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Color fluctuation effects in hard nucleon and photon collisions with nuclei

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Abstract:. We test the hypothesis that configurations of a proton with a large-x parton, $x_p > 0.1$, have a smaller than average size. The QCD Q^2 evolution equations suggest that these small configurations also have a significantly smaller interaction strength, which has observable consequences in collisions with nuclei. We perform a global analysis of jet production data in proton- and deuteron-nucleus collisions at RHIC and the LHC. Using a model which takes a distribution of interaction strengths into account, we quantitatively extract the x_p-dependence of the average interaction strength, $\sigma(x_p)$, over a wide kinematic range. By comparing the RHIC and LHC results, our analysis finds that the interaction strength for small configurations, while suppressed, grows faster with collision energy than does that for average configurations. We check that this energy dependence is consistent with the results of a method which, given $\sigma(x_p)$ at one energy, can be used to quantitatively predict that at another. This finding further suggests that at even lower energies, nucleons with a large-x_p parton should interact much more weakly than those in an average configuration, a phenomenon in line with explanations of the EMC effect for large-x_p quarks in nuclei based on color screening. We also consider color fluctuations in various photon –nucleus processes which can be explored in the ultraperipheral heavy ion collisions at the LHC

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