

QUANTUM FIELD THEORY (2022-2023)

[Íñigo L. Egusquiza, Miguel García Echevarría]

1. Classical Field Theory and Canonical Quantization.

- a) Introduction and the Poincaré group.
- b) Classical theory of scalar field. Klein-Gordon equation.
- c) Lagrangian and Hamiltonian formalism.
- d) Noether theorem. Symmetries and conserved currents.
- e) Canonical quantization ('second quantization'). Free scalar field.

2. Interactions and Feynman diagrams.

- a) Interacting field theory.
- b) Perturbations and Feynman diagrams
- c) S matrix.

3. Renormalization.

- a) Statement of the problem.
- b) Regularisation.
- c) Renormalizability: general scalar fields.
- * d) Renormalizability in QED: fermions, Feynman rules, gammology.

Bibliography

M. D. Schwartz, *Quantum Field Theory and the Standard Model*, Cambridge University Press, 2014.

M. Maggiore, *A Modern Introduction to Quantum Field Theory*, Oxford University Press, 2005.

M. E. Peskin and D.V. Schroeder, *Introduction to Quantum Field Theory*, Addison Wesley, 1995.

L. Alvarez-Gaumé and M. A. Vázquez-Mozo, *An Invitation to Quantum Field Theory*, Lecture Notes in Physics, vol. 839. Springer Nature, 2019.

A. Zee, *Quantum Field Theory in a nutshell*, Princeton University Press, 2003.

T. Banks, *Modern Quantum Field Theory: a Concise Introduction*, Cambridge Univ. Press, 2008.

A. Altland and Ben D. Simons, *Condensed Matter Field Theory*, Cambridge University Press, 2010.

Assessment by **written final exam, with weight given to take-home assessment elements.**