RevMexAA (Serie de Conferencias), **17**, 270–270 (2003)

THE CONTRIBUTION OF X-RAY SELECTED SOURCES TO THE SUB-MILLIMETER BACKGROUND

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The connection between the sub-millimeter (sub-mm) and hard X-ray background (XRB) has been studied by comparing data at 2-10 keV and at 850 μm for a sample of 54 sources. At the limiting fluxes reached in our sample most of the background (∼70%) in the two bands has been resolved into discrete sources. We find that sources making most of the X-ray background do not contribute significantly to the sub-mm background.

The Sample: The objects included in our program are two sub-samples of hard X-ray sources detected by Beppo-SAX in the HELLAS survey (Fiore et al. 2001) and by *Chandra* in the deep hard X-ray survey of the Hawaii Field SSA13 (Mushotzky et al. 2000). The X-ray and sub-mm observed fluxes and redshifts for the selected sources are reported in Table 1. For these objects our own SCUBA observations have been carried out. The SCUBA observations and data reduction are described in details in Severgnini et al. (2000). None of the sources has been detected at 850μm.

TABLE 1

Source	$F_{2-10keV}$ [10^{-13} cgs]	F^{a}_{850} [mJy]	z
Beppo-SAX 0045-2515	3.5	<2.6	0.111
1054+5725	2.7	<3.4	0.205
1117+4018	1.3	<7	1.274
2302+0856	3.3	<2.4	0.135
Chandra 1312+4239	0.27	<3.2	1.048
1312+4240	0.042	<3	...
1312+4241	0.23	<4.4	1.32
1312+4242	0.049	<2.8	2.415

[a] Upper limits are at 2σ.

We have combined our two sub-samples with other 46 sources obtained by cross-correlating sub-mm and X-ray data available from the literature (Mushotzky et al. 2000, Barger et al. 1999, 2001a; Fabian et al. 2000; Hornschmeier et al. 2000; Bautz et al. 2000). The whole sample here considered comprises thus 54 objects.

Results: For each source we have computed the sub-mm-to-X-ray index α_{SX} ($F_\nu \propto \nu^{-\alpha}$), using the rest-frame flux densities at 850 μm and 5 keV (or upper limits if the source was not detected). By comparing the α_{SX} as a function of redshift for our whole sample with that of various classes of templates (Type 1 unobscured AGN, Type 2 obscured AGN and starburst galaxies) and with that of the Cosmic Background, constraints have been given on the contribution of the hard X-ray population to the sub-mm background. In particular, we find that, under conservative assumptions, the contribution to the sub-mm background from 2-10 keV sources brighter than $\sim 10^{-15}$ erg s^{-1}cm^{-2} (which resolve at least 75% of the background in this band), is about 7%. Recent *Chandra* observations (Brandt et al. 2001; Barger et al. 2001b) have extended our results to the X-ray sources making about 90% of the hard XRB, and find that their contribution to the sub-mm background is about 15%. This value, derived with better statistics and obtained with a different approach, is in agreement with our results. Any significant contribution to the sub-mm background is limited to fainter hard X-ray sources which might contribute at most for 10% of the 2-10 keV background. Finally, our estimate is also in good agreement with the recent models predicting the contribution of X-ray sources to the sub-mm background (see Brusa et al. 2001 and references therein).

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Galaxy Evolution: Theory and Observations (Cozumel, Quintana Roo, México, 8-12 April 2002)
Editors: Vladimir Avila-Reese, Claudio Firmani, Carlos S. Frenk & Christine Allen