The Rotation and Revolution of the Earth

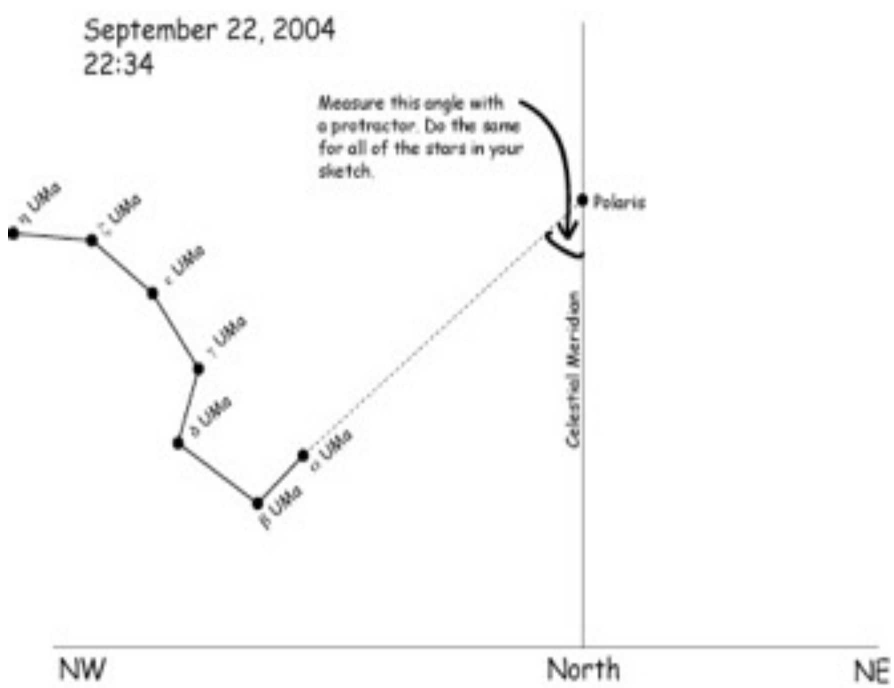
1. The Rotation

The object of this observation is to measure the length of time required for the stars to appear to have revolved once about the Earth in order to determine the **actual** length of time required for the Earth to rotate once on its axis.

It is not necessary to watch the stars make a complete apparent revolution; watch them for an hour or so, and then compute how long would be required for them to turn once completely.

At the bottom of a page, draw a horizontal line with a ruler to represent the northern horizon. Mark the centre point of the line as “North”; mark “NW” at the left end of the line and “NE” at the right end of the line. Up from North, draw a vertical line at least 15 cm long. Mark the top of this line, “Zenith”. This line represents the northern half of the celestial meridian, from horizon to zenith. Mark the position of Polaris about 5/9 of the way up from N. (Why 5/9?)

Early in the evening stand facing due north, at a place that can later be identified and reoccupied. Along the apparent horizon sketch any trees, lights, or other landmarks that show, to serve as reference points. Then draw in the sky, indicating by properly placed small circles, the stars of the Big Dipper, the stars β and γ Ursae Minoris, and the stars of Cassiopeia (the “W”). Label the stars with their Greek letters. Record the date and time of completion of the sketch.



As late as possible on the same evening, repeat this observation and sketch on a second page ruled like the first, again recording the date and time.

The computation is a simple one, but first the two drawings must be measured. Using a protractor, measure the angle from the upper part of the meridian to the line joining Polaris with each star of the first chart. Read this angle in a counterclockwise direction. Record the individual values of this angle in the second column of Table 1. Repeat for the second chart, recording the values in the third column of the same table.

Subtract each of the values in column 2 from the corresponding values in column 3, recording the differences in column 4. These are the angles through which the stars appeared to have moved due to the rotation of the Earth. Add the values in column 4 and divide by 14 to obtain the average. The values and the average should be written keeping 1 decimal place. Divide 360 by the average and the result is the factor by which the time interval elapsing between the two observations, in minutes, is to be multiplied to give the rotation period of the Earth, in minutes. Divide by 60, to obtain the Earth’s sidereal rotation period in hours, with a remainder of minutes.

2. The Revolution

On a third sheet of paper, ruled as before, repeat the observations at the same hour of the night as for the first sketch, but on a night at least one month later.

Measure the sketch as before, and record the values in column 3 of Table 2. Column 2 should be filled with the values of the corresponding column in Table 1.

Again take the differences and the average, and divide into 360. This factor is now used to multiply the number of days elapsed from the first observation to the one just made. The result is the sidereal period of the revolution of the Earth, in days.

Table 1: Rotation of the Earth			
DATE of BOTH OBSERVATIONS:			
	Time 1	**Time 2**	
Star	**Angle 1**	**Angle 2**	**Difference** (Angle 1 - Angle 2)
α UMa			
β UMa			
γ UMa			
δ UMa			
ε UMa			
ζ UMa			
η UMa			
β UMi			
γ UMi			
β Cas			
α Cas			
γ Cas			
δ Cas			
ε Cas			
Sum of Differences			
Average Difference			

Table 2: Revolution of the Earth			
TIME of BOTH OBSERVATIONS:			
	Date 1	**Date 2**	
Star	**Angle 1**	**Angle 2**	**Difference** (Angle 1 - Angle 2)
α UMa			
β UMa			
γ UMa			
δ UMa			
ε UMa			
ζ UMa			
η UMa			
β UMi			
γ UMi			
β Cas			
α Cas			
γ Cas			
δ Cas			
ε Cas			
Sum of Differences			
Average Difference			

3. The Discussion

a). Is there any evidence of personal or systematic errors? What are they and how do they influence your results? What is the effect of making many individual observations?

b). Should you really use Polaris as the origin for measurements? Why or why not? Does it influence your results significantly? Justify.

c). Just how important is it to make the observation for the revolution at exactly the same time as one of the observations of the rotation? (Try a simple quantitative argument.) Does the duration of the observation significantly affect the results? Why or why not?

d). How could one improve one's results? Do your results exceed your expectations of them? Explain.

-updated by idc on 2015-09-11