Galactic magnetic fields may control the boundaries of our solar system

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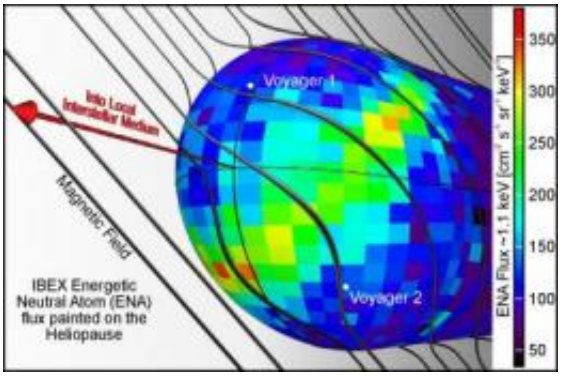

This image illustrates one possible explanation for the bright ribbon of emission seen in the IBEX map. The galactic magnetic field shapes the heliosphere as it drapes over it. The ribbon appears to trace the area where the magnetic field is most parallel to the surface of the heliosphere (the heliopause). Credit: Adler Planetarium/Southwest Research Institute (SwRI)

The first all-sky maps developed by NASA's Interstellar Boundary Explorer (IBEX) spacecraft, the initial mission to examine the global interactions occurring at the edge of the solar system, suggest that the galactic magnetic fields had a far greater impact on Earth's history than previously conceived, and the future of our planet and others may depend, in part, on how the galactic magnetic fields change with time.

"The IBEX results are truly remarkable, with emissions not resembling any of the current theories or models of this never-before-seen region,"

says Dr. David J. McComas, IBEX principal investigator and assistant vice president of the Space Science and Engineering Division at Southwest Research Institute. "We expected to see small, gradual spatial variations at the interstellar boundary, some 10 billion miles away. However, IBEX is showing us a very narrow ribbon that is two to three times brighter than anything else in the sky."

A "solar wind" of charged particles continuously travels at supersonic speeds away from the Sun in all directions. This solar wind inflates a giant bubble in interstellar space called the heliosphere — the region of space dominated by the Sun's influence in which the Earth and other planets reside. As the solar wind travels outward, it sweeps up newly formed "pickup ions," which arise from the ionization of neutral particles drifting in from interstellar space. IBEX measures energetic neutral atoms (ENAs) traveling at speeds of roughly half a million to two and a half million miles per hour. These ENAs are produced from the solar wind and pick-up ions in the boundary region between the heliosphere and the local interstellar medium.

The IBEX mission just completed the first global maps of these protective layers called the heliosphere through a new technique that uses neutral atoms like light to image the interactions between electrically charged and neutral atoms at the distant reaches of our Sun's influence, far beyond the most distant planets. It is here that the solar wind, which continually emanates from the Sun at millions of miles per hour, slams into the magnetized medium of charged particles, atoms and dust that pervades the galaxy and is diverted around the system. The interaction between the solar wind and the medium of our galaxy creates a complex host of interactions, which has long fascinated scientists, and is thought to shield the majority of harmful galactic radiation that reaches Earth and fills the solar system.

"The magnetic fields of our galaxy may change the protective layers of

our solar system that regulate the entry of galactic radiation, which affects Earth and poses hazards to astronauts," says Nathan Schwadron of Boston University's Center for Space Physics and the lead for the IBEX Science Operations Center at BU.

Each six months, the IBEX mission, which was launched on October 18, 2008, completes its global maps of the heliosphere. The first IBEX maps are strikingly different than any of the predictions, which are now forcing scientists to reconsider their basic assumptions of how the heliosphere is created.

"The most striking feature is the ribbon that appears to be controlled by the magnetic field of our galaxy," says Schwadron.

Although scientists knew that their models would be tested by the IBEX measurements, the existence of the ribbon is "remarkable" says Geoffrey Crew, a Research Scientist at MIT and the Software Design Lead for IBEX. "It suggests that the galactic magnetic fields are much stronger and exert far greater stresses on the heliosphere than we previously believed."

The discovery has scientists thinking carefully about how different the heliosphere could be than they expected.

"It was really surprising that the models did not generate features at all like the ribbon we observed," says Christina Prested, a BU graduate student working on IBEX. "Understanding the ribbon in detail will require new insights into the inner workings of the interactions at the edge of our Sun's influence in the galaxy."

Adds Schwadron,"Any changes to our understanding of the heliosphere will also affect how we understand the astrospheres that surround other stars. The harmful radiation that leaks into the solar system from the

heliosphere is present throughout the galaxy and the existence of astrospheres may be important for understanding the habitability of planets surrounding other stars."

More information:

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