



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

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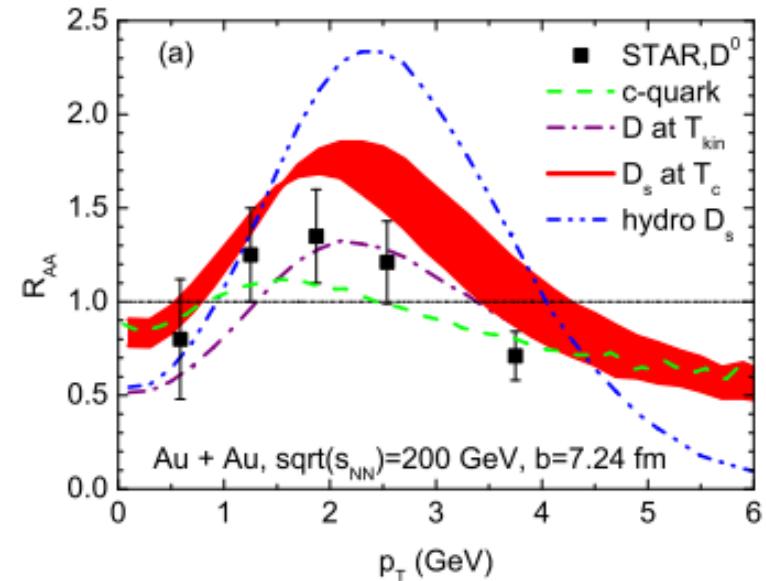
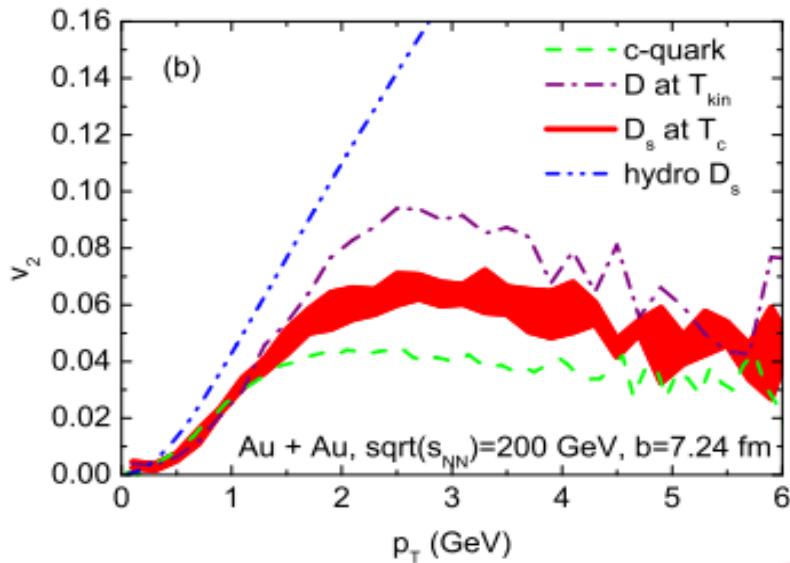
Overview of the talk

- 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

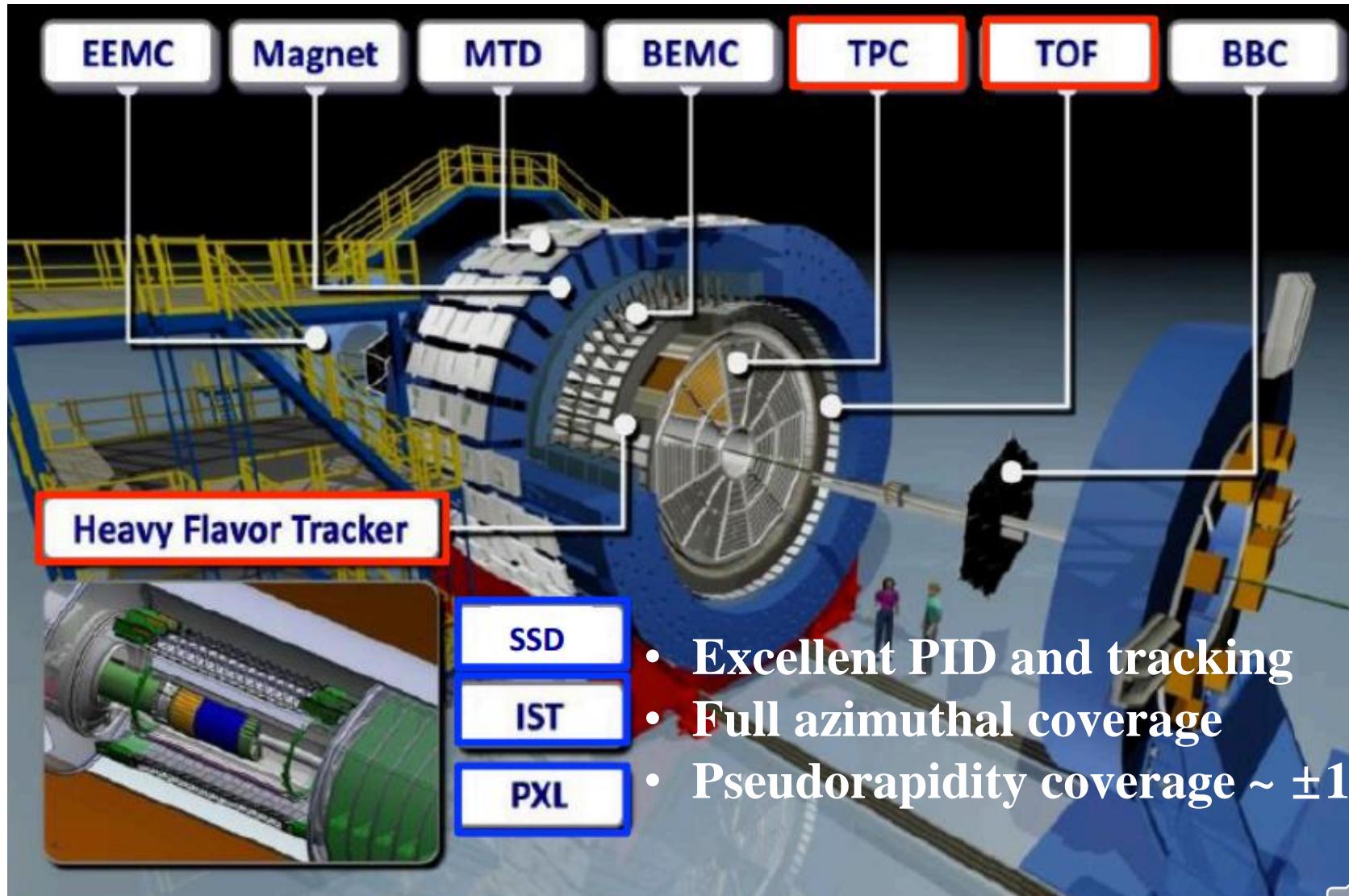


- Sensitivity to properties of Quark Gluon Plasma
 - Elliptic flow of D_s is expected to be smaller than that of non-strange D meson as a result of earlier freeze-out for D_s meson.

