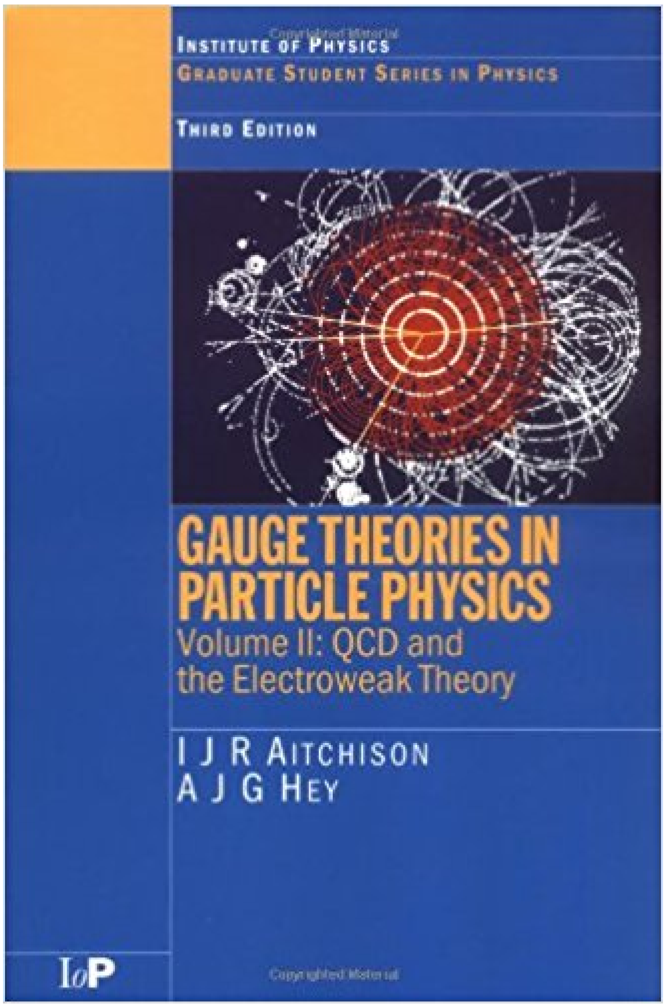
Gauge Theories In Particle Physics, Vol. 2: Non-Abelian Gauge Theories: QCD And The Electroweak Theory (Volume 1)



Synopsis

This is the second volume of the third edition of a successful text, now substantially enlarged and updated to reflect developments over the last decade in the curricula of university courses and in particle physics research. Volume I covered relativistic quantum mechanics, electromagnetism as a gauge theory, and introductory quantum field theory, and ended with the formulation and application of quantum electrodynamics (QED), including renormalization. Building on these foundations, this second volume provides a complete, accessible, and self-contained introduction to the remaining two gauge theories of the standard model of particle physics: quantum chromodynamics (QCD) and the electroweak theory.The treatment significantly extends that of the second edition in several important respects. Simple ideas of group theory are now incorporated into the discussion of non-Abelian symmetries. Two new chapters have been added on QCD, one devoted to the renormalization group and scaling violations in deep inelastic scattering and the other to non-perturbative aspects of QCD using the lattice (path-integral) formulation of quantum field theory; the latter is also used to illuminate various aspects of renormalization theory, via analogies with condensed matter systems. Three chapters treat the fundamental topic of spontaneous symmetry breaking: the (Bogoliubov) superfluid and the (BCS) superconductor are studied in some detail; one chapter is devoted to the implications of global chiral symmetry breaking in QCD; and one to the breaking of local SU(2)xU(1) symmetry in the electroweak theory. Weak interaction phenomenology is extended to include discussion of discrete symmetries and of the possibility that neutrinos are Majorana (rather than Dirac) particles. Most of these topics are normally found only in more advanced texts, and this is the first book to treat them in a manner accessible to the wide readership that the previous editions have attracted.

Book Information

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Customer Reviews

This book (2nd edition) has 15 chapters . I have just finished chapter 4 entitled QFT and I am compeled to write this review! After a year of studying of QFT informally I can report that this is the way to introduce yourself to the topic. I’ve been through Mandl & Shaw, Peskin & Schoeder, Ryder, Weinberg and a few others and this is heads and tails the BEST intro available. In 42 pages, Aitchison & Hey make the transistion from classical to QM and from QM to QFT as gracefully as I can conceive. For example, the transition from the discrete Lagrangian to the field Lagrangian is very explicit. One benfit of this is that the dependence of L on partial of phi wrt x is clearly motivated leading to the manifestly relativistically invariant form of L. They explicitly develop physical intuition at every step of the way - for example, this is the only book that I have found that explicitly asks the question where is QM’s wavefunction in the QFT formalism? Answer - The vacuum to one-particle matrix elements of the field operators. The transistion from free fields to interacting fields is far clearer than any other treatment I’ve seen. I also appreciated that the problems were used to basically fill in details left out of the text. I was able to ’practice’ the various kinds of manipulations that are required.

