solar orbiter

→ THE SUN UP CLOSE

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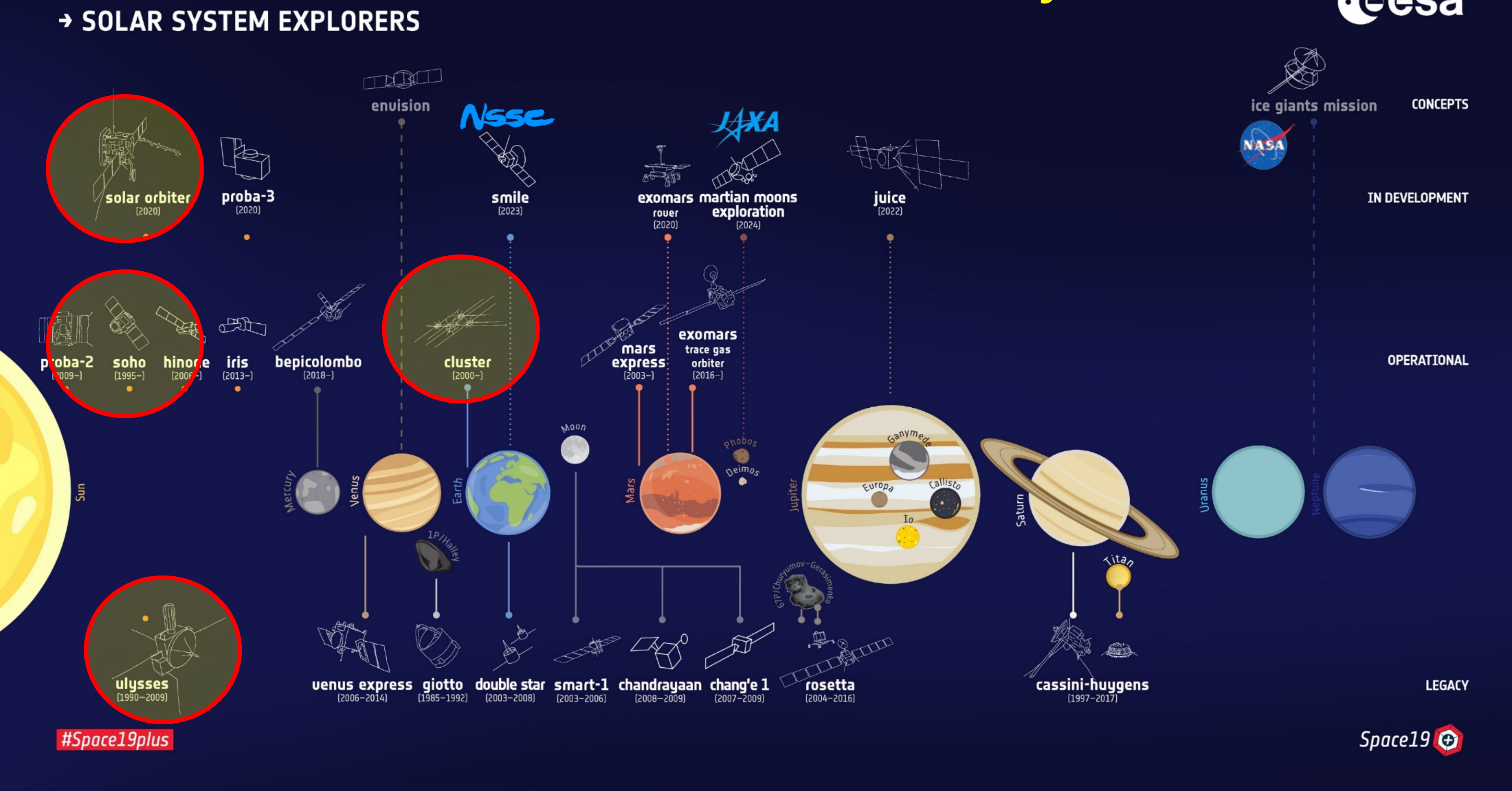
The ESA Fleet in the Solar System



Science objectives

- Solar Orbiter addresses central questions concerning our Sun:
  - How does the Sun create and control the heliosphere?
  - What drives the solar wind?
  - Why does solar activity change over time?

