Effect of bremsstrahlung radiation emission on fast electrons in plasmas

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Bremsstrahlung radiation emission is an important energy loss mechanism for energetic electrons in plasmas. In this contribution we investigate the effect of spontaneous bremsstrahlung emission on the momentum-space structure of the electron distribution, using a Boltzmann transport model fully accounting for the emission of finite-energy photons. We implement the model in a 2D continuum kinetic-equation solver [1], and study the solutions to determine the effect of bremsstrahlung on the electron distribution function. We find that electrons accelerated by electric fields can reach significantly higher energies than predicted in previous work [2, 3], which considered only the average energy loss of a test particle. We demonstrate that significant fractions of electrons reach twice the expected energy or more, due to the difference between the average and Boltzmann model of bremsstrahlung radiation losses. Furthermore, we show that the emission of low-energy photons, which have previously been neglected because they do not contribute to net energy loss, can contribute significantly to the dynamics of electrons with an anisotropic distribution by enhancing the angular-deflection rate.

References

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