High p_t pion spectra and di-hadron correlations at CBM@SIS100

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The hard probes in heavy ions collisions can provide the information of the coexistence phase already in the energy domain of SIS100. The first step of such investigations at CBM can be the study of high transverse momentum spectra of pions, because high energy single partons forming the secondary particles are valuable probes of hot dense matter.

Transverse momentum spectra of $\pi^+(\pi^-)$ and the π^+/π^- - ratios are obtained for the simulated *Au+Au* central collisions at 6, 8 and 10 AGeV for CBM setup. The momentum reconstruction and particle identification procedures are reported. The first results on the two charged particles azimuthal correlations are also presented.

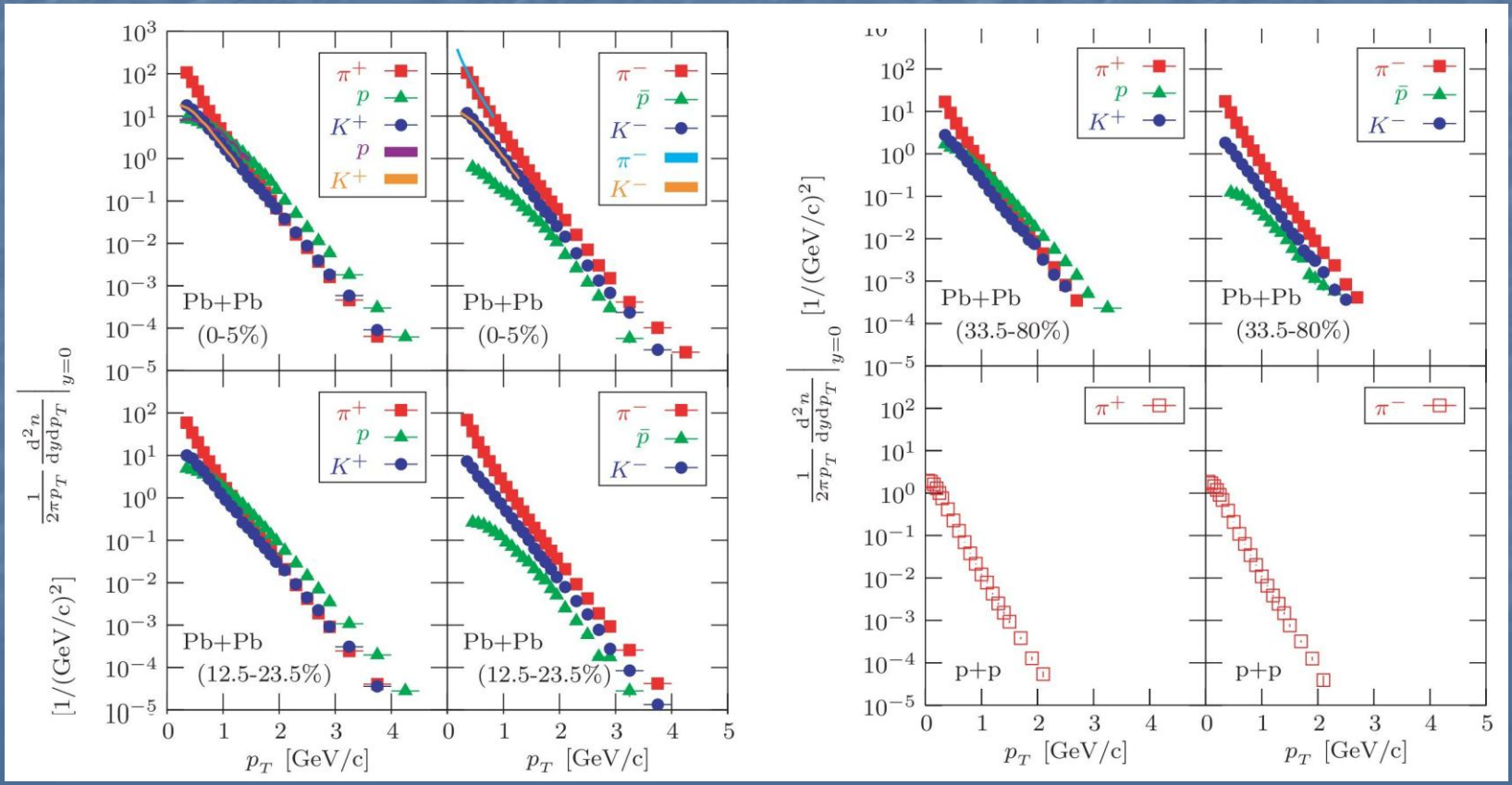
Outlook

1. Motivation
2. CBM experiment
3. Particle identification
4. High P_t pion spectra
5. π^+/π^- ratios
6. Azimuthal correlations

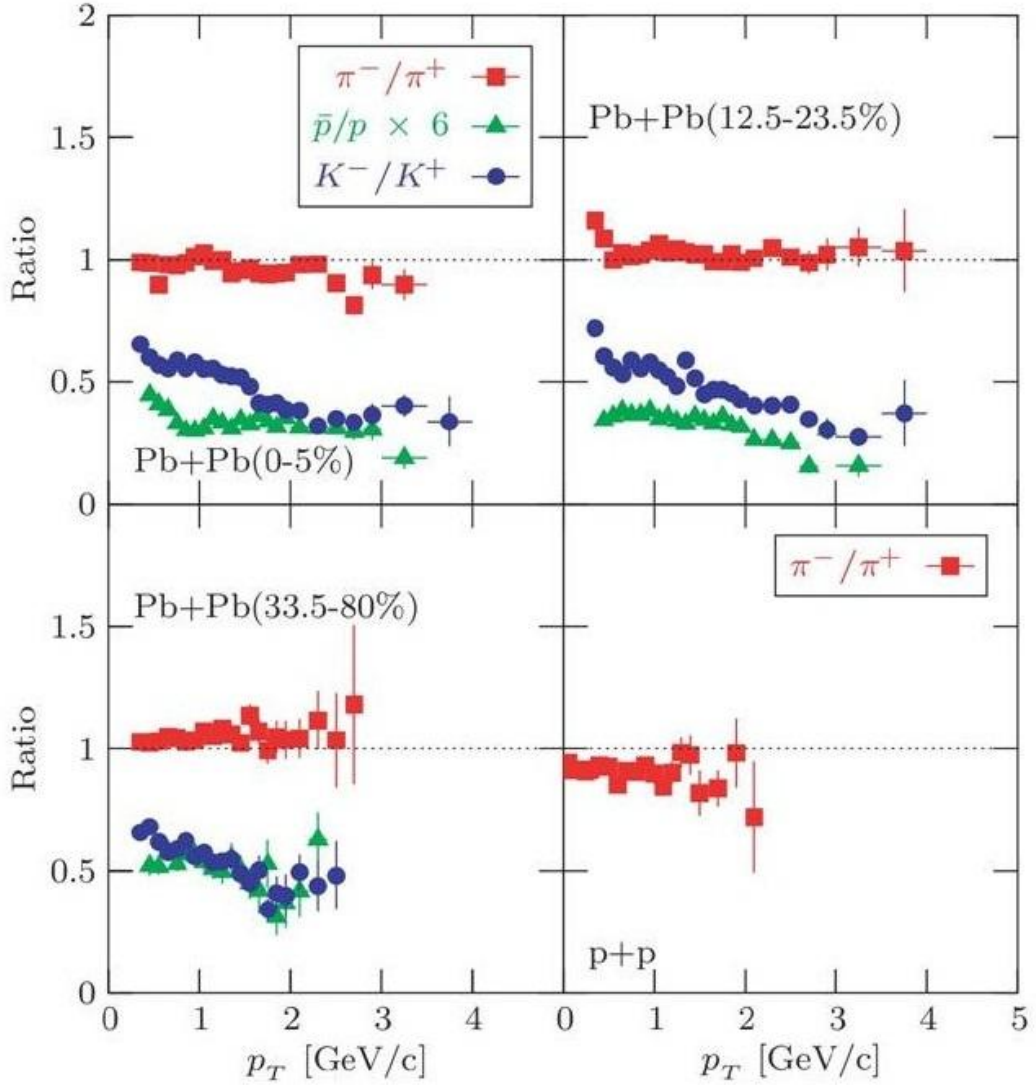
Conclusions

Invariant yields per inelastic collision of $\pi^{+/-}$, $K^{+/-}$ and p, anti-p *vs* p_t for Pb+Pb and p+p coll. at midrapidity and sqrt(s_{NN}) = 17.3 GeV

Pb+Pb@NA49, C.Alt et al., PRC C77, 034906 (2008)



Ratios between antiparticle and particle yields vs p_t at 17.3 GeV



Pb+Pb@NA49, C.Alt et al., PRC C77, 034906 (2008)

Isospin argument:

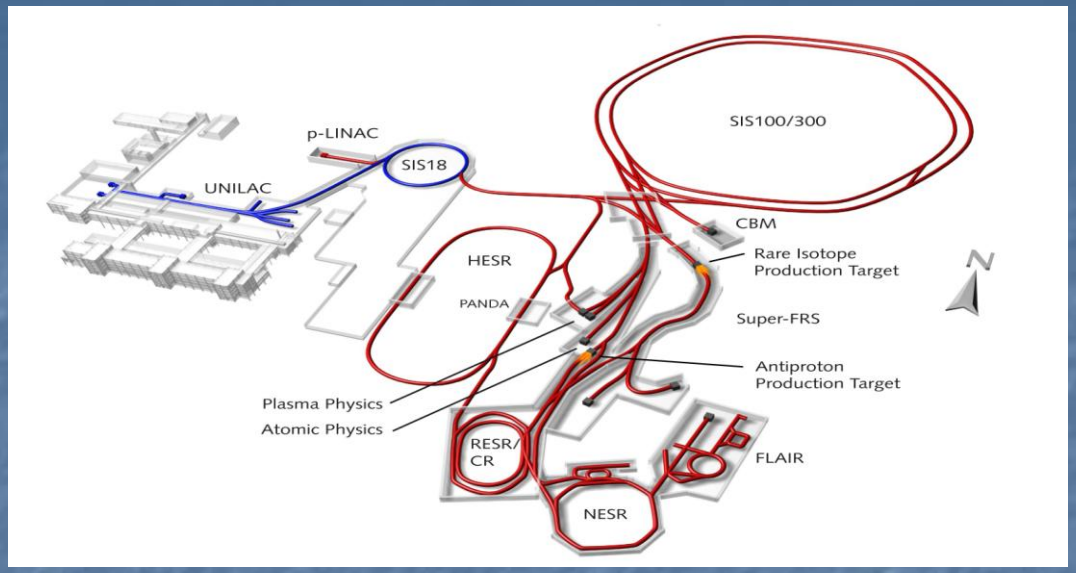
P+P: maximally isospin-asymmetric system

