Bull. Astron. Belgrade № 152 (1995), 59 – 63

UDC 524.47-54
Original scientific paper

AN ANALYSIS OF NINE MOVING–CLUSTERS

G. M. Popović, S. Ninković and R. Pavlović

Astronomical Observatory, Volgina 7, 11050 Belgrade, Yugoslavia

(Received: September 18, 1995)

SUMMARY: The nine moving star clusters discovered by Agekian and Orlov (1984) are analysed by applying two methods. In the first one we calculated the velocity directions for the cluster stars relativ to the Sun and in the second one the circles of their proper motions are analysed. Though a satisfactory agreement is found, it is possible to eliminate on the basis of the second approach some stars as not beeing cluster members.

1. INTRODUCTION

By analysing the components of the space velocities U, V, W for 1132 stars of Gliese's catalogue (1969) Agekian and Orlov brought out 9 moving star clusters. Cluster VII was identified as the Ursae Maioris Cluster. Their classing of the member stars was based on a criterion according to which the amounts of the velocity components within a cluster do not variate by more than 6 $\mathrm{km\,s^{-1}}$. The present paper, proceeding from the results of Agekyan and Orlov (1984) is aimed at answering two questions: 1. What is the accuracy of the radiant (vertex) positions l_r and b_r for these clusters? 2. What is the agreement between the radiant positions derived from the U, V, W components with those obtained from the star proper motions? By answering the first question one may come closer to the classing of cluster stars when it is done through the space velocities only, whereas by answering the second one it is possible to find an insight in the reliability of cluster-member classing by applying different procedures.

2. PROCEDURE APPLIED

The direction of the space velocities for the stars of each cluster is obtained by means of the well-known relations:

$$l_v = \arctan(\frac{V}{U}),$$

and

$$b_v = \arctan \frac{W}{\sqrt{U^2 + V^2}},$$

where U, V, W are the velocity components, as said above. The obtained positions are given in plots together with the great circles of the proper motions for these stars. The velocity directions for a given cluster are concentrated within narrow ranges $\Delta l_v, \Delta b_v$ whose width is determined by the velocity direction dispersion. The great circles of star proper motions would have to pass through this part of the sky, i. e.

ought to have intersection in it. The moving–cluster radiant is within the defined region. In this way one can establish for each cluster star whether its proper-motion great circle crosses the defined region of the radiant. If this is not the case, the star membership should be questioned. Here the radiant positions, as well as their errors, are derived after the elimination of those stars whose proper–motion great circles do not cross the $\Delta l_v, \Delta b_v$ region. For the purpose of obtaining possible deviations of the radiant position l_r, b_r (without giving up the criterion of velocity-components – U, V, W – dispersion) the new regions obtained after the elimination are treated.

3. RESULTS

As could be expected a satisfactory, but not a full, agreement is obtained between the velocity directions derived from the input data U, V, W and the positions following from the star proper motions. In each cluster there appear a few stars yielding great proper-motion circles not crossing the regions $\Delta l_v, \Delta b_v$ determined from the components U, V, W. These stars are identified and left out. They are listed in the fifth column of Table 1. Their designations are the same as those in Gliese's catalogue (1969). In Figs. 1,2 this selection is seen from the example of Cluster III. Fig. 1 yields all the velocity directions for the stars of Cluster III and also their great proper-motion circles. Fig. 2 yields the same thing, but after the elimination of the stars whose proper-motion great circles do not intersect in the radiant region for the given cluster. In Fig. 1, for instance, there are nine proper-motion great circles "avoiding" the defined radiant region. The membership of the concerned stars becomes questionable. The reason why the directions of their velocities are within the cluster-radiant region, but without being confirmed by the proper motion, should be looked for in the inadequate accuracy of their parallaxes, proper motions and line-of-sight velocities.

