NUCLEAR GLUON DISTRIBUTION AT SMALL *X* FROM PHOTOPRODUCTION OF J/ψ IN ION ULTRAPERIPHERAL COLLISIONS AT THE LHC

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Distributions of quarks and gluons in nuclei describe the structure of nuclei in Quantum Chromodynamics (QCD) and play an essential role in phenomenology of hard processes with nuclei measured at Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC). At high energies, nuclear parton distribution functions (PDFs) are suppressed by nuclear shadowing compared to those of the free proton, but the suppression magnitude is presently poorly constrained by the data, especially for the gluon distribution.

Ion ultraperipheral collisions (UPCs) at the LHC offer a unique possibility to study photon-nucleus and photon-proton collisions at unprecedentedly high energies [1]. The recent LHC data on coherent photoproduction of J/ψ in Pb-Pb UPCs [2,3] is analyzed and the nuclear suppression factors $S(W=92\ \text{GeV})=0.61$ and $S(W=20\ \text{GeV})=0.74$ are extracted [4]. (Here W is the photon-nucleon invariant center-of-mass energy.) It is shown [4,5] that in the framework of perturbative QCD, S is equal to the gluon shadowing factor and can be described well by the theoretical approaches predicting significant nuclear gluon shadowing at $x=0.001$ and $x=0.02$ ($x=M_{J/\psi}^2/W^2$).

In symmetric UPCs, both nuclei can serve as a source of photons and as a target, which leads to theoretical ambiguity and limitations in the probed small x. This difficulty can be overcame by considering UPCs accompanied by electromagnetic excitation of one or both nuclei with the subsequent forward neutron emission [6]. It is shown [7] that this method allows one to probe the nuclear gluon distribution down to $x=10^{-4}$.

Incoherent J/ψ photoproduction in Pb-Pb UPCs was also measured at the LHC [2]. The cross section of this process is calculated in the framework of the leading twist theory of nuclear shadowing and compared to the data [7].

The rapidity and momentum transfer distributions of coherent J/ψ photoproduction in proton-Pb UPCs is calculated [8]. It is shown that after a cut excluding small momentum transfers, this process gives a possibility to study the proton gluon distribution down to $x=10^{-5}$.

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