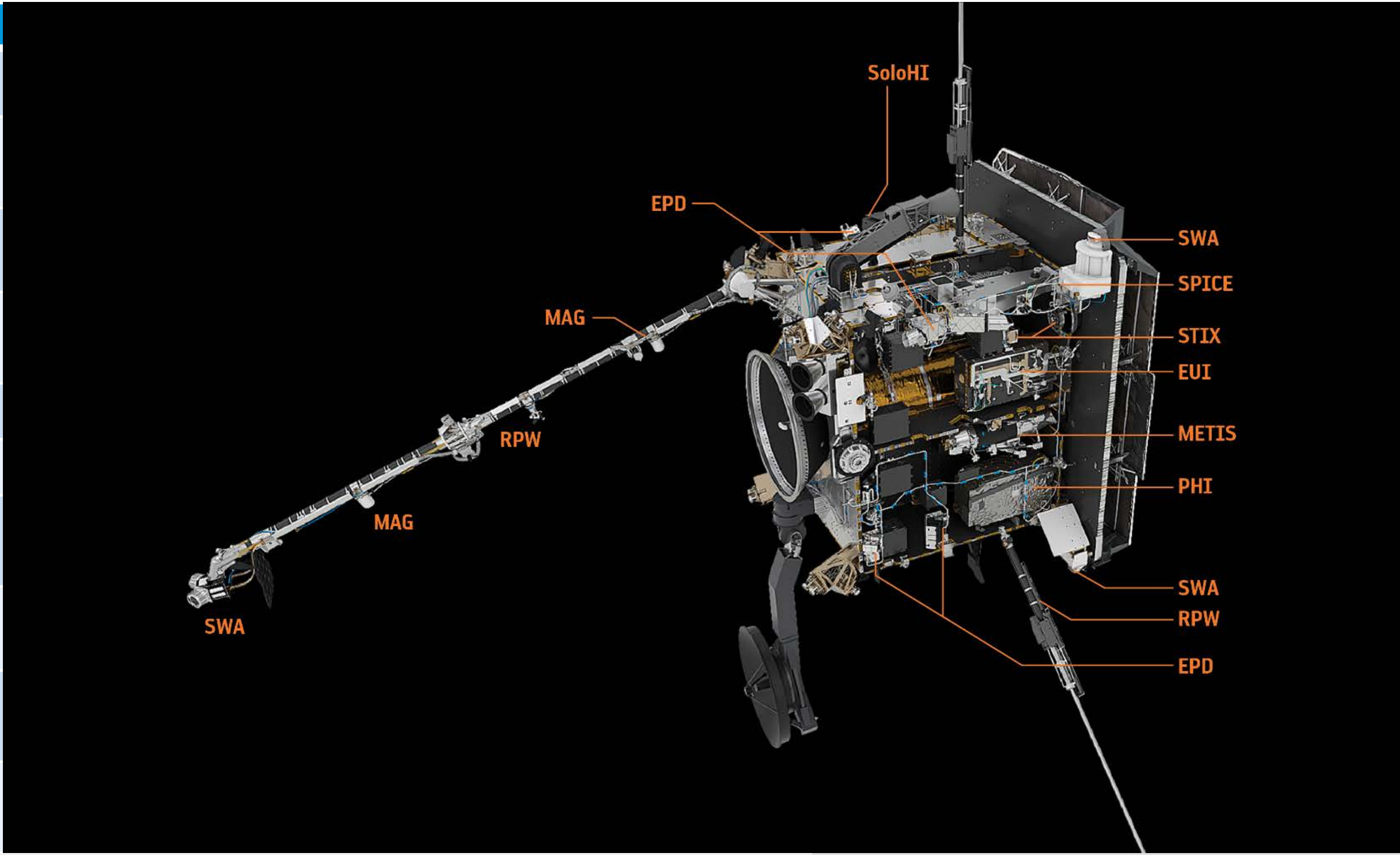
- Closest approach 0.28 AU (42 million km – within the orbit of Mercury) – **closest-ever images and following features at the surface**

