Application of the EPOS model (ver. 1.68) to the STAR experiment

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Outline

- Introduction
- EposFemto code
- Examples of calculation (very preliminary!)
  - Inclusive: eta, p_T, particle ratios
  - π^+ π^+ correlations
- Conclusions

Introduction-Motivation

- EPOS is not MC event generator (pretends to physical event generator based on multiply scattering theory)
- EPOS gives space-time coordinates of hadrons
- Possibility to study femtoscopy with EPOS
- EPOS is a model for energy scan

  (applicability: pp,AA 5GeV<sqrt(s)<5TeV)

Basics of EPOS(parton model)

Klaus Werner. Nucl.Phys.175-176(2008)81-87

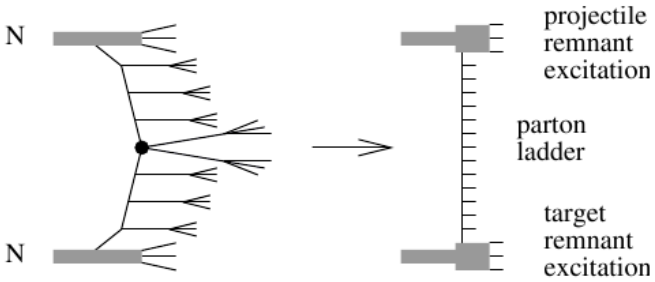
EPOS is a sophisticated multiple scattering approach based on partons and Pomerons (parton ladders), with special emphasis on high parton densities. The latter aspect, particularly important in proton-nucleus or nucleus-nucleus collisions, is taken care of via an effective treatment of Pomeron-Pomeron interactions, referred to as parton ladder splitting. In addition, collective effects are introduced after separating the high density central core from the peripheral corona. EPOS is the successor of the NEXUS model.

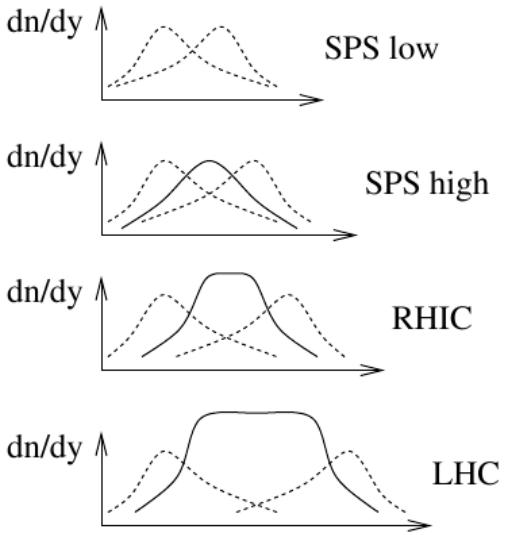
Energy conserving quantum mechanical multiple scattering approach based on

Parton (parton ladders)

Off-shell remnants, and

Splitting of parton ladders



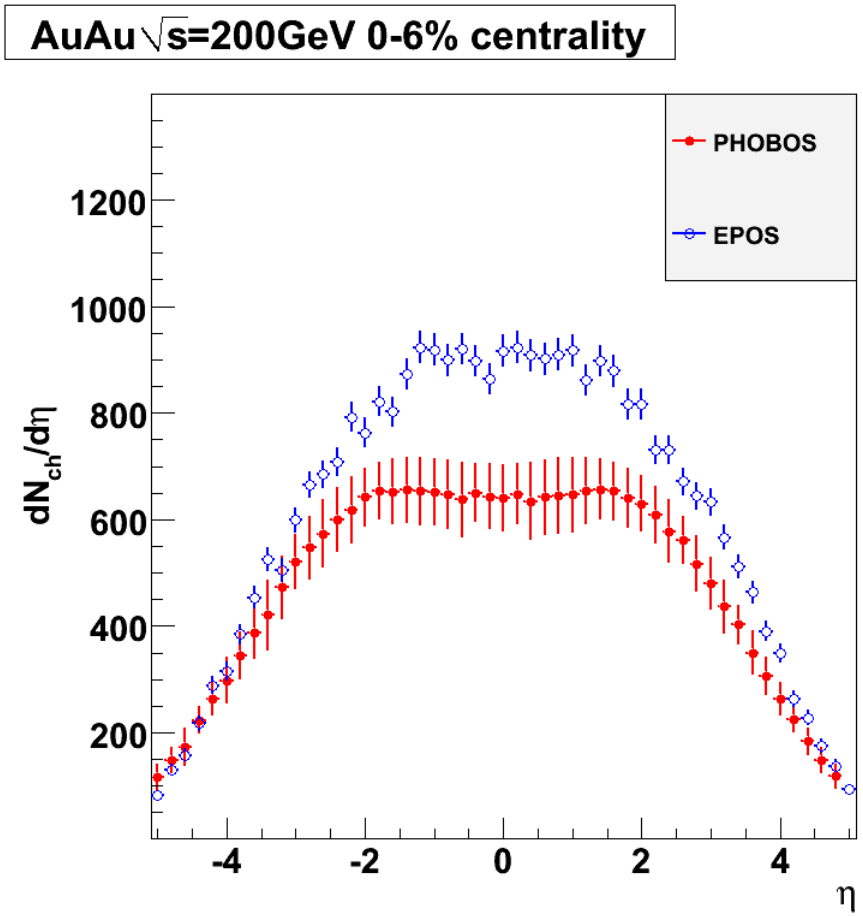


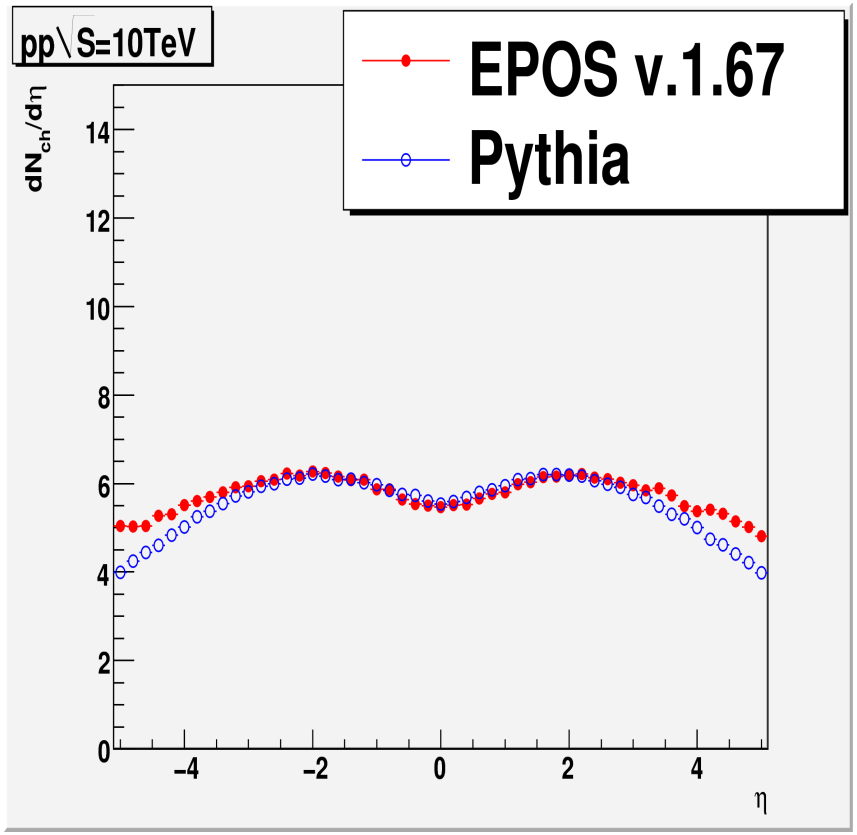
EposFemto code

C++ EposFemto code:

- Convert epos text output file to root tree
- Read energy-momentum and space-time coordinates of particle from root tree
- Calculate inclusive values (p_T spectra, pseudorapidity, particle ratios)
- Calculate two particle correlation function
  (weight using Lednicky's code and mixing procedure to construct reference distribution)

