Development of Mercury Sodium Atmosphere Spectral Imager (MSASI)

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The Mercury Sodium Atmosphere Spectral Imager (MSASI) on the Mercury Magnetospheric Orbiter (MMO) of the Bepi-Colombo Mission will address a range of fundamental scientific questions pertaining to Mercury's exosphere. The measurements will provide new information on regolith-exosphere-magnetosphere coupling as well as new understanding of the dynamics governing the exosphere bounded by the planetary surface, the solar wind and interplanetary space('surface-bounded exosphere'). MSASI is a high-dispersion visible spectrometer for the sodium D2 emission (589 nm). A single high-resolution Fabry-Perot etalon is used to achieve a compact and efficient instrument design. A one degree-of-freedom scanning system is employed in combination with the spin of the MMO spacecraft to obtain full-disk images of the planet.

Ground-based observations of Na-D2 emissions from Mercury's exosphere have revealed that the regolith of Mercury releases a fraction of its content to the exosphere. The responsible release mechanisms are thought to be as follows; (1) Thermal desorption, (2) Photon-stimulated desorption, (3) (Solar wind) Ion sputtering, (4) Micro-meteoroid impact/vapourisation, and (5) Chemical sputtering. Each of these candidates seems to be in operation, and no single process can explain completely the range of phenomena observed from the Earth. The fate of ejecta from the regolith is still unknown. Some are expected to return to the lithosphere, the other are lost into interplanetary space. Circulation of lithospheric sodium atoms via exosphere-magnetosphere might bring a significant change in the composition of surface layer on Mercury.

BepiColombo/MMO is the first and unique opportunity to study the formation, circulation, and maintenance of the exosphere. The MSASI measurements clearly and definitely can identify the release mechanisms, how exospheric sodium is born from the regolith, and bring comprehensive picture of global circulation of regolith materials by way of comparison with model calculations.