On the transport of test particles in stochastic plasmas with percolative magnetic flux structures

M.Neuer and K.H.Spatschek

Institut für Theoretische Physik
Heinrich-Heine-Universität Düsseldorf
D-40225 Düsseldorf

ABSTRACT

For stochastic magnetic flux functions with percolative contours the test particle transport is investigated. The calculations make use of the stochastic Liouville approach. They start from the so called A-Langevin equations, including stochastic magnetic field components and binary collisions. Using the decorrelation trajectory method (DCT), a relation between the Lagrangian velocity correlation function and the Eulerian magnetic field correlation is derived and introduced into the Green-Kubo formalism. Finite Larmor radius effects are included. New results are presented in the percolation regime corresponding to high Kubo numbers. Previous analytical results found within the Corrsin approximation, including the Rechester-Rosenbluth regime, are found to be limiting cases of the DCT for small Kubo numbers. For different percolative scenarios, e.g. for the Isichenko limit, the diffusion is analyzed and strong influences of the percolative structures on the transport scaling are found. The finite Larmor radius effects are discussed in detail. Numerical simulations of the A-Langevin equation confirm the semi-analytical predictions.