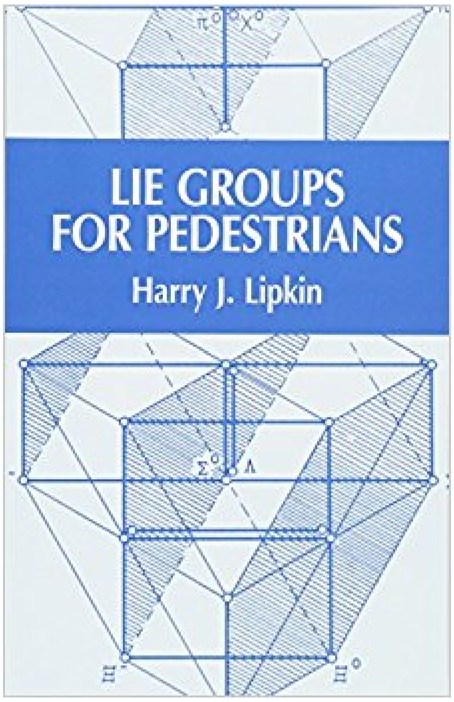
Lie Groups For Pedestrians (Dover Books On Physics)



Synopsis

According to the author of this concise, high-level study, physicists often shy away from group theory, perhaps because they are unsure which parts of the subject belong to the physicist and which belong to the mathematician. However, it is possible for physicists to understand and use many techniques which have a group theoretical basis without necessarily understanding all of group theory. This book is designed to familiarize physicists with those techniques. Specifically, the author aims to show how the well-known methods of angular momentum algebra can be extended to treat other Lie groups, with examples illustrating the application of the method.Chapters cover such topics as a simple example of isospin; the group SU3 and its application to elementary particles; the three-dimensional harmonic oscillator; algebras of operators which change the number of particles; permutations; bookkeeping and Young diagrams; and the groups SU4, SU6, and SU12, an introduction to groups of higher rank. Four appendices provide additional valuable data.

Book Information

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Customer Reviews

This book is a nice, concise review of Lie algebras and groups as they are used in particle physics. The content is a bit dated, but the explanations of building the mathematical operators used in quantum mechanics are quite lucid. I think this would be an excellent companion to a more modern text on particle physics. This book is NOT Lie groups 101. Topics include the different flavors of spin, harmonic oscillators, multiplets of a few SU(n) groups, and tying everything back to Young diagrams.The title is a bit misleading- if this is the "pedestrian" approach, I would hate to see what the author thinks is the more exotic route. The book jumps in right at basic angular momentum operators, so if it’s been a while you might need to break out notes from a QM class. Important concepts are not defined, or are left as a vague mathematical mumbo-jumbo that doesn’t at all hint at the underlying physical concept. Many times the author says "it clearly follows that..." or something similar, but I found it a nontrivial exercise to follow. Despite the fact that I had to go to other sources and push my pencil around a bit (probably my own shortcomings than anything in the book), I found this book easy enough to learn from.

I like the fact that it is compact and avoids a lot of the abstractions that might only be used by mathematicians.It is a different way of approaching the subject but difficult to relate to other approaches, if your expertise in adding quantum angular momentum is limited like mine, but I am still working on the book, part way thru at this time, to see if it broadens my intuitive grasp of the subject. Hard to say what others should know before buying it until they read it and see if it applies to their needs. Check out the Sakaton model on the sample pages and see if you can relate to it. I’ve never seen anything quite like this book, but apparantly it is based on the published work of a number of researchers.

