$D_s^{\pm}$ meson production in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV in STAR

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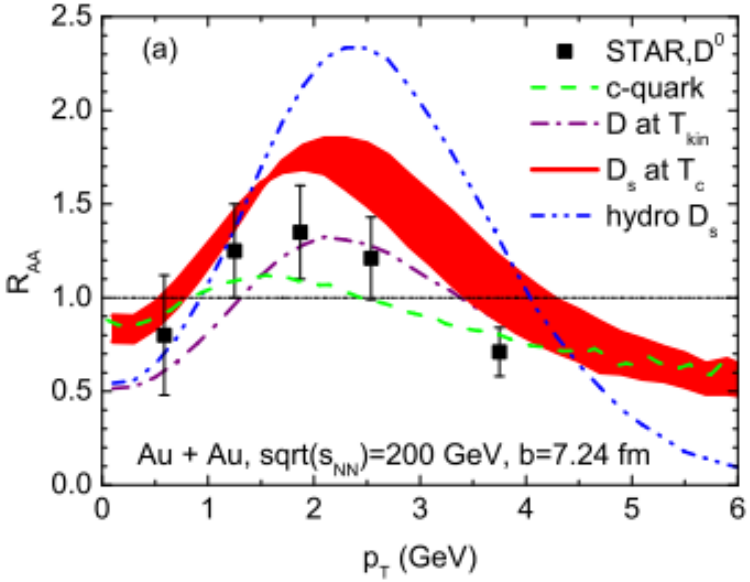
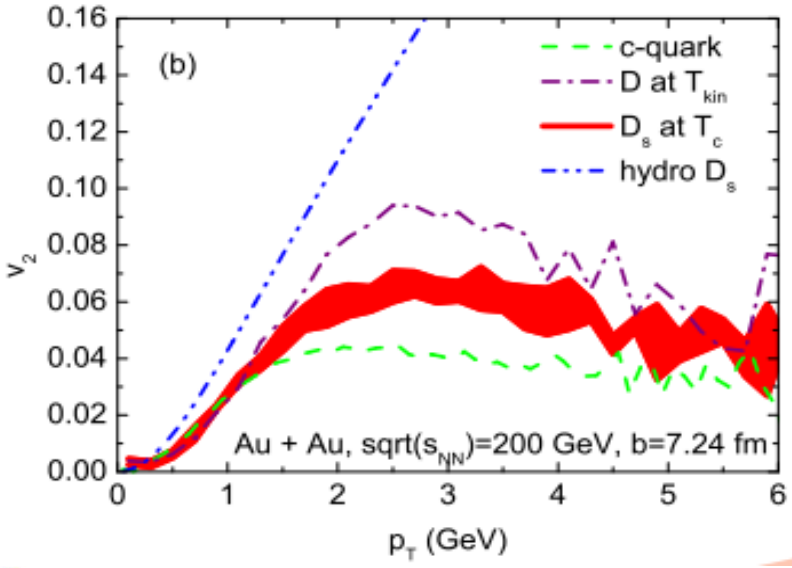
Overview of the talk

- **Motivation**
- **Experimental Setup**
  - **Heavy Flavor Tracker**
- **Physics results in Au+Au data**
  - **Analysis method**
  - **Nuclear modification factor (R_{AA})**
  - **Elliptic flow (v_2)**
- **Summary**

Why strange charmed meson ?

- Better constrain total charm yield
- Study hadronization mechanism
  - The medium created in heavy-ion collisions enhances strange quark production
  - R_{AA} of D_s meson is expected to be larger than non-strange D meson if charm quarks hadronize via coalescence in the medium

