

Exclusive production of $\pi^+\pi^-$ and $\pi^0\pi^0$ pairs in photon-photon and in ultrarelativistic heavy ion collisions

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We will discuss a possibility to study the $\gamma\gamma \rightarrow \pi\pi$ processes in ultrarelativistic heavy ion collisions.

The $\gamma\gamma \rightarrow \pi\pi$ processes are more complicated than commonly believed. We will present an approach which takes into account many mechanisms not included so far in the literature. We will also present how our approach describes both $\gamma\gamma \rightarrow \pi^+\pi^-$ and $\gamma\gamma \rightarrow \pi^0\pi^0$ reactions from kinematical threshold up to about $\sqrt{s} = 5$ GeV.

We include dipion continuum due to pion exchange (Born approximation), pion-pion rescattering, coupling between channels as well as many s-channel resonances. We also include less pronounced resonances $f_0(1500)$ and $f_0(1710)$ being glueball candidates. In addition, we will show the prediction of cross section in the framework of pQCD Brodsky-Lepage mechanism with distribution amplitudes describing recent BABAR data on pion transition form factor. We include pomeron, reggeon and ρ meson exchange for the pion-pion rescattering. We will compare the results of our approach with experimental data from the Belle Collaboration for angular distributions and total cross section as a function of the energy in the photon-photon (sub)system.

Finally, we will present cross sections for exclusive production of two neutral and two charged pions in ultrarelativistic heavy ion collisions. We will present the prediction for lead-lead collisions at an energy of $\sqrt{s} = 5.5$ TeV which could be measured e.g. by the ALICE collaboration at the LHC. The cross section for the latter process is calculated in the framework of equivalent photon approximation.

[1] M. Klusek-Gawenda and A. Szczurek Phys. Lett. **B700** (2011) 322

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