π^-/π^+ - slightly below unity;

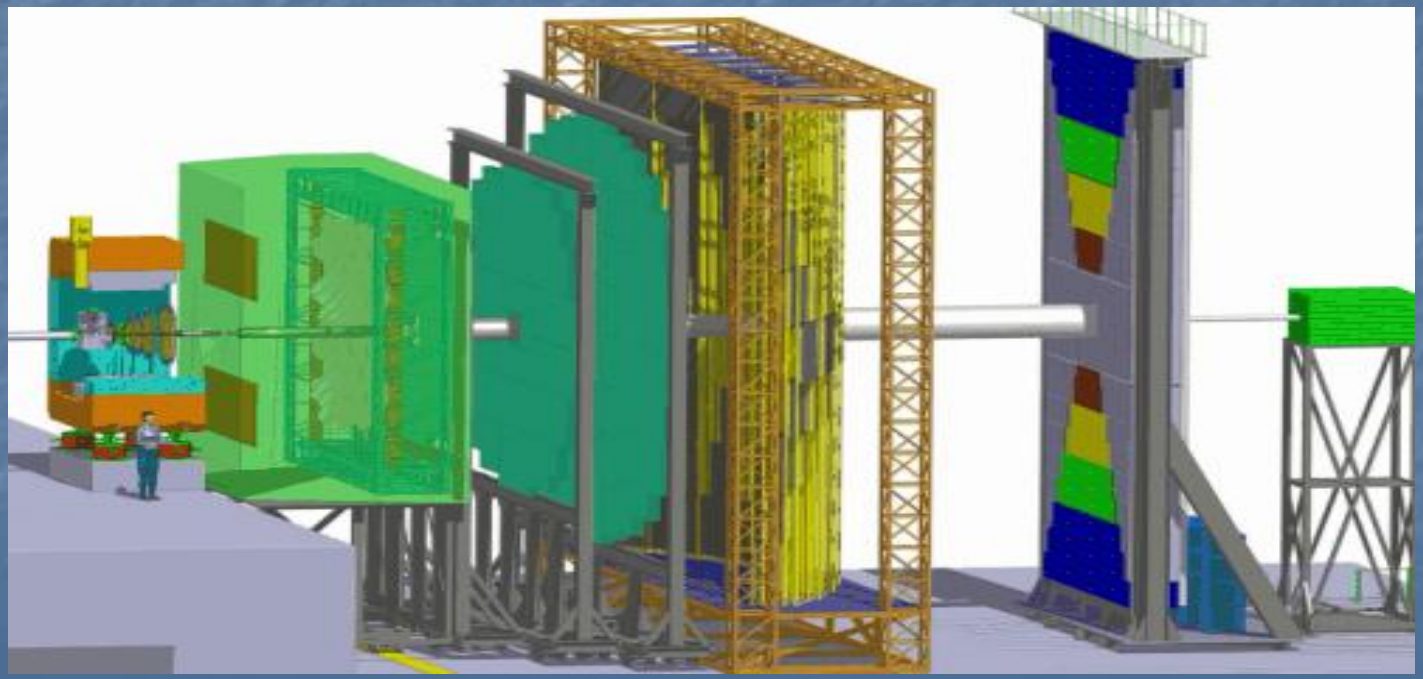
Pb+Pb: is less asymmetric in isospin.

π^-/π^+ - closer to unity

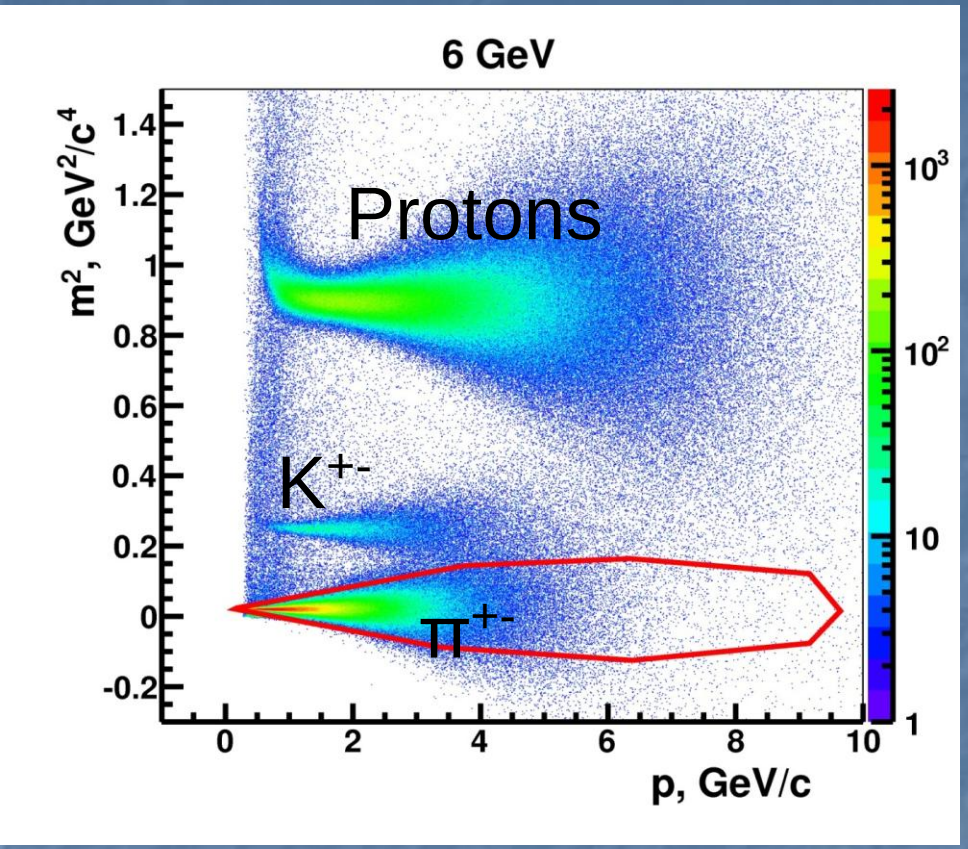
K-/K+ and **~p/p** are not hold due to net-baryon density;

