The study of orbital periods and parameters of eclipsing binary stars NY Vir and HW Vir

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Abstract

NY Vir and HW Vir are binary star systems that belong in the rare class of subdwarf b stars and are considered detached binary star systems. To study the orbital periods and parameters to create a scientific model of these binary star systems, photos of eclipsing binaries will be taken and run through the application AstroImageJ to create a flux graph. The flux graph will be then processed in another application PHOEBE to find the parameters and a scientific model of these binary systems will be created. The result of our study shows us that the orbital periods of NY Vir and HW Vir are 0.1000 days and 0.1166 days respectively. From this information, it is clear that both binary star systems have very similar parameters, causing the flux graph and orbital periods to have similar results. After analyzing the parameters of both systems, the value of CHI^2 is 0.161458 and 0.012687 respectively.

Introduction

NY Virginis (NY Vir, RA: 13h 38m 48.17s, DEC:-02°01'49.2095") and HW Virginis (HW Vir, RA: 12h 44m 20.24s, DEC: -08°40'16.8486") are 1800 light-years and 563 light-years away respectively. The stars in each system eclipse each other from our point of view on earth. When these eclipsing binaries are orbiting each other, it causes the light curve level to change and when they eclipse each other, it then causes the light curve level to decrease substantially due to these stars blocking each other. The facts mentioned above will be used to find out the period of orbit of both binary systems.

Method

In this experiment, Photos of NY Vir that were used were taken with a 1-meter telescope at the Thai National Observatory, while the photos of HW Vir that were used were taken with a 0.7-meter Thai robotic telescope at Sierra remote observatories, both using R filter. The photos taken were then sent through the application AstroImageJ to carry out photometry to find out the light curve from the relationship between Flux and time. For this experiment, HJD will be used as our measurement of time. Second, the period of orbit can be calculated by finding out the difference between the time of minimum of the primary phase that is next to each other. Third, the value of flux analyzed in the application AstroImageJ will be used to calculate the normalized flux. Finally, the physical parameter and model will be created by using the normalized flux and phase through the application PHOEBE.

Results and discussion

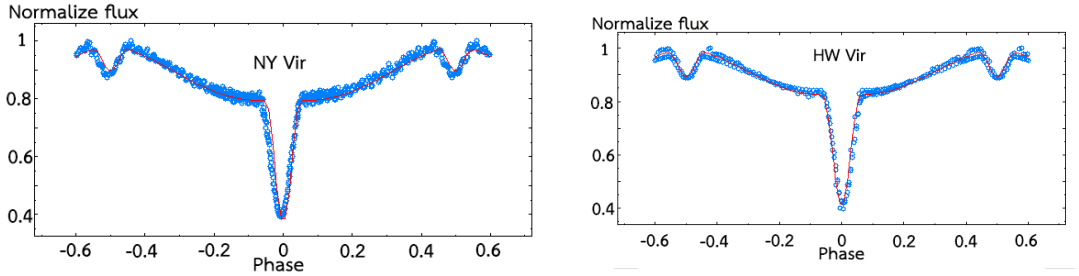

Figure 1: Showing the relationship between Normalized Flux and Phase

Table 1 : Physical parameters of the binary star systems

Parameters	NY Vir	(M. Vuckovic, et al. 2021)	Error	HW Vir	(Jae Woo Lee, et al.2009)	Error
$\Omega(L_1)$	2.404255	5.503	56.310%	2.451443	5.020	51.166%
$\Omega(L_2)$	2.233381	2.771	19.401%	2.267888	2.806	18.785%
Mass 1	0.530849	0.389	36.465%	0.485019	0.485	0.004%
Mass 2	0.144566	0.110	31.424%	0.142159	0.142	0.112%
Radius 1	0.124544	0.141	11.671%	0.182586	0.183	0.226%
Radius 2	0.153463	0.151	1.631%	0.175861	0.175	0.492%
Log G 1	5.972173	5.745	3.954%	5.600672	5.600	0.012%
Log G 2	5.225908	5.145	1.572%	5.100282	5.100	0.005%

From Figure 1 is a graph that represents the relationship between normalized flux and Phase. By observing, it can be seen that NY Vir and HW Vir have very similar light curve patterns. Table 1 represents the parameters of NY Vir and HW Vir. It can be seen that NY Vir and HW Vir has similar parameters.

Conclusion

The orbital period for binary star systems NY Vir and HW Vir are 0.1000 days and 0.1166 days respectively.

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Reference

M. Vuckovic, G. Nelemans, and others (2007). The binary properties of the pulsating subdwarf B eclipsing binary PG 1336-018 (NY Vir). Astronomy & Astrophysics.471, 605-615.DOI: https://doi.org/10.1051/0004-6361%3A20077179.

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