

FIELDS

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AfterMath 866

OUTLINE

In this Outline we give a brief description of each item listed in the Contents. While the Contents and Index are quick ways to search, or learn the general layout of the book, the Outline gives more detail for the uninitiated. (The PDF version also allows use of the “Find” command in PDF readers.)

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general remarks on style, organization, focus, content, use, differences from other texts, etc.	
Some field theory texts	36
recommended alternatives or supplements (but see Preface)	

PART ONE: SYMMETRY

Relativistic quantum mechanics and classical field theory. Poincaré group = special relativity. Enlarged spacetime symmetries: conformal and supersymmetry. Equations of motion and actions for particles and fields/wave functions. Internal symmetries: global (classifying particles), local (field interactions).

I. Global

Spacetime and internal symmetries.

A. Coordinates

spacetime symmetries

- 1. Nonrelativity** 39
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- 2. Fermions** 46
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- 3. Lie algebra** 51
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- 4. Relativity** 54
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Symmetries that act independently at each point in spacetime. Basis of fundamental forces.

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PART TWO: QUANTA

Quantum aspects of field theory. Perturbation theory: expansions in loops, helicity, and internal symmetry. Although some have conjectured that nonperturbative approaches might solve renormalization difficulties found in perturbation, all evidence indicates these problems worsen instead in complete theory.

V. Quantization

Quantization of classical theories by path integrals. Backgrounds fields instead of sources exclusively: All uses of Feynman diagrams involve either S-matrix or effective action, both of which require removal of external propagators, equivalent to replacing sources with fields.

A. General

various properties of quantum physics in general context, so these items need not be repeated in more specialized and complicated cases of field theory

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VI. Quantum gauge theory

Gauge fixing and more complicated vertices require additional methods.

A. Becchi-Rouet-Stora-Tyutin

easiest way to gauge fix, with fermionic symmetry relating unphysical degrees of freedom; unitarity clear by relating general gauges to unitary gauges; general discussion in framework of quantum physics and canonical quantization, so field theory can be addressed covariantly with path integrals

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VII. Loops

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PART THREE: HIGHER SPIN

General spins. Spin 2 must be included in any complete theory of nature. Higher spins are observed experimentally for bound states, but may be required also as fundamental fields.

IX. General relativity

Treatment closely related to that applied to Yang-Mills, super Yang-Mills, and supergravity. Based on methods that can be applied directly to spinors, and therefore to supergravity and superstrings. Somewhat new, but simplest, methods of calculating curvatures for purposes of solving the classical field equations.

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starting point for deriving field equations for gravity (and matter)

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