Physics 522

Quantum Mechanics II

Tuesday and Thursday, 12:55 to 2:10PM,

Recitation, Tuesday and Thursday 4:30-6PM, (room TBD)

Prof. Cristian D. Batista

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Office Hours: TBD
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Course Description: .

1. *Symmetry.* Symmetry, conservation laws and degeneracies. Continuous symmetries: SU(2) and SO(4). Discrete symmetries. Parity or space inversion. Selection rules. Antiunitary operators. The time reversal discrete symmetry. Time reversal of a spin system. Kramers degeneracy.

2. *Gauge potentials.* Potentials and gauge transformations. Constant potentials. Gravity in quantum mechanics. Electromagnetic potential. The Aharonov-Bohm effect. Magnetic monopole.

3. *Time independent approximations.* Time independent perturbation theory. Non-degenerate spectrum. Formal expansion. Eigenket expansion. Eigenenergy expansion. Ket renormalization. Degenerate spectrum. Necessary and sufficient condition for removal of degeneracy. Linear Stark effect. Particle in periodic potential.

4. *Time dependent approximations.* Time dependent potential: the interaction picture. Solution of Schrödinger's equation in the interaction picture. Time dependent perturbation theory. Constant perturbation. Fermi's golden rule. Harmonic perturbation. Applications to the interaction with the classical radiation field. The electric dipole approximation. Photoelectric effect. Hamiltonians with extreme time dependence. Adiabatic approximation. Sudden approximation. Berry phase.

5. *Quantum theory of scattering.* Scattering as a time dependent perturbation. T-matrix and S-matrix. Transition rates and cross sections. The scattering amplitude. Scattering in one dimension. Reflection and transmission coefficients. The Born approximation. Spherically symmetric potentials. Rutherford scattering. The optical theorem. Partial wave analysis. Phase shifts. Partial wave analysis for inelastic scattering. Generalized optical theorem.

6. *Identical particles.* Permutation symmetry. Symmetryzation Postulate. Two electron system. The Helium Atom.

Credit Hours: 3

Texts: *Modern Quantum Mechanics*, 2nd Edition, J. J. Sakurai and Jim J. Napolitano **ISBN:** 978-93-325-1900-8. *Quantum Mechanics*, 2nd Edition, Claude Cohen-Tannoudji and Bernard Diu Franck Laloë, **ISBN:** 2-7056-5834-3.

Grade Distribution:

Homework	30%
Midterm Exam	30%
Final Exam	40%

Course Policies:

- **General**
  - Computers are not to be used unless instructed to do so.
  - Quizzes and exams are closed book, closed notes.
  - **No makeup quizzes or exams will be given.**
- **Grades**
  - Grades in the **C** range represent performance that **does not meet expectations**; Grades in the **B** range represent performance that **meets** the expectations; Grades in the **A** range represent work that is **excellent**.
  - Students are responsible for tracking their progress by referring to the online gradebook.
- **Assignments**
  - Students are expected to work independently. **Offering** and **accepting** solutions from others is an act of **plagiarism**, which is a serious offense and **all involved parties will be penalized according to the Academic Honesty Policy**. Discussion among students is encouraged, but when in doubt, direct your questions to the professor.
  - **No late assignments will be accepted**.