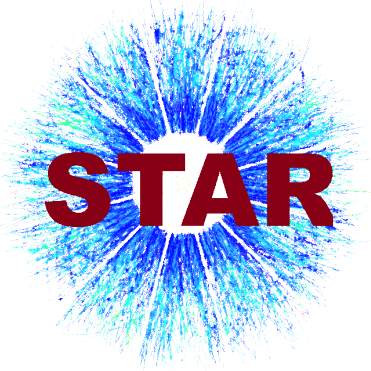


Pion-kaon femtoscopy for Au+Au collisions at $\sqrt{s_{NN}}=39$GeV from Beam Energy Scan program at STAR

Katarzyna Poniatowska*

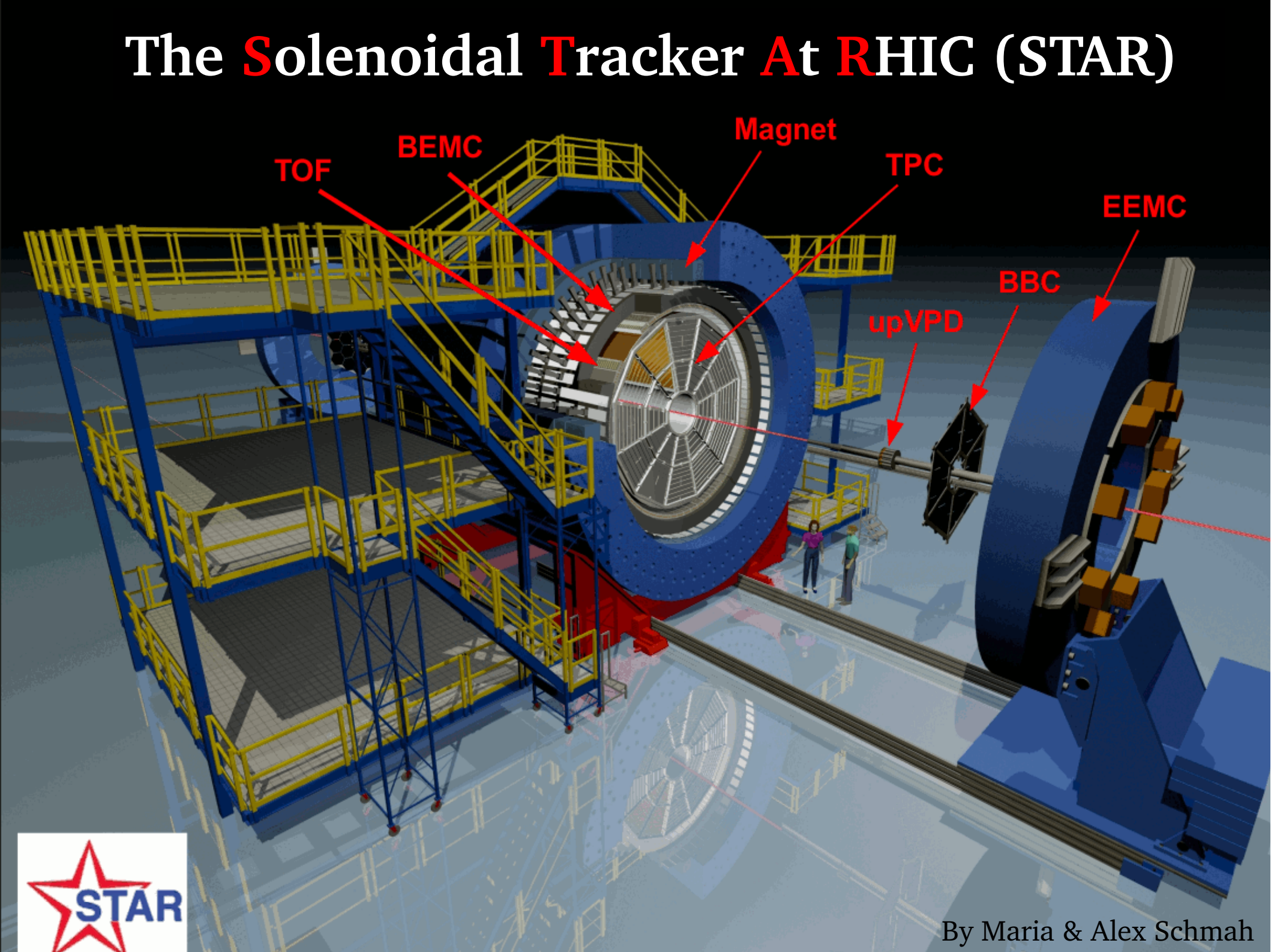
For STAR Collaboration

*Warsaw University of Technology
Faculty of Physics

Outline

- Correlation functions
- Space-time asymmetry
- Motivation
- Results for AuAu collision at $\sqrt{s_{NN}} = 130\text{GeV}$
- Results for AuAu collision at $\sqrt{s_{NN}} = 39\text{GeV}$
  - Particle identification
  - Analysis in 39GeV
  - Comparison of results for analysis in 39GeV and 130GeV
- Summary

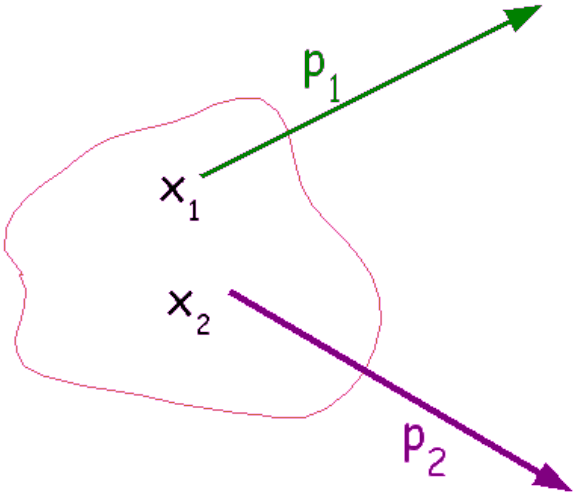
The Solenoidal Tracker At RHIC (STAR)



By Maria & Alex Schmah

Correlation function

$$C(\mathbf{p}_1, \mathbf{p}_2) = \frac{P_2(\mathbf{p}_1, \mathbf{p}_2)}{P_1(\mathbf{p}_1) P_1(\mathbf{p}_2)}$$



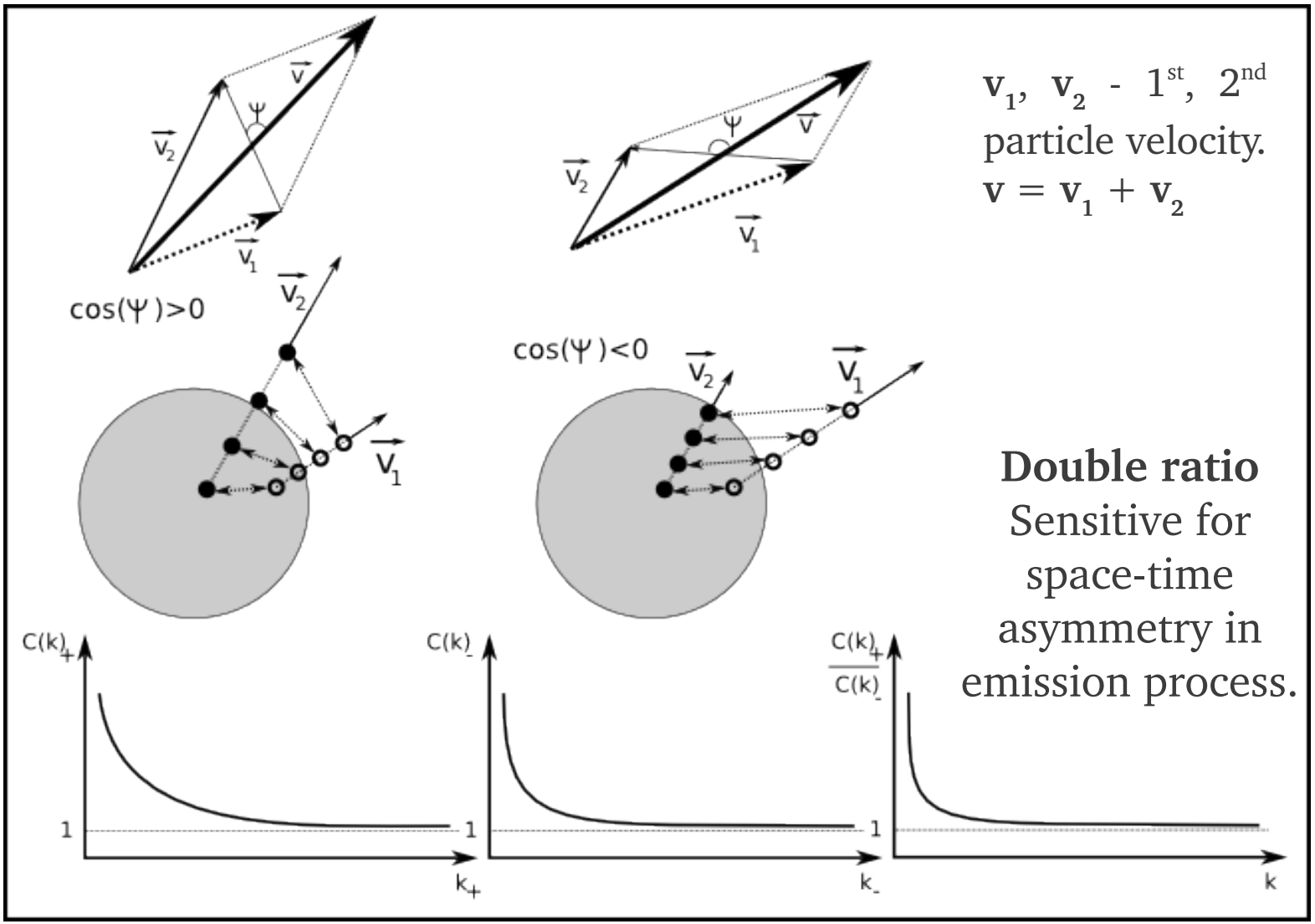
$P_2(\mathbf{p}_1, \mathbf{p}_2)$ – the probability of observing two particles with momentum p_1, and p_2 at the same time and the same place.

$P_1(\mathbf{p}_1)$, $P_1(\mathbf{p}_2)$ – the probability of observing two particles with momentum p_1, and p_2 separately.

Space-time asymmetry

cos(Ψ)>0
Catching up
Long time of effective interaction.
Strong correlation.

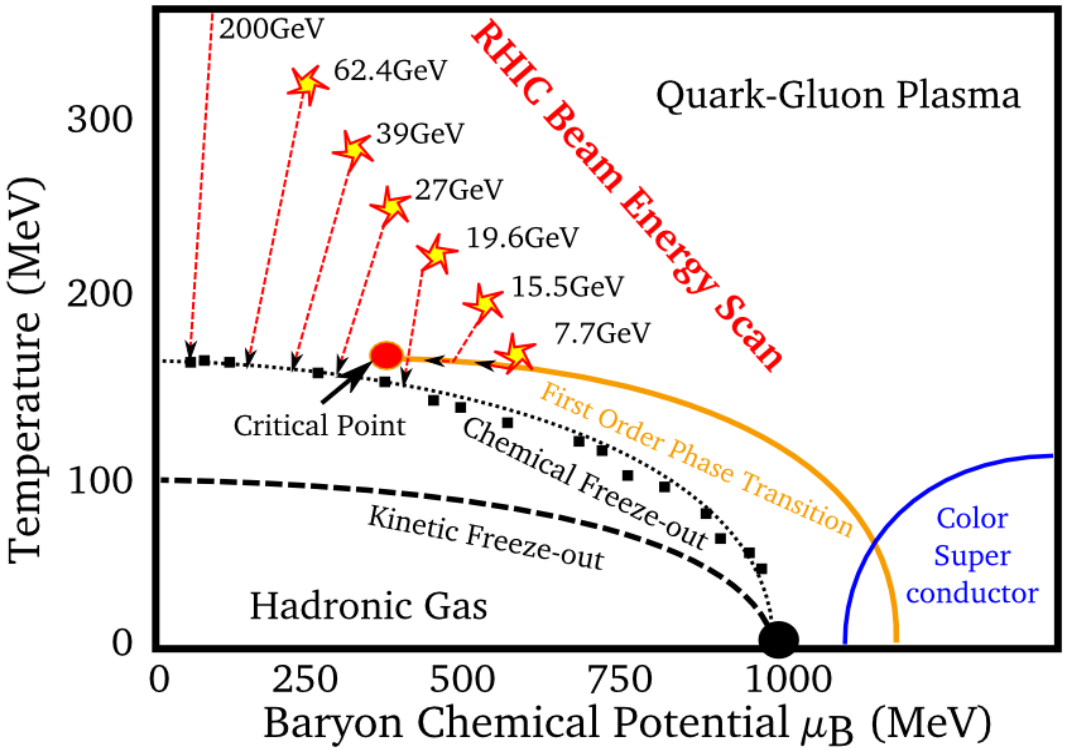
cos(Ψ)<0
Run away
Short time of effective interaction.
Weak correlation.



$\mathbf{v}_1$, $\mathbf{v}_2$ - 1st, 2nd particle velocity.
$\mathbf{v} = \mathbf{v}_1 + \mathbf{v}_2$

Double ratio
Sensitive for space-time asymmetry in emission process.

Motivation



Analyze all BES energies and find answers:

If or how pion-kaon source changes with energy?

