

Bulge Globular Cluster NGC 6558: A Data Science Perspective

Abstract:

A study on globular star clusters helps us to understand more about the origin of our Milky Way galaxy. Our galaxy has many globular clusters where each cluster is bound together by gravity, with a higher concentration of stars toward their centers. Some clusters may have several instances of star formation and can be the remnants of smaller galaxies captured by larger galaxies. Globular clusters have star populations formed from a single giant molecular cloud and having uniform age and metallicity. Globular clusters contain stars that are formed at different times and have differing compositions. They are generally metal-poor and are well separable from the field stars. In this study, we are using an automated tool(Asteca) to conduct a test on the star clusters to determine their basic parameters. The code makes use of positional and photometric data extracted from the Gaia database to obtain precise and objective values for a given cluster's center coordinates, radius, luminosity function, and color-magnitude relationship through a statistical method. The study is made on the star cluster NGC 6558 with a low dust extinction range between 0.4 and 1.4.

The analysis started by manually setting the cluster's center coordinates, and dust extinction value. An accurate determination of a cluster's central coordinates by will have greater importance in its radius estimation. A reliable radius determination is essential to the correct assignation of membership probabilities through the Bayesian field star decontamination algorithm. The Radial Density Profile is estimated to characterize the variation of the density of stars per unit area with the distance from the cluster's central coordinates. The best fit process aims at estimating the cluster's fundamental parameters. The process basically consists in comparing the observed cluster's photometric diagram with the diagrams of many synthetically generated clusters with known parameter values. We can observe the existence of tidal tails and red giants in the cluster. The color-metallicity relationships were able to differentiate between horizontal branch stars and stars in the main sequence, which are the two main populations in the globular clusters we are interested in. The model was able to trace the main sequence of the NGC6558 star cluster and estimate the age as 11 billion years, metallicity(FE/H) as 0.0001(metal-poor), and distance from the earth ranging between 14.4 and 15 parsecs.