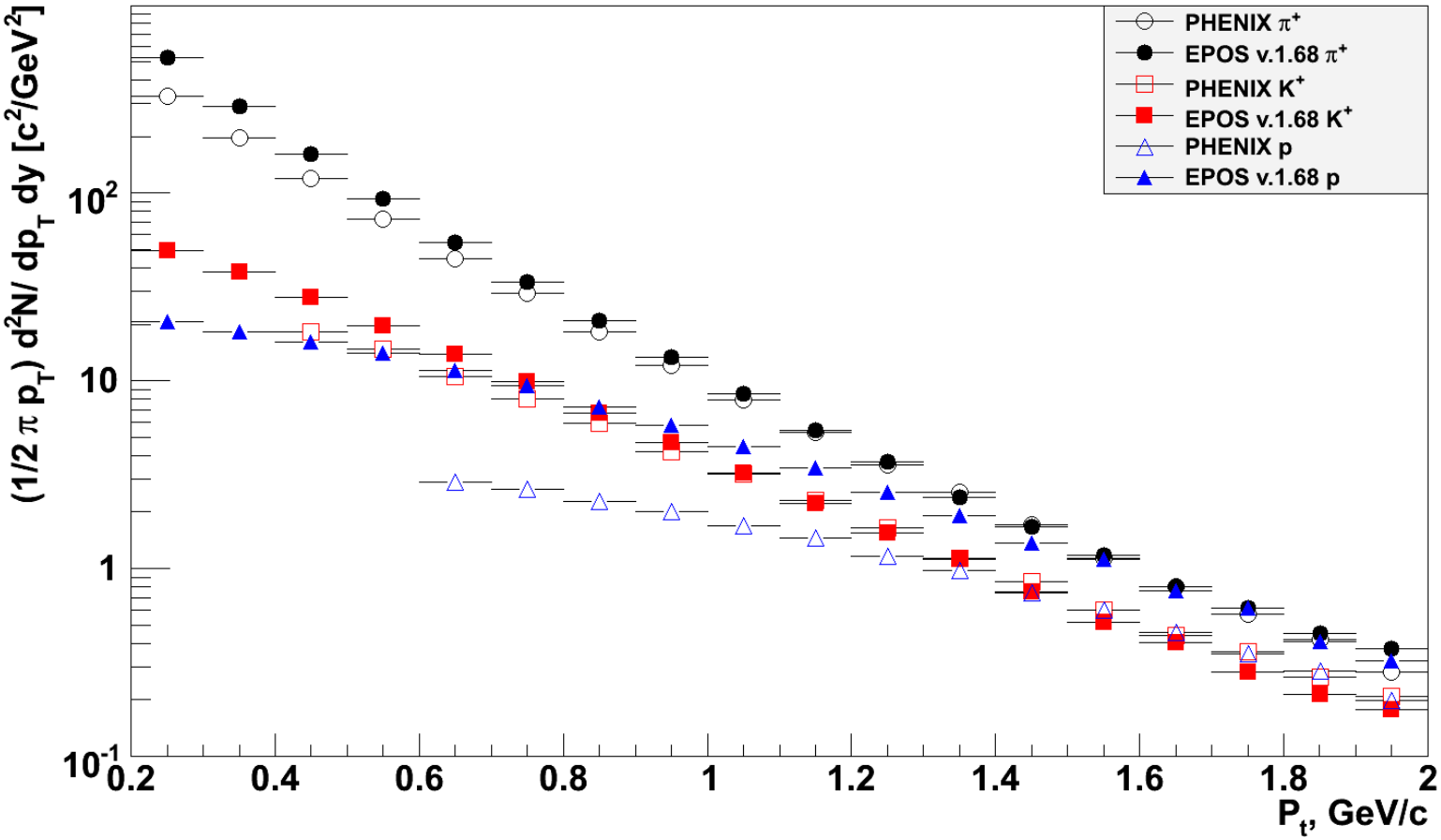
Pseudo-Rapidity





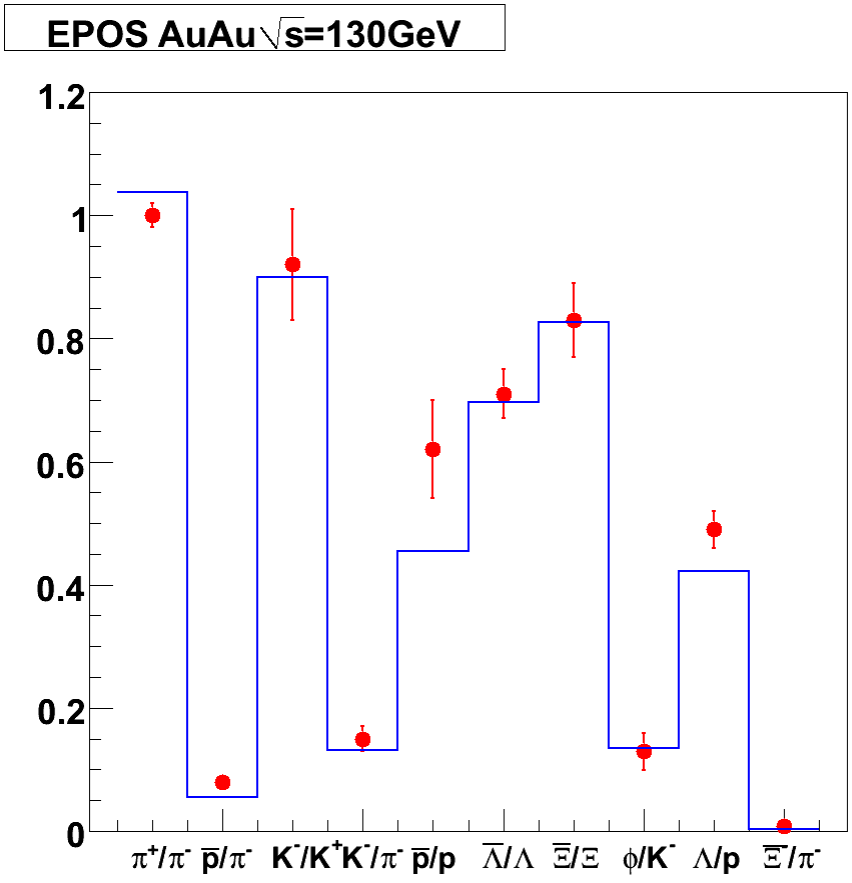
P_T distributions

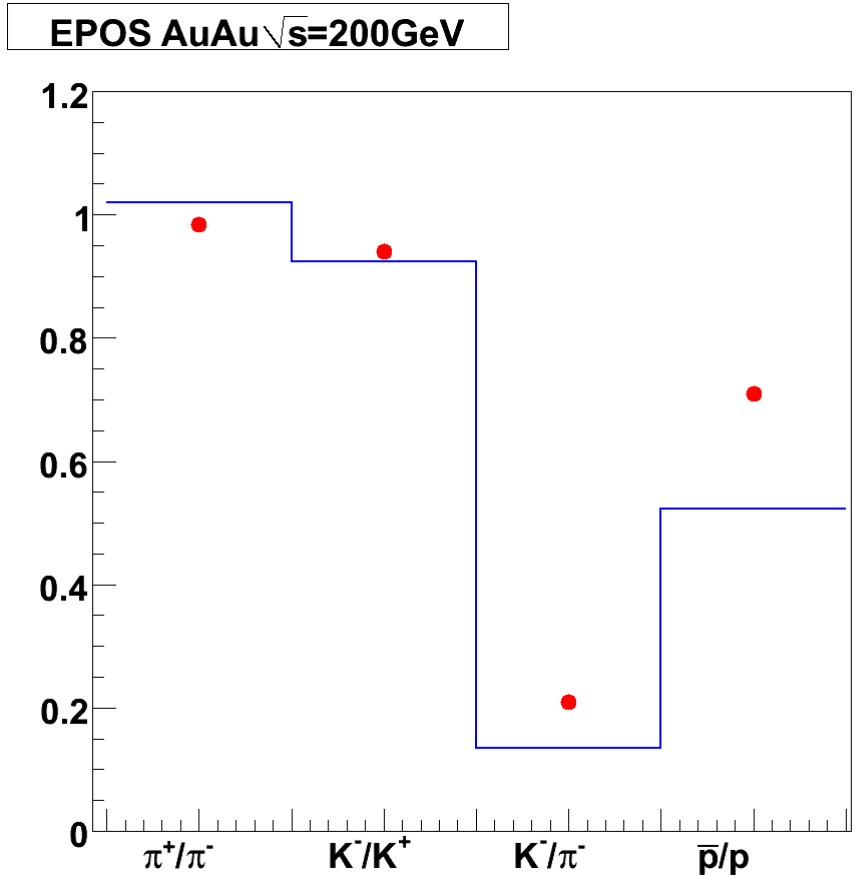
S.S. Adler et al. [PHENIX Collaboration], Phys.Rev. C69 (2004) 034909



