Quantum Field Theory

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Part I

Quantum fields

Chapter 1

Free fields

1.1 Canonical quantization

Classical fields(sigma model?) CCR, CAR, Heisenberg group, spin-statistics theorem Fock representation(universality) field equations particles and irreducible representations wave function

1.2 Path integral

functional integral

1.3 Correlation function

renormalization Feynman diagram

Chapter 2

Relativistic fields

2.1 Wigner classification

2.2 Dirac equation

$\mathrm{Spin}(1,3) \cong \mathrm{SL}(2,\mathbb{C})$ Dirac and Weyl representations helicity and chirality positive energy representation

Chapter 3

Conformal fields

more general than Lorentz symmetry, locally SO(2,4) for Minkowski

Local operators are not generally fields. Conformal group is not compact so that the representations may not be given as the direct sum of finite dimensional irreducible representations, which implies that there are no particles in CFT.

Part II

Gauge theory

Chapter 4

Yang-Mills theory

Why spin 1?: vector-like particles can be interpreted as the field in (1/2,1/2) representation of Lorentz group.

4.1 Interacting fields

pair production(1941)

lagrangian of standard model mass, charge, superselection sectors

4.2 Higgs mechanism

4.3 Quantum electrodynamics

Chapter 5

Supersymmetry

Chapter 6

Geometric quantization

GB, BRST, BV formalisms

Part III

Chapter 7

Phase transition, Ginzburg Landau theory, Thermal states, Phonon, Quantum Hall effect,

Chapter 8

Chapter 9

Part IV