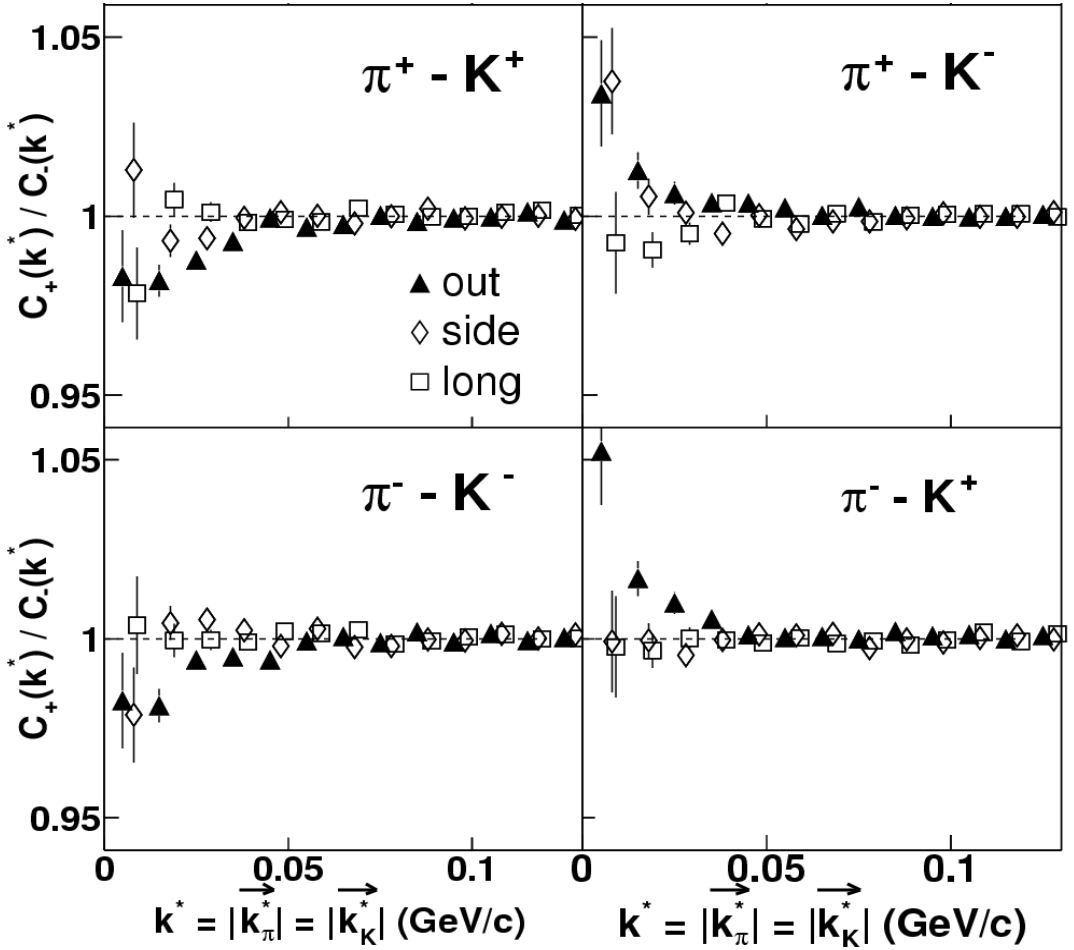
If or how pion-kaon asymmetry in emission process looks for all BES energies?

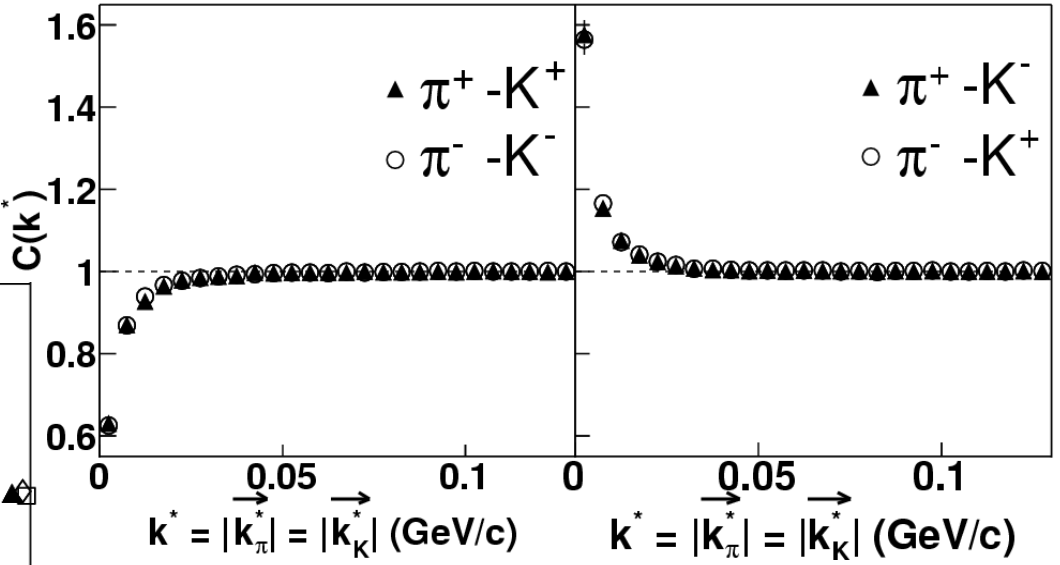
If or how the flow affects the pion-kaon system, consisting of particles of different mass?

Results for AuAu collisions at $\sqrt{s_{NN}} = 130$GeV

AuAu collision at $\sqrt{s_{NN}} = 130$GeV

Phys. Rev. Lett. 91 (2003) 262302





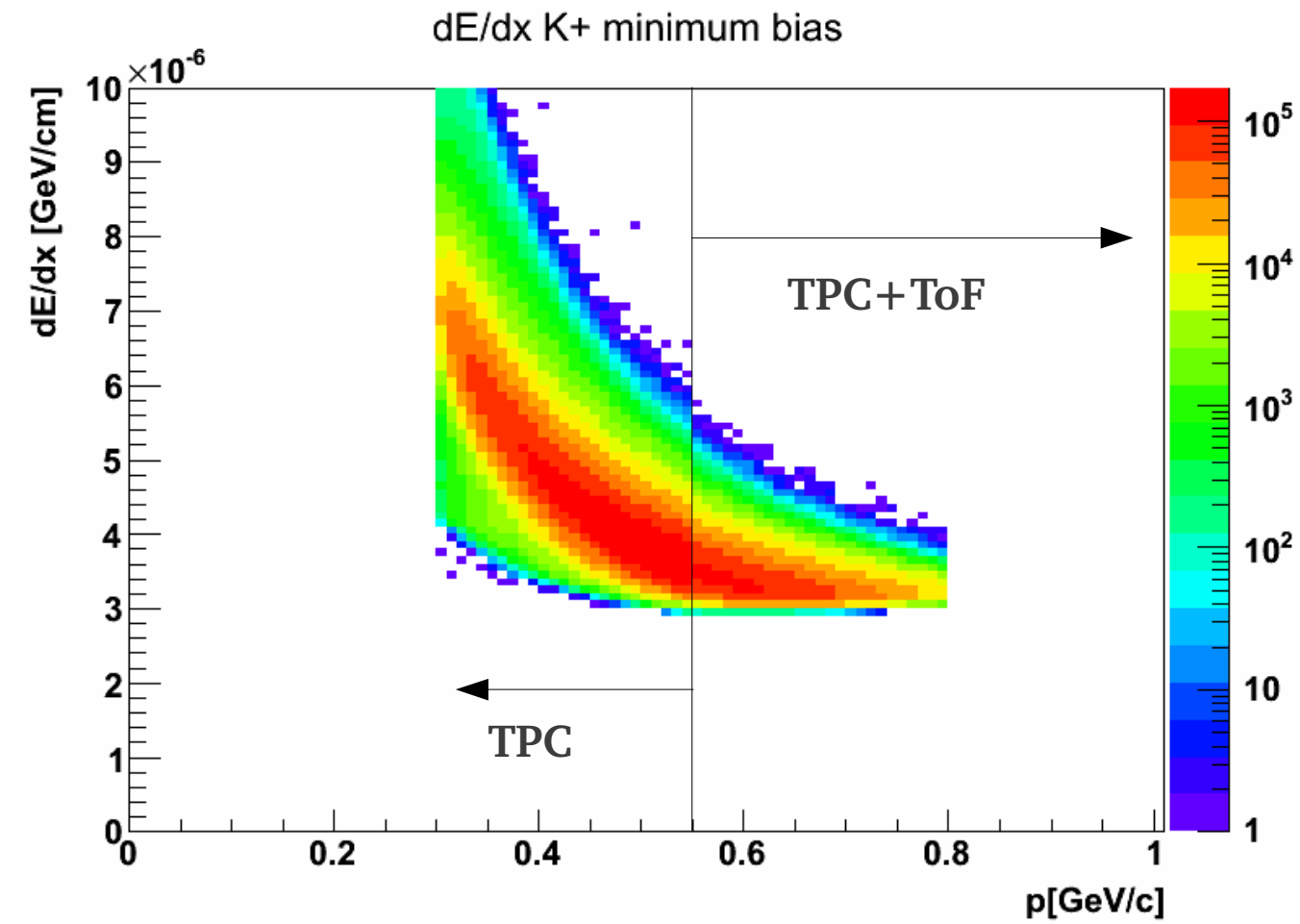
Matching assumes that the source is Gaussian for r^*_{out}:

Sigma: 12.5 ± 0.4 fm
Mean shift: -5.6 ± 0.6 fm

Results for AuAu collisions at $\sqrt{s_{NN}}$=39GeV

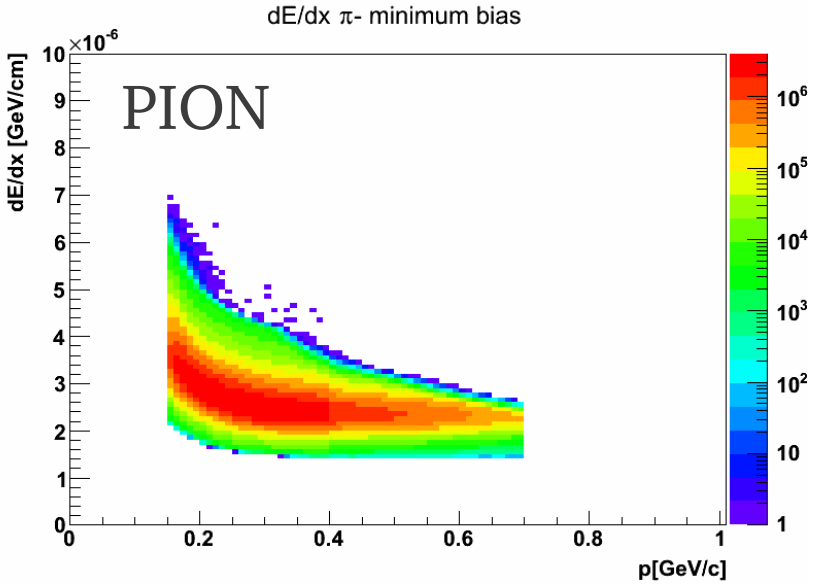
Threshold for π & K particles

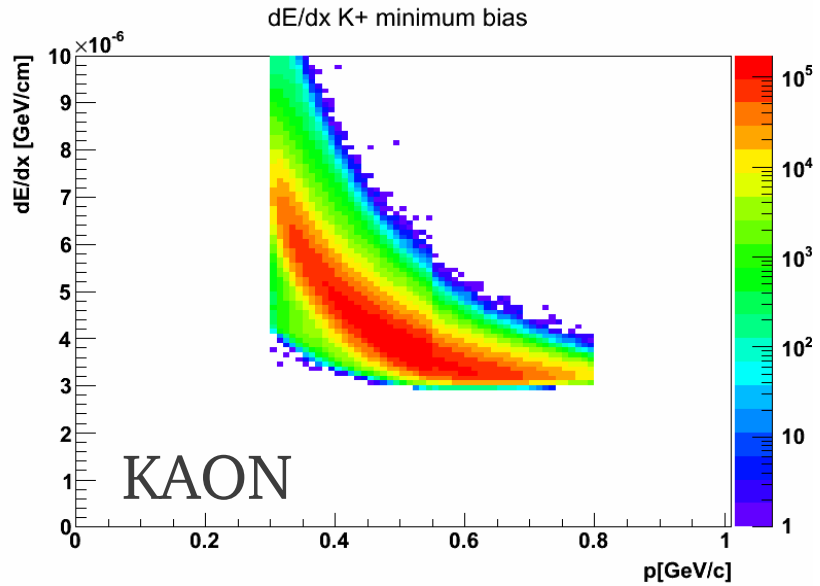
p = 0.55GeV/c



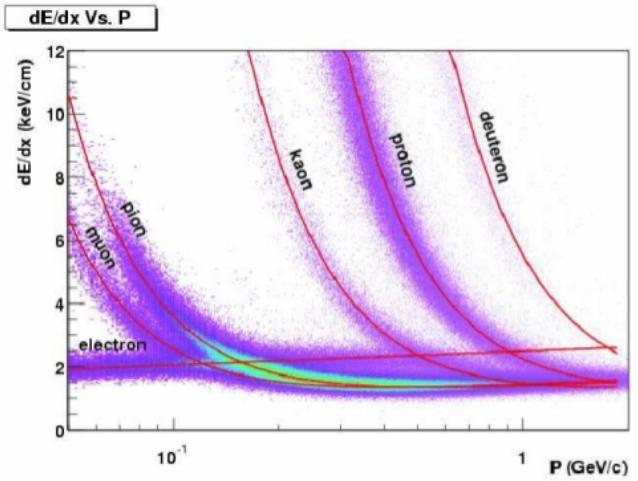
Results for AuAu collisions at $\sqrt{s_{NN}}=39\text{GeV}$

