

Combination of Single Muon Triggers at the DØ Experiment

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The identification of muons with the DØ detector is performed through three dedicated subsystems and toroidal magnets. To improve the resolution of the muon momentum measurement, muons detected in the muon system (local muons) can be required to match tracks detected by the central tracking system. The muon system consists of proportionnal drift tubes in the central region (for pseudorapidities $|\eta| \leq 1.0$), and mini-drift tubes in the forward region ($1.0 < |\eta| \leq 2.0$). Scintillation counters provide muon triggering and background rejection [1].

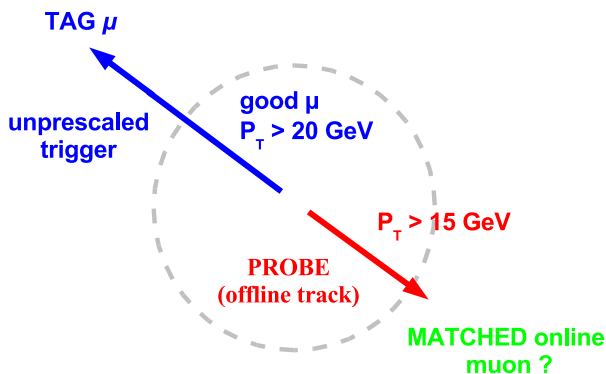


Fig. 1: Schematic representation of the tag-and-probe method, in the configuration used for the OR calculation, and in the case of the muon triggering efficiency measurement. The tag muon and the probe track are of good quality.

We calculated the combined efficiency of 33 single muon triggers by using an inclusive OR.

The DØ detector has three trigger levels (L1, L2, L3) that can be combined to define a trigger. Mostly in order to keep a smooth data taking flow, some of the triggers configured for a given run can be prescaled at L1. Only a specified fraction of the events accepted by a prescaled trigger are actually recorded. For each data taking epoch, one overall OR efficiency is calculated, gathering all three trigger levels, and the inefficiency due to the prescales.

The OR efficiency is estimated by the tag-and-probe method, with data events containing a Z boson decaying to two muons. We test each level term of the 33 combined triggers by trying to match a probe central track (for muon detector terms) or a probe local muon (for tracking terms) to a local muon or a central track respectively (see Figure 1). We account for the prescales by requiring that the condition at L1 is fulfilled and accepted. Only a trigger which is accepted and for which the matching is successful at the three levels contributes to the calculated OR efficiency.

The inclusion of the prescale inefficiencies could introduce a correlation between the tag and the probe objects, which tends to overestimate the OR efficiency. To avoid this effect, the tag muon is required to only have fired unprescaled triggers (see Figure 1).

In Figure 2, the gain of the OR efficiency compared to single muon efficiencies is clearly seen. The acceptance

is increased in the forward region, thanks to the contribution of the trigger (MUH5_LM15), which is designed for forward rapidities. The complementariness of the triggers MUH1_TK12_TLM12 and MUH1_LM15 contributes to the gain, as the former requires L3 muon, tracking and central matching criteria, while the latter fires for a tighter L3 muon.

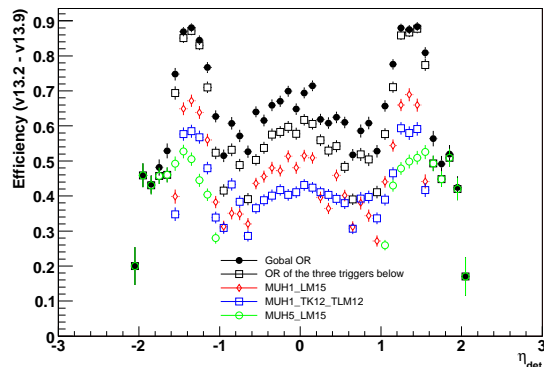


Fig. 2: Dependence of the single muon OR efficiency as function of the pseudo-rapidity η_{det} , for data collected during a given epoch, in comparison with other single muon triggers (that are part of the OR). The efficiencies are given with respect to a tightly isolated muon of loose quality and a matched track of medium quality.

Figure 3 shows the influence of the prescales. At low luminosity, the triggers remain mainly unprescaled, and thus offer the greatest contribution to the OR efficiency. This behaviour is confirmed when not requiring the L1 condition to be accepted (dashed plots). In this case, no prescales are taken into account, and therefore, the efficiencies do not drop at high luminosity.

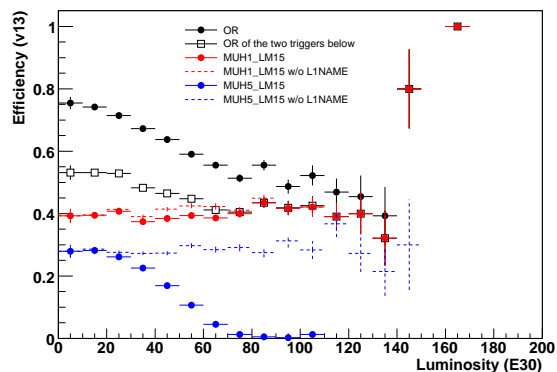


Fig. 3: Dependence of the single muon OR efficiency as function of the instantaneous luminosity, for data collected during a given epoch, and in comparison with other single muon triggers (that are part of the OR). When the L1 condition is required to be fulfilled and accepted (continuous plots), the prescales are taken into account. The efficiencies are given with respect to a tightly isolated muon of loose quality and a matched track of medium quality.

References

- [1] R. Ströhmer *et al.*, MLL Annual report 2001, p. 43.
T. Christiansen *et al.*, MLL Annual report 2000, p. 34.