New research on giant radio galaxies defies conventional wisdom

October 25 2019, by Michelle Ulyatt

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Conventional wisdom tells us that large objects appear smaller as they get farther from us, but this fundamental law of classical physics is reversed when we observe the distant universe.

Astrophysicists at the University of Kent simulated the development of the biggest objects in the universe to help explain how galaxies and other cosmic bodies were formed. By looking at the distant universe, it is possible to observe it in a past state, when it was still at a formative

stage. At that time, galaxies were growing and supermassive black holes were violently expelling enormous amounts of gas and energy. This matter accumulated into pairs of reservoirs, which formed the biggest objects in the universe, so-called giant radio galaxies. These giant radio galaxies stretch across a large part of the Universe. Even moving at the speed of light, it would take several million years to cross one.

Professor Michael D. Smith of the Centre for Astrophysics and Planetary Science, and student Justin Donohoe collaborated on the research. They expected to find that as they simulated objects farther into the distant universe, they would appear smaller, but in fact they found the opposite.

Professor Smith said: "When we look far into the distant universe, we are observing objects way in the past—when they were young. We expected to find that these distant giants would appear as a comparatively small pair of vague lobes. To our surprise, we found that these giants still appear enormous even though they are so far away."

Radio galaxies have long been known to be powered by twin jets which inflate their lobes and create giant cavities. The team performed simulations using the Forge supercomputer, generating three-dimensional hydrodynamics that recreated the effects of these jets. They then compared the resulting images to observations of the distant galaxies. Differences were assessed using a new classification index, the Limb Brightening Index (LB Index), which measures changes to the orientation and size of the objects.

Professor Smith said: "We already know that once you are far enough away, the Universe acts like a magnifying glass and objects start to increase in size in the sky. Because of the distance, the objects we observed are extremely faint, which means we can only see the brightest parts of them, the hot spots. These hot spots occur at the outer edges of

the radio galaxy and so they appear to be larger than ever, confounding our initial expectations."

The full research, "The Morphological Classification of distant radio galaxies explored with three-dimensional simulations," has been published in the *Monthly Notices of the Royal Astronomical Society*.

More information: Michael D Smith et al, The morphological classification of distant radio galaxies explored with three-dimensional simulations, *Monthly Notices of the Royal Astronomical Society* (2019). DOI: 10.1093/mnras/stz2525

Provided by University of Kent