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Finding Distant X-ray Clusters in XMM Archive Data – Possibilities and Limitations

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ABSTRACT

Context. The XMM-Newton Distant Cluster Project (XDCP) is a new generation serendipitous X-ray survey focused on distant galaxy clusters at $z \gtrsim 1$. The survey strategy is based on the selection of extended X-ray sources, their identification as clusters and redshift estimation via two-band imaging, and their final spectroscopic confirmation. For the current project phase, more than 15 Msec of XMM data in 469 fields fields have been analyzed and almost 1 000 cluster candidates have been identified, 250 of which are distant cluster candidates at $z \gtrsim 0.6$.
Aims. Since the amount of analyzed X-ray data is comparable to the proposed XXL project, the XDCP survey can serve as a benchmark of what can be done with existing data.
Methods. Here we provide some material on the XDCP field and source charcteristics.
Results.
Conclusions.

Key words. XMM archive surveys, XMM field characteristics

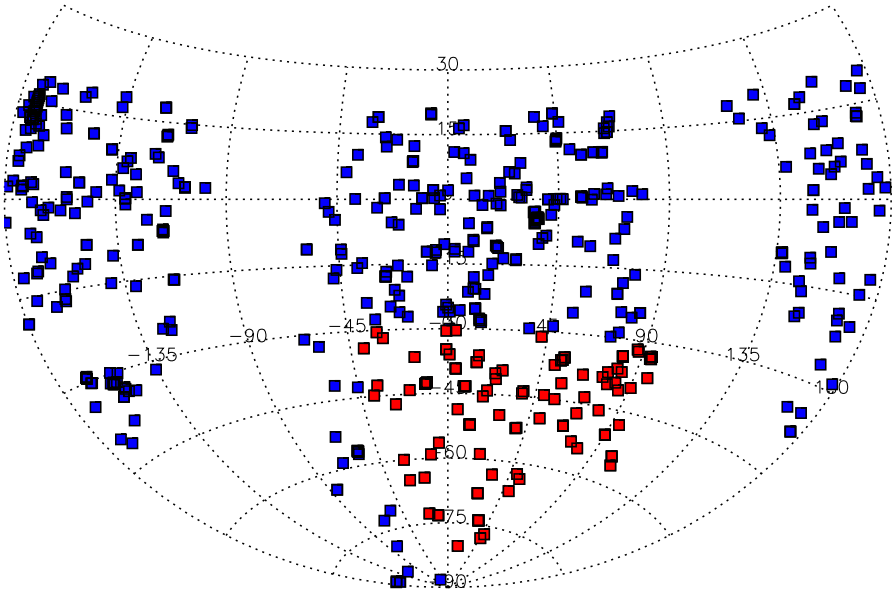

Fig. 1. Sky distribution of the 575 Southern XMM-Newton fields suitable for a survey (*raw XDCP sample*). The red squares indicate the 106 fields which will be covered by SZE observations with the South Pole Telescope. Square symbols are not to scale.

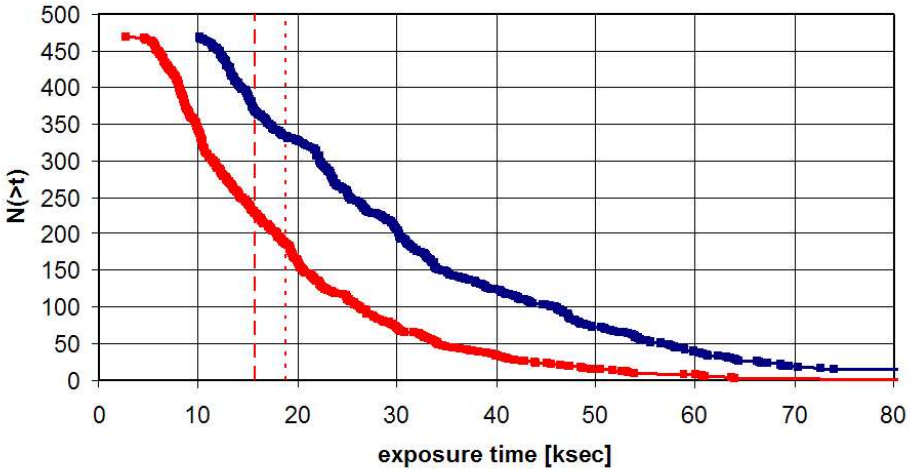

Fig. 2. XDCP survey field statistics. Cumulative distribution of nominal exposure times (blue line) and flare cleaned times (red line) for the 469 usable XDCP survey fields. The average clean exposure time of 18.78 ksec is indicated by the vertical dotted line, the median of 15.71 ksec is illustrated by the dashed line.

