MESSENGER Orbital Observations of Mercury’s Hydrogen Exosphere. R. J. Vervack, Jr., D. M. Hurley, W. Pryor, and R. M. Killen, Johns Hopkins Applied Physics Laboratory, 11100 Johns Hopkins Rd., Laurel MD 20723, USA (ron.vervack@jhuapl.edu), Central Arizona College, Coolidge AZ 85128, USA, NASA Goddard Space Flight Center, Greenbelt MD 20771, USA.

Introduction: Because of the difficulty of remotely observing H Lyman α emission at Mercury, the MESSENGER mission afforded the first chance since Mariner 10 to investigate in detail the hydrogen exosphere of Mercury. Mariner 10 discovered H at Mercury [1-2], but raised questions about the puzzling temperature and density distributions seen in the data. In particular, altitude profiles revealed a two-component distribution for H, with a 420 K “warm” component at high altitudes and a 110 K “cold” component dominating below 300 km [2]. Because Mariner 10 data were limited to flyby observations, an understanding of this distribution, including the mechanism of release for the two components, has remained a mystery.

Observations: Dayside limb observations during the MESSENGER flybys of Mercury suggested that the H exosphere was grossly similar to what was observed by Mariner 10, but with higher overall emission levels [1]. A more complete set of observations of H Lyman α emission was obtained during the orbital phase of MESSENGER, which spanned nearly 17 Mercury years. The Ultraviolet and Visible Spectrometer (UVVS) [4] onboard MESSENGER regularly conducted observations of the H Lyman α emission. It is important to note, however, that H Lyman α can come from three sources at Mercury: exospheric emission, scattered solar H Lyman α from the dayside surface, and background interplanetary H Lyman α (IPH). Accounting for these effects is crucial to proper interpretation of the exospheric signal.

To mitigate the effects of the IPH background, this analysis focuses on observations for which the pointing was inertially fixed. In these cases, the IPH is essentially constant during the observation, allowing determination of an IPH level far from the planet that can be subtracted from all of the measurements to yield an altitude profile.

Altitude profiles determined in this manner have been summed over the entire orbital phase and binned by local time to give a global picture of the H exosphere, as illustrated in Figure 1. Each point shown represents the average of at least 100 individual measurements. H Lyman α is brightest at morning local times, with slightly lower emission intensities in the evening and much lower emission levels on the nightside.

Figure 2 shows the altitude profile of emission integrated along the lines of sight for one set of observations. A Chamberlain model (green) is fitted to the data using two components with temperatures of 400 K (red) and 100 K (blue), chosen to approximate the Mariner 10 temperatures. Clearly, this model is a good match to the MESSENGER profile. The altitude profile shown in Figure 2 is representative of the MESSENGER observations, indicating that the two temperature populations are a persistent, real feature of Mercury’s H exosphere.

We will present a complete analysis of the H altitude profiles, with an emphasis on changes in the two components on both local-time and seasonal timescales.

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