TRACKING JUPITER'S MOONS

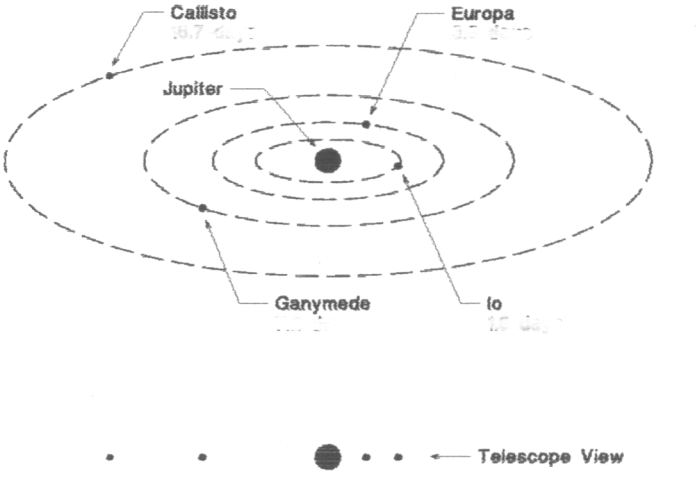
Background:

At the present time, Jupiter has over 60 recognized moons. The word *recognized* is used because this number could grow or shrink depending upon how small an object can be and still be considered a moon, and there would be perhaps only 16 moons. On the other hand, scientists could decide one of the smaller rocks orbiting Jupiter ought to be given moon status, and we would have way more than 60 moons.

As far as most people are concerned, Jupiter has just four moons, because that's how many you can see with a small telescope. In fact, Galileo saw these four largest moons with a simple telescope that was quite poor by today's standards. For that reason the four largest moon are often called the Galilean moons.

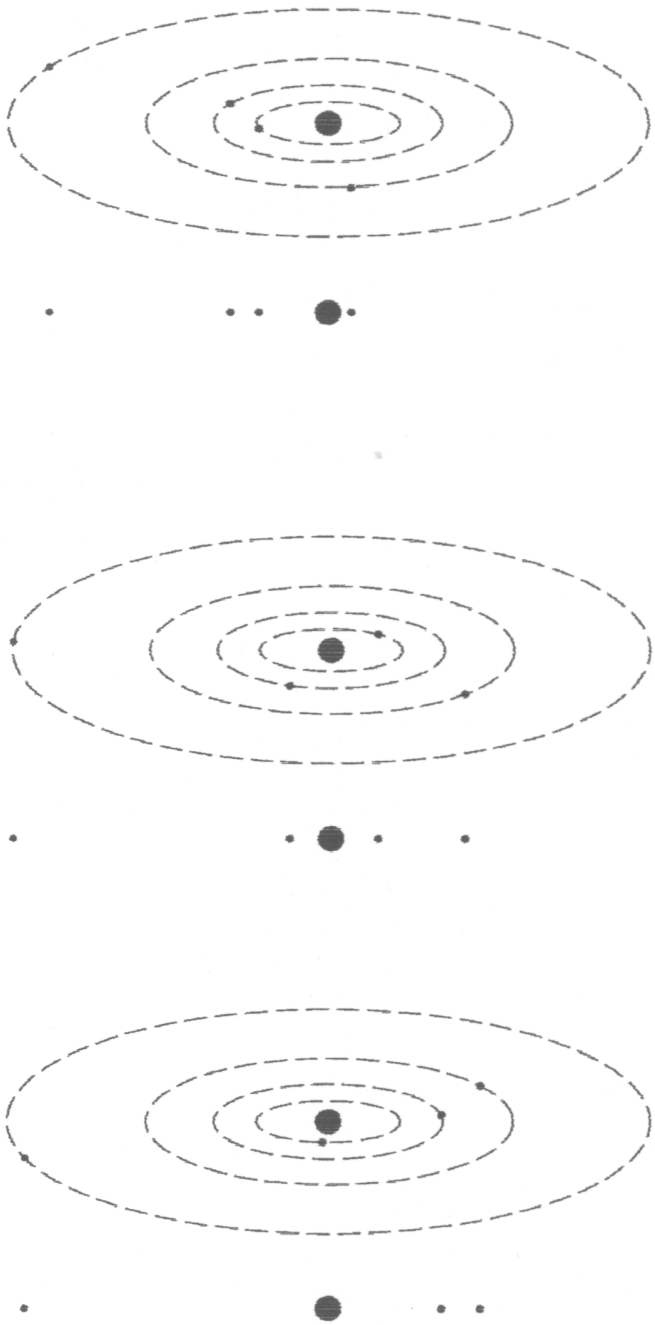
The Galilean moons can be seen with binoculars, but it is difficult to see them well because it is hard to hold binoculars stead. However, if the binoculars are mounted on a tripod, or some other technique is used to hold tem steady, it is possible to observe Jupiter's Galilean moons with an ordinary pair of binoculars with a magnification of about 10X. It is easiest to study the Galilean moons with a small telescope having magnification between 25X and 75X. The extra magnification over the binoculars makes it easier to see the moons, and the telescope would probably be mounted on a tripod to hold it steady. Beware that more magnification might mean you can't fit all four moons in the field of view at one time.

