Hadron Structure in Electroweak Precision Measurements

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Abstract

Precision measurements offer important, low-energy tests of the Standard Model. The Q_{weak} and (proposed) MOLLER experiments at Jefferson Lab are two such measurements. Since the interpretation of the experimental results depends on the precision of the theory prediction, radiative corrections need to be properly accounted for. In this thesis we examine the γZ box correction to the weak charge of the proton. Previously poorly understood, by using phenomenological information to constrain the input structure functions, we determine this important correction at Q_{weak} kinematics to a precision more than twice that of the previous best estimate. The γZ box is also evaluated at energies relevant to the MOLLER experiment for the first time.

The constructed Adelaide-Jefferson Lab-Manitoba model structure functions may also be used to study other low-energy phenomena. The electromagnetic parametrisations of the cross sections are utilised in the context of the generalised Baldin sum rule to investigate the momentum transfer dependence of the electric and magnetic polarisabilities. Additionally, both the electromagnetic and interference structure functions' moments were calculated in order to determine the higher-twist contributions to the structure functions. These results serve to increase our understanding of the internal structure of the nucleon.

Statement of Originality

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