Physics 217 Introduction to Quantum Field Theory I Fall 2015

Instructor:	Stefano Profumo
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Office Hours:	Wednesday 1:00 PM (or – better – by appointment)
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Course Web Page:	http://scipp.ucsc.edu/~profumo/teaching/phys217_14/phys217.html

Lectures:	Mondays and Wednesdays, 3:00 PM – 4:55 PM (includes 10' break)
Lecture Room:	ISB, Room 235

NOTE ON WHEN I WILL BE AWAY:
*** October 19 –> Friday October 23 3 PM ISB 235**
*** November 16 –> Friday November 13 3 PM ISB 235**
*** November 18 –> Friday November 20? 3 PM ISB 235**

Course Description

This course is the first quarter of a 3-quarter graduate-level introduction to relativistic quantum field theory (QFT). The focus is on introducing QFT and on learning the theoretical background and computational tools to carry out elementary QFT calculations, with a few examples from tree-level quantum electrodynamics processes. The course will be broadly based on the first 13 chapters of Matthew Schwartz's "Quantum Field Theory and the Standard Model".

Course Outline

1. Quantum Mechanics, Special Relativity and their "marital issues"
2. Lorentz invariance and second quantization
3. Elements of Classical Field Theory
4. Cross sections and decay rates
5. The S-matrix and time-ordered products
6. Feynman rules
7. Spin 1 and gauge invariance
8. Scalar QED

9. Spinors
10. Spinor solutions and CPT
11. Spin and stantistics
12. QED

"Recommended" Textbook

- *Quantum Field Theory and the Standard Model* by Schwartz
  (1 day reserve)

Other Reference Textbooks

- *An Introduction to Quantum Field Theory* by Peskin and Schroeder
  (1 day reserve)
- *Modern Quantum Field Theory* by Banks (1 day reserve)
- *Quantum Field Theory* by Srednicki
- *Quantum Field Theory* by Mandl and Shaw
- *The Quantum Theory of Fields: Foundations* by Weinberg
- *Quantum Electrodynamics* by Berestetskii, Lifshitz and Pitaevskii
- *Quantum Field Theory* by Itzykson and Zuber
- *Relativistic Quantum Mechanics* by Bjorken and Drell
- *A Modern Introduction to Quantum Field Theory* by Maggiore
- *Fields* by Siegal

Homeworks and Grading Policy

Grading will be based on weekly or bi-weekly homework exercises. Each homework will consist of typically a couple of exercises on the material discussed in class, or on complements to that material. The homework problems will be posted on the course web page during the quarter. After attempting each problem by yourself, you are encouraged to discuss the problems with the Instructor and with each other.

One week after the homework is handed out, during the first half hour at the beginning of class 1-2 "*volunteers*" will either spontaneously step forward or (in the absence of volunteers) will be drafted by the Instructor to solve the assigned problems, or to sketch the solution on the blackboard. Volunteers will rotate throughout the class participants, and will be required to write full solutions to the problems in LaTeX by the following week. Grading will be given according to the quality of (i) the oral presentations, (ii) the timeliness and quality of the LaTeX-ed solutions (a LaTeX skeleton template is provided on the Course webpage) and (iii) the interaction/suggestions given to the volunteer when one is not at the blackboard (i.e. participation will be an important component).

The idea behind this homework and grading policy is to familiarize you with presenting orally your work and in producing a written account of what you learnt. Doing this effectively is a fundamental skill for your current and future research career. Presenting orally, in particular, both at the informal level of group meetings and at the more formal level of conference talks or job interviews is of crucial importance to the successful scholar. Interaction with those presenting their research is also a fundamental aspect of doing research. Furthermore, this will give everybody an opportunity to discuss and re-think the assigned homework material, and to try to conceptualize and digest it in order to present it to others. Finally, writing up the solutions will help you familiarize with writing scientific-style papers and with the gymnastics related to learning to use LaTeX, and will help others by providing clearly written solutions and complements to the homework.

On the bright side, this course won't have any midterm or final exams. We are grown-ups now, after all!

Three interesting quotes

"Mr. Faulkner, some of your readers claim they still cannot understand your work after reading it two or three times. What approach would you advise them to adopt?"
William Faulkner: "Read it a fourth time"

"When I became a student of Pomeranchuk in 1950, I heard from him that the Book of Physics had two volumes: Volume one is "Pumps and Manometers", volume two is "Quantum Field Theory". (Lev Okun)

"QFT is sterile with respect to strong interactions and, like an old soldier, it is destined not to die, but just to fade away."
(Geoffrey Chew, 1961)