Implications of MESSENGER Observations for Models of Exospheric Magnesium

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The presence of magnesium in the exosphere of Mercury was detected during the second and third flybys of Mercury by the MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft. Modeled fits to the data obtained during the second flyby indicate that energetic processes, such as sputtering and photo-dissociation of a Mg-bearing oxide, must provide most of the exospheric population at altitudes exceeding 100 km. Closer to the surface, observations from this flyby indicate an additional colder, gravitationally bound source, or a non-uniform impact source associated with a meteoroid stream at dawn. Measurements made during MESSENGER's third Mercury flyby constrain the scale height to 2160 km over the southern pole; over the northern hemisphere, the measured emission profile is suggestive of a spatially extended source that may be related to a finite lifetime against dissociation. These observationally derived inferences are examined by means of exospheric transport models in order to assess whether any combination of proposed source and loss processes can describe the data obtained during the two flybys in a consistent fashion.