Homework #2, PHY 215C

Due: April 18, 2017

Problem 1. Gauge Invariance in Schrödinger Approach. 20 points.

Work through Shankar's exercise Ex. 18.4.4. Then ask and answer the question: what does gauge invariance mean (or require) in this case?

Problem 2. Vibrating Floor in a Square Well Potential. 20 points.

A particle in a 1D infinite square well, $0 < x < a$, is subjected to a small vibrating potential of the form

$$H^1(t) = Vcos(\pi\frac{x}{a})sin(\omega t)$$

that is turned on only at t=0, and left on. Supposing the particle is in some eigenstate i (any one), find the probability it will be in eigenstate f at time $t > 0$. From your solution, discuss how the results depend on the initial and final states, and how the t-dependence changes as the system progresses from early time to long time.

Problem 3. t-dependent Angular Momentum . 20 points.

Consider a spin=1/2 in a field B_z with spin up initially. At time t=0 it is perturbed by an oscillating transverse field, so the Hamiltonian is

$$H^0 + H^1(t) = \sigma_z B_z + \sigma_x B_x sin(\Omega t)\Theta(t),$$

where Θ is the Heaviside theta step function. Any extra constants have been absorbed into the magnetic field symbols (which have units of energy).

(i) Calculate to 1st order the probability that the system will be in the spin down state at time t. Describe the dependence on Ω, and if there is a limit as $t \to \infty$.

(2) Evaluate the expectation value of the direction of the spin at time t, then characterize the time evolution.