No matter their size black holes 'feed' in the same way

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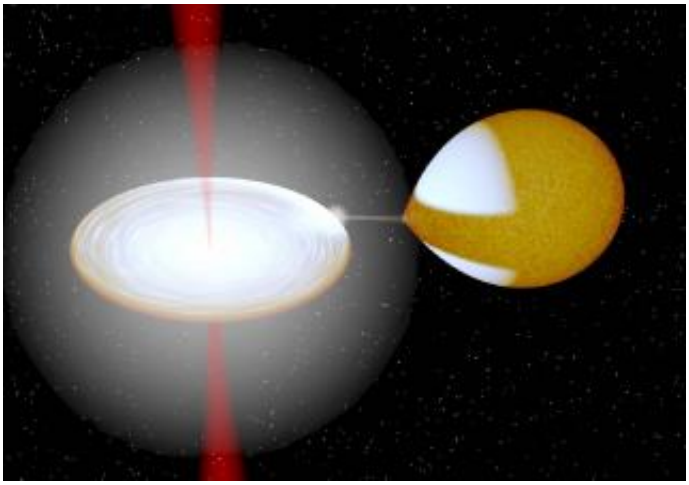

An X-ray binary system consisting of an accreting black hole and a binary star. Credit: R Hynes

Research by UK astronomers, published today in *Nature* reveals that the processes at work in black holes of all sizes are the same and that supermassive black holes are simply scaled up versions of small Galactic black holes.

For many years astronomers have been trying to understand the similarities between stellar-mass sized Galactic black hole systems and the supermassive black holes in active galactic nuclei (AGN).In particular, do they vary fundamentally in the same way, but perhaps with any

characteristic timescales being scaled up in proportion to the mass of the black hole. If so, the researchers proposed, we could determine how AGN should behave on cosmological timescales by studying the brighter and much faster galactic systems.

Professor Ian McHardy, from the University of Southampton, heads up the research team whose findings are published today (along with colleagues Drs Elmar Koerding and Christian Knigge and Professor Rob Fender, and Dr Phil Uttley, currently working at the University of Amsterdam). Their observations were made using data from NASA's Rossi X-ray Timing Explorer and XMM Newton's X-ray Observatory.

Professor McHardy comments, "By studying the way in which the X-ray emission from black hole systems varies, we found that the accretion or 'feeding' process - where the black hole is pulling in material from its surroundings - is the same in black holes of all sizes and that AGN are just scaled-up Galactic black holes. We also found that the way in which the X-ray emission varies is strongly correlated with the width of optical emission lines from black hole systems."

He adds, "These observations have important implications for our understanding of the different types of AGN, as classified by the width of their emission lines. Thus narrow line Seyfert galaxies, which are often discussed as being unusual, are no different to other AGN; they just have a smaller ratio of mass to accretion rate."

The research shows that the characteristic timescale changes linearly with black hole mass, but inversely with the accretion rate (when measured relative to the maximum possible accretion rate). This result means that the accretion process is the same in black holes of all sizes. By measuring the characteristic timescale and the accretion rate, the team argues this simple relationship can help determine black hole masses where other methods are very difficult, for example in obscured

AGN or in the much sought after intermediate mass black holes.

Professor McHardy continues: "Accretion of matter into a black hole produces strong X-ray emission from very close to the black hole itself. So, studying the way in which the X-ray emission varies with time, known as the X-ray lightcurves, provides one of the best ways of understanding the behaviour of black holes.

It has been known for over two decades that characteristic timescales can be seen in the X-ray lightcurves of Galactic black hole systems. The timescales are short (second) and so can be found in short observations. However to find the equivalent timescales in AGN is much harder as we must observe for months or years."

Citation: The paper ‘Active galactic nuclei as scaled-up Galactic black holes’ by Professor Ian McHardy and Drs Elmar Koerding and Christian Knigge and Professor Rob Fender of the University of Southampton (UK), and Dr Phil Uttley of the University of Amsterdam, is published in *Nature* today (7 December) pp 730-732.

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