ERC Consolidator Grant 2018
Research proposal [Part B1]
(Part B1 is evaluated both in Step 1 and Step 2, Part B2 is evaluated in Step 2 only)

Quasars in the 4th Dimension

Q4D

Principle Investigator: Nicholas P. Ross
Host Institution: University of Edinburgh
Duration: 60 months

Along with nuclear fusion in stars, accretion onto a central supermassive black hole (SMBH) is the main energy source available to a galaxy. All massive galaxies are thought to have SMBHs at their centres and to have undergone a "quasar phase" in their past. This has led to the hypothesis that energy from the quasar feeds back into the galaxy, becoming a regulating mechanism and shutting down star formation. However, while the fusion processes in stars have been on solid theoretical footing for over 70 years, current theories of galaxy formation and evolution are still missing a deep understanding of how the energy associated with the SMBH escapes the central engine to impact the host galaxy and the intergalactic medium.

Further issues arise since very recent observations of extreme variability in quasars, where some objects show changes in luminosity and activity *over the course of weeks to years,* have broken standard viscous accretion disk models.

Here we propose to use and combine the data from several next-generation state-of-the art surveys (SDSS-V, DESI, LSST, 4MOST, ESA *Euclid* and JWST) in order to go beyond the state-of-the-art and construct the extragalactic dataset with the crucial time-domain aspect that is necessary to address the current challenges. Our goal is to create and exploit a revolutionary new extragalactic dataset of the variable extragalactic Universe. We will use this as the boundary conditions for a holistic theory of accretion disk physics and quasar feedback in galaxy formation theory. I am also extremely well placed to discover brand new extragalactic variable phenomena, e.g. the EM signatures of merging binary SMBHs.

The experience of the PI, along with the strategic data centre aspect of the Royal Observatory at the University of Edinburgh makes my group uniquely positioned to address this challenge, and provide a fundamental new understanding of quasars, galaxy formation and evolution.