

The measurement of non-photonic electrons in STAR

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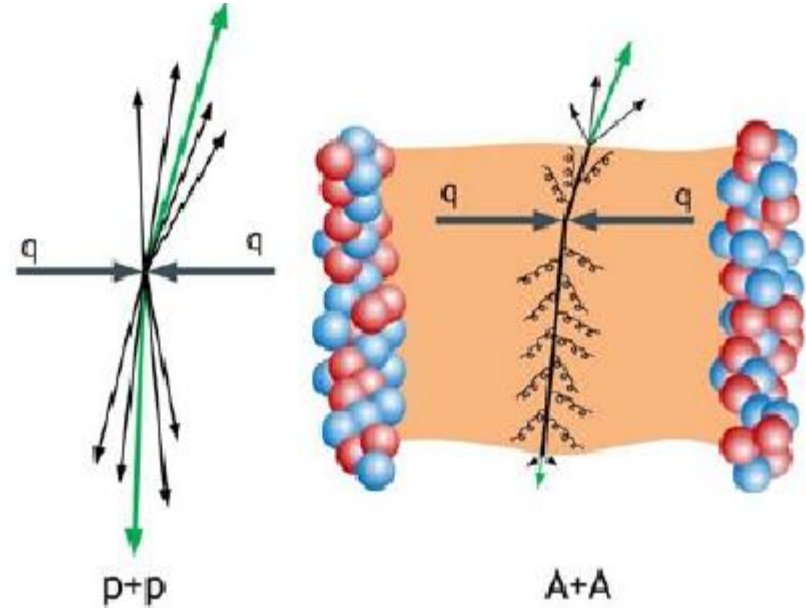
Outline

- Motivation.
- Non-photonic electrons (NPE) analysis method.
- NPE results:
 - p+p at 200 GeV.
 - Au+Au collisions, nuclear modification factor R_{AA} at 200 GeV.
 - Azimuthal anisotropy v_2 in Au+Au at 200 GeV.



Heavy ion collisions

- Heavy ion collisions:
 - hot and dense nuclear matter formation - **Quark-Gluon Plasma**
 - cold and hot nuclear matter effects
- p+p collisions:
 - **baseline** to study cold and hot medium effects
- Medium effects quantified by **nuclear modification factor**:
 - R_{dA} – cold nuclear matter effects.
 - R_{AA} – hot nuclear matter effects.

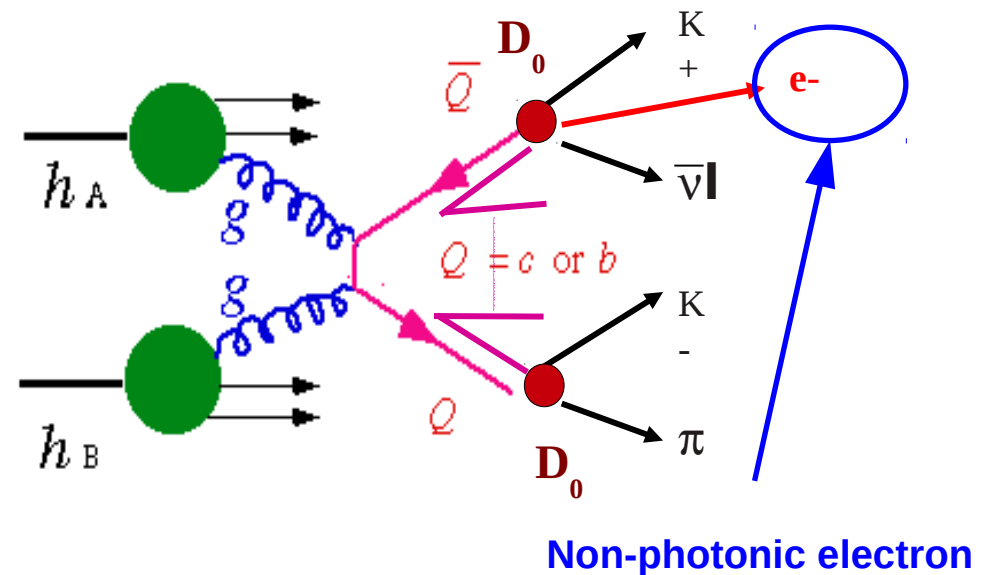


$$R_{AA} = \frac{1}{\langle N_{coll} \rangle} * \frac{dN_{AA}/dy}{dN_{pp}/dy}$$



Heavy quarks

- Heavy quarks:
 - large masses
 - early production
 - p+p collisions - test of the validity of the pQCD
- Heavy ion collisions:
 - energy loss
 - thermalization (elliptic flow v_2)



- Study of non-photonic electrons is a good way to measure production of bottom and charm hadrons via semi-leptonic decays.

