



MESSENGER Observations and Models of Exospheric Magnesium on Mercury on the Eve of Orbit Insertion

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Magnesium was detected in the exosphere of Mercury during the second and third flybys of Mercury by the MERcury Surface, Space ENVironment, GEOchemistry, and Ranging (MESSENGER) spacecraft. As MESSENGER prepares for orbit insertion this March, it is useful to summarize what has been learned from flyby measurements for this species. Comparison to a large number of exospheric transport models have suggested the following possibilities: (1) scale-height arguments imply the presence of at least two distinct temperatures; (2) energetic processes, such as micrometeoroid impact vaporization, ion sputtering, and photo-dissociation of a Mg-bearing oxide, must provide most of the exospheric population at high altitudes, but no single process dominates; (3) given the replenishment rates of the surface by gardening, the lifetime of the putative molecule may not exceed ~ 100 s in order to provide the needed rates; and (4) at low altitudes, thermal processes appear to act on a limited reservoir of volatiles that may be provided by recycled atoms from hot processes. We discuss how planned MESSENGER orbital-phase observations can validate or refute these inferences, and what laboratory experiments can quantify needed physical parameters such as velocity distributions, lifetimes, and the interaction of adsorbed Mg particles with the surface.