Polarization:

T

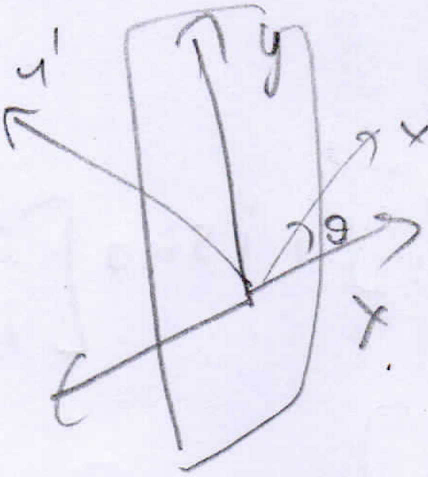
$|x\rangle = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$

$\langle x| = (1 \;\; 0)$ Verify completeness.

$\langle x|x\rangle = 1$

$|y\rangle = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$

$\langle x|y\rangle = 0$



Now assume your co-ordinates or crystal is rotated

$\langle x|x'\rangle = \cos\theta \quad \langle x'|y\rangle = \sin\theta$

$\langle y'|x\rangle = -\sin\theta \quad \langle y'|y\rangle = \cos\theta$

For any stat $\langle\psi|$

$$\begin{pmatrix} \langle x'|\psi\rangle \\ \langle y'|\psi\rangle \end{pmatrix} = \begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix} \begin{pmatrix} \langle \\ \langle\psi| \end{pmatrix}$$

$$|\psi'\rangle = R(\theta)|\psi\rangle = \underbrace{\xi}_{\text{Eigen value.}} |\psi\rangle$$

In complex notation

$$R(\theta) = \cos\theta \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} + i\sin\theta \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$$

$$S = \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$$

$$R(\theta) = \cos\theta\, \mathbb{1} + i\hat{S}\sin\theta$$

$$S^2 = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$$

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

$$S^2|\psi\rangle = \hat{S}(\hat{S})|\psi\rangle = S\lambda|\psi\rangle$$

$$1|\psi\rangle = \lambda^2|S\rangle$$

$$\lambda = \pm 1$$

Other Basis for Photons Polarization.

$$|R\rangle = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 \\ i \end{pmatrix}$$

$$|L\rangle = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 \\ -i \end{pmatrix}$$

$$\langle R|R\rangle = 1 \quad \langle L|L\rangle = 1$$

$$|R\rangle = \frac{|x\rangle + i|y\rangle}{\sqrt{2}}$$

$$|L\rangle = \frac{|x\rangle - i|y\rangle}{\sqrt{2}}$$

$$S|R\rangle = |R\rangle$$

$$S|L\rangle = -|L\rangle$$

$$\int \frac{(\vec{r} \times (\vec{E} \times \vec{H}))\, d^3 r}{4\pi c} = L$$

$$E_{LCP} = \frac{E_x + i E_y}{\sqrt{2}}$$

$$E_{RCP} = \frac{E_x - i E_y}{\sqrt{2}}$$

K - Meson

$$\pi^- + p \to \Lambda^0 + K^0$$

$1 \quad\quad 1$

$- \quad\quad +$

$P = 0 \quad\quad\quad 0$

$S = 0 \quad S_{\Lambda^0} = -1 \quad S_{K^0} = 1$

$S = 0$

$$\bar{K}^0 + p \to \Lambda^0 + \pi^+$$

$$S\,|K^0\rangle = |K^0\rangle$$

$$S\,|\bar{K}^0\rangle = -|K^0\rangle$$

$$S = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

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$$CP|K^0\rangle = |\bar{K}^0\rangle$$

$$CP|\bar{K}^0\rangle = |K^0\rangle .$$

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

$$|K_S\rangle = \frac{1}{\sqrt{2}}\left[|K^0\rangle + |\bar{K}^0\rangle\right]$$

$$|K_L\rangle = \frac{1}{\sqrt{2}}\left[|K^0\rangle - |\bar{K}^0\rangle\right]$$

$$CP|K_S\rangle = |K_S\rangle$$

$$CP|K_L\rangle = -|K_L\rangle$$

K_S & K_L decay.

$\omega_S = \frac{E_S}{\hbar}$ $\quad E_S = \sqrt{p^2c^2 + m_S^2c^4}$

$e^{-t/\tau}$ is decay timescale. τ

$$|\psi(t)\rangle = e^{-i\left(\omega_s t - \frac{t}{2\tau_s}\right)}|K_s\rangle$$

<u>Interference</u>

$$|\psi(t=0)\rangle = |K^0\rangle$$

$$= \frac{1}{\sqrt{2}}\left[|K_s\rangle + |K_L\rangle\right]$$

$$|\psi(t)\rangle = \frac{1}{\sqrt{2}}\left[e^{-i\omega_s t - \frac{t}{2\tau_s}}|K_s\rangle + e^{-i\omega_L t - \frac{t}{2\tau_L}}|K_L\rangle\right)$$

$$\langle \bar{K}^0|\psi\rangle = \frac{1}{2}\left(e^{-i\omega_s t - \frac{t}{2\tau_s}} - e^{-i\omega_L t - \frac{t}{2\tau_L}}\right)$$

$P =$

$$\frac{1}{4}\Big[e^{-t/\tau_S} + e^{-t/\tau_L} - 2e^{-t(\tau_S^{-1}+\tau_L^{-1})/2} \cos(\omega_S-\omega_L)t \Big]$$

interference term