The measurement of non-photonic electrons in STAR

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Outline

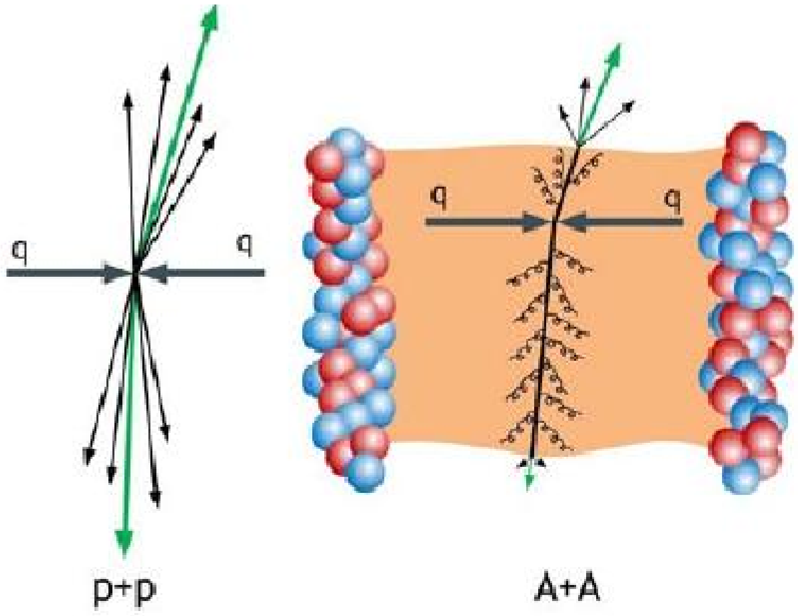
- Motivation.
- Non-photonic electrons (NPE) analysis method.

- NPE results:
  → 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



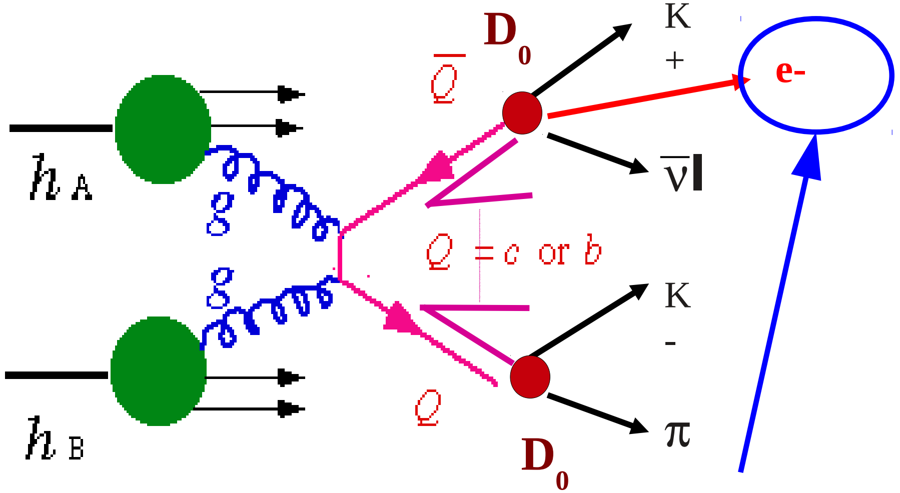
- p+p collisions:
  - → baseline to study cold and hot medium effects

- Medium effects quantified by nuclear modification factor:
  - → R_{dA} – cold nuclear matter effects.
  - → R_{AA} – hot nuclear matter effects.

