SUMMARY
The alpha deuteron system has been the most investigated few nucleon system during recent years. Because of its simplicity, the three nucleon system was previously favourite among other few nucleon systems and had been investigated exhaustively in the past. Nucleon deuteron interactions above break up threshold had been an important tool for the investigation of three particle problem. Information concerning n-n scattering length, in particular, has been achieved from n-d break up experiments, which cannot be obtained from two body experiments since a free neutron target is not available.

The integral equation approach with Faddeev type of equations has proved to be an exact method in treating three particle problems leading to exact and unique numerical solutions for the assumed interactions. These interactions, in order to be realistic, are supposed to agree with already established facts of two- and three particle systems, like phase shifts, scattering lengths, effective ranges and other known observables of deuteron and bound three nucleon systems. Unfortunately, this condition cannot always be satisfied completely because of the computational complexity involved. Faddeev calculations have been mostly done with separable potentials and in some cases with realistic local potentials.

From experimental point of view, it has been well known that cross section alone is not the sole observable to study the few nucleon interaction in detail since the spin dependent forces cannot be neglected and may be informed mainly through polarisation observables. With the rapid development of polarized beams and
targets, high precision experiments giving polarisation data on the three particle system have been developed. The present investigation is concerned only with the data on angular distributions.

The alpha-deuteron system is considered as a three particle system where alpha can be reasonably treated as a single particle (structureless boson) below alpha break up threshold. From both theoretical and experimental points of view, this alpha deuteron system is simpler than the nucleon-deuteron system due to the fact that reaction products ($\alpha$, $n$, $p$) here are all distinguishable with alpha having zero spin and only one break up channel ($d+\alpha \rightarrow d+n+p$) is open. Some new informations have been obtained from earlier experiments done elsewhere because of resonances in the two body subsystems ($^5$He and $^5$Li systems) as well as in the three body system itself ($^6$Li).

The project undertaken by the Burdwan University Nuclear Research Group with the joint collaboration of VECC was to study the alpha-deuteron interaction at incident alpha energies between 30 Mev and 90 Mev in order to investigate two body final state interaction in the light of Faddeev equations. The thesis is basically devoted to the following three aspects according to the condition envisaged during actual running of the project:

a. Design and fabrication of a small scattering chamber together with its vacuum fittings.

b. Alpha deuteron elastic scattering.

c. Alpha deuteron break up.
According to our plan to use a gas target a small hex-shaped scattering chamber (12" inside diameter) is designed and fabricated. Two manually controlled rotating arms inside the chamber with a minimum angular separation of 29° are also fabricated for mounting the two charged particle detectors. A suitable collimating system is designed and fabricated for the selection of desired events. Geometry for an angular correlation for asymmetric angles is discussed. The resulting geometry factor for the detection system has been calculated. High vacuum fittings of the chamber has been developed.

Differential cross section for the elastic scattering of alpha particles of energy around 40 Mev by deuterons have been measured. Solid deuterated polyethylene foil is used as the deuterium target. The data cover laboratory angles ranging from 10° to 65°. Outgoing charged particles (α and p) are detected by Si(Li) detectors. The data were collected on a Canberra Series-88 MCA in singles mode using a standard electronics. They are normalised using a monitor at 45°. As compared to some existing data at energies close to ours, a remarkable energy dependence of the differential cross section has been observed for a certain range of scattering angles. Analyses of the data are being carried out with the help of Faddeev formalism.

Some break up data were obtained during a few hours of available beam time. The correlation cross section along the arc of the kinematic locus shows interesting features. A complete analysis will only be possible after more data are obtained.