BULLETIN
DE
L'OBSERVATOIRE ASTRONOMIQUE DE BELGRADE

№ 132

UDC 522.982

PRELIMINARY RESULTS OF THE FLEXURE INVESTIGATION OF THE BELGRADE LARGE VERTICAL CIRCLE IN THE PERIOD 1976–1979

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(Received May 3, 1981)

SUMMARY: An account is given of the preliminary results of the flexure determinations of the Large Vertical Circle of the Belgrade Observatory, carried out regularly under the observing program of bright stars in the period 1976–1979. A satisfactory accuracy of the measurements is stated, except for the year 1976, namely ±0".20. Of particular importance is the finding that the flexure of our LVC keeps its properties over longer time intervals. More intense investigations of this parameter is rekomended.

1. Upon completing, late in 1976, the reconstruction of the Large Vertical Circle of the Belgrade Observatory, carried out under the direction of D.S. Usanov (Usanov et al., 1978), we took up, early in 1976, the observation by absolute method of a program of bright stars within the zone +65° to +90° declination (Teleki, Mijatov, 1976). Alongside with these obeservations, regular flexure determinations of the instrument's tube were made as required by absolute method. An account is herein presented of the preliminary results of the flexure determinations executed in the period 1976–1979.

2. The flexure of the LVC was investigated according to Bessel method using a pair of collimators (80/1000 mm.) installed horizontally in the east-west direction. The measurements of the horizontal flexure component $\underline{b}$ were accomplished either by two observers,whereby one of them had first to secure the alignment of the collimators, after which he made the settings of the movable wire of the main instrument on the cross -wires of the collimators, or, failing two, one single observer carried out all the requisite operations.

Before starting the measurements the indoor and outdoor temperatures, as well as humidity, were read off. Besides, note was taken on the atmospheric conditions (clearness, wind).

The horizontal flexure component was determined on almost each observing night. In addition, several nights were entirely dedicated to the flexure determination in order to establish the variation of this parameter with the time. Thus there were in the period from March 1976 to October 1979 altogether 229 series of flexure determination.

3. Tabele 1 presents the number of flexure determinations according to observers.

Table I

Year	Observers						Total
	MM,DjB	DjB,MM	MM,BK	MM,MD	DjT,BK	BK	
1976	-	- 7	16	9	3	2	37
1977	82	- 1	-	-	-	-	83
1978	25	30 -	-	-	-	-	55
1979	28	24 2	-	-	-	-	54
Total	135	54 10	16	9	3	2	229

Observers: MM-M.Mijatov, DjB-Dj.Božičković, BK-B.Kubicela, MD-M.Dačić i DjT-Dj.Teleki

As apparent from the above Table, the year 1976 is characteristic by the fewness of observations, carried out by a great number of observers. This fact is reflected in lower accuracy of the results from this period.

Table 2 gives the number of flexure determinations according to seasons.

Table II

Year	I-III	IV-VI	VII-IX	X-XII	Total
1976	-	24	13	-	37
1977	21	34	26	2	83
1978	3	5	36	11	55
1979	13	24	17	-	54
Total	37	87	92	13	229

The greatest number of determinations was, quite naturally, effected in the spring-sommer period.

4. The accidental error of a single determination of ϵ_b the horizontal flexure component was derived in two ways: from the difference of two consecutively determined values in the course of a series of measurements of $(b_{ew} - b_{we})$ and from several successive series, executed in the course of those nights which were dedicated solely to the flexure investigation. Tabele 3 presents the mean systematic difference $b_{ew} - b_{we}$ and ϵ_b.

