Black holes in the high-redshift Universe with the next-generation X-ray observatory

Supervision team: Judith Croston, Hugh Dickinson, Jane Bromley

Lead Contact: Judith Croston

Project highlights:
- Be involved in planning for Europe’s next large space telescope
- Develop skills in machine learning and its application to astronomical surveys
- Work with real and simulated data from X-ray space observatories to tackle important questions about black hole and galaxy co-evolution

Project description:
The European Space Agency’s Athena X-ray observatory (https://www.the-athena-x-ray-observatory.eu and https://sci.esa.int/web/athena) is the next large-class European space observatory, which will be a successor to XMM-Newton. With more than ten times the sensitivity of existing facilities, and exquisite spectroscopic capabilities, Athena will provide a step-change in mapping the hot and energetic Universe. This project will involve working with members of the Athena science team to develop predictions and simulated datasets to explore Athena’s ability to map black holes in the early Universe, with particular focus on the impact of astrophysical jets on galaxy evolution.

Jets and winds from supermassive black holes dramatically affect how galaxies grow and change over the history of the Universe. Athena is expected to revolutionise our understanding of black hole growth and the impact of black holes on their environments (a process commonly known as AGN feedback). Dr Croston is a member of the ESA science study team for Athena, and our group at the OU has pioneered methods of investigating AGN feedback using a combination of X-ray and radio observations. This project will involve using current-generation X-ray observations and the recently released largest ever radio AGN catalogues from the LOFAR project (www.lofar-surveys.org) to inform simulations of high-redshift AGN populations, with a particular focus on predictions for their extended X-ray emission.

The much deeper sensitivity of next-generation X-ray surveys leads to interesting technical challenges in extracting optimal information from the observations for accurate source
characterisation. The OU astronomy group are developing a variety of machine learning tools for detecting rare objects in multi-wavelength surveys data and for optimal image reconstruction at the limits of instrument spatial resolution. As part of this PhD project you will explore adapting techniques developed primarily for infrared wavelengths for use with Athena wide-field imager observations.

References:


Additional resources required: The project will make use of the STEM linux cluster as well as external HPC resources as needed.

Qualifications required: A first class BSc in astrophysics or similar, or a 2:1/merit in an integrated masters such as an MPhys or a BSc 2:1 plus a Masters qualification. Strong computing skills are essential.