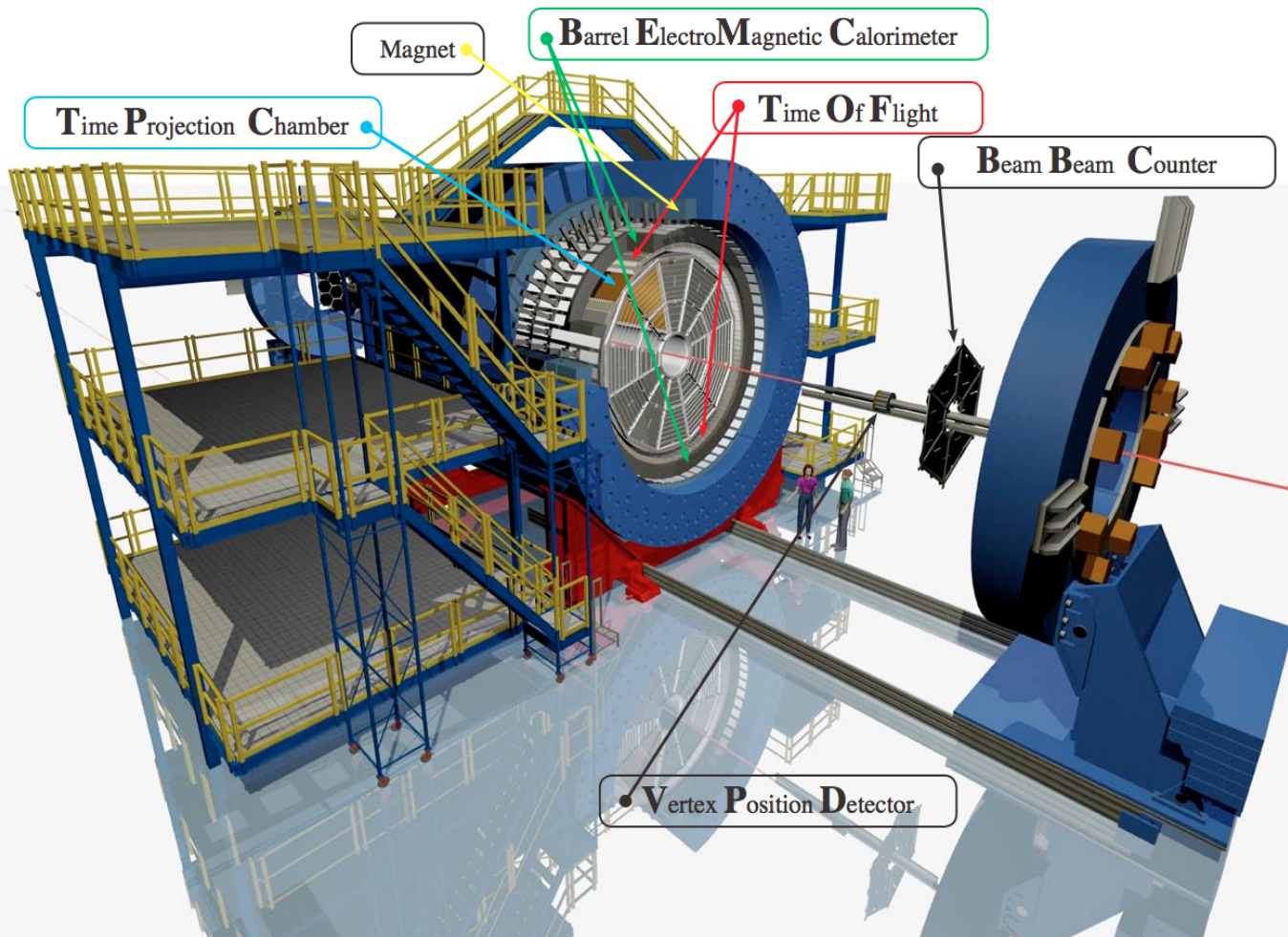
$$b \rightarrow e^{\pm} + \text{anything} (10.86\%)$$

