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The most obscured AGNs with Simbol-X

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Abstract. The Cosmic X-ray Background (CXB) synthesis models and the 'relict' Super Massive Black Hole mass function suggest that present 2-10 keV X-ray surveys are missing a large number of obscured (log $N_H > 23$) AGNs. Most of these obscured AGN should shine above 10 keV. However, up to now only a few hundred sources are known above this energy, mainly thanks to the BeppoSAX PDS, INTEGRAL and Swift. We study the Simbol-X capabilities to find the most obscured AGNs, which are expected to be the most important contributors to the Cosmic X-ray Background, where it peaks at ~30 keV. We show that in a single 1 Msec observation Simbol-X can detect 10-20 sources up to a 10-40 keV flux limit of $5\text{-}6\times10^{-15}$ erg cm^{-2} s^{-1}. A simulation of a 1Msec observation of the Chandra Deep Field South shows that Simbol-X will detect in the 10-40 keV band several highly obscured AGN invisible even in the deepest Chandra exposure.

Key words. Obscured Active Galactic Nuclei

1. Introduction

Deep Chandra and XMM-Newton surveys have resolved the majority of the CXB below 5-7 keV. However, AGN synthesis models for the CXB predict a large fraction of highly obscured AGNs, which are missing in all the present X-ray surveys performed below 10 keV. Obscured AGNs ($N_H \leq$ a few 10^{-24} cm^{-2}) show nuclear emission and/or Compton reflection continuum at energies $\geq$ 10 keV. We performed detailed simulations to study how Simbol-X can provide crucial information on these highly obscured AGNs.

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2. The Simbol-X hard X-ray sky

We simulated 1 Msec Simbol-X observations in the energy range 10-40 keV. The simulated hard X-ray sources follow the logN-logS evaluated by extrapolating the 2-10 keV luminosity functions of La Franca et al. (2005) at hard X-ray energies. To account for photoelectric absorption we have evaluated the 10-40 keV logN-logS in bins of N_H, assuming, following La Franca et al., a flat distribution up to 10^{25} cm^{-2}. Fig. 1 shows a simulated image for the SDD (10-20 keV and exposure 0.5 Msec to account for the dead time) and for the CZT (10-40 keV and exposure 1 Msec) cameras.

3. The CDFS in the hard X-rays

It has been recently found that sources with high F(24μ m)/F(O) and high R-K colours,

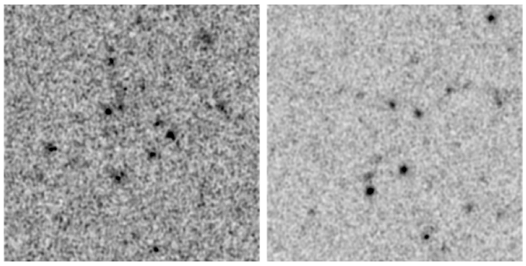

Fig. 1. Left panel: a 0.5 Msec simulated SDD camera observation. Right panel: a 1 Msec simulated CZT camera observation. The field of view is 13×13 arcmin.

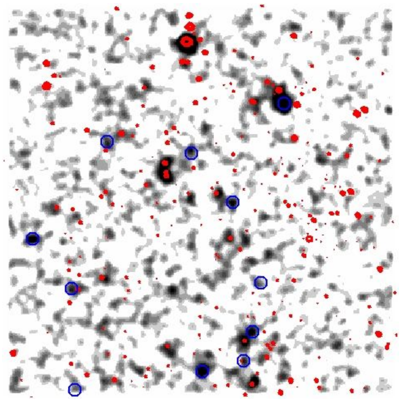

Fig. 2. The combined CZT+SDD 1 Msec image of the CDFS in the 10-40 keV band. The blue contours are the X-ray 0.3-8 keV Chandra contours. The red circles are the IR-selected sources. The field of view is 13 × 13 arcmin.

form a distinct source population, and that their infrared luminosity is dominated by AGN emission (Fiore et al. 2007, Daddi et al. 2007). The infrared selected sources have been detected in X-rays through a stacking techniques. Interestingly, the signal is stronger at higher energies, thus suggesting that this source population is dominated by highly obscured AGN (Fiore et al. 2007). To investigate whether these sources could be detected by Simbol-X, we have simulated a 1 Msec Simbol-X observation of the CDFS including the X-ray sources detected by Chandra below 10 keV plus the infrared selected highly obscured AGNs. For the Chandra sources we have computed the 10-40 keV fluxes extrapolating the 2-10 keV fluxes using a spectral model consistent with the Chandra hardness ratios. For the infrared selected sources we converted their 24μ m fluxes using typical infrared to X-ray unobscured flux ratios and logN_H in the range 24-25. Fig. 2 shows the combined CZT+SDD 1 Msec image of the CDFS in the 10-40 keV band (note that the exposure in the SDD camera is half of the total elapsed time to account for dead time).

4. Conclusions

We have simulated several 1 Msec Simbol-X observations, detecting 10-20 sources per field (see Fig. 1) down to a flux limit of 5-6$\times10^{-15}$ erg cm^{-2} s^{-1} in the 10-40 keV energy range. In this range we could resolve ~60% of the Cosmic X-ray Background.

We have simulated a 1 Msec Simbol-X observation of the CDFS including the X-ray sources detected by Chandra plus a sample of infrared selected highly obscured AGNs. Of course the superior PSF of the Chandra observatory allows the detection of the very faint sources, only a fraction of which is seen by Simbol-X above 10 keV. However several infrared selected highly obscured AGNs, which are invisible at energies below 10 keV, can be detected by Simbol-X (see Fig. 2).

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References

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