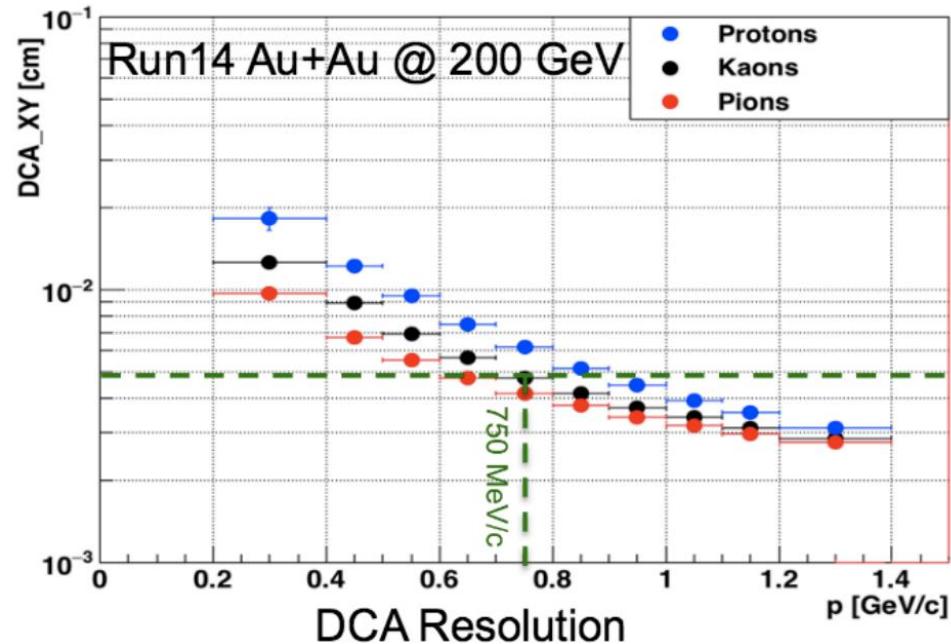
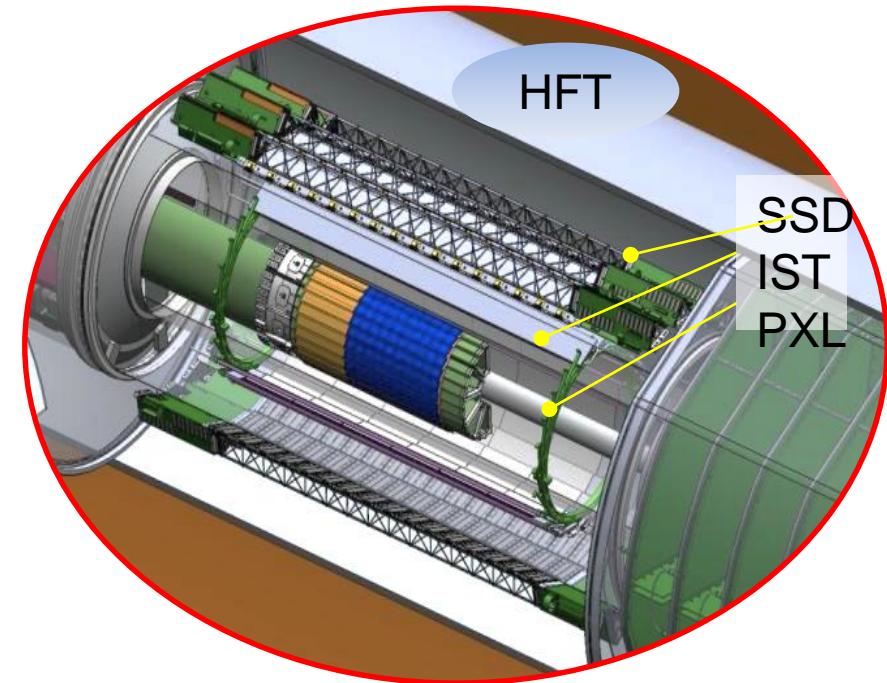
He, Min et al. Phys.Rev.Lett. 110 (2013) 11, 112301



Experimental Setup



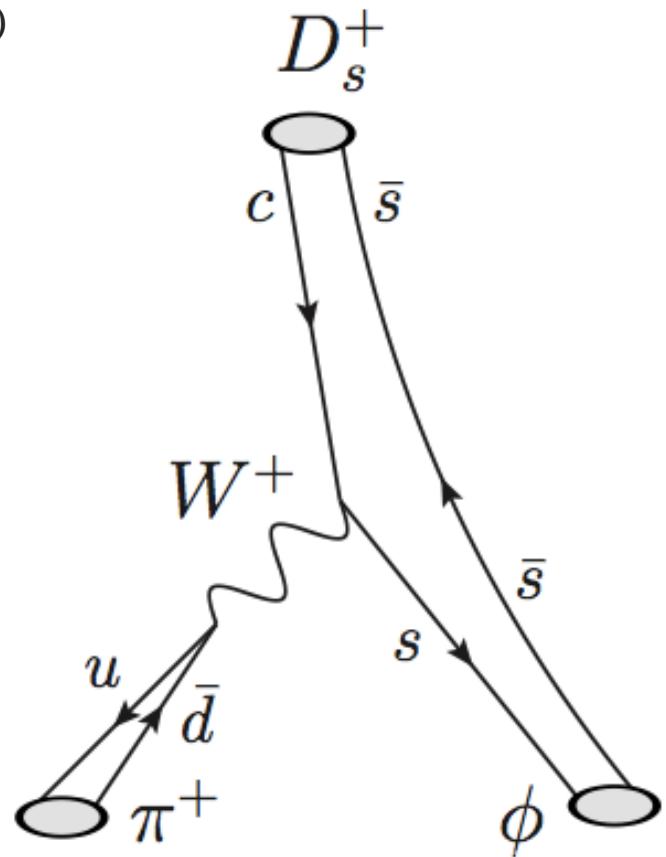
HFT detector



- Four-layer silicon detector
- Resolution of Distance of Closest Approach (DCA)
 - $\sim 30 \mu\text{m}$ at high p_T
 - $< 50 \mu\text{m}$ for $750 \text{ MeV}/c$ kaons

