Physics 10293 Lab #4:
Starry Night – Student Exercises I

Introduction

For today's lab, we are going to let the Starry Night software do much of the work for us. We're going to walk through some of the sample setups provided by Starry Night to understand some of the concepts we've talked about in lab and lecture this semseter.

Part A1

First, we will look at the relationship between the solar day and the sidereal day on Earth.

Open the SkyGuide tab on the sidebar...

- Select Student Exercises
- Select A - Earth, Moon and Sun
- Select **Exercise A1:** Diurnal Motion
- Select Part 2: Diurnal Motion Rate, and answer:

At what rate (degrees/hour) does the Sun move? ____________

Now select Part 3: The cause of diurnal motion, and watch the associated animation.

Now select Part 4: Diurnal motion and location, and answer:

Describe the difference in the daily path of the rising Sun as seen from New York (latitude 41° N) and Quito, Ecuador (latitude 0°).

Part A2

Now move on to **Exercise A2:** Earth's revolution around the Sun. For Part 1: Night sky changes daily, follow the instructions carefully (step time forward only once, do not run time forward) to determine how long it takes for the star Vega to return to the meridian each day as measured from its previous day's meridian crossing. Note the start time below before you begin the exercise.

How long does it take the star Vega to return to the merdian to the nearest second?

Start: Aug 14, 2010 8 hr 59 min 32 sec

Return to meridian, Aug 15, 2010 _____ hr _____ min _____ sec

Length of sidereal (stellar) day to the nearest minute: ______ hr ______ min

Now click on Part 2: Constellations shift throughout the year, and answer:

On what date in the exercise is the constellation Leo on the meridian at midnight?

____

Now move on to Part 3: The cause of shifting constellations. This simulation is showing you a view of the Earth as seen from the Sun. The constellations back behind the Earth are the ones seen by the night-time side of Earth. These are the same constellations we watched pass through the meridian in the previous step.

Part A3

Now move on to **Exercise A3:** The Local Coordinate System. The first view shows a view of the sky like that seen in the back of your textbook, only with the local altitude and azimuth coordinate system overlaid. You can see as you look around the horizon that the azimuth angle varies from 0° (true North) to 90° (East) to 180° (South) to 270° (West) and then back to 0°. Also, note that East and West on the sky map is reversed from a normal map just like in your book's star charts.

Work through Part 1: Altitude and azimuth and answer:

At the beginning of the exercise, what is the approximate altitude of the star Regulus? _______________

After two hours passes, what is the altitude? ____________

At the same time, what is the altitude of the constellation Gemini? _____________

At the same time, what is the approximate azimuth direction (e.g. N, NE, E, SE, S, etc.) for the constellation Orion? _____________

At the same time, what is the approximate azimuth direction of the constellation Ursa Major? ____________

Now start Part 2: The meridian and answer the associated questions below . Note that you can determine the altitude of Antares by right-clicking and going to the bottom of the menu to "show info" (look under "Position in the Sky" in the sidebar). But then be sure to return to the skyguide tab when you are done.

At what time does Antares cross the meridian? ______________

What is the altitude of Antares at this time? _____________

From Part 3: Altitude and latitude:

What is the altitude of Antares from 53° N latitude? ___________

At the same time, what is the altitude from 25° N? ____________

Part A5

Skip ahead to **Exercise A5: The Celestial Sphere**, and work through the 8 associated exercises, answering the associated questions below:

From Part 1: The celestial equator:
For each of the following constellations, answer "yes" if it is on the Celestial Equator and "no" if it is not on the Celestial Equator.

Orion	_______________	Gemini	________________
Cetus	_______________	Ursa Major	______________
Scorpius	_______________	Virgo	_____________

From Part 4: North celestial pole and an observer's latitude:
If you want to use the angular separation tool, you can access that at the top left where the hand with the + sign is located. There is a little drop-down menu to the right of that that allows you to select different tools. The angular separation tool works by clicking on a particular place on the sky, then dragging to the other place. You can also estimate the altitude of the North Celestial Pole above the horizon by clicking "Show Info" on Polaris.

What is the altitude of the NCP from New York City? __________

What is the altitude of the NCP from Key West? ___________

From Part 7: The equinoxes and Part 8: The solstices, determine the dates when the Sun approaches each reference point on the sky. You may wish to increase the rate of time flow for these parts.

