

NGC 4424

A Cosmic Romance Written in the Stars

60'' ~ 4.8 kpc

An international team of astronomers, including local astrophysicist Dr. Ben Davis, recently had taken a step forward in understanding the evolution of galaxies, and in so doing, told a story written in the heavens.

It has long been a mystery how some spiral galaxies obtained their central black hole. By combining visible and X-ray observations, astronomers have now discovered traces of what was probably once a small sphere-shaped galaxy, seen falling into a spiral galaxy and delivering what is thought to be the right-sized black hole. The facts make for a cosmic romance, a similarity not lost on the lead-author of

this new research, Professor Alister Graham, from Swinburne University of Technology's Centre for Astrophysics and Supercomputing.

The team discovered that galaxies can have a mutual (gravitational) attraction for each other. The body of a smaller galaxy may fade over time, but its heart remains intact as it falls into and partners with a larger galaxy. In this case, the heart is a million-strong cluster of stars, seen with the Hubble Space Telescope near the center of the Spiral Galaxy NGC 4424, which was already known to display signs of activity from a past merger event. Professor Graham says, "The gal-

axy's bar-like structure is excited and buckled. There was also a star-forming event less than 500 million years ago. One can think of this as a star party of sorts, associated with the announcement of the upcoming galaxy wedding." To the astronomers, "This appears to be an important discovery for understanding the coevolution of black holes and galaxies." A massive discovery! This is the first infalling galaxy found to have a massive black hole. The noted discovery contributes to our understanding of how black holes come to be inside spiral galaxies.

So... you might say, how does that affect me or even, why should I be

interested in this discovery, or even why should I have an interest in the ongoing research by the team members, Alister Graham, based in Australia, and co-authors Professor Roberto Soria from the Chinese Academy of Science, and Dr. Ben Davis, with New York University Abu Dhabi? Well, Ben has been working for the past couple of years in a downtown Galena office because of the pandemic travel restrictions with his assignment to Abu Dhabi. Ben continues his research throughout the world, working with many of his colleagues as they work to unlock the mysteries of space. Ben is a 2003 graduate of Riverton High

School. His parents are Jeff & Sara Davis. Furthermore, his wife, Nicolette Davis, is an employee here at the Galena Sentinel-Times.

From their research, the astronomers have informally named the star cluster "Nikhuli." They turned to the Sumi tribe in the Indian State of Nagaland for the word, used for a festive period where the descendants of head-hunters celebrate and wish for a rich harvest and gathering. It seemed appropriate to the astronomers, who refer to space as "the field" and whose discovery focuses on how a larger galaxy has harvested a smaller galaxy. According to Professor Roberto Soria, images he obtained using the Chandra X-ray Observatory, shows a high-energy X-ray source emanating from the stretched-out star cluster seen in the Hubble Space Telescope's image.

"We are likely seeing activity from around a black hole within what was the centrally-located star cluster of the infalling galaxy," says Soria. Although 50 million light-years away, each square meter of Earth is bathed in an X-ray from this active black hole roughly every 80 seconds. The X-ray hotspot is just 1300 light-years from the center of NGC 4424, a galaxy some sixty thousand light-years across. The main body of the smaller galaxy – which once housed the resilient star cluster – is now contributing to an inner "bulge" of stars above and below the spiral galaxy's disk, which contains the bar and spiral pattern.

Expanding our knowledge of the Universe, the

team's best estimate for the mass of the black hole is seventy thousand times the mass of our Sun. This mass makes it a candidate for the largely-missing population of "intermediate-mass" black holes with masses greater than stars and smaller than the supermassive black holes known to reside at the centers of giant galaxies, like M87 – which is often remembered as the famous first-ever image of a black hole, taken by the Event Horizon Telescope, and announced in 2019. "This in itself is exciting," says Graham. "Moreover, this mass is on par with that expected at the center of NGC 4424."

"We may be witnessing a supply mechanism for black holes into spiral galaxies," says Dr. Davis. "Furthermore, potential collisions with other black holes make this an ideal setting for the emission of long-wavelength gravitational waves rippling across space," says Davis. The next step for the team is to find more infalling galaxies containing black holes in their drive to answer how black holes come to be within spiral galaxies. Professor Graham and Dr. Ben Davis are also members of the LISA Consortium, whose Laser Interferometer Space Antenna, aka LISA, and the Chinese TianQin space missions are working towards discovering events involving the collision of big black holes.

This research has been published in The Astrophysical Journal and is available online at: <https://iopscience.iop.org/article/10.3847/1538-4357/ac235b>