Study of the high-p_T pion and strangeness production in heavy ion collisions for the experiments with fixed target

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JINR

Outlook

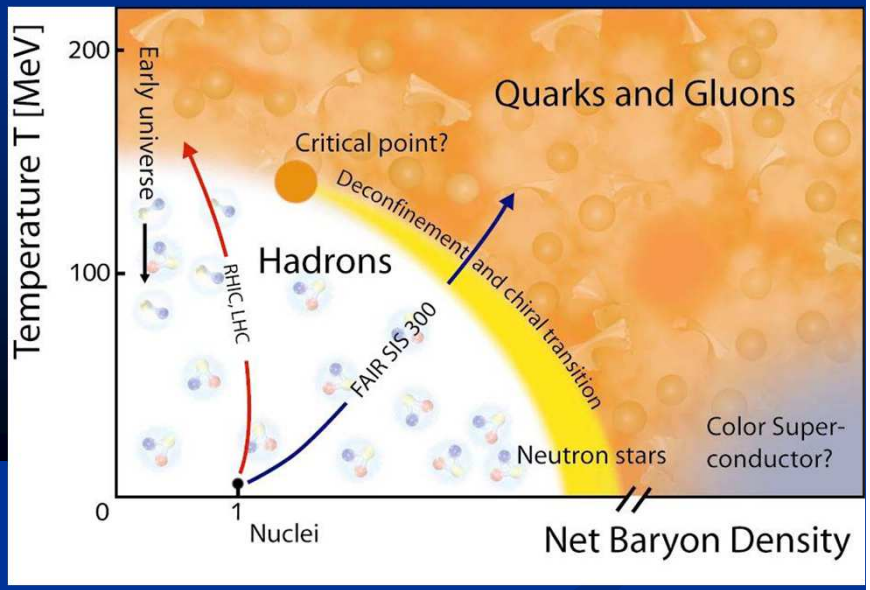
Motivation

1. Fixed target experiments
2. Particle identification with STS-TOF
3. High momentum Pion-ID with STS-RICH
4. High-$\mathbf{p}_T$ pion spectra
5. Hyperons reconstruction with ST + Warm Magnet

Conclusions

Signals of the phase transition:

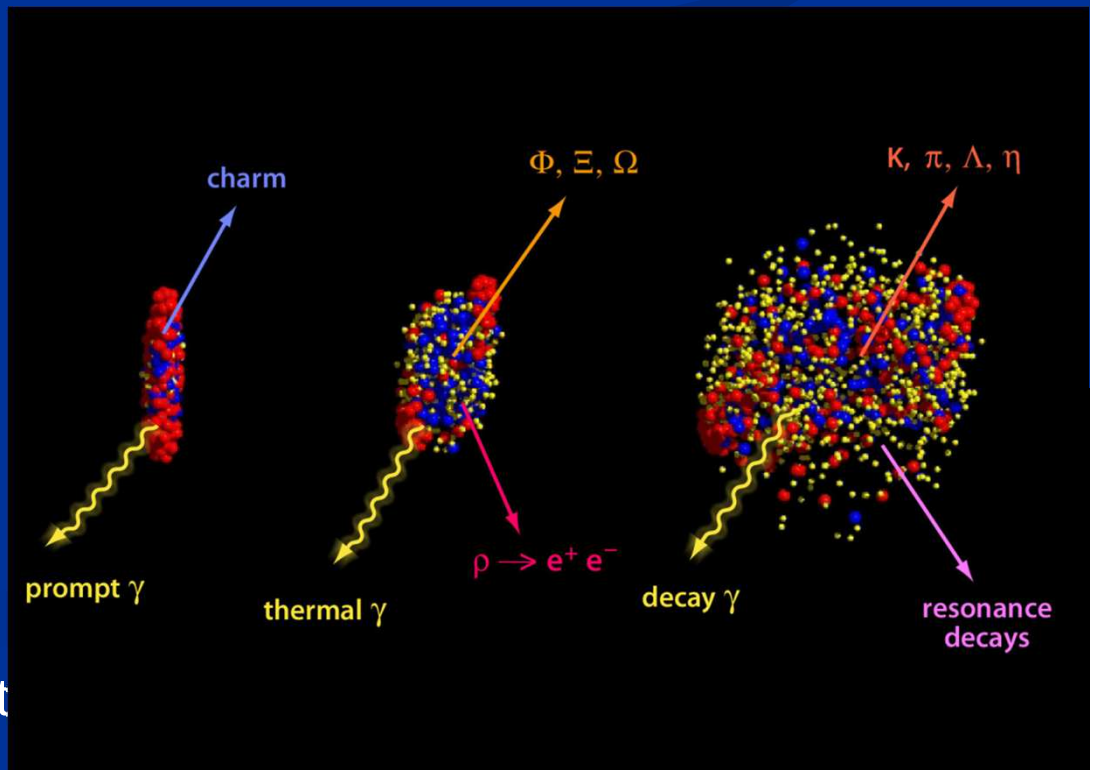
- **Multi-strange particle enhancement in A+A**
- **Charm suppression**
- **Collective flow (v1, v2)**
- **Thermal dileptons**
- **Jet quenching and angular correlations**
- **High p_T suppression of hadrons**
- **Non-statistical event by event fluctuations and correlations**



Experiment: measures final hadrons and leptons

Signals of the phase transition:
How to learn about physics from data?
Compare with theory!

Microscopic transport models:
pHSD, UrQMD



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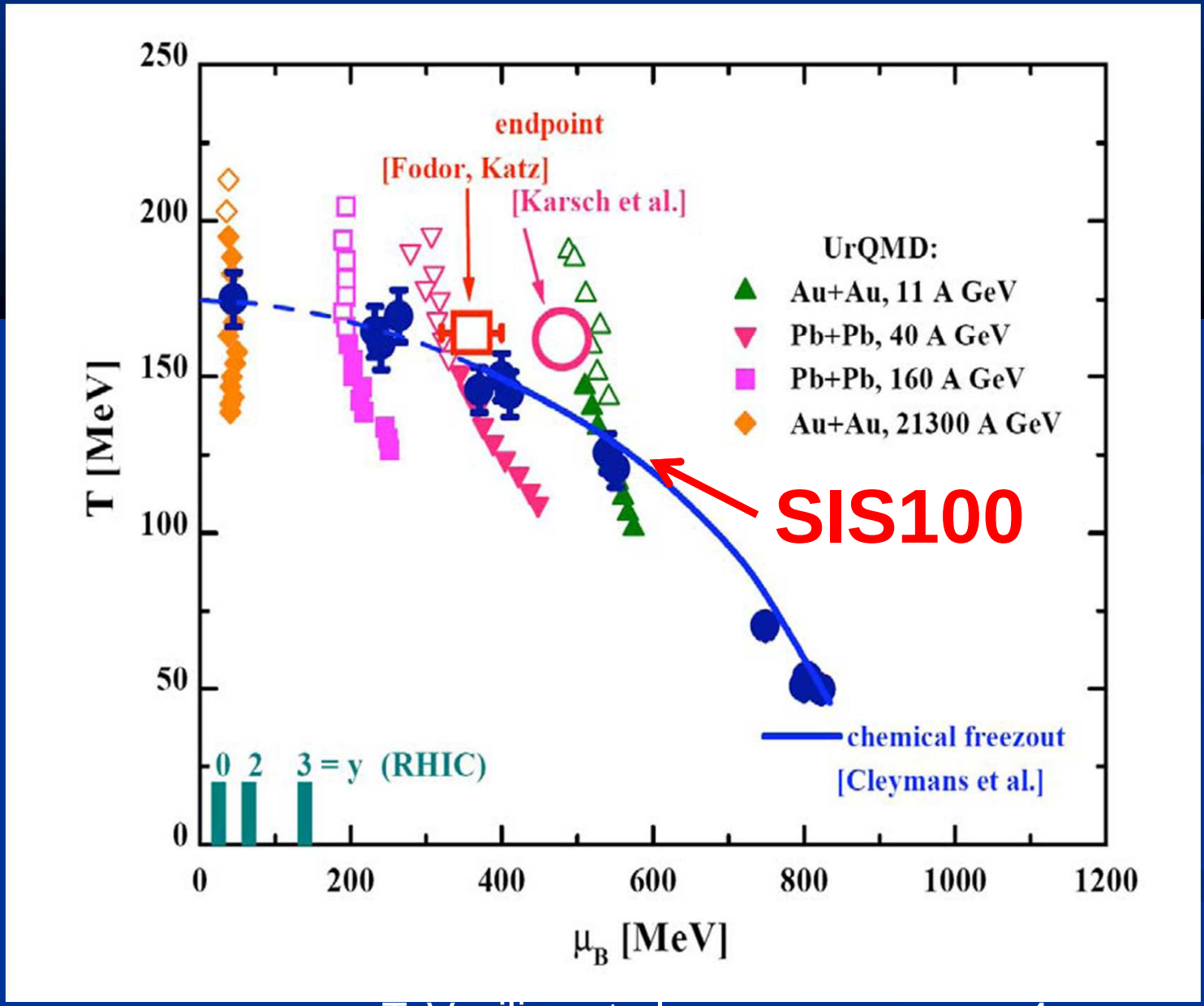
UrQMD (hadronstring transport): Phase transition reached already at 11 GeV/nucleon



