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Heavy Ion Composition of Mercury's Magnetosphere

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We modeled the exospheric densities for sputtering and thermal desorption in detail for the time period of the first MESSENGER flyby of Mercury. From the exospheric densities we calculate ion production rates. These ions will be transported to the location of MESSENGER if they are produced on magnetic fields lines connecting the cusp with the downwind side. From these ions we produce mass spectra that we compared with the Fast Imaging Plasma Spectrometer (FIPS) measurements performed during this flyby. We find good qualitative agreement between the modeled and the measured ion mass spectrum. We find that sputtering is a major process to contribute to the ion population in the magnetosphere because of the large scale height of the exospheric particles, and the resulting long flight times. In addition, thermal desorption of Na contributes significant amounts to the magnetospheric ion population. From the volatile species we can identify He, OH, H_2O, and Ne in the measured mass spectrum. However, for most of the volatile species the reported upper limits must be reduced by 2 – 3 orders of magnitude to be compatible to the measured ion spectrum.