Chaotic Scattering and the Magneto-Coulomb Map

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Abstract

A non-relativistic classical electron scattering by a fixed ion in a uniform magnetic field is discussed. The system is non-integrable, and there is chaotic scattering for certain class of initial conditions. Indeed, this has been noticed by Delos *et al.* [1] and analyzed later by Schmidt *et al.* [2] (also see [3,4,5,6] for the trapped motion of the electron and for the classical case as well as the quantum case). So far, all analyses were based on the continuous flow generated by the equation of motion. However, as we shall show below, that there are many cyclotron periods in a single scattering during the electron-ion interaction time interval. As a result, the numerical integration of the equation of motion for the continuous flow is very time-consuming and the predictions for long time behavior become unstable, which is the typical case of the chaotic scattering. For this reason, we derive a two-dimensional discrete map of the chaotic scattering from the equation of motion. Our map exhibits four different types of motion by changing the parameters which characterize the initial condition. The fractal structure for certain observables is obtained. The width of the chaotic scattering region in the impact parameter is estimated numerically. We suggest a certain class of plasma enviroments where the chaotic scattering may have an important role.

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