

# The study of determining and comparing open and globular clusters ages by HR-diagram

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## Abstract

This research aimed to calculate the age of open and globular clusters and compare them with each other. In this research, B and V filters observation was conducted using 0.7-meter Thai robotic telescopes in Springbrook, Australia and Sierra, America. From the observation data, HR-diagrams of open and globular clusters were compared with standard HR-diagrams.

## Introduction

Hertzsprung – Russell diagram (HR diagram) is a diagram that can determine the age of the cluster. Stars spend most of their lives in the main sequence. Stars which become red giant will move out of the main sequence to the upper right called the turnoff point. The turnoff point can help estimate the age of clusters.

## Material and methods

First, take photographs of globular and open clusters using NARIT's robotic telescopes by B and V filters. Secondly, the data were taken into AstromageJ program and Aperture Photometry Tool program to find dimensionless of each star. After that, find the reference star's magnitude from SAOImage DS9 program. The diagram is created with X-axis as B – V filter value and Y-axis of V filter magnitude, that we call HR-diagram. From HR-diagram, compared the turnoff point with the stellar classification table to find the star's mass. And then, we can calculate the age of clusters using the following equation,

$$T = 10^{10} (M/M_{\text{sun}})^{-2.5} \quad T = \text{the cluster's age} \quad M = \text{star at turnoff point mass} \quad M_{\text{sun}} = \text{the Sun's mass}$$

Plotting an isochrone is another way to find cluster's age using the information from CMD 3.3 input form database.

## Result and Discussion

After creating diagrams, B-V values were compared with stellar classification table to find the mass and calculate into an equation. The results are shown in the table. Then the results are compared with other researchers' results to find error of this research.

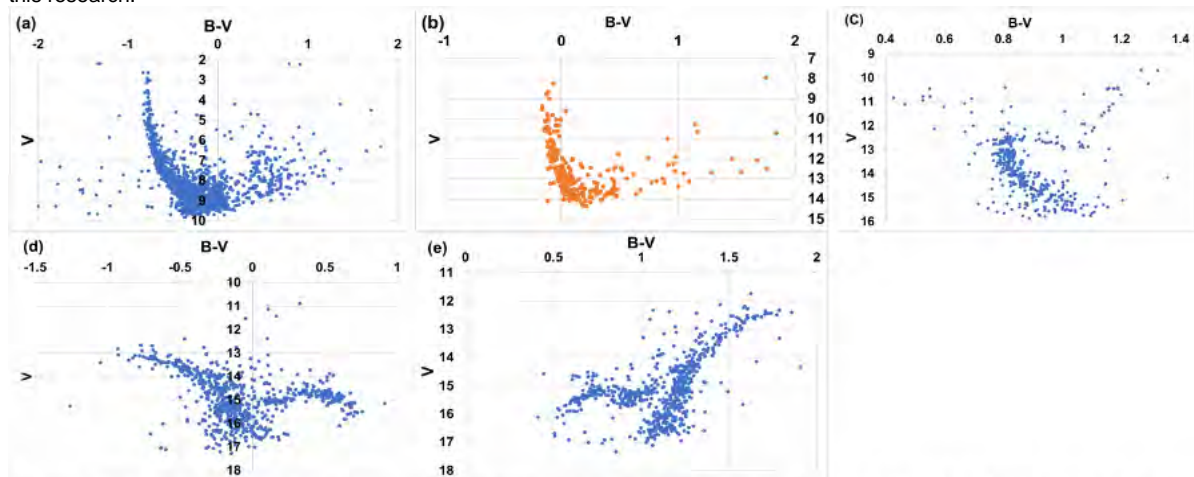


Fig 1. Show HR-diagrams (x-axis as B-V filter value and Y-axis of V filter magnitude) of (a) NGC 3766 (b) NGC 4755 (c) M67 (d) M5 and (e) M3

Table 1. Compared ages of each open clusters

| Clusters | Reference      | Calculation       | Calculation error | Isochrone     |
|----------|----------------|-------------------|-------------------|---------------|
| NGC 3766 | 30 million     | 5 - 10 million    | 66.7 %            | 30 million    |
| NGC 4755 | 7 - 15 million | 16 million        | 45.5 %            | 15 million    |
| M67      | 3 - 7 billion  | 1.3 - 1.7 billion | 53.0 %            | 4 - 5 billion |

## Conclusion

The way to calculate the open clusters' ages still gives a lot of error. As the result of globular cluster diagrams, they are needed to be compared with other researcher diagrams. Globular cluster diagrams are needed to be compared. M3 has the age of 10 billion years old and M5 is 13 billion years old. There are some open clusters which is really old such as M67.

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## Reference

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