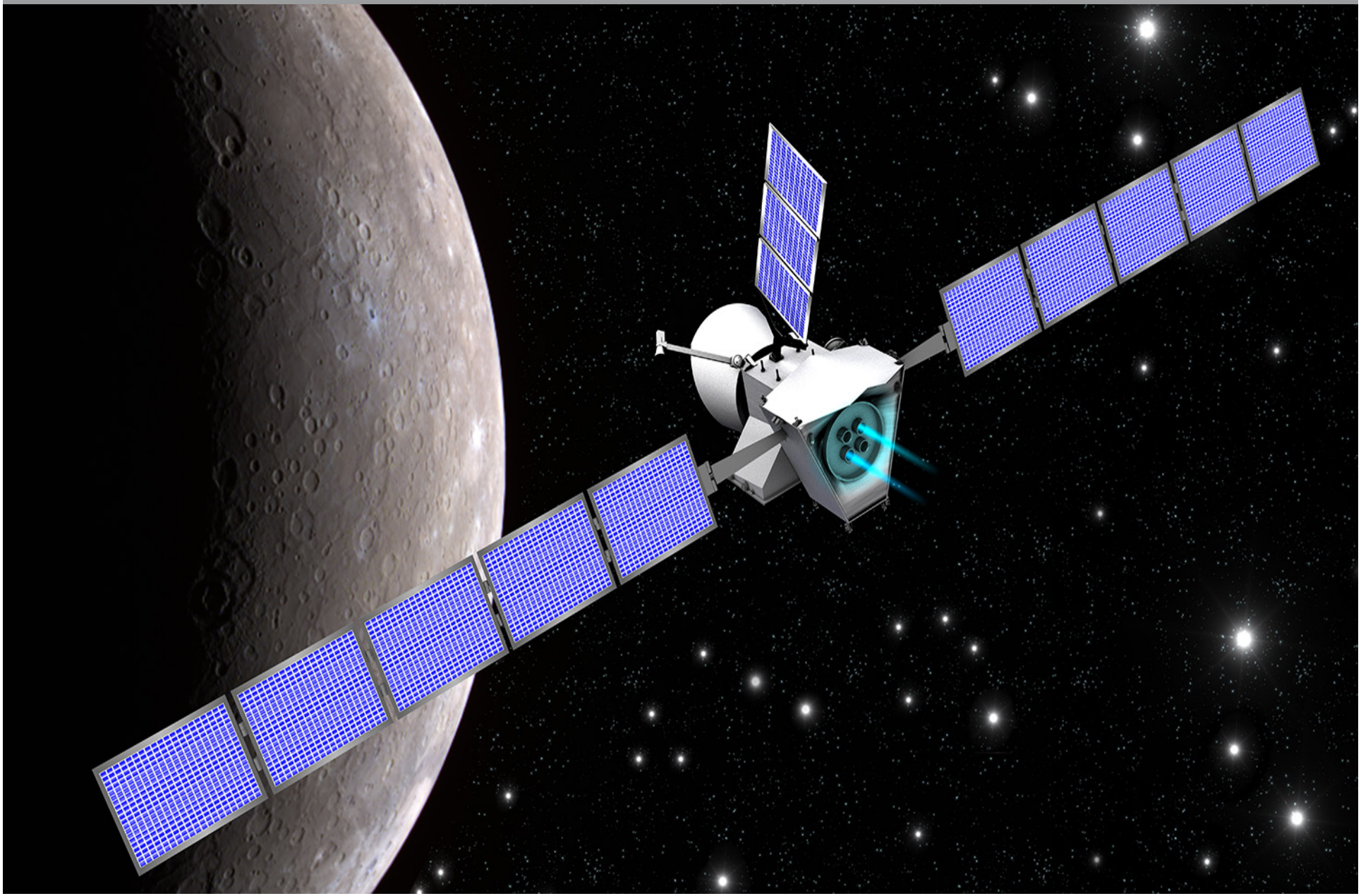
BEPI COLOMBO
Long journey to Mercury

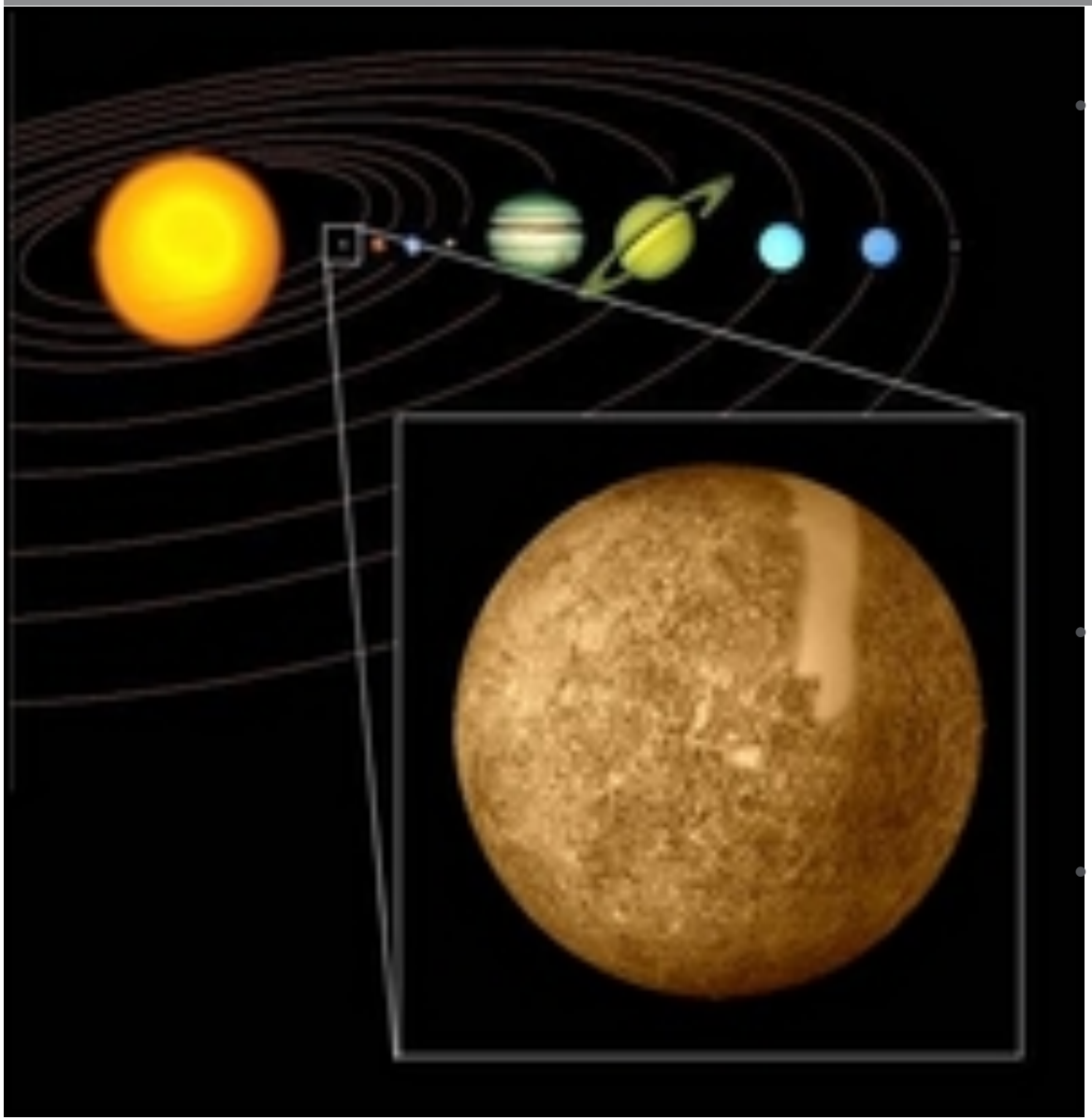


BEPI COLOMBO

Scientific goals

- To explore how a planet close to the sun evolves
- To explore internal and external materials
- To understand Mercury's magnetic filed
- To explore the exosphere
- To explore the magnetosphere
- To test Einstein's general theory of relativity

