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The density of local Compton-thick AGN

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Abstract. We present a new efficient diagnostic method, based on mid-infrared and X-ray data, to select local (z<0.1) Compton–thick (CT) AGN with the aim of estimating their volume density. In order to test the efficiency of the proposed method, we use the results of the X-ray spectral analysis performed on all sources in a sample composed of 43 CT AGN candidates selected using data from the IRAS–PSC and 2XMM catalogues. After taking into account the different selection effects, we estimate the number of CT AGN in the local Universe and their surface density down to the IRAS flux limit ($F_{25\mu m}$(AGN)=0.5 Jy). The co-moving volume density of CT AGN with intrinsic $L_X > 10^{43}$ erg s^{-1} (0.004<z<0.06) is: $F_{CT} \sim 3.5 \times 10^{-6}$ Mpc^{-3}, in good agreement with the prediction for CT AGN based on the synthesis model of XRB in Gilli et al. (2007).

Key words. Infrared: galaxies, X–ray: galaxies, Galaxies: active

1. Introduction

In Severgnini et al. (2012), we propose a new diagnostic plot to select Compton–thick (CT) AGN candidates in the local Universe. The plot is based on the combination of the F(2-12 keV)/($\nu_{25}F_{25}$) flux ratio with the XMM-Newton color (HR4[1]). While the F(2-12 keV)/($\nu_{25}F_{25}$) flux ratio allows us to separate heavily obscured AGN candidates and starburst galaxies from less obscured (NH<5×10^{23} cm^{-2}) AGN, the X-ray color is very efficient to separate starburst (HR4<-0.2) from obscured AGN (HR4>-0.2). On the basis of this plot we define the expected CT AGN region (F(2-12 keV)/($\nu_{25}F_{25}$)<0.02 and HR4>-0.2). We have then cross–correlated the IRAS–Point Source Catalog with the bright end of the v1.0 2XMM incremental slim catalogue ($|b^{II}|$ >20 deg) and found 145 matches, 44 of which lie in the CT region of Fig. 1 (red filled squares in the electronic version only). Forty-three sources are extragalactic objects and one (the isolated encircled source) is a Galactic object. The full list of these 43 sources is reported in Severgnini et al. (2012). We performed our own X-ray spectral analysis for all the 43 sources and we confirm the CT nature for 36/43 candidates (84%), 7 of which are newly discovered ones. One of these is IRAS 04507+0358, that we have extensively discussed in Severgnini et al. (2011). We estimate that our method to select local CT AGN is complete at 95% (see Severgnini et al. 2012 for details).

2. Compton-thick AGN density

By excluding the contribution to the 25 μm flux due to star-formation (∼60–90%), we es-

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[1] HR4 =[Cts(4.5-12 keV) - Cts(2-4.5 keV)]/[Cts(4.5-12 keV)+Cts(2-4.5 keV)]

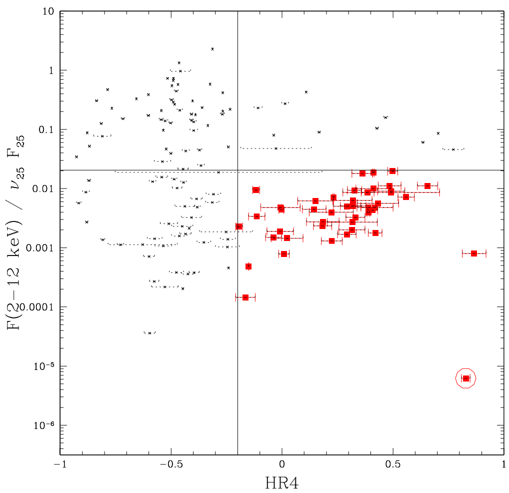

Fig. 1. F(2-12 keV)/(ν_{25}F$_{25}$) vs. HR4 diagnostic plot for the 145 source found by cross-correlating the IRAS-Point Source Catalogue at 25μm and the 2XMM catalogue. Filled squares (red symbols in electronic version only) are the 44 sources that have flux ratios and X–ray colors typical of Compton–thick AGN. The isolated object in the bottom–right part of the diagram marked with an empty circle is the only galactic source (V* R Aqr) present in the Compton–thick candidate region.

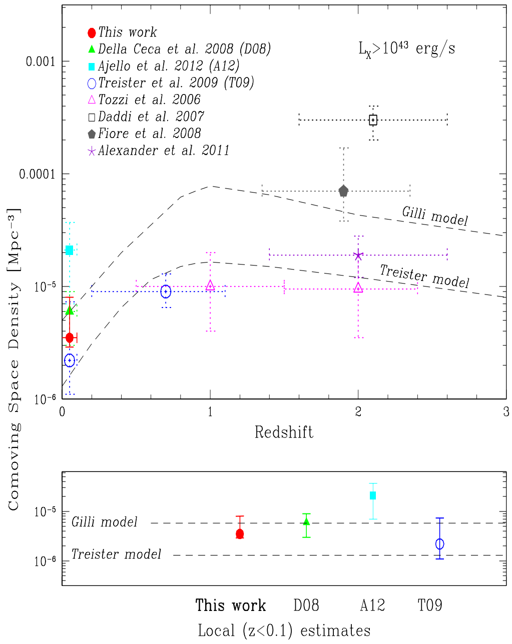

Fig. 2. Co-moving space density of Compton–thick AGN. All the data and the model plotted in the figure refer to L$_X$ >10^{43} erg s^{-1}. The results are compared to the predictions of the models proposed by Gilli et al. (2007) and Treister et al. (2009a), dashed curves. The local co-moving space density estimates are reported also as a function of the different authors.

timate the *CT AGN surface density* down to F$_{25\mu m}$ (AGN)=0.5 Jy. We find: $\rho^{CT} \sim 3\times10^{-3}$ src deg^{-2}. This value is consistent with the density computed in the hard X-ray surveys with SWIFT-BAT by Burlon et al. (2011). We then estimate the *co–moving volume density* for sources with L$_X$ > 10^{43} erg s^{-1} and 0.004<z<0.06. We find: $\Phi^{CT} \sim 3.5\times10^{-6}$ Mpc^{-3}. In Fig. 2 we compare this value with previous results at different z and with the predictions of the synthesis models of the Cosmic X–ray Background. The local co-moving space density estimates are reported also in the lower panel as a function of the different authors. The prediction for CT AGN based on the synthesis model of the CXB in Gilli et al. (2007) is consistent with our value, while the prediction by Treister et al. (2009a) is significantly lower.

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