Proton Acceleration in Structured Collisionless Shock Waves

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The acceleration of low energy ($\sim$ 1-20 keV) protons by collisionless shock discontinuities is investigated. The effect of the structure associated with such shocks on the reflection and energization of near thermal energy protons is the main concern. We have considered the effect of finite shock width, including the micro–structure within the transition region, and the effect of shock curvature. We show that protons within this energy range are more easily reflected and energized by shocks that include the phenomonological shock structure than those that are considered to be infinitely thin and planar. This result is important with regard to the energization of thermal energy protons (which constitute the bulk of interplanetary, interstellar and intergalactic particles) to energies that are more susceptible to undergo further acceleration by the shock or other accelerating mechanisms.