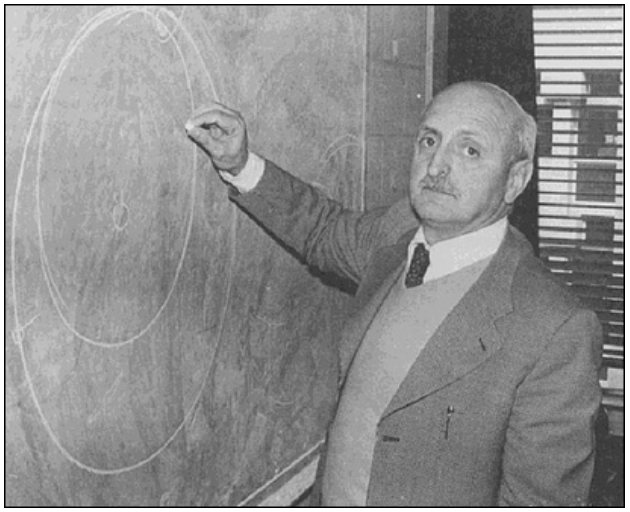
MERCURY



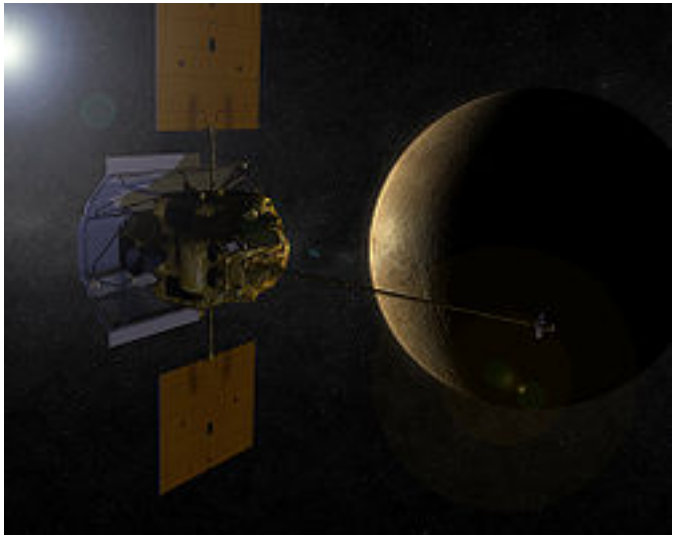
- Close to the sun – far away
  - 46-70 million km (earth is about 150 milli onkm)
  - Hot, up to 400°C (and cold, down to -170 °C)
  - Sun irradiation up to 10 times higher than on earth
  - Difficult to observe from earth
  - High radiation levels
  - Communication delay
- 3:2-resonance – two rotations around its axis per 3 rotations around the sun
  - 1 year = 88 terrestrial days
  - 1 day = 176 terrestrial days
- The orbit turns slowly– this is explained by Einstein's theory of relativity

