Diagnosis murder: Study shows supermassive black holes may strip galaxies of life

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(PhysOrg.com) -- Black holes have long been beloved of science fiction writers for their destructive capabilities and peculiar ability to warp space time. Now a study led by researchers from The University of Nottingham reveals the awesome power of supermassive black holes — the ability to strip massive galaxies of the cool gases required to form new stars, leaving ageing red giants to splutter out of existence with no stars to replace them.

The study, led by Asa Bluck in the School of Physics and Astronomy, used images of unprecedented depth and resolution from the Hubble Space Telescope and the Chandra X-Ray Observatory to detect black holes in distant galaxies. Researchers looked for galaxies emitting high levels of radiation and x-rays — a classic signature of black holes devouring gas and dust through accretion, or attracting matter

gravitationally.

As this matter swirls around the event horizon of a black hole it heats up and radiates energy — as an accretion disc. The study, which was funded by the Science and Technology Facilities Council and NASA and was a collaboration between researchers at The University of Nottingham and Imperial College London, gleaned some startling results. In supermassive black holes this radiation can reach huge proportions, emitting X-ray radiation in far greater quantities then is emitted by the rest of the objects in the galaxy combined — meaning that the black hole 'shines' far brighter than the entire galaxy it lies at the heart of. In fact, the amount of energy released is sufficient to strip the galaxy of gas at least 25 times over.

Results have also shown that the vast majority of the X-ray radiation present in the universe is produced in these accretion discs surrounding supermassive black holes, with a small proportion produced by all other objects, including galaxies and neutron stars.

The accretions discs surrounding supermassive black holes produce so much energy that they heat up the cold gases lying at the heart of massive galaxies. The accretion disc shines across all wavelengths — from radio waves to gamma waves. This speeds up the random motions of the gas, making it rise in temperature and pushing it away from the galactic centre, where it becomes less dense. Gas needs to be cold and dense to collapse under gravity to form new stars, this resulting hot, low-density material must cool down before gravity will take effect — a process which would take longer than the age of the universe to achieve.

Old stars are therefore left to die out with no new stars replacing them, leaving the galaxy to grow dark and die. And by pushing gas away from the galactic centre, the accretion disc starves the supermassive black hole of new material to devour, leading to its eventual demise.

"It's thought that black holes form inside their host galaxies and grow in proportion to them, forming an accretion disc which will eventually destroy the host. In this sense they can be described as viral in nature," said Asa Bluck, a PhD student at the University and a Fellow of the Royal Astronomical Society. "Massive galaxies are in the minority in our visible universe — about one in a thousand galaxies is thought to be massive, but it may be much less. And at least a third of these have supermassive black holes at their centre. That's why it's so interesting that this type of black hole produces most of the X-ray light in the universe. They are the minority but they dominate energy output."

Asa will present these results at the Royal Astronomical Society National Astronomy Meeting in Glasgow on Friday 16 April.

Provided by University of Nottingham