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Study Of Near-earth Radiation Belts Aims To Make Space Exploration Safer

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Boston University today announced it has received an eight-year, $42.5 million contract from NASA to study Earth's radiation belts, a region which can be dangerous to astronauts and orbiting satellites.

The project, called the Radiation Belt Storm Probes - Energetic Particle, Composition, and Thermal Plasma (RBSP-ECT), will place several science instruments into Earth's orbit on a pair of satellites designed to measure the behavior of charged particles which cause space radiation. The study aims to achieve a better understanding of the physical processes that control the shape and intensity of the ever-changing radiation belts to help make space exploration safer for humans and satellites.

The two-satellite mission, slated for launch in 2012, is part of NASA's Living with a Star (LWS) program which aims to learn how and why the sun varies, how planetary systems respond, and the effects on human activities in space and on Earth.

"Many satellites orbiting at high altitudes pass through the radiation belts, a dynamic region where energetic electrons and ions are trapped in Earth's magnetic fields. Even the low-altitude International Space Station orbit skims the radiation belts, posing serious concerns for astronauts during certain conditions," said Harlan Spence, a BU professor of astronomy and the ECT principal investigator. "A better physical understanding of the radiation belt environment has extremely important practical applications in the areas of spacecraft operations and design, mission planning, and astronaut safety. RBSP-ECT is designed to provide the observations needed to distinguish between competing theories of radiation belt physics."

According to studies, in order to protect satellites and astronauts from high-energy radiation and other adverse effects, it is essential to understand first how energetic charged particles are accelerated in space. This happens every day in Earth's radiation belts making them the ideal place to study radiation processes, explained Spence.

Adverse effects abound. High-energy electrons can penetrate spacecraft components and produce catastrophic electrical discharges. High-energy ions interact with spacecraft systems in other ways, sometimes producing abnormal changes in the logic state of a computer chip or degrading the efficiency of the satellite's solar cells. At sufficiently high energies, particles penetrate even thick layers of shielding and produce damaging radiation as they pass through human tissue or electrical components.

"Some effects from this radiation may be immediate, such as loss of power to a spacecraft, while others may be cumulative, like increased risk of cancer for astronauts," said Spence.

To develop the physical understanding needed to predict such effects, the RBSP-ECT suite will consist of three instruments designed to measure electrons and ions from low to very high energies. All three are based on measurement techniques proven in the radiation belts and optimized to provide clear separation of ions and electrons and clean energy responses - even in the extreme radiation belt environment. The coordinated ECT particle measurements on the two RBSP satellites are necessary for understanding the acceleration, global distribution, and variability of radiation belt electrons and ions - key objectives of the Living with a Star program.

"The ECT team applies our extensive experience in designing, fabricating, and operating spaceflight instrumentation in the harsh RBSP radiation environment to ensure that these measurements have the reliability needed to answer important LWS science questions," said Spence. "It is personally gratifying that NASA selected BU to lead this effort on one of their flagship space physics missions. I am honored to be working with such an outstanding team of scientists, engineers, and managers. The team is excited about getting started on RBSP, a mission that many have dreamed about for decades."

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BU will share the funding with partner ECT researchers from MIT, The Aerospace Corporation, Los Alamos National Laboratory, the University of Colorado at Boulder, Southwest Research Institute, Dartmouth College, and UCLA, who will collectively implement the RBSP-ECT instrument suite. The team also includes scientists from the National Oceanic and Atmospheric Administration's (NOAA) Space Environment Center, and from three international institutions - University of Alberta, Canada; British Antarctic Survey, England; and CERT/ONERA, France. The team will initially be provided $1.75 million to conduct a one-year study of cost, management, and technical feasibility.

Faculty research in BU's Department of Astronomy is coordinated through its Institute for

Astrophysical Research and its Center for Space Physics. Research areas include observational and theoretical studies in galactic and extragalactic astrophysics, magnetospheric and ionospheric physics, planetary and cometary atmospheres, space weather, space plasma physics, star formation and galactic structure, star and star clusters, active galaxies and quasars, high-energy and particle astrophysics, galaxy formation, and cosmology.

Founded in 1839, Boston University is an internationally recognized institution of higher education and research. With more than 30,000 students, it is the fourth largest independent university in the United States. BU consists of 17 colleges and schools along with a number of multi-disciplinary centers and institutes which are central to the school's research and teaching mission.

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