Black hole astrophysics through timing studies

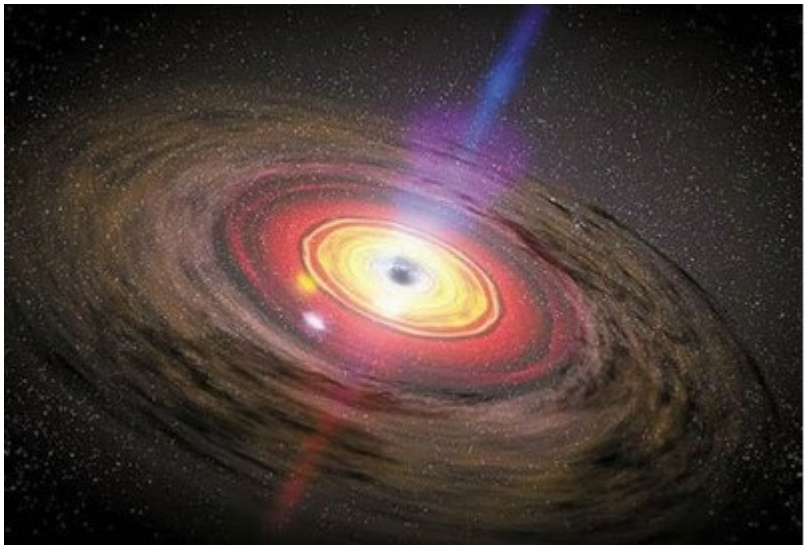
- **Novel methods of data analysis in astrophysics**
- **Observations of accreting black hole systems**

Level	PhD
First Supervisor	Simon Vaughan
Second Supervisor	Michael Goad
Application Closing Date	19 January 2022
PhD Start date:	26 September 2022

Project Details:

Accreting black holes hold many mysteries despite five decades of study. Most are far too small and distant to image directly, and so to understand the physics of such systems we must rely on what we can learn from the variations in brightness and the energy spectrum of the light they emit.

In this project we will develop and test new methods for analysing and interpreting the patterns contained in the brightness variations of black holes - both stellar-mass black holes in our Galaxy (see image) and super-massive black holes in Active Galactic Nuclei. We will focus on data from optical and X-ray observatories, and study variations over a range of timescales from milliseconds to years. Extracting the most useful information from such data poses some interesting analysis challenges due to the limitations of the data, which are often noisy and the timing of observations may be quite irregular, often with data coming from different instruments.



An active galaxy

The methods we develop will have applications in fields outside of astrophysics faced with similar challenges. This project may be of interest to anyone keen to investigate the astrophysics of accreting black holes and with an interest in the emerging field of data science.

References:

1 Vaughan, S. 2013, Random time series in astronomy (http://arxiv.org/abs/1309.6435)

2 Roberts S, 2013, Gaussian Processes for Time Series Modelling (https://royalsocietypublishing.org/doi/full/10.1098/rsta.2011.0550)

3 Vaughan S., et al. 2016, MNRAS, 461, 3145 (https://arxiv.org/abs/1606.02620)

4 Kelly, B. 2014, ApJ, 788, 33 (https://ui.adsabs.harvard.edu/abs/2014ApJ...788...33K/abstract)

5 Eckersall, A., Vaughan S., Wynn G., 2015, MNRAS, 450, 3410 (https://arxiv.org/abs/1504.00251)

Further information on how to apply and funding can be found HERE