Intermediate-mass and supermassive black holes likely suffer the same obscuration biases.

An intermediate-mass black hole growing within a dense circum-nuclear environment

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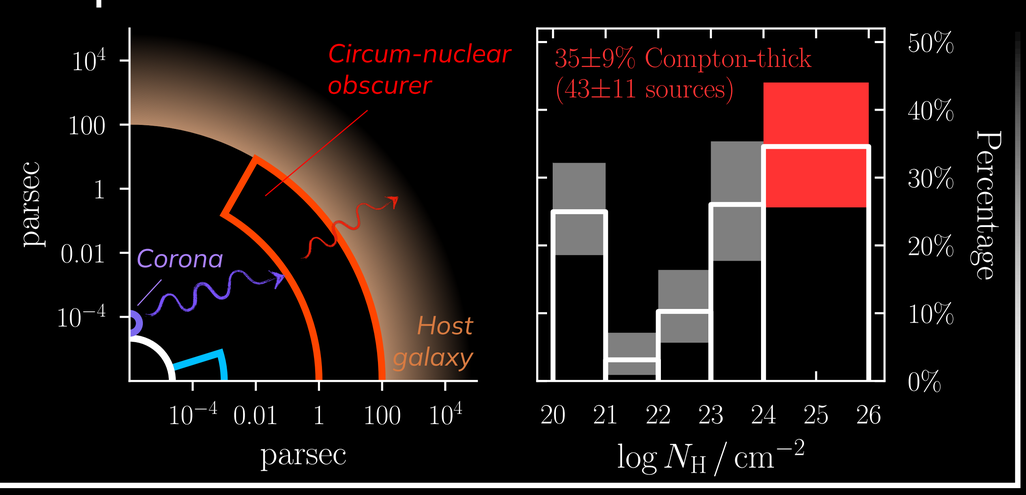
1. The prevalence of Compton-thick supermassive black holes

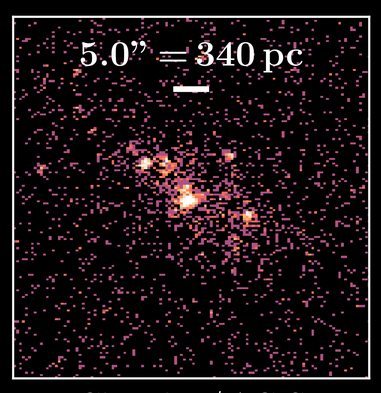
Almost all growing supermassive black holes (aka active galactic nuclei; AGN) will feature some level of circum-nuclear obscuration (see left panel; Hickox & Alexander 2018, Boorman et al., 2024).

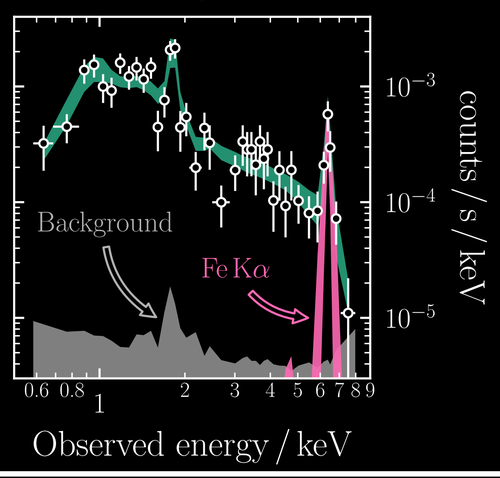
Compton-thick AGN are defined in X-rays to have line-of-sight column densities $N_H > 10^{24}$ cm^{-2} and are notoriously difficult to characterise. The latest compilation in the Database of Compton-thick AGN (DoCTA) finds just 66 Compton-thick AGN currently known. However, the latest measurements from the NuSTAR Local AGN N_H Distribution Survey (NuLANDS) show that at least 35 ± 9% of all AGN within 200 Mpc should be Compton-thick (right panel). **Compton-thick AGN are thus one of the least-understood classes of AGN due to their obscuration bias.**



The Database of Compton-Thick AGN (DoCTA)

2. IC 750: The first Compton-thick intermediate-mass black hole





IC 750 is the only AGN with a precise megamaser-based black hole mass firmly in the intermediate mass regime ($M_{BH} = 70^{+70}_{-40} \times 10^3$ $M_\odot$). A previous short Chandra exposure revealed a very faint AGN in X-rays, though with insufficient sensitivity to characterize the source in detail (see Chen et al., 2017, Zaw et al., 2020).

Deep Chandra follow-up observations totalling 177 ks of exposure revealed numerous off-nuclear spatially-resolved contaminants (left panel). By fitting the co-added high-sensitivity Chandra spectrum (right panel) with physically-motivated models, we find the AGN in IC 750 is Compton-thick to >99% probability.

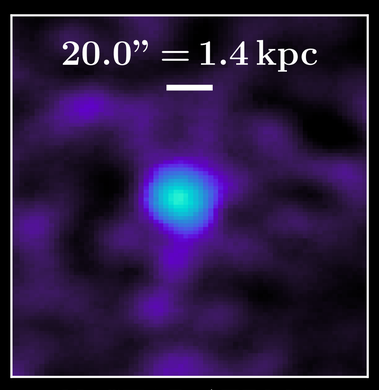
IC 750 is thus the first Compton-thick intermediate mass black hole.

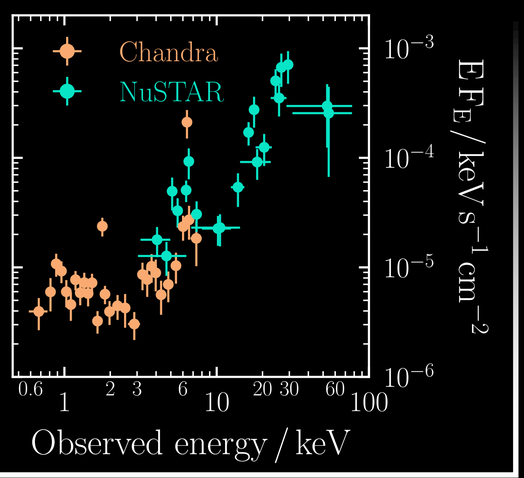
The NuSTAR Local AGN N_H Distribution Survey (NuLANDS)

3. Prospects for the future by pairing Chandra with NuSTAR

With no other Compton-thick intermediate mass black holes currently known, IC 750 provides the first evidence that intermediate mass black holes suffer the same obscuration biases as supermassive black holes. Any attempt to estimate population demographics or construct a census of intermediate mass black holes **should thus consider dense circum-nuclear obscuration as a source of selection bias**.

Only Chandra was able to spatially resolve the faint X-ray signal from the Compton-thick AGN in IC 750, but more clues are hidden within the broadband spectrum. Our recently-approved and ongoing 220 ks observing campaign with NuSTAR (see left and right panels) aims to fully characterise the properties of the circum-nuclear environment of IC 750 with broadband spectroscopy over the 0.5-80 keV passband.





Read more about IC 750 here!

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