



Functional Methods and Models in Quantum Field Theory

Herbert Fried

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The purpose of this volume is to present from a unified point of view a description of the major soluble and approximate models of relativistic quantum field theory. While the proper content of (realistic) field theories remains a matter of speculation, it seems to be clear that an understanding of the structure of matter, deeper than a phenomenological one, will rest on an understanding of the dynamics of interacting fields. For this reason alone it is worthwhile to collect, as this book does, those results that are now known about model theories. Considerations of efficiency and the anticipation of future usefulness suggest the employment of the beautiful functional methods developed by Schwinger, Symanzik, and Feynman, among others.

The level of presentation is such that students familiar with conventional field theoretic arguments should make the transition to a functional description both without difficulty and with a certain sense of excitement.

The first half of the book is a compact expression and derivation of functional methods that are applicable to relativistic quantum field theory, while the second deals with the models themselves—it employs these rather elegant functional techniques in describing almost all the soluble and approximate models of field theory.

After introducing functional field theory, the first part takes up in turn the S-matrix and the generating functional; construction of the generating functional: the Symanzik construction, the Schwinger construction, several interacting fields, rearrangements/grouping of Feynman graphs, and fields at the same point; noncanonical (e.g., Chiral) generalizations; and special properties of quantum electrodynamics: the heavy proton limit, Green's function equations, and gauge transformations and Ward identities.

The second half of the book, on soluble models, covers perturbation expansions: the Born (tree-graph) functional, lowest-order radiative corrections, the Lamb shift, and renormalization procedures; two-dimensional electrodynamics and the Thirring model; the Lee model; static and Bloch-Nordsieck models; and relativistic eikonal physics.

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