Study of low p_T non-photonic electron production in 200 GeV Au+Au collisions in STAR Experiment at RHIC

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for the STAR Collaboration
Pusan National University

the 4th Asian Triangle Heavy Ion Conference
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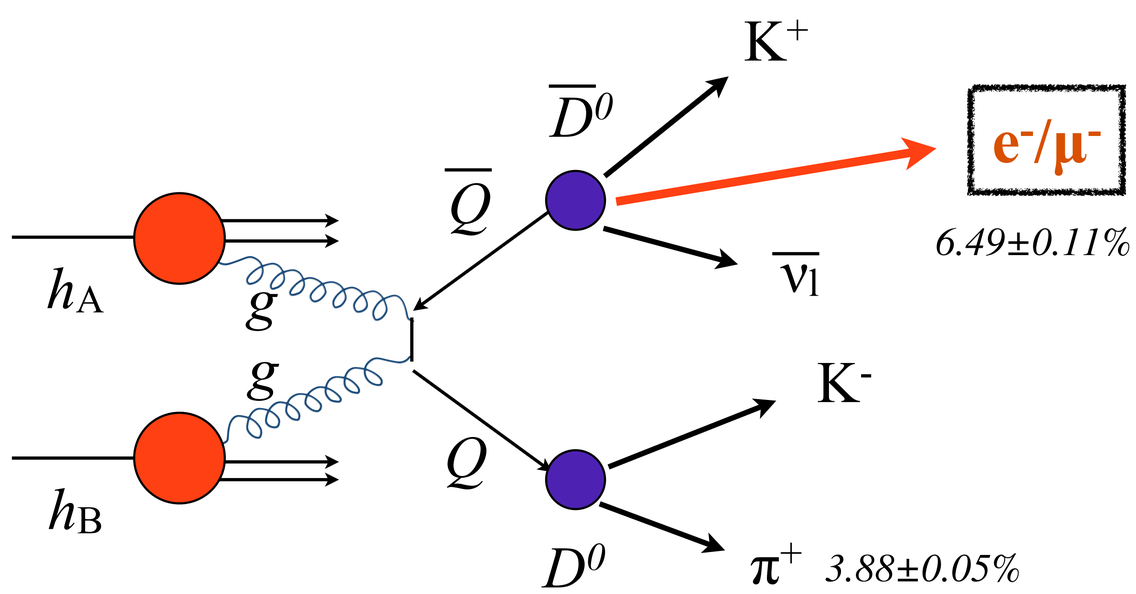
Outline

- Motivation
- STAR Experiment
- Status of NPE analysis in detail
  - Inclusive electrons
  - Reconstruction of photonic electrons background
  - Partner finding efficiency
  - Inclusive / photonic electron ratio
- Summary and outlooks

Motivation

- **Heavy Flavor** in heavy-ion collisions
  - Created mostly in initial parton-parton hard scatterings
  - Study flavor dependence of *parton energy loss* machanisms.
  - Interaction with hot and dense ***QCD*** matter differently from that of light quarks.
- **Non-photonic electrons (NPE)**
  - *Semileptonic channel* have higher B.R. than the hadronic channels of *open heavy flavor mesons.*
  - *Easy for triggering.*
  - *Does not suffer from large combinational background.*

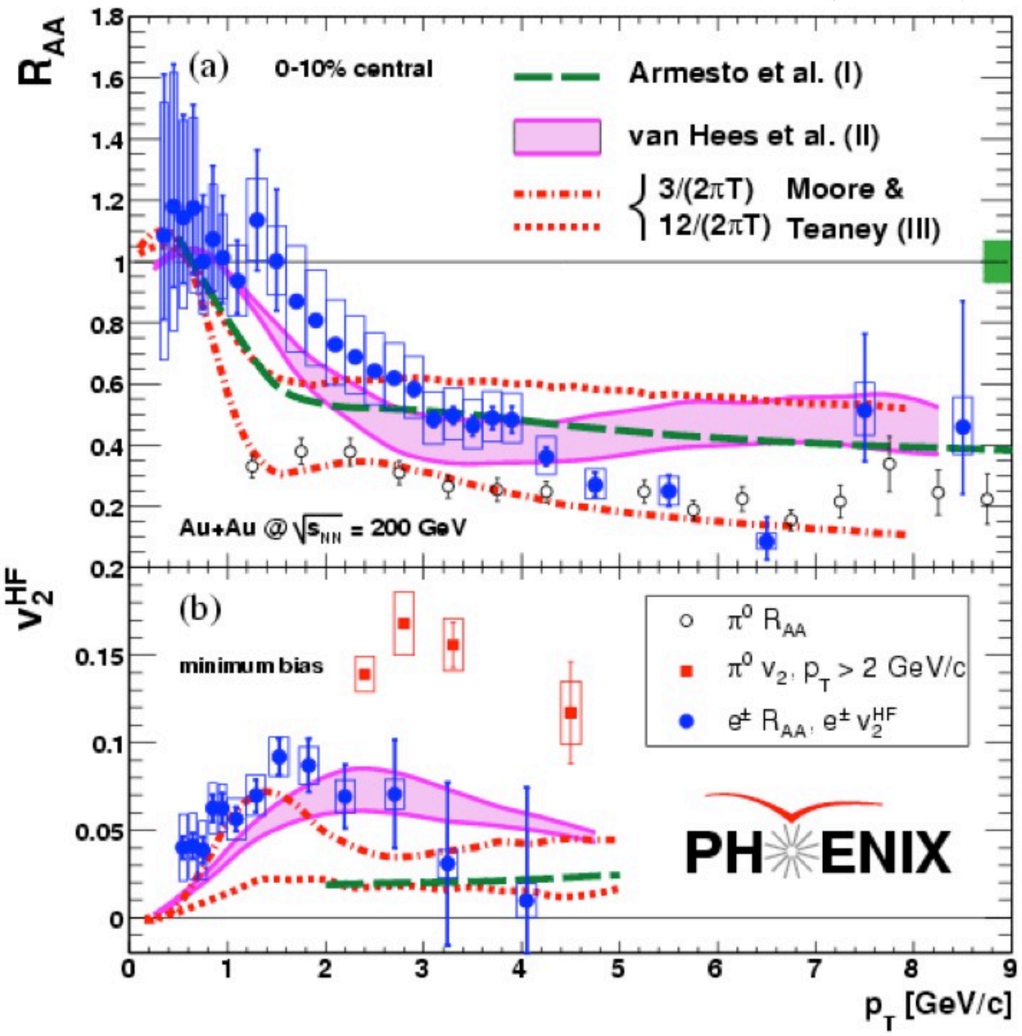


Inclusive electrons (after electron PID) = ***Non-photonic electrons(NPE)*** + *Photonic electrons(PE)*

