Stochastic theory of test-particle transport in perturbed magnetic flux structures

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ABSTRACT

Trajectories of charged particles in a stochastic magnetic field can be described by the A-Langevin equations. We solve the A-Langevin equation and derive an expression for the velocity correlation function, which is averaged with respect to the stochastic variables. An implicit differential equation for the mean-squared-displacement is obtained, depending mainly on the Lagrangian correlation function of the magnetic field. By applying a suitable set of approximations, a rather general description of this correlation function is found, which also covers the transport of particles on percolative flux structures. We investigate this equation for various cases and find different transport regimes, including the well-known Rechester-Rosenbluth diffusion coefficient and the percolation result proposed by Isichenko. We also briefly comment on recent results, as e.g. the transport of randomly charged dust particles.