

Modifications in high energy higher order Born approximation

K SUJA and H S DESAI

Physics Department, Faculty of Science, M.S. University of Baroda, Baroda 390 002, India

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Abstract. A systematic study is made to find out the differential scattering cross-section in the case of electron-atom collisions. The first and the second Born terms of $O(1/k_i)$ are calculated in the framework of Yates high energy higher order Born approximation. The second Born term of $O(1/k_i^2)$ is calculated using the second order Wallace term, the third term is calculated using the Glauber-eikonal series of Yates. The method is applied to the elastic scattering of electrons by atomic hydrogen in the energy range 100–400 eV and by helium for energies 200 eV and 400 eV. Comparison is made with other theoretical results and the experimental data.

Keywords. Elastic scattering; electron; hydrogen atom; helium atom.

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1. Introduction

It is now an established fact that the first Born approximation holds true only in a limited class of low energy scattering problems. The second Born approximation, although a bit cumbersome, is done for atoms. However, an approximation to the second Born term on the lines of the eikonal approximation was carried out by Yates (1979). Basically this is a simple approximation and easier to compute. But it has some serious drawbacks: (i) it is easily seen that the second high energy higher order Born (HHOB) approximation term is invariant under transformation $-e \rightarrow e^+$. (ii) The results overestimate at large angles. In order to improve the HHOB method we have attempted and improved the approximation on a line similar to the Wallace treatment of the eikonal approximation. In §2 we have developed the theory and applied it to the targets of hydrogen and helium. The results of the theory are discussed in §3.

2. Theory

The T matrix can be written as

$$T = \langle \psi_f | (V + VG_0 V) | \psi_i \rangle = T^1 + T^2, \quad (1)$$

where $T^1 = \langle \psi_f | V | \psi_i \rangle, \quad (2)$

$$T^2 = \langle \psi_f | VG_0 V | \psi_i \rangle, \quad (3)$$