

Multi-Parton Interactions at HERA

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Three- and four-jet final states have been measured in photoproduction at HERA, using the ZEUS detector and an integrated luminosity of 121 pb^{-1} . Both the three- and four-jet events have been studied in a semi-inclusive, $M_{\text{nj}} > 25 \text{ GeV}$, and high-mass region, $M_{\text{nj}} > 50 \text{ GeV}$. The three-jet cross sections have been compared to an $\mathcal{O}(\alpha_s^2)$ perturbative QCD calculation and are shown to be sensitive to higher-order processes at low M_{3j} . The calculation describes the higher M_{3j} region reasonably well. In addition, the three- and four-jet cross sections have been compared with leading-logarithmic Monte Carlo models that rely on parton showers to generate events with high jet-multiplicities. The Monte Carlo models describe the data well once multi-parton interactions are included. Results on underlying events are also presented in terms of the energy flow between jets and energy correlations in an inclusive photoproduction sample. Finally, leading neutron data measured at HERA in photoproduction and deep inelastic scattering results are presented and compared to different models on pion-exchange followed by secondary interactions.