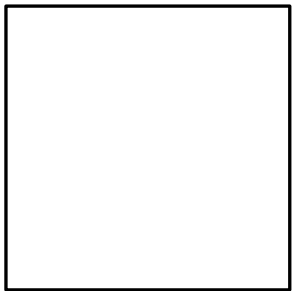
Indoor Lab 5 - The Planets

Objectives: To explore some aspects of telescopic observations of the planets, including a tour, and the relations between telescopic observations and where the planet is in the sky.

1 A Tour of the Planets

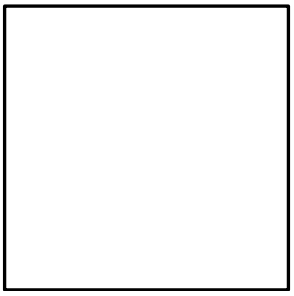
We are first going to use SN to take a look at the planets as they would appear in a large telescope in perfect observing conditions: in fact, much better views than any telescope on Earth. We shall set the field of view to 3'(= 180") which corresponds to a typical eyepiece at ultra high magnification (≈ 800). For convenience, get rid of daylight and the horizon so we can visit all the planets in one session. Make sure View /Solar System /Planets is checked or you will see no planets.



(a) Mercury

Rotation:_____

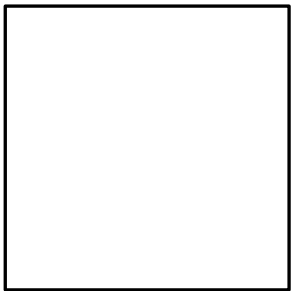
Moons:_____



(b) Venus

Rotation:_____

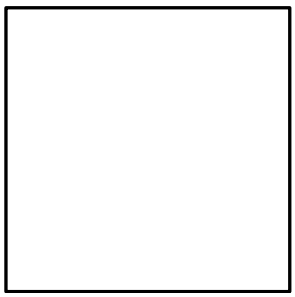
Moons:_____



(c) Mars

Rotation:_____

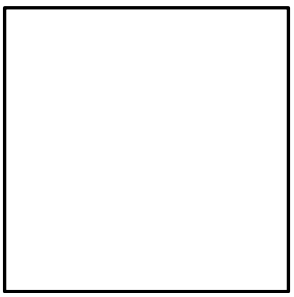
Moons:_____



(d) Jupiter

Rotation:_____

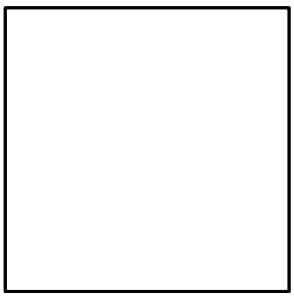
Moons:_____



(e) Saturn

Rotation:_____

Moons:_____



(f) Uranus

Rotation:_____

Moons:_____

Click Options /Orientation /Ecliptic to orient the ecliptic from side to side. Then for each planet in turn, double click the box in the Find panel to lock it, and make sure the field of view is correct (3'). Sketch the disc of each planet to scale (the box = the SN field of view) with any features, and indicate any possible moons in the field. Set the clock interval to 1 day. Observe the planet again with a few single 1 day time steps (like observations from night to night) and then continuously, and comment whether you can detect rotation of the planet, and confirm the presence of moons (possible answers are yes /no /maybe). You will see that the planets exhibit very different angular sizes (according to their true size and distance), and some of them show distinct phases.

2 Venus

We now examine Venus in more detail as the most easily visible example of an inner planet. We are going to observe it simultaneously in a wide field, and close up, to see how the two views are related. Setup. The setup requires some patience. Click Options /Orientation /Ecliptic; turn off daylight. Click Sun and lock; re-size the window to a long rectangle to cover the top half of the screen. Make the field 100° across. Set the time interval to about 12 hr. Run the clock and make sure you can see Venus shuttling back and forth each side of the Sun (you can also see Mercury as well). Stop the clock. Now open a second window using File /New. Do the same setup steps as above, but this time set and lock on Venus, with a field of 2'. Run the clock with a 12 hr interval, and Venus should change size due to approaching and receding from us, and change phase. With both windows running, click the arrow to the right of the date to Synchronize Times in All Windows. Check that the dates change in the same way. Watch the two windows carefully and see how the views correspond. In the table below, fill out the phase sequence that you observe that corresponds to the sequence of configurations given in the first column. Measure the maximum elongations and the angular size of the disk as the planet goes through its phases. Note that there are two types of conjunction (depending on where they occur in the sequence), and elongation is the angle between Venus and the Sun. N.B. To measure the elongations and the diameters you will need to stop the clock at the right time; and then resynchronize the motion for the next measurement.

	Elongation	Phase	Angular Diameter
Conjunction			
Max Elongation East(left)			
Conjunction			
Max Elongation West(right)			
Conjunction			

Note the dates between successive passages of Venus between two superior conjunctions:

Date 1:_____

Date 2:_____

Questions: Estimate the synodic period (in days) from your date measurements. Compare this with the value from the relation to the orbital period P=225 days.

_____

Remember: 1/S = 1/P - 1/E

During roughly half of this synodic period, Venus is east of the Sun, and is seen as the "evening star" after sunset, and for the other half it is seen as the "morning star" before sunrise. From your observations, is Venus approaching or receding from Earth during the evening star period ?

_____

Can Venus ever be seen on the meridian at midnight in NY. Explain:_____

Can Venus ever be seen in the sky at midnight in NY. Explain:_____

3 Mars

We now take a similar look at Mars as an example of an outer planet. You will see that the behavior of the outer planets is somewhat different. Keep both windows open, and in one of them set on and lock Mars, with a field of 30", and in the other set on and lock Mars, with a field of 100°. With a time interval of about 1 day, synchronize the windows as before and watch. Record the phases and angular sizes of Mars in the following table, and record the dates of successive minima in size.

	Phase	Angular Diameter
Min size		
Max size		
Min size		

Note the dates of successive minima in size:

Date 1:_____

Date 2:_____

Questions: Estimate the synodic period (in days) from your date measurements. Compare this with the value from the relation to the orbital period P=1.88 years.

_____

Remember: 1/S = 1/P - 1/E

In which direction does Mars usually travel against the background stars:_____

What is the least illuminated phase that Mars reaches:_____

What astronomical body passes Mars every time it is smallest in angular diameter:_____

When Mars retrogrades, is it biggest or smallest, and why:_____

From your measurements, what is the ratio of the maximum to minimum angular size of Mars?

Max/Min :_____

The radius of Mars orbit is 1.5 AU. So its nearest approach to Earth is _____ AU and its farthest distance is _____ AU.

Based on this, what is the theoretical ratio of the max/min angular sizes: _____

(It should be close to your measured ratio above.)

4 Jupiter and Saturn

While we are examining the planets, it is worthwhile to revisit Jupiter and Saturn.

For Jupiter set the interval to 1 hr and study the motions of the 4 bright moons. For Saturn, a time step of 1 hr is also good for looking looking at the moon motions. A longer time interval of 1 month allows you to see the ring orientation change.