Finding the synodic rotation period of 20-Massalia

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Abstract

This paper's goal is to find the rotation period of 20-Massalia asteroid and some of its physical properties by using variable star method/photometry method. Using CCD Camera which is connected to reflecting telescope with the diameter of 0.7 meters at NARIT (Nakhon Ratchasima branch) to collect the data of the asteroid through V and B filters to compare reflections in different wavelengths. The author found that the synodic rotation period of the asteroid is approximately 0.33741 days and the light curve is not perfect because the asteroid has a weird shape.

Objective

To study synodic rotation period of this asteroid with photometry method and the light curve of the asteroid

Method

First step is to capture the asteroid image with CCD camera that is mounted to the telescope then import WCS (World coordinate system) data into the picture with Astrometric stacking program then find 3 "fixed star" to be its reference star using SAOImageDS9. Reduce the noise of the image with AstroImageJ and using AstroImageJ to measure the intensity of the asteroid and the reference star. Using the magnitude formula to find its magnitude then using the magnitude to plot Magnitude vs Phase graph which the phase is given by the equation HJD = HJD0 + (Epoch * Period)

Result

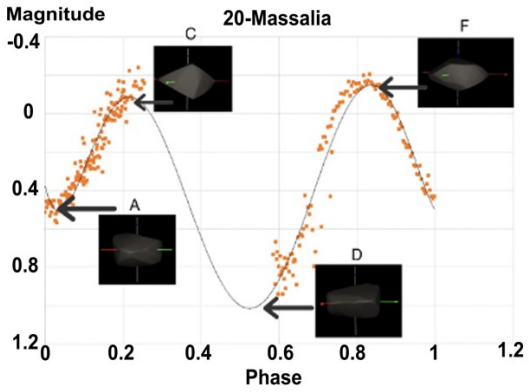

Fig 1. Shows the change of brightness over time

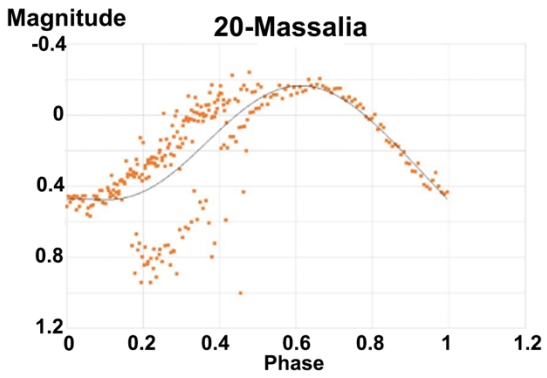

Fig 2. Shows that 2 waves do not overlap if we change the period to 0.5 real period

1) From the period study in Fig1. we found that the light curve has 2 waves similar to a sine wave and found that at the bottom of the graph the asteroid is dimmest at phase = 0.55. The 2 brightest points are almost the same at phase = 0.25 and 0.84 from the graph. Observing this we can conclude that 20-Massalia doesn't have a circular shape and does not reflect light evenly in different angle when it rotates.

2) When comparing the graph and the asteroid model from 3d Asteroid Catalogue we can conclude that at point F and C the asteroid will be the brightest because the bigger surface area is facing the observer and the surface area is the smoother side, but point A and D are the sides that have the least surface area, and isn't as smooth as the other sides, which affects the reflected light.

By changing the period of the asteroid into different values E.g. half of the real period we found that the 2 waves will not overlap perfectly which means that the 2 waves are 1 rotation not 2 rotations. At phase 0 and 0.9 the wave will line up perfectly if the period is 0.34 days or approximately 8.1 hours. (The image of Fig2. is half of the real period)

Conclusion

From this study by using photometry method found that the synodic rotation period is approximately 8.1 hours. The light curve graph is not perfect because the asteroid shape which we can use the brightness data to roughly know which side the asteroid is facing by using 3d Asteroid Catalogue and with this we know the reason for it is the asteroid rotates and faces the observer with different angles and surface area which the more surface area and the smoother the side is the better it reflects light.

Reference

3d Asteroid Catalogue - https://3d-asteroids.space/
Photometric studies of asteroids - https://articles.adsabs.harvard.edu/pdf/1954ApJ...120..200G
jet propulsion laboratory - https://ssd.jpl.nasa.gov