Martian Moons eXploration (MMX)

JAXA MMX Mission:

- Launch in 2024
- Phobos: remote sensing & *in situ* observation
- Deimos: remote sensing observation (multi-flyby)
- Retrieve samples (>10 g) from Phobos & return to Earth in 2029 (TBD)

THE 1ST SAMPLE RETURN MISSION FROM THE MARTIAN SATELLITES!

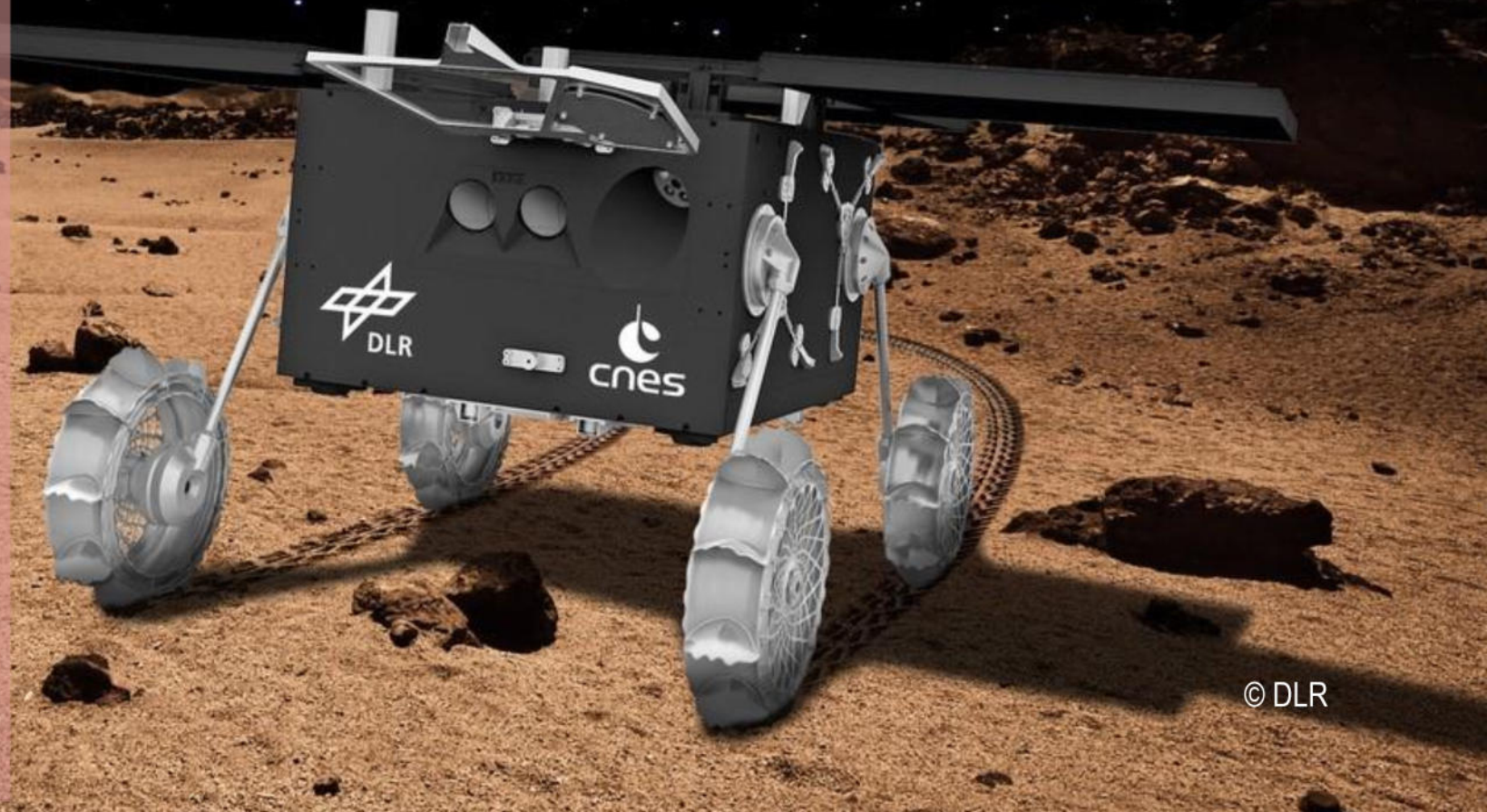
http://mmx.isas.jaxa.jp/en/

The MMX Rover is a DLR-CNES contribution to the JAXA MMX Mission to investigate Phobos and Deimos

