Do black holes zap galaxies into existence?

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Courtesy European Southern Observatory
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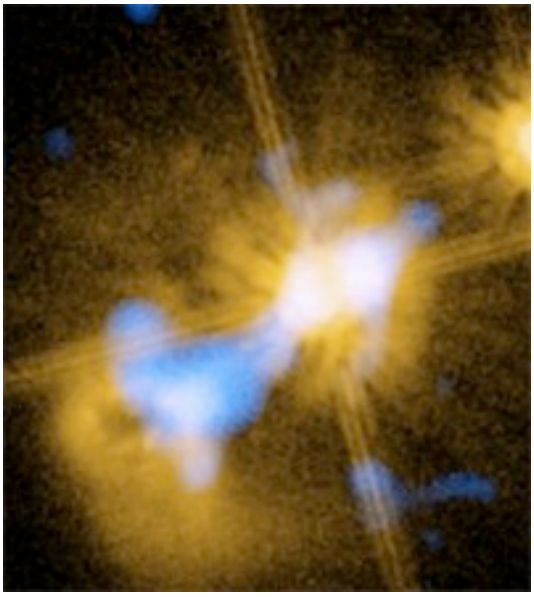
Which come first: the supermassive black holes that frantically devour matter, or the huge galaxies where they reside?

A new scenario has emerged to answer this contentious "'chicken and egg' question," said David Elbaz of the Center for Nuclear Studies of Saclay in Gif-sur-Yvette, France, one of the researchers who developed the model.



Colour composite image of quasar HE0450-2958, the brightest object in the image. The image was obtained with the VISIR instrument on ESO's Very Large Telescope, the Hubble Space Telescope and the Advanced Camera for Surveys. The quasar is believed to be zapping the object to its lower left, a galaxy, with an energetic beam of particles.

The issue is "one of most debated subjects in astrophysics," he added. "Our study suggests that supermassive black holes can trigger the formation of stars, thus 'building' their own host galaxies."

A black hole is a super-compact astrophysical object whose gravity is so powerful that it drags into itself any object passing too nearby, including light. That accounts for the "black" moniker, but actually many black holes are thought to be easily visible thanks to violent activity going on around them.

Elbaz and colleagues studied a peculiar object some five billion light years away, believed to be a black hole without a home galaxy and dubbed quasar HE0450-2958. A light year is the distance light travels in a year.

It had been speculated that the quasar's host galaxy was hidden behind dust. The astronomers thus used an instrument on the European Southern Observatory's Very Large Telescope designed to detect so-called mid-infrared light, which would make dust clouds brightly visible.

Yet no dust appeared, indicating there was no home galaxy, said Knud Jahnke of the Max Planck Institute for Astronomy in Heidelberg, Germany, who led the observations. "Instead we discovered that an apparently unrelated galaxy in the quasar's immediate neighbourhood is producing stars at a frantic rate," he said, the equivalent of about 350 Suns yearly.

Earlier observations had shown that the companion galaxy is, in fact, under fire: the quasar is spewing a jet of energetic particles towards its companion, accompanied by a stream of fast-moving gas. The injection indicates that the quasar itself might be inducing the formation of stars and thereby creating its own host galaxy, according to Elbaz and colleagues. In such a scenario, galaxies would have evolved from clouds of gas hit by the energetic jets emerging from quasars, or giant black holes.

"The two objects are bound to merge in the future: the quasar is moving at a speed of only a few tens of thousands of kilometers [or miles] per hour with respect to the companion galaxy and their separation is only about 22,000 light-years," said Elbaz. "Although the quasar is still 'naked', it will eventually be 'dressed' when it merges with its star-rich companion. It will then finally reside inside a host galaxy like all other quasars."

The findings may also represent the long-sought missing link to understanding why the mass of black holes is larger in galaxies that contain more stars, the researchers added. "A natural extension of our work is to search for similar objects in other systems," said Jahnke.

The findings are being presented in new papers published in the journals *Astronomy & Astrophysics* and *Astrophysical Journal*.