Like the 2nd edition this 2 volume set is very readable. I like it’s informal style, and the wealth of background material presented, as well as the hints about when to expect further discussions of a subject in succeding chapters. By far the best Quantum Field Theory book I’ve come across.

The 3rd edition of that book clarified to a degree the fog left in my mind by a two-semester QFT course. The book is better suited for beginners than Peskin & Shroeder, Mandl & Show or Lahiri & Pal simply because it senses better the difficult points for beginners and tries to explain them at lower level. It focuses on the main concepts and doesn’t try to `cover broad material in shortest time’ or get into extreme computational technicalities totally irrelevant to beginners. The correct historical perspective of many ideas is given and the important historical papers are cited. The theory is frequently compared to the experimental results. Violin string is used as a prototype of a continuous system described by a classical field which is the first field quantized later. The book develops physical intuition showing how a scattering process can be analyzed in full QED (all fields are operators), in semiclassical approximation (all fields are operators except the EM field) or using the lowest level wavefunction approximation (all fields are treated like wave functions just like scattering in nonrelativistic QM) often getting the same result (see chapter 8). Important concepts like Feynman diagrams and Renormalization of a theory are first explored in a simple theoretical playground - a hypothetical `ABC theory' of three massive scalar fields with an interaction ABC term - and later discussed again in the case of QED with all the complications like fermions and Electromagnetic gauge field.Topics discussed include gauge invariance principle; relativistic field equations describing free particles like Klein-Gordon and Dirac; Feynman interpretation of the negative energy solutions of Dirac eq. (no its not `antiparticle going back in time'); Dirac equation with EM field; Lagrangian and Hamiltonian densities for continuous systems; quantization of free fields like KG (real and complex scalar), Dirac and Electromagnetic field [the quantization is by postulating commutators/anticommutators, no path integrals]; Normal ordering of operators; Interaction picture for interacting fields, Time ordering of operators, Dyson expansion of the S matrix; Wick's theorem; scattering processes in QED at tree level; Ward identity; form factors for scattering from non point particle; parton model, Bjorken scaling; diagrams with loops, regularization and renormalization of ultraviolet divergences in QED.It took me a month and a half to read the book and solve all problems (10 problems per chapter on average). The problems are exactly the ones every beginner should solve and usually revolve about filling in details from the text or proving statements in the text. Solving them is usually easy with a few exceptions and teaches you the typical computational tricks of the trade. You have to know quantum mechanics (at least have seen scattering theory) and special relativity. You have to at least have heard of Green function and contour integration in the complex plane. The book provides nice appendices about all these.Not everything is crystal clear in that book, sometimes it took me a few days for an idea to sink in or I understood some paragraphs only after I read the whole book. Other ideas I did not understand at all. Sometimes it's hard to tell what they are trying to say although they say it several times from different angles ... The authors should work on expressing an idea in a direct succinct way once and for all instead of repeating several fuzzy versions of it. Overall that book made me understand MUCH more than a regular QFT course and I highly recommend it as a prep for such a course.

I have tried many "classics" QFT textbook, but still find that is difficult to learn, until I meet this book.Without a teacher, this book would be a great bridge between your undergraduate studies and the "classics" QFT textbook.

I received my copy of Aitchison and Hey last week and have nearly finished reading the first volume.

So far, the text is living up to its legend: it is very readable, well cited (so the historical context can be reconstructed) and pitched for a graduate student who has seen the topic before but is looking for the kind of "handle" on the subject that is missing in nearly all other volumes on QFT (esp so Peskin). If you are struggling with your first look at QFT, reviewing the subject or trying to get a headstart through self instruction --- this book is essential. I would strongly recommend that all physics graduate students read this text after completing the usual third semester grad course in QM that often includes a first look at relativistic QM, KG eqn, and Spinors. I would also recommend that one begin by just READING the book carefully before trying problems. Aitchison and Hey have created a very reader friendly intro to QFT and the standard model that is not watered down.Take my advice: start reading this book in parallel with your QFT coursework or beforehand if you can. These books are worth every penny and every minute of your study time. Many mysteries are resolved! Enjoy.

I have read a number of books on gauge field theory. This one just seems to be the clearest presentation, balanced with unerstandable problems, I have ever seen. Many physics texts leave you wishing they would get to a point. Others leave you wondering what truckload of math just ran over you. This book, and its first volume, just satisfy. Each section is clear, to the point, and enjoyable. If you want to learn some field theory, just read these books. Actually, you may need a couple of basic quantum mechanics books first. But it's well worth it, to see the beauty of gauge theory.

This book is the best book I've seen on the subject. The qualitative description of qunatum field theory in particular are amazingly lucid for the subject. The only possible flaw in the book is that the problems at the end of each chapter are both few in number and for the most part do not challenge the student at all; for the most part they are just rote calculations.

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