

## Cluster and Association Members

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### Abstract

The selection of known members of star clusters as BRITE targets is highly preferable. The given apparent visual magnitude limit for the targets, can be immediately transformed into a distance limit of about 750 pc around the Sun depending on the absolute magnitude. For a spectral type of A0, we are, for example, limited to about 65 pc only.

With the help of WEBDA (<http://www.univie.ac.at/webda>), we have found 60 possible candidates which are true members of star clusters (including associations). The membership offers the opportunity to use the results from a detailed cluster analysis “for free”. This includes the determination of the age, the distance, the reddening, the overall metallicity and thus the mass with a high accuracy. These are very valuable starting parameters for any detailed astrophysical study of an individual object.

### Star clusters - Why are they unique?

Open clusters and associations (denoted as “star clusters” in the following) are physically related groups of stars held together by mutual gravitational attraction. Therefore, they populate a limited region of space, which is typically much smaller than their distance from the Sun, so that the members are all approximately at the same distance. They are believed to originate from large cosmic gas and dust clouds (diffuse nebulae) in the Milky Way, and to continue to orbit the galaxy through the disk. In many clouds visible as bright diffuse nebulae, star formation still takes place, so that we can observe the birth of new young star clusters. This process of formation takes only a considerably short time (a few Myrs) compared to the lifetime of the cluster, so that all member stars are of similar age. Also, as all the stars in a cluster formed from the same diffuse nebula, they all have similar initial chemical composition. Hence, star clusters are of great interest for scientists:

- The cluster members are all at about the same distance from the Sun.

- They have the same age - within approximately a few million years - compared to the cluster age (up to a few billion years).
- The chemical composition of cluster members is quite homogeneous. Open cluster metallicities range from about  $-1.0$  to  $+0.6$  dex compared to the Sun.

The determination of distance, age and metallicity is, in general, not straightforward for galactic field stars. Star clusters on the other hand represent samples of stars of constant age and homogeneous chemical composition, suited for the study of processes linked to stellar structure and evolution. They allow to fix lines or loci in several important astrophysical diagrams such as the color-magnitude diagram (CMD), or the Hertzsprung-Russell diagram (HRD). Comparing the “standard” HRD, derived from nearby stars with sufficiently well known distances, or the theory of stellar evolution with the measured CMD of star clusters, provides a considerably good method to determine the distance of star clusters. Comparing their HRDs with stellar theory provides a reasonable way to estimate the age of star clusters.

## BRITE target stars as members of star clusters

For a given apparent magnitude limit of targets stars ( $V = 4$  mag) we can immediately calculate the distance limit for different absolute magnitudes. At maximum (not taking reddening into account)  $M_V = -6$  mag (early O) we can reach 1000 pc whereas the distance significantly decreases to 65 pc for a star with  $M_V = +0$  mag (A0).

With the help of WEBDA (<http://www.univie.ac.at/webda>), a highly efficient and successful database for the study of star clusters in the Milky Way and the Small Magellanic Cloud, it is possible to extract and retrieve all needed information. The database includes about 3.4 million individual measurements in most photometric systems in which cluster stars have been observed, spectroscopic observations, astrometric data, various kinds of supplementary information, and an extensive bibliography.

Taking a distance limit of 750 pc, we find in WEBDA about 220 star clusters which are closer than this value. Including the members of associations, we find about 60 *potential BRITE target stars* which are members of a star cluster.

## Why to observe members of star clusters?

From kinematic (proper motions as well as radial velocities) and photometric studies we are able to establish the membership of a star to a corresponding

cluster quite accurately, especially if we take the rather close distance of our given regime into account. The proper motions, for example, are significant and can be measured with high accuracy. Several new catalogues on this topic are now available (e.g., Dias et al. 2006).

If we are able to establish the cluster membership of a BRITE target star, we get its age, distance, reddening as well as (to some extent) the overall metallicity and thus its mass “for free” from the cluster analysis. Such an analysis is always based on the isochrone fitting technique (Jørgensen & Lindegren 2005). Extensive grids of stellar tracks covering the most important evolutionary phases and a large metallicity range are available. This method is based on the knowledge of all members of the cluster making it statistically significant.

Recently, Paunzen & Netopil (2006) have summarized our current knowledge of the published cluster parameters (age, distance and reddening) on the basis of a statistical analysis. Taking their data set and restricting it to our sample volume, we find the following approximate accuracy limits according to the absolute values:  $\Delta \log t \leq 15\%$ ,  $\Delta d \leq 10\%$  and  $\Delta E(B - V) \leq 5\%$ . These errors can be still significantly decreased by an independent isochrone fitting procedure for each star cluster using all published and newly observed data.

## Conclusions

It is preferable to observe members of star clusters (open clusters and associations) because we are able to a-priori determine their age, distance, reddening, overall metallicity and thus the mass with a high accuracy.

WEBDA, the database for star clusters will provide the already published data and an extensive number of tools to derive and extract all data and parameters.

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## References

- Dias, W.S., Assafin, M., Flório, V., et al. 2006, A&A 446, 949
- Jørgensen, B.R., Lindegren, L. 2005, A&A 436, 127
- Paunzen, E., Netopil, M. 2006, MNRAS 371, 1641