The drawing on the right shows quite a bit of information about the Galilean moons of Jupiter. The drawing is drawn to scale except for the sizes of the moons themselves. Their diameters are so small compared to Jupiter that they should be mere specks on this drawing. But the orbital sizes are correct with respect to each other and with respect to the size of Jupiter. For example, it would be possible to fit about six Jupiter diameters across the orbit circle of Io. You can fit about 26 Jupiter diameters across the orbit of Callistro.



From Earth we view the orbits of Jupiter's moons almost exactly edgewise. What we see looks like the string of dots shown at the bottom of the figure. It is also interesting to note that in this view Europa actually looks closer to Jupiter than Io, although this is clearly never true since the orbits are nearly circular. Also note that in this view neither Ganymede nor Callisto look as far away from Jupiter as they actually are. Not shown in the drawing is the fact that all the moons would be orbiting Jupiter in a counterclockwise direction if we assume the north pole of Jupiter is pointed upward in this drawing.

Now lets see what happens as we observe Jupiter each night over a four-day period. The figure on the right shows Jupiter and the moons exactly one day later than the drawing on the last page. Io, the innermost moon has traveled a bit further than halfway around. Europa has traveled almost a fourth of the way around; Ganymede about a seventh of the way, and Callisto about a sixteenth. The easiest thing to notice is the first-day picture has two moons on the right and two on the left. The second-day picture shows three moons on the left and one on the right. Also, the moon that appears closest, Ganymede, is actually third farthest.



The third night we would see the view depicted in the middle-right picture. We are back to seeing two moons on the left and two on the right. And this thime they are almost in the right order, except Europa looks a little bit closer than Io.

The fourth night something odd happens; we can only see three moons. It's going to happen that we sometimes choose to observe Jupiter when one or more moons are behind Jupiter or in front of Jupiter. We clearly cannot see a moon if it is behind Jupiter. We also are not likely to see a moon if it is in front of Jupiter because they are about the same brightness and it is too difficult to discern the bright moon on top of the bright planet.

It is also bound to happen that two moons almost overlap with each other and appear as one rather than two. How often this happens depends upon how good yur

telescope is and how steady the tripod is. If the two moons are very close, but not overlapping, a good telescope at sufficient magnification will allow you to resolve them. A smaller telescope, or low magnification, or a shaky tripod will make it difficult to resolve two moons that appear almost on top of each other. It also is difficult to resolve a moon if it appears next to Jupiter, but is not quite behind or in front.

Procedure

You will be shown slides of the motion of the moons of Jupiter over a 9-night period. Record the position of the moons and identify each moon by color or name. Using your data, find the period of each moon. Measure the farthest distance each moon is from the center of Jupiter.

Data Table

MOON	PERIOD	DISTANCE (cm)
Io (red)		
Europa (yellow)		
Ganymede (blue)		
Callistro (white)		

Analysis

Using Kepler's Third Law find the constant, k, for Jupiter. Show your work below.

$$\frac{\text{period}^2}{\text{distance}^3} = k$$

The constant is calculated to be (average the four values) _____

Name _____

TRACKING JUPITER'S MOONS