

Particle Acceleration at Weak Shocks Induced by Mergers of Galaxy Clusters

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Low Mach number shocks with $M^2 \sim 2-3$ are induced in the hot tenuous intracluster medium (ICM) by mergers of galaxy clusters. Cosmic ray (CR) protons are expected to be accelerated mainly at quasi-parallel shocks, whereas CR electrons are expected to be accelerated preferentially at quasi-perpendicular shocks. Microinstabilities excited by reflected protons and electrons, and the ensuing self-excitation of plasma waves are critical in the energization of background thermal populations. Moreover, scattering of backstreaming particles back to the shock by those upstream waves play important roles in particle injection to the Fermi-I process and the further acceleration to relativistic energies. We review these kinetic processes operating in such ICM shocks.

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