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REQUIRED TEXTBOOK:

Quantum Field Theory and the Standard Model, by Matthew D. Schwartz

Recommended Outside Reading:

<u>Secondary texts:</u>

An Introduction to Quantum Field Theory, by Michael Peskin and Daniel Schroeder
Quantum Field Theory (Second edition), by Lewis H. Ryder

<u>Other useful texts:</u>

Introduction to Gauge Field Theory (Revised Edition), by David Bailin and Alexander Love
Modern Quantum Field Theory, by Thomas Banks
The Conceptual Framework of Quantum Field Theory, by Anthony Duncan
Quantum Field Theory: A Modern Perspective, by V. Parameswaran Nair
Gauge Field Theories, by Stefan Pokorski
The Quantum Theory of Fields, Volumes 1, 2 and 3, by Steven Weinberg
Field Theory: A Modern Primer, by Pierre Ramond *Quantum Field Theory*, by Mark Srednicki
An Introduction to Quantum Field Theory, by George Sterman
Quantum Field Theory in a Nutshell by Anthony Zee
Quantum Field Theory, by Claude Itzykson and Jean-Bernard Zuber

Winter 2016 Course Outline

Topic	Readings*
1. Path Integral Formulation of Quantum Field Theory	Chapter 14
2. The anomalous magnetic moment of the muon	Chapter 17
3. Implications of Unitarity	Chapter 24
4. Non-Abelian Gauge Theory	Chapters 25, 26.1
5. Spontaneous Symmetry Breaking and Goldstone's Theorem	Chapters 28.1, 28.2
6. Spontaneously Broken Gauge Theories and the Higgs Mechanism	Chapters 28.3, 28.4
7. Two-component fermion notation; Dirac and Majorana fermions	Chapters 10.5, 10.6
8. The Standard Model of particle physics	Chapter 29
9. Gluon scattering and the spinor-helicity formalism	Chapter 27

* The readings above refer to the textbook by Schwartz.

Course Requirements

The requirements of this course consist of four problem sets and a final project. There will be no midterm or final exam. A list of suggested topics for the final project is provided in the next two pages. Some of the topics require only additional readings in Schwartz or one of the other recommended textbooks already cited. Others will require some consultation with outside sources. Feel free to ask for additional references if needed.

The project may be presented orally or in written form at the end of the academic quarter. Oral presentations are encouraged since they will benefit all members of the class. In choosing your project, you should plan on meeting the following deadlines:

Initial choice of topic for term	February 9
Short written proposal for term	February 23
Oral Presentation of term project, Part 1	March 16, 5:30–8 pm
Oral Presentation of term project Part 2	March 17, 12–3 pm
Written version of term project	March 18

All projects should include a one page bibliography (containing references pertinent to the project). For those projects presented orally, a digital copy of the powerpoint slides (or equivalent) will be acceptable in lieu of a full written version.

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 office hours for suggestions and consultation on your choice for the term project.

1. Spinor Helicity methods
   (a) Spinor Helicity formalism and applications to tree-level processes
   (b) MHV and NMHV amplitudes
2. QCD
   (a) Deep inelastic scattering and the parton model
   (b) Parton showers and QCD jets
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) Summing soft photons
   (b) The Kinoshita-Lee-Nauenberg theorem
5. Effective field theory
   (a) The chiral Lagrangian and its applications
   (b) Higher dimensional operators for electroweak physics
6. Further topics of the Standard Model (and slightly beyond)
   (a) CP-violating phenomena of the Standard Model
   (b) Heavy Quark physics
   (c) Theories of neutrino masses
   (d) Extended Higgs boson sectors
   (e) Grand unified theories
   (f) The supersymmetric extension of the Standard Model