EPSC Abstracts
Vol. 7 EPSC2012-66-1 2012
European Planetary Science Congress 2012

Saturn after equinox 2009 - some changes of the methane absorption latitudinal variations

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Abstract

The study of latitudinal variations of the methane absorption bands on Saturn was continued in 2010-2012 after the equinox 2009. In the northern hemisphere there is a clearly defined absorption maximum, moving in time from the latitude of 40 degrees to 25-30 degrees. The depression of the absorption observed at higher latitudes is also expanding to the south.

1. Introduction

Last equinox on Saturn occurred in 2009. At this time there was an opportunity to compare the latitudinal distribution of the intensity of the methane absorption bands with observed in the previous equinox in 1995. In contrast to the clearly expressed asymmetry of the absorption in the southern and northern hemispheres in 1995 and 1996 [1] at the time of the equinox in 2009 the difference in absorption between the hemispheres at middle latitudes was almost absent. Before that, when Saturn was tilted toward the Sun by the Southern Hemisphere, there was observed the growth of the absorption in the southern hemisphere as it was seen in the depth of the CH4 725 nm absorption band [2]. The task of our further spectroscopic observations of Saturn was to track changes in the latitudinal distribution of the CH4 absorption with the northern hemisphere of the planet gradual slope to the Sun.

2. Observations

As earlier the basis of our research consists of the spectrophotometric observations with 0.6-m telescope RZ-600 equipped by diffraction spectrograph SGS with the CCD-camera ST-7XE (dispersion of 4.3 A / pixel, the registered wavelength range 580-900 nm). The spectra were recorded mainly from exposures 20 seconds. To increase the accuracy and greater detailing than spectra of the central meridian of Saturn we have used also the method of sequential scans of the planetary disk. The spectrograph slit was located parallel the major axis of the ring. In this case it may be obtained not less than 60-70 spectrograms for one south-north scan. As supporting the spectrum of the ring of Saturn have been used. Comparison of the profiles of the absorption derived from usual central meridian spectra and zonal scan spectra showed similar data. During three seasons of observations more than 4000 CCD-spectrograms were recorded. On the basis of spectral measurements a number of the computer atlases compiled profiles of the absorption bands of methane and latitudinal variations of the absorption were prepared. Their full analysis requests additional time.

3. Results

In Figures 1-3 there are shown the examples of the latitudinal distribution of equivalent widths and depths of several methane absorption bands from spectra of Saturn's central meridian in 2010-2012.

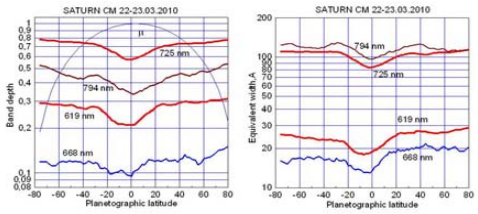

Figure 1: Latitudinal variations of the central depths and equivalent widths of the CH4 absorption bands от Saturn in 2010 Earth declination Be=+3.2 deg..

In early 2010 the planetocentric declination of the Earth Be was about 3 degrees, so that the ring of Saturn, projecting to the disk, had a minor effect on estimates of the parameters of absorption bands, so that the characteristic absorption of Saturn in the equatorial belt is mainly determined by the properties of the cloud layer.

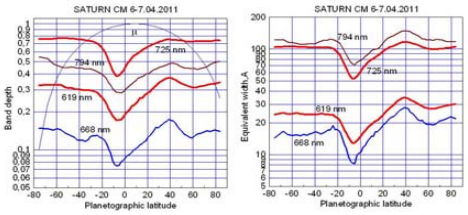

Figure 2: Latitudinal variations of the methane absorption in 2011. Earth declination Be=+8.6 deg.

However, at this time a relative increase in the central depths of the methane bands was noted on equator relatively to temperate latitudes with an increase in Be. Therefore, the most realistic values of the differences should be recognized for the depths of the bands corresponded to the values of Be <1 degree. For the band of CH4 725 nm $\Delta R = 0.12 + / - 0.02$, for the CH4 band 619 nm $\Delta R = 0.055 + / -0.010$. These values may be used to determine the differences in the optical and physical characteristics of clouds at the equator and the temperate latitudes of Saturn in the framework of different models of the cloud layers structure. In later periods the observed increase of ΔR is related to the influence of the ring, and although you can see that the weakening of the absorption is visible also in the equatorial belt outside the ring, the estimates can not be sure.

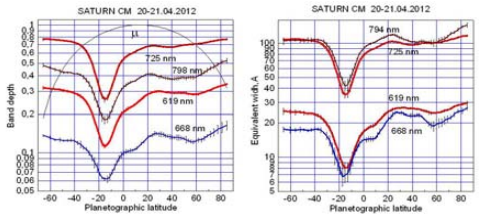

Figure 3: Latitudinal variations of the methane absorption in 2012. Earth declination Be=+13.6 deg.

In the northern hemisphere there is a clearly defined absorption maximum, moving in time from the latitude of 40 degrees to 25-30 degrees. The depression of the absorption observed at higher latitudes is also expanding to the south. It is worth comparing a feature of the equivalent widths of the CH4 absorption bands 619 and 725 nm. Their ratio W619/W725 on average is equal to 0.23-0.26, but usually its value in the southern hemisphere was smaller than in the north by about 20 percent (Figure 4). This ratio is variable in nature. Thus, in December 2010 as the scans as the spectra of the central meridian of Saturn showed a much smaller difference in this ratio in the northern and southern hemispheres than observed earlier and later. It is possible that this was connected with longitudinally sprained the Northern Great Disturbance.

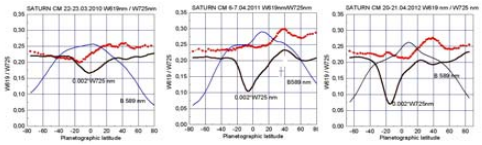

Figure 4: The latitudinal variations of the ratio W619/W725 in 2010-2012 (red points). The brightness profiles and normalized values of W725 nm are shown also.

All observed variations of molecular absorption bands are connected certainly with seasonal changes of the thermal and radiation regime in different zones of Saturn [3] and this comparative study is necessary.

Acknowledgements

The authors thank their colleagues in the Laboratory of Lunar and planetary physics for the important and useful discussions, as well as our colleagues from the Jet Propulsion Laboratory Dr.G.Orton, Dr.L.Fletcher and others for the continued friendly cooperation.

References

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