CONSTRUCTING OF THE STELLAR VELOCITY FIELD USING THE HIPPARCOS DATA

ALEXANDER TSVETKOV and MARIA BABADZHANYANTS
Astronomical Institute of St.- Petersburg University St. Petersburg, 198504, Russia

Abstract. To investigate the velocity field in the solar vicinity we have to know three components of stellar velocities. Since the Hipparcos catalogue does not contain the radial velocities we cannot find the spatial velocity of each star. The individual parallaxes allow us to arrange the selections of stars, which can form any configuration in space. The solution of the Airy-Kowalsky equations using such selections yields the components of the solar motion with regard to a group of stars. The differences between the various values are the main idea to construct the stellar velocity field.

1. The Method of Constructing Velocity Field

The influence of the Solar motion on a proper motion of star is described by the Airy-Kowalski equations (Kulikovsky, 1991):

$$\mu_l \cos b = \frac{V_x}{kr} \sin l - \frac{V_y}{kr} \cos l \tag{1}$$

$$\mu_b = \frac{V_x}{kr} \cos l \sin b + \frac{V_y}{kr} \sin l \sin b - \frac{V_z}{kr} \cos b \tag{2}$$

These equations were solved over the Hipparcos data using standard least square method.

2. Constructing Velocity Field - Selection of the Stars

We consider the galactic orthogonal coordinate system and chose a net 400pc size with the distances 50 pc from one knot to another. Every knot was a center of a sphere of radius 200 pc. The combined solution of equation (1) and (2) was derived for stars belonged to a sphere. We denote the solution as $V_i = (V_x, V_y, V_z)$ for i-sphere. The central solution is V_0. The vector $DV_i = V_0 - V_i$ can be interpreted as relative motion of the center of i-sphere with respect to the Sun. This algorithm was applied to three groups of stars: O-B, A-F and K-M giants. The accuracy of parallaxes better than 25% and proper motions less than 30 "/cy were used. Figures 1a and 2a, b show the results for O–B stars.

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3. Artificial Velocity Fields Based on the Oort-Lindblad Model

We compared the derived fields with the model ones based on the Oort-Lindblad model, which contains only the plane Galactic rotation. The artificial proper motions were calculated according to this model. The result is represented by Figure 1 b. The velocity field for XZ and YZ planes are equal to zero.

4. The Main Results

In the XY-plane the velocity field of O-B stars is in a good correspondence to the Oort-Linblad model. The XZ and YZ planes indicate significant rotation in non-galactic plane. It means that the rotation vector of the nearby O-B stars is non-orthogonal to the Galactic plane. The kinematics of the solar neighborhood is more complicated than one described of standard kinematical models.

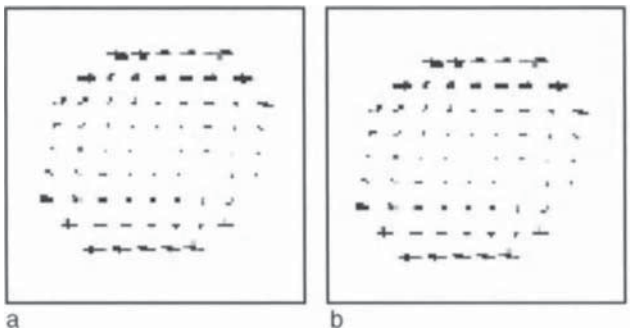

Figure 1. a. Original velocity vector field for O–B stars in XY plane and b. model velocity vector field for O–B stars in XY plane.

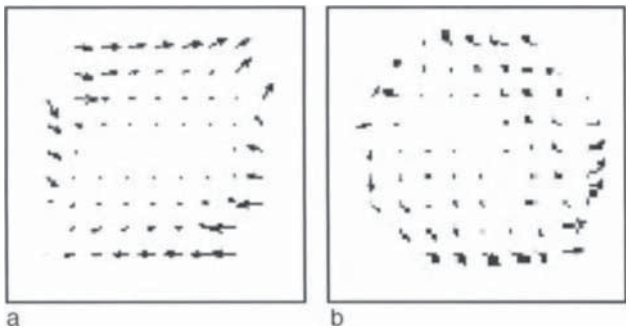

Figure 2. Original velocity vector field for O–B stars a. in XZ plane and b. in YZ plane.

References

Kulikovsky, P.G.: 1991, *Stellar Astronomy*, Nauka, Moskva (in Russian).