This is the best book I have come across to explain Lie groups/algebras to someone who has at least taken an introductory quantum mechanics course and is comfortable with the angular momentum operators-more particularly the raising/creation and lowering/annihilation operators. This is not for someone who has watched NOVA and wants to learn more. If you have a good background in group theory and quantum mechanics, or even a very basic understanding of them and you want to learn more about the fascinating word of Lie Algebras/groups, this book is for you.As a companion to this book I would highly recommend Lie Groups, Lie Algebras, and Some of Their Applications by Robert Gilmore. This book gives an excellent exposition of the subject, going into more detail than Lie Groups for Pedestrians, but not so much detail that you need to have taken a course on group theory in order to digest the information. It also has very informative exercises at the end of the chapter, which in my opinion is a plus.If you’re looking for a quick and dirty introduction to string theory and that ilk, this is not your ticket. If you are looking to expand your horizons of QM theory and second quantization-which leads to wonderful results and ’toys’ in not only particle physics, but also in spectroscopy of atoms and molecules-this is your book.

Good book to start learning lie groups

The book of Lipkin has become a classical reference in group theoretical methods in physics, and is one of the most valuable reviews at the time of the establishment of the Gell-Mann-Ne’eman octet model. Divided into seven chapters and various later written appendixes, this work was originally thought as a comprehensive introduction to the unitary symmetry. This has been achieved in an impressive way, as shows the careful development of the topics and successive refinements. The su(3) symmetry is deduced naturally starting from the annihilation-creation operator formalism employed for the nucleon, and introducing the needed tools step by step. The (1966) more relevant groups SU(3), SU(4), SU(6) and SU(12) groups are analyzed in some detail, as well as some low rank symplectic groups and various subgroups intervening in the state labeling problem, such as the Wigner supermultiplet model. The author makes a self-contained presentation of the combinatorial technique of Young diagrams, which is inspired in the milestone work of M. Hammermesh, but presented here with astonishing simplicity to be applied by the reader without requiring a deep theoretical background.A quite interesting section is devoted to the experimental predictions obtained from the octet model, like the classical example of the negative hyperon, discovered by Barnes et al. following the theoretical model. In all, this book shows the situation of the global internal symmetries in the 60s.There is however one surprising fact about the book. In spite of the title, the concept of Lie group is nowhere defined adequately through the book. Although it is commonly understood that the group is meant when working with the corresponding Lie algebra, this can mislead some readers. Also the (informal) definition of Lie algebra given in equation (1.15) on page ten is false, or at least incomplete. A set of operators with some bracket (either of bosonic or fermionic type) defines a Lie algebra only if it is closed with respect to this brackets and additionally satisfies the Jacobi identity. None of this is found in the definition given in the book. To "satisfy commutation relations similar to those of angular momentum operators" is definitively not sufficient for higher rank algebras. I agree that this minor detail is irrelevant for the rest of the book, because the used operators obviously define a Lie algebra, but this can also lead to confusion, since apparently any arbitrary collection of operators would have the same property.Although this book has aged quite well and remains an important reference, it is no more adequate for those who want an actualized overview of the classification of particles. There are obvious reasons for this, as the non-covered topics correspond to concepts or models that were developed later than the publication of the book. One example is the attribute color (around 1973), introduced to explain some remaining difficulties. This absence obviously extends to QCD (Quantum Chromodynamics).

Also the unified theories and the model SU(5) of Georgi-Glashow (1974) are not covered, as well as the symmetry broken down from this group to the reductive group SU(3) x SU(2) x U(1), or the resulting proton decay. Such important absences, easily detected by the expert, are not immediate for the beginner. However, there is no doubt that this book is an excellent introduction to the specific problems of group theory applied to particle physics. In any case, in order to have a larger comprehension of the topic, the text must be completed with the reading of more modern or detailed monographs. Good complements to the book of Lipkin containing later developments and theories would be, for example, the work of Ne'eman [SymÃƒÂ©tries jauge et variÃƒÂ©tÃƒÂ©s de groupe, PUM, MontrÃƒÂ©al, 1979], the book of Georgi [Lie algebras in particle physics, Perseus Books, Reading, 1982] or the encyclopedic work of Cornwell [Group theory in physics, Academic Press, San Diego, 1984, volume 2].

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