

## 10.3: Completeness and time-dependence

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In the discussion on formal aspects of quantum mechanics I have shown that the eigenfunctions to the Hamiltonian are complete, i.e., for any  $\psi(x, t)$

$$\psi(x, t) = \sum_{n=1}^{\infty} c_n(t) \phi_n(x) \quad (10.3.1)$$

where

$$\hat{H} \phi_n(x) = E_n \phi_n(x). \quad (10.3.2)$$

We know, from the superposition principle, that

$$\psi(x, t) = \sum_{n=1}^{\infty} c_n(0) e^{-iEt/\hbar} \phi_n(x), \quad (10.3.3)$$

so that the time dependence is completely fixed by knowing  $c(0)$  at time  $t = 0$  only! In other words if we know how the wave function at time  $t = 0$  can be written as a sum over eigenfunctions of the Hamiltonian, we can then determine the wave function for all times.

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