PROCEEDINGS OF SCIENCE

D^0 production in U+U collisions at $\sqrt{s_{NN}} = 193$ GeV at the STAR experiment

Jana Crkovská* **for STAR Collaboration**
Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Břehová 7, Prague, Czech Republic
E-mail: crkovjan@fjfi.cvut.cz

The relativistic heavy-ion collisions at RHIC in Brookhaven National Laboratory allow to produce a hot and dense nuclear matter - the Quark-Gluon Plasma (QGP). During the initial phase of the collision, enough energy can be released from the hard scattering to produce heavy quarks such as charm and bottom. Due to their large masses, heavy quarks do interact differently with QGP than light quarks. The measurement of the production of mesons containing heavy quarks, such as D^0, in heavy ion collision is important to understand the properties of QGP.
The STAR experiment previously measured the production of charm mesons via hadronic channels in p+p, d+Au and Au+Au collisions. Heavy quarks were observed to be strongly suppressed in central Au+Au collisions. As U+U collision should produce even higher energy density, new information on heavy quark energy loss could be acquired. In this proceedings, the status of D^0 measurement in U+U collisions at $\sqrt{s_{NN}} = 193$ GeV via hadronic decay channel $D^0 \longrightarrow \pi^+ + K^-$ is presented.

The European Physical Society Conference on High Energy Physics -EPS-HEP2013
18-24 July 2013
Stockholm, Sweden

*Speaker.

PoS(EPS-HEP 2013)037

1. Motivation

Open charm measurements are an important part of investigation of heavy-quark production in ultrarelativistic nuclear collisions. These measurements are important test of the pQCD calculations and also improve the understanding of the parton energy loss mechanisms in hot and dense nuclear matter. Previous measurements of nuclear modification factor of heavy quark particles indicate that there is similar suppression of charm and light hadrons at RHIC [1] although there is indication of some difference at LHC energies[2].

The hadronic decay $D^0 \longrightarrow K^- + \pi^+$ allows direct reconstruction of D^0 mesons. The drawbacks are large combinatorial background and a small branching ratio of 3.89%. Compared to previous STAR measurements of the hadronic channel $D^0 \longrightarrow \pi^+ + K^-$ [1,3,4], the U+U system is believed to provide new information on heavy quark energy loss.

2. Data Analysis

For the analysis presented here, minimum-bias events collected in Year 2012 for U+U collisions at $\sqrt{s_{NN}} = 193$ GeV were used. Decay products were identified using a combination of the Time Projection Chamber (TPC) and the Time of Flight (TOF) subsystems.

The TPC detector provides information about ionisation energy loss of the passing particle together with its momentum based on track curvature in magnetic field. TPC particle identification (PID) cuts were applied at $p_T = 0.2 - 0.6$ GeV$/c$ and $p_T > 3.0$ GeV$/c$. Only tracks fulfilling $|n\sigma_K| < 2$ and $|n\sigma_\pi| < 2$ were accepted,where $n\sigma$ is a number of standard deviation from the expected value of ionisation loss d$E/$dx for a given particle. The $n\sigma$ is defined as $n\sigma = (\ln \mathrm{d}E/\mathrm{d}x - \ln \mathrm{d}E/\mathrm{d}x_{meas})/R$, with R being the detector resolution. The TOF detector measures the velocity $1/\beta$ of the particles. Together with momentum information acquired from TPC, the mass of the particle can be calculated, providing a clear identification of the species. The TOF was used over p_T range of $0.6 - 3.0$ GeV$/c$. We required $1/\beta \in \left[\sqrt{\frac{m^2}{p^2}+1} - 2\sigma; \sqrt{\frac{m^2}{p^2}+1} + 2\sigma\right]$ where $\sigma_K = 0.0076 + 0.0014/(1.89^{1.758p} - 1.152^{1.57})$ and $\sigma_\pi = 0.0075$. The standard deviation was determined from the real data.

3. Results

We have investigated the production of D^0 meson for p_T up to 5.0 GeV$/c$. The mixed-event method has been used to describe the combinatorial background. Candidates for the daughter particles are selected from different events. In this case, each kaon (pion) was combined with pions (kaons) from 5 different events. The obtained mixed background was then normalised using a ratio of integral of unlike and mixed background over the invariant mass range $1.2 - 1.3$ GeV$/c^2$. The invariant mass distribution after background subtraction divided into 5 p_T-bins is shown in Fig. 1. The residual background was described using a second degree polynomial. The significance was calculated as $sign = S/\sqrt{S+B}$.

