



Prediction of nonidentical particle correlations for the Beam Energy Scan program

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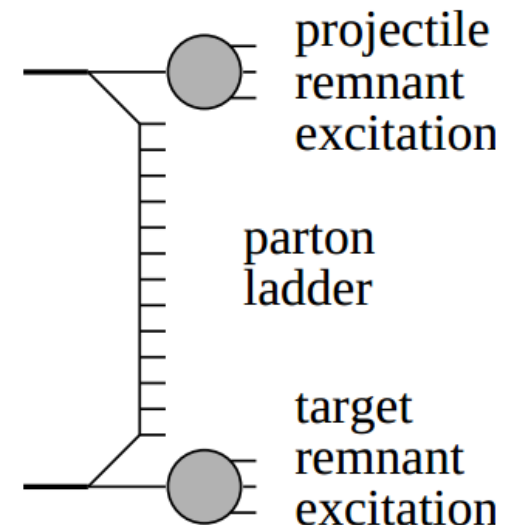
Outline

- EPOS model
 - Spectra p_T from EPOS and STAR²
 - Four-vector of space and momentum
- Correlation functions
 - STAR public data
 - Results from EPOS
 - Centrality dependence
 - Fits
 - Sizes calculated from correlation functions
- Summary
- Annotation

EPOS model¹

EPOS is a parton model, with many binary parton-parton interactions, where each one creating a parton ladder.

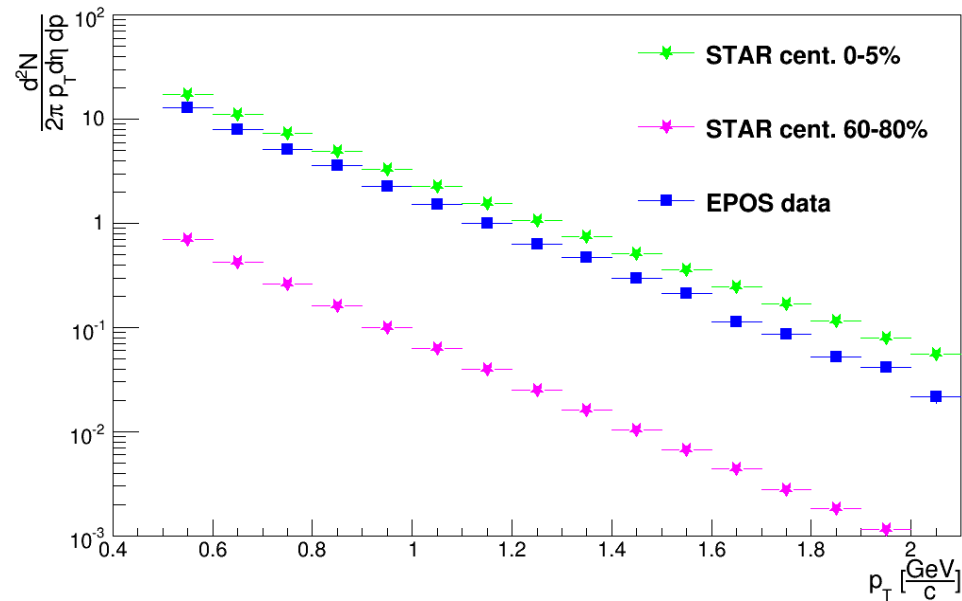
- **E**nergy-sharing : for cross section calculation and particle production
- **P**arton Multiple scattering
- **O**utshell remnants
- **S**creening and shadowing via unitarization and splitting
- Collective effects for dense systems (LHC energies)
- We do not have the hydrodynamics for low RHIC energies.



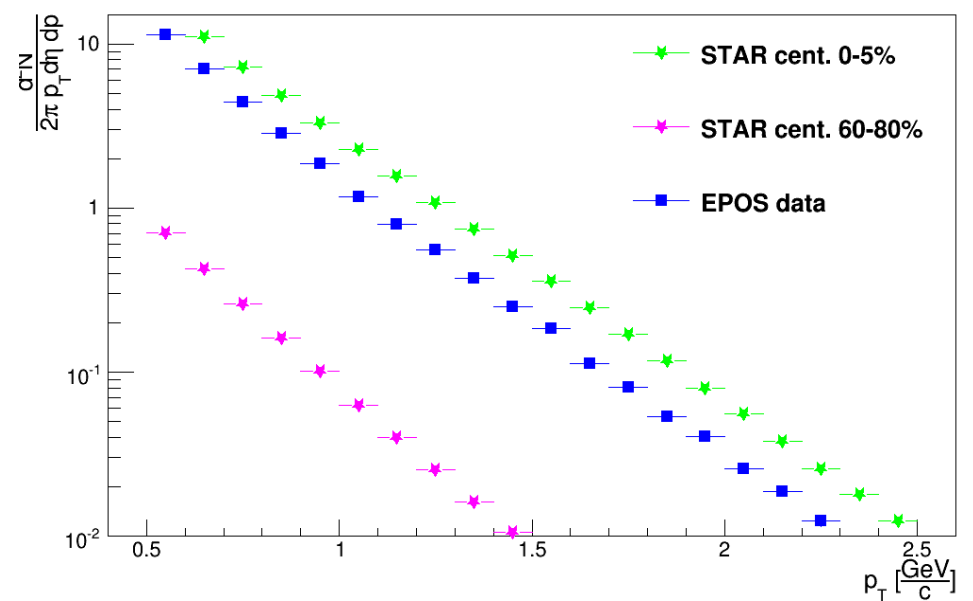
Author of the EPOS model is Klaus Werner from SUBATECH, University of Nantes – IN2P3/CNRS– EMN, Nantes, France.

