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A whiff of interstellar cloud

NASA satellite sniffs 'alien' atoms from beyond the Solar System.

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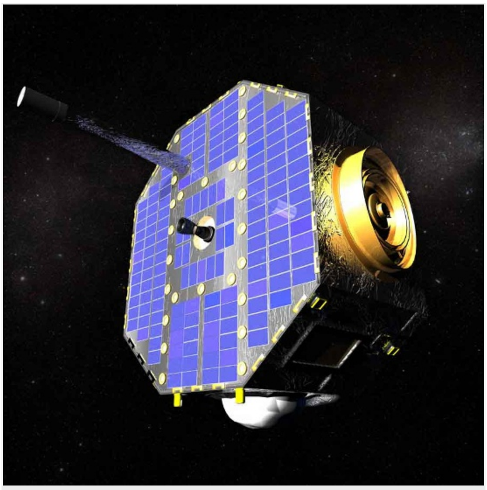
A NASA spacecraft has directly detected atoms from outside the boundary of the Solar System — and has found that the region is unexpectedly depleted in oxygen.



GSFC/NASA

The NASA IBEX mission: to probe the boundary between the Solar System and interstellar space.

The result from the Interstellar Boundary Explorer (IBEX) suggests that oxygen abundances throughout the Galaxy are more variable than expected. It could also mean that oxygen atoms are being locked up somehow in the trace grains of dust and ice that populate the mostly empty space between stars, says David McComas, a heliophysicist at Southwest Research Institute in San Antonio, Texas, and principal investigator for IBEX. “This is the stuff that stars, planets and people are made of,” he says. “It’s important to measure.”

McComas presented the results today at NASA’s headquarters in Washington DC, to coincide with the publication of a suite of papers detailing the results in the *Astrophysical Journal*. The findings paint the most detailed compositional picture yet of the 'Local Cloud' — the interstellar cloud of gas in which our Solar System is situated.

The US$100-million IBEX mission was launched in October 2008 with the goal of mapping the heliosphere, the volume of space that is influenced by the Sun. Within this volume, a solar wind of charged particles pushes outward and creates a bubble that extends well beyond the orbit of Pluto. As the Sun travels through the Galaxy, the bubble stops electrically charged atoms in their tracks and keeps them from crossing into the Solar System.

The IBEX spacecraft is far from this boundary, in orbit around the Earth, but it has detectors that are sensitive to neutral atoms that can enter the heliosphere. Because they lack electric charge, these atoms are unaffected by the Sun's magnetic field. McComas says that it takes about 30 years for particles to cross the bubble wall at the heliosphere’s edge and travel to the inner Solar System, where they are caught by IBEX. “I call it the 15-billion-mile hole-in-one,” he says.

Although a previous NASA mission, Ulysses, measured neutral helium from beyond the heliosphere, IBEX is the first to measure heavier elements, such as oxygen and neon, that formed in the nuclear cores of stars and were later scattered into space as those stars expired. IBEX found the ratio of oxygen atoms to neon atoms to be lower in the Local Cloud than the average ratios for both the Solar System and the Galaxy as a whole (which astronomers can measure by looking at the absorption features of the light from distant stars).

George Gloeckler, a heliophysicist at the University of Michigan in Ann Arbor, points out that the ratios could offer information about how the Galaxy has changed in the 4.6 billion years since the Sun was born. “It tells us what the present state is of the interstellar medium,” says Gloeckler, who was a member of the Ulysses mission, which ended in 2009.

Based on the speeds and directions of the neutral atoms, the IBEX team was also able to refine its picture of the shape of the heliosphere. McComas says that the pressure from the incoming atoms is about 20% less than what was estimated by Ulysses. That has led the IBEX team to picture the leading edge of the heliosphere as flatter, or more snub-nosed than previously imagined. “It’s a challenge to the Ulysses measurements,” says Gloeckler.

The team was also able to pinpoint the Sun’s location at the edge of the Local Cloud. But, as happens every 40,000 years or so, the Sun is about to leave the Local Cloud for a neighbour, says Priscilla Frisch, an IBEX investigator at the University of Chicago. “All the data indicate we’re going to leave it in the next few thousand years.”