Lab #11: The Rotation of the Sun

The time of spin of the Sun has been measured by following the motion of various features ("tracers") on the solar surface. The first and most widely used tracers are sunspots. Though sunspots have been observed since ancient times, it was only when the telescope came into use that they were observed to turn with the Sun and that rotation could be seen at all.

Sunspots are temporary phenomena on the "surface" of the Sun (the photosphere) that appear visibly as dark spots compared to surrounding regions. They are caused by intense magnetic activity, which inhibits convection (which normally brings up heat from the depths of the Sun), forming areas of reduced surface temperature. Although they are at temperatures of roughly 3,000-4,500 K, the contrast with the surrounding material at about 5,780 K leaves them clearly visible as dark spots. If a "dark" sunspot were isolated from the surrounding photosphere it would be still brighter than the electric arc. Since sunspots are on the surface of the Sun, which is spherical in shape, they become foreshortened as they move across the face of the Sun. They can be as large as 80,000 km (50,000 miles) in diameter, making the larger ones visible from Earth without the aid of a telescope, although we can look directly into the Sun only a few minutes before Sunset, when the Sun is not overwhelmingly bright.

In this lab, you will trace the movement of sunspots over a sequence of days based on images taken by the SOHO spacecraft (SOlar and Heliospheric Observatory), operated jointly by NASA and the European Space Agency (ESA).

PROCEDURE AND LAB REPORT

Date:_______ Your name: ___________Partner's name: ___________ Section: ___/___

Maximum two students may work together as partners!

1. Open the picture file by double clicking on the setup file *Sunspots.pdf*, located in the *Desktop/AstroLabs/AstroDocuments* folder. Use the down arrow to see the daily change due to the rotation of the Sun.

2. *Read off longitudes:* For each of the sunspots (A, B, and C), record the date and the longitude for each day in the chart below as they progress across the face of the Sun.

3. *Determine daily motion:* In each table fill in the last column by taking the difference of the longitudes as they change in any one day.

Sunspot A			
Day	Date	Longi tude	Daily change
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
Average daily change:			

Sunspot B			
Day	Date	Longi tude	Daily change
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
Average daily change:			

Sunspot C			
Day	Date	Longi tude	Daily change
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
Average daily change:			

4. Interpret your results:

a. Do all sunspots "move" around the Sun with the same rate? ________.

b. What was the average daily rate the sunspots appear to be moving? ________. (Average for all three spots.)

c. Did some spots seem to change in size or shape? ______
If so, explain how and why:

___ ______ ______ ______ ______ ______ ______ ______ ______ ______ ___

d. From your answers you can conclude that sunspots appear to move around the Sun at the rate of _______ degrees per day. However, this is not the true rotation of the Sun. We are watching the Sun from an Earth that orbits the Sun in 365 days, and that is almost exactly one degree a day. Sunspots in actual fact must be moving 1°/day faster than they appear from Earth. You can conclude that sunspots (and so the Sun itself) rotate at a true rate of _______ degrees per day.

e. At this rate, how long a time is needed to make one full rotation? ________ days.

f. Other measurements give an average value of 25.375 days for the rotation of the Sun. Did your procedure give a reasonably close value to this? Calculate the percent difference: ______ %. It is not expected that any two measurements ever give exactly the same answer. There is always a little measurement error; that is part of the process. What do you think the main reason for the difference is?

___ ______ ______ ______ ______ ______ ______ ______ ______ ______ ___

(Note that "human error" should not be the answer. That would mean that you did your job wrong; that hopefully did not happen.)