D_s reconstruction

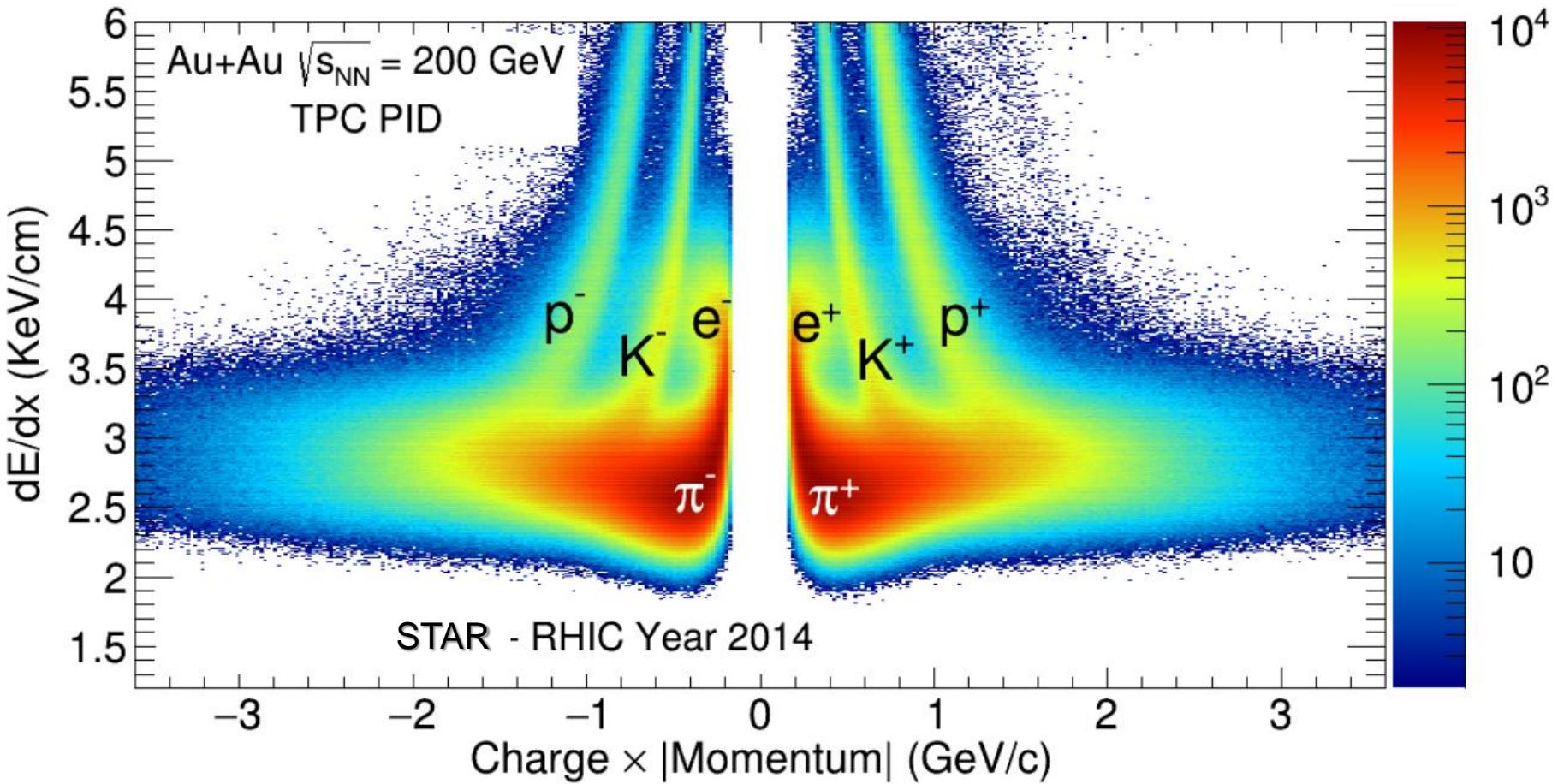
- Dataset
 - Au+Au at $\sqrt{s_{NN}} = 200\text{GeV}$ in 2014
 - 750M minimum bias events (70% of collected data)
- Event Selection
 - $|\text{Vertex Z}| < 6 \text{ cm}$
- Decay channel of interest
 - $D_s \rightarrow \phi(1020) + \pi \rightarrow K^+ + K^- + \pi$
 - Branch ratio : 2.32 %
 - Decay length $c\tau = 149.9 \mu\text{m}$
 - Mass 1968.47 MeV/c²
- 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



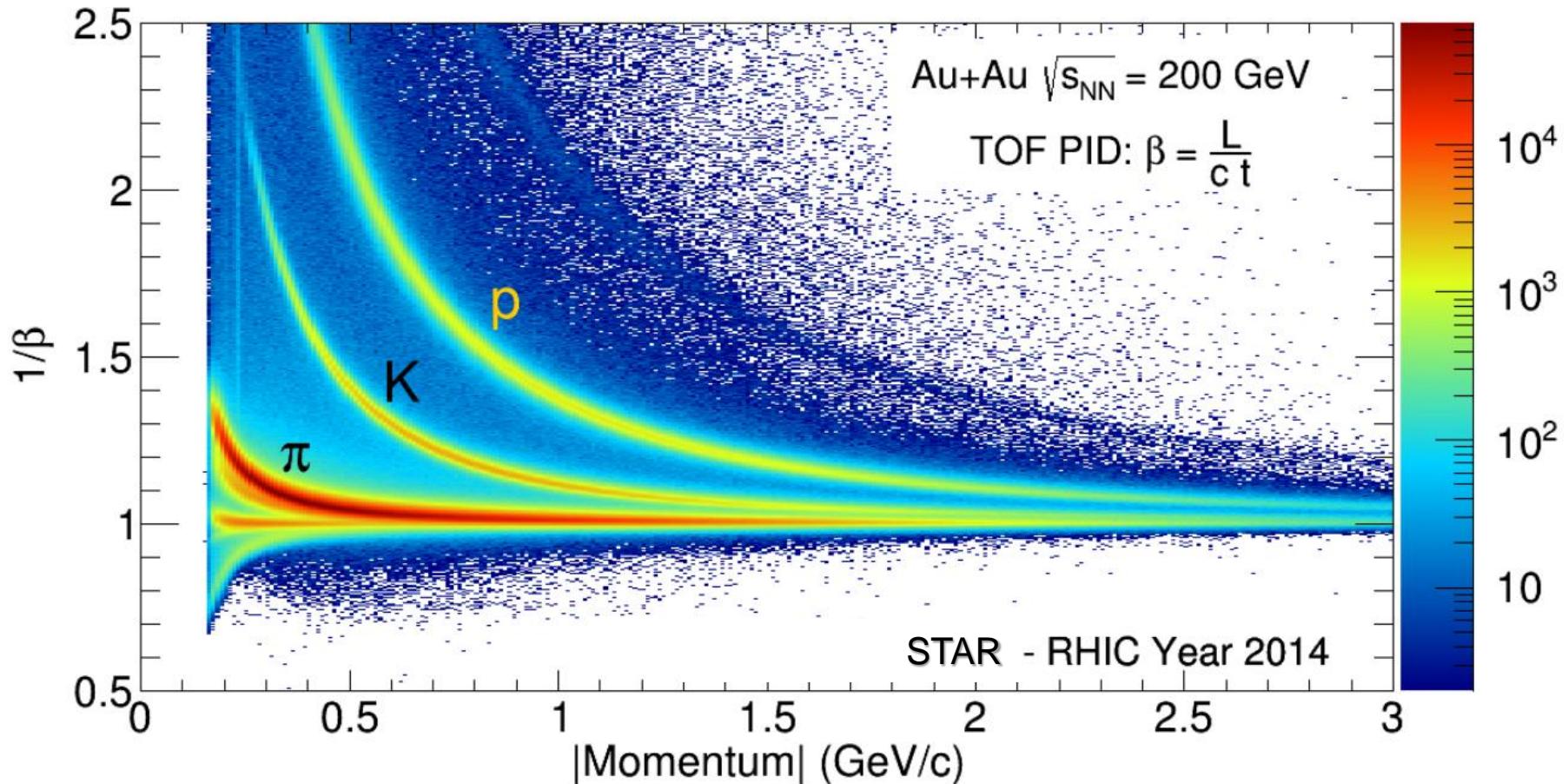
Particle identification using TPC



TPC PID: Using energy loss (dE/dx)



