D^0 Meson Tagged Jets in Heavy Ion Collisions at STAR

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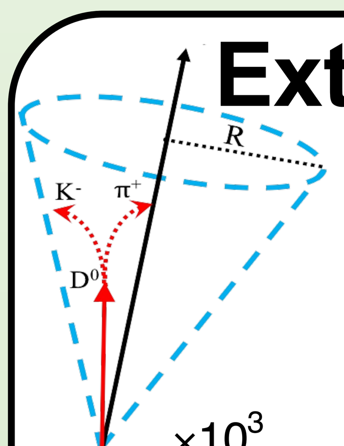
Introduction

Heavy flavor quarks (charm and bottom), produced in the early stages of heavy-ion collisions, serve as excellent probes to study the properties of the Quark-Gluon Plasma (QGP). When traversing the medium, charm quarks suffer from 'jet quenching' because of the interactions with the QGP. It can manifest as **charm quark energy loss** and **modifications to the fragmentation pattern**, both of which are predicted to depend on parton flavor and quark mass. Additionally, in-medium interactions can affect the propagation of the charm quark, which can manifest as **charm quark diffusion**. To quantify these effects, we present some new measurements of D^0 ($c\bar{u}$) meson tagged jets in $\sqrt{s_{NN}} = 200$ GeV *Au+Au* collisions at STAR.

