Studying the Orbital Period of the Moon

Pancharee Anujorn
e-mail:Pancharee_anujorn@hotmail.com
Advisor Jiraporn Kakaew
Pua School Nan Thailand

This research aims to find the orbital period of the moon by the relationship between the moon's orbital period, the time that the moon uses to come back to pass the observer's meridian again and the earth's sidereal period. This research finds that the average orbital period of the moon is 36541 minutes or 25.38 days. The research also reflects that there is an error from the standard orbital period of the moon (27.322) that is about 7.124%. This research calculated angular velocity and have got the distance of the moon from the earth and found out that the orbit eccentricity of the moon is 0.0494.

Introduction

The moon is the only earth's natural satellite. The distance of the moon from the earth is almost 384,403 km. Its orbit inclination is 5.145°and orbit eccentricityis0.0554. The moon's orbital period is 27.322 days.

The earth is one of the planets in the solar system. The mass of the earth is5.9722×10^{24} kilograms. Its sidereal rotation period is 23.934 hours. Its equatorial inclination is 23.4393 degree.

Procedure

1. Finding the observer's meridian. First set sharp pole at the ground and observe sharp pole's shadow. The the shortest shadow is the meridian that was been observed (Figure1).Then mark a line of the shortest shadow.
2. Set tool for observing by setting the optical tube parallel to the observer's meridian (Figure 2). After that we look to the moon through the optical tube and wait for the moon to pass the front of the optical tube (pass meridian's observer) and then start to count the time.

Figure1: sharp pole's shadow

Figure2:set tool for observing

3. Observe the moon that passed through the observer's meridian again in the following day and then record the time (T).
4. Use this equation$\frac{1}{M}=\frac{1}{E}-\frac{1}{T}$ tocalculate the moon's orbital period.

From the figure3 we get equation relationship 2 equation

The first equation is $\frac{\theta}{T}=\frac{360°}{M}$ become $\theta=T\times(\frac{360°}{M})$

The second equation is $\frac{\theta}{T-E}=\frac{360°}{E}$ become $\theta=(T-E)\times(\frac{360°}{E})$

From 2 equation $\theta=\theta$ become $\frac{1}{M}=\frac{1}{E}-\frac{1}{T}$

θ is the an angular displacement of the observer and the movement of the moon from A to B. (Degree)

T is the time that the moon moves from A to B or the time that was used for the observation of the moon to come back and to pass the observer's meridian again (Minute)

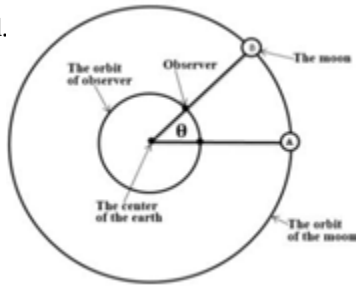

Figure3: circle orbit

E is sidereal rotation period of the earth or the time that uses for observing the movement around the center of the earth. (23.934×60 = 1436.04minute)

M is orbital period of the moon (Minute)

5.Calculate to find the angular velocity from $\omega=\frac{2\pi}{T}$

Ω is the angular velocity (radian/second)
T is the period (in this T is orbital period of the moon (M))

6. Take angular velocity to find the distance of the moon from the earth in each day by equation $r^3=\frac{GM}{\omega^2}$

Where G stands for Newton's law of universal gravitation (6.673×10^{-11} N m^2 kg^{-2})

r is the distance of the moon from the earth (meter),M is the mass of the earth (5.9722×10^{24} kg.)
ω is the angular velocity (radian/second)

7.Take the moon's distance from the earth in order to find its orbit eccentricity with the use of the equation$e = \frac{r_a - r_p}{2a}$byr_p is the radius at perigee r_a is the radius at apogee **a** is length of semi-major axis and **e** is eccentricity

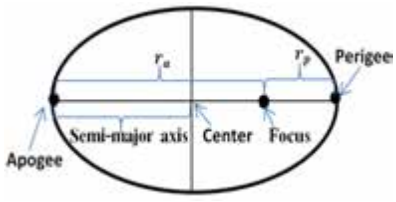

Figure4 : ellipse orbit

Results

Date	Time use by the observer to observe the moon to come back and pass the observer's meridian again(T)(minute)	Orbital period of the moon (M)(minute)	Angular velocity (radian/second) ($\omega = \frac{2\pi}{T}$)	Distance of the moon from the earth (meter) ($r^3 = \frac{GM}{\omega^2}$)	Note
1Aug.-2Aug. 2014	1496	35,830	9.323×10^{-6}	360,000,000	
2Aug.-3Aug. 2014	1494	37,020	2.829×10^{-6}	367,900,000	
3Aug.-4Aug. 2014	1496	35,830	2.923×10^{-6}	360,000,000	
4Aug.-5Aug. 2014	1497	35,260	2.970×10^{-6}	356,200,000	
5Aug.-6Aug. 2014	1499	34,190	3.063×10^{-6}	348,900,000	Perigee
6Aug.-7Aug. 2014	1499	34,190	3.063×10^{-6}	348,900,000	Perigee
7Aug.-8Aug. 2014	1496	35,830	2.923×10^{-6}	360,000,000	
31Aug.-1Sep. 2014	1496	35,830	2.923×10^{-6}	360,000,000	
1Sep.-2Sep. 2014	1495	36,410	2.880×10^{-6}	363,900,000	
2Sep.-3Sep. 2014	1495	36,410	2.880×10^{-6}	363,900,000	
3Sep.-4Sep. 2014	1496	35,830	2.923×10^{-6}	356,000,000	
4Sep.-5Sep. 2014	1494	37,020	2.829×10^{-6}	367,900,000	
5Sep.-6Sep. 2014	1494	37,020	2.829×10^{-6}	367,900,000	
1Oct.-2Oct. 2014	1493	37,640	2.782×10^{-6}	372,000,000	
2Oct.-3Oct. 2014	1491	38,960	2.688×10^{-6}	380,700,000	
3Oct.-4Oct. 2014	1492	38,290	2.735×10^{-6}	376,300,000	
4Oct.-5Oct. 2014	1490	39,660	2.640×10^{-6}	385,200,000	Apogee
Average		36,540	-	-	
Standard deviation		1,494	-	-	

Summary

The average orbital period of the moon is 36540 minute or 25.38 day and in error from the standard orbital period of the moon (27.322) is about7.124%.The distance of the moon is change every day so its orbit isn't circle. The orbit of the moon is ellipse and the orbit eccentricity is 0.0494.