Compton Thick AGN in the COSMOS field

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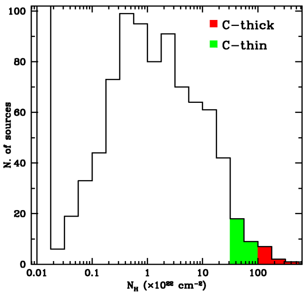
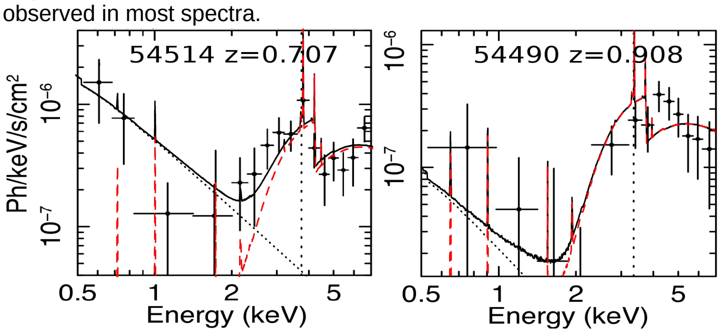
Intro: Highly obscured, Compton thick (N_H>10^{24} cm^{-2}) AGN are common in the local Universe[1], and a large population of CT AGN at all redshifts is required in order to reproduce the Cosmic X-ray Background[2]. Identifying these obscured sources beyond the local Universe, however, is challenging even in the deepest X-ray surveys[3].CT column densities suppress the nuclear emission up to 10 keV, and therefore the N_H distribution above 10^{24} cm^{-2} is largely unknown. In two recent papers we combined deep X-ray spectroscopy and a new multi-wavelength approach to identify a sample of the most obscured sources in the COSMOS field, and study the host and SMBH properties of these systems.

X-ray selection of CT AGN:

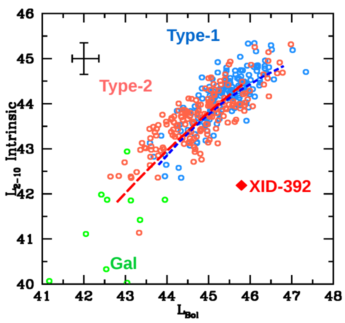
In **Lanzuisi et al. 2015 A&A, 573A, 137** we selected a small sample of CT AGN in the COSMOS field: 10 CT candidates out of ~1200 sources for which X-ray spectral analysis is feasible (>30 counts). The X-ray selected CT AGN have a wide distribution of z and L_X (**z= 0.1 – 2.5, Log(L_{2-10}) = 43.5 - 45 erg s^{-1}**). The total Chandra+XMM spectra are fitted with a simple model (BNTorus[4]+ scattered emission). The Fe absorption edge and Fe emission line are observed in most spectra.

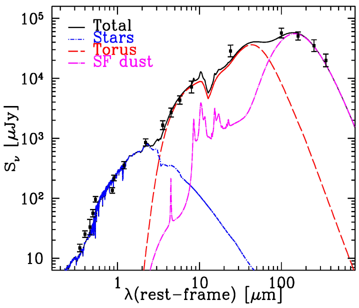




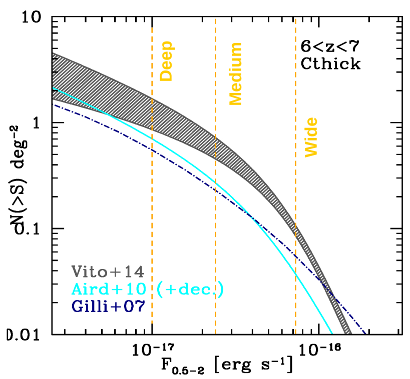
Multi-λ selection:

in **Lanzuisi et al. 2015 A&A 578A 120** we compared the L_{Bol} derived from SED fitting[7] and the intrinsic L_X of **~400 COSMOS** sources and identified one source (**XID-392** in the XMM catalog) that is >2 order of magnitudes away from the expected L_{Bol}-L_X relation[6]. XID-392 is a **ULIRG** (Log(L_{IR})=45.3 erg/s) at z=0.353. The AGN fraction between 3 to 60 μm is 90%. The host galaxy is massive ($LogM_{Star}$=11.4 M_{Sun}) and the SFR is 22.2 M_{sun}/yr.





