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RICH ring reconstruction using machine learning for CBM

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The Compressed Baryonic Matter experiment (CBM) at FAIR is designed to explore the QCD phase diagram at high baryon densities with interaction rates up to 10 MHz using triggerless free-streaming data acquisition. For the overall PID, the CBM Ring Imaging Cherenkov detector (RICH) contributes by identifying electrons from lowest momenta up to 10 GeV/c, with a pion suppression of > 100 . The RICH reconstruction combines a local Cherenkov ring finding with a ring-track matching of found rings and extrapolated tracks from the Silicon Tracking System (STS).

The existing conventional algorithms were revised and optimized, and alternative machine learning approaches were investigated. Methods based on CNN/GNN architectures were developed for ring finding, noise suppression and ring-track matching while taking into account the latency and data format (space and time, i.e. 3+1) constraints of the triggerless free-streaming readout. The methods were tested and validated on simulations taking into account the time data stream and on data from the prototype mini-RICH (mRICH) in the mini-CBM (mCBM) experiment, which shares the same free-streaming readout concept as the future CBM experiment.

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