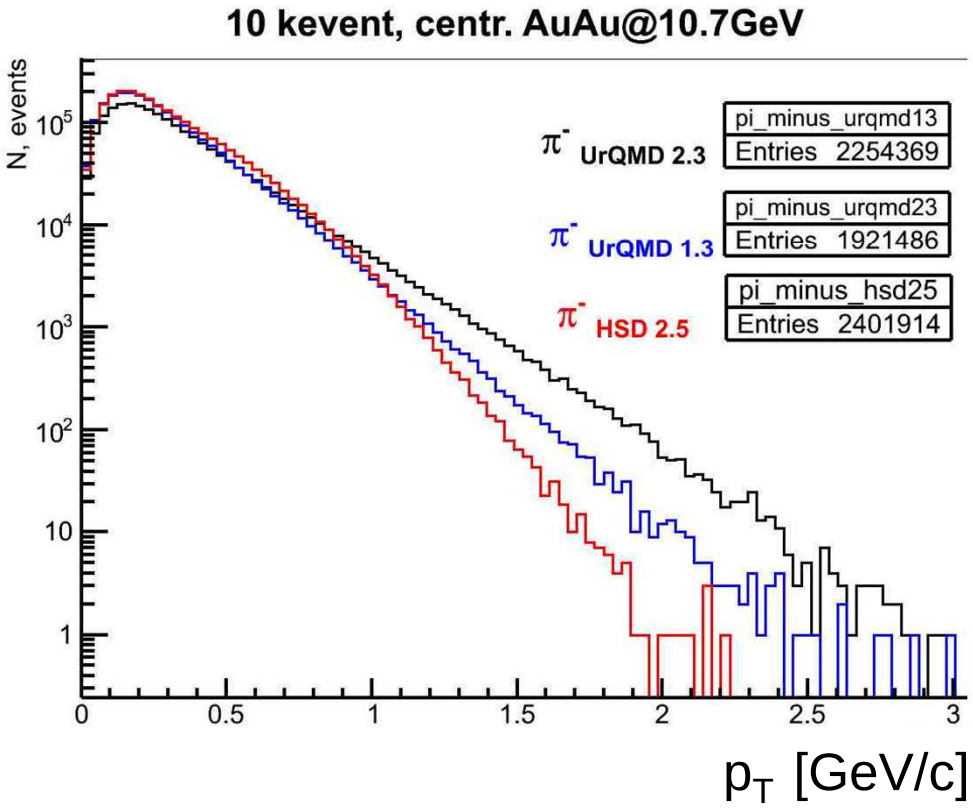
High p_T pion data:

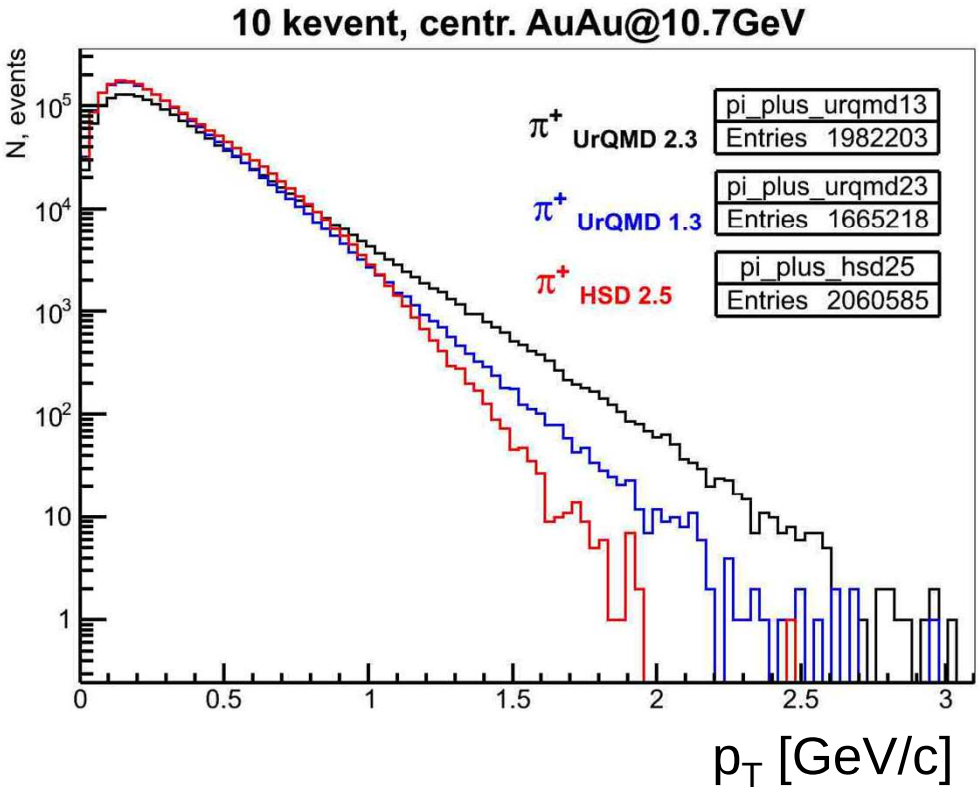
the energy scale of the obtained or to be measured data at AGS, SPS and SIS rings at FAIR

		sqrt(s)	
E866@AGS	Au+Au@10.7A GeV	4.86	GeV
NA49@SPS	Pb+Pb@20,30,80,158A GeV	up to 17.3	GeV
CBM@SIS100	Au+Au@10A GeV	4.72	GeV
CBM@SIS300	Au+Au@25A GeV	7.10	GeV

The high p_T pions in HIC can be sensitive to the partonic phase of the nuclear matter at the energy domain of Nuclotron and SIS100/SIS300.

UrQMD v.1.3 and 2.3 *vs.* HSD 2.5 data comparison for High P_t pion spectra of central AuAu coll. at 10.7 AGeV





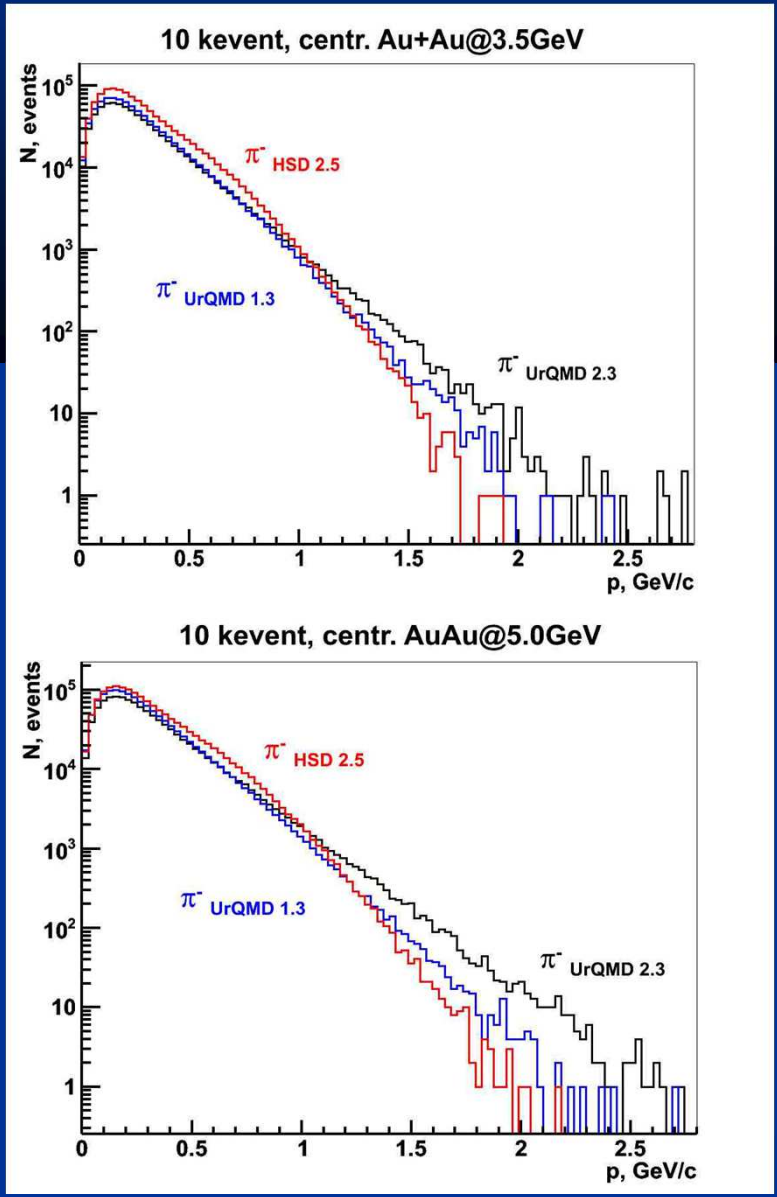
This diff is assigned to multi-particle production mechanisms in elementary interactions (BB/mB).

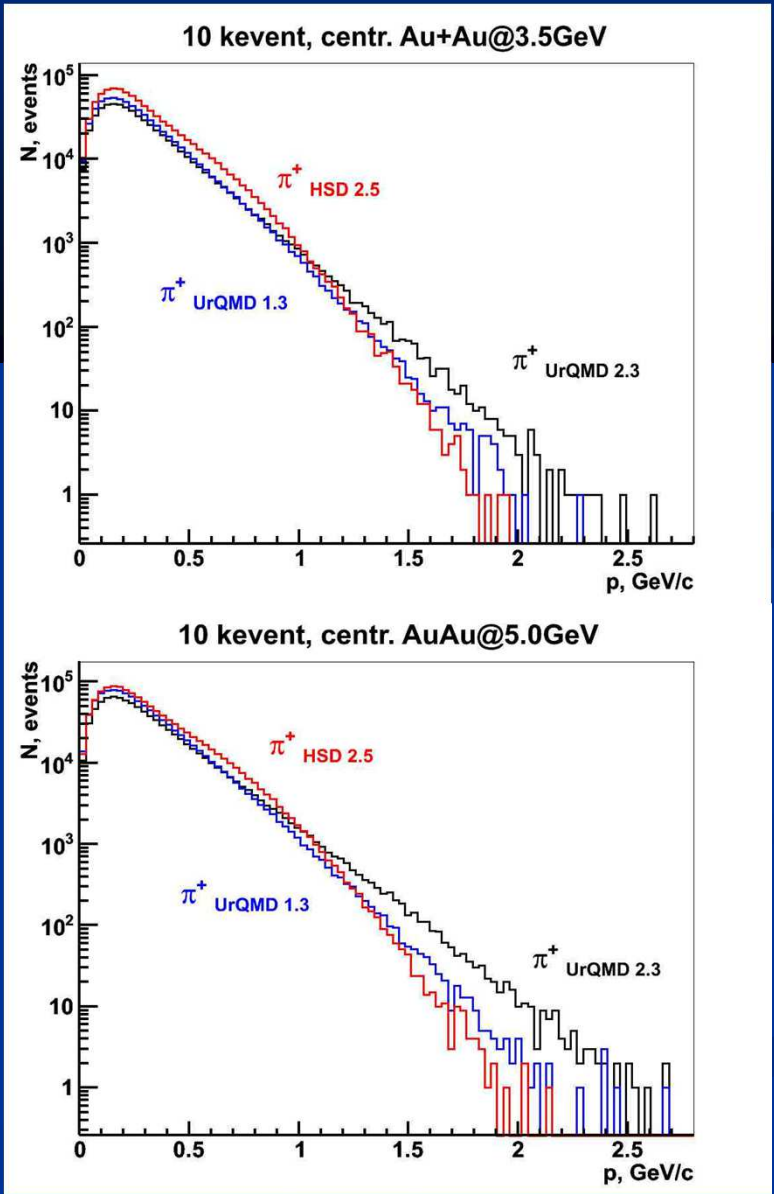
Adding Effective Res. Instead of Strings to describe hard m_T spectra since UrQMD 2.0. This gives this effect of pumping energy from many to pairs.

