

PHY 741 – Problem Set #21

Continue reading Chap. 7 in **Mahan**; homework is due Monday , November 1, 2010.

Consider an electron in the ground state of H:

$$\phi_{1s}(r) = \frac{1}{\sqrt{\pi a_0^3}} e^{-r/a_0}.$$

At $t = 0$ a perturbing electric field of amplitude E_0 (along the z-axis) is gradually turned on and off such that the perturbing Hamiltonian is given by

$$\mathcal{H}^1(\mathbf{r}, t) = -eE_0 r \cos \theta \left\{ \frac{1}{\tau\sqrt{\pi}} e^{-[(t-T)/\tau]^2} \right\}.$$

Assume that $T/\tau \gg 1$.

1. Find the general expression for the first order probability amplitudes for the electron to be in an excited state nlm for $n > 1$ and evaluate the expression for at least two excited states.
2. Using convenient choices of T and τ , plot your results for the square modulus of the amplitudes as a function of time.