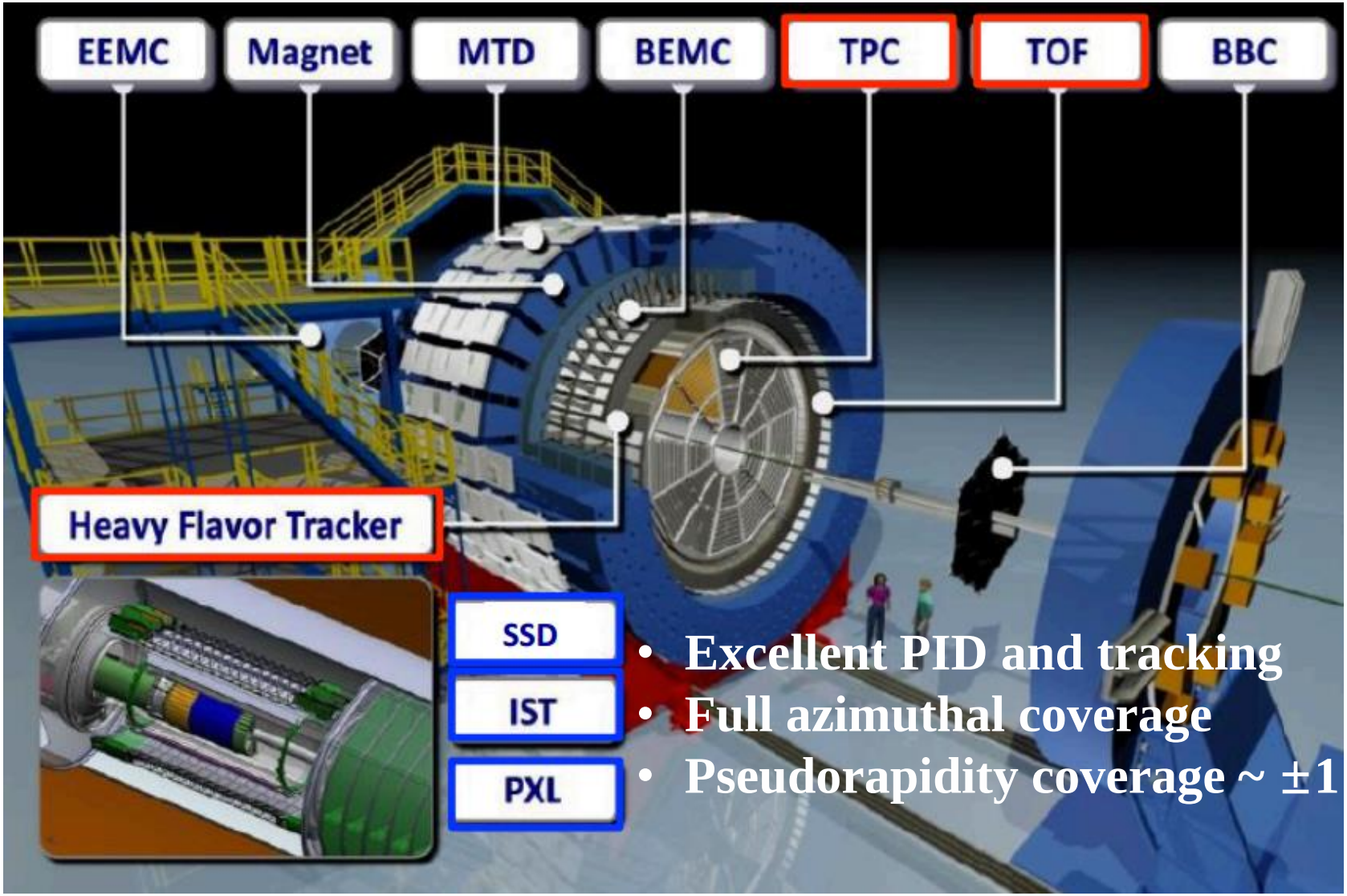




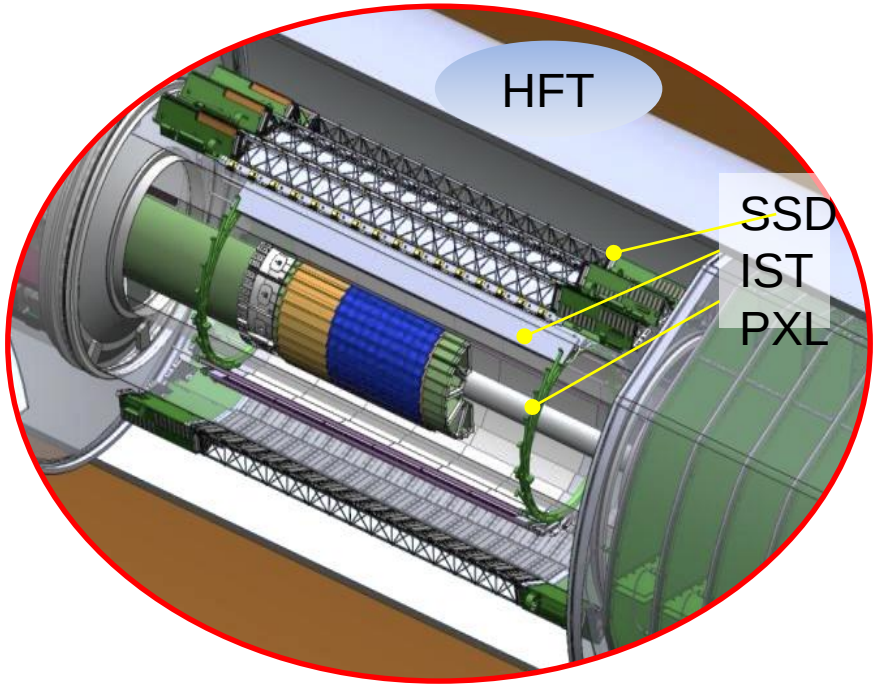
- Sensitivity to properties of Quark Gluon Plasma
  - Elliptic flow of D_s is expected to be smaller than that of non-strange D meson as a result of earlier freeze-out for D_s meson.

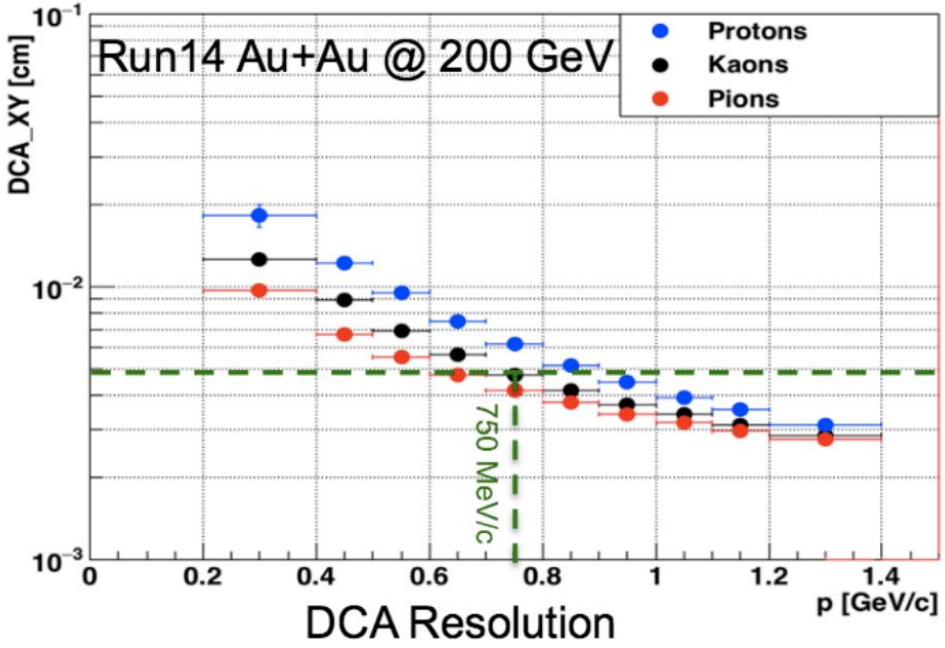
He, Min et al. Phys.Rev.Lett. 110 (2013) 11, 112301

Experimental Setup



HFT detector

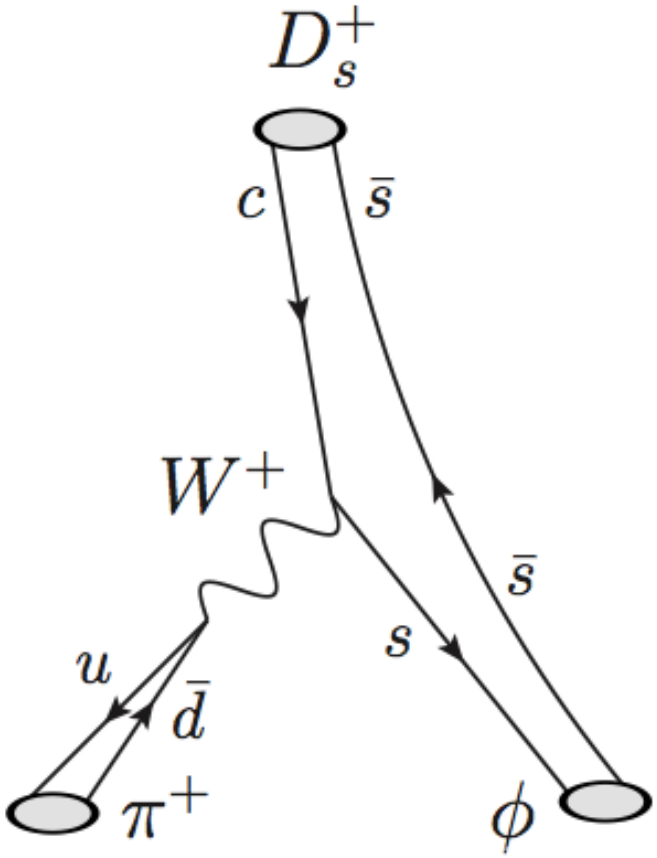




- Four-layer silicon detector
- Resolution of Distance of Closest Approach (DCA)
  - ~ 30 μm at high p_T
  - < 50 μm for 750 MeV/c kaons

