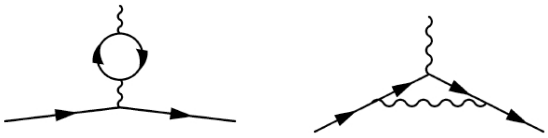
Physics 531: Quantum Mechanics

"If quantum mechanics hasn't profoundly shocked you, you haven't understood it yet."
- Niels Bohr



Course Description

Quantum Mechanics (Physics 531) is a an upper division required course which sits at the junior/senior level in the physics curriculum. This course is very different from traditional upper division science courses that most students have encountered in their undergraduate studies. **There is little to no lecture in this course**. Instead the pedagogical technique used is that of project/problem-based learning; a "problem" in 20th century physics is presented (along with the accompanying physical evidence); this problem is then used to derive and develop the theory of quantum mechanics. The theoretical machinery developed is then applied to similar yet unrelated problems as a test of the theory. Theoretical calculations are compared to actual data to determine the accuracy of quantum theory.

Using project-based learning, class time will be structured along the following pattern:

Problem/Physical Evidence → Foundational Material → Hypothesis → Theory → Applications

Course Components

The course is roughly divided into five modules each focussing on a different problem in quantum mechanics. Students will work in teams to complete lecture tutorials (essentially work through lecture material in an active, student-centered way), problem sets, quizzes, and projects in each module. The project for each module will guide and motivate the learning. For example, to understand the absorption spectrum of carbocyanine dyes, students will need to learn to solve the Schrodinger Equation in 1D, grapple with selection rules, and learn about absorption spectroscopy.

Module	Quantum Topics	Project	Deliverable
#1	1D Quantum Wells and Scattering	Carbocyanine Dyes or Uranium Decay	5 page scientific paper
#2	Time Dependence	Neutrino Oscillations	10 page review article
#3	Spin	Spin Oscillations (Rabi Paper)	Journal Club Presentation
#4	3D Quantum Mechanics	HCl Rotovibrational Spectrum	Poster Presentation
#5	Radial Wave Functions	Hydrogen Atom	Final Exam