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Revealing deeper secrets: Developing a new higher-resolution technique for XMM imaging analysis

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We develop a new technique to resolve small-scale structures in galaxy groups and clusters using XMM-MOS. This study takes advantage of the steep nature of the on-axis XMM PSF which encloses ~60% of the incident photon energy within 10 arcsec. Standard pipeline processing of XMM-MOS data yields images with 4 arcsec binning by default; however, images may be created with 1 arcsec bins to better sample the PSF. Our study demonstrates that this sampling can highlight structures such as cavities better than the default processing. We apply this technique to XMM-MOS observations of multiple objects, all of which have confirmed cavity structures detected in Chandra images. By creating unsharp masked images, we demonstrate that this new technique is most effective if the cavities are located beyond the very core (< 10 arcsec) where the PSF blurring remains the main limitation. Cavities beyond this region are clearly revealed. By measuring the decrease in the azimuthally averaged surface brightness at the position of the detected cavities, we estimate a statistical significance of 2-3 sigma for these features. Many of these features remain undetected however if we apply unsharp masking to the 4 arcsec binned images created by the default XMM-MOS processing.

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