Flickering black hole at center of IC 310 shaking up ideas on how jets form

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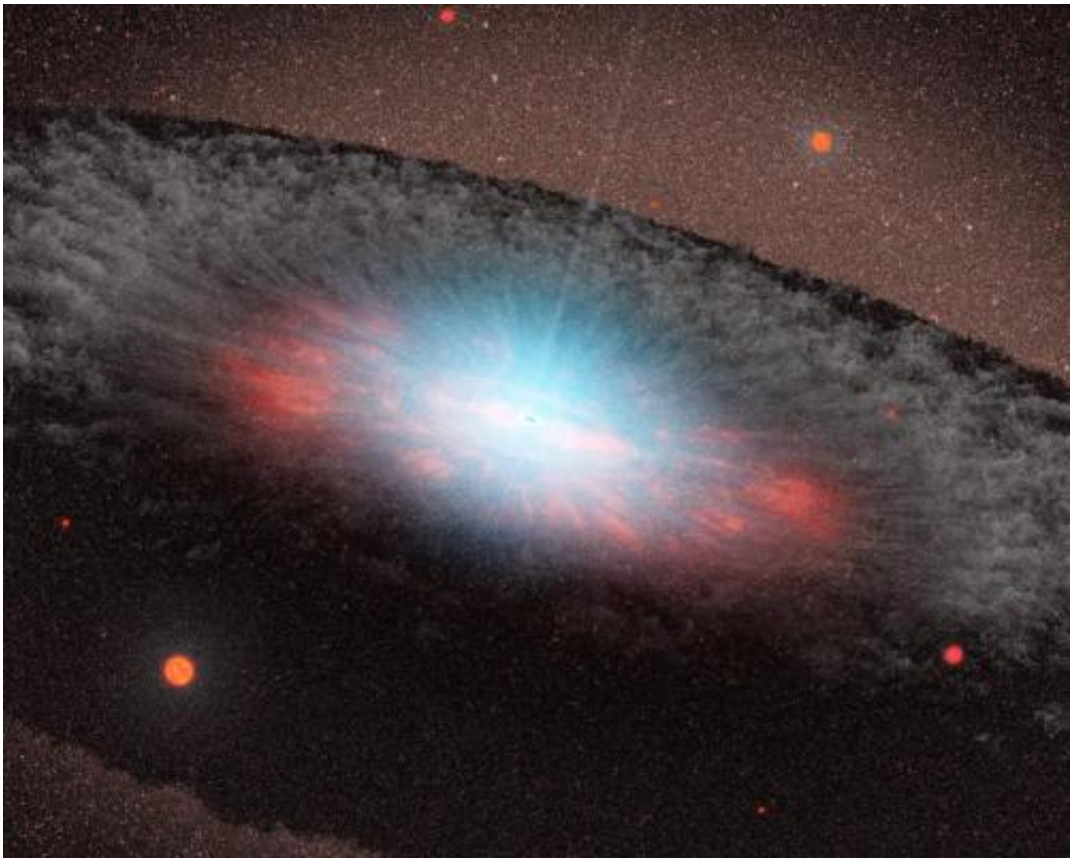

This artist's concept depicts a supermassive black hole at the center of a galaxy. The blue color here represents radiation pouring out from material very close to the black hole. The grayish structure surrounding the black hole, called a torus, is made up of gas and dust. Credit: NASA/JPL-Caltech

(Phys.org) —A very large team of astronomers and astrophysics from a

wide variety of countries has contributed to a research paper published in the journal *Science*, describing observations made of a black hole at the center of the IC 310 galaxy—a black hole that was observed with a flickering jet that didn't conform to existing theories. The team offers possible explanations for the unique type of flickering observed and suggests more research will need to be done before any real conclusions can be drawn.

The black hole at the center of IC 310 (located in the Perseus constellation, approximately 260 million light years away) was first observed in 2012 by a team using a pair of telescopes that together are known as the MAGIC project located on the Spanish Island of La Palma. What struck the team was that the jet of gamma rays being emitted appeared to flicker (showed variations in brightness) at a very high rate—over a period of just minutes. Flickering jet emissions from black holes aren't something new, of course, but every other one observed thus far has done so over much longer periods of time. When they do occur, researchers have theorized that it occurs due to what they call shock accelerations—particles being suddenly accelerated by shockwaves. But the time rate of the black hole in IC 310 is too fast to be explained by such a theory which means space scientists have had to come up with something else.

In this new effort, the researchers suggest that the flickering is likely caused by the same thing that causes pulsars to flicker, namely, spin. Pulsars are stars that have died and collapsed down to a shrunken core—they tend to emit two beams of light. As the pulsar spins, the light that is seen by observers here on Earth appears to flicker, like a beam from a lighthouse to a ship at sea. In this instance, the team suggests the flicker observed with the black hole jets is likely associated with pulsar-like particle acceleration, caused by an electric field that exists spanning the magnetospheric gap that is thought to exist at the base of the jet.

The team acknowledges that their theory is weak due to insufficient evidence and they express hope that other examples of similar jet flickering will be found offering more evidence that in the end will more firmly explain the nature of such jet activity.

More information: Black hole lightning due to particle acceleration at subhorizon scales, *Science* DOI: 10.1126/science.1256183

ABSTRACT

Supermassive black holes with masses of millions to billions of solar masses are commonly found in the centers of galaxies. Astronomers seek to image jet formation using radio interferometry but still suffer from insufficient angular resolution. An alternative method to resolve small structures is to measure the time variability of their emission. Here we report on gamma-ray observations of the radio galaxy IC 310 obtained with the MAGIC telescopes, revealing variability with doubling time scales faster than 4.8 min. Causality constrains the size of the emission region to be smaller than 20% of the gravitational radius of its central black hole. We suggest that the emission is associated with pulsar-like particle acceleration by the electric field across a magnetospheric gap at the base of the radio jet.