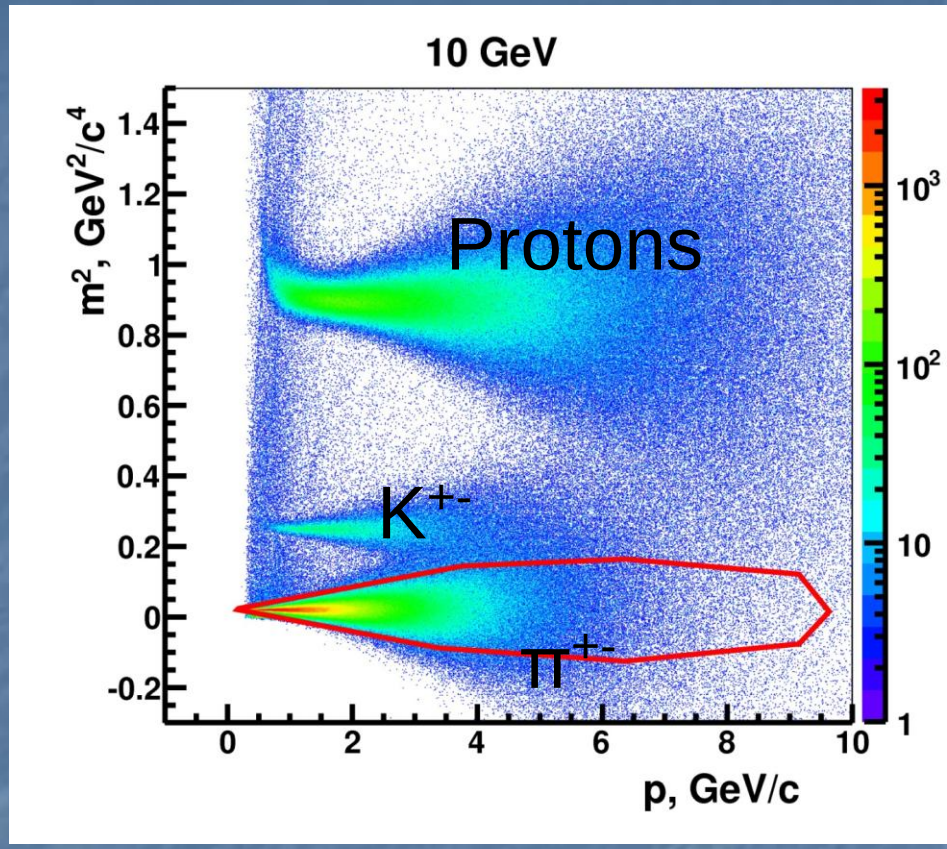


FAIR and CBM setup in electron version



Particle identification at 6 and 10 AGeV

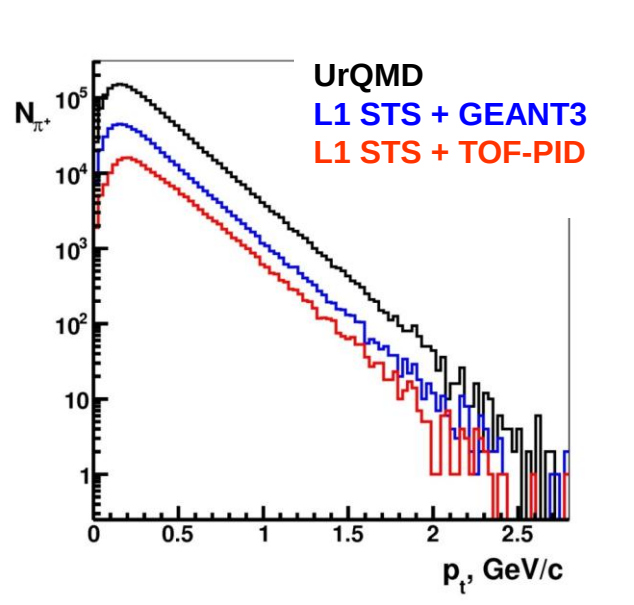


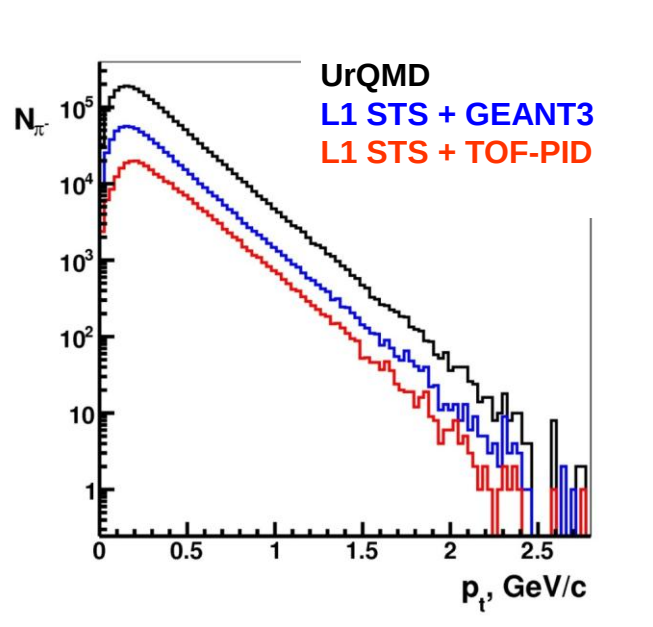


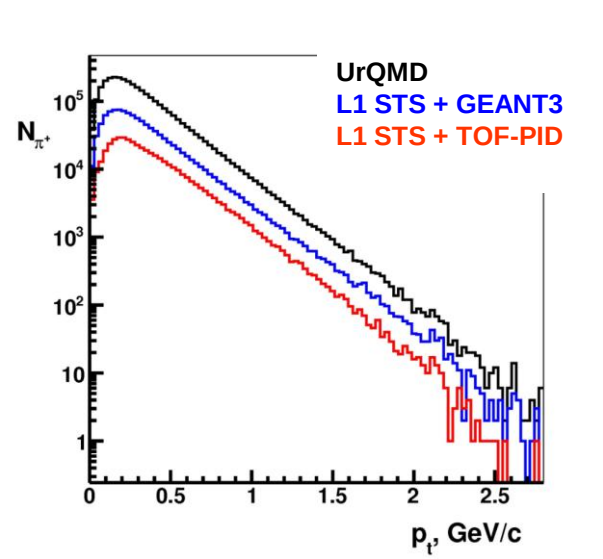
1. CBMROOT
2. UrQMD 10 kEvents: Au + Au, central events at T_{kin}= 6, 8 and 10 AGeV
4. KF L1 STS -RECO, PID from TOF

