Dust in the Wind of Black Holes

Where did all the dust in the young universe come from? New findings from NASA's Spitzer Space Telescope suggest that at least some of the early space dust was manufactured in the winds from black holes that populated our early universe. 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.

Dust is essential for the formation of stars, galaxies and even life as we know it. We are partly made up of the dust that was needed for our young sun to cool and collapse into a star. The dust in our nearby universe was piped out by dying stars that were once a lot like our sun. But, when the universe was less than a tenth of a its present age of 13.7 billion years, sun-like stars hadn't been around long enough to make dust. So, what produced the precious substance back when the universe was just a toddler?

Theorists have long-suspected that short-lived, massive, exploding stars -- called supernovae -- might be the source of this mysterious dust, while others have proposed that a type of energetic, growing, supermassive black hole -- called a quasar -- could be a contributing factor. Quasars consist of a supermassive black hole surrounded by a dusty doughnut-shaped cloud from which the black hole feeds. Theoretically, dust could form in the outer portion of the winds that slowly blow away from this doughnut cloud. Yet, nobody had found conclusive proof that either quasar winds or supernovae can create enough dust to fill the early universe.

Dr. Ciska Markwick-Kemper of the University of Manchester, in the United Kingdom, and her team decided to investigate a quasar located in the center of a galaxy about 8 billion light-years away. This particular quasar is not located in the early universe, but is closer and therefore an easier target for addressing the question of whether quasars can make dust. They used an instrument on Spitzer, called the Infrared Spectrograph, to look for signs of various molecules in the infrared light from the quasar.

What they found was a mix of material, including crystalline silicate, olivine, forsterite, corundum, periclase, and magnesium oxide -- ingredients that, on Earth, make up glass, sand, marble, and even rubies and sapphires.

While the main constituent of glass was expected, the others were a surprise. These minerals are not typically detected in galaxies, suggesting they could have been freshly formed in the winds rushing away from the quasar.

For instance, the ingredient that makes up sand, crystalline silicate, doesn't survive for long free-floating in space. Radiation from stars zaps the molecules back to an amorphous, glass-like state. The presence of crystalline silicate therefore suggests

something -- possibly the quasars winds -- are churning the newly made substance out.

Likewise, the ruby and sapphire ingredient, corundum, is an important clue. Corundum is often hidden beneath a coat of silicates, making it undetectable. The fact that Spitzer found corundum means it must have formed in a region with both low and high densities of silicates. Such clumpiness is characterstic of quasar winds.

Markwick-Kemper and her team say the case of the missing dust is not closed. They hope to study more quasars for further evidence of their dust-making abilities. Also, according to the astronomers, quasars might not be the only source of dust in the early universe. As always, new answers lead to new questions.

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

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