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Extraction and comparison of free and intranuclear proton structure functions from experimental data

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Abstract

In this paper, a quantum chromodynamics-based analysis is presented to determine the proton parton distribution functions in the second order of the Feynman diagram. This analysis uses a large and combined experimental dataset including deep inelastic scattering data from the HERA and BCDMS experiments, non-LHC hadron collider data including jet production cross sections from the tevatron experiments, and LHC data, especially jet production and heavy quark production cross sections. These data provide accurate coverage in the small fractional momentum region and provide valuable information about the proton flavor structure. In the first step, the free proton parton distribution functions were extracted by fitting to these data. Then, by generalizing these functions to the nuclear environment and using experimental data related to nuclei, the nuclear parton distribution functions are calculated. The EMC effect is subsequently investigated quantitatively, and the results are compared with those obtained by other global analyses. This comprehensive analysis shows good agreement with experimental data and provides a more detailed understanding of the partonic structure of the proton in free and bound states.

Keywords: Partonic distribution functions, Quantum Chromodynamics, Free and Nuclear Protons, Nucleon Structure Function.

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