Open charm yields in d+Au collisions at $\sqrt{s_{NN}}$ = 200GeV

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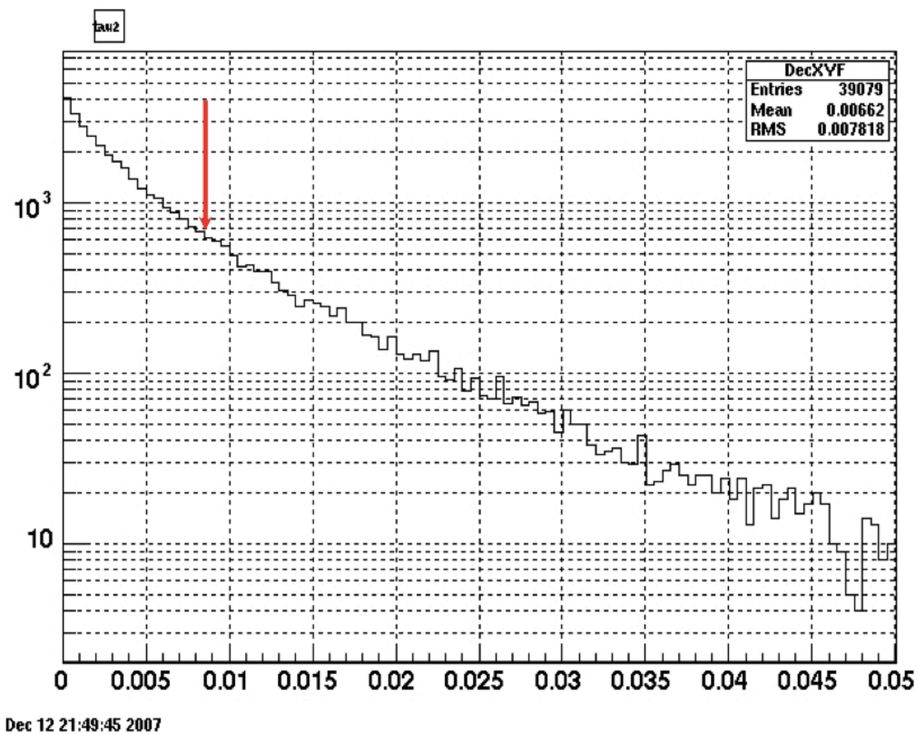
Introduction

- Motivation
- Method
- Direct Reco and Semileptonic Deays
- Cross Section Measurement
- Summary

Why D^0s?



- D^0 studies proposed to study nuclear shadowing and parton distribution function in nucleons
- Charm quark coalescence, J/ψ suppression and charm flow tools to study matter produced in collisions at RHIC energies
- D^0s have short lifetime $c\tau$=124μm, low production rates and large combinatorial background

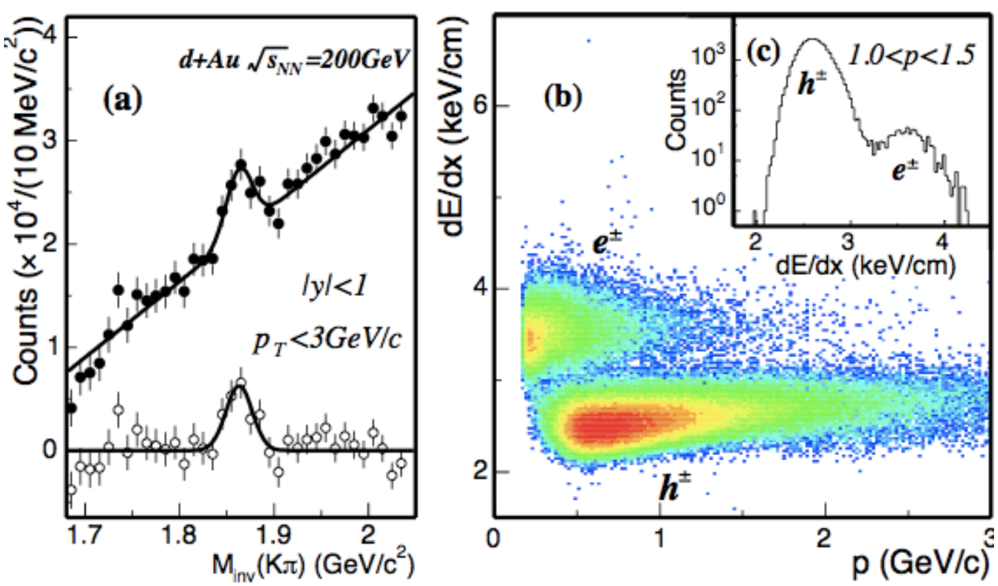
Why D^0s at RHIC?

