34 SMC distance estimation using Cepheid variables.

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Introduction

There are several methods to determine the distance of celestial objects. Radar can be used to find the distance of the planets, parallax to find distance of nearby stars, and redshift or type Ia supernovae for galaxies. The method of using a closer, well-calibrated, distance indicator to calibrate successively farther indicators is called the "distance ladder". In this work we apply the period-luminosity relation of the Cepheid variable stars to determine distance to the Small Magellanic Cloud (SMC).

Data Acquisition and Reduction

We acquired data of SMC form the Robotic Optical Transient Search Experiment (ROTSE; www.rotse.net) 0.5-meter robotic telescope at Siding Spring Observatory, Australia over 2004 - 2005 and use the catalog of Cepheid from the Optical Gravitational Lensing Experiment (OGLE) to locate Cepheid variables in our data. We perform photometric analysis of three Cepheids using the MaxIm DL software with three reference stars. An example light curve of our Cepheid variable and the reference stars is shown in Figure 1.

Analysis

When we get apparent magnitude of variable star from photometry method in MaxIm DL software, then we plot the light curve of GSC 9141:3140 variable star. From graph in figure 1, it reveals that period magnitude of GSC 9141:3140 variable star is 14.7 days and average apparent magnitude is 14.63.

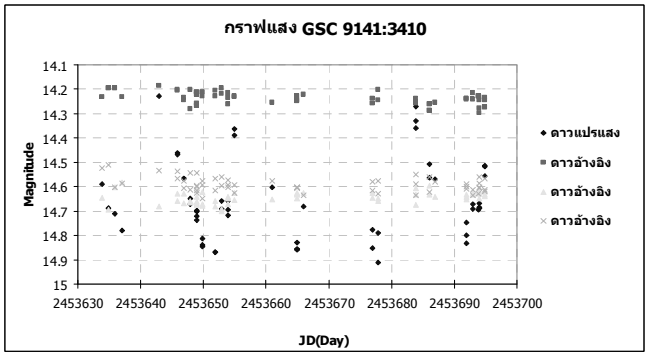

Figure1 Light Curve of GSC 9141:3140 variable stars

Then we find absolute magnitude of GSC 9141:3140 variable stars from the period-luminosity relation of Cepheid variables illustrated in figure 2 (Tanvir 1999), X-axis is logarithmic relation of period - magnitude that we has calculated, we get 1.16, then we find absolute magnitude by crossing between vertical line from coordination

(1.16,0) in X-axis perpendiculars horizontal line from Y –axis. We will obtain absolute magnitude in V-band about -4.5

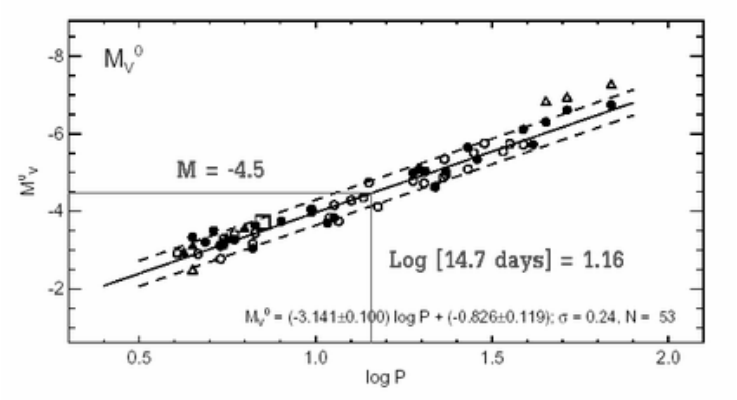

Figure 2 Determination of absolute magnitude of GSC 9141:3410 variable star

Then we substitute average apparent magnitude (m_1) and absolute magnitude of GSC 9141:3410 variable stars (m_2) in following equation:

$$m_1 - m_2 = -2.5 \log_{10} [(10/R)^2]$$

The average magnitude over the entire period of Cepheids is taken as its representative apparent magnitude m_1, and m_2 absolute magnitude is -4.5.

$$14.57 - (-4.5) = -2.5 \log_{10} [(10/R)^2]$$

We solve the equation above to obtain distance (R) of 210,000 light years

Conclusion

After studying variable stars in Small Magellanic Cloud by analyzing light curve from photometry method and calculate distance of variable stars from earth. We found that distance of the first variable star is 210,000 light years, the second variable star is 240,000 light years, and the third variable star is 220,000 light years. And average distance of variable stars from earth is 220,000 light years that few different from accepted distance of SMC from earth (200,000 light years). Due to SMC is dwarf galaxy that is irregular shape. Gas, dust, and stars in galaxy are distributed in SMC. So each variable star that has been studied may have different distances from earth.

Reference

Tanvir, N. R., 1999, ASPC, 167, 84