RevMexAA (Serie de Conferencias), **25**, 63–64 (2006)

COMPARISON OF SOLAR MOTION RELATIVE TO STARS OF DIFFERENT COLOR INDEX IN THE SOLAR NEIGHBORHOOD

W. Cepeda[1]

RESUMEN

El autor de este trabajo hace una determinación del movimiento solar a partir de velocidades radiales de estrellas del catálogo Hipparcos, con distancias entre 10 y 100 pc y diferentes valores de índice de color. Fueron elegidas 3,362 estrellas del catálogo, las cuales fueron agrupadas en función de su distancia al Sol en el rango dado. Para la reducción de los datos, fue aplicado el método de mínimos cuadrados. Dado que la muestra elegida es pequeña, los resultados muestran gran dispersión respecto a los señalados en la literatura. El promedio es aceptable: $V_\odot = 25.3$.

ABSTRACT

Solar motion is determined by using radial velocities of the Hipparcos Catalogue, for distances between 10 pc and 100 pc and different values of color index; 3,362 stars with radial velocities and color index were chosen and different groups were formed as a function of the distance from the Sun in intervals of 10 pc, until 100 pc. For this reduction, the least squares method has been applied. Since the sample was small, the results show a great dispersion with respect to literature data. The average gives an acceptable result: $V_\odot = 25.3$.

Key Words: **ASTROMETRY — GALAXY: KINEMATICS AND DYNAMICS — GALAXY: SOLAR NEIGHBORHOOD — STARS: FUNDAMENTAL PARAMETERS**

1. GENERAL

The velocity distribution of stars in solar neigborhood has turned out to be a very important parameter for the study of stellar kinematics (Skuljan et al. 1999). The arrival of the Hipparcos Catalogue, provided a very useful tool for making possible the study of Galaxy structure in greater detail. One of the measurements made by Hipparcos (ESA 1977) is the color index determination, which together with the determination of radial velocities, makes possible a different analysis. The color index measures the relation of stellar flux between two characteristic wavelengths, generally the effective filter wavelength. As a convention, the zero color index is chosen as an average for $A0$ type stars having the same magnitude in all wavelengths: $(B - V) = (U - B) = 0$.

2. BASIC EQUATIONS

In order to derive the basic equations required in this paper the Sun was considered the center of an orthogonal system of coordinates. The x axis is directed to the equinox, the y axis to 90°, and the z axis to the north pole. A star with coordinates (x, y, z) wil be located at a distance d from the Sun, then:

$$\begin{aligned} x &= d\cos\delta\cos\alpha & (1)\\ y &= d\cos\delta\sin\alpha & (2)\\ z &= d\sin\delta\ . & (3)\end{aligned}$$

Differentiating equations (1, 2, 3) with respect to time, we obtain the equatorial components of the radial velocity. Solving this new set of equations, we obtain the expression for the radial velocity:

$$\dot{x}\cos\delta_i\cos\alpha_i + \dot{y}\cos\delta_i\sin\alpha_i + \dot{z}\sin\delta_i = \dot{d}_i \quad (4)$$

$(i = 1, 2, .., N)$.

The set of equations (4) can be solved by least squares by solving the equation (Mihalas & Binney 1981):

$$X_\odot\sum_{i=1}^{N} a_i^2 + Y_\odot\sum_{i=1}^{N} a_i b_i + Z_\odot\sum_{i=1}^{N} a_i c_i = \sum_{i=1}^{N} a_i k_i\ . \quad (5)$$

With these results we obtain the radial velocity of the Sun, $S_\odot$, and the equatorial coordinates of the apex (α_A, δ_A):

$$\begin{aligned} V_\odot &= (X_\odot^2 + Y_\odot^2 + Z_\odot^2)^{1/2} & (6)\\ \tan\alpha_A &= \frac{Y_\odot}{X_\odot} & (7)\\ \tan\delta_A &= \frac{Z_\odot}{(X_\odot^2 + Y_\odot^2)}^{1/2}\ . & (8)\end{aligned}$$

[1]Observatorio Astronómico Nacional, Universidad Nacional de Colombia, Apartado Aéreo 59534, Bogotá, Colombia (wecepedap@unal.edu.co).

TABLE 1

RANGE OF COLOR INDEX

No.	$B-V$	
1	−0.22	−0.03
2	−0.03	0.26
3	0.26	0.57
4	0.57	0.78
5	0.78	1.49
6	1.49	1.91

The velocity vector of the solar motion is determined by:

$$u_\odot = -V_\odot \cos l_A \cos b_A \tag{9}$$
$$v'_\odot = +V_\odot \sin l_A \cos b_A \tag{10}$$
$$w_\odot = +V_\odot \sin b_A \ , \tag{11}$$

where (l_A, b_A), are the galactic coordinates of the solar apex.

3. DISTRIBUTION OF THE STARS BY THEIR DISTANCES TO THE SUN

3,362 stars with radial velocity and color index from the Hipparcos Catalogue were chosen in the neigborhood of the Sun (< 100 pc). Five groups of stars spaced by 20 pc radially from the center of the Sun were formed. In addition, six subgroups were formed according to $B-V$ range, as indicated in Table 1.

4. CONCLUSIONS

- The sample has been very small (3,362 stars vs. 118,218 stars from Hipparcos)
- For small samples, the results are affected by great uncertainties (Pavlovskaya 1964).
- The results obtained for the solar motion show a great dispersion compared to the data from the literature.
- However, when the velocities of the sample are averaged, is obtained a good approximation to the data in the literature which is: $V_\odot = 25.3$.

REFERENCES

ESA, 1997, The Hipparcos Catalogue. ESA SP-1200

Mihalas D., & Binney J. 1981, Galactic Astronomy - Structure and Kinematics (2nd edition), W. H. Freeman and Company, San Francisco.

Skuljan J., Cottrell, P. L., & Hearnshaw J. B. 1999 MNRAS, 308, 731

Pavlosvskaya E. D., SvA 1964, 7,6 849