Physics 500A — Quantum Mechanics — Fall 2017

Instructor: Pavel Kovtun

Meeting Wednesdays 9:30 – 12:30, Clearihue C116

Office hours: Monday 1:30 – 3:30, or send an email

This is a one-semester graduate class on Quantum Mechanics. We'll meet once a week for lectures, in the meantime feel free to stop by my office (Elliott 110) to discuss any physics-related questions. There will be regular homework assignments, and a take-home final exam. The grade for the class is 65% homework assignments and 35% final exam.

Plan: The goal of this class is to remind you of Quantum Mechanics, and to get better at solving problems. Most of what you are going to learn in this class will *not* come from lectures, but from your own study. This is how real research happens – if you are to discover new and original things, there will be no-one to teach them to you. I encourage you to discuss the material from this class with other graduate students, myself, other faculty members, and postdocs. You should think of PHYS 500A as a collection of topics in QM which are used to solidify what you have learned in your undergraduate Quantum class. We will be using states, operators, and their matrix representation, using the Dirac notation. The physics topics include the harmonic oscillator, quantized electromagnetic field, coherent states, time evolution, symmetries, angular momentum, particles in electromagnetic fields, the Aharonov-Bohm effect, magnetic monopoles, density operators, and quantum statistical mechanics.

Mathematical methods: We'll be working with linear algebra, differential equations, special functions, contour integration and approximation methods, so it's a good idea to get comfortable with some book on basic mathematical methods used in physics such as Arfken-Weber. Many homework problems will require the use of a computer algebra program such as `Mathematica` or `Maple` — please familiarize yourself with one of such programs.

Homework assignments: The problem sets will be long. It is the problem sets, not the lectures, which are at the core of the class. Feel free to consult any books or research papers to solve the homework problems. It's a good idea to discuss the problems among yourselves, but the final written solution must be your own. I will not distribute the marked assignments in class – rather, you will pick up your assignments in my office, at which point we will briefly discuss the problems. Each assignment will have a pick-up date, typically about two weeks from the due date. *Assignments which are not picked up by the pick-up date are recycled and do not contribute to the final grade.* Homework assignments (or parts thereof) submited by email are not accepted. If you write computer code to solve a problem, write a human-readable explanation of what you are doing, and attach a hard copy print-out of the code to your handwritten solutions. References to Wikipedia in your solutions are not accepted. Late assignments are not accepted. Your solutions must be clear and tidy, providing detailed explanations of what you are doing. Simply writing down the answer or a mess of formulas will result in zero credit, regardless of whether the answers are correct or not.

Books: There is no required textbook for the class. A standard graduate QM textbook is Sakurai's "Modern quantum mechanics" (either edition is ok). Another good graduate-level book is "Quantum mechanics: fundamentals" (2-nd edition) by Gottfried and Yan. I encourage you to take regular trips to the library to study the books on QM and related subjects there.