$$c \rightarrow e^{\pm} + \text{anything} (9.6\%)$$



STAR detector at RHIC

Solenoidal Tracker At RHIC : $-1 < \eta < 1, 0 < \phi < 2\pi$



Time Projection Chamber (TPC) – tracking, particle identification, momentum

Time of Flight detector (ToF) – particle identification

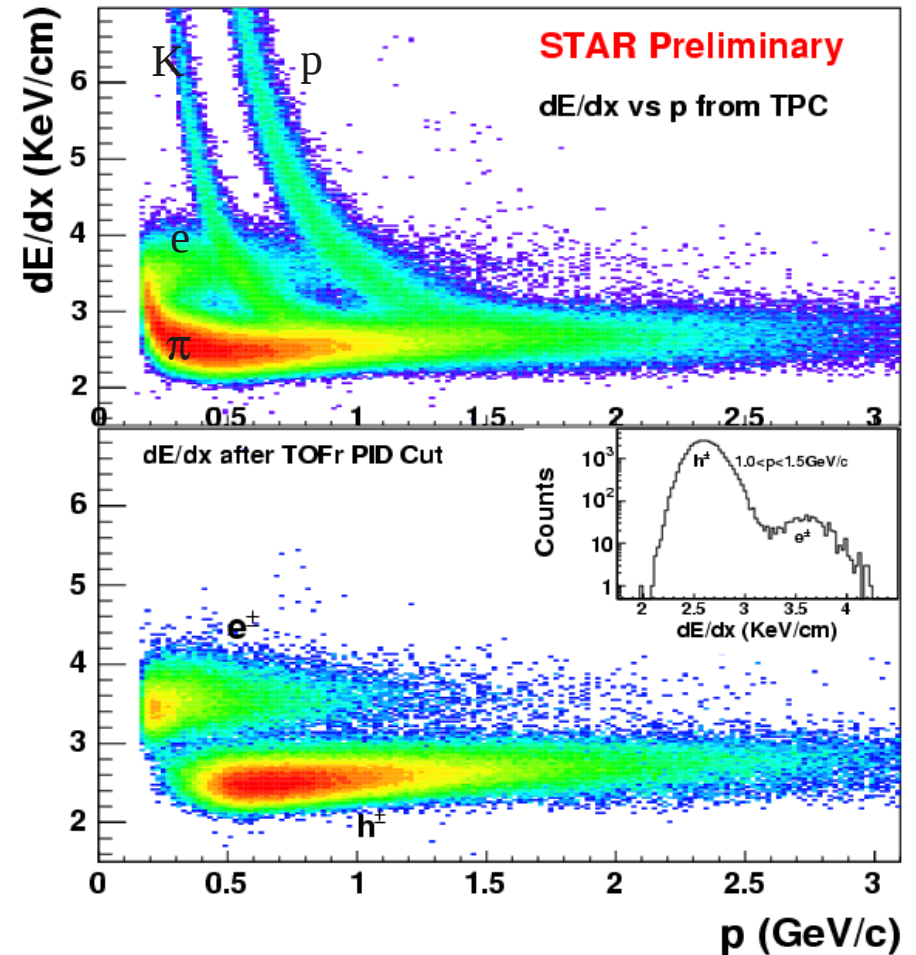
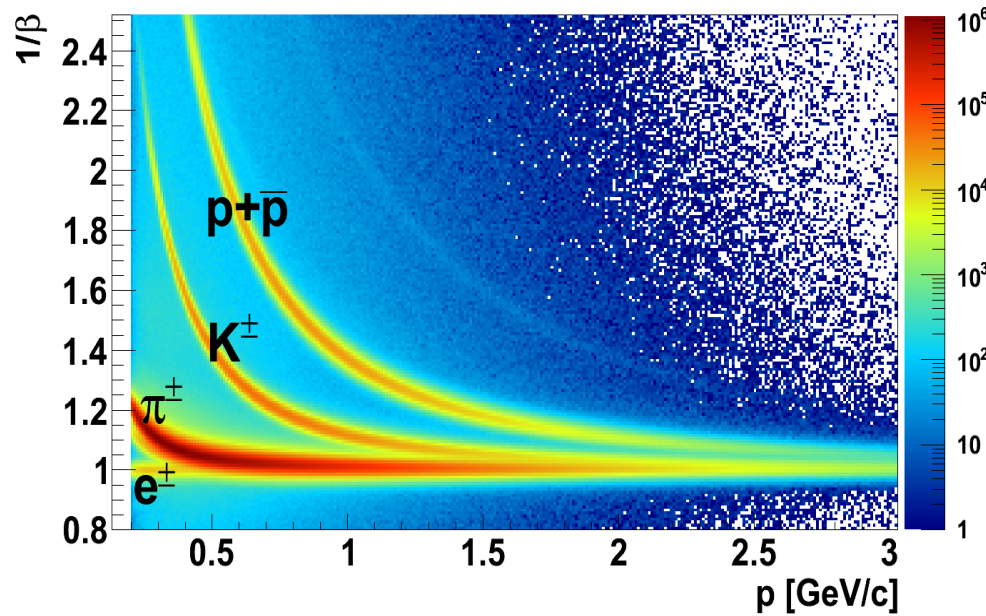
BEMC – electron identification, triggering (High Tower triggers)

BSMD – electron identification at high p_T



Electron identification

TPC and TOF together are great tool for distinguish electrons and hadrons in low p region.