What day does the Sun reach the Vernal equinox? _______________

What day does the Sun reach the Autumnal equinox? _____________

What day does the Sun reach the Summer solstice? ______________

What day does the Sun reach the Winter solstice? ______________

Part A6

Work through **Exercise A6:** The Celestial Coordinate System and work through the 6 associated exercises, answering the corresponding questions below.

From Part 3: Right Ascension:
What is the Right Ascension of each of the following points?

The Vernal equinox: _____________ hours

The Summer solstice: _____________ hours

The Autumnal equinox: _____________ hours

The Winter solstice: _____________ hours

From Part 4: Measuring Coordinates:
What are the coordinates of Altair?

RA = ________________________, Dec = ______________________

Which star is at the coordinates RA = 3h 59m, Dec = -13° 28′?

____

Which star is at the coordinates RA = 13h 48m, Dec = +49° 14′?

____

From Part 5: Celestial coordinates and an observer's location:

What are the coordinates of Vega as measured from New York City?

RA = _____________________, Dec = ____________________

What are the coordinates of Vega as measured from Quito, Ecuador?

RA = _____________________, Dec = ____________________

Notice that the altitude and azimuth of Vega varies depending on one's location (these are local coordinates) while RA and Dec of Vega is independent of location (global coordinates). Each type of coordinate is useful in certain situations. RA and Dec are typically used in star maps used around the world.

From Part 6: Precession:

What are the coordinates of Vega in the year 3009?

RA = ____________________, Dec = ____________________

When studying the alignments of temples and monuments in ancient cultures, we must be sure to adjust for precession before determining whether or not there is an alignment with the particular star or constellation.

Part A7

Work through **Exercise A7:** Solar and Sidereal Days and the four associated exercises, answering the corresponding questions below.

From Part 1: Apparent Solar Day, to the nearest second, what is the length of the solar day on

June 21-22, 2010: ________ hours _______ min _______ sec

September 21-22, 2010: _______ hours _______ min _______ sec

Briefly summarize what causes the variation in the solar day.

From Part 4: Sidereal day, to the nearest second, what is the length of a sidereal day?

________ hrs ________ min ________ sec

Note that this length does not vary with time of year as it depends only upon the Earth's rotation speed, which is constant. The solar day depends on both the Earth's rotation speed and Earth's orbital speed, the latter of which is not constant.

In Part 3: Equation of time, you are introduced to the analemma, which is constructed by marking the Sun's location in the sky on successive 24-hour intervals. The Sun moves north and south along the meridian due to the tilt of the Earth as it orbits the Sun. This North-South motion gives us the seasons. If you go to the Options sidebar and display Equator under Celestial Guides, you can see the Sun moving north and south of the Celestial Equator as we have shown on horizon diagrams.

The east-west motion to either side of the meridian comes from the varying speed of Earth as it orbits the Sun, as explained in part 1 of this exercise. The up-down motion combined with side-to-side motion creates the analemma.

Part A8

Work through **Exercise A8:** The Year and Seasons and the five associated exercises, answering the questions below.

From Part 1: Earth's orbit, answer the following. Remember, you can find the distances or angular distances between two things by using the angular separation tool, which is accessible on the menu in the top left corner just to the left of the time and date control panel.

1 AU (Astronomical Unit) is the average distance from the Earth to the Sun, equal to 93 million miles. We measure distances in our solar system in AU for convenience.

What is the Earth-Sun distance on Dec 21? ______________ AU

What is the Earth-Sun distance on Jun 21? ______________ AU

What is the percentage difference? You can calculate this by taking the difference and multiplying by 100. ________%

From Part 5: Seasons on Mars, answer: Does Mars experience seasons like the Earth? Explain.

Part A9

Work through **Exercise A9:** The Analemma and the five associated exercises, and answer: Is Mars' orbit more eccentric than Earth's? Less? About the same? Explain your answer, based on the shape of its analemma.

Essay

Look back through each part of this lab and pick the one that (a) was most interesting to you and then pick the part that was (b) most helpful in your understanding of a concept you didn't previously understand. Briefly justify each choice with a sentence or two of explanation.