MASTERS IN INNOVATION

Optical Systems

Creator
Developer
Manufacturer

Challenges and Applications of Compact Optics for Space Exploration

22/09/2023 – Paris, EPIC meeting

LAMBDA-X | HIGH-TECH INNOVATION

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Outline

- Introduction – Lambda-X activities
- The space environment
  - Peculiarities of the space environment
  - Constraints on the hardware (design, integration & qualifications)
- Hands-on examples – Lambda-X optics in space missions
- Conclusions

Introduction

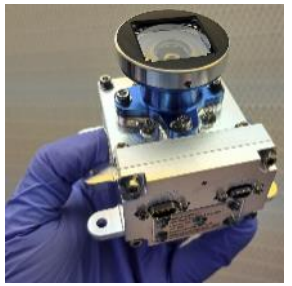
Space at Lambda-X

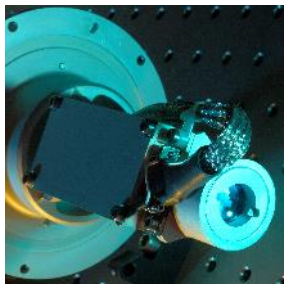

Micro-gravity experiments


In-orbit servicing


Earth observation


Space exploration





The constraints on the hardware

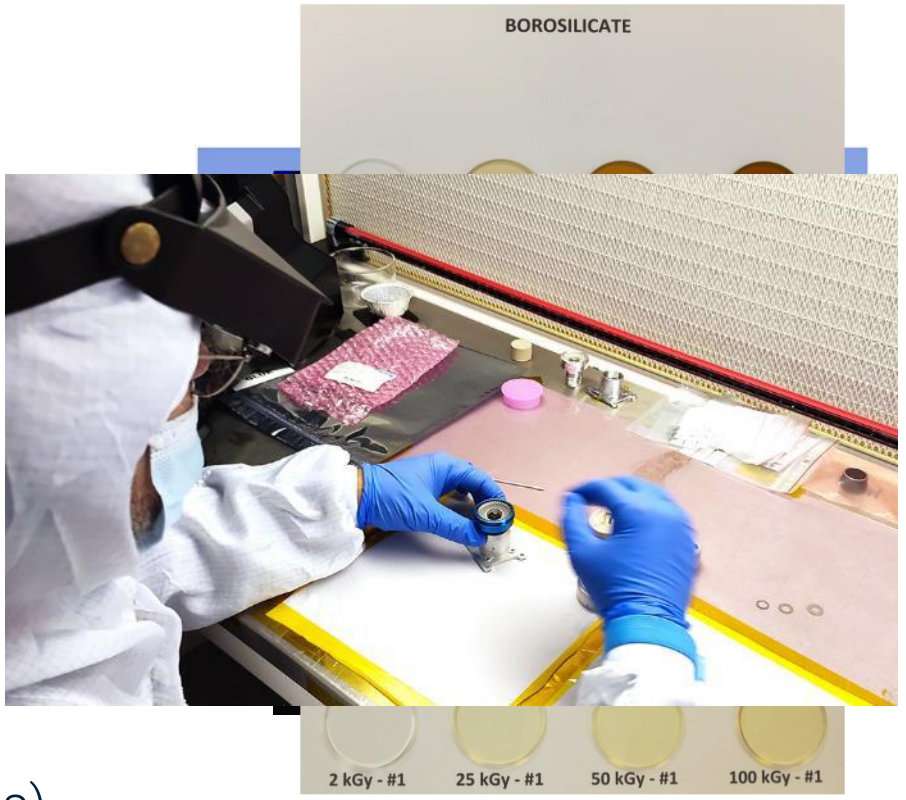
The space environment

Characteristics of the space environment

Space environment can be very harsh…

- It starts at ~130km
  - Light and small structures
  - Vibration resistant (launch & landing)
    - Temperature (large gradients & no convection)
      - Athermal designs & shielding
      - Thermal cycling tests
        - Vacuum
          - Outgass & contamination
          - Clear Room integration
            - Radiation (electromagnetic & particles)
              - Damage of materials (electronics, glasses, ..)
              - Radiation qualifications

Synergistic effects



A. Floriduz, & J.D. Devine, *2018,18th European Conference on Radiation and Its Effects on Components and Systems (RADECS)* IEEE.