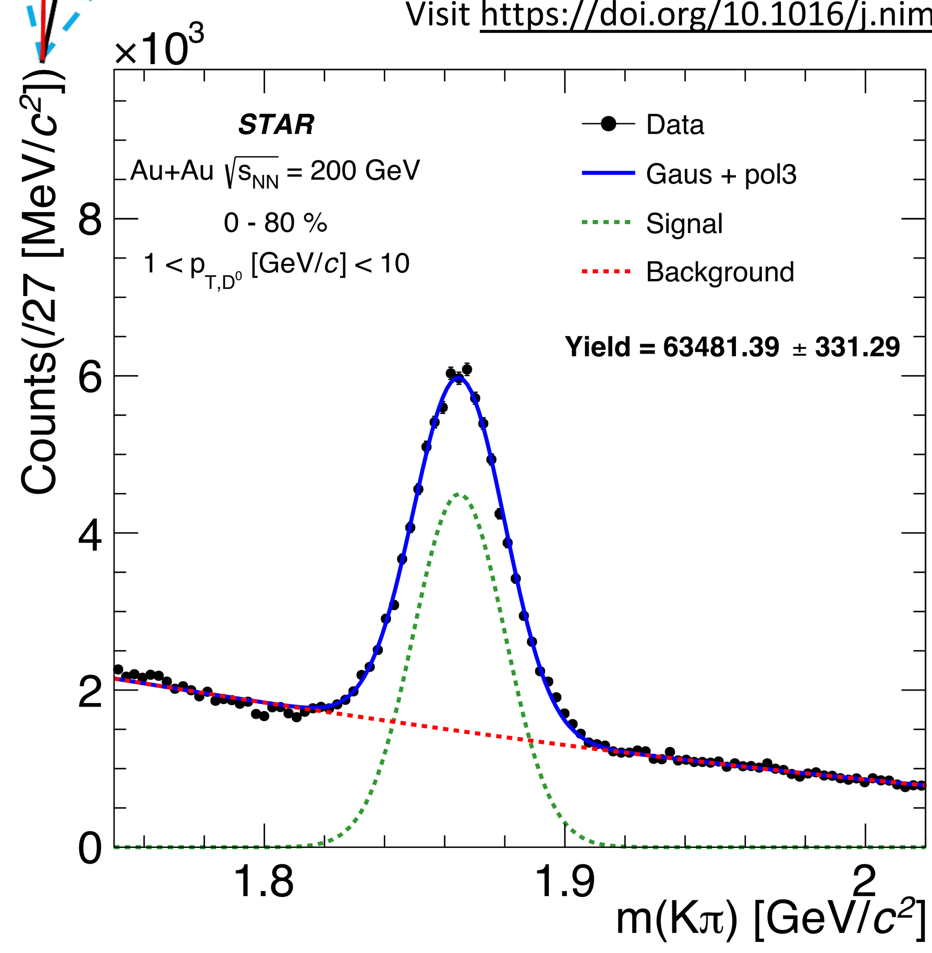
Extracting Raw D^0 Tagged Jet Yield



$_s\mathcal{P}lot$

$$_s\mathcal{P}_n(m_{K\pi,i}) = \frac{\sum_{j=1}^{N_T} V_{nj} f_j(m_{K\pi,i})}{\sum_{k=1}^{N_T} N_k f_k(m_{K\pi,i})}$$

Visit https://doi.org/10.1016/j.nima.2005.08.106 for more details on *sPlot*



Unbinned Maximum Likelihood Fit

- ★ ***n*** = n^{th} fit component(sig/bkg)
- ★ $\boldsymbol{N_k}$ = k^{th} yield (**T=2**)
- ★ $\boldsymbol{f_k(m_{K\pi,i})}$ = per-event PDF value with k^{th} hypothesis
- ★ **V** = cov. matrix

Jet Clustering

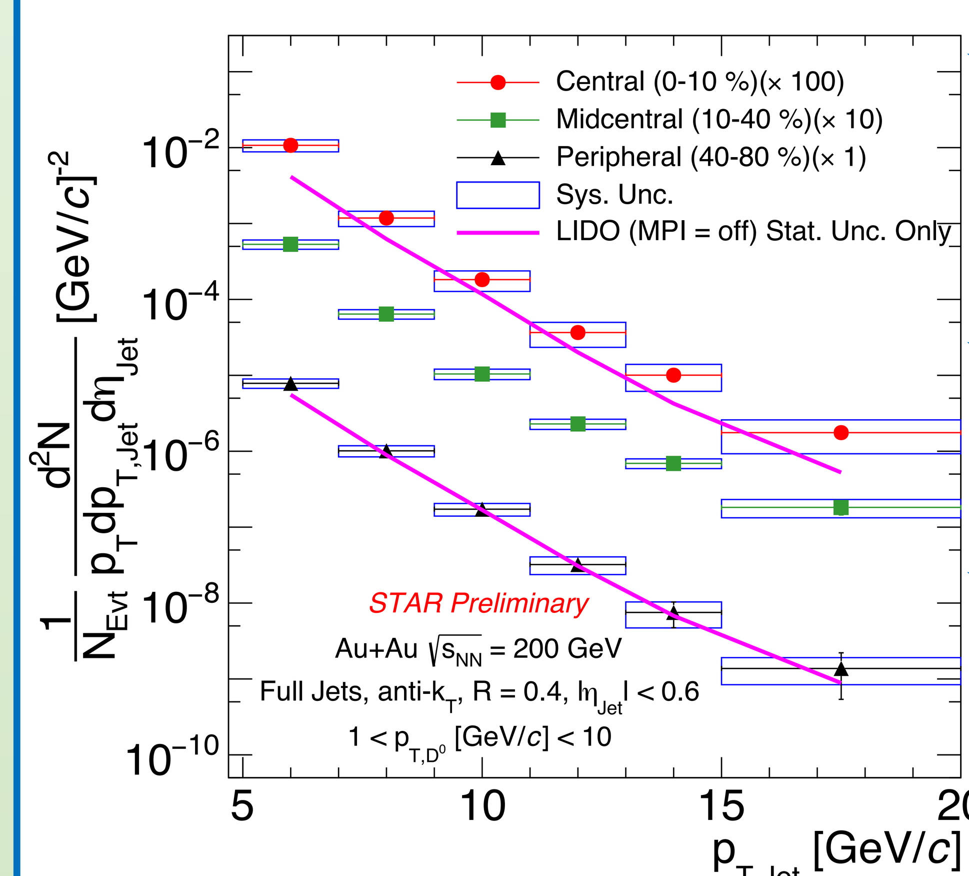
- ★ Replace Kπ in event with D^0
- ★ Cluster tracks/towers with **anti-k_T algorithm**, radius **R = 0.4**