Analyzed 91.2 mln events

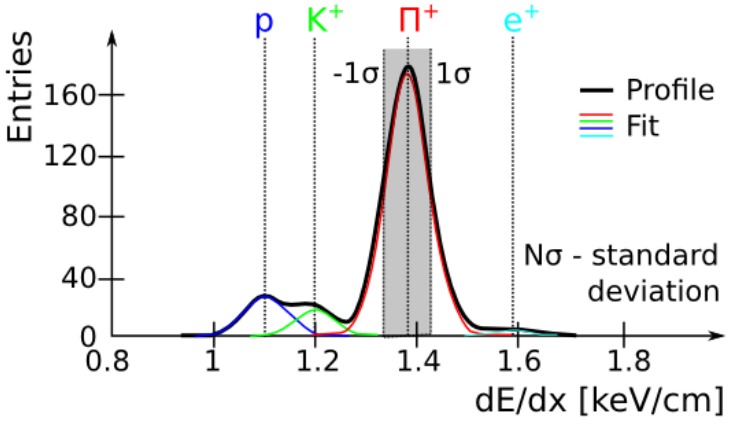




PID for TPC detector



Example of momentum projection



PION

$p \in [0.15, 0.7]\, GeV/c$

$N\sigma\ \pi < 3.0$

$N\sigma\ K, p > 3.0$

$m^2 \in [0.017, 0.026]\, GeV^2/c^4$

KAON

$p \in [0.3, 0.8]\, GeV/c$

$N\sigma\ K < 3.0$

$N\sigma\ \pi, p > 3.0$

$m^2 \in [0.22, 0.27]\, GeV^2/c^4$

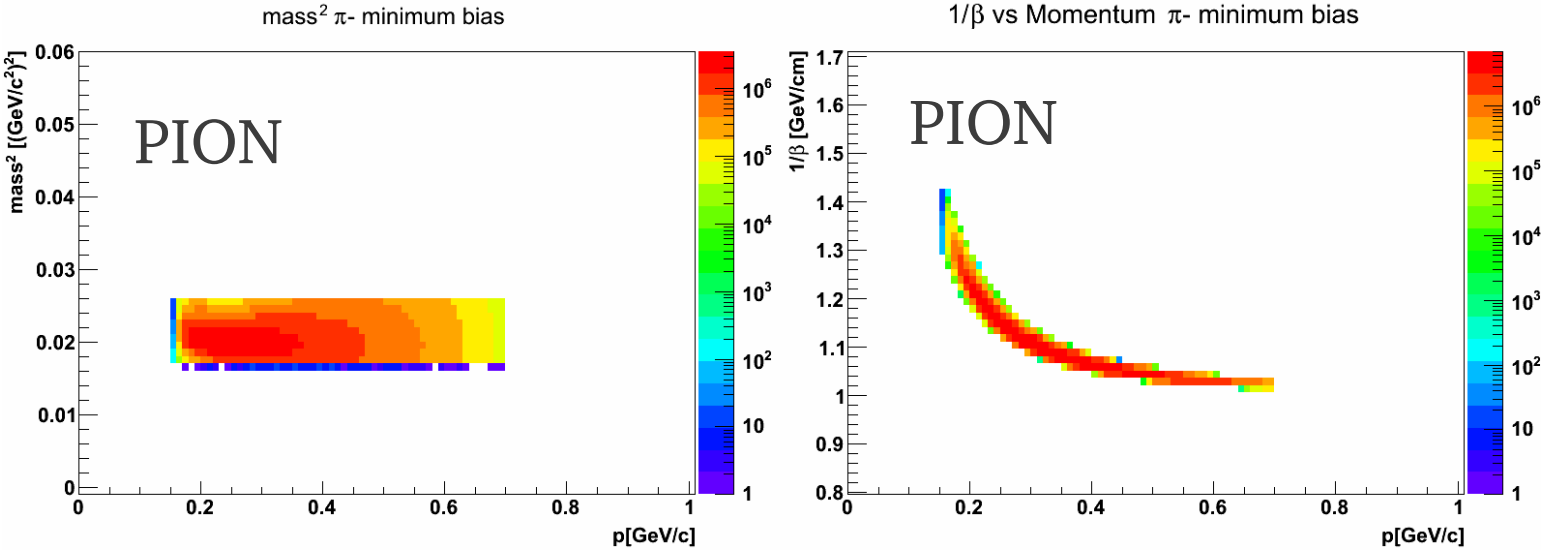
π & K

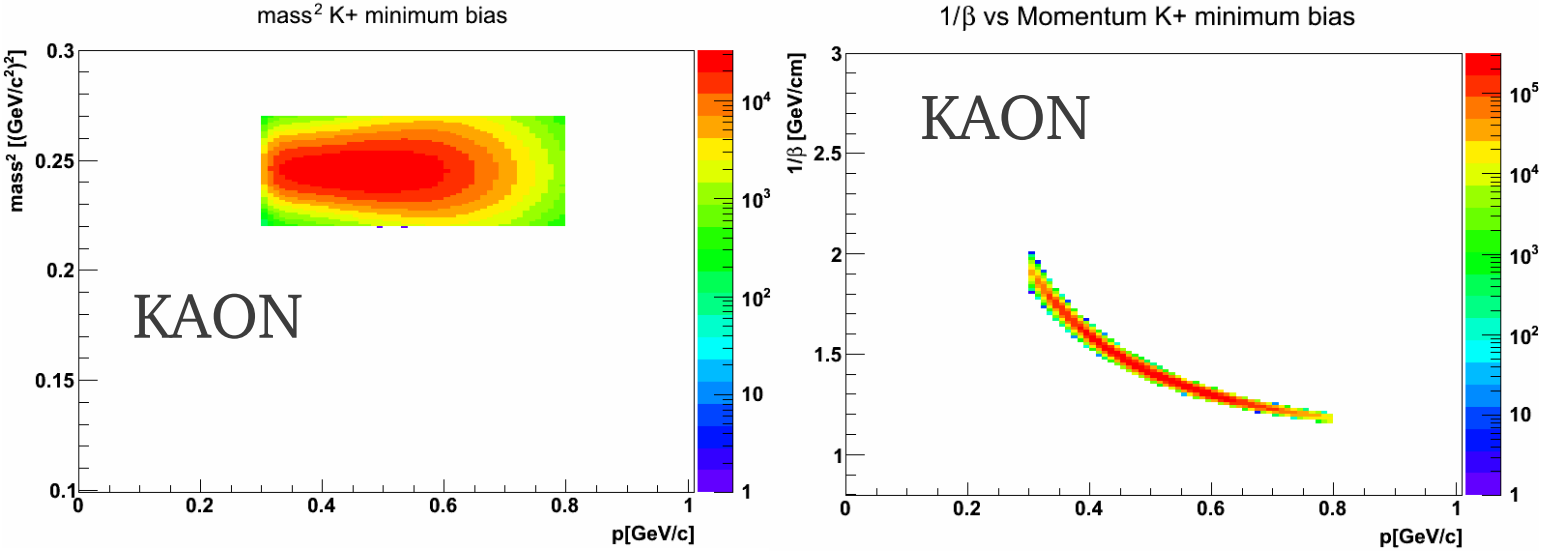
$|\eta| < 0.5$

$DCA < 3\text{cm}$

Results for AuAu collisions at $\sqrt{s_{NN}}=39\text{GeV}$

Analyzed 91.2 mln events





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π & K

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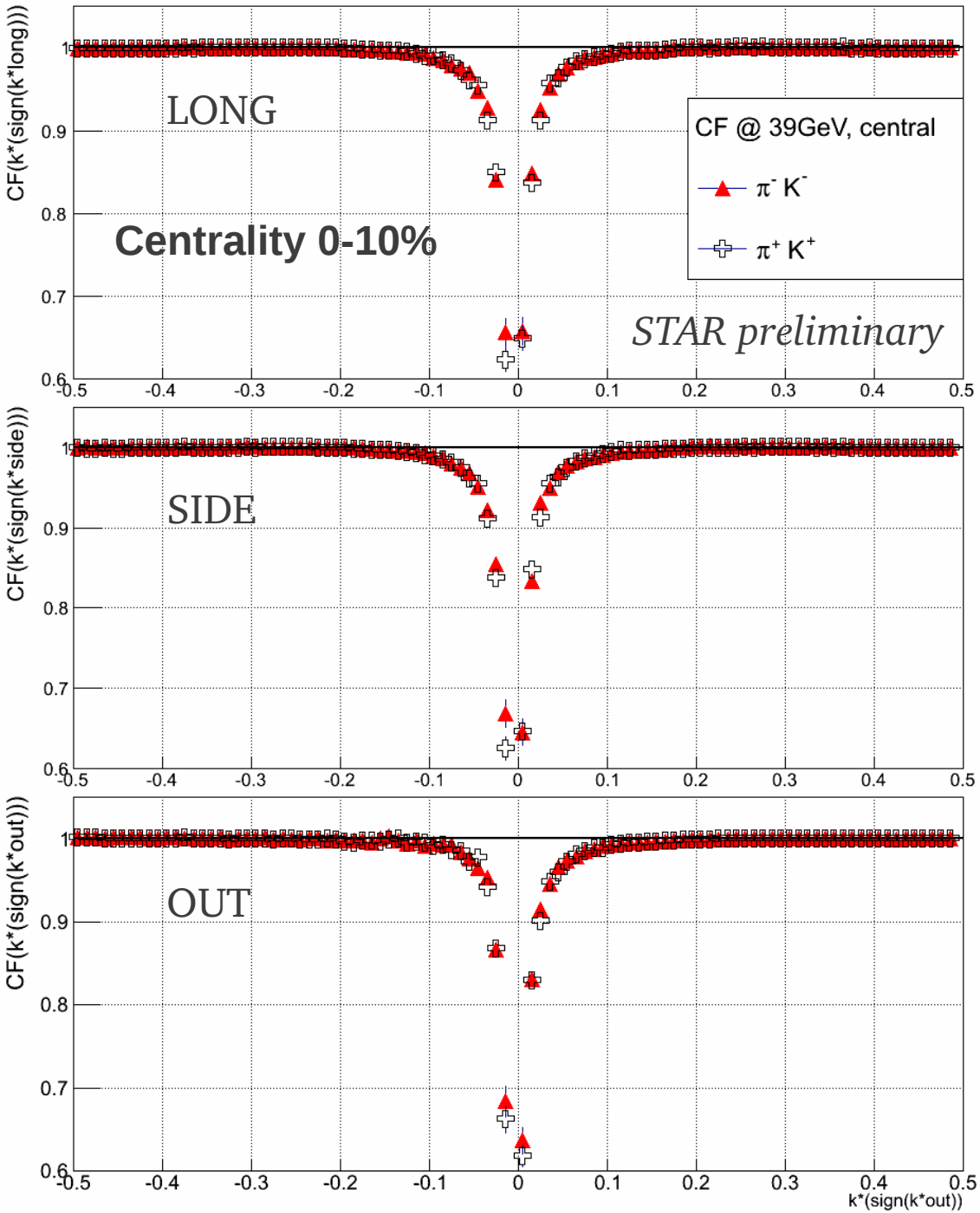
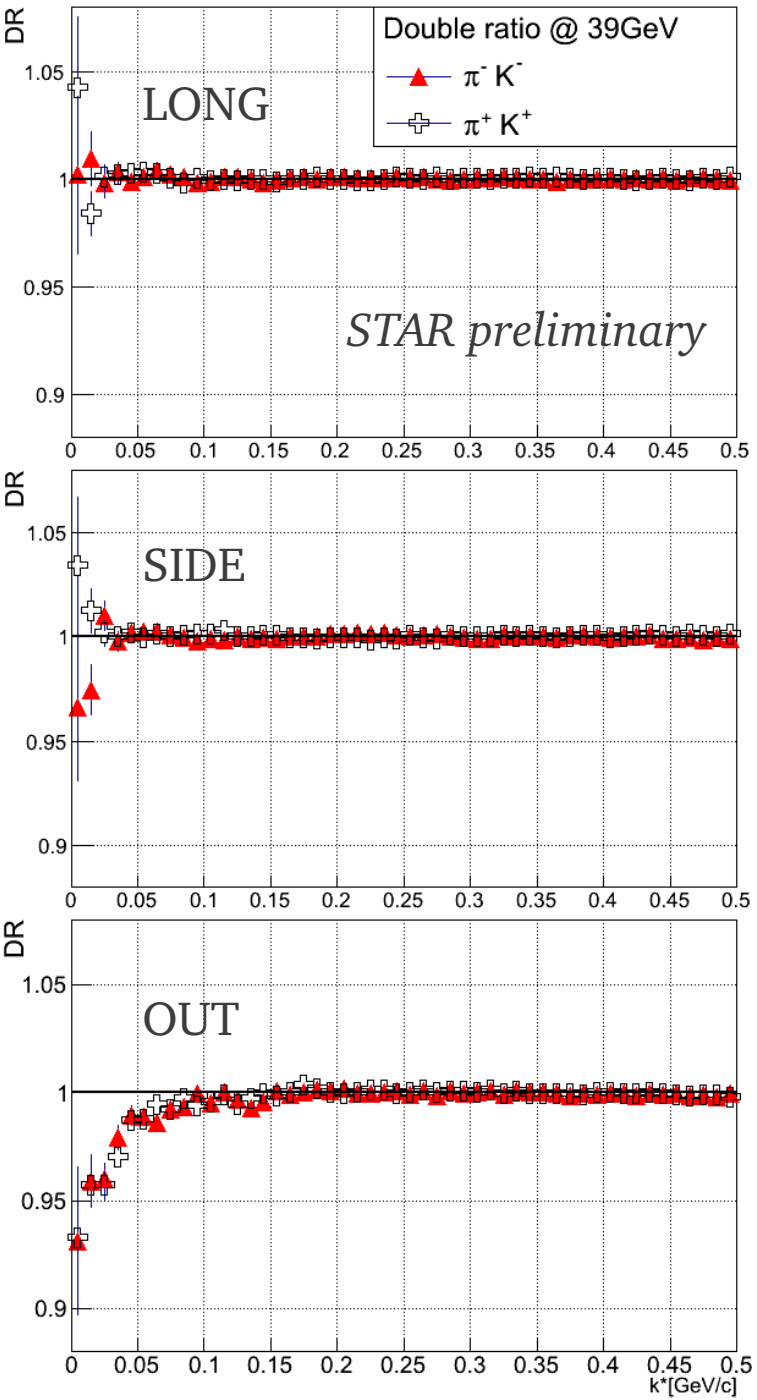
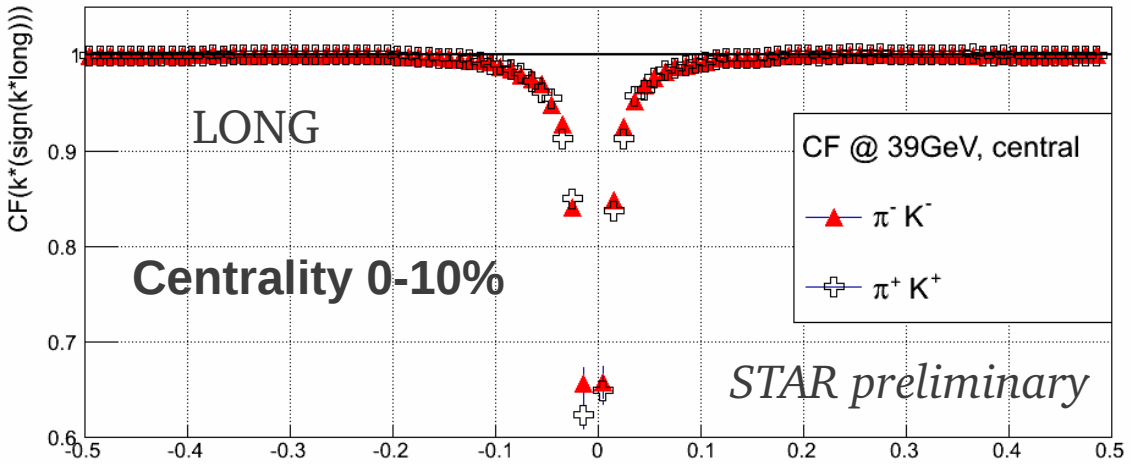
$DCA < 3\text{cm}$