Table 1 gives the following: cluster number according to Agekian and Orlov (1984) (Column 1), radiant places with their errors after the elimination of the stars listed in Column 5 (Columns 2-3), the extension of areas $\Delta l_v, \Delta b_v$ of the cluster radiant (also after the elimination of the stars mentioned in Column 5 (Column 4).

The results of the velocity direction calculation for all stars belonging to the eight moving star cluster proposed in Agekian and Orlov (1984) are presented in Figs. 3,4. A strong concentration of these directions towards the region corresponding to the solar antiapex (237°, −22°) is seen. Besides, there are no clearly distinct boundaries in the directions from cluster to cluster. Only Clusters III and VII are clearly standing apart by their space directions. For the stars of Cluster I (the Sun is among them) the velocities are chaotically directed. This can be expected because even the smallest errors in the velocity components U, V, W result in a significant error in the direction of the vector defined by them. Fig. 4 repeats the state from Fig. 3, but without the eliminated stars. The proper-motion great circles for Cluster I stars do not yield a satisfactory result.

Table 1

No	$l_r \pm \sigma_{l_r}$	$b_r \pm \sigma_{b_r}$	$\Delta l \times \Delta b$	eliminated stars
II	202.°8 4.°4	−11.°6 3.°4	13.°5 × 10.°6	473, 527
III	230.1 6.4	−20.3 4.6	17.0 × 15.8	560, 594, 601, 781.3, 824, 836.7, 842.2, 863.2, 898
IV	199.3 3.1	−1.8 4.2	9.4 × 13.8	473, 669
V	218.9 10.6	−25.3 7.1	33.1 × 19.5	521.2, 564.1, 721, 755, 765.2, 781.2, 799, 826
VI	204.9 4.9	−22.3 4.3	14.8 × 15.3	456.1, 517, 749
VII	10.8 9.3	−34.4 5.8	40.0 × 19.9	196, 410, 519, 569, 620, 624
VIII	209.4 6.2	−8.6 5.9	22.3 × 22.9	83, 781.2, 811, 895.3
IX	242.1 5.7	5.9 7.9	16.6 × 20.1	507.1, 532.1, 599, 617, 753, 764.2

