PREFACE

Two extreme models of nuclear reactions have received particular attention for a long time and enjoyed commensurate success in explaining the experimental observations at low energies. They are direct reaction model and compound nucleus model. These extreme view points of nuclear reaction studied are prompted by the time scale of occurrence of these reaction modes. As a general rule in Physics, it is much simpler to describe the extreme cases, as they allow one to neglect a lot, in favour of one or other, of specific features, and thereby allow the use of simple models. However, there is a large body of experimental data which deviate systematically from these two well established theories of nuclear reaction and constitute the experimental signatures of third mechanism which is operative at moderate energies and is called "preequilibrium" reaction mode. This third mechanism of nuclear reaction is envisioned as occurring on a time scale between those of direct and compound reactions, as the compound system proceeds towards equilibrium.

In order to explain preequilibrium phenomena, several models were proposed based on classical, semi-classical and quantum mechanical ideas during the past three decades which embody few of the details of nuclear structure but employ more general properties of nuclei such as mean free path of nucleon in nuclear matter, densities of particle-hole states at varying excitation, Fermi energy, effect of nuclear surface etc. In short, those are really 'nuclear matter' calculations. By means of closed form analytical expressions, they give fairly accurately the angle integrated particle spectra from which integral cross sections at each bombarding energy as well as the variation of cross section with energy, can be readily obtained. These developing preequilibrium models have to be tested at high energies.

There have been far reaching improvements in the semi-classical or phenomenological models such as Hybrid, Geometry Dependent Hybrid, Exciton, Index models. These are often used for making comparison with experimental results on account of their simplicity and transperency. Efforts are also in progress to give a fully quantum mechanical picture of the preequilibrium reactions in the frame work of multistep theories, but due to the complexity of the computation of the interaction of complex particles like an α-particle, the quantum mechanical picture is yet to come.

A survey of literatures reveal that most of the available data on alpha particle induced reactions in the low energy regions are measured with poor resolution detectors and there are mutual discrepancies among many previous measurements. Discrepancies were also observed even between the Ge measurements for the same reaction.

In view of large uncertainties and mutual discrepancies, a reinvestigation of twenty three reactions were undertaken with two main objectives

(i) to make a careful and systematic experimental study of the individual reactions and to suppliment them with new energy point cross sections and

(ii) to compare the measured excitation functions of the reactions with Hybrid model of Blann (ALICE/90).

The alpha particle induced reactions on the target elements iron, indium, antimony and gold have been studied upto 50 MeV, using the stacked foil activation technique and high resolution HPGe gamma ray spectroscopy. These experimental results and the corresponding theoretical predictions based on preequilibrium Hybrid model together with the conclusions drawn from the present works are incorporated in this thesis.

The REFERENCES, throughout this thesis, are numbered between two slashes in the text and are listed at the end of each chapter.