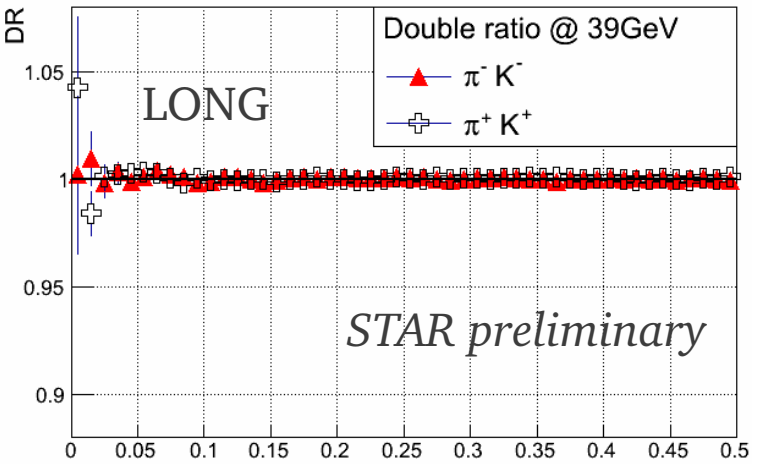
CF & DR for π- K- and π+ K+

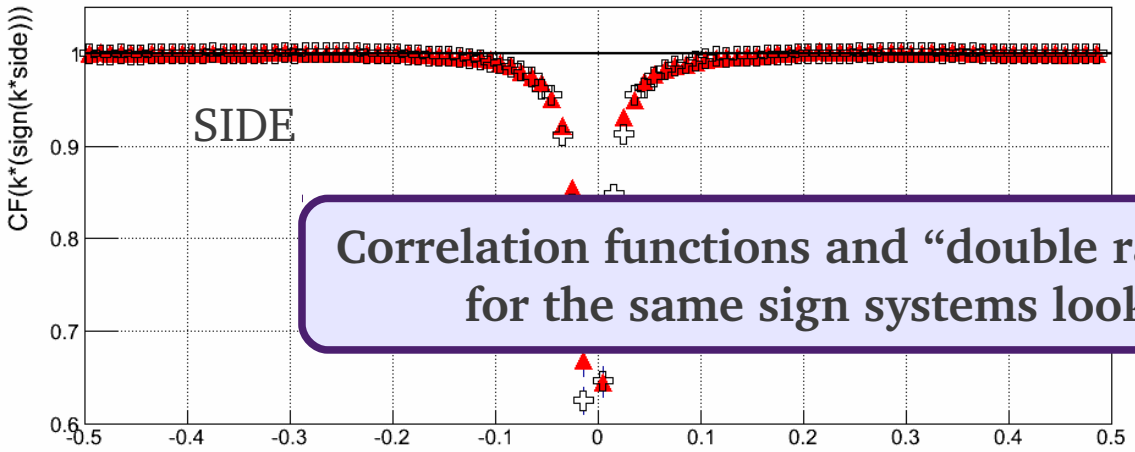


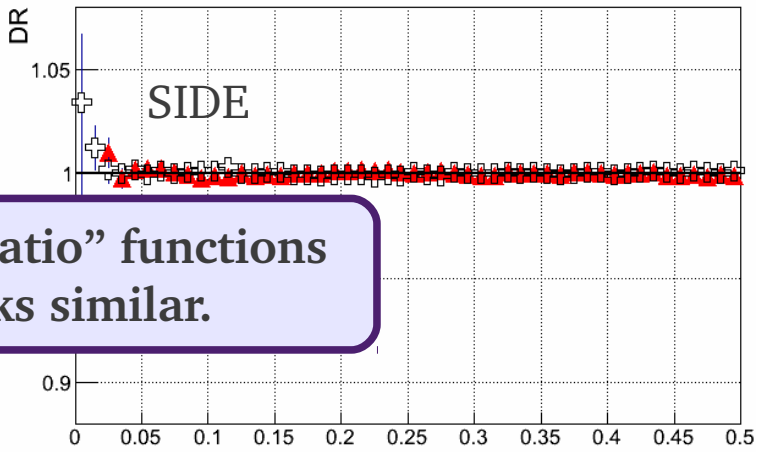


CF & DR for π- K- and π+ K+

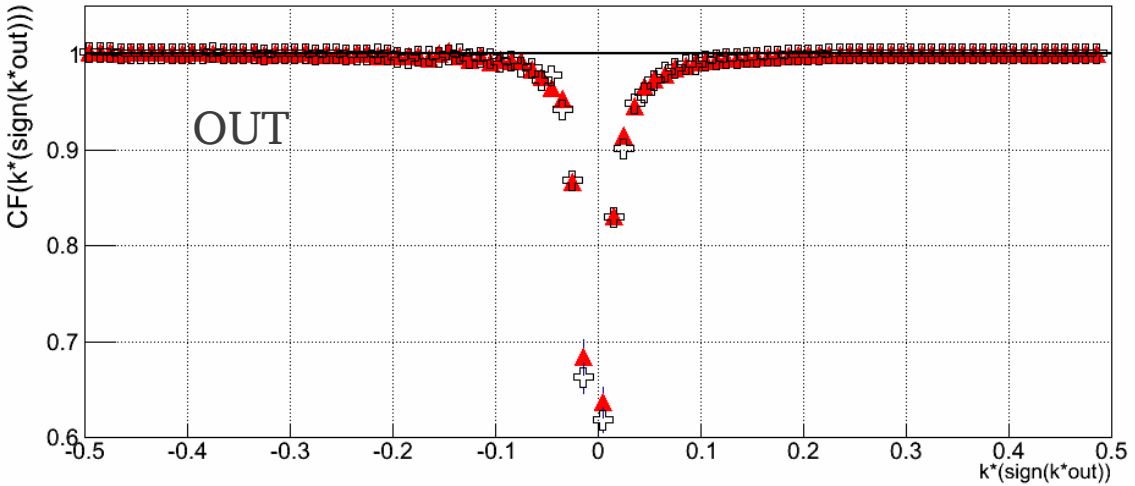


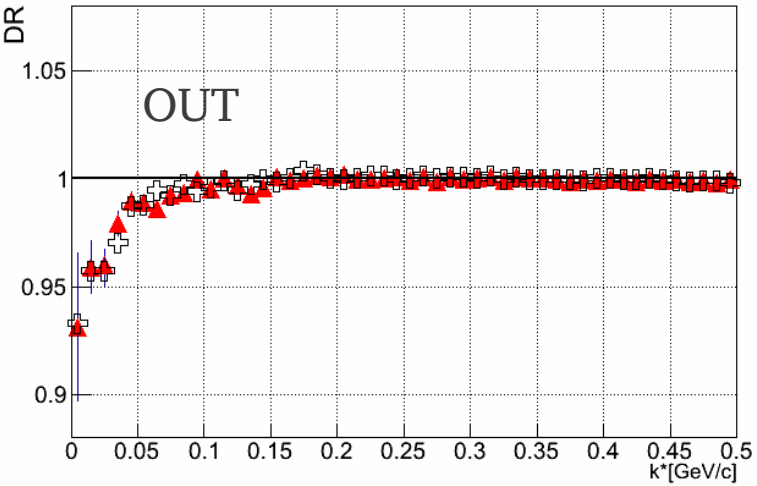




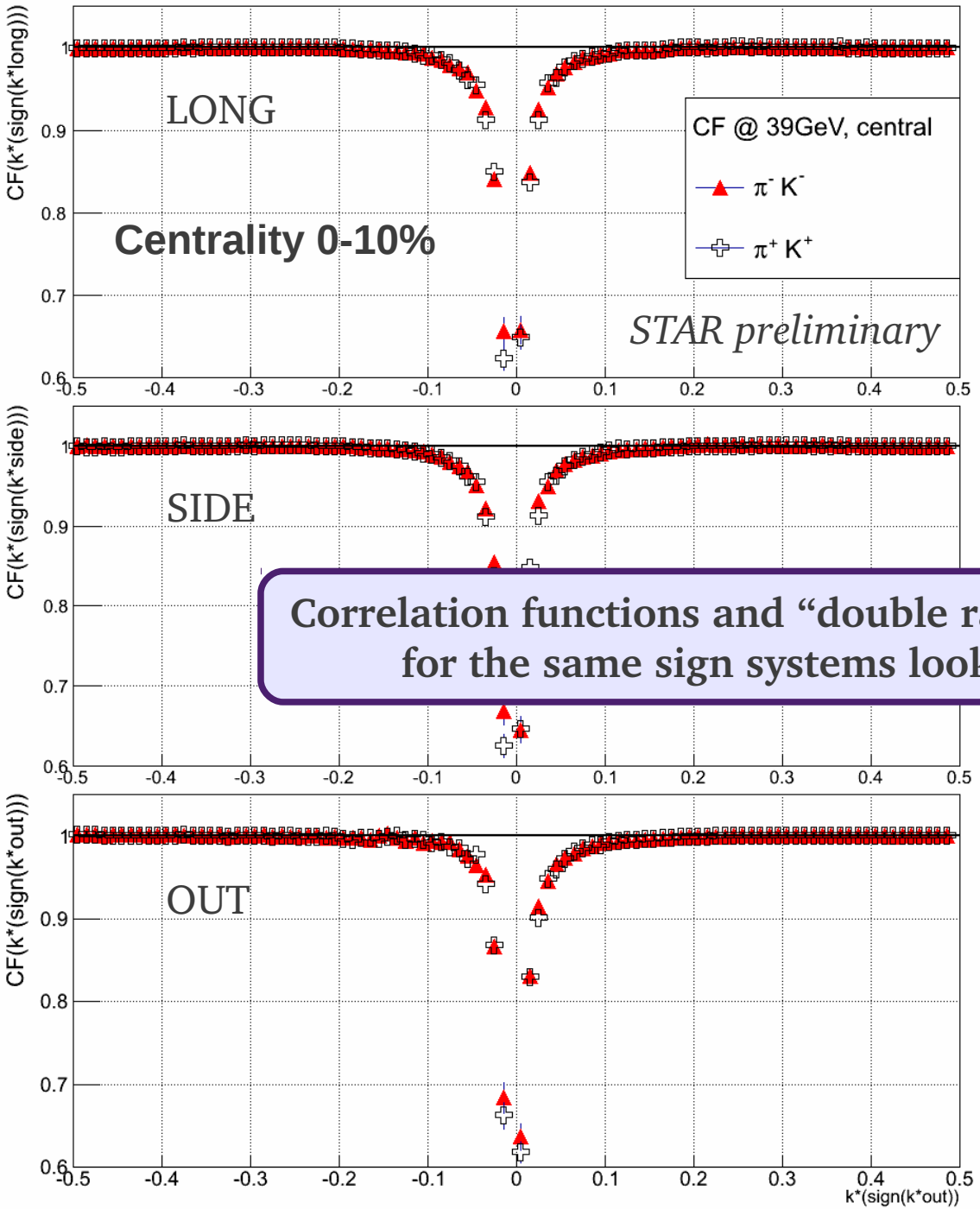


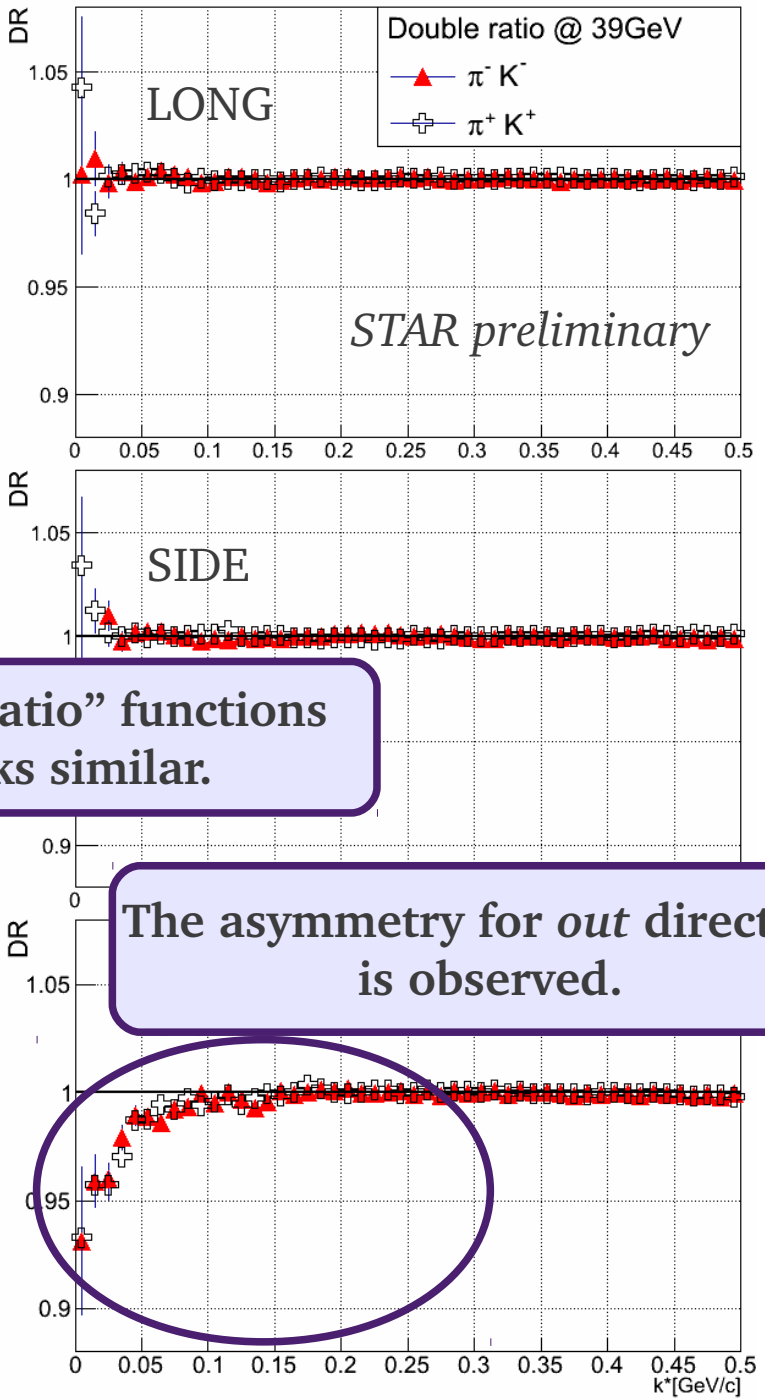
Correlation functions and "double ratio" functions for the same sign systems looks similar.