Particle identification using TOF



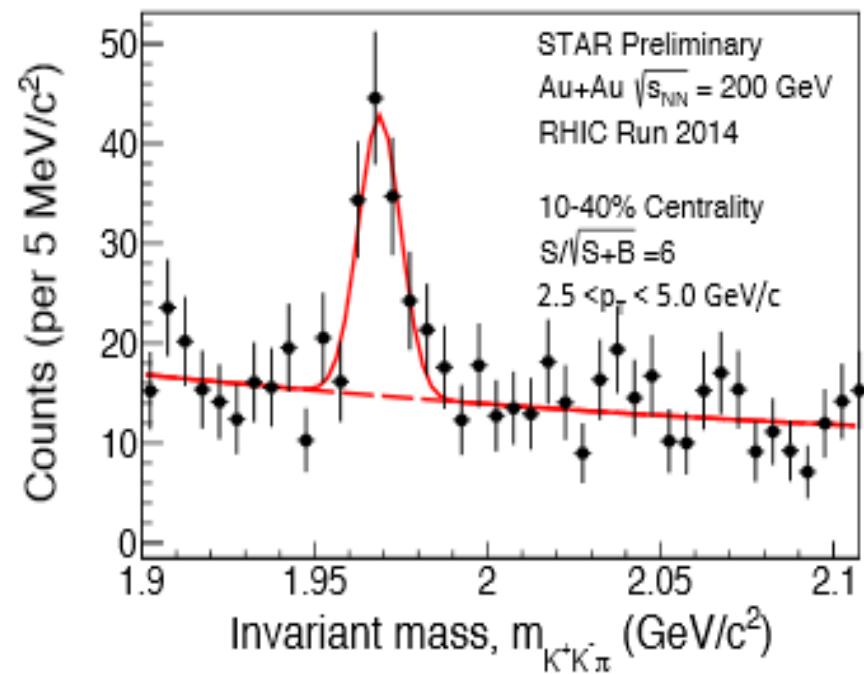
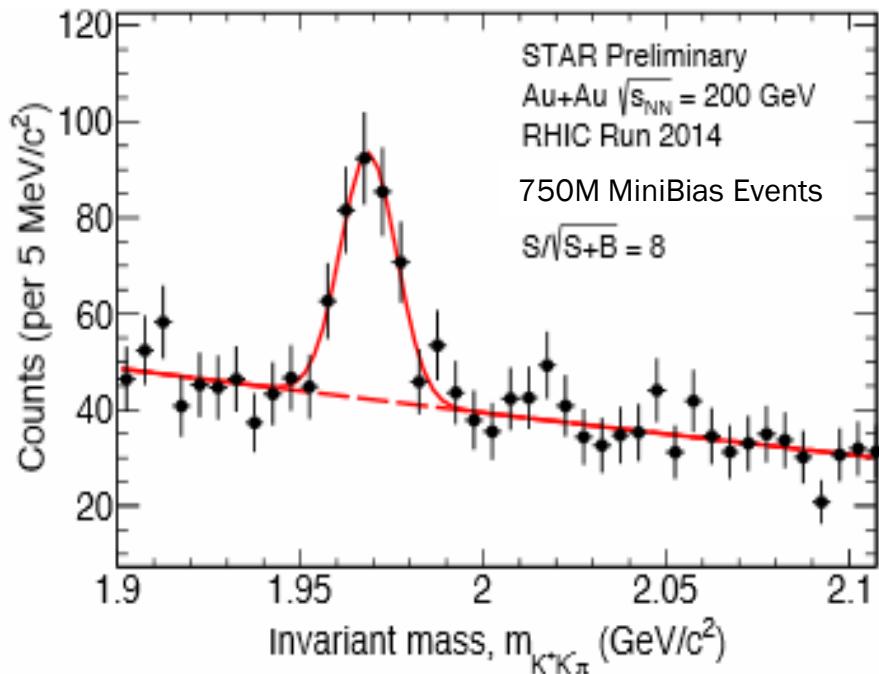
TPC PID: Using energy loss (dE/dx)

TOF PID: Using time-of-flight (β)*

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



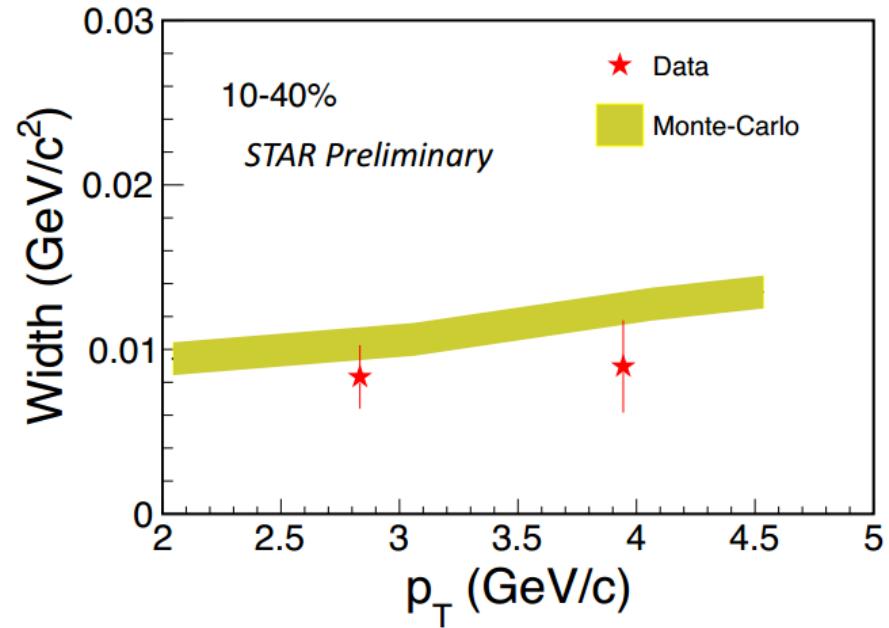
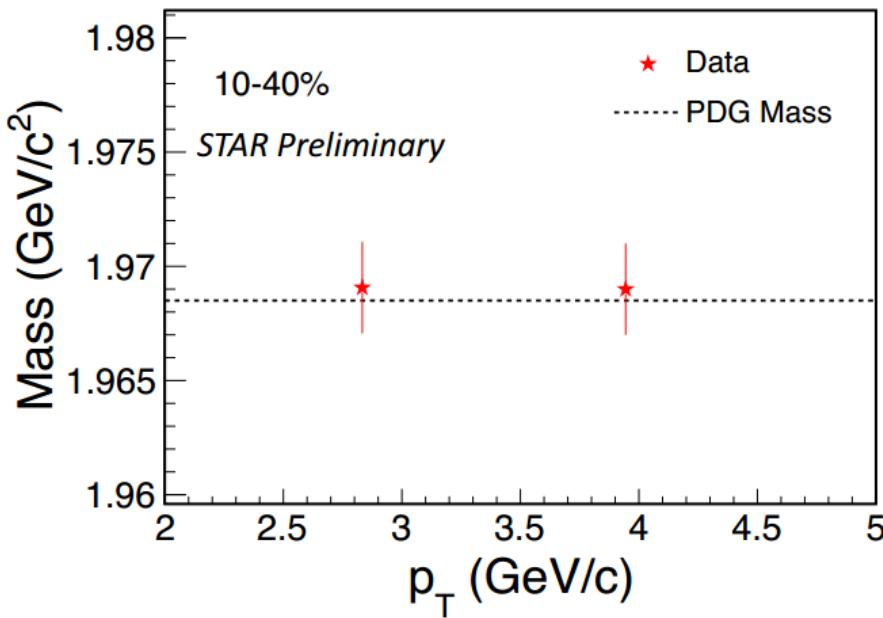
p_T integrated D_s signal



