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Energy and system size dependence of the subnucleonic fluctuations

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Understanding the geometric eventy-by-event distribution of gluons in protons and nuclei is a fundamentally interesting task. Moreover, their fluctuating structure has a significant effect on the outcome of hydrodynamical simulations of e.g. proton-nucleus collisions. Thus, it is of utmost interest to determine both the average geometrical structure, and its event-by-event fluctuations, for the hadrons used in high-energy QCD experiments.

Recently, we have shown how the event-by-event fluctuations of the geometric structure of the proton can be constrained from the HERA exclusive vector meson production data [1], and that this information is crucial in order to describe the measured flow harmonics in proton-nucleus collisions [2].

In this talk, we study to what extent the large geometric fluctuations of the proton have effect in nuclear targets. In particular, we show that at large momentum transfer, the J/Psi photoproduction in ultraperipheral heavy ion collisions is sensitive to the event-by-event fluctuations of the nucleon geometry in the LHC kinematics [3]. We also discuss the possibilities of the future Electron Ion Collider to study fluctuations also in light nuclei such as deuteron and helium, whose structure is necessary input for hydrodynamical simulations of e.g. deuteron-gold collisions studied at RHIC.

The high-energy photon-nucleus and proton-nucleus scatterings measured at the LHC make it also possible to study the energy dependence of the fluctuations. We present our ongoing work on describing the Björken-x evolution of the proton structure by solving the JIMWLK evolution equation. The non-perturbative input for the small-x evolution is obtained by fitting the HERA structure function data, which then allows us to predict the energy dependence of the fluctuating structure of the proton.

[1] Phys. Rev. Lett. 117 (2016), 052301
[3] Phys.Lett. B772 (2017) 681-686
[4] Phys.Lett. B772 (2017) 832-838

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