[QM] [ISW - continued]

The whole wave fn?

$$\Psi(x,t) = \sum_{n=1}^{\infty} c_n \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi x}{a}\right) e^{-iE_n t/\hbar} \quad \text{where } E_n = \frac{n^2\pi^2\hbar^2}{2ma^2}$$

[redefine $E_n = n^2 \hbar \omega$ where $\omega = \frac{\pi^2 \hbar}{2ma^2}$]

In order to solve this, we need a starting value for this at $t=0$ to calculate c_n.

Okay, the energies are quantized, but we're mixing eigenfunctions here. What gives?

What is a superposed state?

Consider an example wavefunction: Ψ that is equal parts ψ_1 and ψ_2 or:

$$\Psi = c_1 \psi_1 + c_2 \psi_2 \quad \text{and } c_1 = c_2$$

What $c_1 = c_2$ means is that when measuring the energy of the system, half the time you'll get E_1, and half the time you'll get E_2. But when calculating the expectation value you'll get the average of the two.

This means that $\langle E \rangle$ is an unphysical quantity! It's not E_1 or E_2.

Consider an ensamble of particles

"Before the measurement"	vs. "After the measurement"
• The total energy of the ensamble $E_{TOT} = N\langle E \rangle$	→ $E_{TOT} = N\langle E \rangle$
• Energy of each member → ~~Unknown~~ undefined ∴ it hasn't been measured yet, we only know the probability.	→ each member has energy E_1 or E_2 and will have that value for all subsequent measurements. [only true if you make no other measurements whose operators don't commute w/ the Hamiltonian]

This leads to an important axiom: <u>Once a measurement is made</u>, the object is <u>then in an eigenstate</u> and <u>stays there</u>.