Single Electron Flow in Au+Au@200GeV

Frank Laue

(Brookhaven National Laboratory)

for

the STAR Collaboration

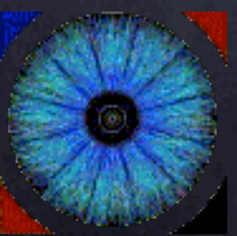
Outline

Motivation

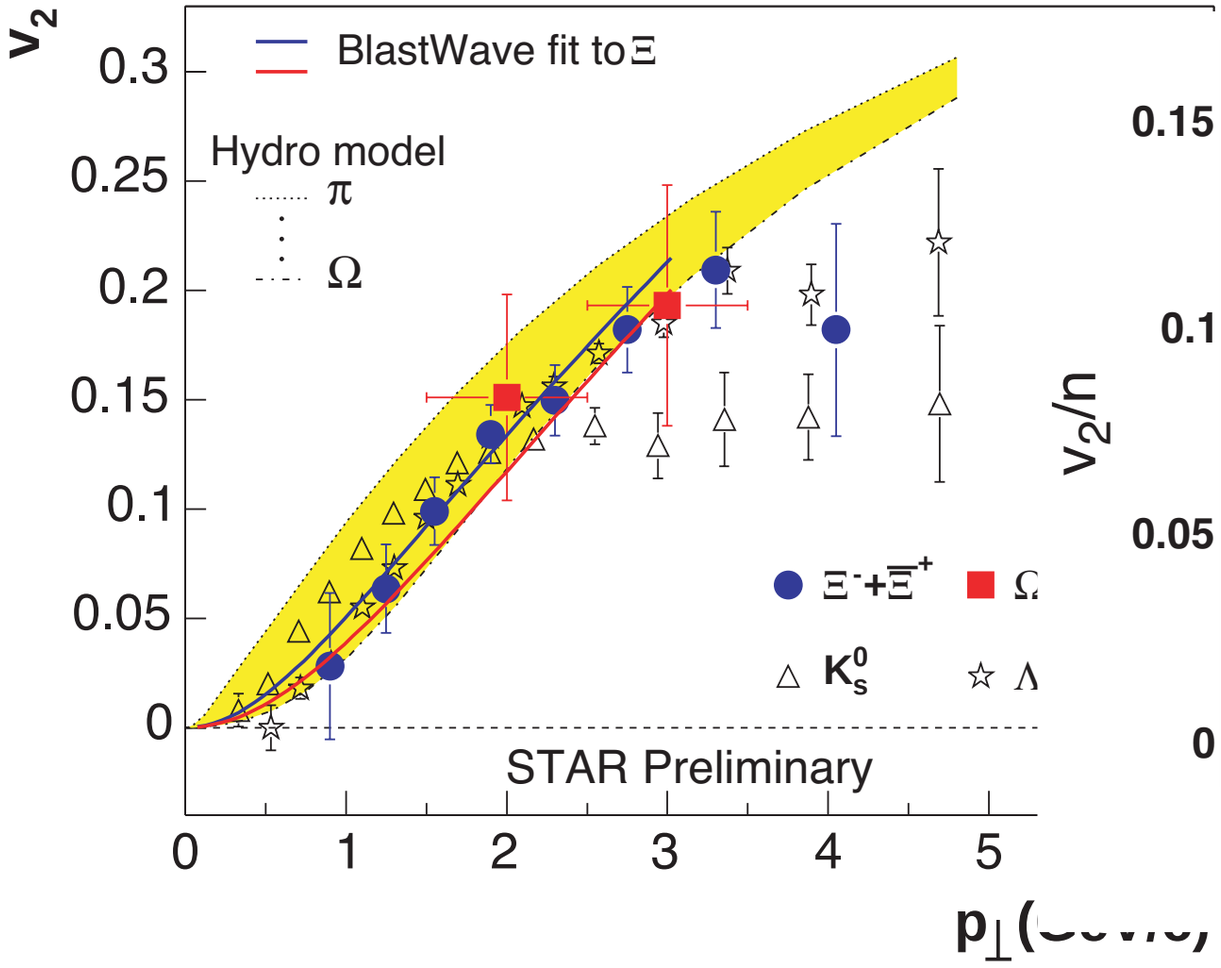
Analysis

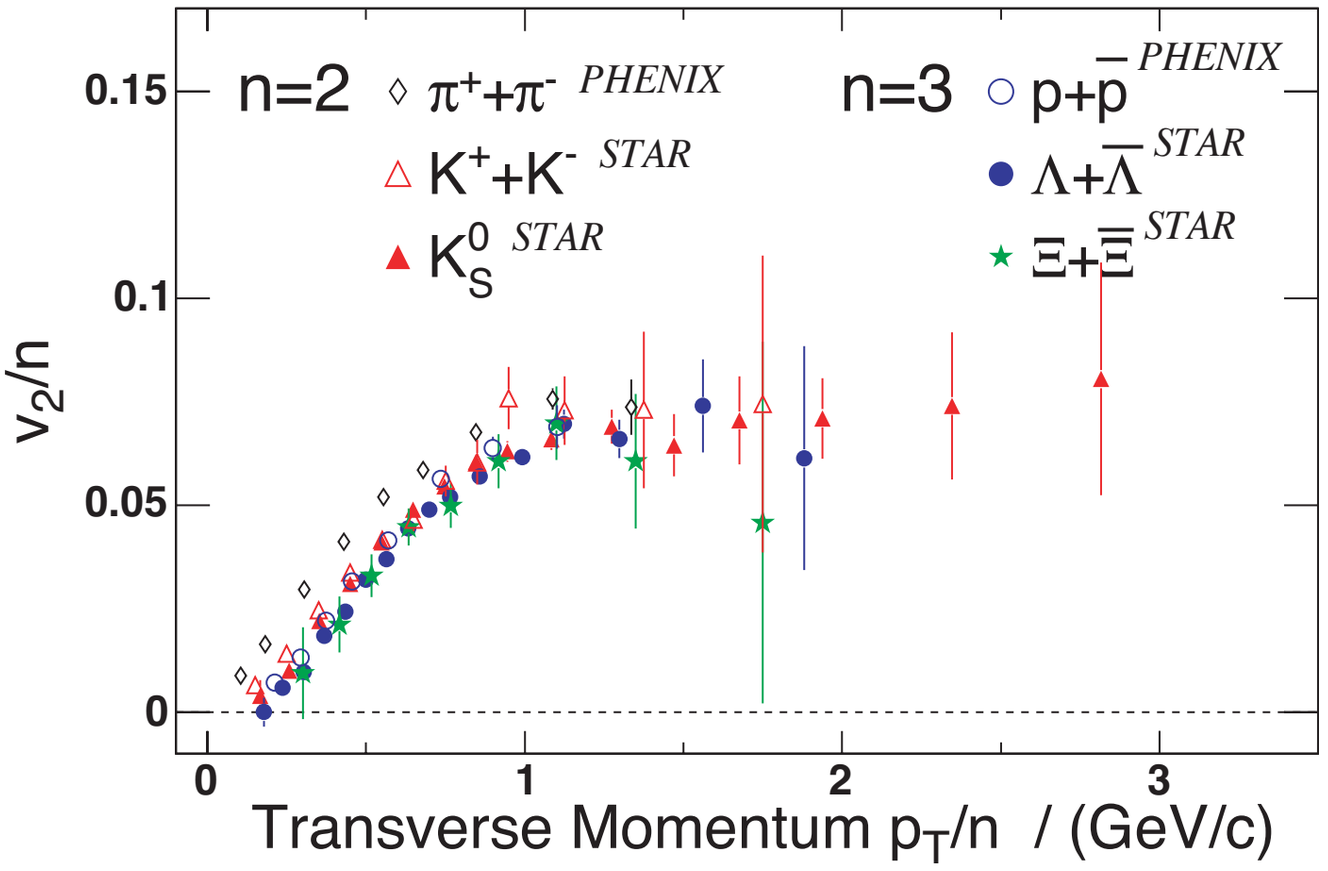
(Preliminary) Results

Outlook



Motivation I: Elliptic flow

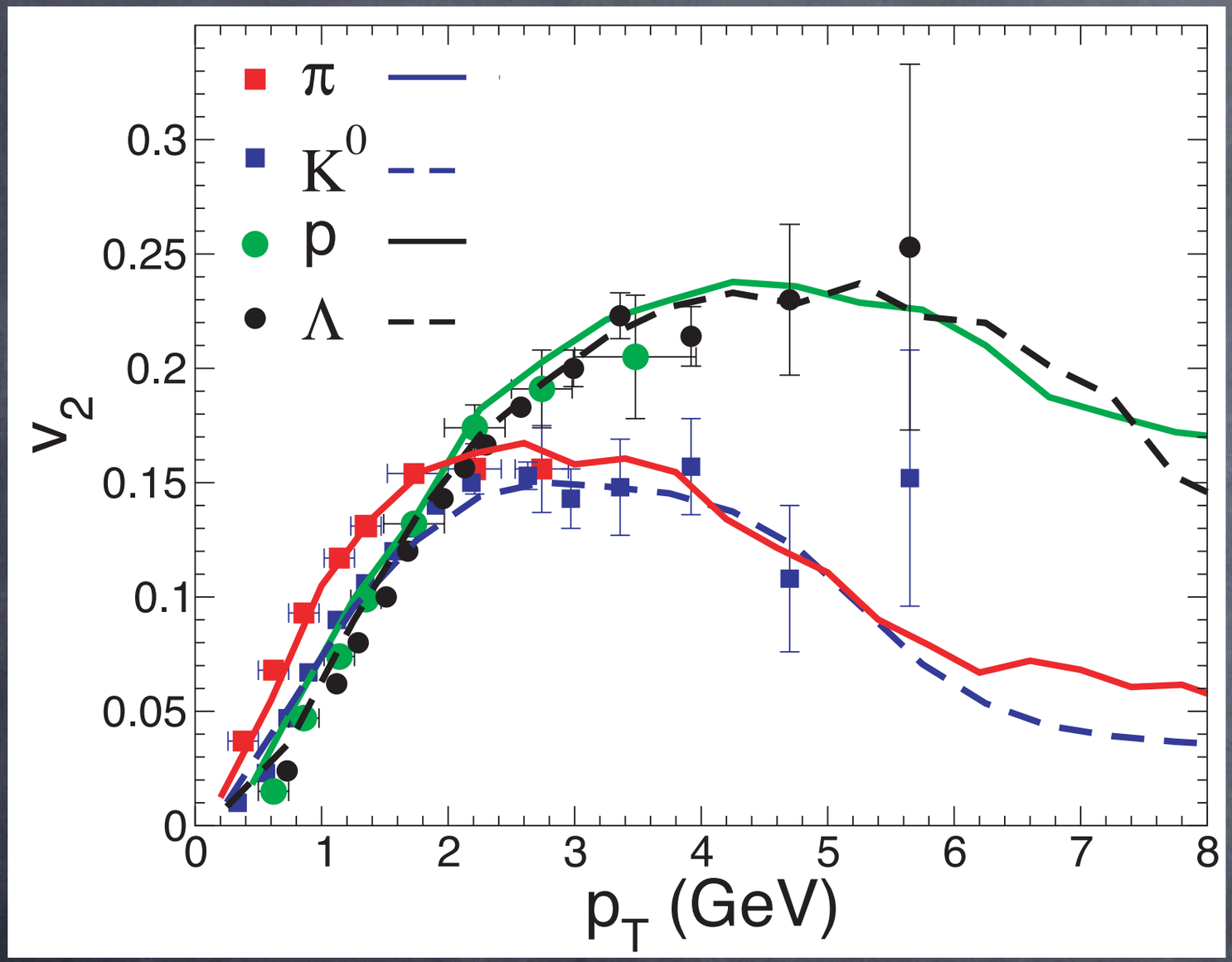




- ✓ strong elliptic flow of multi-strange baryons
- ✓ consistent with hydro up to 3GeV/c
- ✗ small hadronic x-sections, → no/little flow (small T in Nu Xu plot)
- ? flow in partonic phase ?

- ✓ no mass dependence at all
- ✓ scaling with number of constituent quarks (NCQ) → partonic degrees of freedom ?
- ✗ π's don't fit, but do they ever ?

