

# Quantum Mechanics

## Schrödinger Equation

$$H\psi(\mathbf{r}, t) = \left[ -\frac{\hbar^2}{2m} \Delta + \mathcal{U}(\mathbf{r}) \right] \psi(\mathbf{r}, t) = i\hbar \frac{\partial}{\partial t} \psi(\mathbf{r}, t)$$

Where  $H$  is a hamiltonian operator. If  $H$  is time independent separation of variables gives:

$$\begin{aligned} \psi(\mathbf{r}, t) &= \Phi(\mathbf{r}) \cdot e^{-\frac{i}{\hbar} Et} \\ \left[ -\frac{\hbar^2}{2m} \Delta + \mathcal{U}(\mathbf{r}) \right] \Phi(\mathbf{r}) &= E\Phi(\mathbf{r}) \end{aligned}$$

The general time dependent solution is:

$$\psi(\mathbf{r}, t) = \sum_n a_n \cdot \Phi(\mathbf{r}) e^{-\frac{i}{\hbar} Et}$$

Where  $a_n$  are found through the boundary conditions ( $t = 0$ ):

$$a_n = \int \Phi_n^* (\mathbf{r}) \cdot \psi(\mathbf{r}, t = 0) d^3r$$