

PHY 1033C - Lab 2
Epicycles, Seasons, and Phases of the Moon

In today's lab we will use a model of the Sun, Earth, and Moon to see how ancient astronomers might have come up with the epicycle description of the motion of heavenly bodies. We will also use it to see how seasons occur. We will also be using a larger scale model of the Earth with a light source to further investigate seasons. Because there is only one of the Large Earth models, groups will have to take turns using it to take data, and it will be graded as extra credit. Do the measurements and analysis for the SEM part of the lab *and* answer the comprehension questions at the end of the lab before working on the extra credit LEM section of the lab and its analysis.

SEM Model

To start out, use the Sun / Earth / Moon model at your desk.

1. Tape your double-sheet of large paper on to your desk in a way that will allow the Earth and Moon to be above the paper while the model's arm swings from perpendicular to the desk to parallel to the desk.
2. Using your protractor, measure the angle of the Earth's rotational axis with respect to vertical and record this angle in your lab book.
3. Place the paper with the angular scale drawn on it underneath your SEM model, centering the base inside the circle so that you can see the angle markings right on the edge of the base.
4. Orient your model and angular scale so that the Earth and Moon will be above the large paper on the desk throughout approximately 70° of motion. Set the model's arm to 0° (by looking from above and setting the edge of the model's arm at the angular mark below) and mark the location on the paper of the Earth and the Moon, which should be directly above the paper. Also indicate the orientation of the rotational axis next to the Earth's data point.
5. Continue taking Moon data every 4° and Earth data every 8° until the Moon or Earth is no longer above the paper. When you finish, you should have 8-9 Earth data points and 16-18 Moon data point and have moved through approximately two full Moon orbits of the Earth, or to describe it another way, two full cycles of the phases of the Moon. **All group members should write their names on the large paper as only one person will be able to turn it in.**
7. If the Large Earth Model is currently being used by another group, move on to the questions at the end of this lab or work on the analysis for the SEM data.

Analysis

8. With your SEM model data, use a pencil to smoothly connect the Earth's data points to show its orbital path. Do the same for the Moon's data points. These paths are in reference to the sun. Notice how the Moon's orbit has a spiraling shape, exhibiting retrograde motion. The Moon's position as viewed from the Sun is similar to the apparent paths of other heavenly bodies as seen from the perspective of the Earth.
9. For the large Earth model data, create a plot in your lab notebook with Angle of the Shadow as the vertical axis and Time as the horizontal axis. Directly below the horizontal axis, indicate the approximate range of each season of the northern hemisphere on this plot.

10. Comprehension Questions

Answer the following questions in your lab notebook, and give a brief explanation or diagram for your choice.

1. When it is spring in Gainesville, FL, it will be what season in Sydney, Australia?
 - (a) Spring
 - (b) Summer
 - (c) Fall
 - (d) Winter
2. Is there anywhere on Earth that has 24 hours of daylight at some time in the year? Explain.
3. Draw diagrams showing the relative positions of the Sun, Earth, and Moon during both a solar eclipse and a lunar eclipse.

Large Earth Model (2 pts. Extra credit)

11. Create a data table in your lab notebook, one column for time ranging from 0 to 240 s in 20 s intervals and another column for angle, which you will be measuring in a moment.
12. Go to the large Earth model. Using the protractor on the glass case and your ruler to measure the angle and a stopwatch to measure the time, record the angle of the shadow as it changes every 20 seconds for a total of 240 seconds. Record your angles as if the vertical 90° line were actually 0° . That is, the angle you should write down will be 90° minus the actual angle you measure from the protractor. You should have 13 data points when you finish.
13. Move on from the model quickly so that another group may begin using it.