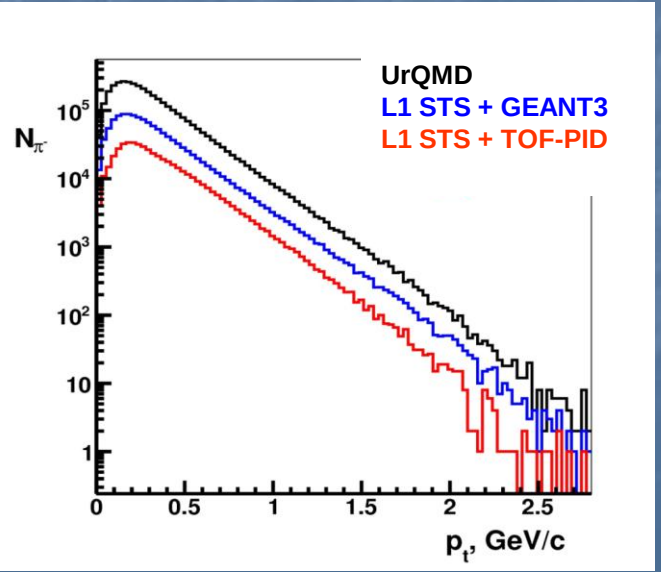
$$M^2 = p^2 (1/\beta^2 - 1)$$

High P_t pion spectra of central AuAu coll. at 6 and 10 AGeV

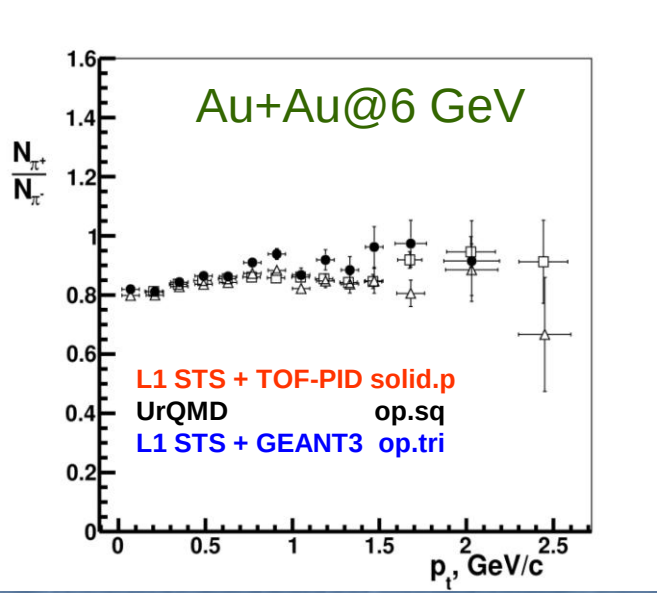


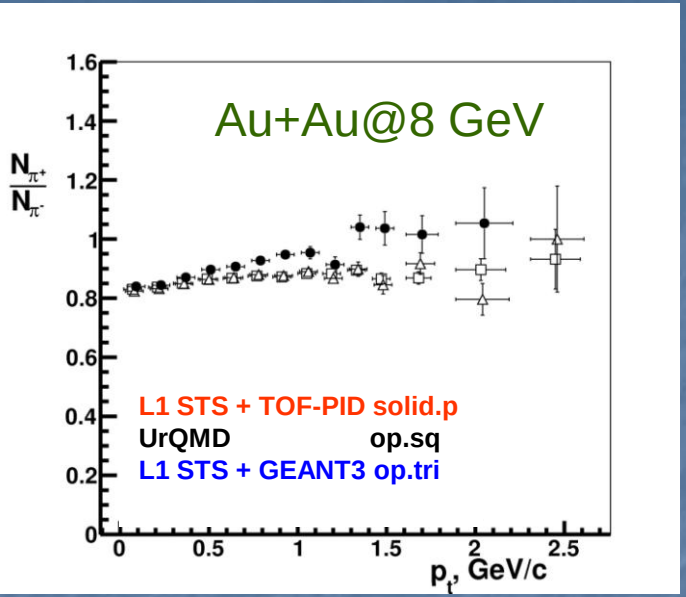


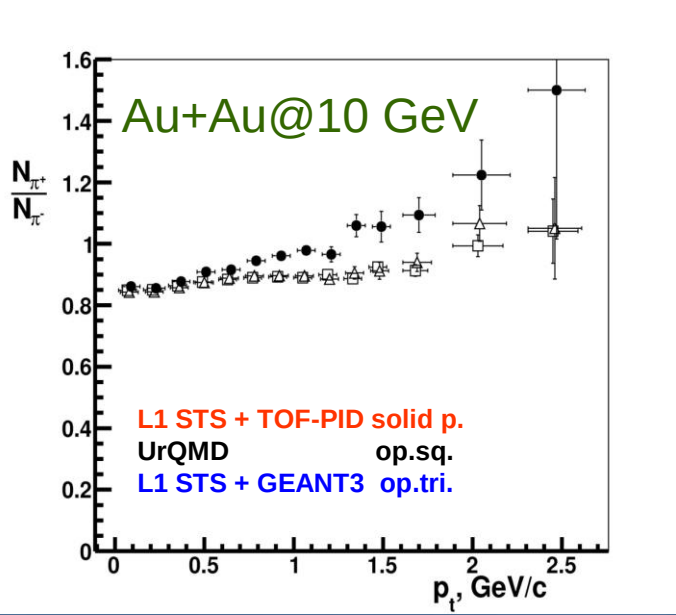




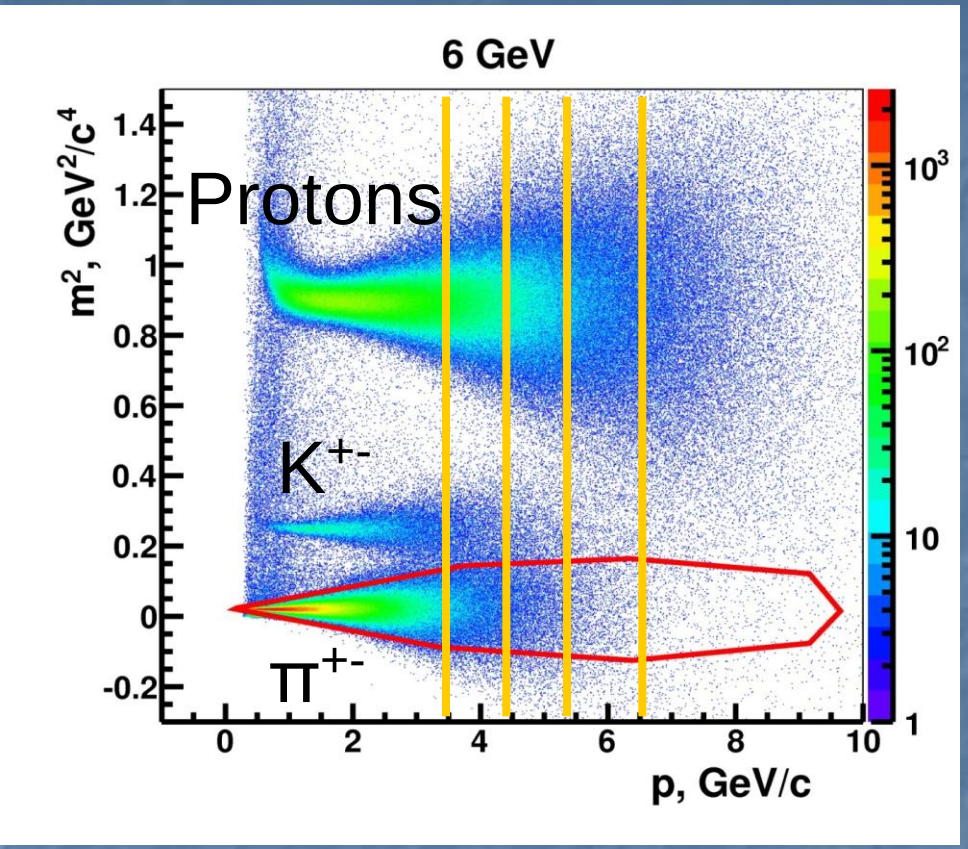
Ratio of π+/π- at 6, 8 and 10 AGeV

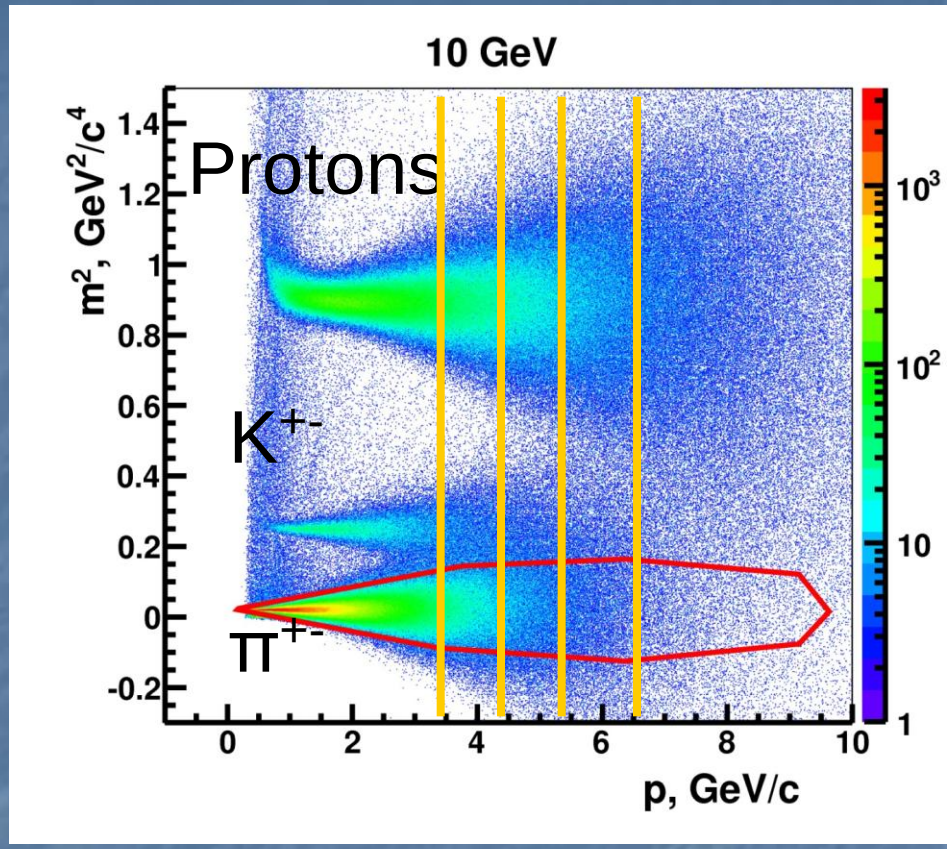






Modification for particle identification at 6 and 10 AGeV





Slice segments:

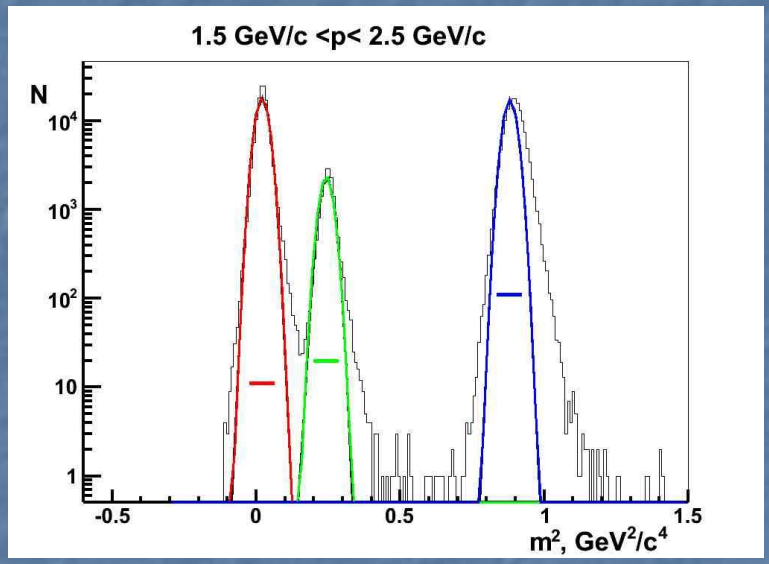
3.5 - 4.5 GeV/c
4.5 - 5.5 GeV/c
5.5 - 6.5 GeV/c

TOF Wall – 10 m
Mass resolution ~ σ_{TOF}

$M^2 = p^2 (1/\beta^2 - 1)$,
$\sigma_t =$ 80 ps

$\sigma_m^2 = 2p^2 (c^2t/l^2) \sigma_t$
$(\sigma_t >> \sigma_{mom} > \sigma_{length})$

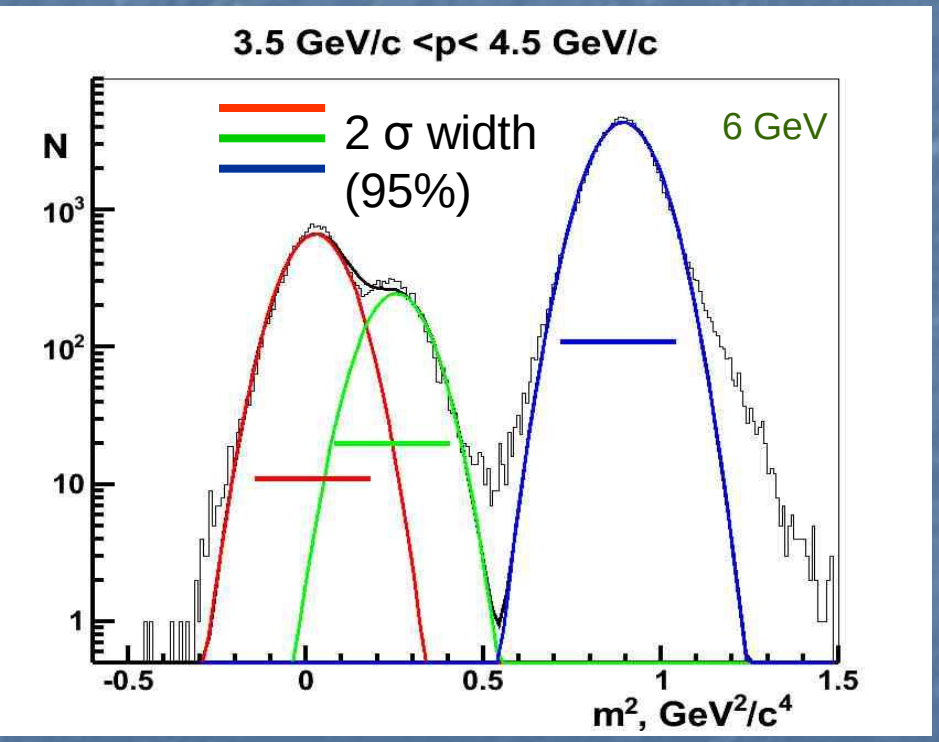
3 x Gaus, 7 par-fit

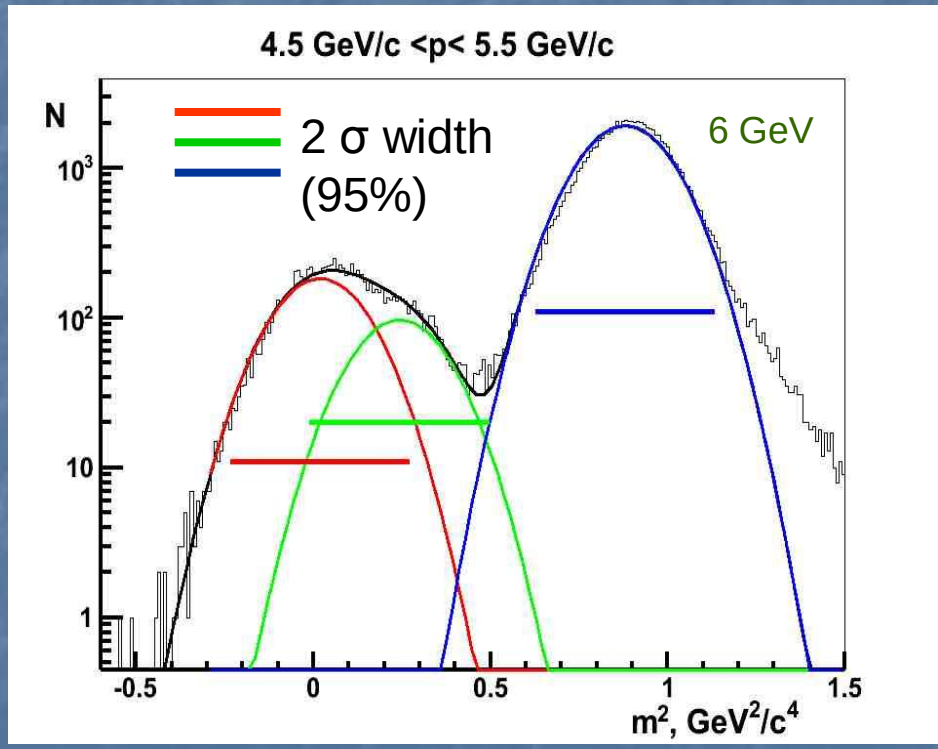


$$f(m^2) = \sum_{i=\pi,K \text{ and } P} A^i \exp\left(-\frac{1}{2}\left(\frac{m^2 - m^{2^i}_{tab}}{\sigma_{tof}}\right)^2\right)$$

