

SPECTRAL PARALLAXES OF THE TYCHO-2 STARS

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ABSTRACT. We present the spectral parallaxes for about 150 thousand stars derived from spectral types and luminosity classes of the Tycho-2 Spectral Type Catalogue. The interstellar absorption was taken into account. The comparison of the derived spectral parallaxes with trigonometric parallaxes from Hipparcos catalogue was made. For the majority of stars the accuracy of the spectral parallaxes was found to be 1-5 mas depending on the spectral type.

1. PROCEDURE.

In this paper, the Hipparcos catalogue [1] is a source of the trigonometrical parallaxes. The Tycho-2 catalogue [2] provides the m , $B-V$, positions and proper motions. The Tycho-2 Spectral Type catalogue [3] contains the spectral types and luminosity classes of the stars. Combination of these catalogues gives us a good opportunity to derive the spectral parallaxes for at least the subset of the Tycho-2 catalogue.

To obtain the spectral parallax of a star one must have its absolute and visual magnitudes. In our case, the high precision visual magnitudes are listed in the Tycho-2 catalogue. The absolute magnitude as a function of the spectral type and luminosity class can be interpolated from the figures and tables taken from [4], and [5]. To estimate the spectral parallax of a star we use the equation

$$\lg \pi_{sp} = 0.2 * (M_{tab} - m_{cat}) - 1 + 0.2 * A, \quad (1)$$

where $A = 3 * [(B - V)_{cat} - (B - V)_{tab}]$ is the interstellar absorption coefficient. Following this technique we derived the spectral parallaxes for 165 thousand stars in the Tycho-2 Spectral Type catalogue with available luminosity classes.

2. COMPARISON OF TRIGONOMETRIC AND SPECTRAL PARALLAXES

To evaluate the accuracy of the obtained spectral parallaxes, we calculated the differences

$$\Delta\pi = \pi_{sp} - \pi_{tr}, \quad (2)$$

where π_{tr} are the trigonometric parallaxes taken from 64 thousand stars of the HIPPARCOS catalogue. Of them 2243 stars with too large $\Delta\pi$ were rejected according to the "3-sigma" rule. Since both the parallaxes are absolutely independent, the r.m.s.e. of the spectral parallaxes may

be evaluated according to equation

$$\sigma_{sp} = \sqrt{(\sigma^2 - \sigma_{tr}^2)}, \quad (3)$$

where σ^2 is the variance of the $\Delta\pi$ and σ_{tr} is the r.m.s.e. of the trigonometric parallaxes. The σ_{sp} (estimated with $\sigma_{tr} = 1$ mas) as well as the mean value, asymmetry and excess of the random values $\Delta\pi$ for stars of different spectral types and luminosity classes are shown in Table 1. The mean values reveal the systematic shifts of spectral parallaxes with respect to the trigonometric ones, while the values of asymmetry and excess measure the deviation of the found probability densities from the probability density of the normal distribution.

Table 1: Mean value, σ_{sp} , asymmetry and excess of the differences $\Delta\pi$ for each spectral type

L	Sp	Mean, <i>mas</i>	σ_{sp} , <i>mas</i>	Asymmetry	Excess	Number of stars
I, III, V	OB	-0.5	0.6	-0.2	0.5	5426
I, III, V	A	0	2.4	0.3	1.4	6285
I, III, V	F	1.8	3.6	0.2	1.2	11974
I, III, V	G	1.8	4.6	0.7	2.6	10768
I, III, V	K	0.5	3.0	0.3	7.4	16226
I, III, V	M	0	1.4	0	4.2	1943
V	all	1.3	2.9	0.3	0.1	26237
V	OB	-0.3	1.0	0	0.6	3526
V	A	0.4	2.2	0.6	1.3	5145
V	F	1.9	2.9	0	0	10867
V	G	2	3.6	0	-0.4	5525
V	K	2.8	5.7	0.2	0.8	1277
III	all	0.1	2.1	-0.2	2.4	24024
III	OBA	-0.9	1.2	-0.2	0.2	2 409
III	GKM	0.3	2.1	-0.1	2.6	20865
I	all	-1.2	0.7	-0.8	1.2	928

3. RESULTS

1. The spectral parallaxes of about 165 000 Tycho-2 stars have been derived from the astrophysical data taken from the Tycho-2 Spectral Type catalogue.

2. For the majority of the stars the accuracy of the obtained spectral parallaxes was evaluated to be 1-5 mas depending on the spectral type.

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REFERENCES

- [1] ESA, 1997, The Hipparcos and Tycho catalogues, ESA SP-1200
- [2] Hog E., C. Fabricius, V.V. Makarov, U. Bastian, P. Schwekendiek, A. Wicenec, S. Urban, T. Corbin, and G. Wycoff., 1999-2000, Tycho-2 catalogue.
- [3] Wright et al., 2003, Tycho-2 Spectral Type
- [4] Mihalas and Binney, 1981, Galactic Astronomy, W.H.Freeman and Company, pp. 108
- [5] 2000, Allen's astrophysical Quantities, fourth Edition, Arthur N.Cox Editor, Springer-Verlag NY, Berlin Heidelberg, pp. 381-393.