Potentially useful information

Spin-1/2 particle

$$\hat{S}_z = \frac{\hbar}{2}\begin{pmatrix}1 & 0\\ 0 & -1\end{pmatrix}\ \hat{S}_x = \frac{\hbar}{2}\begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix}\ \hat{S}_y = \frac{\hbar}{2}\begin{pmatrix}0 & -i\\ i & 0\end{pmatrix}$$

Eigenstates for the spin operators:

$$|+z\rangle = \begin{pmatrix}1\\0\end{pmatrix};\ |-z\rangle = \begin{pmatrix}0\\1\end{pmatrix};\ |+x\rangle = \frac{1}{\sqrt{2}}\begin{pmatrix}1\\1\end{pmatrix};\ |-x\rangle = \frac{1}{\sqrt{2}}\begin{pmatrix}1\\-1\end{pmatrix};\ |+y\rangle = \frac{1}{\sqrt{2}}\begin{pmatrix}1\\i\end{pmatrix};\ |-y\rangle = \frac{1}{\sqrt{2}}\begin{pmatrix}1\\-i\end{pmatrix}$$

Spin-1 particle

$$\hat{S}_z = \hbar\begin{pmatrix}1 & 0 & 0\\ 0 & 0 & 0\\ 0 & 0 & -1\end{pmatrix}\ \hat{S}_x = \frac{\hbar}{\sqrt{2}}\begin{pmatrix}0 & 1 & 0\\ 1 & 0 & 1\\ 0 & 1 & 0\end{pmatrix}\ \hat{S}_y = \frac{\hbar}{\sqrt{2}}\begin{pmatrix}0 & -i & 0\\ i & 0 & -i\\ 0 & i & 0\end{pmatrix}.$$

Eigenstates of the $\hat{S}_z$ operator (in the z-basis):

$$|1,1\rangle = \begin{pmatrix}1\\0\\0\end{pmatrix};\ |1,0\rangle = \begin{pmatrix}0\\1\\0\end{pmatrix};\ |1,-1\rangle = \begin{pmatrix}0\\0\\1\end{pmatrix}$$

The commutator of two operators is defined as $[\hat{A},\hat{B}] = \hat{A}\hat{B} - \hat{B}\hat{A}$.

Potentially useful mathematical expressions

$$i\cdot i = -1;\ i\cdot(-i) = 1;\ 1/i = -i;$$
$$e^{i\phi} = \cos\phi + i\sin\phi; e^{i\pi/2} = 1;\ \cos\phi = (e^{i\phi} + e^{-i\phi})/2;\ \sin\phi = (e^{i\phi} - e^{-i\phi})/2i;$$
$$e^{i\pi} = -1; e^{\pm i\pi/2} = \pm i; e^{\pm i\pi/4} = \frac{1}{\sqrt{2}} \pm \frac{i}{\sqrt{2}};$$
$$\left|e^{i\phi}\right|^2 = 1;$$
$$\cos 2\phi = \cos^2\phi - \sin^2\phi;\ \sin 2\phi = 2\sin\phi\cos\phi$$