

EC4301

Quiz 1

2023.11.01

Name:

In the nonlocal correlation between paired photons, whose bases are orthogonal polarizations, the mathematical description of the nonlocal correlation should satisfy the inseparable product-basis relation between local parameters. Discuss the role of coincidence detection. What are the followings?

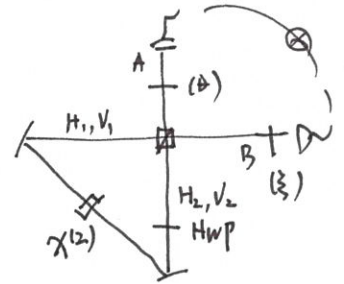
1. Mathematical description
2. Joint parameter relation
3. Inseparability

Sol.)

$$R_{P_1 P_2} = \frac{I_0^2}{2} \sin^2(\theta + \xi)$$

$$E_{P_1} = \hat{V}_1 \sin \theta e^{i\Delta_j t} + \hat{H}_2 \cos \theta e^{i\Delta_k t}$$

$$\bar{E}_{P_2} = \hat{H}_1 \cos \xi e^{-i\Delta_j t} + \hat{V}_2 \sin \xi e^{-i\Delta_k t}$$



where $\hat{H}_j \times \hat{V}_j$ vectors are meaningless due to the quantum eraser.

The coincidence detection :

$$R_{P_1 P_2} = (E_{P_1} \bar{E}_{P_2})_{CC} = \frac{I_0^2}{2} (\hat{V}_1 \hat{H}_1 \sin \theta \cos \xi + \hat{H}_2 \hat{V}_2 \cos \theta \sin \xi + \hat{V}_1 \hat{V}_2 \sin \theta \sin \xi e^{i\Delta_j t} + \hat{H}_1 \hat{H}_2 \cos \theta \cos \xi e^{-i\Delta_k t})$$

$$= \frac{I_0^2}{2} (\sin^2 \theta \cos^2 \xi + \cos^2 \theta \sin^2 \xi) = \frac{I_0^2}{2} \sin^2(\theta + \xi)$$

1. Mathematical description

$\neq \bar{I}_{P_1} \bar{I}_{P_2}$, \neq inseparability 2. joint parameter

where $\bar{I}_{P_1} = \bar{E}_{P_1} \bar{E}_{P_1}^* = \sin^2 \theta + \cos^2 \theta + \sin \theta \cos \theta (e^{i\Delta_j t} + e^{-i\Delta_j t}) = 1 + \sin 2\theta \cos \Delta_j t$

$$\bar{I}_{P_2} = \bar{E}_{P_2} \bar{E}_{P_2}^* = 1 - \sin 2\xi \cos \Delta_k t$$

At $T=0$ (coincidence), $\bar{I}_{P_1} \bar{I}_{P_2} = (1 + \sin 2\theta)(1 - \sin 2\xi)$