Motivation II: Elliptic Flow in the Quark Coalescence Model



V.Greco, C.M.Ko
nucl-th/
0405040

Similar Models
from Ohio, Duke and
other groups

Quark Coalescence models describe the NCQ scaling when assuming (strong contributions of) a partonic phase with thermalized quarks

Motivation III: Charm v_2

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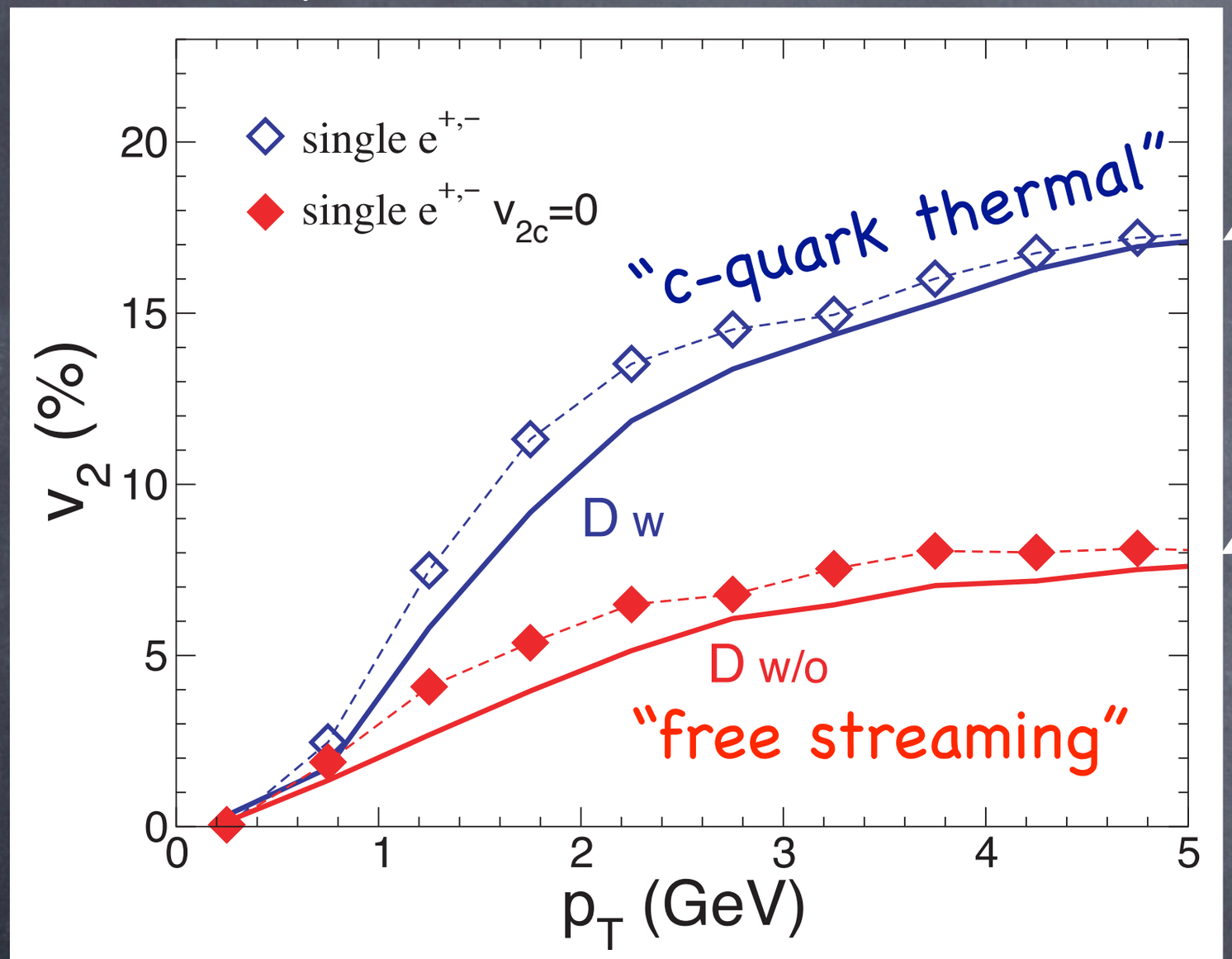


charm quarks flow just like light quarks (upper limit, no jets)

+

only light quarks flow (lower limit)

=

Elliptic flow of D-Meson and their decay electrons is a sensitive probe for thermalization

Charm flow extremely interesting, because of the c-quark's mass (m=1.5GeV). Should the c-quarks flow, there must have been enough interactions to easily thermalize light quarks.