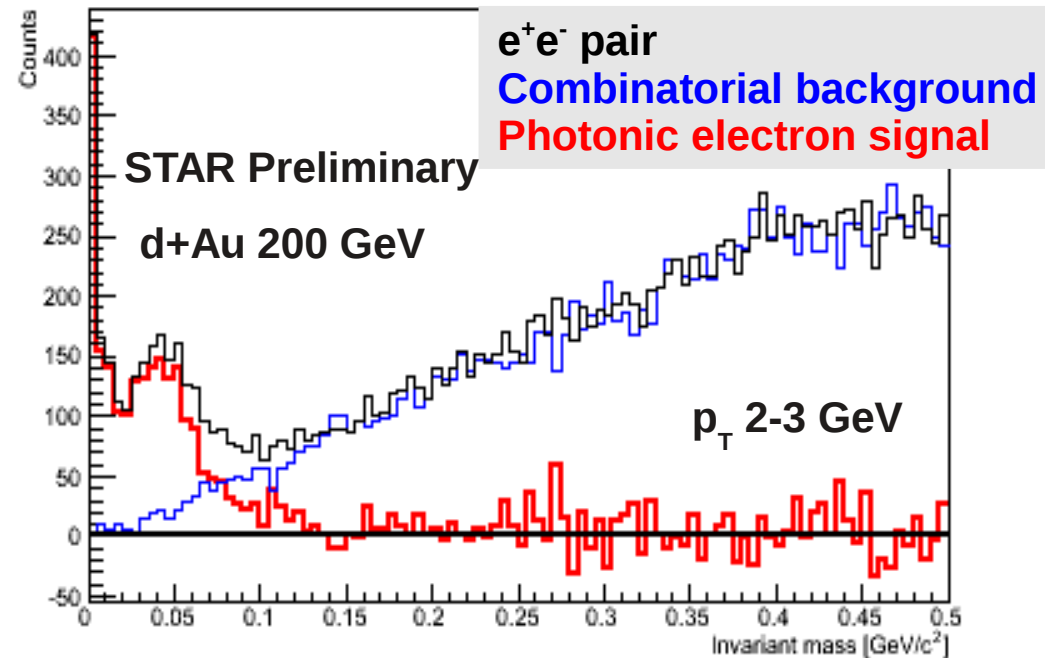




NPE analysis method

$$NPE = N_{Inclusive} * purity_{Inclusive} - \frac{N_{Photonic}}{\epsilon_{Photonic}}$$

- **Inclusive electrons** – identification with TPC, TOF, BEMC.
- **Photonic electrons** – background
 - identified via small e^+e^- invariant mass
 - statistically reconstructed
 - main **background** comes from:
 - Dalitz decay: $\pi^0 \rightarrow \gamma + e^+ + e^-$ (BR: $\sim 1.2\%$)
 - Gamma conversions: $\gamma \rightarrow e^+ + e^-$
 - corrected for **reconstruction efficiency** via simulation.





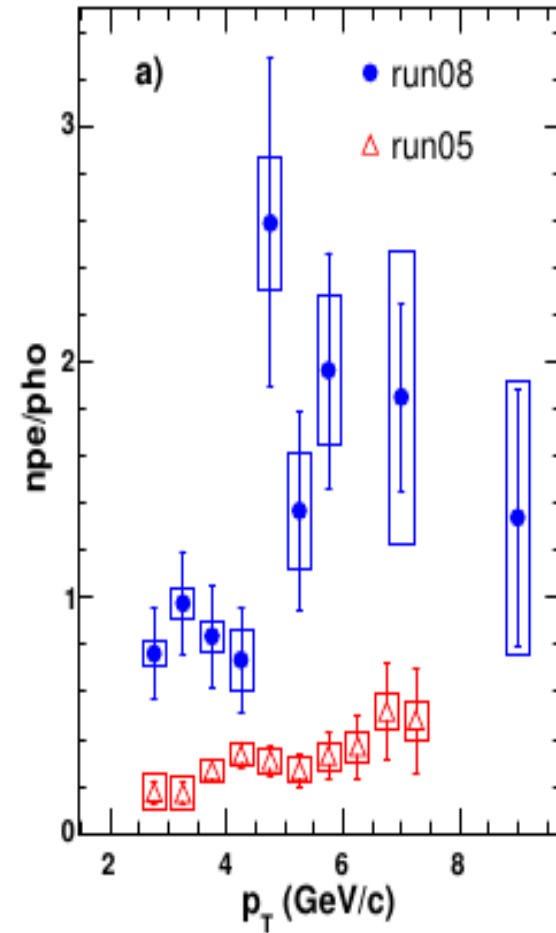
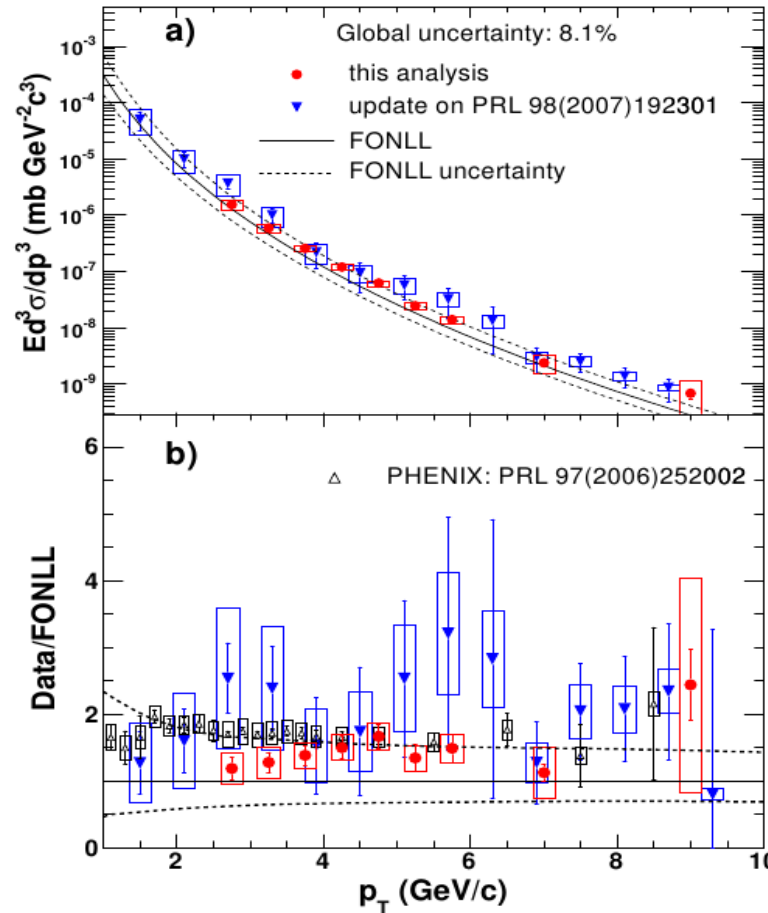
NPE in p+p collisions at $\sqrt{s}=200\text{GeV}$