Spectra p_T from EPOS and STAR²

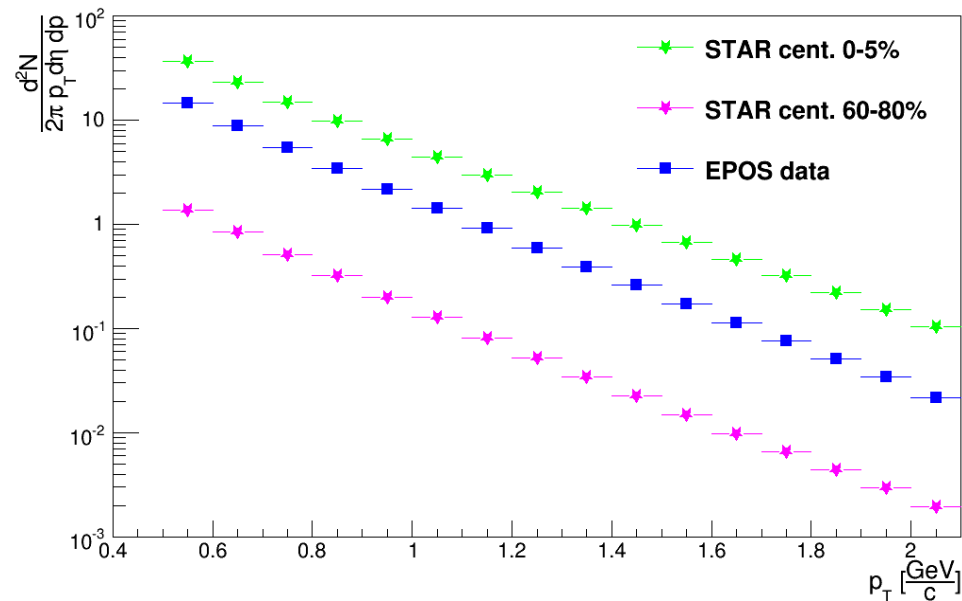
spectra p_T 7.7GeV



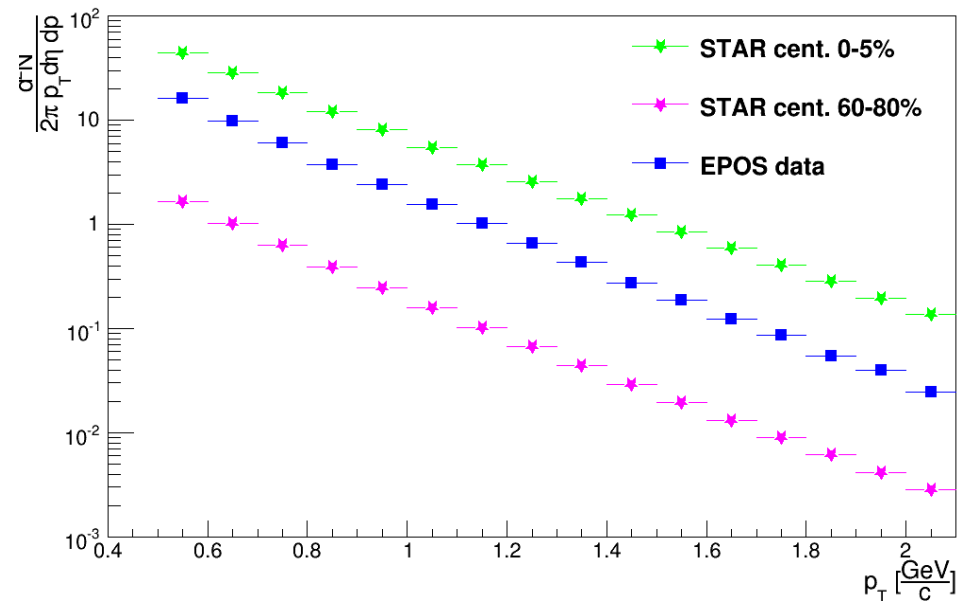
Spectra p_T 11.5GeV



Spectra p_T 19.6GeV



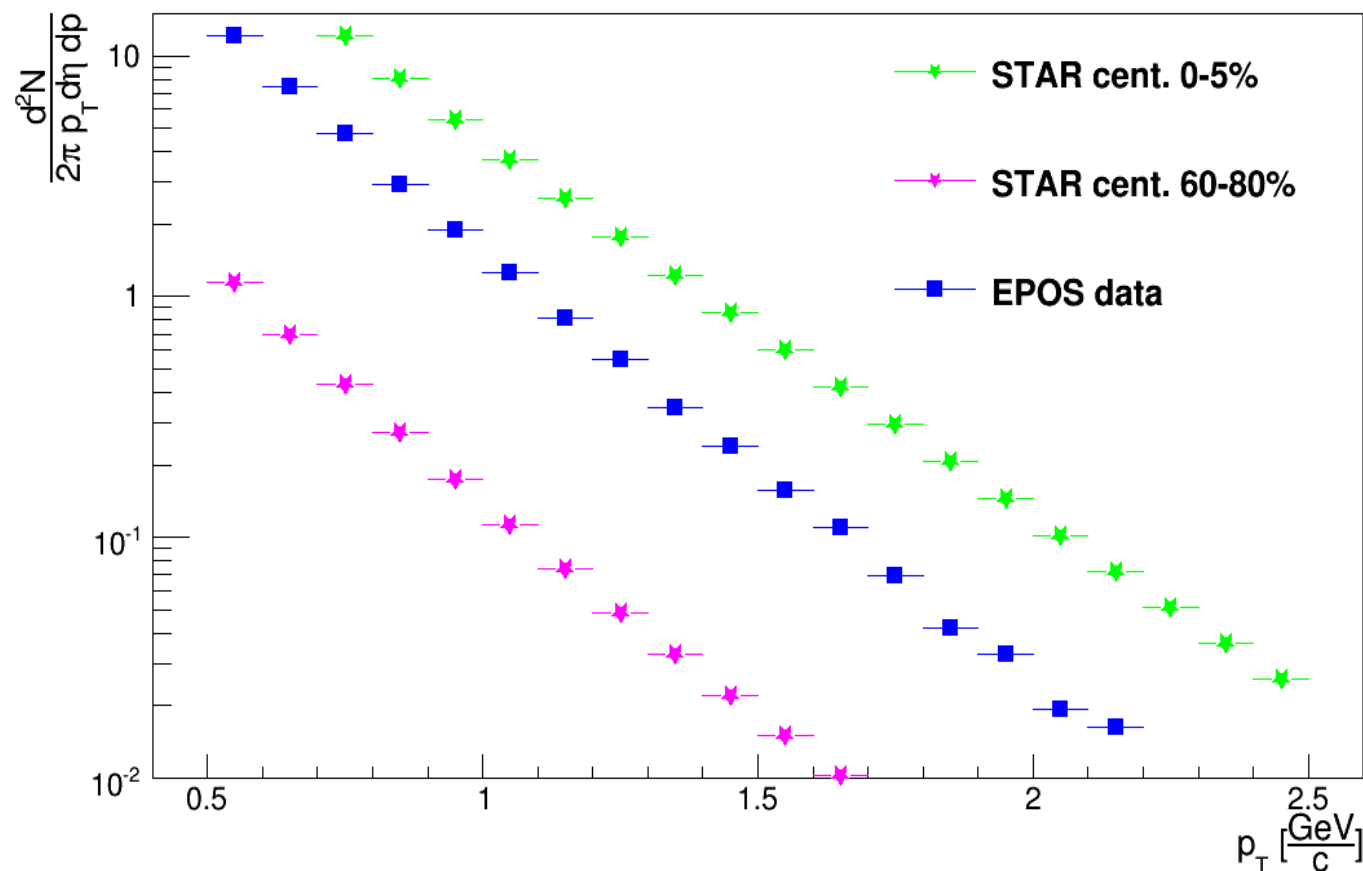
Spectra p_T 27GeV



Spectra p_T from EPOS and STAR²

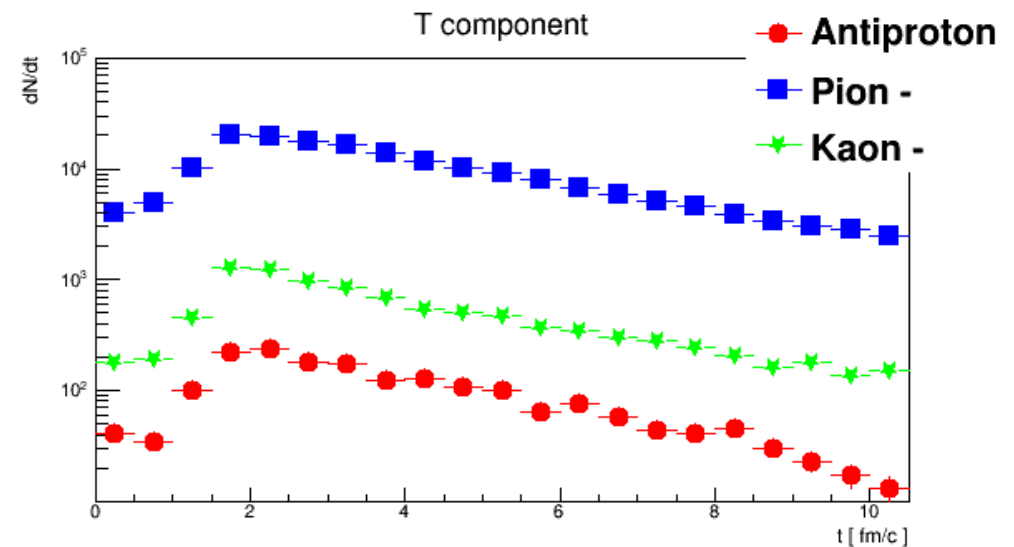
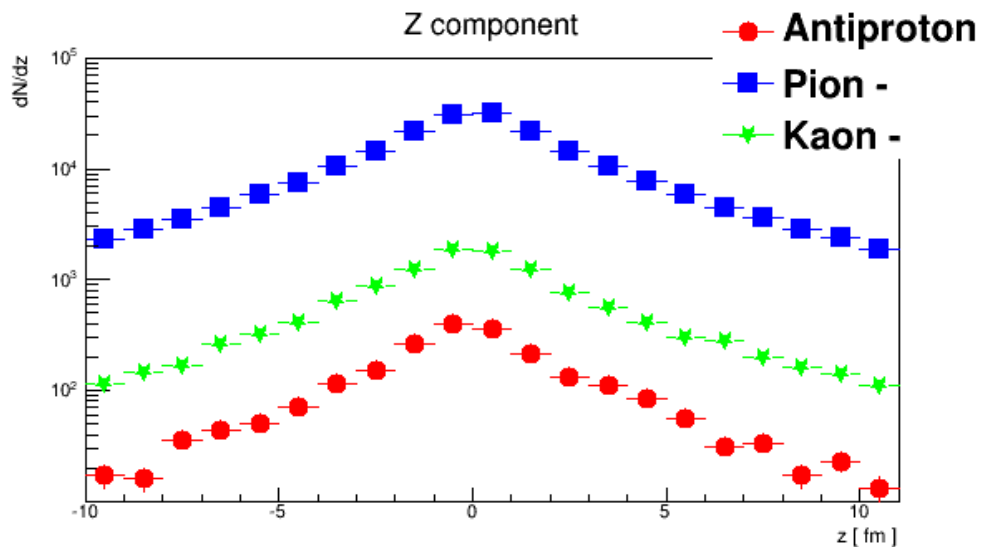
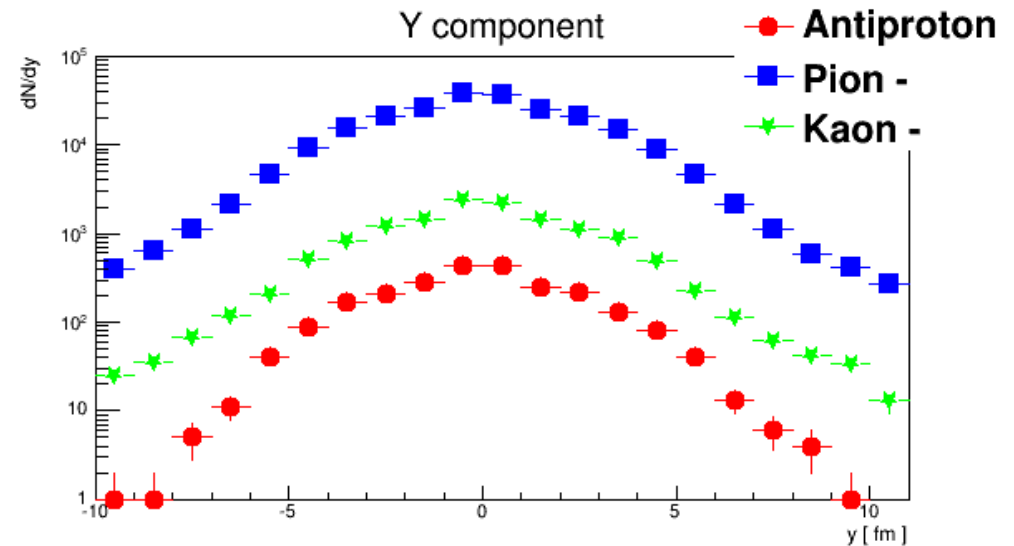
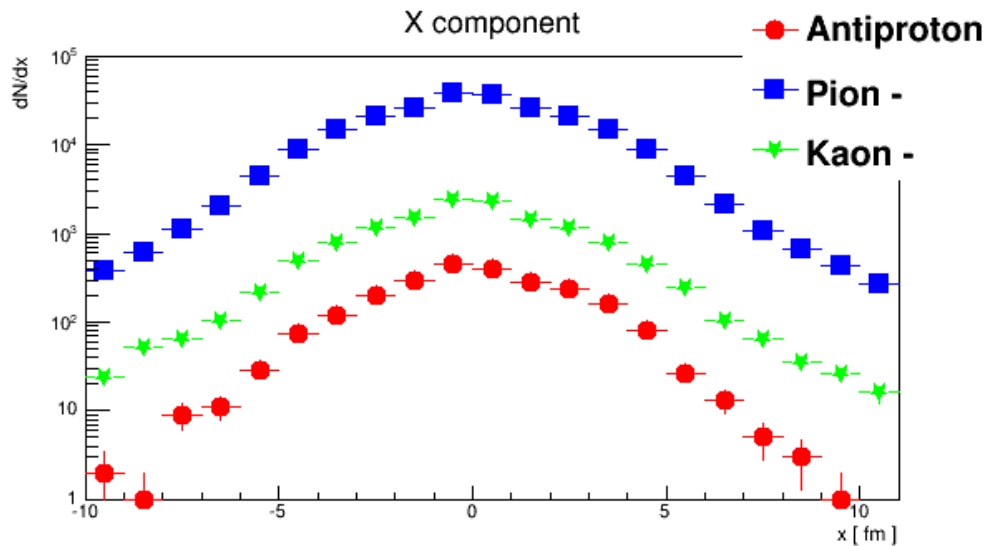
- Transverse momentum spectra results for charged particles from EPOS model are between STAR p_T spectra for the most central collisions (0-5%) and peripheral collisions (60-80%).

