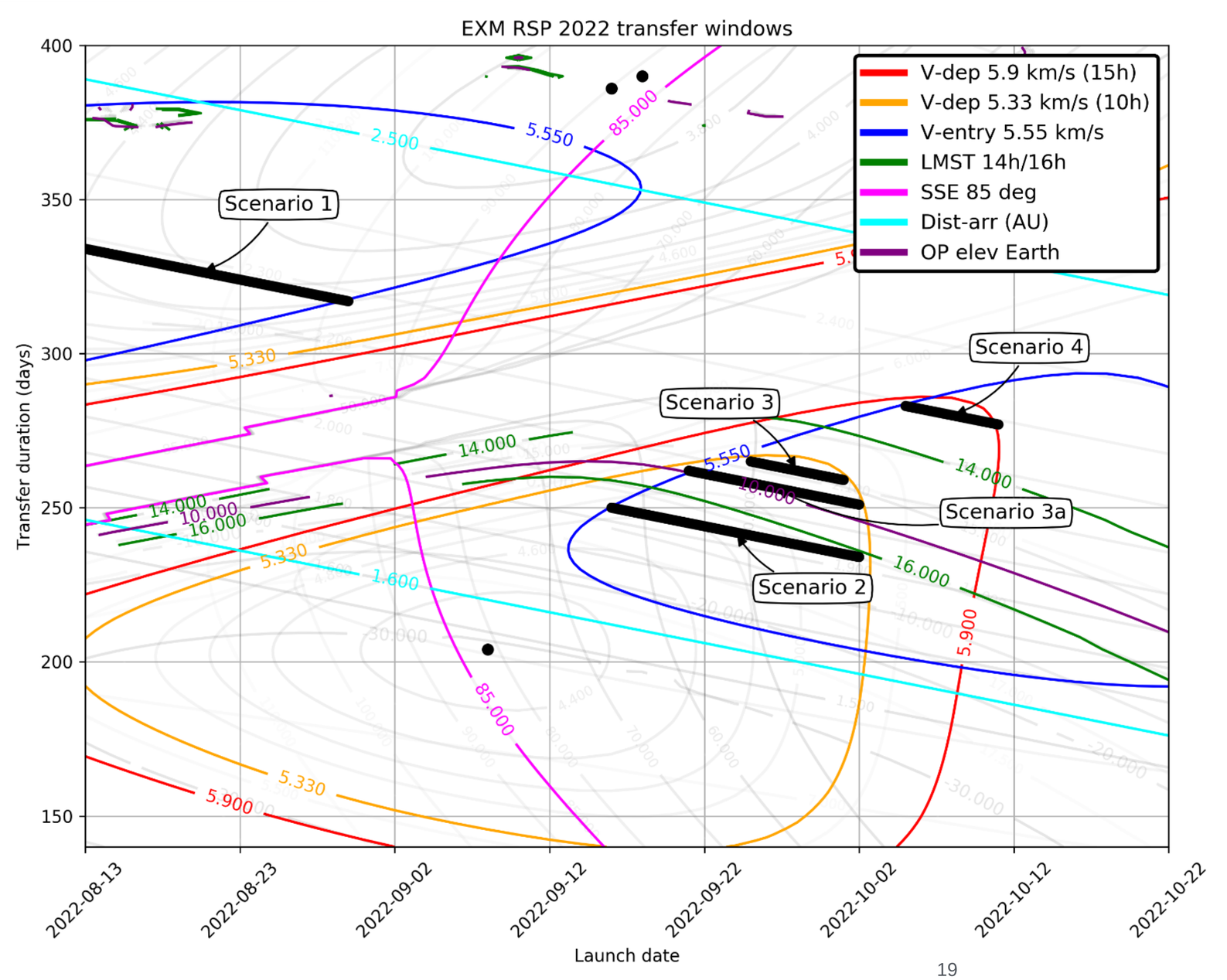
2022 Trajectory Analysis



Yellow line: Max launch escape velocity for a 10-hr injection phase.

Red line: Max launch escape velocity for a 15-hr injection phase.

Purple line: Max entry velocity 5.5 km/s.

Green line: Touchdown local mean solar time (LMST).

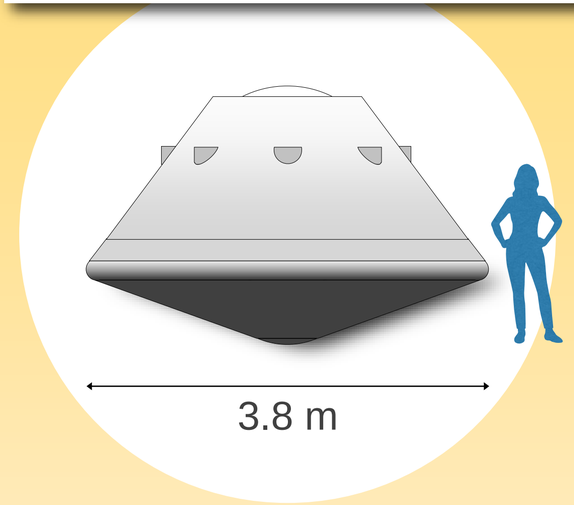
Remarks:

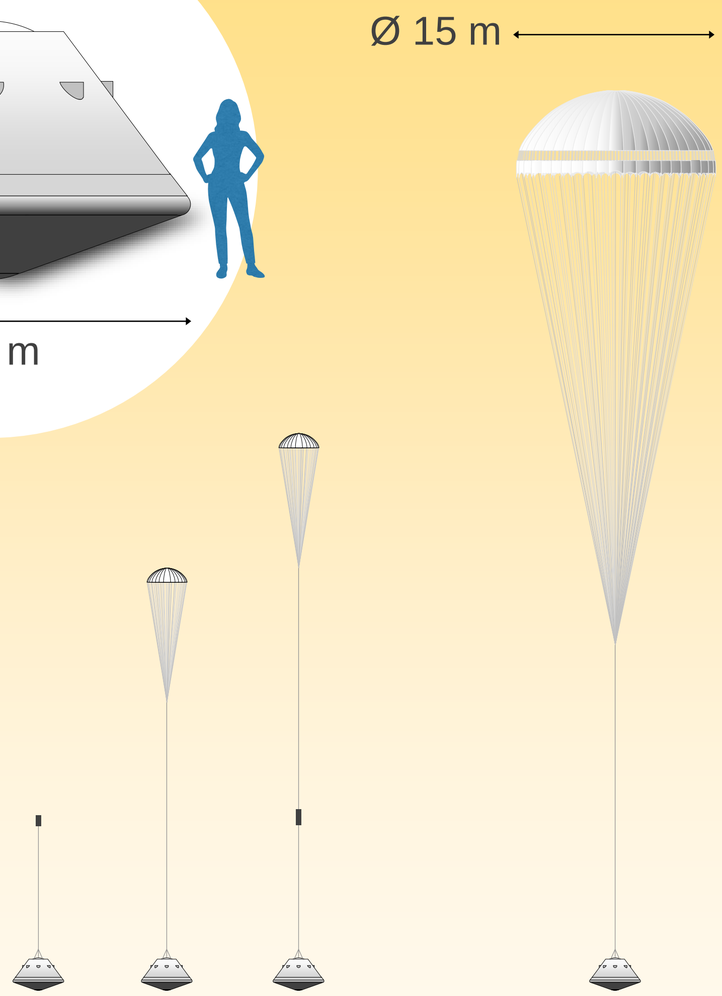
- For T1, the sooner in the day we land, the longer the cruise.
- For T1, the intersection between yellow and purple defines the allowable zone.

2022 Trajectories

Case	Scenario 1 (T2)	Scenario 2 (T1)	Scenario 3 (T1)	Scenario 3a (T1)	Notes
Launch	11 Aug – 30 Aug 2022	16 Sep – 2 Oct 2022	25 Sep – 1 Oct 2022	21 Sep – 2 Oct 2022	
Arrival	13 Jul 2023	24 May 2023	17 Jun 2023	10 Jun 2023	
Transfer duration	11.5 months	~8 months	~8.5 months	~8.5 months	Scenario 1: TBC by Industry if transfer duration is acceptable.
Launch window with current committed launcher performance	15 days	17 days	6 days	12 days	Launch window can only cover weather effects. Any failures must be adjusted on launch pad because roll off-on takes 14 days; otherwise we would need 25 days.
Assumed launched mass	2900kg	2900kg	2900kg	2900kg	Might be relaxed to 28xx kg (TBC).
Escape sequence duration	4.5 h	10h	10h	10h	Scenarios 2, 3, 3a require increase of escape sequence duration. (OK for TAS-I/ESA but needs detailed cyclogram by KhSC).
Escape velocity	< 4.45 km/s	< 5.33 km/s	< 5.33 km/s	< 5.33 km/s	
Launcher compatible	Yes	Yes	Yes	Yes	
Launcher inclination	65 deg	65 deg	65 deg	65 deg	
Eclipse duration	< 20 min	TBD	TBD	TBD	Scenarios 2, 3, 3a: Eclipse duration analysis requires detailed cyclogram by KhSC).
Initial station visibility	Poor (good from Usuda)	TBD	TBD	TBD	Scenario 1 needs tracking station at Japan longitudes for first acquisition.
Initial Sun-SC-Earth angle	100 - 120 deg	< 85 deg	< 85 deg	< 85 deg	Scenario 1 has consequences on SCC attitude at launcher separation and on survival mode attitude (feasibility TBC by Industry).
Earth-SC distance at arrival	2.3 AU	1.9	2.1	2.06	All scenarios: TBC data rates at max distance (70-m DSN mandatory).
Delta-V	Only TCM	Only TCM	Only TCM	Only TCM	
Solar conjunction in cruise	No	No	No	No	
Entry velocity	< 5.55 km/s	< 5.55 km/s	< 5.55 km/s	< 5.55 km/s	
Local time at landing	13:00 – 14:00	16:30	15:00	15:30	Scenario 3, 3a: SP energy is marginal. First night must be in “low power” mode. Scenario 2: Lander energy budget is VERY marginal.
Landing azimuth	45-58 deg	TBC, similar to 2020	TBC, similar to 2020	TBC, similar to 2020	Scenario 1: Requires characterisation of landing ellipses. Scenario 2, 3, 3a: Expected to be similar to 2020 launch case (TBC by ESOC).
Landing Mars Solar Longitude	90º	68º	78º	75.5º	All scenarios atmospheric density rate to be verified.
EDL visible from Earth (elev.<10º)	Yes	No	Yes	Yes	
Nominal Rover mission (sols prior to GDS)	~179 sols (109 <SC + 33 SC + 37 <GDS)	~228 sols (158 <SC + 33 SC + 37 <GDS)	~204 sols (134 <SC + 33 SC + 37 <GDS)	~211 sols (141 <SC + 33 SC + 37 <GDS)	Scenario 1: Solar Conjunction (SC) is 3.5 months after landing. Scenario 2, 3, 3a: SC is 4–5 months after landing (more mission sols before SC).
Solar conjunction on surface (1 Nov – 4 Dec 2023)	Yes	Yes	Yes	Yes	