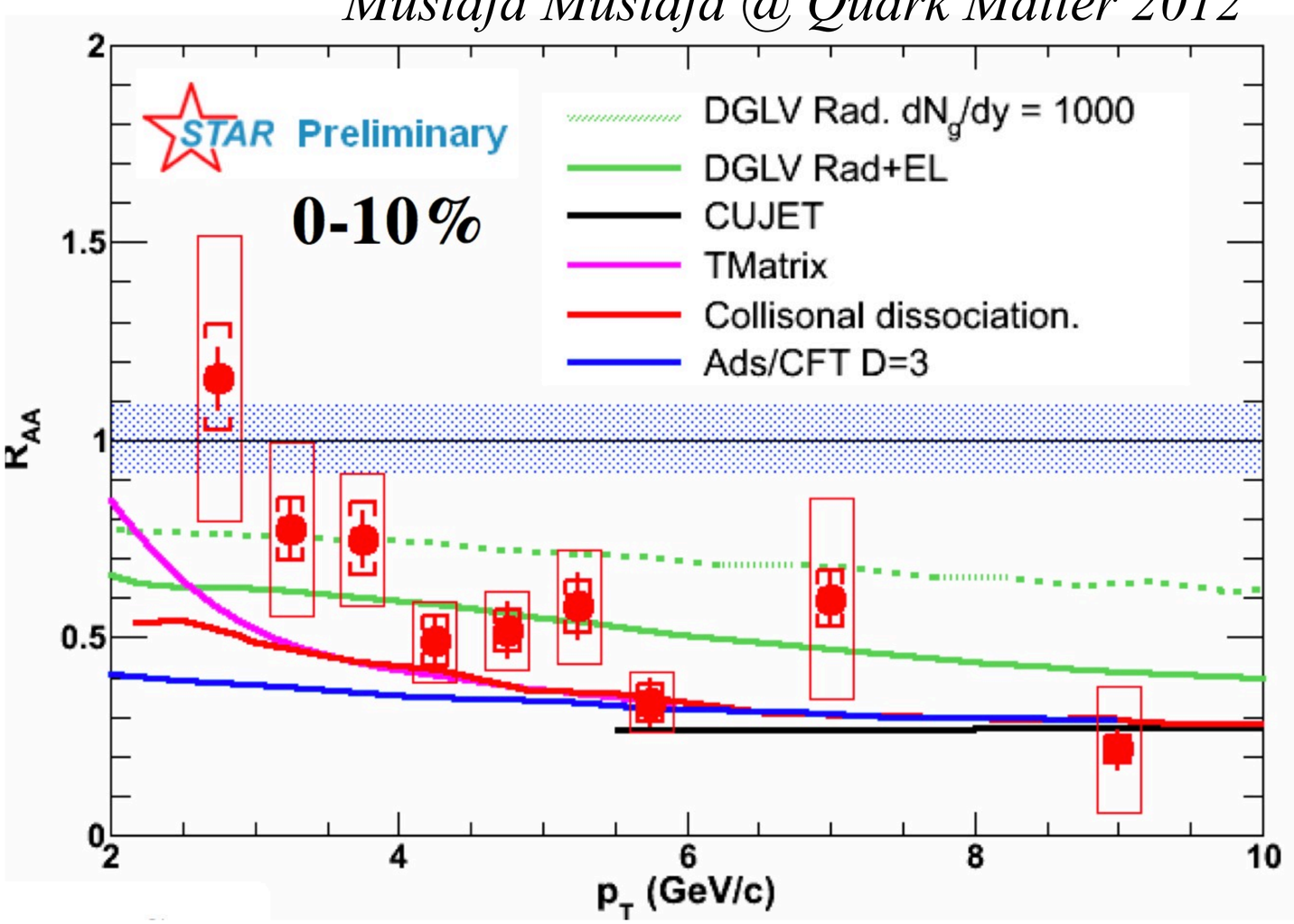
D^0, $D^{\pm}$, B, Λ_c ... | γ, π^0, η ...

