08.128.165 Theoretische Physik 6a, Relativistische Quantenfeldtheorie

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- Lectures: Mondays and Wednesdays, 10:00-12:00 pm (c.t.), Minkowski Room, Staudinger Weg 7, 05-119
- Discussion/homework sessions: Thursdays, 14:00-16:00 (c.t.), Seminar room F
- Homework: due on Wednesdays at the beginning of lecture
- Exam: Written exam, July 30, 2024, 9:00-12 pm (s.t.)
- Exam requirement: 50% of homework credits

Main topics

Motivation and introduction Review of classical field theory, Lorentz invariance, Hamiltonian and Lagrangian formalism

Quantization: scalars Klein-Gordon equation and free scalar fields; Real and complex scalar fields

Quantization: fermions Fermi-Dirac equation and free fermion fields; Dirac algebra; Fermion bilinears; Discrete symmetries, CPT

Interacting field theories Perturbation theory; Feynman rules; Correlation functions and S-matrix elements

Quantum electrodynamics (QED) Tree-level calculations; Scattering cross sections; Pair production, pair annihilation, Compton scattering and other examples

Renormalization of QED One-loop behavior of QED; Regularization of ultraviolet divergences; Regularization of infrared divergences; Counterterms; Renormalized QED Lagrangian

Field theory formal aspects Gauge symmetries and the Ward-Takahashi identity; Tree-loop connections and the optical theorem

Renormalization in other interacting theories ϕ^4 theory; Scalar QED; Yukawa theory

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

Lecture notes The lecture notes will be uploaded to Moodle. Additional arXiv or supplementary textbook references for specific topics will be given upon request.