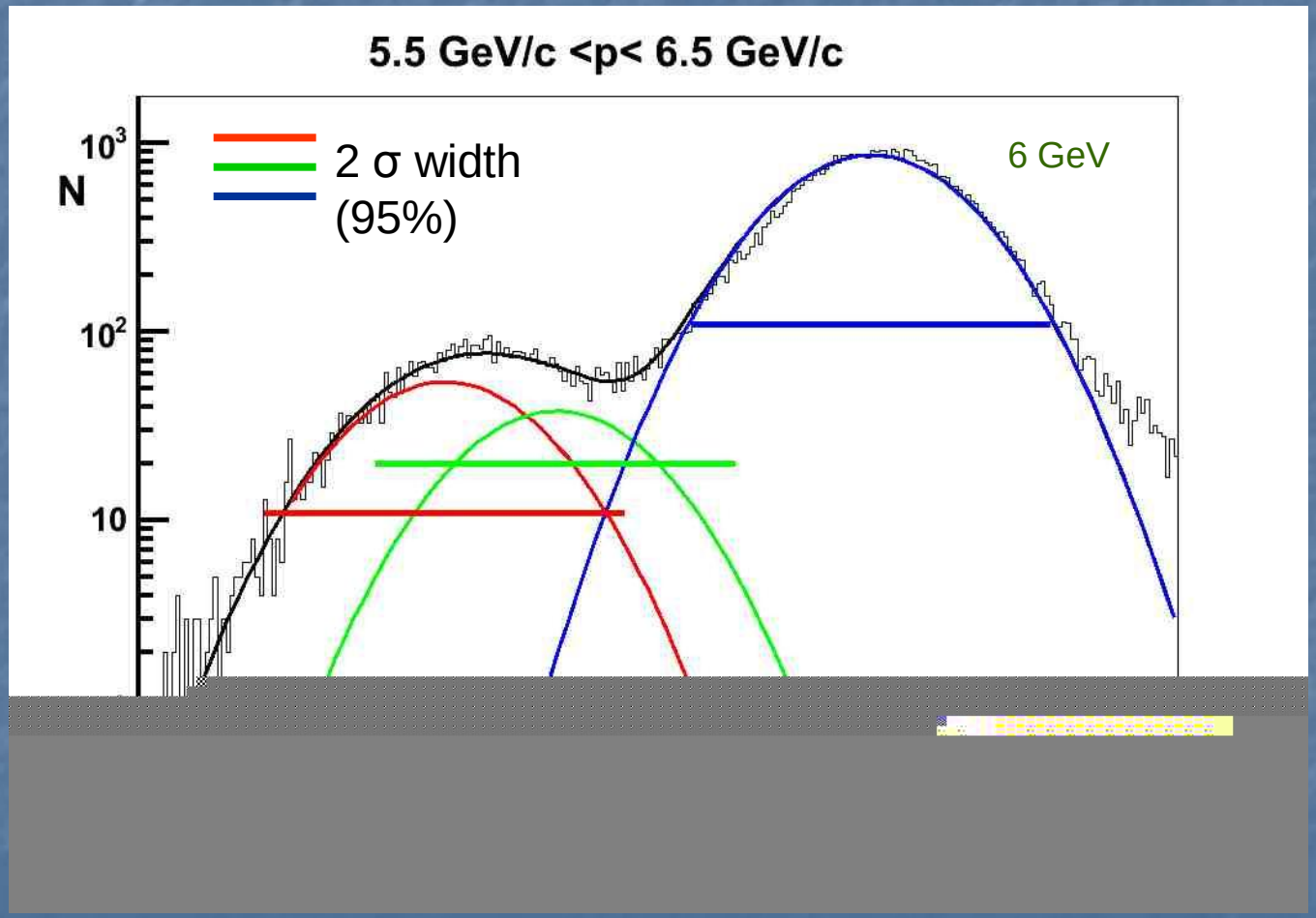
4 FREE parameters:
A1, A2, A3 and σ

Squared mass spectrum of reconstructed π^+, K^+ and protons at 6 AGeV and 3.5<p<4.5 GeV/c, and 4.5<p<5.5 GeV/c

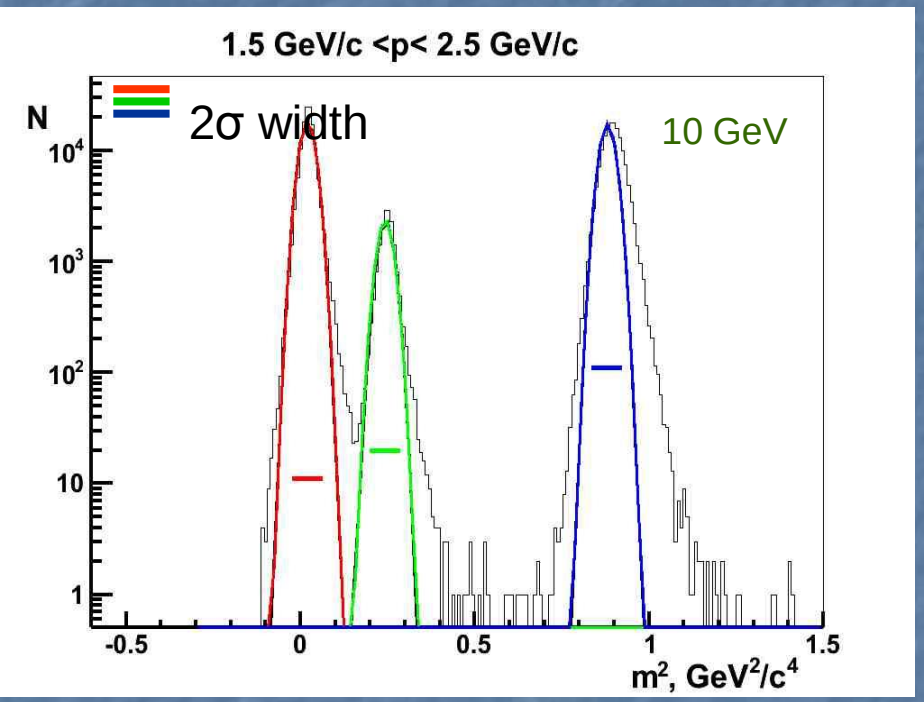


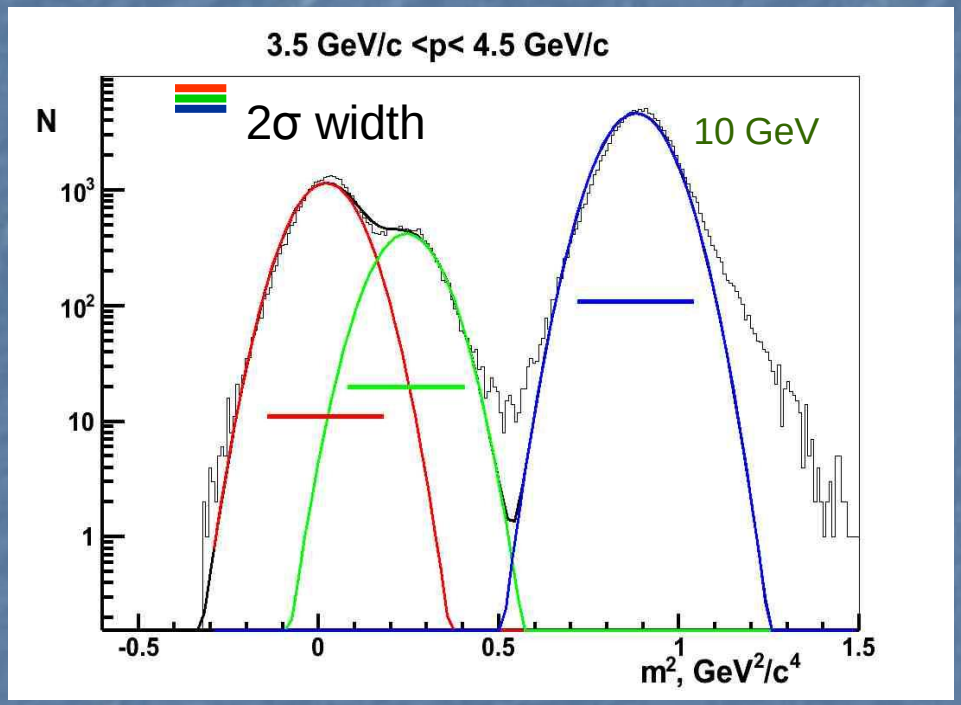


Squared mass spectrum of reconstructed π^+, K^+ and protons at 6 AGeV and 5.5<p<6.5 GeV/c

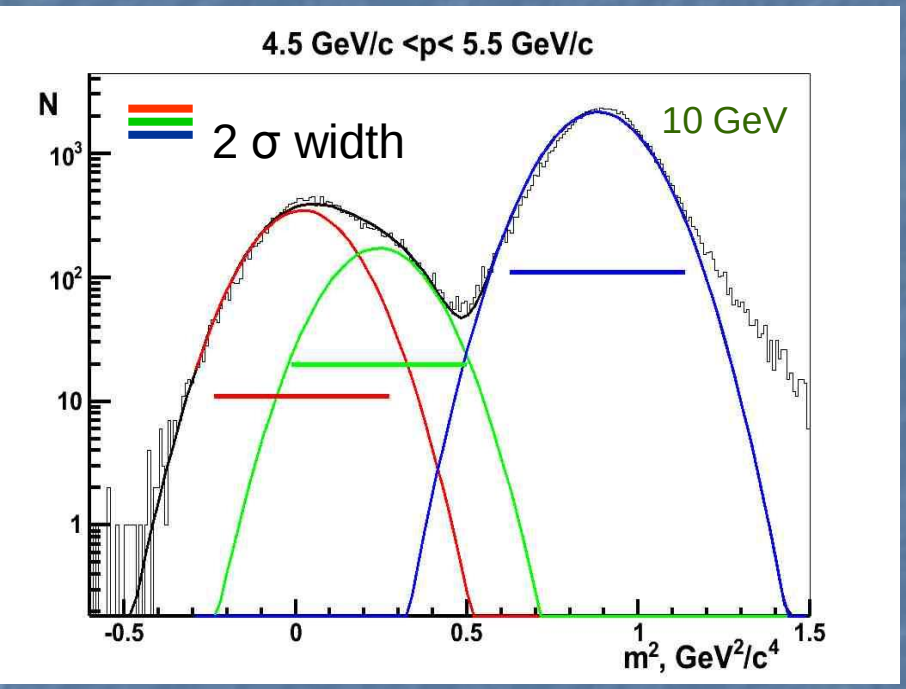


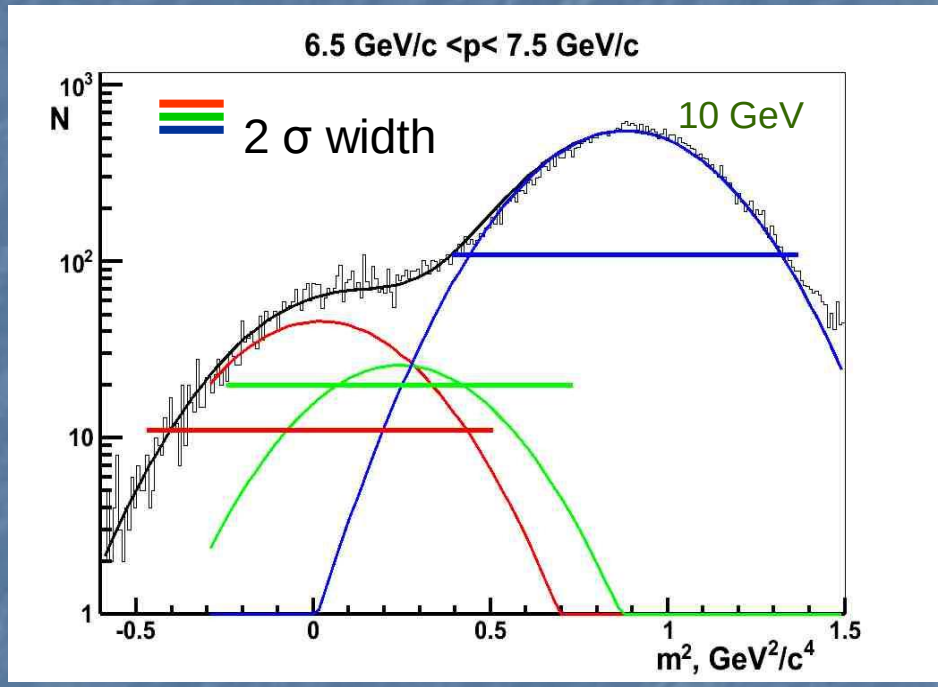
Squared mass spectrum of reconstructed π^+, K^+ and protons at 10 AGeV and 1.5<p<2.5 GeV/c and 3.5<p<4.5 GeV/c



