Lie Algebras In Particle Physics From Isospin To Unified Theories

This high-level, rigorous, and technical treatment was written by a distinguished teacher and researcher. Equally valuable as a text for advanced undergraduates and graduate students and as a reference for professionals. 1984 edition.

This widely acclaimed introduction to N = 1 supersymmetry and supergravity is aimed at readers familiar with relativistic quantum field theory who wish to learn about the supersymmetry algebra. In this new volume Supersymmetry and Supergravity has been greatly expanded to include a detailed derivation of the most general coupling of super-symmetric gauge theory to supergravity. The final result is the starting point for phenomenological studies of supersymmetric theories. The book is distinguished by its pedagogical approach to supersymmetry. It develops several topics in advanced field theory as the need arises. It emphasizes the logical coherence of the subject and should appeal to physicists whose interests range from the mathematical to the phenomenological. In praise of the first edition: "A beautiful exposition of the original ideas of Wess and Zumino in formulating N = 1 supersymmetry and supergravity theories, couched in the language of superfields introduced by Strathdee and the reviewer.... [All] serious students of particle physics would do well to acquire a copy."--Abdus Salam, Nature "An excellent introduction to this exciting area of theoretical physics."--C. J. Isham, Physics Bulletin

A concise, modern textbook on group theory written especially for physicists Although group theory is a mathematical subject, it is indispensable to many areas of modern theoretical physics, from atomic physics to condensed matter physics, particle physics to string theory. In particular, it is essential for an understanding of the fundamental forces. Yet until now, what has been missing is a modern, accessible, and self-contained textbook on the subject written especially for physicists. Group Theory in a Nutshell for Physicists fills this gap, providing a user-friendly and classroom-tested text that focuses on those aspects of group theory physicists most need to know. From the basic intuitive notion of a group, A. Zee takes readers all the way up to how theories based on gauge groups could unify three of the four fundamental forces. He also includes a concise review of the linear algebra needed for group theory, making the book ideal for self-study. Provides physicists with a modern and accessible introduction to group theory Covers applications to various areas of physics, including field theory, particle physics, relativity, and much more Topics include finite group and character tables; real, pseudoreal, and complex representations; Weyl, Dirac, and Majorana equations; the expanding universe and group theory; grand unification; and much more The essential textbook for students and an invaluable resource for researchers Features a brief, self-contained treatment of linear algebra An online illustration package is available to

professors Solutions manual (available only to professors)
Newer Edition Available: Group Theory for Physicists (2nd Edition)This textbook explains the fundamental concepts and techniques of group theory by making use of language familiar to physicists. Application methods to physics are emphasized. New materials drawn from the teaching and research experience of the author are included. This book can be used by graduate students and young researchers in physics, especially theoretical physics. It is also suitable for some graduate students in theoretical chemistry.

Semiclassical Physics

Symmetries, Particles and Fields

Lie Groups and Algebras with Applications to Physics, Geometry, and Mechanics

Finite and Infinite Dimensional Lie Algebras and Applications in Physics

An Introduction

A self-contained introduction to the cohomology theory of Lie groups and some of its applications in physics.

This volume presents modern trends in the area of symmetries and their applications based on contributions to the workshop "Lie Theory and Its Applications in Physics" held near Varna (Bulgaria) in June 2019. Traditionally, Lie theory is a tool to build mathematical models for physical systems. Recently, the trend is towards geometrization of the mathematical description of physical systems and objects. A geometric approach to a system yields in general some notion of symmetry, which is very helpful in understanding its structure. Geometrization and symmetries are meant in their widest sense, i.e., representation theory, algebraic geometry, number theory, infinite-dimensional Lie algebras and groups, superalgebras and supergroups, groups and quantum groups, noncommutative geometry, symmetries of linear and nonlinear partial differential operators, special functions, and others. Furthermore, the necessary tools from functional analysis are included. This is a large interdisciplinary and interrelated field. The topics covered in this volume from the workshop represent the most modern trends in the field : Representation Theory, Symmetries in String Theories, Symmetries in Gravity Theories, Supergravity, Conformal Field Theory, Integrable Systems, Polylogarithms, and Supersymmetry. They also include Supersymmetric Calogero-type models, Quantum Groups, Deformations, Quantum Computing and Deep Learning, Entanglement, Applications to Quantum Theory, and Exceptional Quantum Algebra for the standard model of particle physics This book is suitable for a broad audience of mathematicians, mathematical physicists, and theoretical physicists, including researchers and graduate students interested in Lie Theory.

