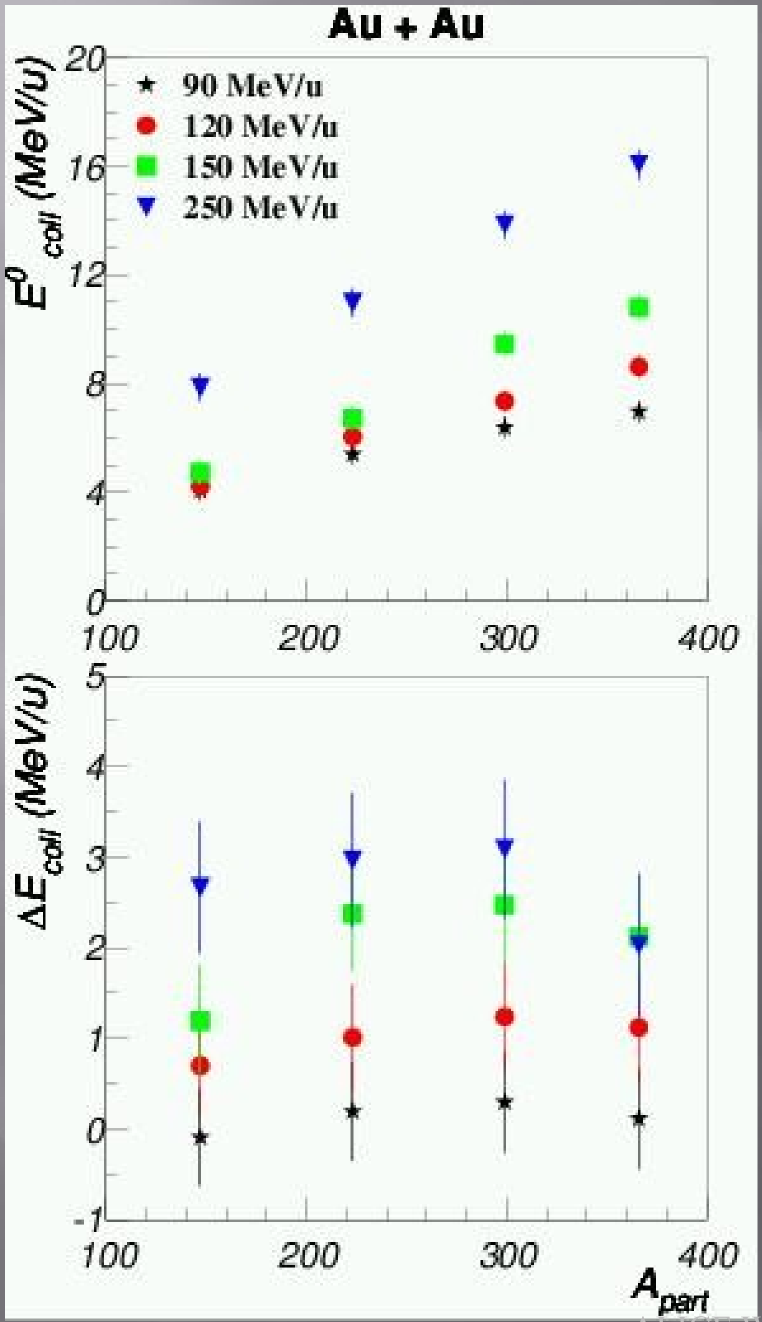
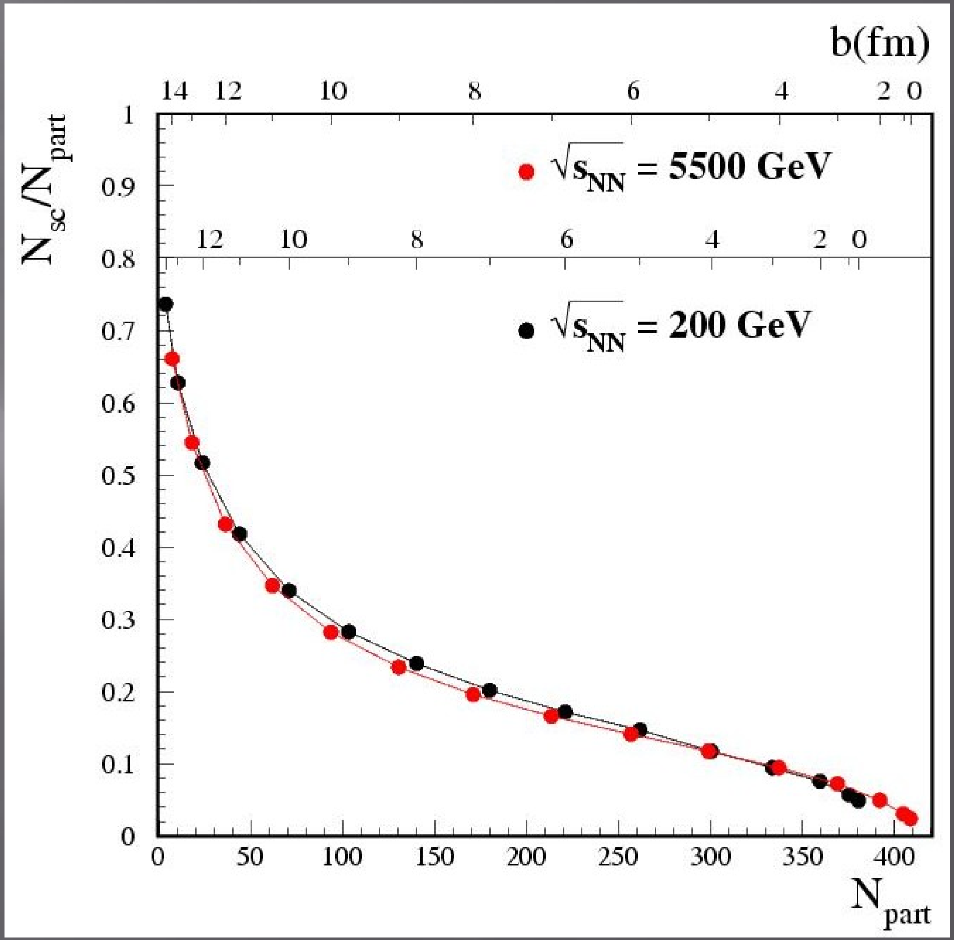
Collective phenomena in heavy ion central collisions