Phys.Rev.C69:054907,2004. T.Vasiliev et al.

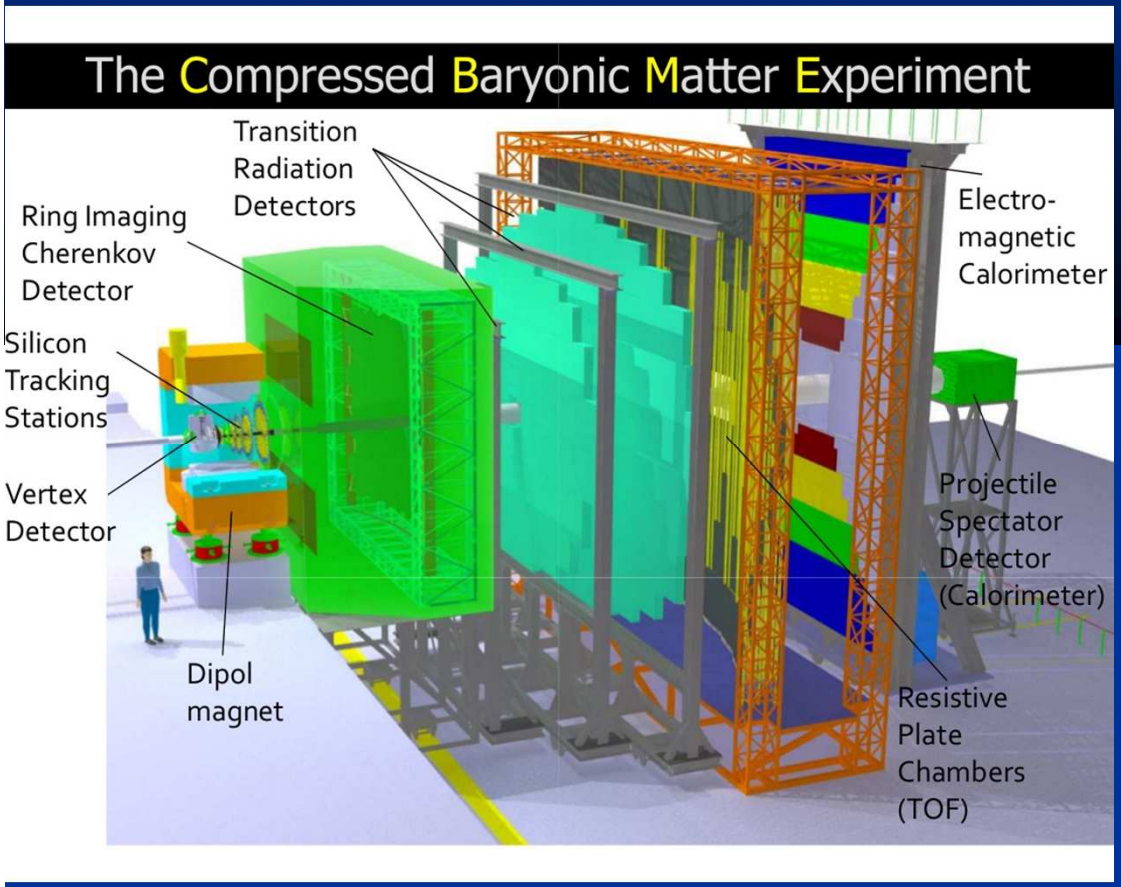
QGP formation should "rise" p_T

UrQMD v.1.3 and 2.3 *vs.* HSD 2.5 data comparison for High P_t pion spectra of central AuAu coll. at 3.5 and 5.0 AGeV





CBM experiment

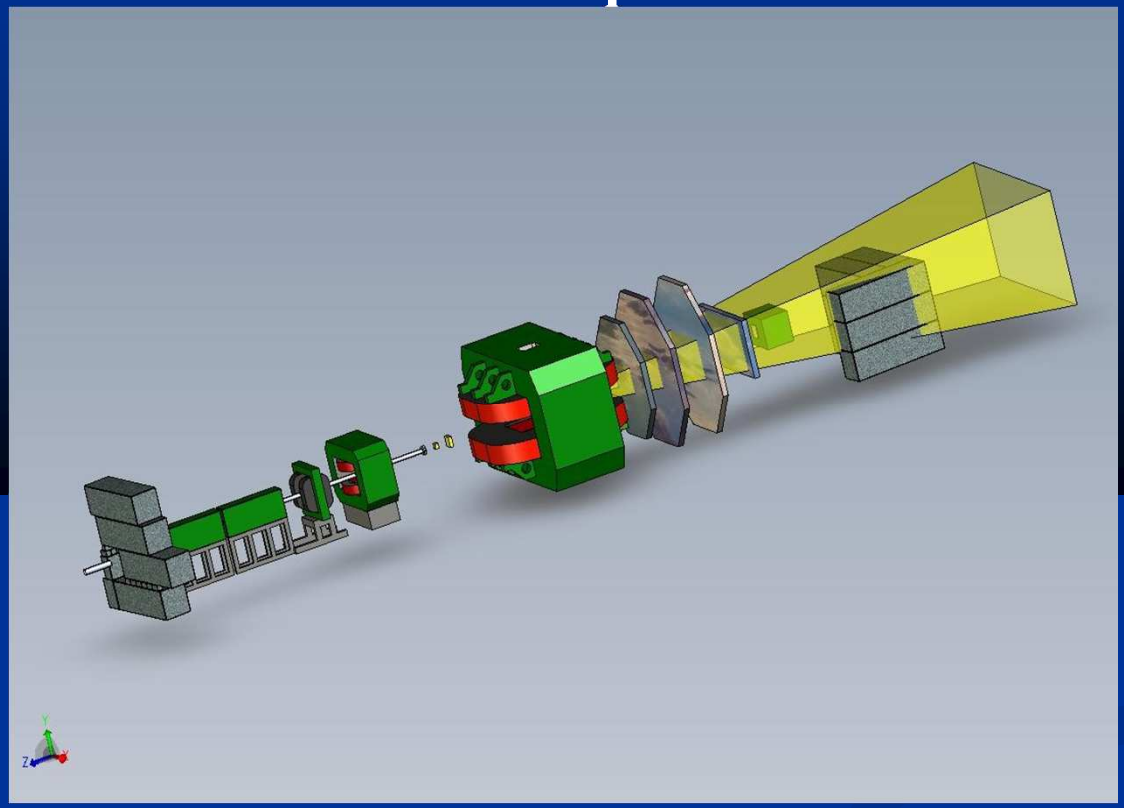


Dipole Magnet

Radiation hard pixel/strip detectors
STS tracker momentum determinatio
STS+MVD vertex reconstruction

Electron(RICH) / Muon (MuCh)
Hadron ID : STS+TOF and RICH
Electrons ID: RICH+TRD
Vertex detector: MVD+STS
Photons, π0, η : ECal
Event character.: PSD
Muons: MuCh (sandwich)

Baryonic Matter experiment At Nuclotron



Nuclotron:
Intensity: 10^7
Protons : max 12 GeV
Ions : max 6A GeV
4.5 AGeV (Au beam)

Fixed Target topics:
Commissioning STS
Establish EoS of dense matter
Multistrange hyperons
Light hyper nucleons