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

Motivation

- Heavy quarks:
  - → large masses
  - → early production
  - → p+p collisions - test of the validity of the pQCD



Non-photonic electron

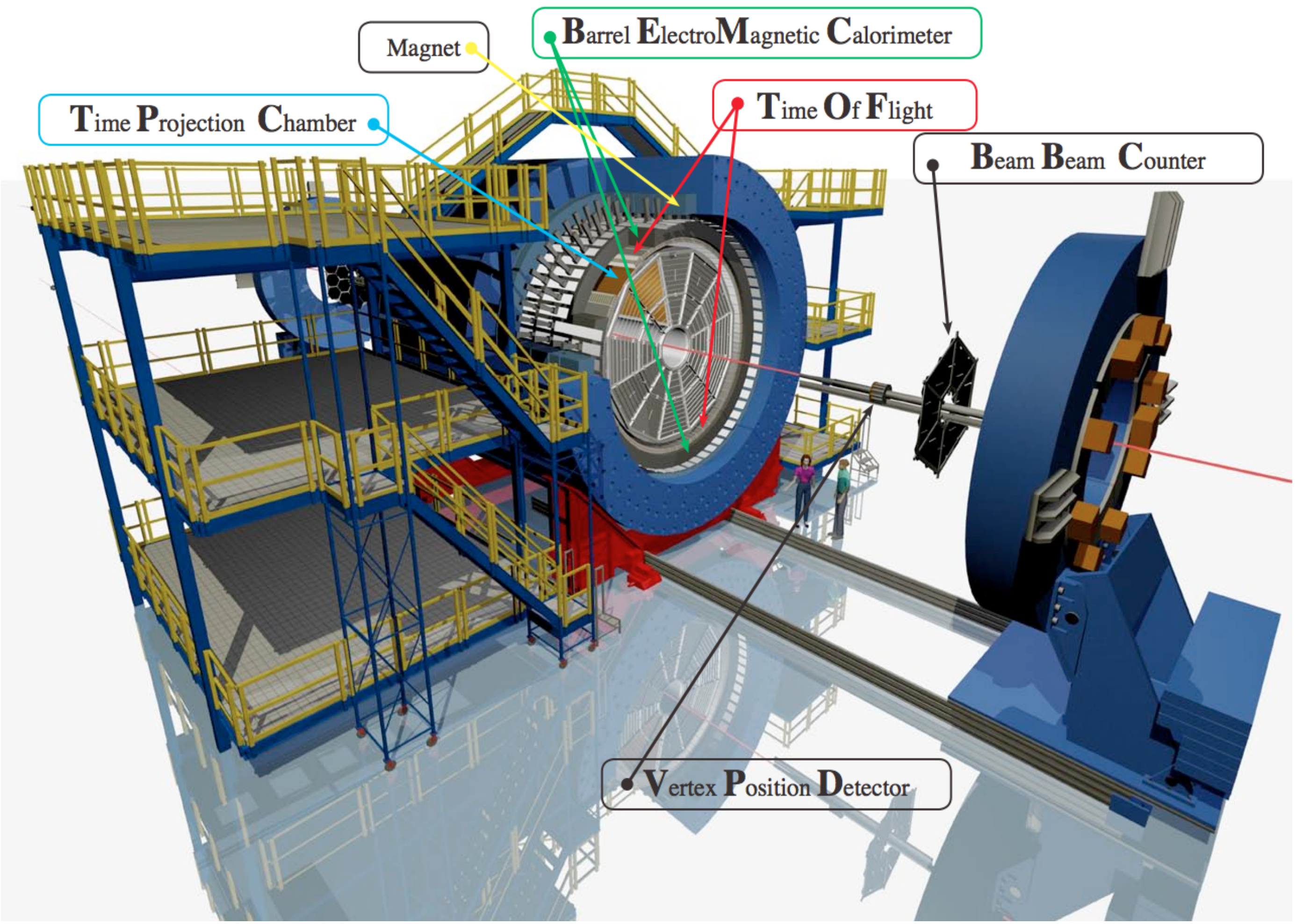
- Heavy ion collisions:
  - → energy loss
  - → thermalization (elliptic flow v_2)

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

$$b \rightarrow e^{\pm} + anything\,(10.86\,\%) \qquad c \rightarrow e^{\pm} + anything\,(9.6\,\%)$$

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

NPE analysis method

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

- Inclusive electrons – identification with TPC, ToF, BEMC.