CF & DR for π- K- and π+ K+

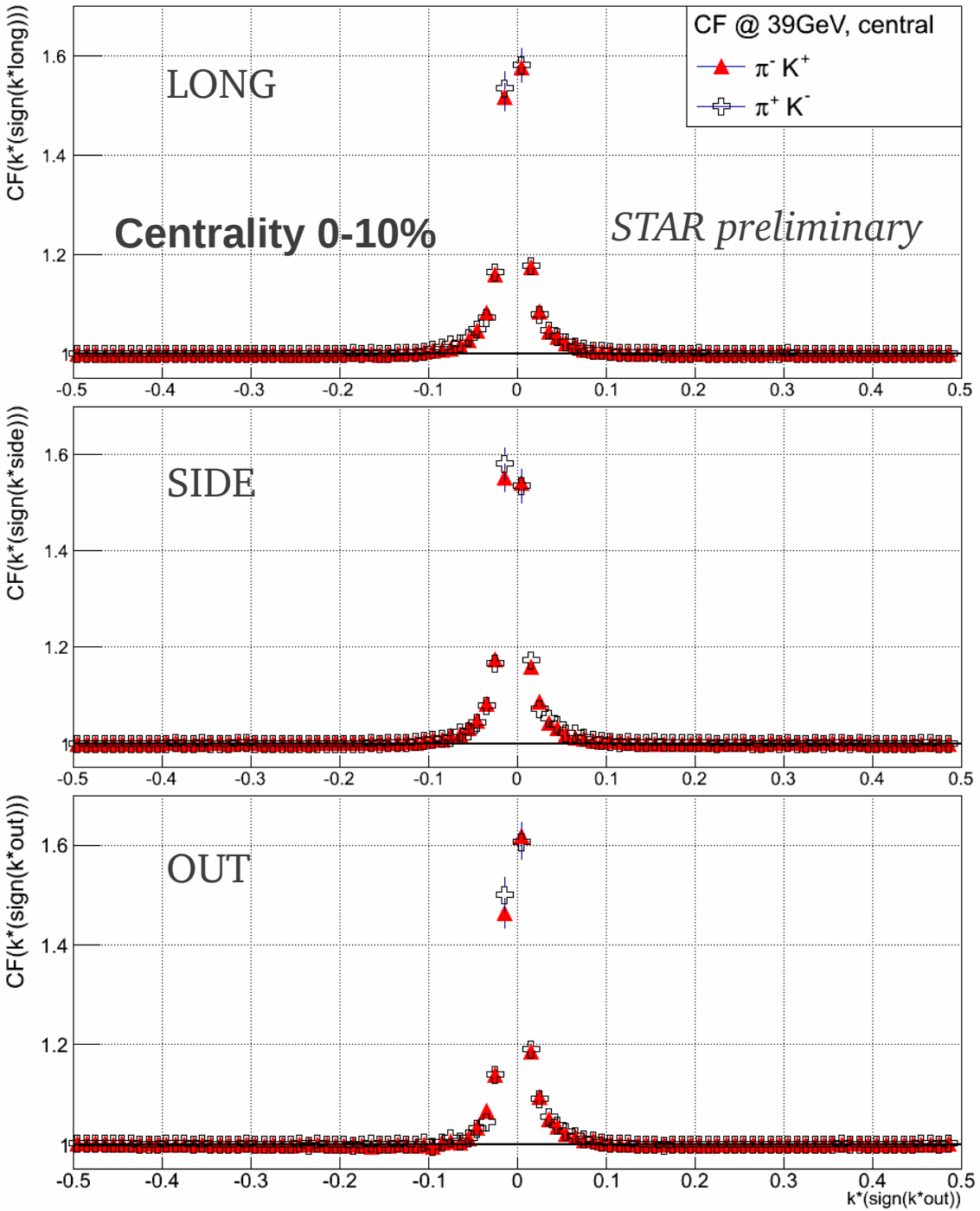


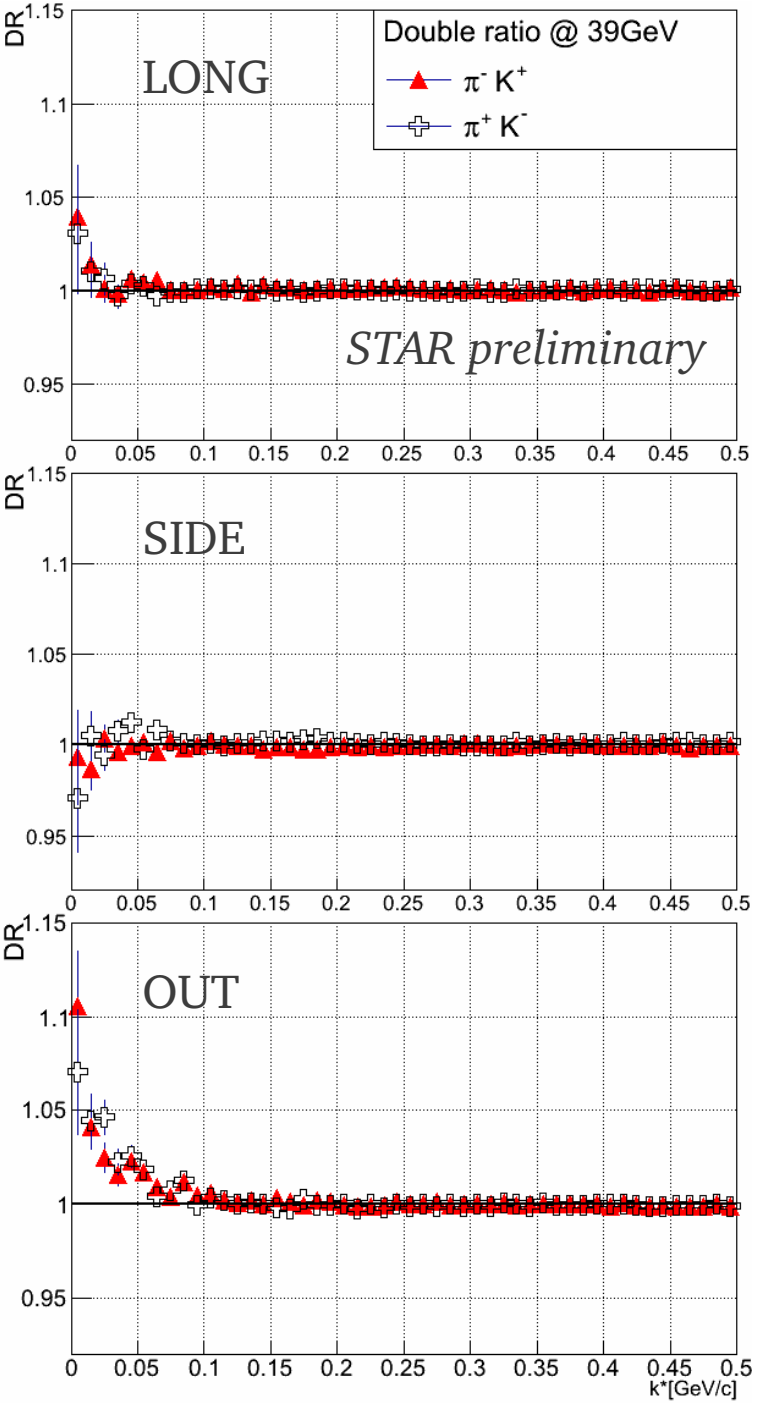


Correlation functions and "double ratio" functions for the same sign systems looks similar.

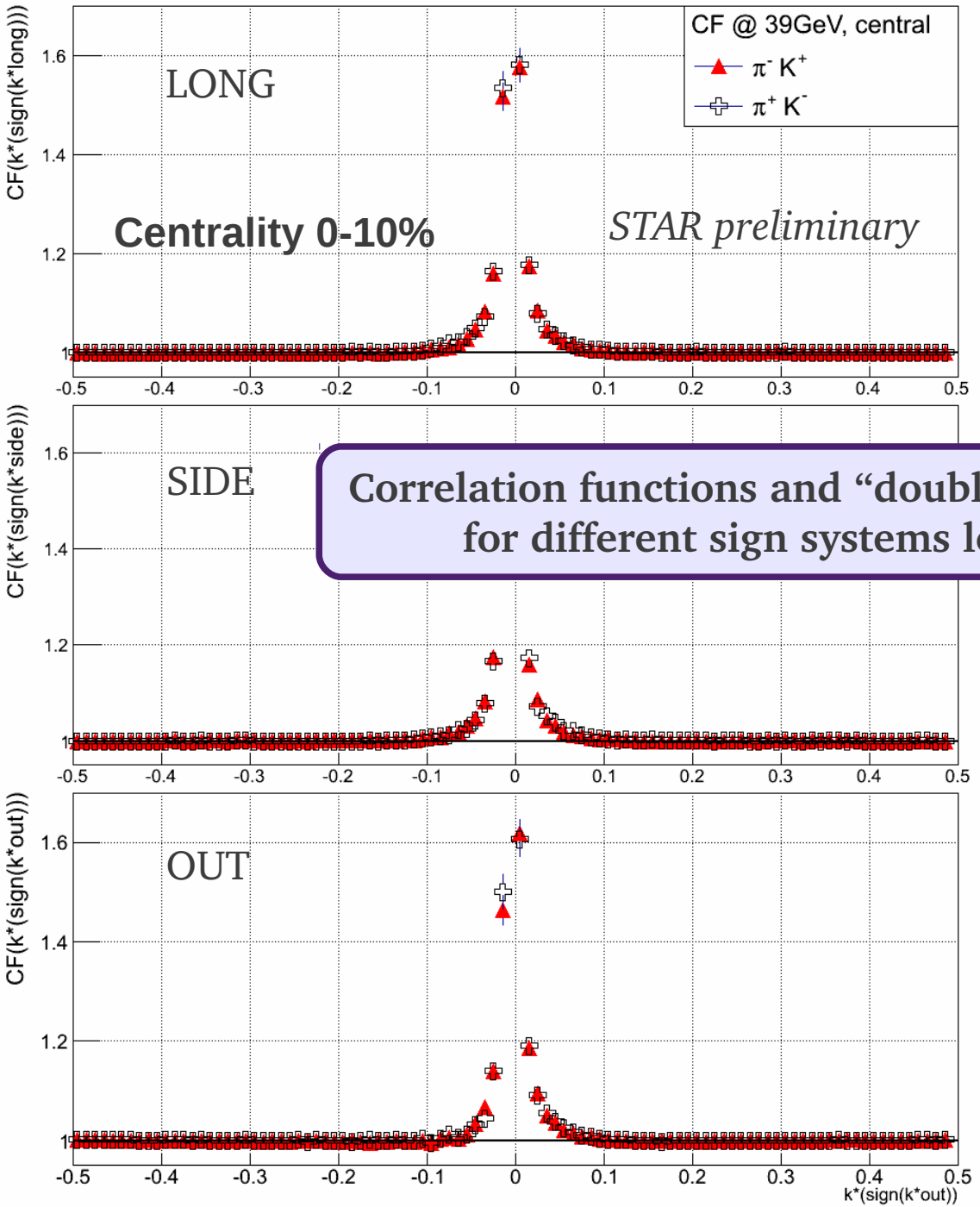
The asymmetry for *out* direction is observed.