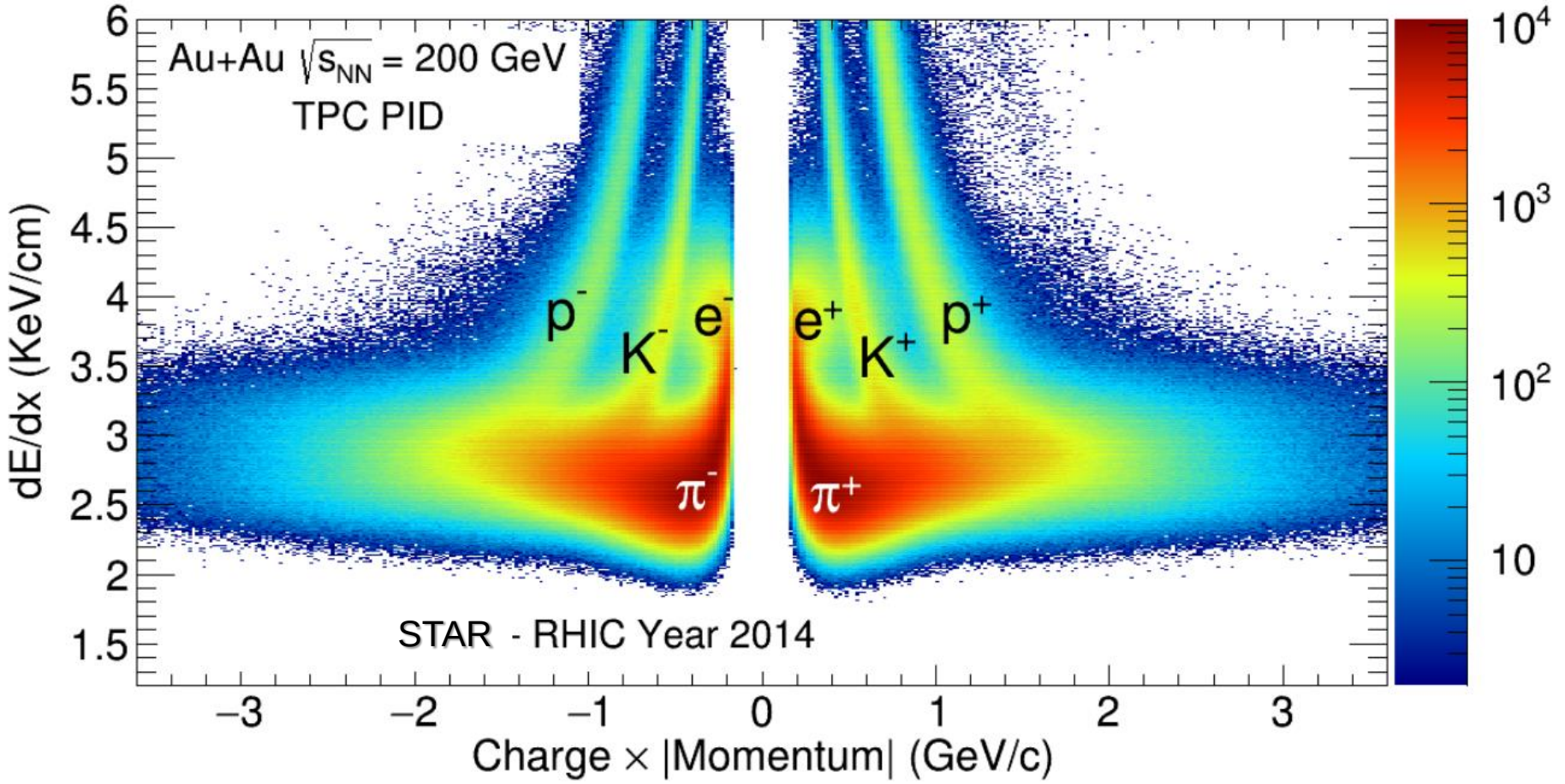
D_s reconstruction

- Dataset
  - Au+Au at $\sqrt{s_{NN}}$ = 200GeV in 2014
  - 750M minimum bias events (70% of collected data)
- Event Selection
  - |Vertex Z| < 6 cm
- Decay channel of interest
  - $D_s \rightarrow \phi(1020) + \pi \rightarrow K^+ + K^- + \pi$
  - Branch ratio : 2.32 %
  - Decay length $c\tau = 149.9\ \mu m$
  - Mass 1968.47 MeV/c^2
- Reconstruction strategy
  - Use HFT to reconstruct secondary vertex
  - Topological cuts to suppress background
  - Require M_{KK} in ϕ meson mass range



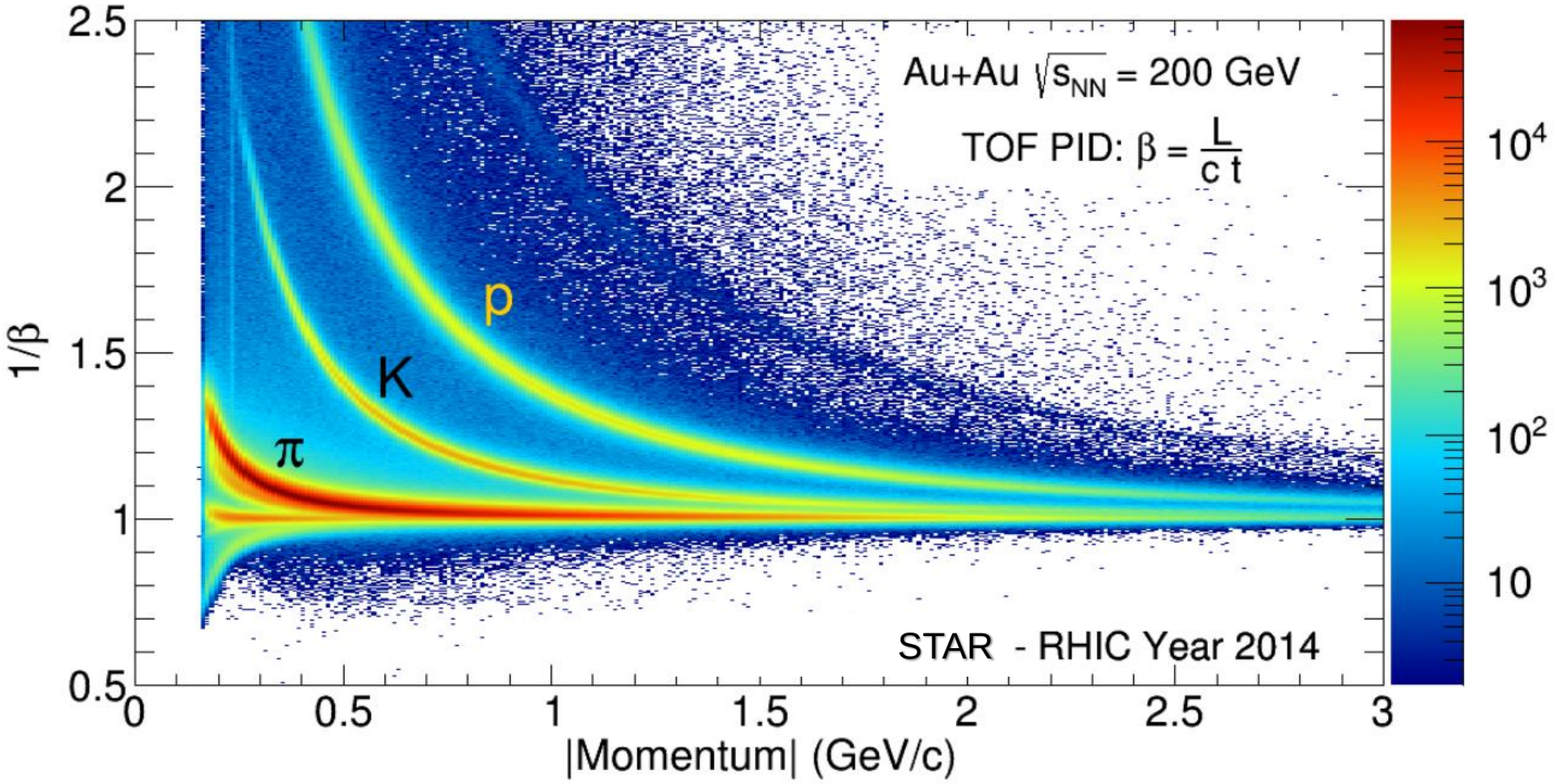
Courtesy of Peter Filip

Particle identification using TPC



TPC PID: Using energy loss (dE/dx)

