The Postulates of Quantum Mechanics

(from *Quantum Mechanics* by Claude Cohen-Tannoudji, Bernard Diu, and Franck Laloë)

First Postulate

At a fixed time t_0, the state of a physical system is defined by specifying a wavefunction $\psi(x, y, z, t_0)$.

Second Postulate

Every measurable physical quantity Q is described by an operator $\hat{Q}$; this operator is called an observable.

Third Postulate

The only possible result of the measurement of a physical quantity Q is one of the eigenvalues of the corresponding observable $\hat{Q}$.

Fourth Postulate (non-degenerate case)

When the physical quantity Q is measured on a system in the normalized state ψ, the probability $\mathcal{P}(q_n)$ of obtaining the non-degenerate eigenvalue q_n of the corresponding observable $\hat{Q}$ is

$$\mathcal{P}(q_n) = \int \phi_n^* \psi \tag{1}$$

where ϕ_n is the normalized eigenvector of $\hat{Q}$ associated with the eigenvalue q_n.

Fifth Postulate

(collapse of the wavefunction resulting from a measurement)

Six Postulate

The time evolution of the wavefunction $\psi(x, y, z, t)$ is governed by the Schrödinger equation

$$i\hbar \frac{\partial \psi}{\partial t} = \hat{H}\psi \tag{2}$$

where $\hat{H}$ is the observable associated with the total energy of the system.

Examples of observables Q: energy, dipole moment, quadrapole moment, field gradient at a nucleus, diamagnetic susceptibility, ...