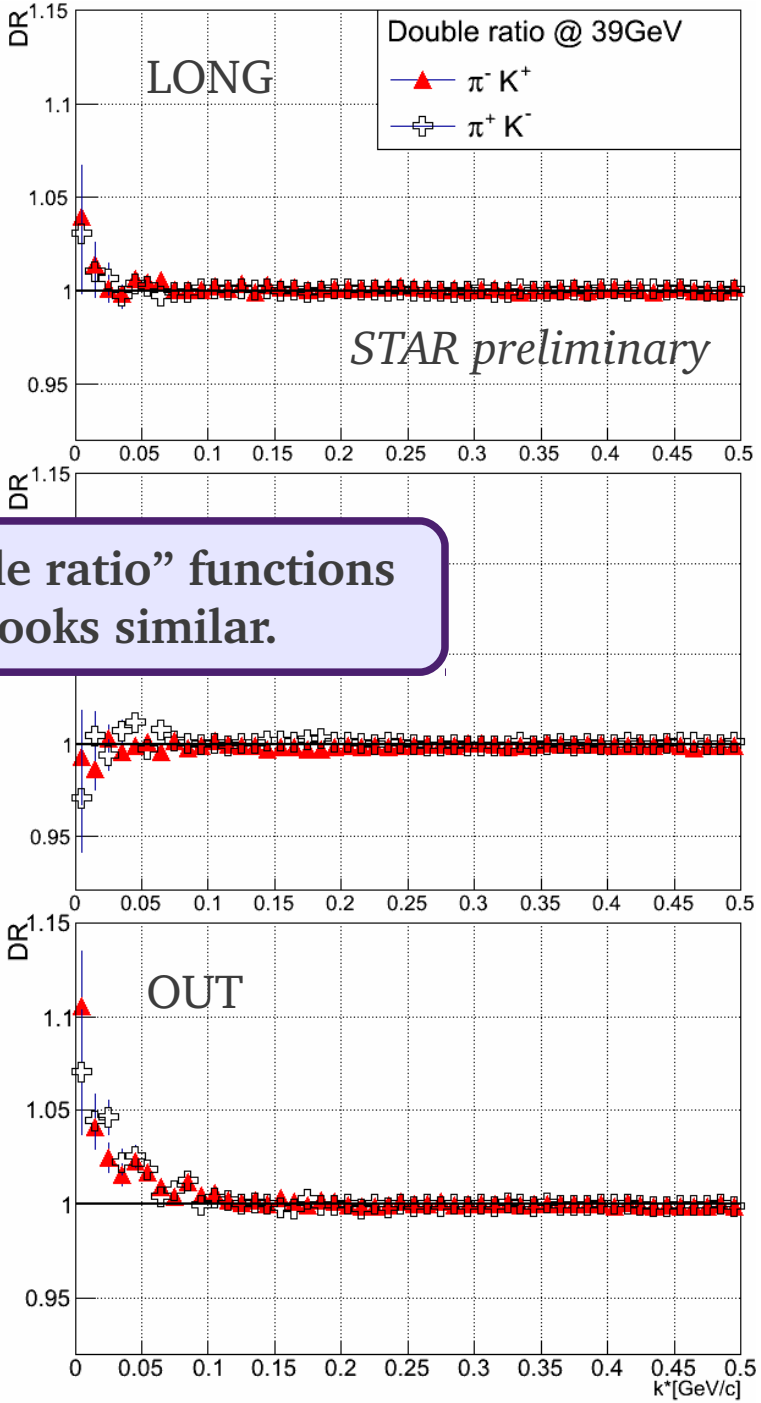
CF & DR for π- K+ and π+ K-





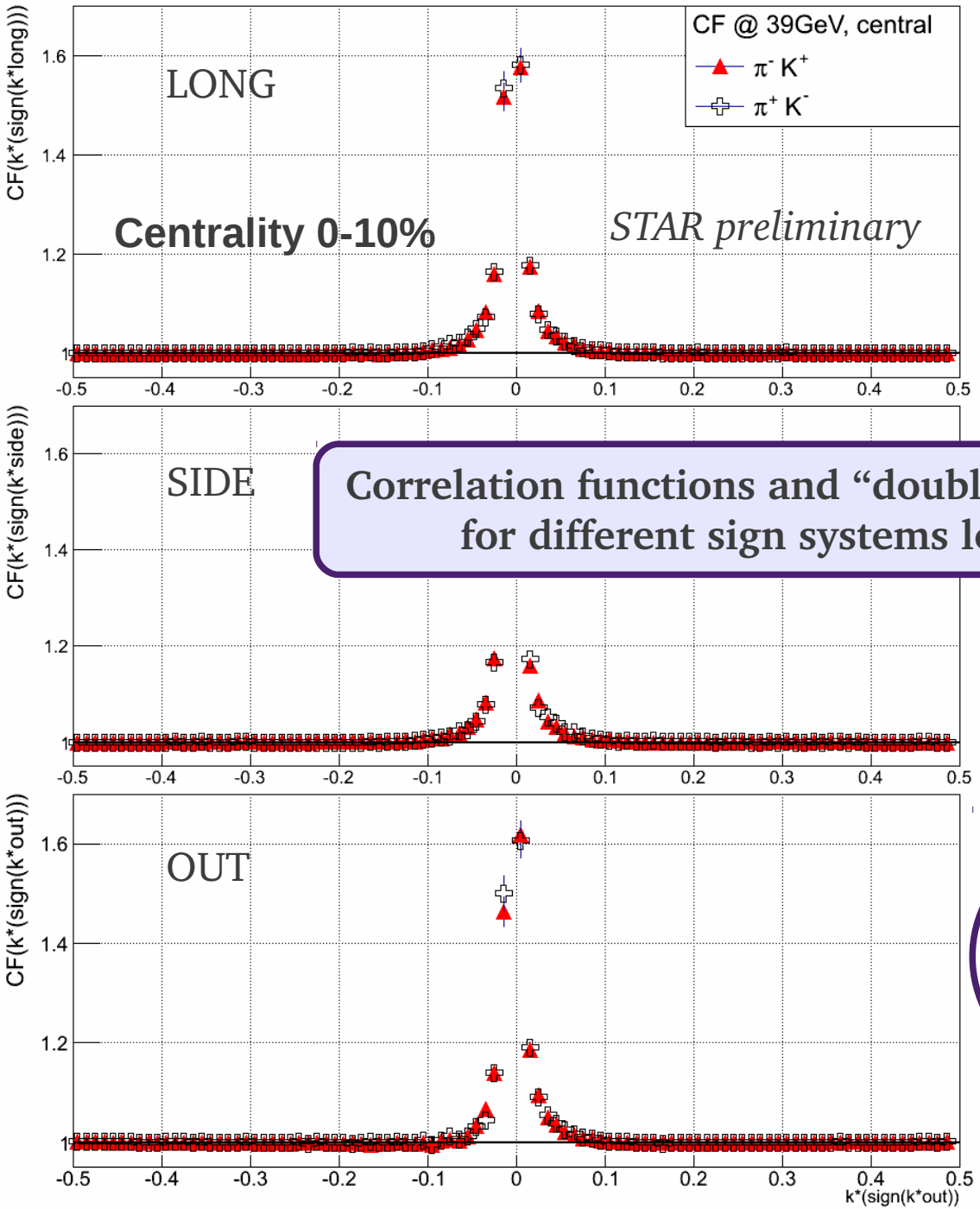
CF & DR for π- K+ and π+ K-

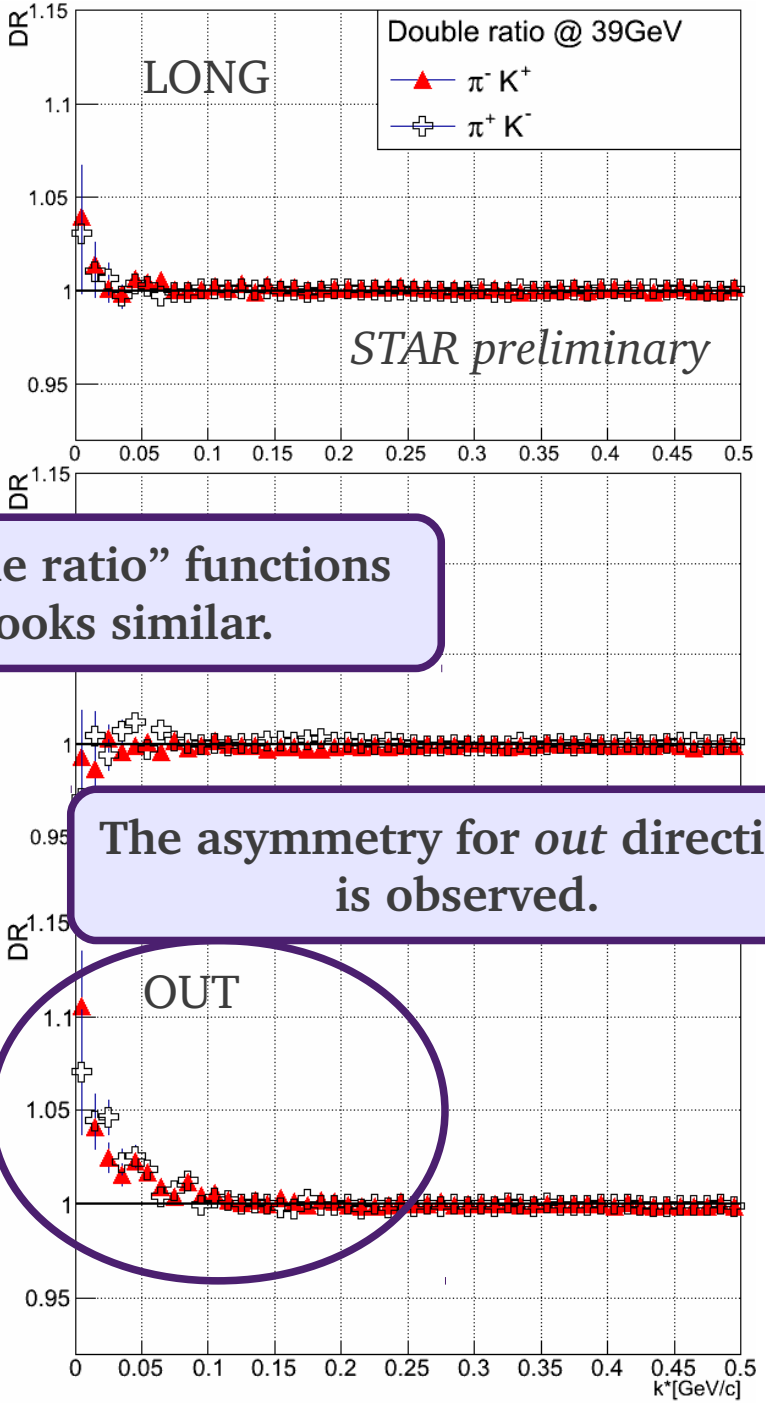




Correlation functions and "double ratio" functions for different sign systems looks similar.

CF & DR for π- K+ and π+ K-

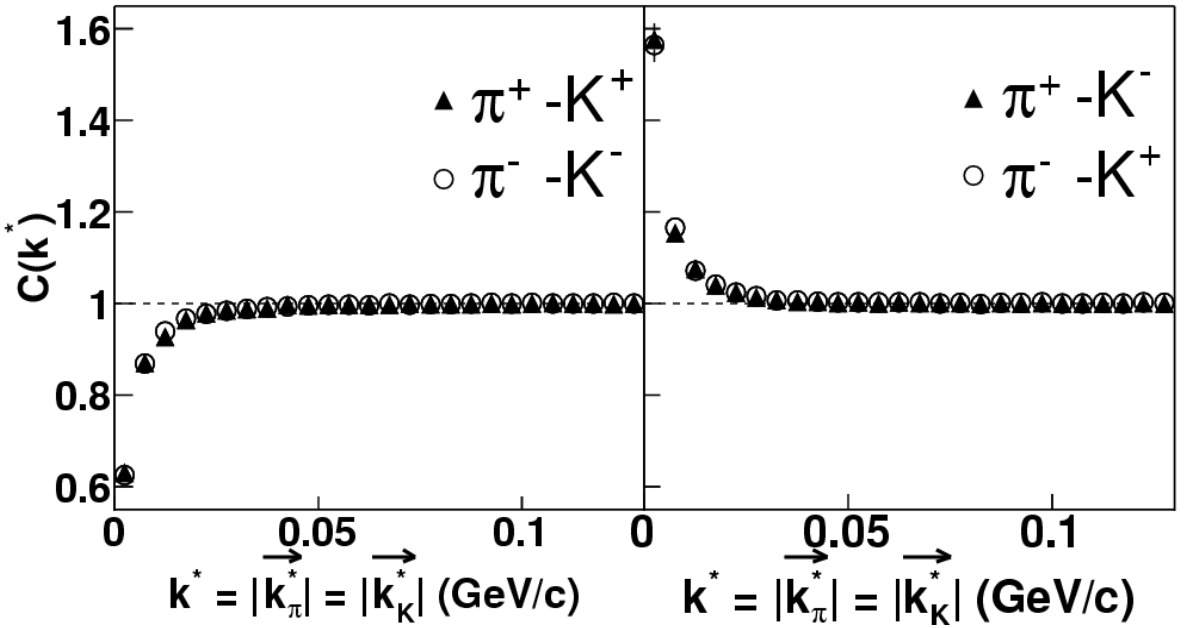




Correlation functions and "double ratio" functions for different sign systems looks similar.

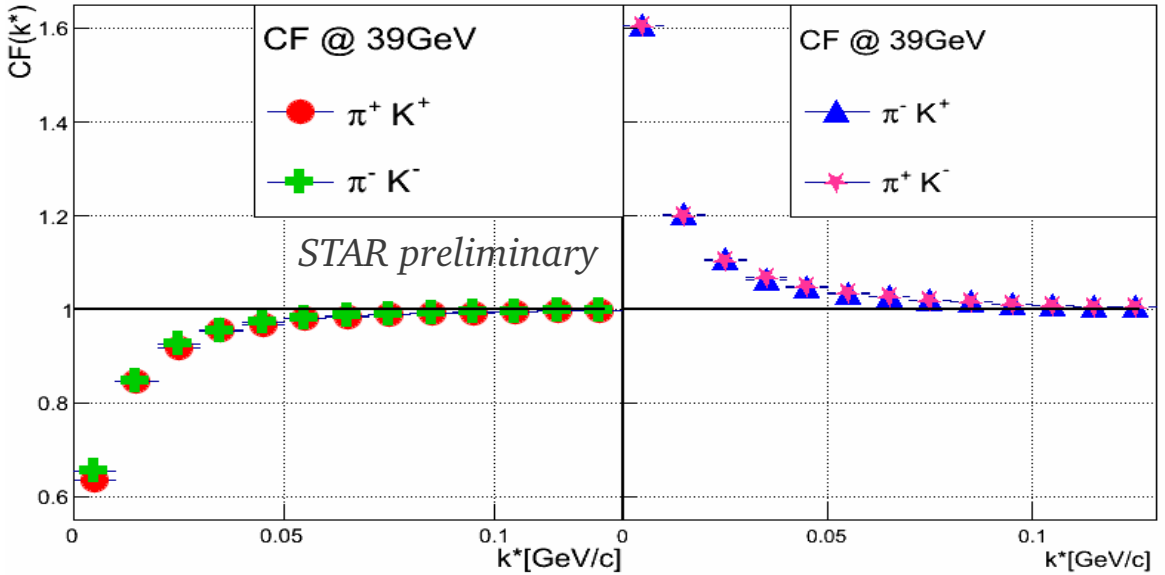
The asymmetry for *out* direction is observed.

Results for AuAu collisions at $\sqrt{s_{NN}}=39$GeV



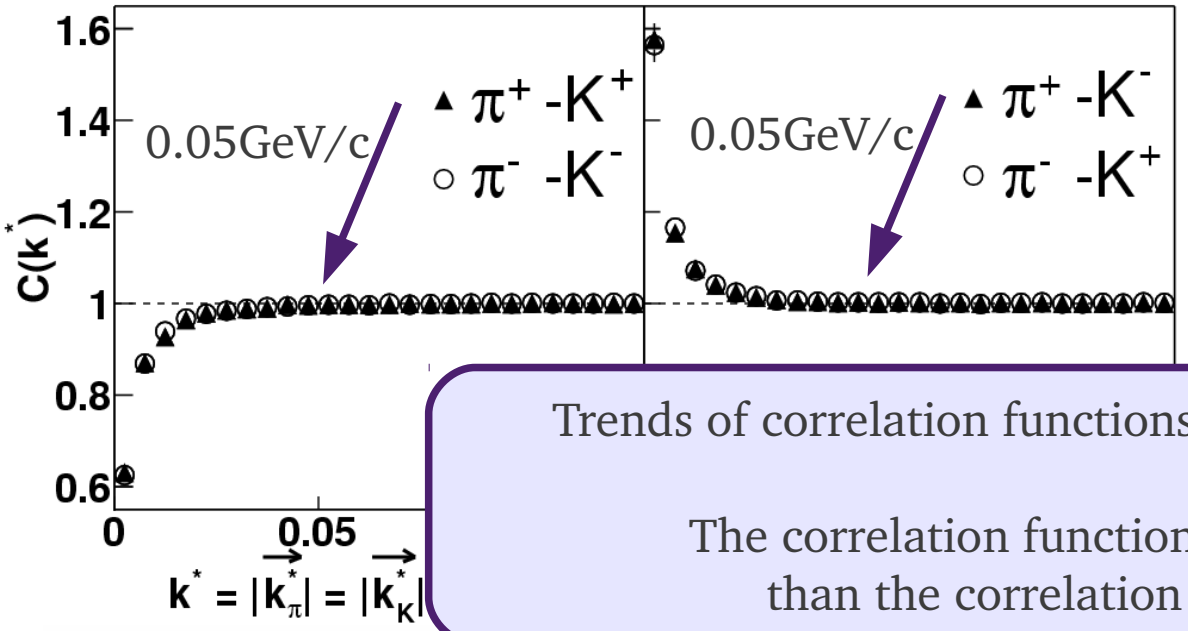
AuAu collision at $\sqrt{s_{NN}}=130$GeV

Phys. Rev. Lett. 91 (2003) 262302



AuAu collision at $\sqrt{s_{NN}}=39$GeV

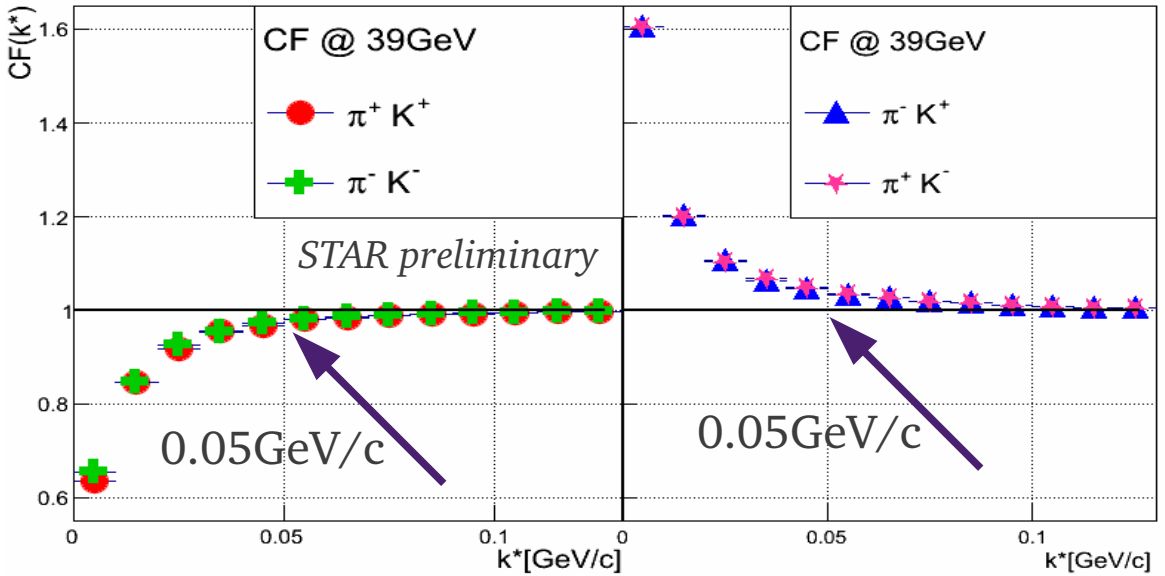
Results for AuAu collisions at $\sqrt{s_{NN}}=39$GeV



AuAu collision at $\sqrt{s_{NN}}=130$GeV

Trends of correlation functions for both energies are the same.