- Photonic electrons – background

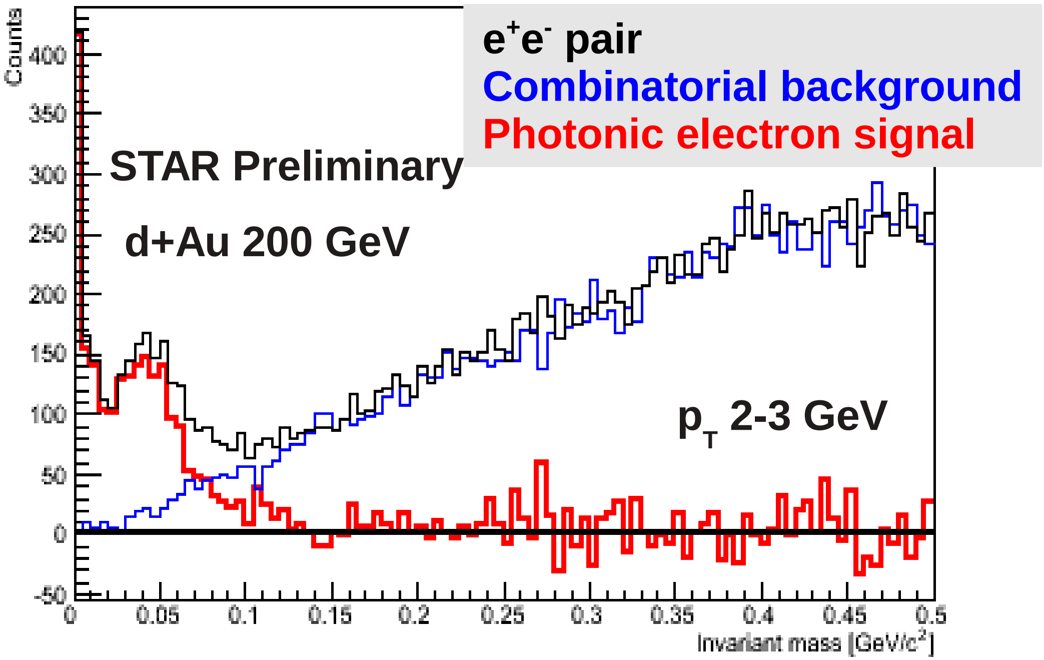
→ identified via small e+e- invariant mass

→ statistically reconstructed

→ main background comes from:

Dalitz decay: $\pi^0 \rightarrow \gamma + e^+ + e^-$ (BR: ~1.2%)

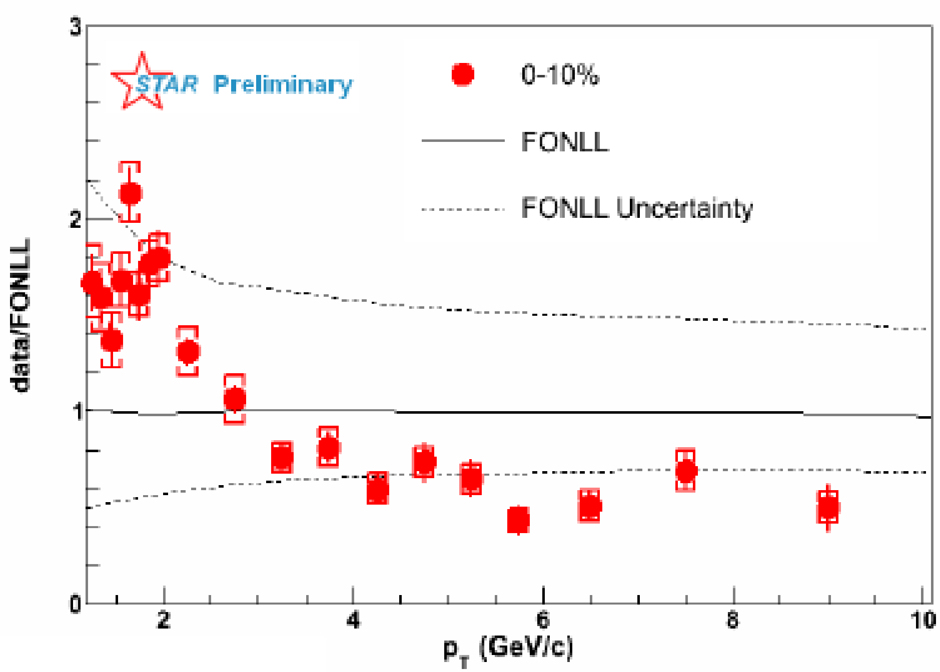
Gamma conversions: $\gamma \rightarrow e^+ + e^-$