- First D_s meson signal observed at RHIC.

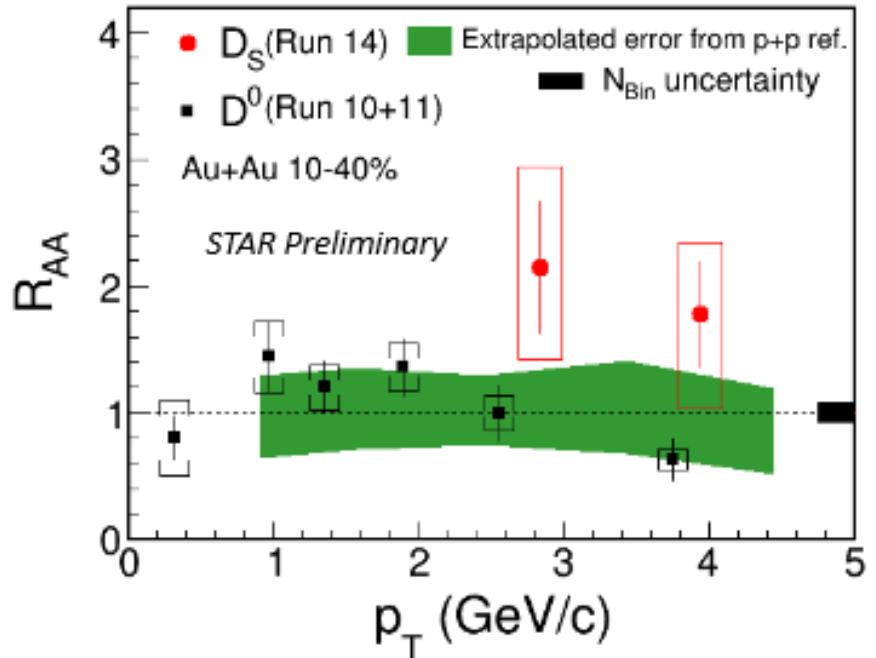
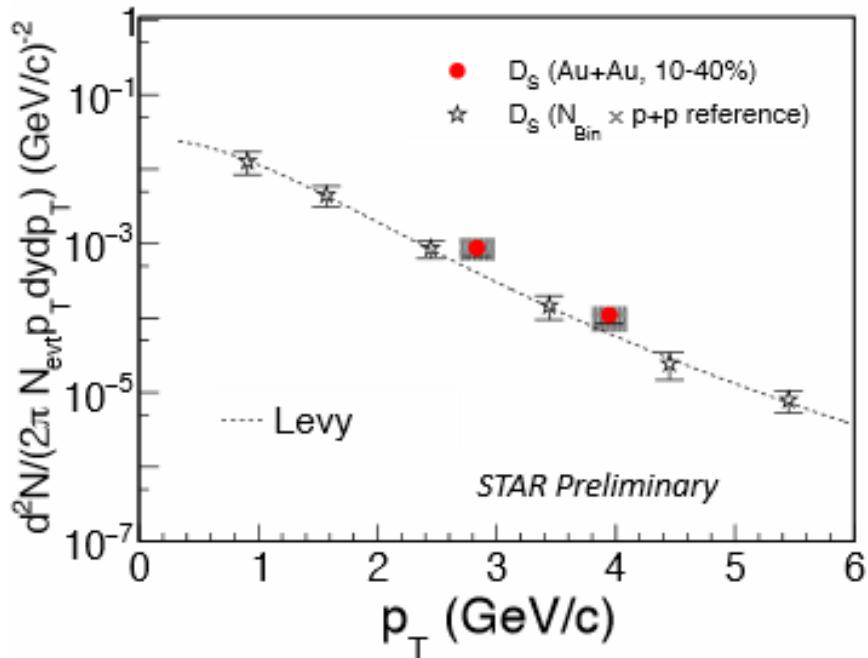


