Relativistic jets from feeding black holes

Research Field
Accretion and slow transients

Project Suitability
PhD, Honours

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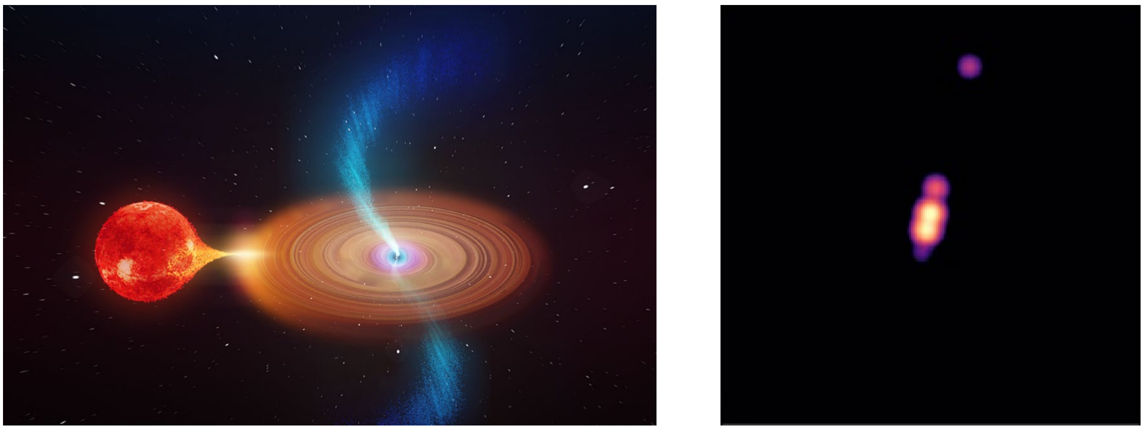
The release of gravitational potential energy as matter falls onto a compact object such as a black hole powers the most energetic phenomena in the Universe, allowing us to study higher energies and stronger gravitational fields than could ever be reproduced in a laboratory here on Earth.

As matter falls in towards a black hole, some fraction of the infalling material can be diverted outwards in powerful oppositely directed jets moving at close to the speed of light, and carrying away large amounts of the gravitational energy released, and depositing it into the surrounding environment. The jets from the most massive, rapidly-feeding black holes, known as quasars, can affect the evolution of their host galaxies, and even the galaxy clusters in which they reside. However, such massive systems evolve slowly, making it difficult to study the physics linking the launching of powerful jets and the inflow of gas in the accretion flow that feeds them.

Happily, smaller, stellar-mass black holes in our own Milky Way galaxy are governed by similar physics, but evolve on much faster timescales (days and weeks rather than millennia). These 'quasars for the impatient' act as excellent probes of the physics governing the link between accretion and outflow around black holes. We can study explosive outbursts of these systems as they evolve in real time, providing new insights into their radiative and kinetic feedback that, when extended to the supermassive black holes in quasars, can have an impact on cosmological scales.

In this project, you will work as part of a large international team conducting multi-wavelength observational studies of the explosive outbursts of stellar-mass black holes in X-ray binary systems, aiming to understand how these powerful events evolve, and in particular the connection between the changing conditions in the inflow and the launching of relativistic jets. You will use leading radio telescopes in Australia and around the world (including SKA pathfinder and precursor facilities) to study the jets launched by these stellar-mass black holes, aiming to determine how they are launched, and how they carry energy outwards into the surroundings.



Left: A schematic of a black hole accreting matter from a donor star via an accretion disk. Relativistic jets (shown in blue, as observed in right panel) are launched from the inner regions of the accretion flow.