PLASMA SCHOOL
Bad Honnef

Electron kinetics in collisional plasmas

(the Boltzmann approach)

L.L. Alves[1] and A. Tejero[2]
[1]Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Lisbon, Portugal
[2]Departamento de Física, Universidad de Córdoba, Córdoba, Spain
llalves@tecnico.ulisboa.pt

Electrons are the prime species to convey energy into a gas, producing plasma. The study of low-temperature plasmas entails a description of the electron transport and interactions with neutral/charged species, for which either electron–neutral scattering cross sections or electron parameters or both are typical data required. Electron parameters can be obtained by averaging different quantities involving the electron-impact cross sections over the electron energy distribution function (EEDF), whose determination is therefore of paramount importance.

This lecture focus on the study of the electron kinetics in collisional plasmas, based on the solution to the differential electron Boltzmann equation (EBE). The lecture is organized in two parts.

The first part introduces the EBE written under the classical two-term approximation (probably, the most popular formulation in low-temperature plasmas), identifies the input data and parameters required for solving the EBE, and announces several freeware solvers available (some as open-source).

The second part is closer to a workshop, proposing several hands-on exercises for the participants to perform actual calculations of EEDFs, by solving the EBE for different gases (argon and nitrogen) under different conditions: to check the influence of the reduced electric field, e-e collisions, and e-vibrational / e-rotational mechanisms; to introduce the concept of “swarm analysis”.

Simulations will use the **LisbOn Kinetics Boltzmann solver (LoKI-B)** that solves a time and space independent form of the two-term EBE, for non-magnetized non-equilibrium low-temperature plasmas excited by DC/HF electric fields from different gases or gas mixtures, adopting electron scattering cross sections obtained from the open-access website LXCat (http://www.lxcat.net/).

LisbOn KInetics

LoKI-B is developed with flexible and upgradable object-oriented programming under MATLAB®, and is available as open-source tool (https://github.com/IST-Lisbon/LoKI), licensed under the GNU general public license.

Participants are requested to install MATLAB® (version R2015b or any later version) on their computers (PC or MAC) to follow the exercises.

ipfn INSTITUTO DE PLASMAS E FUSÃO NUCLEAR

RUB TU/e Technische Universiteit Eindhoven University of Technology