Spectra p_T 39GeV



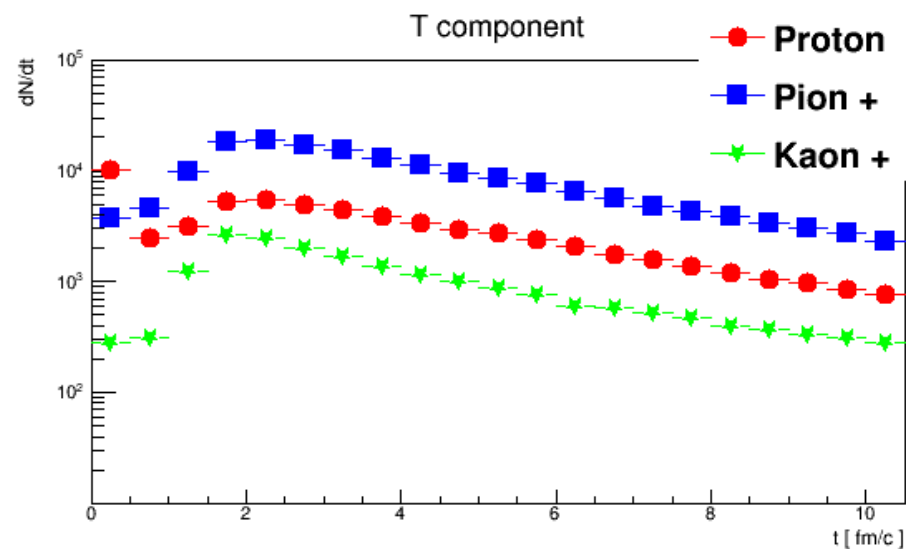
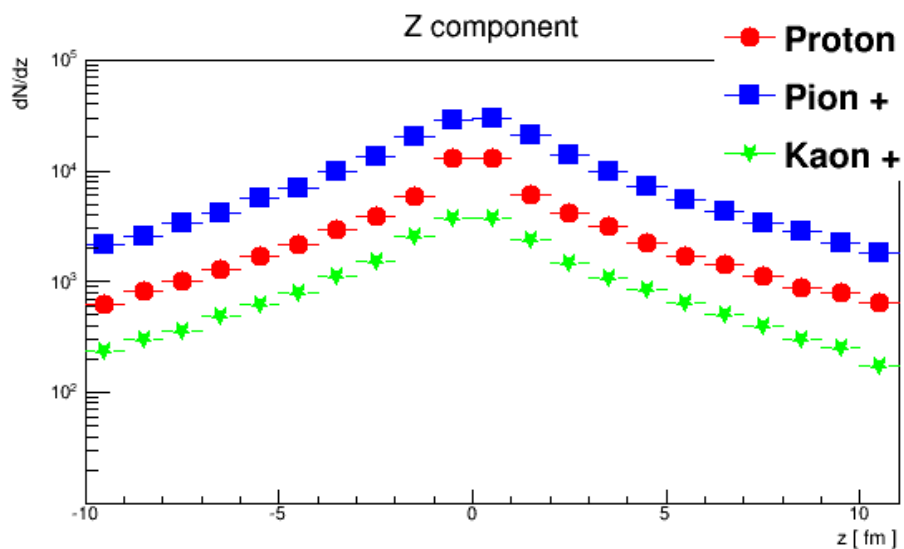
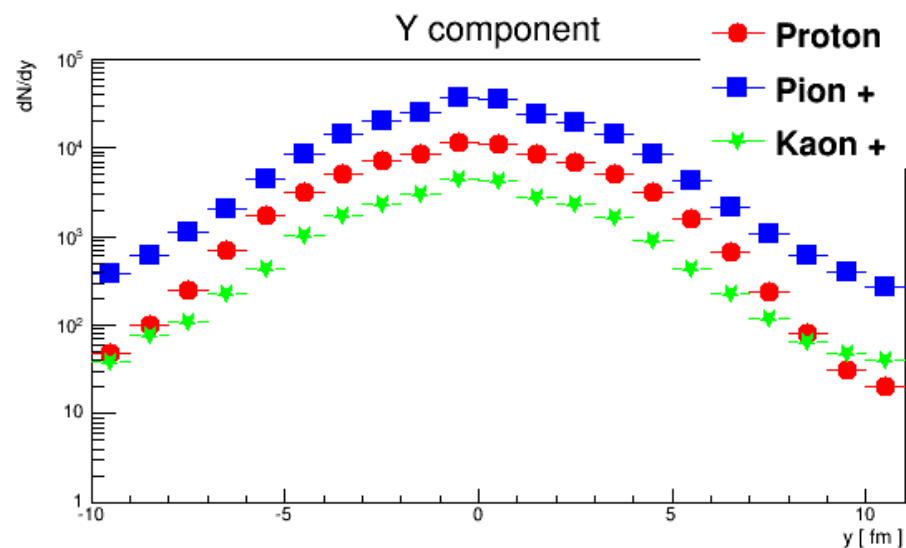
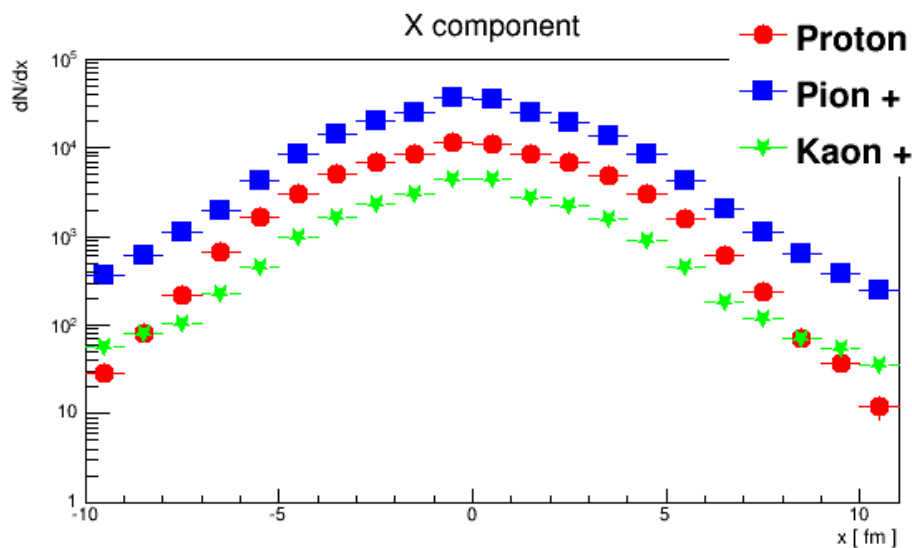
Space four-vector

Particles with negative charge @ 11.5GeV



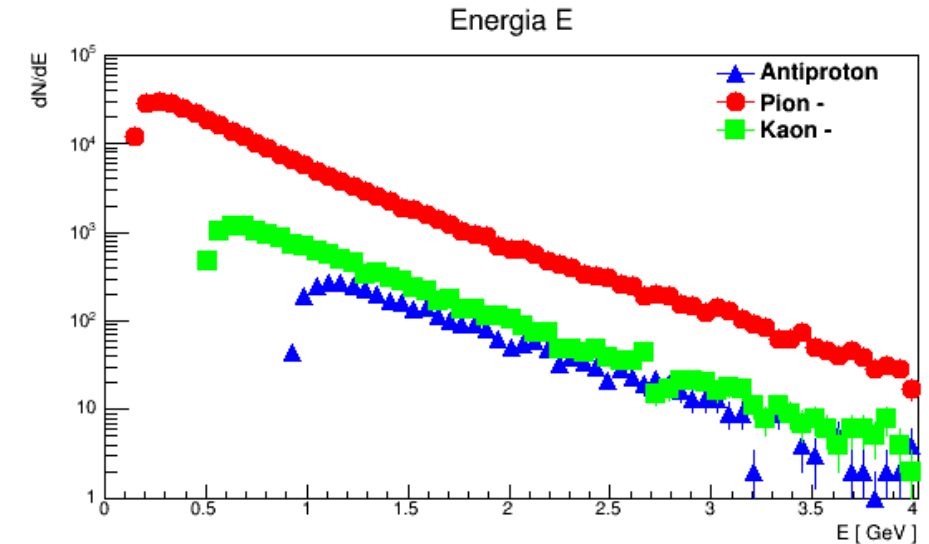
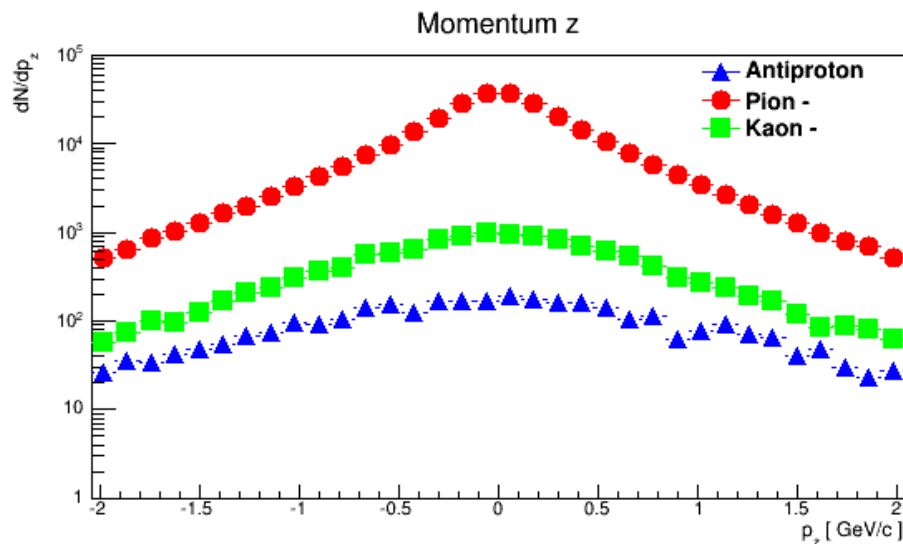
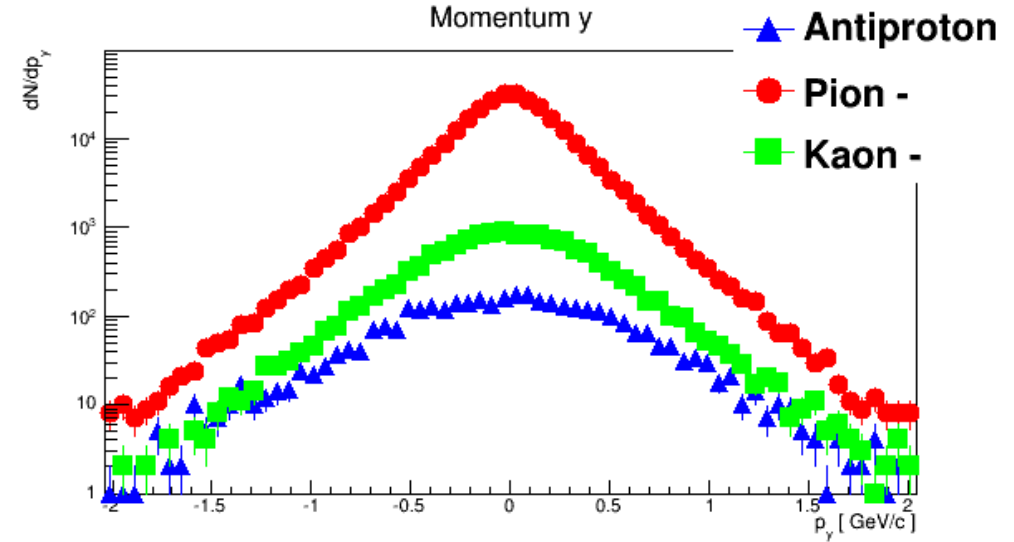
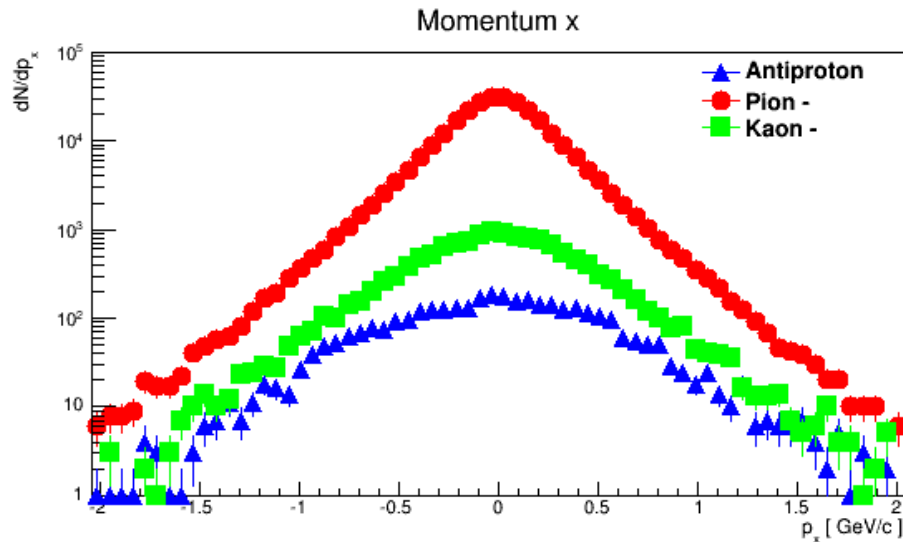
Space four-vector

