Voyager 1 spacecraft reaches interstellar space, study confirms

September 12 2013

An artist's concept shows the Voyager spacecraft traveling through space against a field of stars. Credit: NASA/JPL-Caltech.

University of Iowa space physicist Don Gurnett says there is solid evidence that NASA's Voyager 1 spacecraft has become the first manmade object to reach interstellar space, more than 11 billion miles distant and 36 years after it was launched.

The finding is reported in a paper published in the Sept. 12 online issue of the journal *Science*.

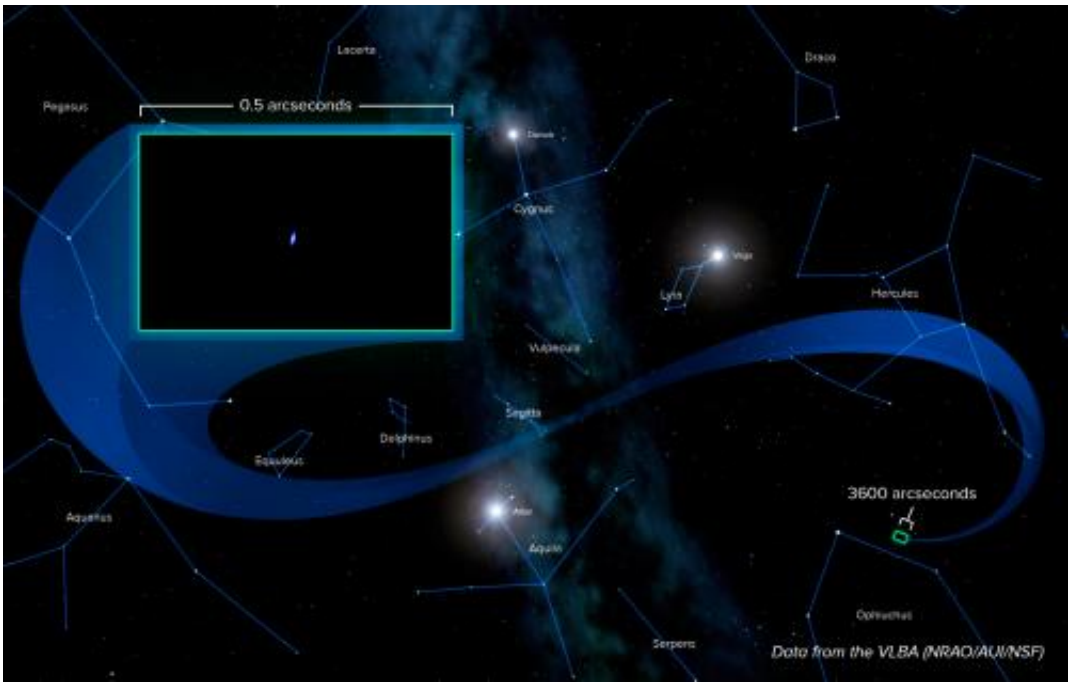
"On April 9, the Voyager 1 Plasma Wave instrument, built at the UI in the mid-1970s, began detecting locally generated waves, called electron

plasma oscillations, at a frequency that corresponds to an electron density about 40 times greater than the density inside the heliosphere —the region of the sun's influence," says Gurnett. "The increased electron density is very close to the value scientists expected to find in the interstellar medium.

"This is the first solid evidence that Voyager 1 has crossed the heliopause, the boundary between the heliosphere, and interstellar space ," says Gurnett, principal investigator for the plasma wave instrument.

For several months, the relative position of Voyager 1 has stirred something of a scientific debate because there remains some lingering evidence of the nearby heliosphere beyond the heliopause.

Even though Voyager 1 has passed into interstellar space, it does not mean that its journey is over, says Bill Kurth, UI research scientist and co-author of the *Science* paper.



This is an artist's impression of Voyager 1's position on the sky when observed by the Very Long Baseline Array (VLBA) on Feb. 21, 2013, at which point -- according to NASA's Jet Propulsion Laboratory -- Voyager was already outside of our solar system. The actual image from the data (enlarged section) is 0.5 arcseconds across. The radio signal as shown is a mere 1 milliarcsecond across. Credit: Alexandra Angelich, NRAO/AUI/NSF.

"Now that we're on the outside, we are learning that interstellar space isn't a bland region," Kurth says. "Rather, there are variations in some of Voyager's measurements that may be due to the nearby presence of the heliosphere. So, our attention is turning from crossing the boundary to understanding what is going on outside," he says.

At age 36, Voyager 1 is the most distant human-made object at more than 11.6 billion miles from the sun, or about 125 astronomical units.

"At that distance it takes more than 17 hours for a radio signal to travel from the spacecraft to one of NASA's Deep Space Network antennas. The signal strength is so incredibly weak that it takes both a 230-foot and a 110-foot-diameter antenna to receive our highest resolution data," Gurnett says.

Launched Sept. 5, 1977, Voyager 1 completed flybys of both Jupiter and Saturn and is currently moving outward from the sun at about 3.5 AU per year. A sister spacecraft, Voyager 2 was launched Aug. 20, 1977, on a flight path that took it to encounters with Jupiter, Saturn, Uranus, and Neptune. At present, Voyager 2 is still inside the heliosphere about 103 AU from the sun and traveling outward at about 3.3 AU per year.

More information: The sounds of the electron plasma oscillations heralding Voyager's entry into interstellar space and other sounds of

space can be heard by visiting Gurnett's website at: www-pw.physics.uiowa.edu/space-audio/

Paper: "In Situ Observations of Interstellar Plasma With Voyager 1," by D.A. Gurnett et al *Science*, 2013.

Provided by University of Iowa