

T07c Shock jump conditions in radio relics studied with MHD simulations including thermal conduction

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Galaxy cluster mergers generate large-scale shocks in the intra-cluster medium (ICM), which are traced as temperature and density discontinuities in X-rays and as synchrotron radio emission from shock-accelerated electrons. However, the Mach numbers inferred from X-ray measurements are often lower than those derived from radio spectra, leading to a long-standing inconsistency in our understanding of shock acceleration in galaxy clusters (e.g., Botteon et al. 2016a). To investigate whether thermal conduction can account for this discrepancy, we performed one-dimensional magnetohydrodynamic (MHD) simulations including anisotropic thermal conduction along magnetic field lines. Starting from a steady-state MHD shock solution, we calculated apparent Mach numbers from the resulting temperature, density, and velocity profiles for comparison. We find that when the magnetic field is oriented approximately parallel to the shock normal, thermal conduction smooths the temperature jump, leading to a lower Mach number derived from temperature (X-ray) compared to that obtained from velocity (radio). This effect may provide a contribution to the discrepancy between X-ray- and radio-derived Mach numbers, in addition to other interpretations such as the biased sampling of high-Mach-number regions in radio emission (e.g., Wittor et al. 2021a) and re-acceleration scenarios (e.g., Markevitch et al. 2005).