Quantum Theory (PHYS 450): Review

Spring 2006 v1.0

All references are to Townsend unless marked.

1. Structure of the theory

1.1. **States.** "the possibility cloud" $|\psi\rangle$
Spin and angular momentum (1.3, 2.1, 3.3, 3.6)
Position and momentum states (6.1-6)
Determination of states - solving the time independent Schödinger equation (6.8-10,7), determination of energy levels, degeneracy
Different representations 2.4-5,6.4

1.2. **Operators.** 3.1 DB 6.2
Commuting operators 3.2
Complete Commuting Set of Operators 9.6 DB 6.4
Raising and lowering operators (3.4, 7.4)
Hamiltonian operators 4.1
Symmetry and operators (2.2, 6.1-3, 9, DB 6.5)

1.3. **Evolution.** Unitary evolution via the Hamiltonian operator (4, 7.8)

1.4. **Interpretation.**

$$P = |\langle\psi \mid \psi\rangle|^2$$

Measurement - State Preparation DB 6.6
Expectation Values 2.6
Uncertainty Relations (3.5, 4.6, 6.7)
EPR 5.4
Bell's Inequalities 5.5

2. Special Systems

2.1. **Hydrogen Atom.** 9, 10

2.2. **Harmonic Oscillator.** 7

2.3. **NH_3.** (4.5, 11.5)

2.4. **1D potentials.** 6

2.5. **Higher D versions.** 10

3. Alternatives

3.1. **Path Integrals.** 8

3.2. **Bohmian and Hidden variables.** Presentations

4. Approximation Methods

4.1. **Perturbation Theory.** 11
Stark Effect 11.4
Zeeman Effect 11.8

4.2. **Time dependent perturbation theory.** We used this mostly as a way of studying transitions (DB 11)

5. Mathematical Methods

5.1. **Complex vector spaces.** DB 6.1

5.2. **Series solutions.** (7.9, 10.2)

5.3. **Special functions.** Bessels (10.4, problems 9.22 and 10.10), Spherical Harmonics (9.9 DB Appendix B)