

SIERRA COLLEGE OBSERVATIONAL ASTRONOMY LABORATORY EXERCISE		
NUMBER	III.E. TITLE: Observing The Sun	
DATE-	PRINT NAME/S AND INITIAL BELOW:	GROUP <input style="width: 40px; height: 20px;" type="text"/>
DAY-		
LOCATION		

PURPOSE:

- To learn how to safely view the sun with a small telescope.
- To observe sunspots and other solar features visible.
- To access online images to understand what the sun looks like with different wavelengths
- To understand how to determine the synodic period of the sun and to calculate sidereal period given the synodic period.
- To determine the diameter of the sun by 'pinhole projection'.

PROCEDURE:

- The student will safely observe the sun through the telescopes. If conditions do not permit, then the students will look at solar pictures over the internet.
- Determine the synodic period (S) of rotation from the photographs by equation #1. Then determine the sidereal (P) period of rotation of the sun using equation #2.
- Determine the diameter of the sun with observations provided by instructor or done by students.

OBSERVING THE SUN:

NOTE: Do NOT look directly at the Sun with your eyes or through a telescope without a proper solar filter!

1. If sky conditions permit, we will use the C-8 telescopes to observe the Sun. The instructor may set up the refracting telescope and show the Sun (and any sunspots) using the projection technique.
2. Set up the telescope as usual (and align the arrow on the mount to north), but make sure to have safe solar filter firmly attached to front the telescope. It may be easier to first "find" the sun in the telescope by minimizing the telescope shadow on the ground.
3. With the solar filter in place in front of the telescope, observe the sun. In the appropriate page in the "F" section in your bluebook, sketch out any sunspots that you can see. Also determine and indicate on the sketch which direction is North.

Internet investigation (can be used if sky conditions do not permit observing):

4. Go to the URL <http://umbra.nascom.nasa.gov/images/latest.html> (Current Solar Images). These are the latest pictures of the Sun taken with various spacecraft at various wavelengths. Scroll down to the very last thumbnail (the optical picture). Click on it and see whether there are any sunspots or other blemishes. Make a sketch of the picture and put this in the Bluebook summary ("H" section). If you were able to sketch out the real Sun (as in step 3), compare your sketch to the picture.
5. Back on the main Current Solar Images page, if the first few thumbnails are available, click on the one that is colored green. This picture is taken in the UV at 195 Å (19.5 nm). Notice that there may be several bright spots on the solar disk. How do their locations compare with the locations of the sunspots and blemishes seen in the optical picture (if the UV pictures are not available, then archive images will be provided)?

The ANALEMMA:

1. Imagine that you took a picture of the Sun at the same time (say, 8:30 am) every 5 days throughout the year. Now one can imagine that the Sun's position will change throughout the year: (1) its altitude will be higher during the spring and summer and (2) the Sun will be further north during the spring and summer. However the changing position of the Sun is more complicated than that. Let's use TheSky to find out.
2. Open TheSky and select File/Open... and then select the file named Analemma. This changes the date to 20 March 1999 and places you in Boulder, Colorado. Notice the Sun in the South sky. We'll make a few changes. Select Data/Site Information and then choose the Date/Time tab and change the time to 8 hours 30 minutes (8:30 am). Change the date to 20 February 1999. Then choose the Look East (yellow E) button.
3. Now we will animate the Sun's motion throughout the year. We will use the Time Skip tools located in the right part of the tool bar. The time interval lies in the white box and should already read 5 Days (if not, change it to 5 Days). Now press the red dot which is located a little bit further to the right. This will allow trailing of the Sun's images as it moves throughout the year. Now press the fast forward button, ►►. Notice the Sun's path does not draw out a simple shape. Once one year has gone by, the Sun should return to its starting location. Press ■ to stop. The shape that is seen is called an *analemma*.
4. Now the look for the Sun symbol which is highest in the sky and click it. A dialogue box appears. Which date does this occur (use first date in box) and what is the altitude and azimuth (to the nearest degree). Do this also for the Sun symbol which lowest in the sky. Put these answers in the BlueBook.

SYNODIC and SIDEREAL PERIOD of the SUN:

1. Sunspots can be used to calculate the rotation period of the Sun (see next page, notice sunspot A and B). The time at which they appear to go around the Sun as seen from the Earth (or any other planet) is called the *synodic* period, while the time at which sunspots appear to go around the Sun as seen by the distant stars, is called the *sidereal* period (which is the true period of rotation). If we carefully measure the motion of the sunspots, we can estimate the sidereal period.
2. Suppose we notice a sunspot be going around Sun at a rate of 12 degrees/day. From this information and Equation #1, what is the synodic period of the Sun? Using Equation #2, what is sidereal period of the Sun?

