NEWS RELEASE

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FAO: SCIENCE CORRESPONDENT

Massive black hole seen feeding its jet, spurting like a geyser

First ever observed link between a supermassive black hole and its jet

Like a celestial version of 'Old Faithful', the Yellowstone Park geyser whose pent-up energy is released in spectacular regular outbursts, scientists have caught a supermassive black hole in a distant galaxy in the act of spurting energy into a jet of electrons and magnetic fields, four separate times in the last three years. The black hole is one of the biggest and most powerful in the Universe and the jet is moving at nearly the speed of light.

Dr Alastair Stirling, from the University of Central Lancashire in Preston, is the only UK member of this international team of astronomers who have discovered the first direct observational link between a supermassive black hole and its jet. His work was part of a project conceived by Dr Tim Cawthorne, the leading radio astronomer in the Centre for Astrophysics at the University in Preston.

This black hole-jet link has been observed in microquasars, several of which are scattered across the Milky Way galaxy, but never before in active galaxies, because the scale (distance and time) is so much greater. These findings, announced only this week, are the result of a three-year monitoring campaign with the Very Long Baseline Array (VLBA), a continent-wide radio-telescope system operated by the National Radio Astronomy Observatory in USA, and NASA's Rossi X-ray Timing Explorer satellite.

The quasar-like "active" galaxy is essentially a scaled-up model of the microquasars within our Milky Way galaxy, which are smaller black holes (as massive as about ten suns) in a solar system with a normal star. This means that scientists can now use their close-up view of microquasars to develop working models of the most massive and powerful black holes in the universe.

"We have long suspected that the jets in active galaxies are powered by disks of hot gas orbiting around supermassive black holes, but now we have the first direct, observational evidence of this," explains Dr Stirling.

Active galaxies are distant celestial objects with exceedingly bright cores, often radiating with the brilliance of thousands of ordinary galaxies. They are fuelled by the gravity of a central million to billion-solar-mass black hole pulling in copious amounts of interstellar gas. The active galaxy in question is one named 3C120 about 450 million light years from Earth.

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The jets in galaxy 3C120 are streams of particles shooting away perpendicularly from the plane of a black hole's accretion disk, moving at 98% the speed of light. In microquasars, radio-emitting features become visible in a jet shortly after X rays from the accretion disk get dimmer, as if the accretion disk suddenly flushes into the black hole and disappears, fuelling the jet. These radio "blobs" then appear to move at faster than light speeds, an illusion caused by their ultra-high speeds.

Now the scientists see this same phenomenon in 3C120. Roughly every ten months, the X-ray-emitting accretion disk around its supermassive black hole becomes suddenly dim, and a month later the telltale bright spot of radio emission appears in the jet. Over three years, the team observed a series of radio blobs floating along the particle jet like smoke puffs, each time following a dip in the brightness of X rays from the accretion disk.

"To be able to find such a direct link between our Galactic microquasars and such distant and powerful objects as 3C120 is remarkable," says Dr Stirling. "The fact that we see such similar behaviour is vital in confirming that we understand the basic physics behind accretion flows and the resulting explosive ejections."

Dr Stirling's colleagues on the observation were Alan Marscher, Institute for Astrophysical Research, Boston University; Svetlana Jorstad, Boston University; Jose-Luis Gomez, the Astrophysical Institute of Andalucia, Spain; Margo Aller, University of Michigan; Harri Terasranta, Helsinki University of Technology; and Matthew Lister of the NRAO.

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Notes to editors:

For further information contact Dr Alastair Stirling on 01772 893556, email amstirling@uclan.ac.uk. Dr Stirling is a research scientist funded by UK's PPARC, on a research grant awarded to Dr Tim Cawthorne's team. They work in the Centre for Astrophysics at the University of Central Lancashire.

The VLBA is a continent-wide radio-telescope system, with one telescope on Hawaii, another on St. Croix in the Caribbean, and eight others in the continental United States. Part of the National Radio Astronomy Observatory, the VLBA offers the highest resolving power, or ability to see fine detail, of any telescope available. The Rossi Explorer was launched by NASA in 1995 to study black holes, neutron stars and pulsars, and is operated by NASA Goddard Space Flight Center.