Homework 3, Due Feb. 18

1. Calculate the energy span of a 5.0 femtosecond laser pulse. If the laser pulse is narrowed further by a factor of 10, what will be the energy span of the photon?

2. If an electron is confined within a 1.0 Å space, what would be the uncertainty of its momentum? Redo the calculation for a neutron. What can you conclude from these results?

3. Evaluate the commutator $[\hat{x}^2, \hat{p}_x]$.

4. We have learned that the eigenfunctions of an Hermitian operator are orthonormal. We have also learned that eigenfunctions of the 1D free particle Hamiltonian are plane waves. Try to normalize the plane waves and see if you run into problems. Read a quantum mechanics book to find out how this problem is dealt with. In particular, explain the Dirac delta function in the context of plane wave normalization.