SYNOPSIS

The present thesis is concerned with the study of the kaon – nucleon $(K^+ - N)$ and kaon-nucleus $(K^+ - A)$ interactions, namely $(K^+ - {}^2H)$, $(K^+ - {}^6Li)$, $(K^+ - {}^{12}C)$ and $(K^+ - {}^{28}Si)$. Hadronic reactions require a microscopic treatment based on quantum chromo dynamics (QCD), the fundamental theory of strong interactions. However, due to the absence of a rigorous solution in terms of explicit quark-gluon dynamics and due to the difficulties concerning the extrapolation of the information, which are coming mostly from high-energy region and other QCD regions without any justification, it is inevitable to use the baryons and mesons as the proper entities, which are considered as collective degrees of freedom of QCD at low and medium energies. The microscopic optical model gives us a more reliable basis, to construct realistic potentials for scattering than fitting the phenomenological forms. We, therefore, use the method of one-boson-exchange potential (OBE) for both the real and the imaginary parts of the $(K^+ - N)$ optical potential. We have constructed this potential based on the exchange of four mesons: the scalar-isoscalar σ (0^+, 0), the vector-isovector ρ (1^-, 1), the vector-isoscalar ω (1^-, 0) and the additional σ_0 –meson (a repulsive meson with space structure that coincides with that of the σ (0^+, 0) meson but with opposite sign for the corresponding potential and a heavier exchange mass) to account for the additional repulsion which is obviously required by the experimental data. The picture of (OBE) potential seems to be a corner stones towards the prediction of some properties of the complicated many body systems.

We used a semi–relativistic decoupled Dirac equation, where the nucleon and the kaon are considered as Dirac particles. An important mathematical advantage is gained by the assumption that each nucleon in the nucleus is moving under the influence of a common harmonic oscillator potential. This allows the wave function of the two particles to be separable in their relative and center of mass coordinates which is known as Talmi – Moshinsky–Smirnov brackets.

Three different static functions for the kaon–nucleon interaction (Yukawa, Generalized Yukawa and Single Particle Energy Dependent) are used with two sets of the parameters to deduce the corresponding $(K^+ - N)$ potential. The charge dependent and spin–orbit forces were incorporated in the calculations without any further adjustable constants. In addition, the potential is extended to include the in-medium effects for $A \geq 2$ to $A \leq 28$ nuclei, taking into consideration both the wave vector and the Clebsch-Gordan coefficients.

The thesis is organized as follows:

Chapter I is an introduction and a historical development of the problem.

Chapter II is devoted to the mathematical formulation, the meson functions and the set of parameters used.

Chapter III includes the discussion of our results and their comparison with the available experimental data. Our conclusive remarks are also given there.

We published a paper under the title ***"Kaon-Nucleon Interaction in One – Boson – Exchange Picture at Intermediate Energy"*** in the "Proceeding of Nuclear and Particle Physics Conference NUPPAC'07 17-21 November. 2007, Luxor, Egypt.

In addition, we have submitted two papers under the titles:

1- ***"One-Boson-Exchange Microscopic Potentials in*** K^+***-Nucleon and Nuclei Interactions."***

2- ***"Scattering of*** K^+ ***Meson from Light Nuclei at Intermediate Energies."***

in the Conference of Nuclear and Particle Physics NUPPAC'09 11-15 Nov. 2009, Sharm El-Sheikh, Egypt.