The study of the distance of the nebula from the angular distance relation

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Abstract

The objective of the distance measurement of the nebula in this research is to study the method in astronomy which will be used in the distance measurement of celestial objects. There are 2 ways from the analyses: Angular distance and radius measurement of nebula from Light Echo in V838 Mon nebula by using the database of photographs taken from Hubble Space Telescope and Measure radius of nebula from assessing stellar wind in NGC 2244 (Rosette Nebula) by using the database of photographs taken from SAO-DSS. According to the study, I found that the distance from the earth to V838 Mon nebula is 2.20 ± 0.40 kpc and the distance from the earth to Rosette Nebula is 2,100 ± 300 pc.

Introduction

Phenomenon of Light Echo is the travelling of light to various points in nebula area and make us found the nebula appear larger. We can use the expansion rate of nebula based on the movement of light to analyze for the angular distance and the radius, then to find the distance of V838 Mon nebula to the earth. The second method is the study of the distance of the nebula from assessing stellar wind in NGC 2244 (Rosette Nebula). According to the study of Bengt Strömgren we found that a star which is in the central of nebula has spectral type O which radiates high-energy ray especially ultraviolet ray. This causes the process of ionization of hydrogen surrounding. The electrons of the hydrogen released into free electrons so we can not see that area called H II Region or Strömgren sphere. We can find its size from the assessment of the fixed stars radiation in the center and use it to find out the distance of nebula to the earth.

Methods

The study of the distance of nebula from the angular distance from the phenomenon of Light Echo in V838 Mon Nebula

Picture 1 showed the rate of travelling of light

1. Find out the radius from the study of the rate of the light we get the radius(s) of nebula at various times.

2. Find out the angular distance (Δθ) which the light travel to in each range of time from SAOImage DS9 software.

3. Find out the distance from the earth to nebula (d) from equation $d = \frac{s}{\Delta\theta}$

4. Repeat steps 1-3 with other ranges of time needed to study the rate of the light movement. Then take the distance from each range to find out the average. The results are in Table 1.

Date	t (s)	Δθ (rad)	s (km)	d (kpc)
6Jan 2002–20 May 2002	11,577,600	6.15×10^{-5}	3.471×10^{15}	1.80
6Jan 2002–2 Sep 2002	20,649,600	1.01×10^{-4}	6.190×10^{15}	2.00
6Jan 2002–17 Dec 2002	29,808,000	1.27×10^{-4}	8.936×10^{15}	2.20
20 May 2002–17 Dec 2002	18,921,600	6.57×10^{-4}	5.672×10^{15}	2.80
Average				**2.20 ± 0.40**

Table 1 showed the angular distance and the distance from the earth to Nebula V838 MON

Result and Discussion

According to the distance measurement of the V838 MON Nebula, I found the problems of error from the angular measurement. When I took all ranges of time to find out the average, the distance was 2.20 ± 0.40 kpc but the distance from the database was 6.6 kpc

The study of the distance from the angular distance measurement of nebula from assessing the stellar wind in NGC2244 (Rosette Nebula)

1. Find out the angular distance of the star which is in the central of nebula with the boundary of Strömgren sphere by SAOImage DS9 software.

2. The central star has spectral type O. When we compare with the temperature table and luminosity the temperature is 42,000 K and the luminosity is 499,000$L_{\odot}$. Then find out the wavelength which the central star and obtained was 69 nm.

3. Find out the energy which the central star. The energy which the central star released is 2.88×10^{-18} J

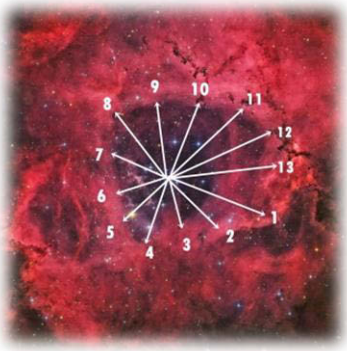
4. Find out photon numbers. Photon numbers is $6.65 \times 10^{49} s^{-1}$

5. Find out the coefficient of the recombination of proton and electron which α will vary to the surface temperature. The coefficient of the recombination is 6.817×10^{-20} $m^3 s^{-1}$

6.When we know all variable values, we can find out the radius of Strömgren sphere from the equation

$$r_s = \left(\frac{3N}{4\pi\alpha}\right)^{\frac{1}{3}} \times (N_H)^{\frac{-2}{3}}$$

The radius of Strömgren sphere is 9.25 pc. Find out the distance of nebula but the angular distances of each side are not equal. I have to find each side to average so it is much accuracy as the photograph. And we can find out the distance of nebula.



Picture 2 showed the Strömgren sphere and stars in each side around the sphere

Result and Discussion

According to the study, I found that the distance of NGC2244 (Rosette Nebula) is 2,100 ± 300 pc. But the distance from data base is 1,600 pc. This error is caused of the analysis of the angular distance of Strömgren sphere. As the central star radiates ultraviolet ray, it causes Strömgren sphere which the radius of each side are not equal.

Acknowledgement

To complete all the processes of this research from the data collection, the data analysis, to the report making, the author was supported, facilitated from several sectors the Advanced Astronomy Workshop for Teachers project, the National Astronomical Research Institute of Thailand (NARIT) and The Institute for the Promotion of Teaching Science and Technology (IPST). The author was very grateful and appreciated the precious supports.

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