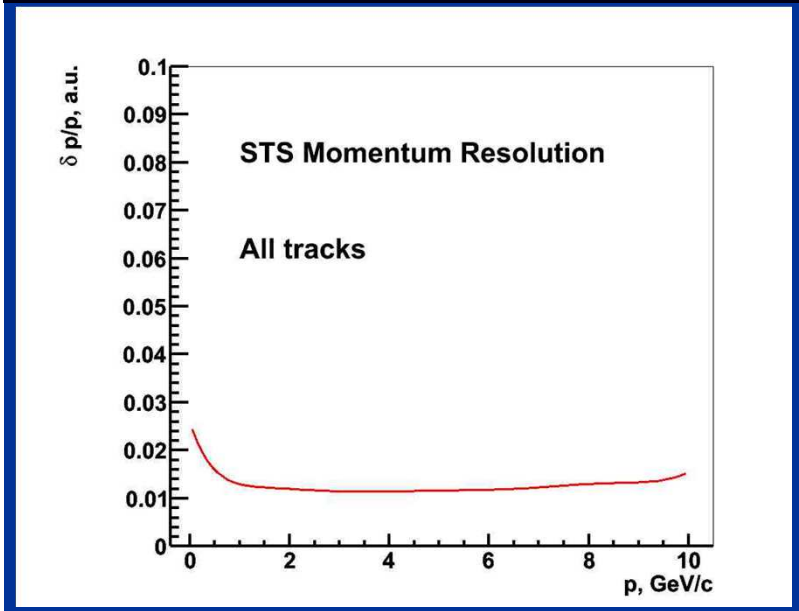
Hadron PID at CBM

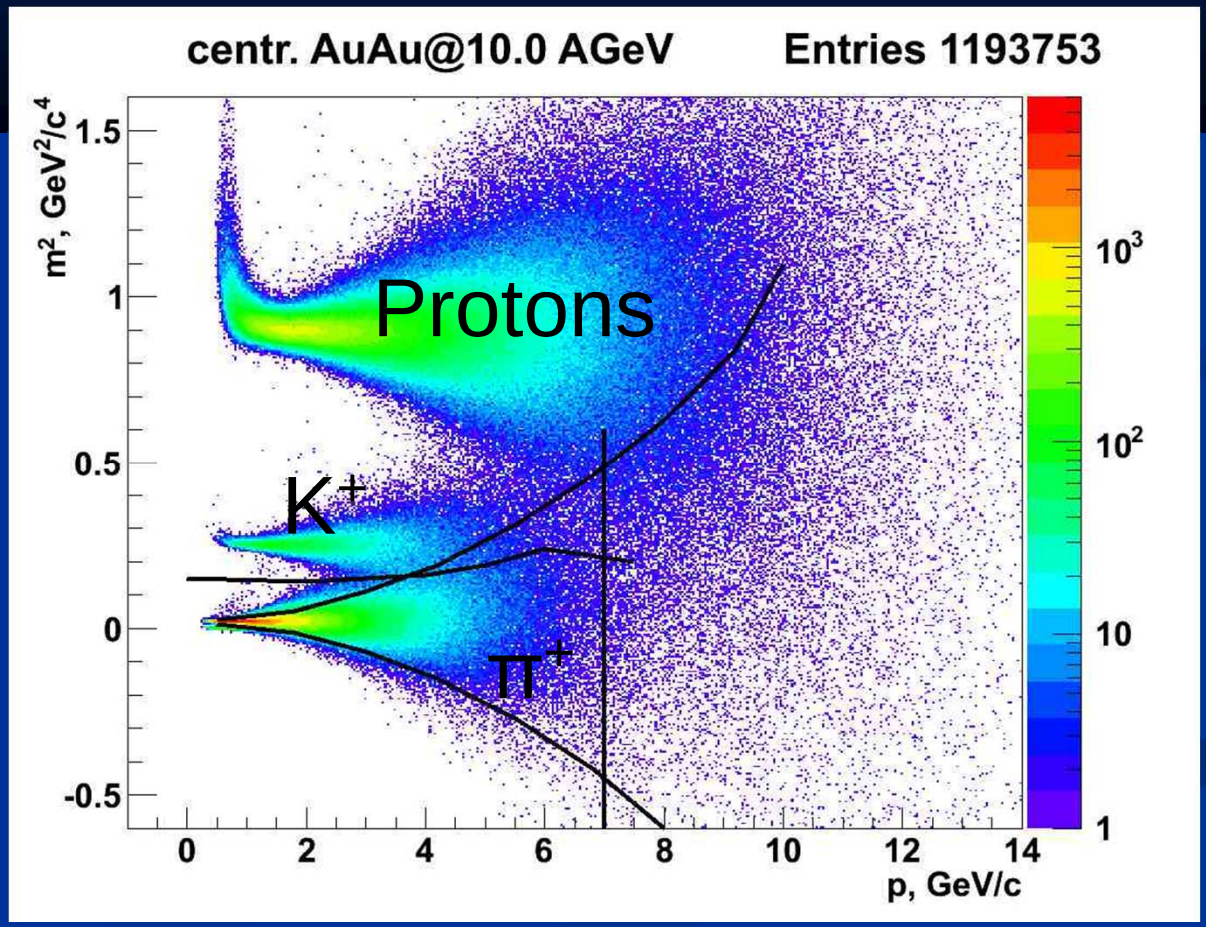
The m^2 *vs. momentum* correlation for the reconstructed tracks in the STS-TOF

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

STS tracker:

$(\Delta p/p)_{STS}=2\%$





ToF Wall :

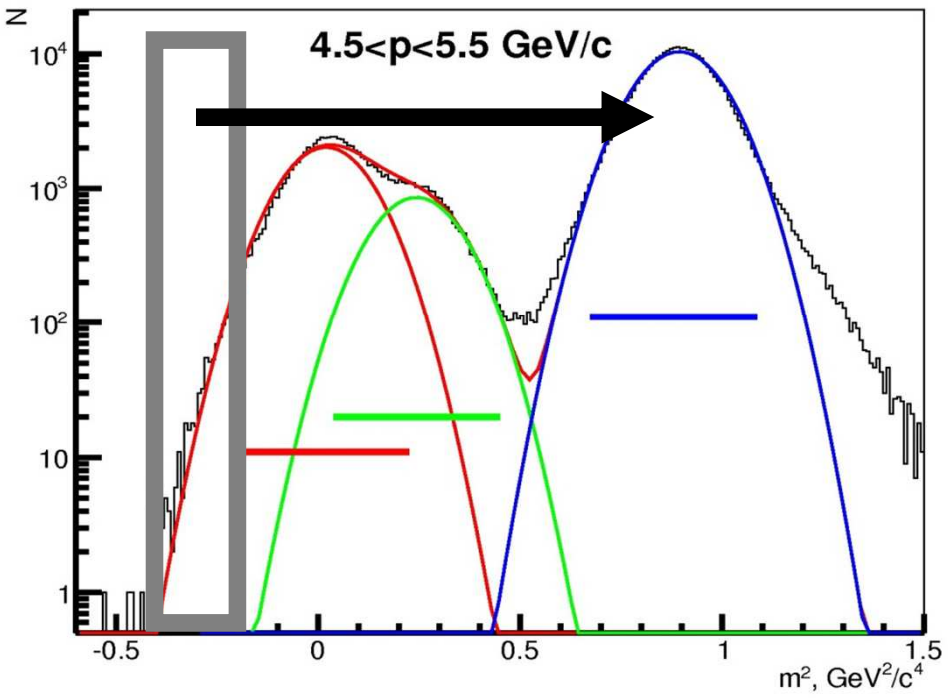
$\sigma_{TOF\ RPC}=80ps$

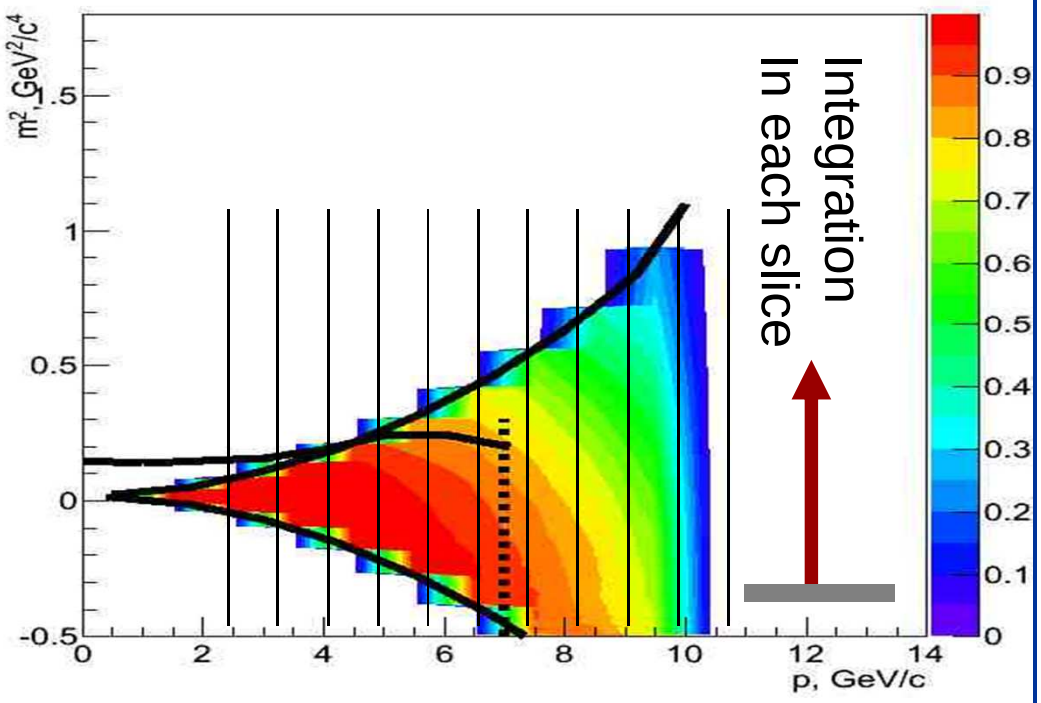
Definition the upper border shape inside the ±2σ region for the event-wise pion identification

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

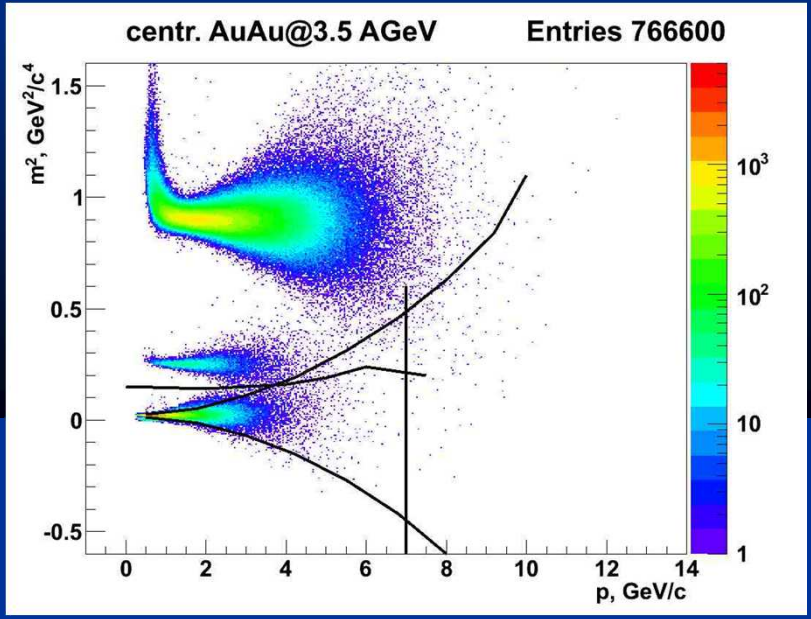
For each slice: 3xGauss Fit, 4 free pars of 9

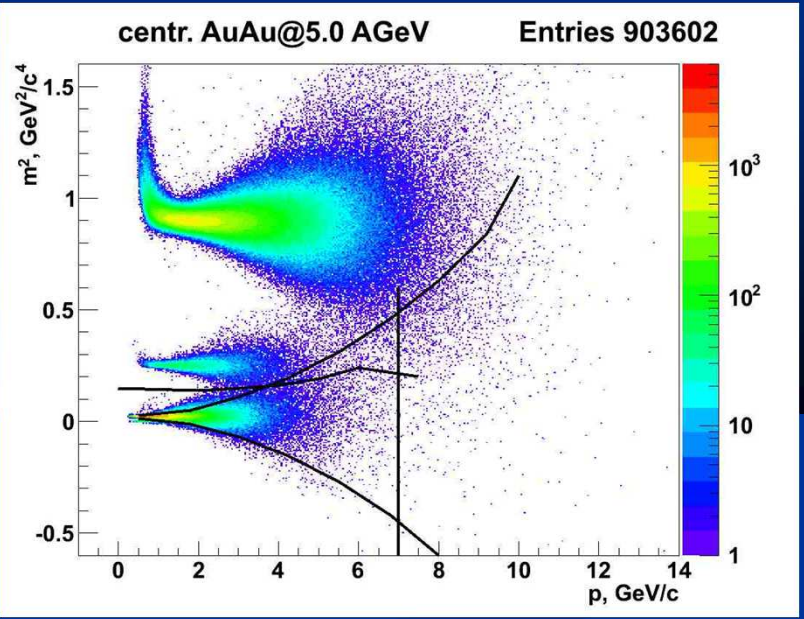
(3 heights and σ_{m^2}) rest are: $m_{p,K,\pi}$, two σ_{m^2})

