Monte Carlo test-particle model of Mercury's ionized exosphere: Global structure and dynamics

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The Mercury plasma environment is enriched in heavy ions (mass-per-charge ratio m/q > 4) from photo-ionization of the tenuous exosphere. The MERCURY Surface, Space ENvironment, GEOchemistry, and Ranging (MESSENGER) time-of-flight spectrometer Fast Imaging Plasma Spectrometer (FIPS) has detected many planetary ion species of which He⁺, the Na⁺-group (including Na⁺, Mg⁺, and Si⁺) and the O⁺-group (including O⁺ and several water group ions) are the most abundant. The Mercury Atmospheric and Surface Composition Spectrometer (MASCS) UltraViolet and Visible Spectrometer (UVVS) has also detected Ca⁺ ions in the nightside plasma sheet. Models of the planetary ion distribution inside Mercury's magnetosphere have mostly concentrated on the abundant Na⁺ and H⁺ ion populations. Comparison with FIPS data has been limited to the first two MESSENGER flybys and no comparison has been made with MASCS/UVVS observations.

We have developed a Monte Carlo test-particle model which describes the ion density distribution produced from photo-ionization of several neutral species in Mercury's exosphere. The global ion density and energy distribution of Ca⁺, Mg⁺, Na⁺, O⁺, and He⁺ will be presented here. We will review the influence of the interplanetary magnetic field (IMF) Bₓ and Bᵧ components on the global structure of the ion density distribution, the composition of the nightside plasma sheet and the evolution of the Na⁺ ion density along the Mercury year.