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

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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.

Introduction

M36, M37, and M38 are open clusters which located in the constellation Auriga, discovered by Giovanni Batista Hodierna. Situated opposite the Galactic Center, they lie at distances of 4,100, 4,500, and 3,480 light-years from Earth, respectively. Notably, all three clusters are positioned within the Perseus Arm. Based on these characteristics, the researcher aims to conduct observations to analyze and compare data from these three clusters. This will be achieved by constructing Hertzsprung-Russell (H-R) diagrams to study stellar classifications and the clusters' main sequence turn-off points. Subsequently, stellar distribution plots will be generated to investigate correlations with stellar types.

Medthodology

Observation [1][5] --------------------------------

Collecting data : Planewave CDK700 telescope
↳ **using filterJohnson B,V**

noise cancelation file
picture : M36, 37, 38 } **Astroimage ASTAP Program** → **Stack Image** → **Apparent Magnitude**

APT

Data analysis (Using python) -------------------------------

Apparent Magnitude color index } Calibrate / Interstellar extinction [2][3] → **HR Diagram [4]** Turn-off → **cluster's age**

RA, DEC, Color Index ➝ **stellar distribution map**

Result and Discusion

M 36

Turn off point absolute magnitude(M_{mstov}) ≈ -2.5
Age = 26.6 million years

M 37

Turn off point absolute magnitude(M_{mstov}) ≈ 0
Age = 403.4 million years

M 38

Turn off point absolute magnitude(M_{mstov}) ≈ -0.7
Age = 172.6 million years
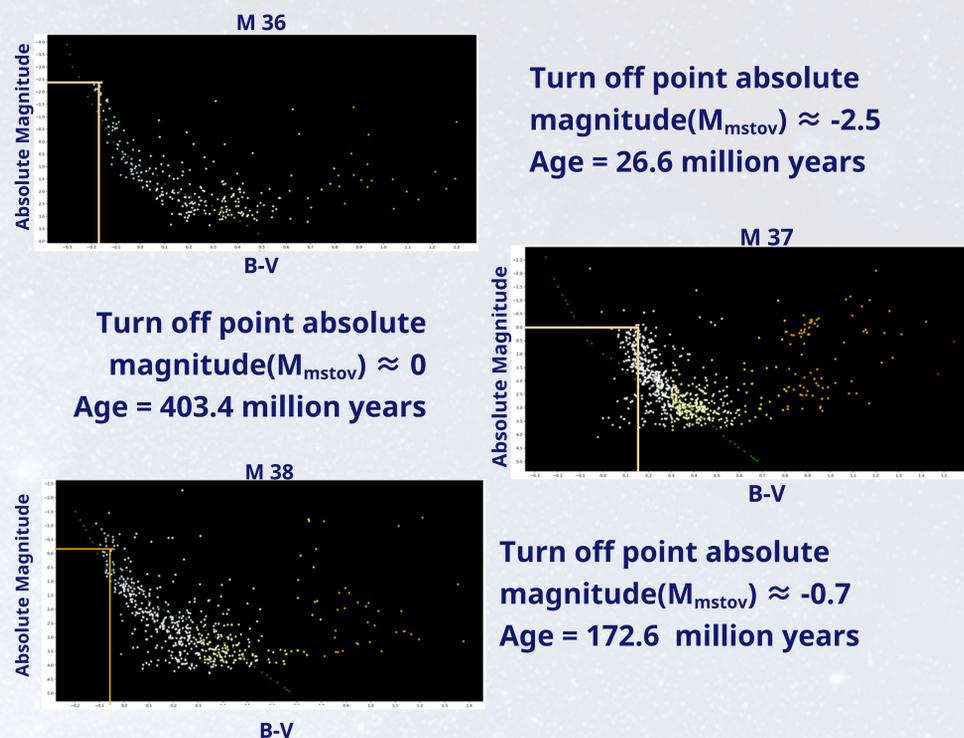
All three open clusters are dominated by A-type stars. The proportion of B-type stars varies among the clusters, which is consistent with their respective ages. The G- and K-type stars in all three clusters, as well as the M-type stars in M37, lie off the main sequence and are likely giants or subgiants.
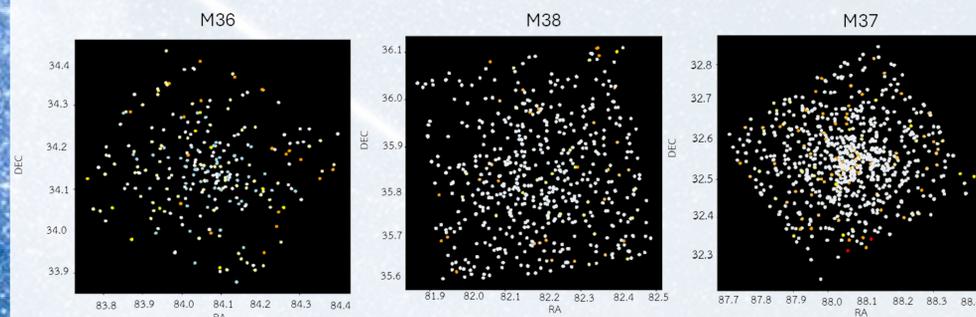
M36   M38   M37

Conclusion

- Among M36, M37, and M38, M36 was found to be the youngest with an estimated age of 26.6 million years. This is followed by M38 and M37, with ages of approximately 172.6 and 403.4 million years, respectively.
- All three open clusters exhibit similar population proportions for spectral types A, F, K, and G. However, the proportion of B-type stars varies, showing a decrease as the cluster age increases.
- Based on the diagram, the stellar densities of M36, M37, and M38 differ significantly. M37 has the highest density, followed by M38 and M36.
- The diagram indicates that M36 and M37 share a similar distribution pattern characterized by a single central concentration. In contrast, M38 does not exhibit concentration at any specific point.

References

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