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Production of lepton, quark and meson pairs in peripheral ulrarelativistic heavy ion collisions

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We discuss exclusive production of lepton-antilepton, quark-antiquark, $\pi\pi$ and $\rho^0\rho^0$ and $D\bar{D}$ meson pairs in ultraperipheral, ultrarelativistic heavy-ion collisions i.e. processes initiated by photon-photon fusion which could be studied at RHIC and LHC.

The cross sections for exclusive muon pair production in nucleus - nucleus collisions was calculated and several differential distributions are shown. Realistic (Fourier transform of charge density) charge form factors of nuclei are used and the corresponding results are compared with the cross sections calculated with monopole charged form factor of a nucleus often used in the literature. Absorption effects are discussed and quantified. The cross sections obtained with realistic form factors are significantly smaller than those obtained with the monopole form factor. The effect is bigger for large muon rapidities and/or large muon transverse momenta. We show predictions for STAR and PHENIX collaborations at RHIC as well as ALICE and CMS collaborations at LHC.

The cross section for exclusive heavy quark and heavy antiquark pair ($Q\bar{Q}$) production in peripheral ultrarelativistic heavy ion collisions was calculated for the LHC energy $\sqrt{s_{NN}}$ = 5.5 TeV. We present results in the impact parameter equivalent photon approximation (EPA) and compare some of them with results obtained by exact calculations of the Feynman diagrams in the momentum space. We include both $Q\bar{Q}$, $Q\bar{Q}g$ and $Q\bar{Q}q\bar{q}$ final states as well as photon single-resolved components. Realistic charge densities in nuclei were taken in the calculation. The different components give contributions of the same order of magnitude to the nuclear cross section.

We present for the first time cross section for exclusive production of $\pi^+\pi^-$ and $\pi^0\pi^0$ pairs. The elementary process $\gamma\gamma \to \pi\pi$ is discussed in detail. We concentrate on high-p_t processes. We consider pQCD processes ala Brodsky-Lepage or alternatively hand-bag mechanism. The nuclear cross section is calculated within b-space EPA for RHIC and LHC.

Similar analysis is performed for $\rho^0\rho^0$ production, where the elementary cross section is less known. Our analysis includes a low-energy phenomenon (close-to-threshold enhancement of the cross section). The cross section for the low-energy phenomenon is parametrized and the high-energy cross section is calculated in a simple Regge model. Predictions for heavy ion collisions are presented.

The cross sections for exclusive D^+D^- and $D^0\bar{D}^0$ meson pair production in peripheral nucleus - nucleus collisions are calculated and several differential distributions are presented. The calculation of the elementary $\gamma\gamma \to D\bar{D}$ cross section is done within the heavy-quark approximation and in the Brodsky-Lapage formalism with distribution amplitudes describing recent CLEO data on leptonic D^+ decay.

The cross sections of a few nb are predicted for RHIC and of a few hundreds of nb for LHC with details depending on the approximation made in calculating elementary $\gamma\gamma \to D\bar{D}$ cross sections.

The speaker will present these different results to domonstrate how reach is the option of ultrarelativistic ultraperipheral collisions at RHIC and LHC.

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Auteur principal: Prof. SZCZUREK, Antoni (Rzeszow University and Institute of Nuclear Physics PAN)

Orateur: Prof. SZCZUREK, Antoni (Rzeszow University and Institute of Nuclear Physics PAN)

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