

Open Clusters in the Hipparcos Catalogue

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1. Introduction

We have begun a project to determine the dynamical properties of the galactic open cluster system. For this purpose we need information about the proper motions, distances, radial velocities and ages of the open clusters. As a first step we have searched the Hipparcos Catalogue for open cluster members. Our search resulted in a list of about 730 probable or possible members, which will enable us to determine the proper motions of nearly 220 open clusters. We found evidence for the membership of several cepheids and other stars of astrophysical interest in open clusters. We could also confirm or reject several dubious star clusters.

2. Member Search and Member Determination

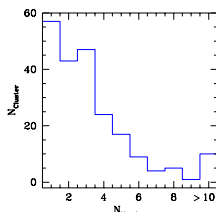
The basic data (positions, distances) of the open clusters were taken from the Lund Catalogue of Open Cluster Data (Lyngå 1987). With rough estimates for the tidal radii, the distances allowed us to obtain the areas that the clusters cover on the sky. Within these areas the Hipparcos Catalogue was searched for possible members of open clusters. About 2800 candidates in 330 clusters were found. Some nearby clusters were omitted, since they require a different method due to their large angular diameters. To separate the members from the non-members, we made use of the following information:

- Photometry (Ground based or Hipparcos)
- Distance from the cluster centre
- Proper motion (Hipparcos, ACT, ground based)
- Parallax (Hipparcos)
- Radial velocity

For every star, we combined the information from all of the above points (if available) to decide upon membership. We also searched the ACT Catalogue (Urban et. al 1997), if the information for a cluster was found to be insufficient. According on how well they fulfill the membership criteria, we divided the stars into three categories: Members, possible members and non-members.

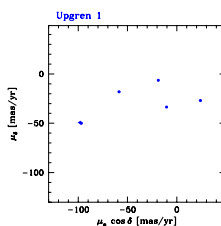
3. Results

About 580 members and 150 possible members were found. For 220 open clusters we could find at least one cluster member in the Hipparcos Catalogue, 60 clusters have only one member, while 35 clusters have more than five members. The distribution of the member numbers is shown in the Figure to the right. Using these stars, it should be possible to derive the proper motions of most clusters with an accuracy of 1 mas/yr or better. Our sample contains about 620 main sequence stars and 110 evolved stars. For several evolved stars Hipparcos gives evidence for their cluster membership. This may help to improve our knowledge about stellar evolution.



3.1 Dubious Clusters

Several debatable star clusters could be confirmed or rejected with the help of the Hipparcos and ACT proper motions. A paper about these clusters has been published (Baumgardt 1998). We found that Collinder 135 and NGC 2451 A are true star clusters. On the other hand we could show that NGC 1252, Upgren 1, Collinder 399 and Melotte 227 are only chance alignments of stars. The results for NGC 2451 B and Collinder 132 remain ambiguous, but star cluster may be present in both cases. As an example we show the proper motions of the stars that Upgren (1963) proposed as members of Upgren 1. The suspected cluster members share no common proper motion. In addition the cluster seems to have no fainter members (Upgren 1963). It is therefore very likely that it does not exist at all.



3.2 Cepheids in Open Clusters

A literature search was made in order to find Cepheids which are possible members of open clusters. 24 stars were found. Five of them could not be found in the Hipparcos Catalogue. For the remaining stars, the Hipparcos and TRC Catalogues (Hog et al. 1998) were searched for known cluster members. If members were found, the mean of their proper motion was taken and compared with the motion of the Cepheid. The following figures show our results.

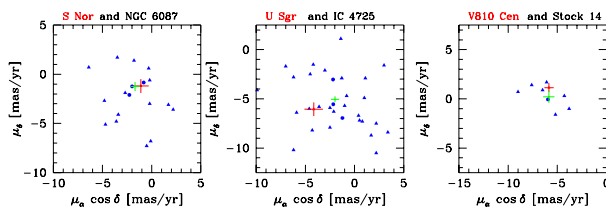


Figure 1. Cepheids that are likely members of open clusters. The proper motions of the Cepheids are shown in red, that of the cluster stars in blue. The mean motion of the clusters is shown in green. Stars from the Hipparcos Catalogue are shown as filled circles, stars from the TRC Catalogue as triangles. Note that the typical error of a TRC star is about 2.5 mas/yr.

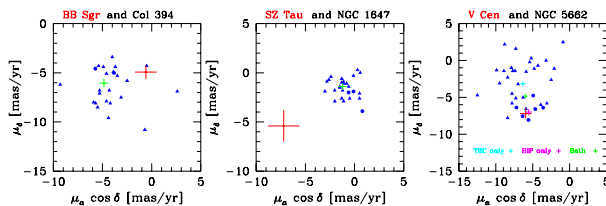


Figure 2. Cepheids that are likely non-members of open clusters. The meaning of the symbols is the same as in Figure 1. There is a discrepancy in the proper motions of the Hipparcos compared to the TRC stars in NGC 5662 (right panel). Therefore V Cen may be a member of this cluster, despite the fact that its proper motion differs significantly from the mean of all cluster stars (see text).

Our data add further evidence for the membership of DL Cas in NGC 129, V810 Cen in Stock 14 and S Nor in NGC 6087. A similar conclusion for the last cluster was already drawn by Lyngå and Lindegren (1998), based on the motion of three members from the Hipparcos Catalogue. Our work confirms and strengthens their results. U Sgr shows a relatively large deviation in its proper motion compared to the bulk of the cluster stars. We nevertheless regard this Cepheid as a member of IC 4725, because it is located in the cluster center and has a radial velocity in very good agreement with 3 other cluster stars (Mermilliod et al. 1987).

We can definitely exclude the cluster membership of 3 Cepheids (BB Sgr in Collinder 394, SZ Tau in NGC 1647 and GU Nor in NGC 6067). The case is less clear for V Cen. We find an appreciable difference in the mean proper motions of the Hipparcos and the TRC members of this cluster (see Figure 2), which may be due to systematic errors in the TRC Catalogue. It is therefore safe to use only the Hipparcos stars for our comparison. Since the motion of the Cepheid is in very good agreement with their mean motion, we conclude that it is probably a member of this cluster.

4. References

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