

Quantum Field Theory (TTP) II

Fall 2016 / Winter 2017

Course description: The course is the second part of Quantum Field Theory. 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), 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: Tuesday – Thursday, 9.45-11.15 am, Lehmann HS

Exercises: Wednesday, 15.45-17.15 , 11/12

Course Syllabus

Dates	Lecture
18/10/16 20/10/16	Optical theorem, Cutkosky rules, unstable particles Optical theorem, Cutkosky rules, unstable particles
25/10/16 27/10/16	LHZ reduction formula and Lehmann representation of the two-point function The idea of renormalization; counting ultraviolet divergences
01/11/16 03/11/16	Renormalized perturbation theory at one-loop in ϕ^4 theory One-loop renormalization in QED: wave function, mass and charge renormalization
08/11/16 10/11/16	One-loop renormalization in QED: wave function, mass and charge renormalization Ward-Takahashi identity in QED
15/11/16 17/11/16	Continuous Lie Groups The geometry of gauge-invariance and the Yang-Mills Lagrangian
22/11/16 24/11/16	Spontaneous symmetry breaking, Goldstone bosons, linear sigma model The Higgs mechanism
29/11/16 01/12/16	The Standard Model of electroweak interactions: bosonic sector The Standard Model of electroweak interactions: the fermion sector
06/12/16 08/12/16	Path integral for quantum fields Quantization of non-abelian theory
13/12/16 15/12/16	Spinor-helicity formalism Scattering amplitudes of quarks and gluons in spinor-helicity formalism
20/12/16 22/12/16	One-loop divergencies in non-abelian gauge theories One-loop renormalization of non-abelian theories: the beta-function and the asymptotic freedom
10/01/17 12/01/17	Renormalization beyond one-loop Renormalization group and the Callan-Symanzik equation
17/01/17 19/01/17	Solutions of the Callan-Symanzik equation Renormalization and symmetry
24/01/17 26/01/17	Axial Anomaly Axial Anomaly
31/01/17 02/01/17	Effective field theory Effective field theory
07/02/17 09/01/17	Renormalization of composite operators Renormalization of composite operators