Particle Ratios

Midrapidity





$\pi^+ \pi^+$ correlation function

Compare EPOS with STAR experiment

J.Adams et al. [STAR Collaboration], Phys.Rev. C71 (2005) 044906

AuAu sqrt(s)=200 GeV 10^3 events generated by EPOS

$0.15<p_T<0.8$GeV/c

$|\eta|<0.5$

0-5% centrality

Calculate $\pi^+ \pi^+$ correlation function (QS only)

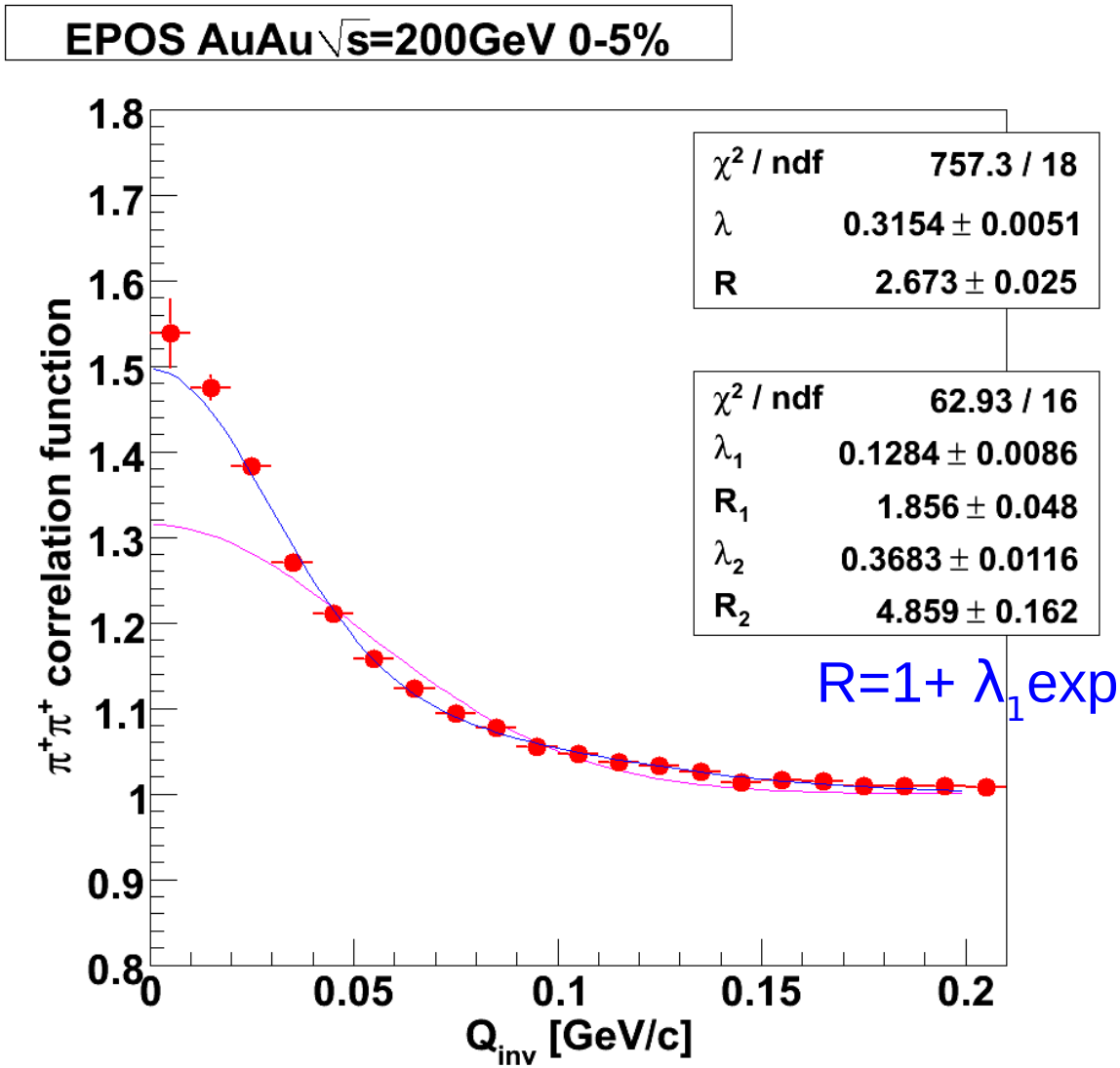
1D fit – superposition of two Gaussians:

$$R=1+ \lambda_1 \exp(-R_1^2 Q_{inv}^2) + \lambda_2(-R_2^2 Q_{inv}^2)$$

R.Lednicky, T.Progulova Z.Phys.C 55, 295(1992)

