

Searching for the First Black Holes with the MWA

How did the first super-massive black holes form and grow? There is growing evidence that some of the very first black holes formed very early in the Universe (within the first billion after the Big Bang) and may have been active during the [Epoch of Reionisation](#) when all the neutral hydrogen was reionised. How they grew so big, in such a short period, is not yet understood. During active phases, accreting black holes are the most luminous objects in the Universe often producing powerful jets of out-flowing material. These jets produce synchrotron radiation visible at radio wavelengths which far out-shine the host galaxy. Hence, radio surveys are a key tool in finding super-massive black holes in the early Universe.

Research Field

Radio Astronomy

Project Suitability

PhD

Honours

Project Supervisor

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This project will comprise three parts:

- (i) Studying the broadband radio properties of known powerful black holes at high redshift in order to characterise their typical jet emission and to examine the role of jets in their evolution. This will involve observing, reducing and modelling radio data from the [Australian Telescope Compact Array](#).
- (ii) Using the all-sky radio surveys from the low-frequency [Murchison Widefield Array](#) (MWA: 70-300MHz) and the [Australian Square Kilometre Array Pathfinder](#) (ASKAP: 700-1800MHz) to search for the earliest black holes. This part of the project will involve combining data from these two radio telescopes to select candidate sources in the early Universe.
- (iii) Follow-up of candidate early black holes with powerful optical and infrared telescopes such as the Very Large Telescope and the Atacama Large Millimetre Array. Such observations shall be used to weigh the primordial black hole, study its host galaxy and environment.

This project will uniquely exploit the large area surveys from the complementary MWA and ASKAP and pave the way for future studies with the Square Kilometre Array.



Fig 1: Model of the distortion of an accretion disk by a black hole as used in the film Interstellar ([James et al. 2015](#)).