Some Systematics in Electron – Atom and Electron – Molecule Cross sections

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Numerous data bases for electron – atom and electron – molecule scattering have been created within national (eg. French, Japanese) and international (EU, IAEA, NIST etc. programmes). The overall collection of data is impressive. What still lacks is some comparison, in search of analogies and differences among total and partial cross sections, in broad energy ranges.

For some processes knowledge of partial cross sections seems to be sufficient. Electron – *ionization* cross sections based on the analytical formulae using energies of the electron binding developed by Kim and Rudd [1] covers a number of targets and is available on-line up to high energies at NIST. On the opposite end of the energy scale the *electron-attachment* cross sections obtained from Rydberg-atom quenching [2] and pulse-radiolysis microwave measurements [3] seem to reach theoretical maximum limits for some targets (like halo-methanes, see [4]). Synchrotron - based electron sources opened new perspectives in the zero energy limit for *elastic scattering* for as important targets, like H_2O [5] and noble gases [6].

In the few eV range, where *resonances* appear in elastic, electron attachment and vibrational excitation channels, critical comparisons with swarm data proved to be stringent tests for the choice of recommended data, see for ex. [7] for NO. Modified effective range theory, recently solved analytically, shows to be applicable to *elastic cross section* in targets like N_2 from zero up to a few eV. However, inverting the scattering potential needed for extrapolations is very sensible to the choice of reference integral cross sections, see for ex. [8]. An improvement can be obtained by using *differential cross sections*, now available from new laboratories.

There remain two energy/ partial cross section ranges: 1) elastic data at *intermediate* and high energies and 2) *electronic excitation* and/or *dissociation* into neutrals cross sections. Both are difficult to estimate theoretically and tedious for measurements. Some scaling rules for elastic/ inelastic partitioning like that observed for noble gases vs. methane, silane, germane series [9] could be developed. The *total cross sections* in the intermediate energy range also allow for some scaling [10]. The remaining difference between total cross sections (corrected for forward scattering [11]) and known partial cross sections (elastic, ionization) would account for *other inelastic channels*. Geophysics of polar aurora is an additional check [12].

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