Total, "direct" and "secondary"(from decay) pions

$\pi^+ \pi^+$ EPOS: 1D fit



$R=1+ \lambda \exp(-R^2 Q_{inv}^2)$

$R=1+ \lambda_1 \exp(-R_1^2 Q_{inv}^2) + \lambda_2 (-R_2^2 Q_{inv}^2)$

EPOS: Fathers of π^+

AuAu sqrt(s)=200MeV

code

-2330 antiΞ^- → $\Lambda\pi^+$ 0.550028 %

-2230 antiΣ- → $n\pi^+$ 0.779207 %

-2221 antiΔ^- → $n\pi^+$ 1.57189 %

-2130 antiΛ → $p\pi^+$ 2.18933 %

-231 antiK^{*0} → $K\pi^+$ 3.22198 %

-1 direct pion 43.2204 %

20 K_s^0 → $\pi^-\pi^+$ 12.2139 %

111 ρ^0 → $\pi^-\pi^+$ 8.53353 %

121 ρ^+ → $\pi^0\pi^+$ 8.85977 %

131 K^{*+} → $K\pi^+$ 3.58867 %

220 η → $\pi^-\pi^+\pi^0$ 2.47243 %

221 ω → $\pi^-\pi^+\pi^0$ 6.93197 %

330 η' → $\eta\pi^-\pi^+$ 0.514977 %

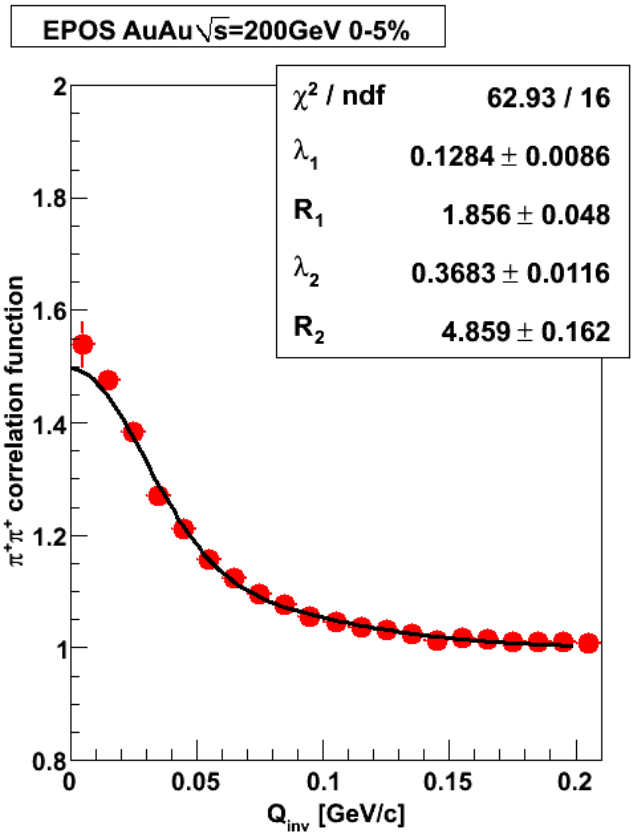
1111 Δ^{++} → $p\pi^+$ 1.80107 %

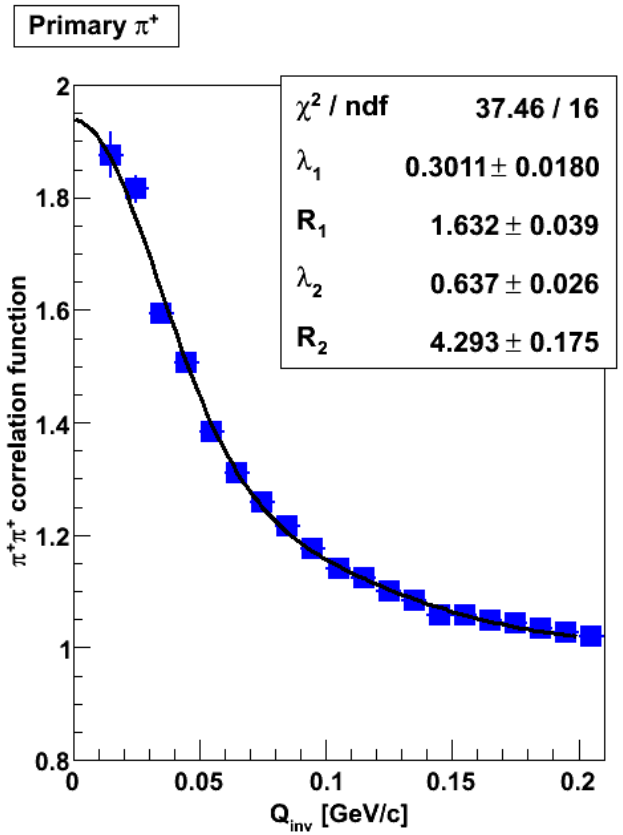
1121 Δ^+ → $n\pi^+$ 0.533851 %

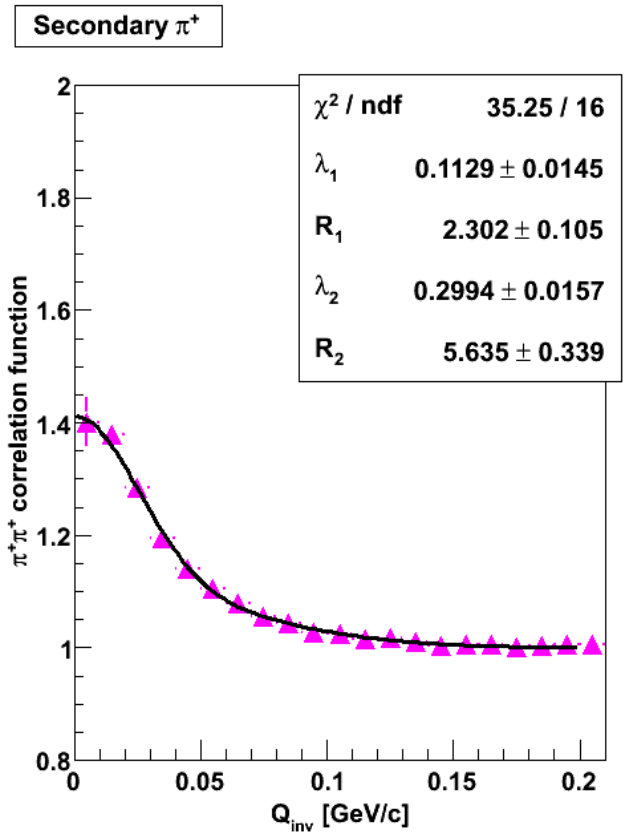
