Union College Spring 2016

**Astronomy 50 Lab: The Periods of the Orbit the Moon and the Lunar Phases**

 In this the lab, you will chart the Moon’s orbit relative to the stars and log the lunar phases and measure the period of both.

**Your Tool for Charting the Moon’s Orbit**

 Figure 1 gives a cartoon idea of the device you will use to measure angles between the Moon and stars. A transparent ruler is thumbtacked to the end of a piece of wood. You place the other end of the stick against your cheek, as close to your eye as possible, and view the sky through the ruler. You can use this device, called a “cross staff,” to measure angles between the Moon and known stars.



**Figure 1**: depiction of a cross-staff being used.

 Imagine that your eye is located at the center of a circle that has a transparent measuring tape going around the circumference, and imagine that this circle has a circumference of 360 cm. Since there are also 360o in a full circle, when you view the sky through the transparent ruler, two objects that appear to be separated by 1 cm on the ruler, must be separated by 1o on the sky. To make your cross staff, we use a stick whose length equals the radius of a circle of 360-cm circumference, or R = 360cm/2 = 57.3 cm.

**Observing**:

1. Time to observe: The time that the Moon is visible varies and depends on where along its orbit it is located. So, to start, we can use the Astronomical Almanac web page (<http://aa.usno.navy.mil/data/index.php>) and note the rise and set time of the Moon. This week the Moon rises in the morning and sets a little after midnight. So, if the weather cooperates, we’ll start by meeting at 9 pm, when the sky is dark enough to also note the stars.

2. Record phase. In Table 1, record the date, which side of the Moon is lit, the phase (crescent, half, gibbous, or full) of the Moon, and what percentage of the Moon is illuminated.

3. Triangulate the Moon’s position relative to the stars.

a. To do this, you first need to identify some stars. Use the star and planet locator as instructed in class, to indentify the constellations near the Moon. Use your star chart (and help from instructor) to identify three bright stars that are close to the Moon on the sky and record the names of these stars in Table 2.

b. Use your cross-staff to measure the angle from each of these three stars to the Moon -- be sure to measure the distance to the *center* of the Moon --, and record these angles in Table 2.

c. Repeat these measurements (noting percent illumination and charting position relative to stars) five times over the next two weeks. You’ll note that the Moon rises later each day, so you may need to adjust the time you look for the Moon.

d. The Moon will no longer be visible in evening hours from April 25 to May 8. On May 8 start looking for the Moon again and make these measurements on three more dates over the next week.

**Analysis:**

1. Bring all your data and star chart to the lab session and use the provided equipment to locate the Moon on the chart for each date that you observed by doing the following. Use a compass to draw circular arcs about each star, where the radii of the arcs equal the angular distances of the Moon from these stars. Use the chart’s legend to set the compass opening angle. Find the location where the three arcs intersect (or come closest)--this is the location of the Moon on that date.

2. Determine the exact amount of time for the lunar phases to complete one cycle.

3. Determine the exact amount of time the Moon takes to complete the orbit.

4. Use a flashlight and two spheres to model the Sun (flashlight) – Earth (larger sphere) - Moon (smaller sphere) system. Move the smaller sphere around thye larger and note the fraction of the lit side that is visible from the larger sphere and compare this to the cycle of lunar phases.

**Additional Questions to consider for your reports:**

1. How do the two periods compare? Since the lunar phases are due, mostly, to the Moon’s orbit about the Earth, why, is the Moon’s orbital period not equal to the period of lunar phases?

2. Which period is the actual amount of time the Moon takes to orbit the Earth? How does this compare to a month (a word whose origin involves the word “moon”) defined? How was the “month” defined?

3. What is the relative angle between the Moon’s orbit that you observed and the ecliptic (the plane of the Solar System)?

**Table 1:** Phase of Moon

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| Date | Side that is Lit | Phase | Percent Illumination |
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**Table 2**: Angular Distances of Moon From Identified Stars

Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Star | Angle (o) | Star | Angle (o) | Star | Angle (o) |
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Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| Star | Angle (o) | Star | Angle (o) | Star | Angle (o) |
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