Lie Algebras In Particle Physics From Isospin To Unified Theories

MCGEE ROWAN

Group And Representation Theory Courier Corporation
Designed to acquaint students of particle physiME already familiar with SU(2) and SU(3) with techniques applicable to all simple Lie algebras, this text is especially suited to the study of grand unification theories. Author Robert N. Cahn, who is affiliated with the Lawrence Berkeley National Laboratory in Berkeley, California, has provided a new preface for this edition. Subjects include the killing form, the structure of simple Lie algebras and their representations, simple roots and the Cartan matrix, the classical Lie algebras, and the exceptional Lie algebras. Additional topiME include Casimir operators and Freudenthal's formula, the Weyl group, Weyl's dimension formula, reducing product representations, subalgebras, and branching rules. 1984 edition.
Supersymmetry in Particle Physics Birkhäuser
This book, designed for advanced graduate students and post-graduate researchers, introduces Lie algebras and some of their applications to the spectroscopy of molecules, atoms, nuclei and hadrons. The book contains many examples that help to elucidate the abstract algebraic definitions. It provides a summary of many formulas of practical interest, such as the eigenvalues of Casimir operators and the dimensions of the representations of all classical Lie algebras.
Symmetries, Particles and Fields Springer Science & Business Media
An introductory text book for graduates and advanced undergraduates on group representation theory. It emphasizes group theory's role as the mathematical framework for describing symmetry properties of classical and quantum mechanical systems. Familiarity with basic group concepts and techniques is invaluable in the education of a modern-day physicist. This book emphasizes general features and methods which demonstrate the power of the group-theoretical approach in exposing the systematics of physical systems with associated symmetry. Particular attention is given to pedagogy. In developing the theory, clarity in presenting the main ideas and consequences is given the same priority as comprehensiveness and strict rigor. To preserve the integrity of the mathematics, enough technical information is included in the appendices to make the book almost self-contained. A set of problems and solutions has been published in a separate booklet.
Mathematical Gauge Theory Springer
This is an introduction to the theory of affine Lie Algebras, to the theory of quantum groups, and to the interrelationships between these two fields that are encountered in conformal field theory.
Symmetries and Group Theory in Particle Physics CRC Press
This book provides an introduction to noncommutative geometry and presents a number of its recent applications to particle physics. It is intended for graduate students in mathematics/theoretical physics who are new to the field of noncommutative geometry, as well as for researchers in mathematics/theoretical physics with an interest in the physical applications of noncommutative geometry. In the first part, we introduce the main concepts and techniques by studying finite noncommutative spaces, providing a “light” approach to noncommutative geometry. We then proceed with the general framework by defining and analyzing noncommutative spin manifolds and deriving some main results on them, such as the local index

formula. In the second part, we show how noncommutative spin manifolds naturally give rise to gauge theories, applying this principle to specific examples. We subsequently geometrically derive abelian and non-abelian Yang-Mills gauge theories, and eventually the full Standard Model of particle physics, and conclude by explaining how noncommutative geometry might indicate how to proceed beyond the Standard Model.
Lie Groups and Algebras with Applications to Physics, Geometry, and Mechanics CRC Press
Describing many of the most important aspects of Lie group theory, this book presents the subject in a 'hands on' way. Rather than concentrating on theorems and proofs, the book shows the applications of the material to physical sciences and applied mathematics. Many examples of Lie groups and Lie algebras are given throughout the text. The relation between Lie group theory and algorithms for solving ordinary differential equations is presented and shown to be analogous to the relation between Galois groups and algorithms for solving polynomial equations. Other chapters are devoted to differential geometry, relativity, electrodynamics, and the hydrogen atom. Problems are given at the end of each chapter so readers can monitor their understanding of the materials. This is a fascinating introduction to Lie groups for graduate and undergraduate students in physics, mathematics and electrical engineering, as well as researchers in these fields.
Group Theory in Physics World Scientific
(Cartan sub Lie algebra, roots, Weyl group, Dynkin diagram, . . .) and the classification, as found by Killing and Cartan (the list of all semisimple Lie algebras consists of (1) the special- linear ones, i. e. all matrices (of any fixed dimension) with trace 0, (2) the orthogonal ones, i. e. all skewsymmetric ma trices (of any fixed dimension), (3) the symplectic ones, i. e. all matrices M (of any fixed even dimension) that satisfy M J = - J MT with a certain non-degenerate skewsymmetric matrix J, and (4) five special Lie algebras G2, F , E , E , E , of dimensions 14,52,78,133,248, the "exceptional Lie 4 6 7 s algebras" , that just somehow appear in the process). There is also a discus sion of the compact form and other real forms of a (complex) semisimple Lie algebra, and a section on automorphisms. The third chapter brings the theory of the finite dimensional representations of a semisimple Lie alge bra, with the highest or extreme weight as central notion. The proof for the existence of representations is an ad hoc version of the present standard proof, but avoids explicit use of the Poincare-Birkhoff-Witt theorem. Complete reducibility is proved, as usual, with J. H. C. Whitehead's proof (the first proof, by H. Weyl, was analytical-topological and used the exis tence of a compact form of the group in question). Then come H.
