Thermal dimuon signal extraction with the Muon Detector setup of CBM experiment @ FAIR at 8 AGeV

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Introduction

Compressed baryonic matter (CBM) experiment is considered as one of the major scientific project at the future accelerator facility for anti-proton and ion research (FAIR) in Darmstadt Germany. CBM is a future fixed target experiment to explore the QCD phase diagram in the region of very high net baryon density in the heavy ion collisions, with very high interaction rate (∼10 MHz) in the energy range 2- 45 AGeV. The research program of CBM at SIS100 includes the pioneering measurements of the dimuon ($\mu^+\mu^-$) spectrum with its full glory in the heavy-ion collisions. Muons being leptons do not respond to strong interactions and thus believed to carry unscattered information about the dense interior of the collision zone. The dimuon spectrum is distributed over the full invarinat mass range starting from low mass region which includes LMVMs upto the high mass region which includes J/ψ along with the intermediate mass range which includes thermal dimuon. These thermal dimuons carry an important information of the fireball produced in the collision. We can get the temperature of the fireball from the slope of the invariant mass of thermal dimuon in intermediate region. In this work we have simulated thermal dimuon and extracted the fireball temperature from the slope of the invariant mass distribution at 8 AGeV central Au+Au collision with CBM-MUCH setup using CBMROOT software.

Analysis Procedure

For this analysis we have used CBM detector setup with Silicon Tracking Stations(STS), MUon CHamber (MUCH), Transition Radiation detector (TRD) and Time of Flight(TOF) detectors [1]. The setup diagram is shown in the Fig. 1.

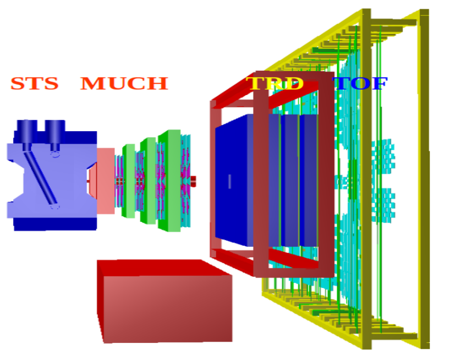

FIG. 1: CBM experimental setup with all other sub detectors

The work has been carried out with CbmRoot framework using GEANT3 transport code to transport the particles through the detector setup. Embedded events (signal+background) was used for central Au+Au collisions at 8 AGeV. To generate background particles UrQMD event generator was used and PLUTO [2] generates signal thermal dimuon with one dimuonic decay per event. Thermal dimuons are detected from those dimuonic decay channels. To identify muon candidates from reconstructed tracks and to reduce background, selection cuts are applied.The selection cuts used here are : a track should have STS hits >=7, MUCH hits>=11 , χ^2_{Vertex}<=2.4,χ^2_{MUCH}<=2.9,χ^2_{STS}<=2.9 and TOF mass parabola cuts have been used. Analysis has been done with 8 AGeV central Au+Au collisions.

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Results and Discussions

After reconstruction of thermal dimuons we can see that it covers only in the forward rapidity region compared to PLUTO input thermal dimuons as shown in Fig. 2. We can see that reconstructed thermal dimuon covers the forward rapidity region.

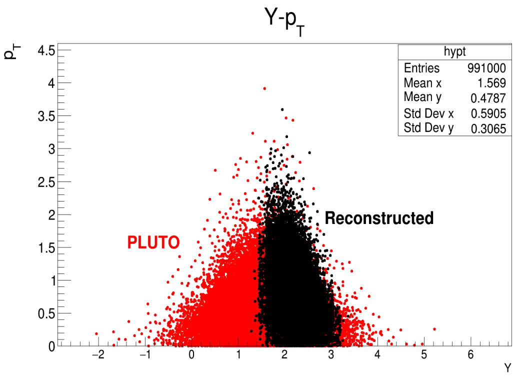

FIG. 2: Y − p_T acceptance of thermal dimuons from PLUTO and reconstructed one.

The $\eta - \phi$ acceptance plot has also been done as shown in Fig. 3

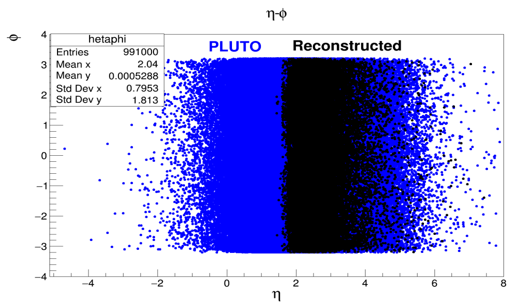

FIG. 3: $\eta - \phi$ acceptance of thermal dimuons from PLUTO and reconstructed one.

In Fig. 4 the p_T distribution of thermal dimuons have been plotted from PLUTO and reconstructed one. But here the spectra is not normalized with multiplicity factor.

Here it is shown the efficiency w.r.t p_T of thermal dimuons. It can be seen that efficiency increases at higher p_T.

Finally we have extracted the tempera-

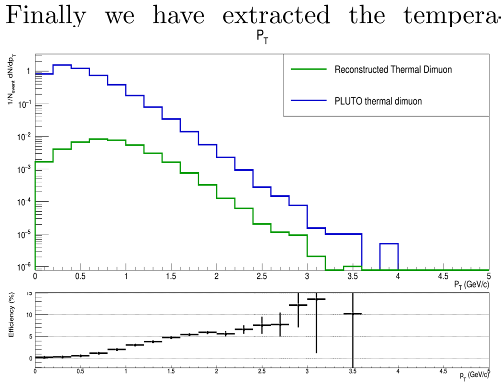

FIG. 4: p_T distribution of thermal dimuons from PLUTO and reconstructed one.

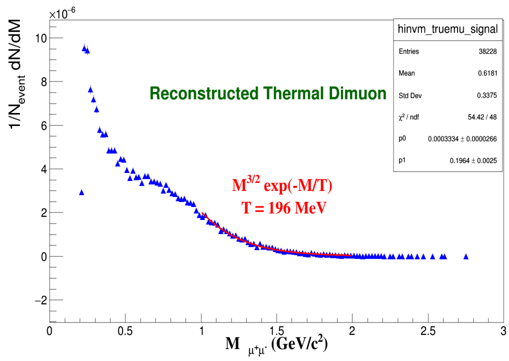

FIG. 5: Invariant mass distribution of reconstructed thermal dimuon.

ture of fireball from fitting the reconstructed invariant mass spectra of thermal dimuon with a function $M^{3/2}$ exp (- M/T),where M −invariant mass and T −temperature of the fireball. From fitting we get temperature 196 MeV.

References

[1] MUCH Technical Design Report.
[2] I. Froehlichet, et al.,Journal of Physics:Conference Series 219 (2010) 032039