

Quantum Field Theory (TTP) I

Summer 2016

Course description: The course is the first part of Quantum Field Theory course (TTP1). We will follow some parts of a book "Introduction to Quantum Field Theory" by Peskin and Schroeder. See the course syllabus on the next page.

Lectures: Prof. Kirill Melnikov (kirill.melnikov@kit.edu). Office hours: room 11/06, Monday, 10-11 am.

Exercises: Dr. Lorenzo Tancredi (lorenzo.tancredi@kit.edu) and Dr. Matthew Dowling (matthew.dowling@kit.edu) 11/08 ; Office hours: (send an e-mail or simply stop by)

Literature: there is a large number of excellent textbooks on Quantum Field Theory and its applications to particle physics. Examples are "Quantum Field Theory in a nutshell" by A. Zee, "Quantum Field Theory" by M. Srednicki, "Quantum Field Theory" by C. Itzykson and J. Zuber, "Quantum Field Theory" by S. Weinberg etc.

Additional resources: [David Tong's lecture notes](#), [Sydney Coleman notes](#).

Lectures: Monday – Friday, 14.00-15.30 , Lehmann HS

Exercises: Wednesday, 15.45-17.15 , PH, 3-1.

Course Syllabus

Dates	Lecture
18/04/16 22/04/16	Attempts at relativistic Quantum Mechanics Canonical quantization of a real scalar field
25/04/16 29/04/16	Scalar field in space-time, propagators Lorentz transformations, Dirac matrices
02/05/16 06/05/16	Dirac equation and its solutions Quantization of a Dirac field
09/05/16 13/05/16	Noether theorem, discrete symmetries, properties of fermion bi-linears Perturbative expansion of correlation functions; Wick's theorem
16/05/16 20/05/16	Feynman diagrams for Green's functions
23/05/16 27/05/16	Cross-section and decay rates; the scattering matrix LSZ reduction formula; S-matrix from Feynman diagrams
30/05/16 03/06/16	Feynman rules for fermions QED Lagrangian, gauge invariance, quantization, Feynman rules
06/06/16 10/06/16	QED Lagrangian, gauge invariance, quantization, Feynman rules Ward-Takahashi identities
13/06/16 17/06/16	Cross-sections in QED: electron-positron annihilation to muons Spinor-helicity formalism
20/06/16 24/06/16	Scattering amplitudes in spinor-helicity formalism: electron-positron annihilation to photons Non-relativistic limit of scattering amplitudes; Breit Hamiltonian
27/06/16 01/07/16	Infra-red divergences in QED; their interpretation and summation Radiative corrections to lepton-photon interactions; form factors, magnetic anomaly
04/07/16 08/07/16	Radiative corrections to lepton-photon interactions; form factors, magnetic anomaly Electron self-energy; mass and field redefinitions
11/07/16 15/07/16	Optical theorem and Cutkosky rules Optical theorem and Cutkosky rules
18/07/16 22/07/16	Euler-Heisenberg Lagrangian Recap