Particles with positive charge @ 11.5GeV



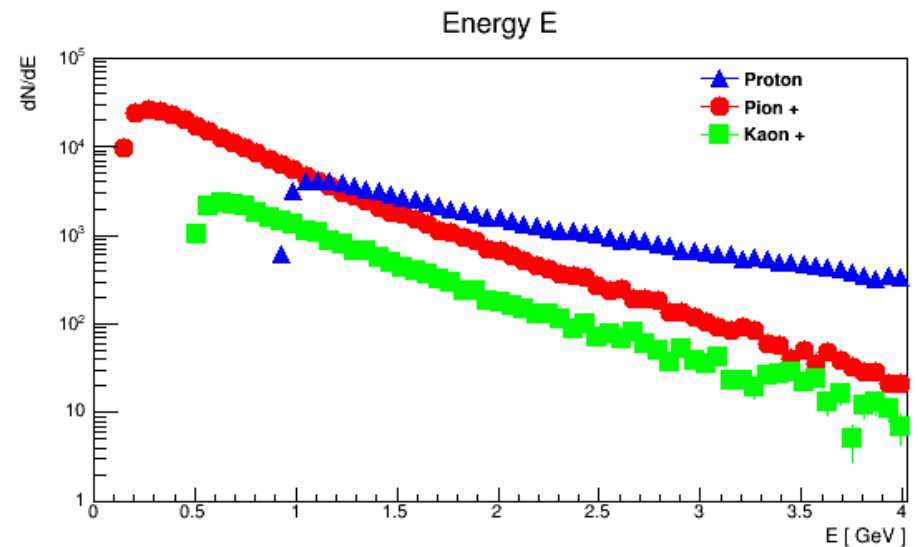
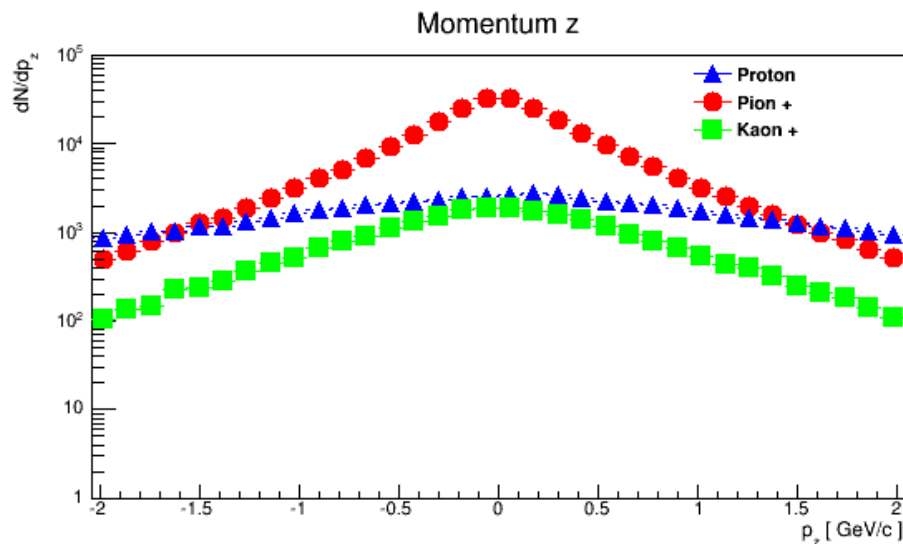
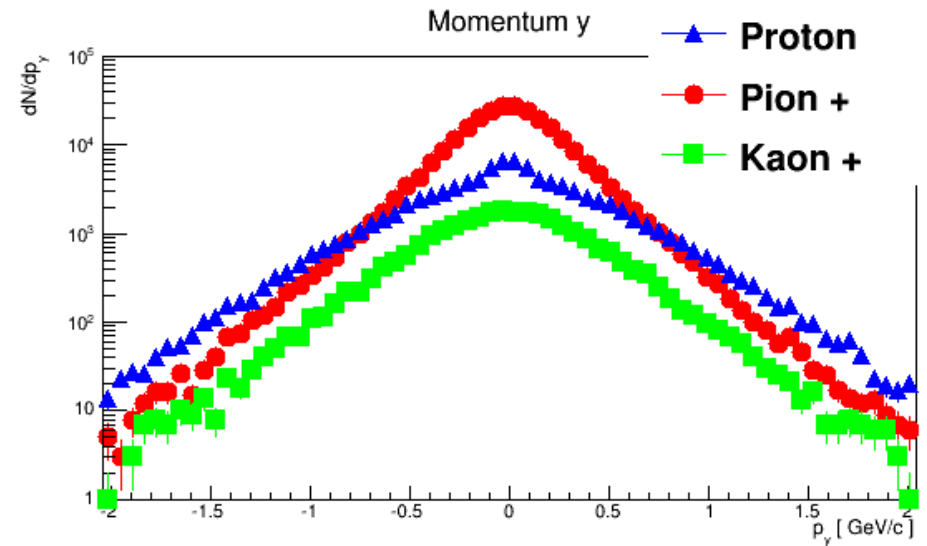
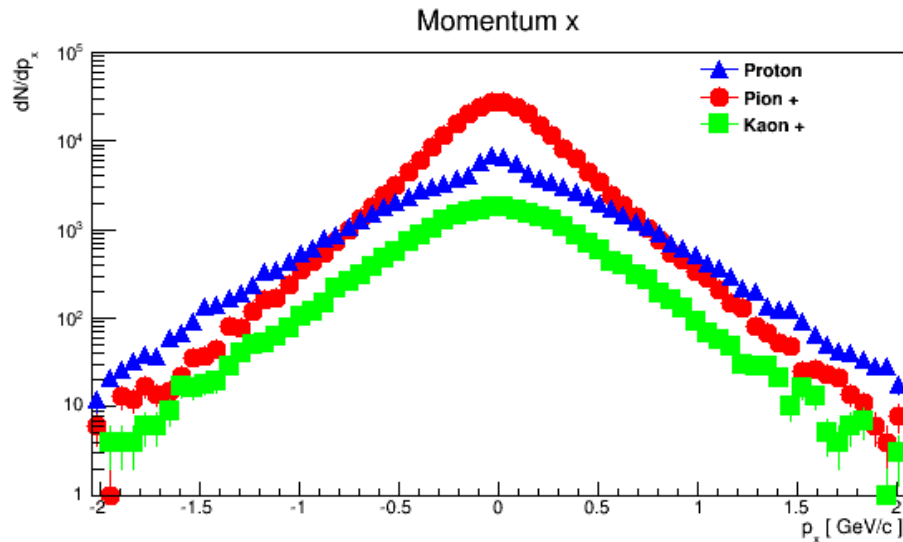
Momentum four-vector

Particles with negative charge @ 11.5GeV

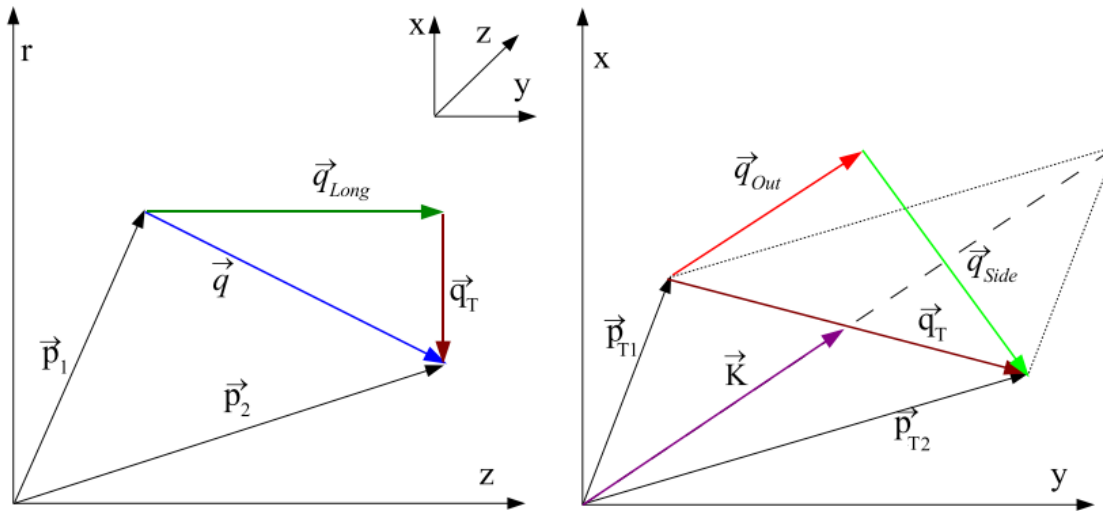


Momentum four-vector

Particles with positive charge @ 11.5GeV



Correlation functions



$$\mathbf{q} = \mathbf{p}_1 - \mathbf{p}_2$$

$\mathbf{k}^* = \mathbf{p}_1 = -\mathbf{p}_2$ (relative pair momentum, calculated in the center of pair mass)

