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Frequency of CP2 (CP4) stars in open clusters compared to the Galactic field

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Abstract. More than ten percent of all A- and B-type stars are chemically peculiar objects and about five percent are well known magnetic chemically peculiar (mCP) stars. This project explores the occurrence of the magnetic CP star groups (CP2 and CP4) in open clusters and in the Galactic field. In a first step, their positions in the Milky Way were analyzed. The next step will include a study of the dependence between various parameters and the Galactic position to identify Galactic environments that might favour the formation of mCP stars. The final goal of the project is to provide evidence for the evolution of the magnetic field by means of the mCP star incidence and their Galactic position.

Key words: stars: chemically peculiar – open clusters and associations: general – Galaxy: stellar content

1. Introduction

The group of mCP stars combines some important properties, such as strong magnetic fields, slow rotation, and chemical surface abundance inhomogeneities (see e.g. Netopil et al., 2017). We used the Michigan Catalogue of spectral types (vol. I–V, the latest by Houk & Swift, 1999) and the Catalogue of Ap, HgMn and Am Stars (Renson & Manfroid, 2009) to extract a list of CP2 and CP4 stars. The Michigan Catalogue is based on a spectral sky survey (108 Å/mm at Hβ) and covers the southern sky ($-90° < \delta < +5°$). It includes about 50 000 stars which are classified as B, A and early F-type objects. Furthermore, the catalogue by Renson & Manfroid (2009) lists more then 8000 known CP stars (spectral type: B to early F), compiled from many different sources. Open clusters were extracted from the online-database WEBDA[1] and the online-database Simbad served as an additional data source.

2. Data analysis

Renson & Manfroid (2009) list 3321 CP2 and CP4 stars, including about 1800 objects from the Michigan Catalogue. WEBDA lists about 1200 open cluster

[1] http://webda.physics.muni.cz

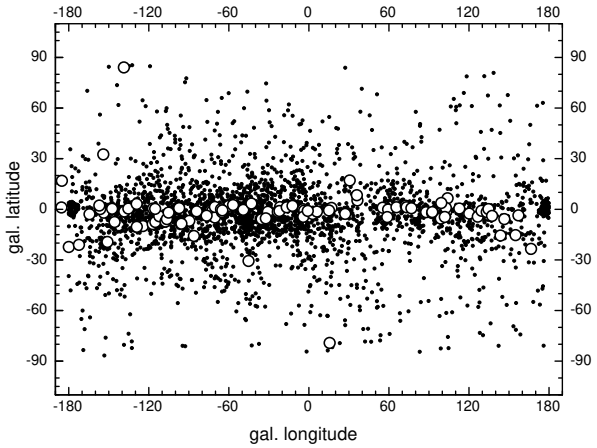

Figure 1. The Galactic positions of all identified mCP field stars (dots) and open clusters with known mCP member stars (open circles).

with 50 000 member stars in total, provides basic information (such as coordinates) and includes numerous photometric and astrometric data for the cluster stars. We identified 245 mCP cluster stars in 95 open clusters. The analysis of field stars is based on the Michigan Catalogue and Renson & Manfroid (2009). Open clusters with mCP star members are more concentrated to the Galactic plane, which also holds for the group of mCP field stars. Only the clusters Blanco 1 in the southern hemisphere and Coma Berenices in the north do not follow the general trend (see Fig. 1).

The sample of cluster mCP stars certainly still requires some improvement. The photometric Δa peculiarity index was developed to identify mCP stars in an economic way (Maitzen, 1976). This three-filter-system (g_1, g_2, y) makes use of a flux depression at 5200 Å, a typical characteristic for this group of stars. Generally, objects showing $\Delta a > 20$ mmag can be classified as mCP star candidates. Paunzen et al. (2005) derived a detection efficiency of up to 95 %, depending on the detection limit. We compiled Δa measurements for about 500 field and cluster mCP stars in our sample. However, not all of the spectroscopic mCP stars also show a remarkable Δa value (see right panel of Fig. 2), which might be a result of spectroscopic misclassification and a lower detection efficiency towards cooler objects. Nonetheless, this photometric system is a valuable tool to detect mCP star candidates which are too faint for detailed spectroscopic surveys; it even allowed the detection of mCP stars in the Large Magellanic Cloud (e.g. Paunzen et al., 2011).

A first evaluation of our data set does not show a clear correlation between the number of detected mCP stars in the individual open clusters and the number of cluster members, the cluster diameter, the distance, or the position.

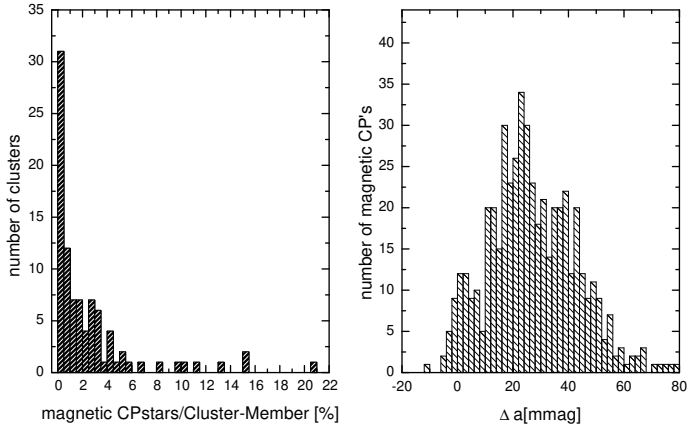

Figure 2. *Left*: Relationship between peculiar and non-peculiar stars in 95 cluster. *Right*: Distribution of the Δa values of spectroscopically identified mCP stars.

3. Conclusions

We know of 95 open clusters that host one or more mCP member stars. Most open clusters (80 objects) show a mCP star incidence between 0.5 % and 5% (left panel of Fig. 2), which is lower than typically quoted values for the Galactic field. Neither the diameter of the open clusters nor the distance seem to show a correlation with the number of detected mCP stars. An improvement of the cluster sample is certainly needed, but a spectroscopic survey is not a practicable option. Photometric measurements and long based time series will help to identify new mCP cluster stars.

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