

**FIRST MEASUREMENTS OF 4 STOKES PARAMETERS
WITH THE 6-M TELESCOPE**

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ABSTRACT. First measurements of 4 Stokes parameters have been made in the wide depression at $\lambda \approx 200$ A for two chemically peculiar stars **53** Cam and **56** Tau using the 6-m telescope spectropolarimeter. Instrumental circular and linear polarization is shown to be insignificant.

The spectropolarimeter for measurements of 4 Stokes parameters is designed and constructed at SAO AS USSR. It is planned to be used for determination of a magnetic field structure of peculiar stars, and dipole orientation, for study of circular and linear polarization wide depressions within $\lambda \approx 4200 - 5200$ A being characteristic for magnetic star spectra and also for other spectropolarimetric investigations of various objects in narrow (dozens of A) and wide (hundreds of A) spectral regions.

The new device is based on the available hydrogen magnetometer (Shtol' et al., 1985). Adjustment and laboratory tests of the spectropolarimeter for narrow spectral regions were realized during 1987. This device is analogous to that described by Wolstencroft et al. (1983) with one electrooptical KDP crystal and two quarter-wave mica plates with optical axes oriented at 45° angle relative each other. When measuring Q and U Stokes parameters phase plates are introduced in turn; V-parameter is determined with both quarter-wave plates taken out from the optical scheme.

The first observations of Serkovsky's (1979) standard stars with zero polarization made in January, 1988 showed that the degree of instrumental polarization in the Main Focus of the 6-m telescope is small : (v, q, u - normalized Stokes parameters).

$$\begin{aligned} v^{in} &= - 0.009 \% \pm 0.005 \% \\ q^{in} &= + 0.058 \% \pm 0.005 \% \\ u^{in} &= - 0.021 \% \pm 0.005 \% \end{aligned}$$

Our polarization degree $p=3.14\%$ for the supergiant HD 43384 (with large interstellar polarization) shows a good agreement with Serkovsky's data $p=3.20\%$.

We began to investigate circular and linear polarization in the wide depression at $\lambda 5200 \text{ \AA}$ for two chemically peculiar stars 56 Tau (its circular polarization was suspected earlier, (see Romanyuk, 1984), and 53 Can with a strong magnetic field. The spectral band width $\Delta\lambda$ in our observations was 20 \AA , the light detector used was EMI-photomultiplier. Table 1 presents the investigation results of 53 Can.

Table 1.

Date	$\lambda(\text{\AA})$	v %	q %	u %
6/7.01.1988	5120	-0.063	+0.050	+0.039
	5135	-0.074	-0.013	+0.064
9/10.01.1988	5120	-0.013	-0.047	+0.002
	5150	-0.008	-0.057	-0.011
	5180	-0.004	-0.005	-0.049
	5210	+0.047	+0.072	-0.054
	5240	+0.035	+0.006	+0.028

$\sigma_v = \sigma_q = \sigma_u = \pm 0.031 \%$

$\sigma_{v,q,u}$ is rms error of each Stokes parameter estimation v, q, u at a given wavelength λ .

The investigation results of 56 Tau are given in Table 2.

Table 2

Date	$\lambda(\text{\AA})$	v %	q %	u %
7/8.01.1988	5120	+0.034	+0.038	+0.050
	5135	+0.035	-0.016	-0.017
	5150	+0.047	+0.028	-0.028
8/9.01.1988	5120	+0.029	+0.036	+0.048
	5150	+0.008	+0.063	+0.080
	5180	-0.006	+0.045	+0.045
	5210	+0.006	-0.025	-0.013
	5000	-0.013	-0.001	+0.004

$\sigma_v = \sigma_q = \sigma_u = \pm 0.023 \%$

The time of measuring of one of Stokes parameters at a given wavelength was 10 min on the average; the time necessary to change the wavelength or to measure another Stokes parameter was 10 s. The Fig. 1 shows the distribution of v , q , u - Stokes parameters along the depression profile at λ 5200A. Fig. 1a is taken from Maitzen's work (1976). It is seen that only the central part of the depression was investigated and a further study at a wider spectral range and with a higher accuracy is needed.

The existence of weak (some hundredths of %) circular and linear polarization in the depression at λ 5200 A in the stars measured by us is highly probable.

The device with two electrooptical crystals for quasi-simultaneous measurements of all the four Stokes parameters is planned to be introduced in the nearest future.

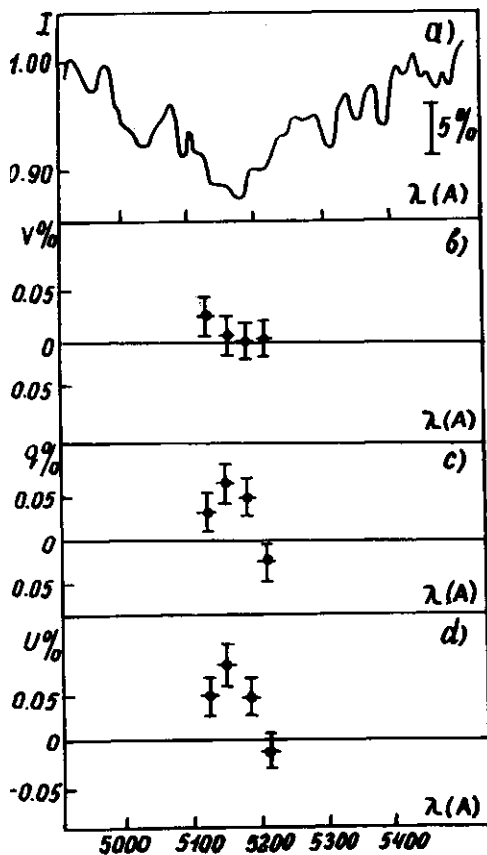


Fig. 1. Distribution of v , q , u Stokes parameters along the profile of λ 5200 A depression in 56 Tau.

REFERENCES

- Nolstencroft, R. D., Cormack, W. A., Campbell, J. W., Smith, P. J.:
1983, *Mon. Not. Roy. Astron. Soc*, v. 205, 23.
- Serkovsky, K.: 1979, In: *Planets, Stars and Nebulae Studies
by photopolarimetry*, University of Arizona press, Tucson.
- Shtol', V. G., Bychkov, V. D., Vikul'ev, N. A., Georgiev, O. Yu.,
Glagolevskij, Yu. V., Drabek, S. V., Naidenov, I. D.,
Romanyuk, I. I.: 1985, *Astrofiz. Issled. (Izv. SAO)*, v. 19, 66.
- Romanyuk, I. I.: 1984, In: *Magnetic stars*, Salaspils, p. 29.
- Haitzen, H.: 1976, In: *Physics of Ap stars*, IAU Coll No. 32,
Vienna, 233.