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Temperature Structure of the Intra-Cluster Medium from SPH and AMR Simulations

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Analyses of cosmological hydrodynamic simulations of galaxy clusters suggest that X-ray masses can be underestimated by 10% to 30%. The largest bias originates by both violation of hydrostatic equilibrium and an additional temperature bias caused by inhomogeneities in the X-ray emitting intra-cluster medium (ICM). To elu- cidate on this large dispersion among theoretical predictions, we evaluate the degree of temperature structures in cluster sets simulated either with smoothed-particle-hydrodynamics (SPH) and adaptive-mesh-refinement (AMR) codes. We find that the SPH simulations produce larger temperature variations connected to the persistence of both substructures and their stripped cold gas. This difference is more evident in no-radiative simulations, while it is reduced in the presence of radiative cooling. We also find that the temperature variation in radiative cluster simulations is generally in agreement with the observed one in the central regions of clusters. Around R500 the temperature inhomogeneities of the SPH simulations can generate twice the typical hydrostatic-equilibrium mass bias of the AMR sample. We emphasize that a detailed understanding of the physical processes responsible for the complex thermal structure in ICM requires improved resolution and high sensitivity observations in order to extend the analysis to higher temperature systems and larger cluster-centric radii.

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