Mean and width



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

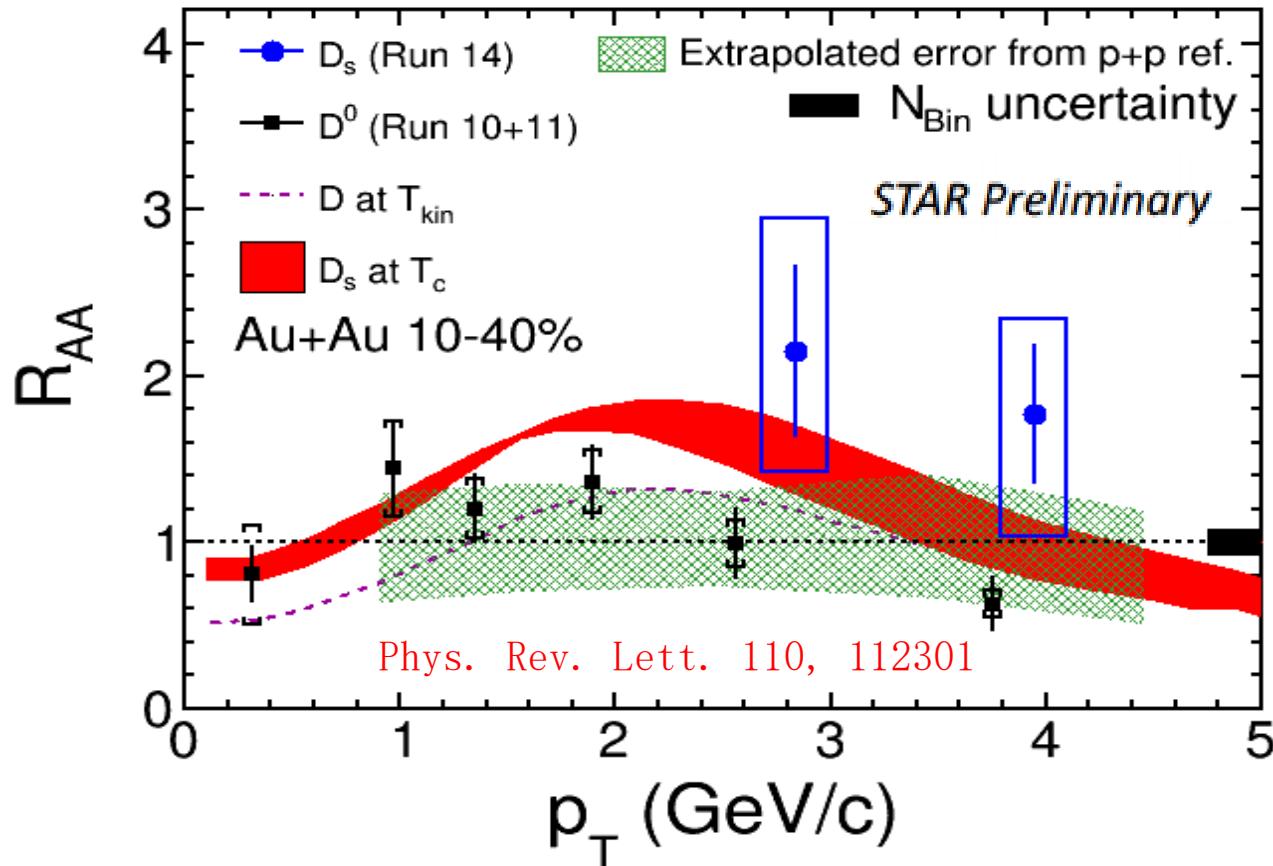
D_s meson spectrum and R_{AA}



- pp reference was obtained from charm cross-section measured by STAR scaled by $c \rightarrow D_s$ fragmentation factor¹
- [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.

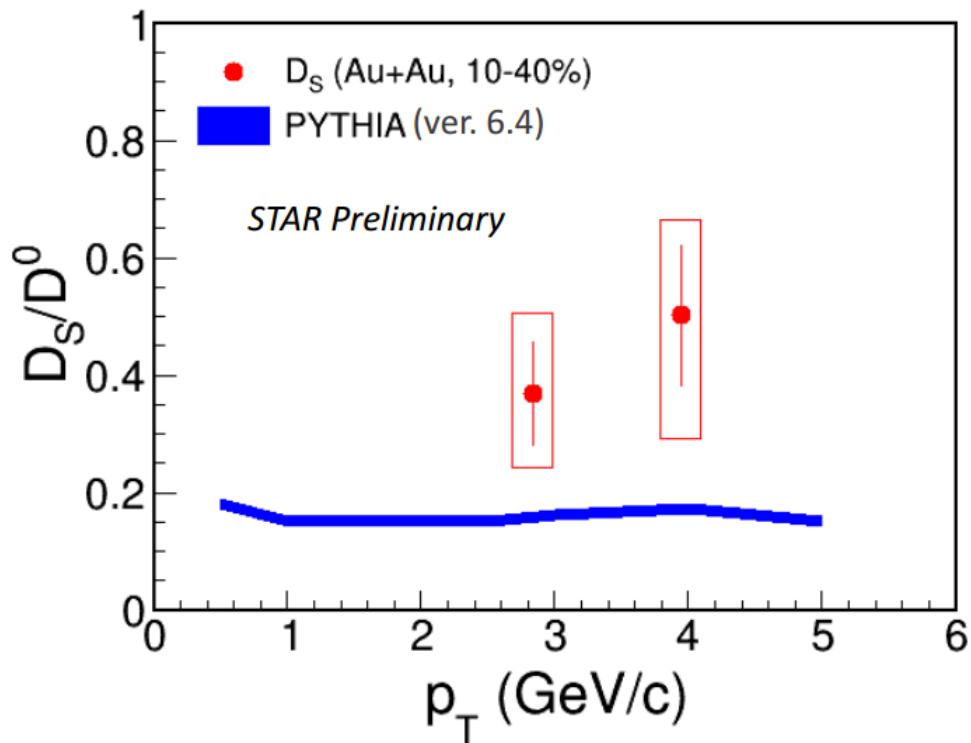
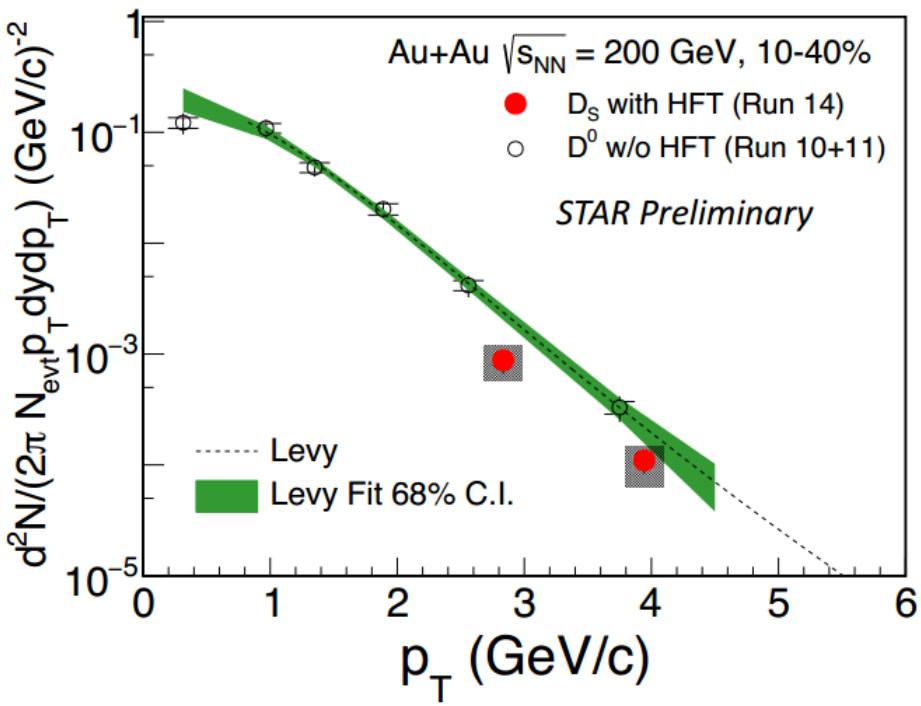


