

Contents

<i>List of Contributors</i>	vii
<i>Preface</i>	ix
<i>Glossary of Symbols and Abbreviations</i>	xvii

The Algebras of Lie Groups and Their Representations

DIRK KLEIMA, W. J. HOLMAN, III, AND L. C. BIEDENHARN

I. Introduction	1
II. Preliminary Survey	7
III. Lie's Theorem, the Rank Theorem, and the First Criterion of Solvability	15
IV. The Cartan Subalgebra and Root Systems	19
V. The Classification of Semisimple Lie Algebras in Terms of Their Root Systems	40
VI. Representations and Weights for Semisimple Lie Algebras	52
References	55

Induced and Subdued Representations

A. J. COLEMAN

I. Introduction	57
II. Group, Topological, Borel, and Quotient Structures	61
III. The Generalized Schur Lemma and Type I Representations	67
IV. Direct Integrals of Representations	73
V. Murray-von Neumann Typology	77
VI. Induced Representations of Finite Groups	80
VII. Orthogonality Relations for Square-Integrable Representations	90
VIII. Functions of Positive Type and Compact Groups	96
IX. Inducing for Locally Compact Groups	100
X. Applications	110
References	116

On a Generalization of Euler's Angles

EUGENE P. WIGNER

I. Origin of the Problem	119
II. Summary of Results	122
III. Proof	124
IV. Corollary	128
References	129

Projective Representation of the Poincaré Group in a Quaternionic Hilbert Space

J. M. JAUCH

I. Introduction	131
II. The Lattice Structure of General Quantum Mechanics	135
III. The Group of Automorphisms in a Proposition System	142
IV. Projective Representation of the Poincaré Group in Quaternionic Hilbert Space	152
V. Conclusion	179
References	181

Group Theory in Atomic Spectroscopy

B. R. JUDD

I. Introduction	183
II. Shell Structure	185
III. Coupled Tensors	193
IV. Representations	198
V. The Wigner-Eckart Theorem	206
VI. Conclusion	218
References	219

Group Lattices and Homomorphisms

F. A. MATSEN and O. R. PLUMMER

I. Introduction	221
II. Groups	223
III. Symmetry Adaption of Vector Spaces	229
IV. The Lattice of the Quasi-Relativistic Dirac Hamiltonian	238
V. Applications	249
References	264

Group Theory in Solid State Physics

STIG FLODMARK

I. Introduction	266
II. Stationary States in the Quantum Theory of Matter	267
III. The Group of the Hamiltonian	271
IV. Symmetry Groups of Solids	285
V. Lattice Vibrations in Solids	304
VI. Band Theory of Solids	312
VII. Electromagnetic Fields in Solids	328
References	336

Group Theory of Harmonic Oscillators and Nuclear Structure

P. KRAMER AND M. MOSHINSKY

I. Introduction and Summary	340
II. The Symmetry Group $U(3n)$; the Subgroup $U(3) \times U(n)$; Gelfand States	345
III. The Central Problem: Permutational Symmetry of the Orbital States	359
IV. Orbital Fractional Parentage Coefficients	387
V. Group Theory and n -Particle States in Spin-Isospin Space	402
VI. Spin-Isospin Fractional Parentage Coefficients	411
VII. Evaluation of Matrix Elements of One-Body and Two-Body Operators	422
VIII. The Few-Nucleon Problem	434
IX. The Elliott Model in Nuclear Shell Theory	441
X. Clustering Properties and Interactions	448
References	466

Broken Symmetry

L. O'RAIFEARTAIGH

I. Introduction	469
II. Wigner-Eckart Theorem	474
III. Some Relevant Group Theory	483
IV. Particle Physics $SU(3)$ from the Point of View of the Wigner-Eckart Theorem	491
V. Foils to $SU(3)$ and the Eightfold Way	503
VI. Broken Symmetry in Nuclear and Atomic Physics	513
VII. General Questions concerning Broken Symmetry	517
VIII. A Note on $SU(6)$	525
References	537

Broken $SU(3)$ as a Particle Symmetry

R. E. BEHRENDTS

I. Introduction	541
II. Perturbative Approach	543
III. Algebra of $SU(3)$	548
IV. Representations	557
V. Tensor and Wigner Operators	574
VI. Particle Classification, Masses, and Form Factors	578
VII. Some Remarks on R and $SU(3)/Z_3$	596
VIII. Couplings and Decay Widths	596
IX. Weak Interactions	611
X. Appendix	625
References	627

De Sitter Space and Positive Energy**T. O. PHILIPS AND E. P. WIGNER**

I. Introduction and Summary	631
II. Ambivalent Nature of the Classes of de Sitter Groups	635
III. The Infinitesimal Elements of Unitary Representations of the de Sitter Group	639
IV. Finite Elements of the Unitary Representations of Section III	643
V. Spatial and Time Reflections	647
VI. The Position Operators	655
VII. General Remarks about Contraction of Groups and Their Representations	664
VIII. Contraction of the Representations of the $2 + 1$ de Sitter Group	667
References	675
 <i>Author Index</i>	677
 <i>Subject Index</i>	683

