

# D<sup>0</sup> Meson Tagged Jets in Heavy Ion Collisions at STAR

Diptanil Roy (roydiptanil@gmail.com), for the STAR Collaboration

Rutgers University



## Introduction

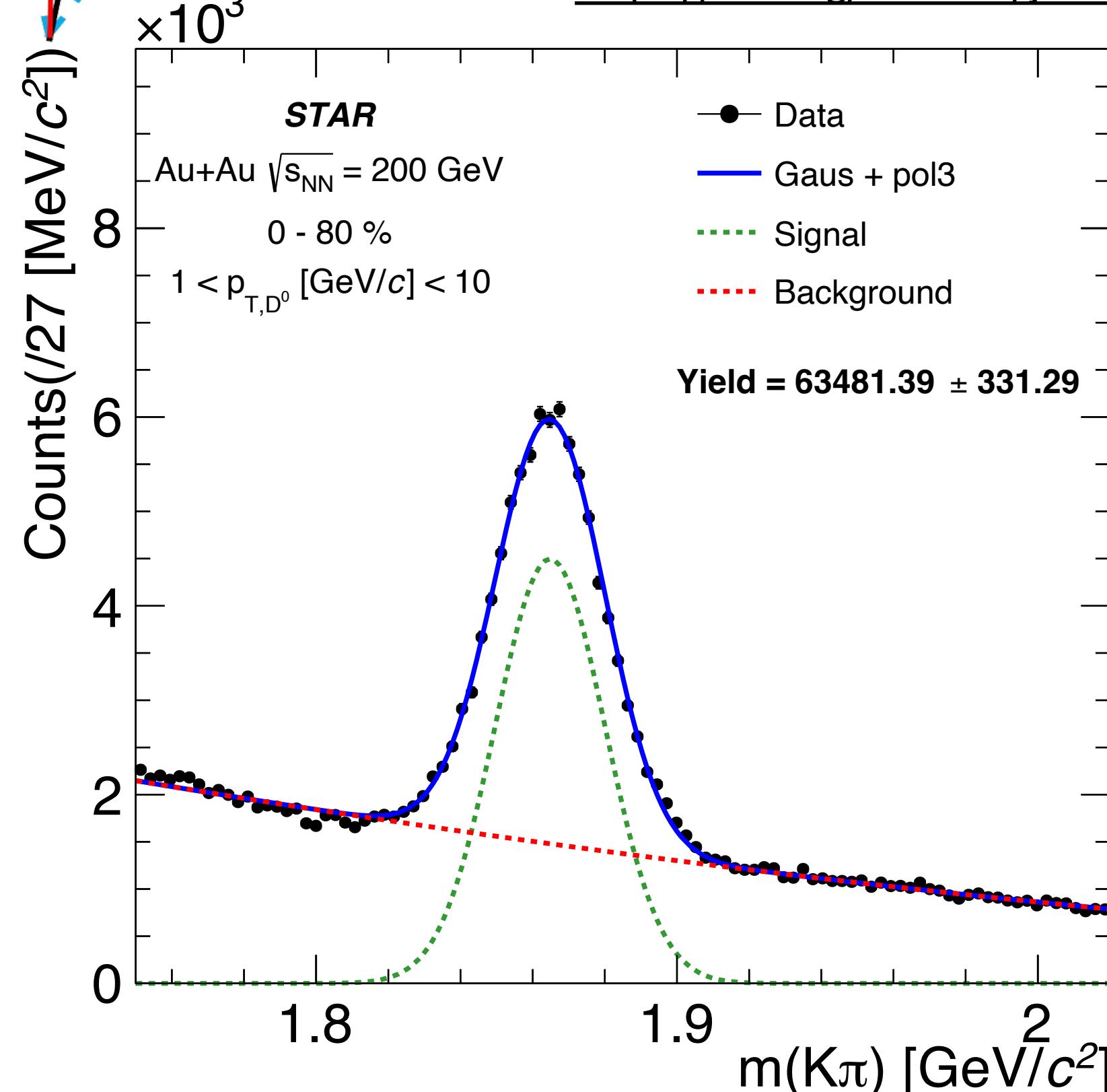
Heavy flavor quarks (charm and bottom), produced in the early stages of heavy-ion collisions, serve as excellent probes to study the properties of the Quark-Gluon Plasma (QGP). When traversing the medium, charm quarks suffer from ‘jet quenching’ because of the interactions with the QGP. It can manifest 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<sup>0</sup> (c<sup>+</sup> c<sup>-</sup>) meson tagged jets in  $\sqrt{s_{NN}} = 200$  GeV Au+Au collisions at STAR.