MMX will drastically enhance our understanding of the Mars – Phobos system

The rover will provide ground truth and information on heterogeneity and physical/ dynamical properties of the surface material

It will demonstrate first time „driving“ on a low gravity body including autonomous navigation



MMX Rover Science Objective

The rover is a **scout**, a **demonstrator** and an **in-situ science investigator**

Scientific Objectives

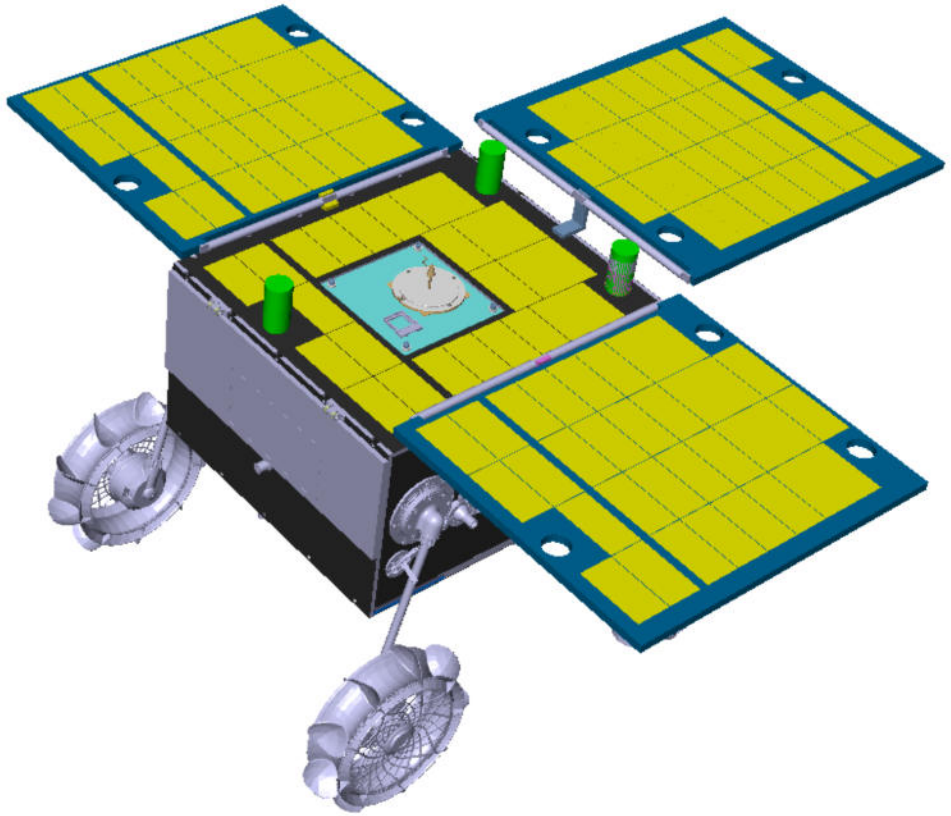
- Regolith science
  - Analyse the physical properties and behavior of the regolith of Phobos
  - Fine scale survey of the roving area
- Mineralogy of surface material
- Thermal properties
- Ground truth
  - Perform multiple in-situ measurement to enrich the interpretation of orbital survey
  - Measurement at small scale over some area to complement sample return and orbital survey
  - Learn about the heterogeneity of the surface