C. Andrei, I. Berceanu , A. Herghelegiu, M. Petrovici, A. Pop, C. Schiaua

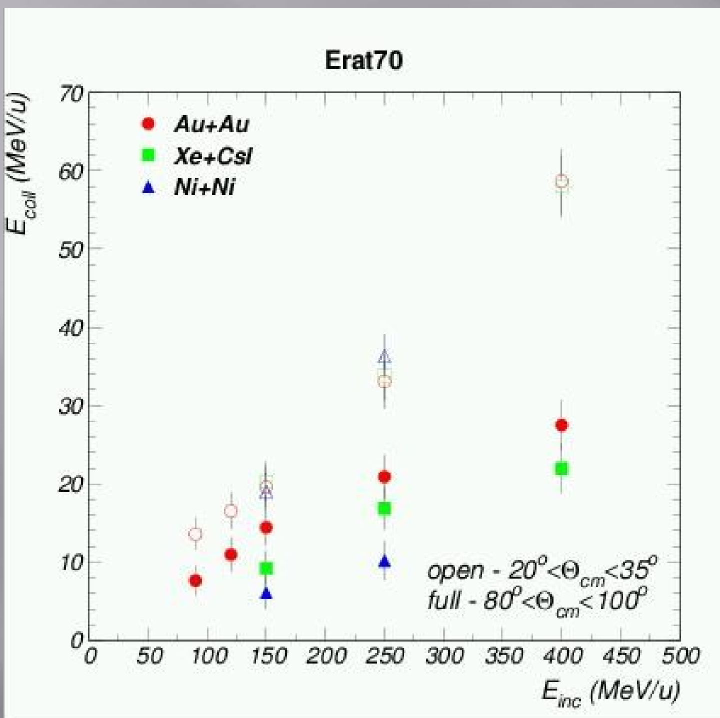
- **Azimuthally isotropic flow – very short review**
- **$\langle p_t \rangle$ as a function of mass at ultra-relativistic energies**
- **Pb + Pb - 5.5 TeV HIJING analysis**
- **Outlook**

