SATURN AT AND BETWEEN THE EQUINOXES 1995 AND 2009. V.G.Tejfel, V.D.Vdovichenko, A.M.Karimov, G.A.Kharitonova, G.A.Kirienko - Fessenkov Astrophysical Institute, Alma-Ata, Kazakhstan, tejf@hotmail.com

Introduction: The research of spatial and time variations of molecular absorption on disks of major planets represents one of the most effective ways of studying of planetary atmospheres instability. In many cases the narrow-band imaging of planets [1-4] is applied for this purpose, but nevertheless it is more preferable to measure profiles of the absorption bands in different sites of planetary disk. Thus it is possible to find out those features which do not come to light by usual photometry. During the last 16 years the Laboratory of lunar and planetary physics in Fessenkov Astrophysical Institute carried out annually CCD-spectrophotometric observations of Saturn. Primary goal of them is the study of the methane absorption bands variations at the wavelengths range 5800-9000 A. The received material gives the chance to track those changes which occurred in Saturn's atmosphere from the previous equinox ("edge-on" position of equator and rings in relation to the Earth and the Sun) to 2009 equinox.

The observation technique: The observations were carried out on 1-meter and 0.6-meter telescopes equipped by prism spectrograph ASP-9, diffraction spectrograph SGS SBIG and CCD-camera ST-6V and ST-7XE.In addition to the spectrograms of the Saturn equator and central meridian the scanning of planetary disk was carried out by consecutive records of zonal spectrograms from South pole to the Northern pole. at the spectrograph slit oriented in parallel to big axis of the ring As a result a number of atlases of profiles of the methane absorption bands and atlases of latitudinal variations of depths and equivalent widths of these bands were made. Under this data it is possible to track a character of the changes occurring on Saturn during all period from an equinox 1995 to equinox 2009.

The features of latitudinal absorption variations at both equinoxes: In 1995 sharply expressed asymmetry of the methane absorption in southern and northern hemispheres has been noted. [5]. For all bands the stronger absorption was observed in temperate latitudes of northern hemisphere. Minimum absorption is characteristic for an equatorial belt and it remained during all period of Saturn's observations. At the temperate latitudes of southern hemisphere the absorption was much less, than in northern (Fig.1). It was possible to expect that the opposite picture must take a place at equinox 2009, that is to say the lowered absorption should be in northern hemisphere and raised in the southern one. However the observed results were very different from expected.. Actually in 2009 the equivalent widths of the CH_4 727 nm absorption band have near equal values at temperate latitudes of both hemispheres. The minimum absorption was observed in an equatorial belt. The absorption bands CH_4 619 nm, 702 nm, 675 nm and others are weaker in southern hemisphere and show increase in northern hemisphere as in 1995 (Fig.2).

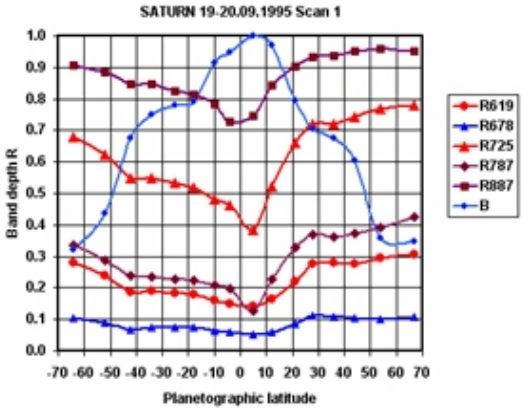

Fig 1 - Latitudinal variations of the methane absorption on Saturn in 1995

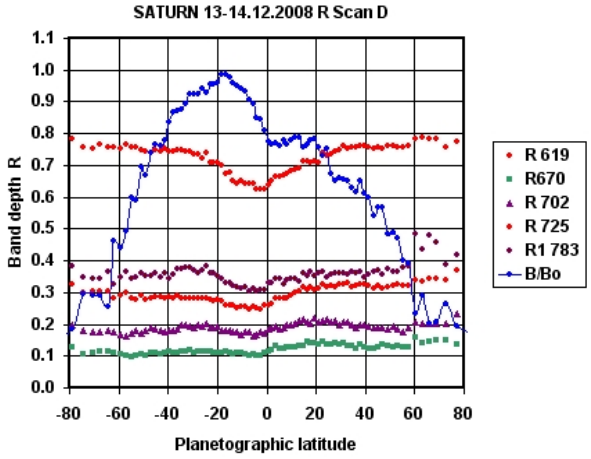

Fig.2 - Latitudinal variations of the methane absorption in December 2008 at minimal saturnocentric Earth declination

Thus, though the overall picture of latitudinal variations of absorption differs from observed in 1995., but there was not opposite character of asymmetry.