Efficiency Correction → $_s\mathcal{P}_n(m_{K\pi,i}) \rightarrow \frac{_s\mathcal{P}_n(m_{K\pi,i})}{\varepsilon(m_{K\pi,i})}$ → **sWeights**

Fill observable histograms with weight = sWeights for data distributions

First application of *sPlot* to STAR data

Transverse Momentum Spectra



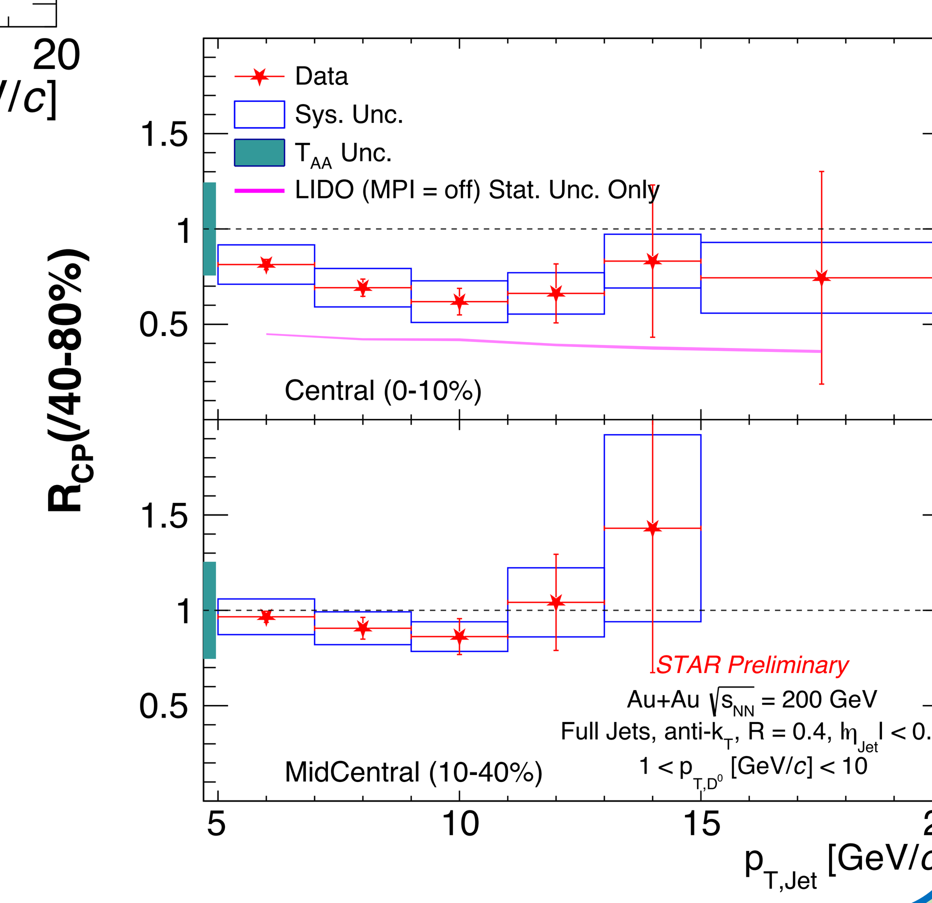
- ★ LIDO → Hybrid transport model for heavy quark evolution in medium with collisional and radiative energy losses

