THERMOSPHERIC AND EXOSPHERIC STUDIES OF THE MARTIAN HYDROGEN LYMAN-ALPHA EMISSION

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Introduction:

The Martian exosphere is the collisionless region surrounding the atmosphere. It is mainly composed of atomic hydrogen. These hydrogen atoms are produced in the Martian mesosphere-thermosphere from water vapor dissociation and reach the exobase by vertical diffusion. A small part of these atoms reaching the exobase can escape into the interplanetary medium leading to a net loss of water. Another part does not escape but populates the exosphere forming a hydrogen corona extending to more than 10,000 km above the Martian surface. The hydrogen atoms can be excited from the electronic ground state to first electronic state by solar photons. The following deexcitation produced the strong UV resonant Lyman-α line at 121.6 nm (Fig. 1).

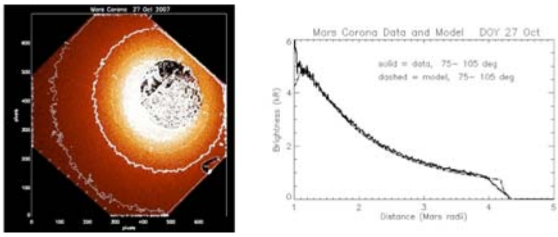

Fig. 1, Left: Example of hydrogen corona image observed by HST with iso-brightness contour (white lines). Right: Brightness profile along the dayside compared to a modeled brightness profile.

A radiative transfer model taking into account multiple scattering is needed to interpret the observations of this optically thick emission and to provide insights on the net atmospheric loss of water (*Chaufray et al. 2008, Chaffin et al. 2010*). Moreover altitude scans of the Lyman-α emission (Fig. 2) can be used to derive the CO_2 density in the thermosphere due to its strong absorption at ~ 110 km (*Chaufray et al, 2010, submitted to Icarus*)

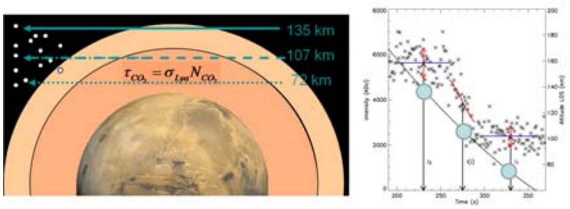

Fig. 2, Left: Cartoon illustrating the geometry of observations of the exospheric+interplanetary emission with a line of sight passing through the Martian thermosphere and a tangent point altitude indicated in blue. Right, Example of temporal brightness profile observed by SPICAM (stars). The evolution of the altitude of the tangent point is indicated by the solid line. Blue dots show altitudes where the emission beyond the tangent point is not absorbed by CO_2 (135 km, τ_{co2} = 0), is partially absorbed (~ 107 km) and totally absorbed (~ 72 km, τ_{co2} ~ ∞).

In this presentation we will present the recent observations of the Martian hydrogen corona performed by SPICAM (*Bertaux et al. 2006*) on Mars Express and the Hubble Space Telescope (*Clarke et al. 2009*), we will estimate the net loss of water deduced from these observations as well as the seasonal variations of CO_2 density in the Martian thermosphere compared to stellar occultations (Fig. 3).

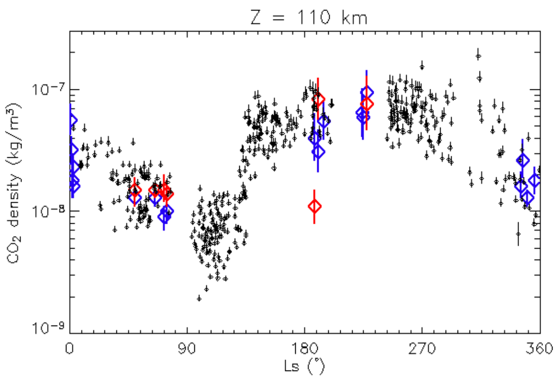

Fig. 3 Seasonal evolution of the CO_2 derived by SPICAM from Lyman-α absorption (blue and red diamonds) and from stellar occultations (black diamonds). Stellar occultation results are from Forget et al. (2009).

References:

Bertaux et al. 2006, JGR, 111, E10S90
Chaffin et al. 2010, DPS
Chaufray et al. 2008, Icarus, 195, 598-613
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