Blasting Water with Stellar Jets

Water is being blasted to pieces by a young star's powerful jets, according to new observations from NASA's Spitzer Space Telescope. Hello, I'm Daniel Brennan.

This Spitzer Space Telescope podcast is part of a series highlighting recent discoveries in infrared astronomy. It's produced by NASA's Spitzer Science Center at the California Institute of Technology in Pasadena. The Spitzer mission is managed by NASA's Jet Propulsion Laboratory.

Young stars form out of thick, rotating clouds of gas and dust. Like the two ends of a spinning top, powerful jets of gas emerge from the top and bottom of the dusty cloud. As the cloud shrinks more and more under its own gravity, its star eventually ignites and the remaining dust and gas flatten into a pancake-like disk, from which planets will later form. Finally, by the time the star ignites and stops accumulating material from its cloud, the jets will have died out.

But observations using the Spitzer Space Telescope led by Dr. Achim Tappe of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, are providing a better understanding of how water is processed in these emerging solar systems.

Tappe and his colleagues used Spitzer's Infrared Spectrometer to peer through the dust surrounding a nascent star, called HH 211, and study its jets in detail. These particular jets are exceptionally young at 1,000 years old. They're also some of the most tightly focused jets ever observed -- what astronomers term "collimated jets."

Spitzer found spectral signatures that indicate rapidly spinning hydroxyl molecules -- those are molecules made up of one oxygen and one hydrogen atom. The hydroxyl molecules are excited to the point that they are rotating with energies equivalent to 28,000 Kelvin -- that's about 27,700 degrees Celsius, or 50,000 degrees Fahrenheit. Energies like those far exceed what would be expected for gas streaming out of a stellar jet.

The results reveal that the star's jets are ramming into a wall of material. Ice commonly coats dust grains around young stars. In this system, however, the highly collimated jets are vaporizing the water. The jet is hitting the material so fast and so hard that a shock wave is also being produced, and, according to Tappe, the shock from the colliding atoms generates ultraviolet radiation, which breaks up water molecules, leaving behind the hydroxyl.

Water is now believed to be abundant in the Universe, and, of course, is essential for life as we know it. Tappe hopes that by understanding the chemistry occurring around nascent stars like this one, we can gain insights into the chemical reactions that made water, and even life, possible in our own solar system. For the Spitzer Science Center, I'm Daniel Brennan.

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