PHYS 611: Advanced Quantum Mechanics/Quantum Field Theory
Fall Semester, 2021
Professor: Anthony Mezzacappa, 206 South College, 4-2621, mezz@utk.edu
Grader: Mu-Hung Chang

Class Times: TTh, 11:20 AM – 12:40 PM
Class Location: Nielsen 608

Course Syllabus

1. Motivation and Need for Quantum Field Theory
2. Review of Canonical Formalism and Quantization for Particles
3. Review of the Harmonic Oscillator in Quantum Field Theoretic Language
4. Connecting Particle and Field Mechanics: The Classical Linear Chain (Strickland, Chapter 2)
5. The Quantum Linear Chain, Phonons (Strickland, Chapter 2)
6. Classical Field Theory, Real Scalar Field (Strickland, Chapter 1)
7. Noether's Theorem, Symmetries, and Conservation (Strickland, Chapter 1; Schwartz, Chapter 3)
8. Quantization of a Free Real Scalar Field (Strickland, Chapter 2)
9. Classical and Quantum Free Complex Scalar Fields, Antiparticles (Strickland, Chapter 2)
10. Causality, the Feynman Propagator for Scalar Fields, Propagators as Green's Functions (Strickland, Chapter 2)
11. Interacting Fields: Dyson's Formula, the S-Matrix (Schwartz, Chapter 7; Strickland, Chapter 3)
12. An Example Interacting Quantum Field Theory: Scalar Yukawa Theory. Particle Decays and Scattering, Wick's Theorem, Feynman Diagrams, Mandelstam Variables, Cross Sections and Decay Rates (Strickland, Chapter 3; Schwartz, Chapter 5)
13. Building Field Theories for Particles of a Definite Spin: The Lagrangian for Massive, Spin 1 Particles, the Classical Equations of Motion, and their Solutions (Schwartz, Chapter 8)
14. Building Field Theories for Particles of a Definite Spin: The Lagrangian for Massless, Spin 1 Particles, the Classical Equations of Motion, and their Solutions (Schwartz, Chapter 8)
15. Quantization of the Spin 1 Field (Schwartz, Chapter 8)
16. The Photon Propagator (Schwartz, Chapter 8)
17. Scalar Quantum Electrodynamics

Course Texts

My lectures will draw primarily from the following texts:

1. Schwartz, Quantum Field Theory and the Standard Model
2. Strickland, Relativistic Quantum Field Theory, Volume I: Canonical Formalism

Grades

Grades will be based on: (1) graded homework assignments, (2) a midterm exam, and (3) a final exam. All three will be equally weighted. The midterm and final exams will be open-book, take-home exams. Mu-Hung will grade the homework assignments. I will grade the midterm and final exams.

Office Hours

TTh, 4:00 PM – 5:00 PM