Simulation concerning trigger and electron separation in the forward chambers of ZEUS

V. Wirth

Diploma thesis, University of Bonn, 1987

A new collider HERA at DESY in Hamburg will probe kinematical regions of deep inelastic electron nucleon scattering, which are hitherto unexplored. One expects reasonable rates for collisions up to several 10,000 GeV^2 for the momentum transfer squared Q^2. In particular, the available energy at HERA could reveal new heavy particles. The ZEUS collaboration is designing and constructing a universal detector suitably equipped to study those deep inelastic electron proton collisions.

This paper is concerned with two different questions related to background effects in the forward chambers of the inner detector of ZEUS.

First it is investigated to what extent the forward chambers can contribute to a first level trigger rejecting proton beam gas events. Such a trigger should yield a fast information on the position of the event vertex along the beam axis. Two different algorithms are studied and compared: the "center of gravity algorithm" and the "single track algorithm". At first glance the "center of gravity algorithm" seems to work fairly well, but a more realistic simulation of background events renders it unsatisfactory. The "single track algorithm", however, efficiently separates true events from background events and, apart from a distortion of the kinematics by mere geometrical acceptance of the detector, the latter algorithm proves rather unbiased. Moreover, it is shown that the combination with a trigger on transverse energy as provided by the calorimeter yields a further considerable reduction of the background.

The second investigation considers the identification of prompt electrons from heavy quark decay and the suppression of background electrons arising from Dalitz decay and gamma conversion within the material of the detector. This is essential since the number of background electrons in the forward chambers of the inner detector is at least by 2.5 orders of magnitude larger than the number of electrons from semileptonic heavy quark decay. Considering only those Dalitz decays and gamma conversion processes for which the identification of the e+e- pair is impossible by mere track reconstruction, one is left with the so-called "singles", i.e. electrons which hardly can be separated from prompt

electrons without further criteria. Even under optimistic assumptions the remaining background still exceeds the signal. However, as background and prompt electrons have considerably different spectra of momentum and transverse momentum, a cut on these quantities reduces the number of background electrons much more than the number of prompt electrons leading to a signal to background ratio larger than one.