Motivation

*PRL **98**, 172301 (2007)*

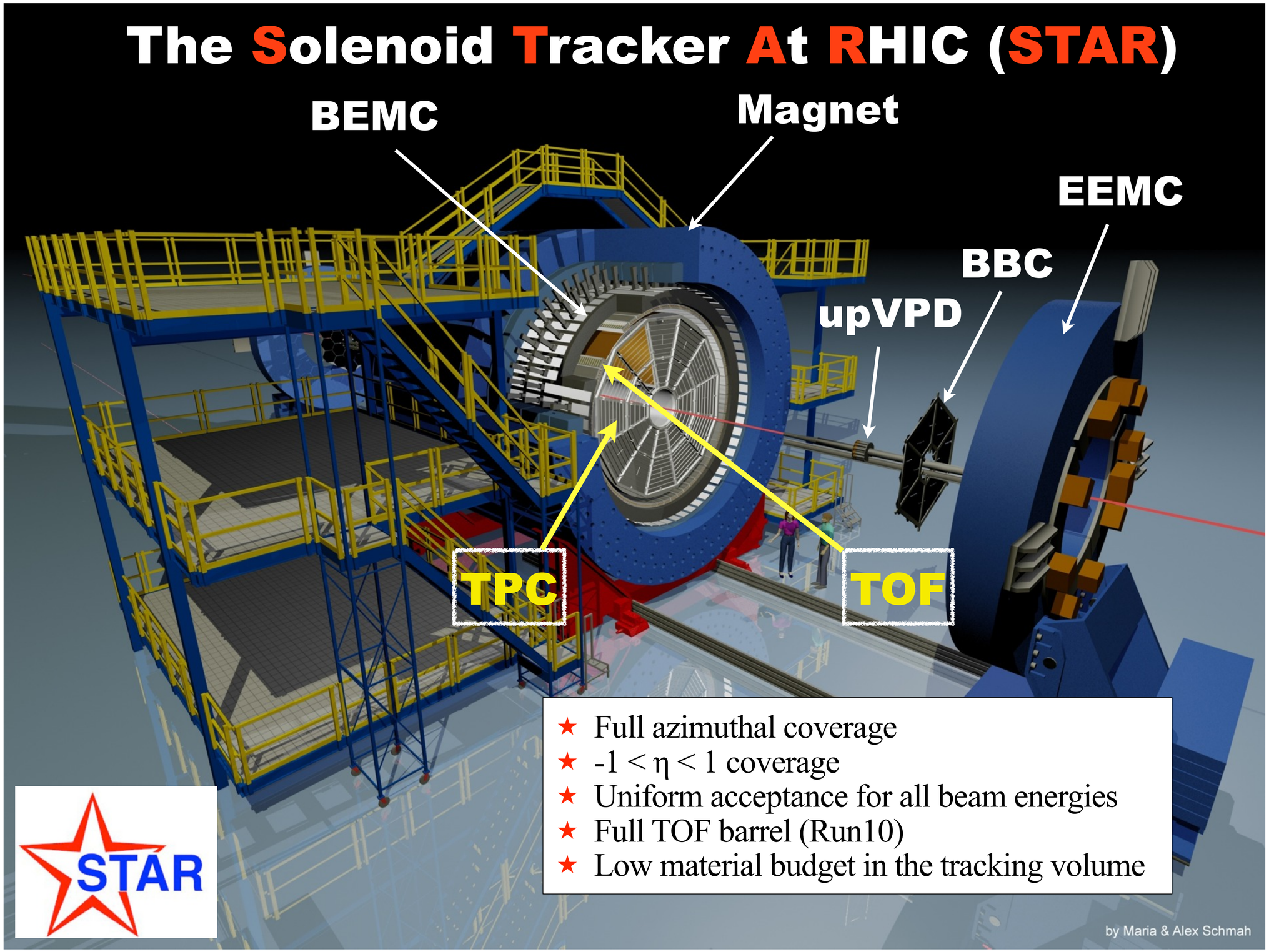


Mustafa Mustafa @ Quark Matter 2012

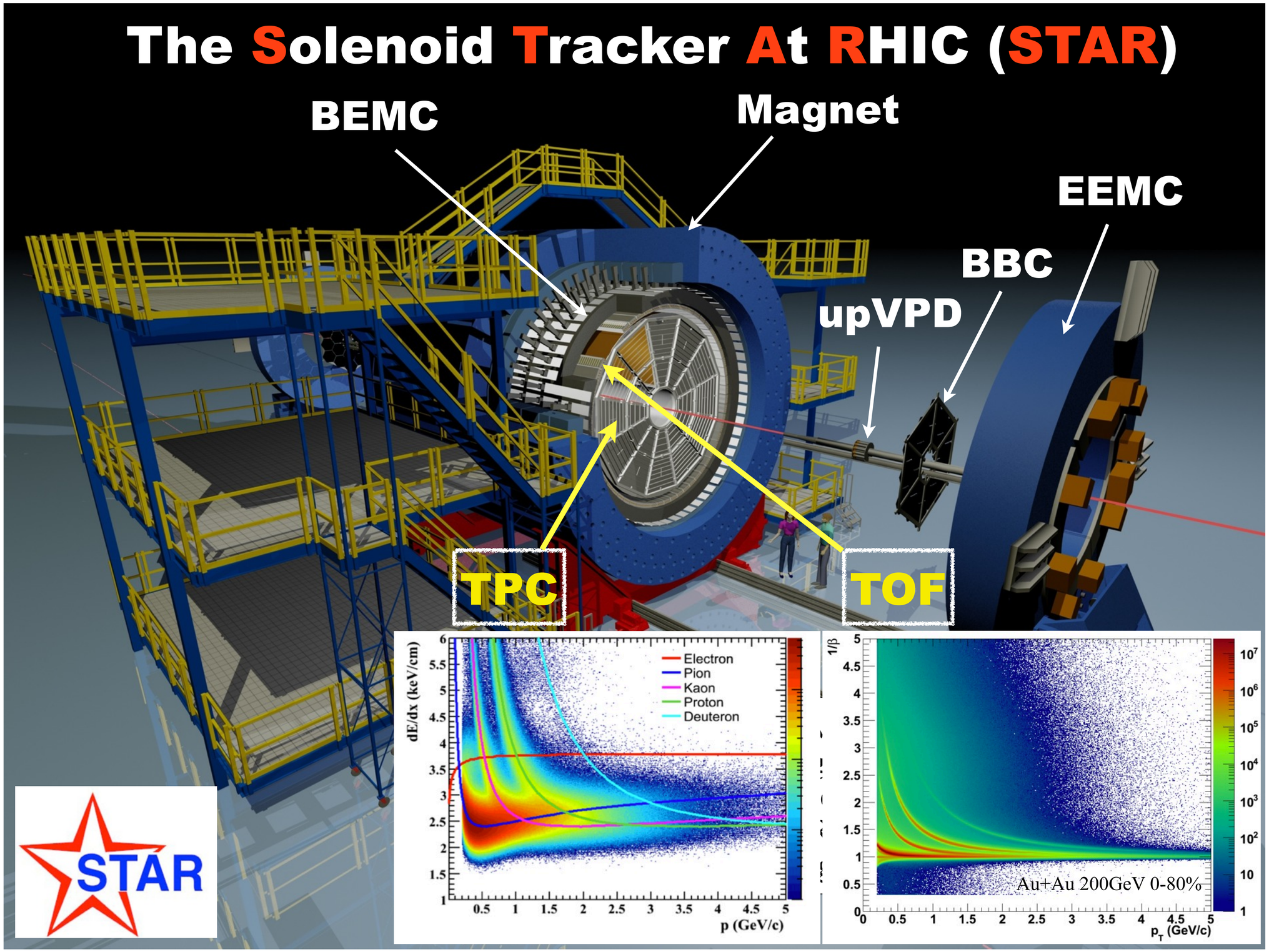


- Production of NPE suppressed at high p_T.
- Complementary to the measurement via hadronic decay channels.
- Low p_T NPE measurement is important for total charm quark cross section measurements.

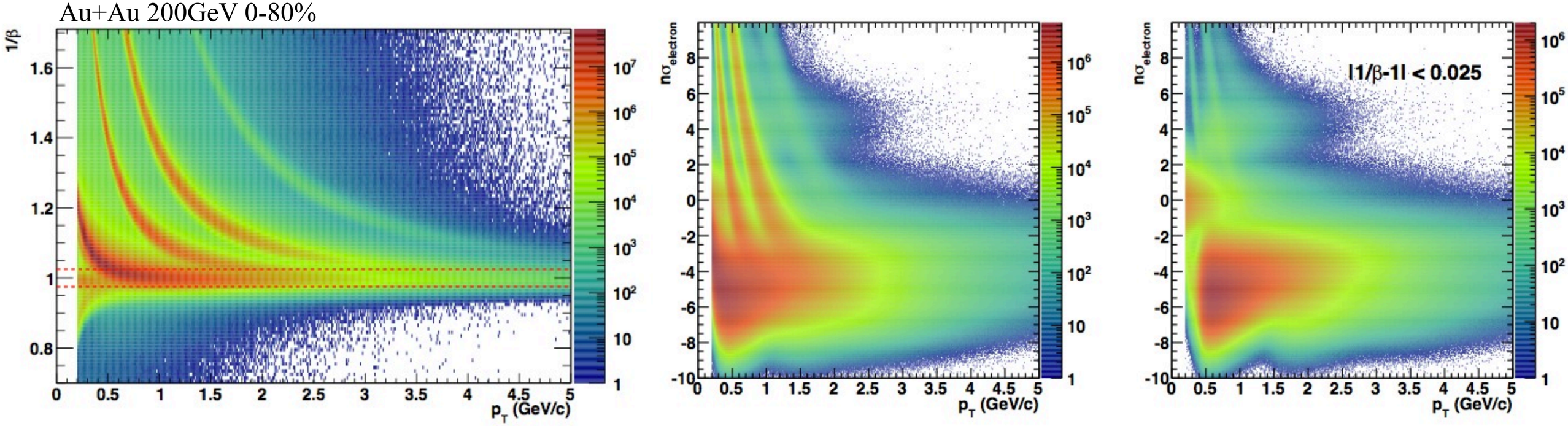
STAR Experiment



STAR Experiment



Inclusive electrons



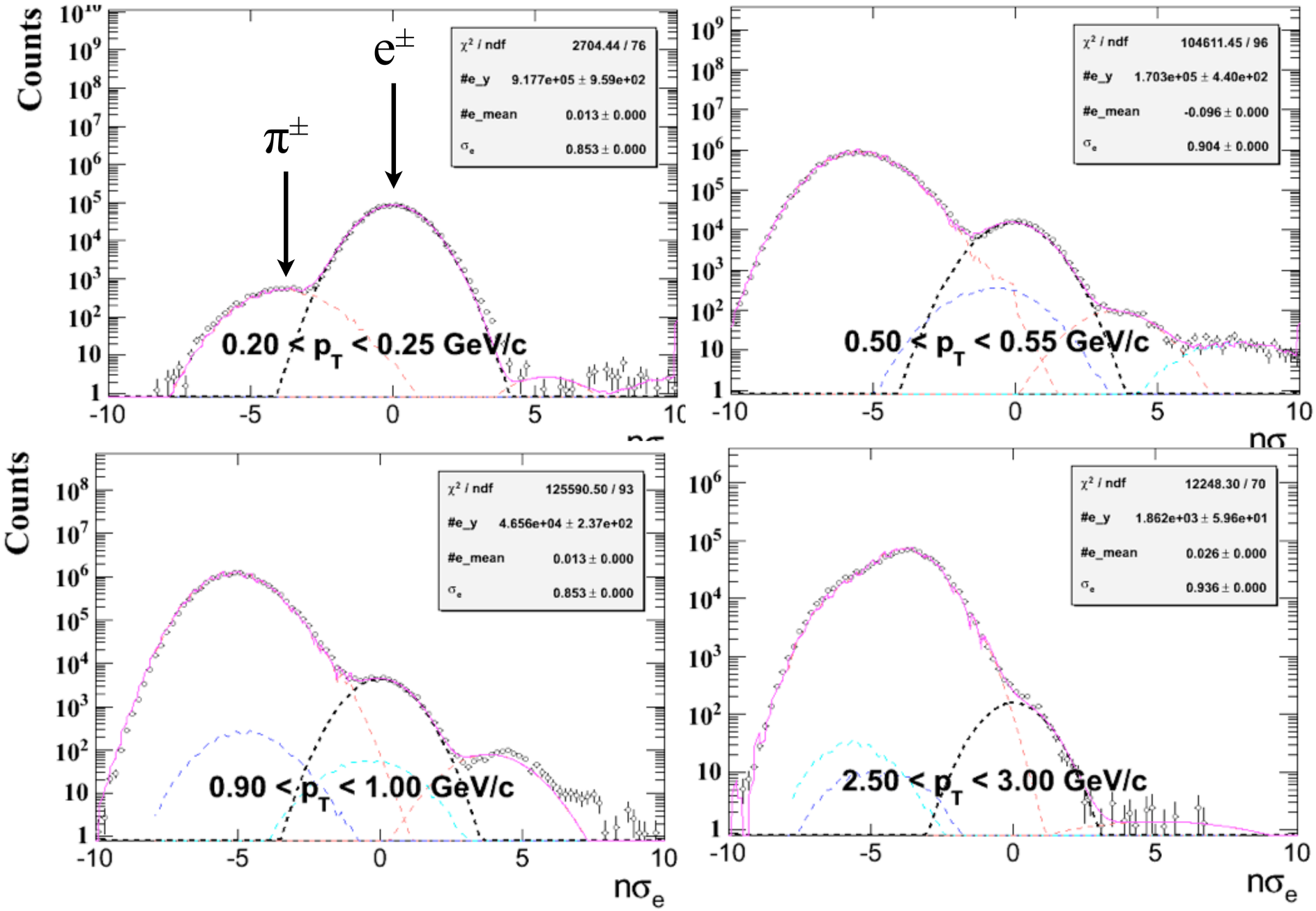
- Au+Au 200 GeV 0-80% VPDMinBais dataset : 217M events
  - electron found event : 37M events
- Inclusive electron identified by **TOF+TPC**

