

10.2: Superposition of time-dependent solutions

There has been an example problem, where I asked you to show "that if $\psi_1(x, t)$ and $\psi_2(x, t)$ are both solutions of the time-dependent Schrödinger equation, then $\psi_1(x, t) + \psi_2(x, t)$ is a solution as well." Let me review this problem

$$-\frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2} \psi_1(x, t) + V(x) \psi_1(x, t) = \frac{\hbar i \partial}{\partial t} \psi_1(x, t)$$

$$-\frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2} \psi_2(x, t) + V(x) \psi_2(x, t) = \frac{\hbar i \partial}{\partial t} \psi_2(x, t)$$

$$-\frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2} [\psi_1(x, t) + \psi_2(x, t)] + V(x) [\psi_1(x, t) + \psi_2(x, t)] = \frac{\hbar i \partial}{\partial t} [\psi_1(x, t) + \psi_2(x, t)]$$

where in the last line I have used the sum rule for derivatives. This is called the superposition of solutions, and holds for any two solutions to the same Schrödinger equation!

Question: Why doesn't it work for the time-independent Schrödinger equation?

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