

MARTIAN ATMOSPHERE LIMB OBSERVATIONS : 1-ATMOSPHERIC STRUCTURE FROM PFS – MEX MEASUREMENTS

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We present a study of Martian atmospheric limb observations made with the Planetary Fourier Spectrometer (PFS) on board Mars Express mission of ESA. The outbound limb observations of orbit 44 and 72 have been considered. Orbit 44 was at Latitude of 20° N, while orbit 72 was at Latitude of 45° N. The Ls values were 338 and 343 degrees, while the Local time was 1340 and 1330 respectively. The phenomena observed and studied are : CO and CO₂ non-LTE emissions in the wavenumber ranges 2000 – 2400 cm⁻¹. CO₂ isotopic band emissions are also studied , as some bands close to the main isotope bands are observed in emission, while others are not seen. We have searched for CO₂ non LTE emission at 2.7 microns, but only an upper limit for the emission can be given. The CO₂ non LTE vertical (altitude) profile is studied. From the continuum scattered radiation we have studied the vertical profile of the scattering centres: it is found that the spectrum changes with altitude, as the particle size distribution changes, bigger particles disappearing at 60-70 Km altitude, and only smaller particles being present at higher altitudes (up to 120 Km). The profile of some

gases is also studied. It is found that the mixing ratio of CO is increasing with altitude, having a maximum at 30-40 Km altitude. This is interpreted as convolution of the two effects : increasing production rate of the CO by photochemistry with altitude, and decreasing molecular density of CO₂ with altitude due to natural gravitational density profile (CO₂ being the mother molecule being photodissociated into CO). Also H₂O mixing ratio increases with altitude up to 40-50 Km and this fact is interpreted as due to the molecular mass (18 for H₂O against 44 for CO₂). Figure 1 shows the spectrogram of the orbit 72 observations in the wavenumber range 2050 – 2550 cm⁻¹. Figure 2 shows the vertical profile of the measured radiation at 2313 and 2250 cm⁻¹. Figure 3 shows the vertical mixing ratio of CO which has a maximum at 30-40 Km altitude. Figure 4 shows the vertical mixing ratio of water vapour with respect to the CO₂ line intensity at 2080 and at 7000 cm⁻¹. Modelling of the limb observations is needed for the quantitative interpretation of the measurements.

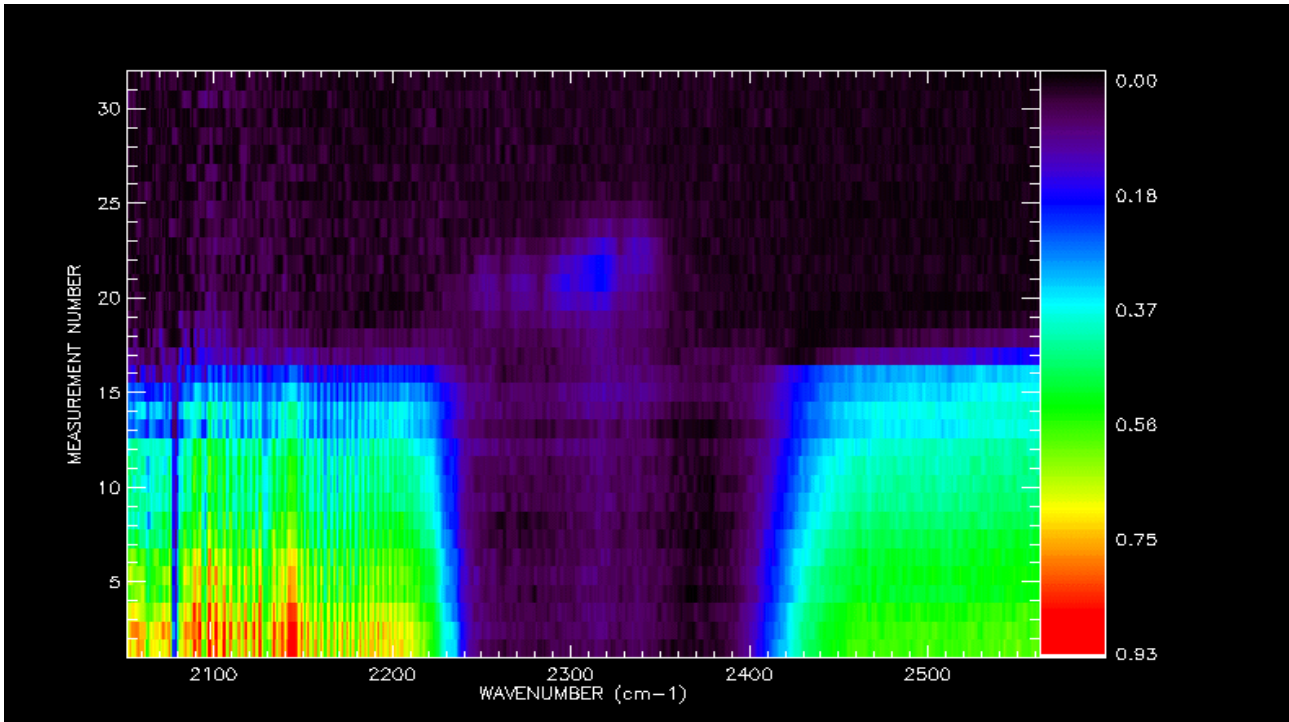


Figure 1 – Spectrogram of portion of the measured spectrum (2050 – 2560 cm^{-1}) for orbit 72. The first measurement out of the planet is measurement number 11.

