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Escape rates and variability constraints for high energy sodium sources at Mercury

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Abstract

We present 3D time-dependent modeling of Mercury's extended sodium exosphere to address new data sets describing the distant neutral tail. These sodium atoms are liberated from the planet's surface by photon-stimulated desorption, ion sputtering and micrometeoroid impact vaporization, ejected at energies capable of escaping Mercury's gravity via substantial aid from solar radiation pressure. Escape rates of these source processes in Mercury's exosphere are determined, and the effects of orbital motion, surface-gas interactions, variable source rates, and spatially heterogeneous sources are explored. More substantial losses of the exosphere than previously considered are needed to match the observed sodium D line brightness in wide-field measurements of Baumgardner et al. (2008) and Schmidt et al. (2010). A simulation of a short-term pulse in high energy sources leads to constraints on the potential detection of variable ejection rates at the surface. Wide-field observations of high energy sodium at Mercury, combined with time-dependent numerical modeling using Monte Carlo techniques, form a powerful tool in our understanding of tenuous surface-bound exospheres.

References

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