\mathbf{z} – beam direction

\mathbf{r} – radius

\mathbf{p}_1 and \mathbf{p}_2 – 1 and 2 particle momentum

Correlation function

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

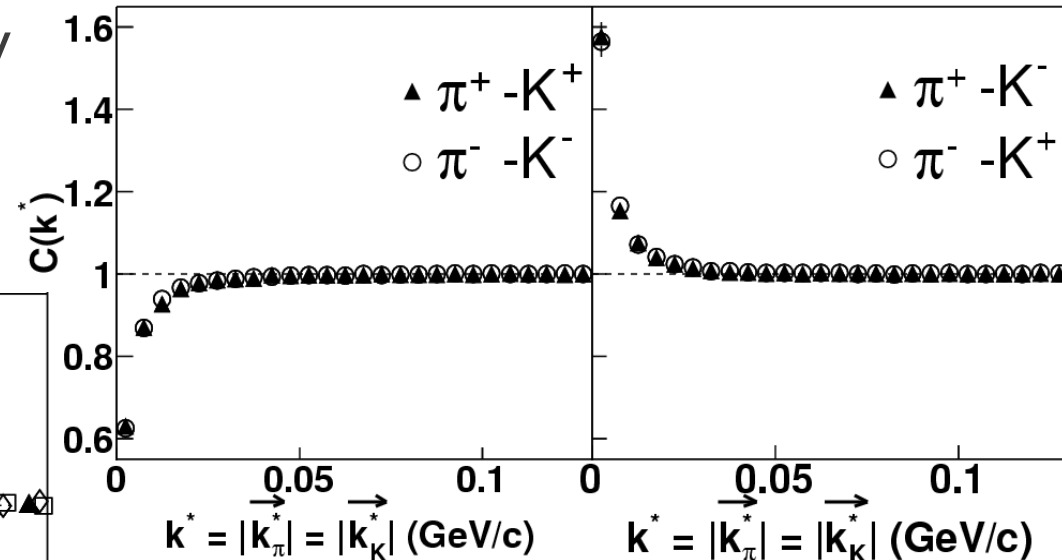
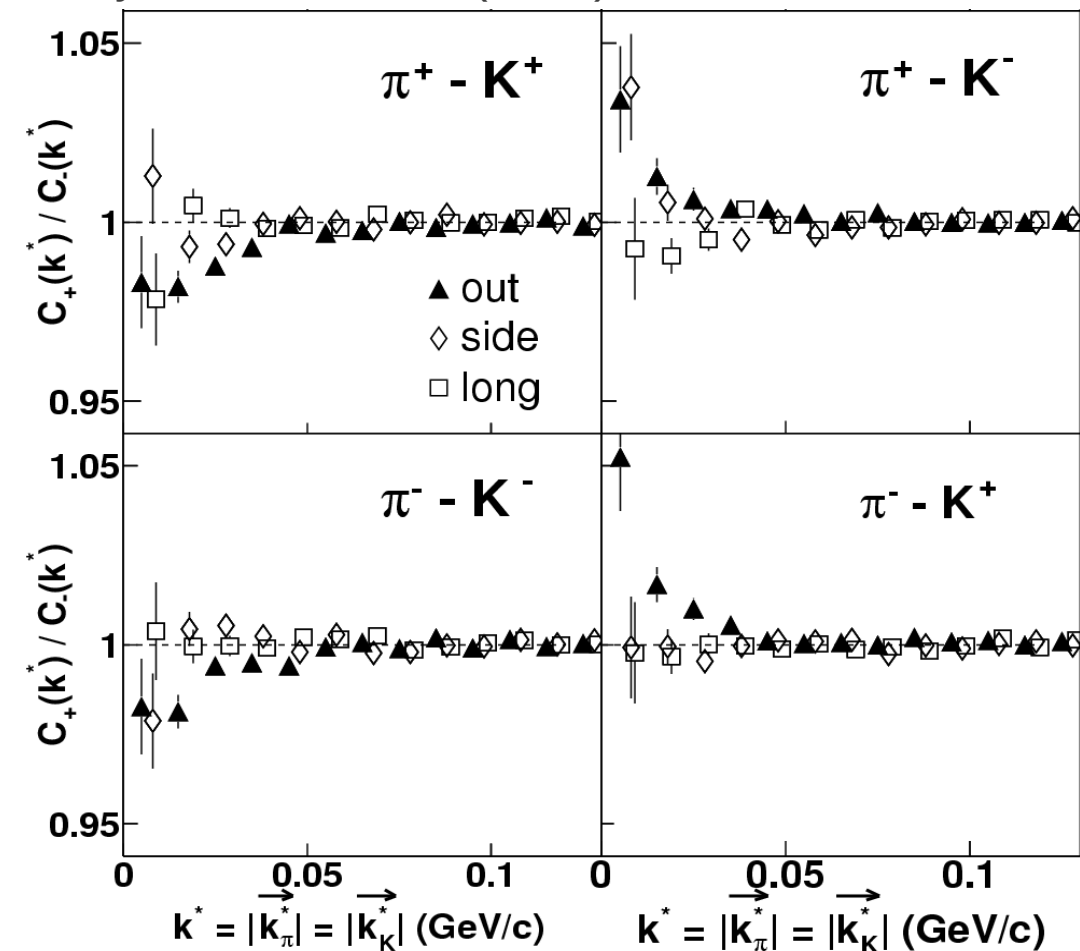
$P_2(\mathbf{p}_1, \mathbf{p}_2)$ – the probability of the simultaneous two particles emission with momentum \mathbf{p}_1 and \mathbf{p}_2

$P_1(\mathbf{p}_1), P_1(\mathbf{p}_2)$ – the probability of the particle emission with momentum \mathbf{p}_1 or \mathbf{p}_2

STAR public data

Energy in the center of mass: 130GeV

Phys. Rev. Lett. 91 (2003) 262302



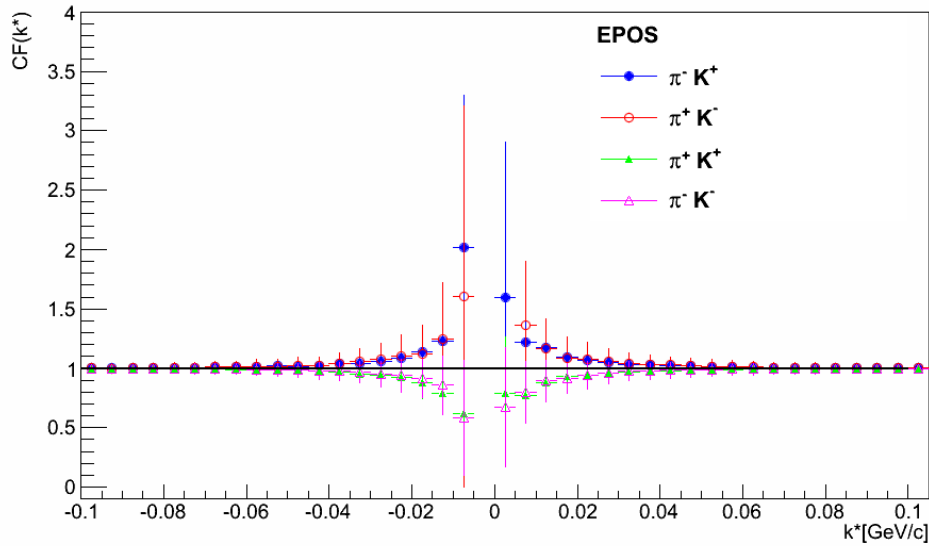
Matching assumes that the source is Gaussian for r_{out}^*

