

Interstellar Boundary Explorer Researchers Quantify How Earth's Magnetosphere Protects The Planet From The Solar Wind

It has long been known that the Earth's magnetic field provides a protective barrier for life on Earth. As energetic particles stream outward from the Sun in the form of the solar wind, they are deflected by a "force field" created by the Earth's magnetosphere. Now, a team of scientists from the Southwest Research Institute (SwRI) in San Antonio, Texas, the Lockheed Martin Space Systems Company Advanced Technology Center (ATC) in Palo Alto, Calif., and several other institutions have used data from NASA's Interstellar Boundary Explorer (IBEX) to understand precisely how the process works.

IBEX, a NASA Small Explorer Mission, was launched into Earth orbit on October 19, 2008 to discover the global interaction between the solar wind and the interstellar medium - the gas, dust and radiation environment between the stars - by measuring the neutral atoms created by that interaction. Because the IBEX spacecraft is in orbit around the Earth, however, it is unavoidable that it views our planet and its magnetosphere during parts of the year. While "looking back" at the Earth, IBEX is able to examine the interaction between the solar wind and the Earth's magnetosphere in unprecedented detail, because of two exquisitely sensitive energetic neutral atom cameras on the spacecraft.

"These are fantastic first images of the important region where the solar wind piles up as it deflects around the Earth's magnetic field," said David J. McComas, IBEX principal investigator, and assistant vice president of the Space Science and Engineering Division at the Southwest Research Institute. "It is particularly satisfying that we were able to use a spacecraft built for a different purpose to unwrap a mystery that has long eluded us."

"Without the Earth's magnetosphere, which extends outward into space, the highly energetic charged particles carried by the solar wind could strip away some of Earth's atmosphere," said Lockheed Martin's Stephen A. Fuselier, lead investigator for the IBEX-Lo sensor. "The exchange of electrical charges between the solar wind and the outer reaches of the Earth's atmosphere is one of the causes of atmospheric loss, but the Earth's magnetosphere blocks the solar wind from penetrating close to the planet. Thus, the charge exchange interaction takes place far away from the Earth, where the very outer reaches of the atmosphere extend beyond the protective magnetic field. At these outer reaches, the atmospheric densities are very, very low and the interaction is weak. The very sensitive energetic neutral atom measurements from IBEX enabled us to correlate the neutrals produced by this charge exchange with measurements of the ion population from another spacecraft outside the magnetosphere - in just the right place at the right time - and quantify this charge exchange process."

The interaction between the solar wind and the Earth's magnetosphere that creates this charge exchange process is detailed in a paper - "Energetic Neutral Atoms from the Earth's Subsolar Magnetopause" - published recently by the American Geophysical Union.

The IBEX-Lo sensor was built by a team of scientists and engineers at the ATC in Palo Alto, Calif., the University of New Hampshire in Durham, N.H., SwRI, GSFC, John Hopkins University Applied Physics Laboratory, and the University of Bern in Switzerland. After integration at the ATC, IBEX-Lo was calibrated at the University of Bern. The other sensor, IBEX-Hi, was built by a team at Los Alamos National Laboratory, SwRI, the University of New Hampshire, and the University of Bern.

IBEX is the latest in NASA's series of low-cost, rapidly developed Small Explorers space missions. Southwest Research Institute leads and developed the mission with a team of national and international partners. NASA's Goddard Space Flight Center (GSFC) in Greenbelt, Md., manages the Explorers Program for NASA's Science Mission Directorate in Washington.

The ATC is the research and development organization of Lockheed Martin Space Systems Company (LMSSC). LMSSC, a major operating unit of Lockheed Martin Corporation, designs and develops, tests, manufactures and operates a full spectrum of advanced-technology systems for national security and military, civil government and commercial customers. Chief products include human space flight systems; a full range of remote sensing, navigation, meteorological and communications satellites and instruments; space observatories and interplanetary spacecraft; laser radar; ballistic missiles; missile defense systems; and nanotechnology research and development.

Headquartered in Bethesda, Md., Lockheed Martin is a global security company that employs about 136,000 people worldwide and is principally engaged in the research, design, development, manufacture, integration and

sustainment of advanced technology systems, products and services. The Corporation's 2009 sales from continuing operations were \$44.5 billion.

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