Particle identification using TOF

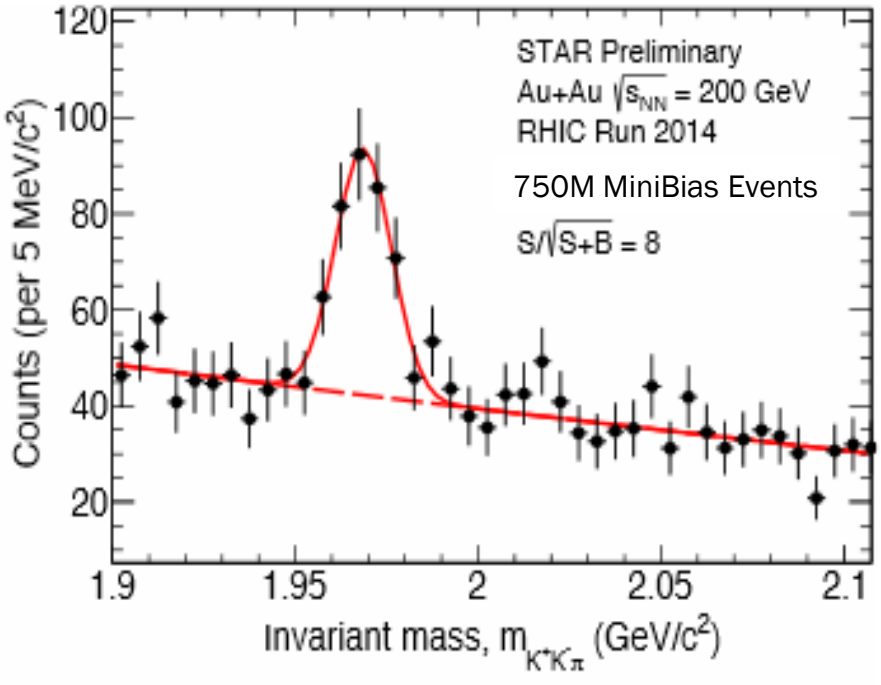


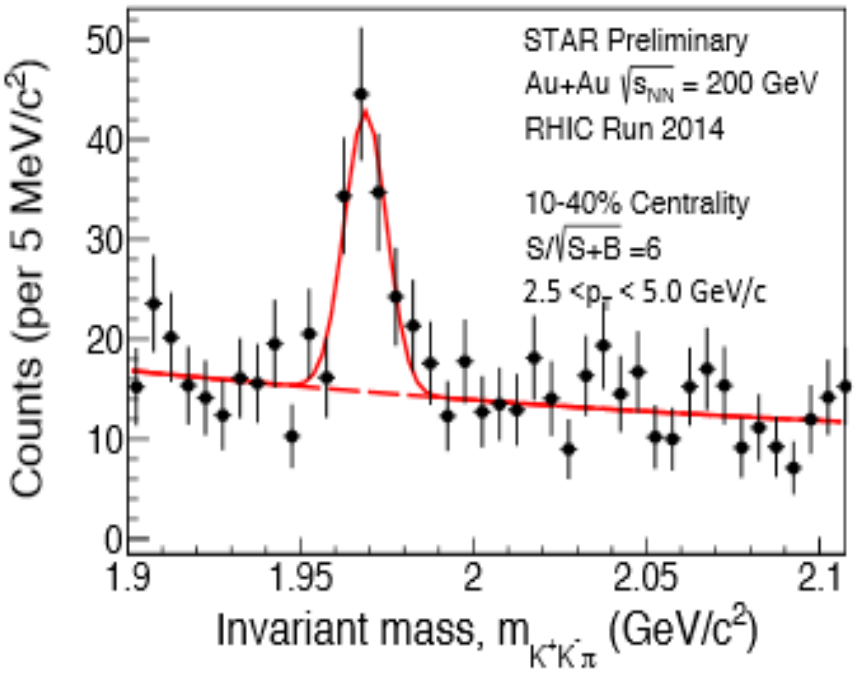
TPC PID: Using energy loss (dE/dx)

TOF PID: Using time-of-flight (β)*

*TOF PID is applied only when β information is available.

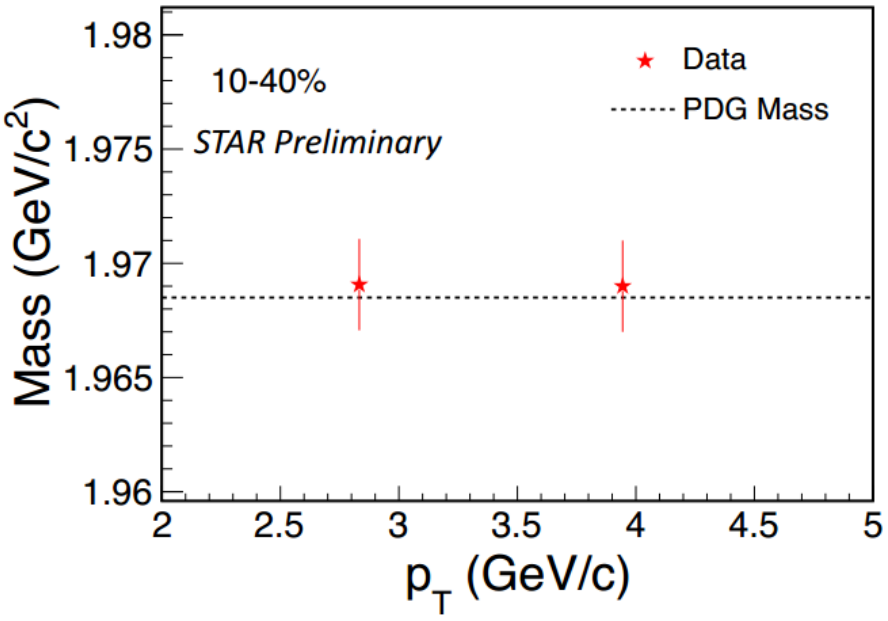
p_T integrated D_s signal

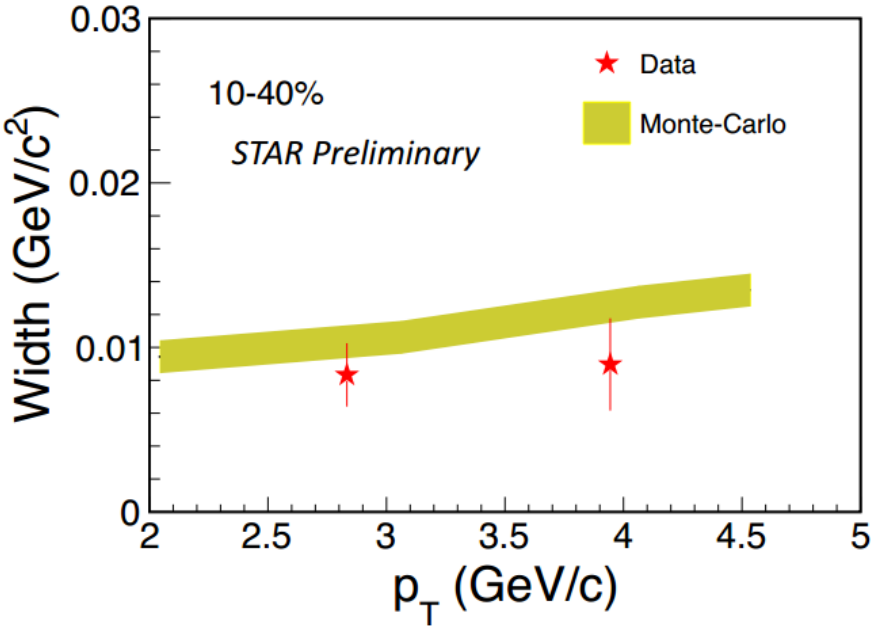




- First D_s meson signal observed at RHIC.