### Extracting Raw D<sup>0</sup> Tagged Jet Yield

sPlot

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

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



#### Unbinned Maximum Likelihood Fit

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

#### Jet Clustering

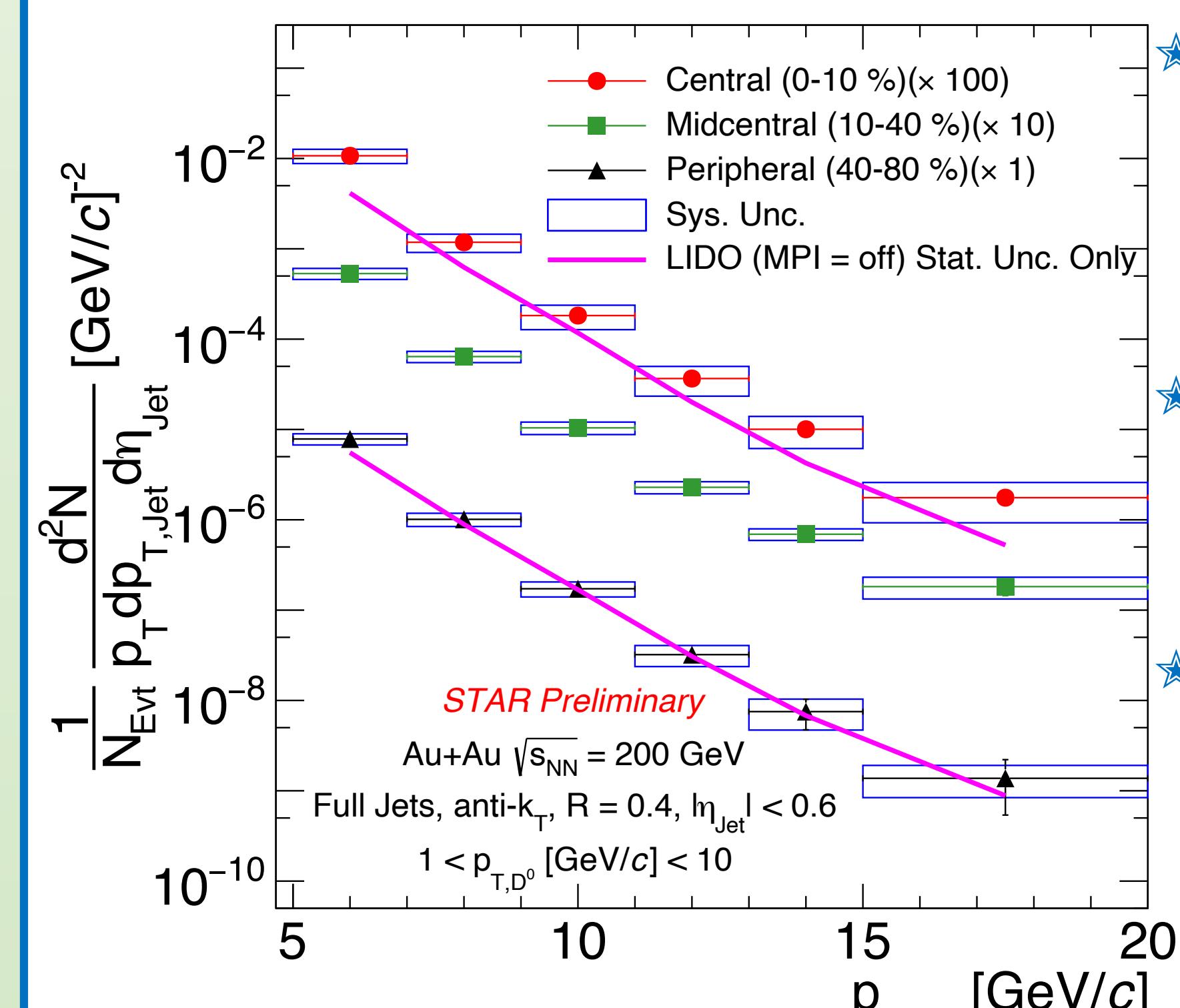
- ★ Replace K $\pi$  in event with D<sup>0</sup>
- ★ Cluster tracks/towers with **anti-k<sub>T</sub>** algorithm, radius **R = 0.4**

