Atoms, Molecules and Radiations

Assignment 3

Analytical:
Derive selection rules for electrons confined within :
(1) an infinite potential sphere [$V(\vec{r}) = 0$ for $|\vec{r}| \leq a$ and ∞ everywhere else], and
(2) an infinite potential cylinder [$V(\vec{r}) = 0$ for $x^2 + y^2 \leq a^2$ and ∞ everywhere else for all z], within dipole approximation.

Numerical:
Recall the wavefunction used in the last assignment: $\psi_0(\vec{r}) = 1$ for $-1 \leq r_{i(=1,2,3)} < 1$ and 0 elsewhere, mimicking a $1s$ orbital, $i = 1, 2, 3$ being three orthogonal direction.
Consider further: $\psi_i(\vec{r}) = r_i/|r_i|$ for $-1 \leq r_{i(=1,2,3)} < 1$ and 0 elsewhere, mimicking the $2p_x, 2p_y, 2p_z$ orbitals.
Consider right and left circularly polarized light with $\vec{k}||\hat{z}$ as done in class and verify the correspondence between Δm selection rule and helicity we argued in class.

Refer to the model diatomic system considered in the last assignment.
With exact same parameters extend the model to five atoms. Consider the lifetime of states in ascending order of energies to 10^{-16} s , 10^{-15} s, 10^{-14} s,10^{-13}s, 10^{-12}s.
Calculate and plot $|C(\omega, t)|^2$ for the two lowest states for stimulated emission from all the states above them.