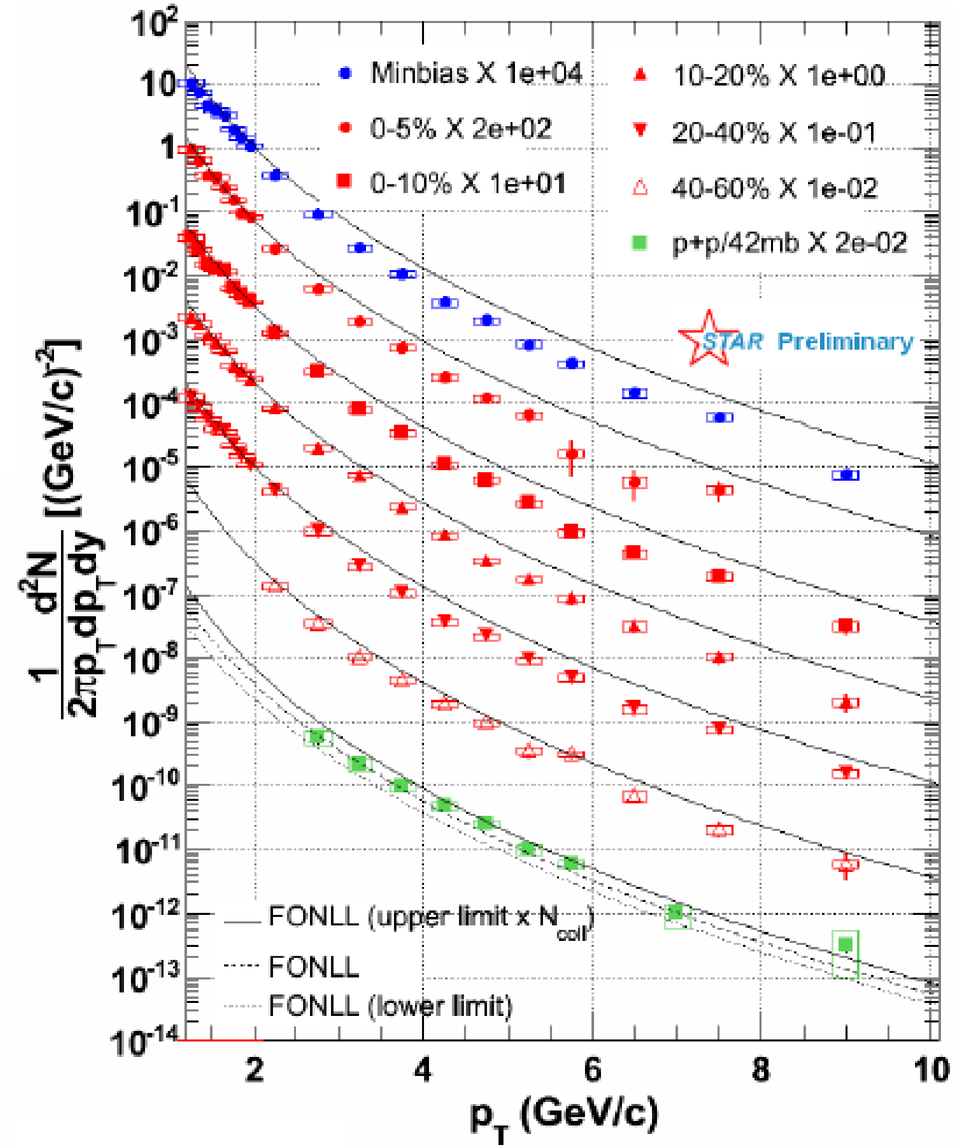


→ corrected for reconstruction efficiency via simulation.

NPE in Au+Au collisions at $\sqrt{s_{NN}}$=200GeV

- Au+Au at 200GeV (year 2010 data):
  - → results were extended to high p_T
