

Inteference of s -wave $\pi\pi$ Primakoff photo-
production with p -wave ρ photo-production

From circa 2012 GlueX collaboration meeting

Total Amplitude

$$\rho^0 \rightarrow \pi^+ \pi^- \quad W(\theta, \Psi) = \frac{3}{8\pi} \sin^2 \theta (1 + P_\gamma \cos 2\Psi)$$

$$\gamma\gamma \rightarrow \pi^+ \pi^- \quad W(\theta, \Psi) = \frac{1}{4\pi}$$

$$\begin{aligned} |A_{\text{Primakoff}} + A_\rho|^2 &= \frac{1}{4\pi} \frac{d\sigma_{\text{Primakoff}}}{d\Omega} + \frac{3}{8\pi} \sin^2 \theta (1 + P_\gamma \cos 2\Psi) \frac{d\sigma_\rho}{d\Omega} \\ &+ 2 \cos \varphi \frac{1}{4\pi} \sqrt{\frac{3}{2}} \sin \theta \sqrt{1 + P_\gamma \cos 2\Psi} \sqrt{\frac{d\sigma_{\text{Primakoff}}}{d\Omega}} \sqrt{\frac{d\sigma_\rho}{d\Omega}} \end{aligned}$$

Complex phase between electromagnetic amplitude and ρ photo-production

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Total Amplitude

$$\rho^0 \rightarrow \pi^+ \pi^- \quad W(\theta, \Psi) = \frac{3}{8\pi} \sin^2 \theta (1 + P_\gamma \cos 2\Psi)$$

$$\gamma\gamma \rightarrow \pi^+ \pi^- \quad W(\theta, \Psi) = \frac{1}{4\pi}$$

$$\left| A_{\text{Primakoff}} + A_\rho \right|^2 = \frac{1}{4\pi} \frac{d\sigma_{\text{Primakoff}}}{d\Omega} + \frac{3}{8\pi} \sin^2 \theta (1 + P_\gamma \cos 2\Psi) \frac{d\sigma_\rho}{d\Omega}$$

Wrong !

~~$$+ 2 \cos \varphi \frac{1}{4\pi} \sqrt{\frac{3}{2}} \sin \theta \sqrt{1 + P_\gamma \cos 2\Psi} \sqrt{\frac{d\sigma_{\text{Primakoff}}}{d\Omega}} \sqrt{\frac{d\sigma_\rho}{d\Omega}}$$~~

Complex phase between electromagnetic amplitude and ρ photo-production

$$\begin{aligned}
|A_{\text{Primakoff}} + A_{\rho}|^2 &= (1 - P_{\gamma}) \left| \frac{1}{\sqrt{4\pi}} \sqrt{\frac{d\sigma_{\text{Primakoff}}}{d\Omega}} + e^{i\phi} \sqrt{\frac{3}{8\pi}} \sin\theta \sqrt{\frac{d\sigma_{\rho}}{d\Omega}} \right|^2 + \\
P_{\gamma} &\left| \frac{1}{\sqrt{4\pi}} \sqrt{\frac{d\sigma_{\text{Primakoff}}}{d\Omega}} + e^{i\phi} \sqrt{\frac{3}{4\pi}} \sin\theta \cos\Psi \sqrt{\frac{d\sigma_{\rho}}{d\Omega}} \right|^2
\end{aligned}$$

$$\begin{aligned}
|A_{\text{Primakoff}} + A_{\rho}|^2 &= \frac{1}{4\pi} \frac{d\sigma_{\text{Primakoff}}}{d\Omega} + \frac{3}{8\pi} \sin^2\theta (1 + P_{\gamma} \cos 2\Psi) \frac{d\sigma_{\rho}}{d\Omega} + \\
2 \cos\phi &\frac{\sqrt{3}}{4\pi} \sqrt{\frac{d\sigma_{\text{Primakoff}}}{d\Omega} \frac{d\sigma_{\rho}}{d\Omega}} \sin\theta \left[(1 - P_{\gamma}) \frac{1}{\sqrt{2}} + P_{\gamma} \cos\Psi \right]
\end{aligned}$$

cos 2Ψ amplitude gives:

$$P_\gamma \sin^2 \theta \frac{d\sigma_\rho}{d\Omega}$$

cos Ψ amplitude gives:

$$P_\gamma \sin \theta \cos \phi \sqrt{\frac{d\sigma_{\text{Primakoff}}}{d\Omega} \frac{d\sigma_\rho}{d\Omega}}$$

Isotropic amplitude gives:

$$\frac{1}{4\pi} \frac{d\sigma_{\text{Primakoff}}}{d\Omega} + \frac{3}{8\pi} \sin^2 \theta \frac{d\sigma_\rho}{d\Omega} + (1 - P_\gamma) \frac{\sqrt{6}}{4\pi} \sin \theta \cos \phi \sqrt{\frac{d\sigma_{\text{Primakoff}}}{d\Omega} \frac{d\sigma_\rho}{d\Omega}}$$

cos 2Ψ amplitude gives:

$$P_\gamma \sin^2 \theta \frac{d\sigma_\rho}{d\Omega}$$

cos Ψ amplitude gives:

$$P_\gamma \sin \theta \cos \phi \sqrt{\frac{d\sigma_{\text{Primakoff}}}{d\Omega} \frac{d\sigma_\rho}{d\Omega}}$$

Isotropic amplitude gives:

$$\frac{1}{4\pi} \frac{d\sigma_{\text{Primakoff}}}{d\Omega} + \frac{3}{8\pi} \sin^2 \theta \frac{d\sigma_\rho}{d\Omega} + (1 - P_\gamma) \frac{\sqrt{6}}{4\pi} \sin \theta \cos \phi \sqrt{\frac{d\sigma_{\text{Primakoff}}}{d\Omega} \frac{d\sigma_\rho}{d\Omega}}$$

Do partial wave analysis of the Ψ distribution to extract amplitudes