  → $|1/\beta-1| < 0.025$ cut
- After selecting very **high purity hadrons** from TOF information (mass^2) and **electron** from e^+e^- pair mass cut, the **$n\sigma_e$ shapes** are used for the **fitting** to obtain yield.
- Inclusive electron purity estimation ~ **96%**

Primary track?	yes
TOF hits matched?	yes
global DCA [cm]	≤ 1.0
TPC Hits [#]	≥ 20
TPC Hits / MaxHit	≥ 0.52
dE/dx Hits [#]	≥ 15
$1/\beta - 1$	(-0.025, 0.025)
rapidity	(-0.5, 0.5)
p_T [GeV/c]	(0.2, 20)

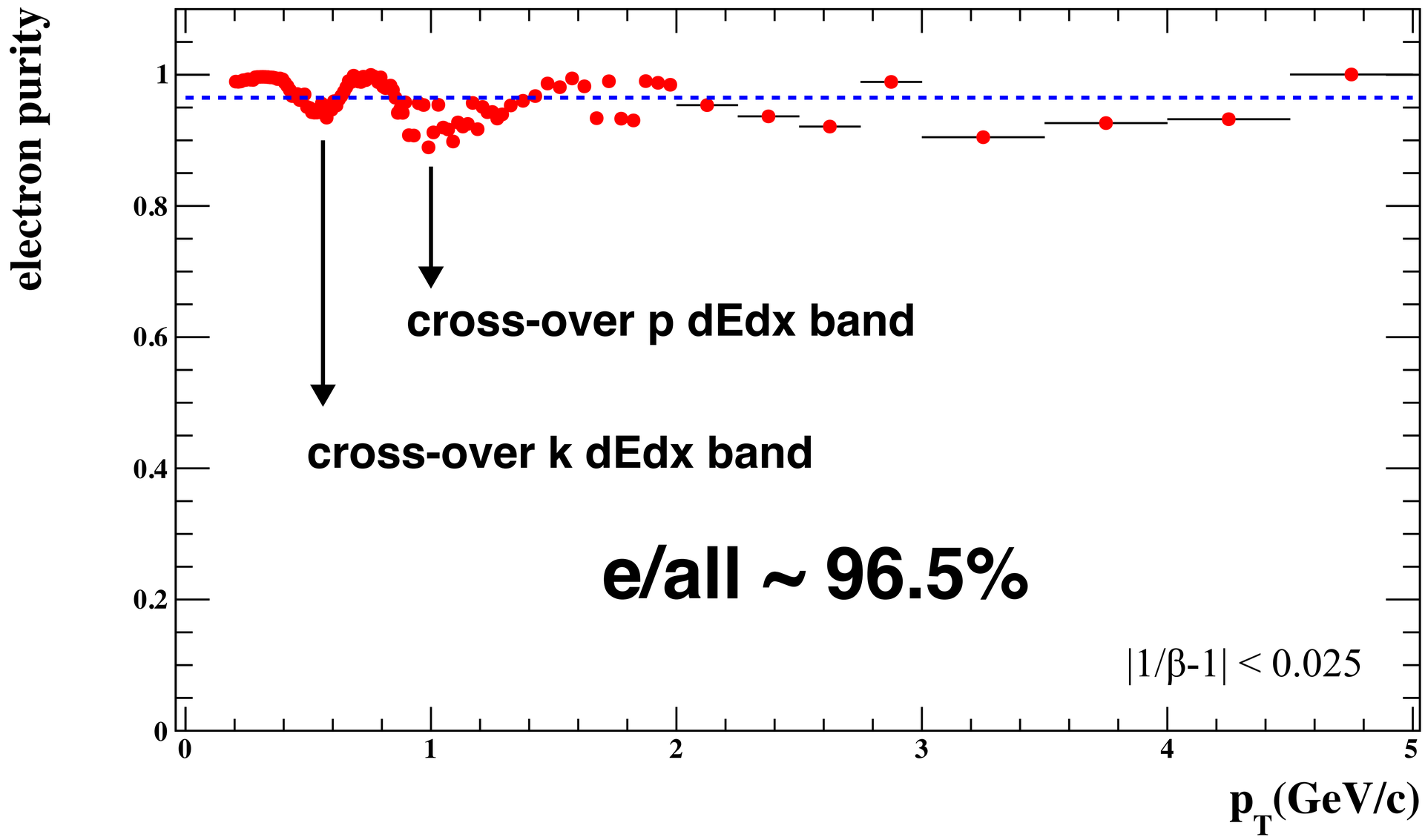
* $n\sigma_e$ is deviation of the *dE/dx* from Bichsel function

Inclusive electrons



After selecting hadrons very high purity, the $n\sigma_e$ shape for hadrons are used for the fitting.

