



Lighting up the dust: the effect of energetic flares on galactic environments

- Probing the interaction of high energy pulses from accreting sources with their environments
- Mapping galactic dust structures whilst unravelling pulse mechanisms
- Utilising comprehensive X-ray catalogues for leading space missions in which the University of Leicester plays a key role

Level	PhD
First Supervisor	Dr Rhaana Starling rlcs1@leicester.ac.uk
Second Supervisor	Name
Application Closing Date	20 th January 2023
PhD Start date	September 2023

Project Details:

Energetic events in the Universe are unique probes of galactic environments on both the distant Universe and local scales. Among the most dramatic effects, are expanding halos seen around variable X-ray sources including X-ray binaries, magnetars, soft gamma-ray repeaters and gamma-ray bursts caused by scattering of the X-ray photons off dust screens along the line-of-sight. This phenomenon combines information about the pulse structure and intensity of the accretion-driven central engine and the properties and geometry of the local dust that acts as a scattering screen. Such events are expected to be quite common, and can be probed with high energy satellite data from the Neil Gehrels Swift Observatory, XMM-Newton and Chandra among others.

Infrared dust halos have been observed in active galaxies and tidal disruption events. These are generated in a different physical process, in which radiation is absorbed by dust located within the host galaxy and re-radiated in infrared. These halos indicate the geometry of the central regions of galaxies hosting black holes, and can be seen alongside a burst of high energy X-ray emission such as disruption of a star by a black hole, or an AGN flare.

Leicester is host to the UK Swift Science Data Centre and part of the XMM-Newton Survey Science Centre through which a treasury of observations is now available for systematic studies. We have a detailed knowledge of key instrumentation and its calibration, having had a build-role in the X-ray telescopes for these and many other missions. The gamma-ray burst of October 2022 has propelled dust halos to the fore once more, where intense luminosity in pulsed high energy emission meets dense dust concentrations in our own Galaxy forming a spectacular expanding ring system, similar to that illustrated in Figure 1 from the outburst of an X-ray binary. The capability to detect the transient and variable objects which produce such events is growing with the imminent deployment of new space missions as well as wide-field survey telescopes on the ground, fuelling a need for more in-depth studies of the interplay between energetic events and their environments.

In this project you will work with a range of observational data, employing analysis and instrumental calibration techniques through developing your own codes and applying existing dedicated software, to discover and understand these events and their effects.

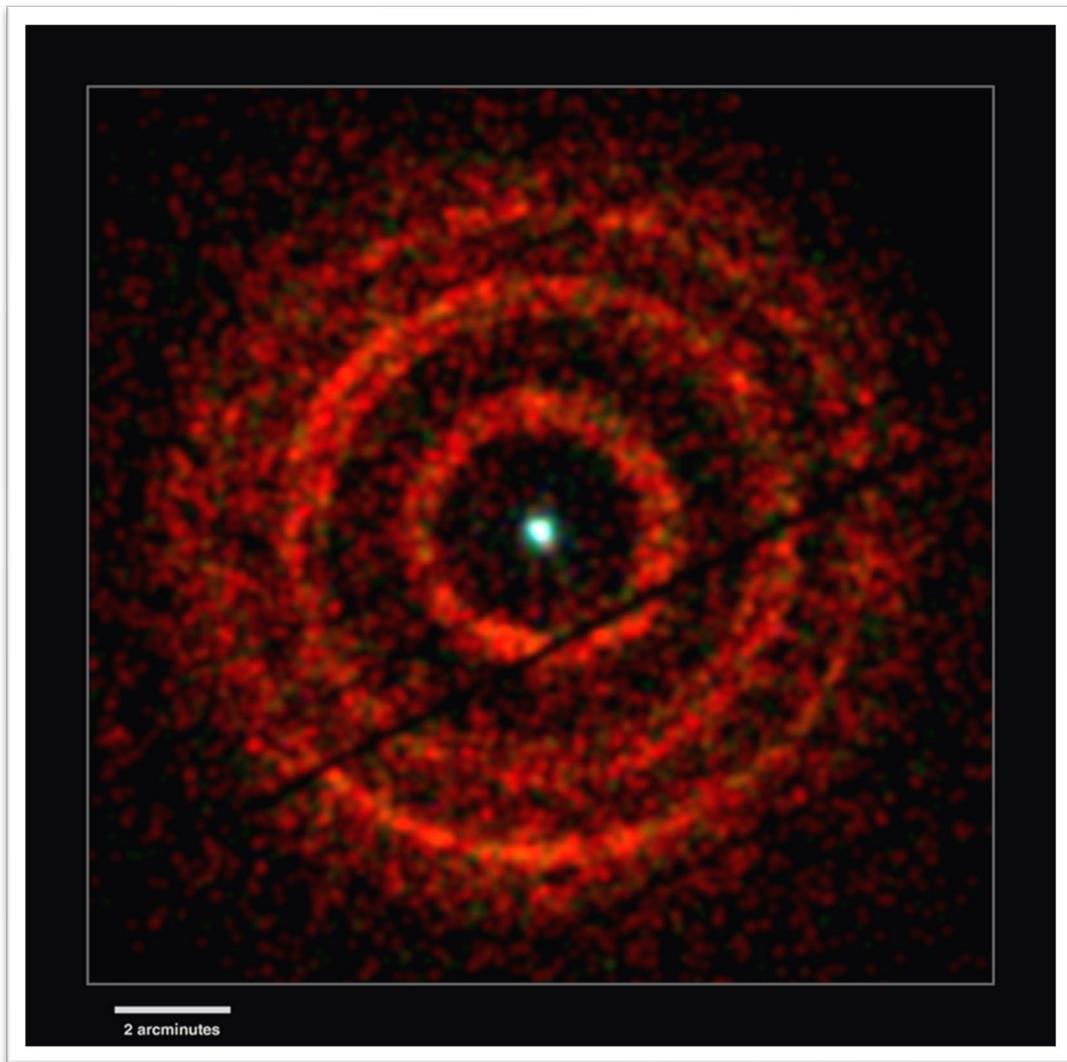


Image of the X-ray binary V404 Cyg in X-rays taken with the Swift X-ray Telescope. Surrounding the central source are several bright rings, called dust halos. Credit A. Beardmore.

References:

- Lord of the Rings – Return of the King: Swift-XRT observations of dust scattering rings around V404 Cygni
- Beardmore et al. 2016, Monthly Notices of the Royal Astronomical Society 462, 1847
- <https://ui.adsabs.harvard.edu/abs/2016MNRAS.462.1847B/abstract>
- Exploring the interstellar medium using an asymmetric X-ray dust scattering halo
- Jin et al. 2019, Astrophysical Journal 875, 157
- <https://arxiv.org/pdf/1903.08099.pdf>

How to apply:

Include with your application:-

- CV
- Degree Certificates and Transcripts
- Details of any study currently being undertaken

- Personal statement
- Enter the supervisor's name and project title in the Proposal Section (no proposal required)
- Enter contact details of two academic referees in the boxes provided or upload reference letters if already obtained.
- Evidence of English language if applicable.
- In the funding section include: Ref: Starling - UKRI (STFC)

The University of Leicester School of Physics and Astronomy has advertised a number of PhD opportunities. If you are applying for more than one University of Leicester project, please indicate if this is your first, second or third choice, in your application.

Further information on how to apply and funding can be found [here](#)