TEMPORAL VARIATIONS IN THE NORTH-SOUTH ASYMMETRY OF POLARIZED LIGHT OF JUPITER; O.M.Starodubtseva, L.A.Akimov, V.V.Korokhin. Astron. Observ. Kharkov Univ., 310022, Kharkov, Ukraine

The polarimetric observations of Jupiter at blue wavelengths made over a 14 year period show the time-variable nature of the north-south asymmetry in polarization at high latitudes. The sign of polarization degree difference between the north and south has changed between 1993 and 1995. Two of the possible explanations - the consequences of the comet SL9 visit to the Jovian system and correlation with solar cycle changes - are supposed.

The polarimetric observations of Jupiter have been made during several Jupiter apparitions over period from 1981 to 1995. Photographic images in 1981 (March 17 - June 6) and spectrograms in 1985 (August 3-5) and 1986 (August 16-18) were taken through the two-refracting crystal. The polarimeter with CCD-line was used in 1989 (November 6-19), 1993 (April 21-28), 1994 (April 29 - May 13, July 6 - August 13) and 1995 (May 8-21). The observations in 1985, 1986 and 1989 have been made with the 40-inch telescope of the high-altitude Assy observatory near Alma-Ata (Kazakhstan). The rest of them have been made with the 28-inch telescope near Kharkov. Measurements of the linear polarization along the central meridian have been obtained for different longitudes. Here we discuss mean for each observational period pole-to-pole polarization degree curves in the blue (0,44 - 0,47 μm).

All of the data, except for those of 1994, show the north - south asymmetry in the polarization degree. However character of the asymmetry is different for different observation periods. Prior to 1994 the polarization degree at high latitudes (north and south of 40 - 50 degrees) near the north limb is greater than that for symmetrical regions near the south limb. The difference between the polarization degree at north and south is about 0.1 -2.5 % depending on the epoch and on the distance from the center of the disk R/Ro. There is some correlation with the changes in planetocentric declination of the Earth (Fig.1). Nevertheless this difference is positive both for positive and negative planetocentric declination of the Earth (and the Sun). However, one can see some changes in character of the asymmetry already in 1993: polarization degree at north is greater than that at south only at R/Ro > 0.9, while it is about equal at R/Ro < 0.9.

In summer 1994 data the difference between the polarization degree at north and south is vanished. As for spring 1994 results we are not very sure about those for some technical reason. Therefore one must consider those results with caution. But anyway at this period the polarizaton degree at north latitudes is not greater than that at the same south latitudes. The observations of 1995 show that the degree of polarization at south latitudes is greater up to 1% than that at the same north latitudes. Thus the change of sign of the north-south asymmetry has took place between 1993 and 1995. This was not associated with the differences in observation (and illumination) conditions because the planetocentric declination of the Earth (and the Sun) was about the same at those periods.

We found earlier longitudinal variations of polarization at high latitudes on Jupiter and that they are correlated with System III and IY longitudes [1]. From this we may suppose magnetospheric influence on the processes in the Jovian polar stratosphere which lead to the formation of the stratospheric aerosol. It allows us to suppose that the asymmetry in the form and magnitude of the Jovian magnetic field with respect to the planet's equator plane is the initial cause of the observed north-south asymmetry. Further we may suppose that the change of sign of the asymmetry between 1993 and 1995 may be related to the consequences of the comet SL9 visit to the Jovian system taking into account coincidence in time of these two unusual phenomena. The passage of the comet through the Jovian magnetosphere may have been accompanied by dust deposition into the magnetosphere [2]. Dust population was probably first increased already in 1992 after comet crossed Jupiter's ring and then through dust production during and after tidal disruption near the planet. Part of this dust particles could then reach the planet's atmosphere in some a way. So that might be the cause of the changes in the asymmetry seen already in data of 1993. Next comet's return to the magnetosphere of Jupiter and its impact on the planet have resulted in long-term effect on stratospheric aerosol abundance. That probably caused further variations in asymmetry up to the sign change seen in data of 1995.

Another possible explanation of the observed long term changes in the north-south asymmetry can be arised from a look at Fig.2. An about 11-year half-wave and its some symmetry with respect to the moments of polarity reversals of the solar magnetic field can be seen in temporal variatins of the polarization asymmetry. Certainly such explanation of the north-south asymmetry in terms of solar cycle changes needs to be supported by further observations.

References. [1] Starodubtseva O.M. et al. (1994) LPSC XXY, 1331; [2] Grun E. et al. (1994) GRL, 21, 1035.

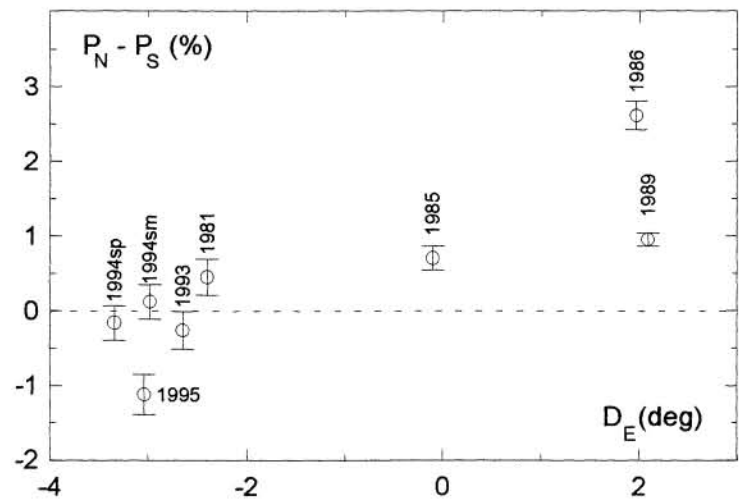

Fig.1. Polarization degree difference between north (N) and south (S) regions at latitudes 60 degrees versus the planetocentric declination of the Earth.

The circles represent data mean for each period of observation. Bars indicate the mean-square errors. "sp" and "sm" mark spring and summer observations.

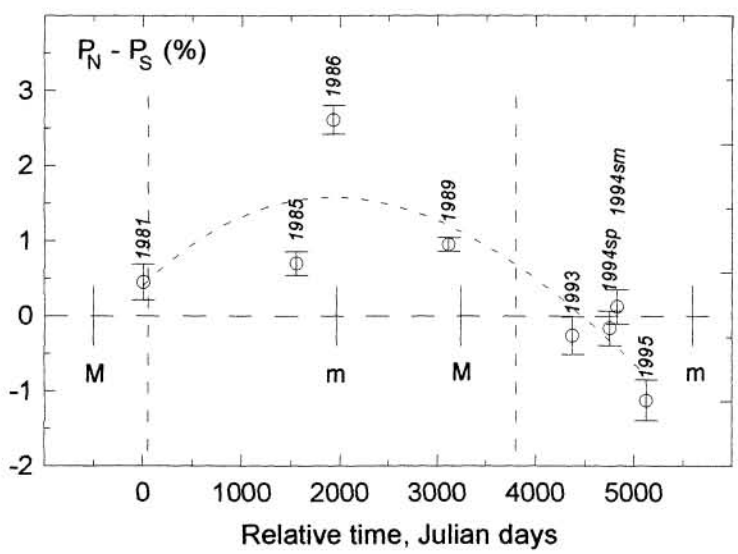

Fig.2. Same as Fig.1 but versus relative time of observations.

The dashed curve is the third power polynom fit to the data. Vertical short solid lines mark the moments of maximum (M) and minimum (m) of solar activity. Vertical dashed lines mark the moments of polarity reversals of the solar magnetic field.