- Most charm cross section measurements done at center of mass energies of 40GeV or less
- $52 < \sqrt{s} < 63$GeV measurements inconclusive due to inconsistencies between measurements
- Higher energy collider experiments only report results at high p_T
- At RHIC energies theoretical results differ significantly
- Precise cross section measurements needed in p+p and d+Au

Method

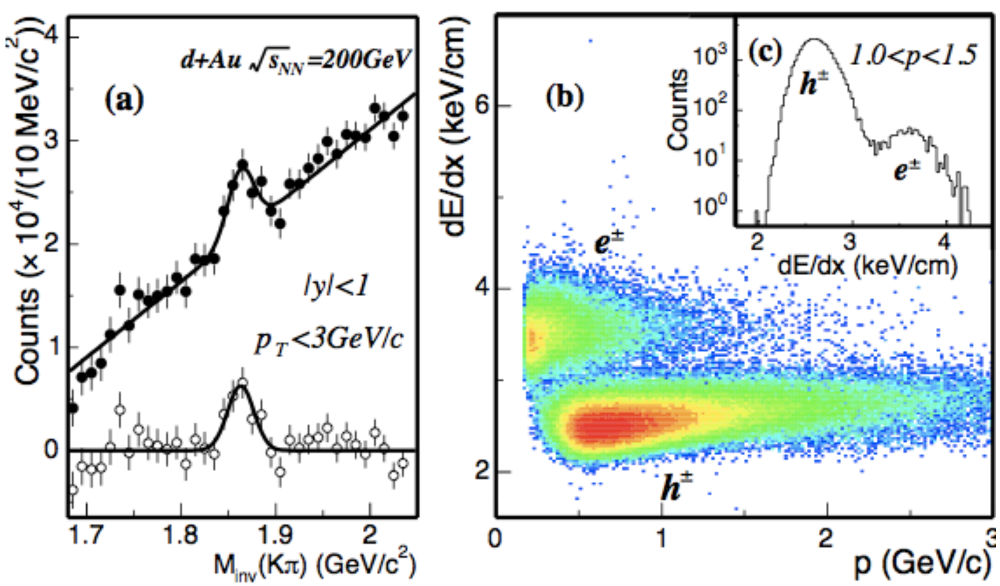
- Use both direct D^0 reconstruction and semileptonic decay analyses
- Use 2003 $\sqrt{s_{NN}}$ = 200GeV p+p and d+Au min bias data sets
- Require at least one spectator neutron in ZDC in the Au beam direction for event trigger
- 15.7 million events used

Direct Reconstruction



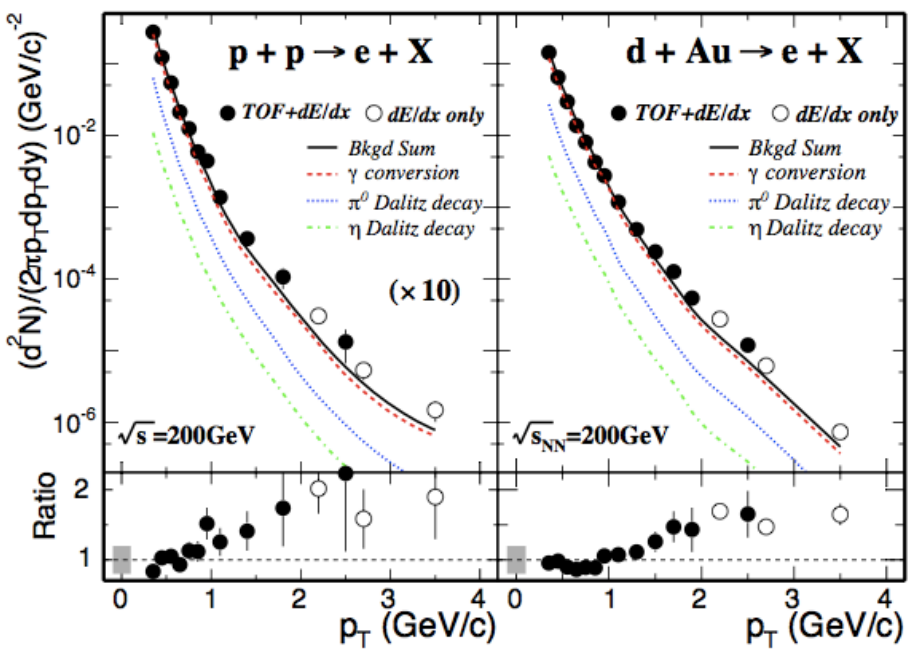
- Use TPC data
- Pair each oppositely charged Kaon and Pion identified using dE/dx
- Select candidates with p_T>0.3GeV and |η|<1
- Fig.1 uses p_T>3GeV and |y|<1
- S/B=1/600, S/$\sqrt{B}$=6
- Use Gaussian plus linear fit after mixed event background subtraction
- Di-hadron correlations can influence shape of background
- Resulting error estimation 15% on D^0 yield