Inclusive electrons



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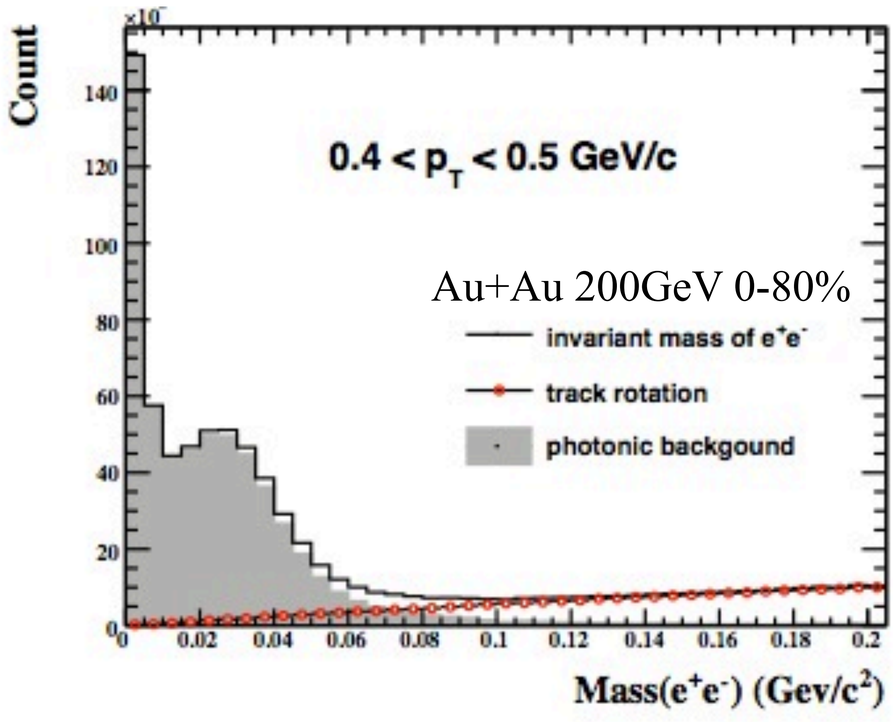
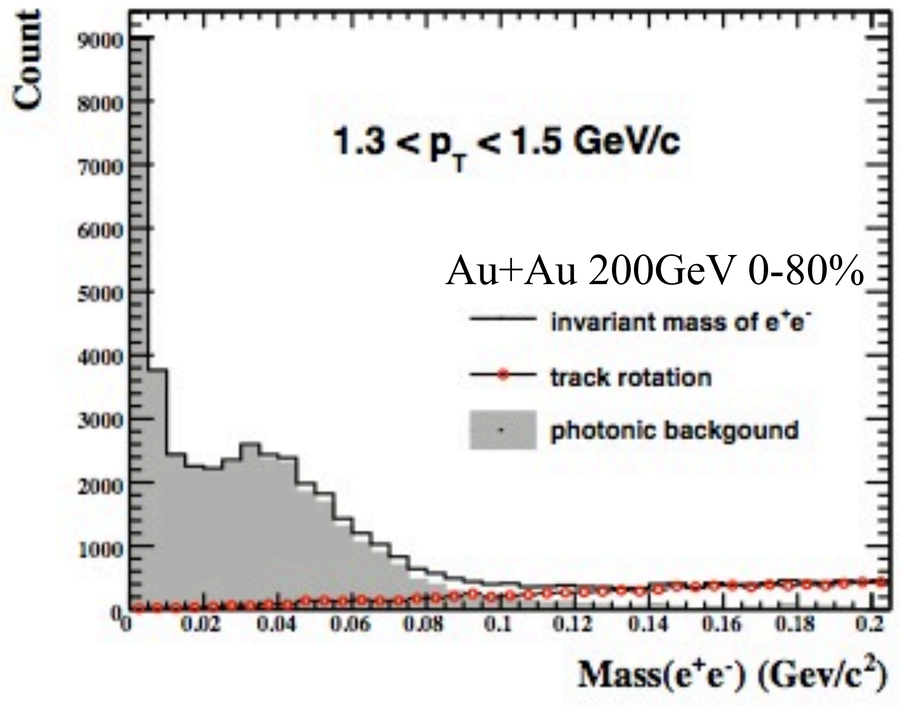
Photonic background



