

A Study of Galaxy Distance and Universe Expansion with Supernova Type Ia

Mr. Ponlawat Yoifo

Chiangkham Wittayakhom School, 4 Mu 8 Amphoe Chiangkham Phayao, 56110, Thailand

Keroro.ranger@gmail.com

Abstract

A Study of Galaxy Distance and Universe Expansion with Supernova Type Ia aimed to find out the distance from the earth to the galaxy where the supernova PSN J05033510+0134176 at RA 5hr 3 m 37.0 s, Dec +1° 34' 24.0". The tools of this study are the photograph data which were obtained from Prompt 5 telescope in CTIO at Chile and then the data obtained were analyzed through photometry method. We found that, the distance from the earth to the galaxy which the supernova occurred was 75.23 ± 5.9 Mpc. From the radial velocity obtained from NED [3], we found that the radial velocity of this galaxy is 4753 km/s. This correspond to the recession rate of the galaxy at 63.2 km/s/Mpc, which is in close agreement with the expansion rate of the universe predicted by current value of Hubble

Introduction

The universe expansion is a vital evidence to support the Big Bang theory. In several studies of the astronomers have indicated that the more distant from the earth to the galaxy is, the more direct proportion of the speed of direction which there is a red shift of the galaxy is. This helps us realize that there is the universe expansion. The data are conventionally analyzed by variety of standard candle such as parallax, variable star, and supernova type Ia to determine the galaxy distance and the universe expansion. In this research supernova type Ia which was from Binary Star consisting of a white dwarf is accreting mass from the nearby companion star and explode into supernova at 1.4 Solar Mass. And, the distance from the earth to the galaxy which supernova type Ia occurred can be calculated when its absolute magnitude of each explosion occurs is at about -19.3.

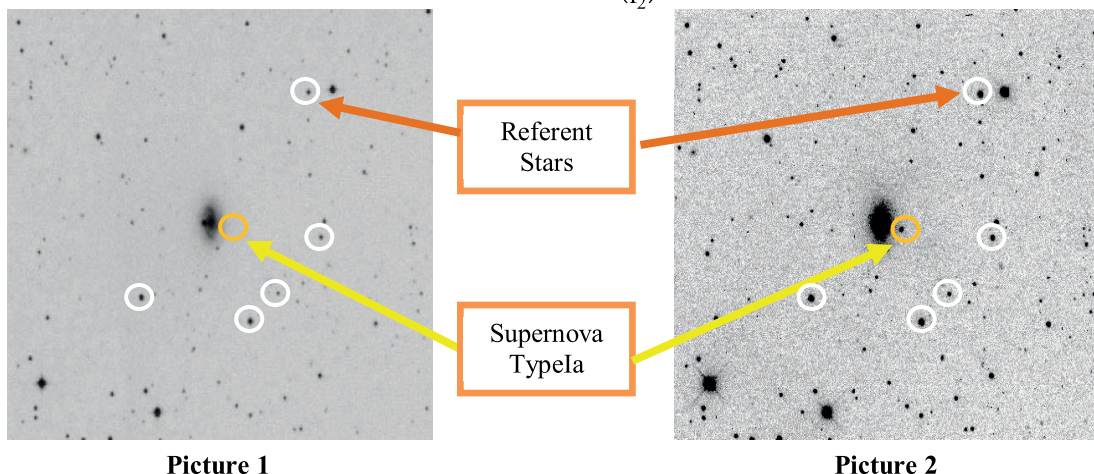
Methods

The data about the explosion of supernova type Ia were searched from the database [1]. In details, positions of the supernova type Ia were the PSN J05033510+0134176 supernova which was in NGC 1762 galaxy at the position of RA 5hr 3 m 37.0 s, Dec +1° 34' 24.0"

Four photographs per day were taken by using filter V and 180 second-exposure time. The data were collected from 7 September to 15 November 2013 which was 38 days all together.

The catalogue of the stars in the area was downloaded to find out the 5 referent stars in order that they could be used in the comparison and calculation of the apparent magnitude of the supernova by the following using equation.

$$m_2 - m_1 = 2.1 \log \left(\frac{f_1}{f_2} \right)$$



Picture 1 showed the photograph from STSCI-DSS database and referent Stars While there was no supernova. **Picture 2** showed photograph of the supernova and referent Stars in the galaxy.

After that the apparent magnitudes were plotted versus the Julian date to create light curve. Then, use polynomial fitting to find the actual peak of the graph.

The absolute magnitude of the supernova was calculated by using the difference values of the apparent magnitude at the actual peak and of the apparent magnitude at the fifteenth date afterward by using the equation from a research of Mario Hamuy (1996) [2].

The distance from the earth to the galaxy which the supernova occurred was calculated from the following equation.

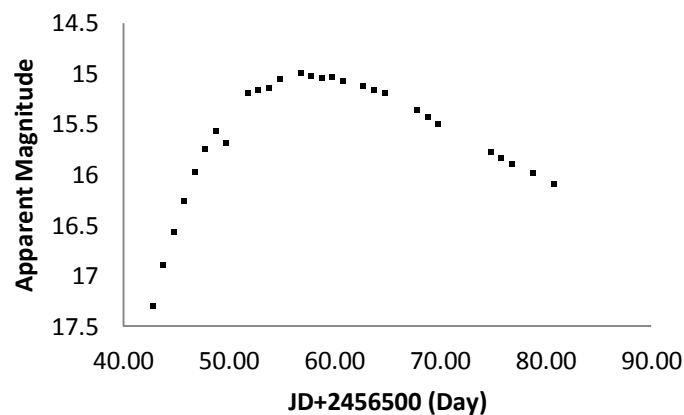
$$m - M = 5 \log d + 25$$

The red shift (z) is obtained from NASA/IPAC Extragalactic Database (NED) [3] and the radial velocity of the galaxy was calculated by the following equation.

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Results and Discussion

The figure showed the relevance between the average apparent magnitudes versus the Julian dates.



From light curve showed the apparent magnitude at the peak at 15.01 ± 0.16 . The absolute magnitude with magnitude calibration [2] is found to be -19.38 ± 0.16 . and finally, the distance from the earth to the galaxy was determined by using the absolute magnitude and the apparent magnitude substitute into the equation $m - M = 5 \log d + 25$. The distance from the Earth to the galaxy where the supernova PSN J05033510+0134176 occurred was 75.23 ± 5.88 Mpc.

The red shift value from the database which was studied to examine the radial velocity of the galaxy was at 4752.91 km/s. This would suggest that the distance between Earth and this galaxy is expanding at the rate of 63 km/s/Mpc, which is in close agreement with the current value for Hubble constant.

Conclusion

The distance from Earth to the galaxy which supernova PSN J05033510+0134176 occurred is calculated from the maximum apparent magnitude and found to be 75.2 ± 5.9 Mpc. From database, the radial velocity of this galaxy is at 4753 km/s. This would correspond to the recessional rate of 63.2 km/s/Mpc which is in good agreement with the current Hubble constant.

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