Line of Thought

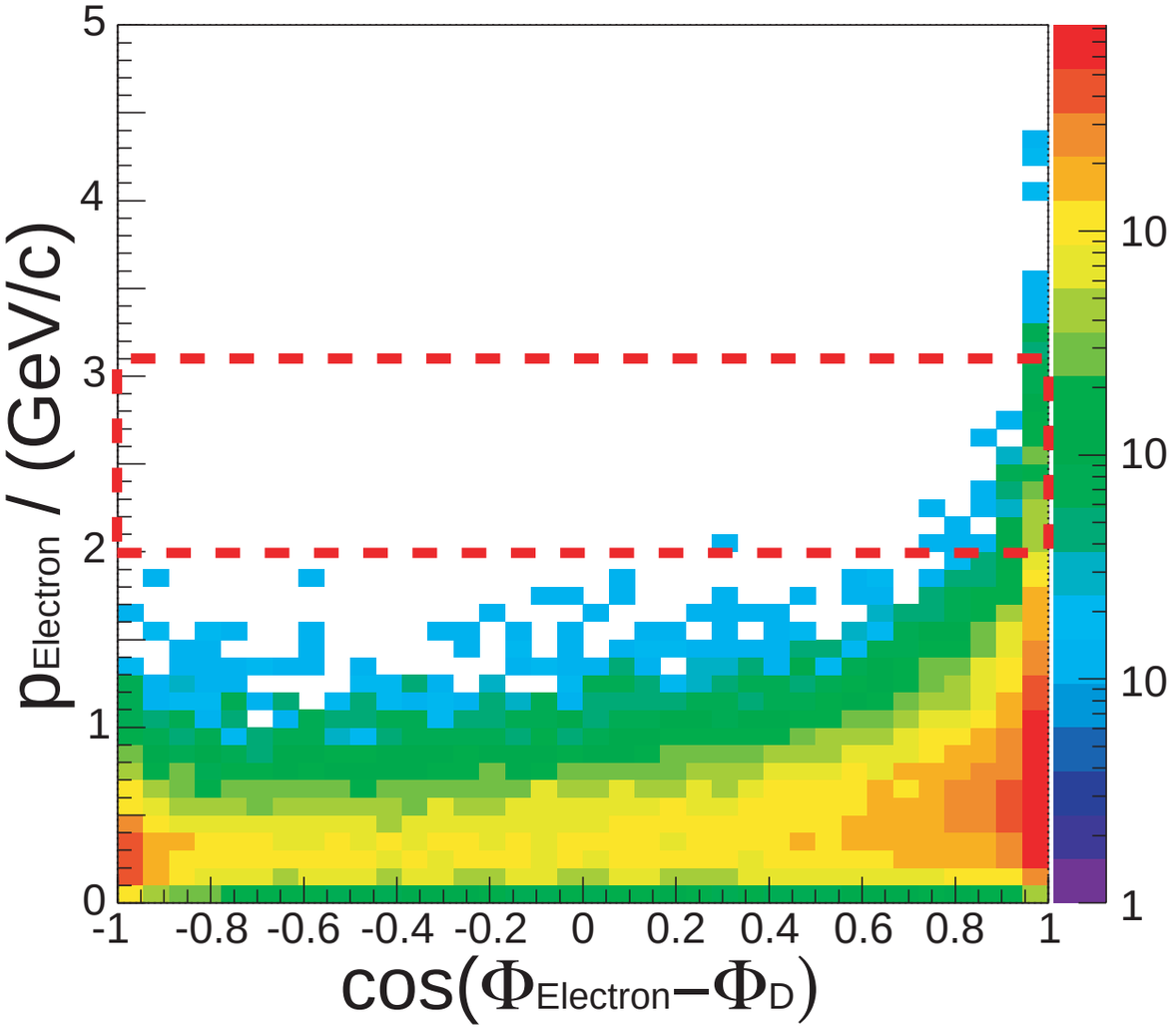
- Can not measure Charm-Flow directly (yet), but we can measure their decay electrons
- Do D-Meson decay electrons reflect the D flow ?
- Electron Identification
- Where do the Electrons come from ?
  - Backgrounds from
    - misidentification (contamination)
    - dominating physical background processes
      - $\pi^0 \rightarrow e^+e^- + \gamma$ B.R. 1.198%
      - $\pi^0 \rightarrow \gamma + \gamma$ B.R. 98.798%
      - detector effects ($\gamma \rightarrow e^+e^-$: few %, dep. on material)

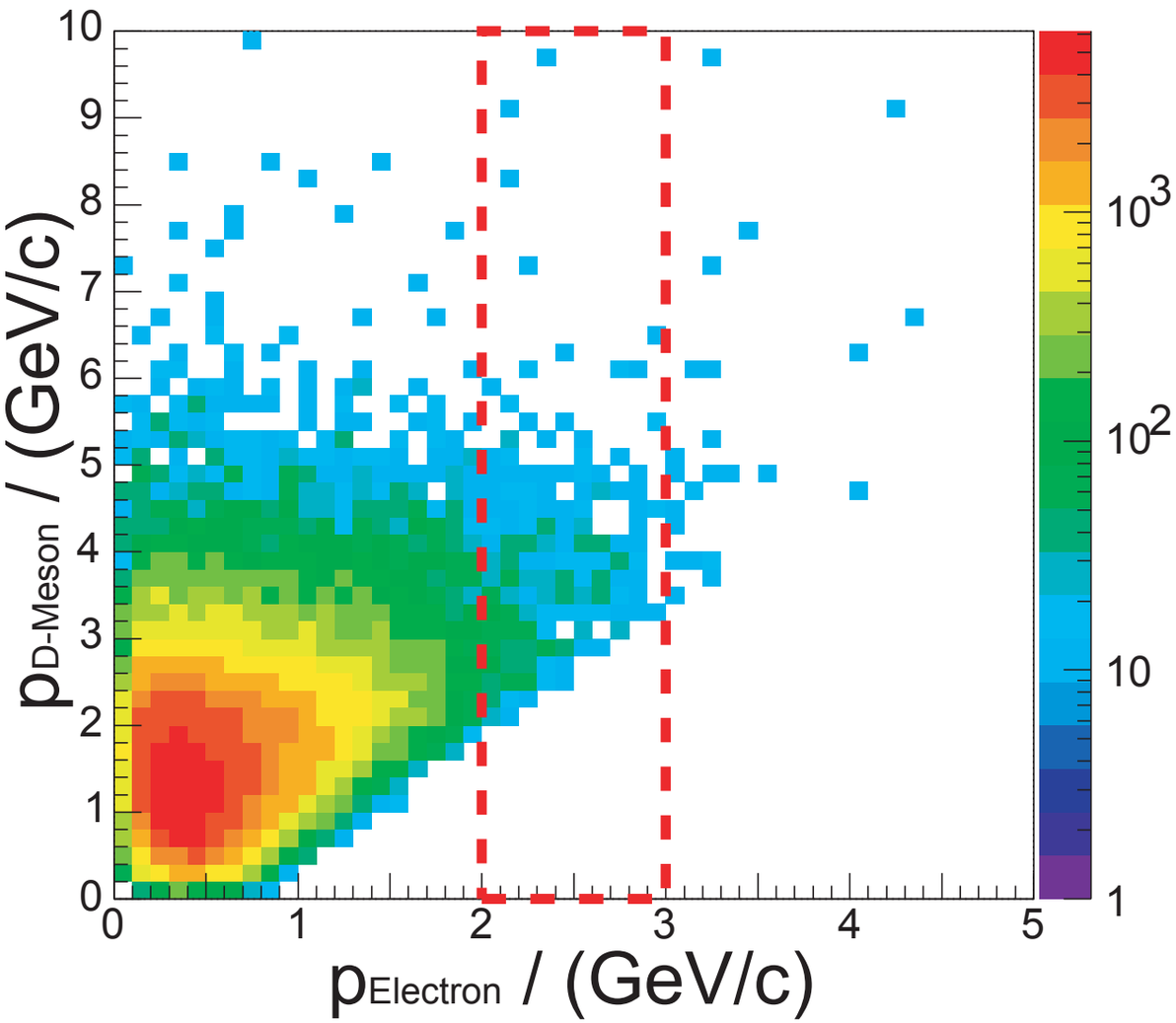
Run II (2001) Dataset:

~2M Au+Au @ $\sqrt{s}$=200GeV

0-80% most central (min. bias triggered)

