



## Satellite reveals surprising cosmic 'weather' at edge of solar system

October 20, 2009

The first solar system energetic particle maps show an unexpected landmark occurring at the outer edge of the solar wind bubble surrounding the solar system. Scientists will publish these maps, based mostly on data collected from NASA's Interstellar Boundary Explorer satellite, in the Oct. 15 issue of *Science Express*, the advance online version of the journal *Science*.

"Nature is full of surprises, and IBEX has been lucky to discover one of those surprises," said Priscilla Frisch, a senior scientist in astronomy & astrophysics at the University of Chicago. "The sky maps are dominated by a giant ribbon of energetic neutral atoms extending throughout the sky in an arc that is 300 degrees long." Energetic neutral atoms form when hot solar wind ions (charged particles) steal electrons from cool interstellar neutral atoms.

IBEX was launched Oct. 19, 2008, to produce the first all-sky maps of the sun's domain – called the heliosphere – which reaches far beyond the solar system's most distant planets. Extending more than 100 times farther than the distance from Earth to the sun, the heliosphere marks the region of outer space subjected to the sun's particle emissions.

The new maps show how high-speed cosmic particle streams collide and mix at the edge of the heliosphere, said Frisch, who co-authored three of a set of IBEX articles appearing in this week's *Science Express*. The outgoing solar wind blows at 900,000 miles an hour, crashing into a 60,000-mile-an-hour "breeze" of incoming interstellar gas.

Revealed in the IBEX data, but not predicted in the theoretical heliosphere simulations of three different research groups, was the ribbon itself, formed where the direction of the interstellar magnetic field draping over the heliosphere is perpendicular to the viewpoint of the sun.

Energetic protons create forces as they move through the magnetic field, and when the protons are bathed in interstellar neutrals, they produce energetic neutral atoms. "We're still trying to understand this unexpected structure, and we believe that the interstellar magnetic forces are associated with the enhanced ENA production at the ribbon," Frisch said.

IBEX shows that energetic neutral atoms are produced toward the north pole of the ecliptic (the plane traced by the orbit of the planets around the sun), as well as toward the heliosphere tail pointed toward the constellations of Taurus and Orion. "The particle energies change between the poles and tail, but surprisingly not in the ribbon compared to adjacent locations," Frisch said.

IBEX is the latest in NASA's series of low-cost, rapidly developed Small Explorers space missions. Southwest Research Institute in San Antonio, Texas, leads and developed the mission with a team of national and international partners. NASA's Goddard Space Flight Center in Greenbelt,

Md., manages the Explorers Program for NASA's Science Mission Directorate in Washington.

Citations: N. A. Schwadron, M. Bzowski, G. B. Crew, M. Gruntman, H. Fahr, H. Fichtner, P. C. Frisch, H. O. Funsten, S. Fuselier, J. Heerikhuisen, V. Izmodenov, H. Kucharek, M. Lee, G. Livadiotis, D. J. McComas, E. Moebius, T. Moore, J. Mukherjee, N.V. Pogorelov, C. Prested, D. Reisenfeld, E. Roelof, G.P. Zank, "Comparison of Interstellar Boundary Explorer Observations with 3-D Global Heliospheric Models," *Science Express*, Oct. 15, 2009.

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### PHOTOS



Priscilla Frisch, senior scientist in astronomy & astrophysics, University of Chicago; and member of the science team, Interstellar Boundary Explorer. She and collaborator Thomas F. Adams made the first spectrum of interstellar hydrogen inside the heliosphere using data from the Copernicus satellite in 1975. Hydrogen and helium gas dominate interstellar space beyond the heliosphere. The spectrum verified that the hydrogen had the velocity expected of interstellar gas, proving its origin. (Jason Smith)

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Related links:

- [Short video of the heliosphere zooming through the Milky Way](#)
- [Animation shows how energetic neutral atoms are made in the heliosheath](#) when hot solar wind protons grab an electron from a cold interstellar gas atom. The ENAs can then easily travel back into the solar system, where some are collected by IBEX. Credit: NASA/GSFC
- [Solar Journey: The Significant of Our Galactic Environment for the Heliosphere and Earth](#), Priscilla C. Frisch, editor.
- [IBEX Web page at Southwest Research Institute](#)
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