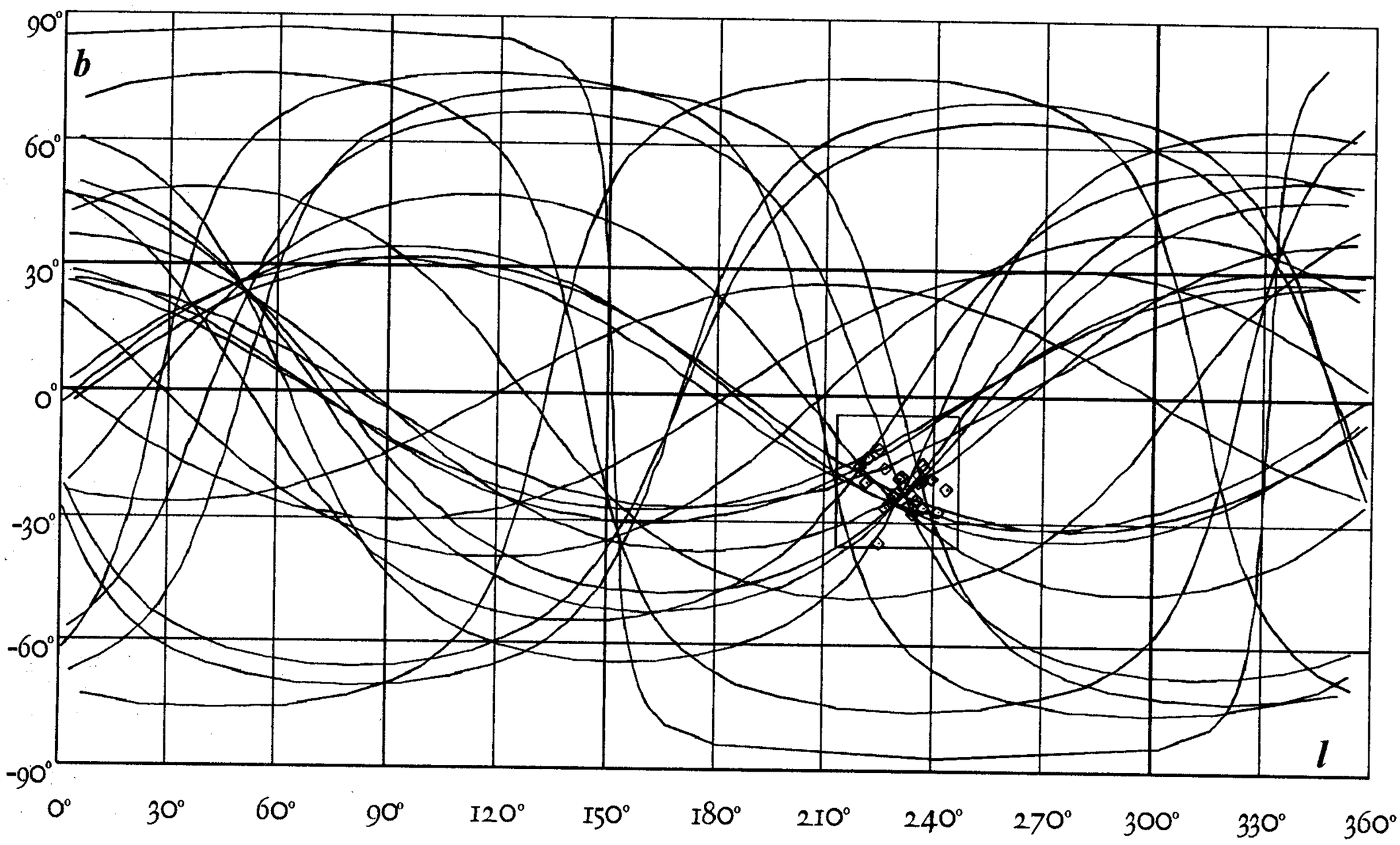

Fig. 1. The velocity directions (squares) for the stars of Cluster III and their great proper-motion circles in Galactic coordinates.