Combined 2005 and 2008 data.

- Different material thickness, much more gamma conversion background in run05.
- Leads to the different NPE/PHE ratio.
- Despite of different analysis sensitivity to the background results agree.

→ pQCD test

Combined results are consistent with PHENIX results, and with FONLL calculations as well.



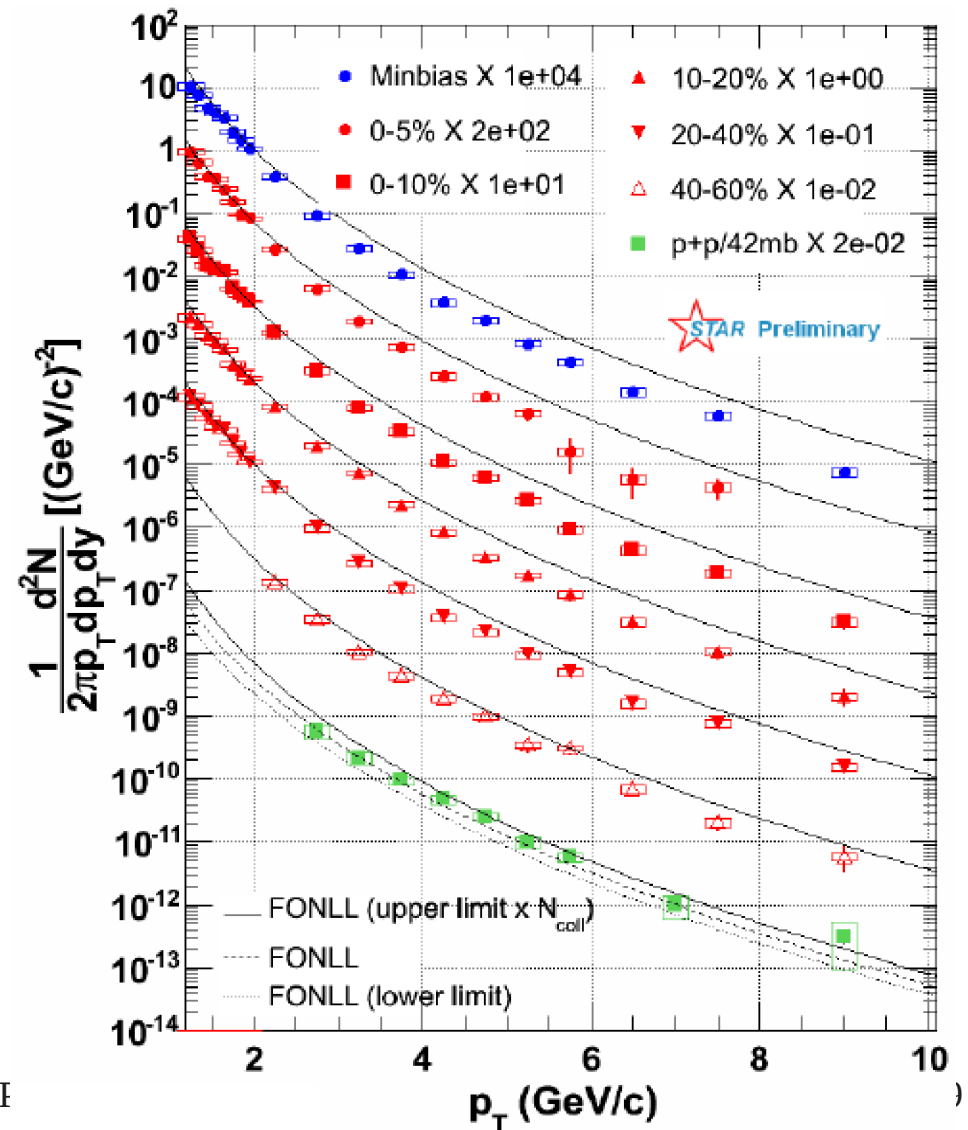
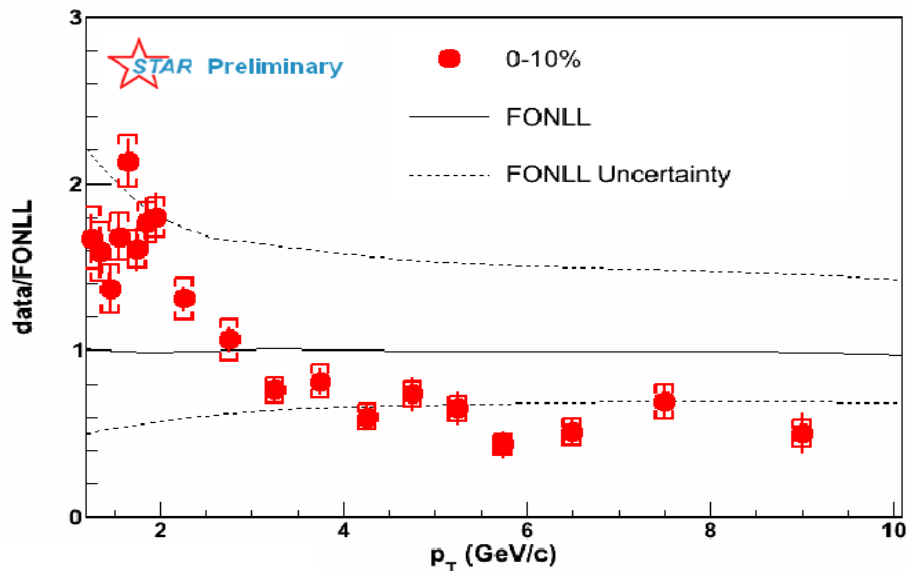


