



SIXS, the Solar Intensity X-ray and particle Spectrometer for BepiColombo

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SIXS is an instrument, which performs measurements of X-rays and particles at Bepi-Colombo. SIXS is capable of broadband measurements of X-ray, proton, and electron spectra with high time resolution and a very wide Field-Of-View.

The surface of Mercury is bombarded with intensive solar X-rays and particle radiation, which make the Hermean surface glow in X-rays. Changes of the input radiation are due to solar activity and eruptive phenomena on the Sun. We are dealing with X-ray and particle radiation that varies unpredictably with time scales from seconds to years and several orders of magnitude in intensity. Also the spectral distribution changes along with the intensity. X-rays are emitted isotropically from the Sun to the dayside surface of Mercury. The paths and energies of particles, on the other hand, depend on the solar magnetic field and are affected by the magnetosphere of Mercury. Thus, the relations between particles observed by BepiColombo and those hitting the surface of Mercury below the S/C are complicated, depending on the orbital phase and position of BepiColombo in the Hermean magnetosphere.

The X-ray glow of Mercury follows the changes of input by the Sun, and provides a “Hermean signature” in the form of fluorescence. The primary task of SIXS is to make observations that are derivable to accurate physical estimates of solar X-ray,

proton and electron irradiation at the surface of Mercury. The surface is simultaneously observed by the Mercury Imaging X-ray Spectrometer (MIXS), a closely linked instrument provided by Dunkin et al. for BepiColombo. Data provided by SIXS is mandatory for a valid fluorescence analysis of MIXS spectra. The solar X-ray monitor is also the single source of this necessary data in orbital phases of Mercury when the planet is behind the Sun. SIXS data may also be of use for other science instruments onboard BepiColombo, which are affected by particle radiation via changes in performance or anomalies in data.

Independent scientific objectives for SIXS are studies of temporal and spectral variability of solar X-ray corona, temporal behaviour and X-ray spectral classification of solar flares, and temporal and spectral variability of proton and electron radiation near Mercury. These will be obtained as bonuses, when the main task for the instrument is performed.

The baseline of the design and functionality for the X-ray detector of SIXS is heritage of the X-ray Solar Monitor (XSM) on-board SMART-1, delivered by the University of Helsinki, the leading institute of present proposal. A similar detector has also been delivered for the X-ray solar monitor of NASA's Mercury mission Messenger, and another application of the SMART-1 XSM concept is the X-ray Solar Monitor planned for the Chandrayaan-1 mission to the Moon by India (ISRO). Significant development is needed for the present X-ray solar monitor, however, to meet the requirements for BepiColombo, and thus the proposed SIXS instrument will be a completely new design.