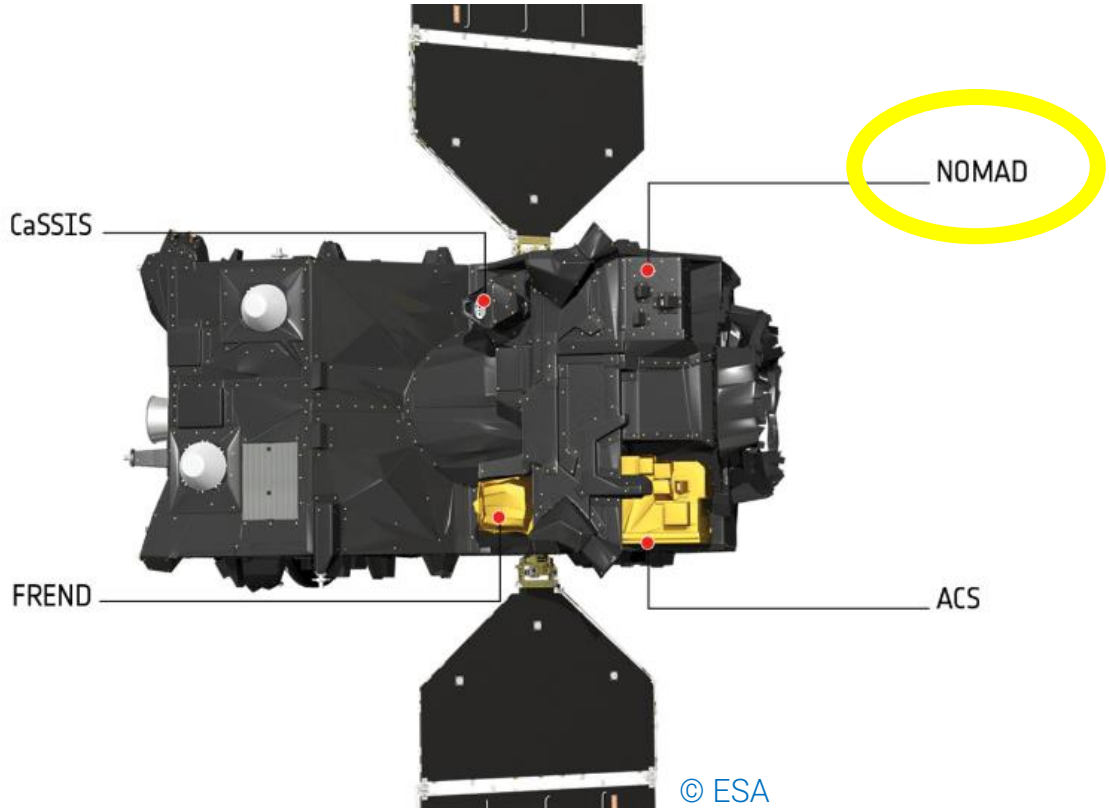
Some hands-on examples – past, present and future

Lambda-X optics in space missions

NOMAD instrument - UVIS

ExoMars 2016 - Trace Gas Orbiter

- ESA-Roscosmos mission
- Martian orbit
- Four instruments (spectrometers, camera and neutron detector) to study the Martian atmosphere and surface
- Timeline:
  - Launched in 2016
  - Arrived at final orbit in 2018
  - Still ongoing



