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## REQUIRED TEXTBOOK:

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

## Recommended Outside Reading:

Secondary texts:

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

Other useful texts:

*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 $\theta$-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