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Electron-molecule collisions

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Electron-molecule collisions play an important role in plasma physics, particularly in cool plasma and discharges where they are the dominant process. In this tutorial lecture, the main processes occurring when an electron collides with a molecule, or a molecular ion, will be briefly introduced. Then, the case of ($e+H_2^+$) will be presented in detail, not only because of its simplicity as a prototype, but also in relation with its importance in plasma fusion physics.

A key point in modelling the collision, is the formation of an intermediate neutral super-excited compound (H_2^{**} in the prototype case), which governs the various outcome channels and gives rise to sharp complex variations in the cross sections at low-energy, especially in the important case of dissociative recombination.

The main theoretical approaches for studying this problem will be introduced, with an emphasis on the method that combines the eigenchannel $R-$matrix formalism with Generalized Quantum Defect Theory. We will show how this approach, so-called Halfium R-matrix, is able to take into account simultaneously the bound spectrum and the fragmentation channels, leading to the key quantities needed for the calculation of the electron-molecule collisions cross-sections and rates of the various processes.

Further Reading

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