Group Theory in Particle, Nuclear, and Hadron Physics Springer
This book is devoted to explaining a wide range of applications of con tinuous symmetry groups to physically important systems of differential equations. Emphasis is placed on significant applications of group-theoretic methods, organized so that the applied reader can readily learn the basic computational techniques required for genuine physical problems. The first chapter collects together (but does not prove) those aspects of Lie group theory which are of importance to differential equations. Applications covered in the body of the book include calculation of symmetry groups of differential equations, integration of ordinary differential equations, including special techniques for Euler-Lagrange equations or Hamiltonian systems, differential invariants and construction of equations with pre scribed symmetry groups, group-invariant solutions of partial differential equations, dimensional analysis, and the connections between conservation laws and symmetry groups. Generalizations of the basic symmetry group concept, and applications to conservation laws, integrability conditions, completely integrable systems and soliton equations, and bi-Hamiltonian systems are covered in detail. The exposition is reasonably self-contained, and supplemented by numerous examples of direct physical importance, chosen from classical mechanics, fluid mechanics, elasticity and other applied areas.
Lie Groups Springer
A self-contained introduction to the cohomology theory of Lie groups and some of its applications in physics.
Problems And Solutions For Groups, Lie Groups, Lie Algebras With Applications Academic Press
In this new textbook, acclaimed author John Stillwell presents a lucid introduction to Lie theory suitable for junior and senior level undergraduates. In order to achieve this, he focuses on the so-called "classical groups'' that capture the symmetries of real, complex, and quaternion spaces. These symmetry groups may be represented by matrices, which allows them to be studied by elementary methods from calculus and linear algebra. This naive approach to Lie theory is originally due to von Neumann, and it is now possible to streamline it by using standard results of undergraduate mathematics. To compensate for the limitations of the naive approach, end of chapter discussions introduce important results beyond those proved in the book, as part of an informal sketch of Lie theory and its history. John Stillwell is Professor of Mathematics at the University of San Francisco. He is the author of several highly regarded books published by Springer, including The Four Pillars of Geometry (2005), Elements of Number Theory (2003), Mathematics and Its History (Second Edition, 2002), Numbers and Geometry (1998) and Elements of Algebra (1994).
High-Energy Particle Diffraction Springer Science & Business Media
This volume goes beyond the understanding of symmetries and exploits them in the study of the behavior of both classical and quantum physical systems. Thus it is important to study the symmetries described by continuous (Lie) groups of transformations. We then discuss how we get operators that form a Lie algebra. Of particular interest to physics is the representation of the elements of the algebra and the group in terms of matrices and, in particular, the irreducible representations. These representations can be identified with physical observables.This leads to the study of the classical Lie algebras, associated with unitary, unimodular, orthogonal and symplectic transformations. We also discuss some special algebras in some detail. The discussion proceeds along the lines of the Cartan-Weyl theory via the root vectors and root diagrams and, in particular, the Dynkin representation of the roots. Thus the representations are expressed in terms of weights, which are generated by the application of the elements of the algebra on uniquely specified highest weight states. Alternatively these representations can be described in terms of tensors labeled by the Young tableaux associated with the discrete symmetry Sn. The connection between the Young tableaux and the Dynkin weights is also discussed. It is also shown that in many physical systems the quantum numbers needed to specify the physical states involve not only the highest symmetry but also a number of sub-symmetries contained in them. This leads to the study of the role of subalgebras and in particular the possible maximal subalgebras. In many applications the physical system can be considered as composed of subsystems obeying a given symmetry. In such cases the reduction of the Kronecker product of irreducible representations of classical and special algebras becomes relevant and is discussed in some detail. The method of obtaining the relevant Clebsch-Gordan (C-G) coefficients for such algebras is discussed and some relevant algorithms are provided. In some simple cases suitable numerical tables of C-G are also included.The above exposition contains many examples, both as illustrations of the main ideas as well as well motivated applications. To this end two appendices of 51 pages — 11 tables in Appendix A, summarizing the material discussed in the main text and 39 tables in Appendix B containing results of more sophisticated examples are supplied. Reference to the tables is given in the main text and a guide to the appropriate section of the main text is given in the tables.
Lie Groups, Physics, and Geometry CRC Press
This user-friendly book on group theory introduces topics in as simple a manner as possible and then gradually develops those topics into more advanced ones, eventually building up to the current state-of-the-art. By using simple examples from physics and mathematics, the advanced topics become logical extensions of ideas already introduced. In addition to being used as a textbook, this book would also be useful as a reference guide for graduates and researchers in particle, nuclear and hadron physics.
