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A critical Mach number for electron injecion in collisionless shocks

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Electron acceleration in collisionless shocks with arbitrary magnetic field orientations is discussed. It is shown that the injection of thermal electrons into diffusive shock acceleration process is achieved by an electron beam with a loss-cone in velocity space that is reflected back upstream from the shock through shock drift acceleration mechanism. The electron beam is able to excite whistler waves which can scatter the energetic electrons themselves when the Alfven Mach number of the shock is sufficiently high. A critical Mach number for the electron injection is obtained as a function of upstream parameters. The application to supernova remnant shocks is discussed.

Keywords: shock wave, particle acceleration, cosmic ray