Quantum Field Theory

Lecturer: Alexei Vladimirov
9th and 10th semesters

Course aims

The course systematically presents the fundamentals of the quantum field theory (QFT) to theoretical physics students. Attention is focused on mastering the basic QFT techniques taking into account the fact that QFT applications like the Standard Model will be the subjects of separate courses. The history of the subject is practically not considered; in many cases, detailed proving is omitted. Rather, the theory is immediately presented in its final, easy-to-use state. Special attention is paid to a logical scheme of the QFT development and to the QFT interrelations.

Prerequisites

Basics of elementary particle physics; being familiar with the fact that there is correspondence between particles and fields; having an idea of Feynman diagrams.

Course contents

Free quantum fields. S-matrix. Disturbance theory. Generating functional. Continual integral. Field transformation and Noether theorem. Discrete symmetries. Ward identity. Gauge theories. Ghosts and BRST. Spontaneous symmetry violation and the Higgs effect. Standard model. Regularization and renormalization. Renormgroup. Diagram calculation techniques. Renormalization of theories with symmetries. Compound operators. Infrared divergences. Heisenberg fields. Challen – Lehmann presentation. Analytic properties. Dispersion methods. Operator decomposition. Monopoles and solitons. Instantons. Confinement. Precisely solvable QFT models. Seiberg – Witten solution. Two-dimensional conformal field theory. Boson string. Compactification and duality.