Media Relations

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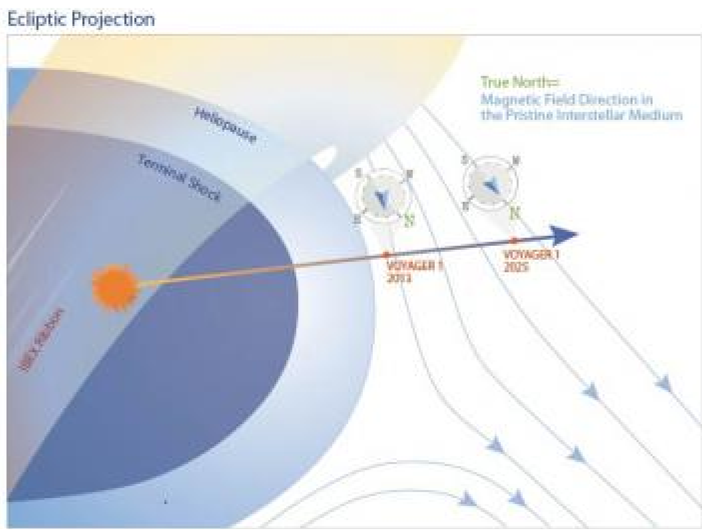
UNH-Led Study Solves Mysteries of Voyager 1's Journey into Interstellar Space



Upon exiting the heliopause, the local measurements of the magnetic field by Voyager 1, shown here as a compass needle, differed by 40 degrees from the ï¿½true magnetic northï¿½ estimated to be the direction of the magnetic field in the pristine interstellar medium. As the spacecraft pushed into interstellar space, the compass needle moved ever closer to true magnetic north.

DURHAM, N.H. -- Scientists from the University of New Hampshire and colleagues answer the question of why NASA’s Voyager 1, when it became the first probe to enter interstellar space in mid-2012, observed a magnetic field that was inconsistent with that derived from other spacecraft observations, in a study published today in the Astrophysical Journal Letters.

Voyager 1 sent back several different indications that it had punched through the edge of our sun’s massive protective bubble inflated by solar wind—the heliosphere—after a 35-year journey. But the magnetic field data gathered by the spacecraft was not what scientists had expected to see. The UNH-led study resolves the inconsistencies.

“There are still naysayers out there regarding Voyager 1 crossing through the heliopause—the edge of the heliosphere,” says astrophysicist Nathan Schwadron of the UNH Institute for the Study of Earth, Oceans, and Space and department of physics and lead author of the paper. “And the reason for this doubt is that when the spacecraft supposedly broke through the heliopause we should have seen some sort of distinctive shift in the magnetic field from one medium to the other,” Schwadron says.

Adding to the mystery, researchers found that the magnetic field direction observed in local interstellar space deviated by an angle of more than 40 degrees from what was expected. Some scientists posited that this deviation was an indication of Voyager 1 still being embedded in the solar wind inside the heliopause.

Schwadron and colleagues solved the discrepancies using triangulation of four different datasets gathered by other spacecraft, including the Interstellar Boundary Explorer (IBEX) mission that in 2009 discovered a mysterious “ribbon” of energy and particles believed to be associated with the interstellar magnetic field.

The scientists discovered that Voyager 1—like an orienteer through the outer solar system—measures the magnetic field moving the needle on a compass with cardinal directions provided by the IBEX ribbon. The ribbon center is the direction of "true magnetic north" for the pristine interstellar magnetic field.

The study shows that the initial direction of the magnetic field observed by Voyager 1 is deflected by the heliopause, like an elastic cord wrapped around a beach ball. Therefore, the spacecraft is moving through a special region of space where magnetic fields are rotated away from true magnetic north. This means that while Voyager 1 did cross the heliopause in 2012, it is still traveling through this "muddied" magnetic field region and won't reach the "pristine" region of interstellar space until at least 2025.

Notes Schwadron, who serves as the lead scientist for the IBEX Science Operations Center at UNH, "Our analysis confirms two things for the first time: that the center of the IBEX ribbon *is* the direction of the interstellar magnetic field and, secondly, that Voyager 1 is now beyond the heliopause."

With the recent discovery, scientists now know they'll need to wait at least another decade before Voyager enters the region of interstellar space that is beyond the reach of the sun. Since the dawn of the space age, humankind has never passed through and explored this far-flung, pristine environment.

"What's the nature of the galactic environment in terms of cosmic rays and magnetic fields?" Schwadron says. "We are beginning to paint a picture of what our local interstellar environment is really like and we can tie that to what's happening in a much broader environment within the galaxy. When Voyager 1 crosses that next boundary we will be poised to probe many longstanding mysteries."

Coauthors on the Astrophysical Journal Letters paper, "Triangulation of the Interstellar Magnetic Field," include John Richardson of the Massachusetts Institute of Technology, Leonard Burlaga of the NASA Goddard Space Flight Center, David McComas of the Southwest Research Institute, and Eberhard Möbius of the University of New Hampshire. To read the paper: http://iopscience.iop.org/article/10.1088/2041-8205/813/1/L20

Image to download: http://www.eos.unh.edu/newsimage/schwadron_ibex_lg.jpg
Caption: Upon exiting the heliopause, the local measurements of the magnetic field by Voyager 1, shown here as a compass needle, differed by 40 degrees from the "true magnetic north" estimated to be the direction of the magnetic field in the pristine interstellar medium. As the spacecraft pushed into interstellar space, the compass needle moved ever closer to true magnetic north. The view in the bottom image is from the starboard side of the heliosphere with the path of Voyager 1 in the plane of the page. Image by Kristi Donahue, UNH-EOS.

Nathan Schwadron can be reached at (210) 632-6451 and nschwadron@unh.edu. Listen to Schwadron discuss the recent discovery about Voyager 1 in this short video: https://youtu.be/fYpUJgfPFxY. UNH Media Relations has an on-site ReadyCam broadcast studio available through VideoLink (617-340-4300) for television interviews and an ISDN line for radio interviews.

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