"Galactic Dust Bunnies Found to Contain Carbon After All"

Using the Spitzer Space Telescope, researchers in Spain have found evidence suggesting that the building blocks of life may exist at the center of the Milky Way galaxy.

Astronomers have long been baffled by a strange phenomenon: why have their telescopes never detected carbon in the stars at the center of our galaxy, even though they have found carbon in stars in other places? But, using Spitzer's powerful infrared detectors, a research team found the elusive carbon.

"The dust [surrounding the stars] emits very strongly at infrared wavelengths," says team-member Pedro Garcia-Lario, "and with the help of Spitzer spectra we can easily determine whether the material returned by the stars to the interstellar medium is oxygen-rich or carbon-rich."

This discovery is significant because it adds to the knowledge of how stars form heavy elements -- like oxygen, carbon, and iron -- and then blow them out across the universe, making the development of life possible.

The team of scientists analyzed the light emitted from 40 planetary nebulae – blobs of dust surrounding stars -- using the Spitzer Space Telecope's Infrared Spectrograph: 26 nebulae in the center of the Milky Way -- a region called the "Galactic Bulge" -- and 14 nebulae in other parts of the galaxy. By examining the results, the scientists found a large amount of crystalline silicates and polycyclic aromatic hydrocarbons, two substances that, respectively, indicate the presence of oxygen and carbon.

This combination is unusual. In the Milky Way, dust that combines both oxygen and carbon is rare, and is usually only found in the presence of dust surrounding a binary system of stars. The Spanish group, however, found that the presence of the carbon-oxygen dust in the Galactic Bulge "seems to be suggestive of a recent change of chemistry experienced" by the star at the center of the dust.

The scientists hypothesize that as these central stars age and die, the heavier elements inside them do not make their way to the star's outer layers, as they do in other stars. Only in the last moments of the star's life, when it expands and then violently expels almost all of its remaining outer gasses, does the carbon become detectable, when astronomers see it in the nebulae surrounding the stars.

According to Garcia-Lario, "The carbon produced through these recurrent 'thermal pulses' is very inefficiently dredged up to the surface of the star,

contrary to what is observed in lower-metallicity, galactic disk stars." It only becomes visible when the star is "about to die."

This aging and expelling process is typical of all stars. As stars age and die, they burn progressively heavier and heavier elements, beginning with hydrogen and ending with iron. Towards the end of their lives, some stars become what are called "red giants:" they swell until they get so large that if one of them were placed in our solar system, where the sun is now, its outer-most border would touch Earth's orbit. As these stars pulsate – losing mass as they do so – and then later contract, they spew out all of the heavier elements that the star had previously formed. These elements are the building blocks of all of the planets, including our own planet Earth, as well as everything on those planets (including human beings, and any other life forms that may exist in the universe).

This study supports a hypothesis about why the carbon in some stars does not make its way to the stars' surfaces. Scientists believe that small stars -- those with masses equal to the mass of our sun, or up to one and a half times the sun's mass -- that contain lots of metal do not bring carbon to their surfaces as they age, that the high-metal conditions prevent the dredging. Stars in the Galactic Bulge tend to have more metals in them than other stars do, and so the Spitzer data supports this commonly held hypothesis. Before the Spitzer study, this hypothesis had never been supported by observation.

These results will be published in Astronomy & Astrophysics journal.