High Energy Physics - Phenomenology

Leading twist nuclear shadowing phenomena in hard processes with nuclei

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We present and discuss the theory and phenomenology of the leading twist theory of nuclear shadowing which is based on the combination of the generalization of Gribov-Glauber theory, QCD factorization theorems, and HERA QCD analysis of diffraction in lepton-proton deep inelastic scattering (DIS). We apply this technique for the analysis of a wide range of hard processes with nuclei---inclusive DIS on deuterons, medium-range and heavy nuclei, coherent and incoherent diffractive DIS with nuclei, and hard diffraction in proton-nucleus scattering---and make predictions for the effect of nuclear shadowing in the corresponding sea quark and gluon parton distributions. We also analyze the role of the leading twist nuclear shadowing in generalized parton distributions in nuclei and in certain characteristics of final states in nuclear DIS. We discuss the limits of applicability of the leading twist approximation for small x scattering off nuclei and the onset of the black disk regime and methods of detecting it. It will be possible to check many of our predictions in the near future in the studies of the ultraperipheral collisions at the Large Hadron Collider (LHC). Further checks will be possible in pA collisions at the LHC and forward hadron production at Relativistic Heavy Ion Collider (RHIC). Detailed tests will be possible at an Electon-Ion Collider (EIC) in USA and at the Large Hadron-Electron Collider (LHeC) at CERN.

Comments:	251 pages, 101 figures, 7 tables. In the revised version, the lower panel of Fig. 64 has been added
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