# An Alternative to A Contiguous Blank Field Survey for Finding Distant Clusters and AGNs

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A comparison of the sky coverage versus sensitivity of various surveys is shown in Fig 1. From the XMM serendipitous source catalog, we find there are about 190,000 sources in about 3,400 individual pointings. If we assume the reduction of initial sources to final sources follows our ROSAT extended SHARC survey (Adami et al. 2007), we would find a reduction of about 100 in the number of candidates. This then turns into about 1,900 candidates in approximately 3,400 fields or about 0.5 per field. This further translates into about 1,900 separate pointings, or about 100 sq degrees after exclusion of the galactic plane regions. Then, a conservative calculation yields about 55 new clusters at $z \geq 0.9$, or about a factor of 5 increase over the current data base. Since all the source strengths will be known before hand, the exposures can be optimized. They will all likely need to be in the 100 ksec range, though. Thus if every pointing were observed it would take 6 years of net observing time. *However*, by using i/K-band information as well, it will be possible to reduce the number of pointings by a factor of about 10 to concentrate only on the distant most interesting objects (about 30% clusters and about 70% AGNs) and hence the net time required is 0.6 years. If we spread out this observing program over a 5 year period, the observing requirement comes to a reasonable $\sim 10\%$ of the total viewing allocation for *XMM-newton*.

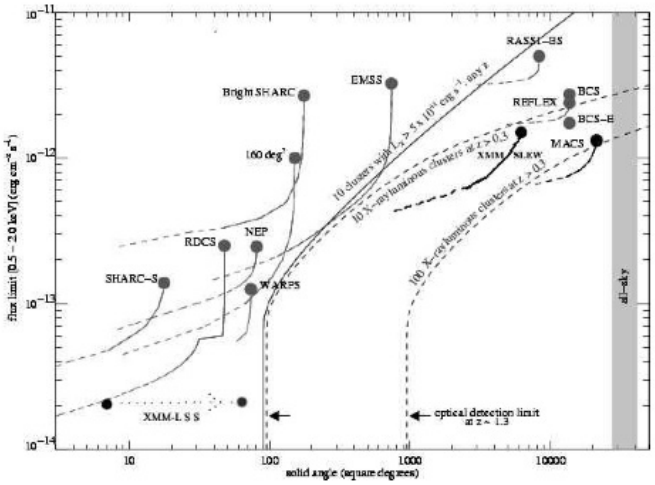


**Figure 1: A compilation of various X-ray surveys from the XMM slew survey web page**

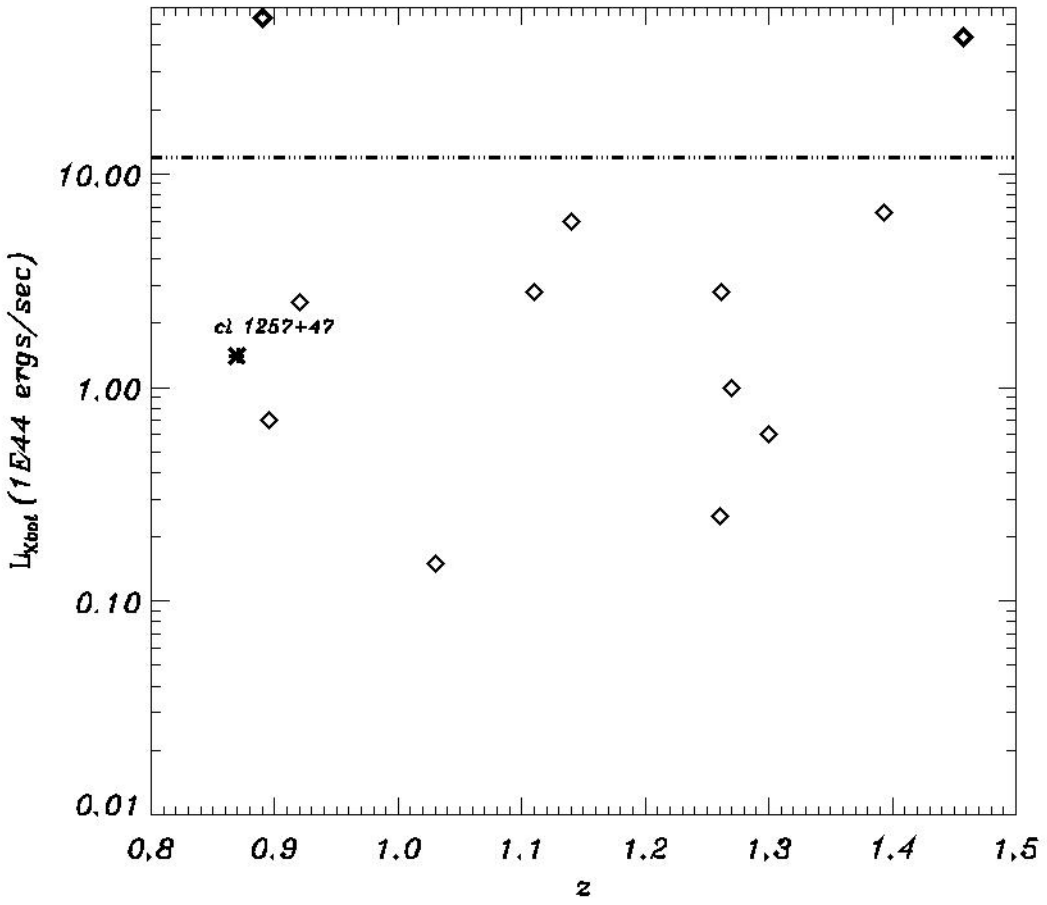


**Figure 2: A compilation of X-ray luminosity versus redshift from Ettori et al. (2004) plus Maughan (2006) leftmost bold diamond, and Stanford et al. (2006) and Hilton et al. (2007) rightmost diamond.**

A nearly complete plot of the distribution of known clusters above about 0.9 is shown in Fig. 2 where it can be seen there are only a handful currently known. Two of the clusters near $z = 0.9$ were found in the SHARC survey, one in the Bright SHARC Survey (Romer et al. 2000) and one in the extended SHARC survey (Adami et al. 2007). The latter used the method we propose to use for XMM.