MERCURY
NASA only visitor this far

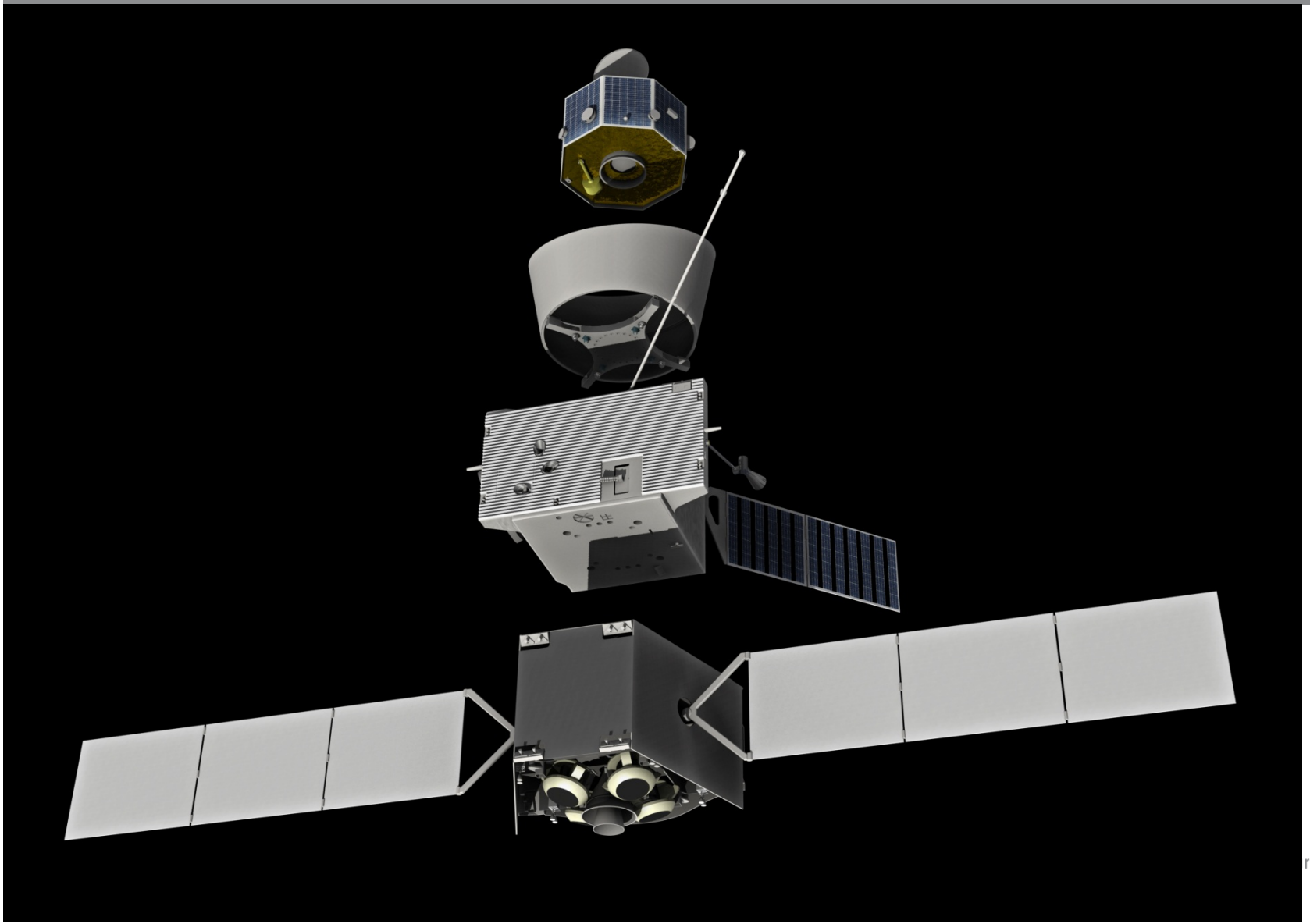
- Mariner 10, 1974-75. Three flybys.



- Messenger, in orbit since March 2011



BEPI COLOMBO



MMO (JAXA)

MOSIF

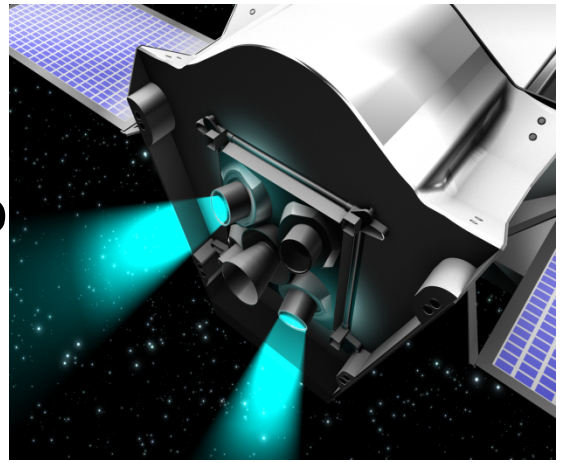
MPO (ESA)

MTM (ESA)

