Discovery of new type of dust leads to new quasar ideas

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In a paper published in the Astrophysical Journal, a team of astronomers led by Martin Gaskell of the University of Nebraska-Lincoln announced that they have detected evidence of a previously unlooked-for type of microscopic interstellar dust.
Gaskell's colleagues in this research are his former UNL graduate student Rene W. Goosmann, now at the Paris Observatory in France, and Robert R. J. Antonucci and David H. Whysong of the University of California at Santa Barbara.

"As radiation from distant objects travels millions of light years through space, it has to pass through gas and dust," Goosmann said, "and the dust leaves a fingerprint in the spectrum of the radiation."

The fingerprint Gaskell and colleagues uncovered was unlike that of any hitherto known dust. The dust has the interesting property that it makes the visible light of objects look redder by preferentially absorbing bluer light, yet, unlike previously known types of interstellar dust, it does not change the shape of the ultraviolet spectrum.

Antonucci said that most of the data for their study came from work published in the late 1990s by astronomer Joanne Baker of Oxford University in England. He was inspired when he found what he called a "puzzling" contradiction in Baker's paper.

"The big contradiction was that if you looked at the visible light from quasars, then you saw evidence of dust. But if you looked at the ultraviolet light of quasars, then you didn't seen any evidence of dust," Gaskell said. "The approach we took was to say that maybe we're comparing basically similar objects and maybe there are some quasars that have dust along our line of sight and some that don't."

According to the paper, the detection of this new type of dust has important implications for understanding the mystery of how quasars work. Quasars are the most luminous and powerful compact steady energy sources in the universe, giving off vast amounts of energy at all wavelengths. Their power sources are massive black holes at the centers of galaxies. Black holes have gravitational fields so intense that nothing can escape once it is drawn inside the black hole.

"The massive black hole attracts matter in its immediate environment, and while the matter is falling into the black hole, it is heated up to very high temperatures so that it emits lots of radiation," Goosmann said. "The inner region of a quasar is a very spectacular place where a lot is happening. Radio waves, infrared light, visible light, ultraviolet light and X-rays are all being produced."

For reasons that Gaskell said are not well-understood, some massive black holes are squirting out long radio-emitting jets while some are not. Astronomers detect less ultraviolet emission from quasars with prominent jets. Because of these differences, some astronomers theorized that some so-called radio-quiet quasars (those lacking the long jets) were releasing energy by swallowing material, while the radio-loud quasars were getting energy by slowing down the spin of the black hole. But, Gaskell and his colleagues wrote, there only seems to be a difference because the dust they detected is seen along the line of sight to some quasars but not others.

"Our results have major implications for our understanding of how quasars work," Gaskell said. "We are providing a powerful argument that the emission from most supermassive black holes, especially in the radio-loud quasars, is fundamentally similar. The old view was these objects look different, so they are different. What we're now saying instead is that they only look different because of the effect of the dust between us and them. When you allow for the effect of the dust, what's going on around a giant black hole is very similar to what is going on around a small black hole."

How much dust there is around a quasar depends on how bright the quasar is, and the brighter quasars have destroyed more of their dust, the paper said. The grains of dust will eventually be destroyed, and Gaskell said this seems to be happening along the lines of sight to the brightest quasars. They've destroyed almost all their grains.

Something that Antonucci said he is excited about is that this affects counts of how many quasars are out there. If there is a lot of dust, then the dust is hiding quasars.

"Our idea that much quasar light is actually absorbed before reaching us means that quasars produced much more light than previously thought," he said.

Source: University of Nebraska-Lincoln

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