THE MARTIAN HOT OXYGEN CORONA: FIRST RESULTS FROM MAVEN IUVS. J. Deighan[1], M. S. Chaffin[1], J-Y. Chaufray[2], A. I. Stewart[1], N. M. Schneider[1], W. E. McClintock[1], J. T. Clarke[3], G. M. Holsclaw[1], and B. M. Jakosky[1], [1]LASP, University of Colorado (1234 Innovation Dr., Boulder, CO 80303, USA, justin.deighan@lasp.colorado.edu), [2]LATMOS/CNRS (Université Pierre et Marie Curie, boîte 102, 75005 Paris, France), [3]Center for Space Physics, Boston University, Boston MA USA

Introduction: The planet Mars currently maintains a very thin, cold, and dry CO_2 atmosphere. However, the surface displays abundant chemical and morphological evidence that a thicker, warmer atmosphere capable of supporting liquid water for extended periods of time was present in the distant past. In order to understand the removal of this atmosphere over the history of the Solar System, the loss mechanisms active at the current epoch must first be well characterized.

One of the most important atmospheric loss mechanisms from modern Mars is the non-thermal escape of atomic oxygen to space. Energized by photochemical reactions in the upper atmosphere, a fraction of this so-called "hot" oxygen population can achieve escape velocity, while the remainder forms a gravitationally bound corona around the planet. Observing the hot oxygen corona is challenging due to its tenuous nature [1–3].

The MAVEN (Mars Atmosphere and Volatile EvolutioN) mission is specifically designed to study the upper atmosphere of Mars and active mechanisms of loss to space. Its IUVS (Imaging UltraViolet Spectrograph) instrument [4] is the most powerful UV instrument ever deployed to Mars, and is now making regular observations of the hot oxygen corona up to a few thousand km. Here we describe these observations and present the first scientific results.

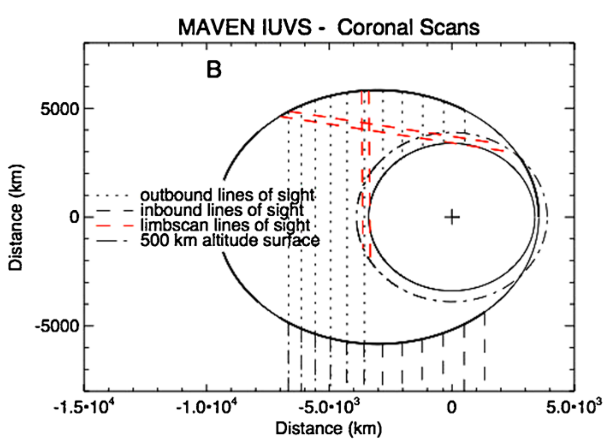

Figure 1: Geometry of nominal IUVS coronal scans. The hot oxygen corona is measured during the outbound segment at altitudes > 500 km.

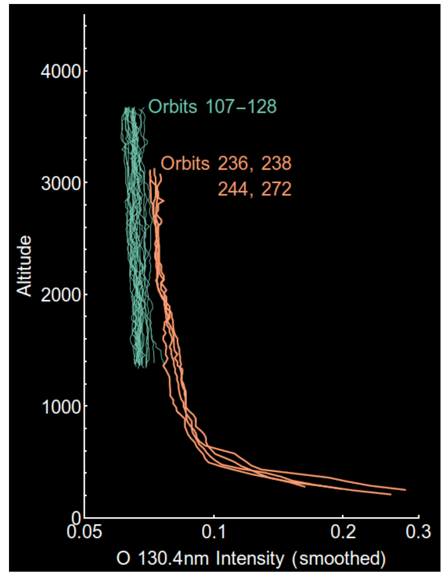

Figure 2: O 130.4 nm relative brightness profiles (arbitrary x-axis). Orbits 107–128 sample night hemisphere and contain little signal. Orbit 236 and later observe the day hemisphere where the corona is dense. Note the transition from thermal to hot oxygen at 500 km in the profile slope.

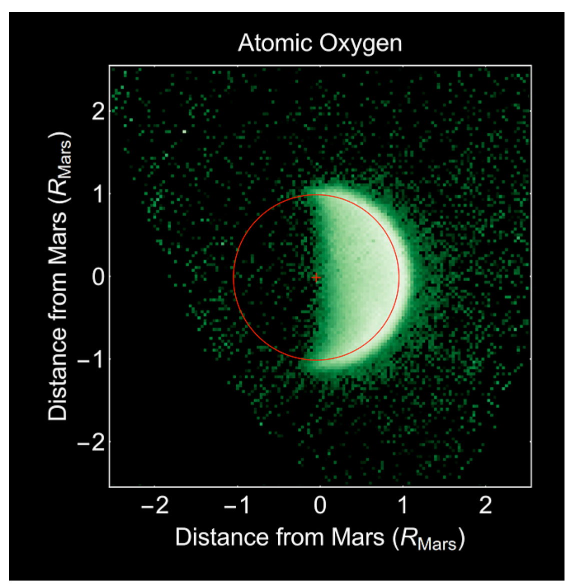

Figure 3: Map of oxygen from the MAVEN 35 hour period orbit. The red circle indicates the surface of the planet. The sunward direction is toward the right. Note the clear transition from day to night hemisphere.

Observations: When making nominal coronal observations on the sides of the MAVEN orbit, the IUVS line of sight is aligned with the orbital semi-minor axis. Integrations are taken every 15 seconds with tangent point altitudes ranging from approximately 300–3600 km (Fig. 1). Illumination conditions change markedly over the course of the MAVEN primary mission, with the solar zenith angle at the tangent point varying from 40° to > 90°. Example coronal profiles of the relative brightness for the O 130.4 nm emission feature are shown in Fig. 2.

In addition, a unique coronal mapping observation was performed while MAVEN was in its 35 hour period insertion orbit (Fig. 3). This provided a global perspective not possible during the nominal 4.5 hour orbit.

Modeling: At the altitudes probed by IUVS, the hot O corona population is dominated by gravitationally bound atoms. Thus, a model is required to infer the escaping population and derive oxygen escape rates. A preliminary comparison of the obervations is made with a 3D Monte Carlo hot oxygen transport model [5]. Collisions with thermal CO_2, N_2, CO and O in the thermosphere are considered. For this initial analysis thermospheric conditions are assumed to be globally symmetric.

References: [1] Chaufray J. Y. et al. (2009) *JGR*, 114, E02006, [2] Feldman et al. (2011) *Icarus*, 214, 394–399, [3] Bhattacharyya D. et al. (2014) Mars 8th Int. Conf., #1287, [4] McClintock et al. (2014) *Space Sci Rev*, [5] Deighan et al. (2013) AAS, DPS meeting #45, #313.23