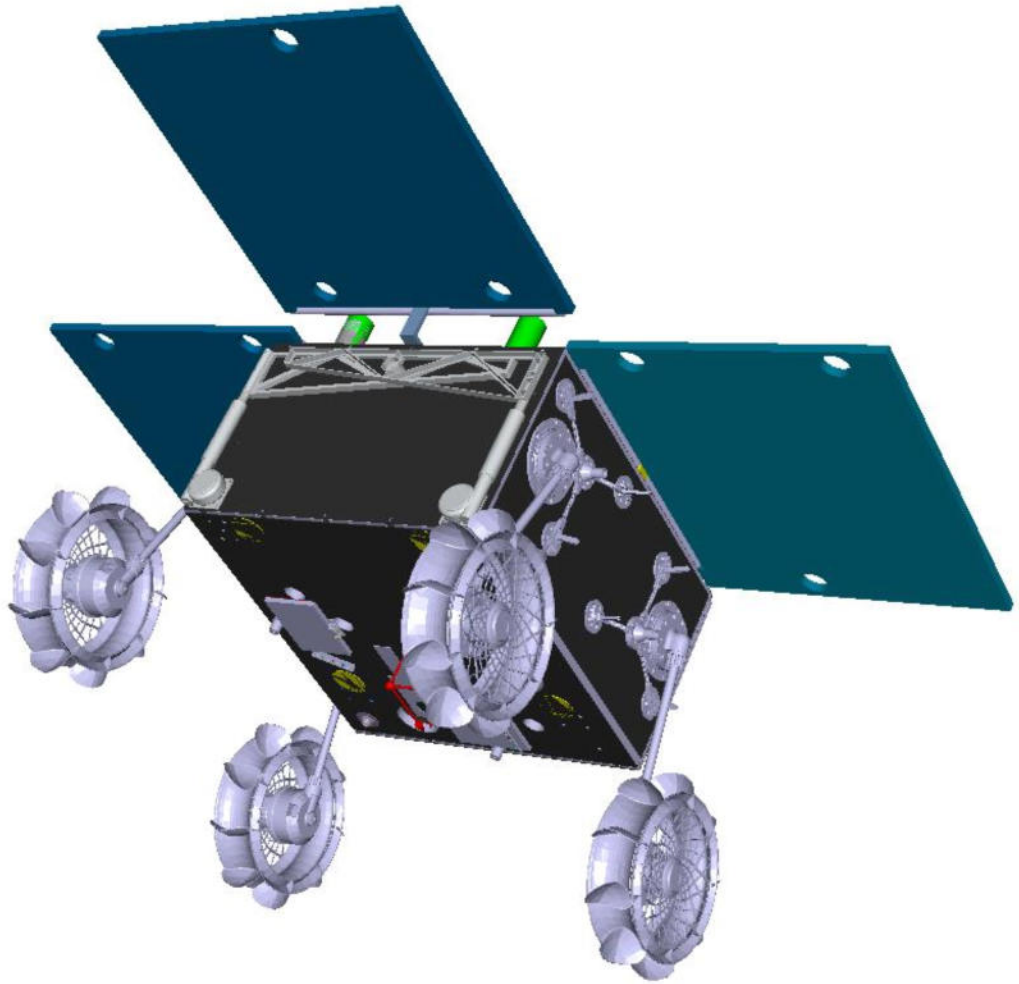
➔ Four instruments

- miniRad
  - IR radiometer
  - Characterization of the thermal properties of the regolith
- WheelCams
  - Two cameras
  - Characterize the structure and wheel-interaction of regolith
- NavCams
  - Two cameras looking to the front (stereo)
  - Observation of the soil and landscape in front of the rover, in RGB
- RAX
  - Raman spectrometer
  - Characterization of the composition of the ground material below the rover.

