UNIVERSITY OF LEICESTER

Listening to Black Holes: New Statistical Tools for AGN Variability

• Study the flickering light from accreting supermassive black holes. • Develop new statistical methods for analysing complex astronomical time series. • Work with data from major space-based and ground observatories and future surveys.	**Level**	PhD
	First Supervisor	Prof. Simon Vaughan
	Second Supervisor	Dr. Mike Goad
	Application Closing Date	17th January 2027
	PhD Start date	27th September 2027

Project Details:

Supermassive black holes at the centres of galaxies are surrounded by hot, accreting material that varies in brightness on timescales ranging from minutes to decades. These fluctuations provide a unique window into the physics of accretion and the environments surrounding black holes, but much of the information contained within astronomical light curves remains poorly understood.

This project will develop and apply novel statistical and machine learning techniques to investigate variability in active galactic nuclei (AGN). Using observations from facilities such as XMM-Newton, Swift, NuSTAR, and other major time-domain surveys, the student will explore whether AGN light curves contain signatures of non-linearity, complex stochastic behaviour, or other patterns that can reveal the underlying physical processes driving variability.

The project is suitable for students with interests in astrophysics, mathematics, statistics, or data science.

Further Reading:

- *Random time series in astronomy, 2013, Vaughan, S., [1309.6435] Random time series in Astronomy*
- *Studies in Astronomical Time Series Analysis: VII. An Enquiry Concerning Non-Linearity, the RMS-Mean Flux Relation, and log-Normal Flux Distributions, 2020, Scargle, J. D., arXiv:2001.08314*
- Peterson, B.M. (2001), *Variability of Active Galactic Nuclei* (arXiv:astro-ph/0109495).

Further Details:

- **Proposed Funding Source:** STFC
- **Proposed Start Date:** 27th September 2027 for 3.5 years.
- **Closing Date:** 23:59 Sunday 17th January 2027.
- **Eligibility:** UK/EU/International; fee waivers will be available for small number of international students; otherwise international applicants must show that they can cover the fee difference between UK/International costs (~£16k/year).
- **Entry requirements:** Applicants are required to hold/or expect to obtain a UK Bachelor Degree 2:1 or better in a relevant subject. The University of Leicester English language requirements apply where applicable.
- **Application enquiries to pgradmissions@le.ac.uk**

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