Monte Carlo method is an effective way of solving the kinetic equation of minority particle species in fusion reactor plasmas [1]. Stochastic nature of particle movement is caused by Coulomb collisions, and their effect can be included to the kinetic equation via Fokker-Planck collision operator [2]. In reactor plasmas, that are subjected to a strong magnetic field, motion of a charged particle is characterized by a fast gyro motion in a plane perpendicular to the field. Usually, only the relatively slow motion of the guiding center is of interest [3]. This brings conflicts as even though the deterministic motion is treated in guiding center phase space, collisional transport is still evaluated in the particle phase space.

Here we present the collision operator compatible with the guiding center formalism that allows uniform treatment of the particle’s motion. The work was originally published in reference [4]. The new collision operator is obtained by applying Lie transform perturbation theory to the particle phase space collision operator. The transformation is evaluated up to the second order, thus including the effects of magnetic field uniformity.


