New Perspectives on Exclusive Diffractive Processes in High-Energy Photon-Proton Interactions

J. A. Crittenden
Physikalisches Institut, Universität Bonn
Nußallee 12, 53115 Bonn, Germany

The first five years of operation of the multi-purpose experiments ZEUS and H1 at the electron–proton collider HERA have opened a new era in the study of diffractive processes in photon–proton interactions. Of particular interest are the investigations of exclusive vector-meson production, $e\,p \to e\,p\,V$, which present an opportunity for testing the recently proposed applications of perturbative quantum chromodynamical (pQCD) calculations to diffractive processes. The high flux of quasi-real photons from the electron beam has allowed high-statistics studies of vector-meson photoproduction to be compared to the deeply inelastic processes at high photon virtuality $Q^2 \gg \Lambda^2_{\mathrm{QCD}}$. The extension of the accessible $\gamma^* p$ c.m. energy range by more than an order of magnitude over previous measurements is of particular importance for studies of diffractive processes, due to the enhanced sensitivity to their characteristically weak energy dependence. Measurements of the energy dependence and the slope of the forward diffractive peak of the elastic cross sections for ρ^0, ω, ϕ, and J/ψ production have provided tests of the proposal that the mass (or size) of the vector meson furnishes an additional scale which can be used to study the transition to the perturbative domain. These issues of scale will be discussed in the context of topical phenomenological models, comparing the HERA results and those from fixed-target experiments at lower energy to the wealth of calculations available in the contemporary literature.