Analytical Fits for Total and Ionization Cross Sections of Electron Impact

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Synopsis In order that the electron cross section data, either experimental or theoretical, may be employed for modeling and other applications, the quantities must be available as functions of impact energy. Therefore, analytical fits to total and ionization cross sections of electron impact of the atomic/molecular targets are reported.

Recent apparent reorientation of atomic and molecular physics, especially electron impact cross section studies, from fundamental research to applied science and technological problems has put forward requirements to the quality of various cross sections calculated. [1]

A theoretical method known as Complex Scattering Potential-ionization contribution to calculate ionization cross sections has been applied to over 100 atomic/molecular targets and has produced significant data [2, 3]. One needs accurate enough values of the cross sections which can be calculated using analytical fits for applications in modeling in which cross sections are input quantities.

The power-law behavior close to threshold as known from the Wannier theory [4] has been taken into account in developing this approach. The analytical method evolved for calculating the total cross section (Q_T) of electron impact is as follows. The energy range for the present calculations is ~50 to 2000 eV.

$$Q_T = a(\alpha_d/E_i)^b \qquad (1)$$

Here α_d is dipole polarizability in Å^3 and E_i is incident energy, while a and b are fitting parameters.

Further,

$$Q_T = a_1/(U_i + a_2) + a_3(lnU_i/U) \qquad (2)$$

This form is Born-Bethe behaviour, except that we are now introducing one more parameter 'a_2'. By using the values of these parameters we have reproduced total cross section for H atom and the calculated data are best fit to the original data. The above expressions accurately (within $\pm 2.3\%$) reproduce the total cross sections of electron impact with H atom.

We also represent the total **ionization** cross section of a target in the parametric form. The results will be presented in the conference.

Such models will be of immense help to researchers who need data for modeling, especially for plasma industry and atmospheric/planetary modeling. This methodology can be extended to metastable H in 2s-state, and other systems. Molecules in their ground state and metastable excited states will also be considered [2, 3].

References

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