Abstract

Globular clusters (GCs) are spherically symetric collections of $10^4 - 10^6$ gravitationally bound stars with characteristic overdensity in the central regions. Nowadays, 157 such objects are known in our Galaxy – Milky Way (MW). Ages of GCs are comparable to the age of the host galaxy which in the case of MW is about 13 billion years. Not long ago, they were considered to be chemically homogeneous objects consisting of low–metalicity II population stars. But in recent years, in GCs there were detected several populations of stars differing in age and chemical composition. GCs can be described as N–body systems, where stars interact only gravitationally. Advanced computer simulations seek answers to problems related to the stellar dynamics in these systems. GCs are important laboratories to study both stellar evolution and dynamics as well as chemical evolution of the universe. But to fully benefit from the properties of GCs, it is important to separate members of the cluster from field stars. Reliable separation can be achieved, e.g., by a proper motions (PMs) study.

In this work we derive relative proper motions of stars in the fields of twelve nearby Galactic GCs. On the base of data collected between 1997 and 2015 with the 1-m Swope telescope we obtained PMs for over 446 000 stars brighter than $V \approx 21$ mag.

Chapter 1 gives an introduction, where we explain the concept of PMs, describe a short history of PM calculations in GCs, as well as the CASE project, and in the end, present a brief description of examined GCs.

In chapter 2 we describe observational data selection and reduction, applied astrometric method (so called local sample method, which allowed us to reduce the effects of distortion), photometric and astrometric calibration methods, and completness of obtained results. Procedures employed for measuring membership status and membership probabilities of individual stars are also discussed.

The results we obtained are summarized in chapter 3. It provides discussion about the quality of PMs calculated independently in overlapping subfields and also the comparison of PMs with other available PM catalogs. We check the completness of our results, and calculate membership status and membership probability for individual stars. Finally, for four GCs we compare membership probabilities based on PM calculations

with membership probabilities based on radial velocities. With this we define the probability limit $P1$ subsequently used to clean the color–magnitude diagrams (CMDs) from interlopers.

Chapter 4 contains the example applications of obtained PMs. We determine membership statuses and membership probabilities of variable stars found in the fields of analyzed GCs and present CMDs of the clusters cleaned from interlopers. We combine ours and HST-based CMDs for four clusters and use them for the selection of blue straggler (BS) candidates to explore their radial distributions. Finally, we find absolute proper motions for six GCs from our sample.

Chapter 5 provides a brief summary of the thesis.

An electronic catalog of the derived PMs is available.

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