Phys. 671 Spring 2015

This class is the second semester of a two-semester course in non-relativistic QM (follows PHYS 670). Please review the free particle solution in spherical polar coordinates as this is important for scattering theory (p 346-350 of Shankar). We talked about this a the end of the last term.

We will move on to the chapter on spin (Shankar, Chap. 14). During the course we will emphasize the applications of QM to complex systems using approximation methods because the dynamics of these systems cannot be solved exactly. We will use Intermediate Quantum Mechanics by Bethe and Jackiw as a supplementary text for Hartree-Fock methods. I encourage you to supplement our text with other excellent texts of your choosing. These include: Sakurai, Merzbacher, Schiff, Landau and Lifschitz, Davydov, Messiah, Baym, Dirac, Weinberg and Gottfried and Yan, to name a few.

Topics to be covered:

- Intrinsic angular momentum of particles (spin)
- Addition of angular momenta
- Energy degeneracies of 3-D Coulomb and harmonic oscillator potentials
- Approximation Methods (WKBJ, perturbation theory, variational methods) and their applications to real systems.
- Time-dependent Hamiltonians using perturbation theory
- Aharanov-Bohm effect, Berry's phase
- Elements of elastic scattering theory
- Self-consistent fields and Hartree-Fock methods
- Relativistic wave equations and failure of relativistic quantum mechanics for one-particle systems
- Quantizing the electromagnetic field
- Decay rates for atomic transitions
- Einstein-Podolsky-Rosen type correlations

While we will definitely cover the core topics in non-relativistic QM (through scattering theory), and depending on time and interest, we will pick and choose from the other topics.

HW will be assigned regularly (roughly weekly), and will count for 1/3 of your grade. Also we will have one midterm and a final exam, each counting for a third of your grade. We will decide the format for these exams when the time approaches.

The class will provide you expertise to work on problems for which non-relativistic quantum mechanics provides an adequate framework, and prepare you for courses in Quantum Field Theory, which is the framework used by research physicists working with quantum systems in which relativistic effects cannot be ignored.