In addition, The XMM Slew Survey (Larazo et al. 2005) covers about 25% of the sky down to about 1/10 the level of sensitivity (less sensitive) of the Bright SHARC (see Fig. 1, which covered nearly 200 sq degrees). This means we lose a factor of about $10^{1.5}$ in raw extra-galactic source counts, assuming no evolution, but we gain a factor of about 10,000/200 = 50, or the net effect is a gain of about 1.2 times the number of slew sources equivalent to SHARC sources. Here we have taken into account the loss in the slew survey of regions in the Galactic plane. The end result of adding in the slew survey is only about a 50% increase in the number of pointings. Hence, 15% of a year's observing time would be required by this approach, and we would likely end up with approximately 10 times the number of known clusters within z $\geq$ 0.9.

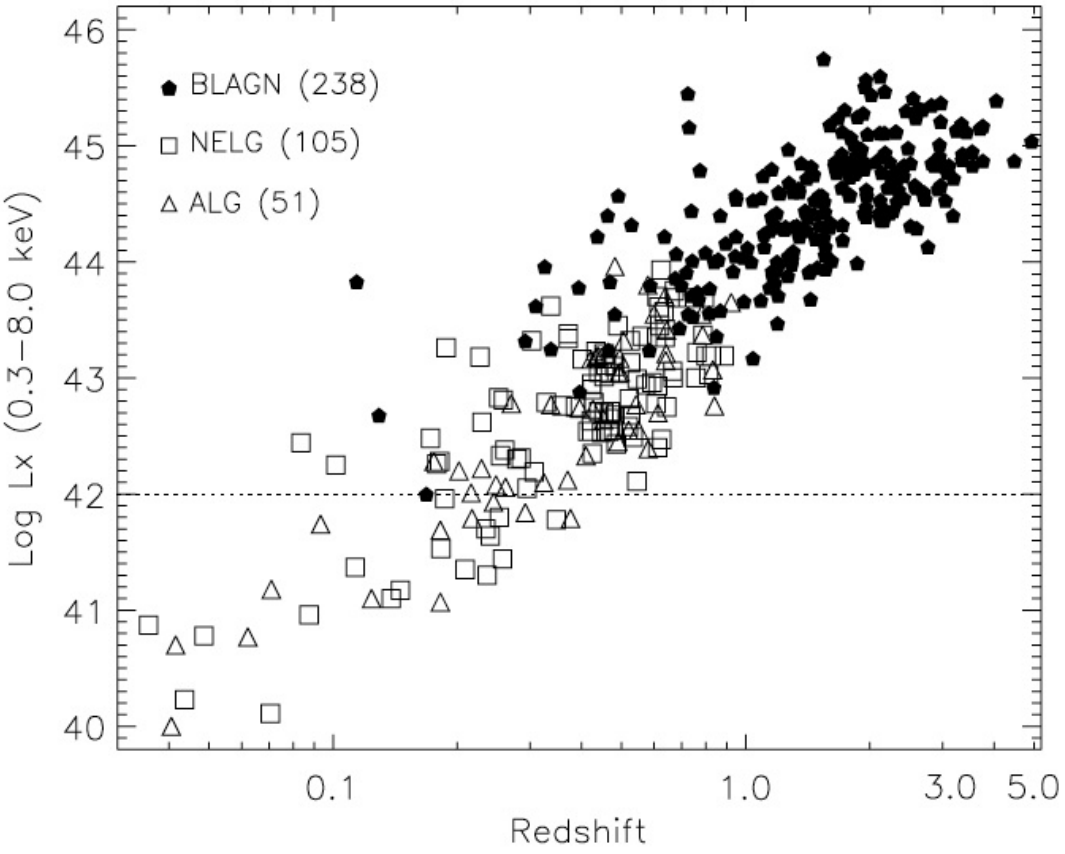


**Figure 3: The detected AGN versus $z$ distribution from the CHAMP survey**

It is the goal of our participation in the workshop to refine these numbers and to produce a final strategy for an optimized XMM distant cluster survey. In addition, this survey will lead to the discovery of many interesting AGN as well. By limiting ourselves to AGNs with z over 4 we will enter a new region of AGN X-ray study (Caccianiga et al. 2008 only go to z = 2; the CHAMP survey barely goes to 5, Silverman et al. 2005) and all those above

about 6 will be valuable not only to AGN evolution studies but can be used as probe of the era of re-ionization.

## References


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Larazo,V., et al in Proceedings of the The X-ray Universe 2005 (ESA SP-604). 26-30 September 2005, El Escorial, Madrid, Spain. Editor: A. Wilson, p.971

Romer, A. K, et al. 2000, ApJS, 126, 209

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