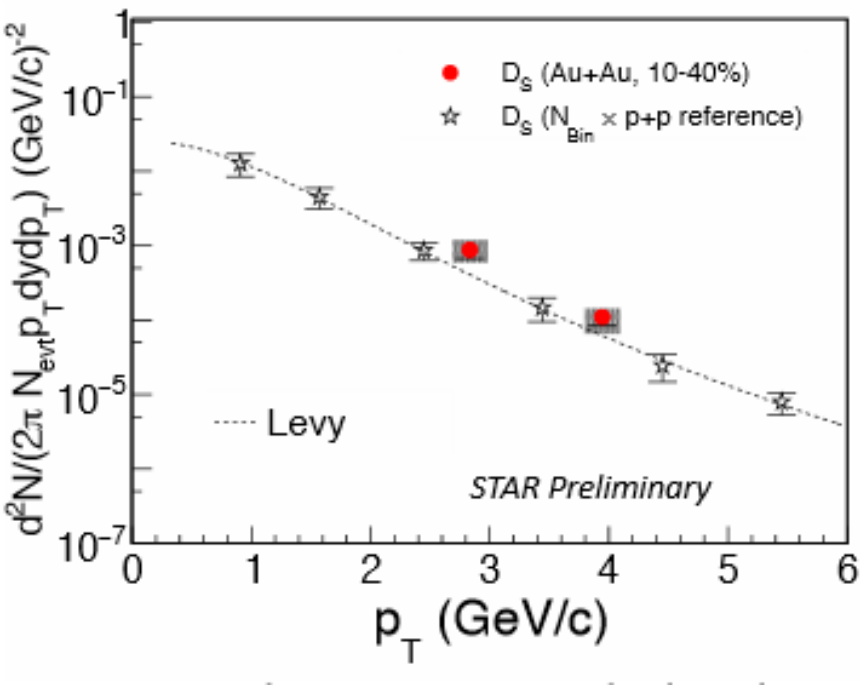
Mean and width

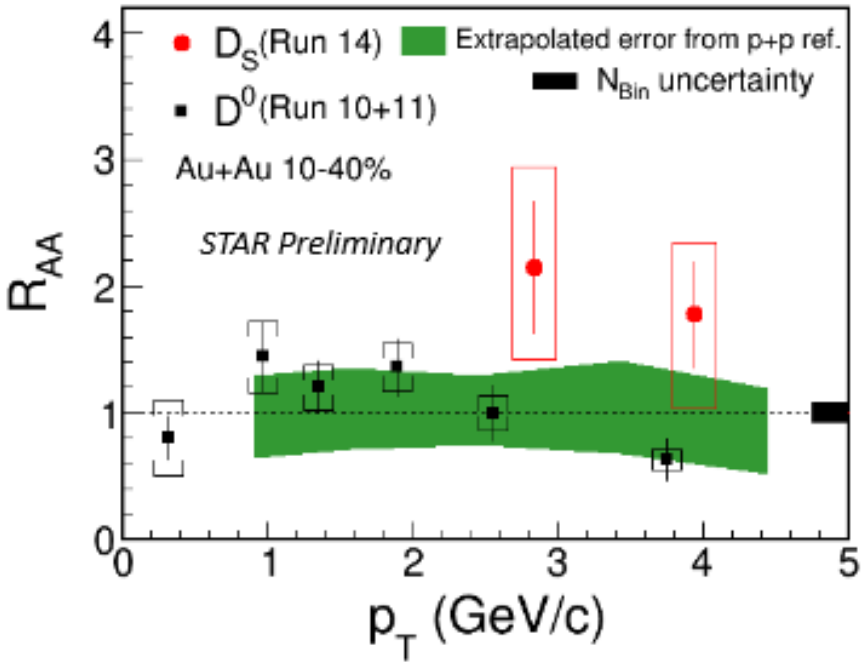




- Mean is consistent with PDG value.
- Width is consistent with simulation.