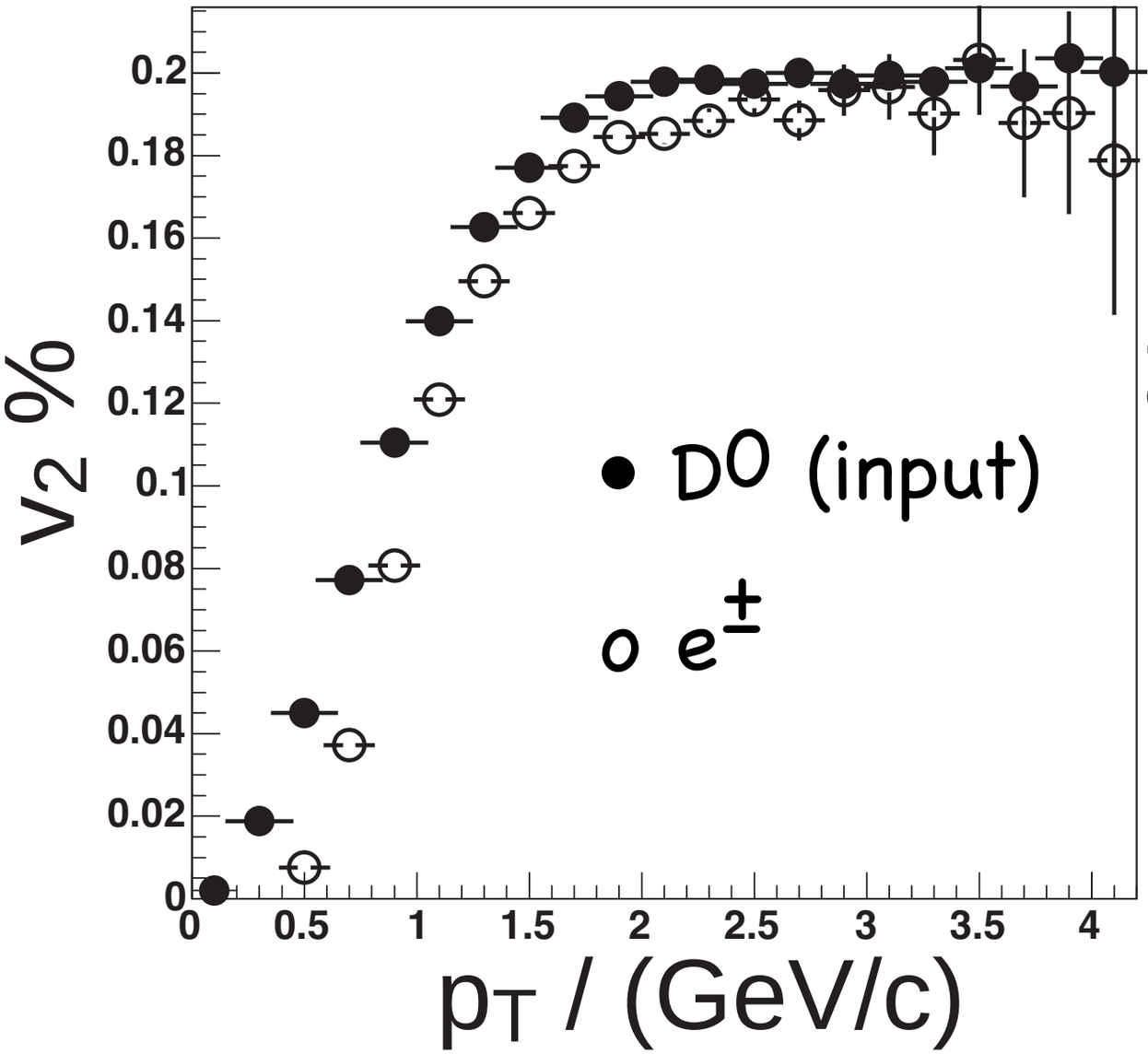
Do Decay-Electrons Reflect the Parent Flow ?
Electron vs D Momenta

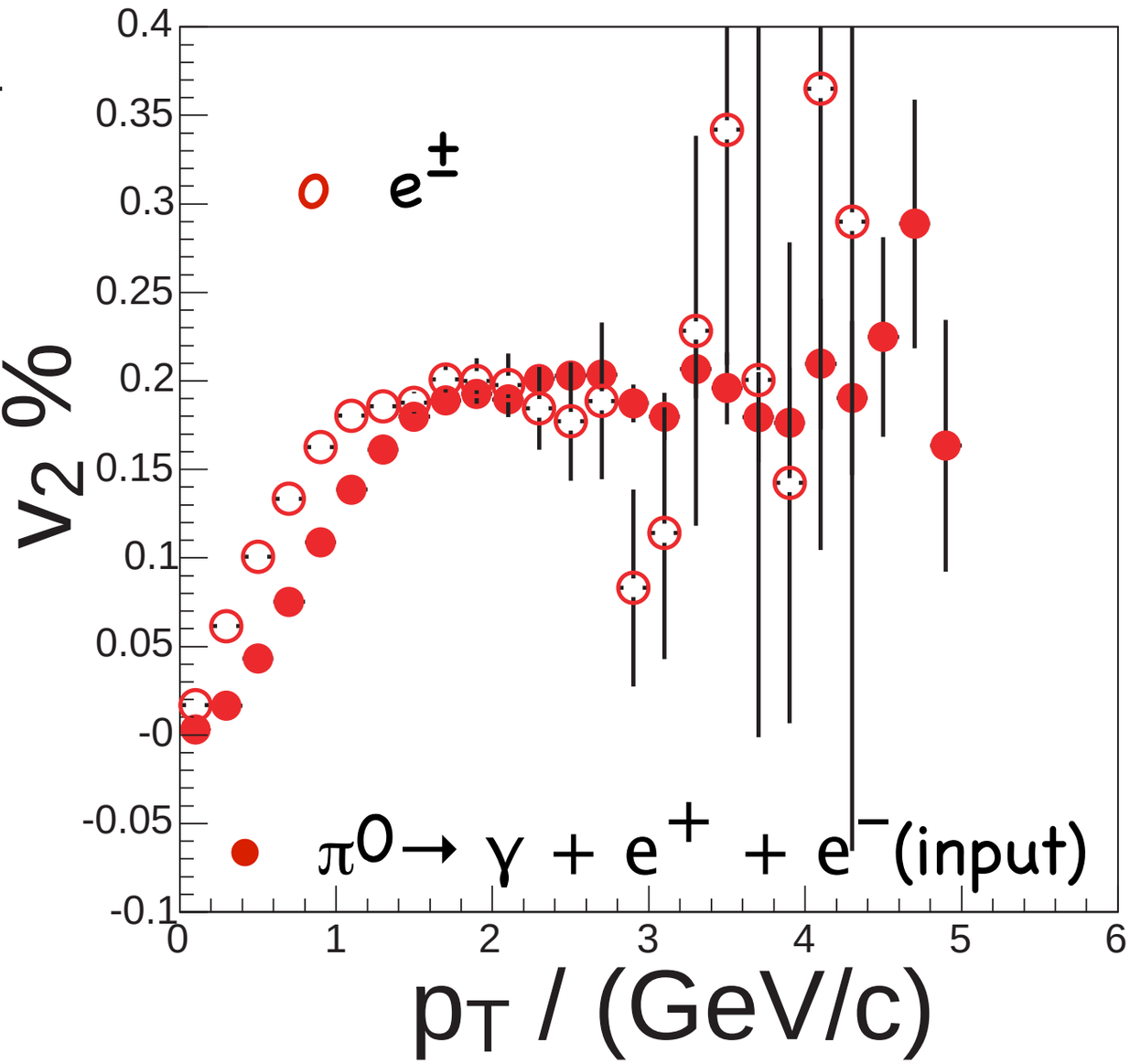




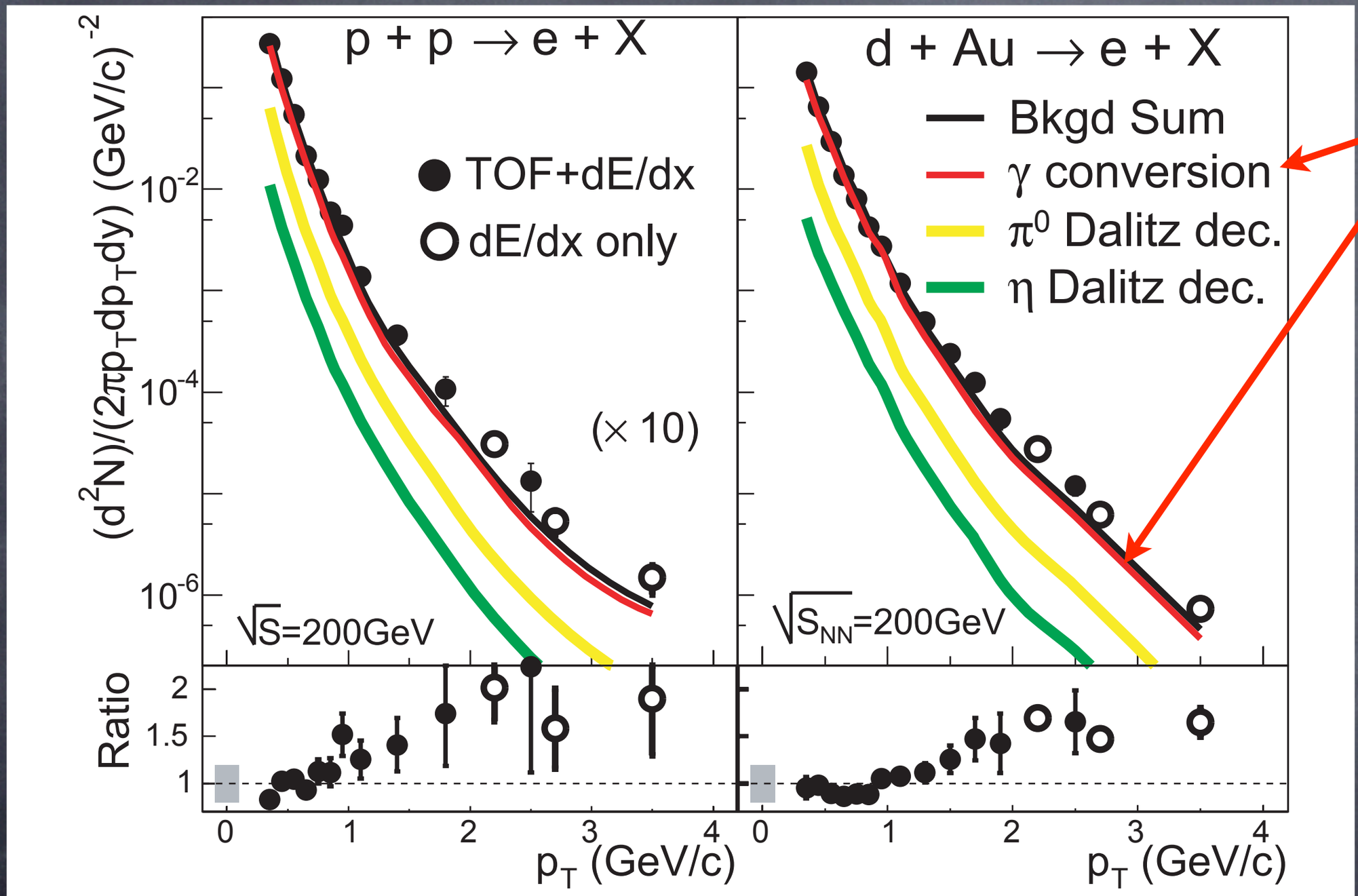
- Emission angles are well preserved above p = 2GeV/c
- 2-3 GeV Electrons correspond to ≈3.8GeV D-Mesons