  - → separation to centrality bins
  - → suppresion at high p_T compared with FONLL calculations





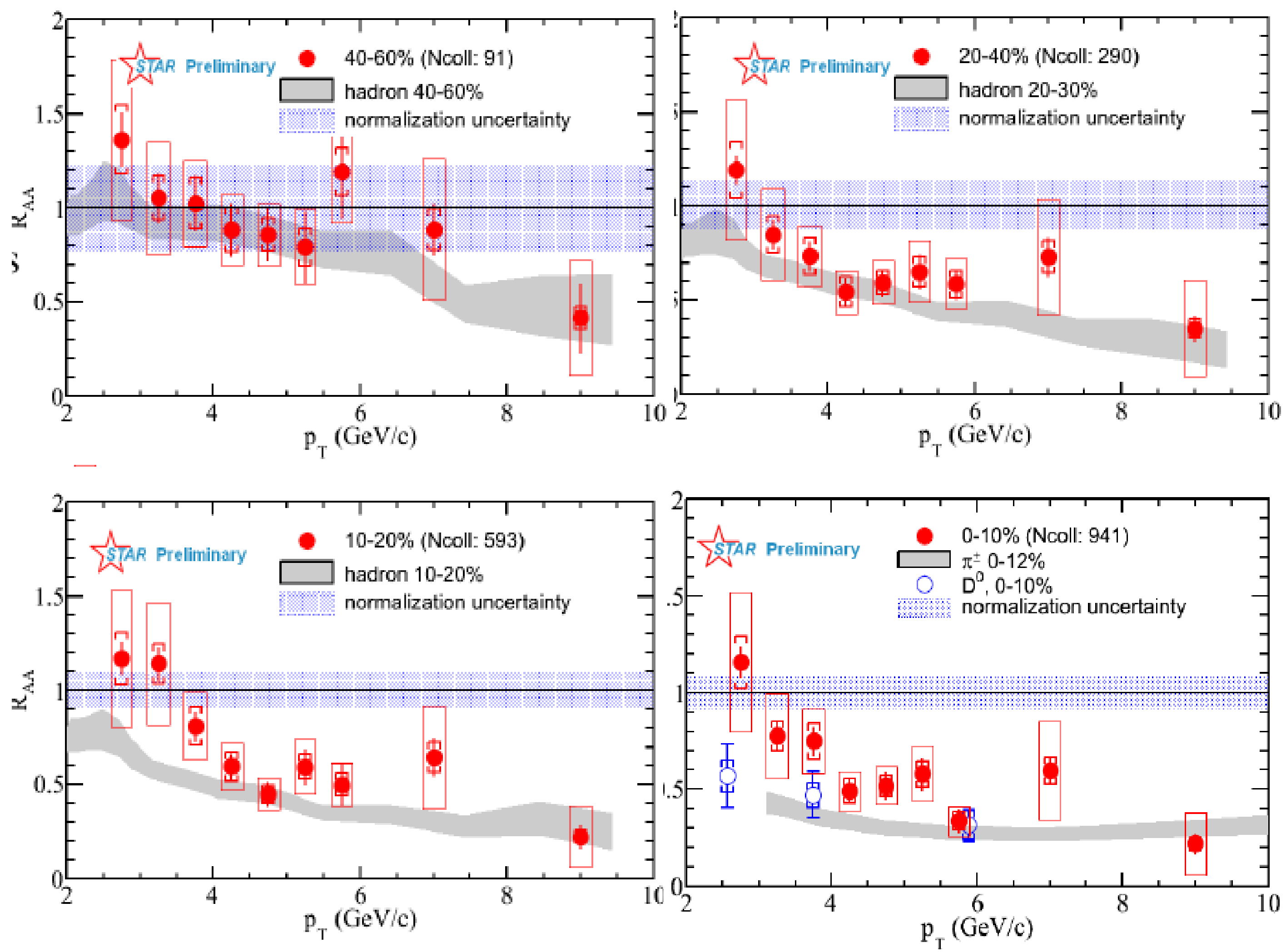
Nuclear Modification Factor in Au+Au collisions at $\sqrt{s_{NN}}$=200GeV

