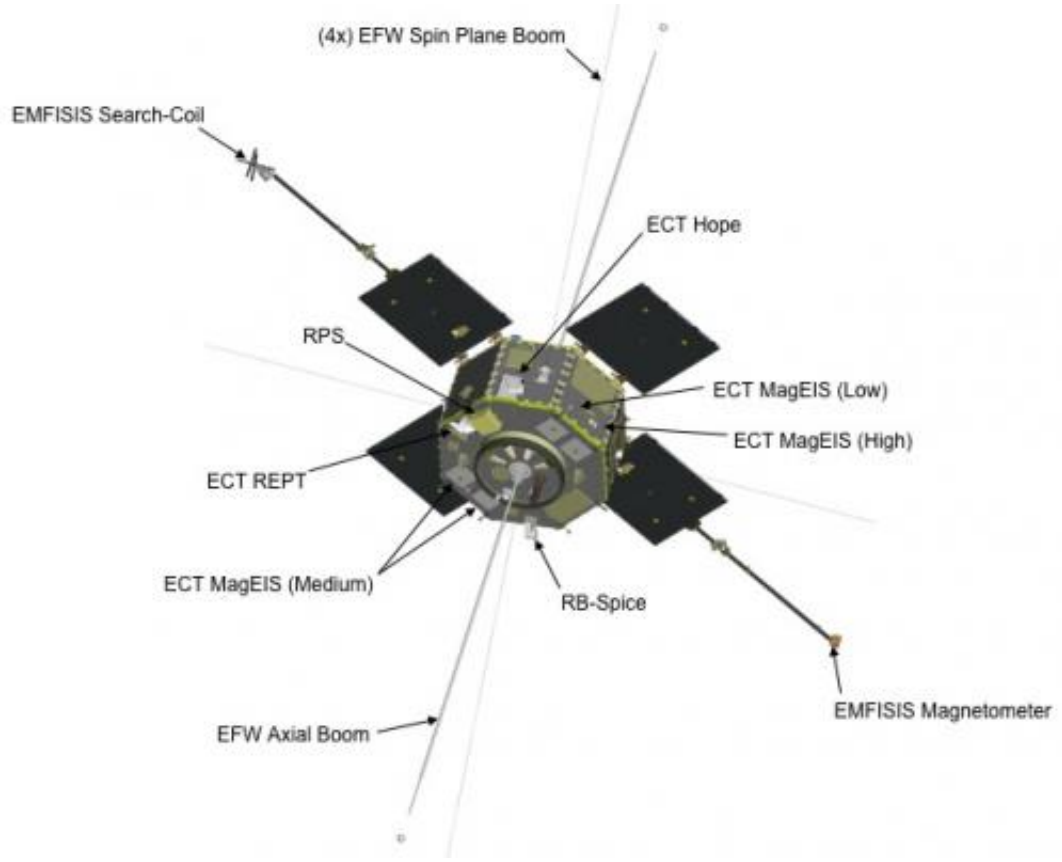
The radiation belt storm probes

August 31 2012, by Tony Phillips



Each of the two Storm Probes is bristling with sensors to count energetic particles, measure plasma waves, and detect electromagnetic radiation.

(Phys.org)—Since the dawn of the Space Age, mission planners have tried to follow one simple but important rule: Stay out of the van Allen Belts. The two doughnut-shaped regions around Earth are filled with "killer electrons," plasma waves, and electrical currents dangerous to

