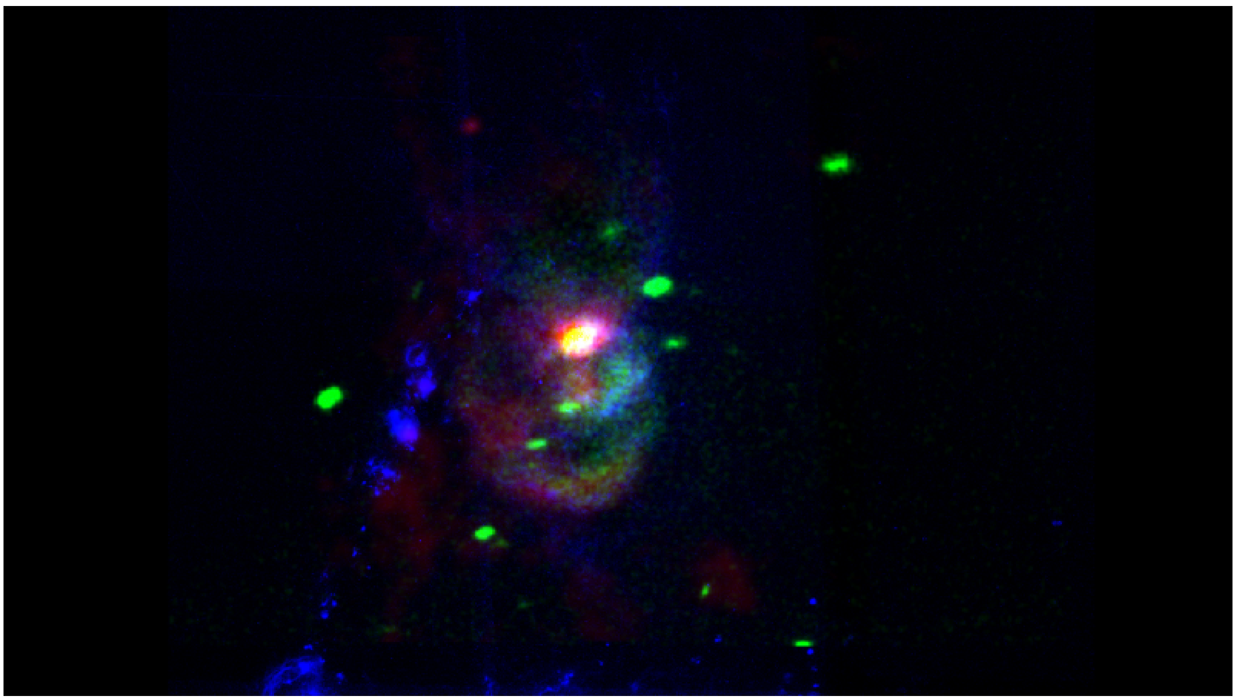
Shocking case of indigestion in supermassive black hole

