MERCURY ORBITER - AN INTERDISCIPLINARY MISSION

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Mercury is the innermost and less known terrestrial planet of the Solar System. It possesses a very high density (5.3 g/cm$^3$ at 10 kbar), a small but unexpected magnetic moment (6×10$^7$ that of Earth), and a tenuous exosphere; ground-based radar observations indicate that water ice may exist at the poles. There are still fundamental questions about its accretion and cratering history, and its thermal and chemical evolution. The size of Mercury’s magnetosphere is just 5% of that of Earth; magnetic substorms last 5 min, on average, and their generation process is influenced by the absence of an ionosphere. The model payload of Mercury Orbiter includes a multi-spectral imager, a gamma and X-ray detector, a magnetometer, charged-particle analysers, a wave receiver and an ion emitter for spacecraft potential control. The spacecraft, the design of which is inherited from ESA’s Cluster spacecraft, has a dry mass of 626 kg and is stabilised at 10 rpm, but the telemetry antenna is despun. The telemetry rate varies between 1.4 and 9 kb/s over the range 1.6 - 0.64 AU. The spacecraft, launched from Kourou with an Ariane-5, will reach its destination after two gravity assists at Venus and two at Mercury. The nominal orbit is polar with periherm and apherom altitudes of 400 and 16 800 km, respectively. The spacecraft’s operating lifetime around Mercury is planned to last for 3 Hermean years.

The 'Survey Committee', which was set up to outline the future activities of the European Space Agency (Horizon 2000 Plus) has recommended that a mission to Mercury be considered as one of the major programmes of the Agency (cornerstone) and be submitted to the ESA Council in 1995.

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**Mercury Orbiter mission summary**

### Objectives
- Morphology, geology and tectonic history of Mercury, and its surface composition.
- Origin of the planetary magnetic field and constraints on the internal structure of the planet.
- Origin and dynamics of Mercury's exosphere.
- Structure and dynamics of Mercury's magnetosphere.
- Study of the interplanetary medium at the orbit of Mercury.

### Payload
- Multi-spectral camera 200–1100 nm, 7 spectral channels, ground resolution 45–550 m
- Gamma and X-ray detectors 0.1–8 MeV (gamma-rays), 0.7–8 keV (X-rays)
- Magnetometer 4 ranges (+64, ±256, ±1024 and ±4096 nT)
- Ion and electron analysers 10 eV–30 keV, 1–100 amu (ions), 5 eV–30 keV (electrons)
- Wave analyser 0–16 MHz (electric field), 0.1 Hz–1 MHz (magnetic field)
- Ion gun current: 1–100 µA, resolution: 0.2 µA
- Radio-propagation experiment
- Doppler tracking and ranging

### Launch and orbit
- Transfer orbit using two Venus and two Mercury gravity assists.
- Mercury operational orbit:
  - periherm altitude: 400 km
  - apherim altitude: 16 800 km
  - inclination: 90°
  - period: 13.45 h
  - latitude of periherm: +30°

### Launcher
- Ariane-5

### Ground stations
- 15 m ESA ground stations: Villafranca and/or Perth

### Spacecraft
- Stabilisation: Spinner (6–10 rpm)
- Dimensions: diameter 2.9 m, height 1.4 m
- Launch mass: 1617 kg
- Dry mass: 626 kg
- Payload mass: 49.4 kg
- Average payload power: 43.8 W
- Total spacecraft power: 215 to 500 W
- Telemetry: 2 to 8 kb/s

### Nominal mission duration
- 3.8 yr cruise, 0.75 yr (3 Mercury years) in operational orbit

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