A Study of the Dynamics of Diffractive Photoproduction at HERA

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Abstract

A measurement is presented, using the H1 detector, of the differential cross-section, $\frac{d\sigma}{dM_X^2}$, for diffractive photoproduction processes in which the proton vertex is elastic, and the final state photon system has mass, $M_X < 27.1$GeV. The average γp centre of mass energy is 187GeV. Using the forward components of the detector, events are selected on the basis of a large gap in the pseudorapidity distribution of final state hadrons adjacent to the leading proton. By using a reconstruction method that is insensitive to any non-containment of parts of the final state in the photon direction, the cross-section is evaluated for values of M_X down to those consistent with the exclusive production of the lowest lying vector meson states, $\rho(770)$, $\omega(783)$, and $\phi(1020)$. The total cross-section for the quasi-elastic production of one of these states, or for the non-resonant photon dissociation to $\pi^+\pi^-$ is found to be $18.2 \pm 0.8(stat) \pm 1.9(sys)\mu$b. The total cross-section for photon dissociation to the continuum of higher mass states in the measured kinematic range is $17.5 \pm 0.4(stat) \pm 2.4(sys)\mu$b. In the high mass region, the differential cross-section is fitted to the triple Regge form, $d\sigma/dM_X^2 \sim (1/M_X^2)^n$, and a value, $n = 1.00 \pm 0.02(stat) \pm 0.03(sys)$, is obtained.

By demanding activity in the pseudorapidity range, $5.5 \lesssim \eta \lesssim 7.5$, and that the largest rapidity gap in the main part of H1 is bounded by the forward edge in acceptance ($\eta \sim 5.5$), a limited measurement of the differential cross-section, $\frac{d\sigma}{dM_X^2}$, has been made for diffractive processes in which the proton dissociates to any state with mass, $m_p < M_Y \leq 10$GeV. The cross-section for such processes that are quasi-elastic at the photon vertex is found to be $5.5 \pm 0.4(stat) \pm 1.2(sys)\mu$b. An investigation of the double dissociative diffractive process, in which both M_X and M_Y are large, suggests that its cross-section is similar to that of single photon dissociation.

The acceptance of the H1 Forward Muon Trigger in its 1995 configuration is evaluated from simulations. For tracks passing through the first three double layers of drift cells, the acceptance is found to be $\sim 95\%$ for single muons generated in the range of polar angle, $7.5^o \lesssim \theta \lesssim 17.2^o$, with momentum, $p \gtrsim 2.9$GeV. For tracks that also traverse the iron toroidal magnet of the system and the three subsequent double layers, the acceptance is $\sim 93\%$ for muons in a similar range of polar angle, and with $p \gtrsim 6.0$GeV.