Do Decay-Electrons Reflect the Parent Flow ? (Pythia/Mevsim Simulation)





Electron Sources: Examples

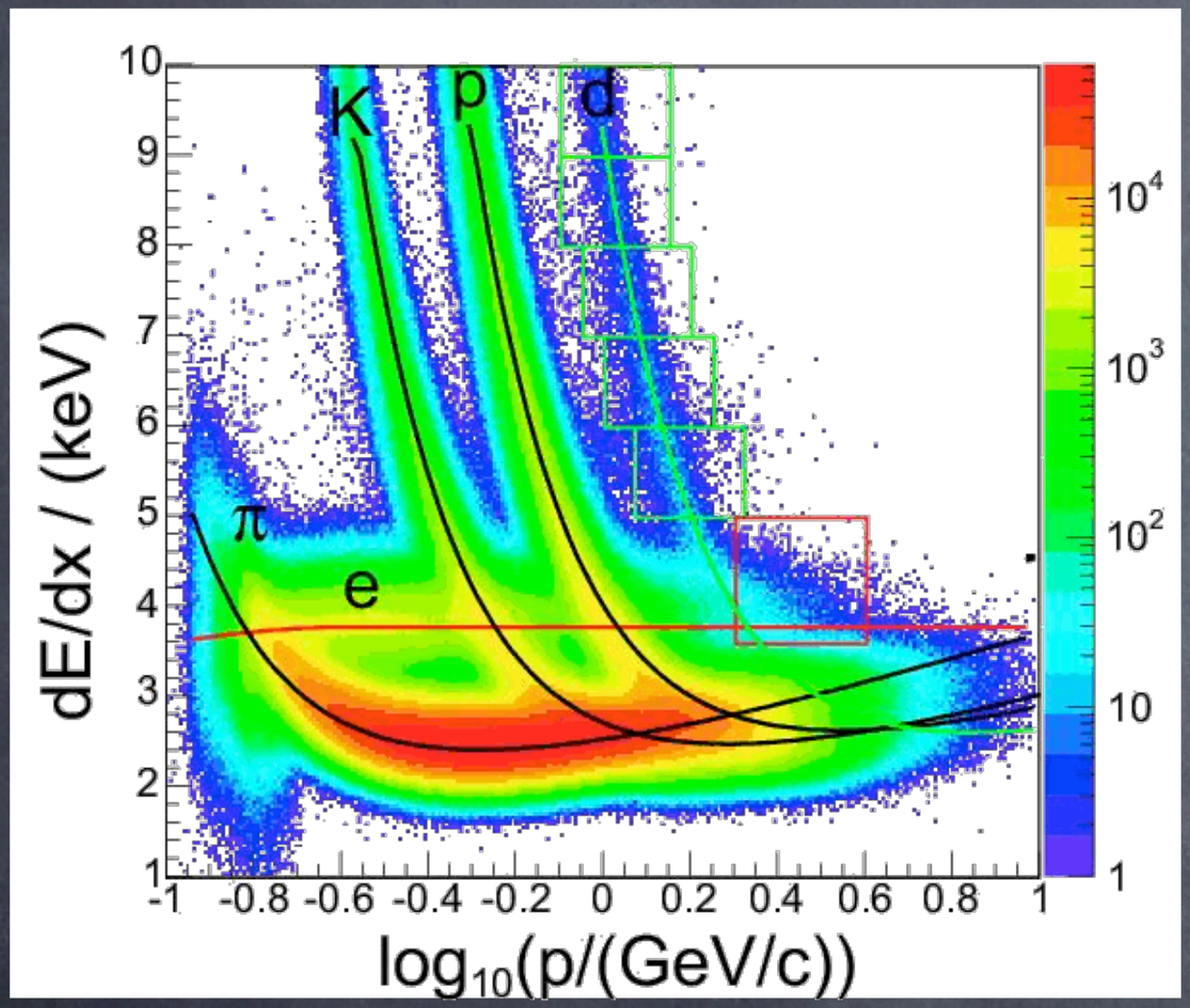


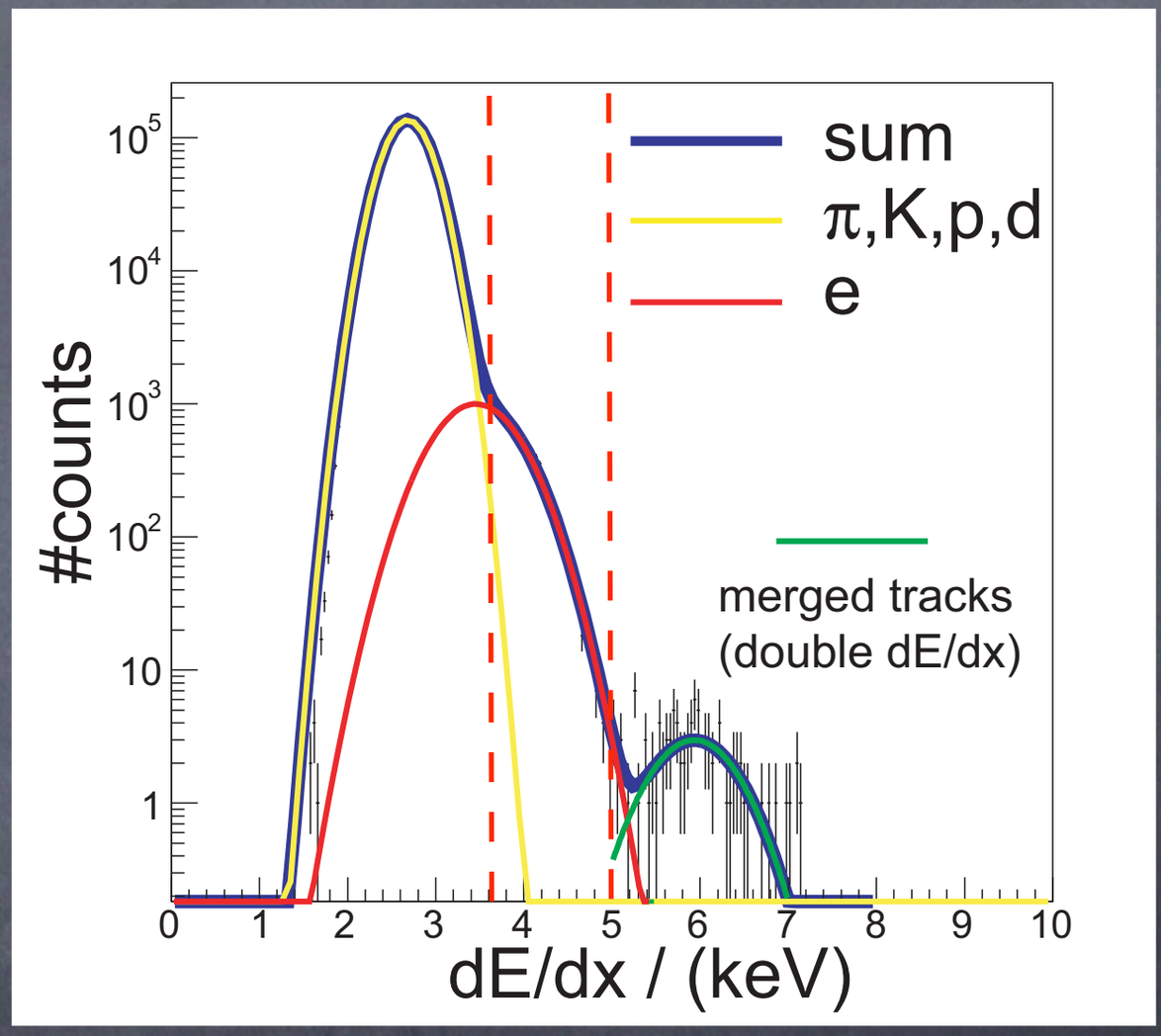
γ's can be reduced by factor 2 via invariant mass method