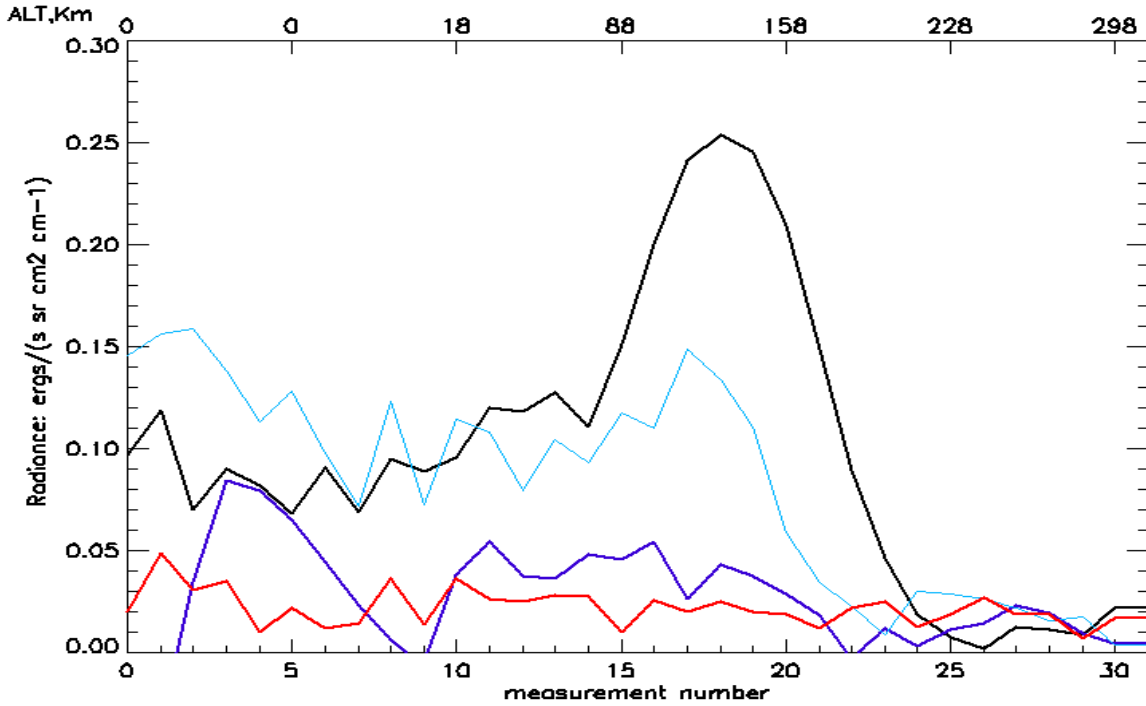


Figure 2 – Behaviour with altitude at limb (orbit 44) of : CO₂ non-LTE emission at 2313 cm⁻¹ (black curve), C13O₂ emission at 2250 cm⁻¹(cyan curve), 2370 cm⁻¹ (CO₂ band minimum, red curve), and 3600 cm⁻¹ (2.7 microns band minimum, blue line). The first measurement out of the planet is measurement number 8.