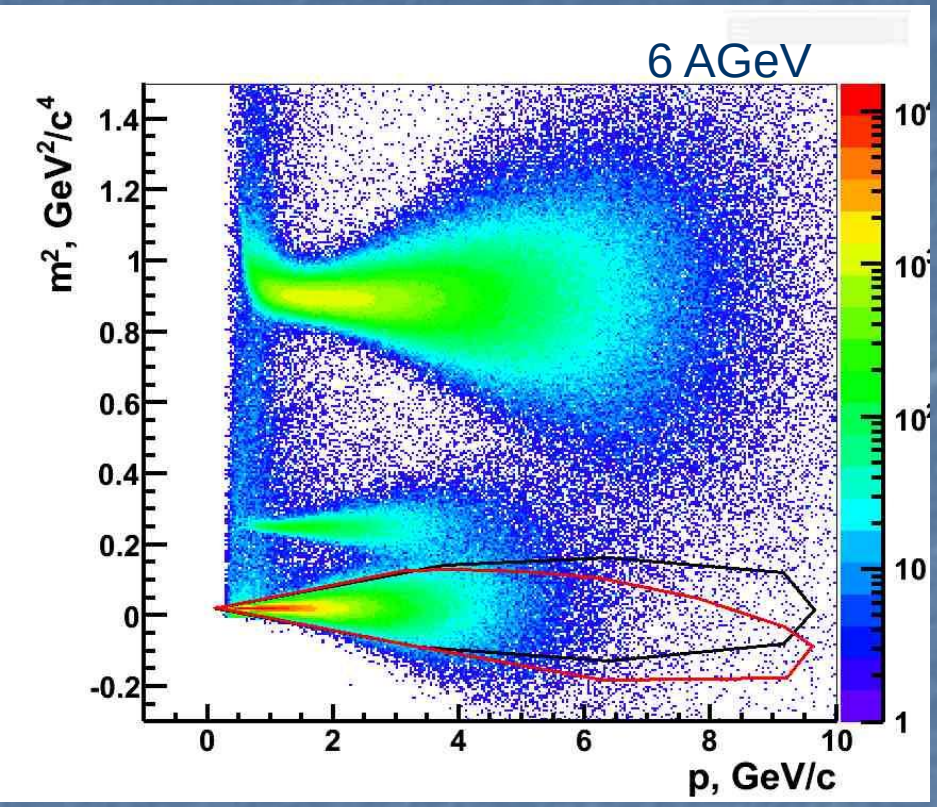


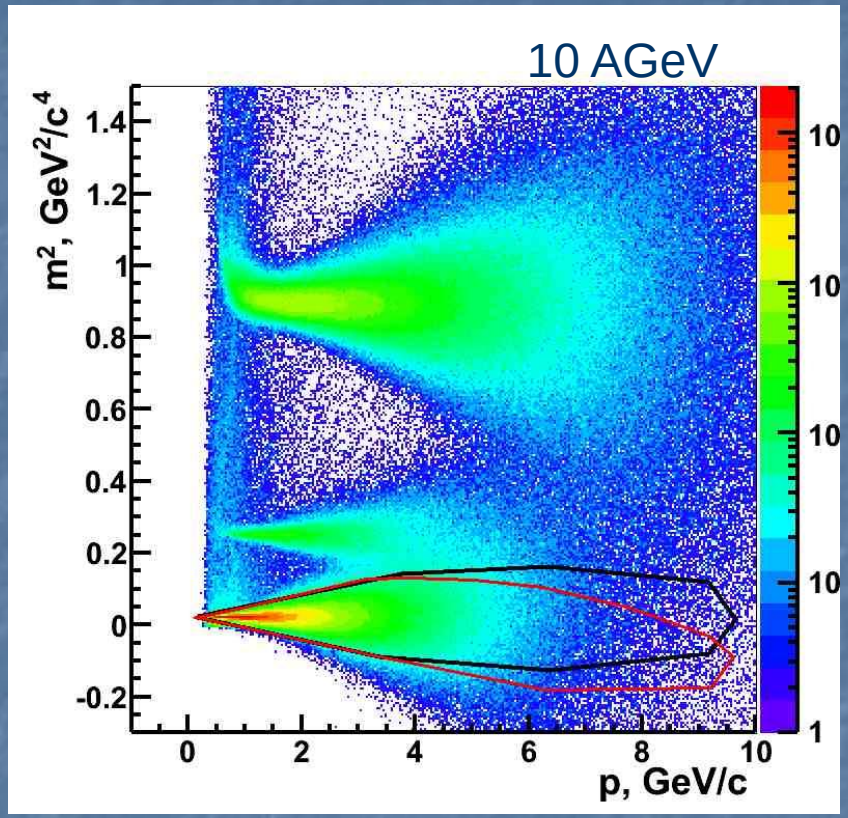
Squared mass spectrum of reconstructed π^+, K^+ and protons at 10 AGeV and 5.5<p<6.5 GeV/c



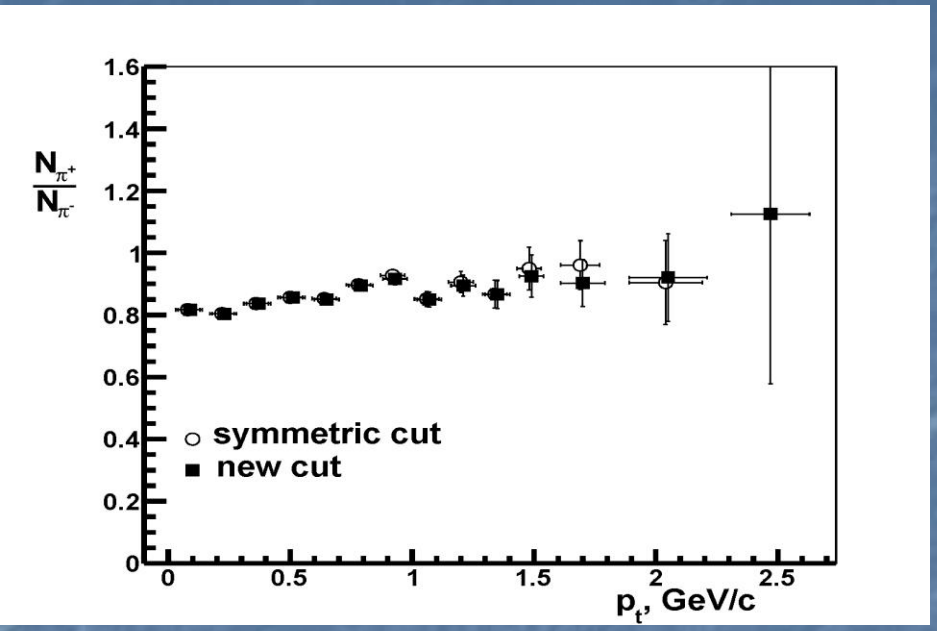


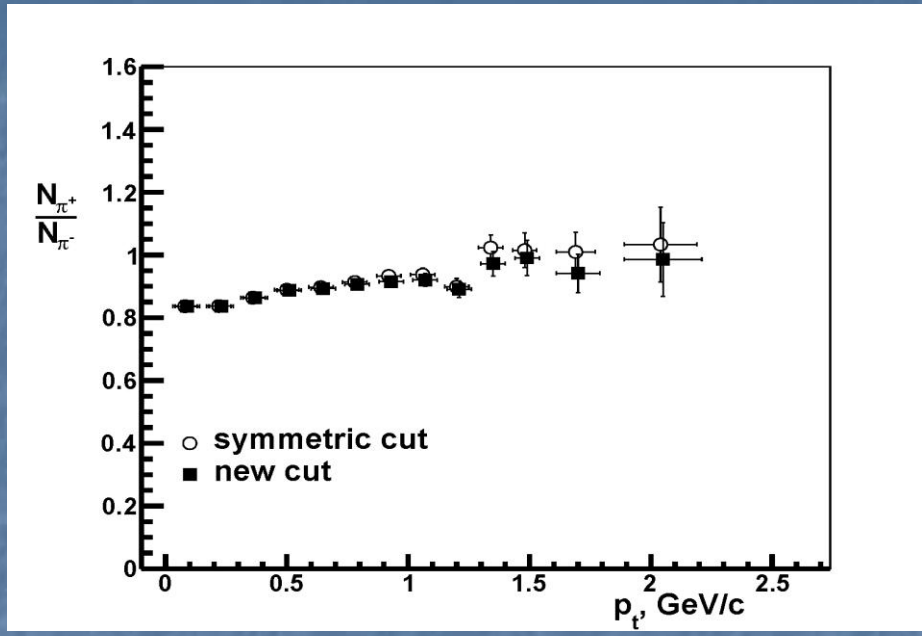
Modified Graphical cuts for Particle identification at 6 and 10 AGeV

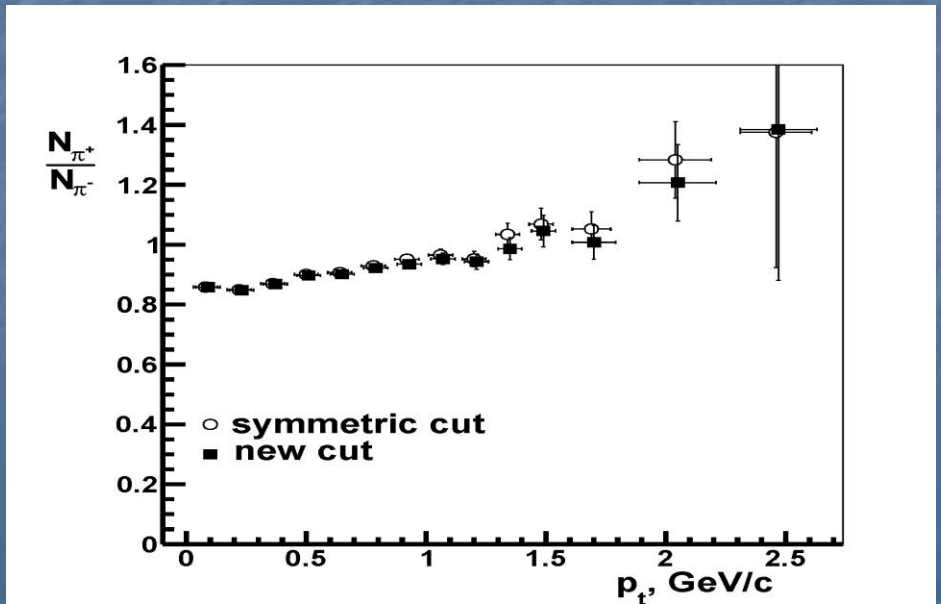




Ratio of π+/π- at 6, 8 and 10 AGeV with new and symmetric cuts







Hole-Jet Transition
Modification properties of jets (azim.corr)

