An Analysis of Local Milky-Way Kinematics based on Proper-Motion and Line-of-Sight-Velocity ARIHIP Data

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Abstract. A rigorous selection of ARIHIP stars is done where, among others, only the stars having line-of-sight velocity are taken into account. It is studied kinematically to find that the velocity dispersion appears to be dependent of both colour index and limiting distance for a group of stars. The inclusion of more remote stars affects the ratio of the square roots of the velocity dispersion along the second axis to that along the main one rather than the amount of the velocity dispersion along the main axis. In the present sample the high-velocity stars are concentrated rather strongly towards a single value of the colour index.

Keywords: Stellar kinematics, Solar neghbourhood

I Introduction

Studied data are from astrometric catalogue ARIHIP (http://www.ari.uni-heidelberg.de/datenbanken/) , Wielen et al. [1] which provides "best data" for 90842 stars .

Unfortunately, most of stars in ARIHIP have no line-of-sight velocities. It is well known that they are obtained from stellar spectra, i. e. spectral lines. Therefore, it is of utmost importance to determine line-of-sight velocities for as many stars as possible. Then we would have space velocities for many stars at our disposal and this is the easiest and most simple way to determine all important kinematical quantities, such as the mean velocity, velocity ellipsoid etc.

II Procedure

Selecton of data

- only 15901 (17%) stars, out of the total of 90842, having line-of-sight velocities are selected
- stars which could be multiple are excluded so that the number of stars is lowered to 8620
- possible variable stars are excluded, the number of remaining stars is 7645
- stars not referred to as "astrometrically excellent stars" also excluded, there are 121 ones
- stars more distant than 200 pc (π < 5 mas) are also excluded

Finally, a sample containing 4614 stars is formed to be subjected to a study in the rest of the present paper.

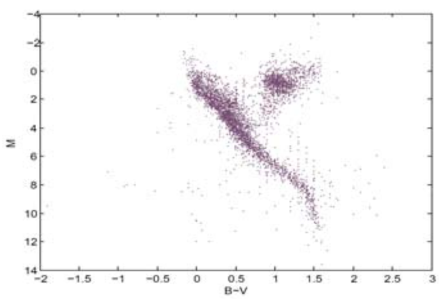

FIGURE 1. Kinematical properties of stars are correlated with astrophysical ones; among the most important astrophysical parameters are certainly the colour index and the absolute magnitude because they are available for a vast number of stars.
An HR diagram with absolute visual magnitude (ordinate) and colour index (abscissa) is constructed. It can be seen in this figure. There it is clearly seen that the present sample contains largely Main-Sequence (MS) stars and red giants, but there are also subdwarfs and white dwarfs. There are no very luminous stars in the sample.

TABLE 1. Components of solar motion ($v_\odot$ is in km s^{-1}), square root of velocity dispersion (km s^{-1}) and vertex deviation for the five colour groups.

Group	$(B-V)_{min,\,max}$		N	$v_\odot$	$L_\odot$	$B_\odot$	σ_1	$\frac{\sigma_2}{\sigma_1}$	$\frac{\sigma_3}{\sigma_1}$	l_V
1	−1.9,	0.14	490	17.4	55.4°	23.4°	23.6	0.91	0.45	70.4°
2	0.14,	0.53	1523	23.6	59.2°	18.3°	40.6	0.93	0.46	−40.2°
3	0.53,	1.00	1367	38.4	68.7°	12.8°	55.9	0.85	0.52	−2.3°
4	1.00,	1.40	988	23.9	66.1°	16.8°	38.9	0.63	0.46	7.4°
5	1.40,	3.00	246	30.4	58.2°	14.3°	41.4	0.73	0.50	23.2°

TABLE 1. The influence of the two astrophysical parameters is examined in (B-V) only. The square root of velocity dispersion along the main axis depends on the limits of colour index for a group. At first it increases with increasing mean colour index of a group, to attain its highest value for the colour-index interval of 0.53-1.0 and for higher colour indexes it is smaller. The ratio σ_2/σ_1 appears to be higher for bluer stars than for redder ones, whereas the ratio σ_3/σ_1 is practically constant.

TABLE 2. Components of solar motion ($v_\odot$ is in km s^{-1}), square root of velocity dispersion (km s^{-1}) and vertex deviation for the four parallax groups.

Group	π_l	r	N	$v_\odot$	$L_\odot$	$B_\odot$	σ_1	$\frac{\sigma_2}{\sigma_1}$	$\frac{\sigma_3}{\sigma_1}$	l_V
1	20.0	(50 pc)	1 112	29.3	64.5°	15.8°	42.6	0.69	0.49	12.8°
2	10.0	(100 pc)	2 469	29.9	63.6°	15.2°	44.8	0.81	0.49	−7.1°
3	6.6	(150 pc)	3 696	28.2	63.3°	15.5°	43.9	0.84	0.49	−13.8°
4	5.0	(200 pc)	4 614	27.7	64.2°	15.9°	43.8	0.87	0.50	−12.6°

TABLE 2. Four groups of stars are formed following the upper limit of the distance comprising all stars of a group. The situation seems to be different; the square root of velocity dispersion along the main axis appears to be unchanged, but the second one shows changes so that its value is increased when more distant stars are included; the ratio σ_3/σ_1 is constant, equal to about 0.5 as in Table 1. This effect is interesting and it deserves more attention.

III CONCLUSIONS

(i) The velocity dispersion for stars in the present sample shows a dependence on the colour index.
(ii) The inclusion of more remote stars affects the ratio of the square roots of the velocity dispersion along the second axis to that along the main one rather than the amount of the velocity dispersion along the main axis.
(iii) In the present sample the high-velocity stars are concentrated rather strongly towards a single value of the colour index.

This is a preliminary phase of the work only. It is planned to be continued so that the influence of different galactic subsystems (thin disc, thick disc, halo) and the role of the luminosity classes would be studied in more details.

[1] R. Wielen, H. Schwan, C. Dettbarn, H. Lenhardt, H. Jahreiß, R. Jährling, & E. Khalisi, 2001, Veroeffentlichungen des Astronomischen Rechen-Instituts Heidelberg, **40**, 1