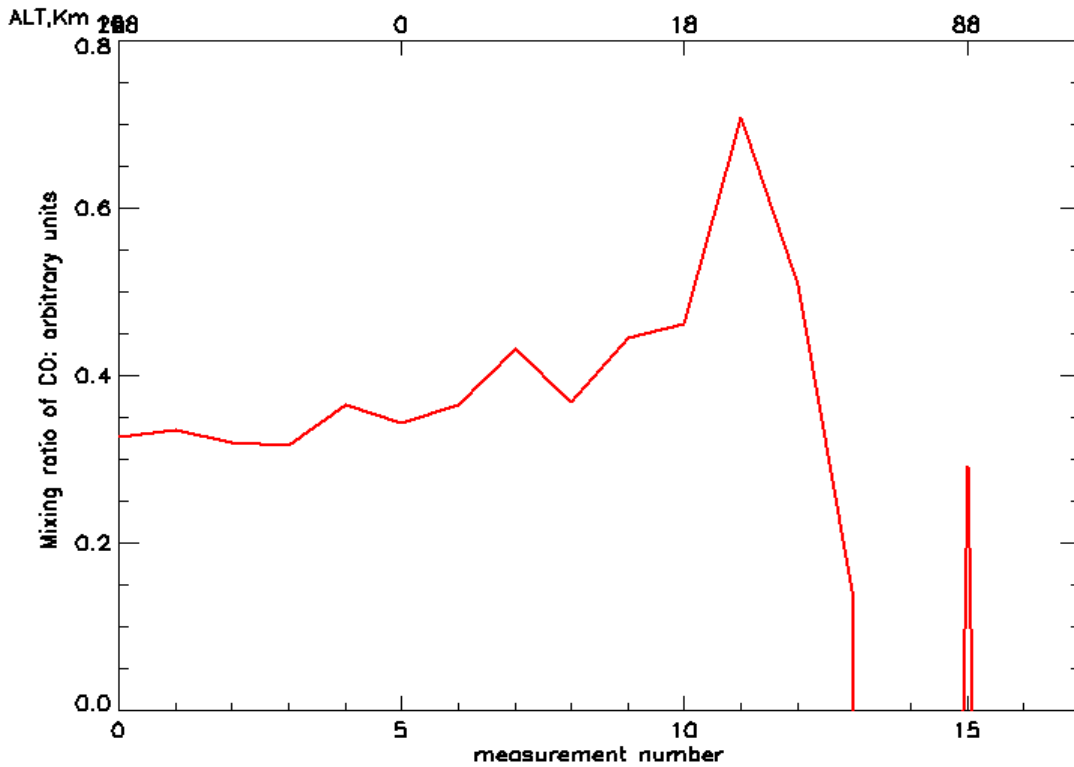


Figure 3- Observed CO to CO₂ abundance ratio for orbit 44 . The first measurement out of the planet is measurement number 8.

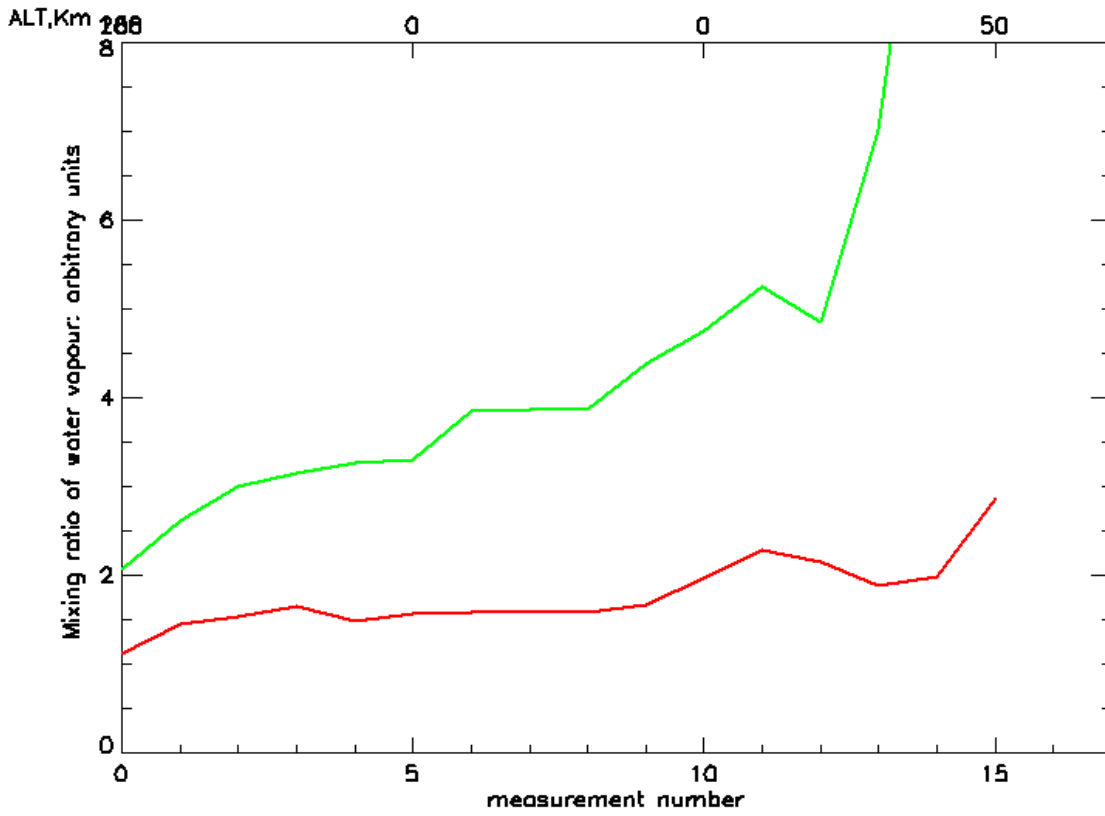


Figure 4- Water lines to CO₂ mixing ratio. Water lines are at 3850 cm⁻¹, CO₂ is at 2080 cm⁻¹ in the green curve, and is at 7000 cm⁻¹ in the red curve. The first measurement out of the planet is measurement number 11 . The mixing ratio has been multiplied by 1000 for both curves. Orbit 72.