CSO Wins the Lottery

A rare type of ammonia containing three atoms of deuterium has been found in a molecular cloud about 1,000 light-years away, in the direction of the constellation Perseus. The comparative ease with which the molecules were detected means that there are more of them than previously thought. The observations were done by an international team of astronomers using the Caltech Submillimeter Observatory atop Mauna Kea in Hawaii, and were reported in the May 20 issue of the *Astrophysical Journal Letters*.

Deuterium, or "heavy hydrogen," has a neutron in its nucleus in addition to the single proton that ordinary hydrogen has. Ammonia contains one nitrogen and three hydrogen atoms per molecule.

Triply deuterated ammonia was thought to be so rare in deep space as to be undetectable from Earth, says Professor of Physics Tom Phillips, director of the Caltech Submillimeter Observatory and leader of the Caltech team. No other molecules containing three deuterium atoms have ever been found in interstellar space. "From simple statistics alone, the chances for all three hydrogen atoms in an ammonia molecule to be replaced by the very rare deuterium atoms are one in a million billion," Phillips explains. "This is like buying a $1 state lottery ticket two weeks in a row and winning a $30 million jackpot both weeks. Astronomical odds indeed!"

Both hydrogen and deuterium are present in the interstellar medium, says Dariusz Lis, a senior research associate in physics and lead author of the paper, and at higher temperatures they freely trade places with their counterparts in the ammonia molecules. But at the frosty 10 to 20 degrees above absolute zero that prevails in the clouds, the deuterium atoms prefer to settle into the ammonia molecules and stay there.

The study furthers our understanding of the chemistry of the cold, dense interstellar medium and the way that molecules transfer from dust grains to the gas phase, Phillips explains. The researchers think the triply deuterated ammonia was returned to the gas state, and thus rendered observable, when it was kicked off dust grains by energy from a young star forming nearby.

The Caltech Submillimeter Observatory, funded by the National Science Foundation, has the world's most sensitive submillimeter detectors, making it ideal for seeking out the diffused gases and molecules crucial to understanding star formation. The observing team also included members from France's Observatoire de Paris and the Max-Planck-Institut für Radio-astronomie in Germany. □—*RT*

This IRAS image (below) shows the galactic neighborhood of Barnard 1, the region of the Milky Way where the Caltech Submillimeter Observatory (below, right) discovered triply deuterated ammonia.