Keep-in-Touch meeting
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Simulation of effects of magnetic field using a Monte Carlo framework

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Electron energy distribution function (EEDF) is important characteristic of almost every discharge. Its knowledge can help greatly plasma diagnostics and also if it often necessary to know EEDF in order to be able to accurately model plasma discharge. At the moment there are several freely available tools (Bolsig+, LoKI-B) which calculates EEDF by solving Boltzmann kinetic equation using so-called two-term approximation. These frameworks are quite fast but two-term approximation might not be sufficient for certain types of plasma or for calculating swarm parameters like diffusion coefficient of electrons or reaction rate coefficients. One possible alternative to two-term approximation is to use more robust, albeit slower, Monte-Carlo based solvers.

One such solver is being developed by Tiago Dias and Vasco Guerra. Instead of directly solving the Boltzmann equation it simulates the trajectories of electrons in background gas. It uses randomly generated numbers to decide when any given electron collides with particle of background gas and what type of collision occurs (elastic, ionization, excitation, ...). Between the collision electron moves according to its motion equations.

At the current state the framework developed at IST Lisbon supports only movement of electrons in DC electric fields. Aim of my work was to implement effect of magnetic field into the framework using two approaches. First is to describe trajectory of electrons using analytical expressions derived from equations of motion of electron in constant electric and magnetic field. The second is to use more general algorithm, so-called Boris rotation. Subsequently, the algorithms were benchmarked with literature and compared to each other. Also, parametric studies in regard to strength of magnetic field and angle between electric and magnetic field were performed.