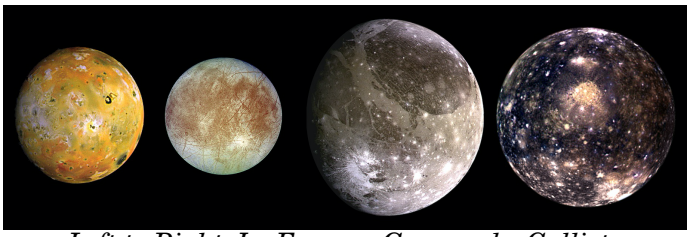
Lab 13-2: **Mass of Jupiter**

Purpose:
1. To plot position verses time data for a moon of Jupiter.
2. To determine the mass of Jupiter based on your plotted data.

Procedure:
From the documentation that comes with the program:
The Jupiter program simulates the operation of an automatically controlled telescope with a charge-coupled device (CCD) camera that provides a video image to a computer screen. It is a sophisticated computer program that allows convenient measurements to be made at a computer console, as well as adjusting the telescope's magnification. The computer simulation is realistic in all important ways, and using it will give you a good feel for how astronomers collect data and control their telescopes. Instead of using a telescope and actually observing the moons for many days, the computer simulation shows the moons to you as they would appear if you were to look through a telescope at the specified time.

1. Turn on the program called "Jupiter Lab." (You don't have to really sign in, just hit ok.) The program shows Jupiter and its 4 largest moons. Once it is running, it is pretty self-explanatory and fairly idiot proof. Click on a moon, and it will identify the moon and give its position.
2. Before you take data: Pick a moon that you want to follow, and follow it over several observations. If the moon is moving quickly (particularly Io), and switches from one side of Jupiter to the other a few times, quit the program and restart – but change the "Observation Interval" to a smaller time when the program starts up again.



Left to Right: Io, Europa, Ganymede, Callisto

3. For each observation, record the radial distance from Jupiter for the moon. This is in units of "Jupiter Diameters" and is labeled "x = ." in the lower right corner of the application. *NOTE: If the moon is to the right of Jupiter (W), call it +, if it is to the left of Jupiter (E), call it –.*
4. If it is a "cloudy night," then don't write down a position for that time. There will be a number of "holes" in your data, but that is ok, and will not mess up your results. (The program is trying to simulate reality, and the weather is a big factor in making telescopic observations.)
5. Click on "Next" to advance in time and make a new observation.
6. Once you are done (fill in the chart!) make a graph of Position vs. Time. Find the best sine curve that matches the data.

Data: moon: _____

Time (days)	Position (Jup-Diam)	Time (days)	Position (Jup-Diam)	Time (days)	Position (Jup-Diam)
0.0					

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Questions:

Paste Position vs Time Graph Here

1. What is the equation that relates position and time for the position of your moon? Be sure to state what the units are.

2. What is the radius, in meters, of the orbit of your moon? (The diameter of Jupiter is 1.43×10^8 m.)

3. What is the period, in seconds, of the orbit of your moon?

4. Calculate the mass of Jupiter. Be sure to show the equation you are using.

5. If the moon is orbiting Jupiter in a nearly circular orbit, why is the position verses time graph you made a sine curve?

Follow Up:

6. From the data on the board, graph T vs R for the four moons of Jupiter and then linearize the data. *(Hint: you have to change both axes!)*

Paste Linearized Graph Here

7. From the graph, what is the mass of Jupiter?