The book presents the main approaches in study of algebraic structures of symmetries in models of theoretical and mathematical physics, namely groups and Lie algebras and their deformations. It covers the commonly encountered quantum groups (including Yangians). The second main goal of the book is to present a differential geometry of coset spaces that is actively used in investigations of models of quantum field theory, gravity and statistical physics. The third goal is to explain the main ideas about the theory of conformal symmetries, which is the basis of the AdS/CFT correspondence. The theory of groups and symmetries is an important part of theoretical physics. In elementary particle physics, cosmology and related fields, the key role is played by Lie groups and algebras corresponding to continuous symmetries. For example, relativistic physics is based on the Lorentz and Poincare groups, and the modern theory of elementary particles — the Standard Model — is based on gauge (local) symmetry with the gauge group SU(3) x SU(2) x U(1). This book presents constructions and results of a general nature, along with numerous concrete examples that have direct applications in modern theoretical and mathematical physics. Contents: Preface Groups and Transformations Lie Groups Lie Algebras Representations of Groups and Lie Algebras Compact Lie Algebras Root Systems and Classification of Simple Lie Algebras Homogeneous Spaces and their Geometry Solutions to Selected Problems Selected Bibliography References Index Readership: Graduate students and researchers in theoretical physics and mathematical physics. Keywords: Lie Groups;Lie Algebras;Representation Theory;Conformal Symmetries;Yangians;Coset Spaces;Differential Geometry;Casimir Operators;Root Systems;AdS Spaces;Lobachevskian GeometryReview:0

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.

Abstract Lie Algebras

Group Theory and Its Applications

Lie Algebras In Particle Physics

Quantum Riemannian Geometry

Group Theory in Physics

Symmetries, coupled with the mathematical concept of group theory, are an essential conceptual backbone in the formulation of quantum field theories capable of describing the world of elementary particles. This primer is an introduction to and survey of the underlying concepts and structures needed in order to understand and handle these powerful tools. Specifically, in Part I of the book the symmetries and related group theoretical structures of the Minkowskian space-time manifold are analyzed, while Part II examines the internal symmetries and their related unitary groups, where the interactions between fundamental particles are encoded as we know them from the present standard model of particle physics. This book, based on several courses given by the authors, addresses advanced graduate students and non-specialist researchers wishing to enter active research in the field, and having a working knowledge of classical field theory and relativistic quantum mechanics. Numerous end-of-chapter problems and their solutions will facilitate the use of this book as self-study guide or as course book for topical lectures.

Illustrating the fascinating interplay between physics and mathematics, this book provides a solid grounding in the theory of groups, and particularly of group representations. It gives the reader a firm grasp of the basics to enable further study. This text systematically presents the basics of quantum mechanics, emphasizing the role of Lie groups, Lie algebras, and their unitary representations. The mathematical structure of the subject is brought to the fore, intentionally avoiding significant overlap with material from standard physics courses in quantum mechanics and quantum field theory. The level of presentation is attractive to mathematics students looking to learn about both quantum mechanics and representation theory, while also appealing to physics students who would like to know more about the mathematics underlying the subject. This text showcases the numerous differences between typical mathematical and physical treatments of the subject. The latter portions of the book focus on central mathematical objects that occur in the Standard Model of particle physics, underlining the deep and intimate connections between mathematics and the physical world. While an elementary physics course of some kind would be helpful to the reader, no specific background in physics is assumed, making this book accessible to students with a grounding in multivariable calculus and linear algebra. Many exercises are provided to develop the reader's understanding of and facility in quantum-theoretical concepts and calculations.