- Later in the mission, orbit change to a highly inclined orbit (up to 32° of solar latitude) – **first images of the poles**

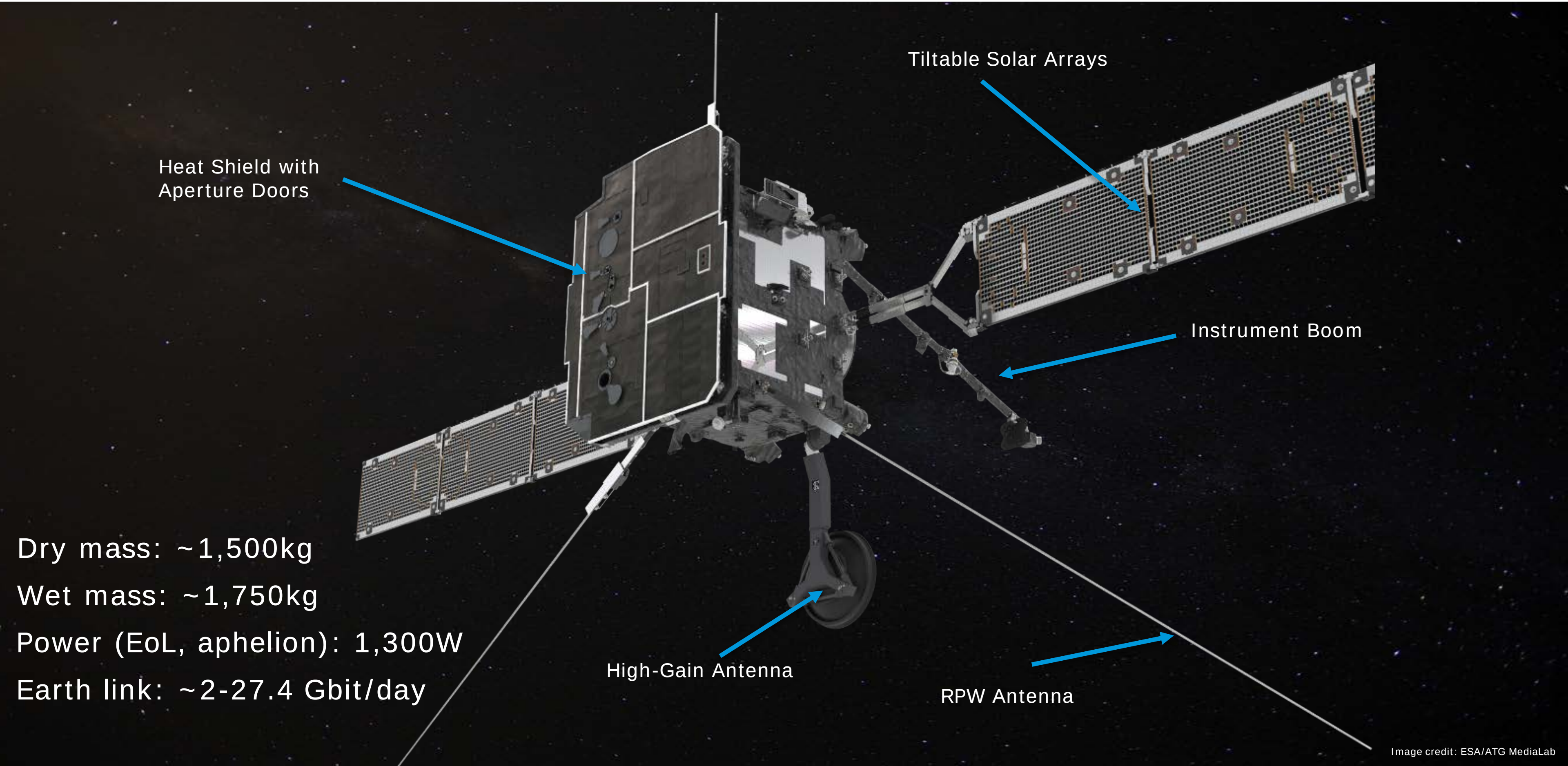
- Unique combination of in-situ and remote-sensing instruments – **correlate what we see and what we measure**