Model calculation for D_s R_{AA}



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

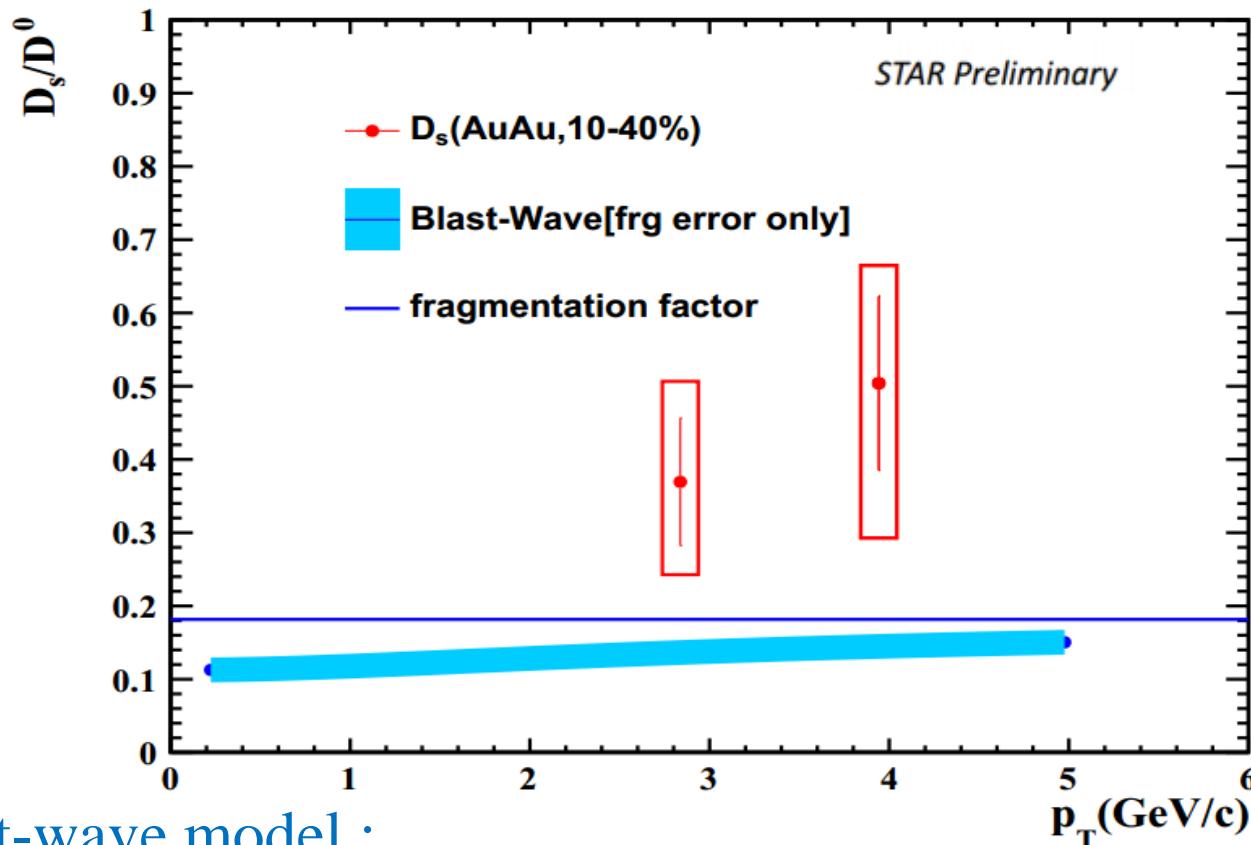
D_s over D^0 ratio



- 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

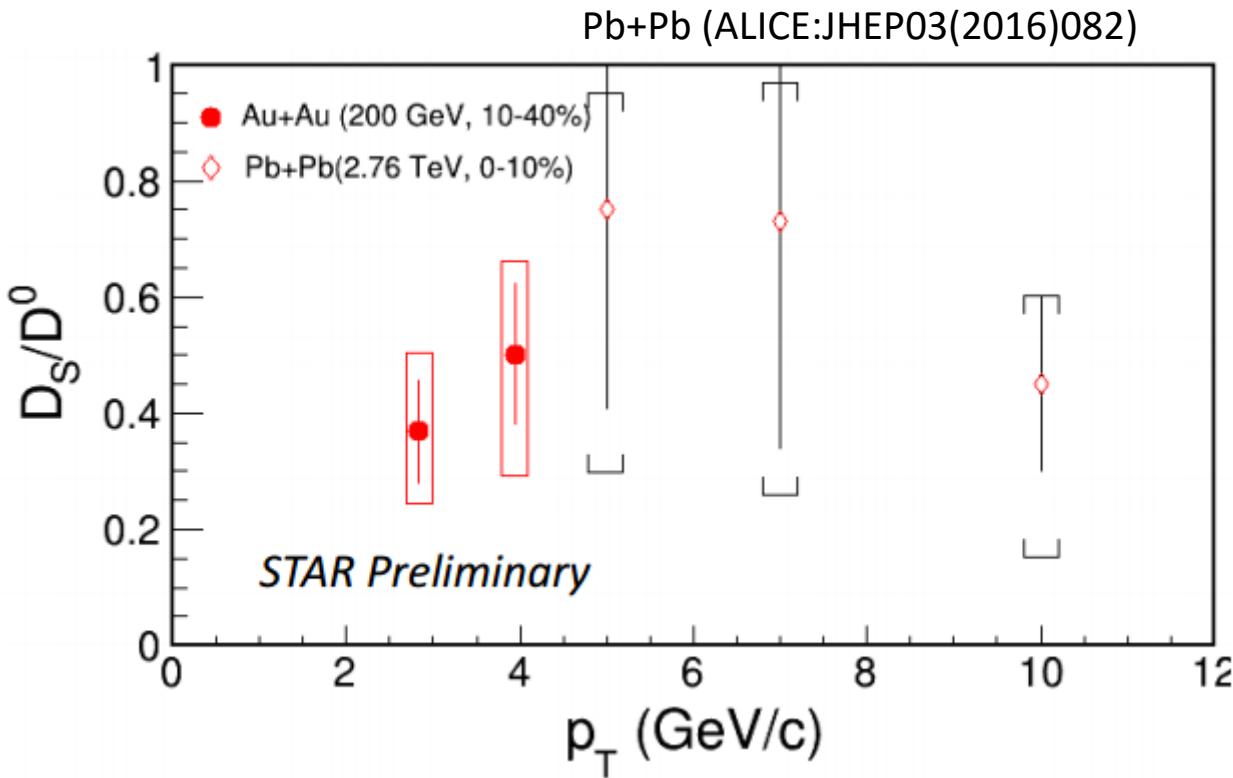


Blast-wave model :

- Blast-wave parameters obtained from fitting D^0 spectra¹
- 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