The Standard Model is the foundation of modern particle and high energy physics. This book explains the mathematical background behind the Standard Model, translating ideas from physics into a mathematical language and vice versa. The first part of the book covers the mathematical theory of Lie groups and Lie algebras, fibre bundles, connections, curvature and spinors. The second part then gives a detailed exposition of how these concepts are applied in physics, concerning topics such as the Lagrangians of gauge and matter fields, spontaneous symmetry breaking, the Higgs boson and mass generation of gauge bosons and fermions. The book also contains a chapter on advanced and modern topics in particle physics, such as neutrino masses, CP violation and Grand Unification. This carefully written textbook is aimed at graduate students of mathematics and physics. It contains numerous examples and more than 150 exercises, making it suitable for self-study and use alongside lecture courses. Only a basic knowledge of differentiable manifolds and special relativity is required, summarized in the appendix.

Supersymmetry and Supergravity

Varna, Bulgaria, June 2019

Symmetries, Lie Algebras and Representations

Groups, Representations and Physics

Symmetry, Broken Symmetry, and Topology in Modern Physics

Contemporary introduction to semisimple Lie algebras; concise and informal, with numerous exercises and examples
This is the long awaited follow-up to Lie Algebras, Part I which covered a major part of the theory of Kac-Moody algebras, stressing primarily their mathematical structure. Part II deals mainly with the representations and applications of Lie Algebras and contains many cross references to Part I. The theoretical part largely deals with the representation theory of Lie algebras with a triangular decomposition, of which Kac-Moody algebras and the Virasoro algebra are prime examples. After setting up the general framework of highest weight representations, the book continues to treat topics as the Casimir operator and the Weyl-Kac character formula, which are specific for Kac-Moody algebras. The applications have a wide range. First, the book contains an exposition on the role of finite-dimensional semisimple Lie algebras and their representations in the standard and grand unified models of elementary particle physics. A second application is in the

realm of soliton equations and their infinite-dimensional symmetry groups and algebras. The book concludes with a chapter on conformal field theory and the importance of the Virasoro and Kac-Moody algebras therein.

A cohesive and well-motivated introduction to group theory and its application to physics.

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.

Problems and Solutions for Groups, Lie Groups, Lie Algebras with Applications

A First Course

Lie Algebras and Applications

Lie Groups and Quantum Mechanics

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.

Howard Georgi is the co-inventor (with Sheldon Glashow) of the SU(5) theory. This extensively revised and updated edition of his classic text makes the theory of Lie groups accessible to graduate students, while offering a perspective on the way in which knowledge of such groups can provide an insight into the development of unified theories of strong, weak, and electromagnetic interactions.

This book gives an introduction to Lie algebras and their representations. Lie algebras have many applications in

mathematics and physics, and any physicist or applied mathematician must nowadays be well acquainted with them.
The second edition of this highly praised textbook provides an introduction to tensors, group theory, and their applications in classical and quantum physics. Both intuitive and rigorous, it aims to demystify tensors by giving the slightly more abstract but conceptually much clearer definition found in the math literature, and then connects this formulation to the component formalism of physics calculations. New pedagogical features, such as new illustrations, tables, and boxed sections, as well as additional "invitation" sections that provide accessible introductions to new material, offer increased visual engagement, clarity, and motivation for students. Part I begins with linear algebraic foundations, follows with the modern component-free definition of tensors, and concludes with applications to physics through the use of tensor products. Part II introduces group theory, including abstract groups and Lie groups and their associated Lie algebras, then intertwines this material with that of Part I by introducing representation theory. Examples and exercises are provided in each chapter for good practice in applying the presented material and techniques. Prerequisites for this text include the standard lower-division mathematics and physics courses, though extensive references are provided for the motivated student who has not yet had these. Advanced undergraduate and beginning graduate students in physics and applied mathematics will find this textbook to be a clear, concise, and engaging introduction to tensors and groups. Reviews of the First Edition "[P]hysicist Nadir Jeevanjee has produced a masterly book that will help other physicists understand those subjects [tensors and groups] as mathematicians understand them... From the first pages, Jeevanjee shows amazing skill in finding fresh, compelling words to bring forward the insight that animates the modern mathematical view...[W]ith compelling force and clarity, he provides many carefully worked-out examples and well-chosen specific problems... Jeevanjee's clear and forceful writing presents familiar cases with a freshness that will draw in and reassure even a fearful student. [This] is a masterpiece of exposition and explanation that would win credit for even a seasoned author." —Physics Today "Jeevanjee's [text] is a valuable piece of work on several counts, including its express pedagogical service rendered to fledgling physicists and the fact that it does indeed give pure mathematicians a way to come to terms with what physicists are saying with the same words we use, but with an ostensibly different meaning. The book is very easy to read, very user-friendly, full of examples...and exercises, and will do the job

