4.1 The Standard Schrödinger Equation

The Schrödinger equation is fundamental to quantum mechanics, describing how the quantum state of a physical system evolves over time:[13]

$$i\hbar\frac{\partial}{\partial t}\Psi(\mathbf{r},t) = \left(-\frac{\hbar^2}{2m}\nabla^2 + V(\mathbf{r})\right)\Psi(\mathbf{r},t),$$

where:

- $\Psi(\mathbf{r},t)$ is the wave function representing the probability amplitude of the system's state.
- $\hbar$ is the reduced Planck constant.
- m is the mass of the particle.
- $V(\mathbf{r})$ is the potential energy as a function of position

The probabilistic interpretation of $|\Psi(\mathbf{r},t)|^2$ as the likelihood of finding a particle at position $\mathbf{r}$ is one of the defining features of quantum mechanics. However, the origin of this intrinsic randomness remains unresolved in the standard model.[5]