ABS T R A C T

A systematic study of the penetration of electrons and positrons through matter has been done, by developing a simple method for calculating practical ranges of these particles in different materials, viz. elements, compounds and alloys for the energy region \(0.03 \, \text{keV} \leq T_0 \leq 5.0 \, \text{keV}\). These calculations are performed by taking into account both parts of the electron (or positron) range, i.e. before and after the diffusion sets in.

Some new analytically convenient, empirical total stopping power relations for low energy \((< 350 \, \text{keV})\) electrons and positrons, have been developed. This is being done to fulfill one of the input requirement for present simple calculations of practical ranges of these particles at energies as low as \(30 \, \text{keV}\). These calculations have been extended above \(350 \, \text{keV}\) (upto \(5.0 \, \text{keV}\)) by making use of earlier total stopping power relations due to Batra and Sehgal. This thesis has been divided in five chapters.

In the first chapter revival of the interest in theoretical calculations of practical ranges of electrons and positrons has been discussed together with the importance of these ranges in various spheres of Physics and Nuclear Engineering. A summary of experimental approaches along
with a brief review of earlier approaches to understand electron transport in the matter and for calculating practical ranges in literature, has also been given.

In the second chapter penetration behaviour of electrons and positrons has been described along with a critical review of their total stopping power and that of multiple scattering theories. This has been followed by description of an earlier attempt towards theoretical calculations of practical ranges due to Rohrlich and Carlson.

In third chapter necessity of analytically convenient total stopping power relations for low energy (\(< 350\) keV) electrons and positrons, has been realized for simple calculations of total stopping power and 'osda' ranges in absorbers of any \(Z\). The importance of these relations for calculating total stopping power of electrons and positrons in compounds has also been discussed.

In fourth chapter the present simple method for calculating practical ranges of electrons and positrons in absorbers of any \(Z\) for three different energy regions between \(0.03\) MeV and \(5.0\) MeV has been described with a sample calculation for electrons. The intrinsic depth \((s^+_D)\) has been added to the remaining range \((r_{av}^-)\) after
the diffusion sets in, to obtain the practical ranges of these particles.

In fifth chapter the present calculated practical ranges of electrons and positrons have been compared with their respective experimental counterparts. A good agreement has been noticed between the two in the energy region \( 0.03 \text{ MeV} < T < 5.0 \text{ MeV} \), for several low, medium and high Z absorbers. Tabata's empirical formula has been used, to obtain practical ranges of electrons for energies where these could not be extracted from literature. The comparison of present calculated ratios of practical ranges of positrons and electrons with corresponding experimental ratios for some energies has also been done satisfactorily in the case of metals, compounds and alloys. The error in the present method of calculation has also been discussed.