D_s meson spectrum and R_{AA}



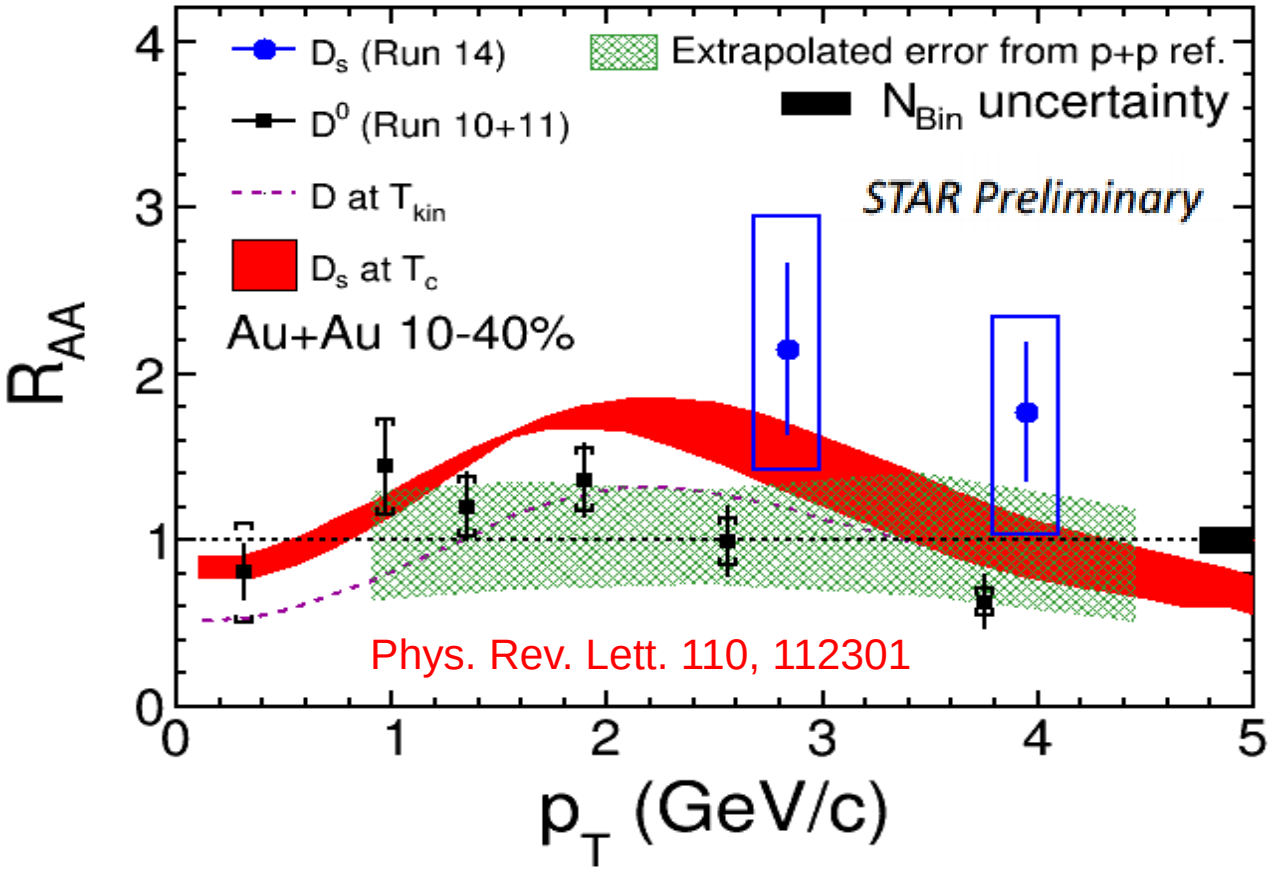


- pp reference was obtained from charm cross-section measured by STAR scaled by $c \rightarrow D_s$ fragmentation factor[1]

[1]:"H1"CollaboraLon,""Eur.Phys.J.C38(2005)447"and""ZEUS"CollaboraLon,"Eur.Phys.J.C44(2005)351

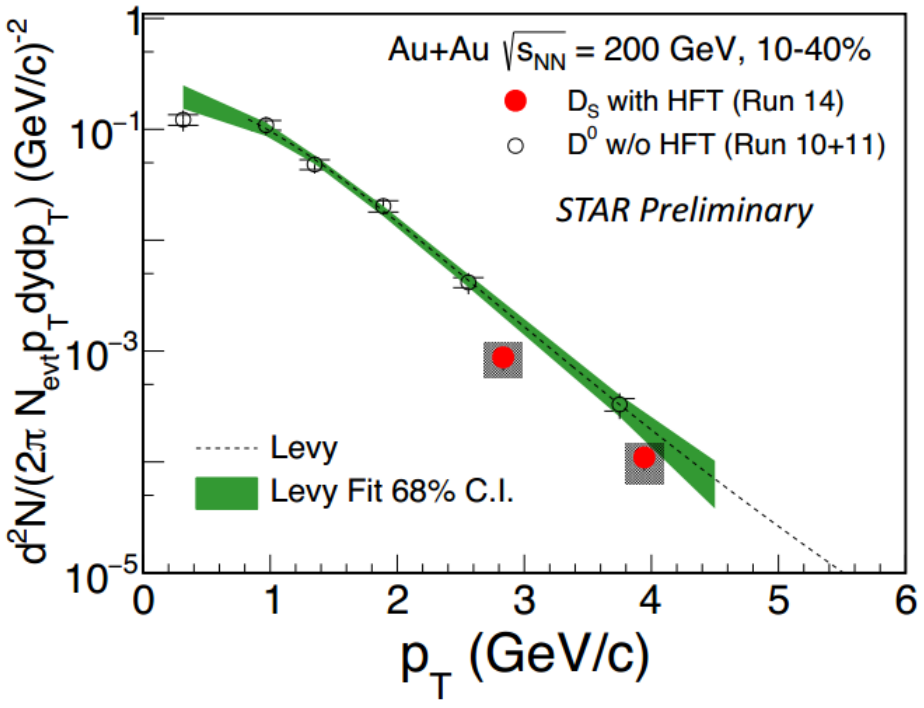
- The R_{AA} of D_s is higher than D^0 R_{AA} but statistically not significant.

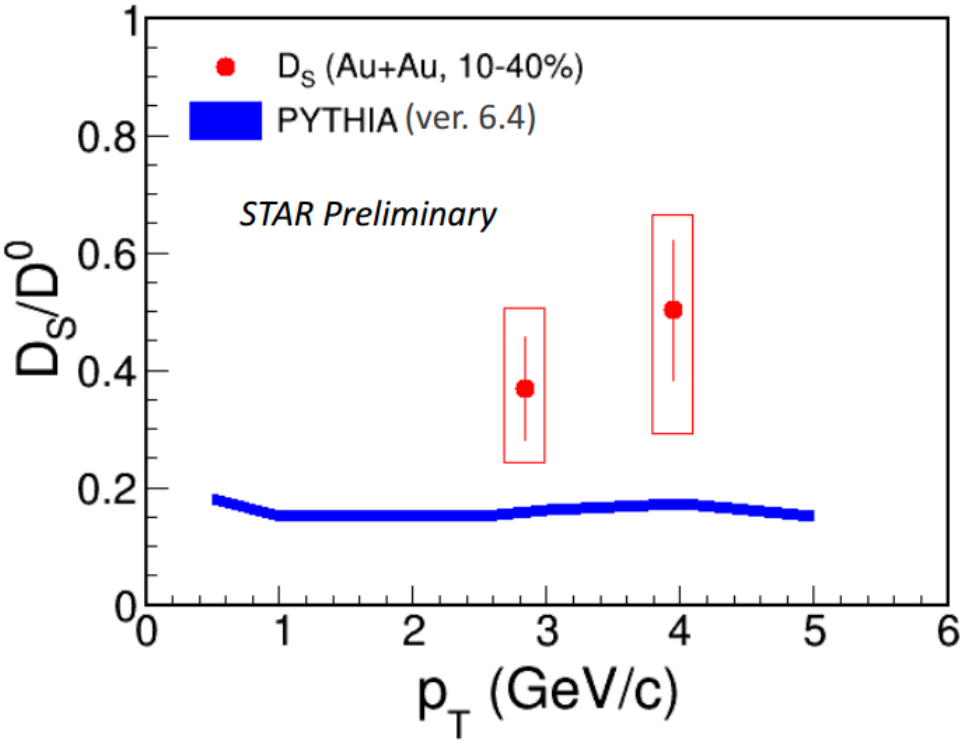
Model calculation for D_s R_{AA}



- Both D_s and D^0 R_{AA} are consistent with model calculation within uncertainty.
- Hint of possible enhancement in D_s meson production.