STAR: nucl-ex/0407006
Pythia tuned to STAR data

Electron Identification:

TPC dE/dx vs p

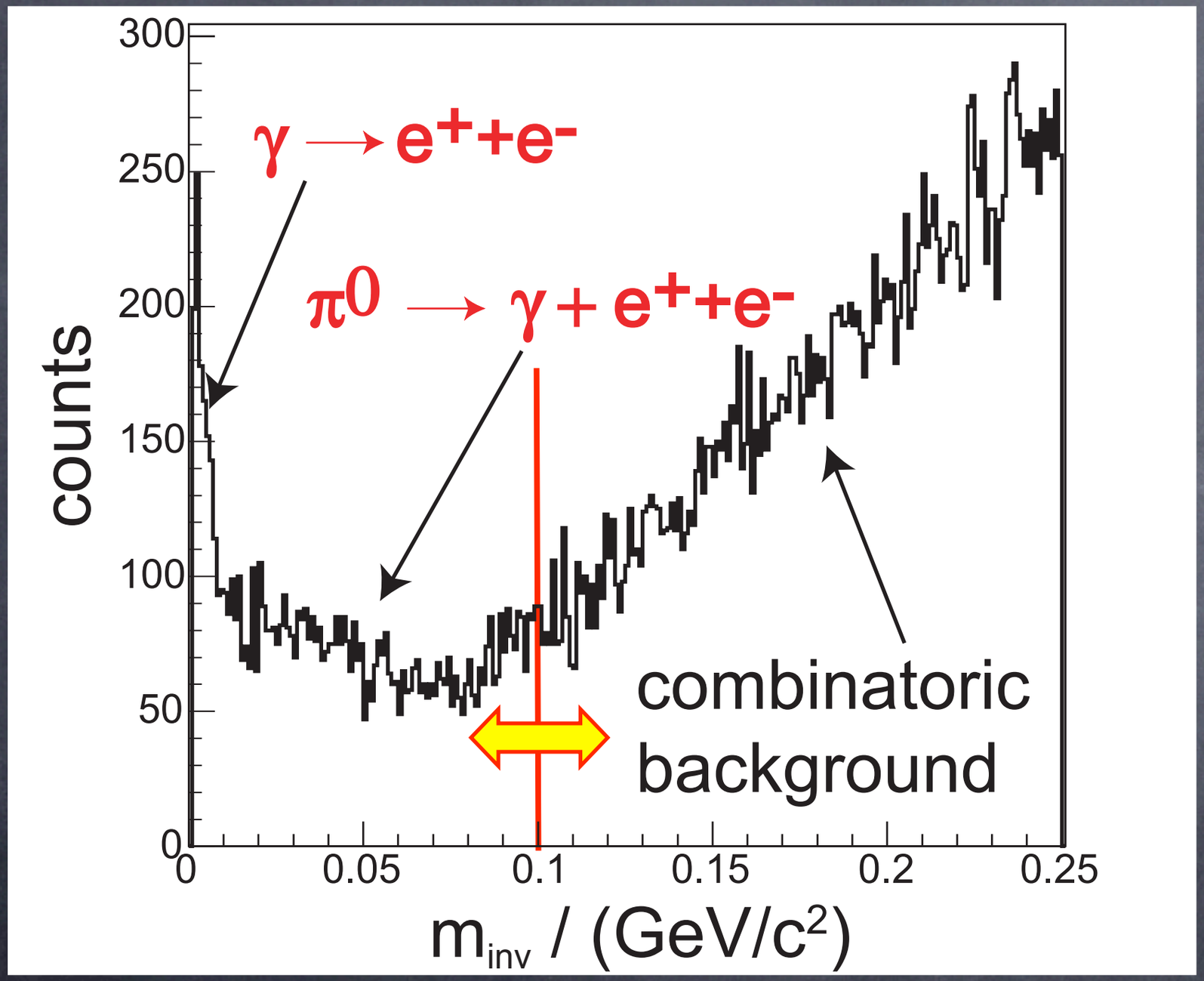




Deuteron background (<5%) easily assessed by comparing positive/negaitve charges

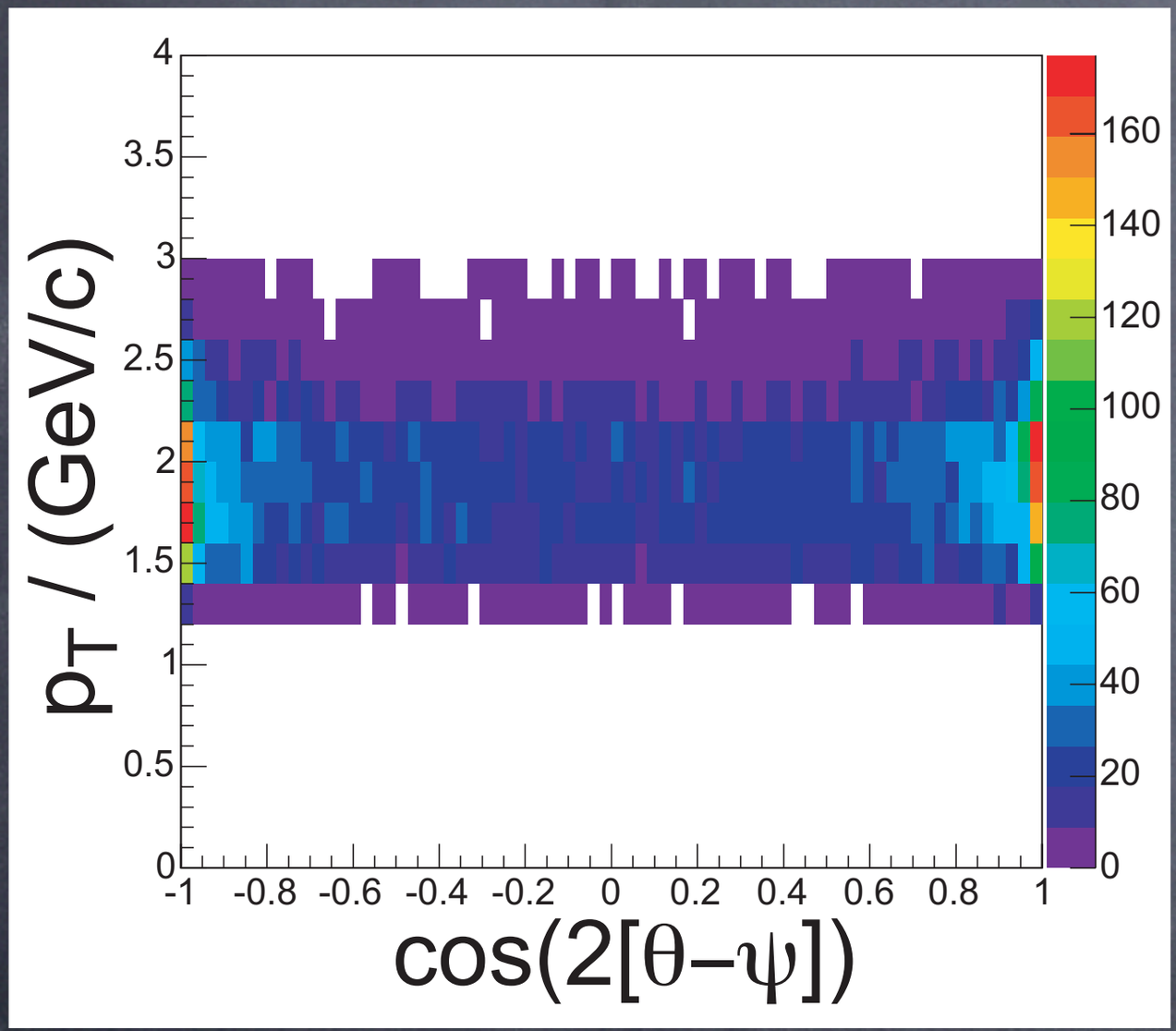
SQM2004 Cape Town,SA Frank Laue (laue@bnl.gov)

