A Measurement of the Diffractive Reduced Cross-Section $\sigma_r^{D(3)}$ at Low Q^2 in Deep Inelastic Scattering with the H1 Detector

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Abstract

A new high precision measurement of the diffractive deep inelastic scattering process $ep \rightarrow eXY$ is presented, where Y is a proton or a low mass excitation and X represents the dissociation products of the photon coupled to the electron. The results are obtained from a dedicated data sample of 2.68 pb^{-1}, taken by the H1 experiment at HERA, with unbiased triggers. The measurement is presented in the form of a 3-dimensional reduced cross-section $\sigma_r^{D(3)}(\beta, Q^2, x_{I\!P})$ which is integrated over the region $M_Y < 1.6$ GeV and $|t| < 1$ GeV^2. The kinematic range covered is $1.5 < Q^2 < 45$ GeV^2 and $0.01 < y < 1$. Through the use of the Backward Silicon Tracker in the electron identification and vertex determination, this analysis considerably extends the kinematic coverage at low Q^2 and low y compared with previous published and preliminary measurements by H1. The low values of y attained result in unprecedented high statistics at high $x_{I\!P}$ ($x_{I\!P} \lesssim 0.03$). Good agreement is generally observed in the region of overlap with a previous H1 measurement. In most of the phase space for $Q^2 > 3.5$ GeV^2, the data are well described by predictions derived from a fit to higher Q^2 data based on QCD hard scattering factorisation for semi-inclusive processes and the DGLAP evolution equations. The measurement thus confirms the dominance of a gluon distribution extending to large fractional momenta in the diffractive exchange. The data presented in this thesis are expected to greatly help to provide more accurate diffractive parton distribution functions and to identify areas where the diffractive factorisation approach fails.