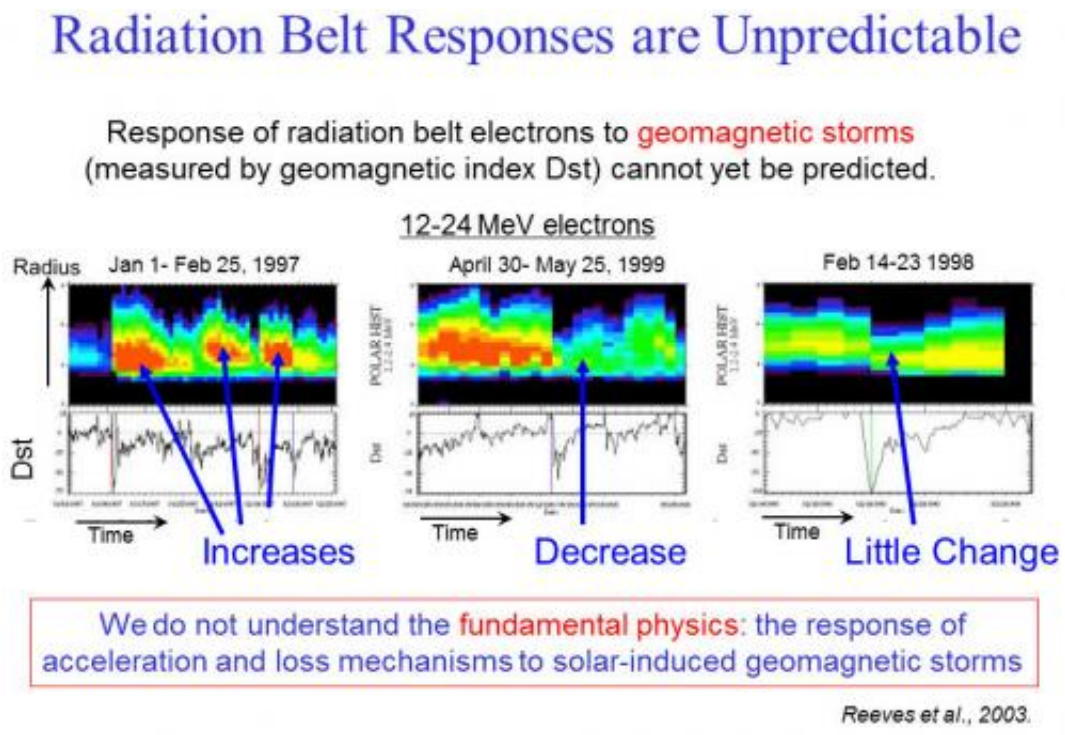
human space travelers and their spacecraft. Lingering is not a good idea.

So much for the old rules. NASA has launched two spacecraft directly into the radiation belts—and this time they plan to stay a while.

NASA's Radiation Belt Storm Probes blasted off from Cape Canaveral on August 30th, 2012. Bristling with sensors, the heavily-shielded spacecraft are on a 2-year mission to discover what makes the radiation belts so dangerous and so devilishly unpredictable.

"We've known about the Van Allen Belts for decades yet they continue to surprise us with unexpected storms of 'killer electrons' and other phenomena," says mission scientist David Sibeck, "The Storm Probes will help us understand what's going on out there."

When the radiation belts were discovered in 1958, they upended orthodox ideas. Most people assumed the space around Earth was empty. America's first satellite, Explorer 1, proved otherwise. The tiny spacecraft was equipped with a Geiger tube for counting energetic protons and electrons. Circling Earth, Explorer 1 found so many charged particles that the counter registered off-scale most of the time.



This plot shows how energetic electrons in the radiation belts can react to solar storms. Sometimes they increase, sometimes they decrease, sometimes they don't change at all. The unpredictability is one of the biggest mysteries of the Van Allen Belts.

Back in the 1950s the radiation belts had little effect on ordinary people. Today they are crucial to our high-tech society. Hundreds of satellites used for everything from weather prediction to GPS to television routinely skim the belts, subjecting themselves to energetic particles that can damage solar panels and short-circuit sensitive electronics. During geomagnetic storms when the belts are swollen by solar activity, whole fleets of satellites can be engulfed, imperiling the technological underpinnings of daily life on the planet below.

"The Radiation Belt Storm Probes directly address these down-to-Earth problems," says Lika Guhathakurta, the lead program scientist of

NASA's Living with a Star Program, which manages the mission. "RBSP is a unique mix of pure science and practical application."

One of the biggest mysteries of the radiation belts is the crazy way they react to solar storms. "Almost anything can happen," says Sibeck.

When a storm cloud from the sun hits the radiation belts, they often respond in counterintuitive ways. One possible outcome is that the radiation belts fill with energetic particles such as the potent "killer electrons" that worry mission planners. However, just as often the opposite happens. A solar storm can cause the belts to lose their killer particles, temporarily making them a safer place. And sometimes nothing happens! The belts remain completely unchanged.

"The problem is, there is no unified idea of what phenomena are most important inside the belts," says Sibeck. He describes attending scientific conferences on the subject: "If there are 100 people at a meeting, there will be 100 different answers for every question. How are killer electrons energized? Some say plasma waves do it; others point to solar wind shocks; others favor diffusion. The list goes on and on."

Researchers hope RBSP will narrow the possibilities. During storms, the probes can sample electric and magnetic fields, count the number of energetic particles, and detect plasma waves of many frequencies. The inner workings of the Van Allen Belts will be an open book to the two spacecraft, providing data for predictive models that tell forecasters when it's safe to enter the belts, perform spacewalks, and operate sensitive electronics.

"The Van Allen Belts are part of our home in space," adds Guhathakurta. "RBSP will help us learn how to live there."

So much for the old rules, indeed.

Provided by NASA