The correlation functions for 39GeV are stronger than the correlation functions for 130GeV.



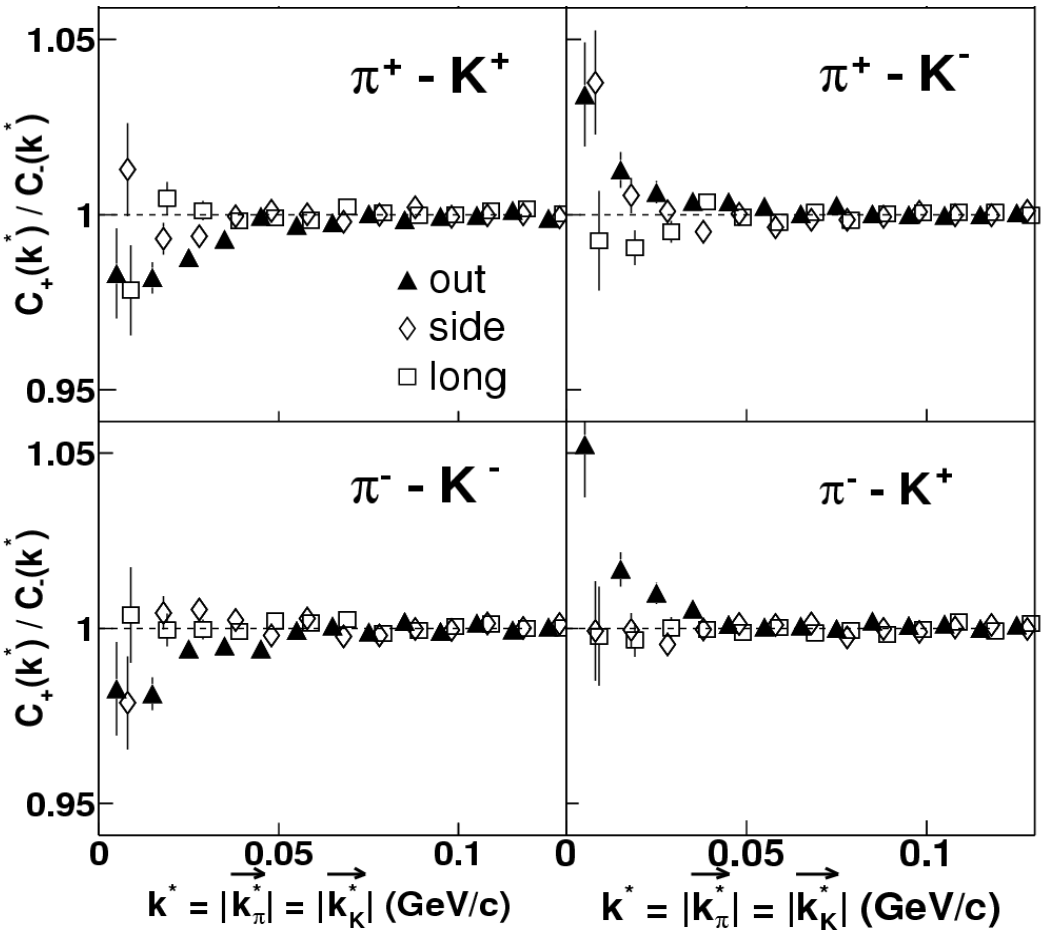
AuAu collision at $\sqrt{s_{NN}}=39$GeV

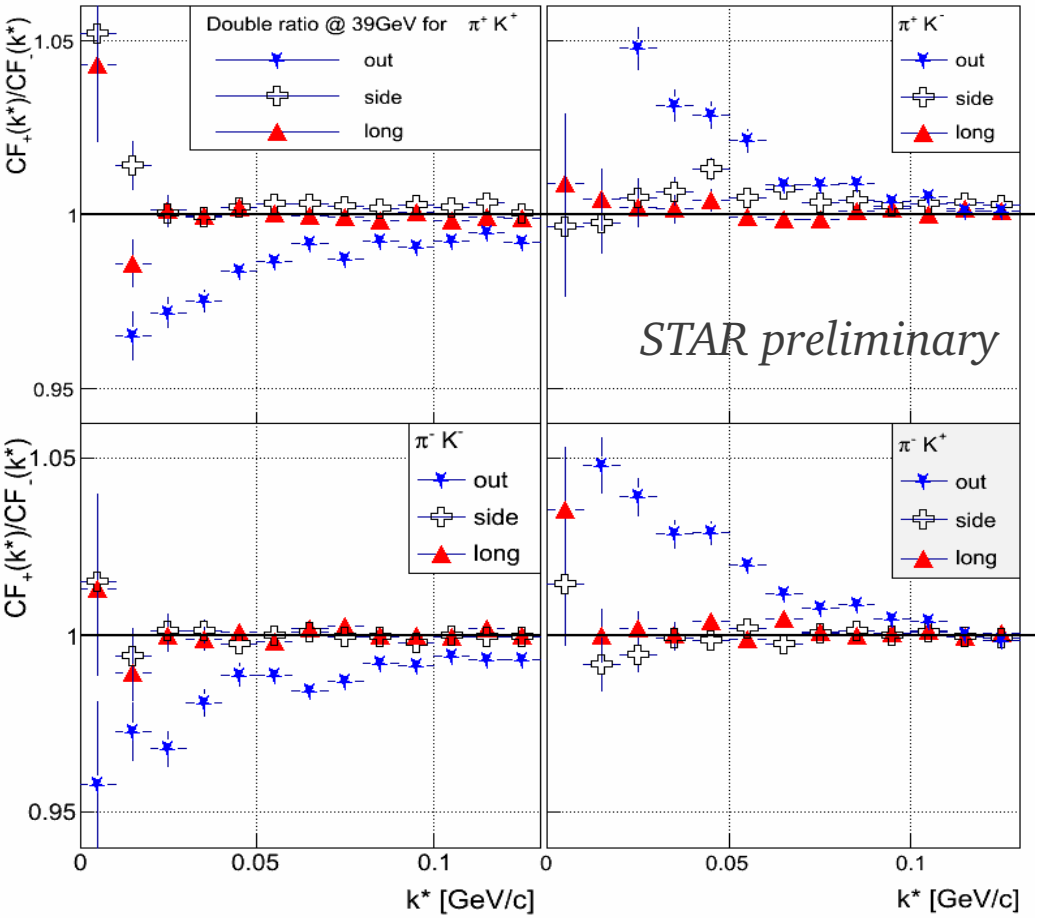
Results for AuAu collisions at $\sqrt{s_{NN}}=39$GeV

AuAu collision at $\sqrt{s_{NN}}=130$GeV

AuAu collision at $\sqrt{s_{NN}}=39$GeV

Phys. Rev. Lett. 91 (2003) 262302



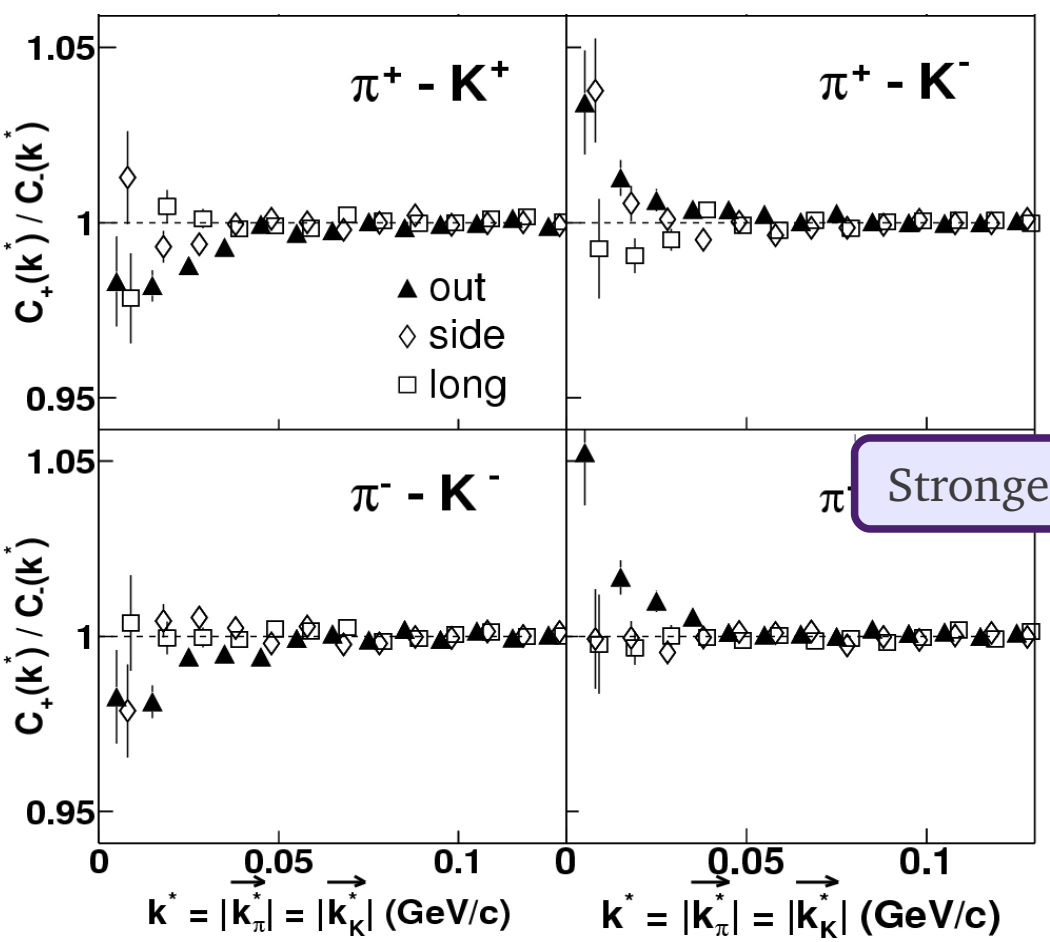


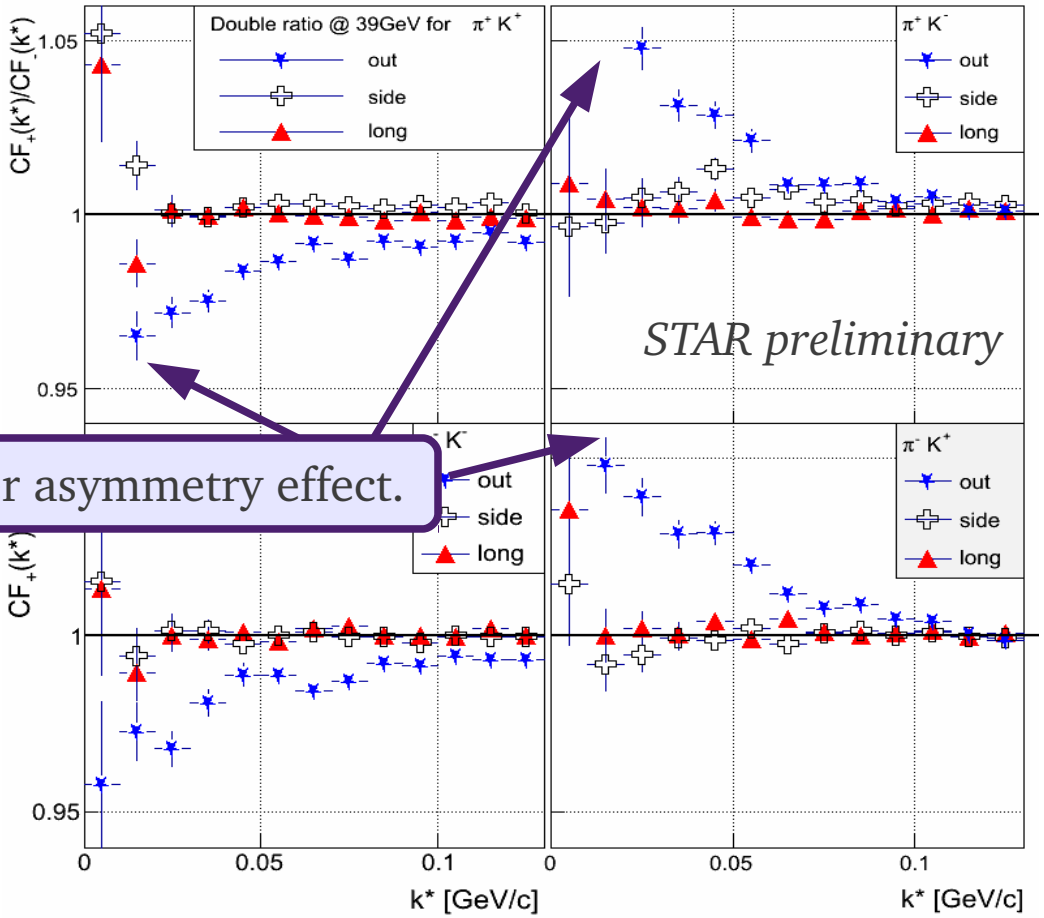
Results for AuAu collisions at $\sqrt{s_{NN}}=39$GeV

