Compton-thick AGN in eROSITA

I. Georgantopoulos, E. Rovilos, A. Comastri

INAF/Osservatorio Astronomico di Bologna, Via Ranzani 1, 40127, Italy

ABSTRACT

We discuss the capabilities of EROSITA for detecting Compton-thick AGN. Despite the fact that eROSITA probes relatively bright flux limits (~3x10^{-13} erg/cm2/s in the 2-10 keV band, all-sky), there is a huge potential for detecting numerous heavily obscured and Compton-thick sources because of the large area covered. In particular about 3,000 Compton thick AGN are expected in the all-sky survey according to the X-ray background synthesis models of Gilli et al. 2007. As Compton-thick sources represent only 1 source out of a thousand, locating them is a painstaking process. Here, we explore the possibility of selecting heavily absorbed sources (and hence candidate Compton-thick AGN) on the basis of low Lx/LIR ratio. The mid-iR WISE mission is particularly suitable for providing the mid-IR fluxes. As a demonstration of this technique, we cross-correlate the existing WISE catalog with the XMM/SDSS (Georgakakis & Nandra 2011), a survey which exploits all the puclicly available XMM observations in regions covered by the SDSS covering an area of 120 sq. degrees. We find 5 heavily obscured sources at redshifts below z=0.2

RELIABILITY OF THE LX/L6 METHOD

Goulding et al. (2010) used the Lx/L6 ratio method to identify heavily obscured AGN in the local Universe. The idea is that in heavily obscured AGN, the absorbed radiation is re-emitted at mid-IR wavelengths. As the mid-IR luminosity represents an isotropic property of the AGN a particularly low Lx/Lmid-IR ratio works as an obscuration diagnostic. The 6 micron emission is most often used as these wavelengths are dominated by hot dust and thus less contaminated by star-formation. Georgantopoulos et al. (2011) checked the validity of this method in the local Universe using the 12μm IRAS sample for which excellent quality XMM observations (and thus reliable X-ray classification of the Compton-thick sources) are presented in Brightman & Nandra (2011). The results of Georgantopoulos et al. (2011) are presented in Fig.2 In summary, the method appears to be reliable in finding Compton-thick sources: practically all the Compton-thick sources of Brightman & Nandra display low Lx/L6 ratios. However, the method is not very efficient. There are many low Lx/L6 sources which are heavily obscured but not Compton-thick according to the X-ray spectroscopy.

THE WISE SURVEY

WISE is a wide-field infrared imager and its main purpose is to conduct an all-sky survey in four bands, 3.4, 4.6, 12 and 22 μm. It reaches a 5σ sensitivity of 0.08 mJy with an angular resolution of 6.1″ in the 3.4 μm band. The preliminary data release covers 57% of the sky and contains over 250 million

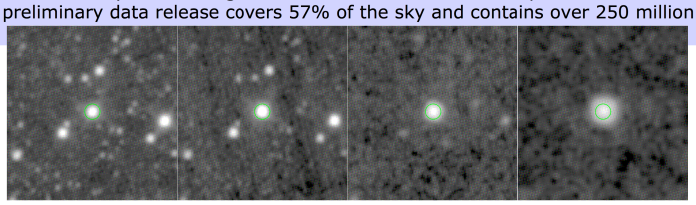

Figure 1
WISE image examples of the heavily obscured source which spectrum is shown in Fig. 4. The four images correspond to the four WISE bands and the green circles have 15″ radii.

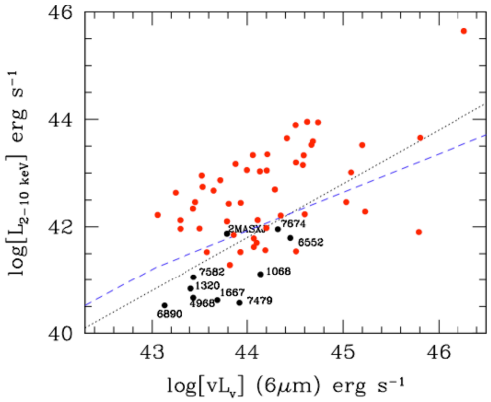

Figure 2
The Lx-L6 relation for the sources in the 12 μm IRAS sample of Brightman & Nandra (2011). The blue line denotes the COSMOS AGN line (Fiore et al. 2009) reduced by a factor of 30 to match the X-ray emission of Compton-thick AGN. The Compton-thick sources according to X-ray spectroscopy are denoted with black.