The preliminary results show that STAR can identify the $D^0 + \overline{D^0}$ signal in U+U collisions with significance larger or equal 3σ up to p_T of 5 GeV$/c$.

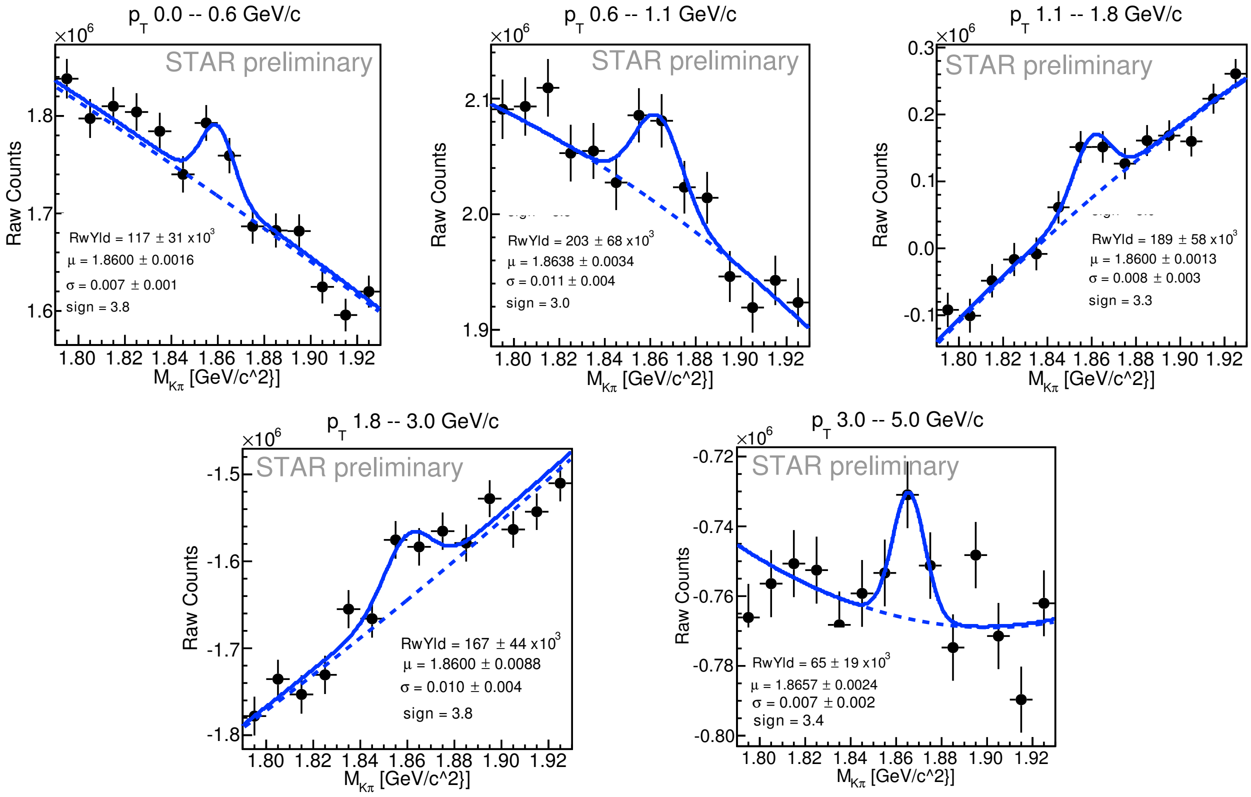

Figure 1: Invariant mass distribution for $K^{\pm}\pi^{\mp}$ pairs in U+U at $\sqrt{s_{NN}} = 193$ GeV after mixed-event background subtraction.

Acknowledgement

This work was supported by the grant of the Grant Agency of Czech Republic n.13-20841S and by the Grant Agency of the Czech Technical University in Prague, grant No. SGS13/215/OHK4/3T/14.

References

[1] D. Tlustý *et al.* (STAR Collaboration), Nucl. Phys. **A 904-905**, 639c (2013).

[2] B. Abelev *et al.* (ALICE Collaboration), JHEP 09 (2012) 112.

[3] L. Adamczyk *et al.* (STAR Collaboration), Phys. Rev. **D 86**, 072013 (2012).

[4] J. Adams *et al.* (STAR Collaboration), Phys. Rev. Lett. **94**, 062301 (2005).

[5] M. Cacciari, P. Nason and R. Vogt, Phys. Rev. Lett. **95**, 122001 (2005).