AuAu collision at $\sqrt{s_{NN}}=130$GeV

AuAu collision at $\sqrt{s_{NN}}=39$GeV

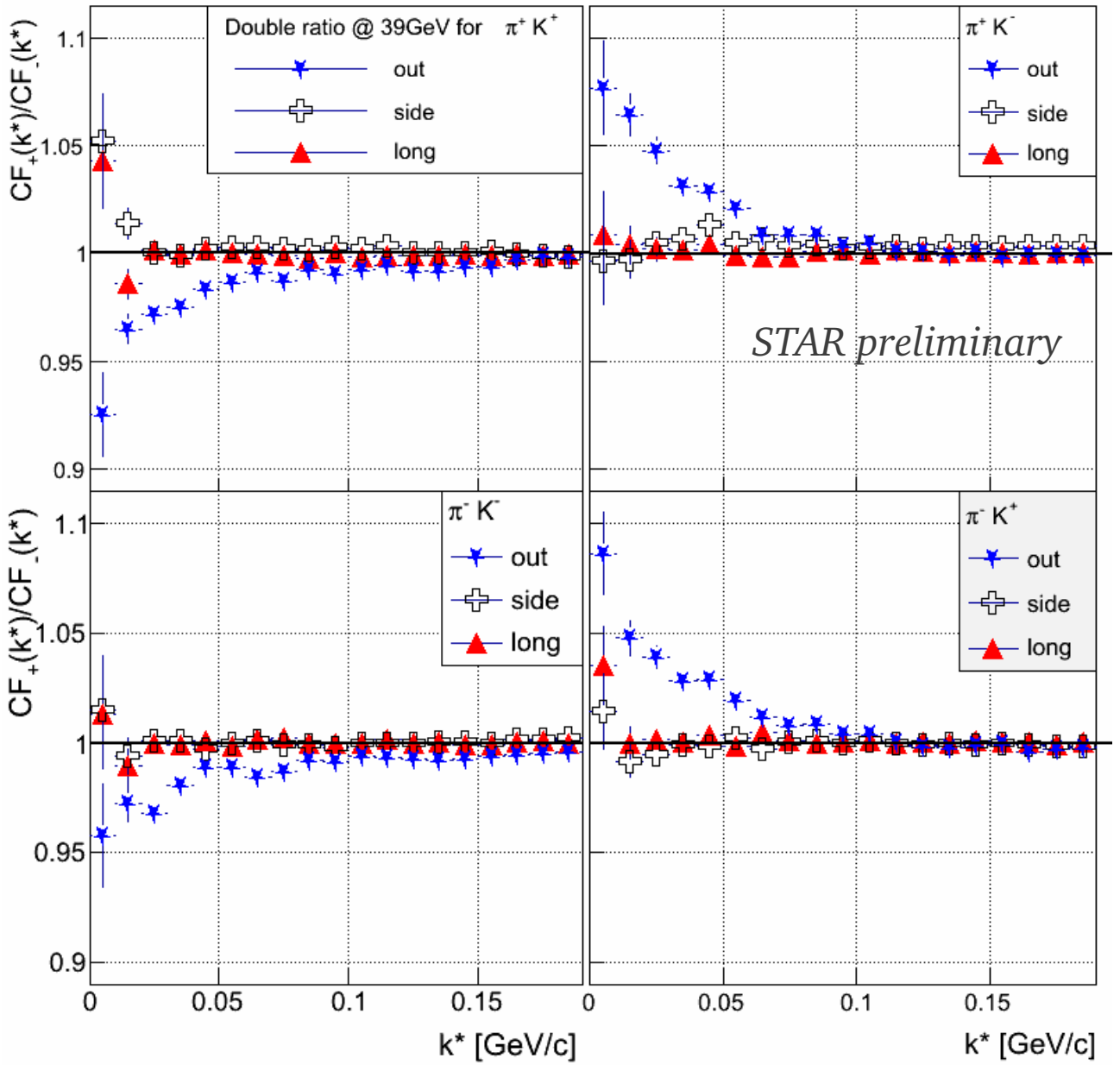
Phys. Rev. Lett. 91 (2003) 262302



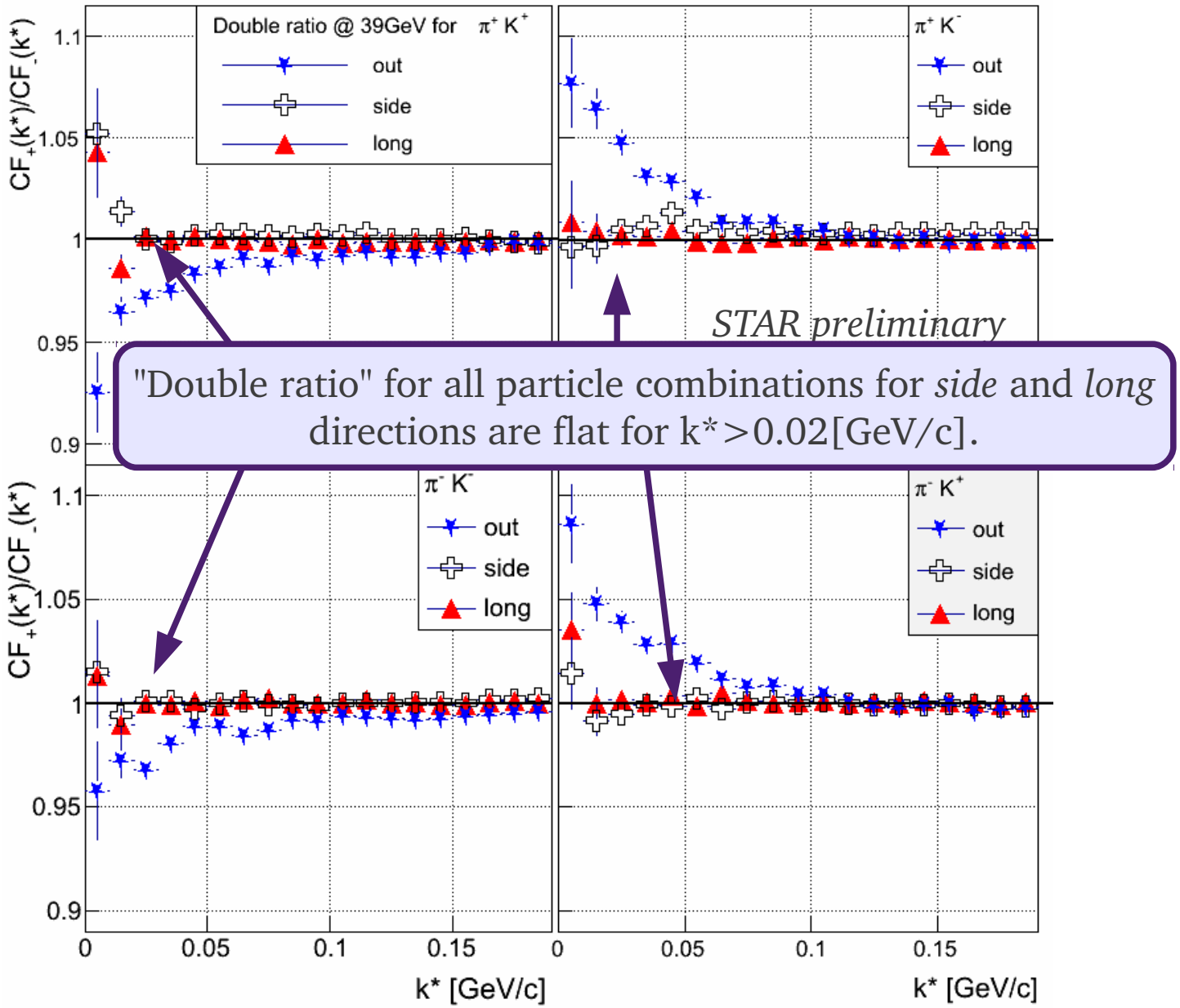


Stronger asymmetry effect.

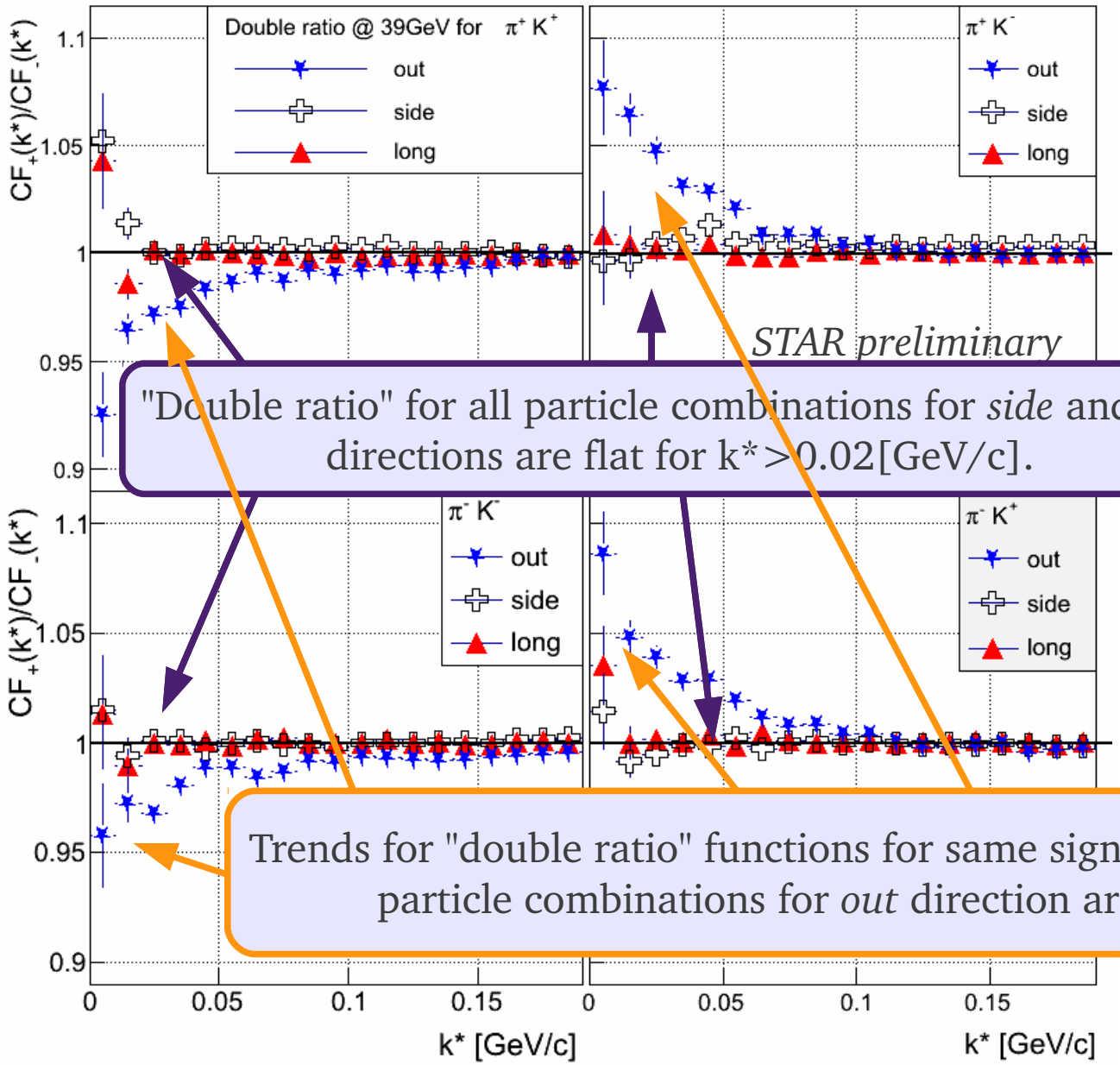
Results for AuAu collisions at $\sqrt{s_{NN}}$=39GeV



Results for AuAu collisions at $\sqrt{s_{NN}}$=39GeV



Results for AuAu collisions at $\sqrt{s_{NN}}$=39GeV



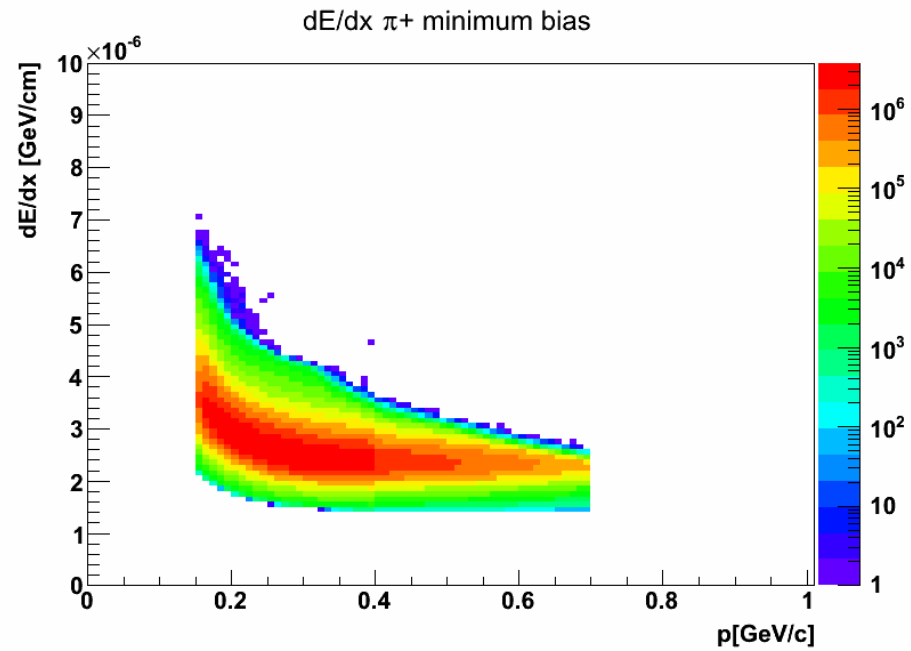
Summary

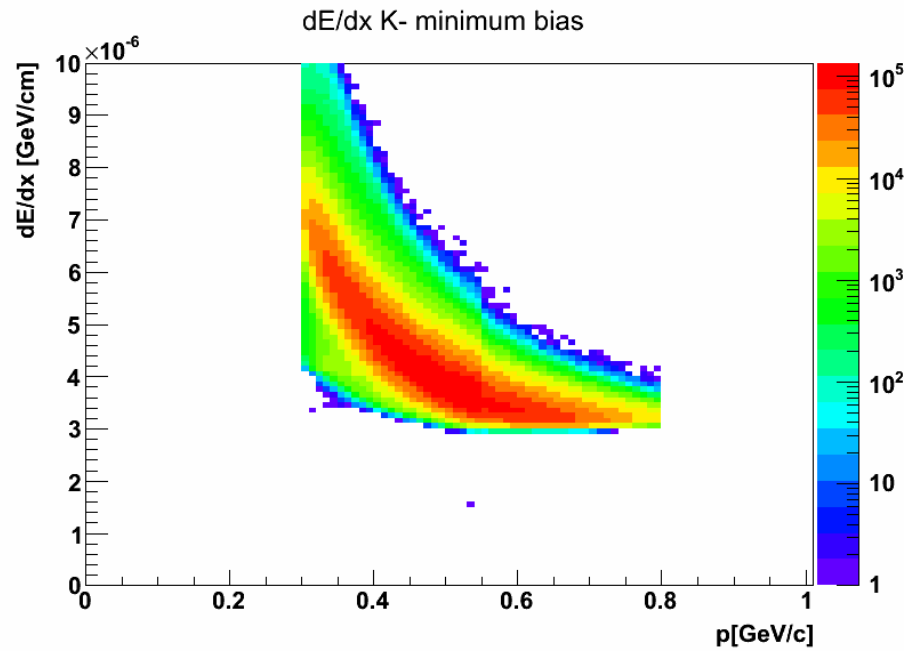
- Correlation functions and “double ratio” functions for central AuAu collisions at 39GeV are calculated.
- Trends of correlation functions and “double ratio” functions for AuAu collisions at 39GeV and 130GeV are the same.
- Pions are emitted closer to the system's center or/and later than kaons.
- The correlation functions for 39GeV are stronger than the correlation functions for 130GeV.
- The asymmetry in emission process in “double ratio” functions for *out* direction for 39GeV are stronger than for 130GeV.

Thank you for your attention!

Back up

Results for AuAu collisions at $\sqrt{s_{NN}}$=39GeV





Results for AuAu collisions at $\sqrt{s_{NN}}=39\text{GeV}$