Variations of Magnesium in Mercury's Exosphere

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Sodium (Na) and calcium (Ca) have been observed in Mercury's exosphere with ground based observations, however the Mercury Surface, Space ENvironment, GEochemistry and Ranging (MESSENGER) spacecraft was the first to detect magnesium (Mg), while also bringing unprecedented measurements of Na and Ca as well. Using the Ultraviolet and Visible Spectrometer channel on the Mercury Atmospheric and Surface Composition Spectrometer, nearly daily observations of Mg, Na, and Ca emissions were made from March 2013 to April 2015.

Merkel et al. (2016) describe and analyze MESSENGER's Mg observations. They find that the Mg emission from Mercury's exosphere show spatial and temporal variations. They observe an enhancement at the dawn terminator, between 6 and 10 am, and they further find that the emission peaks at perihelion. Such variations have also been observed in Na and Ca emissions in Mercury's exosphere. Proposed production mechanisms for these elements include ion sputtering, dissociation, and micrometeoroid impact vaporization. By calculating the Mg characteristic temperature and density, Merkel et al. (2016) show that the temperatures are consistent with micrometeoroid impact vaporization being the dominant process. While micrometeoroid flux enhancements have been observed at Earth and at the Moon, it has not yet been observed at Mercury.

While these variations have been observed in Na, Ca, and Mg, the three have however not been compared to each other. To extend this work, I will obtain production rate data for Ca and Mg (I am excluding Na because of a lack of published Na MESSENGER data), as a function of true anomaly and compare them. Since these two atoms should have different reaction timescales, if they are produced by meteoroid impact vaporization, we would expect a time lag between enhancements for each atomic species. In comparing the flux measurements as it varies with true anomaly, I will search for any systematic offset and try to relate it to the ejection process.

Finally, Killen and Hahn (2015) model the variations with true anomaly of Ca in Mercury's exosphere with a dust-disk model. I will apply a simplified version of their model to the Mg measurements and compare the results to the Ca results.

References

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