Employing the CBM Micro Vertex Detector for Background Rejection in Dilepton Analyses *

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Low mass electron (muon) pairs are considered to be excellent probes of the processes taking place in the interior of extreme states of matter formed in the collision zone of heavy-ions. However, the reconstructed distribution of of electron pairs contains in addition contributions from mesons decaying after freeze-out and from combinatorial pairs. 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. The excellent position resolution of the Micro-Vertex Detector (MVD) of the CBM experiment and its proximity to the target offers a chance to reject efficiently the close pairs. This holds in particular for the abundant case, in which the magnetic field of CBM bends the low momentum partner out of the CBM acceptance while the high momentum partner contributes to the combinatorial background of the invariant mass spectrum. We tried to improve the reconstruction the low momentum partner by including points from the MVD into the track reconstruction and to reject the pair based on the reconstructed opening angle.

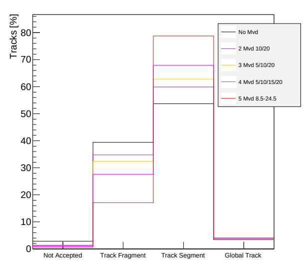

Figure 1: Track topology of dielectrons from π^0-Dalitz decays assuming different configurations of the MVD, i.e. no MVD or a MVD featuring different amount of sensor planes, see text.

Emission from a thermal source was assumed to simulate electron pairs from meson decays for Au+Au reactions at SIS-100 and SIS-300 energies. The simulation parameters were chosen such that the meson spectra are consistent with p_T and rapidity distributions measured by NA49 [1]. The pairs simulated with the Pluto[4] event generator are embedded into hadronic final states calculated with UrQMD. Two versions of the hadronic cocktail were used: one cocktail simulates vector meson decay in vacuum, the second one assumes an in-medium modification of the ρ_0.

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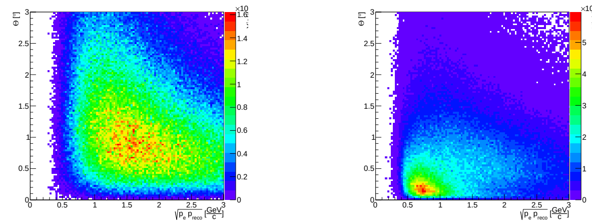

(a) ρ^0 (b) π^0-Dalitz

Figure 2: Opening angle vs. momentum of an identified electron and its nearest reconstructed track for pairs from (a) ρ^0 decays and (b) π^0-Dalitz decays.

Figure 1 shows the track type of the low momentum partner of an e^+/e^--pair from a π^0-Dalitz decay, where the high momentum partner was reconstructed and identified in the RICH. We distinguish track fragments (only individual hits are seen), track segments (also charge and momentum were reconstructed) and global tracks (also particle ID was reconstructed). The number of reconstructed track segments was found to increases substantially with the amount of MVD stations. This comes with draw backs in terms of increasing computing time. In Figure 2, the opening angle between an identified electron and its nearest track segment is correlated to the product of the momenta of these two tracks. A wedge cut can be applied to reduce the background [2] [3]. The additional number of reconstructed low-momentum electrons increases the number of background pairs, which is rejected by this cut. This suggests that the MVD might help to reduce the related background and that this capability is getting more pronounced with an increasing number of MVD-stations.

Further studies are needed to conclude on the optimal number and positions of MVD stations and the optimal magnetic field configuration. The impact of the numerous δ-electrons emitted from the target remains to be taken into account. Finally, the rejection strategy for γ-conversions occurring in the additional MVD stations has to be optimized.

References

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