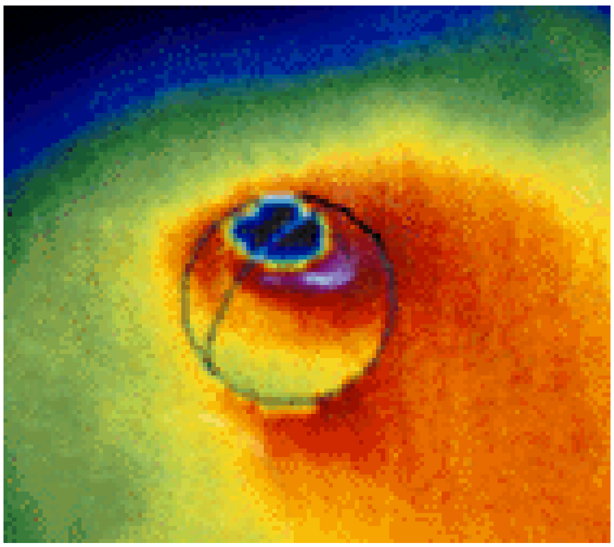
National Aeronautics and
Space Administration

Educational Product	
Educators & Students	Grades 9-12

Educational Brief

Exploring the Ring Current with IMAGE



Simulated view of neutral atom cloud near the Earth

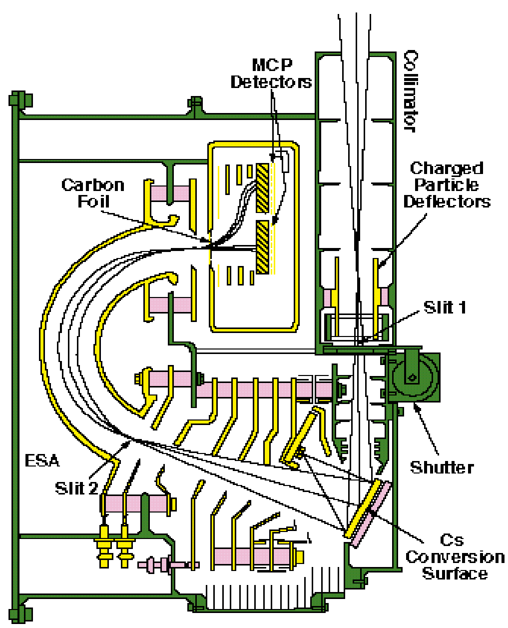
Electrically-charged particles from the Sun can become trapped in the Earth's magnetic field. Some of them circulate around the Earth's equatorial regions at distances between 1,000 and 40,000 kilometers. Positively charged particles circulate from west to east, while negatively charged particles flow from east to west. Space scientists call these the *ring current*, and they can cause rapid changes in the magnetic field of the Earth. These changes are especially severe during solar storm conditions when the ring current becomes very strong.

The Imager for Magnetosphere-to-Auroral Global Exploration (IMAGE) will study how the ring current is produced using instruments called Energetic Neutral Atom imagers: LENA, MENA and HENA (***http://image.gsfc.nasa.gov/poetry***)

Energetic Neutral Atom Imagers (ENA)

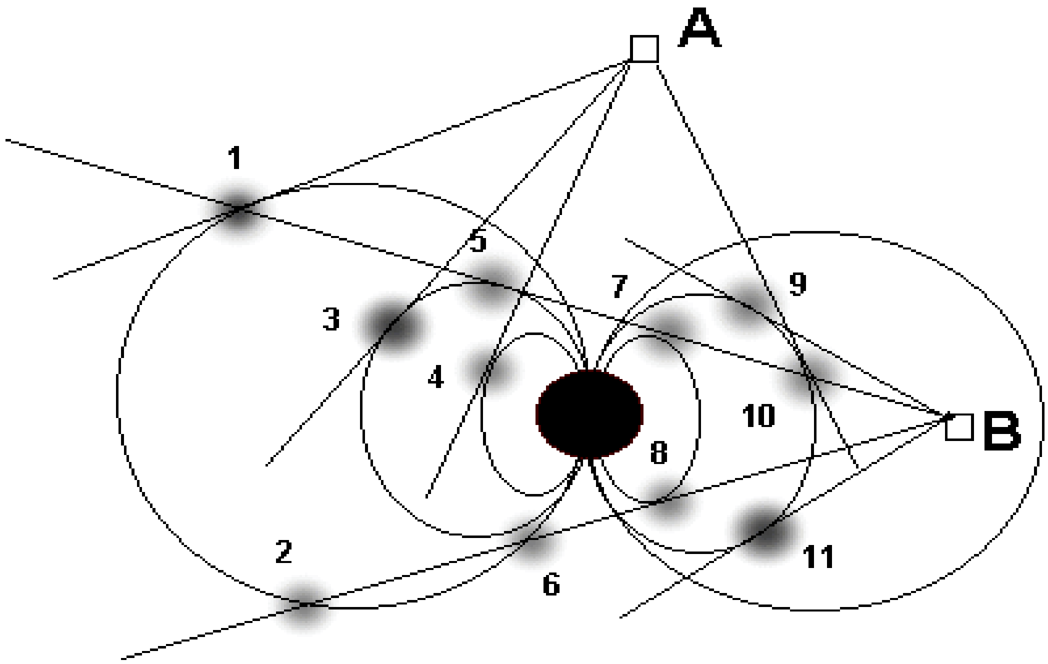
The ring current involves charged particles, but scientists cannot study them directly. Instead, the ENA imager onboard the IMAGE satellite detects the neutral atoms in the Earth's outer atmosphere which the ring current particles collide with. Like a gigantic billiard game, the charged particles collide with the neutral particles. Some of these neutral particles escape to where the IMAGE satellite is located in its orbit, and enter one of the three ENA imagers. Each imager detects one of three types of particles: low-energy (LENA), medium-energy (MENA) and high-energy (HENA). Together, these particles help scientists explore the ring current.

From this data, space scientists will study how plasma enters the magnetosphere and gets accelerated to high energies, and how the ring current populations change during large solar storm events.



Schematic of the LENA instrument.

Exploring clouds of plasma near the Earth



The IMAGE satellite sees the ring current as a blob of light near the equatorial plane of the Earth, but scientists have to use other clues to decide where parts of this blob are located in space. In this simplified example, let's assume that the instruments can only detect neutral atoms if they come from collisions with charged atoms near the point where the local magnetic field is tangent to the line-of-sight of the instrument. By knowing what the geometry of the Earth's field is like, scientists can work backwards to find where the particles were.

In the above figure, the IMAGE satellite observes a set of clouds located at the indicated positions from two vantage points in its orbit: A and B. From what you have learned about how the neutral atom imagers operate, identify which of the 11 clouds can be seen at satellite locations A and B.

Answer:
Location A: Cloud 1, 3, 4 and 10.
Location B: Cloud 7, 8, 9 and 11.

Are there some clouds seen at one satellite location but not at another?
Answer: Yes. Cloud 10 can be seen at Location A but not at Location B even though it is close to location B.

Which clouds cannot be seen at either location? Answer: Cloud 2 and 6.

Where would additional vantage points have to be to see these clouds?