Evidence found for existence of intermediate size black hole

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Galaxy ESO 243-49, about 300 million light-years away, is home to the newly found black hole. Credit: NASA, ESA and S. Farrell (U. Sydney)

(Phys.org) -- Over the years, cosmologists have found ample evidence of just two kinds of black holes: stellar mass black holes and supermassive black holes. The former are considered small by most standards, just several times the weight of our sun; the latter, as their name implies, huge and as heavy as millions of our sun combined. Not so easy to find have been those that lie somewhere in-between, and because of that,

their existence has been mostly speculative. Now, it appears that has changed as a group of international researchers has found evidence that suggests one such black hole appears to be on the order of 90,000 of our suns. The team has found as they explain in their paper published in the journal *Science*, that ESO 243-49 HLX-1, first discovered in 2009, appears to have the characteristics of an intermediate mass black hole.

HLX-1 has been described as being discovered almost by accident, as the research team at the time was instead focused on its host spiral galaxy. Black holes are generally more likely to sit at the center of galaxies such as the one that is believed to exist at the center of our own Milky Way. But HLX-1 was found, uncharacteristically, out in the spiral. It came to notice only because it was spewing a lot of x-rays and radio flares.

Because of those findings, this new research team began to focus exclusively on the black hole, hoping that it would be the first example found of an intermediate sample. To figure out if it was, the team took measurements from around the time HLX-1 was first discovered and applied theoretical formulas that have been derived over the years to predict the behavior of intermediate black holes. Then, last year, they made a second round of observations and found they matched almost perfectly with what the theories had predicted leading the researchers to proclaim HLX-1 as the first discovered intermediate mass black hole.

An arrow shows the location of the black hole HLX-1 in the galaxy ESO 243-49. Credit: NASA, ESA and S. Farrell (U. Sydney)

How intermediate mass black holes have come to exist is still not very well understood however. Some suggest they may have sprung into existence as tight clusters of stars collapsed into one single black hole. Others theorize that they may have come about as entities all on their own in the aftermath of the big bang; others yet say that maybe they started out as massive black holes that shrunk over time for unknown reasons. Because of the many possibilities, researchers will undoubtedly be kept busy for many years trying to find the best possible explanation, but at least now they will have a real one to study.

More information: Natalie Webb, David Cseh, Emil Lenc, Olivier Godet, Didier Barret, Stephane Corbel, Sean Farrell, Robert Fender, Neil Gehrels, Ian Heywood. "Radio Detections During Two State Transitions of the Intermediate Mass Black Hole HLX-1." *Science*

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ABSTRACT
Relativistic jets are streams of plasma moving at appreciable fractions of the speed of light. They have been observed from stellar mass black holes (~3–20 solar masses, M⊙) as well as supermassive black holes (~106–109 M⊙) found in the centres of most galaxies. Jets should also be produced by intermediate mass black holes (~102–105 M⊙), although evidence for this third class of black hole has until recently been weak. We report the detection of transient radio emission at the location of the intermediate mass black hole candidate ESO 243-49 HLX-1, which is consistent with a discrete jet ejection event. These observations also allow us to refine the mass estimate of the black hole to be between ~9 × 103 M⊙ and ~9 × 104 M⊙.

Press release