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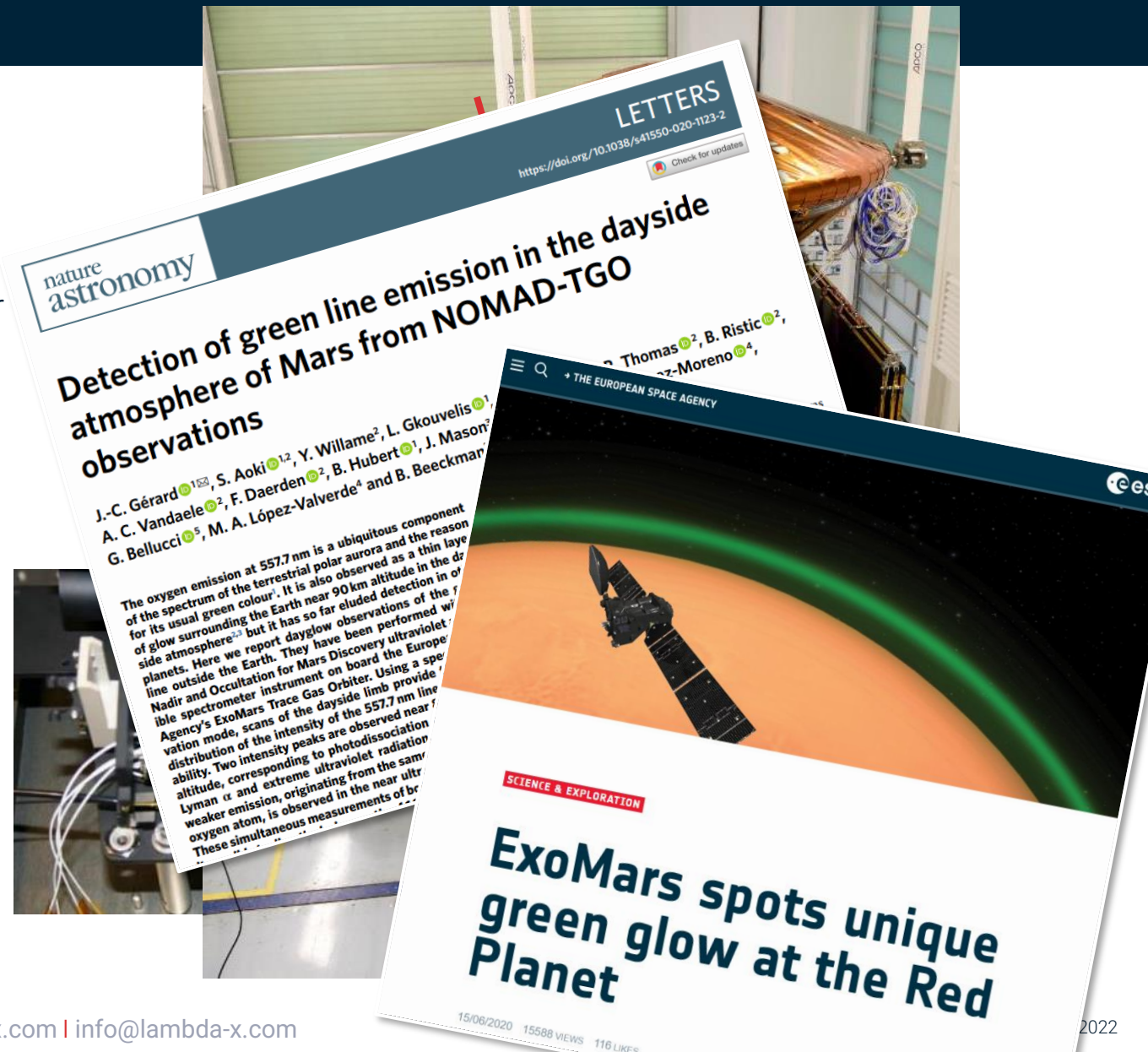
NOMAD instrument - UVIS