1130 Σ^+ → $n\pi^+$ 0.501496 %

1131 Σ^{*+} → $\Lambda\pi^+$ 0.57699 %

$\pi^+ \pi^+$ EPOS: direct and secondary

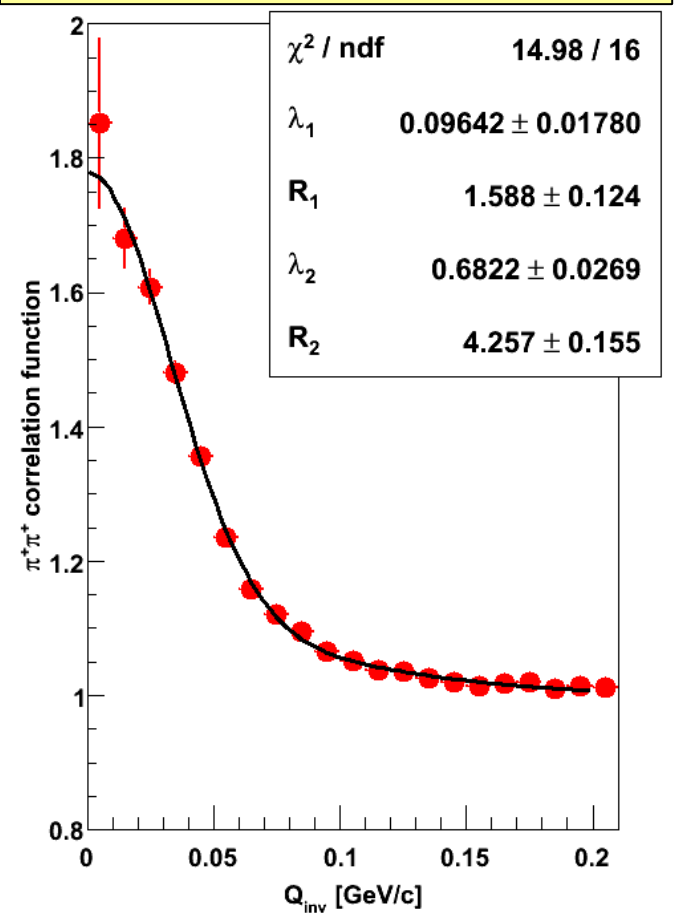




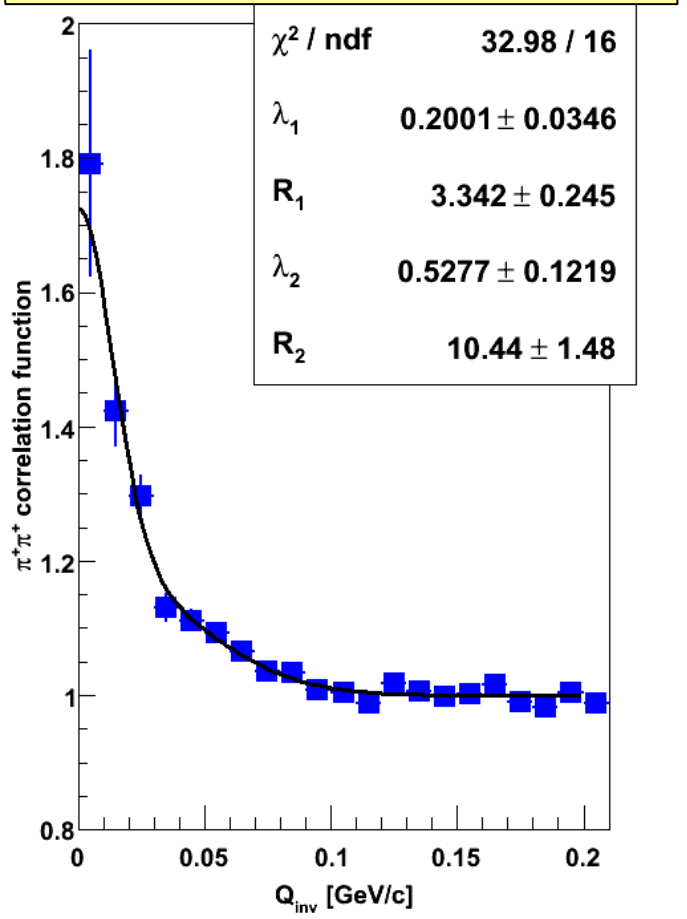


$\pi^+\pi^+$ EPOS: ρ, ω and K*

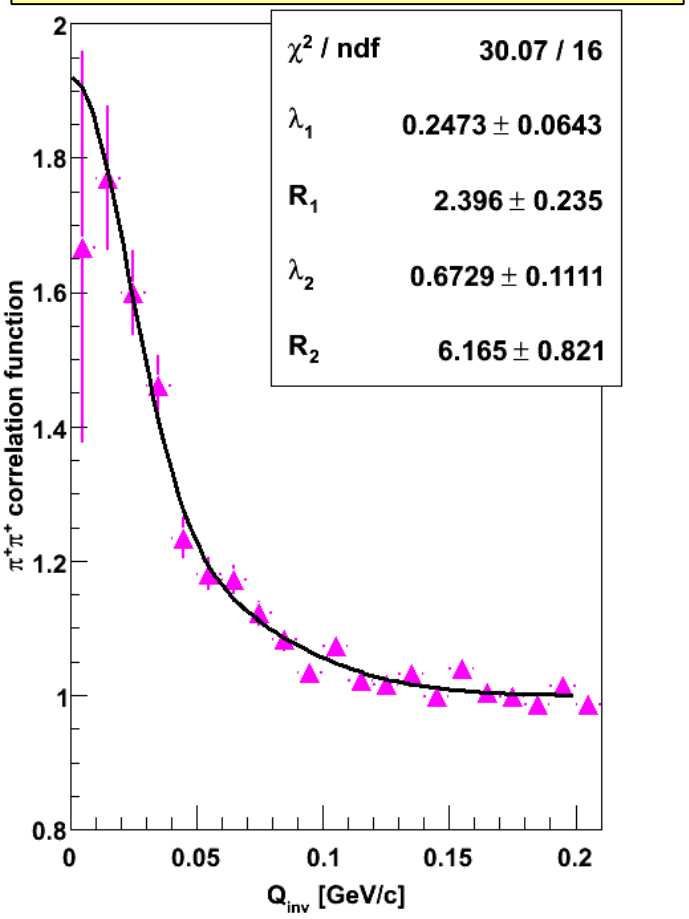
$\pi^+_{dir}\pi^+_{\rho}$



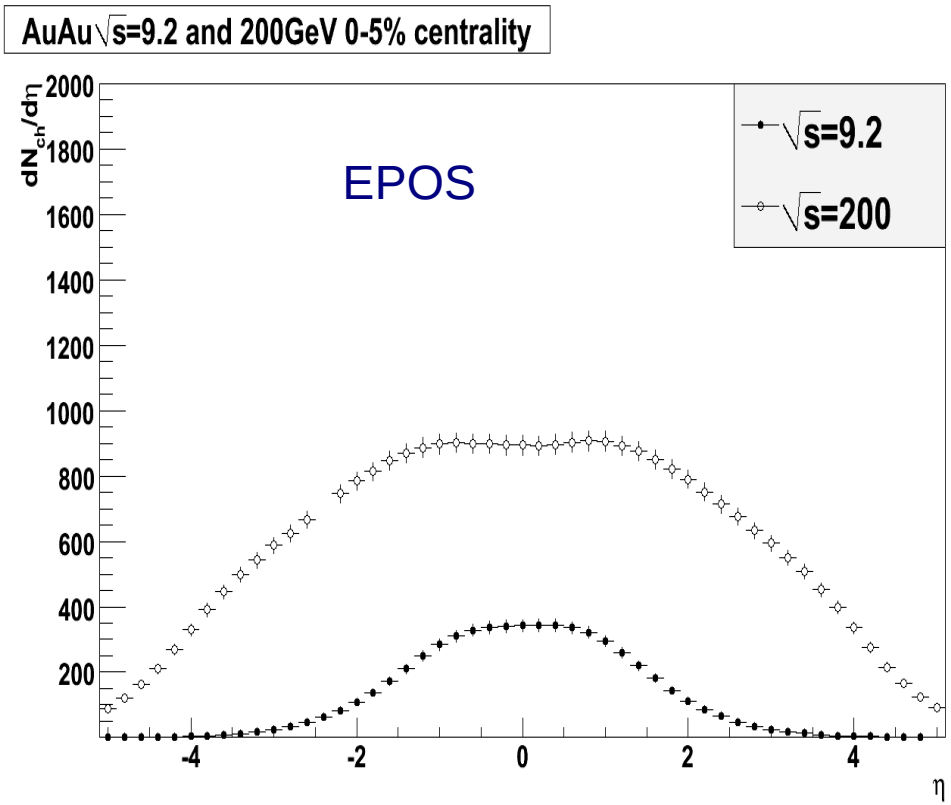
$\pi^+_{dir}\pi^+_{\omega}$

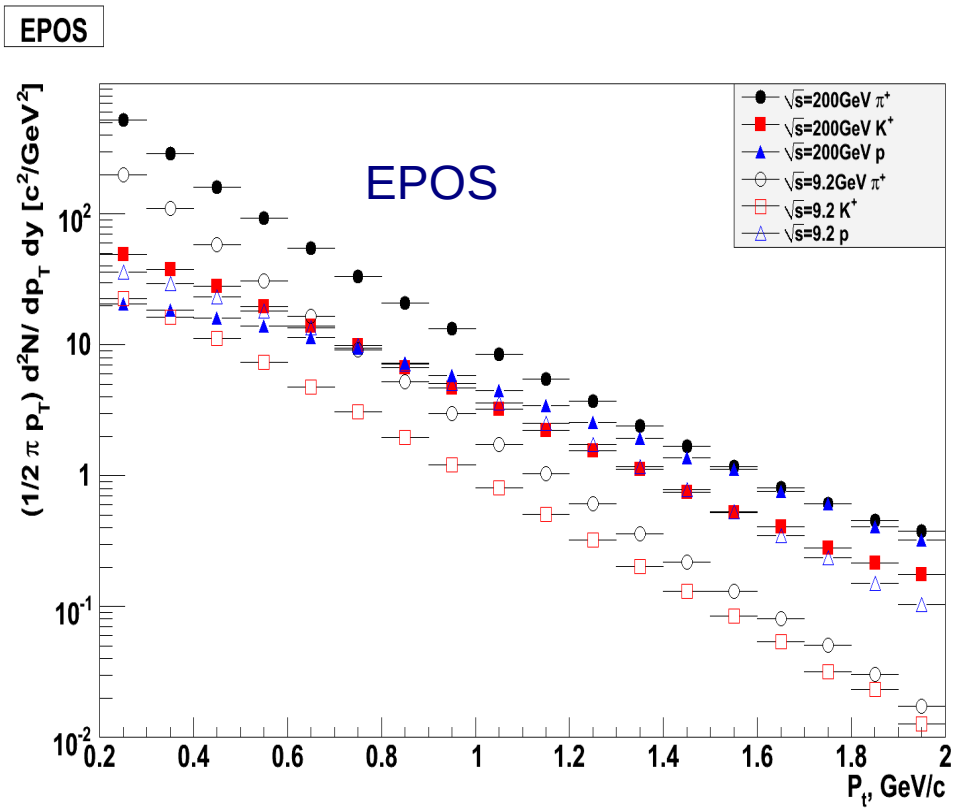


$\pi^+_{dir}\pi^+_{K^*}$



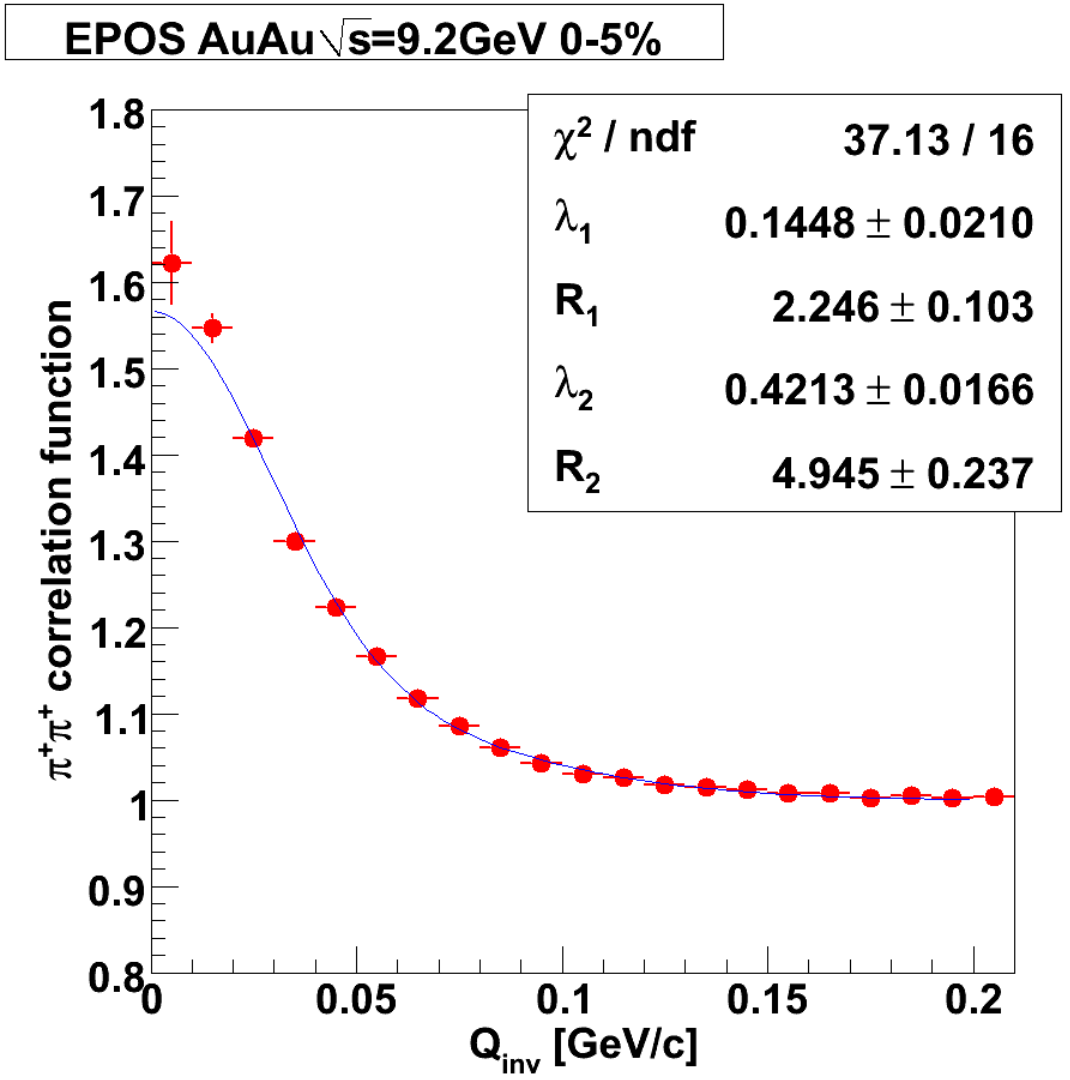
AuAu sqrt(s_{NN})=9.2 GeV





$\pi^+ \pi^+$ EPOS: AuAu sqrt(s)=9.2 GeV

$6*10^3$ events,
$0.15<p_T<0.8$GeV/c,
$|\eta|<0.5$,
0-5% centrality

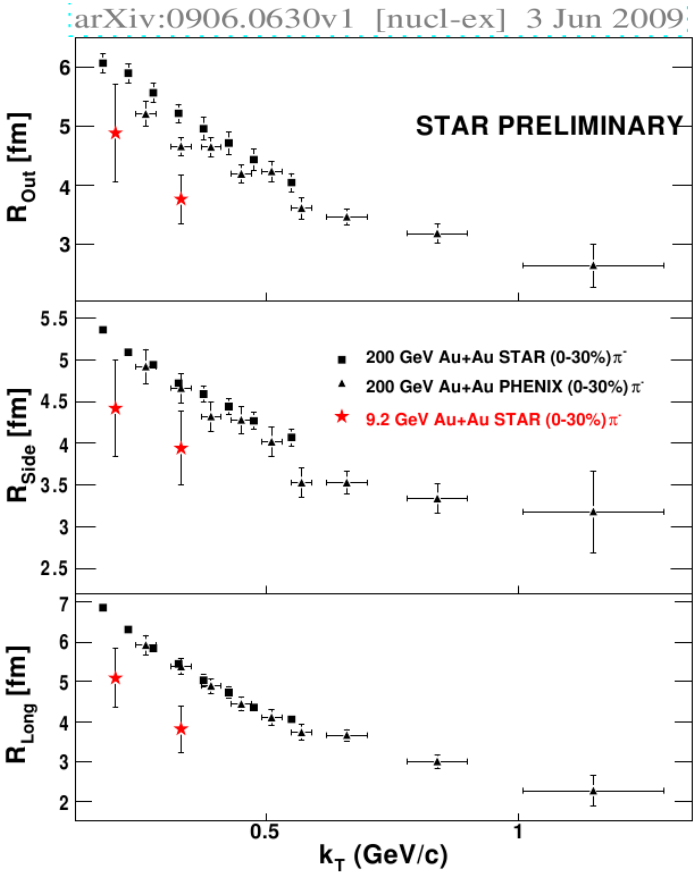


9.2 and 200 GeV

Recent results from STAR experiment in Au+Au collisions at $\sqrt{s_{NN}} = 9.2$ GeV

EPOS

$\sqrt{s}$	R_1	R_2
200 GeV	1.9 ± 0.1	4.9 ± 0.2
9.2 GeV	2.2 ± 0.3	4.9 ± 0.4



NEXT STEPS

- New EPOS (ver. 2.00) with full hydro evolution and hadronic cascade will come soon
- Tune up the model parameters and tune up the code.
- Test of new EPOS to compare with experimental data in wide range of sqrt(s)
  - Inclusive values
  - Pion femtoscopy (also 3D fit)

Conclusions

- p_T spectra for pions and kaon are close to experimental data, but proton p_T spectra is not good
- The shape of the pseudorapidity distribution is close to experimental one, and the absolute value is 40% larger.
- Most particle ratios are close to the experimental one.
- The feasibility of femtoscopy study with Epos model are shown.
- Pion source size is about 5 fm.

THANK YOU FOR THE ATTANTION!!!

Extra Slides

1D fit

- *R.Lednicky, T.Progulova Z.Phys.C 55, 295(1992)*

$$R(p_1, p_2) = c[1 + \lambda_1 \exp(-r_1^2 Q^2) + \lambda_2 \exp(-r_2^2 Q^2)]/(1 + \delta Q^2).$$

