Putting the Brakes on Star Formation

What do supermassive black holes have to do with star formation? New evidence from NASA's Spitzer Space Telescope shows that they may stunt the birth of new stars. 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.

For the first time ever, astronomers using Spitzer have detected dust grains mingling with 10-million-degree gas in an area surrounding an elliptical galaxy called NGC 5044. This finding could help explain what puts the brakes on star formation in elliptical galaxies.

It seems counter-intuitive, but stars actually form in the coolest parts of space. Stars form when clouds of gas and dust condense, and then gravity collects enough material to start a nuclear reaction. Most elliptical galaxies are made up of mostly older stars, while spiral galaxies like our own Milky Way have stars of all ages. The question of why has been the subject of a lot of debate.

The blazing hot gas that tends to surround elliptical galaxies was well known before this observation. It has been detected by X-ray telescopes. But scientists could only hypothesize about what keeps this gas from cooling. Now, new evidence collected by a team of scientists led by Dr. Pasquale Temi of the NASA Ames Research Center and the SETI Institute in California may provide the best explanation to date. When Temi pointed Spitzer's infrared eyes toward NGC 5044, he surprisingly found dust grains mixed with the gas. Dust grains normally wouldn't exist in such a hot environment. One scientist on the team compares this observation to finding a snowflake in Hell. While team members initially thought this was an odd sight, they suspect that the process forcing the dust grains and hot gas to mingle is very common in the universe. In fact, it even has a name: "feedback heating."

The process of feedback heating works like this. Observations with NASA's Hubble Space Telescope have shown small, massive clouds of dusty gas near the cores of many elliptical galaxies. This gas and dust was probably ejected by dying stars -- a normal part of their life cycle -- and then pulled toward the center of the galaxy by the core's strong gravity.

But, the cores of elliptical galaxies contain supermassive black holes. When some of this dusty gas approaches the host galaxy's central black hole, the black hole releases a lot of energy -- enough to heat nearby gas to extremely high temperatures, making it buoyant. Like smoke carrying ashes away from a fire, Temi's team believes that this buoyant gas floats away from the galaxy's center, carrying some dust with it. As plumes of this dusty smoke fill the area around the galaxy, gas there is also heated.

Feedback heating reduces the amount of star formation in elliptical galaxies in two ways. First, by keeping the galaxies too warm, gas clouds can't condense. Second, by causing gas to become buoyant and escape, there is less raw material for star formation left in the galaxy. If the Spitzer observations of hot, dusty gas around NGC 5044 are typical of elliptical galaxies throughout the Universe, we may finally understand why elliptical galaxies turn into communities comprised exclusively of older stars. Supermassive black holes act as a sort of thermostat, regulating and preventing the formation of new stars.

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

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