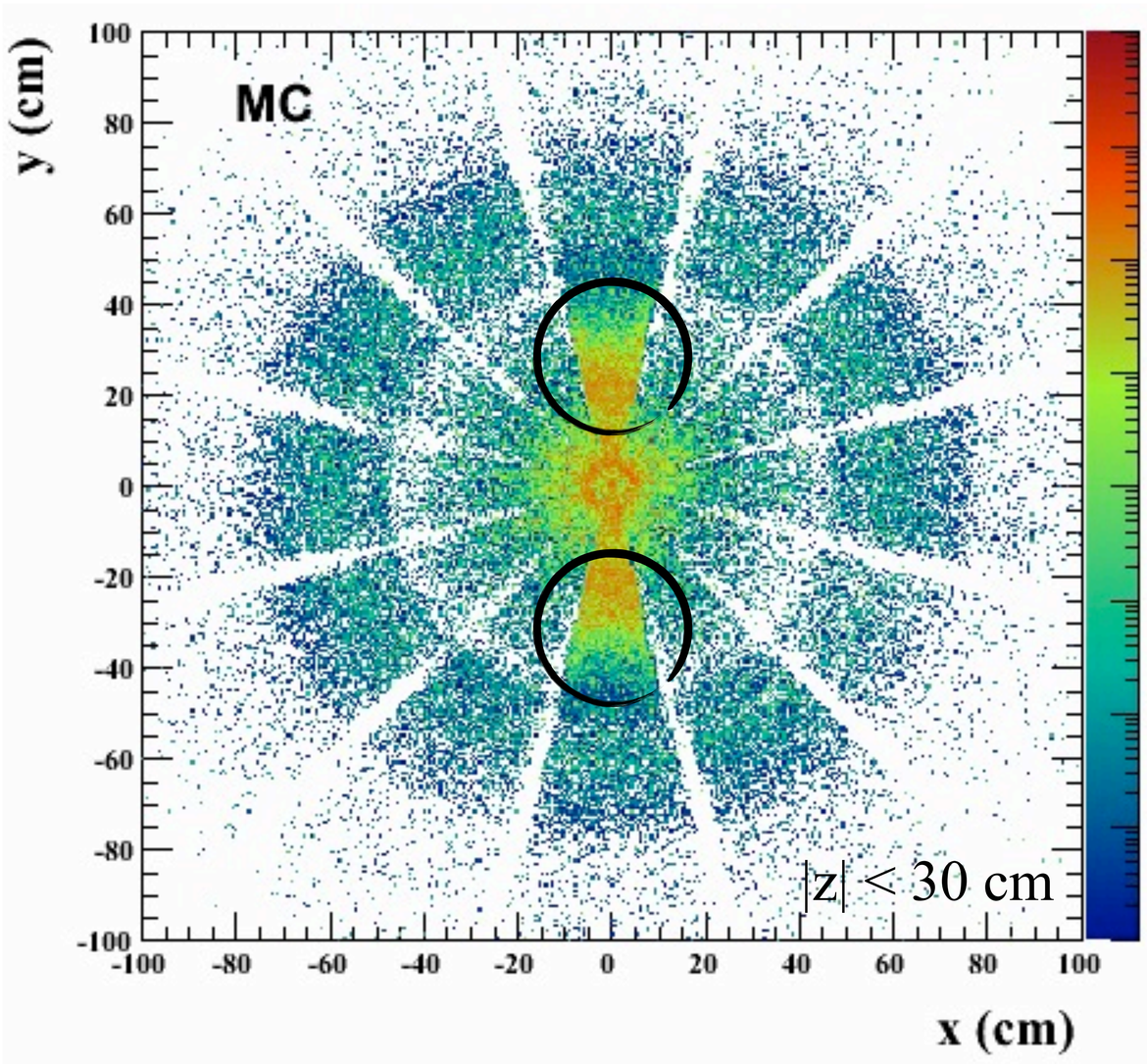


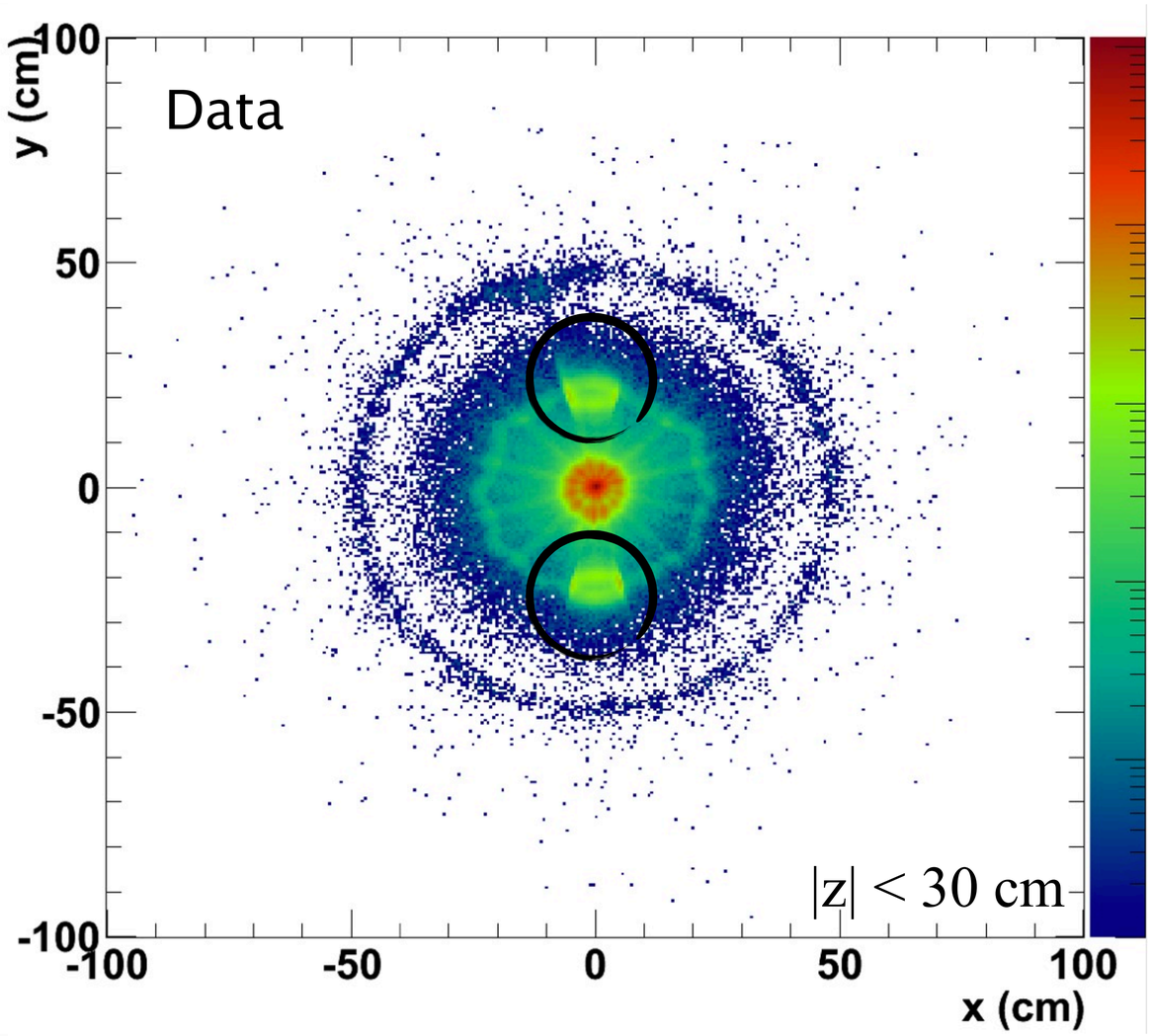
- We used the "**reconstruction method**" to statistically subtract the contribution of photonic electrons to inclusive electrons.

- **pair invariant mass < 0.15 GeV/c^2** cut to obtain photonic electron yield
  - $\gamma \rightarrow e^+ e^-$ photon conversion in the material in STAR detector.
  - $\pi^0 \rightarrow \gamma\, e^+ e^-$ $(1.174 \pm 0.035)\%$
  - $\eta \rightarrow \gamma\, e^+ e^-$ $(0.70 \pm 0.07)\%$

- Photonic electrons needed partner finding (photonic electrons reconstruction) efficiency.

