Cross sections for electron collisions with carbon monoxide

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Carbon monoxide (CO) is one of the main constituents of Venus and Mars atmospheres [1], is the most abundant molecule observed in the interstellar space after hydrogen, and is relevant in laboratory gas discharges for the production of syngas and the reforming of CO_2. Therefore, the study of the electron kinetics is essential to understand how the energy gained by the electrons from the applied field is transferred to the different heavy-particles. This work presents a complete and consistent set of electron-neutral scattering cross sections for CO, to be soon included in the IST-Lisbon database with LXCat.

The current set includes the elastic cross section, the cross sections for the excitation of 16 rotational states [3], 10 vibrational states and 7 electronic states [2,4,5], as well as the cross sections for dissociation, dissociative attachment and ionization [4]. The cross sections are defined for kinetic energies up to 1000 eV. The elastic cross section is built in two steps: the mid- and high-energy regions are taken from [2], with small modifications, while the low-energy region was recalculated from an effective cross section in order to ensure consistency when rotational excitations are explicitly accounted for.

The current set reproduces very well the available experimental swarm data, as it is exemplified in figure 1 for the case of the reduced Townsend ionisation coefficient. The good agreement between calculations and measured data is extended to the other swarm parameters, namely mobility and characteristic energy. Our analysis reveals that it is essential to consider rotational excitation and de-excitation mechanisms, as well as superelastic collisions with the first vibrational level, to correctly describe the low field region (E/N<2 Td).

References

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Acknowledgements: This work was partially supported by the Portuguese FCT, under Projects UID/FIS/50010/2013, PTDC/FISPLA/1243/2014 (KIT-PLASMEBA) and PTDC/FIS-PLA/1420/2014 (PREMiERE), and grant PD/BD/114398/2016 (PD-F APPLAuSE).