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Two-Photon-Exchange Effects in the Electromagnetic Production of Pions

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Abstract : The high precision measurements and experiments play more and more important roles in particle physics and atomic physics. To analyse the precise experimental data sets, the corresponding precise and reliable theoretical calculations are necessary. Until now, the form factors of elemental constituents such as pion and proton are still attractive issues in current Quantum Chromodynamics (QCD). In this work, the two-photon-exchange (TPE) effects in $ep \to en\pi^+$ at small -t are discussed within a hadronic model. Under the pion dominance approximation and the limit $m_e \to 0$, the TPE contribution to the amplitude can be described by a scalar function. We calculate TPE contributions to the amplitude, and the unpolarized differential cross section with the only elastic intermediate state is considered. The results show that the TPE corrections to the unpolarized differential cross section are about from -4% to -20% at Q^2=1-1.6 GeV^2. After considering the TPE corrections to the experimental data sets of unpolarized differential cross section, we analyze the TPE corrections to the separated cross sections σ(L,T,LT,TT). We find that the TPE corrections (at Q^2=1-1.6 GeV^2) to σL are about from -10% to -30%, to σT are about 20%, and to σ(LT,TT) are much larger. By these analyses, we conclude that the TPE contributions in $ep \to en\pi^+$ at small -t are important to extract the separated cross sections σ(L,T,LT,TT) and the electromagnetic form factor of π^+ in the experimental analysis.

Keywords : differential cross section, form factor, hadronic, two-photon
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