Physics 501 Course Information (Winter 2008)

Instructor: Joanna Karczmarek (Hennings 280, 2-2929, joanna@phas)

Office hours (Hennings 280): will be scheduled if needed. Please drop by anytime!

TA: Lionel Brits (Hennings 277, 2-5096, lionelbrits@phas)

Time and place: Hennings 302, Wednesdays and Fridays, 12:30-14:00.

Course webpage: http://www.physics.ubc.ca/∼joanna/phys501

Textbook(s): the lectures will be based on a variety of sources, and I will try to point you towards at least some of them as we go along. You might find these two books useful: *Quantum Physics* by Stephen Gasiorowicz (especially the (free) on-line supplements, see a link on the course website), and *Quantum Mechanics* by Abers.

Grading scheme: 50% assigments and 50% presentation(s). There will be a major presentation due at the end of term, on a topic of your choice (more details soon). In addition, I will randomly assign people to briefly present solutions to the harder homework problems in class (you will be given a warning ahead of time).

Course goals:

- To became familiar with a variety of advanced topics in quantum mechanics, with an appreciation for the scope of their theoretical and experimental relevance.
- To develop/improve calculation technique by solving nontrivial quantum mechanical problems.
- To improve the ability to communicate clearly in both written and oral form.

Course outline (Might change a bit as we go along):

- **Fundamental issues in QM**

  EPR, Bell's theorem, entanglement, teleportation, quantum cryptography. Density matrix formalism, decoherence and the measurement problem. (4 weeks)

- **Normal modes: second quantization**

  Phonons: classical vibrations, quantization, acoustic and optical branches, contribution to heat capacity of solids, lattice momentum and neutron scattering. (2 weeks)

  Photons: quantization, coherent states, the classical limit of quantum electromagnetism, review of time dependent perturbation theory and coupling to matter, spontanueos emission and detailed balance, some quantum optics (maybe, time permitting). (3 weeks)

- **Paths and topological considerations**

  The path integral formulation of quantum mechanics. Born-Aharonov effect. Berry's phase. (2 weeks)

- **Dirac equation and the relativistic electron:**

  Derivation of the Dirac equation, antimatter interpretation, relativistic corrections to the hydrogen atom (the Darwin term and spin orbit coupling, the Zeeman effect). (1 week)