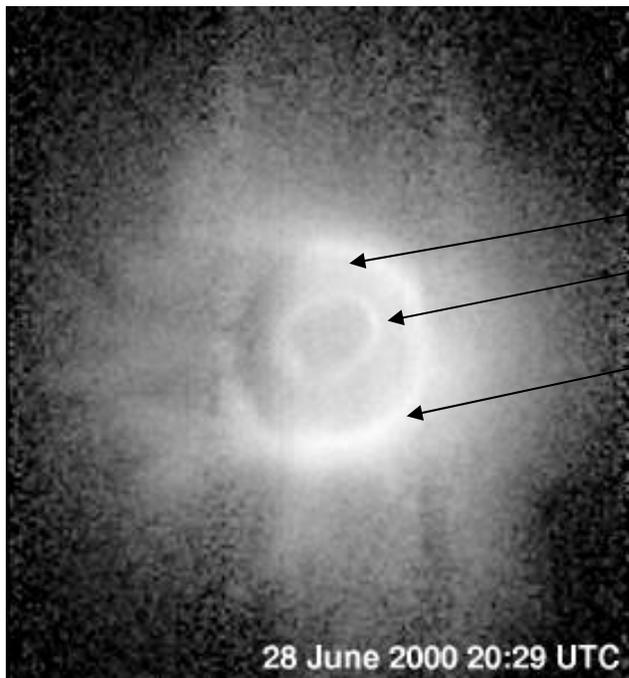


## The Plasmasphere.

Most people, when asked, would say that the atmosphere of Earth probably comes to an end a few hundred kilometers above the surface of Earth. In fact, our atmosphere has been detected more than 10,000 kilometers above the surface. This region of very dilute gas is called the Plasmasphere because the atoms are often ionized by the very harsh ultraviolet light from the sun. This kind of gas is called a plasma. Wherever the ultraviolet light reaches the plasmasphere's gas, the gas glows and can be photographed with special equipment.

The image below was taken by the IMAGE EUV instrument on June 28, 2002 at 4:09 PM (EDT). It shows the plasmasphere as revealed by the glow of ionized helium atoms at a wavelength of 121.6 nanometers (1216 Angstroms). Additional 'still' images and movies can be retrieved at the IMAGE satellite's EUV instrument website at the University of Arizona (<http://euv.lpl.arizona.edu/euv/>)



The image was taken above the North Pole. Helium atoms excited by the ultraviolet light from the sun give off a special wavelength of light that the IMAGE instrument can detect.

The round disk in the center is Earth.

The smaller, irregular oval-shaped ring is the ring of aurora (the auroral oval).

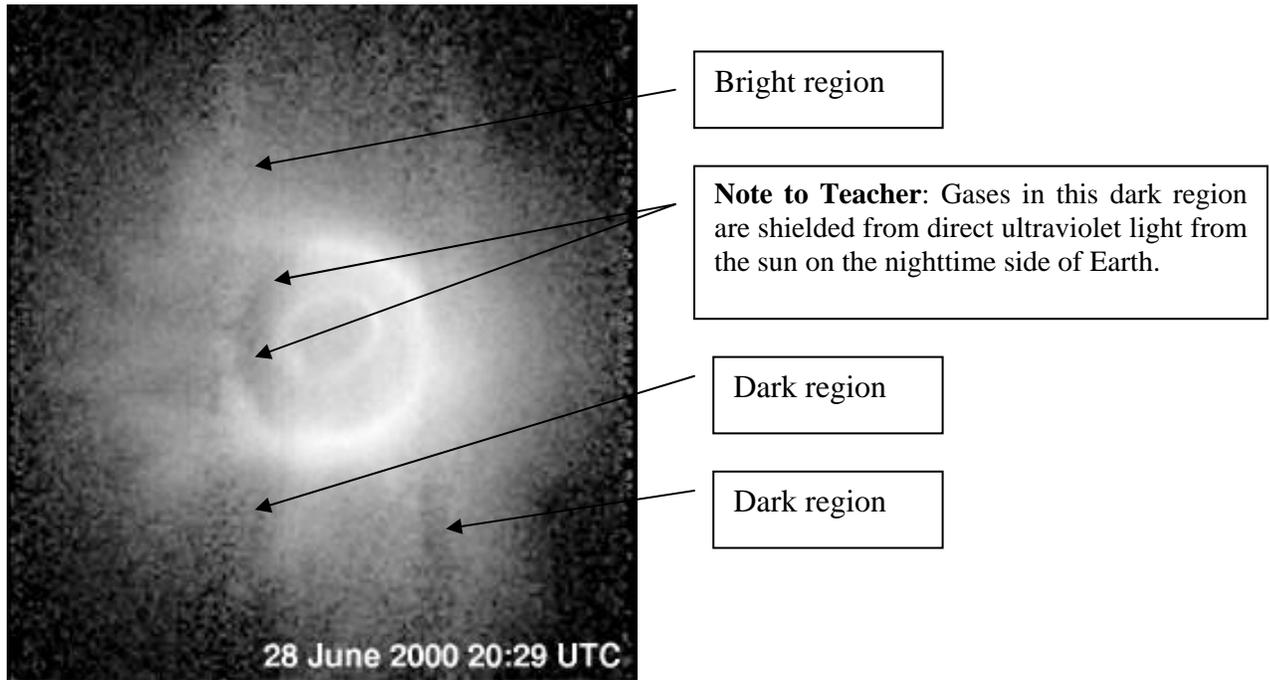
The larger ring is the glow of helium atoms in the dense part of the plasmasphere nearest Earth.

With the center of the Earth disk as the origin, use a millimeter ruler and a compass to answer the following questions:

**Question 1** - Is the gas in the plasmasphere lumpy or smooth? Use the picture above to give examples that support your answer.

**Question 2** - If the radius of Earth is 6,378 kilometers, what is the maximum and minimum range for the plasmasphere altitude above Earth's surface?

**Question 3** - Using the scale of this image calculated from Question 2, draw circles that represent the orbits of the International Space Station (altitude 400 km), the Global Positioning Satellite system (altitude 20,200 km) and GEO communications satellites (altitude 35,900 km). Are they inside or outside the plasmasphere?



**Question 1** - Is the gas in the plasmasphere lumpy or smooth? Give examples.

**Answer:** The gas is mostly lumpy. As examples, students can point out specific features by drawing arrows to them and describing what they see as in the examples above.

**Question 2** - If the radius of Earth is 6,378 kilometers, what is the maximum and minimum range for the plasmasphere altitude above Earth's surface?

**Answer:** If the page is printed using normal printer defaults for enlargement, the Earth disk has a diameter of 24 millimeters. This means the image scale is  $6378/12 = 530$  km/millimeter. The typical range of the plasmasphere outer edge from the edge of the earth disk is between 20 – 40 millimeters, so the physical range is  $20 \times 530 = 10,600$  to  $40 \times 530 = 21,200$  kilometers!

**Question 3:** The scale of the image is 530 km/mm.

ISS orbit = 0.8 mm from edge of Earth limb in above image.

GPS satellites =  $20200/530 = 38$  mm from earth's limb.

GEO satellites = 67.7 mm from Earth's limb.

The ISS and GPS satellites are inside the plasmasphere. The GEO communications satellites are just outside the plasmasphere. Students may draw circles of radii 12.8, 50, and 79.7 mm on the above image to represent the orbits.