



An Introduction to Quantum Field Theory

George Serman

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This is a systematic presentation of Quantum Field Theory from first principles, emphasizing both theoretical concepts and experimental applications. Starting from introductory quantum and classical mechanics, this book develops the quantum field theories that make up the "Standard Model" of elementary processes. It derives the basic techniques and theorems that underly theory and experiment, including those that are the subject of theoretical development. Special attention is also given to the derivations of cross sections relevant to current high-energy experiments and to perturbative quantum chromodynamics, with examples drawn from electron-positron annihilation, deeply inelastic scattering and hadron-hadron scattering. The first half of the book introduces the basic ideas of field theory. The discussion of mathematical issues is everywhere pedagogical and self contained. Topics include the role of internal symmetry and relativistic invariance, the path integral, gauge theories and spontaneous symmetry breaking, and cross sections in the Standard Model and the parton model. The material of this half is sufficient for an understanding of the Standard Model and its basic experimental consequences. The second half of the book deals with perturbative field theory beyond the lowest-order approximation. The issues of renormalization and unitarity, the renormalization group and asymptotic freedom, infrared divergences in quantum electrodynamics and infrared safety in quantum chromodynamics, jets, the perturbative basis of factorization at high energy and the operator product expansion are discussed. Exercises are included for each chapter, and several appendices complement the text.

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