Parachute Deployment Sequence



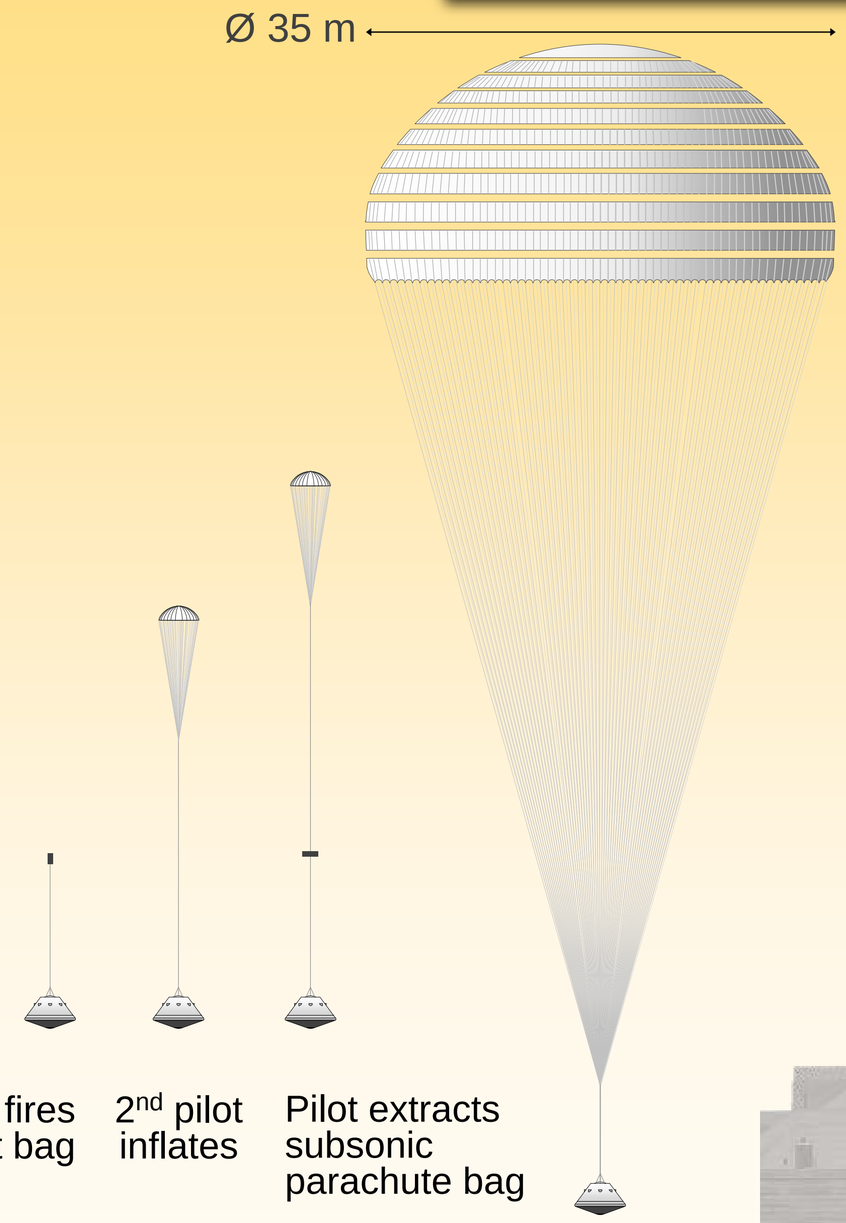


Mortar fires 1st pilot bag

1st pilot inflates

Pilot extracts supersonic parachute bag

Supersonic parachute inflates



Mortar fires 2nd pilot bag

2nd pilot inflates

Pilot extracts subsonic parachute bag