Development of the spectral imaging camera for the BepiColombo/MMO mission, vol. 2

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The Mercury Sodium Atmosphere Spectral Imager is an instrument of the BepiColombo Mercury Magnetospheric Orbiter (MMO). The target of this imager is sodium D2 emission (589.0 nm) from Mercury's exospheric atmosphere. Since spatial extent of sodium atoms largely depend on their initial velocity, that is, ejection mechanism from Mercury, observations of spatial distribution of sodium emission are important to investigate the source mechanisms of the exosphere. An intensity of sodium D2 emission is strong (typically a few mega Rayleighs) due to the large cross section for the resonance scattering of solar photons. However, its line width is quite narrow (~5pm) and there is reflected solar continuum from the surface of Mercury. To distinguish the emission from the reflected continuum, it is necessary to carry out a high dispersion observation. Due to its high wavelength resolution, light-weight and bright optics, a Fabry-Perot interferometer (FPI) enables us to achieve such observations from the spacecraft.

A current design of the spectral imager is as follows.

The spectral imager is a refractive optical system. A field of view (FOV) of the instrument is about 2 degrees. By using a spin motion of MMO and a moving reflector (FOV scanning), a two dimensional image of the whole disk of Mercury (22 degrees @4Rm) can be obtained in about 60 seconds.

A tandem FPI, which consists of two etalons with different full widths at half maximum and free spectral ranges, is used to solve a problem in wavelength shift of an interference filter caused by temperature variations (0.018 nm/K @589 nm). Both etalons are gap-fixed types and finesses are 40.

etalon1 FSR:1.255 nm, FWHM:31 pm
etalon2 FSR: 0.2 nm, FWHM: 5 pm

To minimize the expansion of etalon gap caused by temperature variation, spacers made of Zerodur are used. The FPI and interference filter is used in the parallel beam region.

As a detector, a radiation hardened CMOS sensor is used. In front of the CMOS sensor an image intensifier (II) is installed. Both integration and photon-counting modes are used for observations.