ASTRO 100/G – Experiment 1

The use of a computer planetarium

Links to Lectures 2, 3, and 4

Name: ID: UPI/Username:	**Grade** /10

Astronomers today use programs like this one to produce current and future astronomical maps. The programs can also interface with telescopes, to move them around automatically. In this experiment, you will use such a program to look at the behaviour of the planets over time.

Planets mostly rise and set with the stars; however, they too orbit the Sun and move slowly relative to the background celestial sphere. Jupiter orbits the Sun once every 12 years, so its motion is difficult to see; but for Mercury, Venus and Mars, which are closer to the Sun with orbital periods more like the Earth's (1 year), they do move noticeably relative to the celestial sphere.

Starting Stellarium

Stellarium is installed by default on all computers in this lab. Go to to Start and search Windows for "Stellarium".

Stellarium allows you to control time by hovering over the bottom left panel. Turn off the ground and the atmosphere by pressing the G and A key, then accelerate time using the controls shown in Figure 1. You should see the sky move, with everything moving at roughly the same speed. This is because of the Earth's rotation, and is the same reason we have a 24-hour day. The stars appear to be fixed relative to one another because they're so far away, but the planets move. This is why they're called planets – it's from the Greek word *planētes*, for 'wanderer'.

The 11$^{\text{th}}$ symbol on the bottom menu switches you between an equatorial mount and an azimuthal mount. If the symbol is highlighted, the virtual telescope is mounted on an equatorial mount that has an axis parallel to the Earth's rotation axis, with the celestial sphere as the reference frame. Therefore the stars appear fixed while the ground appears to move as you change time. This means that when you advance in time, the stars will not move but horizon will. This setting makes it easiest to see how the planets are moving relative to the background stars.

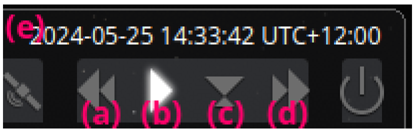

Figure 1: Stellarium's time controls: (a) slow down time, (b) pause/play time, (c) set time to right now, (d) speed up time, (e) the current simulation date and time

There are two intuitive ways to measure orbital periods. An orbital period is the length of time that something takes to make one full revolution around its Sun. If you know where it originated from, and that the orbit appears truly circular to you, then you are able to measure its **sidereal** period (think "side-**real** is the **real** period"). When we speak of periods, this is the one we normally mean. However, there is another method:. If you measure the time between successive orbital phenomena (such as retrograde to retrograde), if these phenomena occur once an orbit, you measure another kind of period: the synodic period (think "syn-**odd**-ic period is the **odd** period"). This period takes into account the fact that the Earth is moving throughout the solar system too. The synodic period will be longer than the sidereal period, because it measures the time the planet appears to go back on itself. For some things, we can only measure the synodic period. For other things, we can only measure the sidereal period. What do you think the difference is that causes this?

At the end of this lab, students will be able to:

- **Qualitatively compare** views of a telescope in equatorial and azimuthal mounts.
- **Estimate** orbital periods of solar system objects using planetarium software.
- **Contrast** the cause of apparent planetary retrograde motion for inner and outer planets.
- **Describe** the difference between synodic and sidereal periods of a planet.