HADRON GAS

- System of hadrons close to equillibrium

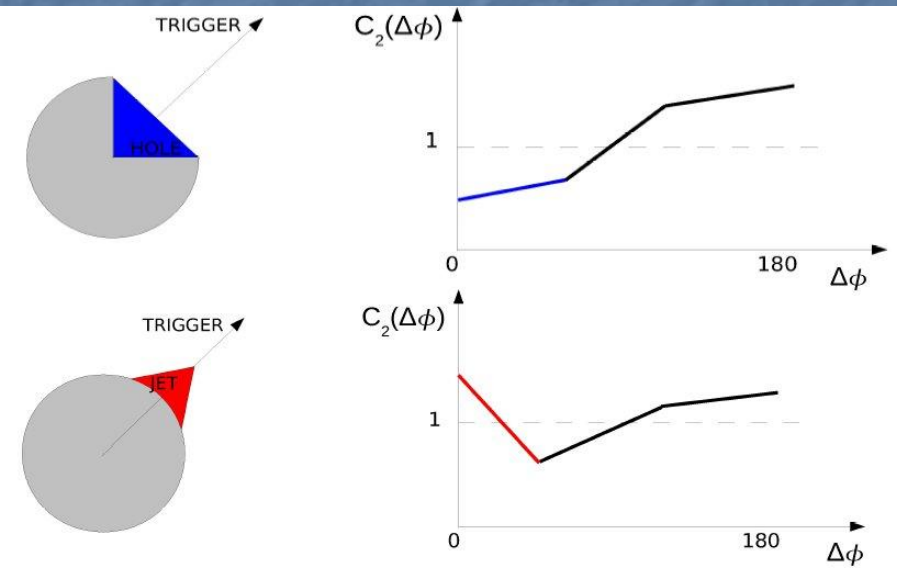
HOLE – a medium range anti-correllation of hadrons with a high transverse momentum hadron

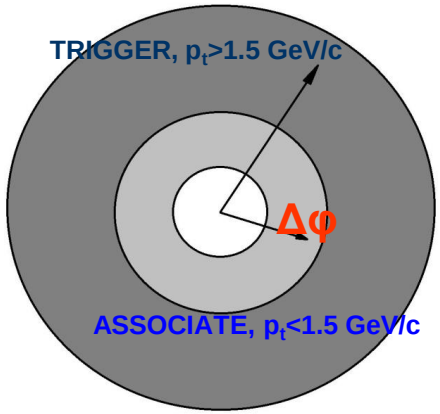
The **HOLE** effect is due to transverse momentum conservation

QGP – a system of quarks and gluons close to equlibrium

JET – a medium-range correlation of hadrons with a high transverse moentum hadron

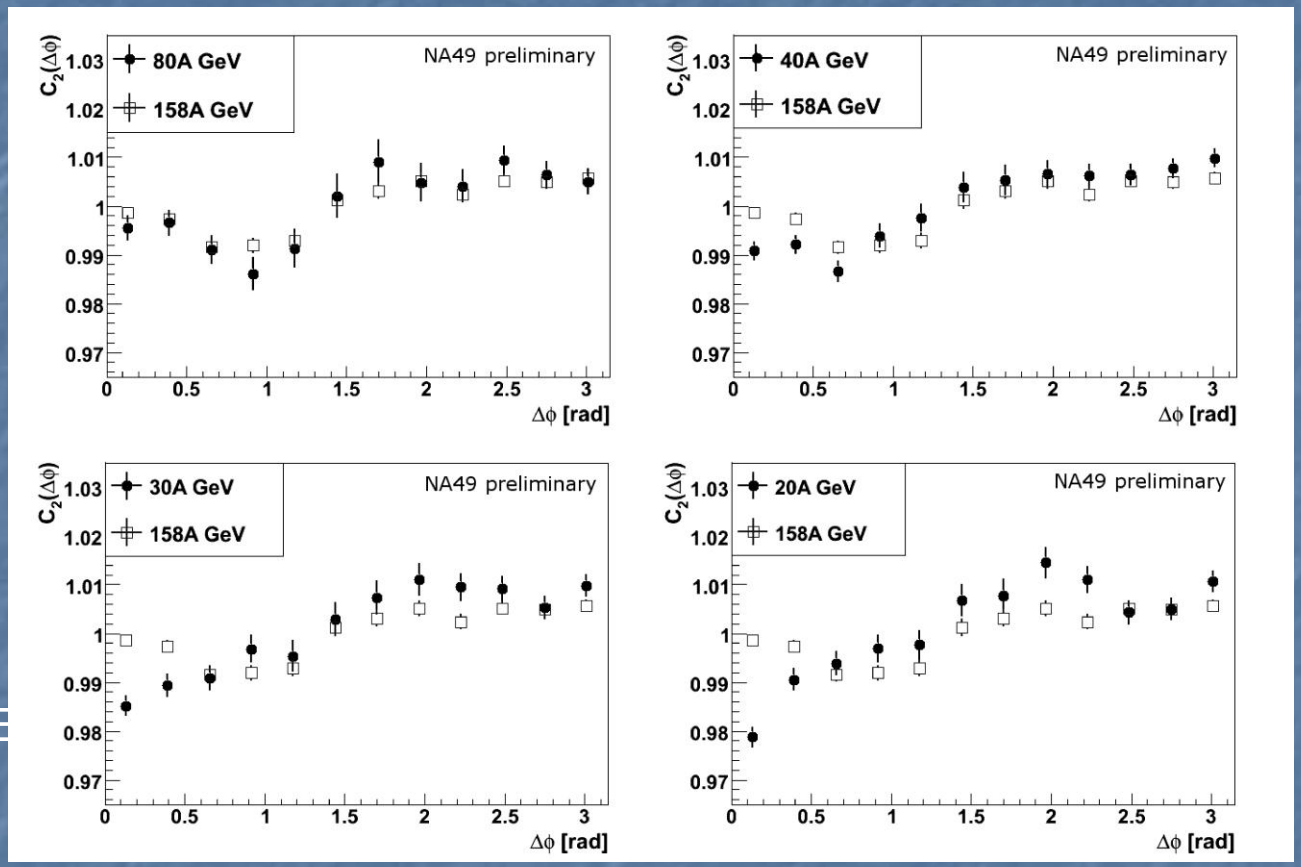
The **JET** effect appears as a consequence of the evolution and hadronization of the QGP quarks and gluons with high transverse momenta





NA49: Hole-Jet transition

Central Pb+Pb collisions at the SPS energies



JET

TRANSITION

HOLE

NA49: M.Szuba et al.,
arXiv:0809.5210v1
[nucl-ex] 30 sep 2008

$\Delta\varphi = \varphi_{associate} - \varphi_{trig}$, centrality 0-5%

$$C_2(\Delta\phi) = \frac{N_{corr}(\Delta\phi)}{N_{mix}(\Delta\phi)} \frac{\int N_{mix}(\Delta\phi')\mathrm{d}(\Delta\phi')}{\int N_{corr}(\Delta\phi')\mathrm{d}(\Delta\phi')}$$

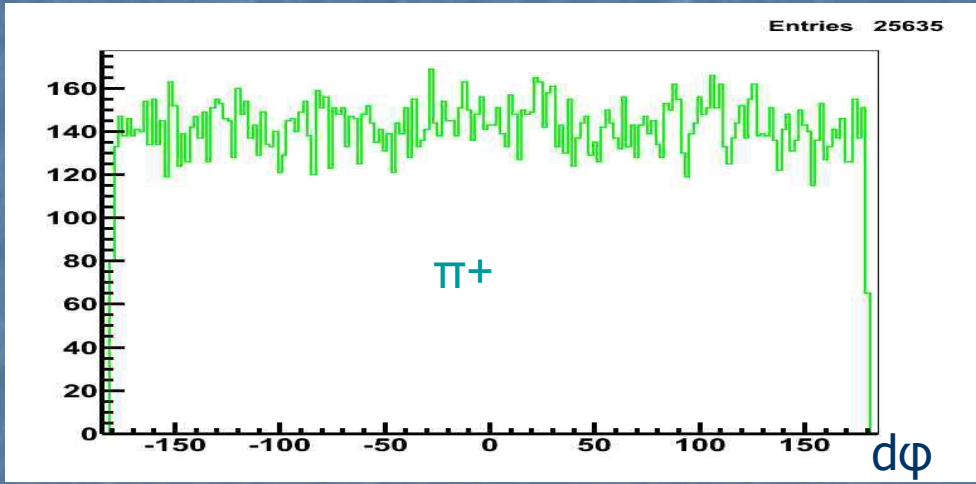
Mixing 50 most recent events

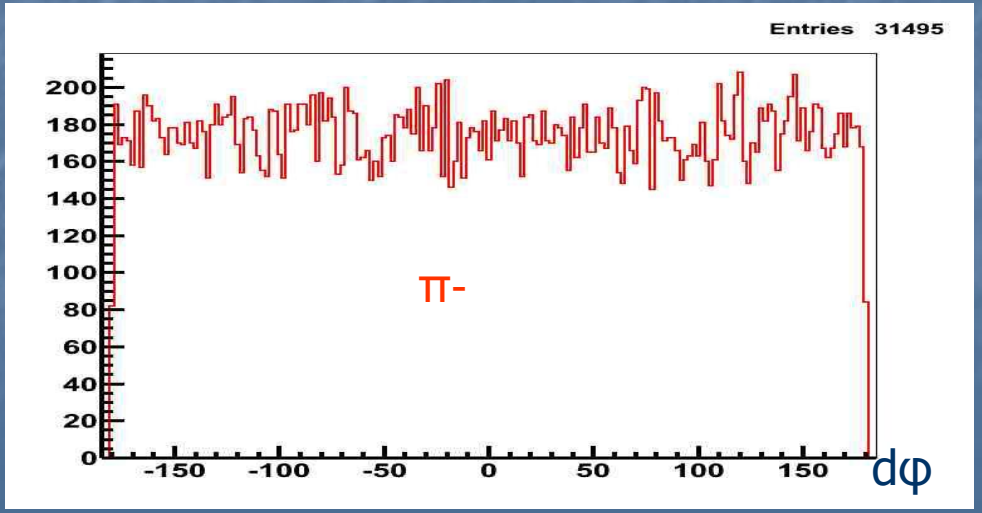
Δφ distribution at 6 AGeV for High P_t events