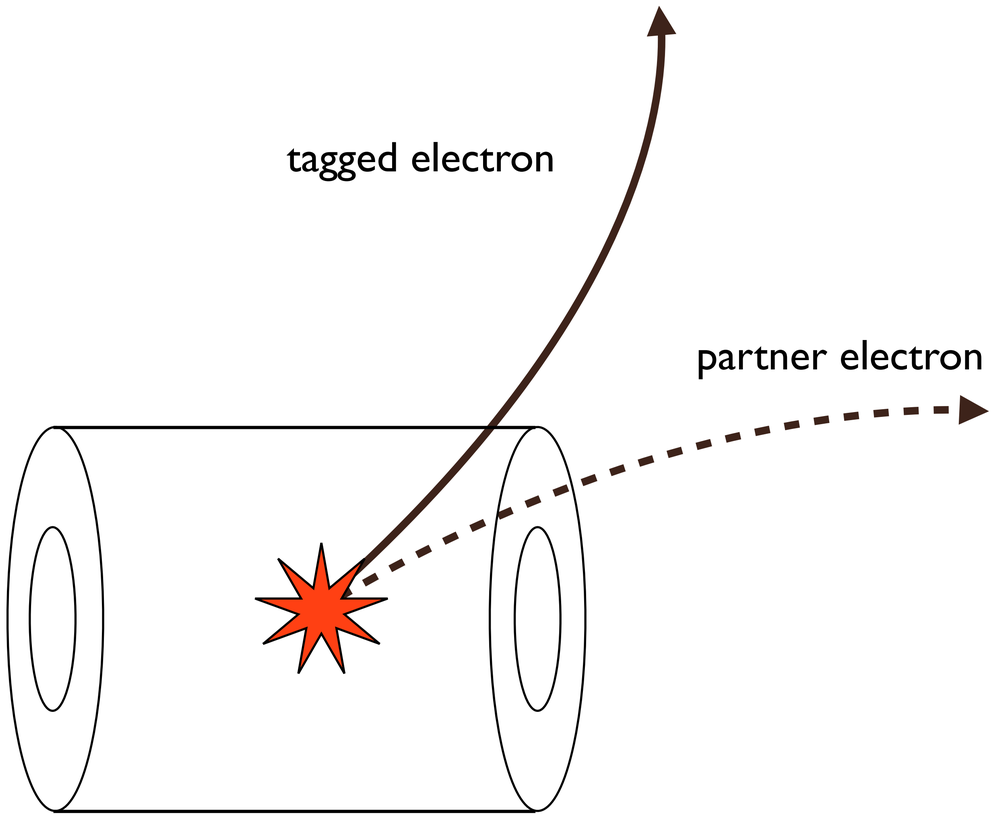
Photonic background



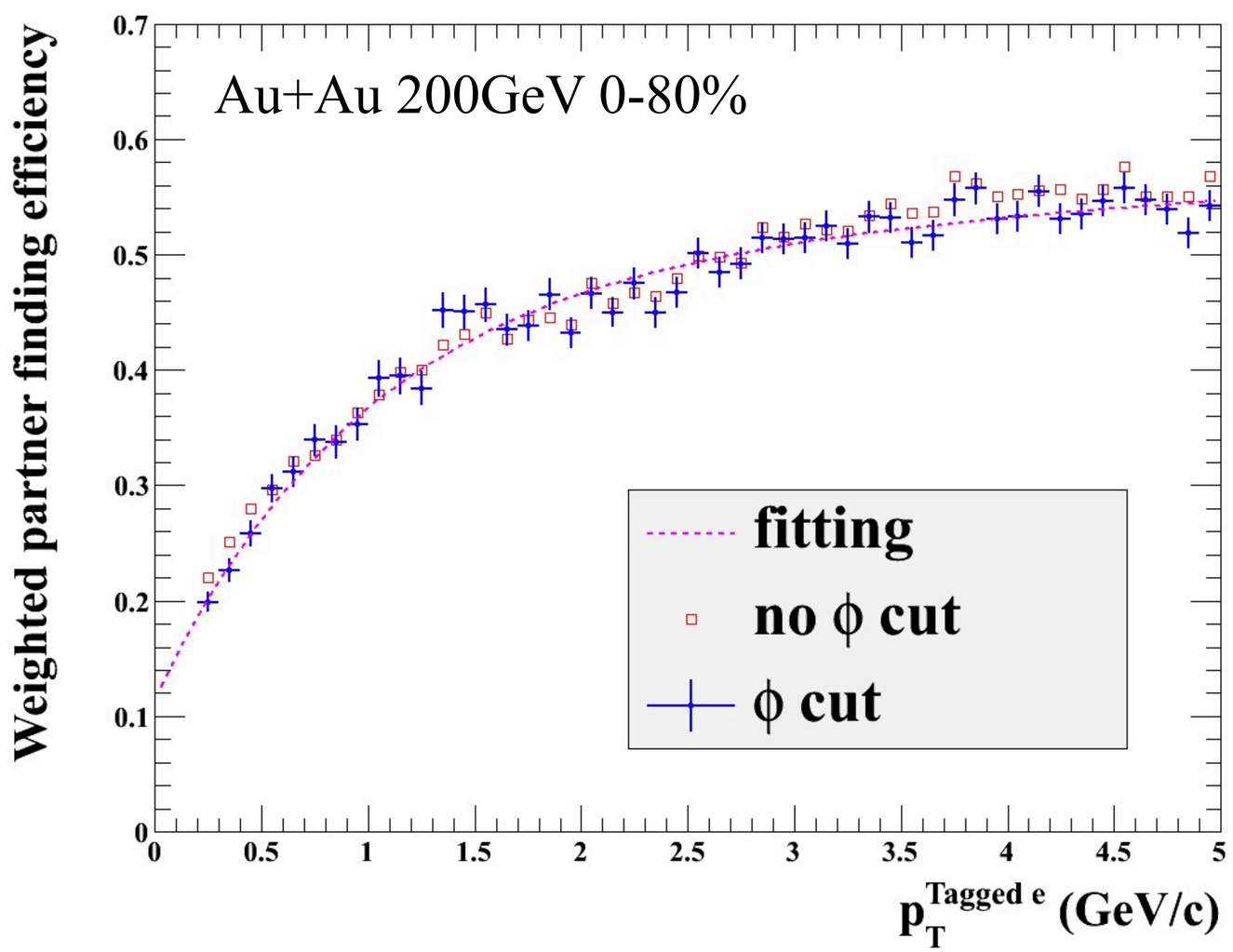


- $1.3 < |\phi| < 1.9$ region has many conversions.
- Beam pipe and supporting structure make many photonic electrons.