THE XMM/SDSS SURVEY

The XMM/SDSS survey (Georgakakis & Nandra 2011) contains about 40,000 sources detected over ~120deg2. Here we use the full band (0.5-8 keV) sample. The XMM/SDSS is deeper than the eROSITA survey: 50% of the survey area has a flux limit of ~10^{-14} erg/cm2/s in the 0.5-10 keV band. There are about 2,000 sources in the 0.8-8 keV band with spectroscopic redshift available in the SDSS. Out of these 560 are in the redshift range 0.03<z<0.2 having r<17.7.

CANDIDATE OBSCURED AGN

We cross-correlate the 0.5-8 keV XMM/SDSS sample with the WISE catalog using a radius of 5 arcsec. We restrict our sample only to those sources which have a spectroscopic redshift available. We find 210 coincidences at redshifts z<0.2 and 85 coincidences at the redshift range 0.5<z<1. Their Lx/L6μm distribution is shown in Fig.2. There are 69 'low' Lx/L6 sources which lie below the AGN COSMOS line. Hardness ratio analysis of these shows that many of these present relatively soft hardness ratios.This togeter with their low X-ray luminosities suggest that these are related with normal galaxies. However, 5 sources present hard X-ray spectra. An example is given in Fig. 4

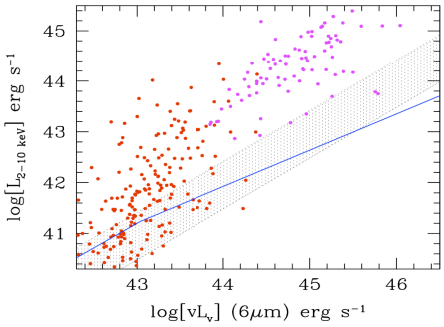

Figure 3
The Lx-L6 relation for the XMM-SDSS/WISE sources for two redshift ranges: 0.4<z<1 (purple) and z<0.2 (red). The hatched region corresponds to the local AGN relation of Lutz et al. (2004) and its associated 1σ error scaled down by a factor of 30 typical of the X-ray emission of Compton-thick AGN. The blue line corresponds to the average COSMOS AGN relation of Fiore et al. (2009) again reduced by the same amount.

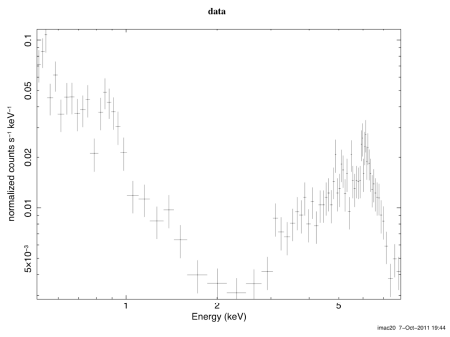

Figure 4
The XMM spectrum of one low Lx/L6 source from the XMM/SDSS sample. The derived column density is a few times 10^{23} cm^{-2}.

References:

Brightman, M., Nandra, K., 2011, MNRAS, 414, 3084
Fiore, F., Puccetti, S., Brusa, M., et al., 2009, ApJ, 693, 447
Georgakakis, A., Nandra, K., 2011, MNRAS, 414, 992
Georgantopoulos, I., Rovilos, E., Akylas, A., et al., 2011, A&A, 534, 23
Gilli, R., Comastri, A., Hasinger, G., 2007, A&A, 463, 79
Goulding, A. D., Alexander, D. M., Lehmer, B. D., Mullaney, J. R., 2010, MNRAS, 406, 597
Lutz, D., Maiolino, R., Spoon, H. W. W., Moorwood, A. F. M., 2004, A&A, 418, 465