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# MUSTANG High Angular Resolution Sunyaev-Zel'dovich Effect Imaging of Sub- Structure in Four Galaxy Clusters

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We present 10" to 18" images of four massive clusters of galaxies through the Sunyaev-Zel'dovich Effect (SZE). These measurements, made at 90-GHz with the MUSTANG receiver on the Green Bank Telescope (GBT), reveal pressure sub-structure to the intra-cluster medium (ICM) in three of the four systems. We identify the likely presence of a previously unknown weak shock-front in MACS0744+3927. By fitting the Rankine-Hugoniot density jump conditions in a complementary SZE/X-ray analysis, we infer a Mach number of  $M = 1.2^{+0.2}_{-0.2}$  and a shock-velocity of  $1827^{+267}_{-195}$  km/s. In RXJ1347-1145, we present a new reduction of previously reported data and confirm the presence of a south-east SZE enhancement with a significance of 13.9 sigma when smoothed to 18" resolution. This too is likely caused by shock-heated gas produced in a recent merger. In our highest redshift system, CL1226+3332, we detect sub-structure at a peak significance of 4.6 sigma in the form of a ridge oriented orthogonally to the vector connecting the main mass peak and a sub-clump revealed by weak lensing. We also conclude that the gas distribution is elongated in a south-west direction, consistent with a previously proposed merger scenario. The SZE image of the cool core cluster Abell 1835 is, in contrast, consistent with azimuthally symmetric signal only. This pilot study demonstrates the potential of high-resolution SZE images to complement X-ray data and probe the dynamics of galaxy clusters

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