Derivation and application of the magnetized Fokker-Planck and Balescu-Lenard-Guernsey collision terms

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In the magnetized and laser fusion plasma, space and astrophysical plasma, the particles' gyro-radii can be smaller than the Debye length when there is a strong magnetic field. This will have a significant influence on collision dynamics and many physical processes such as parallel velocity slowing down, temperature relaxation, particle diffusion, thermal transport, and so on.

The Fokker-Planck collision including a uniform magnetic field is derived meanwhile the analytical expressions of magnetized Fokker-Planck coefficients have been derived explicitly within the binary collision model. The fully magnetized Fokker-Planck kinetic equation is also manipulated into the Landau form.

The Balescu-Lenard-Guernsey collision term including a uniform magnetic field is derived by employing the Fokker-Planck approach. By using the fluctuating electrostatic field for quiescent plasmas, the magnetized Fokker-Planck coefficients are calculated explicitly based on the wave theory which includes the collective effects in a proper manner. Manipulating the magnetized Fokker-Planck collision term into the Landau form, the magnetized Balescu-Lenard-Guernsey collision term is obtained.

The magnetized Fokker-Planck coefficients are simplified to study the temperature relaxation and stopping power. It is shown that the effect of strong magnetic field is significant on those physical processes.