Partner finding efficiency

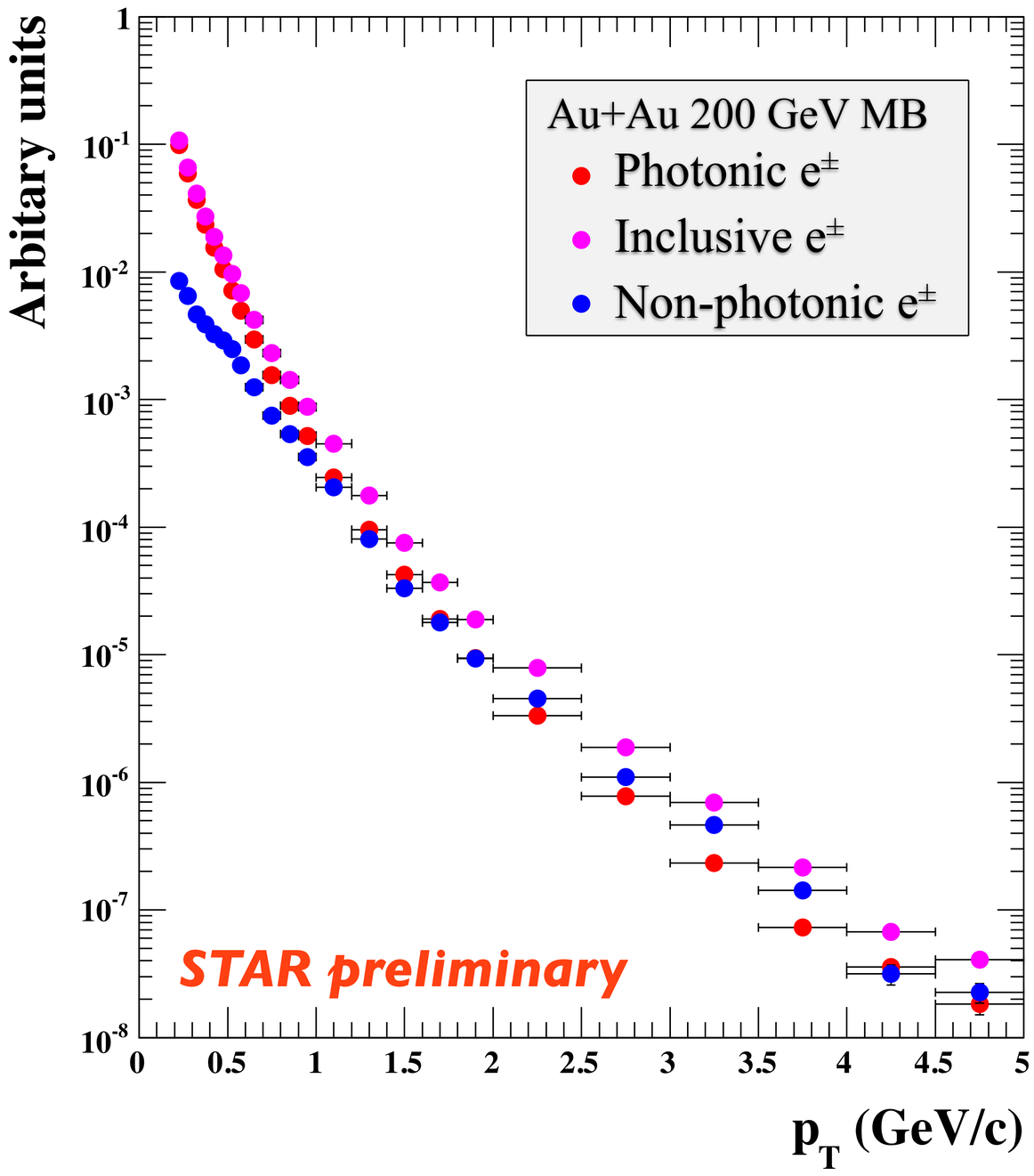


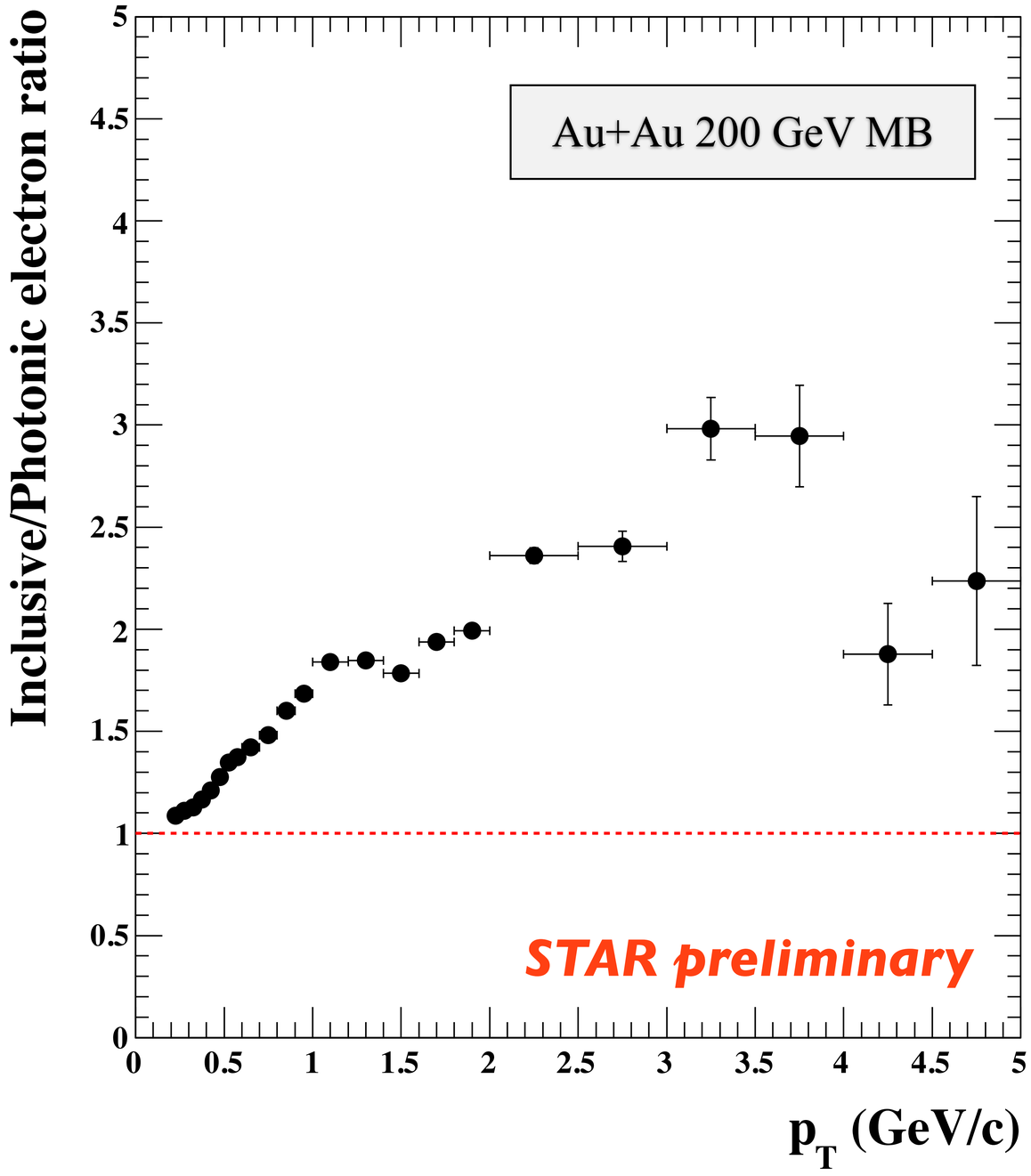
Sometimes, we cannot identify or detect the partner electron. (geometry, efficiency...)



- Monte-Calo γ embedding simulation with real γ and π^0 distribution.
- Partner finding efficiency is 15~50% in minimum-bias Au+Au collisions.

Raw NPE spectrum





Summary and Outlook

- ***Summary :***
  - Low pT non-photonic electron production in heavy-ion collisions is being studied.

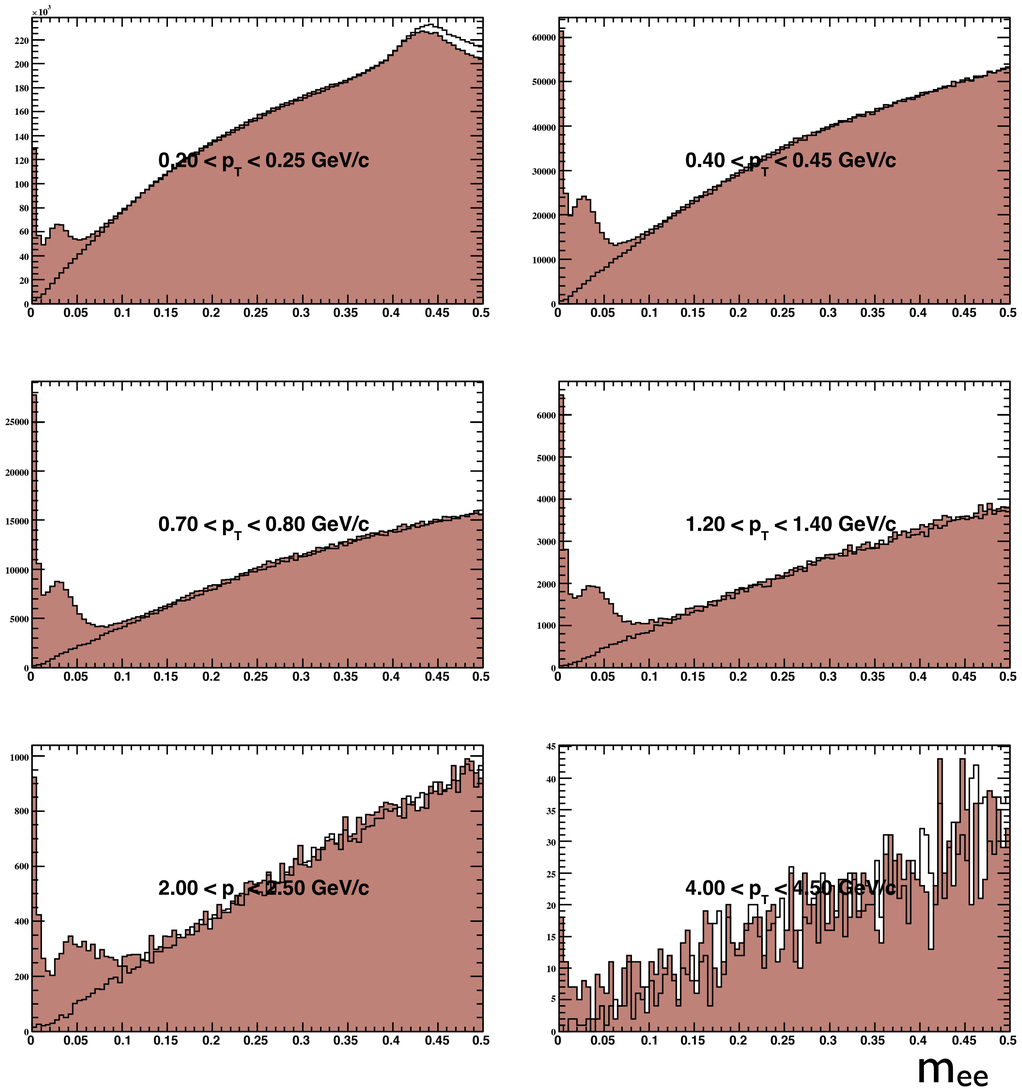
- ***Outlook :***
  - Obtain NPE invariant yield as a function of p_T.
  - Centrality dependence of NPE invariant yield.
  - Obtain NPE invariant yield in p+p collisions.
  - Nuclear modification factor.

Thank you.

Backup slides

Photonic electrons cuts in detail

Cuts	*e^-e^+ pair*
pair DCA [cm]	(0, 1)
Pair PseudoRapidity	(-1, 1)
Pair mass	< 0.15 GeV



Cuts	*Tagged e*	*Global Partner 1*	*Global Partner 2*	*Global Partner 3*
Primary track?	yes	no		
TOF hits matched?	yes	no	yes	yes
ylocal	(-1.9, 1.9)	-	(-1.9, 1.9)	(-1.9, 1.9)
zlocal	(-3.2, 3.2)	-	(-3.2, 3.2)	(-3.2, 3.2)
global DCA [cm]	≤ 1.0	-	-	-
nFitPts [#]	≥ 20			
nFitPts/nMax	> 0.52			
ndEdxFitPts [#]	**≥ 20**	**-**		
p_T [GeV/c]	(0.2, 20)			
pseudo-rapidity	-	(-1, 1)		
rapidity	(-0.5, 0.5)	-		
1/beta - 1	(-0.025, 0.025)	-	(-0.025, 0.025)	-
nSigE	**(0, 2)**	**(0, 2)**		
|ϕ|	**(0, 1.3), (1.9, π)**	**-**		