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

Fill observable histograms with weight = sWeights for data distributions

#### First application of sPlot to STAR data

### Transverse Momentum Spectra

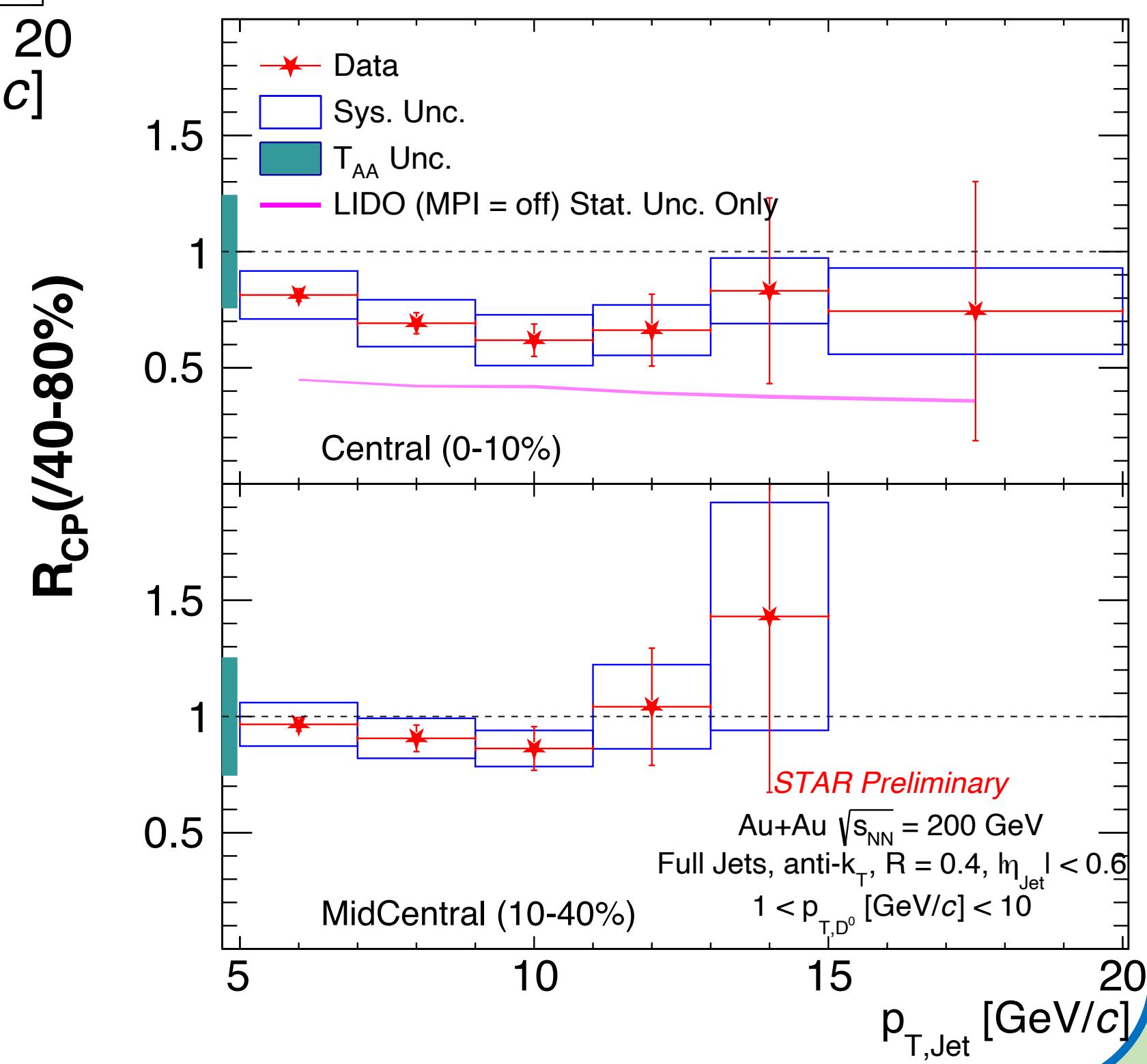


LIDO → Hybrid transport model for heavy quark evolution in medium with collisional and radiative energy losses  
Visit <https://doi.org/10.1103/PhysRevC.98.064901> for details on LIDO

