Mystery of black hole fireworks solved

Spectacular galactic jets are driven by galaxies melding together.

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ESA/Hubble, L. Calçada (ESO)

Driven by merging black holes, gas thrown off in galactic jets can reach nearly the speed of light (artist's impression).

Gigantic jets of gas that leap out of galaxies at nearly the speed of light occur only after two galaxies merge, a survey of the distant Universe shows. The results suggest that the jets are powered by the collision of black holes at the galaxies' centres and solve the puzzle of why only some galaxies emit these jets.

The link between mergers and galactic jets seems to be a "slam dunk", says astronomer Sylvain Veilleux of the University of Maryland in College Park, who was not involved in the work.

Most large galaxies are thought to host black holes at their centres, and these can be billions of times as massive as the Sun. Some black holes, including the one at the heart of our own Milky Way, are dormant and are mostly only noticeable from the gravitational pull that they exert on nearby stars. But other black holes are surrounded by a disk of matter, light years across, that shines more brightly than the rest of its galaxy combined as the matters spirals into the black hole.

Fast jets and fireworks

Only a few of these 'active galactic nuclei' have been seen producing what are probably the most spectacular fireworks in the Universe: jets of matter accelerated to nearly the speed of light that stream out of the galaxy centres in opposite directions, at right angles to the disks. These jets shine brightly in the radio spectrum and their hosts are therefore known as radio galaxies.

But why some systems have jets and some do not has been a puzzle. Marco Chiaberge, an astronomer at the Space Telescope Science Institute in Baltimore, Maryland, and his collaborators stumbled on an explanation almost by chance in late 2013, during a survey of radio galaxies using the Wide Field Camera 3 on the Hubble Space Telescope. "We printed out the images of this new survey and put them on a table," Chiaberge recalls. "We looked at them and we said, 'These are all mergers!'"

The team followed up their initial intuition with more careful work on a larger sample of 19 radio galaxies, all of them at least 7.8 billion light years (2.4 billion parsecs) away. Nearly all had irregular shapes with regions of intense star formation, a sign that they were the result of a recent merger, on cosmic time scales. Not all galaxy mergers are seen producing jets because in some of them the central black holes are still falling towards each other and are not merging, Chiaberge suggests. The results are available on the preprint server arXiv[1] and are due to be published in the *Astrophysical Journal*.

Mergers should set the resulting larger black hole into a faster spin, which would twist the black hole's magnetic field around it, accelerating surrounding gas particles to close to the speed of light and ejecting them out of the galaxy. The idea that galactic jets are powered by the rapid spinning of black holes has been around for at least two decades[2] and the latest results support it, Veilleux says.

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References

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2. Wilson, A. S. & Colbert, E. J. M. *Astro. J.* **438**, 62–71 (1995).

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