Semileptonic Decays



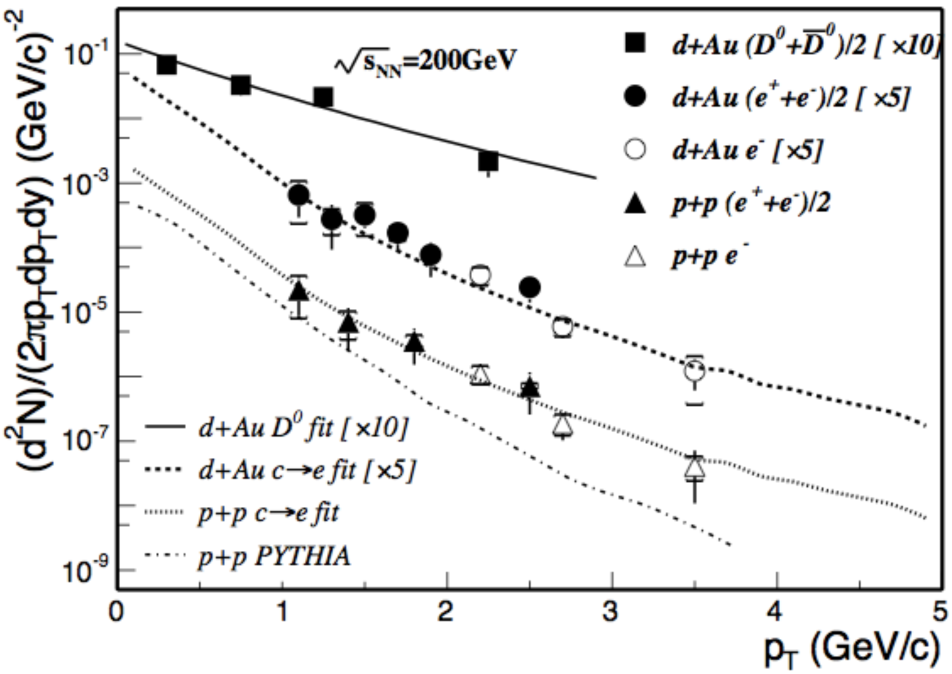
- TOFr prototype used to help with PID
- Coverage $\Delta\phi \approx \pi/30$, $-1<\eta>0$
- Use combination of velocity, TOFr, and dE/dx to identify hadrons and $e^\pm$
- Use TOF cut of $|1/\beta-1| \leq 0.03$ to eliminate crossing of electron and hadron bands
- Require electrons to originate at primary vertex

Semileptonic Decays



- $\gamma \rightarrow e^+e^-$ and $\pi^0 \rightarrow \gamma e^+e^-$ major sources of background
- Estimate background by checking invariant mass and opening angle of every other oppositely charged electron/positron pair reconstructed in TPC
- Simulations using HIJING, PYTHIA, and GEANT were used to estimate efficiency of 60% for electrons with p_T>1GeV
- More than 95% of electrons originating from sources other than heavy-flavor semileptonic decays were measured
- Signal clearly above background for p_T>1GeV