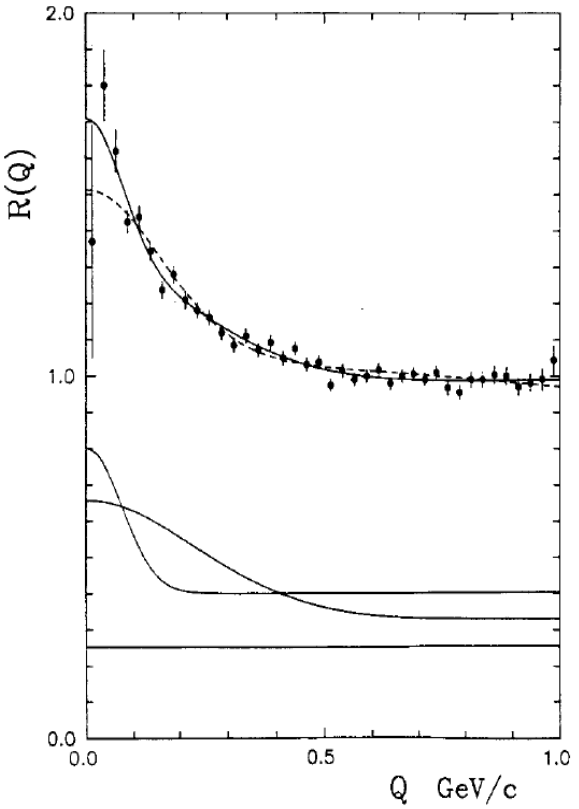
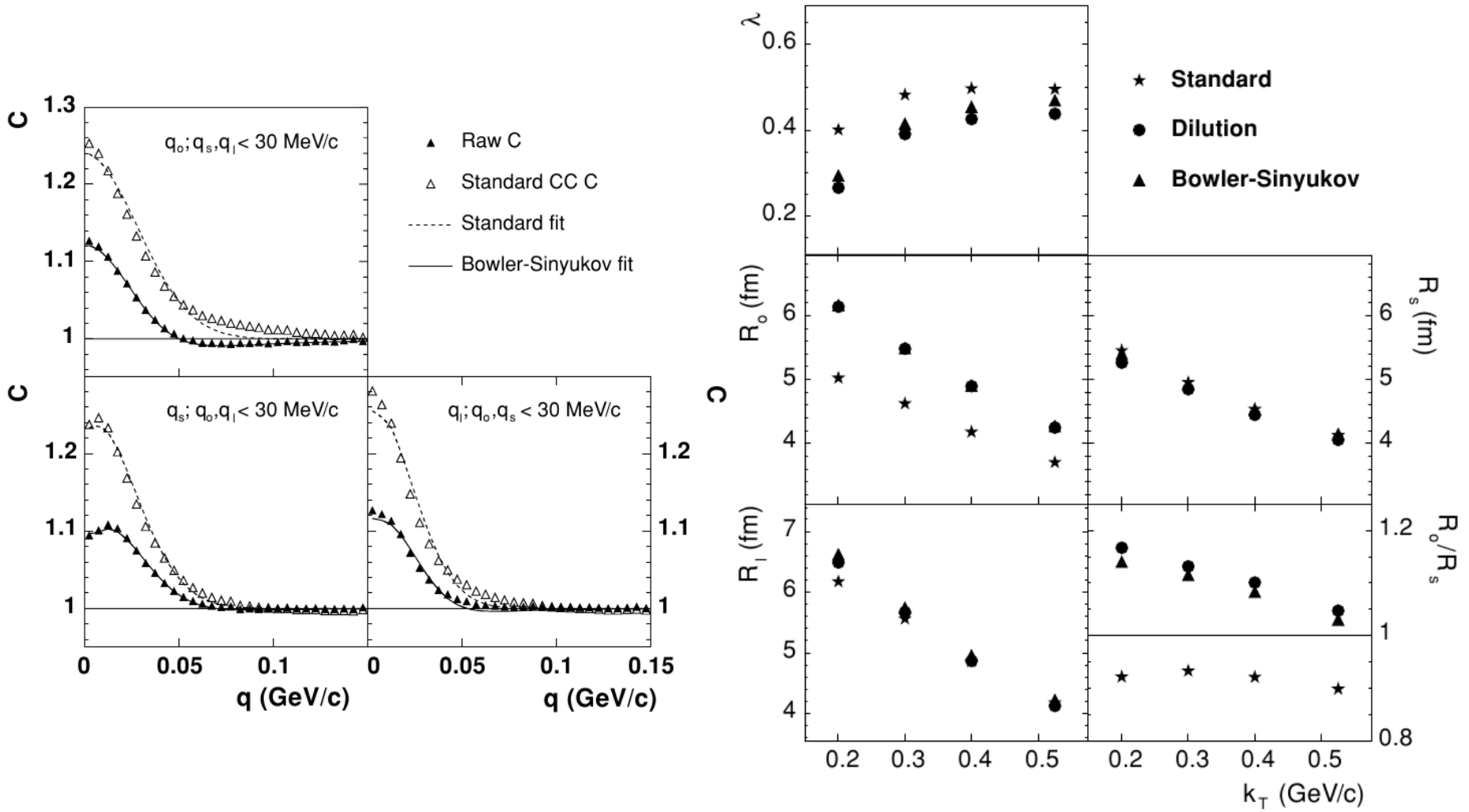


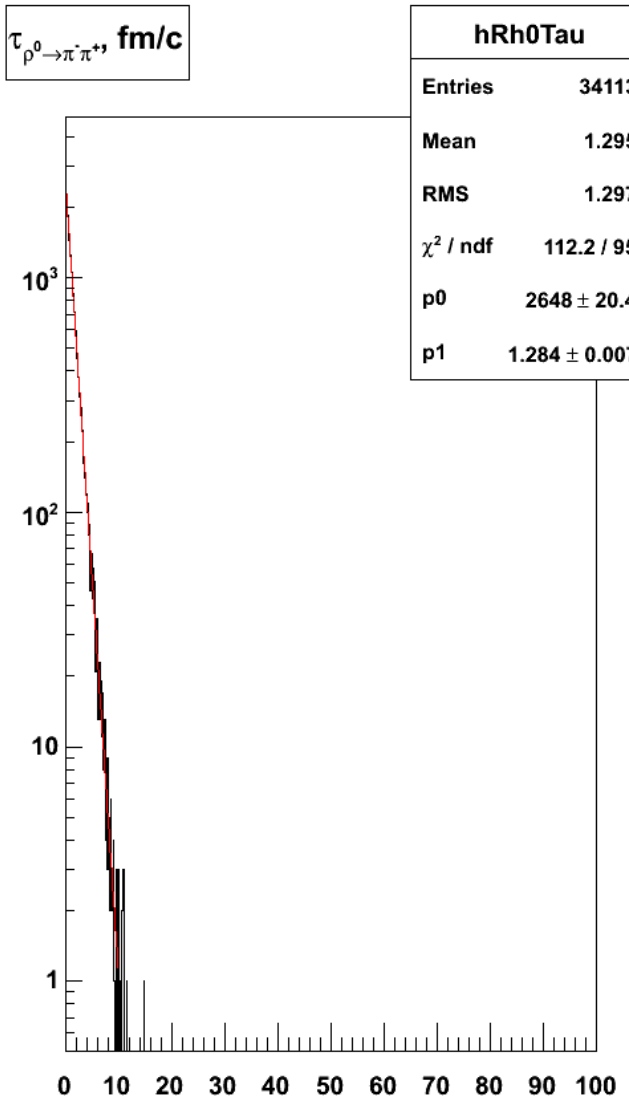
Fig. 1. Results of the fits by one (dashed curve) and superposition of two Gaussians according to (1) of the correlation function of two charged like pions, measued with a soft "minimum-bias" trigger in pp- and $\bar{p}p$-interactions on ISR at $\sqrt{s} = 63$ GeV [12]. The contributions to (1) proportional to λ_1, λ_2 and $1 - \lambda_1 - \lambda_2$ are also shown