Sigma: 12.5 ± 0.4 fm

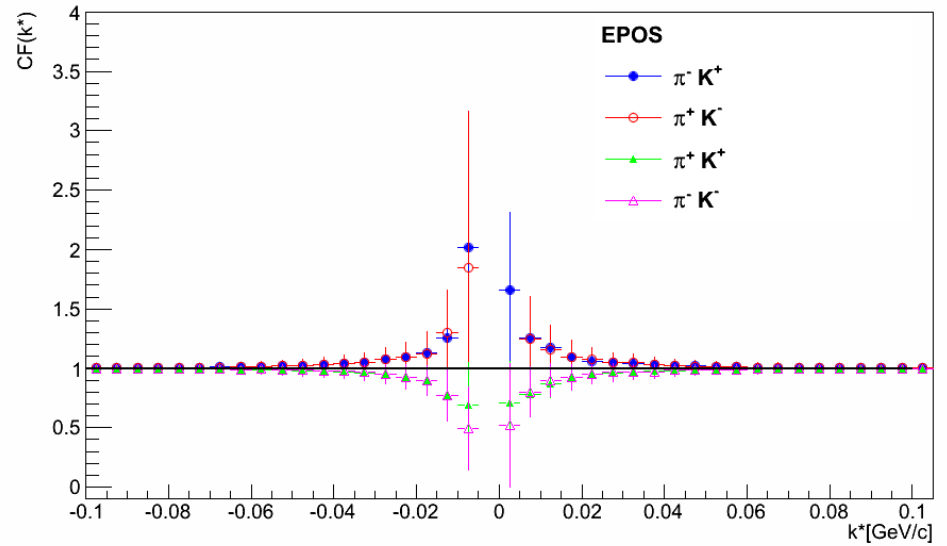
Mean shift: -5.6 ± 0.4 fm

Results from EPOS

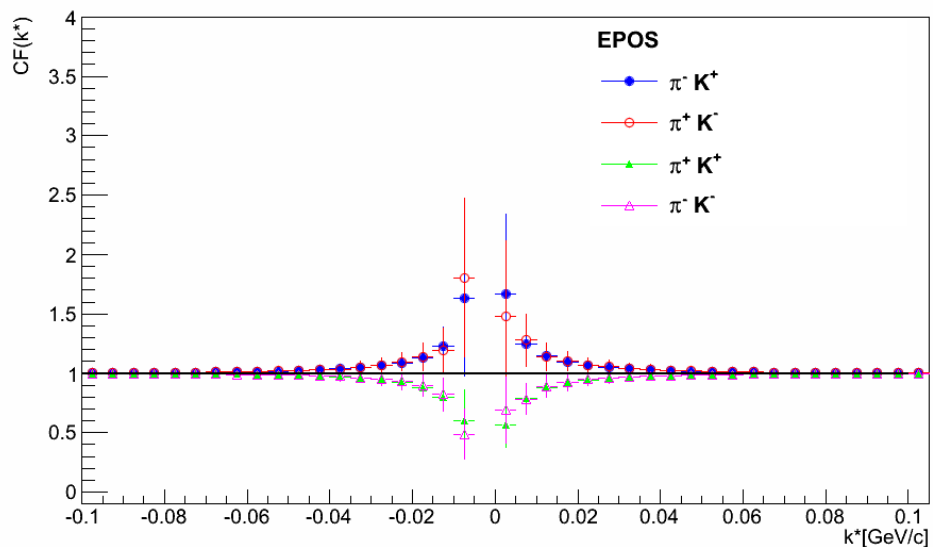
Correlation function @ 7.7GeV



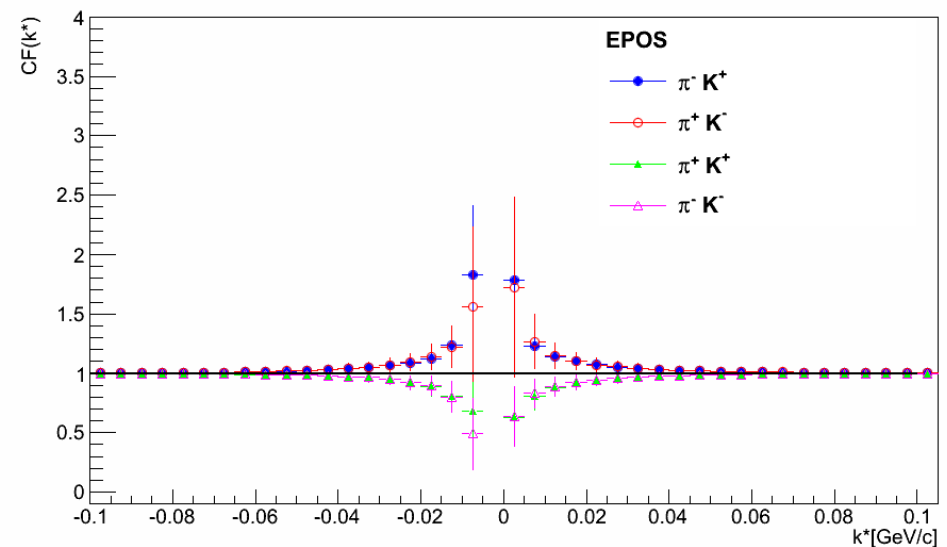
Correlation function @ 11.5GeV



Correlation function @ 19.6GeV

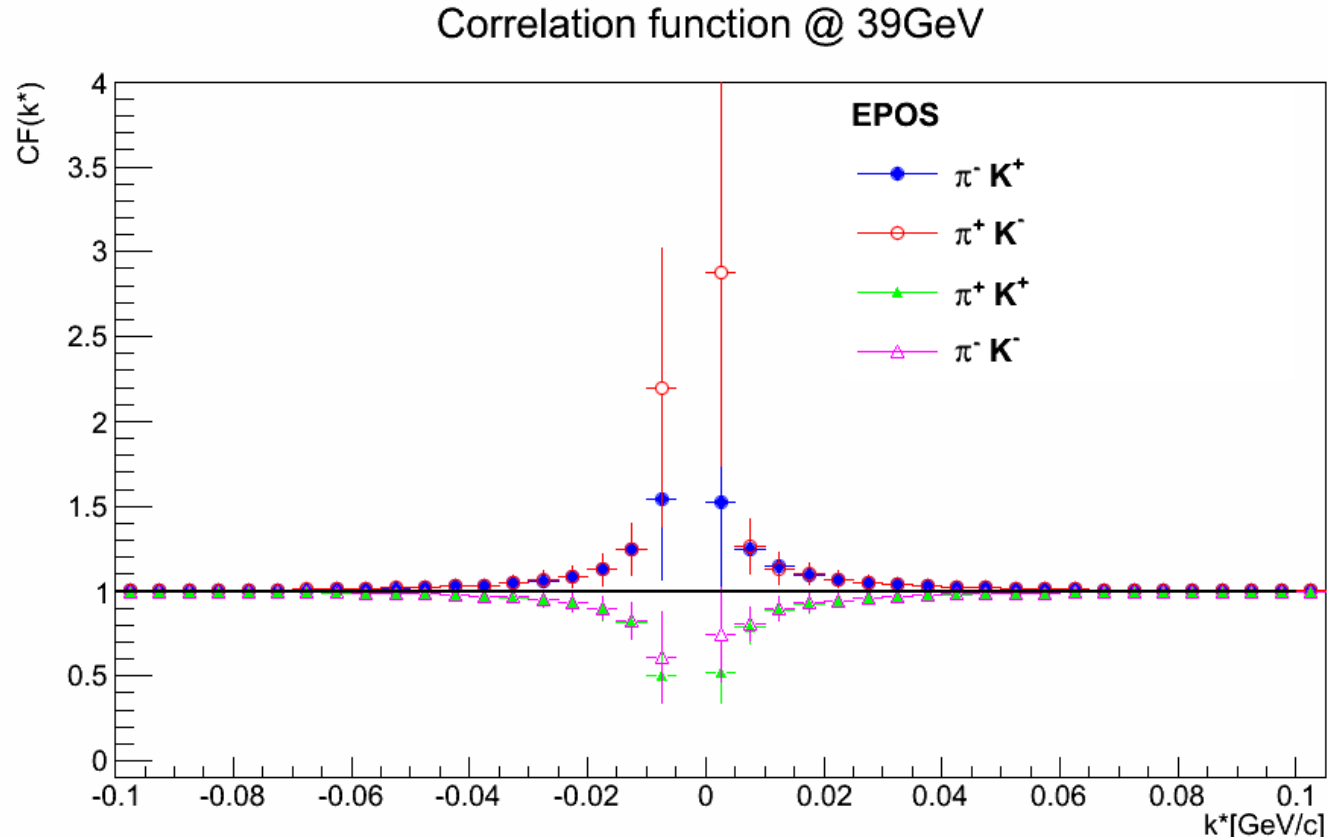


Correlation function @ 27GeV

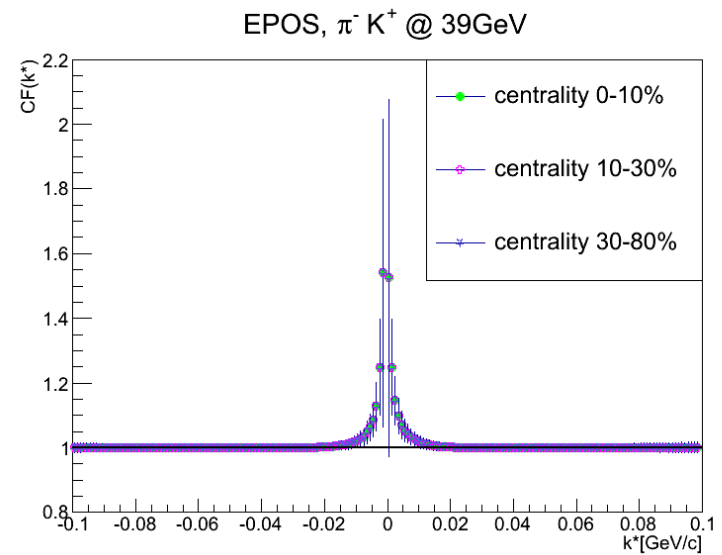
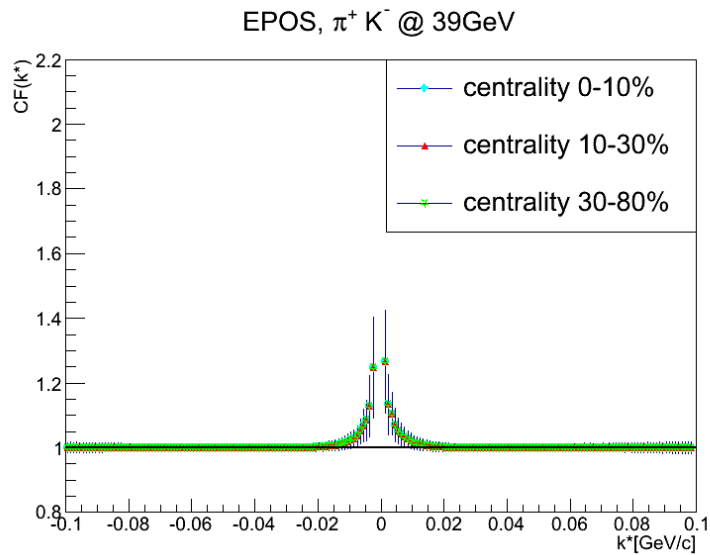
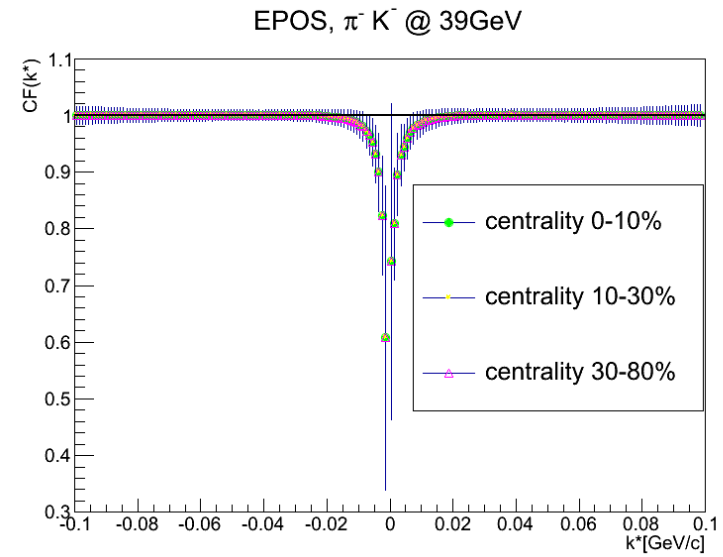
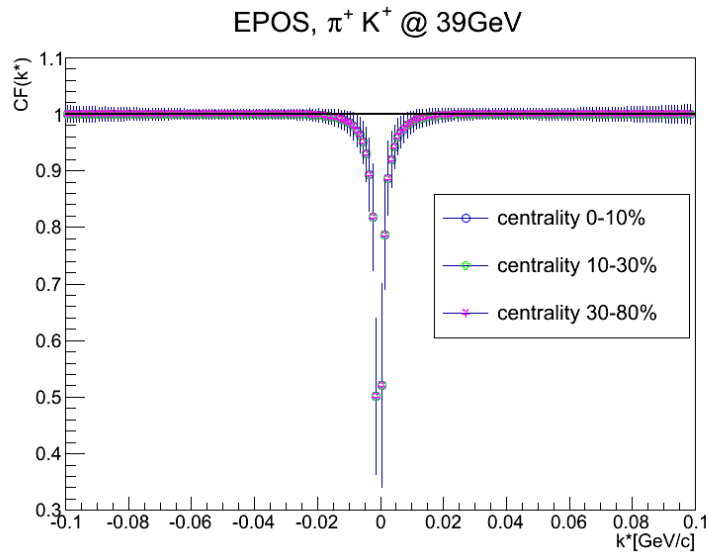


