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# The X-SERVS survey: new *XMM-Newton* point-source catalog for the XMM-LSS field

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**ABSTRACT**

We present an X-ray point-source catalog from the XMM-Large Scale Structure survey region (XMM-LSS), one of the XMM-Spitzer Extragalactic Representative Volume Survey (X-SERVS) fields. We target the XMM-LSS region with 1.3 Ms of new *XMM-Newton* AO-15 data, transforming the archival X-ray coverage in this region into a 5.3 deg$^2$ contiguous field with uniform X-ray coverage totaling 2.7 Ms of flare-filtered exposure, with a 46 ks median PN exposure time. We provide an X-ray catalog of 5252 sources detected in the soft (0.5–2 keV), hard (2–10 keV), and/or full (0.5–10 keV) bands to a false-detection probability of $P = 0.0025$. A total of 2386 new X-ray sources are detected compared to previous archival data in the same area. Our flux limits and distributions are comparable to those of the XMM-COSMOS survey. The median fluxes in the soft, hard, and full bands are $2.9 \times 10^{-15}$, $1.5 \times 10^{-14}$, and $9.4 \times 10^{-15}$ erg cm$^{-2}$ s$^{-1}$, respectively. We identify multiwavelength counterpart candidates for 99.5% of the X-ray sources, of which 93% are considered to be reliable based on their matching likelihood ratios. The reliabilities of these high-likelihood ratio counterparts are further confirmed to be $\approx 97\%$ reliable based on deep *Chandra* coverage over $\approx 5\%$ of the XMM-LSS region. Results of multiwavelength identifications are also included in the source catalog, along with basic optical-to-infrared photometry and spectroscopic redshifts from publicly available surveys. We compute photometric redshifts for X-ray sources in 1 deg$^2$ of our field using forced-aperture multi-band photometry; 70% of the X-ray sources have either spectroscopic or high-quality photometric redshifts.

**Key words:** catalogues – surveys – galaxies:active – X-rays:galaxies – quasars: general

## 1 INTRODUCTION

Due to the penetrating nature of X-ray emission and its ubiquity from accreting supermassive black holes (SMBHs), extragalactic X-ray surveys have provided an effective census of active galactic nuclei (AGNs), including obscured systems, in the distant universe. Over at least the past three decades, the overall design of cosmic X-ray surveys has followed a "wedding cake" strategy. At the extremes of this strategy, some surveys have ultra-deep X-ray coverage and a narrow "pencil-beam" survey area ($\lesssim 1$ deg$^2$), while others have shallow X-ray coverage over a wide survey area ($\approx$ 10–10$^4$ deg$^2$). The wealth of data from cosmic X-ray surveys (and their co-located multiwavelength surveys) have provided a primary source of information in shaping understanding of how SMBHs grow through cosmic time, where deep surveys generally sample high-redshift, moderately luminous AGNs, and wide-field surveys generally probe the high-luminosity, rare objects that are missed by surveys covering smaller volumes. However, narrow-field surveys lack the contiguous volume to encompass a wide range of cosmic large-scale structures, and wide-field surveys generally lack the X-ray sensitivity to track the bulk of the AGN population though the era of massive galaxy assembly (see Brandt & Alexander 2015 for a recent review).

Among extragalactic X-ray surveys, the medium-deep COSMOS survey over $\approx 2$ deg$^2$ has the needed sensitivity-area combination to begin to track how a large fraction of distant SMBH growth relates to cosmic large-scale structures (e.g., Hasinger et al. 2007; Civano et al. 2016). However, even COSMOS cannot sample the full range of cosmic environments. The largest structures found in cold dark matter simulations are already as large as the angular extent of COSMOS at $z \approx 1$ (80–100 Mpc in comoving size, which covers 2–3 deg$^2$; e.g., see Klypin et al. 2016). Clustering analyses also demonstrate that COSMOS-sized fields are still subject to significant cosmic variance (e.g., Meneux et al. 2009; de la Torre et al. 2010; Skibba et al. 2014).

Therefore, to study SMBH growth across the full range of cosmic environments and minimize cosmic variance, it is necessary to obtain multiple medium-deep X-ray surveys in distinct sky regions (e.g., Driver & Robotham 2010; Moster