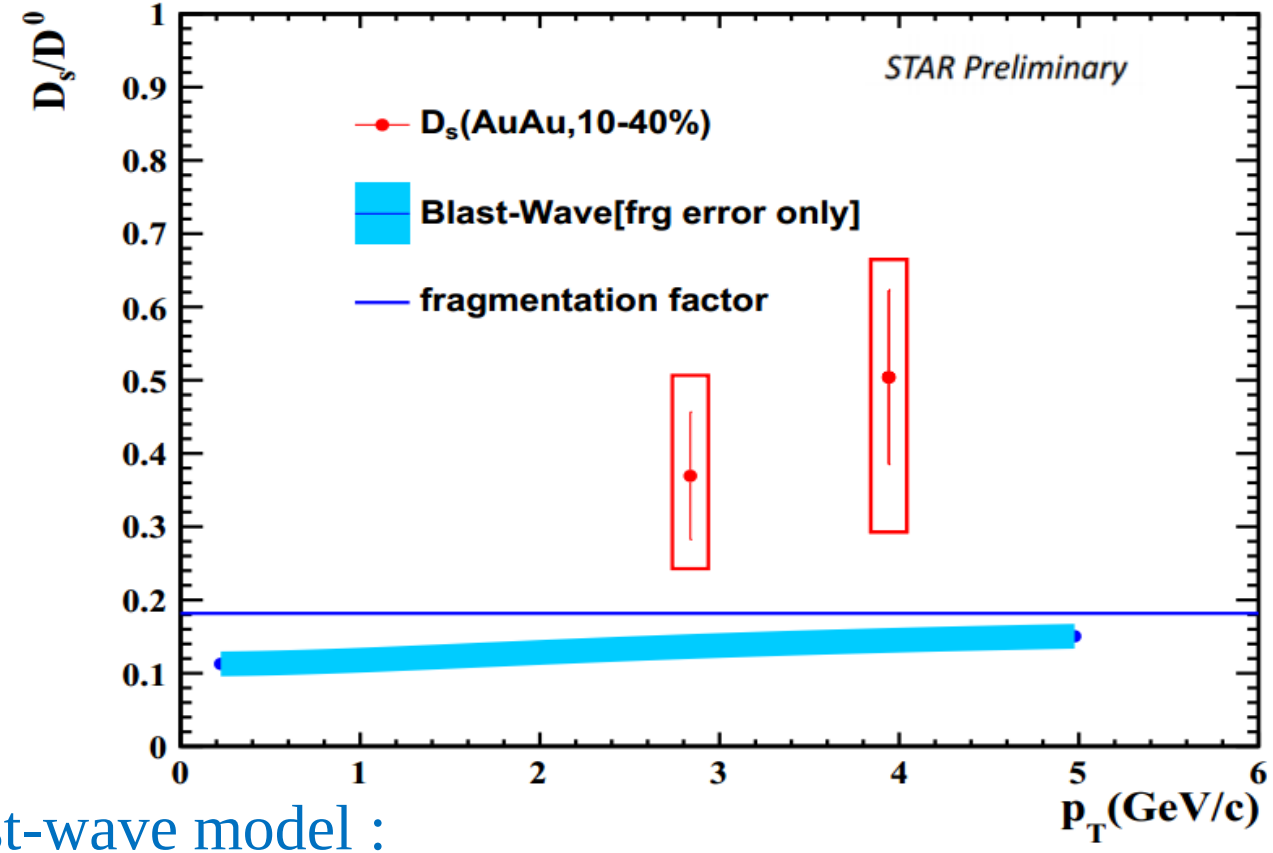
D_s over D^0 ratio





- The ratio D_s/D^0 seems to be higher than the prediction for p+p collisions from PYTHIA, but not significant.

Mass effect on D_s/D^0 ratio

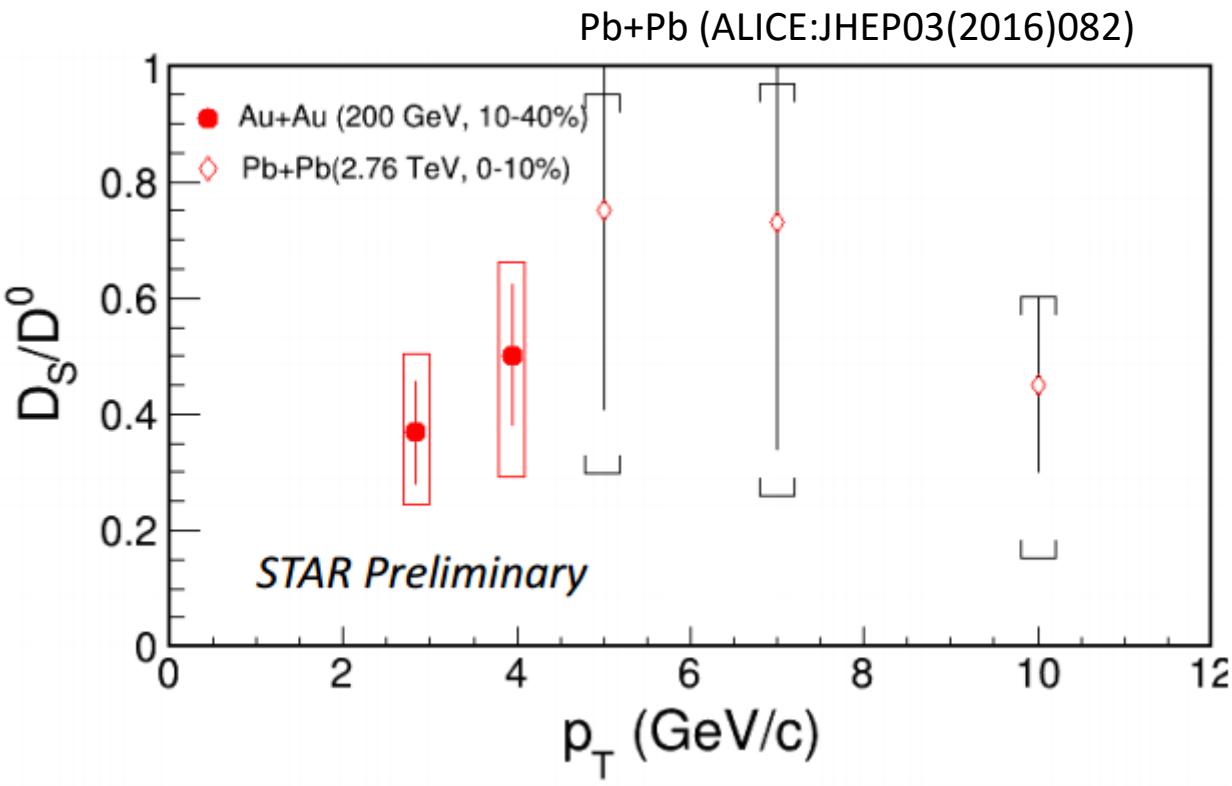


Blast-wave model :

- Blast-wave parameters obtained from fitting D^0 spectra[1]
- Mass effect is small, and it alone can not account for the difference in D_s/D^0 ratio between PYTHIA and data.

