

# List of Figures

1.1	Types of reaction processes distinguished on the basis of the impact parameter at which these reactions occur. . . . .	3
1.2	Decomposition of the total reaction cross-section into different components as a function of the orbital angular momentum parameters at which they occur. . . . .	6
1.3	Example of Threshold anomaly for $^{16}\text{O} + ^{208}\text{Pb}$ [1]. . . . .	10
1.4	Example of Threshold anomaly for $^{11}\text{B} + ^{209}\text{Bi}$ [2]. . . . .	11
1.5	Example of breakup threshold anomaly for $^6\text{Li} + ^{208}\text{Pb}$ [3]. . . . .	12
1.6	Example of breakup threshold anomaly for $^6\text{Li} + ^{64}\text{Zn}$ [4]. . . . .	14
1.7	Example of the real and imaginary potentials, at the strong absorption radius, for the elastic scattering of $^6,7\text{Li} + ^{80}\text{Se}$ [5]. . . . .	16
2.1	Schematic drawing of the Mumbai Pelletron accelerator facility. The left panel of the figure shows the 5 beam lines. . . . .	23
2.2	Schematic diagram of the 6 MV Folded Tandem Ion Accelerator. . . . .	26
2.3	The different regions of operation of a pulse mode gas detector. The pulse amplitude is plotted for two different energies of the radiation. . .	28
2.4	Typical energy levels diagram of an organic scintillator. . . . .	31
2.5	Schematic (a) and real (b) views of typical silicon surface barrier detector. . .	33

2.6	Schematic diagram showing $\Delta E$ -E telescope setup. $\Delta E$ is generally thin solid state detector or gas detector so as to pass the incident particle and E detector is thick solid state detector chosen to stop the remaining energy of incident particle. . . . .	36
2.7	Schematic block diagram of the experimental setup for the elastic scattering, quasi elastic and transfer angular distribution measurements. . .	39
2.8	Four silicon surface barrier detectors telescopes placed on the one movable arm of the scattering chamber and target ladder and gas detector also shown in the figure. . . . .	40
2.9	Scattering chamber of elastic scattering angular distribution experiment.	42
2.10	Schematic block diagram of the complete electronic set up corresponding to a typical experimental set up as shown in Fig (2.7). . . . .	45
2.11	Woods and Saxon potential graph shown in eq.(2.12) . . . . .	50
2.12	The linear schematic model for W (E), consisting of three straight line segments (19). . . . .	56
3.1	A 2D spectrum ( $\Delta E$ vs $E_{res}$ ) for the ${}^7\text{Li} + {}^{232}\text{Th}$ system at $E_{lab} = 44$ MeV and $\theta_{lab} = 60^\circ$ . . . . .	61
3.2	The projection of the ${}^7\text{Li}$ elastic peak of the bi-parametric $\Delta E$ vs $E_{res}$ spectrum (from above two dimensional fig.(3.1) ). . . . .	62
3.3	Experimental elastic scattering cross section ( $\sigma_{El}$ ) normalized to the Rutherford cross section ( $\sigma_{Ruth}$ ) as a function of $\theta_{c.m.}$ for the ${}^6\text{Li} + {}^{232}\text{Th}$ system (solid circles) (suitably scaled up for each energy) and their best fits from optical model calculations (solid lines). The curves corresponding to the best fits by ECIS code. . . . .	65
3.4	Figure of sensitivity of radius for 44 MeV for ${}^6\text{Li} + {}^{232}\text{Th}$ systems, (a) real and (b) imaginary parts. . . . .	66

3.5	Experimental elastic scattering cross section ( $\sigma_{El}$ ) normalized to the Rutherford cross section ( $\sigma_{Ruth}$ ) as a function of $\theta_{c.m.}$ for the ${}^7\text{Li} + {}^{232}\text{Th}$ system (solid circles) (suitably scaled up for each energy) and their best fits from optical model calculations (solid lines). The curves corresponding to the best fits by ECIS code. . . . .	68
3.6	Sensitivity radius for ${}^7\text{Li} + {}^{232}\text{Th}$ systems, (a) real and (b) imaginary parts at 44 MeV. . . . .	69
3.7	Elastic scattering angular distributions at different energies for the ${}^6\text{Li} + {}^{232}\text{Th}$ system and their best fits from optical model calculations. The curves correspond to best fits were obtained using the Sao Paulo potential (SPP). . . . .	71
3.8	Elastic scattering angular distributions at different energies for the ${}^7\text{Li} + {}^{232}\text{Th}$ system and their best fits from optical model calculations. The curves correspond to best fits were obtained using the Sao Paulo potential (SPP). . . . .	73
3.9	Energy dependence of the real and imaginary potentials at $R_s = 12.14$ fm and 11.27 fm for ${}^6\text{Li} + {}^{232}\text{Th}$ and ${}^7\text{Li} + {}^{232}\text{Th}$ systems, respectively. The straight line segments represent various fits of imaginary potential $W(E)$ and the corresponding curves for real potential $V(E)$ were obtained from these by using the dispersion relation. Figs. (a) and (b) correspond to the real and imaginary potential curves for ${}^7\text{Li} + {}^{232}\text{Th}$ system, whereas (c) and (d) represent the ${}^6\text{Li} + {}^{232}\text{Th}$ system. . . . .	75

