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#### ULYSSES MEASUREMENTS GIVE NEW CLUES TO DARK MATTER

Measurements from the joint NASA/European Space Agency Ulysses mission found a surprisingly small increase in the amount of helium-3 since the formation of the solar system, allowing a more precise estimate of the amount of dark matter in the universe, two scientists announced today. Their findings, from measurements of the Solar Wind Ion Composition Experiment aboard Ulysses, were published today in Nature magazine

Drs. George Gloeckler, professor of physics at the University of Maryland, and Johannes Geiss, director at the International Space Sciences Institute in Bern, Switzerland, reported the first measurements of helium-3 in the interstellar cloud surrounding our solar system. They said their findings of this lighter isotope of helium give additional clues to the amount of dark, or invisible matter, that was produced at the beginning of the universe -- the Big Bang -- 15 billion years ago.

The exact nature of dark matter is one of the most intriguing mysteries in astronomy. Although scientists do not know what it is, their best estimates indicate most of the universe -- perhaps as much as 90 percent -- is composed of dark matter. This estimate is based partly on observations showing stronger gravitational attraction between galaxies than should be the case with the amount of matter they can see. The dark matter may be "ordinary" matter such as planets and burned-out stars too dim to detect, or perhaps exotic objects such as black holes or as-yet-undetected particles which pervade the universe.

"Basically, our measurements indicate the amount of dark matter in the early universe was fairly high," Gloeckler said. "Visible matter is a small fraction of the total. By measuring the relative portions of the lightest elements and their isotopes, one can infer the amount of ordinary matter in the universe."

"Since current theories of the earliest stages of the universe predict a much larger amount of matter coming out of the Big Bang, the difference is surmised to consist of an entirely different and unfamiliar kind of matter, commonly called dark matter," Geiss said. "The precise nature of this dark matter is not known at this time, because it has eluded so far all efforts of detecting it directly. It could very well have survived to this day, filling the whole universe and dominating its dynamics,

yet be invisible to us."

The light elements of helium-3, hydrogen, deuterium -- a heavy isotope of hydrogen -- and helium-4 were created in the Big Bang, the scientists said. The abundance of helium-3 has been changing ever since because it is both produced and destroyed in stars.

The direction and amount of this change have until now remained undetermined, they said. They found, however, that the reported amount of helium-3 indicates a surprisingly small increase -- about 50 percent -- since the time of the formation of the solar system 4.6 billion years ago.

Since the change was smaller than earlier models indicated, Gloeckler and Geiss said, the density of dark, or unseen, matter relative to that matter which we can see must be greater.

"What is so exciting is that we have good numbers for the helium-3 abundance during three time epochs spanning the life of the universe," Gloeckler said. "This gives a firm handle on how matter is processed or 'cooked' in stars."

He said current models that predict large amounts of helium-3 are not consistent with the new findings.

The measurements were made over the south pole of the Sun at distances several times the distance of the Sun to Earth. They detected the interstellar gas that made its way deep into the inner solar system and determined the composition of helium-3 in that gas.

The Ulysses mission is managed jointly by NASA and the European Space Agency (ESA). The Jet Propulsion Laboratory manages the U.S. portion of the mission for NASA's Office of Space Science, Washington, DC.

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