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Machine learning application for electron identification in CBM

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The Compressed Baryonic Matter experiment is a future fixed target experiment designed to probe the QCD phase diagram at high baryonic density and moderate temperatures. Di-electrons are a penetrating probe well suited to understand the initial QCD medium since the electrons interact only electromagnetically and are hence not affected by the strong medium effects. Efficient identification of the electrons with minimum pion contamination is paramount in these kinds of studies. The CBM experiment uses a Ring Imaging Cherenkov detector (RICH) in combination with a Transition Radiation Detector (TRD) for electron-pion separation, and a Time of Flight(ToF) detector for identification of high-mass hadrons.

In the RICH reconstruction, a Single-Layer Perceptron (SLP) is used so far for the classification of $e^{\pm}$ and $\pi^{\pm}$. In it's first part, this contribution will focus on improving electron identification in CBM, particularly with the RICH detector where the classic SLP is compared to tree-based ensemble models (XGBOOST, LightGBM) and corresponding feature optimization.

Almost 80% of the electron rings in RICH stem from photon conversion in the detector material after the tracking stations. Removing such conversion electron rings from the sample can substantially reduce the false identification of pion tracks as electrons. This can be achieved by tracking conversion electrons behind the RICH (using TRD). Additionally, the information from ToF can be used as an additional electron reference (rejecting hadrons in the TRD track sample). In it's second part this contribution will discuss the efficient use of the information from TRD and ToF using ensemble models to reduce the contribution from conversion electrons.

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