A comparative study of stellar population in the open clusters of the Auriga constellation

Miss Chayada Kulchanapakorn (Grade 12), Miss Navinda Lertpenmetha (Grade 12)
Miss Mingkamol Waiwattana (Grade 12)
[Engineering Science College, Bangkok, Thailand]

Abstract

The study of open clusters currently plays a vital role in understanding stellar evolution and the characteristics of open clusters. The objective of this study is to compare the evolution and distribution of various types of stars within the open clusters of the constellation Auriga. Data was extracted from images of the clusters M36, M37, and M38 using B and V filters through the Aperture Photometry Tool software. Subsequently, Hertzsprung-Russell diagrams and distribution maps for each stellar type were constructed. While all three clusters share a similar descending trend in the proportions of A, F, K, and G-type stars, the relative abundance of B-type with respect to observed stars varies on the age of the clusters. This corresponds with the estimated ages from the turn-off points, which are 26.6 Myrs (M36), 172.6 Myrs (M38), and 403.4 Myrs (M37). Regarding stellar distribution, M38 has a lower population density at its core than M36 and M37, which may be due to differences in the initial gas clouds, amount of dark matter, and stellar dynamics across different evolutionary stages.

Methodology

We collected data by using planewave CDK700 telescope and analyzed the data using python. The detailed methodology was presented below (Shown in Fig1.) based on referenced data. [1],[2],[3],[4],[5]

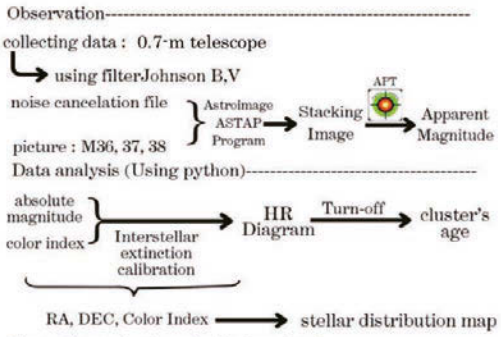
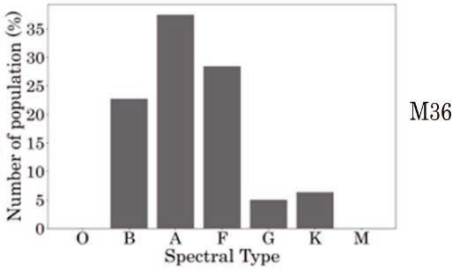
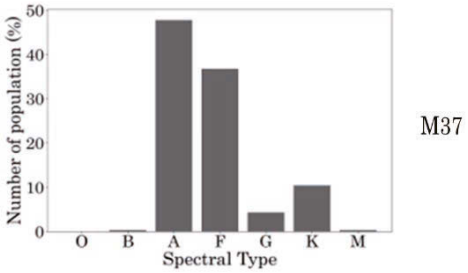


Fig1. Show the detailed of method.

Results





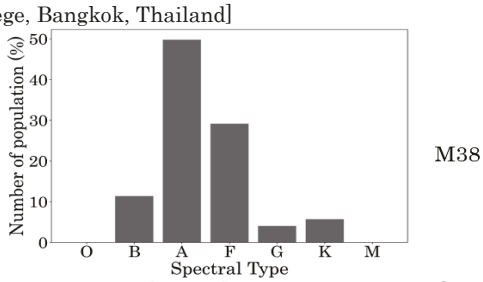


Fig 2. Bar charts showing proportion of each spectral type in M36, M37, and M38

We found that M36 turn off point is at absolute magnitude -2.5 implying its age to be the lowest (26.6 Myrs). The next one is M38 with the turn off point at absolute magnitude - 0.7, implying its age to be 172.6 Myrs. The oldest one is M37, with the turn off point at – absolute magnitude 0, implying its age to be 403.4 Myrs.

Discussion

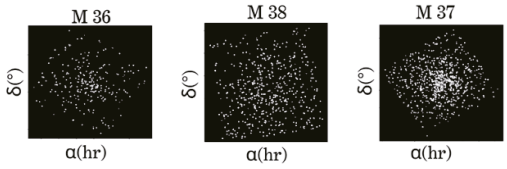


Fig 3. Stellar distribution map (color are based on spectrum) of M36, M37 and M38 open clusters

While A, F, K and G-type stars proportions show similar descending trends across all three clusters, B-type stars proportions depend on the age of the open cluster, as shown in Fig 2. G and K-type stars in all three clusters, and M-type stars in M37, appear off the main sequence. These are likely giants or subgiants, though the stars with high absolute magnitude are likely background stars. However, the discrepancy between A-type stars age and estimated turn-off point age may stem from lower flux density in Filter B images compared to data from other observation days.

Considering the stellar distribution map in two dimensions (Fig.3), M37 is the densest cluster, followed by M38 and M36. While M36 and M37 have a high density of stars at the center, M38 lacks a central peak. This might happen due to two possible reasons: (i) the formation of M38 from several density peaks gas clouds, and (ii) the death of B-type stars in M38 possibly caused by some processes of the stellar evolution, leaving an empty space at the center. It might evolve into a cluster similar to M37 because of mass segregation. Nonetheless, this needs further studies by using mathematical models and eliminating background stars.

References

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