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The Nightglow Spectrum of Jupiter as seen by the Alice UV Spectrograph on New Horizons

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Abstract

We present the nightside spectrum of Jupiter as seen by the New Horizons Alice UV spectrograph seen after the flyby of March 3, 2007. New Horizons completed four back-to-back scans of the nightside disk. The nightglow spectrum, presented here, is considerably fainter than the nightglow spectrum observed by the Voyager UVS instrument. The Lyman$-\alpha$ brightness during the Voyager mission was variable across the disk and was as bright as 1 kR. The Lyman$-\alpha$ brightness as observed with New Horizons is largely constant across the nightside disk at ~ 240 R. We also compare the New Horizons nightglow spectra to spectral models of the Lyman and Werner bands in order to examine possible sources of the nightglow emission.

1. Introduction

While dayside atmospheric emissions (dayglow) of Jupiter have been studied for many years from Earth, the nightside emissions (nightglow) can not be observed without a flyby or orbital mission. The non-auroral nightglow spectrum as seen by the UV spectrometer on Voyager was quite bright. The Voyager spectrum also showed the He 584 Å line and two unidentified lines at 926 Å and 1570 Å [1]. McConell, Sandel, and Broadfoot [3] also measured Lyman$-\alpha$ intensities from the nightside equator that varied with longitude between 700 and 1000 R. Possible sources of the nightside emission include particle precipitation or scattered interstellar medium Lyman$-\alpha$ [4].

Here we present new nightglow spectra obtained from the Alice UV spectrograph onboard New Horizons [5, 8]. We will also compare our models of the photoelectron and fluorescence Lyman and Werner bands to these nightglow emissions.

2. Observations and Data Reduction

New Horizons made several observations of Jupiter during the flyby encounter, with closest approach on 2007 February 28. The nightside was observed on March 3 in a series of four back-to-back scans of the disk with the Alice UV spectrograph between 06:28 and 09:57 UT. The Alice effective spectral range is from 520 to 1870 Å at a resolution of 1.8 Å/bin. The Alice instrument has 32 spatial channels. During the nightside scans, two spatial channels observed the equatorial (non-auroral) region of Jupiter [2]. The time-tagged data is stored in a series of frames, with the exposure time included in each frame dependent on the count rate. The first disk scan had a larger background count rate (and thus a lower signal to noise) than the subsequent scans. The observed counts in each of these two spatial channels and in each frame were summed and divided by the total scan time across the disk and included a dead-time correction. Alice's slit width is 0.1° and each spectral row covers 0.3° for an observational area of 0.06 sq deg across the two channels. Alice has a wavelength-dependent detector area. A polynomial is fit to the background and subtracted from the spectrum. The Io Torus spectrum, scaled from Cassini observations of Jupiter [7], is also subtracted. The resulting nightglow spectrum from the four scans is shown in Figure 1.

3. H_2 Photoelectron and Fluorescence Spectral Modeling

Our modeling code calculates H_2 Lyman and Werner band spectra using a modified version of the glow code used for Earth airglow modeling [6]. We will compare the New Horizons nightglow emissions to the model spectrum resulting from several different sources of emission. These include scattered light from the inter-

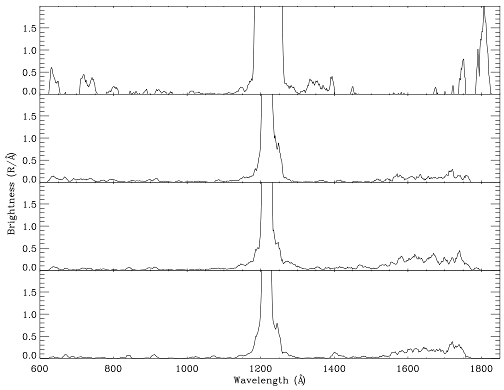

Figure 1: The four scans of the nightside of Jupiter.

planetary medium, scattered light from the limb, and reprocessed emission from lightning.

4. Summary and Conclusions

In contrast to the Voyager observations, the nightglow of Jupiter during the New Horizons flyby is quite faint. The integrated Lyman$-\alpha$ brightness from $1200-1230$ Å is $\sim$ 240 R. An analysis of the He 584 line will be presented. However, the He 584 Å emission line is not detected in the nightglow or dayglow spectrum. It is to be noted that the Voyager 1 and 2 flybys were during solar maximum, while the New Horizons flyby was during solar minimum. It is possible that Jupiter changed in some way between these two missions. Also, the dependence on longitude seen with Voyager is not observed with New Horizons. The Lyman$-\alpha$ flux is largely constant across the face of the disk.

Acknowledgments

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