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Chandra Observations of the Planck ESZ Sample: A Re-Examination of Masses and Mass Proxies

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Galaxy clusters reside in the highest ranges of the halo mass function. In the standard ΛCDM cosmology, massive halos form by the accretion of smaller sub-clumps. Under the influence of gravity, uncollapsed and collapsed sub-clumps fall into larger halos and, occasionally, objects of comparable mass merge with one another. A well established relation between the cluster mass and its observables (such as X-ray luminosity, gas temperature etc) is crucial to any work that explores the theoretical relation between the number density of collapsed halos (the mass function) and the underlying cosmological parameters. The second Planck catalogue (PSZ2), detected 1653 cluster candidates. The vast majority (>1200) of these candidates have been confirmed, making the PSZ2 catalog a reference for cluster studies. Among the many quantities provided by the PSZ2 catalog for each cluster, the mass estimate is arguably the most important. Using Chandra observations, we derived the $\mathrm{Y_X}$ proxy and associated total mass measurement, $\mathrm{M_{Y_X}}$, for 147 clusters with z < 0.35 from the Planck Early Sunyaev-Zel'dovich catalog, and for 80 clusters with z < 0.22 from an X-ray flux-limited sample. We re-extracted the Planck $\mathrm{Y_{SZ}}$ measurements and obtained the corresponding mass proxy, $\mathrm{M_{Y_{SZ}}}$, from the full Planck mission maps, minimizing the Malmquist bias due to observational scatter. In this talk, I will present new relations between the $\mathrm{Y_X}$ and $\mathrm{Y_{SZ}}$ quanties, as well as $\mathrm{M_{Y_X}}$ and $\mathrm{M_{Y_{SZ}}}$. I'll also present results from extensive simulations to deal with selection effects, intrinsic scatter, and covariance between quantities. Finally, I'll demonstrate analytically how the $\mathrm{Y_X}-\mathrm{Y_{SZ}}$ relation changes when expressed in intrinsic quantities (units of Mpc^2) instead of apparent flux (units of arcmin^2).

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