The scientific payload complement

	Instrument Name
In-Situ	Energetic Particle Detector (EPD)
	Magnetometer (MAG)
	Radio & Plasma Waves experiment (RPW)
	Solar Wind Analyser (SWA)
Remote Sensing	Extreme Ultraviolet Imager (EUI)
	Coronagraph (Metis)
	Polarimetric & Helioseismic Imager (PHI)
	Heliospheric Imager (SoloHI)
	Spectral Imaging of the Coronal Environment (SPICE)
	Spectrometer Telescope for Imaging X-rays (STIX)



Spacecraft overview



Dry mass: ~1,500kg

Wet mass: ~1,750kg

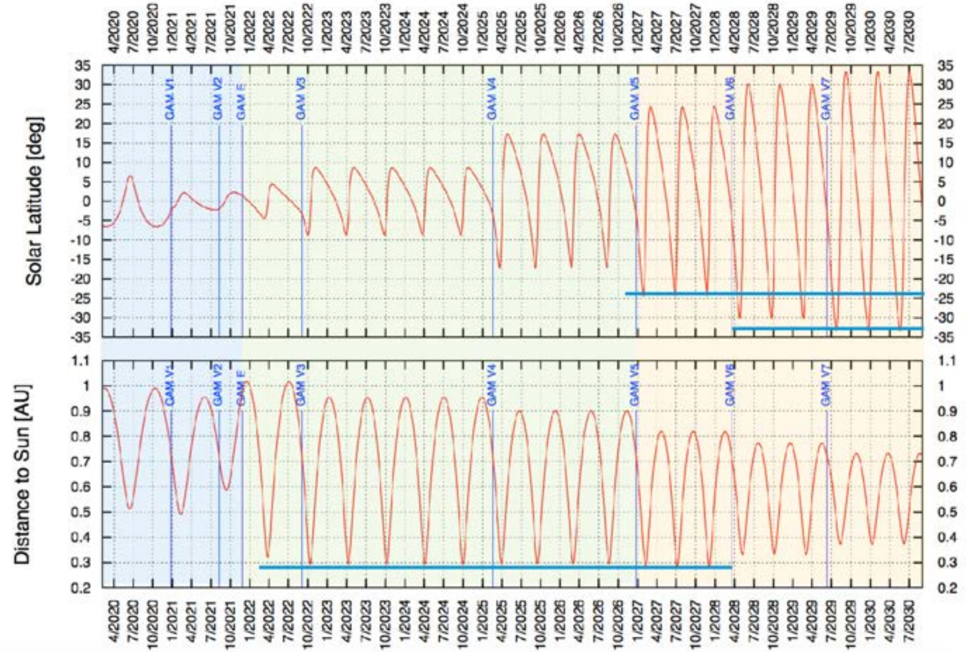
Power (EoL, aphelion): 1,300W

Earth link: ~2-27.4 Gbit/day

Image credit: ESA/ATG MediaLab

Launch and trajectory

- Launch from KSC, Florida, by NASA-provided Atlas V 411 in February 2020
- Direct injection escape trajectory to Venus, first acquisition expected at New Norcia ESA ground station
- Trajectory design driven by required planetary alignment for gravity assist maneuvers
- Highly elliptical orbit