→ Strong suppresion is observed at high p_T.

→ p+p results as a baseline

→ at high p_T suppression similar as for light hadrons

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



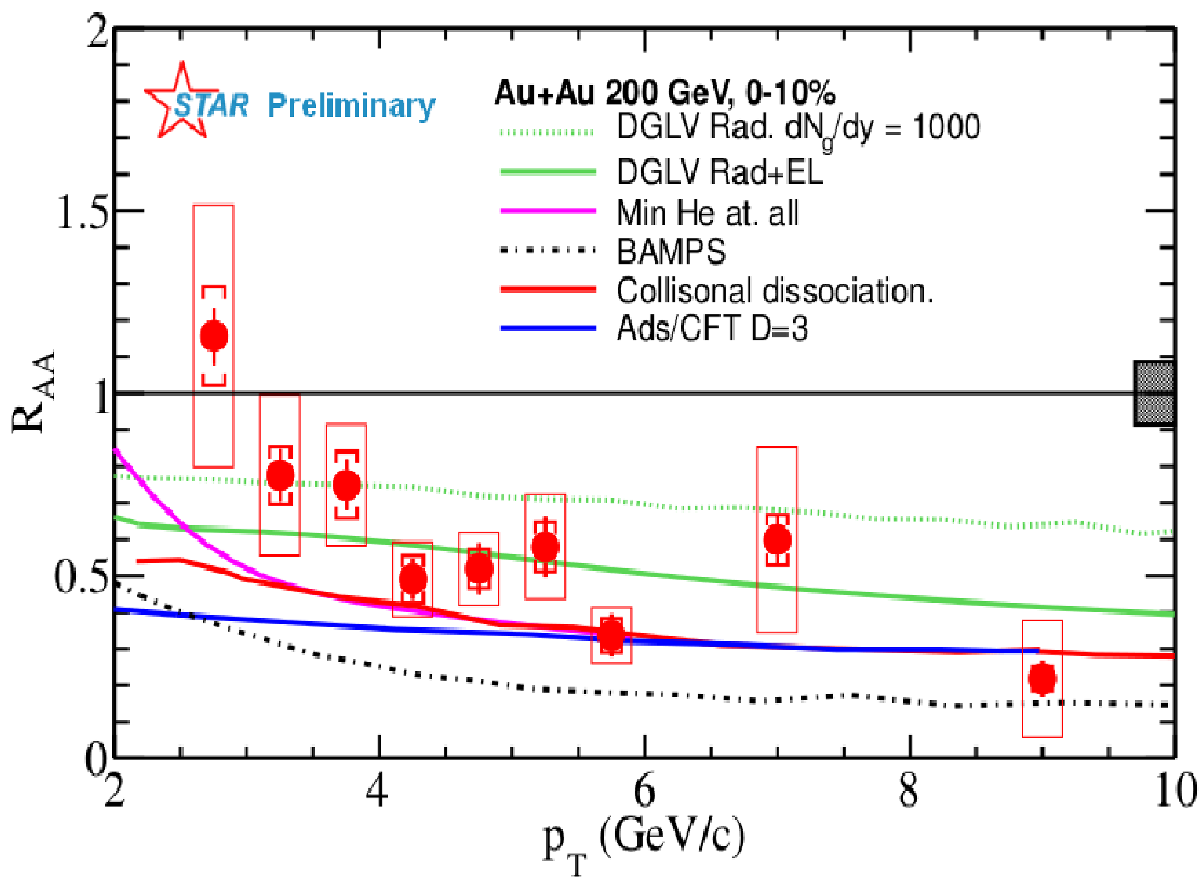
Nuclear Modification Factor in Au+Au collisions at $\sqrt{s_{NN}}$=200GeV