the author wants it to do with style." —MAA Reviews
Affine Lie Algebras and Quantum Groups
An Introduction for Physicists, Engineers and Chemists
Groups, Representations, and Physics
An Introduction to Space-Time and Internal Symmetries
Lie Algebras, Part 2

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.
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.
An exciting new edition of a classic text
This book provides a comprehensive account of a modern generalisation of differential geometry in which coordinates need not commute. This requires a reinvention of differential geometry that refers only to the coordinate algebra, now possibly noncommutative, rather than to actual points. Such a theory is needed for the geometry of Hopf algebras or quantum groups, which provide key examples, as well as in physics to model quantum gravity effects in the form of quantum spacetime. The mathematical formalism can be applied to any algebra and includes graph geometry and a Lie theory of finite groups. Even the algebra of 2 x 2 matrices turns out to admit a rich moduli of quantum Riemannian geometries. The approach taken is a `bottom up' one in which the different layers of geometry are built up in succession, starting from differential forms and proceeding up to the notion of a quantum `Levi-Civita' bimodule connection,

geometric Laplacians and, in some cases, Dirac operators. The book also covers elements of Connes' approach to the subject coming from cyclic cohomology and spectral triples. Other topics include various other cohomology theories, holomorphic structures and noncommutative D-modules. A unique feature of the book is its constructive approach and its wealth of examples drawn from a large body of literature in mathematical physics, now put on a firm algebraic footing. Including exercises with solutions, it can be used as a textbook for advanced courses as well as a reference for researchers.

Mathematical Gauge Theory

An Introduction to Lie Groups and Lie Algebras

With Applications to the Standard Model of Particle Physics

Group Theory and Physics

Group Theory In Physics: A Practitioner's Guide

Group Theory and its Applications, Volume III covers the two broad areas of applications of group theory, namely, all atomic and molecular phenomena, as well as all aspects of nuclear structure and elementary particle theory. This volume contains five chapters and begins with an introduction to Wedderburn's theory to establish the structure of semisimple algebras, algebras of quantum mechanical interest, and group algebras. The succeeding chapter deals with Dynkin's theory for the embedding of semisimple complex Lie algebras in semisimple complex Lie algebras. These topics are followed by a review of the Frobenius algebra theory, its centrum, its irreducible, invariant subalgebras, and its matric basis. The discussion then shifts to the concepts and application of the Heisenberg-Weyl ring to quantum mechanics. Other chapters explore some well-known results about canonical transformations and their unitary representations; the Bargmann Hilbert spaces; the concept of complex phase space; and the concept of quantization as an eigenvalue problem. The final chapter looks into a theoretical approach to elementary particle interactions based on two-variable expansions of reaction amplitudes. This chapter also demonstrates the use of invariance properties of space-time and momentum space to write down and exploit expansions provided by the representation theory of the Lorentz group for relativistic particles, or the Galilei group for nonrelativistic ones. This book will prove useful to mathematicians, engineers, physicists, and advance students.

