Structure of the ϕ photoproduction amplitude at a few GeV

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Together with an examination of the conventional Pomeron trajectory (P_1) with an intercept $\alpha_1(0) \sim 1.08$ [1, 2], it has been suggested that the $\gamma p \to \phi p$ reaction can be used to probe more exotic processes associated with additional trajectories including the glueball trajectory [3] with negative intercept $\alpha_2(0) \sim -0.75$ (P_2). In order to learn about the Pomeron structure and possible manifestation of more exotic dynamics, such as the hidden strangeness in proton one should first fix the "non-strange" background determined by the conventional mechanisms. Namely, we need to evaluate as accurately as possible the leading amplitudes due to the pseudo-scalar (π, η)-exchange and the direct ϕ-radiation from the nucleon legs.

In this work we present some results of our recent analysis of the ϕ photoproduction amplitudes in a few GeV region with different models for diffractive (Pomeron exchange) amplitudes and predict all spin density matrix elements that are needed to evaluate various observables associated with the K^+K^- angular distributions from the decay of the produced ϕ meson [4, 5]. We consider the $(\pi,\eta)-$exchange, and the direct $\phi-$radiation amplitudes using the parameters *predetermined* in previous works constrained by SU(3) symmetry. This will allow us to pin down the parameters associated with an additional Pomeron trajectory.

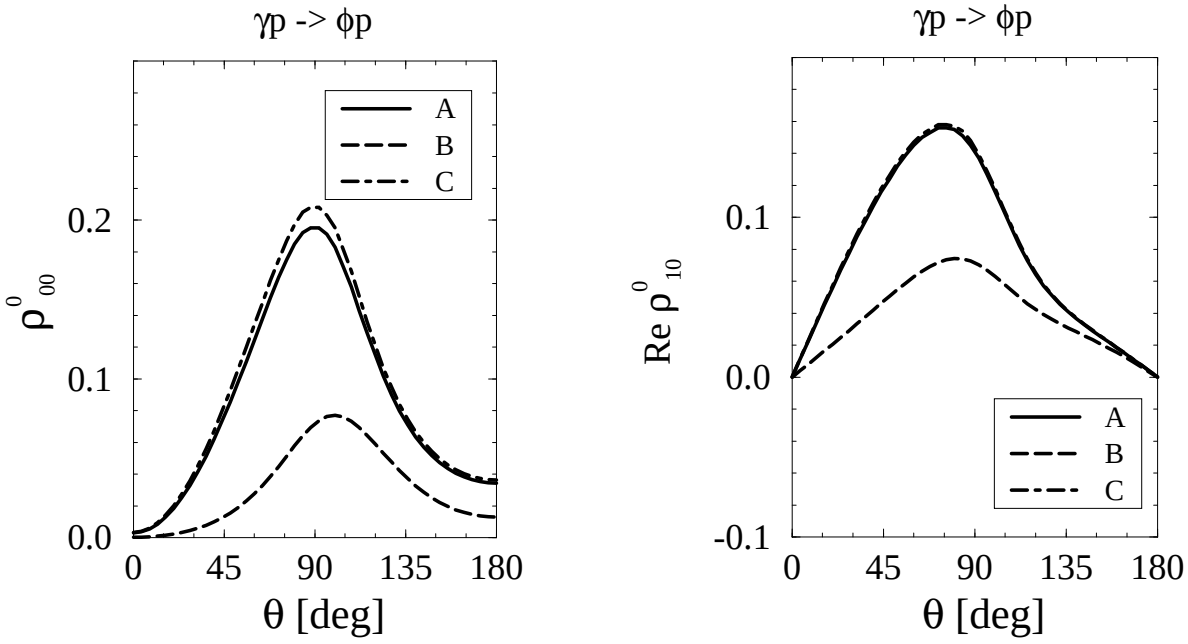

Figure 1: Spin-density matrix element ρ^0_{00} (left panel) and $\mathrm{Re}\rho^0_{10}$ (right panel) for the different models.

We have considered three models for diffractive amplitude:

Model A. In this model we consider only P_1, pseudoscalar meson(π,η) exchange amplitudes and the direct ϕ radiation.

Model B. This model is obtained by extending Model A to include the P_2 amplitude.

Model C. This model is obtained by extending Model A to include scalar meson exchange amplitude [5]. We find that this additional amplitude has very small effect on the unpolarized cross sections.

Our predictions for spin-density matrix elements ρ^0_{00} and $\mathrm{Re}\rho^0_{10}$ which are responsible for K^+K^- angular distribution [6] with unpolarized photon beam at $E_\gamma = 2$ GeV are shown in Fig.1. In Fig.2 we show ρ^1_{00} and $\mathrm{Im}\rho^3_{10}$ which are responsible for the angular distributions with linear and circular polarized beam, respectively. From the Figs.1,2 one can see that some of spin-density matrix elements are sensitive to the models and the corresponding K^+K^- angular distributions may be used for understanding the role of P_2 amplitudes at low energy.

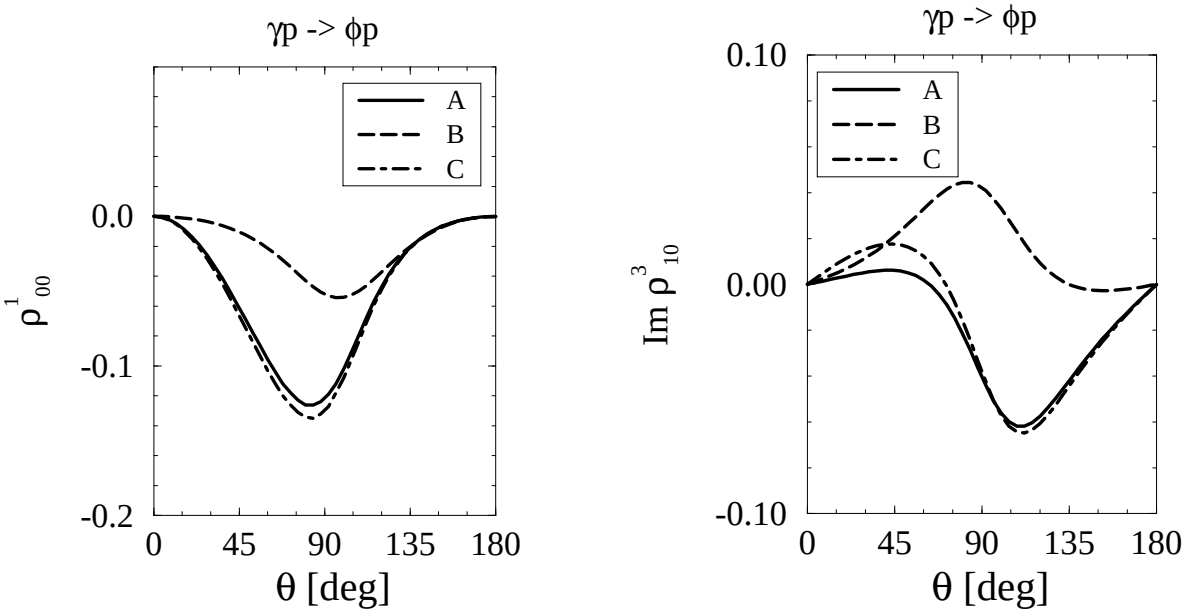

Figure 2: Spin-density matrix element ρ^1_{00} (left panel) and $\mathrm{Im}\rho^3_{10}$ (right panel) for the different models.

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