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Updates on the parity-odd structure function of the nucleon from the Compton amplitude

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The parity-odd structure function, F_3, accessible via neutrino-nucleon deep-inelastic scattering, plays an important role in estimating the hadronic uncertainties in the extracted weak parameters of the Standard Model (SM). Controlled and reduced uncertainties in SM processes are crucial for beyond the standard model searches progressing via CKM matrix elements or the weak mixing angle. Incidentally, the electroweak box diagrams contribute the dominant theoretical uncertainty and can be related to the lowest Nachtmann moment of F_3 through a dispersive approach, enabling a model-independent estimation of their contributions. Unfortunately, the experimental data for F_3 either do not exist or belong to a separate isospin channel which requires modelling, thus, makes it challenging to control the systematic uncertainties. Therefore a first-principles calculation of F_3 is highly desirable to reliably calculate the electroweak boxes. Additionally, the Gross-Llewellyn Smith (GLS) sum rule is also associated with the lowest moment of F_3 structure function and in the parton model, it counts the number of valence quarks in a nucleon, with known perturbative corrections up to $\mathcal{O}(\alpha_s^4)$. A precise first-principles determination of the Q^2 dependence of the GLS sum rule would therefore provide a pathway to a high-accuracy extraction of α_s from an hadronic observable.

In this contribution, we provide an update on the CSSM/QCDSF/UKQCD Collaboration's progress in calculating the lowest moment of the F_3 structure function from the forward Compton amplitude at the SU(3) symmetric point. We study the Q^2 dependence of the lowest moment and give a comparison to the GLS sum rule. We discuss the effects of higher-twist/power corrections, extraction of α_s, and a possible determination of electroweak box contributions.

Primary author: CAN, K. Utku (The University of Adelaide)

Co-authors: SCHIERHOLZ, Gerrit (DESY); ZANOTTI, James (University of Adelaide); RAKOW, Paul (University of Liverpool); HORSLEY, Roger (University of Edinburgh); YOUNG, Ross (University of Adelaide)

Presenter: CAN, K. Utku (The University of Adelaide)

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