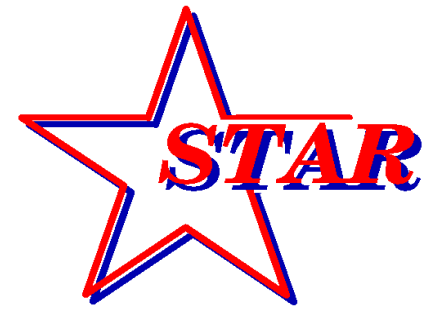
NPE in Au+Au collisions at $\sqrt{s}_{NN} = 200\text{GeV}$

Au+Au at 200GeV (year 2010 data):

- results were extended to high p_T
- separation to centrality bins
- suppression at high p_T compared with

FONLL calculations

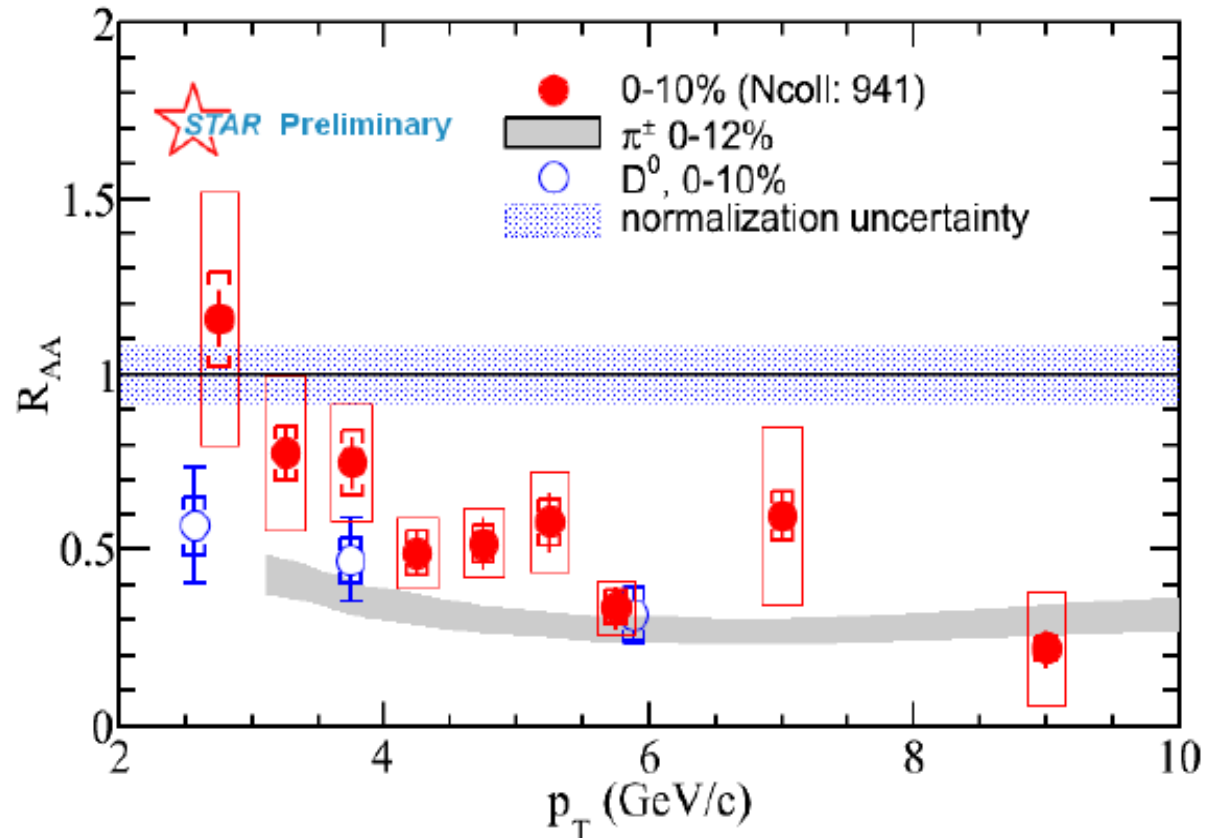




Nuclear Modification Factor in Au+Au collisions at $\sqrt{s}_{NN} = 200\text{GeV}$

→ Strong suppression is observed at high p_T .

→ Strong suppression is similar as for D0 mesons and light hadrons.