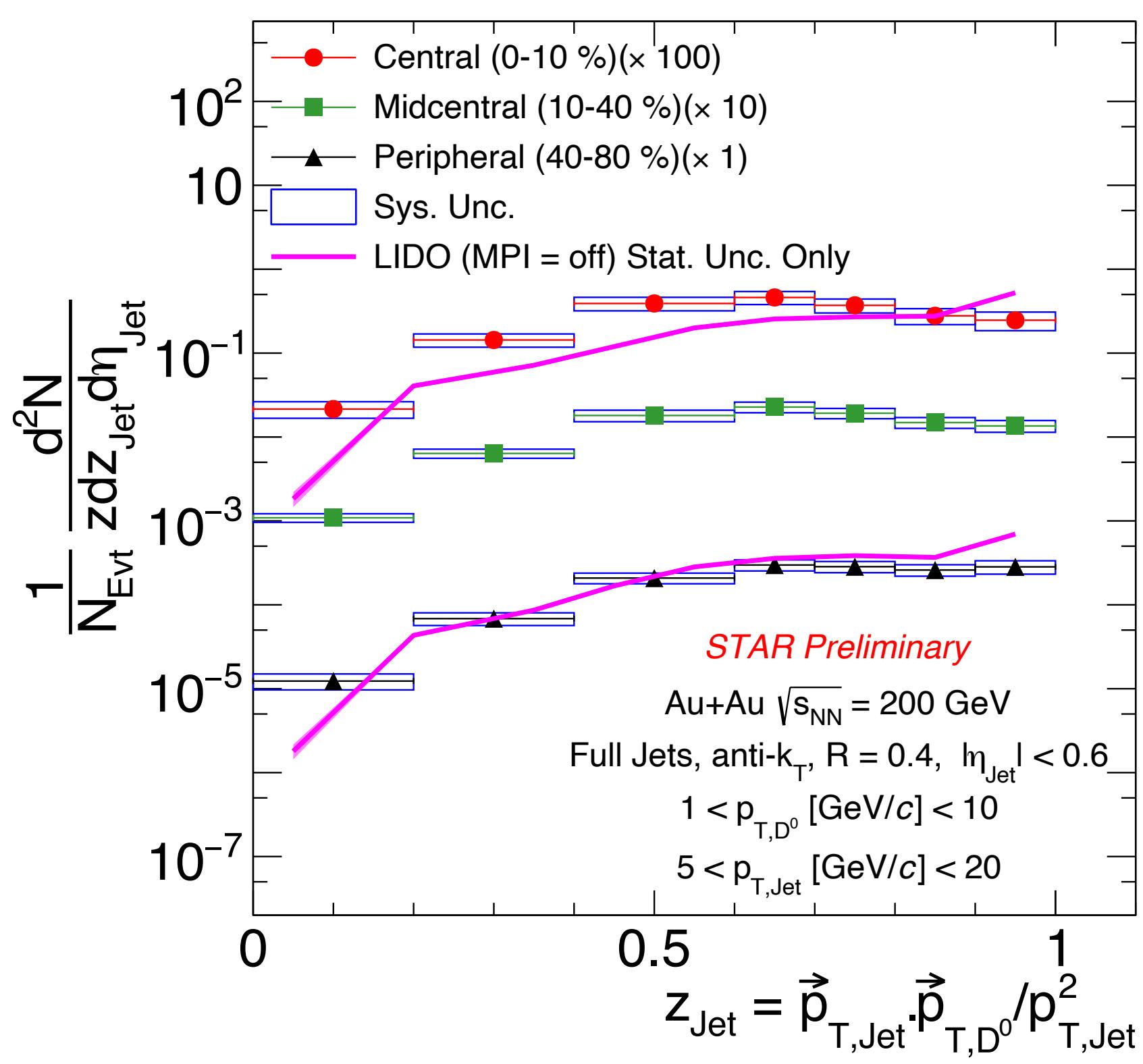
LIDO **agrees well** with yield in peripheral events, **slightly underpredicts** yield in central events

MPI might be important for low p<sub>T,D<sup>0</sup></sub> yield [1]

