Elastic J/ψ Photoproduction and the Detection and Triggering of Muons at Low $W_{\gamma p}$ using the H1 Detector

Kirstee Louise Hewitt

Thesis submitted for the degree of
Doctor of Philosophy

School of Physics and Space Research
Faculty of Science
University of Birmingham

March 1998

Synopsis

The electron-proton colliding beam facility HERA consists of two independent accelerators designed to store 820 GeV protons and 27.5 GeV electrons. The two beams circulate in opposite directions in an underground tunnel, 6.3 km in length. At two interaction points the beams are collided head on and some of the highest energy ep collisions ever attained are observed. The H1 detector is situated at one of these interaction points and observes the reaction products from these collisions.

This report firstly discusses briefly the physics potential that HERA has to offer and follows this by a description of the H1 detector at HERA. Particular emphasis is made on the subdetectors which can be found in the 'forward direction' (the direction of the proton beam) which is defined by the angular region $7^\circ < \theta < 25^\circ$. The detailed studies presented here concentrate on the detection and triggering of muons within this region with the aim to calculate the elastic cross-section for the production of J/ψ mesons.

Muons are detected in the forward region by the Forward Tracking Detector (FTD), the instrumented iron (which surrounds the whole of the H1 experiment), and the Forward Muon Detector (FMD). Analyses have been completed on the correlation of the momenta measured in the FTD, CTD and the FMD for 1995 and 1996 data and significant differences have been found which can be attributed to problems associated with vertex fitted FTD tracks. Additionally, a preliminary determination of the efficiency and acceptance of the Forward Muon Trigger (FMT) and FMD have been made. These are both important steps towards analysing forward muon producing processes and ultimately other forward processes.

Cross-section measurements for the $\gamma p \rightarrow J\psi p$ process have been made by de-

tecting the products of the J/ψ decaying to $\mu^+\mu^-$. The measurements give an indication of the $W_{\gamma p}$ dependence of the cross-section extended to $W_{\gamma p}$ values lower than measured previously by H1.