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.
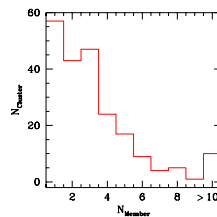

3.1 Cepheids in Open Clusters

Our memberlist contains about 130 variable stars, among them 11 cepheids. For three cepheids Hipparcos adds new evidence for their cluster membership because the proper motions of the cepheids and several confirmed cluster members agree with each other. These are DL Cas in NGC 129, S Nor in NGC 6087 and U Sgr in IC 4725 (M 25). A similar conclusion for the last two clusters was already drawn by Lyngå and Lindegren (1998). The following Figure shows the proper motions of the cluster stars and the cepheids. The cepheids are shown with red symbols.
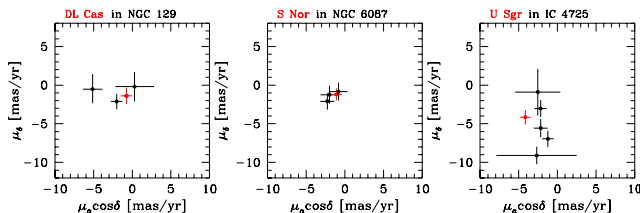

## 4. Individual Clusters

4.1 IC 2602

The figure to the right shows the proper motions of all Hipparcos stars in an 8 by 8 degree field centred on the position of IC 2602. One notices the presence of three distinct stellar groups. The group near $\mu_\alpha \cos \delta = -7$ mas/yr, $\mu_\delta = 2$ mas/yr is just the background of Milky Way stars and will not be discussed further. The group centred at $\mu_\alpha \cos \delta = -18$ mas/yr, $\mu_\delta = 11$ mas/yr is the cluster IC 2602 while the stars near $\mu_\alpha \cos \delta = -16$ mas/yr, $\mu_\delta = 3$ mas/yr form a so far undiscovered group. From now on, we will call the cluster IC 2602 A and the new stellar group IC 2602 B. An algorithm was developed, which separates the members of IC 2602 A and B from the field stars.
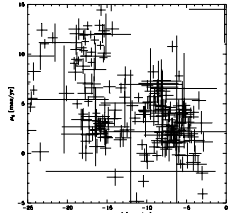
The following figure shows the projected distribution of the stars which were found to be members of IC 2602 A and B respectively. The members of IC 2602 A (left Figure) show a clear concentration, which supports the idea that IC 2602 A is a true star cluster. On the contrary the members of IC 2602 B are scattered uniformly over the region studied. Hence it is more likely that IC 2602 B is an unbound association of stars. From the Hipparcos parallaxes we obtain distances of 145 and 400 pc to IC 2602 A and B respectively.
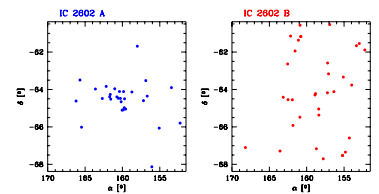

We finally show the colour-magnitude diagram of both groups. The brighter stars of IC 2602 B have colours comparable to stars in IC 2602 A. They have therefore been mistaken as members of IC 2602 A in previous studies of the cluster. The earliest spectral types are B0 for HIP 52419 in IC 2602 A and B2 for HIP 50067 in IC 2602 B. Both groups can therfore be of approximately the same age. They may have formed at the same time, with IC 2602 A being the core of the more widely distributed association IC 2602 B. A relative velocity of about 10 km/sec between both groups is necessary to explain their separation today.
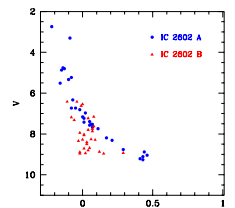
4.2 Other Clusters

Several debatable star clusters can be confirmed or rejected with the help of the Hipparcos and ACT proper motions. A paper about these clusters is in preparation (Baumgardt 1998). We find that Collinder 135, NGC 1901 and NGC 2451 A are true star clusters. On the other hand we can 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.
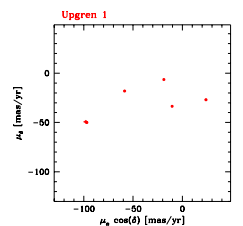
5. References

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