CHINESE JOURNAL OF PHYSICS VOL. 49, NO. 6 December 2011

Study of the Magnetic Field Effect on the Electrons' Thermal Equilibrium

B. Liani* and B. Ardjani

Laboratory of Theoretical Physics, Science Faculty, Tlemcen University, PO Box 119 13000, Tlemcen, Algeria

(Received March 13,2010)

The thermal equilibrium of the electrons in a plasma is very important since, if it is sustained, many approximations can be used and many problems can be solved. The magnetic field (transverse and longitudinal) effect on the electrons' thermal equilibrium is studied here using the Monte Carlo method. It is confirmed that: In the presence of a transverse magnetic field, for low values of B there is no change of the distribution function and of the transport parameters; for medium values of B the Maxwellian distribution and the steady state of the transport parameters always remain, except that the transverse diffusion coefficient is not in the steady state; for high values of B the electrons' energy also leaves the steady state. In the presence of a longitudinal magnetic field, the distribution function and the transport parameters don't change, except that the transverse diffusion coefficient decreases, but it remains in the steady state. Generally, under a magnetic field, the steady state of the electrons' energy is always achieved if the time is long enough.

PACS numbers: 52.25.Fi

I. INTRODUCTION

Generally in a plasma the electrons are supposed to be in thermal equilibrium, with this supposition many approximations can be used and many problems can be solved, such as: the possibility of using the approximations of the hydrodynamic regime, the distribution function of the electrons can be taken Maxwellian, the possibility of simulating the electronic density by the fluid model method, and the Boltzmann equation can be easily resolved. Furthermore continuous electrical discharges are often used to create a dynamical steady state in which there is a balance between production (sources) and loss (sinks) [1]. A number of investigators have studied the steady-state electron energy distribution function (EEDF) in various gas discharges under an applied dc electric field. For example, Engelhardt and Phelps [2] derived a set of elastic and inelastic collision cross sections for electrons in H and D, by solving the Boltzmann equation using the two-term approximation. Nighan [3] studied the EEDF and collision rates in N_2, CO, and CO_2 gases. Tagashira, Sakai, and Sakamoto [4] solved the Boltzmann equation for large reduced electric fields (E/N) in Ar. Yachi *et al.* [5] used a multi-term approximation to solve the Boltzmann equation. Yochida *et al.* [6] studied the effect of the electrons produced by ionization on the calculated electron-energy distribution.

*Electronic address: b_liani2000@yahoo.fr

