Using X-rays to Reveal Hidden Monster Black Holes

1 Introduction

Every galaxy in the Universe hosts a super-massive black hole at their centre, billions of times the mass of our Sun. These systems capture vast quantities of matter due to their strong gravitational pull. The in-falling matter then emits radiation across the full electromagnetic spectrum before being destroyed by the black hole, creating an **Active Galactic Nuclei (AGN).**

The emission can be absorbed by **thick layers of gas and dust** covering the AGN. As the obscuration increases, only the **highest energy X-rays** can escape.

2 Method

X-rays are absorbed by the atmosphere, so I use data from X-ray satellites located above the atmosphere, such as ***NuSTAR*** and ***Swift***. Both these have specialist instruments onboard to detect high energy X-ray emission throughout the Universe.

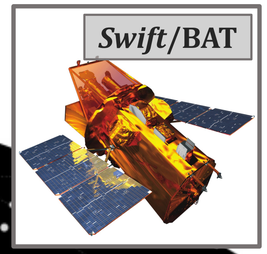
Below, I have plotted an all-sky map of AGN, detected by the Burst Array Telescope (BAT) onboard *Swift*. The size of the points gives the relative strength in X-ray flux detected.

Overlaid are images of a selection of these AGN, from the ***Chandra*** X-ray satellite, with the size scale for each. The brightest point on many of these images is the centre of the AGN, illustrating why X-ray observations are so useful for studying the **closest regions to the central black hole**.
Also included is a *NuSTAR* image of the highly obscured (and X-ray faint) source I've been studying **– IC 3639**.

3 Future

I hope to be able to understand the connection between X-rays emitted by AGN and radiation emitted at other lower energy wavelengths.
In addition, my aim is to determine the **distribution of obscured AGN** across the Universe, to figure out how these super-massive black holes have **evolved and grown** since their formation over 13 billion years ago.

The full BAT catalog:



I've been studying a black hole ***so*** hidden, that there is no detection with *Swift*/BAT – instead, I use data from the *NuSTAR* satellite (imaged here), which is more sensitive at detecting heavily obscured AGN.

This is one of the best *ideas* of what an unobscured black hole might look like, adapted for the movie *Interstellar*.
(The arrow is pointing to a largely unobscured AGN, 'NGC 3080').

James et al. (2015, arXiv:1502.03808)

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1 Astronomical Unit (AU) is the distance from the Earth to the Sun, or 150 million km.

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