Galaxy mergers not the trigger for most black hole feeding frenzies

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A survey of distant galaxies found that disk galaxies like those pictured above are just as likely to host active galactic nuclei as galaxies involved in disruptive mergers, like those in the images below. Credit: A. Koekemoer (Space Telescope Science Institute), NASA, ESA.

(PhysOrg.com) -- A survey of distant galaxies using the Hubble Space Telescope has put another nail in the coffin of the theory that galaxy mergers are the main trigger for turning quiescent supermassive black holes into radiation-blasting active galactic nuclei.

Led by astronomers at the University of California, Santa Cruz, the new study examined the morphology and structure of distant galaxies hosting active central black holes. The researchers found that these galaxies were no more likely to be involved in an ongoing merger than non-active galaxies of similar mass.

"Theoretical models show that a merger is a great way to trigger an

active galactic nucleus, because it funnels a lot of gas to the center of the galaxy. But we found that most of the host galaxies did not look disturbed. They look like disk galaxies, and a disk would be destroyed by a merger," said Dale Kocevski, a postdoctoral researcher at UC Santa Cruz and first author of a paper on the findings to be published in the Astrophysical Journal.

A supermassive black hole (millions or even billions of times the mass of the sun) sits at the core of most if not all large galaxies. But only a fraction of these are the bright radiation sources known as active galactic nuclei, which light up when the central black hole is actively gobbling up nearby gas clouds. The galactic center glows brightly at all wavelengths because the gas heats up as it falls into the black hole and emits intense radiation.

"The problem has been how to get the gas into the center of the galaxy, rather than orbiting around in the disk," said coauthor Sandra Faber, University Professor of astronomy and astrophysics at UC Santa Cruz.

The study used new images from Hubble's WFC3 infrared camera taken as part of the Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey (CANDELS). Faber, who leads the CANDELS project, said the images include galaxies at distances of nearly 11 billion light years. Looking deep into space gives astronomers a window back in time, revealing earlier stages in the evolution of the universe. This study covered a period when the brightest active galaxies, known as quasars, were at their peak, and theoretical models predicted that galaxy collisions would be an important trigger, Faber said. "Theory says that collisions should be more important, but we did not find that," she said.

These are not the first findings to suggest that violent galactic mergers are not needed to fuel active black holes. Earlier imaging studies of galaxies at distances of up to 8 billion light years had also failed to find evidence that mergers were triggering most active galactic nuclei. More recently a team of astronomers reached the same conclusions based on an analysis of the distribution of active galaxies out to almost 11 billion light years. But only Hubble's WFC3 could provide images showing the morphologies of galaxies at that distance.

"We were surprised to see that they look a lot like galaxies much closer to us," Faber said.

If galaxy collisions are not responsible for triggering active galactic nuclei, it suggests less violent processes within galaxies may play a greater role in feeding black holes, Kocevski said. "We call these secular processes. They happen randomly about ten percent of the time and are common in the local universe, such as when a star or a giant gas cloud gets too close and falls into the black hole."

Alternatively, the black holes may be fueled by a process that is unique to the early universe. "Recent theories suggest distant galaxies are fed by streams of cold gas, which can lead to violent instabilities in disk

galaxies that result in large amounts of gas being funneled to the central black hole," Kocevski said. "Only with further study will we know for sure."

Provided by University of California - Santa Cruz