examples

Example

- If you measure S_x on a particle in general state $\chi = a\chi_+ + b\chi_-$ what result will you get?

- Find the eigen values and eigen functions of S_x

$$S_x = \frac{\hbar}{2}\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

To solve any eigen values

$$\det(S_x - \lambda I) = 0$$

$$S_x = \begin{pmatrix} 0 & \frac{\hbar}{2} \\ \frac{\hbar}{2} & 0 \end{pmatrix}$$

I : identity matrix

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\Rightarrow \det\left\{\begin{pmatrix} 0 & \hbar/2 \\ \hbar/2 & 0 \end{pmatrix} - \begin{pmatrix} \lambda & 0 \\ 0 & \lambda \end{pmatrix}\right\} = 0$$

$$\det = \left\{ \frac{\hbar}{2}\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} - \lambda\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}\right\} = 0$$

$$= \left\{\begin{pmatrix} 0 & \hbar/2 \\ \hbar/2 & 0 \end{pmatrix} - \begin{pmatrix} \lambda & 0 \\ 0 & \lambda \end{pmatrix}\right\} = 0$$

$$\det\left\{\begin{pmatrix} 0 & \frac{\hbar}{2} \\ \frac{\hbar}{2} & 0 \end{pmatrix} - \begin{pmatrix} \lambda & 0 \\ 0 & \lambda \end{pmatrix}\right\} = 0$$

$$\begin{vmatrix} -\lambda & \hbar/2 \\ \frac{\hbar}{2} & -\lambda \end{vmatrix} = 0$$

$$\lambda^2 - \hbar^2/4 = 0 \qquad \boxed{\lambda^2 = \frac{\hbar^2}{4}}$$

$$\boxed{\lambda = \pm \frac{\hbar}{2}}$$