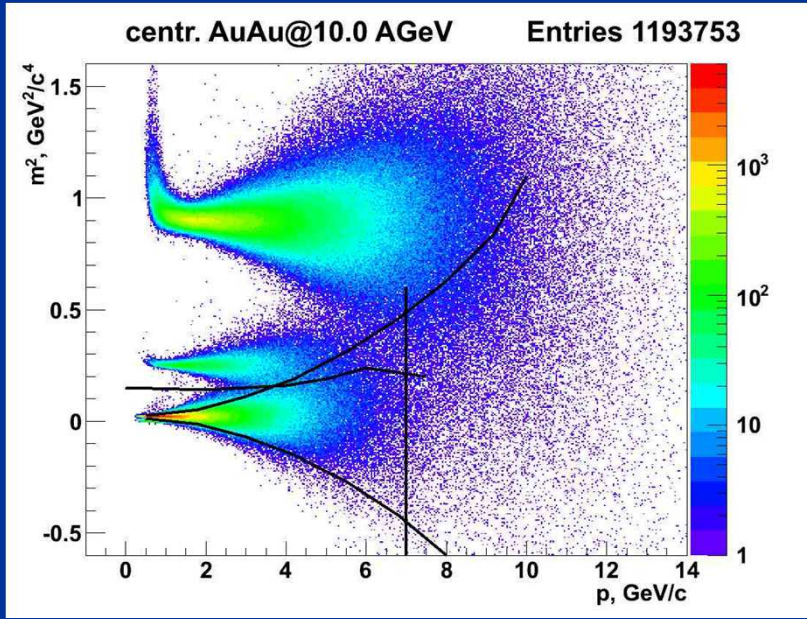


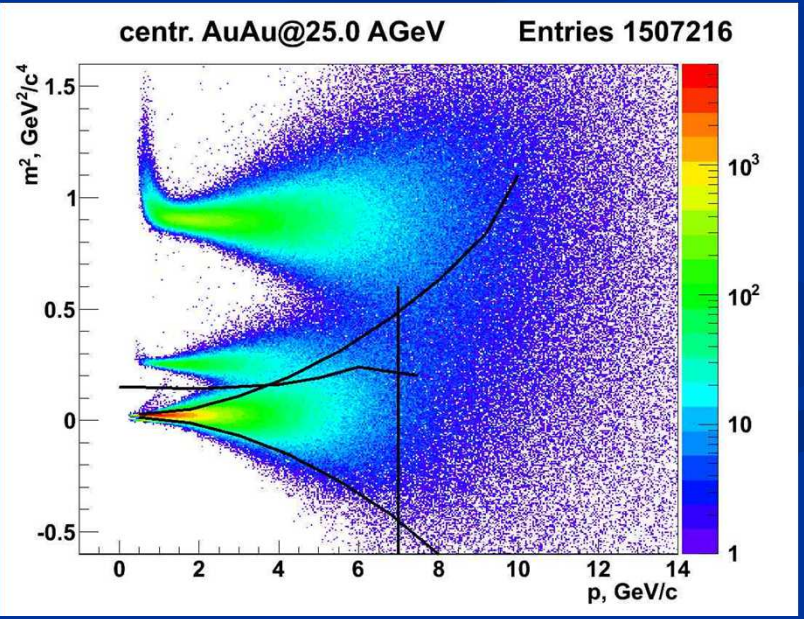


Pion ID via STS-TOF at 3.5, 5, 10 and 25 AGeV, and L_{TOF} =10m

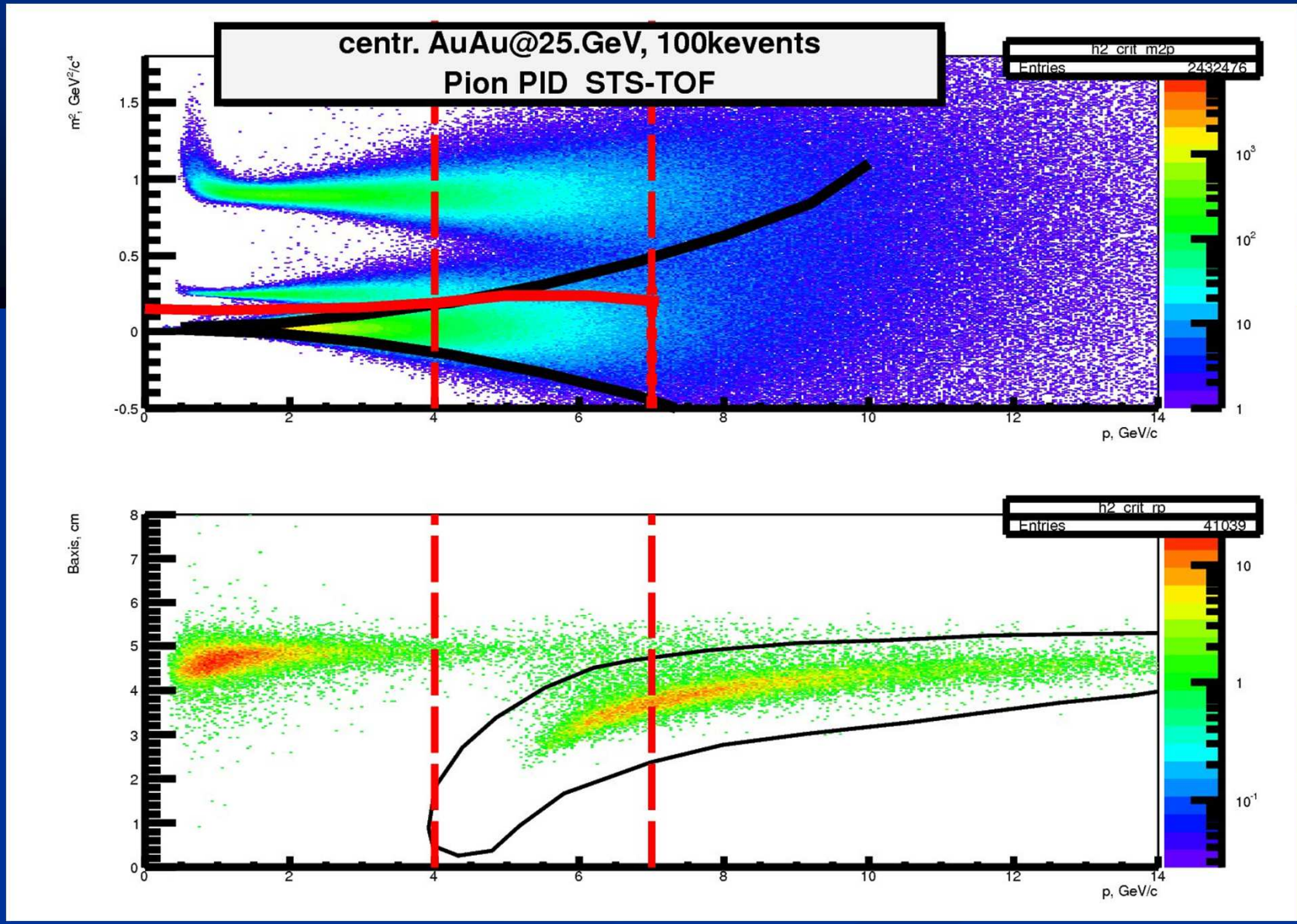




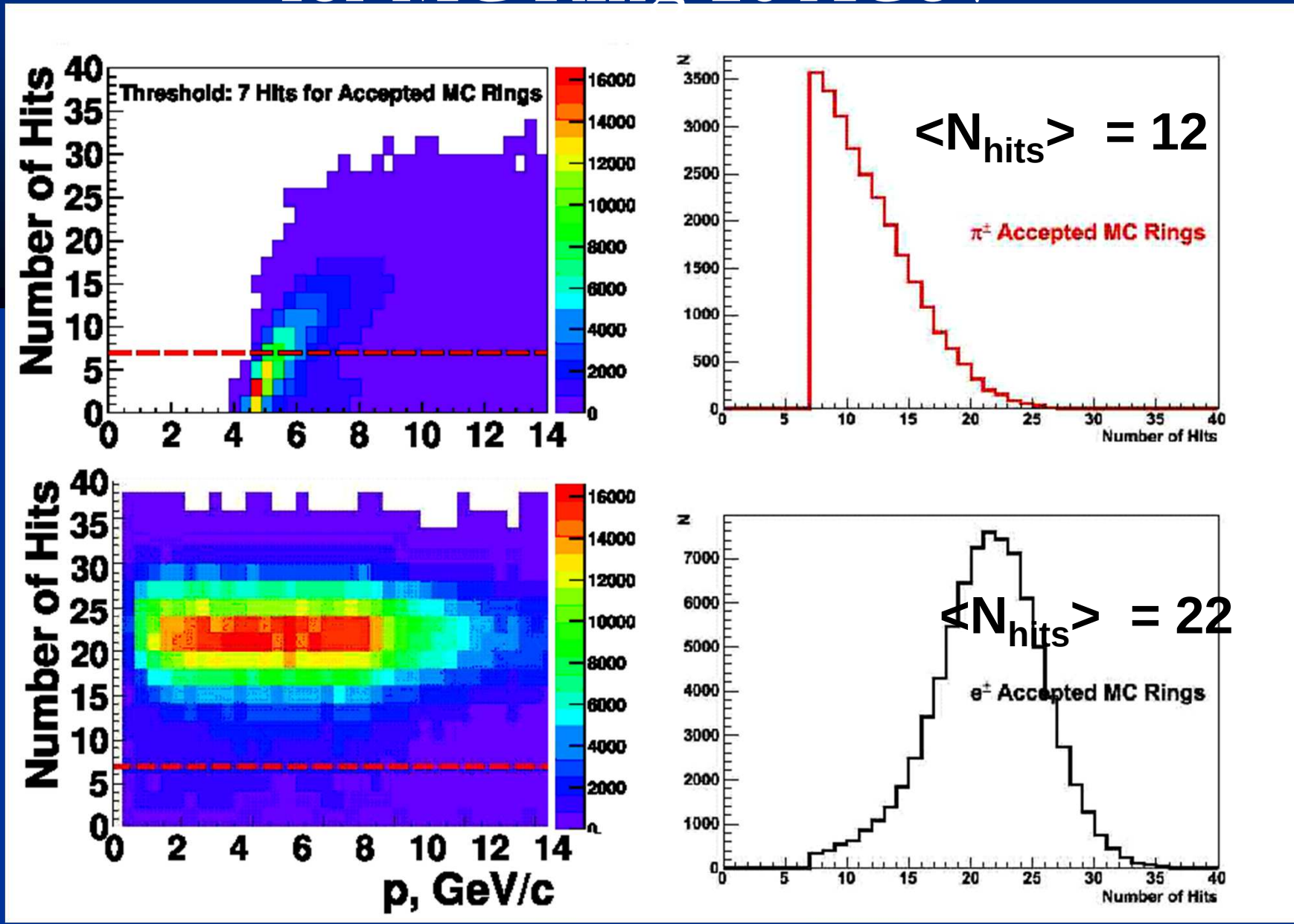




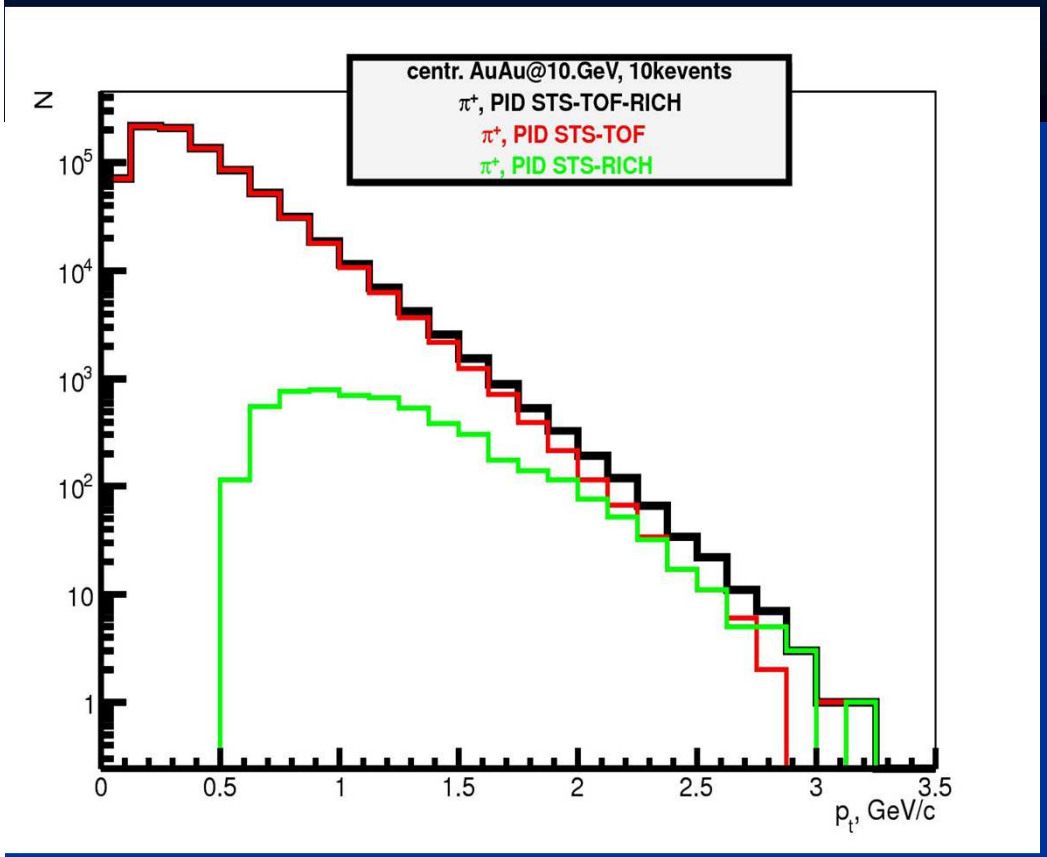
Pion ID in STS-TOF and STS-RICH at 25 AGeV

