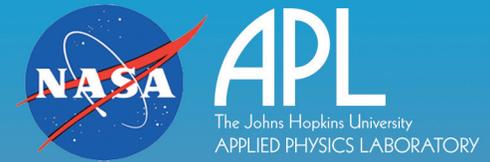


Radiation Belt Storm Probes

Exploring the Extremes of Space Weather



To help us understand how the Earth responds to changes in the Sun's energy, and how that response affects life and society, NASA plans to launch the twin Radiation Belt Storm Probes (RBSP) in spring 2012 for a prime mission of two years. This critical science investigation will be carried out by a pair of Sun-oriented, spinning spacecraft that will chase each other in their common orbits around the Earth, gathering data to help the scientific community understand the planet's radiation belts and their role in space weather.

Why Study the Radiation Belts?

The RBSP mission is part of NASA's Living With a Star (LWS) program, designed to understand how and why the Sun varies, how planetary systems subsequently respond, and the resulting effect on human activities in space and on the ground. RBSP will contribute to the broader understanding of heliophysics phenomena that govern space weather at Earth.

The radiation belts are two donut-shaped regions encircling the Earth, where high-energy particles are trapped by our planet's magnetic field. These belts are often referred to as the "Van Allen Belts," named for their discoverer, James Van Allen.

Energetic ions and electrons within the Earth's radiation belts are dangerous to both astronauts and spacecraft. The RBSP mission will quantify the processes that generate the radiation belts and cause them to change.

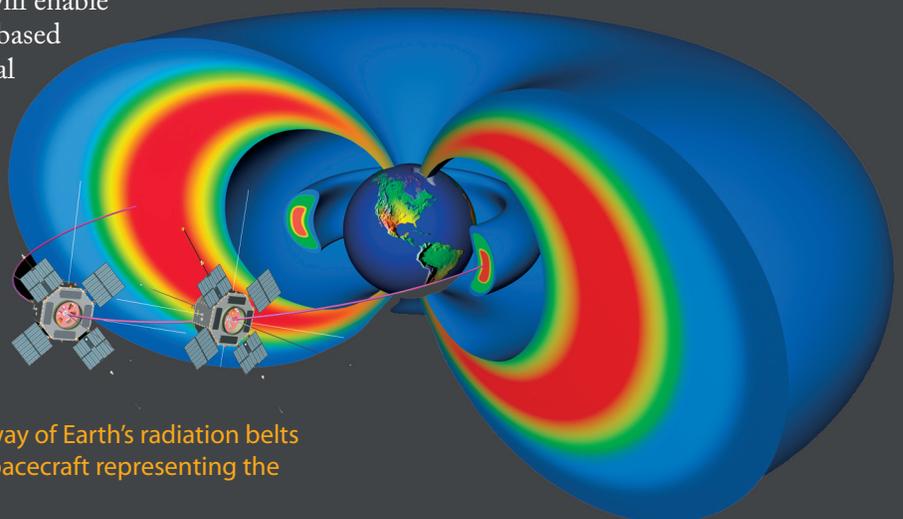
Observations from the two spacecraft will enable the development of empirical and physics-based models for the radiation belts. The empirical models will be used by engineers to design radiation-hardened spacecraft, while the physics-based models will be used by forecasters to predict space weather phenomena and alert astronauts and spacecraft operators to potential hazards.

What is Space Weather?

Everyone is familiar with changes in the weather on Earth, but "weather" also occurs in space. Changes in the Sun's energy flow cause changes in the space environment near Earth.

The Sun emits a continuous stream of ionized gases called the solar wind, and periodically releases bursts of billions of tons of matter in what are called coronal mass ejections. These immense clouds of material, when directed toward Earth, can cause large magnetic storms in the space environment around the planet, including its magnetosphere and upper atmosphere.

Space weather can affect the performance and reliability of space-borne and ground-based technologies, and pose a potential danger to both astronauts and spacecraft.



Artist's rendering showing a cutaway of Earth's radiation belts together with two (not to scale) spacecraft representing the Radiation Belt Storm Probes.

Designing for an Extreme Environment

Most spacecraft in Earth orbit operate partly or entirely within the radiation belts. During periods of intense space weather, the density of particles within the belts increases, making it more likely that sensitive electronics will be hit by a charged particle.

Ions striking satellites can overwhelm sensors and degrade wiring and other equipment. When conditions get especially rough in the radiation belts, satellites often switch to safe mode to protect their systems. The RBSP spacecraft do not have that luxury because they are being built specifically to monitor those storms. The spacecraft engineers must therefore design probes and instruments that are “hardened” to continue working even in the harshest conditions.

The Instruments

The RBSP spacecraft will carry a number of instruments and instrument suites that will make in situ measurements of the ions and electrons, electric and magnetic fields, and electric and magnetic waves in the radiation belts.

Because it is vital that the two craft make identical measurements to observe changes in the radiation belts through both space and time, each probe will carry the following:

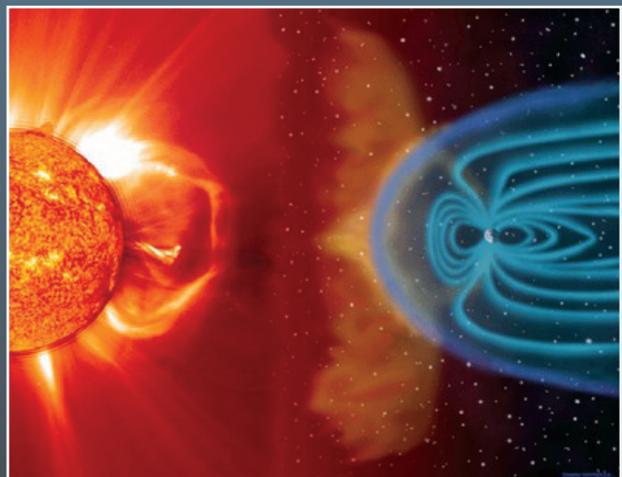
- Energetic Particle, Composition, and Thermal Plasma Suite (ECT)
- Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS)
- Electric Field and Waves Suite (EFW)
- Radiation Belt Storm Probes Ion Composition Experiment (RBSPICE)
- Relativistic Proton Spectrometer (RPS)

Managing Success

RBSP will make critical contributions to the research efforts of NASA's Heliophysics Division, which is within the Science Mission Directorate. This division manages flight programs that carry out the exploration of the Sun, its effects on the planets within the solar system, and space environmental conditions and their evolution. Specifically, it seeks to understand the transfer of energy from the Sun to the Earth, and the interaction of solar plasma and radiation with Earth, the other planets, and the galaxy.

The Johns Hopkins University Applied Physics Laboratory (APL), in Laurel, Md., will build and operate the twin RBSP spacecraft for NASA's Living With a Star program, which is managed by NASA Goddard Space Flight Center, in Greenbelt, Md. RBSP is part of the Geospace element within the larger LWS program.

The instruments will be provided by broad teams managed by Boston University, University of Iowa, University of Minnesota, the New Jersey Institute of Technology, and the National Reconnaissance Office.



NASA/ESA

This SOHO image shows a coronal mass ejection leaving the Sun, with an artist's rendition of the blast of material interacting with Earth's magnetosphere.