Diffractive Structure Functions and Diffractive PDFs

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Abstract

This section of the Proceedings contains papers summarising the current status of the F_2^D measurements at HERA, the extraction of the diffractive parton distribution functions and the relevance of a direct measurement of F_L^D.

The selection of a pure sample of inclusive diffractive events, $ep \to eXp$, is a challenging task. Three alternative approaches have been used so far by the H1 and ZEUS collaborations at HERA:

1. a fast proton in the final state is required;
2. a rapidity gap in the forward direction is required;
3. the different shape of the M_X distribution for diffractive and non-diffractive events is exploited.

The results obtained with these approaches exhibit a level of agreement which varies from tolerable to poor. This is not surprising since different final states are selected, in which the reaction $ep \to eXp$ appears with different degrees of purity. The paper by Newman and Schilling presents a systematic comparison of the results available, quantifies the differences and discusses their origins, when understood.

NLO QCD fits to the diffractive structure function F_2^D are used to extract the diffractive parton distribution functions (dPDFs) in the proton. They can be interpreted as conditional probabilities to find a parton in the proton when the final state of the process contains a fast proton of given four-momentum. They are essential to determine the cross sections of less inclusive processes in ep diffractive scattering, such as dijet or charm production. They are also a non-negotiable ingredient for the prediction of the cross sections for inclusive diffractive processes at the LHC.

Several groups have so far performed such fits to the available data. The results of these fits are presented in the papers by Newman and Schilling, Groys et al. and Watt et al. All fits give diffractive PDFs largely dominated by gluons. However, significant differences are apparent, reflecting the differences in the data, but also in the fitting procedure. Newman and Schilling and Groys et al. assume the so-called Regge factorisation hypothesis, i.e. take $F_2^D = f_{I\!P}(x_{I\!P}, t) \cdot F_2^{I\!P}(\beta, Q^2)$. This assumption has no basis in QCD and is critically discussed by Groys et al. and by Watt et al. The latter also argue that the leading-twist formula used by Newman and Schilling and by Groys et al. is inadequate in large parts of the measured kinematics, and use a modified expression which includes an estimate of power-suppressed effects.

The parametrisations of the dPDFs discussed in these three papers are available in a code library discussed in the paper by Schilling.

Finally, the paper by Newman addreses the importance of measuring the longitudinal diffractive structure function F_L^D. A measurement of F_L^D to even modest precision would provide a very powerful independent tool to verify our understanding of diffraction and to test the gluon density extracted indirectly in QCD fits from the scaling violations of F_2^D.