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The Venus visible oxygen nightglow with VIRTIS on board Venus Express

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Abstract

The oxygen nightglow emissions in the visible spectral range have been known since the early observations with the Venera spacecraft. The more recent observations with the VIRTIS (Visible and InfraRed Thermal Imaging Spectrometer) instrument on board the ESA mission Venus Express, allow a detailed study of the Herzberg II system of O_2, reporting a maximum value of 200 kR for the integrated intensity of the progression. The (0-7), (0-8), (0-9), (0-10) and the (0-11) bands of the Herzberg II system have been identified in the limb geometry observation data. In this work, we present results about the vertical profile of the observed bands, as well as the total integrated intensity of each single band.

1. Introduction

The nightglow O_2 emissions at 1.27 and 1.58 µm have been observed both from ground and from space, the latter favoured also by the recent observations with VIRTIS on board Venus Express. The oxygen nightglow is known to be highly variable and mainly driven by the sub-solar to anti-solar circulation [1, 2]. The maximum of the volume emission rate (VER) is observed close to midnight, at equatorial latitudes, with an emission rate at 1.27 µm of 1.2 MR (1R = 10^6 photons cm^{-2} s^{-1} $(4\pi$ ster$)^{-1}$), while a mean value of 0.52±0.4 MR is obtained on average. The peak of the VER is observed at 97.4±2.5 km, with a full width at half maximum of 7.6±2.2 km, variable with latitude [1].
The oxygen dayglow on Venus was observed in 1975 from ground, with a high resolution spectrometer (spectral resolution ranging from 12 to 50x10^{-3} cm^{-1}, [3]). Subsequent observations failed in detecting it, both from ground and from space.

The Herzberg II system in the visible spectral range was detected for the first time from the Venera 9 and 10 data [4], reporting a value of about 150 R, and subsequently with the Pioneer Venus Orbiter data [2]. Recent observations with VIRTIS allowed to identify 6 bands of the system [5], though only partial information on the vertical profile of these bands has been reported so far.

2. Method and results

To investigate the nightglow properties of the Herzberg II system emissions, data acquired in the so-called limb-tracking method are used. An example of mean spectrum in the 0.3-0.8 µm spectral range is shown in figure 1.

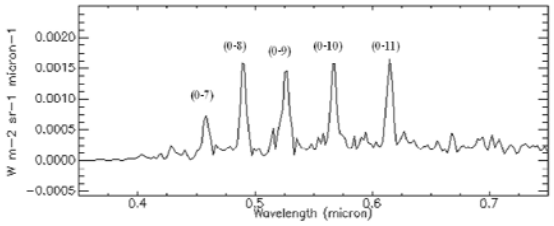

Figure 1. Mean spectrum in the 0.3-0.8 µm range. The (0-7), (0-8), (0-9), (0-10) and (0-11) Herzberg II bands are clearly observed.

The vertical profile in limb view for each single band is recorded. The peak is observed on average at about 95 km of tangent altitude, with a FWHM of about 16 km. An example of vertical profile in limb view is shown in figure 2, for the (0-9) band, centred at 0.52 µm.

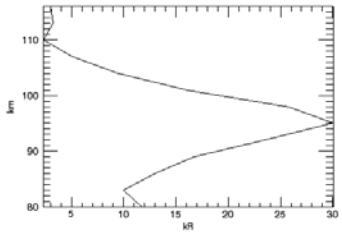

Figure 2. Vertical profile of the (0-9) Herzberg II band, centred at 0.52 µm. The emission is maximum at about 95 km. The shown profile was acquired on 05 November 2011.

In figure 3 the horizontal distribution of intensity of the Herzberg II system is shown. It is obtained as the total integrated intensity of the detected Herzberg II bands. The continuum is estimated for each single band, and subtracted; then the resulting intensities are summed. From the available data, it is not possible to derive conclusions for the moment but the observations are progressing well in the course of the mission, so that it will allow a comparison of these emissions with the mean distribution derived in the case of the oxygen IR nightglow emissions at 1.27 and 1.58 µm [1].

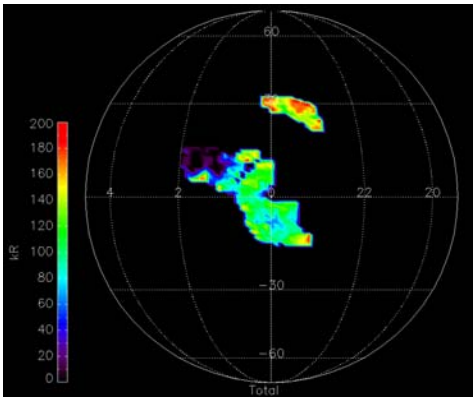

Figure 3. Distribution of the total integrated intensity in the Herzberg II bands, detected on VIRTIS data. The continuum is estimated and subtracted for each single band.

3. Conclusions

The O_2 emissions on the nightside of Venus are reviewed in the present work, focusing on the visible spectral range. The Herzberg II system is investigated, as observed with VIRTIS, where six bands have been identified on the limb-tracking data and analyzed. According to the data acquired so far, the emission for each band is maximum at about 95 km of tangent altitude, on average. The horizontal distribution of this sequence of emissions is continuously constructed along with the acquired data day by day. It will then be possible to compare these data with the O_2 distribution in the IR spectral range already reported in the literature.

Acknowledgements

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References

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