

**TOWARD AN UNDERSTANDING OF CLUSTER EVOLUTION:
A DEEP X-RAY SELECTED CLUSTER CATALOG FROM ROSAT**

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After completing our X-ray analysis and optical identification of the 200 extended sources we identified from 647 ROSAT PSPC pointed observations, we have focussed on both examining the properties of the class of distant clusters and on studying individual unusual objects. The latter primarily involves proposing Chandra or XMM-Newton follow-up observations and searching for lower redshift counterparts using ROSAT pointed and All Sky Survey observations. In particular we have found eleven nearby “fossil” groups, systems dominated by a single bright galaxy but with the X-ray extent and luminosity characteristic of a group. We are currently writing a paper that presents the properties of these nearby systems compared to the four fossil groups identified in the ROSAT distant cluster survey. We also have Chandra observations, either scheduled or taken, or two distant fossil groups and three of the nearby fossils. Also for a sample of the most distant clusters, we completed and published a comparison of the optical galaxy content of these X-ray selected clusters with nearby clusters (published in the 2001 *Astrophysical Journal*, vol 558, page 590) . We found that the distant clusters were significantly poorer in galaxies for their X-ray luminosity than are nearby clusters. The paper title, authors and abstract are given below.

“A Richness Study of 14 Distant X-Ray Clusters from the 160 Square Degree Survey”

McNamara, B. R., Vikhlinin, A., Hornstrup, A., Quintana, H., Whitman, K., Forman, W., & Jones, C.

ABSTRACT –

We have measured the surface density of galaxies toward 14 X-ray-selected cluster candidates at redshifts $z_i \leq 0.46$, and we show that they are associated with rich galaxy concentrations. These clusters, having X-ray luminosities of $L_X(0.5-2 \text{ keV}) \sim (0.5 - 2.6) \times 10^{44} \text{ ergs sec}^{-1}$ are among the most distant and luminous in our 160 deg² ROSAT Position Sensitive Proportional Counter cluster survey. We find that the clusters range between Abell richness classes 0 and 2 and have a most probable richness class of 1. We compare the richness distribution of our distant clusters to those for three samples of nearby clusters with similar X-ray luminosities. We find that the nearby and distant samples have similar richness distributions, which shows that clusters have apparently not evolved substantially in richness since redshift $z=0.5$. There is, however, a marginal tendency for the distant clusters to be slightly poorer than nearby clusters, although deeper multicolor data for a large sample would be required to confirm this trend. We compare the distribution of distant X-ray clusters in the L_X -richness plane to the distribution of optically selected clusters from the Palomar Distant Cluster Survey. The optically selected clusters appear overly rich for their X-ray luminosities, when compared to X-ray-selected clusters. Apparently, X-ray and optical surveys do not necessarily sample identical mass concentrations at large redshifts. This may indicate the existence of a population of optically rich clusters with anomalously low X-ray emission. More likely, however, it reflects the tendency for optical surveys to select unvirialized mass concentrations, as might be expected when peering along large-scale filaments.