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Pressure profiles of galaxy cluster from SPT and Planck observations.

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We present a full set of numerical tools to extract Galaxy Cluster pressure profiles from the joint analysis of Planck and South Pole Telescope (SPT) observations.
Pressure profiles are powerful tracers of the thermodynamical properties and the internal structure of the clusters. Observations of nearby galaxy clusters show a remarkable self-similarity in the shape of the radial pressure profiles. This suggests that the intra-cluster gas resides in Hydrostatic Equilibrium within a self-similar gravitational potential. This relation may break in case of significant deviation from equilibrium, e.g. due to AGN feedback or mass accretion. Tracing the pressure over the cosmic times allows to constraints the evolution of the cluster structure and the contribution of astrophysical phenomena.
SPT and Planck are complementary to constrain the cluster structure at various spatial scales. The high sensitivity of the Planck High-Frequency Instrument makes it ideal to observe the faint peripheries, while with its 1.75 arcmin resolution SPT can resolve the innermost regions. The SPT cluster catalogue from the 2500 square degree survey counts 677 cluster candidates up to redshift 1.7 with $M_{500} \geq 2 \times 10^{14} M_{\odot}$. It is a nearly mass limited sample, an ideal benchmark to test cluster evolution.
We developed a pipeline to first separate the cluster signal from the background (CMB) and foreground (galactic emission) components and then jointly fit a parametric Nagai profile models on a combination of Planck and SPT data. In this work we validate our algorithm on a sub-sample of 6 clusters, comparing the results with the profiles obtained from X-ray observations with XMM-Newton. We check the consistency of the two observables, and we exploit the high resolution of X-ray data to study the impact of cluster substructure on their relation.

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