23.3: Postulate 3- Individual Measurements

In any measurement of the observable associated with operator $\hat{A}$, the only values that will ever be observed are the eigenvalues a that satisfy the eigenvalue equation:

$$\hat{A}\Psi = a\Psi. \tag{23.3.1}$$

This postulate captures the central point of quantum mechanics: the values of dynamical variables can be quantized (although it is still possible to have a continuum of eigenvalues in the case of unbound states). If the system is in an eigenstate of $\hat{A}$ with eigenvalue a, then any measurement of the quantity A will yield a. Although measurements must always yield an eigenvalue, the state does not have to be an eigenstate of $\hat{A}$ initially.

An arbitrary state can be expanded in the complete set of eigenvectors of $\hat{A}$ $\left(\hat{A}\Psi_i = a_i\Psi_i\right)$ as:

$$\Psi = \sum_i^n c_i\Psi_i, \tag{23.3.2}$$

where n may go to infinity. In this case, we only know that the measurement of A will yield one of the values a_i, but we don't know which one. However, we do know the probability that eigenvalue a_i will occur (it is the absolute value squared of the coefficient, $|c_i|^2$, as we obtained already in chapter 22), leading to the fourth postulate below.