CORRELATION OF MERCURY’S MAGNESIUM EXOSPHERE WITH MICROMETEOROIDS FROM JUPITER FAMILY COMETS. M. Sarantos1 (menelaos.sarantos-1@nasa.gov), P. Pokorny1,2, D. Janches1, and the MESSENGER UVVS Team. 1Heliophysics Science Division, NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA 2Department of Physics, The Catholic University of America, Washington, DC 20064, USA.

Introduction: New observations from the MESSENGER mission enable us to constrain the physical processes that contribute to the Hermean exosphere. By understanding the processes that promote and deplete Mercury’s exosphere, we learn about other objects in the solar system where similar conditions exist. Such objects include asteroids and the moons of Earth, Mars, Jupiter and Saturn.

Measurements by MESSENGER of key exospheric constituents in Mercury’s atmosphere have suggested that meteoroid impact vaporization may be an important source process for these gases as altitude profiles are consistent with temperatures expected from meteoroid impacts [1, 2]. However, several features of these measurements remain unexplained. For instance, Ca, the most refractory of these elements, appears to have a peak in gas density almost always at dawn, but Mg, a chemically related species, appears to peak around mid-morning. We wish to understand what processes are responsible for these differences.

Methods: We analyzed measurements of Mg in Mercury’s dayside and nightside exosphere obtained by the UltraViolet and Visible Spectrometer (UVVS) on MESSENGER. The key improvements over the state-of-the-art come from 1) the availability for the first time of a dynamical model of the zodiacal cloud, which includes meteoroids from Jupiter Family, Halley Type and Oort Cloud Comets, and which predict where meteoroids arrive at Mercury [3], with what velocity distribution, with what distribution in latitude and local time, and how this changes with Mercury’s True Anomaly Angle (TAA); and 2) the application of a unique physics-based tomography technique [4] which enables us to derive the spatial dependence and magnitude of the number flux of neutral Mg leaving Mercury’s surface from UVVS sightlines.

Results: Meteoroids from long-period comets (Halley-type and Oort Cloud Comets) arrive at the apex of Mercury’s motion, whereas meteoroids from short-period comets (Jupiter Family Comets, or JFCs) arrive at different local times during different Mercury TAs. When Mercury is heading towards the Sun (TAA>180°) most JFC meteoroids impact the dayside near the subsolar point. During this leg we find that the Mg exosphere peaks well sunwards of its usual 8 AM peak, and the local time of the peak Mg density varies with TAA in the same way as the modeled vapor from JFC meteoroids [Fig. 1]. This result suggests that measurements of Mercury’s exosphere may be used to probe meteoroid populations in the inner Solar System.

Fig 1: Model-predicted micrometeoroid arrival directions from Jupiter Family Comets (vapor shown in blue contours) agree with Mg atom efflux derived from UVVS data (color-coded flux as a function of latitude and local time). Units indicate the number flux (Mg atoms/cm²/s) leaving the surface and with what temperature.