BEPI COLOMBO
Challenges, temperature

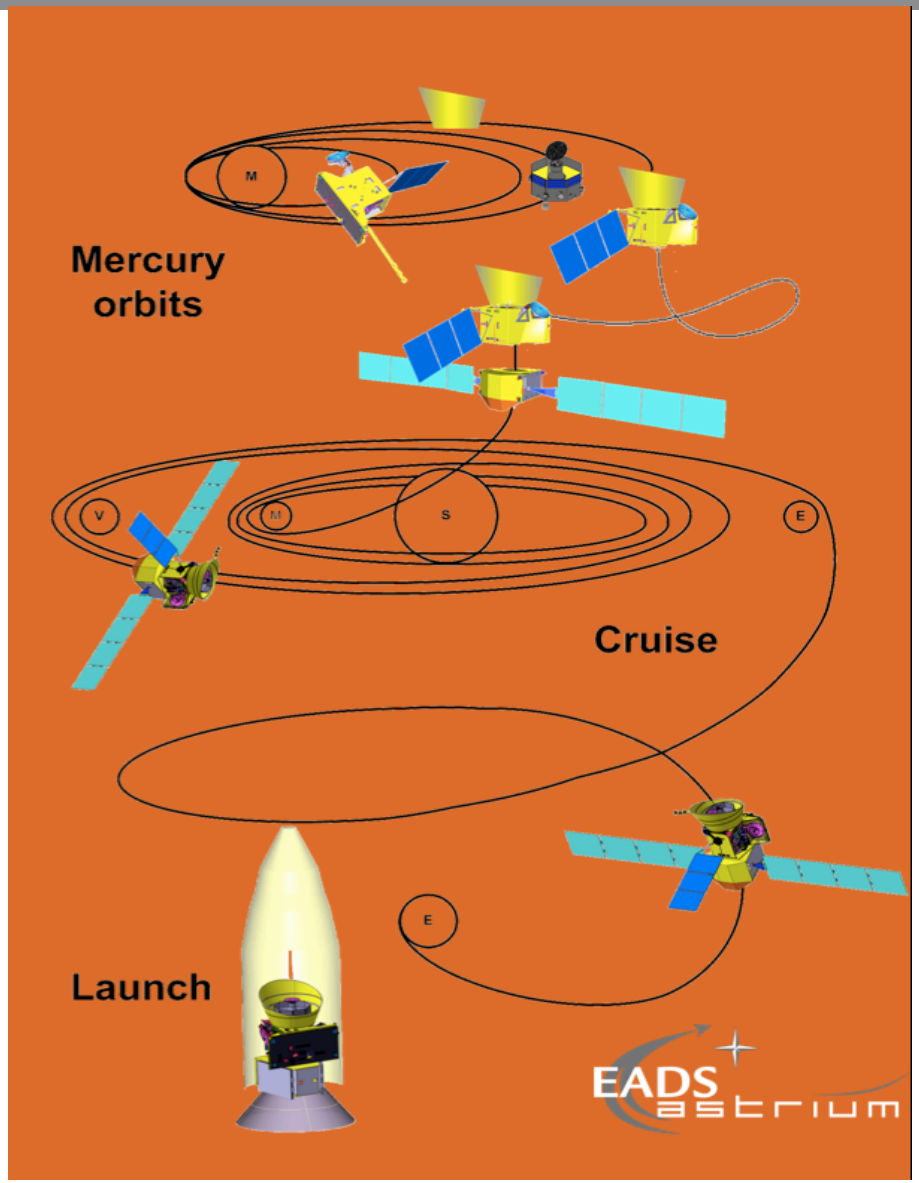
- Mechanical and thermal design – radiators, MLI, surface finish … - adjust temperature to the inner of the satellite to benign levels. Most of the electronics is operating in this environment
- For obvious reasons this is not possible for all equipment– solar panels, antennas, some of the instruments etc.
- Specifically for the solar panels:
  - Solar cells are of new design.
  - Panels are angled for best compromise between power and temperature.
  - Blocking diodes are new design, first time SiC is used in ESA program.
- Stearable antennas

BEPI COLOMBO
Challenges, transport



- To send a spacecraft to Mercury requires more fuel than sending one to Pluto.
- Acceleration and more demanding deceleration
- Solution – electric propulsion SEPS (Solar Electric Propulsion System) during transport from launch to Mercury orbit injection
- “Fly-bys” around earth, Venus and Mercury

BEPI COLOMBO
Challenges, transport



BEPI COLOMBO

BEPI COLOMBO

	Mercury Planetary Orbiter (MPO)	Mercury Magnetospheric Orbiter (MMO)
Stabilisation	3-axis stabilised	15-rpm spin-stabilised
Orientation	Nadir pointing	Spin axis at 90° to Sun
Orbit	Polar orbit, period of 2.3 h 400 × 1508 km	Polar orbit, period of 9.3 h 400 × 11 824 km
Spacecraft Mass	4100 kg (at launch) 1150 kg (in Mercury orbit)	275 kg (in Mercury orbit)
Payload Mass	80 kg	45 kg
Payload Power	100-150 W	90 W
Data downlink	1550 Gbits/year 50 kbits/s average	160 Gbits/year 5 kbits/s average
Antenna	High-temperature resistant 1.0 m X/Ka-band high-gain steerable antenna	0.8 m X-band phased array high-gain antenna
Operational lifetime	> 1 year	> 1 year

BEPI COLOMBO
MPO and MMO in orbit