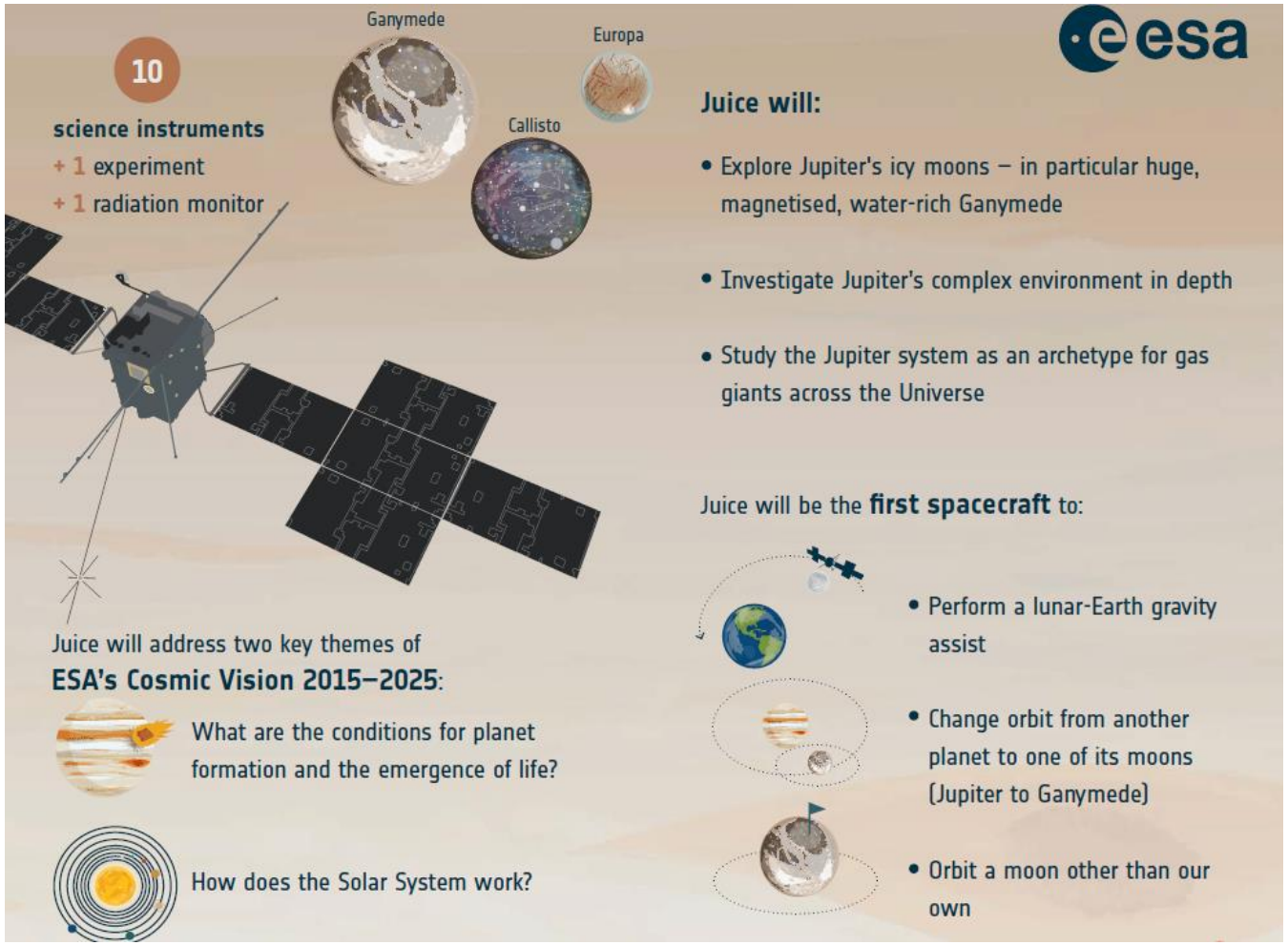
- NOMAD (Nadir and Occultation for MArs Discovery):
  - two IR spectrometers
  - Lambda-X: High-sensitivity UV-VIS spectrometer for orbital identification of atmospheric components
- Specifications:
  - 200-650 nm
  - ~1.5 nm resolution
  - Compact
    (700g for 12.5 x 16.5 x 9.5 cm³)
  - Athermal design
  - Nadir & solar occultation observations