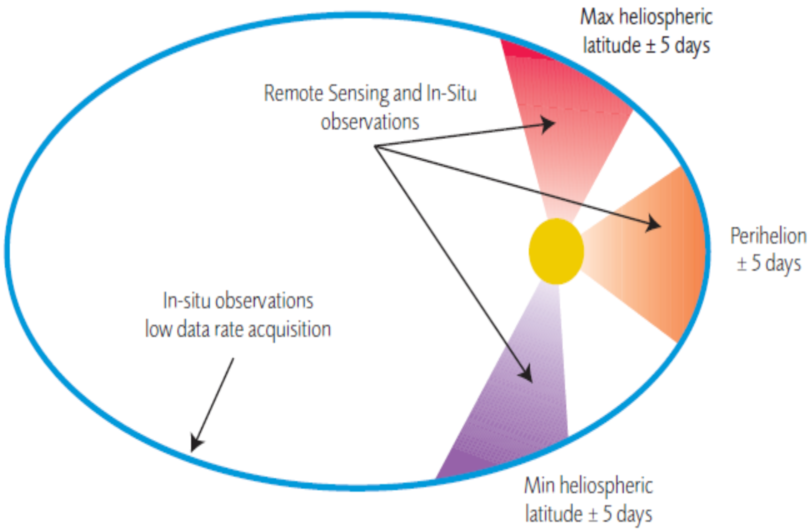
Cruise phase: 1.8 years - Nominal mission: 4 years

Orbital period: 150-180 days

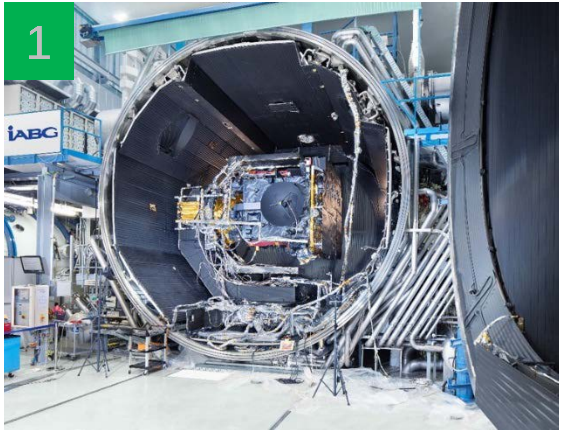
Concept of operations

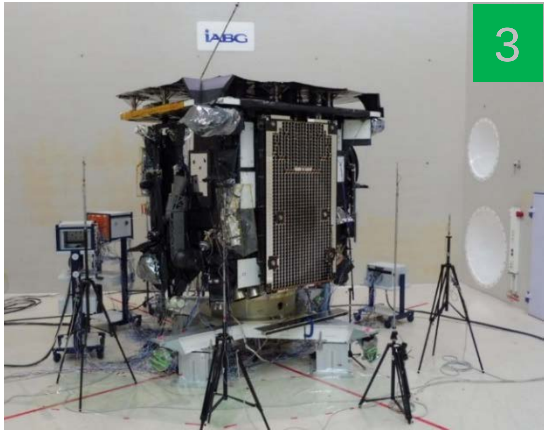
- Nominally sun pointing, with possibility to point at the limb for off-limb observations

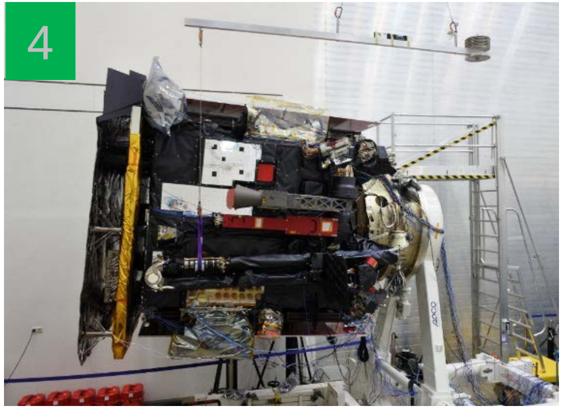
- Telemetry-constrained
  - In-situ data continuously acquired
  - Remote-sensing operations planned in three 10-day Remote Sensing Windows per orbit
  - Planning cycles (long-term to very-short-term)
  - Inter-instrument communication capability on board