Solid but concise, this account of Lie algebra emphasizes the theory's simplicity and offers new approaches to major theorems. Author David J. Winter, a Professor of Mathematics at the University of Michigan, also presents a general, extensive treatment of Cartan and related Lie subalgebras over arbitrary fields. Preliminary material covers modules and nonassociate algebras, followed by a compact, self-contained development of the theory of Lie algebras of characteristic 0. Topics include solvable and nilpotent Lie algebras, Cartan subalgebras, and Levi's radical splitting theorem and the complete reducibility of representations of semisimple Lie algebras. Additional subjects include the isomorphism theorem for semisimple Lie algebras and their irreducible modules, automorphism of Lie algebras, and the conjugacy of Cartan subalgebras and Borel subalgebras. An extensive theory of Cartan and related subalgebras of Lie algebras over arbitrary fields is developed in the final chapter, and an appendix offers background on the Zariski topology.

Designed to acquaint students of particle physics 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 topics include Casimir operators and Freudenthal's formula, the Weyl group, Weyl's dimension formula, reducing product representations, subalgebras, and branching rules. 1984 edition.

This 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.

Theory Of Groups And Symmetries: Finite Groups, Lie Groups, And Lie Algebras

from Isospin To Unified Theories

Group Theory For Physicists

Lie Theory and Its Applications in Physics

An Introduction, with Applications in Conformal Field Theory

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.

The book is intended for graduate students of theoretical physics (with a background in quantum mechanics) as well as researchers interested in applications of Lie group theory and Lie algebras in physics. The emphasis is on the inter-relations of representation theories of Lie groups and the corresponding Lie algebras.

Written for use in teaching and for self-study, this book provides a comprehensive and pedagogical introduction to groups, algebras, geometry, and topology. It assimilates modern applications of these concepts, assuming only an advanced undergraduate preparation in physics. It provides a balanced view of group theory, Lie algebras, and topological concepts, while emphasizing a broad range of modern applications such as Lorentz and Poincaré invariance, coherent states, quantum phase transitions, the quantum Hall effect, topological matter, and Chern numbers, among many others. An example based approach is adopted from the outset, and the book includes worked examples and informational boxes to illustrate and expand on key concepts. 344 homework problems are included, with full solutions available to instructors, and a subset of 172 of these problems have full solutions available to students.

This book is intended as an introductory text on the subject of Lie groups and algebras and their role in various fields of mathematics and physics. It is written by and for researchers who are primarily analysts or physicists, not algebraists or geometers. Not that we have eschewed the algebraic and geo metric developments. But we wanted to present them in a concrete way and to show how the subject interacted with physics, geometry, and mechanics. These interactions are, of course, manifold; we have discussed many of them here-in particular, Riemannian geometry, elementary particle physics, sym metries of differential equations, completely integrable Hamiltonian systems, and spontaneous symmetry breaking. Much ofthe material we have treated is standard and widely available; but we have tried to steer a course between the descriptive approach such as *found in Gilmore and Wybourne, and the abstract mathematical approach of Helgason or Jacobson. Gilmore and Wybourne address themselves to the physics community whereas Helgason and Jacobson address themselves to the mathematical community. This book is an attempt to synthesize the two points of view and address both audiences simultaneously. We wanted to present the subject in a way which is at once intuitive, geometric, applications oriented, mathematically rigorous, and accessible to students and researchers without an extensive background in physics, algebra, or geometry.*

Lie Groups And Lie Algebras For Physicists

Noncommutative Geometry and Particle Physics

Revised Edition

Quantum Mechanics Via Lie Algebras

Lie Groups, Physics, and Geometry

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 w

This book is a detailed reference on Lie algebras and Lie superalgebras presented in the form of a dictionary. It is intended to be useful to mathematical and theoretical physicists, from the level of the graduate student upwards. The Dictionary will serve as the reference of choice for practitioners and students alike. Key Features: * Compiles and presents material currently scattered throughout numerous textbooks and specialist journal articles * Dictionary format provides an easy to use reference on the essential topics concerning Lie algebras and Lie superalgebras * Covers the structure of Lie algebras and Lie superalgebras and their finite dimensional representation theory * Includes numerous tables of the properties of individual Lie algebras and Lie superalgebras

