

# TABLE OF CONTENTS

	Page No.
Undertaking from the Candidate	ii
Declaration	iii
Certificate from the Supervisor	iv
Course work Completion Certificate	v
Pre-Submission Seminar Completion Certificate	vi
Copyright transfer Certificate	vii
Acknowledgement	viii-ix
Abstract	x-xii
Table of contents	xiii-xvi
List of the Tables	xvii
List of the Figures	xviii-xx
List of Symbols and Abbreviations	xxi
<b>CHAPTER 1: INTRODUCTION</b>	
<b>1.1 PREHISTORY OF NUCLEAR PHYSICS</b>	<b>1</b>
1.1.1 Angular Momentum	2
1.1.2 Electric Quadrupole Moment of Nuclei	2
1.1.3 Nuclear Forces	2
1.1.4 Magic Number and Stability of Nucleus	3
<b>1.2 LIQUID DROP MODEL</b>	<b>3</b>
<b>1.3 NUCLEAR SHELL MODEL</b>	<b>4</b>
1.3.1 Successes and Limitations of the Shell Model	4
<b>1.4 BOHR-MOTTelson COLLECTIVE MODEL</b>	<b>5</b>
1.4.1 Successes and Limitations of the Shell Model	5
<b>1.5 ROTATIONAL-VIBRATIONAL MODEL (RVM)</b>	<b>6</b>
<b>1.6 ASYMMETRIC ROTOR MODEL (ARM)</b>	<b>6</b>

1.7 THE DYNAMIC PAIRING –PLUS –QUADRUPOLE MODEL	7
1.8 INTRACTING BOSON MODEL (IBM)	7
1.9 SUBJECT OF STUDY IN THIS THESIS	9
CHAPTER 2: NUCLEAR MODELS	10
2.1 INTRODUCTION	10
2.2 BOHR-MOTTELSON UNIFIED COLLECTIVE MODEL	10
2.2.1 The Vibrational Model	11
2.2.2 Rotational Model	12
2.2.3 Rotation Vibration Interaction Model (RVM)	14
2.3 ASYMMETRIC ROTAR MODEL	15
2.4 INTERACTING BOSON MODEL (IBM)	20
2.4.1 Sub-group U (5)	22
2.4.2 Sub-group SU(3)	22
2.4.3 Sub-group O(6)	23
2.5 VARIOUS INDEPENDENT PARAMETERS	24
2.5.1 NpNn Product	24
2.5.2 P-factor	24
2.5.3 Energy Ratio ( $R_4$ )	24
CHAPTER 3: SYSTEMATIC DEPENDENCE OF ASYMMETRIC PARAMETER FOR EVEN Z EVEN N NUCLEI IN LIGHT AND MEDIUM MASS REGION	
3.1 INTRODUCTION	25
3.2 LITERATURE REVIEW	26
3.2.1 Calculation of Asymmetric Parameter	26
3.3 RESULT AND DISCUSSION	27
3.3.1 The variation of asymmetry parameter ( $\gamma_0$ ) in	

quadrant- I for $50 \leq Z \leq 66$ and $82 \leq N \leq 104$ region:	27
3.3.2 The variation of asymmetry parameter $\gamma_0$ for quadrant-II for $66 \leq Z \leq 82$ and $82 \leq N \leq 104$ :	30
3.3.3 The variation of asymmetry parameter $\gamma_0$ for quadrant-III for $66 \leq Z \leq 82$ and $104 \leq N \leq 126$	34
3.4 CONCLUSION	37
CHAPTER 4:SYSTEMATIC STUDY OF $B(E2; 4g \rightarrow 2g)/B(E2; 2g \rightarrow 0g)$ BRANCHING RATIO USING ASYMMETRY ROTOR MODEL AND ITS VARIATION WITH N AND Z	
4.1 INTRODUCTION	41
4.2 ASYMMETRY ROTOR MODEL	42
4.2.1 Reduced Transition Probabilities	43
4.2.2.Calculation of Asymmetric Parameter ( $\gamma_0$ )	44
4.3 Result and Discussions	45
4.3.1 Variation of ARM $B(E2; 4g \rightarrow 2g)/B(E2; 2g \rightarrow 0g)$ ratio versus asymmetry parameter ( $\gamma_0$ )	45
4.3.1.1 Variation of Experimental and ARM $(E2; 4g \rightarrow 2g)/B(E2; 2g \rightarrow 0g)$ ratio versus Asymmetry Parameter ( $\gamma_0$ )	46
4.3.1.2 Conclusions	47
4.3.2 SYSTEMATIC DEPENDENCE OF $B(E2; 4g \rightarrow 2g)/ B(E2; 2g \rightarrow 0g)$ BRANCHING RATIO ON N AND Z	48
4.3.2.1 Result And Discussions	48
4.3.2.1.1 The variation of experimental $B(E2; 4g \rightarrow 2g)/ B(E2;$ $2g \rightarrow 0g)$ ratio verses neutron number (N)	48
4.3.2.1.2 The variation of experimental $B(E2; 4g \rightarrow 2g)/ B(E2;$	

2g→0g) ratio verses proton number (Z).	51
4.3.2.1.3 Conclusions	54
CHAPTER 5: STUDY OF <sup>152, 154</sup> SM USING INTERACTING BOSON MODEL-I	
5.1 INTRODUCTION	56
5.2 LITRATURE REVIEW	57
5.3 THE INTERACTING BOSON MODEL AND CALCULATIONS	59
5.4 RESULT AND DISCUSSION	60
5.4.1 The B(E2) Branching Ratios in the SU(5) and SU(3) Limit	65
5.4.2 The <sup>152</sup> Sm isotope	66
5.4.2.1 Energy spectrum	66
5.4.2.2 B(E2)values	68
5.4.2.3 The B(E2) branching ratios for β– band	72
5.4.2.4 The B(E2) branching ratios for γ–band	74
5.4.2.5 The B(E2) branching ratios for K <sup>π</sup> = 0 <sup>+</sup> <sub>3</sub> , β <sub>2</sub> –band	74
5.4.3 The <sup>154</sup> Sm isotope	74
5.4.3.1 Energy spectrum	74
5.4.3.2 B(E2) values	75
5.4.3.3 The B(E2) branching ratios for β-band	75
5.4.3.4 B(E2) branching ratios for γ –band	76
5.5 CONCLUSIONS	79
CHAPTER 6: SUMMARY AND CONCLUSIONS	80-81
REFERENCES	82-88
LIST OF PUBLICATIONS	89-90
CURRICULUM VITAE	91