[1] Weiyao Ke, Personal Communication



### Fragmentation Function

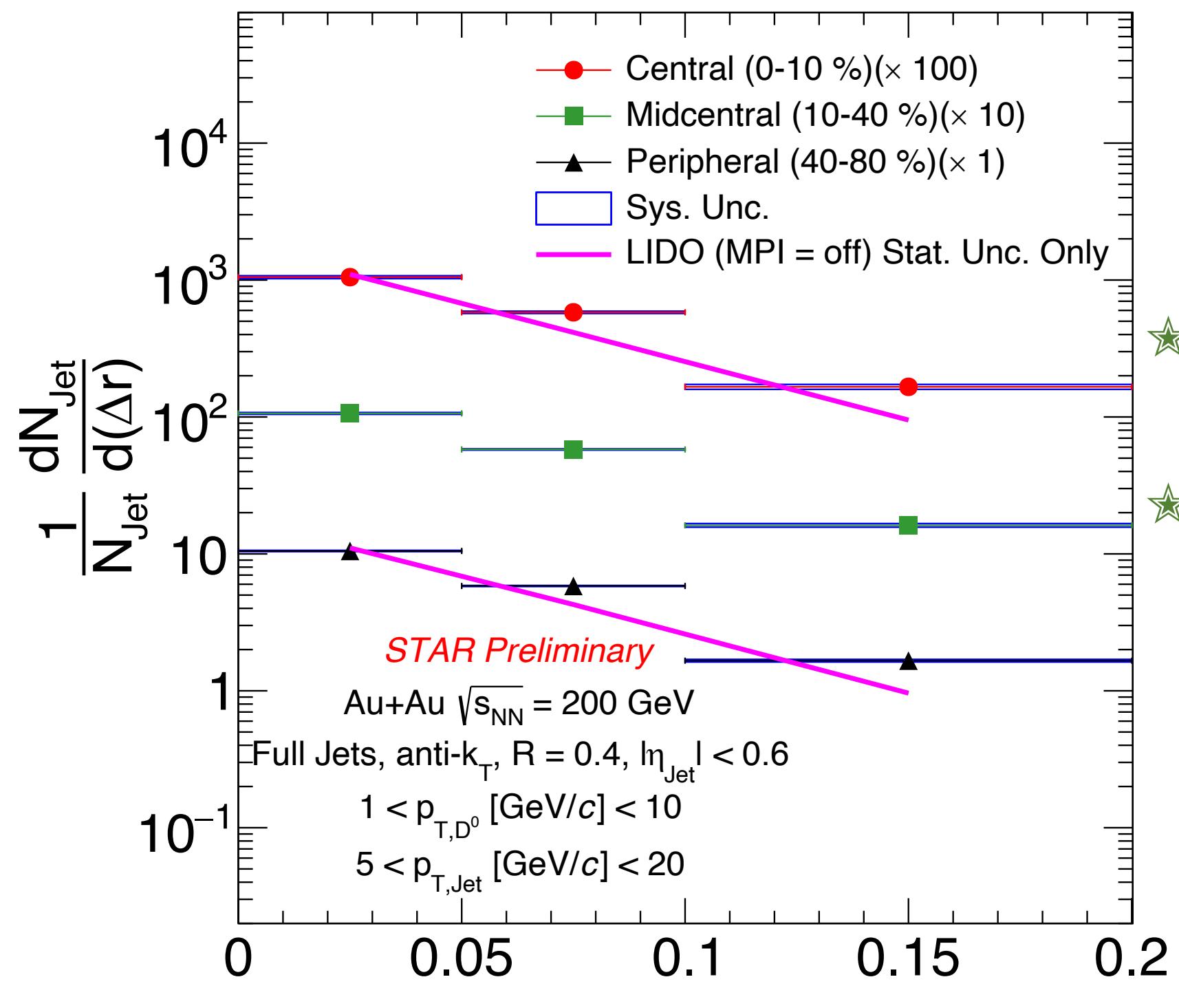


- ★ Z<sub>Jet</sub> related to fragmentation function in DGLAP equation
- ★ 2D unfolded with jet p<sub>T</sub> spectra
- ★ LIDO slightly overpredicts hard-fragmented D<sup>0</sup> mesons
- ★ LIDO **agrees well** with yield in peripheral events, **slightly underpredicts** yield in central events

★ Hard fragmented D<sup>0</sup> jet yield **suppressed** in central/midcentral events