3.10	Energy dependence of the normalization factors $N_R$ and $N_I$ , for the real and imaginary potentials, corresponding to the Sao Paulo potential (SPP) with two free parameters, for the ${}^6\text{Li} + {}^{232}\text{Th}$ and ${}^7\text{Li} + {}^{232}\text{Th}$ systems. The lines represent possible behaviours of $N_R$ and $N_I$ that are compatible with the dispersion relation [7,14]. Figs. (a) and (b) correspond to the real and imaginary potential curves for ${}^7\text{Li} + {}^{232}\text{Th}$ system, whereas (c) and (d) represent the ${}^6\text{Li} + {}^{232}\text{Th}$ system. . . . .	76
3.11	The total fusion cross sections ( $\sigma_{fus}$ ) calculated by CCFULL and total reaction cross sections ( $\sigma_R$ ) for the ${}^{6,7}\text{Li} + {}^{232}\text{Th}$ systems obtained by using ECIS code and SPP calculation shown in 7 ((a,b)) respectively plotted as a function of the bombarding energy. The total fission cross sections ( $\sigma_{fis}$ ) [60] and the total fusion cross sections for the ${}^{6,7}\text{Li} + {}^{232}\text{Th}$ systems are plotted in 7 (c). . . . .	78
3.12	Reduced total reaction cross section vs reduced projectile energy for the ${}^{6,7}\text{Li} + {}^{232}\text{Th}$ reactions using the prescription given in Ref [67]. . . . .	79
4.1	A typical two dimensional plot of $\Delta E$ versus $E_{res}$ (residual energy) for the ${}^{11}\text{B} + {}^{232}\text{Th}$ system at $E_{lab} = 61$ MeV and $\theta_{lab} = 90^\circ$ . The bounded region (dashed line) on $Z = 5$ events shows quasi-elastic events. . . . .	83
4.2	One dimension spectrum from above two dimensional figure (4.1) of the bounded region (dashed line) on $Z = 5$ events. . . . .	84
4.3	Quasi-elastic scattering angular distributions normalizes with Rutherford cross section for ${}^{10}\text{B} + {}^{232}\text{Th}$ system at various energies after suitably scaling. Solid line represents Woods-Saxon fitting procedure. . . . .	86
4.4	Quasi-elastic scattering angular distributions normalizes with Rutherford cross section for ${}^{11}\text{B} + {}^{232}\text{Th}$ system at various energies after suitably scaling. Solid line represents Woods-Saxon fitting procedure. . . . .	87

4.5	Sensitivity radii based on the crossing of the real (a) and imaginary (b) parts of the WSP potential at $E_{\text{lab}} = 65$ MeV for different diffuseness parameter values ( $a_v$ and $a_w$ ). . . . .	89
4.6	Sensitivity radii based on the crossing of the real (a) and imaginary (b) parts of the WSP potential at $E_{\text{lab}} = 65$ MeV for different diffuseness parameter values ( $a_v$ and $a_w$ ). . . . .	90
4.7	Energy dependence of the real and imaginary potentials at sensitivity radii $R_s = 12.39$ fm for $^{10}\text{B} + ^{232}\text{Th}$ system in Panels (a), (b) and at $R_s = 12.45$ fm for $^{11}\text{B} + ^{232}\text{Th}$ in panels (c), (d). Solid (red) and dashed (blue) lines are two different sets of line-segment fits. Arrows in the panels (b) and (d) indicate the positions of Coulomb barriers ( $V_b$ ) for $^{11}\text{B} + ^{232}\text{Th}$ and $^{10}\text{B} + ^{232}\text{Th}$ , respectively. . . . .	92
4.8	Transfer angular distributions for $^{12,13}\text{C}$ , $^{9,10}\text{Be}$ and $^{6,7}\text{Li}$ at various bombarding energies for $^{10,11}\text{B} + ^{232}\text{Th}$ systems. . . . .	94
4.9	Total reaction cross sections for $^{10}\text{B} + ^{232}\text{Th}$ system (solid square) and $^{11}\text{B} + ^{232}\text{Th}$ system (open square) derived from fit to the quasi-elastic scattering angular distribution using the ECIS code. The transfer cross section (only sum of $^{12,13}\text{C}$ , $^{9,10}\text{Be}$ and $^{6,7}\text{Li}$ ) are plotted for $^{10}\text{B} + ^{232}\text{Th}$ (solid circles) and for $^{11}\text{B} + ^{232}\text{Th}$ (open circles). Dashed and dash-dotted lines are guide to eye. . . . .	95
4.10	The fraction of the transfer cross section ( $\sigma_{\text{tr}}$ ) to the total reaction cross sections ( $\sigma_R$ ) as a function of the beam energies for the both $^{11,10}\text{B} + ^{232}\text{Th}$ systems. The dashed curves are guide to eye. . . . .	96
4.11	Reduced total reaction cross section for the $^{10,11}\text{B} + ^{232}\text{Th}$ systems compared with $^{6,7}\text{Li} + ^{232}\text{Th}$ systems [26] using the two reduction procedures (first taken from ref [26,67,78] and second taken from [78] as mention in the text). . . . .	98