JUICE – optics for monitoring camera

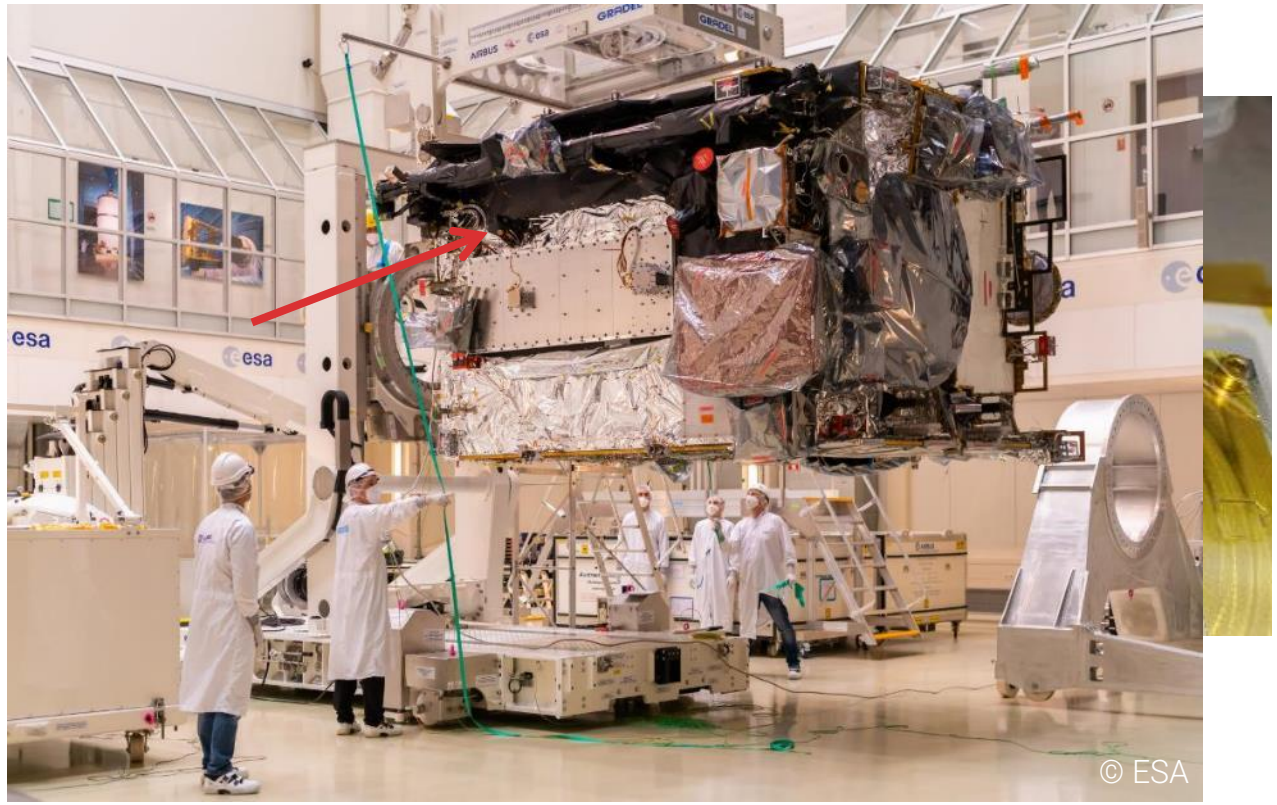
JUpiter ICy moons Explorer:

- ESA mission
- Jupiter and Jovian moons orbit
- 10 instruments to study Jupiter and its three large water-rich moons – Callisto, Europa and in particular Ganymede
- Timeline:
  - Launched in April 2023
  - ETA: 2031



JUICE – optics for monitoring camera

- Optics for 2 monitoring camera
- Specifications:
  - FOV: 90°-105°; DoF: 1.2m to inf
  - VIS
  - 4.5 x 5 x 5 cm³
- Qualifications:
  - Temperature: -40°C to 70°C
  - Radiation (40Mrad!)

