

CONTENTS

Chapter 1

NUCLEAR FISSION André Michaudon

1. Introduction	1
2. Conventional Description of the Fission Process: Liquid Drop Model, Channel Theory of Fission	6
2.1. Liquid Drop Model	7
2.2. Fission Barrier Heights	13
2.3. Spontaneous Fission of Nuclei in Their Ground State	17
2.4. Fission Channel Theory of A. Bohr	26
3. Experimental Results Which Cannot Be Explained by Conventional Descriptions of the Fission Process	54
3.1. Fission Isomers	55
3.2. Intermediate Structure in Sub-barrier Fission Cross Sections	70
4. Potential Energy of Strongly Deformed Nuclei. Shell Effects	94
4.1. Existence of Shells at Large Deformations	94
4.2. Influence of Shells on the Binding Energy of the Nucleus	96
4.3. Strutinsky's Phenomenological Prescription for the Calculation of Shell Effects on the Binding Energy	100
4.4. Types of Potentials Used for Calculation of Shell-Energy Corrections	104
4.5. Fission Barrier Calculations with the Inclusion of Shell-Energy Corrections	111
4.6. Other Approaches to the Study of the Effect of Shells on the Potential Energy of Strongly Deformed Heavy Nuclei	119
5. Some Aspects of the Fission Process for Nuclei Having a Double-Humped Fission Barrier	120
5.1. Fission Isomers	121

5.2. Gross Structure in Some Cross Sections for Near-Threshold Fission Processes	134
5.3. Intermediate Structure in Sub-barrier Fission Cross Sections	150
5.4. Intermediate Structure in the Fission Cross Sections of Fissile Nuclei	174
5.5. Measured and Calculated Fission Barriers	194
6. Conclusion	201
Acknowledgments	205
Appendix	205
References	209

Chapter 2

THE MICROSCOPIC THEORY OF NUCLEAR EFFECTIVE INTERACTIONS AND OPERATORS

Bruce R. Barrett and Michael W. Kirson

1. Introduction	219
2. General Theory	221
2.1. Time-Dependent Derivation	222
2.2. Time-Independent Derivation	229
2.3. Brueckner Theory	237
2.4. The Algebraic Approach	241
3. Calculation of the Effective Two-Body Interaction	242
3.1. Perturbation Calculations	244
3.2. Nonperturbative Calculations	254
3.3. Convergence of the Perturbation Expansion	261
3.4. Conclusions	263
4. Calculation of the $E2$ Effective Charge	264
4.1. Effective Charge in Mass-17 Nuclei	265
4.2. Effects of Nucleon–Nucleon Force and Single-Particle Potential	272
4.3. Other Mass Values	275
5. Discussion and Conclusions	277
Acknowledgments	282
References	282

Chapter 3

TWO-NEUTRON TRANSFER REACTIONS
AND THE PAIRING MODEL

Ricardo A. Broglia, Ole Hansen, and Claus Riedel

1. Introduction	287
2. The Reaction Mechanism	290
2.1. The DWBA Method for Two-Nucleon Transfer Reactions	290
2.2. The Two-Nucleon Transfer Form Factor	291
2.3. Discussion of the Form Factor	295
2.4. Comparison Between DW Theory and Experiment	299
2.5. Two-Particle Units and Sum Rules	309
3. Presentation of the Data	314
3.1. The Gross Trends of $0^+ \rightarrow 0^+$ and $0^+ \rightarrow 2^+$ Transitions	314
3.2. Nuclei Far from Neutron Shell Closures	317
3.3. The Closed Shell Regions	322
3.4. Subshell Closures	335
4. The Pairing Model and Two-Neutron Transfer Reactions to $J^\pi = 0^+$ States	336
4.1. Pairing Deformed Systems	337
4.2. Normal Systems	351
4.3. The Pairing Phase Transitions	357
5. Analysis of the $L = 0$ Two-Neutron Transfer Reactions	362
5.1. Systems Far Away from Closed Shells	363
5.2. Systems Near Closed Shells	368
5.3. Intermediate Situations	378
5.4. Limitations of the Pairing Collective Description	381
5.5. Summary	383
6. Two-Neutron Transfer Reactions to States with $J \neq 0$ and Natural Parity	384
6.1. Normal Systems	384
6.2. Superfluid Nuclei	398
6.3. Particle-Vibration Coupling and the Problem of Anharmon- icities	406
6.4. Anharmonicities of the Pairing Vibration Spectrum as De- termined from (t, p) and (p, t) Reactions	413
6.5. Summary	418
Acknowledgments	419

Appendix 1 420

 Data References for the Appendix Tables 437

Appendix 2 438

 A2.1. Introduction 438

 A2.2. Coexistence Model 440

 A2.3. SU_3 Model 442

 A2.4. Pairing Model 445

Appendix 3 449

References 451

Index 459