  Visit https://doi.org/10.1103/PhysRevC.98.064901 for details on LIDO

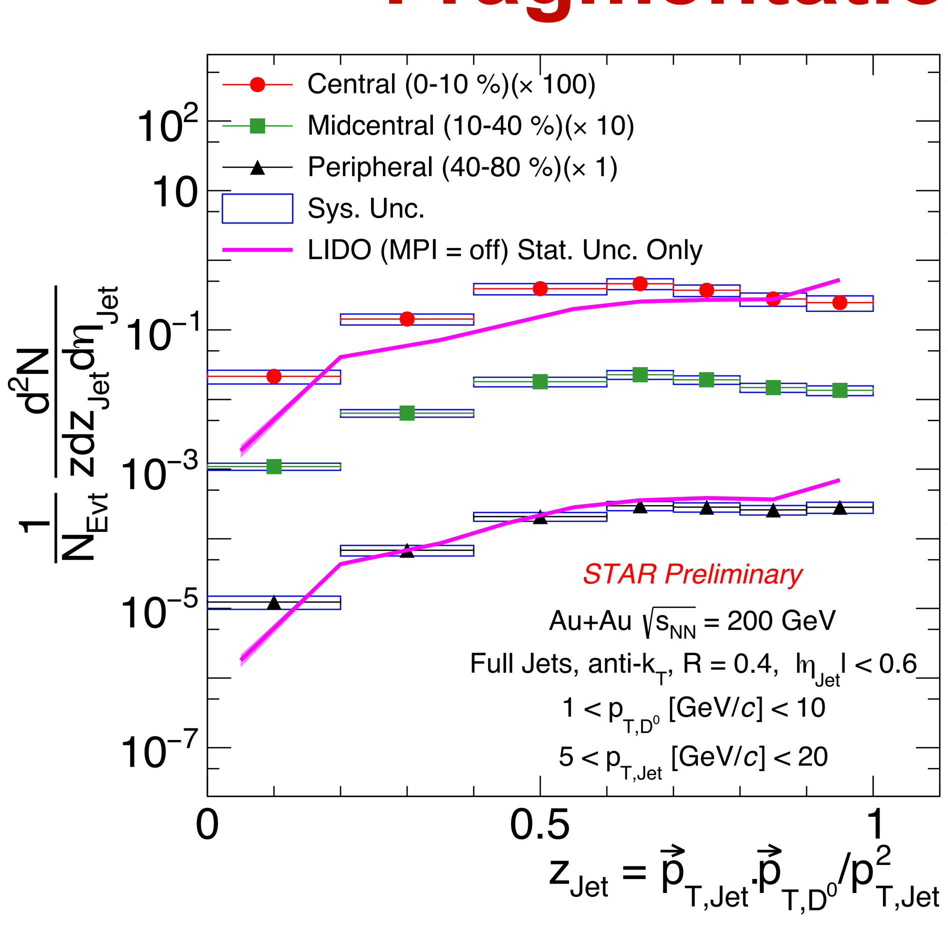
- ★ LIDO **agrees well** with yield in peripheral events, **slightly underpredicts** yield in central events
- ★ MPI might be important for low p_{T,D^0} yield [1]

[1] Weiyao Ke, Personal Communication

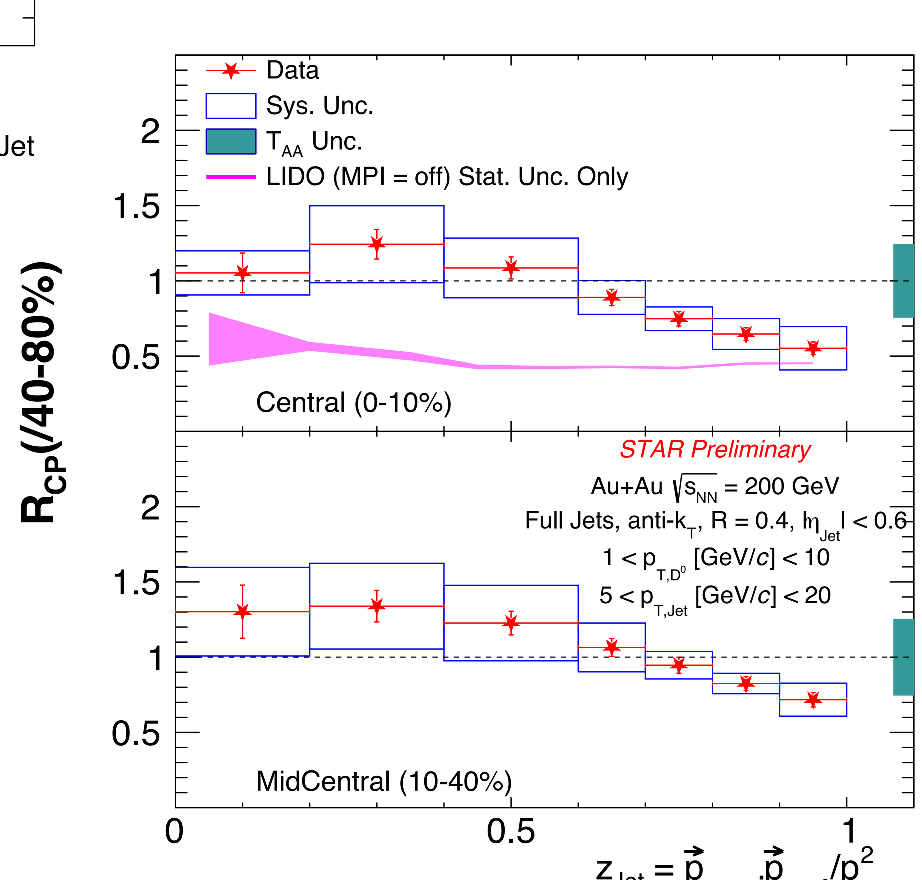
- ★ **Hint of suppression** of D^0 jet yield in central events
- ★ **Ratio** in midcentral events **consistent with 1**