July 4 2017



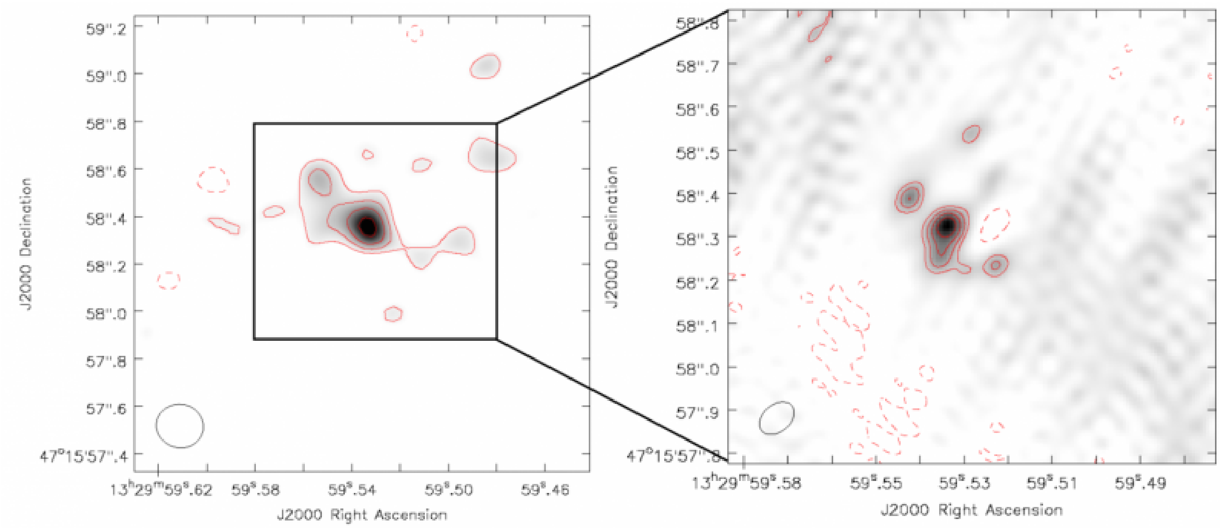
False colour image of NGC 5195 created by combining the VLA 20 cm radio image (red), the Chandra X-ray image (green), and the Hubble Space telescope H-alpha image (blue). The image shows the X-ray and H-alpha arcs, as well as the radio outflows from the supermassive black hole at the centre of NGC 5195. Credit: NRAO / AUI / NSF / NASA / CXC / NASA / ESA / STScI / U. Manchester / Rampadarath et al.

A multi-wavelength study of a pair of colliding galaxies has revealed the cause of a supermassive black hole's case of 'indigestion.' Results will be presented by Dr Hayden Rampadarath at the National Astronomy Meeting at the University of Hull.

Once every couple of hundred million years, the small galaxy NGC 5195 falls into the outer arms of its larger companion, NGC 5194, also known as the Whirlpool galaxy. Both galaxies are locked in a gravitational dance that will result – billions of years in the future – in the formation of a single galaxy.

As NGC 5195 plunges into the Whirlpool, matter streams onto the supermassive black hole at NGC 5195's centre and forms an accretion disc. The disc grows to a point where the supermassive black hole can no longer accrete or 'digest' efficiently and matter is blasted out into the surrounding interstellar medium. Last year, NASA's Chandra X-Ray observatory spotted arcs of X-ray emission that appeared to result from this 'force-feeding.'

Now, new high-resolution images of the core of NGC 5195, taken with the e-MERLIN radio array, and archive images of the surrounding area from the Very Large Array (VLA), Chandra and the Hubble Space Telescope, reveal in detail how these blasts occur and spread. The study was led by astronomers at the University of Manchester's Jodrell Bank Centre for Astrophysics.



e-MERLIN maps of the nuclear region of NGC 5195 at 1.4 GHz (left) and 5 GHz (right). The images display a partially resolved source with possible parsec-scale outflows. Credit: e-MERLIN / U. Manchester / Rampadarath et al.

The supermassive black hole at the centre of NGC 5195 has a mass equivalent to 19 million Suns. When the accretion process breaks down, immense forces and pressures create a shock wave that pushes matter out into the interstellar medium. Electrons, accelerated close to the speed of light, interact with the magnetic field of the interstellar medium and emit energy at radio wavelengths. The shock wave then inflates and heats up the interstellar medium, which emits in the X-ray, and strips the electrons from surrounding neutral hydrogen atoms to make ionised hydrogen gas. This inflated bubble creates the arcs detected by Chandra and Hubble.

Rampadarath explains: "Comparing the VLA images at radio wavelengths to Chandra's X-ray observations and the hydrogen-emission detected by Hubble, shows that features are not only connected, but that the radio outflows are in fact the progenitors of the structures seen by

Chandra and Hubble. This is an event of galactic proportions that we can see right across the electromagnetic spectrum."

He adds: "The age of the arcs in NGC 5195 is 1-2 million years. To put that into context, the first traces of matter were being forced out of the black hole in this system at about the time that our ancestors were learning to make fire. That we are able to observe this event now through such a range of astronomical facilities is quite remarkable."

Provided by Royal Astronomical Society

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