



Impact of the Eulerian chaos of magnetic field lines in magnetic reconnection

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Stochasticity is an ingredient that may allow the breaking of the frozen-in law in the reconnection process. It will first be argued that the non-ideal effects may be considered as an implicit way to introduce stochasticity. Yet there also exists an explicit stochasticity that does not require the invocation of non-ideal effects. This comes from the spatial (or Eulerian) chaos of magnetic field lines that can show up only in a truly three-dimensional description of magnetic reconnection since the two-dimensional models impose the integrability of the magnetic field lines. Some implications of this magnetic braiding, such as the increased particle finite-time Lyapunov exponents and increased acceleration of charged particles, are discussed in the frame of tokamak sawteeth that forms a laboratory prototype of spontaneous magnetic reconnection. A justification for an increased reconnection rate with chaotic vs. the integrable magnetic field lines is proposed. Moreover, in 3D, the Eulerian chaos of the magnetic field lines may coexist with the Eulerian chaos of velocity field lines, that is more commonly named the turbulence.