L14: Particle Motion in a Well

The probability density is given by: $|\Psi(x,t)|^2$:

$$|\Psi(x,t)|^2 = \psi_1^2 + \psi_2^2 + 2\psi_1\psi_2\cos((\omega_2 - \omega_1)t)$$

Interference term

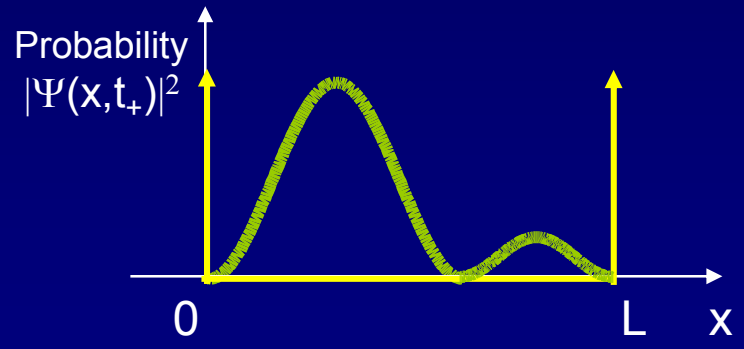
We used the identity:
$e^{i\theta} + e^{-i\theta} = 2\cos\theta$

So, $|\Psi(x,t)|^2$ oscillates between:

In phase: (cos = +1)

$$|\Psi(x,t)|^2 = (\psi_1 + \psi_2)^2$$

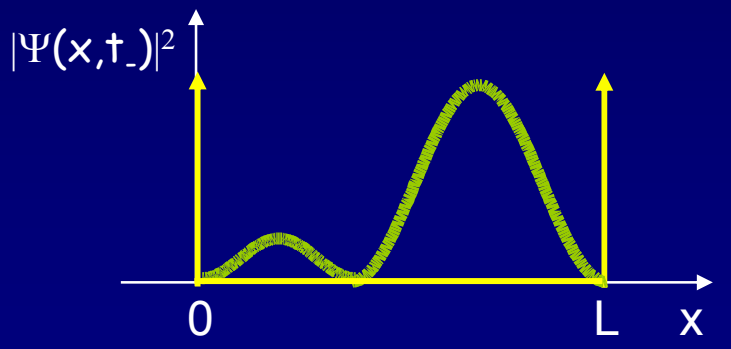
Particle localized on left side of well:



Out of phase: (cos = -1)

$$|\Psi(x,t)|^2 = (\psi_1 - \psi_2)^2$$

Particle localized on right side of well:



The frequency of oscillation is $\omega = \omega_2 - \omega_1 = (E_2 - E_1)/\hbar$, or $f = (E_2 - E_1)/h$.
This is precisely the frequency of a photon that would make a transition between the two states.