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New observations of the topside ionosphere at Mars

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The daytime Martian ionosphere consists of a main layer M2 at typically 135 km altitude and a secondary layer M1 at 110 km altitude, both formed by solar radiation at EUV and X-ray, respectively. The peak altitudes and peak densities vary according to the diurnal changes in solar zenith angle as expected when under solar control. These layers are controlled by photochemical processes and can be represented as Chapman layers. However, the topside ionosphere is more complex and difficult to model. It is affected by plasma transport due to dynamical processes and changing ion chemistry (increasing amounts of O+ ions, as observed by the Viking Landers). New Mars Express Radio Science experiment MaRS observations show the transition from the region around the photochemically-controlled EUV peak, which is effectively an O2+ Chapman layer, to the topside in great detail. We discuss how these observations can be used to better understand the complex topside ionosphere, relating them to Mars Global Surveyor observations and predictions from numerical models. Vertical profiles of excess topside electron density have shapes that resemble a Chapman function. We shall investigate whether these shapes are caused by photochemical processes or the transition to a transport-dominated region.