(45T)

Determination of Open and Globular Clusters Age Using Isochrone and Horizontal Branch Morphology

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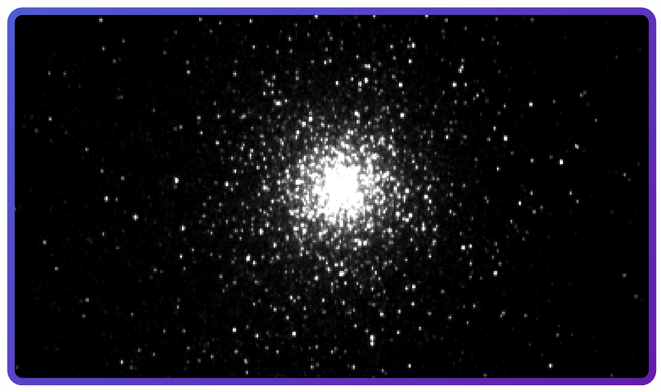
Abstract

This project explores methods for determining the age of open clusters M35, M37, M67 and globular clusters M3, M53. The Isochrone method was the most accurate method to study the age of open clusters, and the Horizontal Branch Morphology for the globular clusters.

Introduction

Star clusters are groups of hundreds of stars closely bound together. HR diagrams give information about the life cycle of stars within a cluster. This project explores methods for determining the age of open clusters M35, M37, M67 and globular clusters M3, M53. Isochrones model stars of the same age and metallicity which helps study the age of clusters. Horizontal Branch (HB) Morphology can be used to find the age of clusters using HB population models



Methodology

1. Take photos of star clusters with B and V filters using telescope at Thai National Observatory.

2. Use Aperture Photometry Tool to measure the apparent magnitude of each star and create HR diagrams.

3. Determine the age of the open clusters using the Isochrone method, retrieving Isochrone models from MIST database [1].

4. Determine the age of the globular clusters using the HB morphology method, where the HBR is calculated and compared with HB population model.

$$HBR = \frac{B-R}{B+V+R}$$

B = number of Blue Stars
R = number of Red Stars
V = number of RR Lyrae Stars

Results and Discussion

Figure 1 : HR diagrams and Isochrones open clusters.

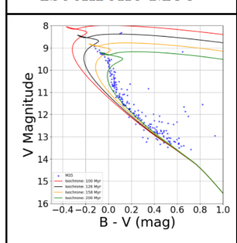
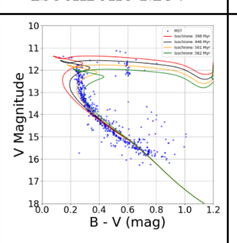
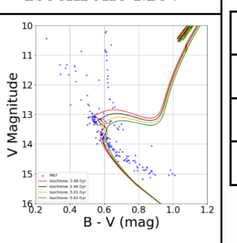
Isochrone M35	Isochrone M37	Isochrone M67
		

Table 1 : Age of open clusters.

Cluster	Age (yrs)	Ref. Age (yrs)	Error %
M35	100-200 M	110-150 M	15.38%
M37	400-550 M	420-520 M	1.06%
M67	4-5.6 G	3.5-4 G	28.00%

It was found that clusters M37 and M67 show clear turnoff points. Whilst M35 doesn't show a clear turnoff point the age can still be determined from the Isochrone.

Figure 2 : HR diagrams and HB population globular clusters.

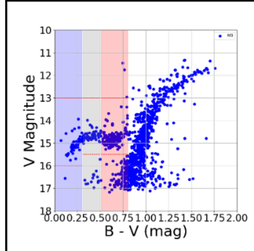
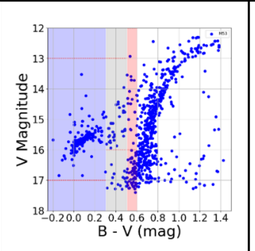
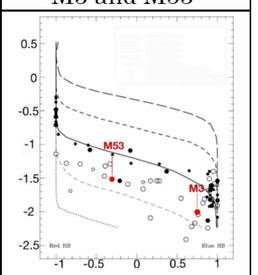
HR diagram and HBR of M3	HR diagram and HBR of M53	HB population of M3 and M53
		

Table 2 : Age of globular clusters.

Cluster	HBR	Age (Gyrs)	Ref. Age (Gyrs)	Error %
M3	-0.36	10.6	11.4	7.02%
M53	0.73	11	12.5	12.00%

The HR Diagrams of globular clusters don't show clear turnoff points, therefore Isochrones can't be used to determine the age. So the HB morphology method is used to study the age of globular clusters, since the Horizontal Branch is clearly shown in the HR Diagrams.

Conclusion

The HR diagrams, as well as the Isochrones for the open clusters are shown in Table 1. It was found that clusters M37 and M67 show clear turnoff points. Whilst M35 doesn't show a clear turnoff point the age can still be determined from the Isochrone. Table 2 shows the age calculated from the Isochrone method for each open cluster.

Acknowledgements

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Reference

[1] Isochrone Models – MIST. Retrieved from https://waps.cfa.harvard.edu/MIST/index.html