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SURVEY OF STELLAR ASSOCIATIONS USING PROPER MOTIONS

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RESUMEN

El movimiento propio de una estrella se puede representar por un círculo máximo sobre la esfera celeste. Este punto de vista crea una geometría sobre la esfera que permite estudiar el paralelismo de movimientos en una forma muy sencilla. El cálculo de las intersecciones de estos círculos puede detectar los puntos de convergencia de los movimientos. Esto puede aplicarse a cúmulos estelares abiertos, identificando el punto de convergencia como ápex y con ello detectar la probabilidad de membresía de las estrellas. O en una forma más general a la determinación de estructuras estelares extensas en nuestra galaxia, lo cual puede llevar a inferir algo sobre su cinemática. Presentamos una descripción del modelo y un ejemplo al aplicarlo al catálogo *Hipparcos*.

ABSTRACT

Stellar Proper Motions can be represented as great circles over the Celestial Sphere. This point of view creates a geometry over the sphere where the study of parallelism of the motions is possible in an easy form. Calculus of intersections between circles can detect convergence point of motions. This means parallel spatial motion. The model can be carried out to open stars clusters, identifying convergence points as apex, in order to get membership probabilities or, in a general form, to stars of our galaxy to detect big stellar structures and to infer some details about their kinematics. We present here a short description of the model and some examples using stars of the *Hipparcos* catalogue.

Key Words: **PROPER MOTION — STELLAR ASSOCIATION — STELLAR CATALOGUE**

1. GENERAL DESCRIPTION

The position catalogs are essential when we define a geometrical system to refer new observations. If the positions cannot be carried out to the epochs when the observations were realized, we can say that the reference system is not exact. Otherwise, if we are able to obtain accurate positions of reference stars for any epoch, we shall have better assigned positions for observations. For this reason, the proper motions can be as important as the positions given by the catalog.

But this is not the only use of proper motions. We all know that the stellar associations members should have a common motion component, so they can stay as an association. This is a reference used since long time ago as a first step to find clusters or stellar associations, assuring later the membership with the distance.

The classic and initial way to search for members of an association is to study the (μ_α, μ_δ) points distribution, where we can suppose that this distribution is the sum of two independent distribution, one that represents the star cluster and the other which represents the rest of the field stars. This is simple when the two distribution are easily separated, but when a complex problem appears it has been necessary to add new conditions such

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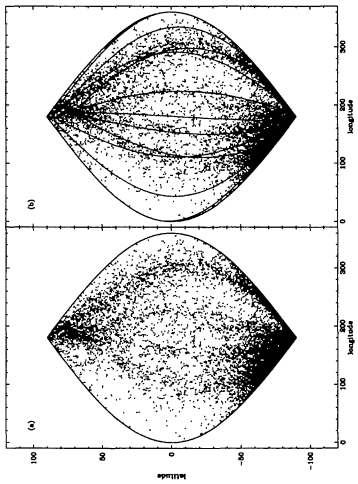

Fig. 1. Representation over the Celestial Sphere of the director vectors of all spectral type B stars of the *Hipparcos* catalog; (*b*) shows the great circles that adjust stellar associations already described by other authors.

as the stars spatial distribution, an apex, etc. In fact, if their are deep fields, the number (quantity) of cluster stars is less meaningful comparing with the field stars, such that the cluster could be unidentified.

The way proper motions are calculated led us to think of a different way of studying them. A proper motion can be considered as a linear fit to the observed points which represents the stars in differents epochs. These points are joined by a line, without information of how the stars goes from one point to another.

The small interval of time for which we have observations and the time scale for which we can discern the star real motion lead us to consider that the idea of representing the proper motion as a great circle. This is not a new idea: Herschel (1786) applied it to the determination of the solar motion and lately it has been used by other authors (Broche) to determine the cluster apex.

We extend this idea convinced of its potential and work with the complete great circle of motion. this allows us to build a naive vectorial geometry where paths (great circle), intersection between each couple of path and motion direction vector, shows us a new perspective on its interpretation.

By this way and with the study of known cluster such as the Hyades, Pleyades, and Praesepe, we observe that, if there exists an apex, we can obtain it in an easy way as the convergent point of all the intersection of each couple of paths, this will be very useful to confirm members or to find new ones.

By the same way, when a sky area is selected, the stars motion is defined by the director vectors which lies over the celestial sphere along a band whose width is at most the same as that of the selected area. If in this area exists an association, the directors vector of the members will lie in a direction that is inside the general band and the orientation can be either parallel or transverse to it, according to the apex distance.

This new point of view is much wider because of the use of all the celestial sphere for the application of the proper motion instead of a two dimension space of an area restricted by the points (μ_α, μ_δ).

Most useful for this new approach is the possibility to determine stellar associations in large scales when the director vectors of catalog stars area represented on an arbitrarily large selected area. The associations are represented as great circles arcs; for example using stars of the *Hipparcos* catalog associations already reported by other authors, but difficult to identify with the classical approach, can be distinguished (Fig. 1).

We think that this new approach of Herschel interpretation can be useful in the study of the solar vicinity kinematics and in the Galaxy afterwards.

REFERENCES

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