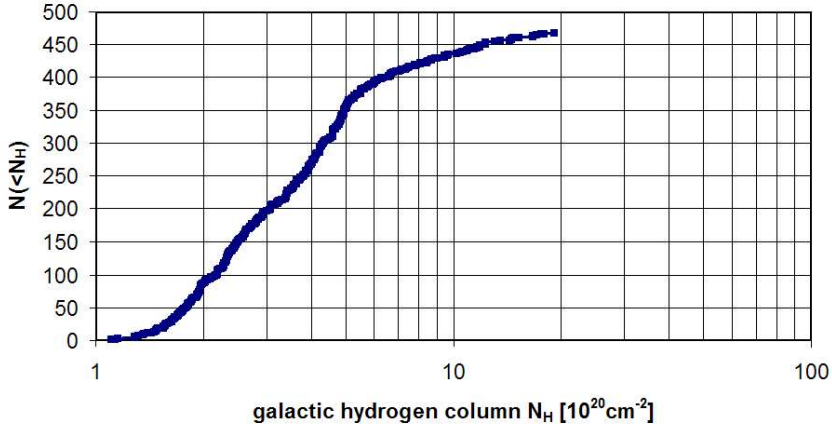

Fig. 3. Cumulative distribution of the galactic hydrogen column for the survey fields.

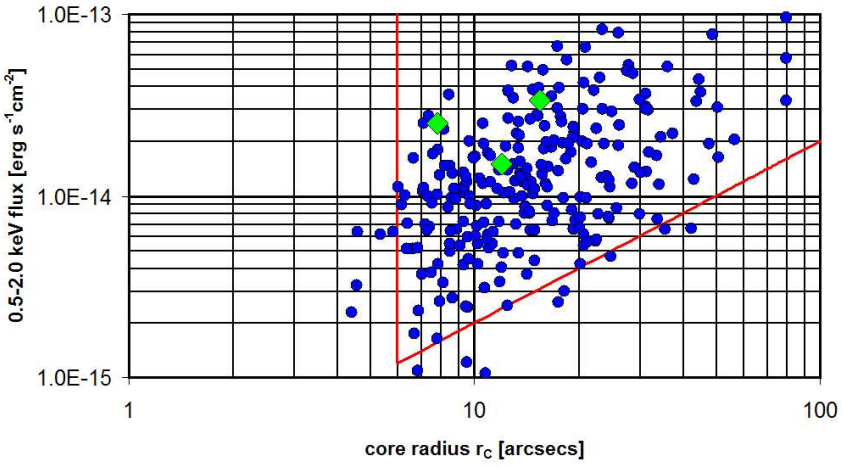

Fig. 4. XDCP distant cluster candidates in the 0.5-2.0 keV flux versus core radius plane. The parameter space of detected candidates is confined by the XMM resolution limit (*vertical red line*) at core radii of about 6″ and the background limit (*lower red line*), where the cluster surface brightness drops below the detection threshold. Green diamonds indicate the positions of three most distant spectroscopically confirmed clusters in the Southern hemisphere (using the source parameters of the XDCP X-ray pipeline), from left to right: XMMU J2235-25 at $z = 1.39$, XCS J2215-17 at $z = 1.45$, and RDCS J1252-29 at $z = 1.24$.

