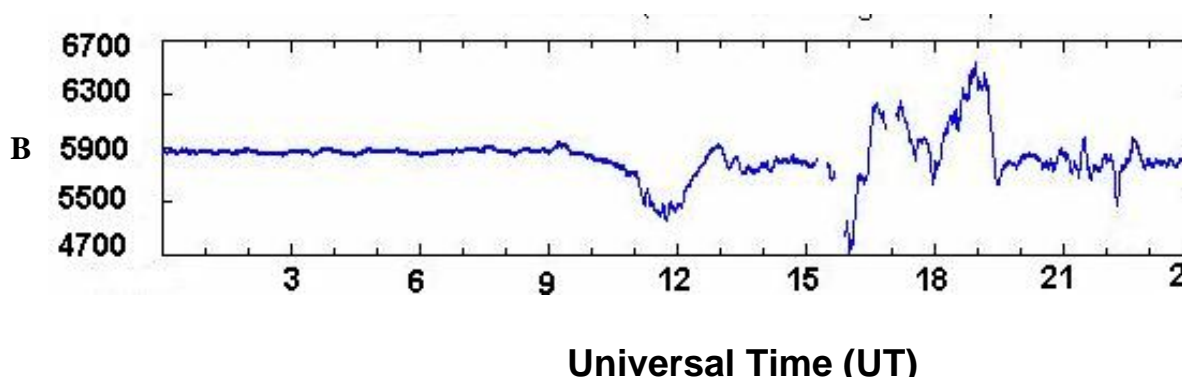**Magnetic Storms** are disturbances in Earth's magnetic field that can be detected from the ground using sensitive instruments called magnetometers. Dozens of these instruments located at 'Magnetic Observatories' around the world keep track of these disturbances. The graph below shows these changes during a 24-hour period on October 24, 2003.

The vertical axis in the plot gives the magnitude, B, of this magnetic change on Earth that is in the East to West direction. The strength of a magnet can be described in terms of a unit called a Tesla. On this plot, the vertical axis gives the magnetic strength in units of nano-Teslas (nT). One nano-Tesla is one billionth of a Tesla (so 1 billion nano-Teslas = 1 Tesla) . We can see that on this day, Earth's magnetic field varied between 4700 and 6700 nano-Teslas.

The horizontal axis is the time measured in Universal Time (UT). When scientists study events that change in time, they often use Universal Time, which is also known as Greenwich Mean Time. All scientific measurements are referred to this standard of time keeping to avoid problems converting from one time zone to another. Universal Time or 'UT' follows a 24-hour clock, so that 6:00 PM is written as 18:00 and 1:00 PM is written as 13:00. Use the time calculator at http://www.indiana.edu/~animal/fun/conversions/worldtime.html to convert your local time to Universal Time!

Universal Time (UT)

Question 1 – If a magnetometer measured a magnetic field of 137,000 nT, how many Teslas would that correspond to?
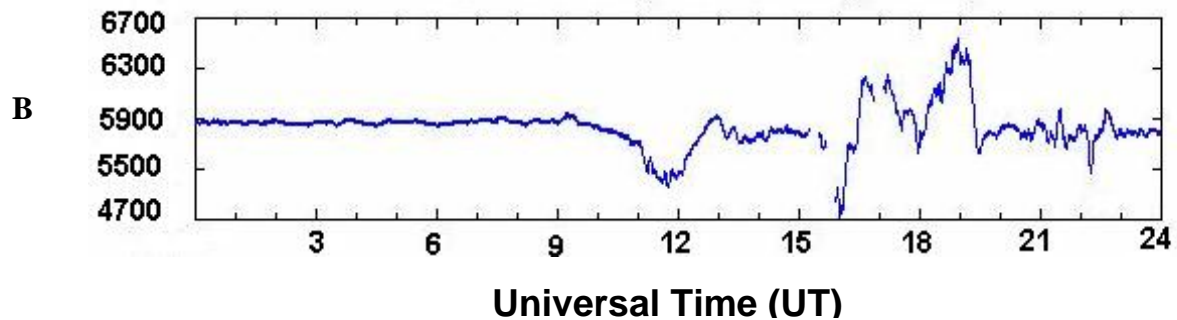
Question 2 – What is the corresponding Universal Time for 9:45 PM?

Question 3 - From the above graph, at what time was the magnetic storm most severe in terms of the absolute magnitude of its change in B?

Question 4 – At what time did the storm episode begin and end?

Question 5 – As a percentage of 5900 nT, what was the largest change in the magnetic field?

Question 6 - How long did the magnetic storm last?

Universal Time (UT)

Question 1 – If a magnetometer measured a magnetic field of 137,000 nT, how many Tesslas would that correspond to?
Answer :

$$\frac{137,000 \ nT}{1} \quad X \quad \frac{1 \ Tessla}{1,000,000,000 \ nT} \quad = \quad 0.000137 \ Tessla$$

Question 2 – What is the corresponding Universal Time for 9:45 PM?
Answer :   21:45 UT.

Question 3 - From the above graph, at what time was the magnetic storm most severe?
Answer: Students should look for the largest 'absolute magnitude' change in the graph from the 'average' level of 5900 nT. That occurs at about 16:00 UT.

Question 4 – At what time did the storm episode begin and end?
Answer: The 'calm' periods occurred between 00:00 and 09:00 and from 23:00 to 24:00. The storm period occurred between 09:00 and 21:00 UT

Question 5 – As a percentage of 5900 nT, what was the largest change in the magnetic field?
Answer: The largest change in terms of absolute magnitude occurred at 16:00 when the magnetic field went from 5900 nT to 4700 nT. This is a decrease of 1200 nT. As a percentage this was (1200/5900) x 100% = 20% from the non-storm conditions.

Question 6 - How long did the magnetic storm last?
Answer: The entire storm lasted 21:00 – 09:00 = 12 hours.

Exploring Space Mathematics   http://image.gsfc.nasa.gov/poetry