Results from EPOS

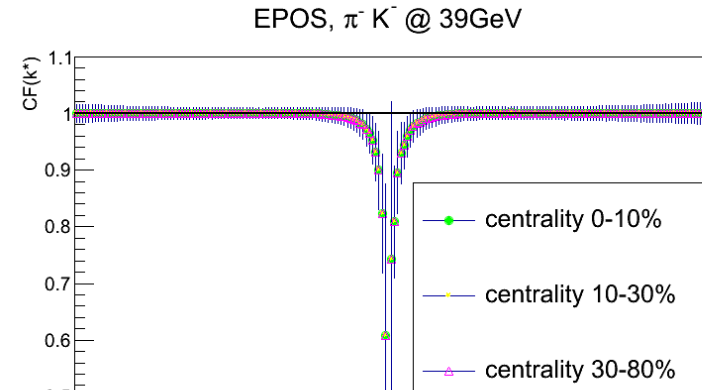
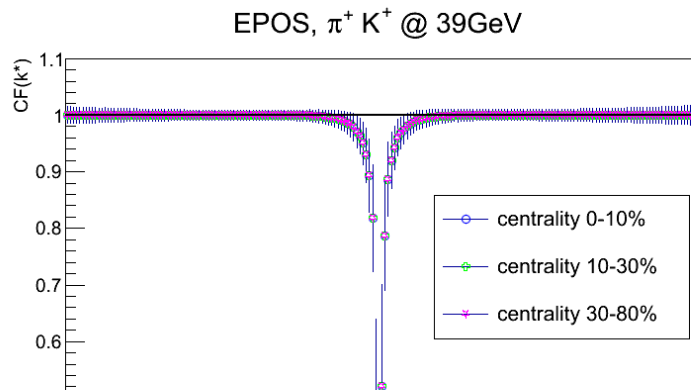
- The shape of the functions is determined by Coulomb force.
- In this model there is no big difference between correlation functions of the same sign systems (Pion - Kaon - and Pion + Kaon +) and for correlation functions for different sign systems (Pion - Kaon + and Pion + Kaon -).



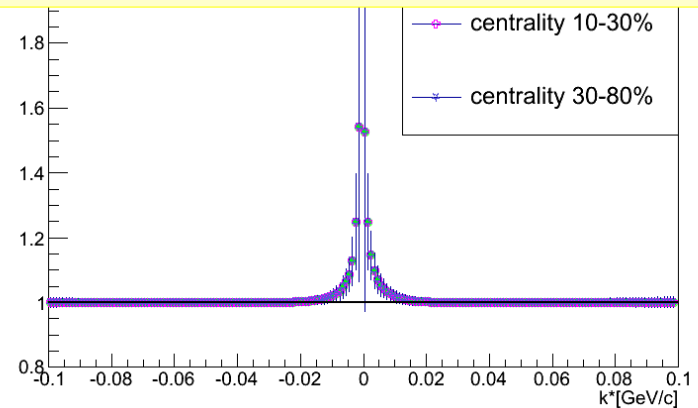
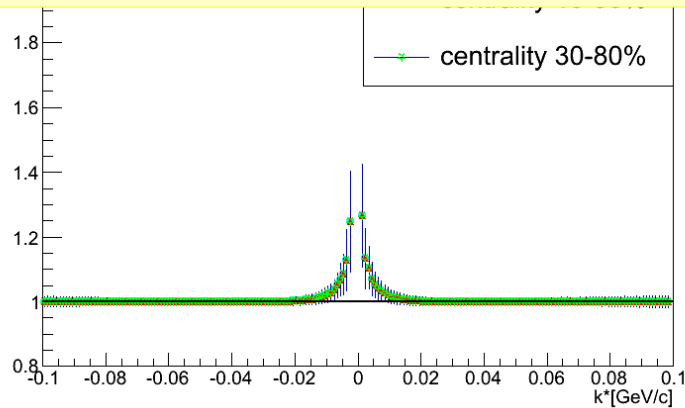
Centrality dependence



Centrality dependence

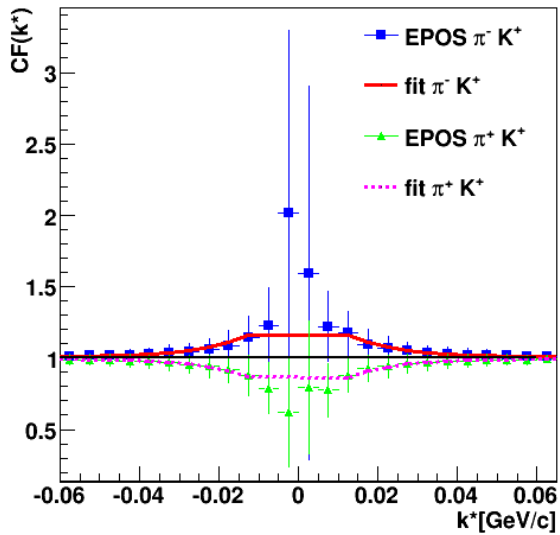


- No association between the strength of interaction and collision centrality for energy 7.7GeV, 11.5GeV, 19.6GeV, 27GeV and 39GeV.

