Neon Signs in Space

What causes planets to rise from the dust and gas around stars? Astronomers using NASA's Spitzer Space Telescope hope that Neon gas recently detected around twenty nearby stars may be a giant leap toward answering this question.
Hi, 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.

On Earth, Neon signs point to motel vacancies and nearby eateries. Now for the first time, astronomers have spotted Neon gas in disks of material surrounding a variety of stars. Until this recent detection, scientists admit that it has been very difficult to get good data about the gas content around stars.

According to Dr. Fred Lahuis of Leiden Observatory and the Netherlands Institute for Space Research, gas plays an important role in the development of planet-forming disks. It contributes to the temperature balance, structure, and chemistry of the disk. And, eventually it will determine if gas-rich and gas-poor planets can form.

The element Neon is particularly significant because it simplifies the chemical picture of planet formation around stars. Very few chemical elements in the universe are found in their pure form. In the disks surrounding a young star, most elements either bond to form molecules, like water, or condense to a solid state, forming dust grains or ice. However, as one of chemistry's "noble elements," Neon does not easily make chemical bonds or form larger molecules.

According to University of Michigan Graduate Student Catherine Espaillat, Neon is also special because it is easily detectable even when very small amounts of the element are present. And, when neon is detected, scientists know that it is likely coming from the planet-forming regions of the disk -- which helps to put constraints on gas giant planet formation.

Like a "sign" illuminated in deep space, astronomers can spot Neon with Sptizer's infrared spectrometer. Once a Neon atom absorbs X-ray and extreme ultraviolet light from its central star, it will then give off lower-energy infrared light, which Spitzer sees.

According to Dr. Ilaria Pascucci of the Steward Observatory at the University of Arizona, Tucson, Neon's relationship with this high-energy light may also provide valuable insights into how the disk around a young star goes from gas-rich, with no planets, to gas-poor with planets. She notes that only a fraction of the gas that starts out in the disk actually ends up in the atmosphere of planets.

Most of the primordial gas in the disk falls onto the central star in a process called accretion. After accretion onto the star is reduced, most of the remaining gas evaporates into space in a process called photoevaporation.

Photoevaporation is a process that occurs as extreme ultraviolet and X-ray light heat the gas in the disk, and the gas molecules become increasingly energetic. When the heated gas has enough energy, gravity from the star and the disk will no longer be strong enough to hold onto it -- allowing it to float off into space. Scientists suspect that if too much gas evaporates too quickly, gas-giant planets may not be able to form.

Once planets do form, Pascucci notes that gas around a young star may also play a crucial role in making them suitable for life. Scientists say gas may help to make the orbits of planets more circular as they form, as well as create atmospheres for rocky Earthlike and gas-giant planets alike. Both the orbit of a planet and its atmosphere plays an important role in stabilizing its climate, and perhaps in determining whether or not complex life can form and survive.

For the Spitzer Science Center, I'm Daniel Brennan.

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