

Extraction of the $\gamma\gamma \rightarrow \pi^+\pi^-$ contribution

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Let's assume that N is the flux-normalized unpolarized yield of the events that we selected as the events corresponding to $\pi^+\pi^-$ production. Then,

$$N = \varepsilon_{\pi\pi}N_{\pi\pi} + \varepsilon_{\rho}N_{\rho} + \varepsilon_{\mu\mu}N_{\mu\mu} \quad (1)$$

where $N_{\pi\pi}$, N_{ρ} , $N_{\mu\mu}$ and $\varepsilon_{\pi\pi}$, ε_{ρ} , $\varepsilon_{\mu\mu}$ are contributions and detection efficiencies of the Primakoff $\pi^+\pi^-$ photoproduction, coherent ρ^0 and coherent $\mu^+\mu^-$, respectively. We know that (or assume that?) for a given E_{γ} and $\theta_{\pi\pi}$

$$N_{\pi\pi}^{pol}(\varphi) \propto N_{\pi\pi}(1 - P_{\gamma} \cos 2\varphi) \quad (2)$$

$$N_{\rho}^{pol}(\varphi) \propto N_{\rho} \quad (3)$$

$$N_{\mu\mu}^{pol}(\varphi) \propto N_{\mu\mu}(1 + P_{\gamma} \cos 2\varphi) \quad (4)$$

and

$$N_{\pi\pi}^{pol}(\psi) \propto N_{\pi\pi} \quad (5)$$

$$N_{\rho}^{pol}(\psi) \propto N_{\rho}(1 + P_{\gamma} \cos 2\psi) \quad (6)$$

$$N_{\mu\mu}^{pol}(\psi) \propto N_{\mu\mu} \quad (7)$$

We can measure φ - and ψ -dependences $N^h(\varphi)$, $N^h(\psi)$ and $N^v(\varphi)$, $N^v(\psi)$ of the $\pi^+\pi^-$ yields for horizontally and vertically polarized photons. Assuming that the photon polarization degree P_{γ} does not depend on the polarization state, one can write

$$N^h(\varphi) = \varepsilon_{\pi\pi}(\varphi)N_{\pi\pi}(1 - P_{\gamma} \cos 2\varphi) + \varepsilon_{\rho}(\varphi)N_{\rho} + \varepsilon_{\mu\mu}(\varphi)N_{\mu\mu}(1 + P_{\gamma} \cos 2\varphi) \quad (8)$$

$$N^v(\varphi) = \varepsilon_{\pi\pi}(\varphi)N_{\pi\pi}(1 + P_{\gamma} \cos 2\varphi) + \varepsilon_{\rho}(\varphi)N_{\rho} + \varepsilon_{\mu\mu}(\varphi)N_{\mu\mu}(1 - P_{\gamma} \cos 2\varphi) \quad (9)$$

$$N^h(\psi) = \varepsilon_{\pi\pi}(\psi)N_{\pi\pi} + \varepsilon_{\rho}(\psi)N_{\rho}(1 + P_{\gamma} \cos 2\psi) + \varepsilon_{\mu\mu}(\psi)N_{\mu\mu} \quad (10)$$

$$N^v(\psi) = \varepsilon_{\pi\pi}(\psi)N_{\pi\pi} + \varepsilon_{\rho}(\psi)N_{\rho}(1 - P_{\gamma} \cos 2\psi) + \varepsilon_{\mu\mu}(\psi)N_{\mu\mu} \quad (11)$$

From this we get

$$N^v(\varphi) + N^h(\varphi) = 2\varepsilon_{\pi\pi}(\varphi)N_{\pi\pi} + 2\varepsilon_{\rho}(\varphi)N_{\rho} + 2\varepsilon_{\mu\mu}(\varphi)N_{\mu\mu} \quad (12)$$

$$N^v(\varphi) - N^h(\varphi) = 2\varepsilon_{\pi\pi}(\varphi)N_{\pi\pi}P_{\gamma} \cos 2\varphi - 2\varepsilon_{\mu\mu}(\varphi)N_{\mu\mu}P_{\gamma} \cos 2\varphi \quad (13)$$

$$N^h(\psi) + N^v(\psi) = 2\varepsilon_{\pi\pi}(\psi)N_{\pi\pi} + 2\varepsilon_{\rho}(\psi)N_{\rho} + 2\varepsilon_{\mu\mu}(\psi)N_{\mu\mu} \quad (14)$$

$$N^h(\psi) - N^v(\psi) = 2\varepsilon_{\rho}(\psi)N_{\rho}P_{\gamma} \cos 2\psi \quad (15)$$

