

Variable stars in open clusters

E. Paunzen¹, M. Zejda¹, Z. Mikulášek¹, J. Liška¹, J. Krtička¹,
J. Janík¹, M. Netopil², L. Fossati³ and B. Baumann²

¹Department of Theoretical Physics and Astrophysics, Masaryk University
Kotlářská 2, CZ 611 37, Brno, Czech Republic
email: epaunzen@physics.muni.cz

²Department of Astrophysics, Vienna University, Türkenschanzstr. 17, A-1180 Vienna, Austria

³Argelander-Institut für Astronomie der Universität Bonn
Auf dem Hügel 71, D-53121, Bonn, Germany

Abstract. We present our joint efforts to study variable stars in open clusters. This includes a new catalogue, a photometric survey for new variables, and the database WEBDA. Our tools will shed more light on stellar variability in open clusters.

Keywords. open clusters and associations: general, stars: variables: other, techniques: photometric, astronomical data bases: miscellaneous, surveys, catalogs

1. Introduction

The study of an individual star provides only limited, frequently inaccurate and uncertain information about it and possibly about the interstellar medium between this object and us. On the other hand, open clusters provide an ideal opportunity to simultaneously study a group of stars located in a relatively small space, at the same distance from the Sun, and with the same age and initial chemical composition. The detection of any variable star in such stellar aggregates and its use to gather further information make research of open clusters very effective. For example, variable stars in open clusters allow one to obtain crucial information on both variable stars and open clusters in general. This improves our knowledge about both variable stars and open clusters and yields new data for the study of the dynamics, evolution, and structure of the whole Milky Way.

2. A new catalogue of variable stars in open cluster fields

In Zejda *et al.* (2012), we presented a new catalogue of variable stars in open cluster fields. For the compilation of the catalogue, the most complete database of variable stars, managed by the American Association of Variable Star Observers, AAVSO, as the International Variable Star Index (VSX, <http://www.aavso.org/vsx>) was used. The list of stars included in the VSX and the version 3.2. Catalogue of Open Clusters DAML02 (<http://www.astro.iag.usp.br/~wilton/>) were matched. We divided the open clusters into two categories according to their sizes, where the limiting diameter was chosen as 60'. We restricted our sample to clusters with diameters of less than five degrees, with the exception of the Hyades (Melotte 25). For both samples of open clusters, we generated a list of all suspected variables and variable stars located within the fields of open clusters. We checked the cluster fields and vicinities up to two times the given cluster radius. In the first group of 461 open clusters smaller than 60', we found 8938 variable stars. In the second group of 74 open clusters, we located 9127 objects.

As a first heuristic approximation to a detailed membership analysis, we present the dependence of areal density of variable stars on the distance to the published cluster centers. In the area of open clusters larger than $60'$ (mostly nearby clusters), the variables are strongly dominated by background objects.

3. Variable star survey in Galactic open clusters

We have started a comprehensive study in order to photometrically monitor all accessible members of several well chosen open clusters. The telescopes used are typically in the one meter class or smaller. The target clusters will cover the known metallicity and age range for such aggregates and the time base of the observations will span from several minutes to several months, which will allow us to study several kinds of variability in much more details. In general, we expect to find pulsation of red giants, variability of young stars due to their accretion disks, planet transits, β Cephei or δ Scuti variability, slowly pulsating B-type stars, stellar winds of the most massive objects, variability due to spots of chemically peculiar (CP) and PMS objects, emission and accretion episodes of Be and shell stars, as well as eclipses of binary systems.

Because we intend to observe a complete sample of members for a given mass and luminosity range, a unique global picture of variability for several open clusters and their member stars will arise. Numerous important astrophysical processes (for example diffusion, mass loss, and rotation) can be analyzed in correlation with the local as well as global Galactic environment. In particular, e.g. the evolution of individual variable groups will be studied in dependence on the age and Galactic location. As a spin-off, we also observe possible variable field stars in the area of the target clusters.

4. Using WEBDA for variable star research

WEBDA (<http://webda.physics.muni.cz>) is a site devoted to observational data of stellar clusters in the Milky Way and the Small Magellanic Cloud. It is intended to provide a reliable presentation of the available data and knowledge about these objects. The success of WEBDA is documented by its worldwide usage and the related acknowledgements in the literature: more than 750 refereed publications since the year 2000 acknowledge its use. The database content includes astrometric data in the form of coordinates, rectangular positions, and proper motions, photometric data in the major systems in which star clusters have been observed, but also spectroscopic data like spectral classification, radial velocities, and rotational velocities. It also contains miscellaneous types of supplementary data like membership probabilities, orbital elements of spectroscopic binaries, and periods for different kinds of variable stars as well as an extensive bibliography. To date, about four million individual measurements are included in the database.

Currently, there are about 4300 periods and frequencies for about 3300 objects in 90 open clusters listed in WEBDA.

Acknowledgements

This project was supported by the SoMoPro II Programme (3SGA5916), co-financed by the European Union and the South Moravian Region, grant GA ČR P209/12/0217, 7AMB12AT003, #LG12001 (Czech Ministry of Education, Youth and Sports), FWF P22691-N16, WTZ BG 03/2013, and CZ-10/2012.

Reference

Zejda, M., Paunzen, E., Baumann, B., Mikulášek, Z., & Liška, J. 2012, *A&A*, 548, A97