## Question

What are the probabilities of getting $+\frac{\hbar}{2}$ and $-\frac{\hbar}{2}$ if you measure $S_z$ & $S_x$

(IV) For $S_z$

① Derive the $x$ equation

$$x = a x_+ + b x_-$$

$$x = \frac{1}{\sqrt{6}} \begin{pmatrix} 1+i \\ 2 \end{pmatrix} \begin{matrix} a \\ b \end{matrix}$$

$$x = \frac{(1)(1+i)}{\sqrt{6}} \begin{pmatrix} 1 \\ 0 \end{pmatrix} + \left(\frac{(1)(2)}{\sqrt{6}}\right)\begin{pmatrix} 0 \\ 1 \end{pmatrix}$$

$$[a][x_+] + [b][x_-]$$

$$a = \left(\frac{(1+i)}{\sqrt{6}}\right) \quad b = \left(\frac{2}{\sqrt{6}}\right)$$

② Find the probability of $S_z$ for the found values a and b

$$|a|^2 = \left|\frac{(1+i)}{\sqrt{6}}\right|^2 \qquad |b|^2 = \left(\left|\frac{2}{\sqrt{6}}\right|^2\right)$$

$$\left(\frac{(1+i)(1+i)}{6}\right) \qquad \left(\frac{4}{6}\right)$$

$$\frac{1+i+i(-1)}{6} \qquad \left(\frac{4}{6}\right)$$

$$\frac{2i}{6} \qquad \frac{4}{6}$$

Hilroy

$|a|^2 = a^* a$ $\qquad$ $|b|^2 = b^* b$

$= \left(\frac{(1-i)}{\sqrt{6}}\right)\left(\frac{(1+i)}{\sqrt{6}}\right)$ $\qquad$ $\left(\frac{2}{\sqrt{6}}\right)\left(\frac{2}{\sqrt{6}}\right)$

no [i] so the value never changes

$\frac{4}{6}$

$= \frac{(1-i)(1+i)}{6}$

$= \frac{(1 + i - 1(-i^2))}{6}$

$= \frac{(1 + i - (-(-1)^2))}{6}$

$= \left(\frac{1+1}{6}\right) = \frac{2}{6} = \frac{1}{3}$ $\qquad$ $b = \frac{4}{6} = \frac{2}{3}$

Probability of $\frac{\pi}{2} = \frac{1}{3}$

Probability of $-\frac{\pi}{2} = \frac{2}{3}$