Solving this system of equations we get

$$\frac{N^v(\varphi) - N^h(\varphi)}{N^v(\varphi) + N^h(\varphi)} = \left[\frac{4\varepsilon_{\pi\pi}(\varphi)N_{\pi\pi}}{N^v(\varphi) + N^h(\varphi)} + \frac{\varepsilon_{\rho}(\varphi)}{\varepsilon_{\rho}(\psi)P_{\gamma} \cos 2\psi} \frac{N^h(\psi) - N^v(\psi)}{N^h(\varphi) + N^v(\varphi)} - 1 \right] P_{\gamma} \cos 2\varphi \quad (16)$$

This equation means that for extraction $N_{\pi\pi}$ we need to use a 2d fit. In the case of the ε not depending neither on φ nor on ψ , the Eqn. (16) simplifies to the form

$$\frac{N^v(\varphi) - N^h(\varphi)}{N^v(\varphi) + N^h(\varphi)} = [2\varepsilon_{\pi\pi}f_{\pi\pi} + f'_\rho - 1] P_\gamma \cos 2\varphi \quad (17)$$

$$\frac{N^h(\psi) - N^v(\psi)}{N^h(\psi) + N^v(\psi)} = f'_\rho P_\gamma \cos 2\psi \quad (18)$$

$$f_{\pi\pi} = N_{\pi\pi}/N \quad (19)$$

$$N^v(\varphi) + N^h(\varphi) = N^h(\psi) + N^v(\psi) = 2N \quad (20)$$

In this case, we can extract the $\pi\pi$ contribution from the 2 1d independent fits (17) and (18).

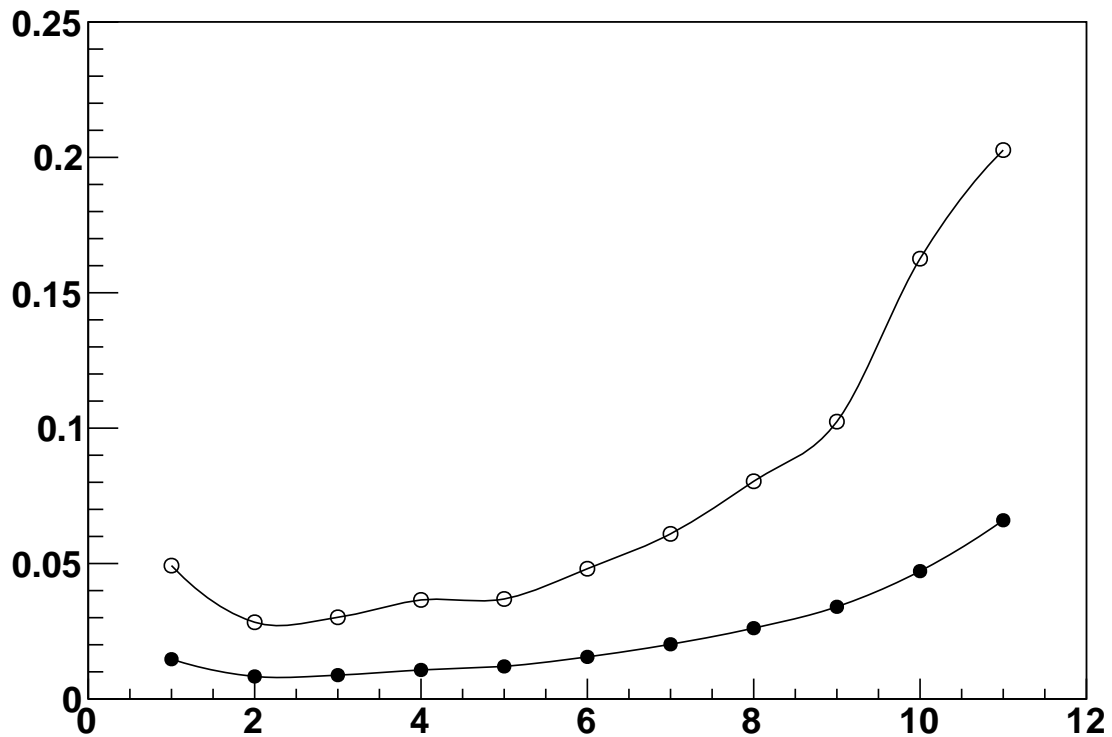


Fig. 1: Relative error for the extracted $f_{\pi\pi}$ as a function of $W_{\pi\pi}$. Open circles: $N_{\mu\mu} = 10N_{\pi\pi}$, Close circles: no $\mu\mu$