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# COSMIC TEST TUBES

# STARS

By Marcia F. Bartusiak

There are no gleaming test tubes, no whirling centrifuges separating exotic mixtures. Yet it is nature's largest chemical laboratory: our home galaxy, the Milky Way.

Over the past 20 years astronomers have found about 60 kinds of molecules tumbling and colliding in the dusty regions of this galaxy where new stars are being born. As radio telescopes scan the heavens, each molecular species is identified by a certain spectral signature, distinctive radio or infrared waves that the molecule emits after absorbing energy from the surrounding dust cloud.

The discovery of this vast galactic chemistry set came as quite a surprise. For many years it was thought only the simplest molecules could survive the rigors of interstellar space; larger ones would be broken apart even as they formed. But now the ever-growing list of celestial chemicals includes water, ammonia, ethyl alcohol, the welding fuel acetylene, the preservative formaldehyde, and a host of exotic molecules too volatile to exist on Earth.

Most experts agree that the list is far from complete. Some speculate that those tenuous seas of gas are concocting even more complex organic compounds, molecules that are the precursors of life itself. The tentative proof comes from the laboratory glassware of a few researchers in the United States and Europe who right here on Earth are simulating the conditions of an interstellar cloud.

One of these cosmic vessels sits atop a workbench in Thomas Wdowiak's (pronounced Dow-ee-ack) physics laboratory at the University of Alabama, at Birmingham. The assembly consists of a tiny vacuum chamber cooled to a frigid space temperature of −441°F and containing a penny-sized sapphire disk that mimics the core of an interstellar dust grain.

Wdowiak's Earth-bound journey into an interstellar cloud begins with a small tube of methane, a basic constituent of interstellar space, and argon gas. Energized with a spark coil, the tube starts to glow like a hot-pink neon sign. Some of the methane molecules ionize (that is, become electrically charged); others break apart, just as they do when struck by ultraviolet rays in space. Millennia of irradiation are compressed into a few hours. These excited molecules race down the tube, enter the vacuum chamber, and strike the cold sapphire disk, forming a thin frost. Some of the molecules react en route, as if colliding in space. Others meet and combine on that pseudo-dust grain.

"Of course, there's no laboratory big enough to simulate an interstellar cloud exactly," Wdowiak notes. "Out in space the molecules are very far from one another. That's why we use the argon. In our experiment we're imprisoning the excited molecules in inert argon ice, so that they can't easily get at one another."

A tungsten lamp shines down on the disk's frosty covering, so that one can observe how the combining molecules absorb and emit light. This spectrum identifies the products. For the first hour of a test, Wdowiak sees *only* simple molecules already detected by radio astronomers. "But later we start to see larger molecules that no one has yet identified in space—molecules composed of long strings of carbon atoms," he says. "Interestingly enough, this star dust smells like synthetic rubber."

Can such laboratory products really be made in space? Quite possibly. When the lamp illuminates the disk, the carbon molecules frozen in that cosmic ice emit three distinct wavelengths of red and yellow light. Wdowiak recently discovered that those same features closely match the spectrum of a glow given off by a cloud of space dust and gas named the Red Rectangle, a nebula located about 1,100 light-years from Earth.

In the future he plans to use his cosmic chamber as a probe to determine what other substances may lie frozen on interstellar grains. The plan: Adjust the composition and proportions of his mixtures to match the as-yet-unidentified spectral signatures coming from space. "You can't create a star in a laboratory," he says, "but you can create the molecules and the dust." ∞

*North American Nebula: Mixes of stars, dust, and gas like this are cosmic chemistry sets.*