Study of the PSF of MAPX, a Mapping X-Ray Fluorescence Spectrometer for Characterizing Rocks on Mars and Asteroids

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MapX will provide elemental imaging at ≤100 μm spatial resolution over 2.5 X 2.5 cm areas, yielding elemental chemistry at or below the scale length where many relict physical, chemical, and biological features can be imaged and interpreted in ancient rocks . In addition to Mars lander and rover missions, MapX could be used for landed science on other airless bodies (Phobos/Deimos, Comet nucleus, asteroids, the Earth's moon, and the icy satellites of the outer planets, including Europa.

MapX is a full-frame spectroscopic imager positioned on soil or regolith with touch sensors. During an analysis, an X-ray source (tube or radioisotope) bombards the sample surface with X-rays or α-particles / γ-rays, resulting in sample X-ray Fluorescence (XRF). Fluoresced X-rays pass through an X-ray lens (X-ray μ-Pore Optic, "MPO") that projects a spatially resolved image of the X-rays onto a CCD. The CCD is operated in single photon counting mode so that the positions and energies of individual photons are retained. In a single analysis, several thousand frames are stored and processed. A MapX experiment provides elemental maps having a spatial resolution of ≤100 μm and quantitative XRF spectra from Regions of Interest (ROI) 2 cm ≤ x ≤ 100 μm. ROI are compared with known rock and mineral compositions to extrapolate the data to rock types and putative mineralogies.

The MapX geometry is being refined with ray-tracing simulations and with synchrotron experiments at SLAC. A flow-down of requirements for both tube and radioisotope sources is being developed from these experiments.