CONTENTS

EDITOR'S FOREWORD vii

PREFACE ix

1 Introduction 1
- 1-1 General Properties of Fermi Systems 2
- 1-2 The Nucleus as a Gas of Quasiparticles—Comparison with Other Methods 6

2 The Green's Function: The Diagram Method 9
- 2-1 Graphical Representation of Processes 9
- 2-2 The Green's Function of a Quantum-Mechanical System 13
- 2-3 The Single-Particle Green's Function 15
- 2-4 The Green's Function in an External Field—Graphical Representation 16
- 2-5 Graphical Derivation of Equations 20

3 Single-Particle Excitations in Fermi Systems 21
- 3-1 The Simplest Excited States: Quasiparticles 21
- 3-2 The Quasiparticle Green's Function 22
- 3-3 Noninteracting Quasiparticles in an External Field 24
- 3-4 Quasiparticle Creation and Annihilation Operators 26
- 3-5 The Shell Model: Justification and Refinement 29
- 3-6 The Effect of Nearby Levels 35
- 3-7 Pairing Correlations 36
- 3-8 Pairing Correlations in Nuclei 39
- 3-9 The Equation for Δ 41

4 The Interaction between Quasiparticles 45
4-1 Equation for the Scattering Amplitude 46
4-2 The Scattering Amplitude for Small Momentum Transfer 48
4-3 The Interaction in Homogeneous Nuclear Matter 51
4-4 Effect of Finite Nuclear Dimensions 53
4-5 Symmetry Energy and Compressibility–Stability Conditions of Nuclear Matter 56
4-6 Interaction via the "Core" 58

5 The Nucleus in an External Field 61
5-1 The Effective Field 61
5-2 Renormalization and Quasiparticle Charges 64
5-3 The Effective Charge in an Unfilled Shell 66
5-4 The Effective Field in the Case of Pairing Correlations 68
5-5 The System of Equations for the Effective Field 72
5-6 Quasiparticle Number Conservation 74
5-7 The System of Equations for a Scalar Field 75
5-8 Equation for the Density Matrix without Pairing 79
5-9 Change of the Density Matrix When the Particle Number Is Changed 80
5-10 Calculation of Averages 83
5-11 Transition Frequencies and Probabilities 84
5-12 Conservation Laws and Quasiparticle Charges for Different Fields 86

6 Static Properties of the Nucleus 91
6-1 Calculation of Nuclear Moments 91
6-2 Magnetic Moments 92
6-3 Quadrupole Moments and Isotope Shifts 99
6-4 Nuclear Radii 103
6-5 Nuclear Mass Differences 107
6-6 The Effect of Nearby Levels 114

7 Electromagnetic and Beta Transitions 121
7-1 Dipole Excitations 121
7-2 Quadrupole Transitions 125
7-3 Magnetic Transitions 126
7-4 Beta-Decay 128
7-5 *l*-Forbidden Transitions 133
7-6 Muon Capture 133

8 Conclusion 136

REFERENCES 139

INDEX 141