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CIRCULAR POLARIZATION ANALYSER OF HYDROGEN-LINE MAGNETOMETER OF THE 6 M TELESCOPE

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ABSTRACT. *In this paper the test results obtained with the circular polarization analyzer of the hydrogen-line magnetometer attached to the 6 m telescope are presented. The spectral transmission of the analyzer in the region 4000-5000 Å is 93%.*

The circular polarization analyzer of the hydrogen-line magnetometer attached to the 6 m telescope (Shtol', 1991) is designed to measure magnetic fields of faint objects such as white dwarfs, polars, etc.

The optical scheme of the analyzer is shown in Fig. 1.

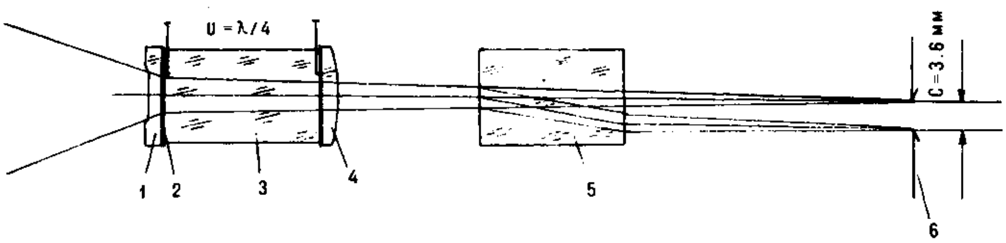

Fig.1.Optical scheme of the circular polarization analyzer.

1. *Negative lens*
2. *Ring electrodes*
3. *Electrooptical phase element*
4. *Positive lens*
5. *Polarization splitter*
6. *Magnetometer entrance slit (height).*

The analyzer consists of an electrooptical phase element with ring electrodes (Pilipovitch et al. , 1987) and a polarization splitter. A distinctive feature of the analyzer is the high light transmission in the working region of the spectrum (4000-5000 Å). The high light transmission (93 %) was attained due to the use of specially selected optical materials, small number of optical surfaces and their coating.

The characteristic of the spectral transmission of the analyzer is presented in Fig. 2.

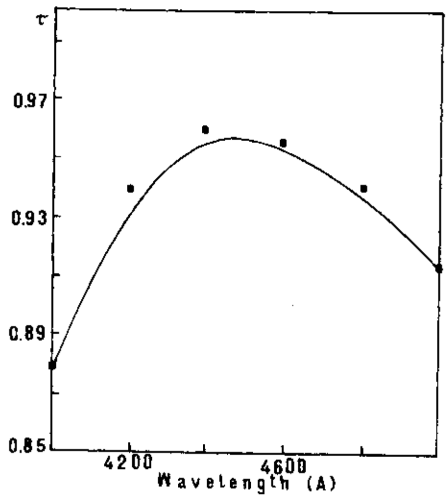

Fig. 2. Characteristics of the spectral transmission of the circular polarization analyzer.

The light transmission of the polarimetrical analyzer of the hydrogen-line magnetometer, constructed on the basis of the electrooptical phase element with semi-transparent electrodes, is about 50%.

At the observations of the 6^m star 33 Gem at the spectral band 9 Å with the circular polarization analyzer the count rate was $2*10^5$ counts/s, and with the polarimeter analyzer with semi-transparent electrodes it was $1.1*10^5$ counts/s. The count rate ratio, equal to 1.82, is sufficiently close to that of the light transmissions of the analyzers - 1.86. The values of count rates were reduced to one image by the technique presented by (Shtol', 1992).

The main difference between the phase element with ring electrodes (ERE) and phase element with semi-transparent electrodes (ESE) is the dependence of the thickness of the ESE (along the optical path) upon the aperture of the parallel light beam (the diameter of ring electrodes) formed by the entrance lens of the ESE (see Fig. 1).

When the thickness of the ERE increases, it is required that the beam should be parallel to a high degree since the S/N ratio and modulation degree are dependent on its high parallelism (Shtol', 1992). The way the analyzer is mounted inside the magnetometer housing and its adjustment are also complicated by this condition. One of the systematic errors of the hydrogen-line magnetometer (Shtol', 1992) is connected with the modulation degree, while the modulation degree depends on the star image size and the size of the entrance slit of the magnetometer (parallel light beam characteristics, passing through ERE). In order to determine these dependencies we performed the measurements of the modulation degree from an artificial star under laboratory conditions and from the star 33 Gem in the prime focus of the 6 m telescope.

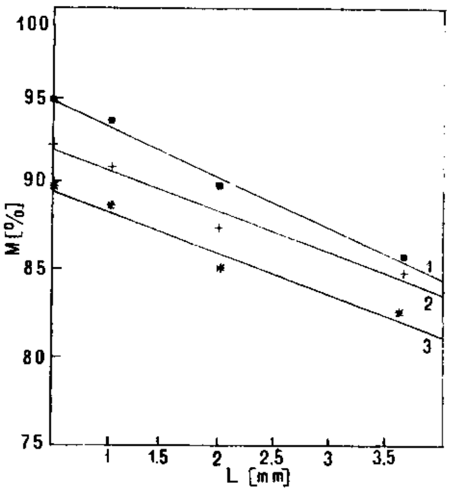

Fig.3. The dependence of the modulation degree M on the magnetometer entrance slit size L.

1 - measurements of an artificial star

2 - on the 6 m telescope after the corrections for the seeing

3 - the same before corrections.

Characteristics of the modulation degree dependence on the size of the magnetometer entrance slit are presented in Fig.3, where 1 is the dependence of the modulation degree M on the slit size L (the width and the height of the slit are equal) when measuring the modulation from an artificial star with the polaroid, cutting off one beam (installed after the polarization splitter of the analyzer); 2 - the same on the 6 m telescope for the slit width L=3 mm at its fixed height, after corrections for the image size, while measuring it was equal to 5"; 3 - the same before the corrections.

The modulation degree of the polarimetric analyzer with ESE does not change with variation of the slit size and for one hydrogen line (after the corrections for the seeing) it is 92%. For two hydrogen H_β and H_γ lines it becomes less and depends on the energy distribution in the star spectrum and on the characteristic of the magnetometer spectral transmission. The modulation degree reduction is caused by its dependence on the wavelength and on the value of the control voltage, supplied to the electrooptical phase element. From Fig.3 it is seen, that the modulation degree varies by 7% when the slit varies from its minimum width (0.5 mm) to maximum one (3.6 mm), at the fixed height of 3 mm. The 7% modulation degree variation, actually, is not important at faint objects observations, oriented mainly on the search for their magnetic fields, so this circular polarization analyzer is designed for this very purpose.

Besides that, on February 6, 1991 from 5^h51^m to 6^h14^m, we carried out observations of α^2 CVn with the known magnetic field, the value B=-990±90 Gs was obtained.

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