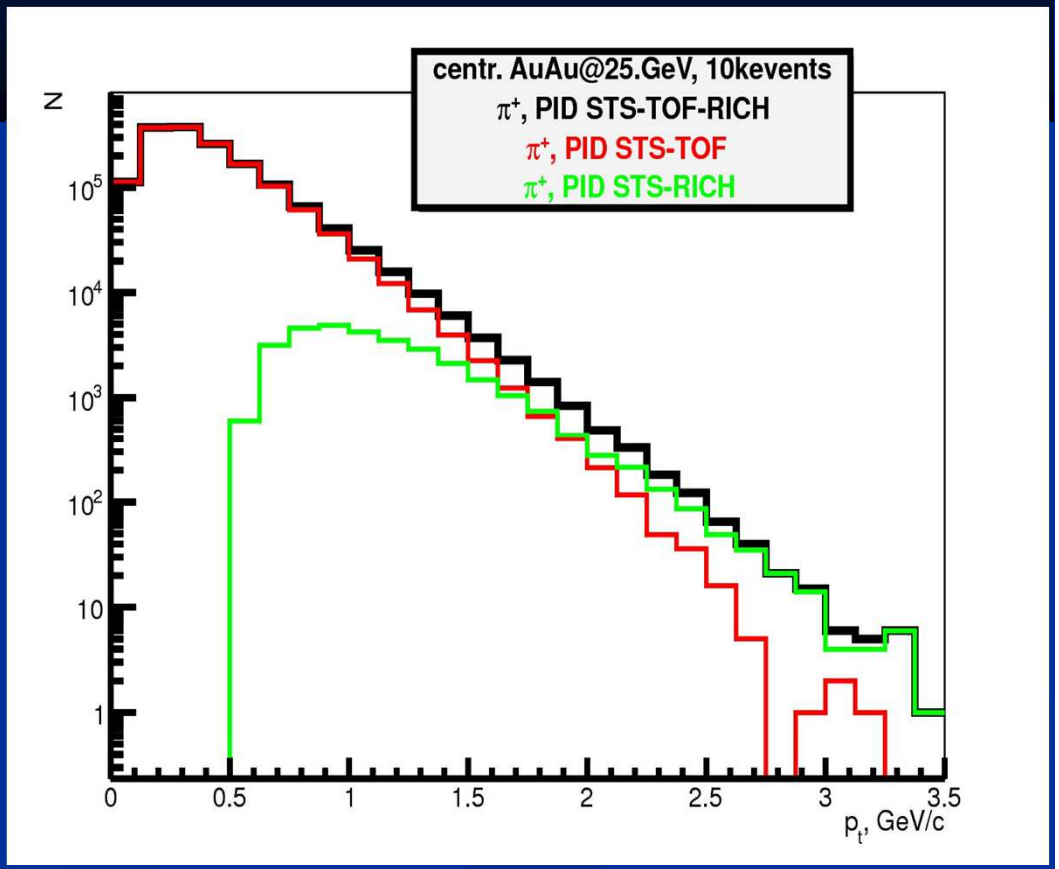


RICH MC data: Number of hits on MAPMT for MC Ring 10 AGeV

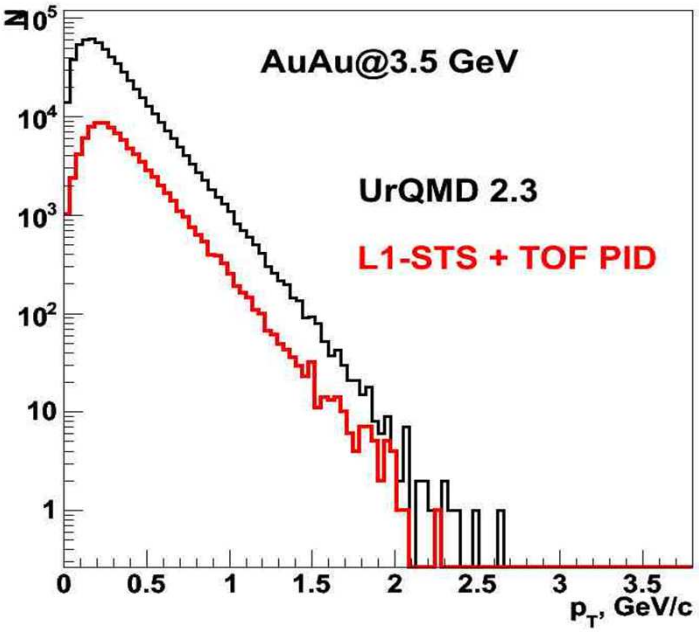


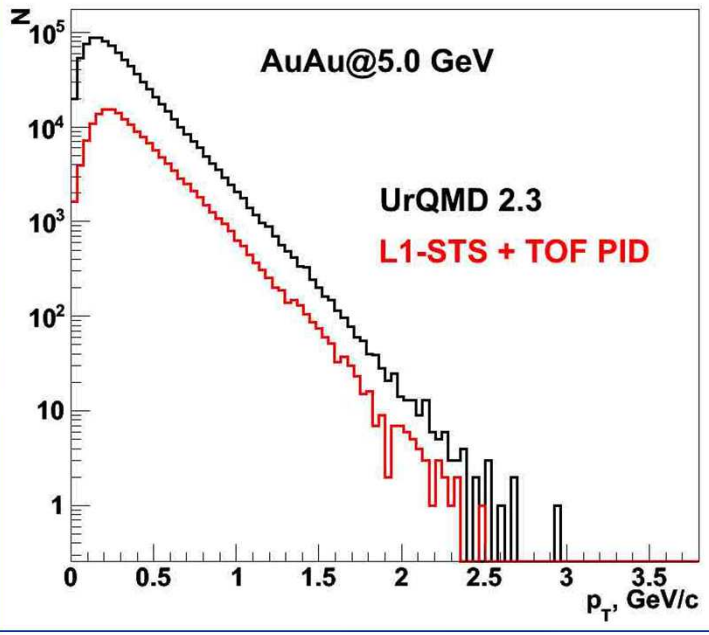
High p_T π^+ spectra at 10 and 25A GeV

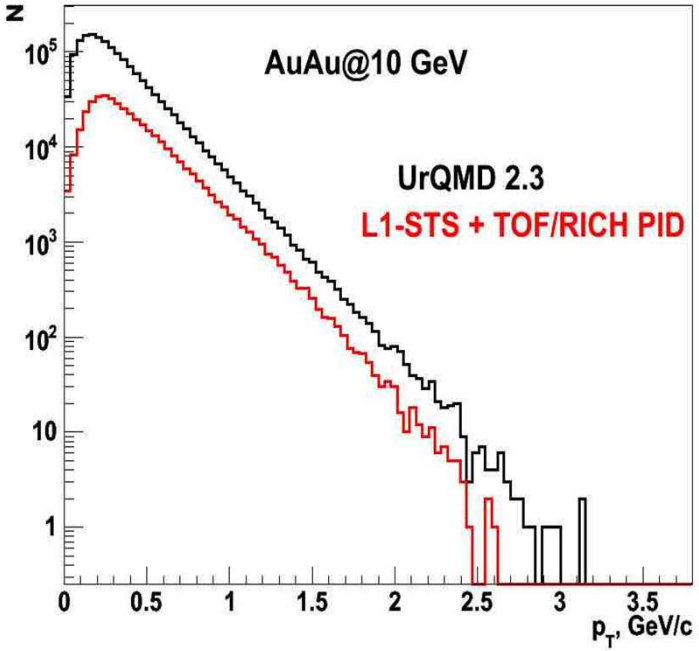


