Performance evaluation of the CBM muon system for a $\omega \to \mu\mu$ trigger

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The emission of lepton pairs out of the hot and dense collision zone of heavy-ion reactions is a promising probe to study the electromagnetic structure of hadrons under extreme conditions. The reconstruction of vector mesons ($\rho, \omega, \phi, J/\psi, \psi'$) is one of the prime tasks of the CBM experiment. To perform this study using the di-muon decay mode, a muon system consisting of a set of absorbers and detector stations will be built.

Since the di-muon yield from vector meson decays is expected to be very low, it is essential to develop a fast and efficient trigger for such events. The muons from decays of low-mass vector mesons (LMVM), e.g. from ω, will be rather soft, making it undesirable to use the total absorber thickness. Therefore, the detector stations surrounding the last but one absorber will be used in the trigger. A similar approach was already presented in [1]. Here somewhat different aspects of this problem are addressed.

At present there are several options for a choice of detectors for the muon system. The homogeneous configuration is based on GEM detectors with pad readout in all tracking stations. The heterogeneous one contains less expensive detectors in several of the downstream stations. The final choice will be based on several considerations including the physics performance. Therefore, it was interesting to compare the ability of these two options to provide a trigger for LMVM. It was also useful to obtain a tool independent from the general tracking to compare two detector configurations, keeping in mind that the general tracking might not be fully tuned to properly handle the heterogeneous detector environment.

A possible heterogeneous muon system configuration is shown in Fig. 1, where the last three detector stations (behind absorbers 4-6) are built from straw tubes. Each station consists of three double layers (doublets), with different doublets rotated around the beam axis to create stereo views. Three doublets of the same station, separated in z by some distance, can be used to create track vectors (segments) necessary for efficient suppression of the background.

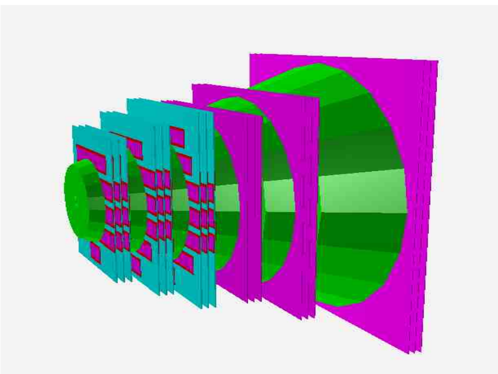

Figure 1: Heterogeneous configuration of the CBM muon system. The last three detector stations (behind absorbers 4-6) are built from straw tubes.

The following event selection strategy was used:

- find track segments in stations 4 and 5;
- merge track segments from different stations, taking into account multiple scattering in the absorber;
- propagate tracks to the target position using a linear extrapolation;
- apply a cut on the radial position of the extrapolated points;
- accept the event if two or more tracks pass the cuts.

In order to ensure a fair comparison of the two detector configurations, the following implementation details were considered:

- simplified (planar) GEM geometry: automatic segmentation and simple digitization and hit finding;
- 6 mm straw tubes: hit producer with hit merging (i.e. only one hit per tube is kept) and left-right ambiguity (i.e. for each “true” hit a mirror one (symmetric relative to the anode wire position) is added (no local left/right ambiguity resolution);
- track segments should include the maximum number of hits (i.e. 3 for GEMs and 6 for straws);
- segment merging: introduced multiple scattering parameters $\sigma_{\alpha\beta}$ and σ_{xy} (thick scatterer approximation) which were obtained from simulation.

The trigger efficiency and background rejection factor were estimated on Monte Carlo event samples of UrQMD central Au+Au events at 25 GeV mixed with $\omega \to \mu\mu$ decays and minimum bias events, respectively. The obtained results are presented in Table 1. Both detector configurations demonstrate a similar performance.

Table 1: Trigger efficiency for the di-muon signal and background rejection factor.

Geometry	Efficiency,%	Bkg. rejection
GEM	6.7±0.4	19.8
Straws	6.7±0.4	19.7

References

[1] A. Kiseleva *et al.*, *CBM Progress Report 2009*, Darmstadt, 2010, p. 67