## **Quantum Mechanics**

## Schrödinger Equation

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

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

$$egin{aligned} m{\psi}(m{r},t) &= m{\Phi}(m{r}) \cdot e^{-rac{i}{\hbar}Et} \ \left[ -rac{\hbar^2}{2m} \Delta + \mathcal{U}(m{r}) 
ight] m{\Phi}(m{r}) &= Em{\Phi}(m{r}) \end{aligned}$$

The general time dependent solution is:

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

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

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