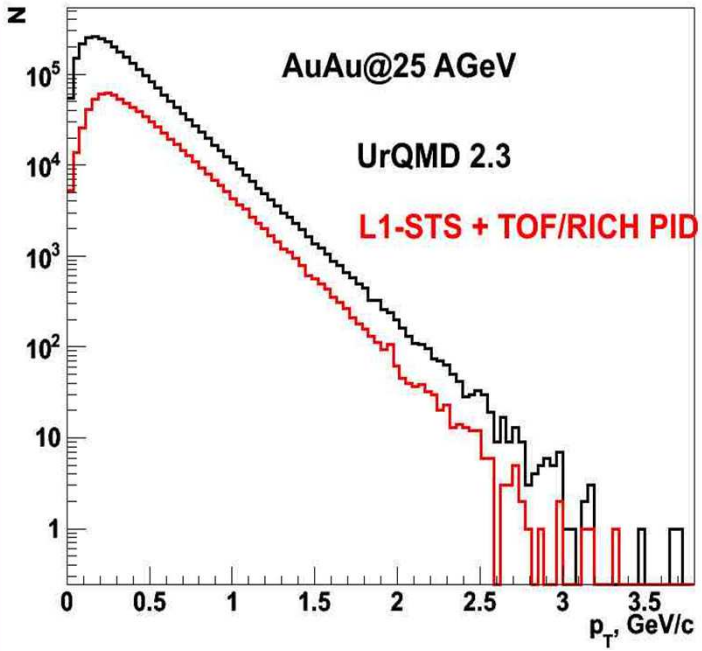


High p_T π^+ spectra at 3.5-25A GeV









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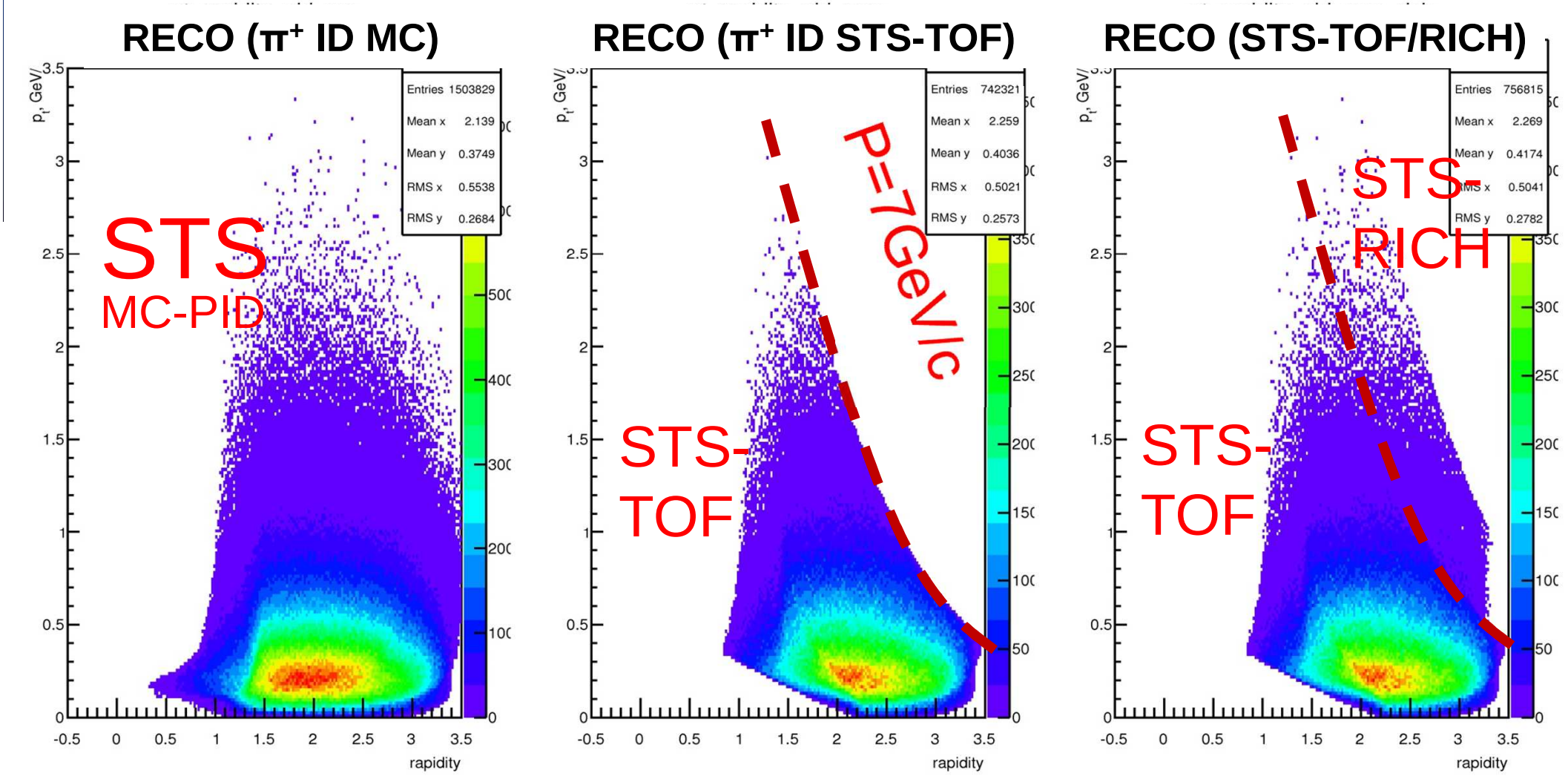
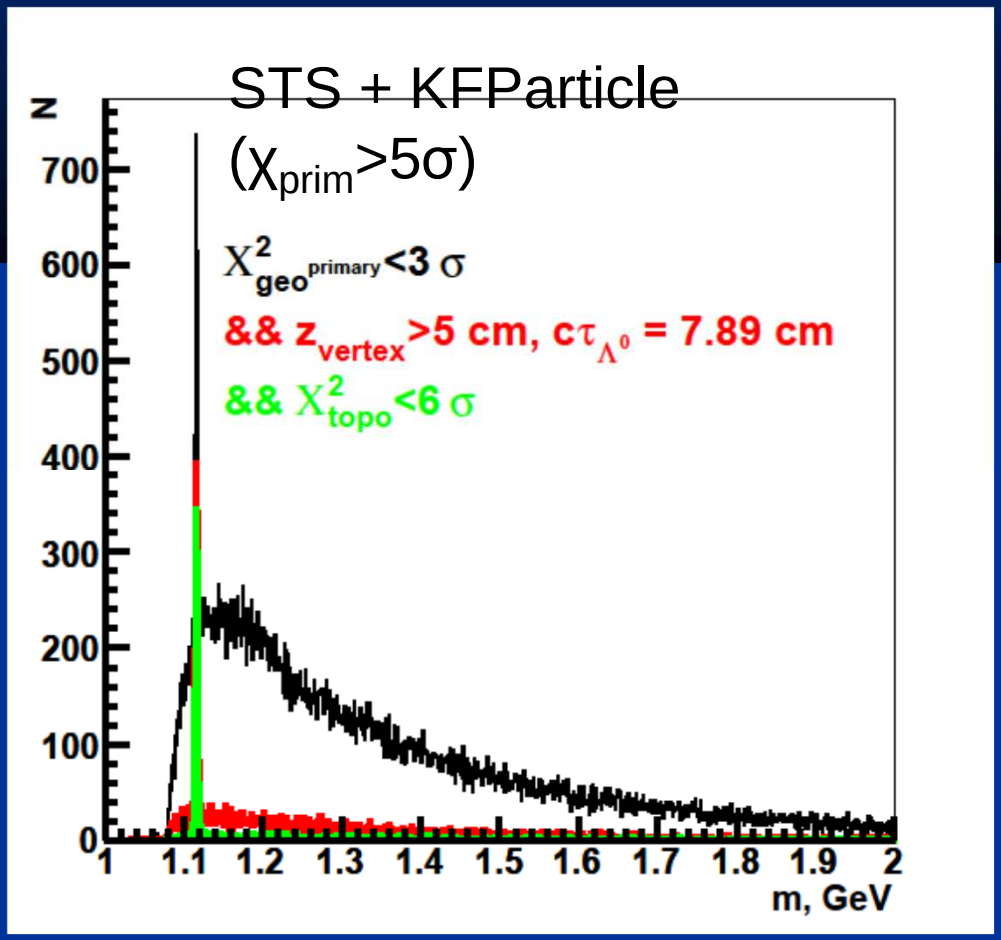
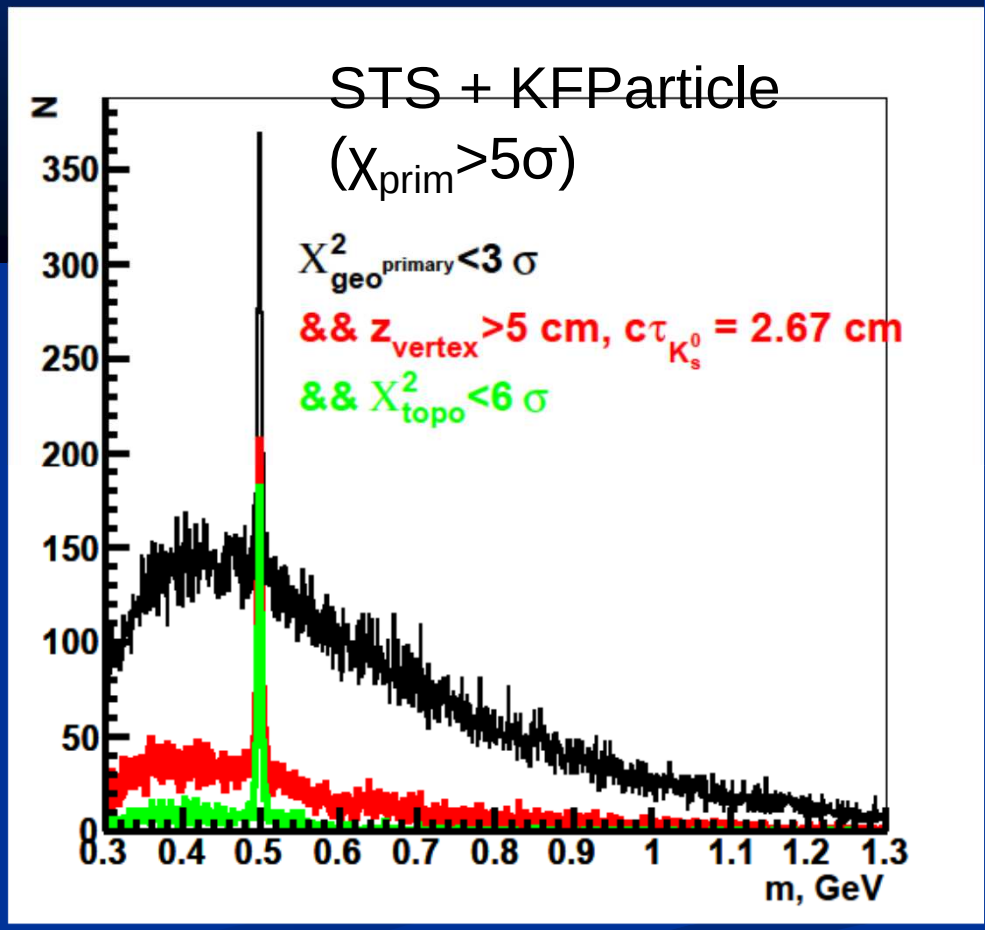
p_T *vs.* rapidity for π^+ at 25A GeV



