HST OBSERVATIONS OF THE MARTIAN HYDROGEN CORONA.

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Introduction:

HST ACS/SBC UV images of the extended H Ly alpha emission from the Martian hydrogen corona were obtained over Oct/Nov 2007, with coincident measurements of the altitude profile of the Lyman alpha emission by the SPICAM instrument on Mars Express in orbit about Mars. Careful measurement of the geocoronal emission background permit the measurement of the martian emission to a low level (less than 1 kilo-Rayleigh) out to 4 mars radii from the planet. Similar angular distributions of the emission were seen on 3 days of observations, reflecting the radiative transfer in the optically thick atmosphere, while the overall level of emission was seen to steadily decrease in both data sets over ~ 4 weeks time. The altitude distribution of the emission out to large distances can be compared with the results of a radiative transfer model (Chaufray et al., *Icarus*, 2008) that includes an exospheric population of cold and hot H atoms. In general, the dominant population of H atoms close to the planet is consistent with the measured temperature of the upper atmosphere, while far from the planet one has the highest sensitivity to a superthermal component of the exospheric H. Overall, the intensity of the emission decreased steadily over a period of 4 weeks, with relatively little change in the slope of the emission profile. This is best fit by a decrease in the exospheric H number density, more than a change in the temperature of the exospheric H atoms. The comparison with radiative transfer model runs then places limits on changing values of exobase temperature and H number density that can be consistent with the observations. The results will be presented with discussion of the escape rate of H from the martian atmosphere, and how this varied over 4 weeks in Fall 2007.

Details of the Observations:

Images of Mars were obtained with the HST ACS/SBC instrument on 3 days in fall 2007, spaced ~ 2 weeks apart. Observations of the Ly alpha sky background were obtained in each case 5 arc min from Mars, with the same sequence of exposures during the HST orbit as the Mars observations, for an accurate estimate and subtraction of the sky background. We had hoped to observe the presence of superthermal H atoms far from the planet, and the emission profiles are consistent with hot H. We had not expected to see rapid changes in the emission over a few weeks time, shown in Figure 2. We are presently comparing the data with radiative transfer model runs to place constraints on the changes at the exobase level needed to explain the changing H corona. It is worth noting that these observations occurred near L_S = 270 deg, when Mars was moving away from the Sun and the water content of the lower atmosphere decreasing. The H atoms at the exobase ultimately come from photodissociated water in the lower atmosphere. A possible connection between decreasing water abundance near the ground and a "shrinking corona" is intriguing, however we must approach the interpretation of the data carefully.

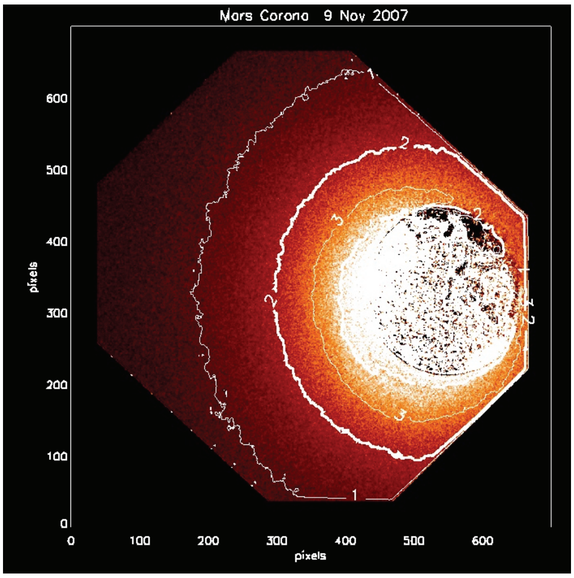

Figure 1: Sample image of the sky-subtracted H Ly alpha emission from Mars on 9 Nov 2007. Contours show the brightness of the emission in kRayleighs. In this view Mars north is up and the sun to the lower left. Mars was offset to the right side of the field of view to observe the extent of the hydrogen corona to larger distances. The disc of the planet appears noisy from the subtraction of a large amount of surface-reflected solar continuum, but above the limb the signal is purely H Ly alpha emission.