NATURE | NEWS

Small galaxy harbours super-hefty black hole

Over-massive black hole at the centre of NGC 1277 challenges theories about how galaxies evolved.

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28 November 2012

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The galaxy NGC 1277 has at its heart a massive black hole.

A newly discovered black hole appears to be too big for its britches, contradicting a widely accepted view about the growth of galaxies. The finding, part of a study reported this week in *Nature*[1], suggests that instead of growing in lockstep with its home galaxy, some of these gravitational monsters might have packed on the pounds earlier.

Although the newfound black hole tips the scales at the mass equivalent of 17 billion Suns, it lies at the centre of the compact galaxy NGC 1277, whose diameter is only about one-quarter that of the Milky Way, says study co-author Remco van den Bosch of the Max Planck Institute for Astronomy in Heidelberg, Germany.

The team used archival data from the Hubble Space Telescope and observations from the Hobby-Eberly Telescope in Fort Davis, Texas, which focused on the most massive galaxies in the nearby Universe, reveal that the black hole is about 59% as massive as the galaxy's central bulge of stars, a much higher per centage than expected.

Van den Bosch and his colleagues identified five other massive but compact galaxies that, like NGC 1277, have stars orbiting the central region at high speed — a hint that the galaxies might also harbour unusually heavy black holes. The masses of those black holes have yet to be measured, however.

Those findings are in contrast to previous estimates based on observations of some 70 other galaxies with central black holes, which indicate that a supermassive black hole typically has about 0.1% the mass of its home galaxy's stellar bulge.

Estimating true heft

Assuming the measured mass of the black hole in NGC 1277 isn't a statistical fluke, scientists may need to revise their understanding of how galaxies evolve, says astronomer Jenny Greene of Princeton University in New Jersey, who is not a member of the discovery team. "It tells us that there are very big black holes in small galaxies" and that measuring the mass of the stellar bulge of galaxies to gauge a black hole's mass may yield underestimations of its true heft, she says.

In the standard picture, Greene notes, galaxies and their central black holes grow in tandem, with gas fuelling the formation of new stars and adding mass to the black holes. When a black hole gets big enough, it generates a wind so powerful that it blows all the gas out of the galaxy, halting both star formation and the infall of new material into the black hole. In this model, the link between black-hole and galaxy mass would remain preserved, Greene says.

"It is hard to explain this observation [of NGC 1277] in a picture where the black hole shuts off its own growth when it reaches a fixed fraction of the galaxy mass," she says. "Instead, this guy kept growing."

NGC 1277 is rare among galaxies in the present-day Universe. In addition to being unusually dense, the galaxy's shape and its elderly population of stars suggest that it has not merged with another galaxy for several billion years. Such compact galaxies were more common about 10 billion years ago, and one possibility is that NGC 1277 has preserved the relationship between black-hole mass and stellar bulge that was typical during that long-ago time, Greene says.

But Greene says that she prefers a different explanation. Early in the life of Universe, she suggests, black holes were randomly paired with galaxies. As galaxies merged, the correlation between black-hole mass and galaxy properties tightened. “We know that repeated mergers must at least help establish the correlation between black holes and their galaxies,” Greene says. In this scenario, “we would expect to find some rare galaxies with overly massive black holes” that had yet to undergo major mergers, she adds.

Nature | doi:10.1038/nature.2012.11913

References

1. van den Bosch, R. C. E. *et al*. *Nature* **491**, 729–731 (2012).