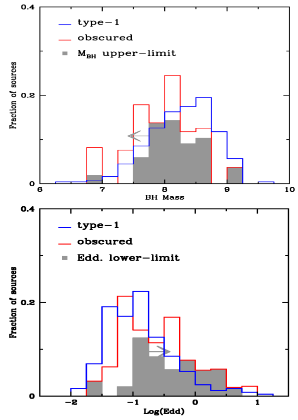
Combining the most up to date models of AGN LF at high redshift[14,15,16] and CT fraction[17], and the current Athena survey design (yellow lines), we present estimates on the detectability of CT, up to redshift ~6-7, with Athena. This demonstrates that we will be able to detect, and recognize as such, a small (few to tens) but incredibly valuable sample of CT AGN at such high redshift.



The results obtained from these works point toward a scenario in which highly obscured AGN occupy a peculiar place in the galaxy-AGN co-evolution process, in which both the host and the SMBH rapidly evolve toward the local relations, and where strong AGN feedback signatures can be seen. Athena will revolutionize the study of such sources at extremely high redshift.

SMBH properties:

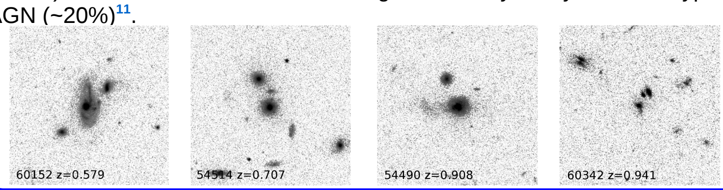
Using SMBH mass estimates derived from stellar mass[5,6] and AGN L_{Bol} from SED decomposition[7], we showed that highly obscured AGN have a distribution of M_{BH} shifted toward smaller masses (at **>2.6 σ significance**), and a distribution of λ_{Edd} shifted toward higher accretion rates (at the same significance), with respect to a control sample of **~250 type-1 AGN**[8], matched in luminosity and redshift. We corrected for redshift- and luminosity-dependent incompleteness for obscured sources due to the flux-limited nature of the COSMOS X-ray coverage.



Host properties:

The sSFR of the selected sources is typical of MS star forming galaxies[9] at all redshifts, and no source is observed in extreme star-burst phase ($sSFR/sSFR_{MS}$>4).

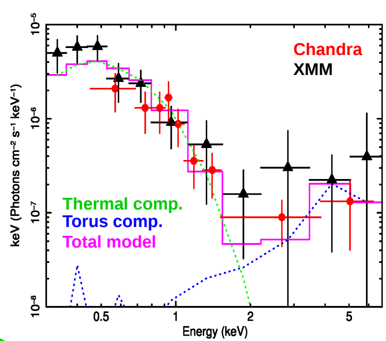
High resolution, HST-ACS images show that 35−45% of our CT sources show some indication of merger/disturbed morphology, a fraction significantly higher than the one observed in X-ray selected AGN samples (~15%)[10], and the one observed for high luminosity X-ray selected type-2 AGN (~20%)[11].

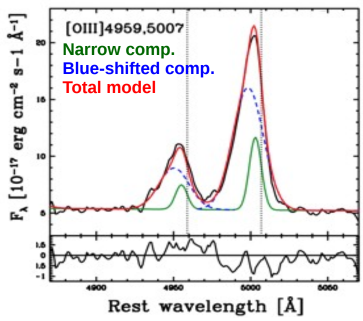


X-ray spectra and outflow signatures:

Chandra and XMM spectra of **XID-392** show a soft component up to 2 keV (thermal emission from the host), while only Chandra detects the source in 2-10 keV. The spectrum in the hard band is **flat (Γ=0.68±0.45)** and can be modeled with an obscured torus template[4]. The column density is **Log(N_H)> 24.5 cm^{-2}**.

Both the OIII and [NeV] doublets in the optical spectrum of XID-392 show broadened asymmetric profiles, with velocity off-sets (to the blue) of ~950-550 km/s and FWHM~1200-1800 km/s. These features are commonly associated with outflows of gas on kpc scales[12,13], possibly driven by the powerful SMBH accretion (L_{Bol}/L_{Edd}=~0.5).





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