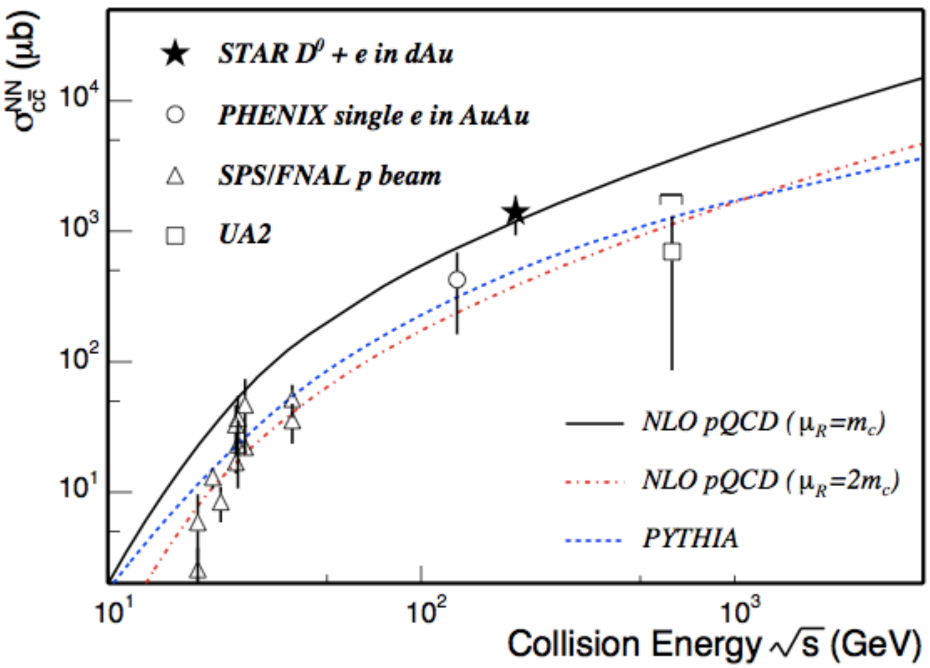
Non-photonic e Spectra



	$dN(D^0)/dy\|_{y=0}$ (10^{-2})	$d\sigma^{NN}_{c\bar{c}}/dy\|_{y=0}$ (mb)
D^0	2.8±0.4±0.8	0.29±0.04±0.08
$D^0+e^{\pm}$	2.9±0.4±0.8	0.30±0.04±0.09

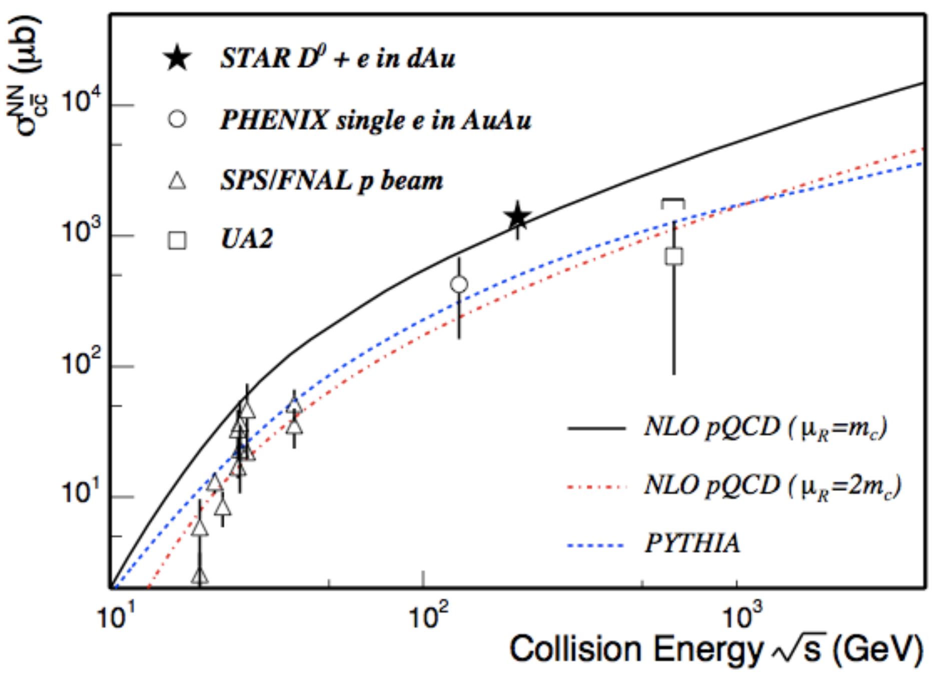
- Obtained by subtracting background from inclusive spectra
- D^0 invariant yields from direct reconstruction solid squares
- 2 fitting methods to extract dN/dy at mid rapidity
- Exponential fit of D^0 yield in m_T
- Fit both D^0 and background subtracted non-photonic electron spectra
  - Assume D^0 follows power law in p_T
  - Generate electron spectra from particle composition and decay generators in PYTHIA
  - Power law Parameters in Table

Cross Section



- Use $R = N_{D^0}/N_{CC^{bar}} = 0.54 \pm 0.05$ from e^+e^- collider data to convert D^0 to cc^{bar} yield
- Use p+p inelastic cross section of 42mb
- Factor of f = 4.7±0.7 used to convert dσ/dy at mid-rapidity to total cross section
- $\sigma_{c\bar{c}}^{NN} = dN_{D^0}^{d+Au}/dy \times \sigma_{inel}^{pp}/N_{bin}^{d+Au} \times f/R$
- Cross section of 1.3±0.2±0.4mb for D^0 alone and 1.4±0.2±0.4mb for D^0 + semileptionic decays

Cross Section



- Nuclear modification factor of 1.3±0.3±0.3 by taking ration of electron spectra in d+Au and p+p collisions
  - Consistent with binary scaling
- Beam energy dependence of cross section
- PYTHIA and NLO pQCD calculations underestimate cross section
- NLO pQCD calculation with $\mu_F=2m_c$ and $\mu_R=m_c$ (m_c=1.2GeV) reproduces results

Summary

- Use D^0s to study medium produced in heavy ion collisions
- Use both direct reconstruction of D^0s and semileptonic decays to study charm production at RHIC
- Report charm cross section measurement