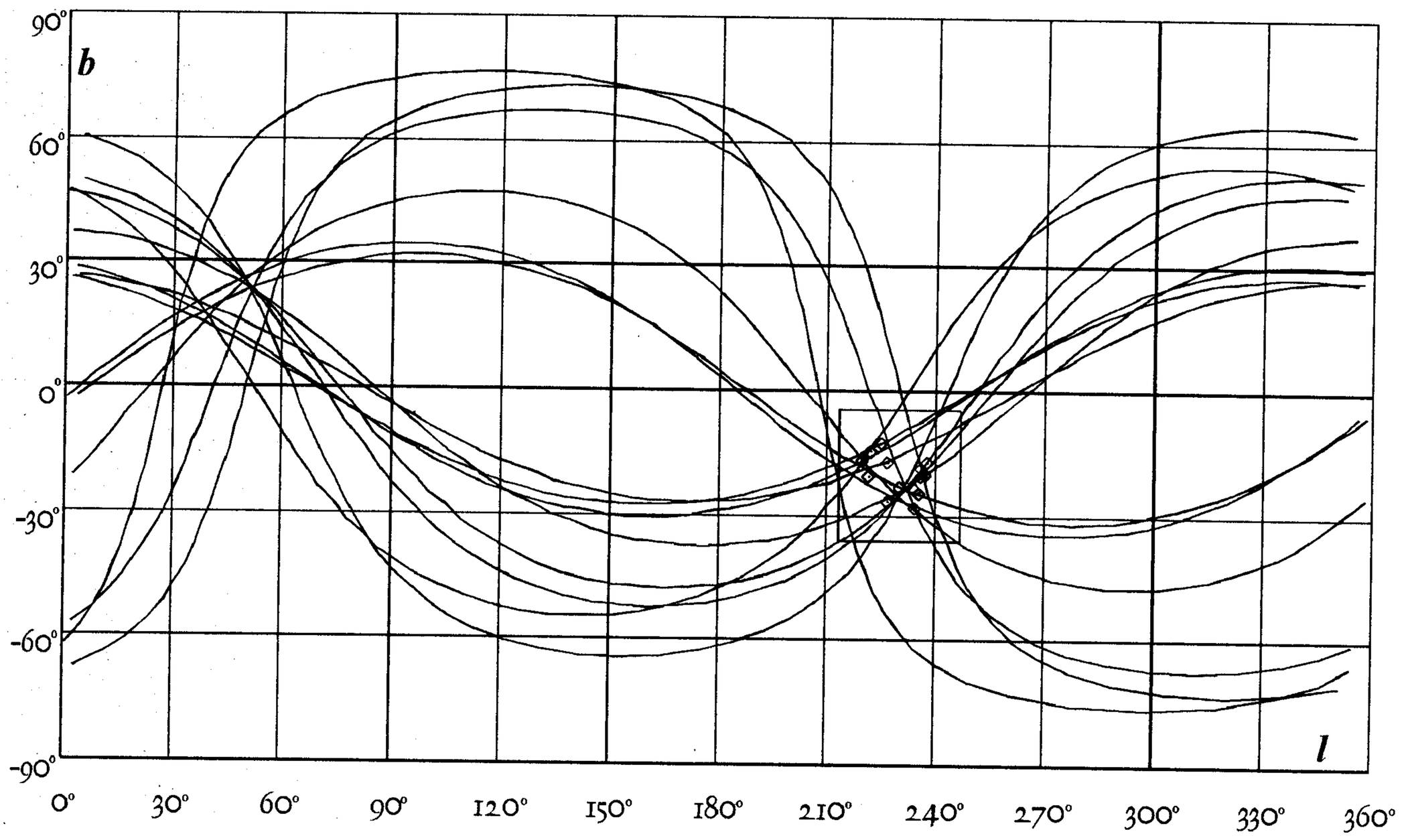

Fig. 2. Same as Fig. 1, after the elimination of stars not satisfying the adopted criterion.