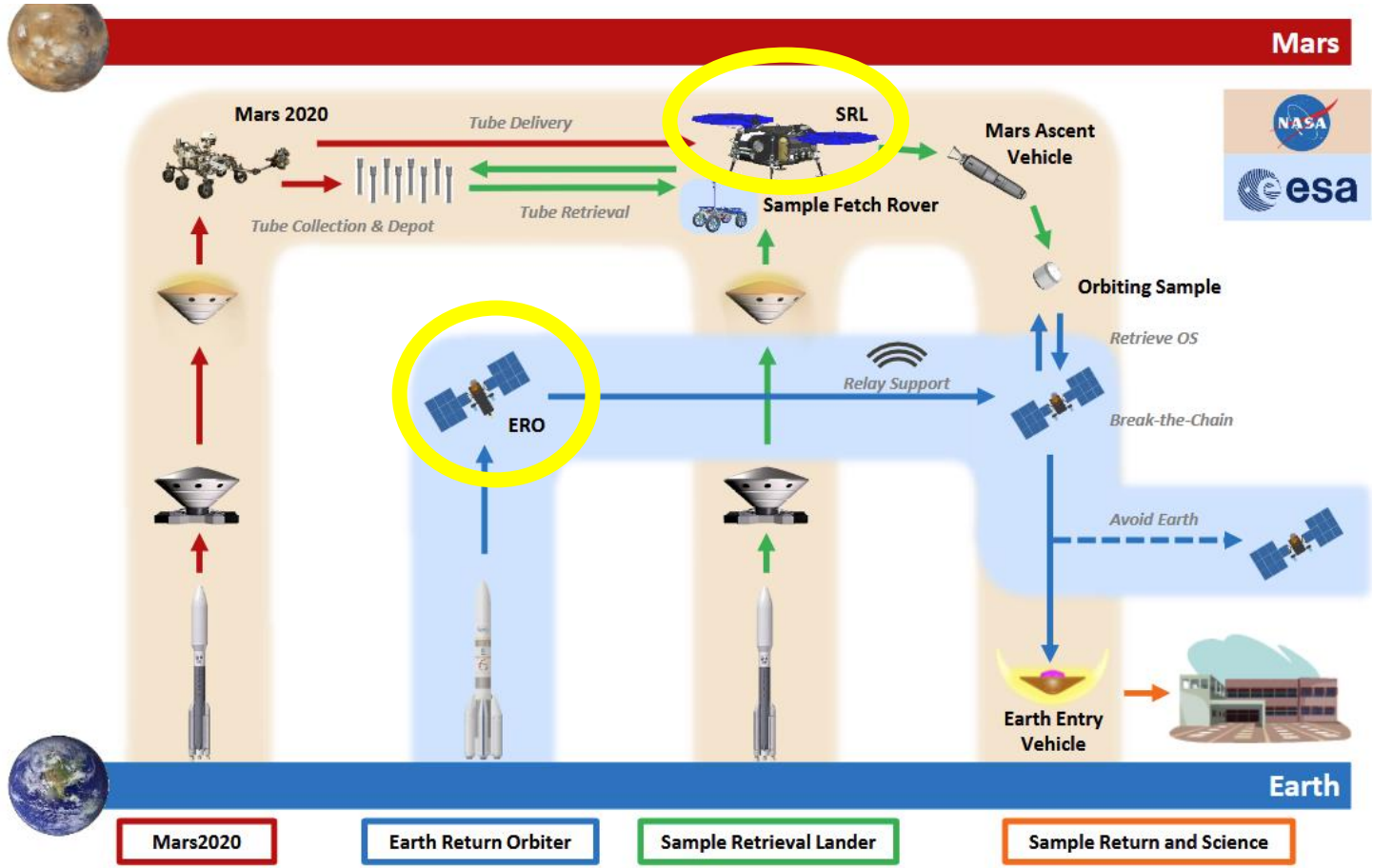


JUICE – optics for monitoring camera

MSR – monitoring and navigation optics

Mars Sample Return (MSR)