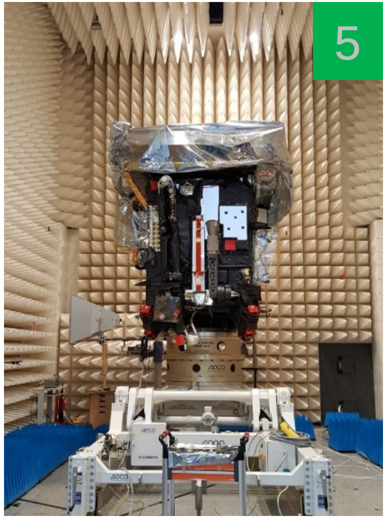


Testing for the harsh space environment



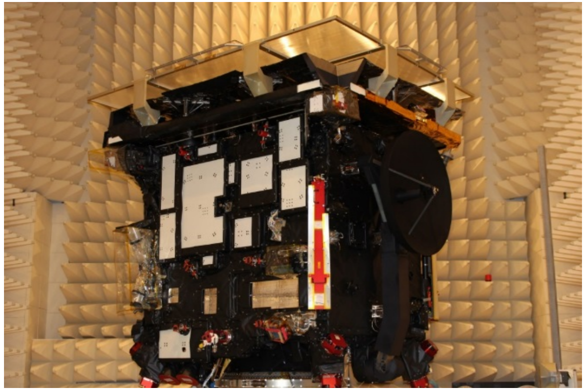


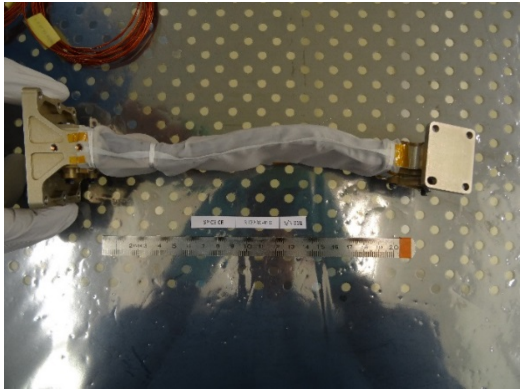




Engineering challenges: thermal

- Heat shield:
  - SolarBlack coating
  - 40 cm thick (high-T MLI, star brackets, low-T MLI)
  - Surface temperature between -200°C and +520°C
- SORA radiators and thermal straps
  - Stand-off from main structure to limit TED
  - Pyrolitic graphite: very high conductivity (1 W/K) for very low structural stiffness



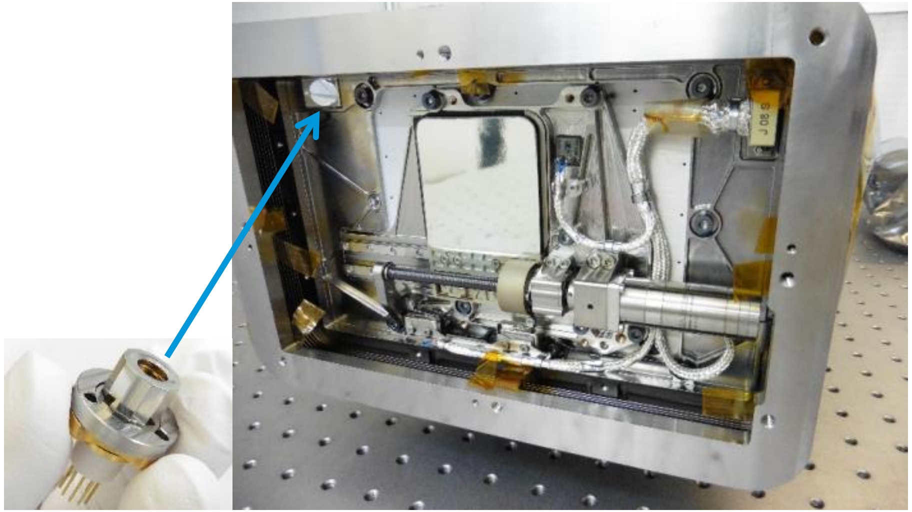


Engineering challenges: EMC, magnetic cleanliness and charging

- Specific design of electronic boards to minimize EMC emissions (and definition of EMC-quiet operations)
- Selection of non-magnetic materials
- Shielding of magnetic components
- Harness layout to avoid creating current loops
- Ensuring conductivity of all external surfaces