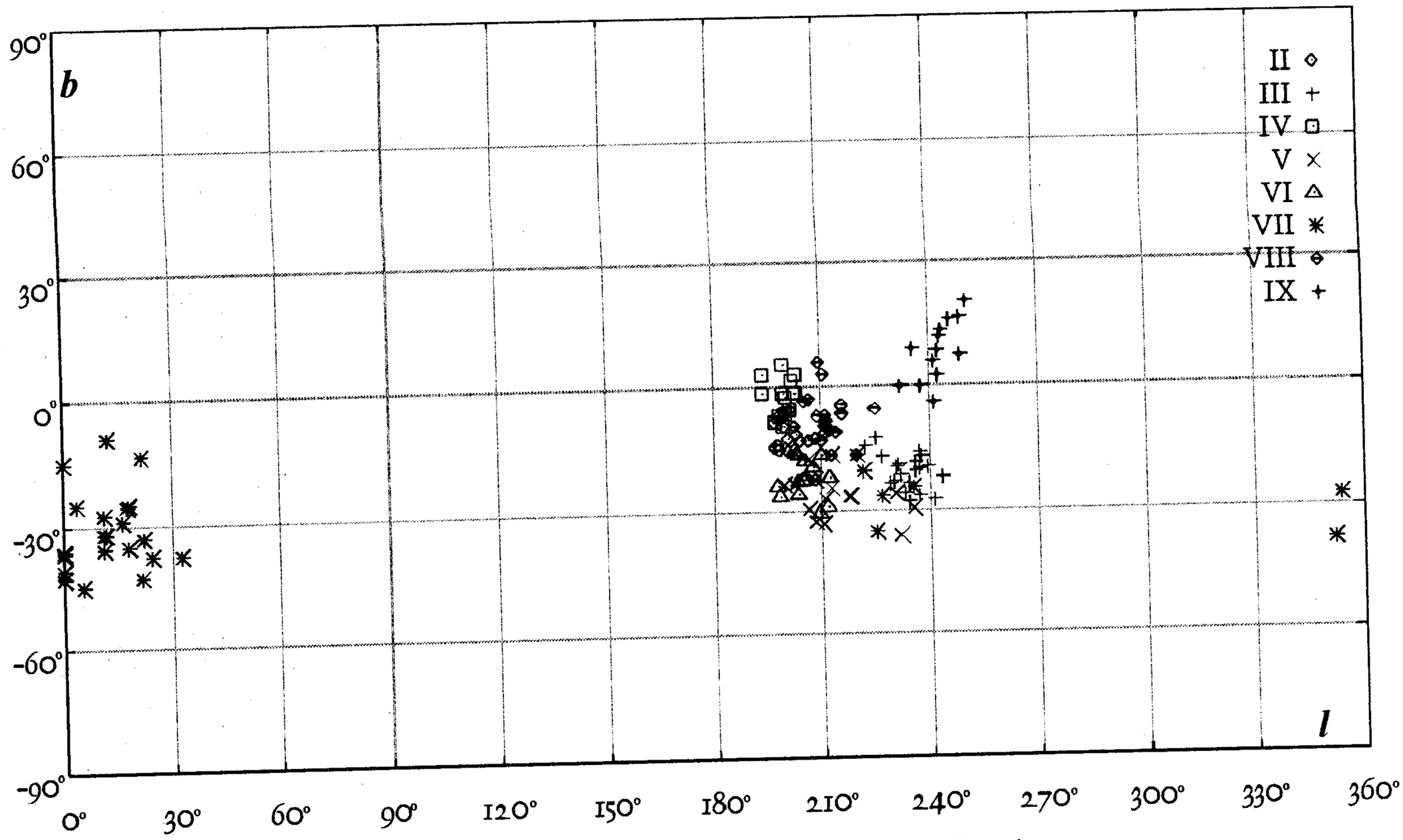

Fig. 3. The velocity direction for all stars belonging to the eight moving star clusters proposed in Agekian and Orlov (1984).