Fragmentation Function

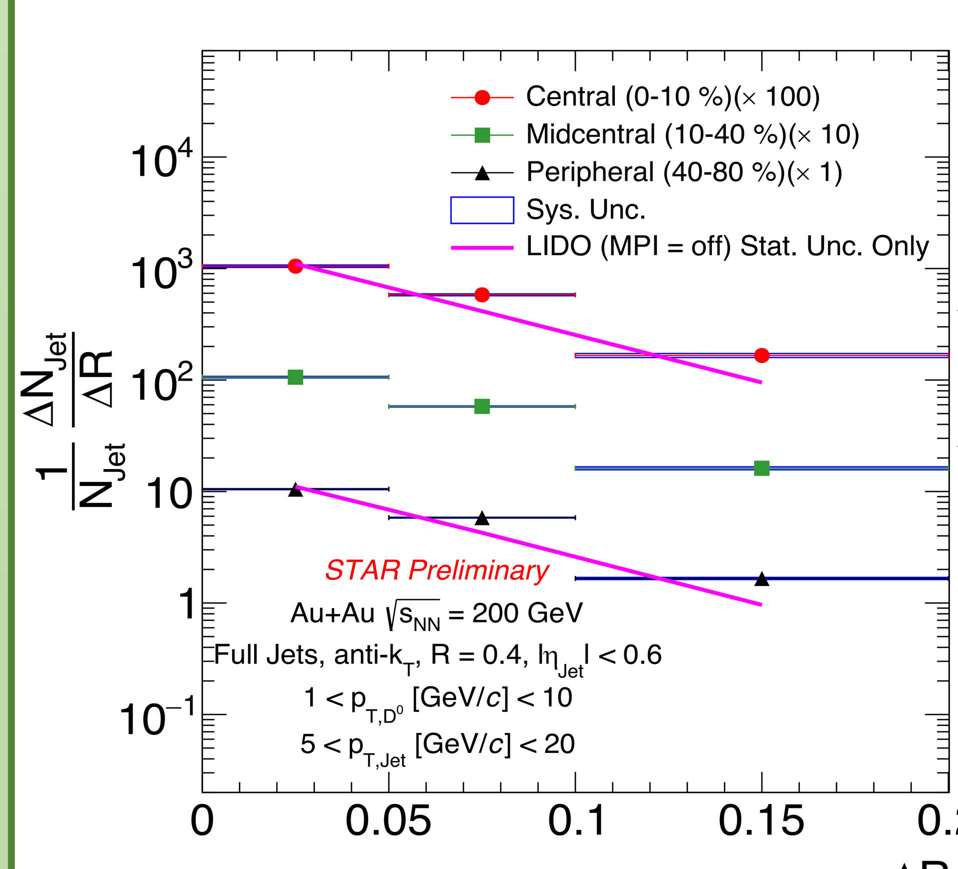


- ★ z_{Jet} related to fragmentation function in DGLAP equation
- ★ 2D unfolded with jet p_T spectra
- ★ LIDO slightly overpredicts hard-fragmented D^0 mesons
- ★ LIDO **agrees well** with yield in peripheral events, **slightly underpredicts** yield in central events



