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Di-Muon cocktail reconstruction using Machine learning technique in CBM experiment at FAIR SIS100 energies

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The CBM experiment at FAIR-SIS100 will investigates strongly interacting matter at high baryon density and moderate temperature. One of proposed key observable is the measurement of the low mass vector mesons(LMVMs), which can be detected via their di-lepton decay channel. As the decayed leptons leave the dense and hot fireball without further interactions, they can provide unscathed information about the fireball, produced in energetic nuclear collisions.

We will report, simulation for the reconstruction of di-muon continuum spectra for AuAu 8AGeV central collisions using machine learning techniques for selection of muon track candidates. We compared the results from various ML models and with the traditional selection cuts for omega(ω), eta(η), phi(ϕ), rho (ρ)mesons and full di-muon cocktail spectra.

We have attempted to reconstruct LMVM (ω, η, ϕ, ρ) in the event by event mode following standard reconstruction software. Background of central Au-Au collisions at 8 AGeV was generated using UrQMD event generator, whereas for low mass vector mesons signals PLUTO event generator was used. Single LMVM decaying into $\mu^+ + \mu^-$ was embedded into each background event. The particles are then transported through the upgraded detector setup using the GEANT3 transport engine. Various ML algorithams like Gradient boosted decision trees (BDTG), KNN, MLP, HMatrix etc. from the TMVA class have been employed for the present study.
From the simulation results, improvement in di-muon performance is reported. For comparable S/B ratio, the pair reconstruction efficiency and significance is seen to be increased significantly for ω, η, ϕ mesons using various ML models.

Hauptautoren: SHARMA, Pawan Kumar (Variable Energy Cyclotron Center (VECC)(VECC)); Herr MUKERJEE, Raktim (VECC Kolkata); Dr. BHADURI, Partha Pratim (VECC Kolkata); Herr AGARWAL, Apar (VECC Kolkata); Dr. DUBEY, Anand K. (VECC Kolkata)

Vortragende(r): SHARMA, Pawan Kumar (Variable Energy Cyclotron Center (VECC)(VECC))

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