Model payloads of BepiColombo/MMO

Yasumasa Kasaba[1], Hajime Hayakawa[1], Toshifumi Mukai[1], Hiroshi Yamakawa[1], Hiroyuki Ogawa[1], Mercury Exploration Working Group MUKAI Toshifumi

[1] ISAS

http://www.stp.isas.ac.jp/mercury/

We introduce the outline and current investigations of the model payloads aboard BepiClombo / Mercury Magnetospheric Orbiter (MMO).

Main targets of MMO are 1) Structure and origin of Herman magnetic field, 2) Structure, dynamics, and physical processes of Herman magnetosphere, 3) Structure, variation, and origin of Herman atmosphere, 4) Macroscopic structure of Herman crust, and 5) Physical environment of inner solar system. For these targets, MMO will have 10 model payloads (Mass: ~33kg [~37kg including margin], Power:~53W).

- Particle Common System [PCS]
  Electron Spectrum Analyzer (ESA), Mass Spectrum Analyzer (MSA), Solar Wind Analyzer (SWA), High Energy Particle (HEP), Energetic Neutral Atoms (ENA)
- Field Common System [FCS]
  Magnetic Field sensor (MGF), Plasma Wave Instrument (PWI), Mercury Dust Monitor(MDM)
- Imaging Common System [ICS]
  Mercury Imaging Camera for Atmosphere (MIC-A), Mercury Imaging Camera for Surface (MIC-S)

These mode payloads are operated by 3 common systems. Each common system has Data Processing Unit (DPU) and Power Conversion Unit (PCU). The former provides the functions of command decoding, telemetry production, integrated operation. The latter provides power supply and control. It is now considered that MGF is separated to two parts and installed into PCS and FCS, for the redundancy of magnetic field measurement.

MMO is spinning spacecraft at 15rpm, for the measurement of 3D distribution functions of plasma particles and extension of two pairs of wire antenna probe (tip-to-tip:32m). Spin axis is almost perpendicular to the Herman equatorial plane. It is because of the prevention of direct solar radiation to upper and lower deck and orientation of HGA to the Earth with minimum attitude control. In order to avoid the shadow on the sphere probe at the tip of the wire antenna, spin axis leans 2-deg from the perpendicular direction. Several anti-thermal investigations are done for the sensors whose heads are out of the spacecraft.

MMO will be at polar orbit with the period of 9.2hour, the periherm of 400km and the apoherm of 12,000km (~6RM). It is selected for the observations of large regions of Herman magnetosphere, mappings of magnetic field and surface, and macroscopic imaging of the Na atmosphere. In the current estimation, the telemetry ability is 20~160Mbytes/day (about 40 Mbytes/day in average). Mission life is 1 Earth year (~4 Mercury year).

Data production rate will show large seasonal variation. It is because the data production rate of in-situ plasma instruments (ESA, MSA, SWA, HEP, MGF, PWI) is correlated to the duration staying in the magnetosphere. The estimated data production rate varies in 20~75MB/day. So basic policy of the operation is storing in the high -production time, and reproduction in the low-production time. This policy requires large DR capacity, above 4GB. Current DR size is sevelal 100s MB ~ 2GB. In the actual operation, we will take data balancing the telemetry rate (depending on Earth-Mercury distance) and remaining DR size.

The specifications of the model instruments in this paper is for the basis of spacecraft investigations and not final ones. Actual selection of the instruments are based on the results of Announcement of Opportunity (A/O) in Japan and Europe. A/O process is in Apr-Oct in 2002 (MPO/MSE) and Jan-Jun 2003 (MMO).