- ★ **Hard fragmented** D^0 jet yield **suppressed** in central/midcentral events
- ★ **Soft fragmented** D^0 jet yield **ratio consistent with 1** in central/ midcentral events

D^0 Radial Profile

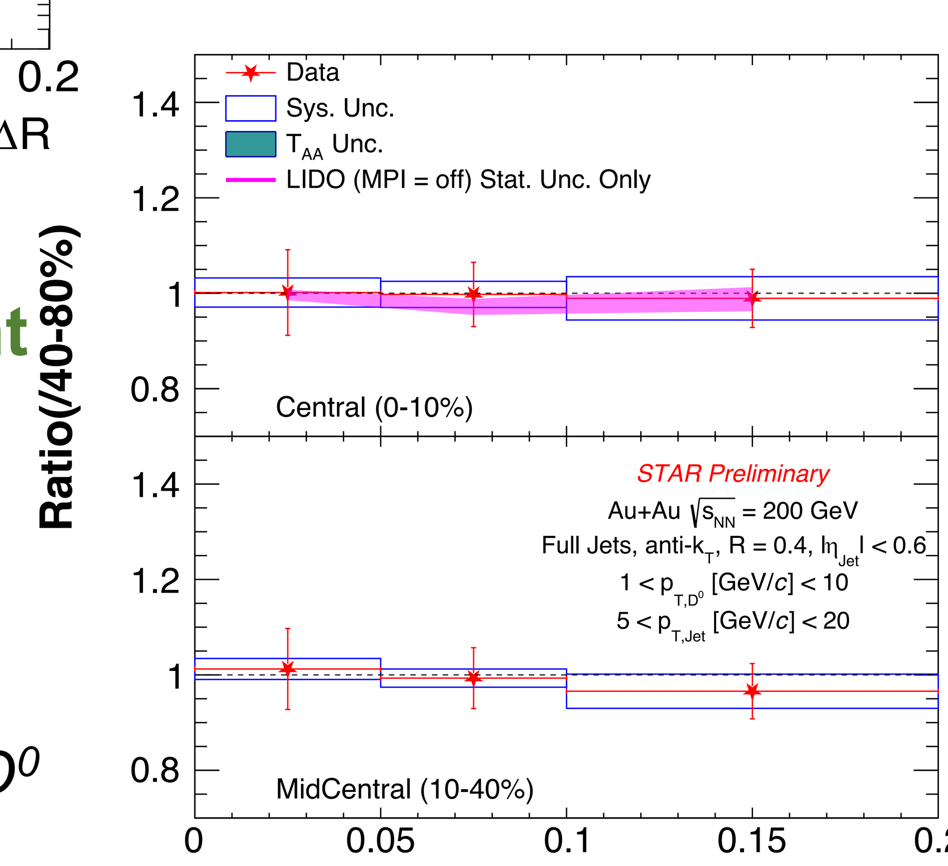


$$\Delta r = \sqrt{(\eta_{Jet} - \eta_{D^0})^2 + (\phi_{Jet} - \phi_{D^0})^2}$$

- ★ 2D unfolded with jet p_T spectra
- ★ LIDO **qualitatively explains** radial profile trends, along with ratio of radial profile for central and peripheral events
- ★ Ratio of radial profiles consistent with 1 – **No hint of D^0 radial profile modification at RHIC energies**

At LHC energies, hint of modification seen for low p_T D^0

For details, visit https://doi.org/10.1103/PhysRevLett.125.102001



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The STAR Collaboration
https://drupal.star.bnl.gov/STAR/presentations