Exclusive meson pair production in proton-proton collisions

Piotr Lebiedowicz$^{(a)}$, Antoni Szczurek$^{(a,b)}$

$^{(a)}$ Institute of Nuclear Physics PAN, PL-31-342 Cracow, Poland
$^{(b)}$ University of Rzeszów, PL-35-959 Rzeszów, Poland

We present a study of the exclusive production of meson pairs, $M\bar{M} = \pi\pi, KK$, in the four-body $pp \to ppM\bar{M}$ reactions at high energies which constitute an irreducible background to three-body processes (e.g. $pp \to pp\phi, f_2(1275), f_0(1500), f'_2(1525), \chi_{c0}$). We consider central diffractive contribution mediated by Pomeron and Reggeon exchanges and new diffractive mechanism of emission of pions/kaons from the proton lines. We include absorption effects due to proton-proton interaction and pion/kaon rescattering. We compare our results with measured cross sections for the CERN ISR experiment. We also take into account photon-photon mechanism calculated in the framework of equivalent photon approximation and the cross section for elementary $\gamma\gamma \to M\bar{M}$ processes calculated in the framework of pQCD Brodsky-Lepage approach with the distribution amplitude used recently to describe recent data of the BaBar Collaboration on pion transition form factor. For comparison we consider the soft hand-bag mechanism proposed by Diehl, Kroll and Vogt advocated to describe recent Belle data. We compare the photon-photon mechanisms with the contribution of the diffractive mechanism through the pQCD $gg \to M\bar{M}$ subprocesses, which can be calculated within the hard exclusive formalism proposed recently by Cambridge-Durham group.

Several observables related to the $pp \to ppM\bar{M}$ process are calculated. Sizeable cross sections are obtained that can be measured at RHIC, Tevatron and LHC. Predictions for the total cross section and differential distributions in pion/kaon rapidity and transverse momentum as well as two-meson invariant mass are presented. We find that the pions/kaons from the new mechanism of emission directly from the proton lines are produced rather forward and backward what offers a possibility of efficient studies of exclusive $\pi^0\pi^0$ pair production with help of the Zero Degree Calorimeters at LHC. Finally we consider a measurement of exclusive production of a scalar $\chi_{c0}$ meson via $\chi_{c0} \to \pi^+\pi^-, K^+K^-$ decay.

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E-mail: piotr.lebiedowicz@ifj.edu.pl