# CHROMATIC REFRACTION IN THE VERTICAL CIRCLE OBSERVATION

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In 1962 a photographic vertical circle (PVC) for determining absolute declinations was designed and constructed at the Pulkovo Observatory under the supervision of Prof. M.S. Zverev (Zverev, M.S., 1960). The Maksutov meniscus cassegrain system (D = 200 mm, f' = 2000 mm) was used for the first time in astrometry. Its construction is symmetric and it is automatically operated. In 1963-1966 the declination observation of bright and faint stars of the southern hemisphere was made with this instrument (Zverev, M.S. et al., 1966). At present after the reconstruction the PVC has been used again for determination of absolute declinations (Bagildinsky, B.K., Usanov, D.S., Smirnov, B.N., 1978).

Observations of the fundamental FK4 stars made in 1974-1976 show that the PVC instrumental system is sufficiently stable and ensures high precision as far as accidental errors are concerned (Bagildinsky, B.K., Zhilinsky, E.G., Shishkina, V.N., 1978). More than 200 stars at zenith distances $Z \leqslant 82^{\circ}.5$ were observed. The mean square error of one observation is $\sigma_0 = \pm 0''.18$ at the zenith and about $\pm 0''.30$ at $Z = 50^{\circ}$. Refraction was computed using the Pulkovo Refraction Tables for $\lambda_0 = 5753$ Å (Pulkovo Refraction Tables, 1956).

An analysis of observations showed the presence of chromatic refraction effects, particularly, at great zenith distances (Figure 1).

As seen from Figure 1 there is a dependence of the calculated deviations on Z, i.e. $\Delta\phi(Z)$; $\phi_i$ is the mean value of latitude from 5 - 8 observations of each star, $\phi_0$ the accepted value of latitude. The results have been tentatively corrected for flexure ($b = 0''.95 \sin Z$). The division errors have not been taken into account. The conventional signs mark spectral types of the stars. It is also clear from Figure 1 that the early type stars (O,B,A) are most affected by chromatic refraction. The refraction effects are northwards and southwards asymmetric in relation to the zenith. Leningrad is situated to the north of the Pulkovo Observatory, so the northern part of the sky is more affected by the city lights and the atmosphere is less transparent. This circumstance seems to be the cause of the asymmetry of our results.



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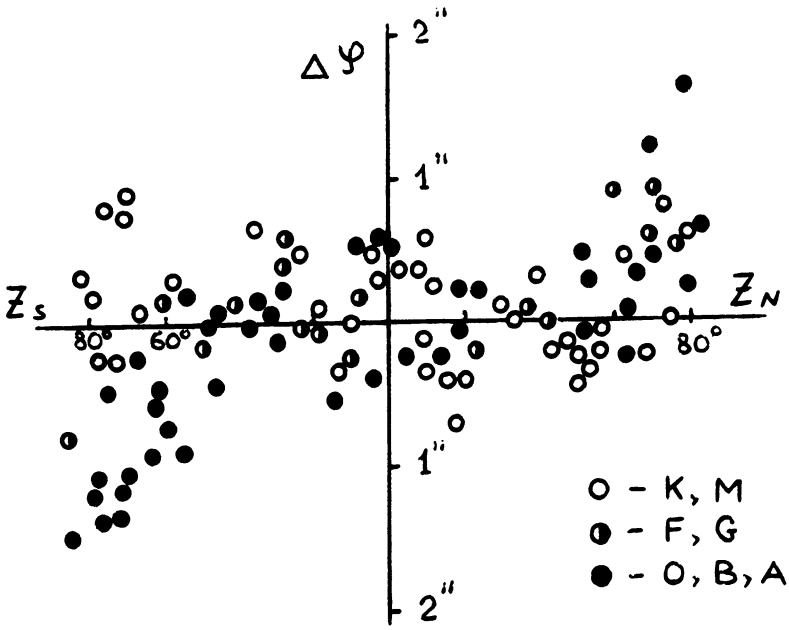


Figure 1

Observations were mostly made on panchromatic plates ORWO-NP27. Sometimes Ilford Ordinary No 30 were used.

For calculating chromatic refraction corrections spectral transparency of the atmosphere and optical system of the PVC and spectral sensibility of the ORWO-NP27 plates were taken into account. For calculating the effective wavelength $\lambda_e$ the stars spectra beyond the atmosphere were also taken into account (Melnikov, O.A., 1957, Straisis, V., Svidezskene, Z., 1957). The $\lambda_e$ values are presented in Figure 2. Corrections for chromatic refraction calculated as the differences between values of refraction for $\lambda_e$ and $\lambda_0$ = 5753 Å at the same Z are given in the table.

For stars at $35^\circ \leqslant Z \leqslant 60^\circ$ we have a decrease in dispersion in latitudes $\phi_i$ and $\phi_0$ a 1.3 fold gain in precision. For observations up to $Z \leqslant 82^\circ.5$ a 1.7 fold increase was obtained. The results are preliminary and will be improved after the reduction of observations with the PVC.

To solve the chromatic refraction problem for meridian and vertical circles we intend to undertake a special investigation.

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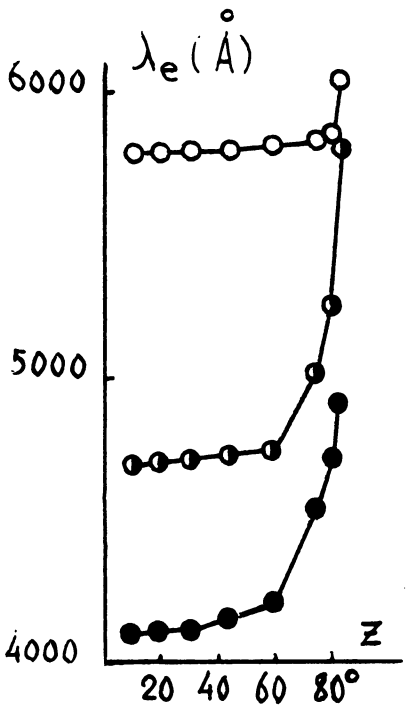


Figure 2

| Z \ Sp | B5 | G0 | M0 |
|---|---|---|---|
| 10° | + 0".17 | + 0".09 | 0".00 |
| 20° | 0.36 | 0.19 | - 0.01 |
| 30° | 0.58 | 0.31 | - 0.01 |
| 45° | 0.95 | 0.50 | - 0.02 |
| 60° | 1.54 | 0.84 | - 0.04 |
| 75° | 2.34 | 1.16 | - 0.11 |
| 80° | 2.87 | 1.14 | - 0.19 |
| 82°.5 | 2.83 | - 0.09 | - 0.64 |

Table of Chromatic Corrections

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It is highly desirable that the programs of fundamental stars both faint and bright, consist of the K-M stars because the chromatic effects for these types of stars are minimum. The Soviet project of the catalogue of faint stars satisfies this requirement (Zverev, M.S., 1952). It seems advisable that the results of the observations of various spectral types stars be reduced to a unique system by applying corrections for chromatic refraction using argument $(\lambda_e - \lambda_0)$ where $\lambda_0$ is the wavelength for which refraction is calculated. For example, for $\lambda_0$ one can take $\lambda_v$ = 5430 Å in accordance with the Vilnius photometric system (Straisis, V., Svidezskene, Z., 1957, Zdanavichus, K. et al., 1972) or $\lambda_v$ = 5500 Å in the UBV system.

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