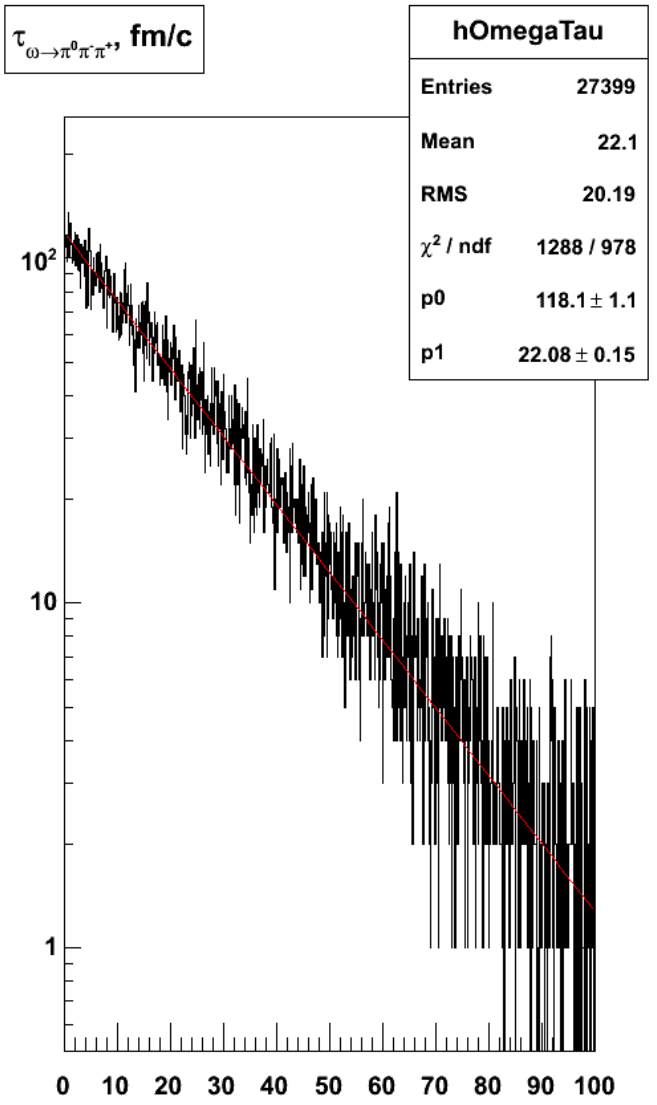
$\pi^+ \pi^+$ STAR

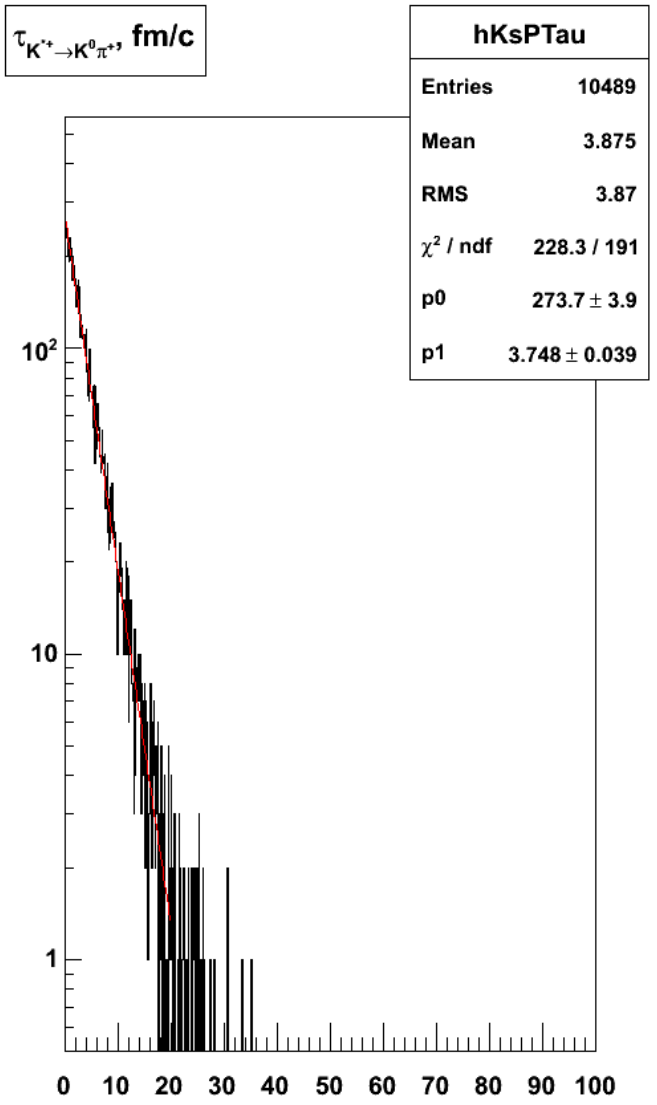
J.Adams et al. [STAR Collaboration], Phys.Rev. C71 (2005) 044906



Check lifetime

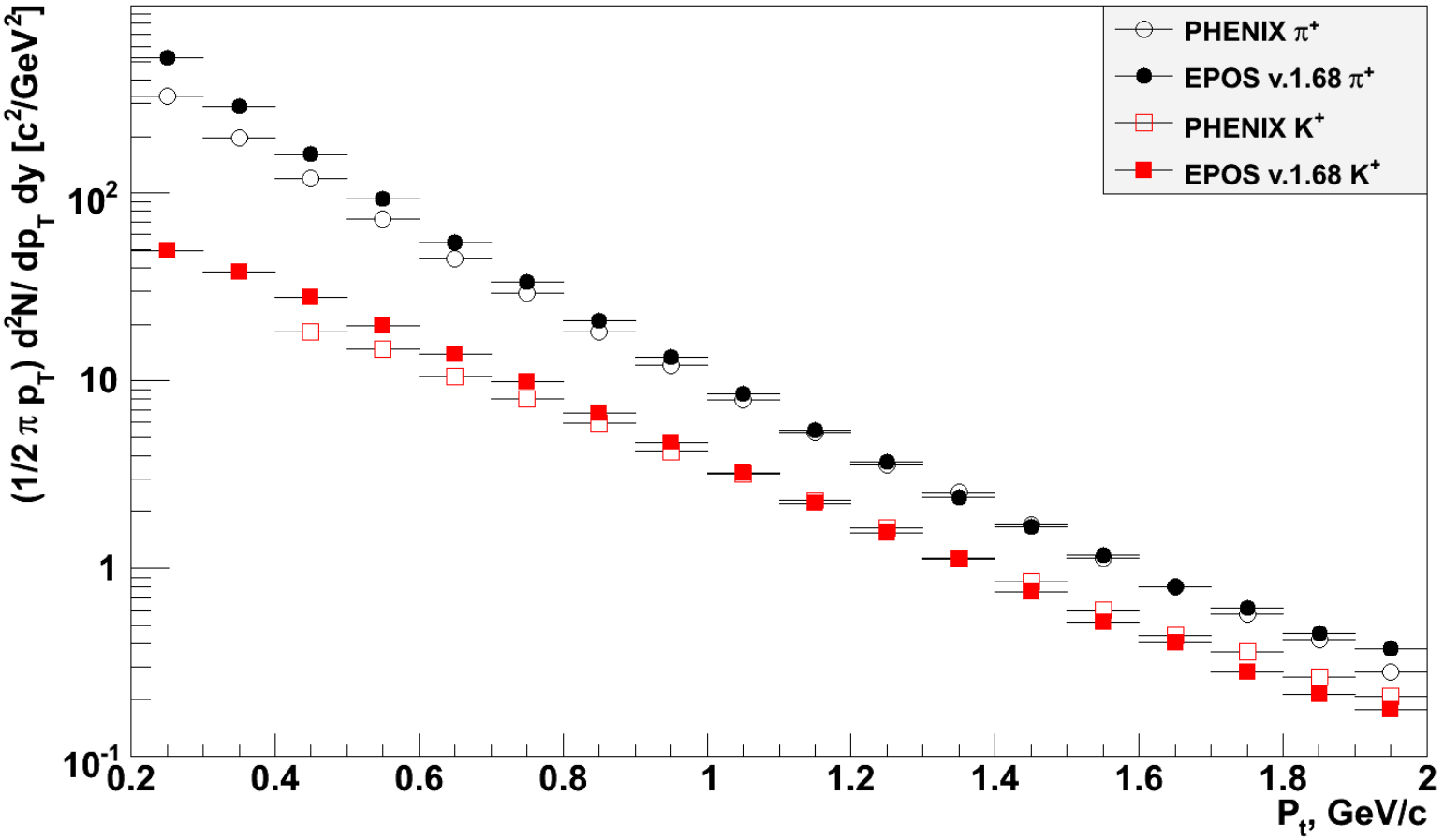






P_T distributions

S.S. Adler et al. [PHENIX Collaboration], Phys.Rev. C69 (2004) 034909



EPOS: AuAu@25GeV/nucleon for CBM experiment (sqrt(S)~7GeV fix target)

DeltaP/P ~ 1%