

Contents

Preface	I
Acknowledgements	III
List of Publications	V
List of Figures	XIII
List of Tables	XIX
1 Introduction	01
1.1 Nuclear Physics far from the stability	03
1.2 Heavy ion reactions	04
1.2.1 Elastic scattering	07
1.2.2 Inelastic scattering	07
1.2.3 Transfer reactions	08
1.2.4 Quasielastic scattering	08
1.2.5 Deep inelastic scattering	08
1.3 Coulomb barrier	08
1.4 General Motivation of the thesis	11
1.4.1 Fusion and Breakup of weakly bound nuclei	11
1.4.2 Elastic scattering in collisions of weakly bound nuclei	14
1.5 Brief literature survey	25
1.6 Plan of thesis	26
2 Theoretical Models	32
2.1 Introduction	33
2.2 Nuclear models	34
2.3 Optical model	35
2.3.1 Wood – Saxon potential	37
2.3.2 São – Paulo potential	39
2.4 Continuum Discretized Coupled Channel (CDCC) formalism	42

3	Breakup threshold anomaly in the near-barrier elastic scattering of ${}^6\text{Li} + {}^{116,112}\text{Sn}$	45
3.1	Introduction	46
3.2	Experimental Description	48
3.2.1	The Pelletron Accelerator Facility	48
3.2.2	Energy Loss Calculations	53
3.2.3	Detection techniques	53
3.2.3.1	Semiconductor Detectors	55
3.2.3.2	Silicon surface barrier detector	57
3.3	Experiment Details	58
3.4	Electronics and Data acquisition	61
3.5	Optical model analysis of the elastic scattering	62
3.5.1	Analysis Using Phenomenological Woods-Saxon Potential	62
3.5.2	Analysis Using the Double-Folding São Paulo Potential	70
3.6	Total reaction cross sections for different systems	72
3.7	Effects of breakup couplings on the ${}^6\text{Li} + {}^{116}\text{Sn}$	76
3.8	Conclusions	81
4	Investigation of threshold anomaly in the near-barrier elastic scattering of ${}^7\text{Li}$ on ${}^{116}\text{Sn}$	85
1.1	Introduction	86
1.2	Experimental Description	88
4.2.1	Energy Loss Calculations	89
4.3	Experiment Details	89
4.4	Electronics and Data acquisition	92
4.5	Optical model analysis of the elastic scattering	93
4.5.1	Analysis Using Phenomenological Woods-Saxon Potential	93
4.5.2	Analysis Using the Double-Folding São Paulo Potential	101
4.6	Total reaction cross sections	106
4.7	Breakup threshold anomaly in ${}^{6,7}\text{Li} + {}^{116}\text{Sn}$ system: A dispersion relation analysis	110
4.8	Conclusions	113

5	Elastic scattering and total reaction cross section with radioactive ion beam	116
5.1	Introduction	117
5.2	Details of radioactive ion beam production	119
5.2.1	Radioactive Beams	119
5.2.2	Ion source	121
5.2.3	Pelletron accelerator	122
5.2.4	RIBRAS (Radioactive Ion Beam in Brazil)	123
5.2.5	Electronics and Data acquisition	125
5.3	Elastic scattering measurements for $^8\text{Li} + ^9\text{Be}$, ^{51}V systems	127
5.4	Optical model analysis of the elastic scattering data	131
5.5	Reduction Procedure of total reaction cross section	135
5.6	Results and discussion of analysis of total reaction by different reduction procedure	136
5.7	Conclusions	139
6	Summary and Conclusions	142