Kent State University
Special Physics Colloquium

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"Measurement of Charm Meson Production in Au+Au Collisions at $\sqrt{S_{NN}}$ GeV"

The study and characterization of nuclear matter under extreme conditions of temperature and pressure, and a full understanding of deconfined partonic matter, the Quark Gluon Plasma (QGP), are major goals of modern high-energy nuclear physics.

Heavy quarks (charm and bottom) are formed mainly in the early stages of the collision. Open heavy flavor measurements, e.g. D0, D±, D*±, are excellent tools to probe and study the hot and dense medium formed in heavy ion collisions. Details of their interaction with the surrounding medium can be studied through energy loss and elliptic flow measurements thus providing valuable information about the nature of the medium and its degree of thermalization.

Initial indirect reconstruction studies of heavy quark particles using the electrons from heavy flavor decays, showed a large magnitude of energy loss that was inconsistent with model predictions and assumptions, at the time. Precise measurements of fully reconstructed heavy mesons would provide better understanding of the energy loss mechanisms and the properties of the formed medium.

In relativistic heavy ion collisions, the relatively low abundance of heavy quarks and their short lifetimes makes them difficult to distinguish from the event vertex and the combinatorial background; therefore the need for a high precision vertex detector to reconstruct their decay particles. In 2014 a new micro vertex detector was installed in the STAR experiment at Brookhaven National Lab. The Heavy Flavor Tracker (HFT) was designed to perform direct topological reconstruction of the weak decays of heavy flavor particles. The HFT improves STAR track pointing resolution from a few millimeters to ~30 microns for 1 GeV/c pions, allowing direct reconstruction of short lifetime particles. Although the results of the open charm meson reconstruction using the HFT improved dramatically there is still a lot of room for optimization, especially for reconstructed particles with low transverse momentum (<1 GeV/c).

In this analysis we use advanced vertex fitting techniques based on the Kalman filter and also advanced multivariate techniques (i.e. machine learning) to maximize the efficiency of the acquired signal. Machine learning techniques are widely used in many data analysis problems and are also in wide use in high-energy physics experiments. Different optimization methods are tested like Likelihood, Neural Networks and Binary Decision Trees (BDT).

We have applied these analysis techniques on our Run-14 data sample (~1.2 billion Au+Au events at 200 GeV) and we present results for D0 meson pT spectra and nuclear modification factor (RAA). We discuss the obtained results and compare with current theory models.

MONDAY, APRIL 4, 2016

10:45 A.M. – 11:50 A.M.

SMITH HALL 111

REFRESHMENTS: 10:30 A.M. – SMITH HALL LOBBY

NOTE: SPECIAL DAY