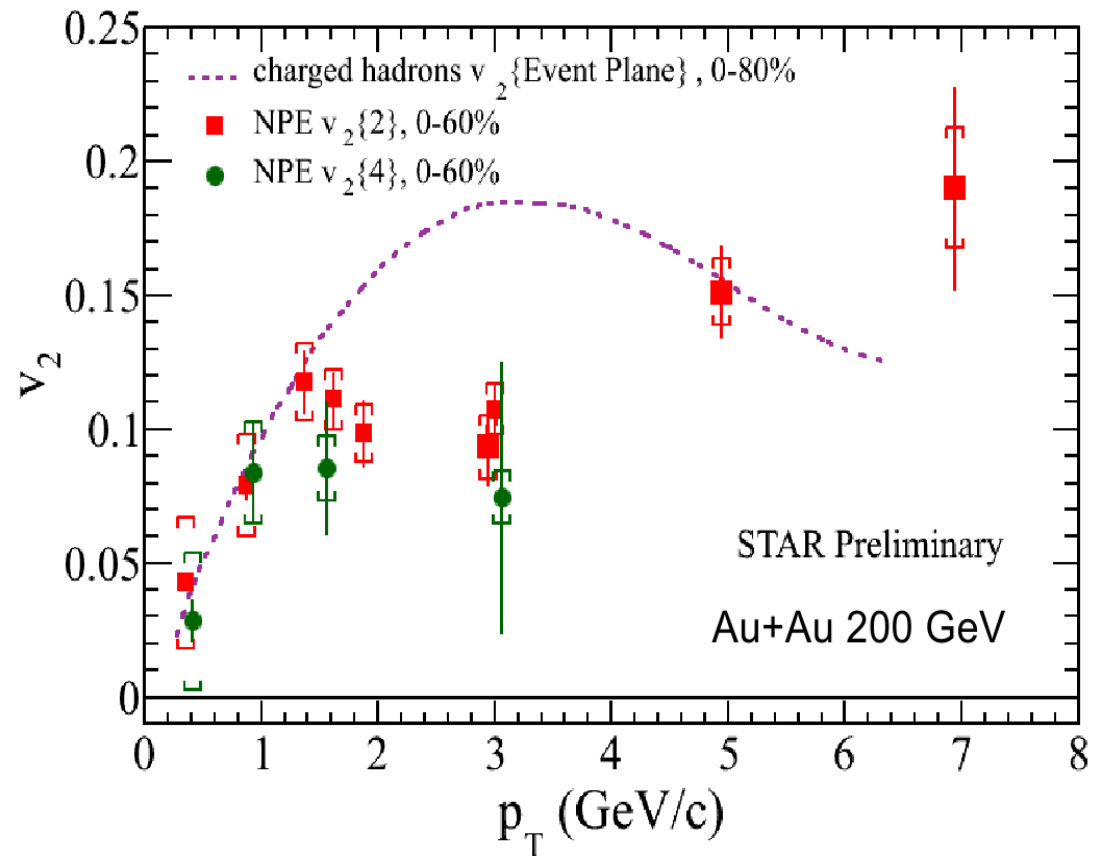


$$R_{AA} = \frac{1}{\langle N_{coll} \rangle} * \frac{dN_{AA}/dy}{dN_{pp}/dy}$$



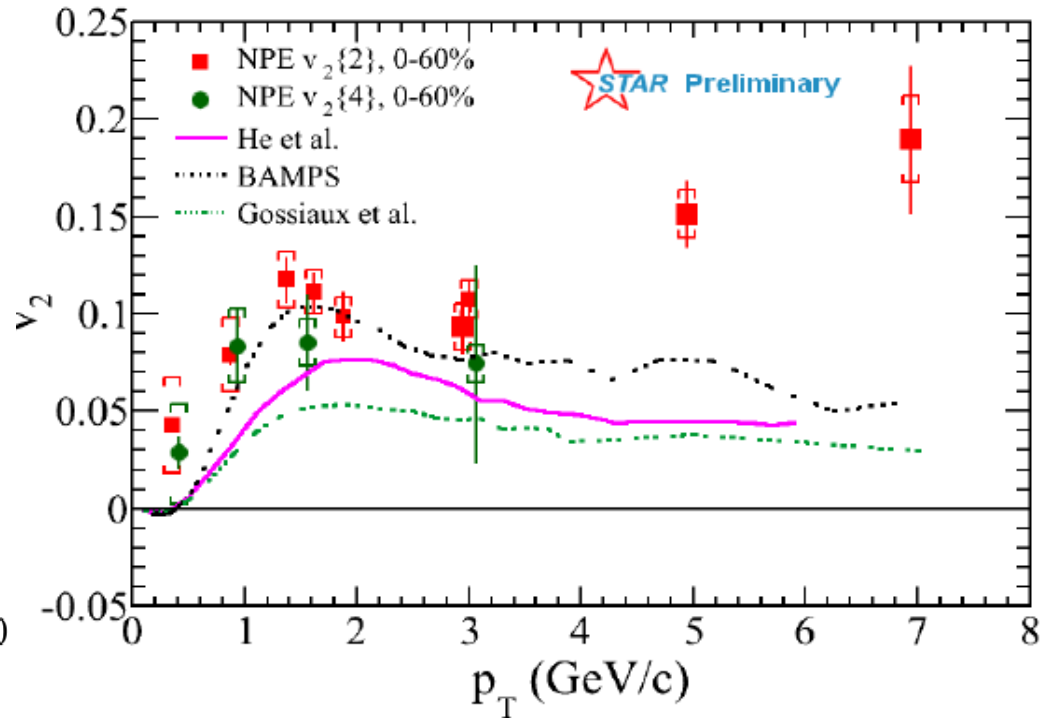
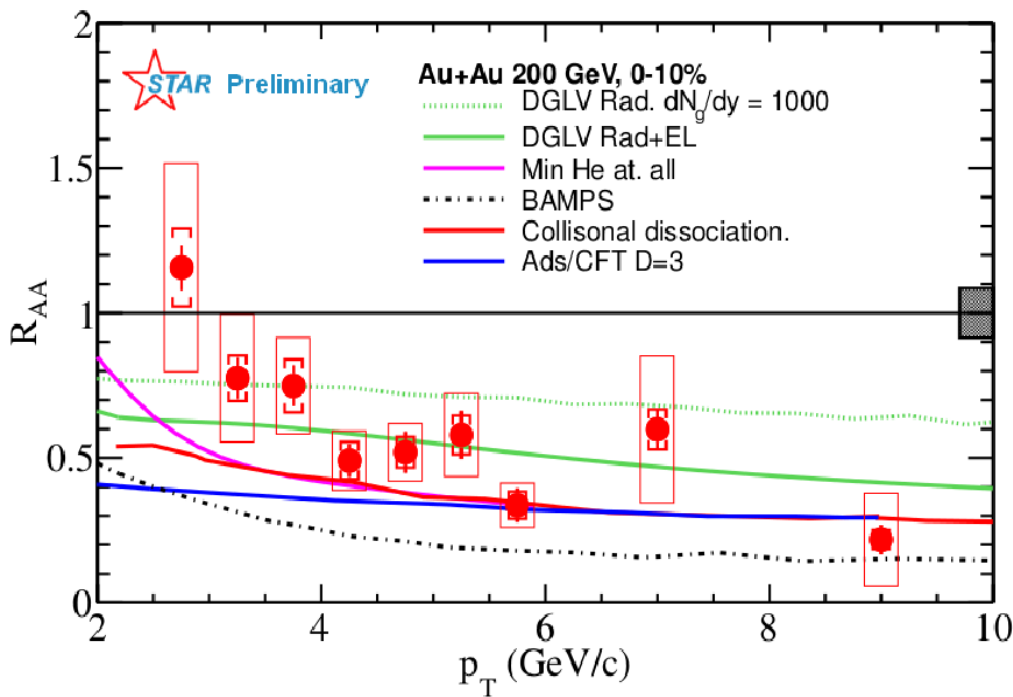
NPE elliptic flow in Au+Au collisions at $\sqrt{s}_{NN} = 200$ GeV

- Initial geometry asymmetry \rightarrow final momentum anisotropy.
- Results obtain using 2-particle and 4-particle correlations.
- Finite v_2 at low p_T indicates strong charm-medium interaction.
- Increase of v_2 at high p_T can arise from jet-like correlations or from path length dependence of heavy quark energy loss.





NPE R_{AA} and elliptic flow in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV



Glueon **radiation scenario** alone **fails** to explain large NPE suppression at high p_T .

Finite elliptic flow and a large suppression at high p_T at $\sqrt{s_{NN}} = 200$ GeV indicate that heavy quarks interact strongly with the surrounding partonic medium.

It's challenging to describe the suppression and v_2 simultaneously.



Conclusions

- NPE v_2 at 200 GeV: finite v_2 at low p_T indicates a strong charm-medium interaction.
- We observed **strong suppression** of NPE in **Au+Au collisions**. Similar suppression as for light hadrons.



Thank you!