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On the acceleration efficiency of low-Mach number shocks

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The recent discoveries in the theory of diffusive shock acceleration (DSA) that originate from first-principle kinetic plasma simulations are discussed. We show that, when ion acceleration is efficient, the back-reaction of non-thermal particles and self-generated magnetic fields becomes prominent and leads to both enhanced shock compression and particle spectra appreciably different from the standard test-particle DSA theory. In particular, we present hybrid simulations of ion acceleration at low-Mach number shocks for different values of plasma beta and we discuss how these results may solve the discrepancy reported between the Mach numbers inferred from radio and X-ray observations of shocks in galaxy clusters.

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