Background rejection in the dilepton analysis with the CBM-Micro Vertex Detector*

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The light vector mesons ρ, ω and ϕ are excellent probes of the strongly interacting matter under extreme conditions. Their leptonic decay channels of interest as leptons leave the hot and dense fireball without strong interaction and may reveal information on the characteristics of the matter created in the collisions. Single electron or positron tracks from incompletely detected γ-conversions and Dalitz decays of π^0-mesons are the most abundant source contributing to the significant combinatorial background. This study aims at exploring the use of MVD hits topology to reduce this background, despite of the fact that additional background is produced due to the material budget of the MVD.

To do so, electron pairs from meson decays have been simulated from a thermal source for central Au+Au reactions at SIS-100 energies such that the meson spectra are consistent with p_T and rapidity distributions measured by NA49 [1]. The decays of various sources simulated with the Pluto[2] event generator are embedded into the hadronic environment calculated with UrQMD transport model calculations. The magnetic field was set to 100% strength and δ-electrons with energies above 1 MeV have been added equivalent to a 10 kHz interaction rate.

The strategy of background rejection comprises several steps. In order to identify leptons from photon conversions that were produced outside of the target region, each reconstructed track is extrapolated to the primary decay vertex and removed from the analysis depending on its deviation to the vertex. One characteristic for conversion pairs is their small opening angle. A wedge cut is applied taking into account the opening angle of an identified electron to its closest neighbor with particle identification and product of the momenta of the two tracks. As lepton tracks from background sources can predominantly be found at low transverse momenta such tracks are rejected as well [3].

The MVD of the CBM experiment can further contribute to reduce this background by including points from the MVD into the track reconstruction. An improved rejection of pairs originating from the target region could be observed. Previous studies have shown that the MVD stations are also a source for γ conversions which can not be effectively rejected by the vertex extrapolation cut, especially in the first two stations closest to the target. Extrapolating tracks to the first MVD station and requiring that they are in its acceptance helped to better suppress off-vertex tracks from γ-conversions and resulted in an improved signal-to-background ratio for the low mass vector mesons ρ, ω and ϕ as depicted in Tab. 1. The invariant mass spectrum of the full cocktail after all analysis steps is presented in Fig. 1.

Mass Range $\left[\frac{\text{GeV}}{\text{c}^2}\right]$	MVD Stations	S/B	$\text{S}/\sqrt{\text{S}+\text{B}}$
$0-0.15$	0 4	6.56 8.27	31.3 29.4
$0.15-0.6$	0 4	0.10 0.14	3.7 3.7
$0.6-1.2$	0 4	0.15 0.21	4.9 5.4
$\omega \to e^+e^-$	0 4	0.67 0.96	7.4 8.0
$\phi \to e^+e^-$	0 4	0.13 0.19	0.74 0.86

Table 1: Signal-to-background ratios and significance for dilepton decays in different mass regions.

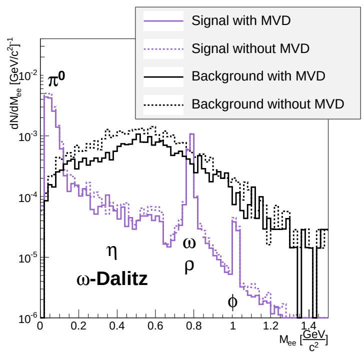

Figure 1: Invariant mass spectrum after all cuts are applied for central AuAu collisions at 8AGeV.

There have been major updates to the CBM software with more realistic digitization and geometries for the CBM detectors, including the MVD [4]. The effects on the dielectron reconstruction are under investigation.

References

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