<p style="text-align: center;">EQUATION #1</p> $\text{SYN. PER} = S = \frac{360^\circ}{\text{rate}}$

<p style="text-align: center;">EQUATION #2</p> $\text{SID. PER} = P = \frac{S \times E}{S + E}$
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E = 365.25 DAYS

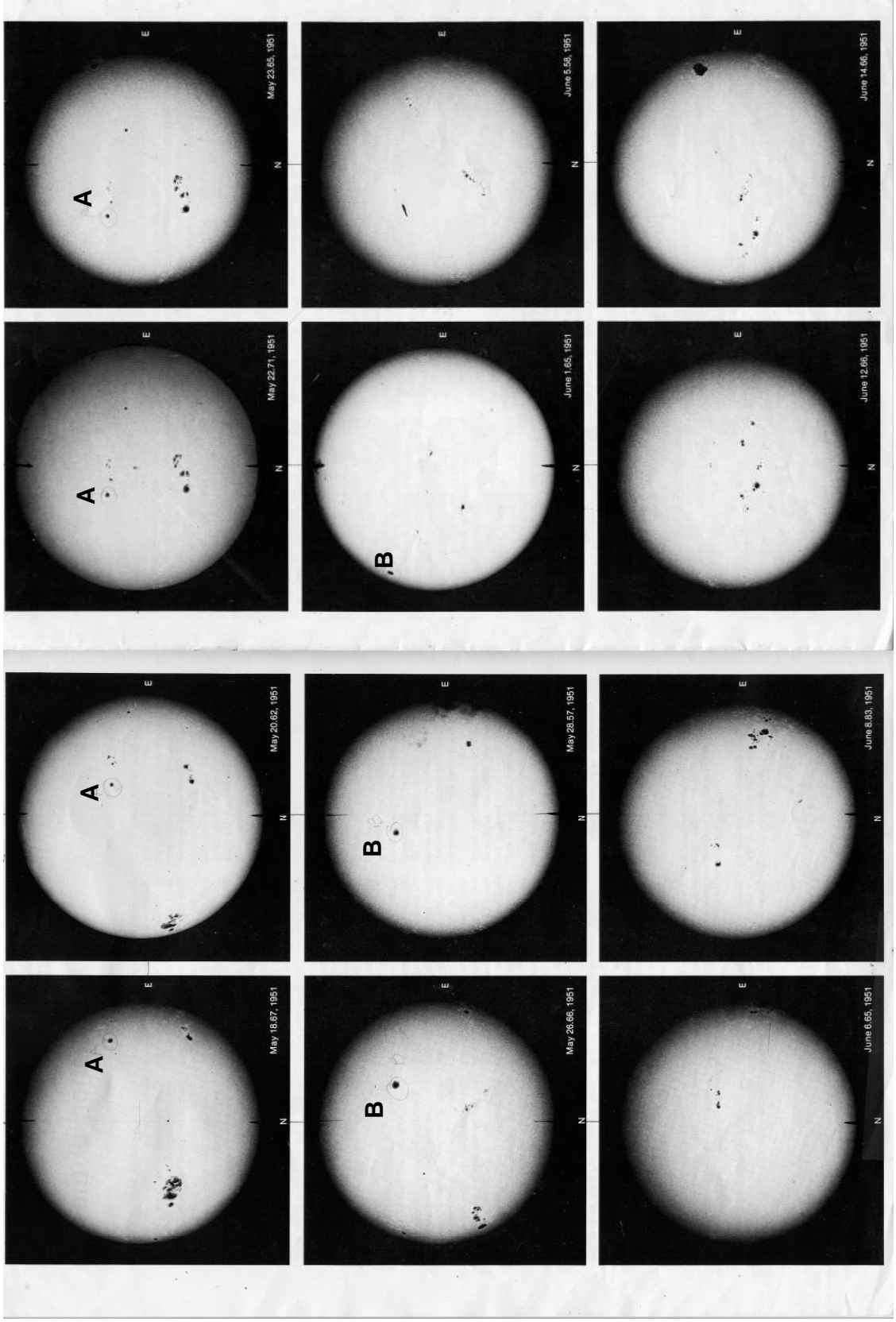
CALCULATIONS:

CALCULATE THE SYNODIC PERIOD

DAYS

CALCULATE THE SIDEREAL PERIOD

DAYS



QUESTIONS:

1. Open TheSky again and once again set it for the analemma (as in The Analemma Section on Page 2). Now select Data/Site Information and choose the Location tab and click on Open ... Now select the file called Cities outside USA.loc. This allows us to find international cities. Find Quito, Ecuador (a city nearly on the equator). As before, the time should be set 8:30 am, the date set to February 20, 1999 and the time interval set to 5 days. Press fast forward so that TheSky can trace out the analemma. How does the orientation of the analemma, compare to the one in Bolder, Colorado? What day does the Sun highest about the horizon? Lowest?

2. What are the two reasons for the analemma?

3. If the period of rotation for the sun changed, how would that affect the length of an 'earth' day?

4. For an observer on the planet Mercury, would the synodic period of the sun be longer, shorter, or the same as that measured by an Earth observer?

5. What 'layer' of the sun is a sunspot located?

6. Is a sunspot hotter, cooler, or the same temperature of the area surrounding it?

7. Calculate the diameter of the sun with the 'pinhole projection' data provided by the instructor. Show work below.

8. For **BLUEBOOK SUMMARY** - What precautions should be taken when observing the sun with the unaided eye **and** with an optical device?