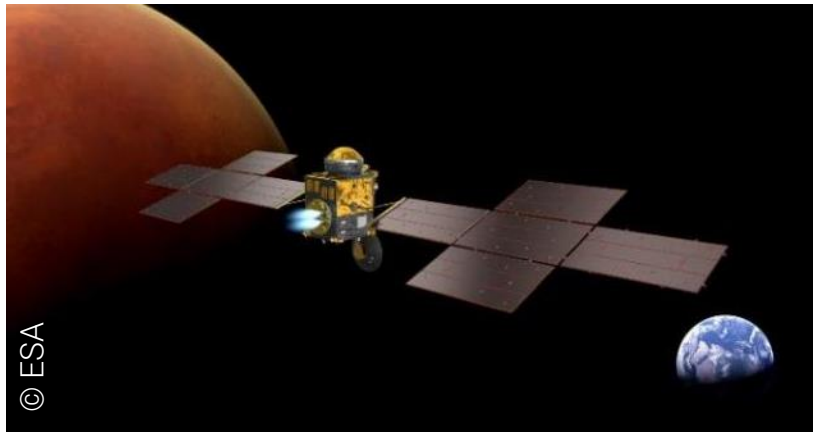
- ESA-NASA mission
- Martian orbit and landing
- Orbiter and rovers to collect and return samples collected by the Mars Perseverance rover to Earth
- Timeline:
  - Planned launches in 2027 (orbiter) and 2028 (lander)
  - Expected to return to Earth in 2033

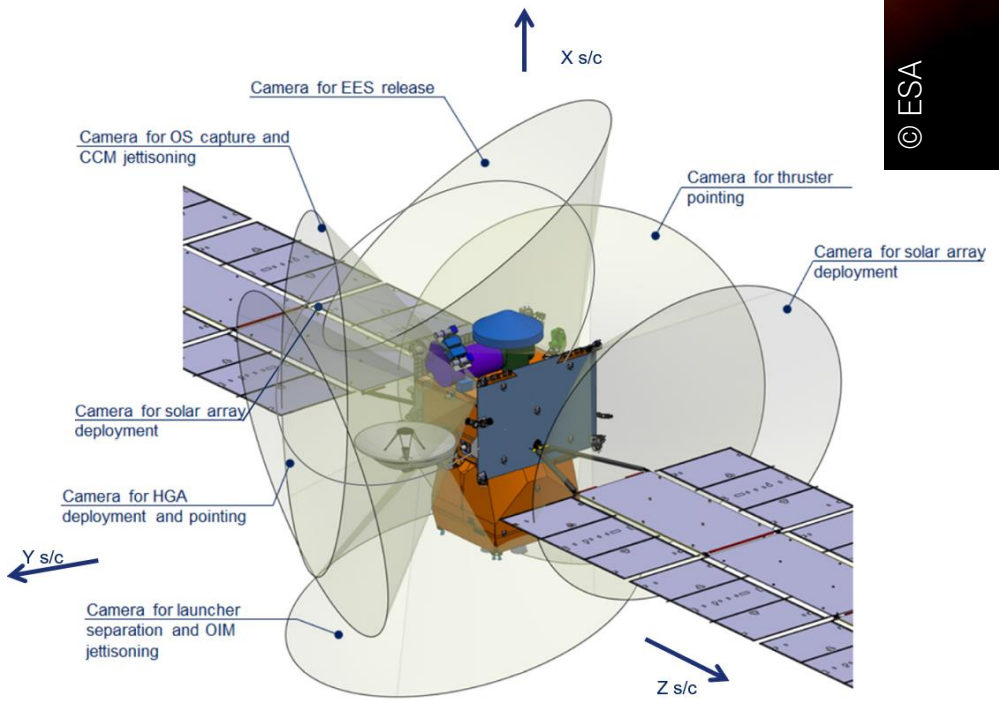


MSR-ERO – monitoring cameras

ERO (Earth Return Orbiter)

- 7 monitoring optics
- Specifications:
  - FOV: 80°; DoF: 1 m to inf
  - VIS
- Qualifications
  - Temperature: -60°C to 70°C
  - Radiations: 1.6 Mrad
- Currently Phase C