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

- Further needed:
  → include cold nuclear matter effects in model calculations

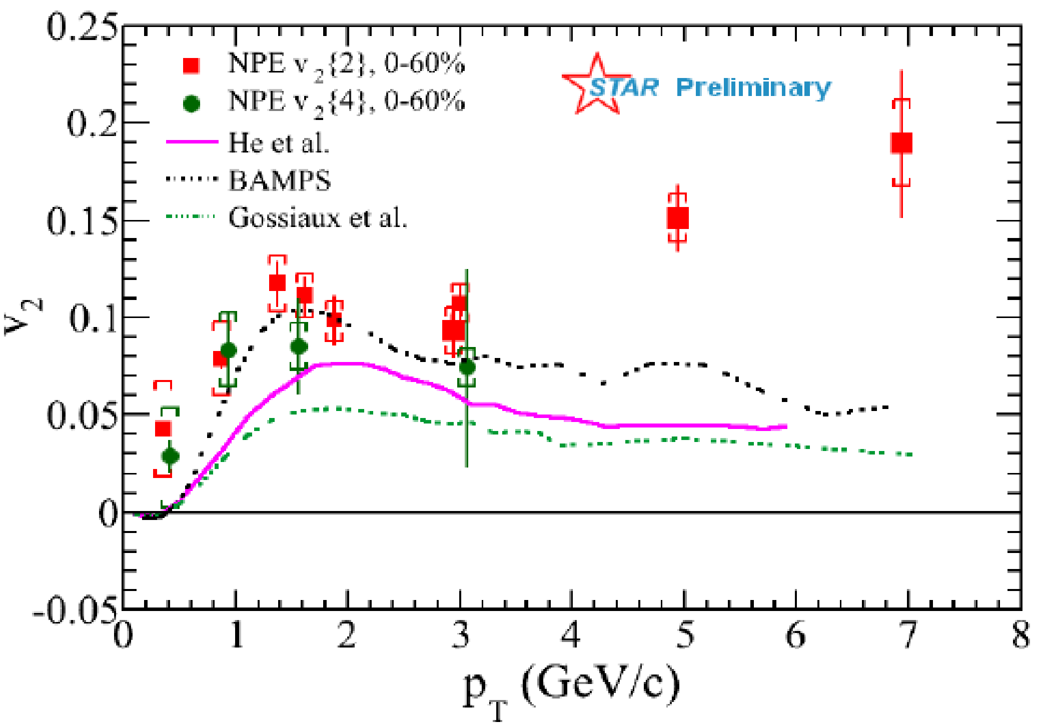
  → separate bottom and charm contribution to NPE.

  → Planned detector upgrades will allow direct reconstruction of D mesons and B electrons.



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

- Initial geometry asymmetry → final momentum anisotropy.
- 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.



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!