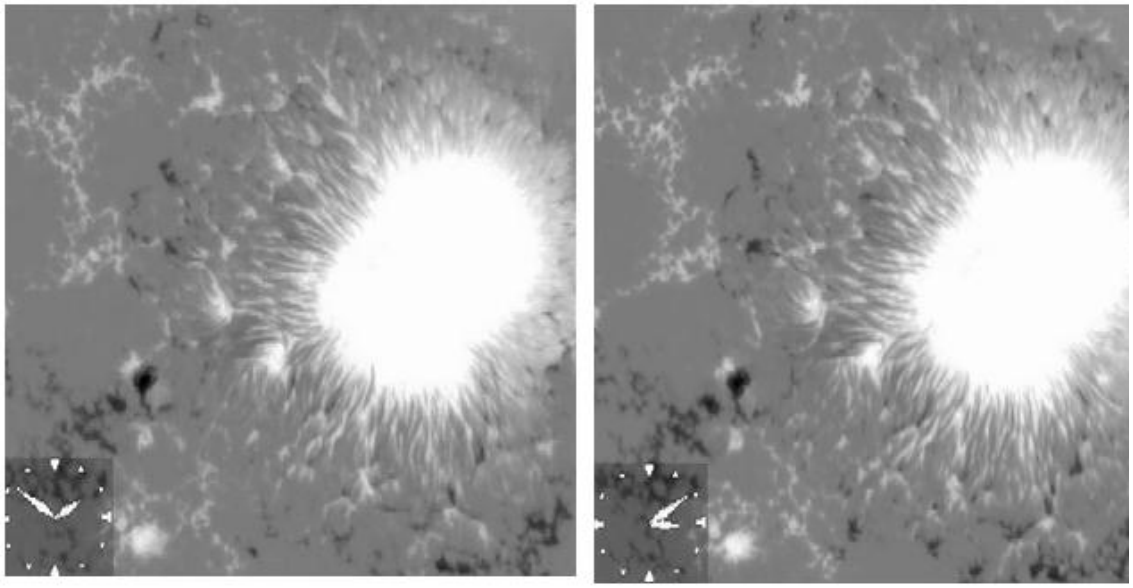
Moving Magnetic Filaments Near Sunspots



These two images were taken by the Hinode (Solar-B) solar observatory on October 30, 2006. The size of each image is 34,300 km on a side. The clock face shows the time when each image was taken, and represents the face of an ordinary 12-hour clock.

1) What is the scale of each image in kilometers per millimeter?

2) What is the elapsed time between each image in; A) hours and minutes? B) decimal hours? C) seconds?

Carefully study each image and look for at least 5 features that have changed their location between the two images. (Hint, use the nearest edge of the image as a reference).

3) What direction are they moving relative to the sunspot?

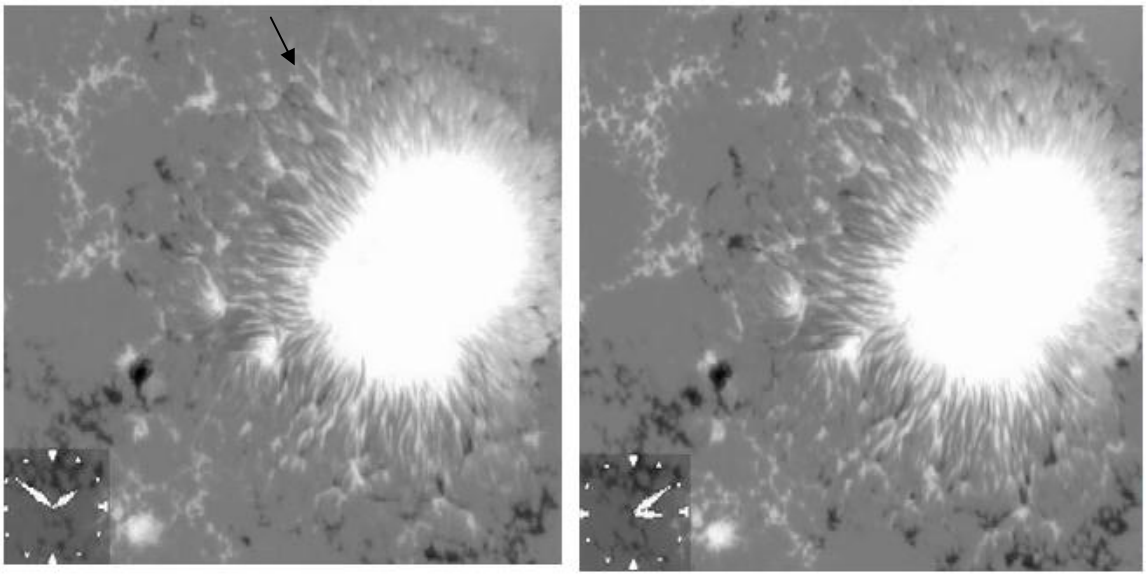
4) How far, in millimeters have they traveled on the image?

5) From your answers to questions 1, 2 and 4, calculate their speed in kilometers per second, and kilometers per hour.

6) A fast passenger jet plane travels at 600 miles per hour. The Space Shuttle travels 28,000 miles per hour. If 1.0 kilometer = 0.64 miles, how fast do these two craft travel in kilometers per second?

7) Can the Space Shuttle out-race any of the features you identified in the sunspot image?

Answer Key:



These two images were taken by the Hinode (Solar-B) solar observatory on October 30, 2006. The size of each image is 34,300 km on a side. The clock face shows the time when each image was taken.

1) What is the scale of each image in kilometers per millimeter? **Answer:** The pictures are 75 mm on a side, so the scale is 34,300 km /75mm = **457 km/mm**

2) What is the elapsed time between each image in;

A) hours and minutes? About 1 hour and 20 minutes.
B) decimal hours? About 1.3 hours
C) seconds? About 1.3 hours x 3600 seconds/hour = 4700 seconds

Carefully study each image and look for at least 5 features that have changed their location between the two images. (Hint, use the nearest edge of the image as a reference). Students may also use transparent paper or film, overlay the paper on each image, and mark the locations carefully.
The above picture shows one feature as an example.

3) What direction are they moving relative to the sunspot?
Answer: Most of the features seem to be moving away from the sunspot.

4) How far, in millimeters have they traveled on the image? **Answer:** The feature in the above image has moved about 2 millimeters.

5) From your answers to questions 1, 2 and 4, calculate their speed in kilometers per second, and kilometers per hour. **Answer:** 2 mm x 457 km/mm = 914 kilometers in 4700 seconds = 0.2 kilometers/sec or 703 kilometers/hour.

6) A fast passenger jet plane travels at 600 miles per hour. The Space Shuttle travels 28,000 miles per hour. If 1.0 kilometer = 0.64 miles, how fast do these two craft travel in kilometers per second? Jet speed = 600 miles/hr x (1 / 3600 sec/hr) x (1 km/0.64 miles) = **0.26 km/sec**. Shuttle = 28,000 x (1/3600) x (1/0.64) = **12.2 km/sec.**

7) Can the Space Shuttle out-race any of the features you identified in the sunspot image? **Answer:** Yes, in fact a passenger plane can probably keep up with the feature in the example above!

8) Are the features moving at increasing speed away from the sunspot, or traveling at a constant speed?