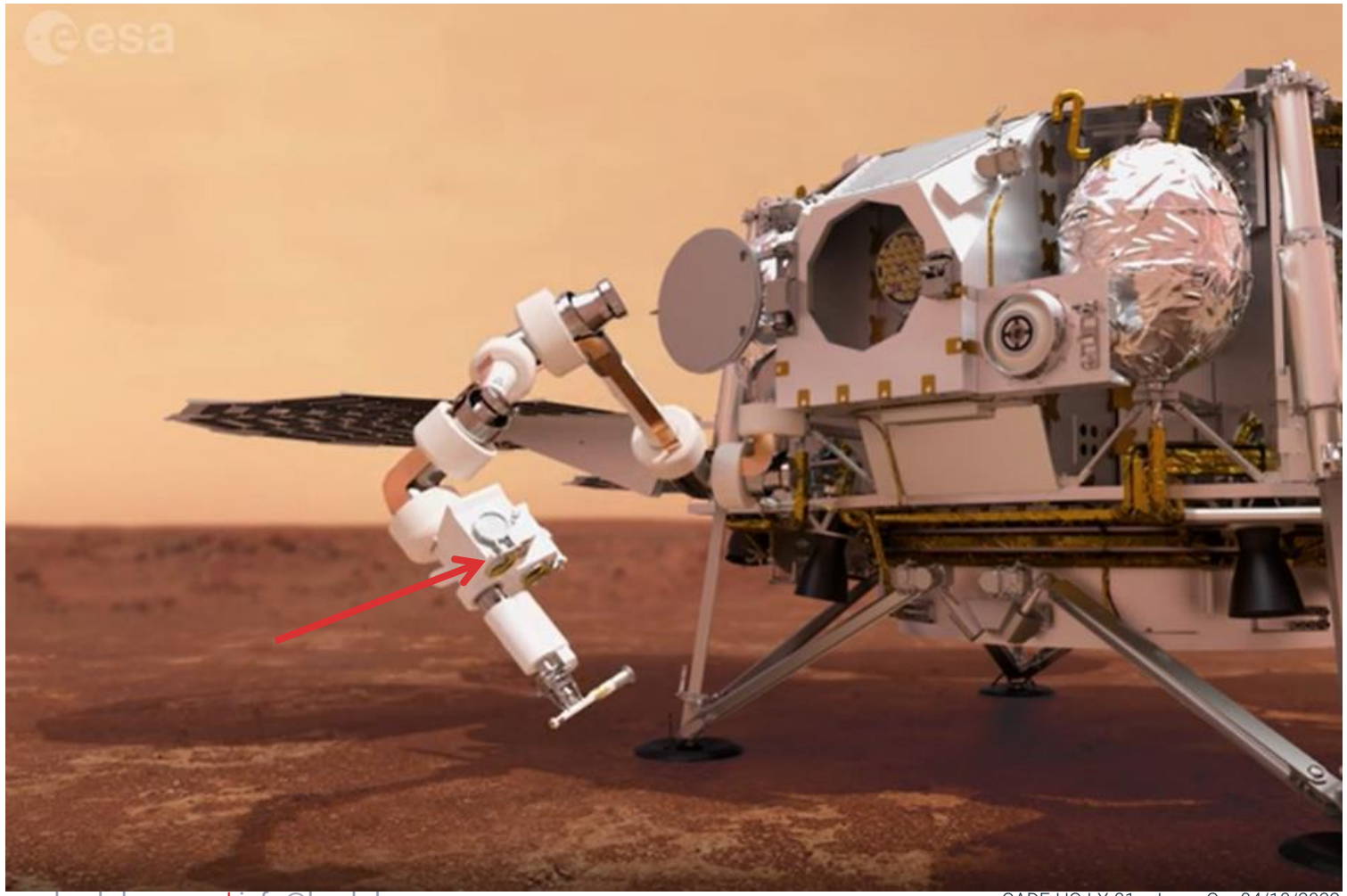


AIRBUS

MSR-STA – navigation cameras

STA (Sample Transfer Arm) on the lander

- Two navigation cameras
- Specifications:
  - FOV: 58°; DoF: 0.3-1 m
  - VIS
- Qualifications
  - Temperature: -130°C to 70°C
  - Radiations: 1.6 Mrad
  - Sterilisable instrument
- Currently Phase B



Conclusions

Conclusions

- Instruments in space are subjected to a particularly exigent environment

- Lambda-X is an active partner in the field of optics for space discovery (and other space fields too!)

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Thank you for your attention !

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