DLR

MMX Rover Design

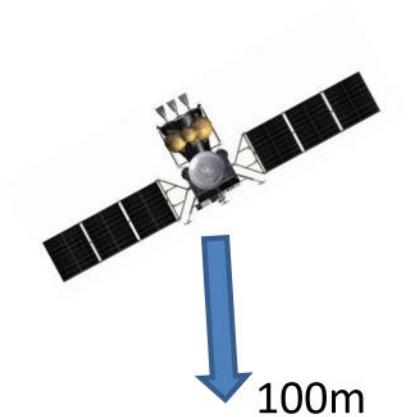




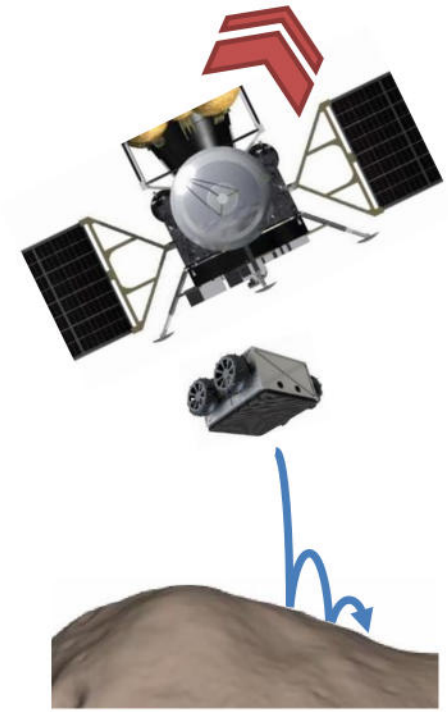
DLR

Separation- Landing – Uprighting – Deployment

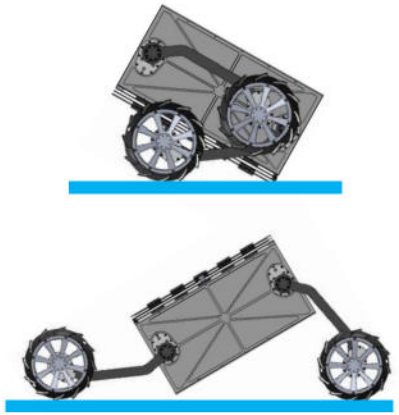
It begins some hours before separation, ends in the nominal safe position: stand on the four legs, with the solar arrays opened.

