

08.128.809 Theoretische Elementarteilchenphysik

Quantum Field Theory II

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- Lectures: Mondays and Wednesdays on Zoom
- Discussion sessions: Approximately every second Monday
- Homework: due at the beginning of each discussion session by e-mail (photo or scan) to yu001@uni-mainz.de
- Exam: Oral exams on request. Currently (as of April 14, 2020), oral exams are expected to be administered via video conference. In the event that JGU Mainz resumes normal operations before the end of the semester, oral exams will be conducted in person on campus.
- Exam requirement: 50% of homework credits

Main topics

Renormalization The need for renormalization in interacting theories; Lehmann-Symanzik-Zimmermann reduction formula; Källén-Lehmann spectral density function; ultraviolet and infrared divergences; counting divergences and operator renormalizability; general features of wavefunction renormalization and vertex renormalization; Callan-Symanzik equation

Functional integrals Path integral approach to scalar field theory and fermion field theory; variational method for deriving Feynman rules

Representation theory Review of group theory; Lie algebras

Non-Abelian gauge theory Pure Yang-Mills theory; quantization of Yang-Mills fields; Fadeev-Popov ghosts; renormalization of Yang-Mills at 1-loop; Quantum Chromodynamics; renormalization of QCD; asymptotic freedom; quark/hadron phenomenology and basic jet physics; (time-permitting, BRST symmetry)

Spontaneous symmetry breaking Goldstone theorem; chiral symmetry; spontaneous symmetry breaking via chiral condensate; spontaneous symmetry breaking via Higgs field; Standard Model electroweak theory; quantization of massive, non-Abelian gauge bosons; R_ξ gauge fixing; Goldstone boson equivalence

Miscellaneous topics Optical theorem; gauge hierarchy problem

Textbook references

Michael Peskin, Daniel Schroeder An Introduction to Quantum Field Theory, Westview Press, 1995, ISBN 0-201-50397-2

Matthew D. Schwartz Quantum Field Theory and the Standard Model, Cambridge University Press, 2013, ISBN 1107034736