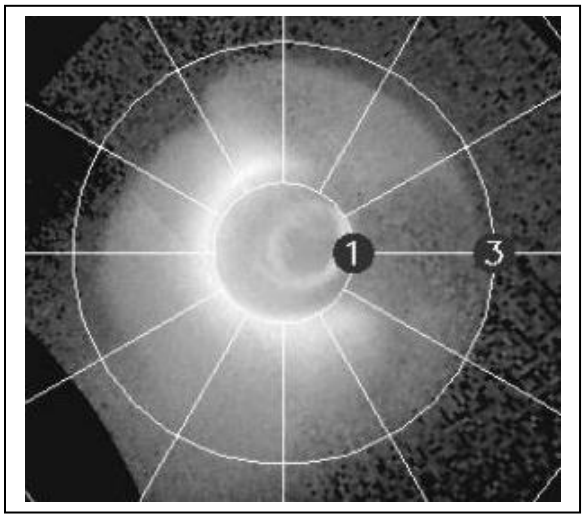
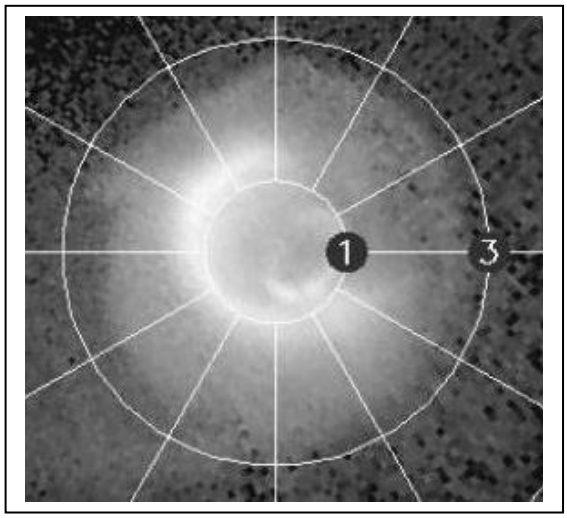
The Plasmasphere is a region of Earth's atmosphere above the ionosphere, and extending over 15,000 kilometers into space. The Space Shuttle and the International Space Station 'fly' through this dilute gas which consists of ions of hydrogen and helium. Solar ultraviolet light ionizes these gases causing them to become charged particles. Because the ions are charged particles, they are strongly effected by Earth's magnetic field. Like riders on a carousel, the ions in the plasmasphere are dragged around the Earth by their intimate connection with the magnetic field. They do not orbit earth like spacecraft because gravity is not strong enough to overcome the magnetic forces acting on the plasmasphere gases. The two pictures below were obtained by the IMAGE satellite. They show the plasmasphere at two different times, 3 hours apart. The central round disk is the silhouette of Earth's disk, which has a radius of 6,400 kilometers. In this problem, you will use a protractor to measure the angular change in the plasmasphere during this 3-hour period, and use this to calculate how long it takes the plasmasphere to rotate around Earth. The image on the left looking down at Earth from above the North Pole was taken on May 24, 2004 at 06:52 UT. The image on the right was taken 3 hours later at 09:52 UT. The lines are drawn at 1-hour intervals with 30-degree spacings. (30 x 12 = 360).





Step 1 – Look carefully at each image and find a feature that has moved between the two images.

Step 2: From the 30-degree markings, or with a protractor, determine how many degrees the feature has moved between the two images.

Question 1: How long would it take your feature to make one complete rotation around Earth?

Question 2: A satellite takes about 100 minutes to orbit Earth. Does the plasmasphere behave like a satellite?

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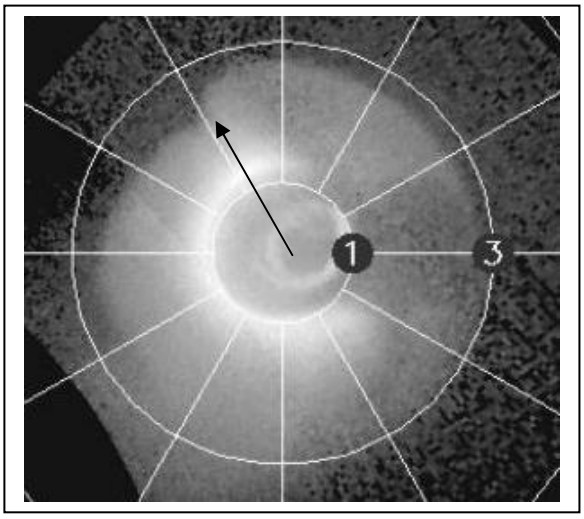
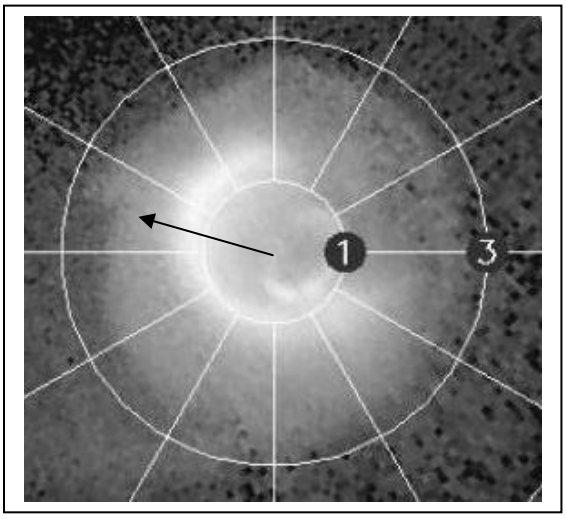
In this activity, students will examine two images of the plasmasphere from space obtained by the IMAGE satellite. By using a protractor, they will measure the motion of the plasmasphere and calculate its rotation period.





Question 1: How long would it take your feature to make one complete rotation around Earth?
Answer: In the left image, the 'notch' at the 11:00 o'clock position has moved in the right image to between the 9 and 10:00 position. The angular change for the feature in the example marked with arrows above, is about 45 degrees. This change took 3 hours, so by a simple proportion (360/45)= (T/3hrs) the time, T, it takes to move a full 360 degrees is about 24 hours.

Question 2: A satellite takes about 100 minutes to orbit Earth. Does the plasmasphere behave like a satellite?
Answer: No. The plasmasphere moves much more slowly than a satellite does. This is because the plasmasphere is not in motion because of gravitational forces, as the reading material discusses. It is anchored to Earth's magnetic field, which rotates with the Earth. That means that it will rotate about once each say even at distances of 15,000 kilometers from the ground.