

Suggestions for the final project

For the final project, you may select from one of the topics listed below, or propose another project that is connected to quantum field theory. (Note that for each subject listed below, each subtopic constitutes a possible project.) I will be available during my virtual office hours for suggestions and consultation on your choice for the term project.

1. Effective field theory methods
 - (a) Heavy quark effective field theory
 - (b) Standard Model Effective Field Theory (SMEFT)
2. QCD
 - (a) Deep inelastic scattering and the parton model
 - (b) Operator product expansions in quantum field theory
3. Topological Objects in Field Theory
 - (a) Classical lumps and their quantum descendants
 - (b) Instantons and the θ -vacua
4. Infrared divergences and mass singularities
 - (a) Sudakov form factors
 - (b) The Kinoshita-Lee-Nauenberg theorem
5. Precision tests of the Standard Model
 - (a) The one-loop prediction of the W mass
 - (b) The S , T and U parameters
6. One-loop production and decays of the Higgs boson
 - (a) The partial rate for $H \rightarrow \gamma\gamma$
 - (b) Gluon-gluon fusion mechanism for Higgs boson production
7. Unification of gauge couplings and Yukawa couplings in grand unified theories
8. Finite-temperature field theory
 - (a) Temperature-dependent effective potential and phase transitions