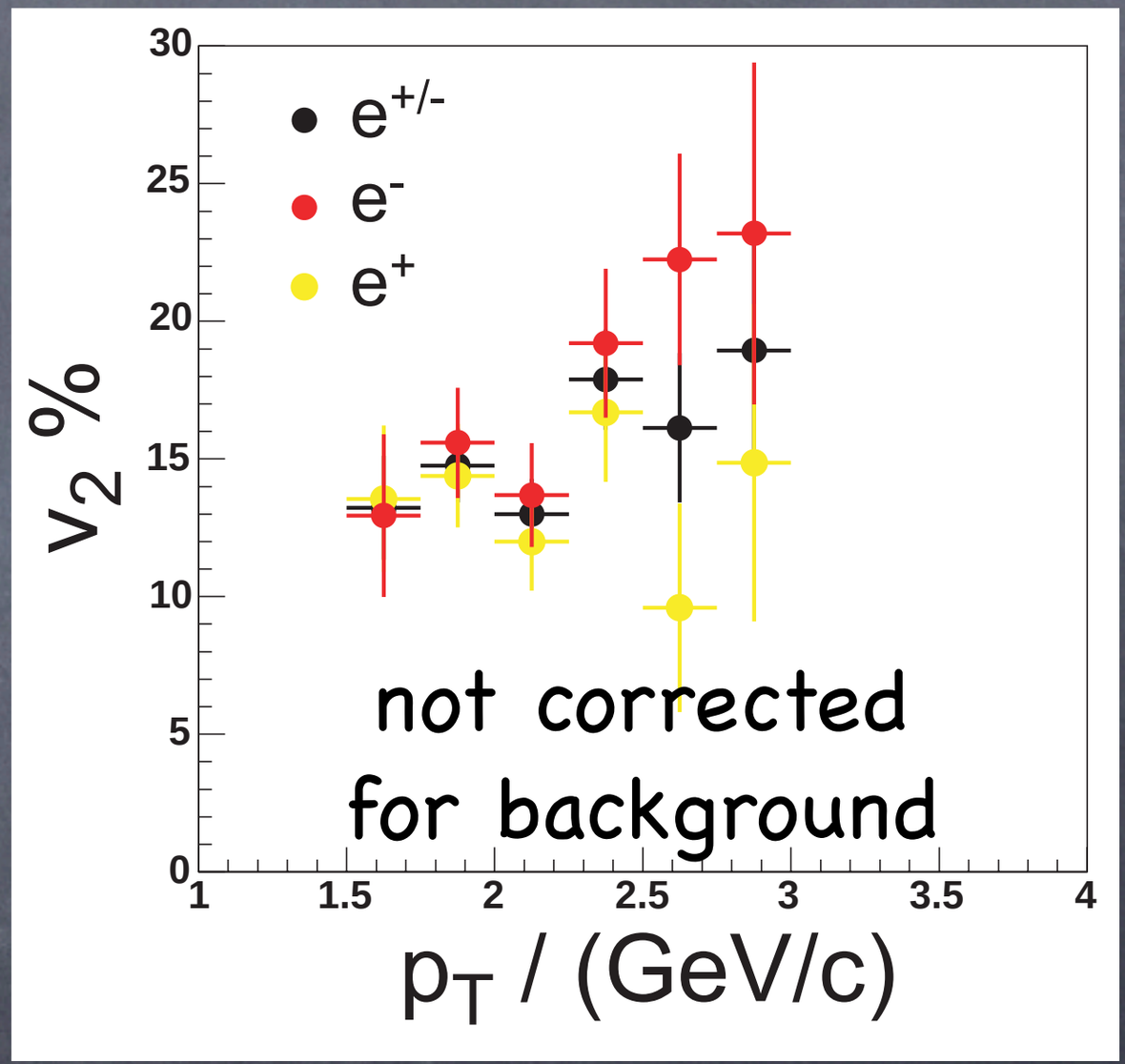
γ-conversions and π^0-Dalitz Decays



50% of electrons originating from γ-conversions and π^0-Dalitz decays can be removed with invariant mass method, but might bias efficiency in central collisions

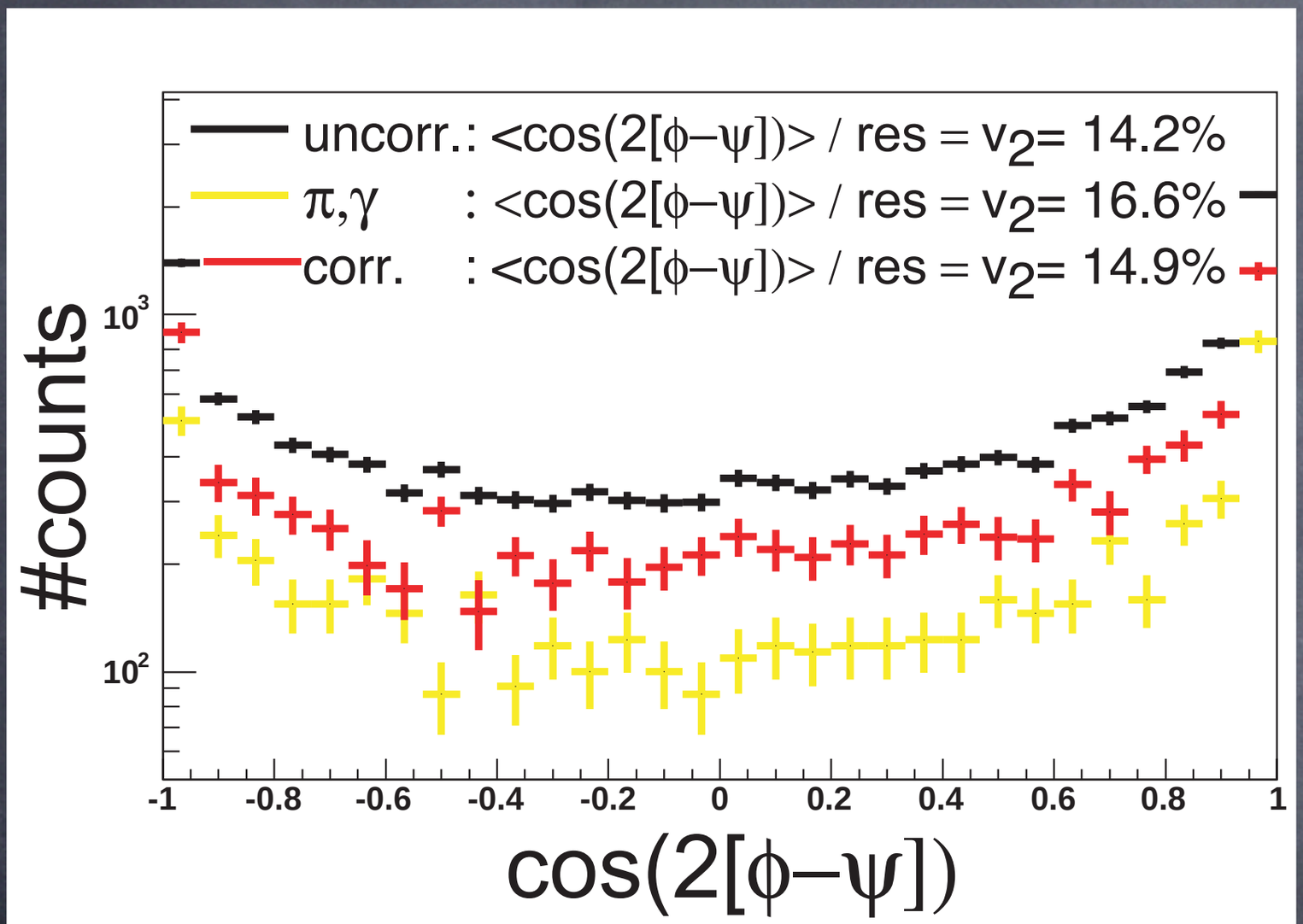
v_2 vs p_T





$$v_2 = \langle \cos(2[\Phi-\psi]) \rangle$$

Background Correction



Monte Carlo π^0 decay

- Phenix π^0 Data from S.S.Adler et al., Phys. Rev. Lett. 91, 072301 (2003).
- Fit with power-law
- 100k events thrown with Mevsim and v2=17% (asymptotic)
- 50% γ-electron removal

π^0-elect. frac. = 0.37

$v_2 = \langle \cos(2[\Phi-\psi]) \rangle$ / Event-Plane-Resolution

Results: (Preliminary)

