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Density, Energy and Phase Space Density Distribution of Planetary Ions He⁺, O⁺ and Na⁺ in Mercury's Magnetosphere

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The Mercury plasma environment is enriched in planetary ions from the tenuous neutral exosphere. We have developed a test-particle model which describes the full equation of motion for planetary ions produced from photo-ionization of the neutral exosphere. The new test-particle model is coupled to a Monte Carlo test-particle model of the neutral exosphere (Exospheric Global Model; EGM; Leblanc et al. 2017) and two hybrid-kinetic models: LatHyS (Modolo et al. 2016) and AIKEF (Müller et al. 2011). This coupling will allow us to consider the impact of non-adiabatic energization on the ion density distribution as well as the connection to seasonal asymmetries in the neutral exosphere.

We compare the density, energy and phase space density distribution of He⁺, O⁺ and Na⁺ from our model with observations from the MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) time-of-flight spectrometer Fast Imaging Plasma Spectrometer (FIPS; Raines et al. 2013). Our results indicate the presence of several interesting high-density structures both inside and outside FIPS observable energy range ($E = 0.05 - 13$ keV), the properties of which are likely very sensitive to the upstream solar wind conditions. We present how these results may aid the interpretation of FIPS data and future measurements by BepiColombo.