Behavior of the methane absorption on Saturn during the period between equinoxes: Last period of the maximum ring opening was in 2001-2003. At this time and in 2004 (Fig. 3) the greatest methane absorption took place at southern latitudes about -20--30 degrees though the absorption minimum was observed in equatorial belt and at temperate southern latitudes with small recession towards the pole. Near South Pole some increase of absorption was noticeable.. During the period between 1995 on 2009 the appreciable trend of the absorption in a southern temperate belt of Saturn was observed. as the growth of the CH_4 725 nm band depth (Fig. 4).

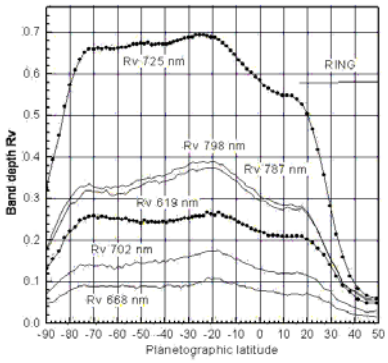

Fig. 3 - Latitudinal variations of the methane absorption on Saturn in 2003-2004

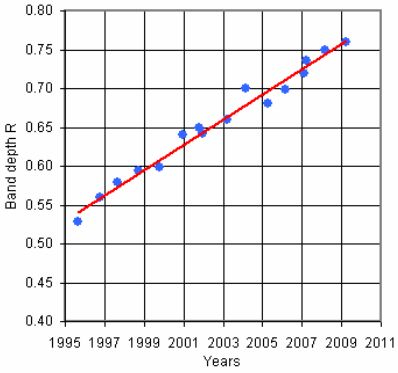

Fig. 4 - The seasonal changes of the CH_4 725 nm absorption band depth in 1995-2009

Discussion: An absence of mirror asymmetry for longitudinal absorption distribution at equinox 2009 in comparison with 1995 is caused most likely by distinctions in the insolation regime of hemispheres of Saturn during the periods of the maximum inclination of equator of a planet to a direction on the Sun and in the years previous to equinoxes.

Before 1995 equinox (Fig.5) Saturn was on greatest distances from the Sun and the inflow of solar radiation for northern hemisphere inclined to the Sun was the least. Before last equinox the distance from the Sun was the least and accordingly raised influx of radiation falled on southern hemisphere.

Convective processes in southern hemisphere should be thus a little weakened and it was confirmed by Saturn's images from "Cassini" [6].

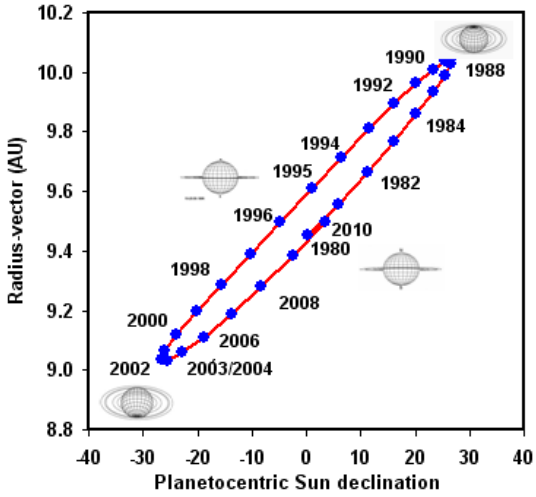

Fig. 5 - The changes of Saturn's radius-vector versus saturnocentric Sun declination

It should affect volume density of the cloud layer. Most likely it went down or an optical thickness of the haze above the cloud deck was increased. Accordingly it may cause strengthening of the absorption bands formed at the multiple scattering process within the clouds and haze. The ammonia absorption in 2008-2009 is also increased in northern hemisphere in comparison with southern as follows from the NH_3 645 nm band. measurements. [7]

References: {1] West R.(1982) *Icarus,51,* 51-64, [2] Ortiz J.I et al.(1995) *Icarus, 117*, 328-344. [3] Temma T. et al.(2005) *Icarus, 175*,464-489, [4] Karkoschka E. and Tomasko M.(2005) *Icarus, 179,* 195-221, [5] Tejfel V.G.(1997) *Sol.Syst.Res.,31*,198-206, [6] Baines R.H. et al.(2005) *Earth, Moon &Planets, 96*,119-147, [7] Tejfel V.G. and Karimov A.M.(2009) *EPSC*, 4, 34