Oxygen Nightglow investigation in the visible spectral range, using VIRTIS/Venus Express data. A. Migliorini[1], G. Piccioni[1], P. Drossart[2], R. Politi[1], M. Snels[3], J.C. Gérard[4], and the VIRTIS-Venus Express Team, [1]IASF-INAF (Via del Fosso del Cavaliere, 100, 00133 Rome, Italy), [2]Obs. of Paris, LESIA (5, Place J. Janssen, 92190 Meudon, France), [3]ISAC/CNR (Via del Fosso del Cavaliere, 100, 00133 Rome, Italy), [4]LPAP (Université de Liège, Belgium)

Introduction: The Herzberg II system was observed in the nightside of Venus by Venera 9 and 10, more than 30 years ago [1]. These are a series of emissions in the spectral range 300-700 nm, corresponding to the molecular oxygen c(0)-X(v'') transition, which are located in the altitude range from 90 to 110 km. Some transitions were observed also from ground, with high resolution spectrometers [2, 3]. Observations with the instruments on board Venus Express allowed to investigate the vertical profile of such emissions, in particular by using data acquired with the VIRTIS imaging spectrometer [4]. In the same spectral region, other O_2 emissions, known as the Chamberlain system, have been identified on the Venera 9 and 10 spectra, and confirmed in the observations by VIRTIS [4]. The present work is dedicated to investigate the vertical profile of the Herzberg II system in more detaile, by using VIRTIS in the limb observing mode. New observations with VIRTIS have been planned and performed with the highest exposure time which is 18 sec, higher than the one experimented in the previous observations and used for the work by [4]. The improved signal to noise ratio allows to detect very weak emissions, to study the intensity of each single band along its vertical profile, the relative band intensity, and potentially the horizontal spatial distribution and variability.

Data analysis: VIRTIS is the imaging spectrometer on board the European Venus Express mission. It is composed of two channels, one in the visible and NIR, called VIRTIS-M, and one in the NIR, called VIRTIS-H. For the present work, we used data acquired with VIRTIS-M. It is composed of two coaligned detectors, operating respectively in the visible (300-1000 nm) with a spectral sampling of 2 nm, and in the NIR (1-5 μm) with a 10 nm spectral sampling. For this study we have used the visible range. The limb observations allow to derive the vertical profile of the emission and the altitude where the maximum of emission occurs. For each band, the integrated radiance has been determined. The continuum level was estimated from adjacent VIRTIS bands and then subtracted. Spectra were selected in the altitude range 92-100 km and an example of a VIRTIS-M spectrum, acquired on October 2009, is shown in Figure 1, as averaged on about 1000 spectra. The (0-7) transition at 0.46 μm, the (0-8) at 0.49 μm, the (0-9) at 0.52 μm, the (0-10) at 0.57 μm and the (0-11) at 0.61 μm are clearly visible in the average spectrum.

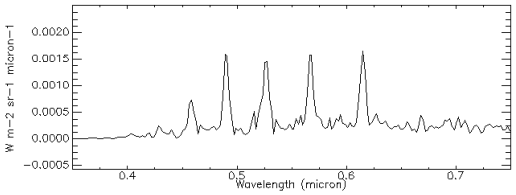

Figure 1: VIRTIS-M spectrum, obtained by averaging about 1300 spectra, acquired on 30 October 2009 in the limb view mode. The Herzberg II progression is clearly visible, with transitions centred at 0.46 μm, 0.49 μm, 0.52 μm, 0.57 μm and 0.61 μm.

Results: Five transitions have been identified on each single image, thanks to the new observations with VIRTIS. For each transition, the profile in the 80-120 km vertical range was computed, with a vertical resolution of 4 km. The peak altitude of each single band is observed at about 95 km (Figure 2). However, slight variations from one transition to another in the vertical profile are observed, though they are not considered significant.

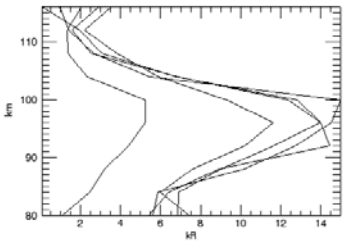

Figure 2: Limb profile of the (0-7), (0-8), (0-9), (0-10) and (0-11) c-X bands. The vertical resolution was smoothed, to avoid spurious features. The maximum of the emission is observed at about 96 km.

The limb profile for the c-X (0-8) band, obtained as the integrated intensity in the 0.48-0.50 μm range, is shown in Figure 3, as an example. The maximum of emission is observed at about 95 km height, derived by fitting the profile with a Gaussian curve. The full width at half maximum (FWHM), estimated from the curve fitting, is about 16 km.

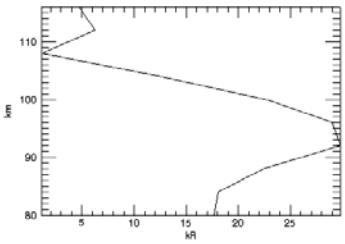

Figure 3: Limb profile of the c-X (0-8) band, integrated over the 0.48-0.50 μm range. The vertical resolution was smoothed, to avoid spurious features. The maximum of the emission is observed at about 95 km height as obtained with a Gaussian curve fit. The FWHM is about 16 km.

The large VIRTIS dataset provides the way to investigate the intensity and distribution of the Herzberg II oxygen nightglow emissions in the visible in great detail. A more global picture of the intensity horizontal distribution and variability of the Herzberg II system can be achieved in the course of the Venus Express mission extension, due to the low increasing with time of the limb observations coverage.

References: [1] Krasnopolsky V.A., Krysko, A.A., Rogachev, V.N., Parshev, V.A., (1977) *Cosmic Res., Engl. Transl., 14,* 687-692. [2] Slanger, T.G., Cosby, P.C., Huestis, D.L., Bida, T.A., (2001) *Science, 291,* 463–465. [3] Slanger, T.G., Huestis, D.L., Cosby, P.C., Chanover, N.J., Bida, T.A. (2006) *Icarus, 182,* 1-9. [4] Garcia-Munoz, A., Mills, F.P., Slanger, T.G., Piccioni G., Drossart, P., (2009) *JGR 114,* E12002.

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