BM@N experiment: Strangeness production in central AuAu collisons at 4AGeV





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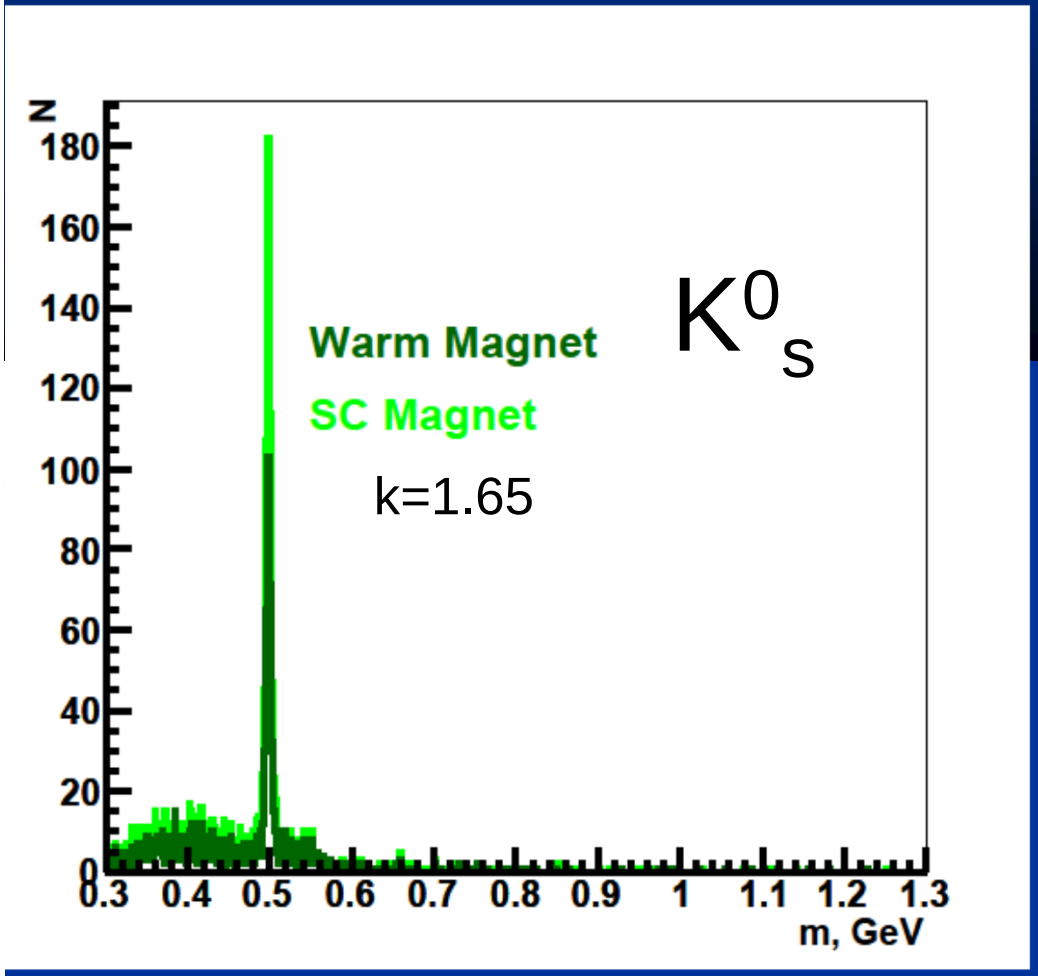

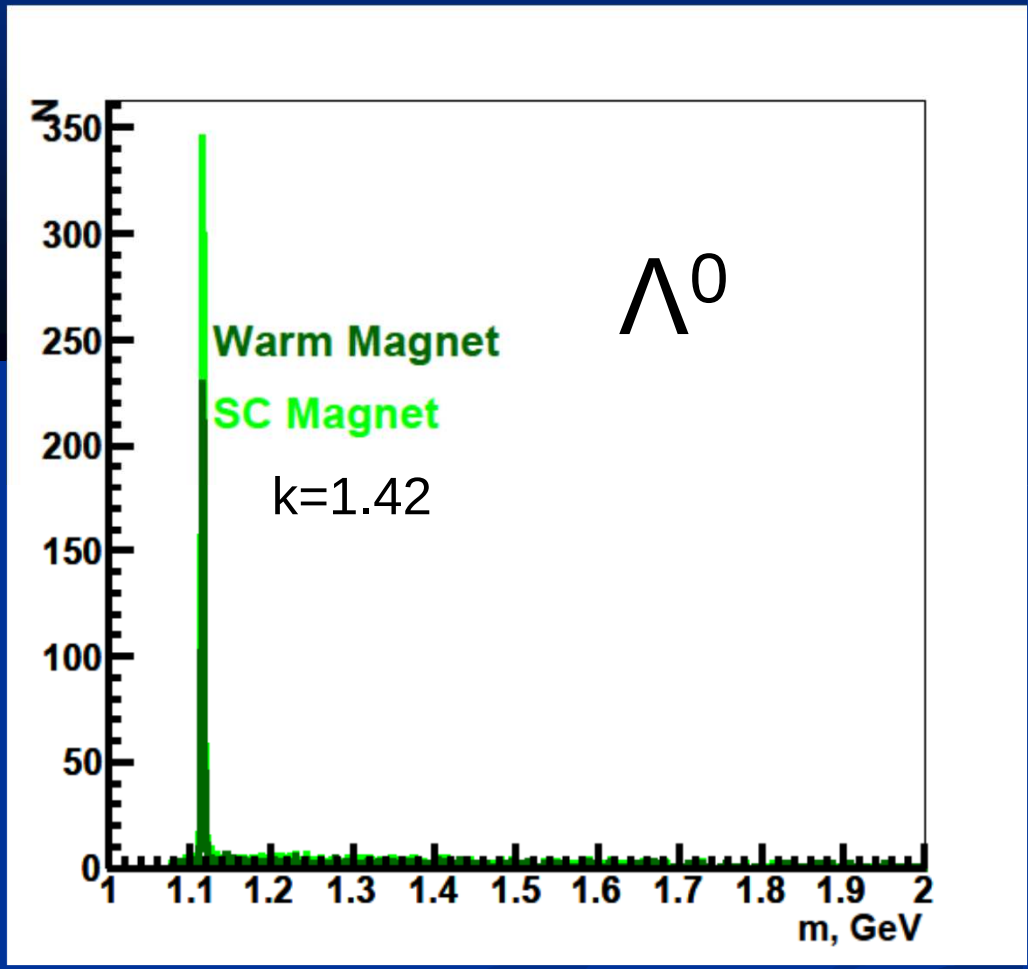

Conclusions

Simulation on high p_T pion production from HIC in the experiments with fixed target is performed in the energy region from 3.5 to 25 AGeV for the central gold-gold collisions

CBM setup can provide the high-p_T data in wide rapidity region

High p_T pion data exhibit the sensitivity to the different transport models already at energies of Nuclotron-M

Feasibility to incorporate RICH detector of CBM setup into the high-momentum pion identification is discussed

Simulation of the strangeness production has been performed for the BM@N experiment

The warm magnet being under the reconstruction and the silicon tracker show the high capability for the reconstruction of hyperons via decays into charged hadrons