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Recent Observations of Venus' OI and O_2 Emission from Apache Point Observatory

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Abstract

Past observations of the Venusian night glow features O($^1S - ^1D$) at 5577.3 Å (atomic oxygen green line) and O_2 $(a - X)$ $0 - 0$ at 1.27 μm were found to be temporally and spatially variable. We report on the analysis of recent observations of these two features, obtained using optical and infrared spectrographs on the 3.5-meter Astrophysical Research Consortium Telescope at Apache Point Observatory (APO) in December 2010.

1. Introduction

In order to understand the physics of the upper atmospheres of terrestrial planets, we must know about the chemistry occurring in these regions. Observations of nightglow emission provides insight into these chemical processes. Nightglow is caused by recombination of atoms into molecules, or electrons with ions, producing excited molecules and atoms, respectively. Three strong nightglow features present in the Venusian atmosphere are O($^1S - ^1D$) at 5577.3 Å (atomic oxygen green line), the O_2 $(a - X)$ $0 - 0$ band at $1.27\mu m$, and the O_2 $(c - X)$ Herzberg II system lying in the visible spectral region.

The Venera orbiters searched for green line emission in the Venusian atmosphere in 1975 but did not find it [1]. Slanger et al. [2] reported the first detection of the Venusian green line on the night side of Venus using Keck data obtained in 1999. This emission has exhibited temporal variability over periods of days to years, as well as spatial variability over scales of several hundred km as one observes closer to the limb. While the 1.27 μm O_2 $(a - X)$ feature exhibits localized temporial and spatial variability, the disk-averaged intensities found in 1996 by Crisp et al. [3] are comparable to more recent results from Garcia-Munoz et al. [4]. The O_2 $(c - X)$ Herzberg II system has been relatively stable over that period [5].

The variability of the atomic oxygen green line in contrast to the stable O_2 $(c - X)$ Herzberg II system suggests that the Herzberg system is caused by different chemical processes than the green line. This is not the case for Earth, where it is believed that the terrestrial green line and Herzberg system are chemically connected. It has been proposed by Slanger et al. [6] that the oxygen green line variability is related to the solar cycle, as the Sun was at solar maximum in 1999 but is now coming out of a deep solar minimum. To test this theory, we observed Venus at the end of solar cycle 23, one year out of solar minimum.

2. Observations

We acquired optical and near-IR spectra of Venus using the ARCES echelle spectrograph and the Triplespec infrared spectrometer, respectively, on the 3.5-meter telescope at APO. We obtained usable data on the evening of December 21 and 27, 2010. Sky conditions were non-photometric throughout the observing campaign.

We present our detections (or detection limits) of the Venusian nightglow for the O($^1S - ^1D$) line, the O_2 $(c - X)$ $0 - 10$ band and the O_2 $(a - X)$ $0 - 0$ band emissionss, and discuss their significance with respect to nightglow emission mechanisms in Venus' atmosphere.

References

[1] Krasnopolskii, V. A., Krysko, A. A., Rogachev, V. N., Parshev, V. A.: Spectroscopy of the night-sky luminiscence of Venus from the interplanetary spacecraft Venera 9 and Venera 10. Cosmic Research Vol. 14, pp. 687-692, 1977.

[2] Slanger, T. G., Cosby, P. C., Huestis, D. L., Bida, T. A: Discovery of the Atomic Oxygen Green Line in the Venus Night Airglow. Science Vol. 291, pp. 463-465, 2001.

[3] Crisp, D., Meadows,V. S., Bézard, B., de Bergh, C., Maillard, J.-P., Mills, F. P.: Ground-based near-infrared observations of the Venus nightside: 1.27-μm O_2 (aΔ_g)

airglow from the upper atmosphere, Journal of Geophysical Research, Vol. 101(E2), pp. 4577-4593, 1996.

[4] Garcia-Muñoz, A.,Mills, F.P.,Slanger, T.G.,Piccioni, G.,Drossart, P.: The visible and near-infrared nightglow of molecular oxygen in the atmosphere of Venus. J.ăGeophys. Res. Planets Vol. 114, E12002, 2009.

[5] Slanger, T. G., Huestis, D. L., Cosby, P. C., Chanover, N. J., Bida, T. A: The Venus nightglow: Ground-based observations and chemical mechanisms. Icarus Vol. 182, pp. 1-9, 2006.

[6] Slanger, T. A., Chanover, N. J., Sharpee, B, D, Bida, T. A: O/O_2 emissions in the Venus nightglow. Icarus, in press, 2011. DOI:10.1016/j.icarus.2011.03.031.