PHYS 665: Quantum Field Theory II  
Winter 2023

Syllabus

This course is the second quarter of a three-quarter sequence on Quantum Field Theory. In this term we will mainly tackle fermions and gauge theory at tree-level, i.e., quantum electrodynamics.

A rough outline of the plan:

(33-35) Representations of Lorentz Group; Spinors; 2-Component
(36) Lagrangian for 2- and 4-Component Spinors
(37) Canonical Quantization (u,v, and Dirac eq)
(38-41) Spinor technology; operators; LSZ
(42) Propagator
(43-44) Fermion Path Integral
(45-47) Feynman rules; spin sums; traces
(54-59) Photons, Feynman rules, QED
(62-64) Radiative corrections (time permitting)

The main goal of the course is to build up the foundations of fermions and photons of QFT so that you can calculate tree-level scattering processes in QED. Depending on time and interest, various more advanced topics will be introduced.

Objectives

The objectives of the course is to gain sufficient grasp of the syllabus material to calculate basic processes in quantum electrodynamics. This involves gaining a detailed understanding of fermion and vector field representations, the associated Feynman diagrammatic expansion, and how to calculate cross sections and decay rates. The course expectations are that you successfully work through all of the problems of the homework assignments and give one excellent lecture to your fellow class students on a topic on QFT to be decided in class.

Texts:  
Srednicki: Quantum Field Theory
http://www.physics.ucsb.edu/~mark/qft.html

Useful References:  
Schwartz: Quantum Field Theory and the SM
https://schwartzqft.fas.harvard.edu
Peskin & Schroeder: Intro to QFT
Weinberg: Quantum Theory of Fields

Instructor:  
Prof. Graham Kribs
Office: 477 Willamette Hall

Office Hours: For questions about assignment problems, I’ll schedule a block of time each week that works for most students at the beginning of the course.

E-mail: kribs@kribs.org
(This is the best way to reach me)

Class Communication: We’ll use Slack, Dropbox, and occasionally email. Slack workspace: http://phys665.slack.com for class communication, including announcements, assignments, auxiliary material, and other relevant information.

Assignments: Homework assignments will be assigned periodically and due roughly one week later. There will be one homework assignment due either the last week of classes and/or the exam week.

Grade: 80% Assignments
20% Mini-Lecture/Presentation

Grading Policy: Pass (A- and above): All or virtually all problems of all homework assignments done correctly and turned in on-time. Mini-lecture/presentation is clear, well-organized, understandable, and student questions are adequately addressed.
Pass (B- and above): A solid attempt on virtually all problems of all homework sets turned in on-time. Mini-lecture/presentation is clear, organized, understandable but with some issues, and student questions are partially addressed.
Fail (C+ and below): Habitually late homework, ≥ 1 missed homework sets, several missed or incorrect problems on several problem sets. Mini-lecture/presentation is unclear, not well organized, not understandable by other students, and most student questions cannot be addressed.

Class Cancellation: In the unlikely event that I have to cancel class at the last minute (bad weather or otherwise), I will attempt to post a message on Slack as well as email everyone.
Late Assignments: General  You must do all of the assignments, and turn them in on-time to get a passing grade in the course.
24 hour rule  Assignments will be accepted up to 24 hours late, but with a late penalty. Assignments will not be accepted nor graded more than 24 hours after the deadline.
Late penalty  The late penalty is an overall reduction of grade by “1/3” times the number of late assignments minus 1. (B+ becomes B, after two late assignments; A− becomes B after three late assignments, etc.). However, it is your responsibility to find the grader and be sure he personally gets it within this timeframe.
One late penalty waiver  Inevitably some students need an extra day to finish one assignment due to some unforeseen reason. To be fair to everyone, all students get one waiver. Use your waiver wisely.

Comments on Assignment Grading
Please write clearly, legibly, and organize your solution. Don’t be afraid to waste paper to ensure your solution can be clearly followed, step-by-step. It is highly preferred that you use one-side of the paper, and start new problems and/or parts of problems on new pages.

Accessible Education Statement
The University of Oregon is working to create inclusive learning environments. Please notify me if there are aspects of the instruction or design of this course that result in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 360 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

Academic Misconduct Statement
The University Student Conduct Code (available at conduct.uoregon.edu) defines academic misconduct. Students are prohibited from committing or attempting to commit any act that constitutes academic misconduct. By way of example, students should not give or receive (or attempt to give or receive) unauthorized help on assignments or examinations without express permission from the instructor. Students should properly acknowledge and document all sources of information (e.g. quotations, paraphrases, ideas) and use only the sources and resources authorized by the instructor. If there is any question about whether an act constitutes academic misconduct, it is the students’ obligation to clarify the question with the instructor before committing or attempting to commit the act. Additional information about a common form of academic misconduct, plagiarism, is available at https://researchguides.uoregon.edu/citing-plagiarism.