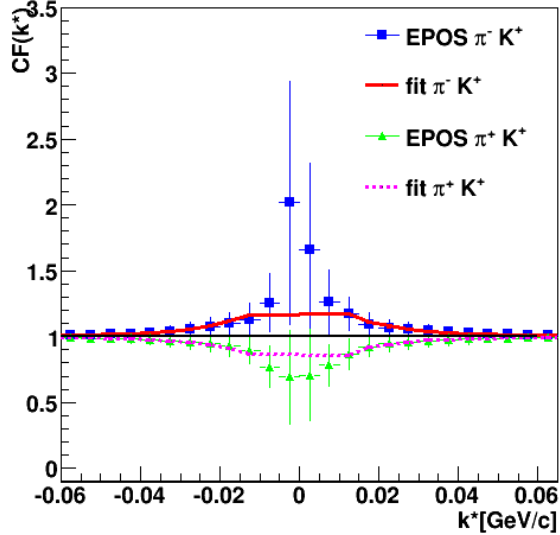


Fits

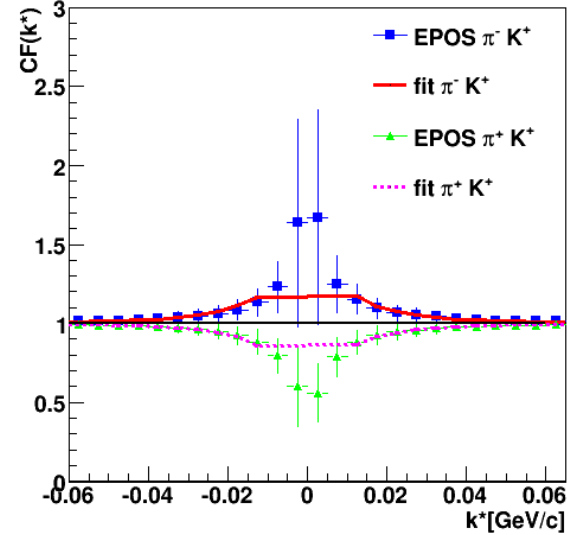
Correlation function with fit @ 7.7GeV



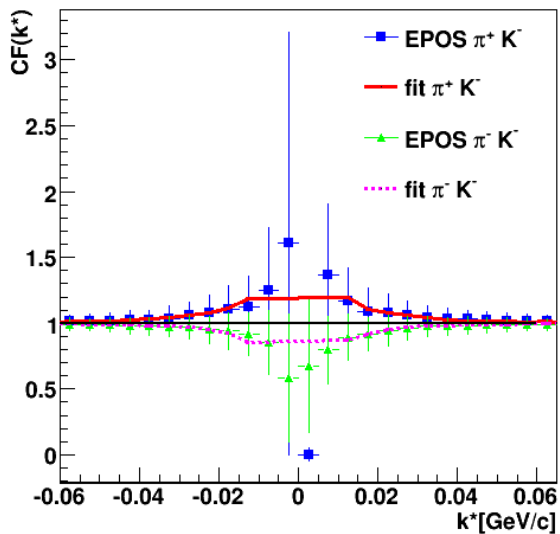
Correlation function with fit @ 11.5GeV



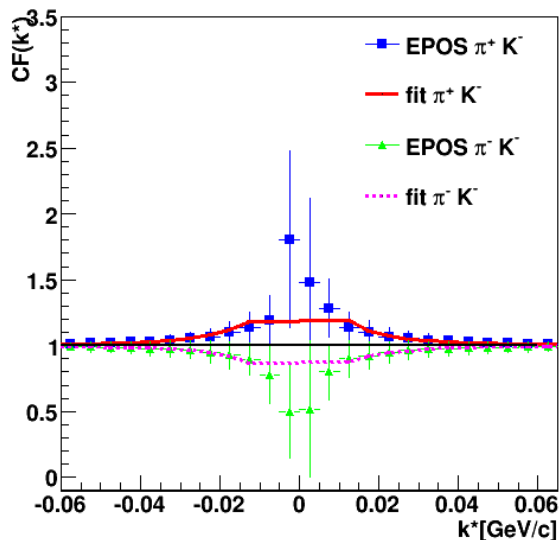
Correlation function with fit @ 19.6GeV



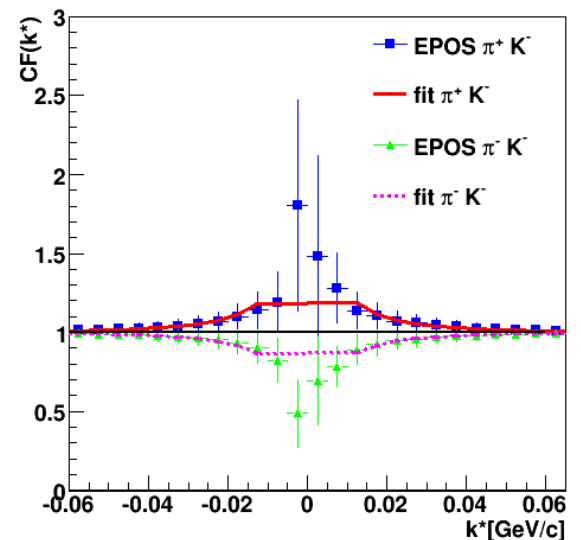
Correlation function with fit @ 7.7GeV



Correlation function with fit @ 11.5GeV

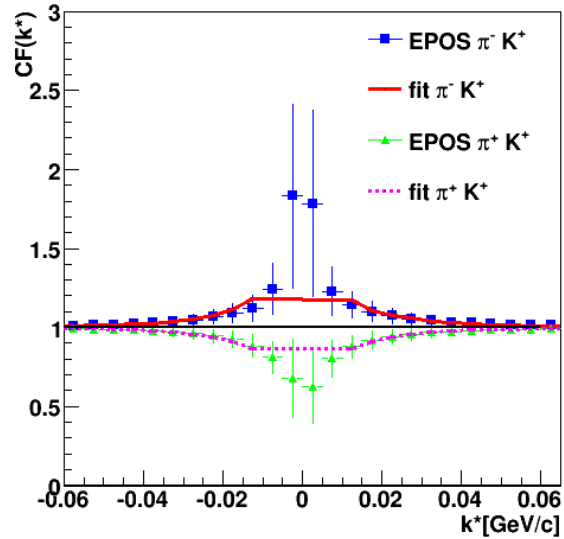


Correlation function with fit @ 19.6GeV

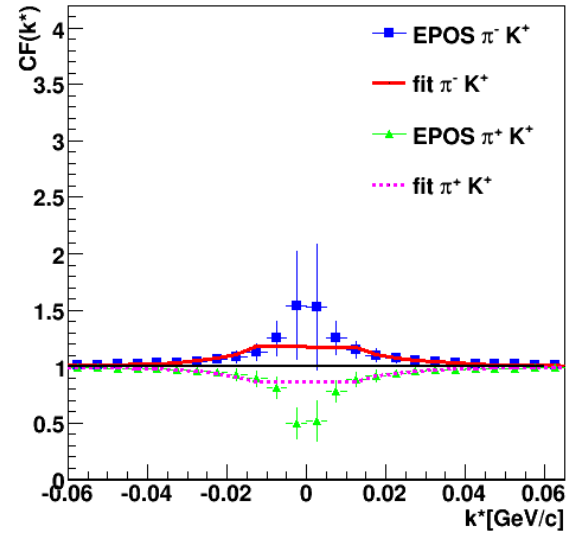


Fits

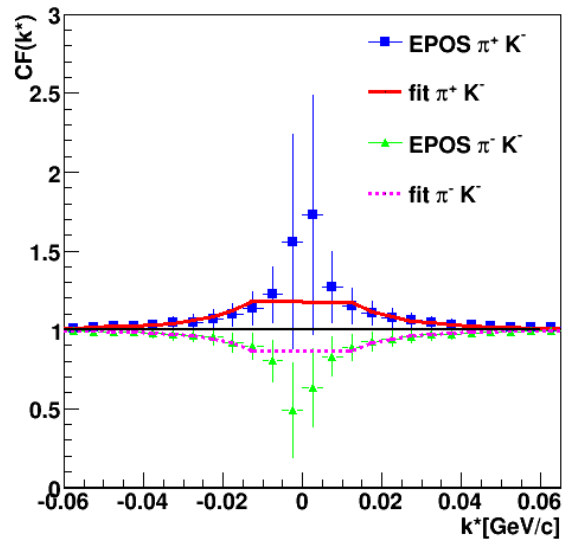
Correlation function with fit @ 27GeV



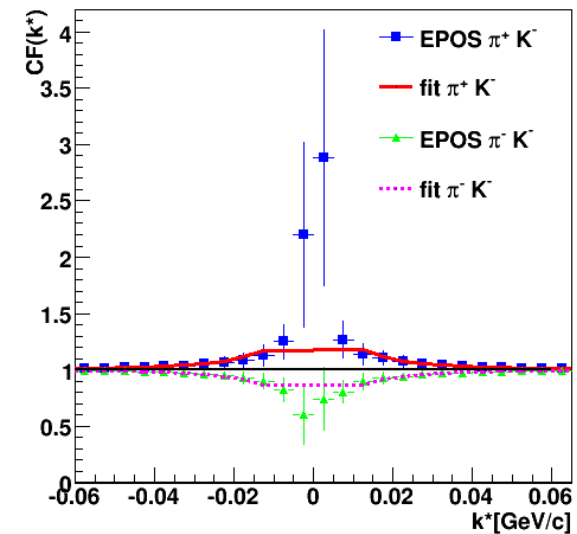
Correlation function with fit @ 39GeV



Correlation function with fit @ 27GeV

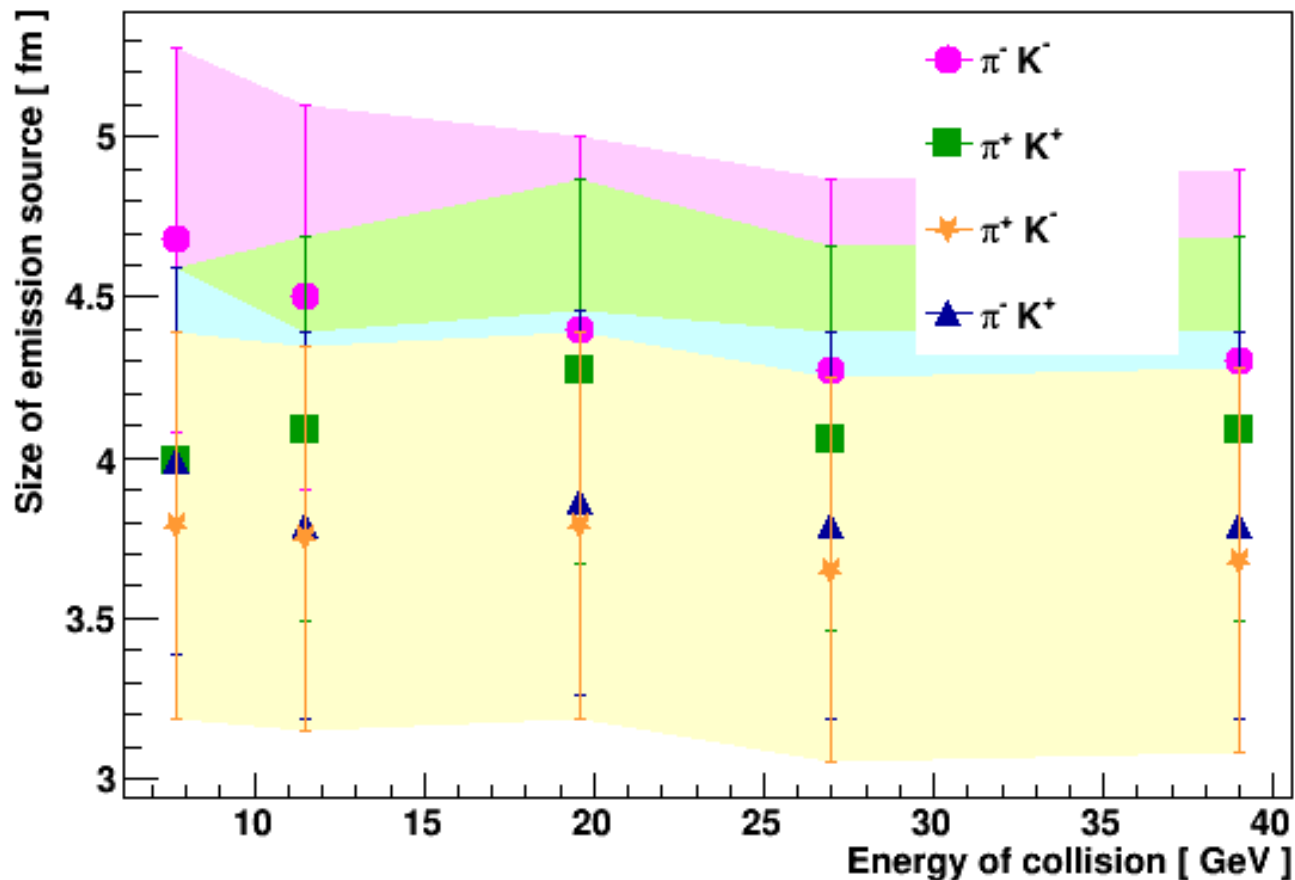


Correlation function with fit @ 39GeV



Sizes calculated from correlation functions

- We do not observe energy dependence in source sizes in EPOS model.



Summary

- Transverse momentum spectra results for charged particles from EPOS model are between STAR p_T spectra for the most central collisions (0-5%) and peripheral (60-80%).
- There is no big difference in EPOS model between correlation functions of the same sign particles systems (Pion - Kaon - and Pion + Kaon +) and for correlation functions for different sign particles systems (Pion - Kaon + and Pion + Kaon -).
- No association between the strength of interaction and collision centrality for energy 7.7GeV, 11.5GeV, 19.6GeV, 27GeV and 39GeV.
- We do not observe energy dependence in source sizes in EPOS model.
- To compare the STAR results from BES with the model, we need the model with hydrodynamics.

Annotation

1. ***New Developments of EPOS 2***; T. Pierog from KIT, Institut für Kernphysik, Karlsruhe, Germany; Iu. Karpenko from Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine; S. Porteboeuf from University of Clermont-Ferrand, Clermont-Ferrand, France; K. Werner from SUBATECH, University of Nantes – IN2P3/CNRS– EMN, Nantes, France

2. ***Quark Matter 12-18 August 2012, Proceedings; R_CP and R_AA Measurements of Identified and Unidentified Charged Particles at High p_T in Au+Au Collisions at 7.7, 11.5, 19.6, 27, 39, and 62.4 GeV in STAR***, Evan Sangaline for the STAR Collaboration

Thank you!