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Reconstruction of Low Mass Vector Mesons via Dimuon decay channel using Machine Learning Technique for the CBM Experiment at FAIR

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The Compressed Baryonic Matter (CBM) experiment, located at the Facility for Antiproton and Ion Research (FAIR) accelerator complex in Darmstadt, Germany, aims to study the phase diagram of strongly interacting matter in the realm of high net baryon densities and moderate temperatures. The SIS-100 accelerator ring at FAIR produces accelerated beams up to the energies of about 30 GeV for protons, and 12A GeV for heavy ions. The identification of muon pairs produced via the decay of vector mesons has been identified as one of the most significant physics observable for characterizing the hot and dense matter created in the collisions. The Muon Chamber (MuCh) detector system is being built to identify the muon pairs in a background mostly populated by muons from weak decay of pions and kaons produced in the collisions.

We will report our present simulation results on the physics performance for the reconstruction of low mass vector mesons in central Au+Au collisions at the beam energy 8A GeV using various machine learning models and compare the results with the traditional dimuon analysis. We treated the decay of low-mass vector mesons into dimuons as our signal simulated using the PLUTO event generator and incorporated into background events generated by the UrQMD event generator passing through the MuCh detector system. The performance of the different machine learning algorithms to improve the reconstruction efficiency (ϵ) without compromising the Signal-to-Background ratio (S/B) will be reported. A comparison with the conventional dimuon analysis software will also be presented.

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