Extracting the $f_0(980)$ from the photoproduced $\pi^+\pi^-$ spectrum

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The direct observation of scalar mesons in $\pi^+\pi^-$ photoproduction is very difficult due to the small value of the S-wave cross section. Their photoproduction can, however, be analysed using observables where the S-wave interferes with the dominant P-wave, like in spin density matrix elements or moments of $\pi^+\pi^-$ angular distribution. This approach was used in experimental analysis performed by the CLAS collaboration which reported the first observation of the $f_0(980)$ photoproduction [1]. Previously this method was also used to evaluate the S-wave component of the K^+K^- photoproduction [2].

In order to properly perform the phenomenological analysis of moments of $\pi^+\pi^-$ angular distribution one needs to account, apart from dominant diffractive $\rho(770)$ photoproduction, also for other production mechanisms. Thus we constructed the model in which the resonant $\pi^+\pi^-$ pair can be photoproduced in the P-wave also through the scalar (σ), pseudoscalar (π) and tensor ($f_2(1270)$) meson exchange. The resonant S-wave ($f_0(980)$) photoproduction is modelled as a vector meson exchange process with meson-meson final state interaction. Moreover we include in the model the spectrum of N and Δ baryonic resonances photoproduced through the Drell mechanism.

The model enabled us to reproduce the moments measured in CLAS experiment. We were also able to evaluate the relative strengths of the resonant (arising from $f_0(980)$ decay) and nonresonant (photoprouced through Drell mechanism) parts of the S-wave $\pi^+\pi^-$ spectrum. Finally we obtained new values of the electromagnetic couplings of particles exchanged.

[1] M. Battaglieri *et al.* [CLAS Collaboration], Phys. Rev. **D80**, 072005 (2009)

[2] Ł. Bibrzycki, L. Leśniak, A. P. Szczepaniak, Eur. Phys. J **C34**, 335 (2004)

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