The Level-2 Muon Trigger at the DØ Experiment

F. Fiedler, O. Biebel, M. Binder, T. Christiansen, J. Elmsheuser, M. Erlebach, B. Leonhardt, T. Nunnemann, D. Schaile, P. Schieferdecker, and R. Ströhmer

1. The DØ Detector and Trigger System

The DØ experiment [1] measures $p\bar{p}$ collisions at 1.96 TeV at the Fermilab TeVatron. The physics programme includes measurements of the strong and electroweak interactions, bottom and top production, and searches for the Higgs boson and physics beyond the Standard Model.

The inner part of the detector consists of a silicon microvertex and scintillating fiber tracker inside a 2 T solenoid. These tracking detectors are surrounded by preshower detectors and the calorimeter, followed by muon chambers inside and outside a toroidal magnet, which allows standalone momentum determination.

The DØ trigger is divided into three levels. The Level-2 trigger first checks the Level-1 decision, currently formed from calorimeter, muon, and tracking information at $\mathcal{O}(1-2\,\mathrm{kHz})$. The Level-2 system is the first to then form event-wide decisions based on the signals from all subdetectors. It reduces the event rate by a factor of ~ 2. Level-3 uses information from the precision detector readout to reduce the rate to $\mathcal{O}(50\,\mathrm{Hz})$.

2. The Level-2 Muon Trigger Performance

The Level-2 muon trigger [2] reconstructs muon tracks in the three layers of muon detectors before and after the toroid. The deflection angle in the toroid is a measure of the muon momentum.

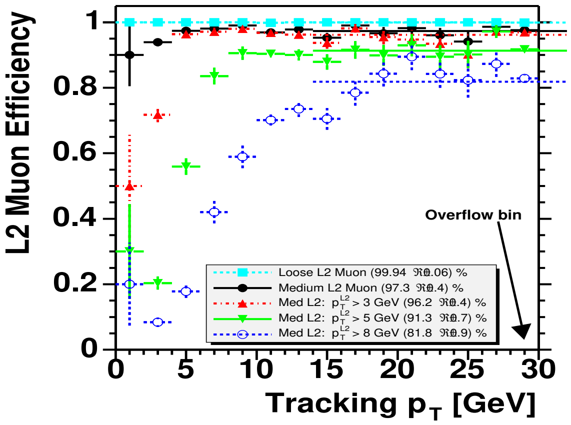

Fig. 1: The efficiency for muon reconstruction in the Level-2 trigger as a function of the transverse muon momentum, measured offline in the central tracking system.

Efficiency studies were performed for isolated muons matched to a track in the central tracking system in offline-reconstructed events. To obtain the efficiency of the Level-2 muon trigger alone, muons were required to be identified in the first trigger level. In figure 1, the efficiency is given as a function of the transverse momentum, reconstructed in the central tracking system, and for different Level-2 muon quality criteria ("loose" and "medium" quality muons). An efficiency of $97.3 \pm 0.4\%$ for "medium" offline muons is obtained. In addition, cuts on the transverse momentum as reconstructed at Level-2 can be used to limit the event rate while retaining high efficiency for energetic muons, as shown in figure 1.

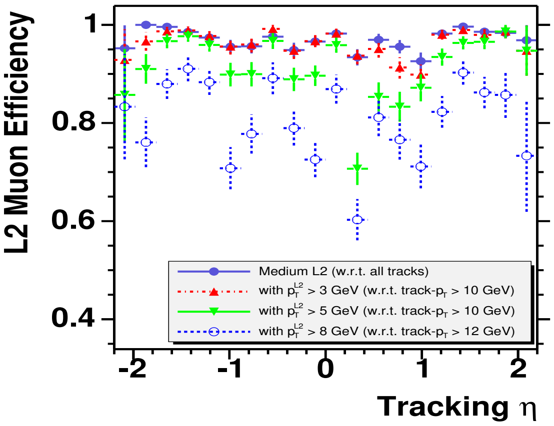

Fig. 2: The efficiency for "medium" Level-2 muons as a function of pseudorapidity η for muons with a given minimum transverse momentum p_T (reconstructed offline in the central tracking system). Different symbols correspond to different requirements on the Level-2 transverse momentum. Note the zero-suppressed vertical scale.

The dependence of the Level-2 muon efficiency on the pseudorapidity η is shown in figure 2. These studies revealed a low efficiency in the region of $0 < \eta < 1$. This effect was traced to an imperfection in the description of the detector geometry, which has now been corrected in the most recent version of the reconstruction software.

Nearly all analyses of final states including muons at DØ are based on the Level-2 muon trigger. Analyses using muons that have been performed by the LMU group can be found e.g. in this document [3].

References

[1] R. Ströhmer *et al.*, Annual report 2001, p. 43
[2] T. Christiansen *et al.*,Annual report 2001, p. 44
[3] M. Binder *et al.*, this report, page 39;
T. Christiansen *et al.*, this report, page 40;
J. Elmsheuser *et al.*, this report, page 37;
B. Leonhardt *et al.*, this report, page 34;
R. Ströhmer *et al.*, this report, page 42