



Unusually strong oblique reflections observed by the Mars Express MARSIS instrument and their causative mechanisms

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The Mars Advanced Radar for Subsurface and Ionosphere Sounding (MARSIS) instrument on the Mars Express spacecraft regularly detects the vertical and oblique echoes from the Martian ionosphere. The vertical echoes are from the normal ionosphere, while the oblique echoes due to specular reflections from oblique directions, generally due to ionization bulges in regions of strong crustal magnetic fields. In a MARSIS ionograms, the peak densities of vertical and oblique echoes are in general nearly same.

In this paper, we report the observation of unusually strong oblique echoes detected by the MARSIS instrument. These echoes are observed on 15, 21, 28 June and 10 July, 2007 at solar longitudes of 258°, 262°, 265°, and 273°, respectively. After correcting for dispersion effects, the altitudes of the peak densities are observed at 88 km, 105 km, 112 km, and 121 km, for the four cases, respectively. The maximum peak density in these profiles is $3.6 \times 10^5 \text{ cm}^{-3}$ observed at ~88 km on 15 June, 2007. Interestingly, all these oblique echoes are confined to the region of strongest crustal magnetic anomaly in the Martian southern hemisphere between longitudes of 160° and 190° and between latitudes of 50°S and 60°S. Considering the unusual behavior of these echoes, we searched for causative mechanisms from both top and bottom.

Interaction with solar wind is an important source for such kind of large densities. During this period there is no solar x-ray or UV flux measurements from Mars. Hence we searched for such data from Earth. From Earth based observations, we found no clear signature of solar flares. The Earth-Sun-Mars (ESM) angle during this time is ~ 90°. Considering the large ESM angle, we cannot discard the possibility of such solar flares. In addition, we analyzed the ASPERA-3 data which suggests that these periods correspond to solar active days. Furthermore, the period of these oblique echoes falls just before the onset of a global dust storm on Mars (MY 28), which could influence the densities in those regions. Considering these external factors, from top and bottom, a plausible explanation is offered for the formation of such high density ionization layers at such lower altitudes.