Angular Clustering of Obscured AGN

P. Gandhi
(Institute of Astronomy, Univ. Cambridge & European Southern Observatory, Chile)
with
O. Garcet, L. Disseau, F. Pacaud, M. Pierre, A. Gueguen, D. Alloin, L. Chiappetti, E. Gosset, D. Maccagni, J. Surdej & I. Valtchanov

Abstract: We studied X-ray point-like sources detected over 4.2 contiguous sq. degs. of the XMM-LSS survey to fluxes of $F_{2-10\ keV} \sim 8 \times 10^{-15}$ erg s^{-1}cm^{-2} and $F_{0.5-2\ keV} \sim 2 \times 10^{-15}$ erg s^{-1}cm^{-2} respectively. For 1200 sources in the soft band, we found a two-point angular correlation function (ACF) signal similar to previous work, but no correlation for 400 sources in the hard band. A sample of 200 faint sources with hard spectra ($HR > -0.2$) does show a 2–3σ positive signal with a power-law normalization $\theta_0 > 40''$. A large correlation length for obscured AGN is inconsistent with simple AGN Unification based on orientation only.

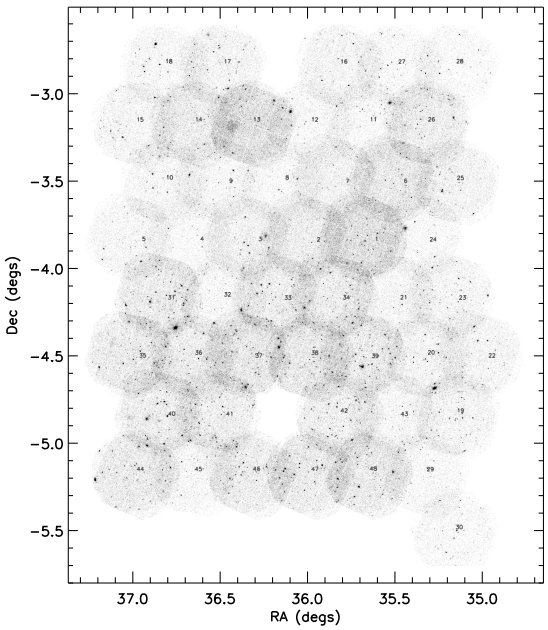

Figure 1: *The full field of the XMM-LSS survey (Pierre et al. 2004; 48 pointings, labelled) covering about 5 deg^2. Point-like as well as extended sources in the full 0.5–10 keV band are seen.*

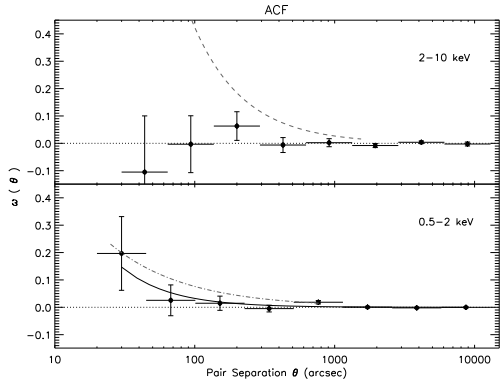

Figure 2: *The ACF, as defined by Hamilton and measured for the XMM-LSS survey in the soft (bottom) and hard (top) bands for sources with signal:noise greater than 3. The bins have equal logarithmic sizes, and have > 20 data-data pairs each. Plotted error bars are Poisson. The solid curve is the best-fit power-law model (shown for the soft band only). Previous power-law ACFs of Basilakos et al. (2004) and of Vikhlinin & Forman (1995) are shown as the dashed and dot-dashed lines respectively.*

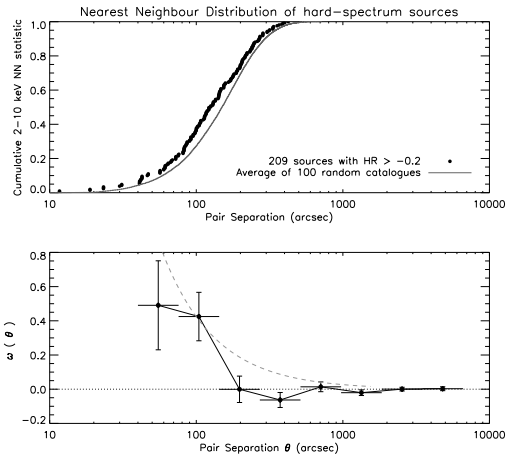

Figure 3: *The Nearest Neighbour (NN) distribution (top) and ACF (bottom) for the 2–10 keV sample of 209 hard-spectrum ($HR > -0.2$) sources with signal:noise> 2. The NN distribution clearly shows an excess, especially near scales of $\sim$100 arcsec, as compared to the random catalogues. In the ACF plot, the dashed line is the best-fit ACF of Basilakos et al. (2004). The excess is significant at the 2 (3)-σ level based on bootstrap (Poisson) errors. Though a power-law is not a good formal fit, fitting $\omega = (\theta/\theta_0)^{-\gamma}$ gives $\theta_0 = 42'' \pm 10$ and $\gamma = 3.1 \pm 0.8$.*

Summary:

- The soft band ACF is consistent with previous measurements for about 1200 sources.
- The hard band ACF is instead consistent with a random distribution based on 400 sources. This discrepancy with respect to previous work might be the result of cosmic variance at our flux limits.
- Selecting a sub-set of 200 fainter hard-spectrum sources in the deepest part of the survey yields a weak but positive signal, and allows for a large angular correlation length.
- This hard sample is likely to be dominated by obscured AGN. The auto-correlation of obscured AGN suggests that they may be associated with higher density peaks of the matter distribution.
- Gas associated with these 'clumps' would feed as well as preferentially obscure the AGN. *This is inconsistent with simple orientation-based Unification schemes.*
- **The XMM-LSS survey is the largest contiguous survey of the hard X-ray sky with medium-deep flux limits**, giving ample opportunity to study the distribution and evolution of AGN and clusters.

References: **Gandhi et al. 2006 A&A in press astro-ph/0607135**; Basilakos et al. 2004 ApJL 607 L79; Pierre et al. 2004 JCAP 9 11; Vikhlinin & Forman 1995 ApJL 455 L109.

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