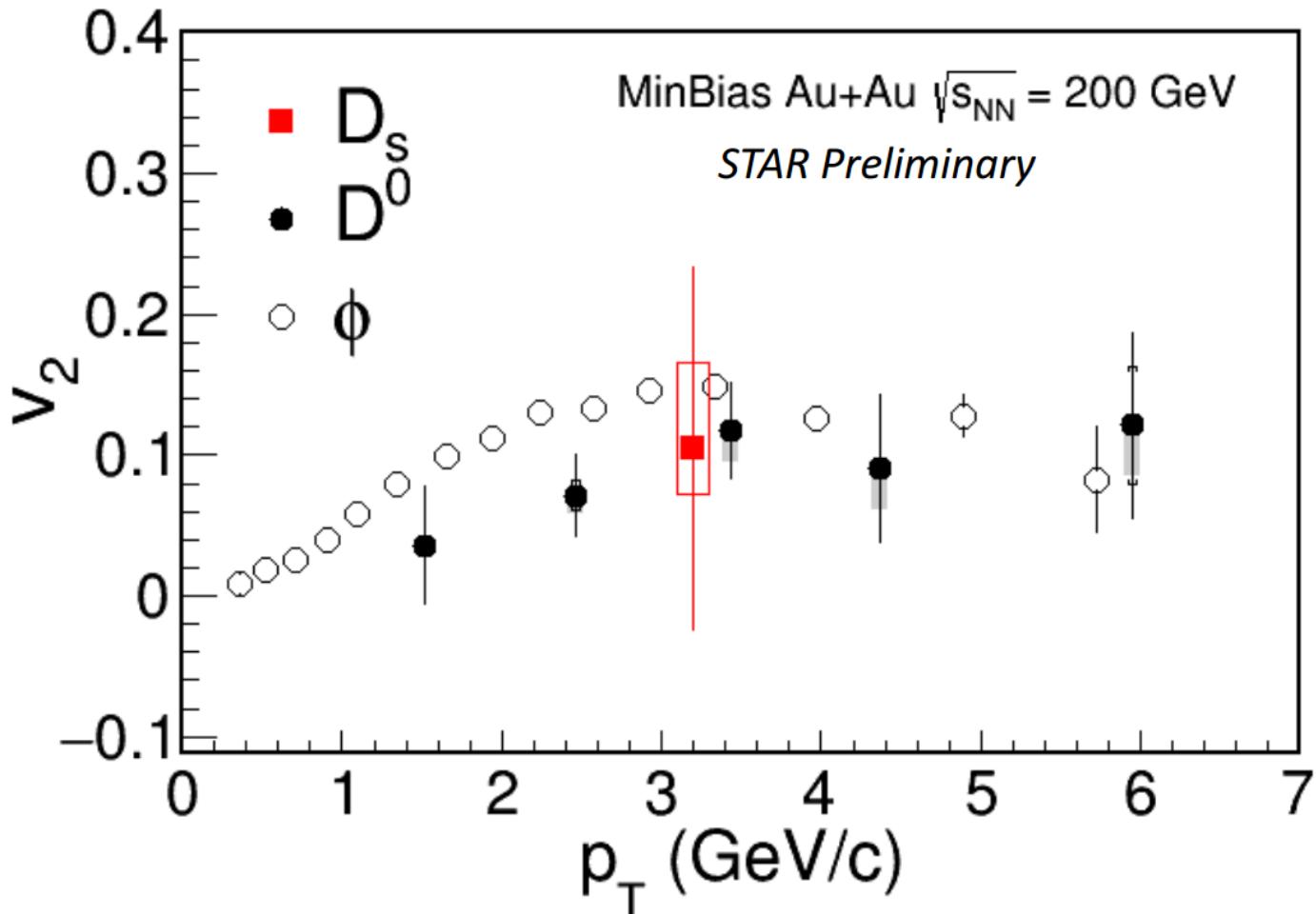
D_s/D^0 ratio: RHIC vs LHC



- Strangeness enhancement is expected to be less at high p_T 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 .

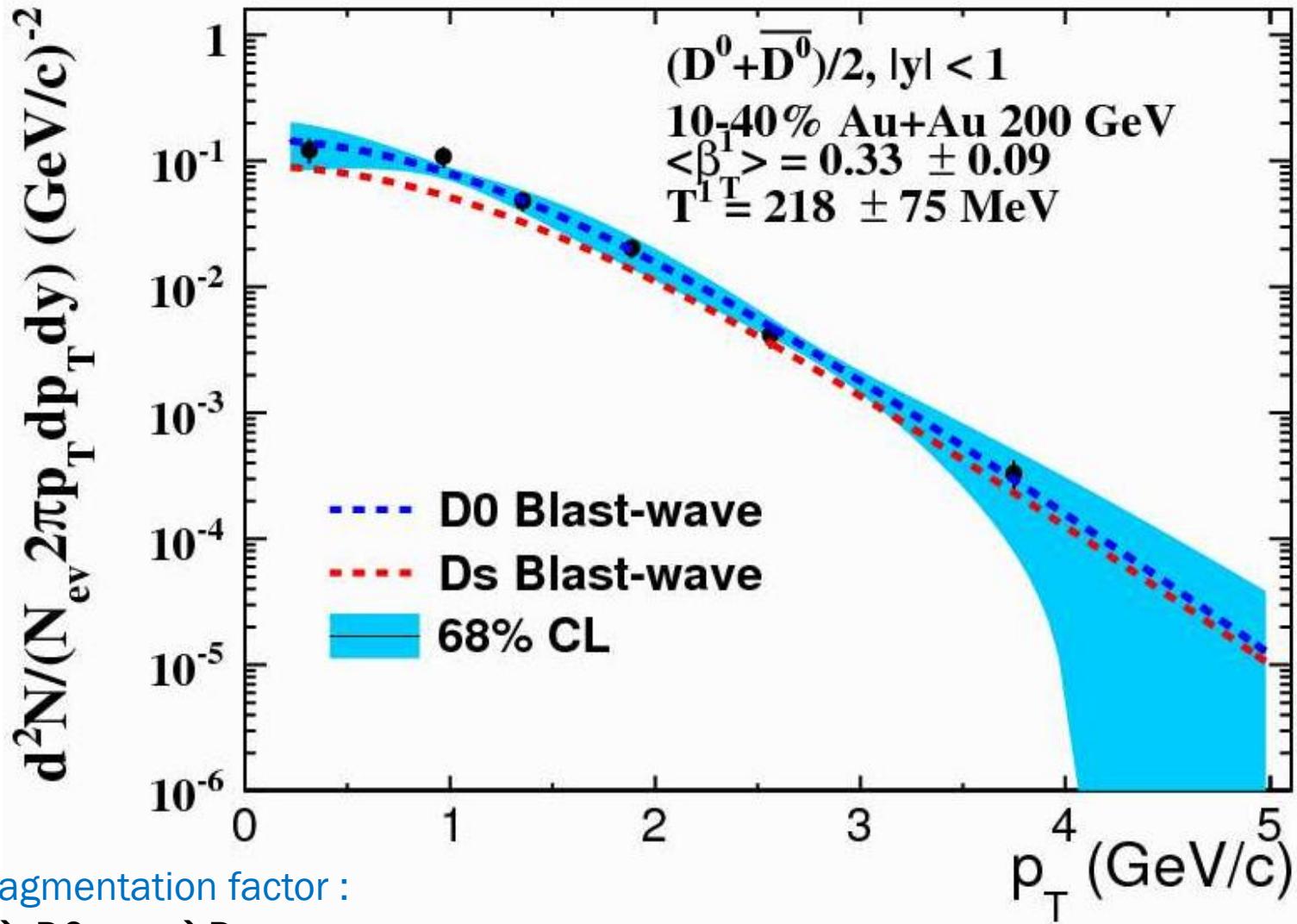


Summary and outlook

- 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 $D_s v_2$ at RHIC.
- Stay tuned for Run 14+16 data with increased statistics and improved detector efficiency + resolution.



Blast wave



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

Compare to k/pi ratio

