Measurements of Energy

We are now ready to deal with the second question from earlier in the lecture:

What happens when we measure the energy of a particle whose wave function is a superposition of more than one energy state?

If the wave function is in an energy eigenstate (E_1, say), then we know with certainty that we will obtain E_1 (unless the apparatus is broken).

If the wave function is a superposition ($\psi = a\psi_1 + b\psi_2$) of energies E_1 and E_2, then we aren't certain what the result will be. However:

We know with certainty that we will only obtain E_1 or E_2 !!

We can't prove this statement. It is one of the fundamental postulates of quantum theory. Treat it as an empirical fact.

To be specific, we will never obtain $(E_1 + E_2)/2$, or any other value.

What about a and b?

$|a|^2$ and $|b|^2$ are the probabilities of obtaining E_1 and E_2, respectively.

That's why we normalize the wave function to make $|a|^2 + |b|^2 = 1$.