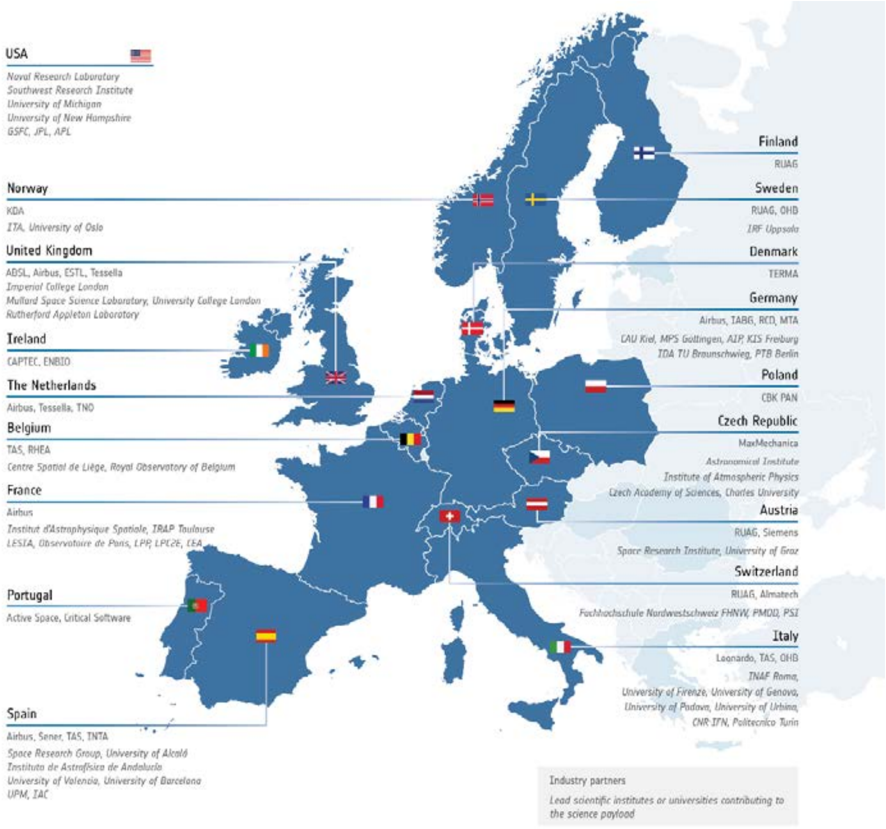
Engineering challenges: contamination control

- Stringent requirements on molecular contamination (UV instruments) and particulate contamination (coronograph and high-voltage instruments)
- Mitigations:
  - Selection of low-outgassing materials and systematic bake-out
  - Purge system with high purity nitrogen
  - Monitoring during Spacecraft TVAC
  - Heat shield doors (+Metis cap), instrument doors
  - Regular inspections and cleaning
- Extensive modelling of in-flight molecular contamination
- In-flight measurements by the Contamination Monitoring System (CMS)



CMS-1 on front panel of SPICE

An international enterprise



- Payload and Spacecraft systems provided by European contributors from 17 ESA Member and Cooperating States
- Collaboration with NASA

For more information and latest news

ESA general portal:

https://www.esa.int/Science_Exploration/Space_Science/Solar_Orbiter

ESA science portal:

https://sci.esa.int/web/solar-orbiter

Solar orbiter’s journey around the Sun: animation showing the orbital manoeuvres:

http://www.esa.int/spaceinvideos/Videos/2019/10/Solar_Orbiter_s_journey_around_the_Sun

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