Semiclassical Physics Courier Corporation
This (post) graduate text gives a broad introduction to Lie groups and algebras with an emphasis on differential geometrical methods. It analyzes the structure of compact Lie groups in terms of the action of the group on itself by conjugation, culminating in the classification of the representations of compact Lie groups and their realization as sections of holomorphic line bundles over flag manifolds. Appendices provide background reviews.
Noncommutative Geometry and Particle Physics CRC Press
In this book, the author convinces that Sir Arthur Stanley Eddington had things a little bit wrong, as least as far as physics is concerned. He explores the theory of groups and Lie algebras and their representations to use group representations as labor-saving tools.
The Lie Algebras su(N) World Scientific
'The book contains a lot of examples, a lot of non-standard material which is not included in many other books. At the same time the authors manage to avoid numerous cumbersome calculations ... It is a great achievement that the authors found a balance.'zbMATHThis book presents the study of symmetry groups in Physics from a practical perspective, i.e. emphasising the explicit methods and algorithms useful for the practitioner and profusely illustrating by examples.The first half reviews the algebraic, geometrical and topological notions underlying the theory of Lie groups, with a review of the representation theory of finite groups. The topic of Lie algebras is revisited from the perspective of realizations, useful for explicit computations within these groups. The second half is devoted to applications in physics, divided into three main parts — the first deals with space-time symmetries, the Wigner method for representations and applications to relativistic wave equations. The study of kinematical algebras and groups illustrates the properties and capabilities of the notions of contractions, central extensions and projective representations. Gauge symmetries and symmetries in Particle Physics are studied in the context of the Standard Model, finishing with a discussion on Grand-Unified Theories.
Lie Algebras and Applications Cambridge University Press
A comprehensive and up-to-date overview of soft and hard diffraction processes in strong interaction physics. The first part covers soft hadron—hadron scattering in a complete and mature presentation. It can be used as a textbook in particle physics classes. Chapters 8-11 address graduate students as well as researchers, covering the "new diffraction": the pomeron in QCD, low-x physics, diffractive deep inelastic scattering and related processes.
Unitary Symmetry and Elementary Particles World Scientific Publishing Company
Illustrating the fascinating interplay between physics and mathematics, Groups, Representations and Physics, Second Edition provides a solid foundation in the theory of groups, particularly group representations. For this new, fully revised edition, the author has enhanced the book's usefulness and widened its appeal by adding a chapter on the Cartan-Dynkin treatment of Lie algebras. This treatment, a generalization of the method of raising and lowering operators used for the rotation group, leads to a systematic classification of Lie algebras and enables one to enumerate and construct their irreducible representations. Taking an approach that allows physics students to recognize the power and elegance of the abstract, axiomatic method, the book focuses on chapters that develop the formalism, followed by chapters that deal with the physical applications. It also illustrates formal mathematical definitions and proofs with numerous concrete examples.
Abstract Lie Algebras Courier Corporation
Solid but concise, this account emphasizes Lie algebra's simplicity of theory, offering new approaches to major theorems and extensive treatment of Cartan and related Lie subalgebras over arbitrary fields. 1972 edition.
Applications of Lie Groups to Differential Equations Cambridge University Press
Lie algebras are efficient tools for analyzing the properties of physical systems. Concrete applications comprise the formulation of symmetries of Hamiltonian systems, the description of atomic, molecular and nuclear spectra, the physics of elementary particles and many others. This work gives an introduction to the properties and the structure of the Lie algebras su(n). The book features an elementary (matrix) access to su(N)-algebras, and gives a first insight into Lie algebras. Student readers should be enabled to begin studies on physical su(N)-applications, instructors will profit from the detailed calculations and examples.
Symmetries, Lie Algebras and Representations Springer
Based on the author’s well-established courses, Group Theory for the Standard Model of Particle Physics and Beyond explores the use of symmetries through descriptions of the techniques of Lie groups and Lie algebras. The text develops the models, theoretical framework, and mathematical tools to understand these symmetries. After linking symmetries with conservation laws, the book works through the mathematics of angular momentum and extends operators and functions of classical mechanics to quantum mechanics. It then covers the mathematical framework for special relativity and the internal symmetries of the standard model of elementary particle physics. In the chapter on Noether’s theorem, the author explains how Lagrangian formalism provides a natural framework for the quantum mechanical interpretation of symmetry principles. He then examines electromagnetic, weak, and strong interactions; spontaneous symmetry breaking; the elusive Higgs boson; and supersymmetry. He also introduces new techniques based on extending space–time into dimensions described by anticommuting coordinates. Designed for graduate and advanced undergraduate students in physics, this text provides succinct yet complete coverage of the group theory of the symmetries of the standard model of elementary particle physics. It will help students understand current knowledge about the standard model as well as the physics that potentially lies beyond the standard model.