★ Soft fragmented D<sup>0</sup> jet yield **ratio consistent with 1** in central/midcentral events

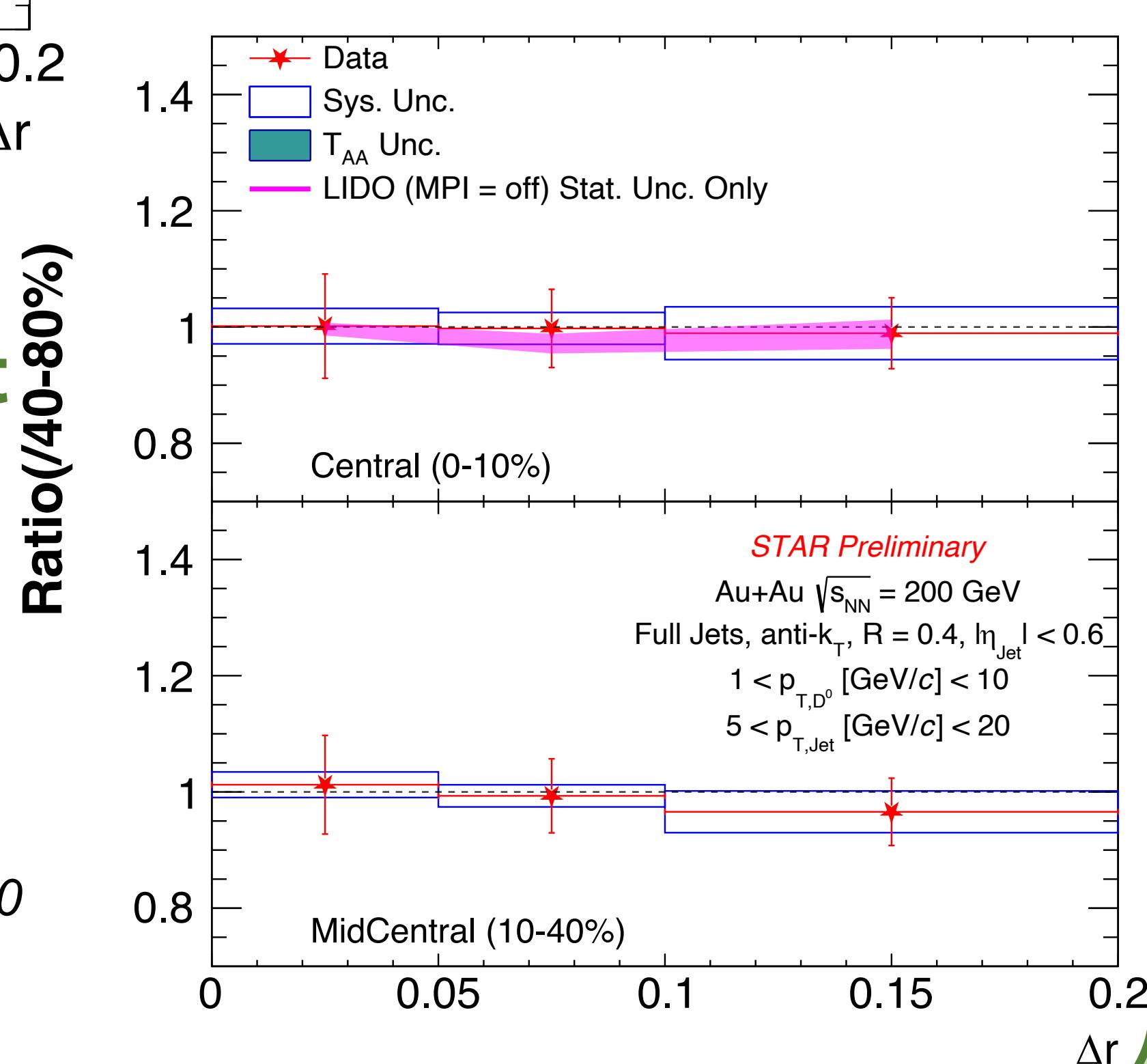
### D<sup>0</sup> Radial Profile



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

★ 2D unfolded with jet p<sub>T</sub> 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<sup>0</sup> radial profile modification at RHIC energies

At LHC energies, hint of modification seen for low p<sub>T,D<sup>0</sup></sub>

For details, visit

<https://doi.org/10.1103/PhysRevLett.125.102001>

