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Study of charged particle acceleration by magnetic reconnection in a plasma

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Abstract

Magnetic reconnection, which occurs in high conducting plasmas, changes the topology of magnetic field lines and converts magnetic energy into the kinetic and thermal energy of plasma and also accelerates charged particles. This phenomenon plays an important role in changing the dynamic of laboratory and space plasmas such as fusion tokamaks and sun's corona. The electric and magnetic fields generated by magnetic reconnection result in acceleration and drift motion of charged particles. Therefore, charged particles, depending on their injection position and initial kinetic energy, can be accelerated and escape or can be trapped in magnetic fields. In this study by considering different injection positions and initial kinetic energies, we investigate how a particle (proton) is accelerated or trapped. Our numerical analyses show that the spine structure for three-dimensional magnetic reconnection can be considered as a potential mechanism for particle acceleration. In this model, a proton can be accelerated up to a few MeV within a few milliseconds. The particle's trajectory and final kinetic energy strongly depend on its injection position.

Keywords: charged particles acceleration, magnetic reconnection, magnetohydrodynamics

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