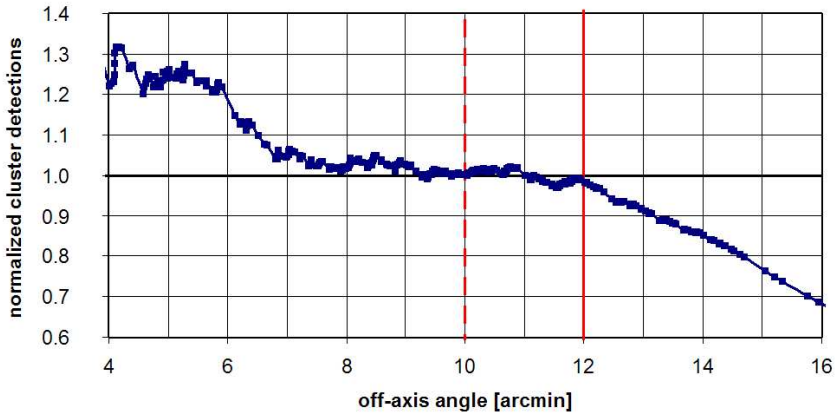

Fig. 5. Cluster detections per unit sky area as a function of off-axis angle normalized to the detections at 10′ off-axis angle (dashed red line). The detection rate is almost constant between 7′ and 12′ from the optical axis. In the central region the detection rate rises owing to the increased effective area. Beyond 12′ the increasing vignetting and the broadened PSF decrease the cluster detections per unit area. The inner 12′ (solid red line) are well-behaved and can be used for the core survey.

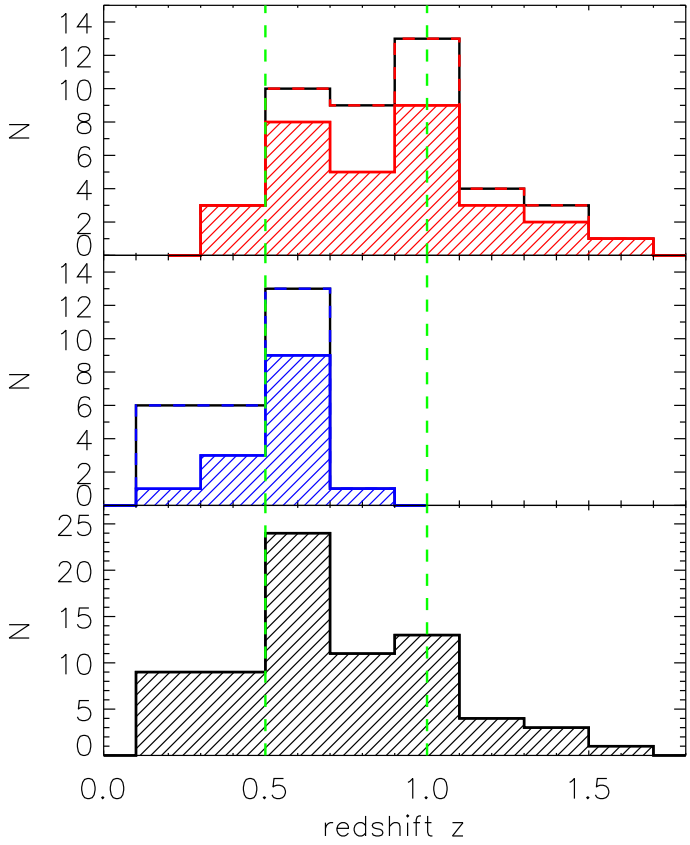

Fig. 6. Redshift histogram of a cluster sample observed at the Calar Alto Observatory based on estimated Z–H red sequence redshifts. *Top:* Redshift distribution of the targeted *distant cluster candidates* in $\Delta z = 0.2$ bins with a secure photometric confirmation (*red hashed*) and including sources with lower photometric confirmation confidence (*top line*). Vertical dashed lines indicate redshifts of 0.5 and 1.0. *Center:* Distribution of *DSS-identified* cluster candidates that were included in the OMEGA 2000 field-of-view of distant candidates. *Bottom:* Redshift histogram of the combined Calar Alto X-ray cluster sample as the sum of the two upper red and blue curves and five additional XMM target clusters, which are not part of the serendipitous object class. The total sample includes 21 X-ray cluster candidates with photometric red sequence redshift estimates of $z > 0.9$, 15 of them with a high confidence level.