PROBING THE HERMEAN EXOSPHERE BY ULTRAVIOLET SPECTROSCOPY (PHEBUS): A EUV-UV SPECTROMETER FOR THE MPO ORBITER OF THE BEPICOLOMBO MISSION

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An instrument aimed at measuring the emission lines of Mercury's exosphere is under study, as a joint effort between French, Russian and Japanese teams. The PHEBUS instrument will have the capability to record full spectra of the Hermean exosphere in the range from 50 nm to 300 nm, with a spectral resolution of 1 nm. A few EUV emissions of interest in the 25-50 nm range (He^+, Na^+) will be recorded at second order, and a devoted channel will be used to measure and monitor the calcium emission line at 422 nm. Several ions of interest, as well as noble gases, will be searched for in the EUV range. In the FUV-UV part of the spectrum, erosion products from the regolith will be measured and monitored. By using a scanning system, it will be possible to perform altitude scans, as well as to maintain the line-of-sight at sufficiently low altitude for long time integration sequences, devoted to the detection of scarce constituents. The night-side surface, including polar craters permanently in the shadow, will be mapped at 121.6 nm in order to measure the EUV albedo of Mercury (illuminated by the interplanetary H Ly-α glow), and possibly evidence ice deposits at polar latitudes.

The instrument consists of an entrance baffle, a one degree-of-freedom scanning system (within the orbit plan), an off-axis parabolic mirror, a slit, two gratings and two detectors. The EUV grating is used in grazing incidence for maximizing reflectivity. A compact design, with a total volume of 2.2 liters and a mass of 2.5 kg, is used, due to severe constraints on the mass of the MPO payload.

Strong synergies between exospheric studies performed by PHEBUS on MPO, and ionospheric and solar wind studies planned on MMO, will allow to fully exploit the dual BepiColombo mission, in order to get a full picture of regolith- exosphere- magnetosphere interaction. Characterizing production mechanisms at the surface and beyond full cycles of volatile species, from extraction to escape, including intermediate stages of adsorption/desorption and/or ion implantation within the regolith, is also of crucial interest. Additional information about regolith composition, present mantle

outgassing, and meteoritic flux and composition, will also be obtained, although in an indirect way, allowing to complement the results of X-ray and Gamma-ray spectrometers about surface material composition.