The distributions of the OH (Δv=1) and (Δv=2) emissions on the Venus nightside

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Abstract

The presence of OH was detected in the spectrum of the Venus mesosphere observed at the limb with the VIRTIS instrument on board the Venus Express spacecraft [3]. The (1-0) and (2-1) transitions at 2.80 and 2.94 mm, respectively and the (2-0) band at 1.43 mm were clearly identified. The results of this study show that a correlation is observed between the emissions associated to the Δv=1 and the Δv=2 sequences.

1. Introduction

The first identification of the OH airglow in the terrestrial mesosphere was made in 1950 [2]. The reaction between ozone and hydrogen atoms leads to the production of vibrationally excited hydroxyl molecules in the $X^2\Pi$ state. Recently, the unexpected presence of the OH nightglow was observed in the Venus mesosphere by [3] using a limb profile from the Visible and Infra-Red Thermal Imaging Spectrometer (VIRTIS) instrument on board the Venus Express spacecraft. They clearly identified the (1-0) and (2-1) transitions at 2.80 and 2.94 mm, respectively and the (2-0) band at 1.43 mm. Additional bands belonging to the Δv=1 sequence also appear to be present longward of the (1-0) band (Figure 1). The maximum intensity in the limb viewing geometry was 0.88±0.09 MR (1 Rayleigh, R, corresponds to the brightness of an extended source emitting 10^6 photons cm^{-2} s^{-1} in 4π sr) and located at 96±2 km. In a detailed study based on the full set of VIRTIS-M limb observations, [4] found that the mean peak intensity along the line of sight of the OH Δv=1 sequence was $0.35\pm^{0.53}_{0.21}$ MR and was located at 96.4±5 km. The emission is highly variable and no dependence of the airglow layer altitude versus the solar zenith angle is observed. The peak brightness appears to decrease away from the antisolar point even if the variability at a given location is very strong.

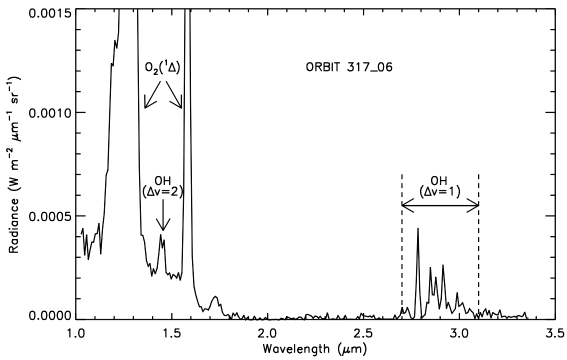

Figure 1: Example of nightside airglow spectrum. The bands between 2.7 and 3.1 µm belong to the Δv=1 sequence of the OH Meinel bands, while the Δv=2 sequence can be identified from 1.40 to 1.49 µm [1].

2. Analysis of the Δv=2 sequence

In this study, we determine the characteristics of the Δv=2 sequence (mean of the peak brightness, mean of the peak altitude). According to a synthetic spectrum from the HITRAN database, the (2-0) emission ranges from 1.40 to 1.49 µm. Limb emission profiles have thus been extracted from the VIRTIS observations using integrated images over wavelengths from 1.40 to 1.49 µm (the procedure is described in [1] and [3]). Sometimes, the OH(Δv=2) peak intensity is too weak to be distinguished from the thermal contribution. For this analysis, a selection has been made to only consider the profiles exhibiting a discernable emission peak. Moreover, a correction of the selected profiles has been applied to remove the contribution presumably caused by scattering of thermal emission by haze [3]. The brightness of the ($\Delta v=2$) sequence emission is compared to that of the ($\Delta v=1$) sequence. The same is made for the altitudes of the peak emissions.

3. Conclusion

First, we note that whenever the OH($\Delta v=1$) emission is observed in a spectrum obtained with VIRTIS, the OH($\Delta v=2$) emission is present as well. We also note a high variability for both emissions. No dependence of the airglow layer altitude versus the antisolar angle is observed either for the $\Delta v=1$ or for the $\Delta v=2$ sequences. The correlation between the brightness of both emissions will be discussed.

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