Introductory Field Theory — Guidance

Rodrigo Alonso Autumn 2023

- Contact Info

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  Office hours: Tuesday 14:00-15:00, Thursday 15:00-16:00

- Outline Classical mechanics. Lagrangian formulation. Legendre transform and Hamiltonian formulation. Poisson bracket. Second quantization. Canonical commutation relations. Creation and annihilation operators. Fock Space and operators. Connection with quantum mechanics. Causality. Symmetry in QFT. Infinitesimal transformations and generators. Lorentz and internal groups. Noether theorem. The Scattering matrix. Evolution operator. Dyson's formula. Transition matrix elements. Fermi's Golden rule. Decay rates. Cross sections. Perturbation theory. Wick Theorem. Feynman diagrams. Correlation functions. LSZ reduction formula. Fermions from Lorentz group representations. Dirac equation. Dirac field quantization. Spin-statistics. Elements of QED.

- Problem sheets

  There will be 5 problem sets which your tutor, Yuber Pérez González, will partially go over in tutorials and the full solutions will be made available roughly weekly. Problems marked with (LP) are low priority, do the other ones first.

- Assignment

  There will be an assignment consisting of two problems to be handed in by early November contributing 10% of the mark. You may and I encourage you to discuss the problems with your peers – just don't hand in identical copies.

- References and referencing

  S Quantum Field Theory and the Standard Model
  Matthew D. Schwartz

  P.S. An Introduction to Quantum Field Theory
  Michael E. Peskin and Daniel V. Schroeder

  Z Quantum Field Theory in a Nutshell
  Anthony Zee

  T Quantum Field Theory Lectures
  David Tong
  www.damtp.cam.ac.uk/user/tong/qft.html

  Chapters in the pdf notes will refer to the relevant chapters of these books e.g.
  2.Quantisation [P.S. 2.3, S 2.3, Z 1.8, T 2.1-2.4]

While the material we cover corresponds to the introductory chapters of QFT books, the approach and notation differs. We will separate symmetry and second quantisation (i.e. not assuming Lorentz invariance right away) and natural units will only be introduced midway through the course. We will also spend more time than the average QFT book taking apart the pieces of elementary QFT to see how it overcomes the shortcomings of QM.