A coursebook for a Master's level course at the University of Cambridge to prepare students for a Ph.D. in theoretical particle physics. Lie groups and Lie algebras are important in the construction of quantum field theories that describe interactions between known particles. One particle states are described in terms of irreducible representations of the Poincare group, a Lie group. Quantum fields may be acted on by operators of the Poincare group. Gauge theories, which describe many of the interactions in the Standard Model of particle physics, also rely on Lie groups. We assume knowledge of quantum mechanics, linear algebras, and vector spaces at the undergraduate level. We do not require knowledge of quantum field theory, although the book was designed with the assumption that some basic quantum field theory is studied simultaneously (in particular, the construction of Lagrangian densities in terms of fields); then, a few applications will make more sense. After some basic properties and preliminaries, we introduce matrix Lie groups, which rely on continuous parameters. Differentially, these act as a Lie algebra.

The exponential map connects the Lie algebra to the Lie group. We then introduce representations in terms of square matrices, describing how to construct various new representations in terms of combinations of others. The group of rotations in three-dimensional space SO(3) is examined, along with SU(2) and the connection to angular momentum states in quantum theory. Representations of each are covered. The relativistic symmetries (the Lorentz group and the Poincare group in four dimensions) are studied from the point of view of their group elements and Lie algebras. Analysis of compact simple Lie algebras and their finite representations comes from mapping them to a geometrical picture involving roots and weights via the Cartan matrix. An overview of the results of the Cartan classification of simple Lie algebras is included. An application in terms of representations of a global SU(3)F flavour symmetry explains some features of the spectrum of hadronic particles. Further properties of the spectrum lead one to introduce an additional local SU(3)c colour symmetry leading to a particular gauge theory called quantum chromodynamics. We cover abelian and non-abelian gauge theories before returning to irreducible induced representations of the Poincare group, which are used to describe one-particle states.
The book presents examples of important techniques and theorems for Groups, Lie groups and Lie algebras. This allows the reader to gain understandings and insights through practice. Applications of these topics in physics and engineering are also provided. The book is self-contained. Each chapter gives an introduction to the topic.
A Graduate Course for Physicists
Group Theory in a Nutshell for Physicists
Lie Groups, Lie Algebras, Cohomology and Some Applications in Physics
Group Theory for the Standard Model of Particle Physics and Beyond
Dictionary on Lie Algebras and Superalgebras
This book attempts to convey to the reader that semiclassical physics can be fun, as well as useful for understanding quantum fluctuations in interacting many-body systems. It presents applications to finite fermion systems in diverse areas of physics.
Lie Algebras In Particle Physicsfrom Isospin To Unified TheoriesWestview Press
This book, an abridgment of Volumes I and II of the highly respected Group Theory in Physics, presents a carefully constructed introduction to group theory and its applications in physics. The book provides anintroduction to and description of the most important basic ideas and the role that they play in physical problems. The clearly written text contains many pertinent examples that illustrate the topics, even for those with no background in group theory. This work presents important mathematical developments to theoretical physicists in a form that is easy to comprehend and appreciate. Finite groups, Lie groups, Lie algebras, semi-simple Lie algebras, crystallographic point groups and crystallographic space groups, electronic energy bands in solids, atomic physics, symmetry schemes for fundamental particles, and quantum mechanics are all covered in this compact new edition. Covers both group theory and the theory of Lie algebras Includes studies of solid state physics, atomic physics, and fundamental particle physics Contains a comprehensive index Provides extensive examples
Semi-Simple Lie Algebras and Their Representations
An Introduction to Tensors and Group Theory for Physicists

Weak Interactions and Modern Particle Theory
Quantum Theory, Groups and Representations
Symmetries and Group Theory in Particle Physics