

661, Spring 2016, Homework III, (2 problems)

Problem 1

Consider the $2p$ states, namely $m = -1, 0, +1$ of a hydrogen atom, ignoring the spin. Assume that the atom is in an external potential that adds to the Hamiltonian a term

$$V = \lambda(x^2 - y^2) \quad (0.1)$$

- Compute the first order correction to the energy and the zero order energy eigenstates.
- Study the behavior under time reversal symmetry of the potential and of the states you found in the previous point.

Problem 2

Consider a rigid rotator in a magnetic field such that the situation is described by the simple Hamiltonian

$$H = AL^2 + BL_z + CL_y \quad (0.2)$$

- Assume $B \gg C$ and compute the eigenvalues using perturbation theory for the last term. The computation should be done to the first order that there is a non-trivial correction.
- Solve the problem exactly and compare with the result you obtained in the previous point.