EPSC Abstracts
Vol. 10, EPSC2015-76, 2015
European Planetary Science Congress 2015

The evidences of latitudinal asymmetry of the ammonia absorption on Saturn

V.Tejfel, A,Karimov, N.Bondarenko, G.Kharitonova
Fessenkov Astrophysical Institute, Almaty, Kazakhstan, (tejf@mail.ru)

Abstract

450 zonal CCD-spectrograms, recorded by scanning the disk of Saturn during its equinox at the beginning of 2009, were processed to find the variation of the absorption band of ammonia NH3 647 nm. This band overlaps with the short-wavelength wing of the absorption band of methane CH4 667 nm, therefore, to highlight the ammonia absorption spectra were used Uranus and laboratory spectra of methane. It was found that ammonia absorption is enhanced in the northern hemisphere of Saturn, as well as relatively weak bands of methane in contrast with stronger CH4 bands [1]. It may indicate on the North-South asymmetry in the density of the deeper parts of the ammonia cloud layer of Saturn .

1. Introduction

The ammonia absorption bands in the visible part of the spectrum of Saturn is much weaker than that in Jovian spectra (Figure 1). They overlap with bands of methane and the selection ammonia absorption so is quite complicated.

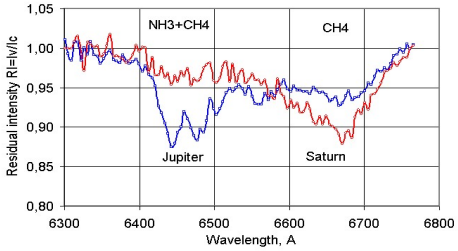

Figure 1: The absorption NH3+CH4 band in the spectra of Jupiter and Saturn

This research was directed to identify possible latitudinal variations of the NH3 absorption Saturn in the equinox 2009 period when both hemispheres of the planet are in equal conditions of lighting and visibility.

2. Observations and processing.

In early 2009 the observations of Saturn were carried out with 0.6-m telescope and diffraction spectrograph SGS . For one night 5-6.01.2009 at the Earth saturnocentric declination -0.8 deg there were recorded 5 series of zonal CCD-spectrograms by scanning the Saturn disk from the south pole to the north. Each scan consisted of 70 spectrograms, so that were received and processed 450 spectra corresponding all latitudinal zones of the planet (Figure 2). To extract the absorption band NH3 647 free of ammonia absorption spectra of Uranus, Saturn's rings were used as well as the calculations based on the laboratory spectra of methane absorption [2].

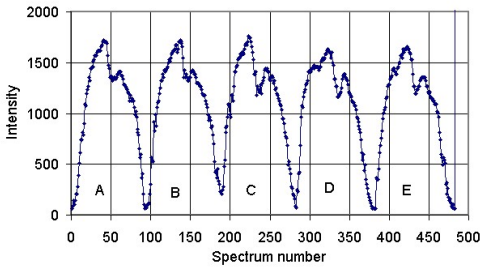

Figure 2: The intensity south-north profiles pf Saturn's spectral scans

.As a result of the spectrograms processing and analysis the atlases pf spectral ratios of individual zones of Saturn's disk to the region in the equatorial zone of the planet were prepared. We also calculated the pairwise spectra ratios for symmetric zones of the northern and southern hemispheres.

3. The hemispheric differences of the NH3 absorption

Analysis of all graphs atlas shows that absorption in the band NH3 647 nm is enhanced in the northern temperate latitudes in comparison with the southern temperate latitudes. Absorption of methane in relatively weak bands is also increased in the northern hemisphere, but, as shown in Figure 3, the ratio of residual intensities RI647 / RI675 in the northern temperate zone is some smaller than in the southern temperate zone. This means an increasing of the NH3 absorption in northern hemisphere.

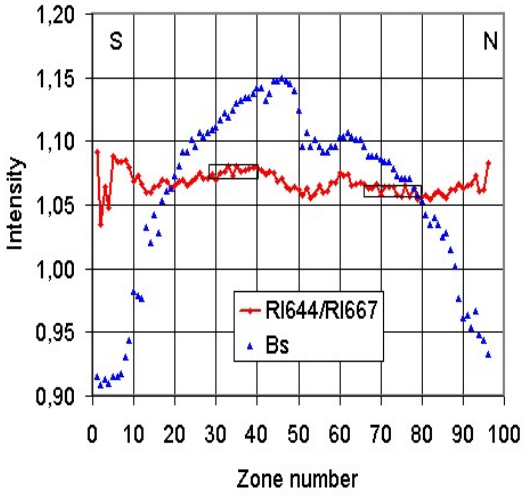

Figure 3: The ratio of residual intensities at 644 and 667 nm for Saturn's zones from South to North.

The ratio of latitudinally averagedon profiles of the absorption bands for the southern and northern hemispheres (RIn / RIs) shows the same result (Figure 4).Although the depth of the ammonia absorption band is considerably less than the depth of long-wave part of CH4 band, it is seen that this ratio for NH3 band indicates a greater difference than the ratio in the region of the pure methane absorption.

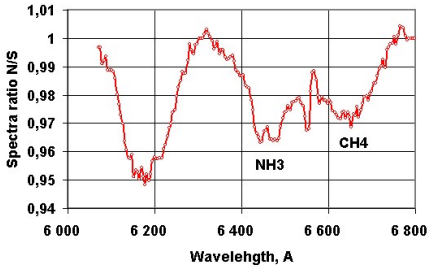

Figure 4: The ratio N/S for latitudinally averaged band profiles

4. Conclusion

The results show that the increased NH3 absorption in Saturn's northern hemisphere coincides with the increase of relatively weak CH4 absorption bands, observed also in the northern hemisphere. At the same time stronger absorption band of methane, for example, 725 nm band, the similar hemispheric difference is not detected. This may be due to a decrease of the volume density and the aerosol scattering coefficient on the large effective optical depths by raising the temperature. In the upper part of the cloud cover the difference in density of the cloud layer apparently absent or much less pronounced. The temperature measurements in the upper troposphere Saturn at the pressure of about 500 mb [3] shows a even decrease in the northern hemisphere, as compared with the south temperate latitudes.

References

[1]. Tejfel V.G. , Karimov A.M., Kharitonova G.A., Kirienko G.A ,Vdovichenko V.D. The hemispheric differences in the methane and ammonia absorptions on Saturn near last equinox in 2008-2010 .Bulletin AAS,Vol.. 42. - P.1021. , 2010

[2]. Dick, K. A.; Fink, U. Photoelectric absorption spectra of methane CH4, methane and hydrogen H2 mixtures, and ethane C2H6 J. Quant. Spectrosc. Radiat. Transfer, Vol.. 18, P. 433-446 ,1977.

[3]. Fletcher, L.N., Achterberg, R.K., Greathouse, T.K., Orton, G.S et al. Seasonal change on saturn from Cassini/CIRS observations, 2004–2009. Icarus, Vol.208 PP. 337–352, 2010.