## Kinetic study of collisional de-excitation processes

## Stage topic description

Many advanced propulsion concepts are based on rarefied plasmas, e.g. Applied-Field Magneto-Plasma-Dynamic (AFMPD) thrusters, Mini-Magnetospheric Plasma Probes (M2P2), and Inertial Electrostatic Confinement (IEC) thrusters. For analysis purposes it is common to assume initially the plasma to be optically thin. This implies the dominance of certain processes – collisional electron excitation and spontaneous emission which is also known as non-collisional de-excitation. This led to the introduction of so-called CR (Collision-Radiative) models. However, applicability of CR models is limited to the corresponding plasma types. As often, one cannot say a priori whether CR models are applicable in certain cases. Also, if the coupling between free and bound electrons is weak the assumption of a Boltzmann distribution of excited states is questionable. Since plasmas exist in many areas of science and technology, this project is not limited to certain electric propulsion plasmas.

## Candidate's tasks

The successful candidate will develop a tool which provides a certain reference needed for verification of probabilistic particle codes like DSMC and the de-excitation modelling therein. The reference of choice is the so-called rate coefficient of the corresponding process. Therefore, the tasks are structured in the following way:

- Development of a numerical integrator for a discrete-continuous distribution function;
- Coupling of the integrator to a cross section data base;
- Contribution to the verification of a DSMC-based high fidelity collision model.

## The ideal candidate

The student should have good knowledge of plasma physics and classical mechanics. Also, knowledge of Matlab and/or Fortran is an asset.

## References

Petkow, D., Herdrich, G., Faoulas, S., Auweter-Kurtz, M., "On the kinetic modelling of collisional effects relevant for non-stationary magnetoplasmadynamic thrusters", IEPC-2011-307, International Electric Propulsion Conference 2011, Wiesbaden