The jet of a black hole drives multiple winds in a nearby galaxy

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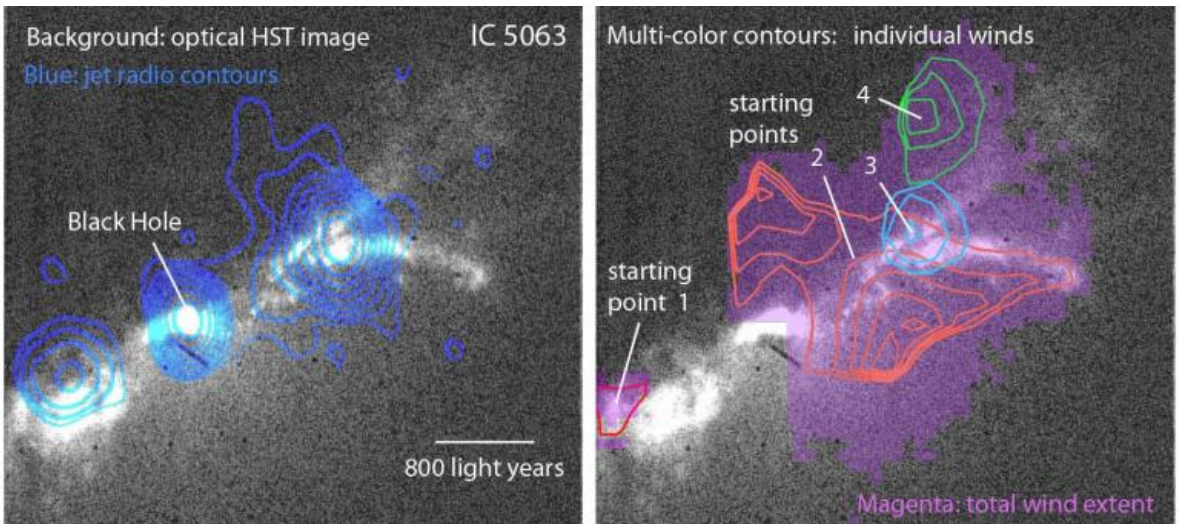

Left: A Hubble Space Telescope optical image of the ionized atomic gas in IC5063, including Hb and [OIII] emission related to the jet. Overlaid is the jet radio emission, displayed in blue (see Dasyra et al. 2015 and references therein). Right: Contours of the ionized gas [FeII] emission showing the winds in our line of sight. Contours of different colors correspond to winds with different starting points. In magenta, we mark the region where > 10% of the line emission comes from gas in the wind. Credit: National and Kapodistrian University of Athens

A team of astrophysicists led by Dr Kalliopi Dasyra discovered fast winds of molecular and atomic gas that were caused by the interaction of the jet of a supermassive black hole with interstellar medium clouds in the nearby galaxy IC5063. The winds are detected in four discrete

regions near the jet, at distances as large as ~3000 light years away from the black hole. This discovery indicates that black hole jets can influence the evolution of galaxies by increasing the turbulence of the gas and suppressing the formation of new stars at large scales.

Supermassive black holes of hundreds of millions of solar masses commonly reside in galactic centers. These black holes can gravitationally attract interstellar matter from within dozens of light years away. As matter inflows toward a black hole, it becomes heated and ionized. Its accretion occurs through a disk because of rotation. Collimated streams of plasma, called jets, emerge from the accretion disk as a result of magnetic fields.

Jets can be very energetic—they can transport energy at a rate that is 10 orders of magnitude greater than that radiated by the sun. By injecting energy into the interstellar medium, jets can expel gas from galaxies, increase gas turbulence, and prevent the gas collapse that leads to star formation. Models have indicated that this process can take place at the scale of entire galaxies because bow shocks sweep the interstellar gas as jets propagate through it. In this manner, jets can affect galaxy evolution.

Most direct evidence that the jet of a black hole accelerates interstellar gas comes from observations of the galaxy IC5063, 160 million light years away from us. This galaxy has a rare characteristic: The jet is nearly aligned with the dense gas disk, depositing energy into it. In most other cases, the energy is expelled perpendicularly to the disk, keeping most of the dense gas intact.

The astrophysicists analysed near-infrared data of IC5063 from the Very Large Telescope of the European Southern Observatory, and discovered winds starting from four discrete regions near the jet. The winds are caused by the impact of the jet upon dense clouds, or by the passage of

the bow shocks by dense clouds. They carry molecular hydrogen and iron ions with high line-of-sight velocities of 600 to 1200 km/s with respect to the regular gas motions. Higher temperatures are observed for the gas in the wind than in its surroundings. The increase in the gas turbulence and temperature can affect star formation in an impressively large area, corresponding to ~1/5th of the molecular gas disk.

More details on this work can be found in an *Astrophysical Journal* paper titled "A radio jet drives a molecular and atomic gas outflow in multiple regions within one square kiloparsec of the nucleus of the nearby galaxy IC5063". The paper, with a publication date of December 04 2015, can be downloaded from the journal's website (available from Friday, December 4) (http://iopscience.iop.org/article/10.1088/0004-637X/815/1/34) or from the arXiv pre-print server (http://arxiv.org/abs/1503.05484).

More information: A radio jet drives a molecular and atomic gas outflow in multiple regions within one square kiloparsec of the nucleus of the nearby galaxy IC5063. arxiv.org/abs/1503.05484

Provided by National and Kapodistrian University of Athens

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