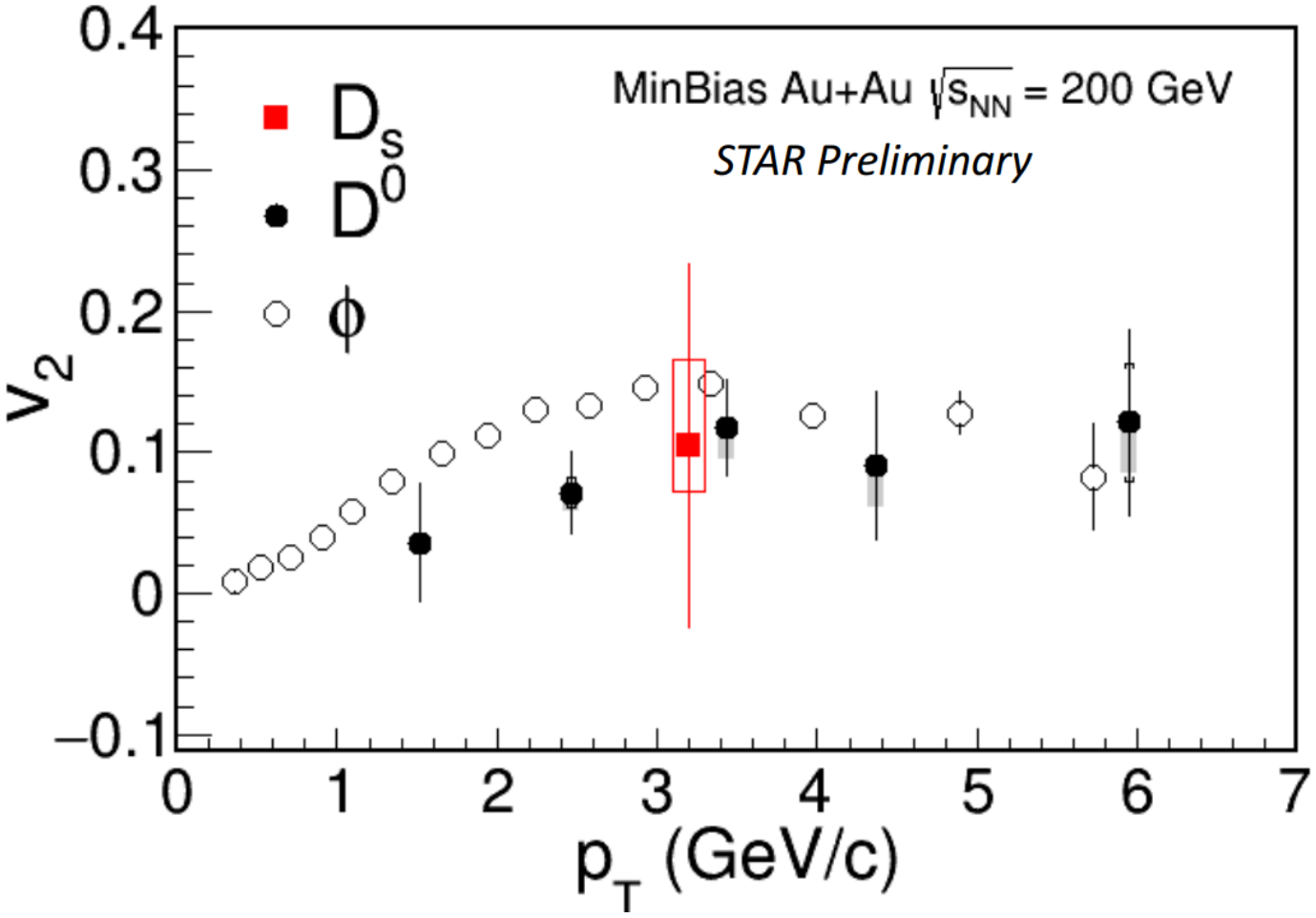
[1] Phys.Rev.Lett.113(2014) 142301

D_s/D^0 ratio: RHIC vs LHC



- Strangeness enhancement is expected to be less at high pt range.
- Need measurements with better precision.

Elliptic flow v_2



- First measurement of D_s v_2 in heavy-ion experiment.
- Hint of finite v_2.

Summary and outlook

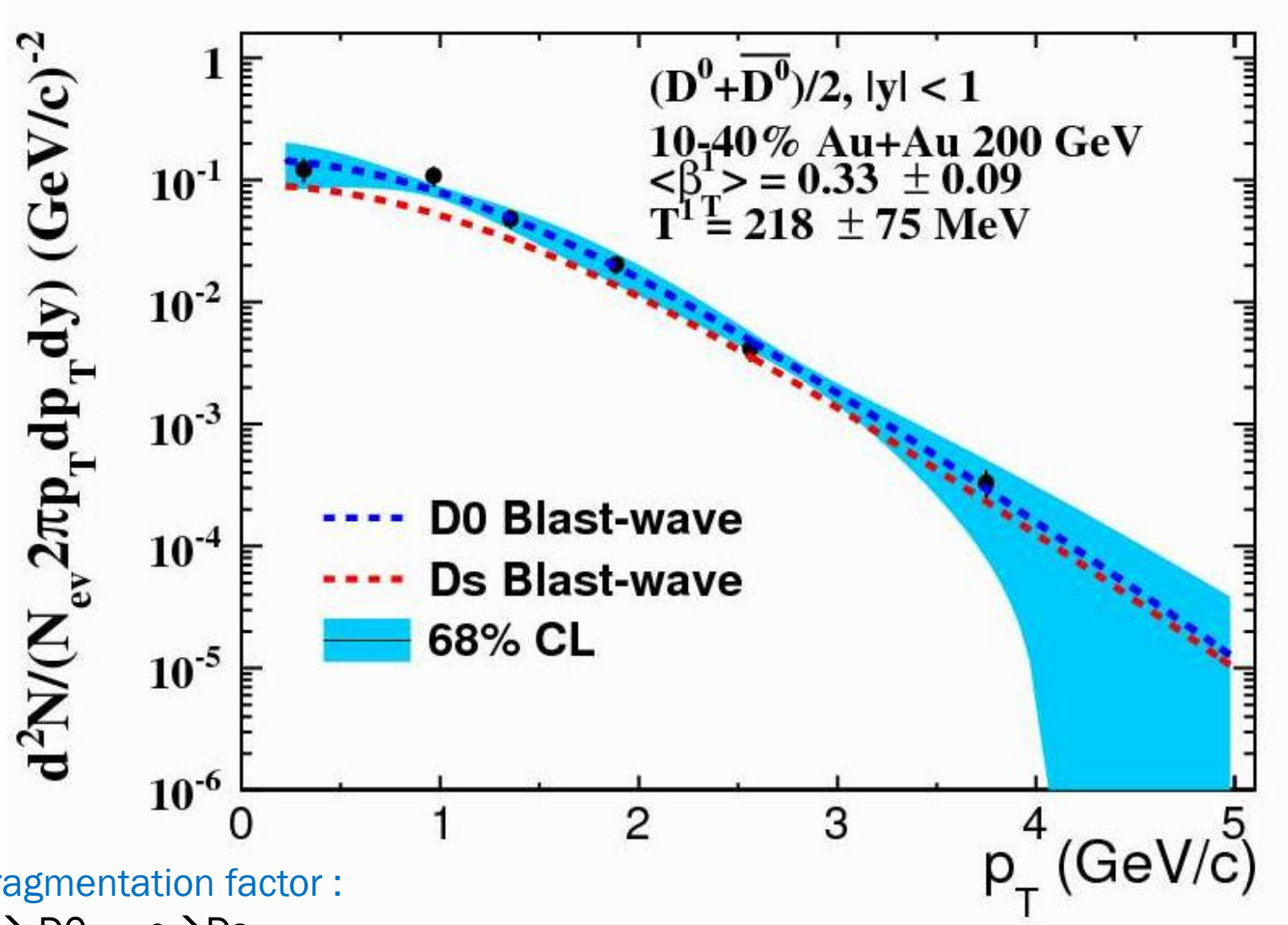
- D_s meson is a good probe to study the mechanism of charm hadronization and the properties of Quark-Gluon Plasma.

- We have observed a clear signal of D_s meson at RHIC for the first time.

- D_s in Au+Au 200 GeV for 10-40% central collisions:
  - The R_{AA} of D_s is higher than D^0 but statistically not significant
  - D_s/D^0 ratio seems to be higher compared to PYTHIA, indicating coalescence between charm and strange quarks in the medium.
  - Hint of finite D_s $\mathbf{v_2}$ at RHIC.

- Stay tuned for Run 14+16 data with increased statistics and improved detector efficiency + resolution.

Blast wave



Fragmentation factor :

c→ D0 c→Ds

ZEUS"CollaboraLon,"Eur.Phys.J.C44(2005)351

Compare to k/pi ratio