Geophysical Research Abstracts
Vol. 14, EGU2012-14079, 2012
EGU General Assembly 2012

Indirect Observations of Mercury's Magnetosphere by MESSENGER XRS

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We have studied X-ray Spectrometer (XRS) observations in the first release of MESSENGER data onto the Planetary Data System archive, and find a significant spatial correlation between background spectral features (i.e. peaks unrelated to the planetary surface) and the structure of Mercury's magnetosphere revealed by the MESSENGER magnetometer.

Data from the first two months of orbital operations show characteristic strong peaks in XRS count rates in the majority of orbits shortly before and after periapsis; the locations of these features in three dimensions coincide with the predicted position of key magnetospheric features. Of the two distinct zones of XRS background enhancement, the first lies on the spacecraft's inbound trajectory at high latitudes and relatively high altitudes, while the second corresponds to the outbound trajectory at low altitudes close to the magnetic equator. We interpret the first enhancement region as MESSENGER's crossing of the bow shock and magnetopause and the second to the crossing of the equatorial plasma sheet. XRS energy spectra during these events show strong evidence of instrumental self-fluorescence, including the K-shell lines of Al and Mg (from the bandpass filters in two of the three XRS counters), of Cu (from the collimator blocks) and of Ti (from the detector bodies), all presumably excited by a low-energy trapped charged particle population.

We note finally that the strongest examples of these enhancements cluster in an equatorial region at approximately 1800h local Mercury time and discuss possible origins of this feature.