Physics 502 Homework assigned on Jan 28, 2004

1. Assume that a particle is in a state described by the wavefunction

$$\Psi(x,t) = \sum_n c_n(t)\psi_n(x)$$

where $\psi_n(x)$ are energy eigenfunctions corresponding to energy eigenvalues E_n. The $\psi_n(x)$ are (a) normalized (b) orthogonal to each other and (c) form a complete set. The $c_n(t)$ are time-dependent coefficients and are called "the amplitude to be in the n^{th} eigenstate".

   a) Use the time-dependent Schrödinger equation to determine how this wavefunction evolves in time, i.e., find the time dependence of the coefficients $c_n(t)$.

   b) The probability (not amplitude) to be in the n^{th} eigenstate is given by $|c_n(t)|^2$. Does this vary with time?

Note: This problem is very important. The solution is one way to determine the time evolution of a quantum state. "Predicting the future" of a particle is a major goal of physics, and therefore this is a critical foundation of quantum dynamics. It is like using Newton's laws to describe projectile motion in classical dynamics.

2. Griffiths problem 2.17.

3. [Grad / Bonus] Solve the time-independent Schrödinger equation for the one-dimensional simple harmonic oscillator and find the energy eigenvalues and eigenfunctions. [Do not merely copy section 2.3.2 of the text. You are expected to understand the material and then present your own version of the solution.]