Astronomers Use Spitzer Telescope to Find Huge Black Hole in Bulgeless Galaxy

A team of researchers has used Spitzer Space Telescope's infrared eyes to find definitive evidence proving that active supermassive black holes do not often exist in the centers of bulgeless galaxies.

Bulgeless galaxies are thought to be a relatively young kind of galaxy, and are particularly interesting to astronomers studying the growth of supermassive black holes.

This Spitzer study is the first time that astronomers have systematically searched for active supermassive black holes in completely bulgeless galaxies at mid-infrared frequencies. The resulting data produced two major results.

First, it lead to the discovery of "the most luminous known accreting supermassive black hole in a completely bulgeless disk galaxy." Says Shobita Satyapal, from George Mason University and lead author of the paper, "This is a uniquely Spitzer discovery, since this black hole is hidden in the optical."

It also strengthened an earlier, more general hypothesis: that most bulgeless galaxies do *not* have active supermassive black holes (also called "AGN's," or "active galactic nuclei") at their centers. According to Satyapal, the "observations confirm that AGNs in completely bulgeless disk galaxies are not hidden in the optical, but truly are rare."

The study investigated the centers of spiral galaxies, the vast collections of stars that look like enormous sidereal starfish, or huge starry pinwheels. In fact, our own Milky Way galaxy is a spiral galaxy. Some of these galaxies, including our own, have a thick concentration of stars at their centers, which form a kind of bulge. These bulges are thought to form when smaller galaxies merge, and the stars in the disk get knocked into random orbits, eventually forming a smooth, central ball. At the centers of some of these bulges are supermassive black holes, giant gravitational monsters that swallow all matter and light that get too close. The Milky Way, for example, is thought to have a central black hole, named "Sagittarius A*," that has the mass of about 4 million Suns.

But, no one knows how those central black holes form. Do they form on their own, during the normal course of the galaxy's life? Or do they form when two galaxies collide, and initiate the creation of a bulge? One way to find out is to study bulgeless galaxies. Since bulgeless galaxies have not formed as the result of a collision, if some of them *do* have central black holes, then astronomers can infer that central black holes can form without galactic collisions.

In this study, the researchers used the Spitzer Telescope to look at mid-infrared radiation emitted from 18 bulgeless galaxies, to see if they could detect active central black holes. The team found the presence of ionized neon in the center of some of the galaxies, an unusual discovery because the energy required to ionize neon -- to strip

away some of its outer electrons -- is immense. It is so large, in fact, that only a active massive black hole can produce it.

According to Satyapal, “the fact that we found NeV [ionized neon] means that something needs to have produced light at very high energies. The only viable thing that could produce such high-energy light is an AGN.”

The study, in essence, shows that active black holes *can* form in bulgeless galaxies, and, indeed, are more common than first thought, though, in general, are still rare.

Astronomers now know of three active black holes in the centers of bulgeless galaxies. And, in each case, the galaxy had a massive star cluster with a mass greater than 1 million suns. This correspondence may suggest that if a bulgeless galaxy has an active massive black hole, it must also have a massive nuclear star cluster. But, any link between the star cluster and the presence of the black hole remains hidden.

Therefore, says Satyapal, the “recipe for forming and growing a massive black hole in a truly bulgeless disk galaxy is still unknown.”

The other authors of the paper include Torsten Boeker (ESA), William Mcalpine (George Mason University), Mario Gliozzi (George Mason University), Tim Heckman (Johns Hopkins University), Nick Abel (University of Cincinnati).

NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington. Science operations are conducted at the Spitzer Science Center at the California Institute of Technology in Pasadena. Caltech manages JPL for NASA. The Spitzer observations were taken during the observatory's "cold" mission, before its coolant ran out and it began operating at a warmer temperature.