1. Trigger track is $\pi^+(\pi^-)$ with p_t>1.5 GeV/c,

2. $\varphi_0 = \varphi_{trigger}$

3. $\Delta\varphi = \varphi_i - \varphi_0$





Conclusions

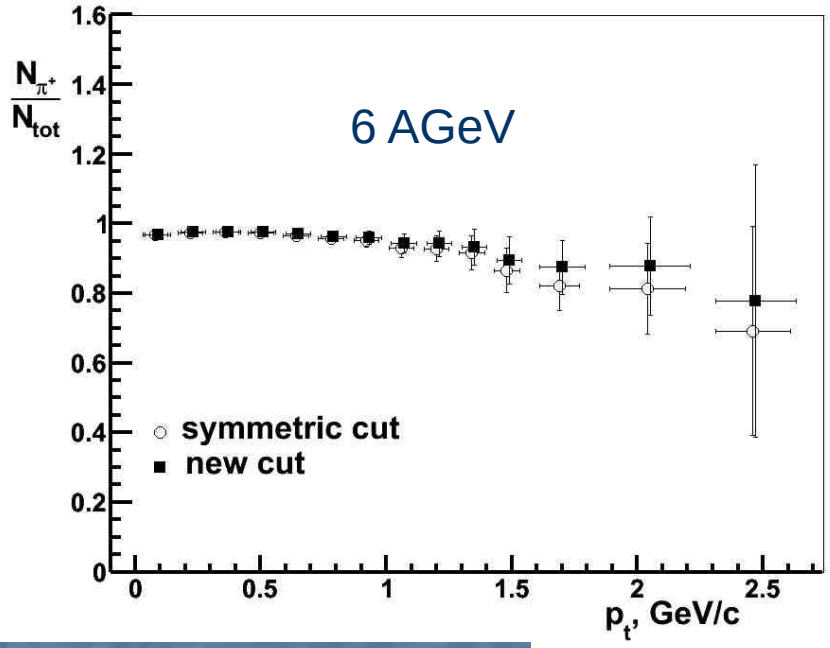
1. Simulation of the high p_t pion spectra from HIC at CBM@SIS100 is performed.

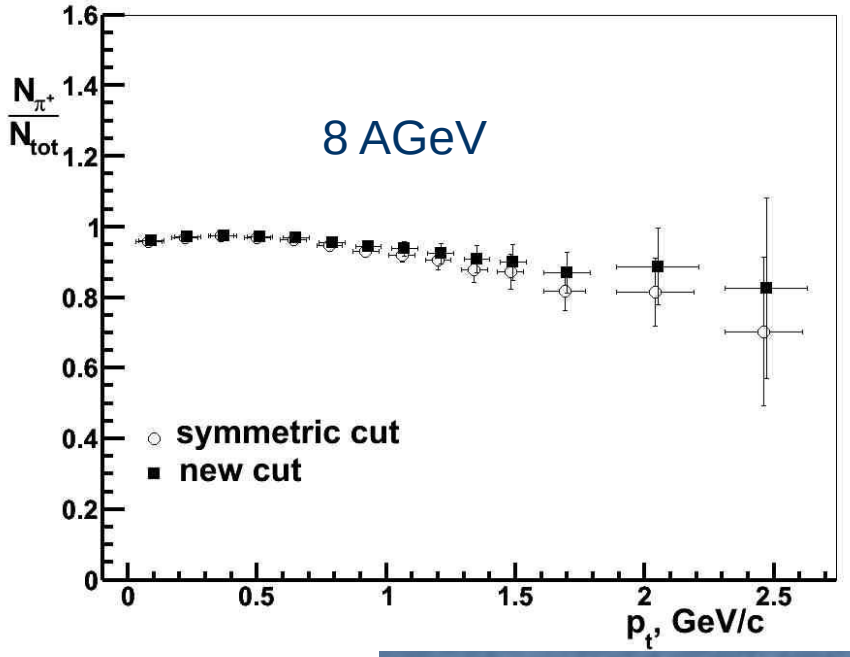
2. It is shown that π^- spectra can be reconstructured with the high purity (~98%) using PID from RPC(TOF).

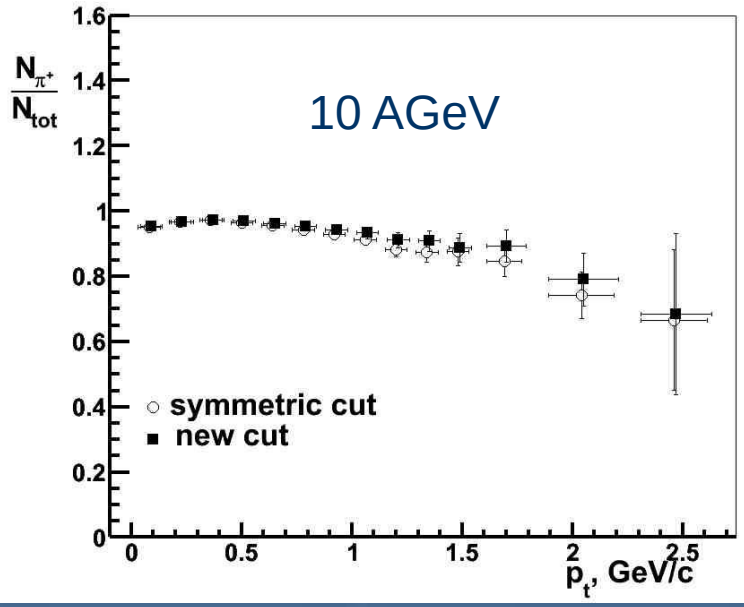
3. The reconstruction of the π^+ spectra requires additional suppression of misidentified K^+ and protons.

4. The study of dipion azimuthal correlations is started.

Purity for π^+ at 6, 8 and 10 AGeV

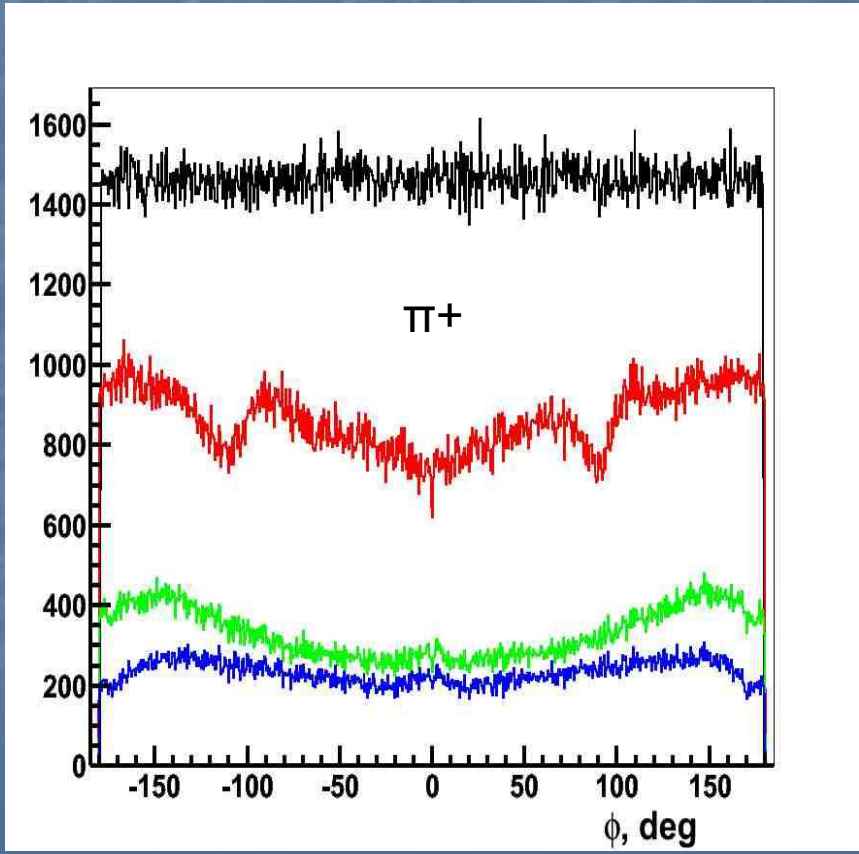




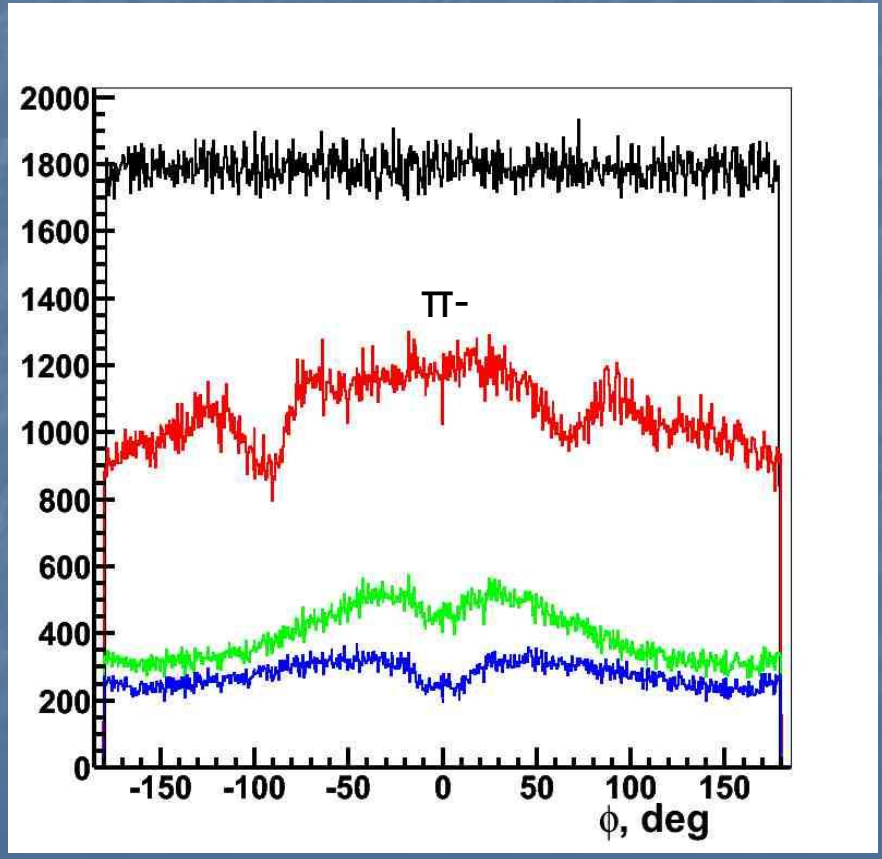


Azimuthal φ-distribution of the π^+ and π^- tracks from UrQMD and RECO-STS with TOF-PID at 6 AGeV

UrQMD
L1-STS + TOF-PID



L1-STS + GEANT PID
L1-STS + TOF-PID + Θ-cutoff



Nonunifromity of the π+ and π- azimuthal φ .vs. Polar Θ

Cutoff on polar angle:
$4.5^{o}<\Theta<20^{o}$