

A QGP Trigger based on Convolutional Neural Network for the CBM Experiment

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The field of heavy-ion experiments, particularly those like the upcoming Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR), requires high-performance algorithms capable of efficient real-time data analysis. The incorporation of machine learning, especially artificial neural networks, into these experiments is a major breakthrough. This report highlights the use of a specialized neural network package, ANN4FLES, tailored for high-performance computing environments, focusing on its application in the CBM experiment to identify and classify events that could indicate the creation of Quark-Gluon Plasma (QGP).

Our study introduces an innovative method using ANN to create a QGP detection system within the First Level Event Selection (FLES) framework, a key component of the CBM experiment. We explore the effectiveness of both fully-connected and convolutional neural networks by training and evaluating them on simulated collision data (Au+Au collisions at 31.2A GeV) created with the Parton-Hadron-String Dynamics (PHSD) model. The findings show that convolutional neural networks significantly outperform their fully-connected counterparts, achieving an impressive accuracy of over 95% on the test data.

This report provides an in-depth look at why the neural network excels in accurately identifying QGP-related events, touching on the complex physics involved. It also covers the critical aspects of neural networks, particularly their relevance to analyzing heavy-ion collisions where detecting quark-gluon plasma is crucial.