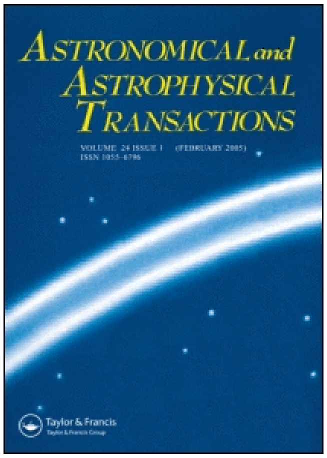

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G. B. Anisimova [a]
[a] Scientific Research Institute, Rostov-on-Don, Russia

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AN EXAMINATION OF THE ELLIPSOIDALITY OF THE STELLAR VELOCITY DISTRIBUTION†

G. B. ANISIMOVA

Scientific Research Institute "Gradient", Rostov-on-Don, Russia

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The ellipsoidality of the distribution of the position angles of proper motions was checked for 44 areas covering 1/4 of the SAO catalogue data.

KEY WORDS Stellar kinematics: velocity distribution

The ellipsoidality of the spatial stellar velocity distribution is checked in the distribution of the positional angles of proper motions (φ). The angles φ are determined for 18569 stars brighter than $V = 9^m$ covering almost 1/4 of the sky in the SAO catalogue data (μ_α , μ_δ). The polar diagrams, or Kovalsky-Kapteyn figures (FKK) in 12 sectors are drawn up for each of 44 areas in the region. The figures are approximated by the ellipses with the following elements: δ_b – the small semi-axis, e – the eccentricity and φ_a – the positional angle of the large semi-axis [1]. The approximation quality was estimated using the χ^2 – criterion for 6 degrees of freedom. The confidence level P is lower than 5% for only 7 areas. When one sector was excluded in the FKK, P became much higher than this level in all the areas except only one in the Solar apex region.

Such a verification does not reject the elliptical φ distribution as a first approximation. But its parameters are not constant in the examined region. Thus there is the known vertex deviation from the Galaxy center direction at $l < 30°$, but it is absent at $l > 30°$.

In order to have the second approximation we studied $\Delta^*_{\rm pi}$, the largest positive deviations from ellipses, including the above ones. To exclude observational errors and random fluctuations, when the positive and negative deviations are balanced, we examine only $\Delta^*_{\rm pi}$ larger than the maximum negative difference.

The vectors $\Delta^*_{\rm pi}$, attributed to the area centers, are shown in Figure 1. Their magnitudes are proportional to the numbers of stars and the directions are the mid-

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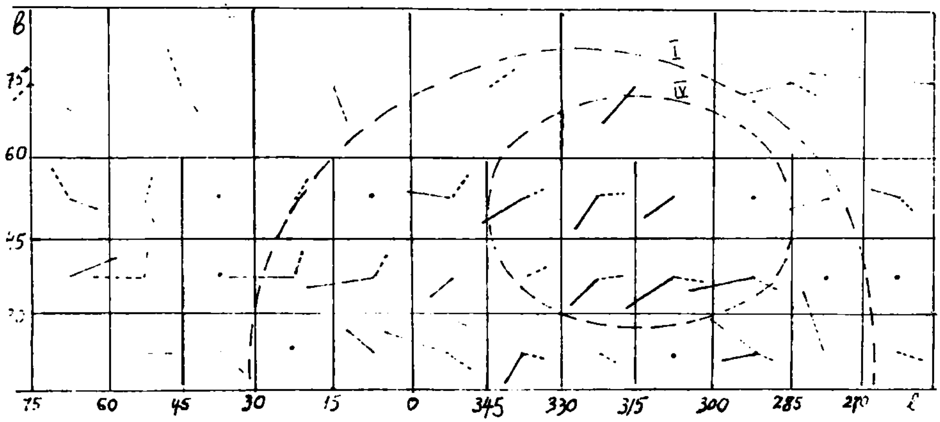

Figure 1 The vectors of maximal FK-K deflexions from ellipses. The radioloops I and IV are marked.

dles of the φ_i sectors. Eight areas where $\Delta^*_{\rm pi} \approx 0$ are marked by dots. They are arranged near $l \approx 30°$ and $l \approx 270°$. These longitudes can be connected with the Radio Loop I where we discovered a stellar component [2, 3] and have expected peculiarities in kinematics. The Loop's I northern part and Loop IV are schematically shown up by broken lines.

A systematic pattern in the identically marked vectors for a number of areas sets suggests stellar streams diverging from the radiants (L, B) or converging to the antiradiants (L', B'). The thick vectors in the Loop IV are converging to $(L' \approx 0,\ B' \approx 0)$. And vectors in the Loop I (continuous and dotted) form the encounter streams at $(L, B) = (22.1° \pm 4.2°, 25.0° \pm 4.8°)$ and $(L', B') = (24.5° \pm 21.9°, 34.2° \pm 9.3°)$. Within mean errors, they coincide with each other and with the coordinates of the ellipsoid's vertex for the areas at $l < 15°$: $(l_v, b_v) = (18.3° \pm 4.4°, 20.7° \pm 2.7°)$. Hence, the encounter streams move along the large axis of the ellipsoid. Then, the second approximation in the distribution can be a figure more extended than the ellipse with the elements (δ_b, e, φ_a). But there can be other interpretations. For example, it can be a circular stream or an axial rotation of the Loop I, when we see its closer and remote sides. The environs of the Loop I show a weaker order; it is desirable to enlarge them.

It is to be noted that the verification concerns the form of the argument of the velocity distribution independently of the form of the distribution itself.

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DISCUSSION

Ossipkov: Please, remind us what is the Kovalsky-Kapteyn figure (FK-K).
Anisimova: It is the polar diagram of the φ-positional angles of stellar proper motions over some sky area.
Ossipkov: How do the errors in $\bar{\mu}$ and the selection of observations affect the FK-K?
Anisimova: The errors of positional angles $\Delta\varphi \approx \Delta/\mu$, where Δ is the mean error of one μ-component. The deviation from the real φ does not exceed one and a half FK-K sector width ($\pm 45°$) in about 90% of cases by $\Delta \leq 0.020''$. The displacements into the nearby sectors are to a considerable extent, compensated by the opposite transitions. That is why $\Delta\varphi$ changes a little the ellipse elements. So the errors in the semi-axis and the eccentricity are by an order smaller than the magnitudes themselves. The observation selection in μ and m removes only the gravity center. It has a small influence on the shape and size of the ellipse.
Ossipkov: Does the ellipsoidality of the velocity distribution mean that the form of the FK-K is an ellipse?
Anisimova: It is true only for small sky with almost identical parallactical and others systematical motions, as we have. In this case an ellipsoidality for the total velocity leads to an elliptical distribution with a and b axis for the tangential velocities v_t. For the directions v_t and for μ, the distribution is also an elliptic one, but with the axes (a^2, b^2), according to the corresponding theorem from [1].