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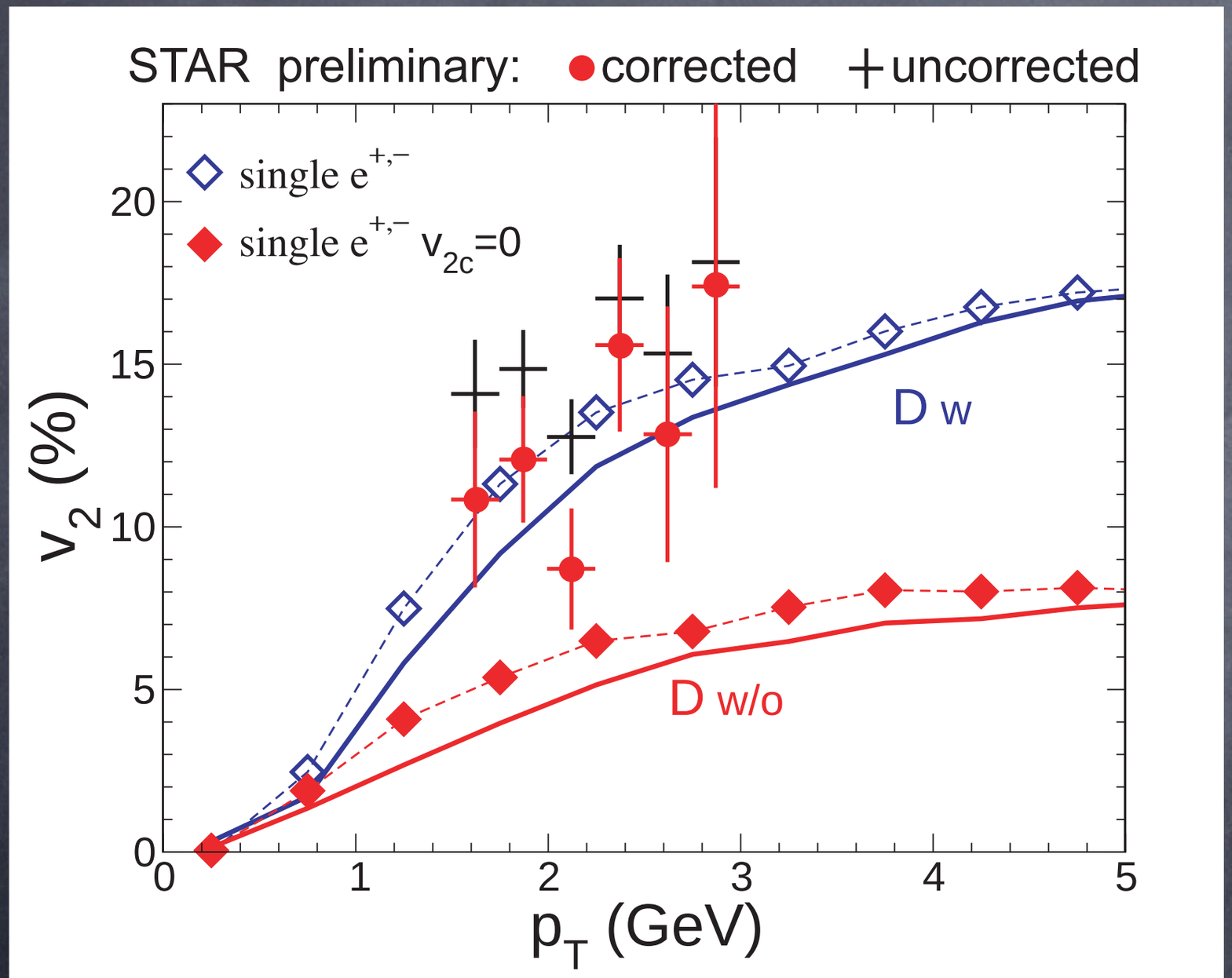


corrected for $e^{\pm}$ contributions from π^0 decays according to Phenix π^0 spectrum with v_{2max}=17%

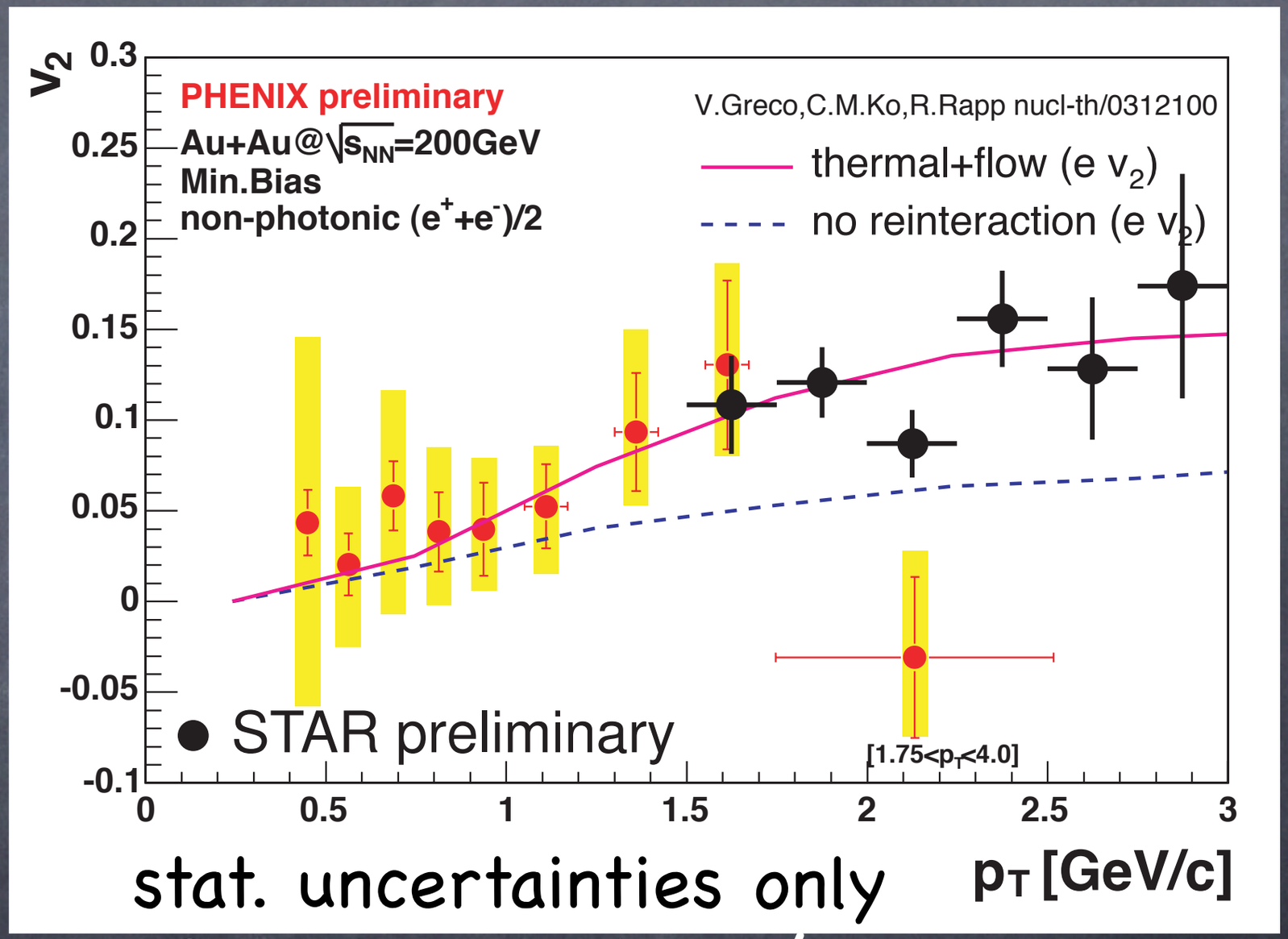
sys. uncertainty evaluation in progress

statistical uncertainties only

Non-photonic electron v2 from PHENIX & STAR

Phenix : Min. Bias
Star: 0-80%

corrected for $e^{\pm}$ contaminations from π decays with v_{2max}=17%



stat. uncertainties only

Phenix: nucl-ex/0404014

Summary / Outlook

- Prel. results indicate strong non-photonic electron v_2
  - consistent with $v_{2c} = v_{2\text{light-q}}$ theory calculations
  - consistent (smoothly extending) Phenix results
  -
- Understand systematic uncertainties
  -
  - 100x better statistics in Run IV (already on tape)
    - centrality dependence
    - reduce backgrounds by 80% with tighter cuts
    -
  - Wanted: Quark Coalescence's centrality dependence
    - Is QC breaking down at some point (charm at least) ?
    - What if it is not breaking down ? (QGP ?!?)

Motivation V: Charm v_2

Z.W. Lin et D. Molnar Phys.Rev.Lett.91-092301