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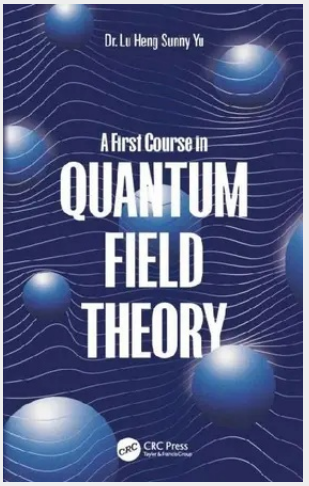
A First Course in Quantum Field Theory



220,50 €
220,50 € (zzgl. MwSt.)

vorbestellbar, Erscheinungstermin ca. Dezember 2026

Quantum Field Theory (QFT) is the essential framework for modern theoretical physics. From particle physics and cosmology to condensed matter and quantum gravity — QFT underpins how physicists describe nature at its most fundamental level. However, due to its complexity, QFT has often been one of the most intimidating subjects to learn for generations of students. This book provides a beginner-focused introduction to QFT, aiming to make a first encounter with QFT both clear and exciting. This book aims to focus strongly on explaining the physical motivations behind the complex equations, and present mathematical derivations as transparent as possible. Emphasis is placed on helping readers understand why the theory is structured as it is, and not just how it works as a calculational tool. This book serves as a perfect follow-up to undergraduate quantum mechanics courses. Building upon standard canonical quantum mechanics, the book guides the reader to see how the objective of understanding relativistic quantum particles and their interactions naturally leads to the idea and concept of "quantum fields", and its associated mathematical framework. The book begins with a survey of the mathematics of tensor algebra — the basic mathematical language for modern theoretical physics — and a review of classical field theory, before discussing how quantum mechanics can be incorporated, resulting in a successful model for relativistic quantum particles. Subsequent chapters then further develop the framework for interactions and particles with quantum "spin", finally culminating in a discussion on the famous theory of quantum electrodynamics (QED). This is an ideal textbook for upper-undergraduate or early postgraduate (Master's/PhD) students of physics or mathematics. Key features: - Ensures concepts are exciting and well-motivated for a first introduction to QFT - Ensures mathematical skills required are easy to learn and follow - Ensures the narrative is easy to read, pedagogically designed with summary boxes, highlighted concepts, worked examples, and practice exercises

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Artikelnummer: 9781032764320
Medium: Buch
ISBN: 978-1-032-76432-0
Verlag: Taylor & Francis Ltd
Erscheinungstermin: 28.12.2026
Sprache(n): Englisch
Auflage: 1. Auflage 2026
Produktform: Gebunden
Seiten: 240
Format (B x H): 156 x 234 mm

Kundenservice Verlag Dr. Otto Schmidt KG
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