

Physics 4410
Quantum Mechanics 2

Lecture 30

Time-dependent perturbation theory

November 11, 2020

1. Set up time-dependent perturbation theory.

2. What is the zeroth order solution?

3. Find an equation for the first order solution.

4. Find the first order solution.

Activity: Atomic transitions.

- (a) Consider an atom with two nearby internal energy levels, hit with a short laser pulse. We model this by

$$H_0 = -\eta (|1\rangle\langle 1| - |2\rangle\langle 2|), \quad H' = \gamma e^{-t^2/2\tau^2} (|1\rangle\langle 2| + |2\rangle\langle 1|).$$

If $|\psi(-\infty)\rangle = |1\rangle$, what is $|\psi(t)\rangle$ to first order in γ ?

(b) What is $\int_{-\infty}^{\infty} dt e^{-at^2+bt}$?

(c) What is the probability that the laser pulse kicks the atom into the excited state? Comment on your answer.