ϵ_b was calculated according to formula:

$$\epsilon_b = 0.625 \frac{\Sigma |\Delta|}{n} \qquad (1)$$

where: Δ – the values $(b_{ew} - b_{we})$ freed from the systematic difference $(b_{ew} - b_{we})$ from Table 3, and n the number of differences Δ (equal to the number of series of measurements)

Table III

Year	bEW-BWE	ϵ_b	n
1976	+0.084	±0.387	37
1977	+0.147	±0.245	83
1978	+0.096	±0.200	55
1979	+0.094	±0.163	54

As evident from Table 3, the measurements performed in 1976 are of an inadequate accuracy, as alrady stated in Section 3. As for the remaining years, the accuracy was on the level characteristic of the flexure determination by Bessel method with this type of instruments. It was increasing from year to year due, probably, to the growing experience of observers. For the whole period of measurements we have: $\epsilon_b = \pm 0''.24$, but if the the year 1976 is omitted then $\epsilon_b = \pm 0''.20$.

The accuracy of the successive series, executed in the course of a single night is $\beta_b = \pm 0''.20$, which is in harmony with the result obtained by the formula (1)

It has been found from earlier determinations (Mijatov, 1971–1972) that the principal systematic influences on the flecure determination by Bessel method had their origin in the unsteadiness of the collimators and in the local refraction. The systematic $(b_{ew} - b_{we})$ in Table 3 of the order $0''.1$ indicate that there must have been some shifting of the collimators. It has, in addition, been stated that the effects of the local refraction have at times been very strong.

5. Preliminary data analysis has already that b was dependent on the temperature and, possibly, on the humidity. In order to scrutinize these effects we used the linear relation:

$$b = b_0 + a\,(t - 15°c) + c\,(v - 70\%) \qquad (2)$$

The results obtained hence by the least square method are given in Table 4.

Table IV

Year	bo	a	c	ϵ_o	K	n
1976	+0.710 ± 137	+0.003 ± 32	+0.002 ± 7	±0.40	0.08	23
1977	+0.726 ± 97	+0.089 ± 8	+0.002 ± 4	±0.47	0.79	83
1978	+0.851 ±0.206	+0.018 ± 9	-0.011 ± 5	±0.33	0.49	47
1979	+0.719 ± 71	+0.042 ± 5	-0.005 ± 4	±0.28	0.77	54

The coefficients of a and c in (2) for the year 1976 are uncertain, and the correlation coefficient k is too small. Thus, one cannot judge on the existence of the dependence of b on the temperature and the humidity on the basis of data from 1976. This is a consequence as earlier stated, of an insufficient accuracy of measurements carried out in that year. In the remaining years a distinct influence, that of the temperature in particular and even with a high correlation coefficient, must be stated.

The residuals of the relation (3) do not exhibit any systematical character, hence it can be claimed that no separate seasonal effect, other than the one dependent on temperature, is in existence.

It is of particular importance to point out that b_0 has remained virtually unchanged during the whole period of investigations, which indicates that the flexure of LVC, under the same temperature conditions, does not undergo any significant chages over longer time intervals. This has a particular weght with the absolute declination determinations.

An appreciable variation of b, of the order 0".4, during the observing night, has been stated. However, this variation has been determined from the measurements at the beginning and of the observing tour. Bearing in mind that the measurements at the beginning of the observing tour (early in the evening) are rather uncertain, there is no sufficient foundation to treat this variation as an established fact. This view is supported by the circumstance that in the course of several nights, which were dedicated exclusively to the flexure determination, no such variation was perceived. But these measurements were never started early in the evening.

6. It follows from the preliminary flexure investigations of LVC that its horizontal component is, in more recent time, being determined with a satisfactory accuracy. To maintain this precision it is necessary that the measurements are executed by experienced observers. It is also necessary to investigate more closely the eventual systematic effects on the determination of b, on those accomplished in the evening in particular. Considerable temperature effects on the values of b have been stated, but in order to determine it definitely it is necessary to have the measurements more evenly distributed over the year.

Applied in the reductions, the values of b improve the accuracy of the declinations observed. We are confident that the flexure determinations of LVC will contribute to obtaining the most accurate possible declinations of the stars comprised by our observing program.

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