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Multi-differential Studies of Strangeness Production with the CBM at FAIR using Machine Learning Techniques

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The Compressed Baryonic Matter (CBM) experiment at FAIR will investigate the QCD phase diagram at high net-baryon densities ($_B$ > 500 MeV) with heavy-ion collisions in the energy range $\sqrt{s_{NN}} = 2.9$—4.9 GeV. Precise determination of dense baryonic matter properties requires multi-differential measurements of strange hadron yields and their collective flow, both for the most copiously produced K^0_s and Λ as well as for rare (multi-)strange hyperons and their antiparticles.

In CBM strange hadrons Λ, K^0_s and $^-$ are reconstructed by their weak decays using a Kalman Filter algorithm. A machine learning model based on boosted decision trees (XGBoost) is used to make a non-linear multi-parameter selection according to the topology of the decay with high purity and high background rejection. For the rare $^-$ baryon a special selection using two consecutive XGBoost models is used. The yield of the strange hadrons is extracted multi-differentially using a multi-step fitting routine, where each p_T-y-interval has its separately trained machine learning model.

The CBM performance for multi-differential analysis of yields and collective flow of strange hadrons Λ, K^0_s and $^-$ will be presented together with an estimation of systematic uncertainties. Also, statistical error projections for flow measurements with rarely produced strange hyperons at the high rate data taking expected at CBM will be shown.

Category

Experiment

Collaboration (if applicable)

CBM

Primary author: PUNTKE, Axel (WWU Münster)

Co-authors: DUBLA, Andrea (GSI); Mr FIDORRA, Felix (WWU Münster); Mr SELYUZHENKOV, Ilya (GSI); Ms KÜMMERER, Lisa Katrin (Ruprecht-Karls-University Heidelberg); Mr LUBYNETS, Oleksii (GSI); Mr KHAN, Shahid (Eberhard Karls University of Tübingen)

Presenter: PUNTKE, Axel (WWU Münster)

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