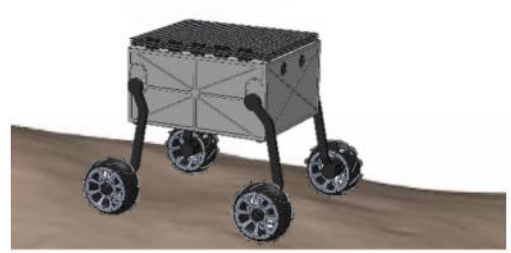


Before separation

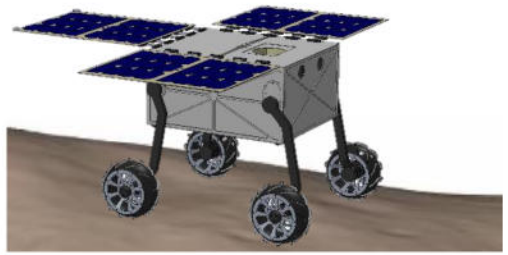


Separation falling and bouncing



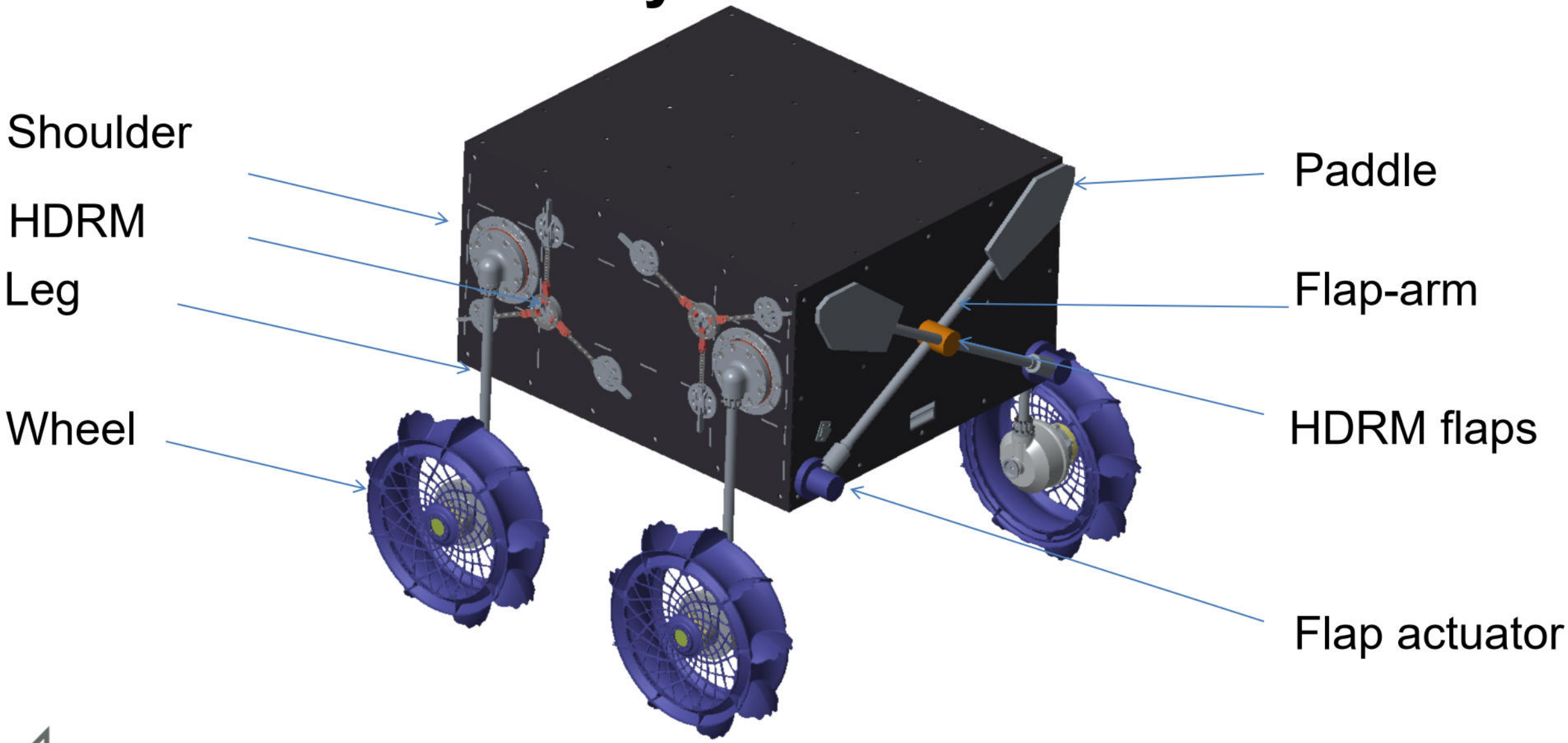


Rover up-righting

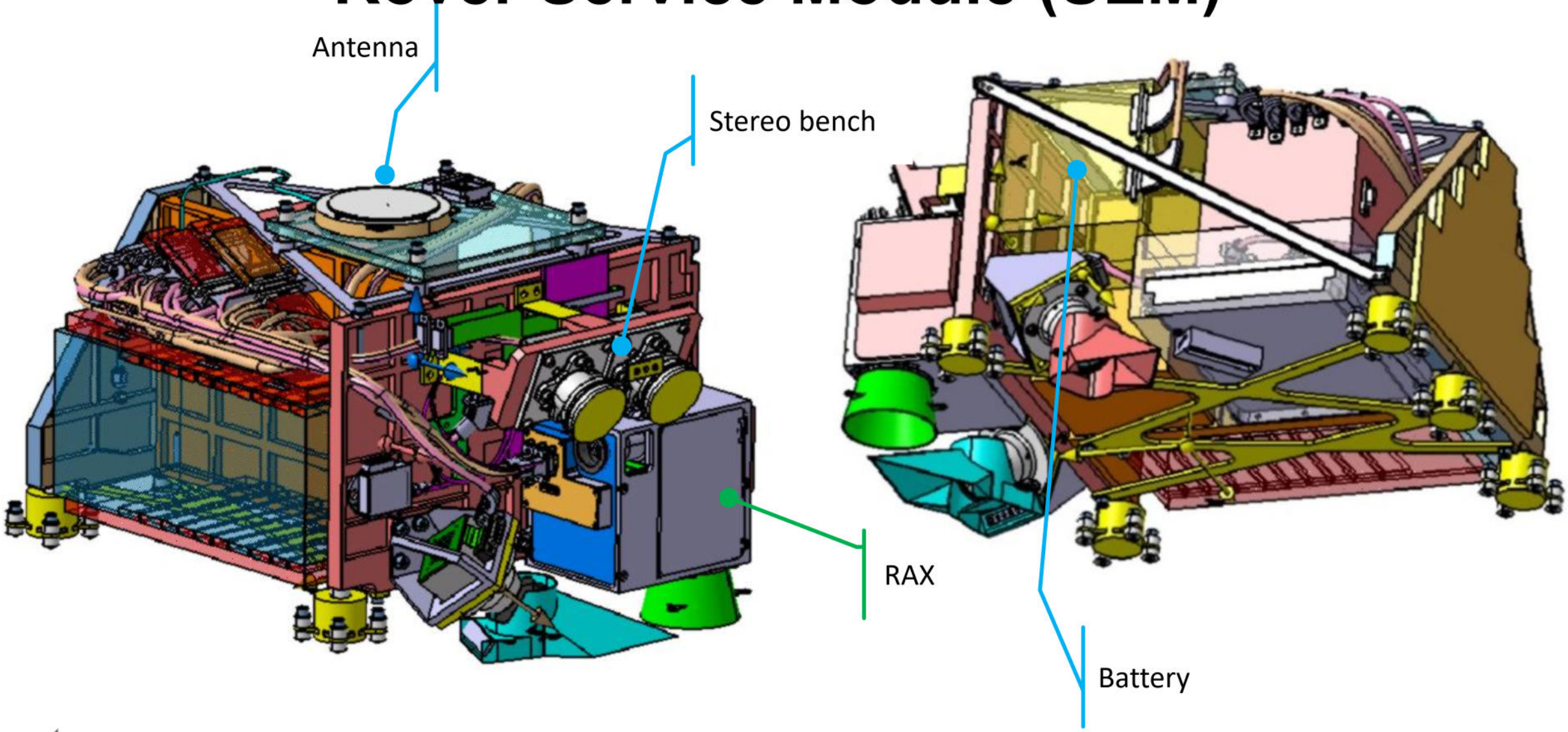


Solar panels deployed

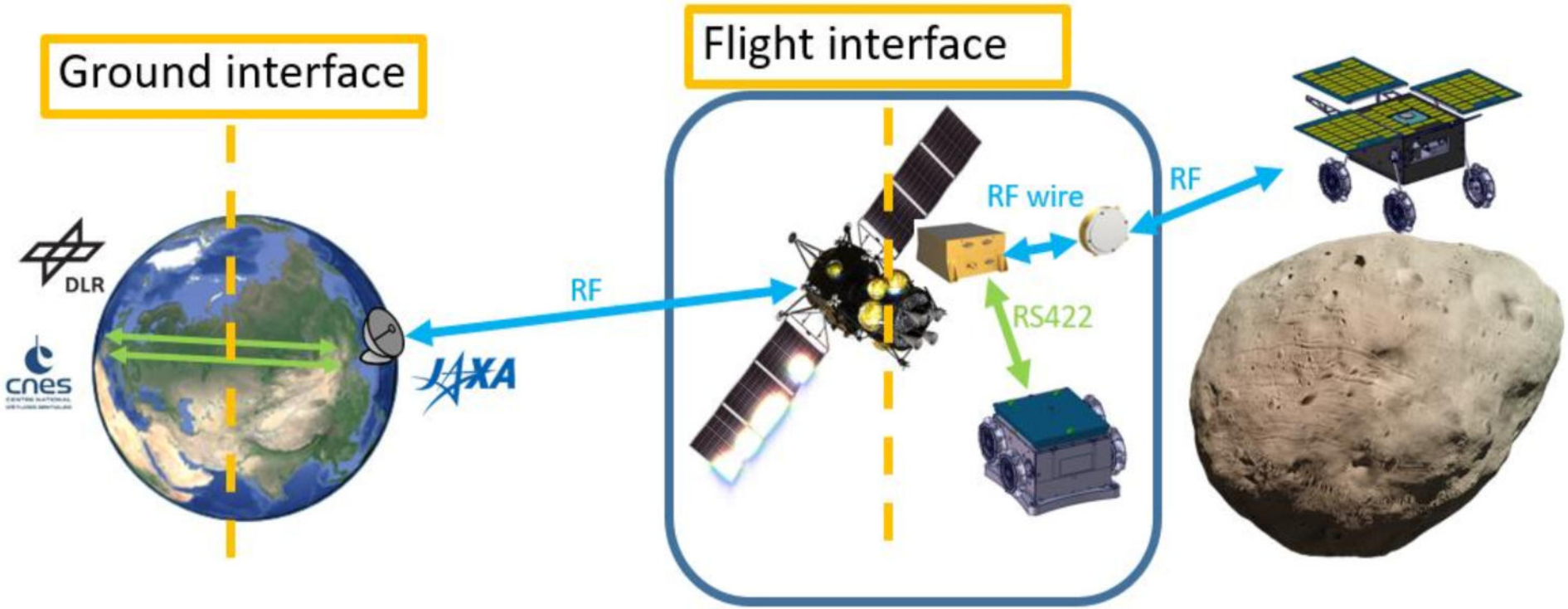
Rover Locomotion System



Rover Service Module (SEM)



Rover Communications and Ground Interaction



- Rover flight segment has 2 configurations: 1st before Rover separation and 2nd after Rover separation from the spacecraft
- In those 2 configurations, there is only one C&DH link between the spacecraft and the RolBox (no direct C&DH link between spacecraft and Rover)

Operational Sequence

- **Launch and Cruise**
  - incl. commissioning, health checks and calibration of instruments
- **Separation-Landing-Upright-Deployment (SLUD)**
  - Separation from the main spacecraft,
  - Descent, bouncing-phase
  - Quasi-autonomous up-righting and
  - solar generator deployment
- **Phobos Commissioning**
- **Phobos Operational**
  - Driving & Science
  - Life-time of >100 days
- **End of Mission**
  - “Risky maneuvers”
  - Passivation