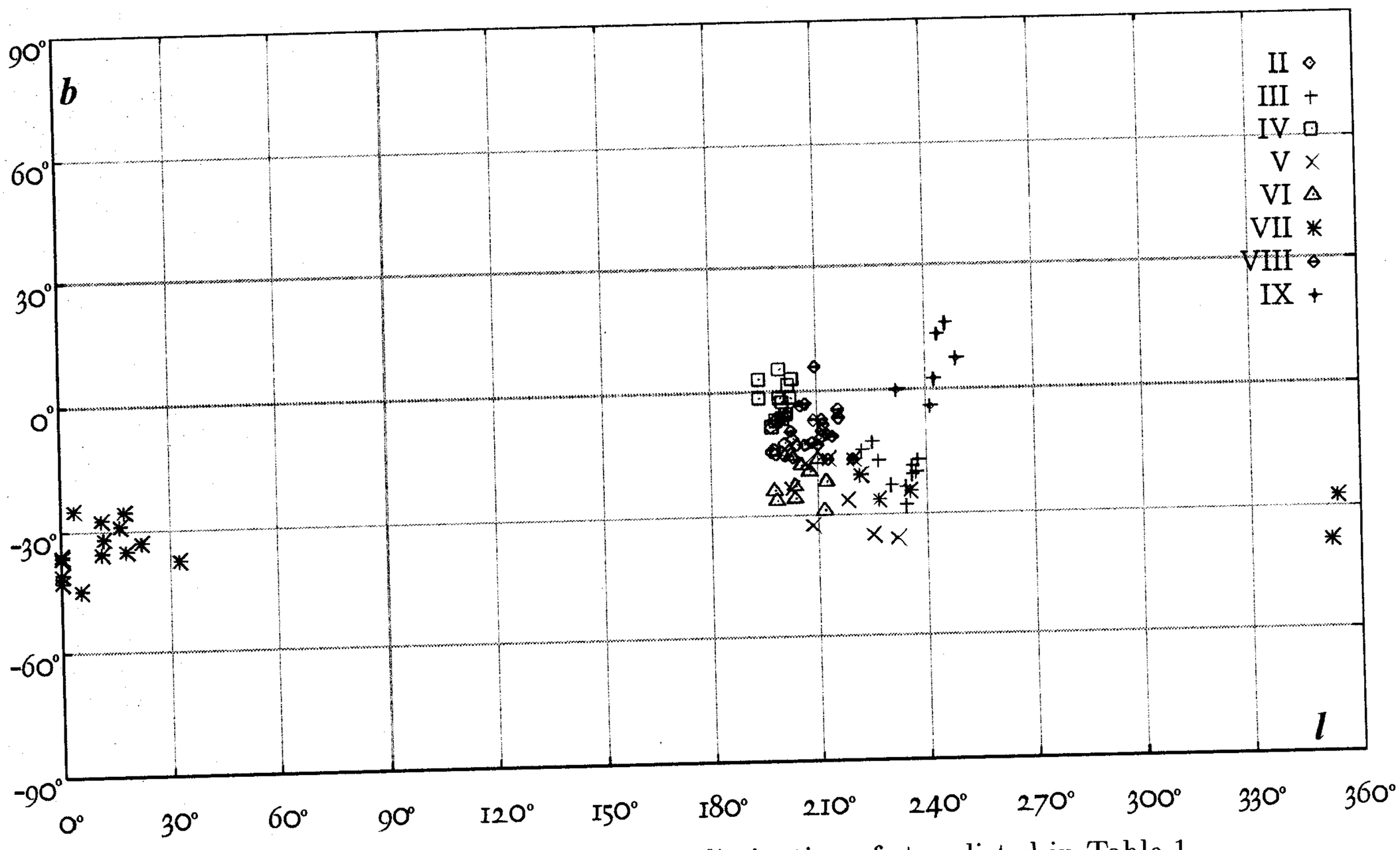

Fig. 4. Same as Fig. 3, after the elimination of stars listed in Table 1.

4. CONCLUSION

1. According to the analysis of 8 moving star clusters (Cluster I containing the Sun is excluded) the biggest tolerance in the star-direction for a moving cluster in the galactic coordinates is $\Delta l = 40°, \Delta b = 23°$ where the error in the velocity components does not exceed 6 $km\,s^{-1}$.
2. The procedure of obtaining the radiant position according to U, V, W on one hand and according to $\alpha, \delta, \mu_\alpha, \mu_\delta$ on the other yields an agreement, offering however, a possibility of elimination of some stars as cluster members.

Acknowledgements – This work is a part of the project "Physics and dynamics of celestial bodies", supported by Ministry of Science and Technology of Serbia.

REFERENCES

Agekian, T. A., Orlov V. V.: 1984, *Astron. Zh.*, **61**, 60.

Gliese, W.: 1969, Catalogue of nearby stars, Veröffentlichungen der Rechen – Instituts, Heidelberg, **22**.

АНАЛИЗА ДЕВЕТ ПОКРЕТНИХ ЈАТА

Г. М. Поповић, С. Нинковић и Р. Павловић

Астрономска Опсерваторија, Волгина 7, 11050 Београд, Југославија

УДК 524.47-54
Оригинални научни рад

Применом два поступка анализирано је девет јата која су открили Агекјан и Орлов (1984). Према првом поступку рачунати су правци усмерења брзина, у односу на Сунце, за звезде јата, а према другом, велики кругови сопствених кретања звезда јата. Нађена је задовољавајућа сагласност оба поступка, као и могућност да се неке звезде елиминишу као "сумњиве" чланице јата.