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The Mercury Imaging X-ray Spectrometer (MIXS) on BepiColombo

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The Mercury Imaging X-ray Spectrometer (MIXS) on the European Space Agency's Mercury Planetary Orbiter (MPO), part of the BepiColombo mission to Mercury, is designed to determine the surface composition of the planet by means of fluorescent X-ray spectroscopy. The Solar Intensity X-ray Spectrometer (SIXS: J. Huovelin, University of Helsinki, PI) is the essential monitor of the solar X-ray flux which, along with solar wind protons, excites the characteristic K-series lines of the elements present in surface material. MIXS is also concerned with the interaction of the solar wind with Mercury's magnetosphere and exosphere which is expected to produce intensive emission of continuum X-rays.

The MIXS-T channel of the BepiColombo instrument features the first true imaging X-ray telescope to be used in planetary science – realised using microchannel plate (MCP) optics manufactured by Photonis SAS (Brive, France). MIXS-T will have an angular resolution of 2-4 arcminutes, sufficient to resolve surface features, dependent on solar flare state, smaller than $\sim$20 km across. A second, conventional non-imaging collimated channel is provided by MIXS-C with superior grasp to MIXS-T, but no spatial resolution on scales less than the field-of-view. The detectors for both channels are 64 x 64 pixels in a macropixel DEPFET active pixel sensor geometry (Max Planck Semiconductor Laboratory, Munich). The energy resolution of these devices is expected to be sufficient to resolve the K series lines of all the elements of interest. An excellent low-energy detector response opens up the possibility of measuring Fe abundance from the L-alpha line at 0.7 keV.

We present calculations of the expected X-ray count rates from Mercury's surface for various solar flare states and mission parameters for the major rock-forming elements and describe in detail the resultant opportunities for multi-scale surface science.