CHAPTER I

INTRODUCTION

In the field of strong interaction dynamics, the nucleon-nucleon (NN) interaction has occupied a central role in all formulations of nuclear reactions and structure theories [1, 2]. In addition, the information one can get from NN interaction is very useful and closely related to nuclear forces. This has been considered as the heart of nuclear physics ever since the field was born in 1932 with the discovery of the neutron by Chadwick [3]. In this picture, the atomic nucleus has been regarded, as an assembly, of Z protons and N neutrons (i.e., Z+N=A nucleons) bound together by powerful nuclear forces. In fact, during the first few decades of nuclear physics, the term nuclear force was often used as synonymous for nuclear physics as a whole. So, one of the main problems of nuclear physics is to find out the nature of nuclear forces.

Nuclear forces differ from all other known types of forces. They cannot be of electrical origin, since they act between charged particles as well as between neutral particles. These forces cannot be magnetic either, since the interaction between the magnetic moments of nucleons is extremely weak. Nor can these be considered as gravitational force, since this force is too weak. The main properties of nuclear forces are almost charge independent, short-range, have saturation, depend on the spin, non-central and tensor type. The law of nuclear interaction is unknown, and there are two ways in which a theory of nuclear interaction between nucleons can be constructed [4]:

- A phenomenological selection of interaction potential satisfying the experimental results, or
- Attributing nuclear forces to a meson field.

In the first approach (the phenomenological potential), studying the scattering of two nucleon in free space, we can obtain knowledge about the phase shifts, which can be related to the potential between the two nucleons. This type of potential is known as *realistic potential.* The potentials constructed in accordance with the observed properties of nuclei are known as *phenomenological or effective potentials.* The form of these potentials is usually chosen to satisfy the qualitative empirical features of nuclear forces. Various authors [5-12] have attempted to determine the parameters of phenomenological NN forces from the analysis of experimental observations. In constructing a phenomenological NN interaction usually four restrictions must be satisfied:

(I) It must be Hermitian in order to conserve energy.

(II) It must depend only upon the relative motion of the two nucleons, to ensure the translation invariance.

(III) The angular momentum, parity and isospin must be conserved.

(IV) It must be invariant under interchange of particles.

Due to the anomalies inherent in these potentials one may use a realistic two nucleon potential, which represents correctly the interaction of two nucleons in free space and could be modified properly by the choice of appropriate configuration space.

The corresponding potential picture of the two nucleons is shown in Fig.1.