SUMMARY OF THE THESIS

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ELECTRON SCATTERING BY SOME LIGHT ATOMS

''Scattering theory'' is one of the recent interesting topics in the subject of Quantum mechanics, which is a well distilled mechanics for the micro-particles. The scattering theory has attracted many experimentalists as well as theorists because of its importance not only in the field of physics but also in biology and engineering. Under this head there are number of problems. They are electron - atom or molecule or ion interactions. The present study deals with the electron - atom interaction. There are many recent developments in experimental as well as theoretical approaches for the discription of electron - atom scattering. The developments of these two correlated ways is gaining importance in the subject of science and engineering.

The studies of intermediate and high energy ($\geq$ 15 eV) electron scattering by atoms has important applications in the subjects of atmosphere, ionosphere, planetary and stellar atmosphere, laser plasmas, electrical discharges, high temperature combustion processes, radio chemistry and Health Physics. The scattering of electrons by atmospheric gas would be an important process in the Aeronomy. Its importance has been recently recognised in the study of M H D (Magneto Hydro Dynamics) plasmas. Apart from this the scattering theory is of great intrinsic interest, playing a leading part in the

establishment of quantum theory and including many aspects of the fundamental importance in the theory of atomic structure.

The present investigations are concerned with the study of scattering of electrons by some light atoms (Hydrogen, Helium and Lithium) at intermediate and high incident energies ($\geq$ 20 eV). The scattering parameters, which are given below :

DCS (Differential Scattering Cross Section)
TCS (Total Cross Section)
TES (Total Elastic Cross Section) and
MTCS (Momentum Transfer Cross Section),

are calculated in the present investigations and compared with the recent experimental and theoretical results. A new theoretical technique proposed by Yates is used to calculate the scattering parameters in the incident energy range E $\geq$ 20 eV. The entire study is being presented in the thesis which is divided in to six chapters.

Chapter I comprises of introduction and experimental background. A typical collision experiment, collision processes (elastic, inelastic and superelastic) for an electron-atom interaction and collision cross sections (DCS, TCS, TES and MTCS) are described . The principles in beam and swarm techniques are described. The typical experiments under each of these two techniques for the measurement of collision cross sections are given. Finally the recent developments in the experiments for the measurement of collision cross sections for hydrogen, helium and lithium atoms are given.

Chapter II is folded with the review of the literature and the approach to the present problem. The basic integral equation for electron - atom collision, the complete analysis of HHOB (High energy higher order Born) approximation and the validity of this approximation are described in this review. Few other approximations (GES, EBS) related to the HHOB approximation are also described. The recent developments in the theoretical approaches to study the electron - atom scattering are mentioned. Finally approach to the present problem is outlined.

Chapter III contains the application of HHOB approximation to the hydrogen atom. The following collision processes are described :

Elastic - Scattering of electrons by hydrogen i.e.(1s $\rightarrow$ 1s)
In elastic - Scattering of electron by hydrogen i.e.(1s $\rightarrow$ 2s)
Elastic - Scattering of electrons by hydrogen i.e.(2s $\rightarrow$ 2s)

and the scattering parameters for all these processes are calculated and compared with recent experimental and theoretical data. The variation of scattering amplitudes and DCS with respect to the choice of the average excitation energy is studied for inelastic process. Finally higher order exchange amplitudes for the elastic scattering of electrons by hydrogen atom are derived. Ochkur type approximation is used in the HHOB approximation for the calculations of higher order exchange amplitudes. These exchange amplitudes are included to the direct scattering amplitudes to study the DCS, TCS and TES.

In Chapter IV we have described the electron scattering by helium atom. In the helium atom calculations, Hartree - Fock and Hyllress wave functions are used for the ground state of helium atom. Elastic and inelastic scattering processes are studied for the interaction of electrons with helium atoms. The variation of scattering amplitudes and DCS with respect to the choice of average excitation energy is studied for elastic process. Optical theorem is used to calculate TCS. DCS and TCS for helium atom are compared with the recent experimental as well as theoretical results.

In Chapter V we have studied the electron scattering by lithium atom. The three electron system of lithium atom is reduced to the one electron system and the elastic collision process for this system is described. Finally complete HHOB approximation is reformulated for static fields of target atoms and the derived scattering amplitudes are applied for the study of elastic collision process of lithium atom. DCS, TCS and TES are calculated and compared with the other theoretical results.

In all the above collision processes, collision cross sections are calculated at the incident energies ranging from 20 to 700 eV. TCS, TES results are found to be in good agreement with the experimental as well as theoretical results. The DCS results are very good at small angles ($\theta \leq 50^{o}$) when compared with the measured and theoretical results. For the DCS calculations three terms are derived viz., the first two terms of Born approximation are derived using Yates (1979) approximation and the third term is derived using Yates (1974) GES (Glauber eikonal series) approximation. The DCS is formulated through the order K_i^{-2} of the incident electron energy. It is also observed that accuracy of the results increases as the incident energy increases.

All the scattering parameters are calculated in the double precession by using the IBM - 360 of the computer system. FORTRAN IV language is used for the computer programming. Very accurate numerical techniques are used for the calculations. The results of the present studies on hydrogen, helium and lithium atoms are shown in the form of tables and graphs (solid curves).

Chapter VI is a concluding chapter of the present investigations. The results of the present investigations on hydrogen, helium and lithium are discussed in this chapter. And some guide lines regarding the extension of the present work and the likely improvements of the present investigations are discussed.