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Electron Collisions with Atoms and Ions: Current Status and Future Prospects[1]

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Accurate data for electron collisions with atoms and ions are required for many modelling applications in a variety of fields, including astrophysics, atmospheric physics, as well as plasma physics over a wide range of electron temperatures [1]. Since it is virtually impossible to measure all the data needed for state-of-the-art collisional radiative models (CRMs), much of the responsibility for generating sufficiently comprehensive datasets has been put on theory. Consequently, a variety of methods have been developed and applied since the early days of quantum mechanics [2]. They include special-purpose approaches that are suitable but also limited to particular processes (e.g., elastic scattering), perturbative techniques (e.g., first- and second-order plane-wave or distorted-wave methods, which are usually limited to sufficiently high energies), and the non-perturbative close-coupling (CC) approach that is based on an (in principle complete) expansion of the projectile + target scattering wave function. CC methods were originally designed for low energies and near-threshold resonances, but the inclusion of so-called "pseudo-states" has extended the regime of applicability tremendously, even enabling the calculation of ionization cross sections. While the problem for electron collisions with light (quasi-)one- and (quasi-)two-electron targets (H, He, light alkalis and alkaline-earth elements, and the corresponding iso-electronic ions) is considered to be essentially solved, this is by no means the case for heavy, complex, open-shell targets. Examples include Fe and its lowly charged ions, which are of tremendous importance for astrophysics, the heavy noble gases (Ne−Xe) for modelling of various plasmas, and targets like W and its ions where data are needed to model fusion reactors. In this talk, I will introduce the basic ideas behind a selection of methods, discuss their strengths and weaknesses, and concentrate on how to assess the quality of the data [3] that are available from a number of databases maintained worldwide. [1] K. Bartschat, Journal of Physics B **51** (2018) 132001. [2] K. Bartschat, J. Tennyson, and O. Zatsarinny, Plasma Processes and Polymers **49** (2017) 1600093. [3] H.K. Chung *et al.*, Journal of Physics D **49** (2016) 363002.

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