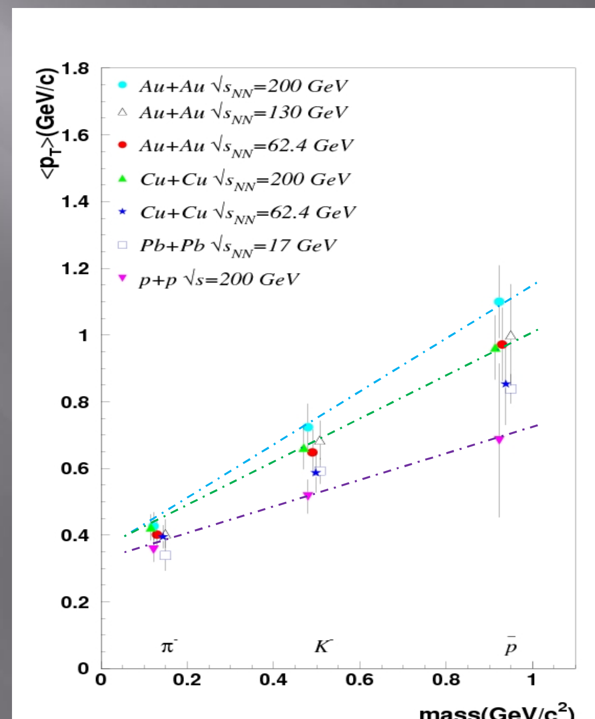
Why highly central collisions ?

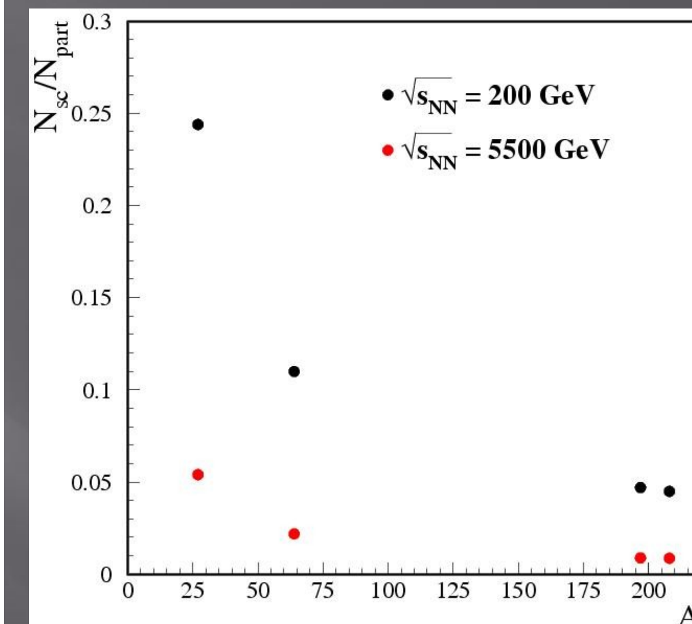




Why heaviest combinations ?

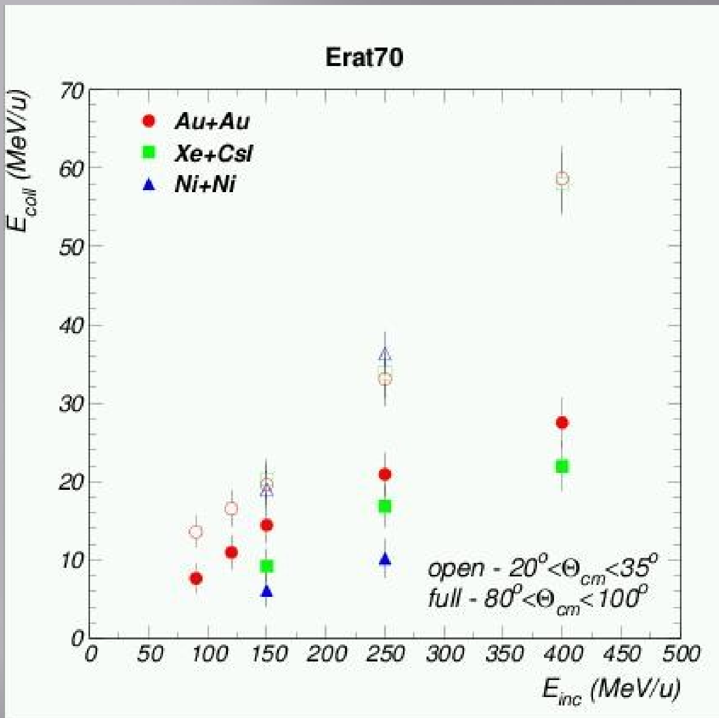


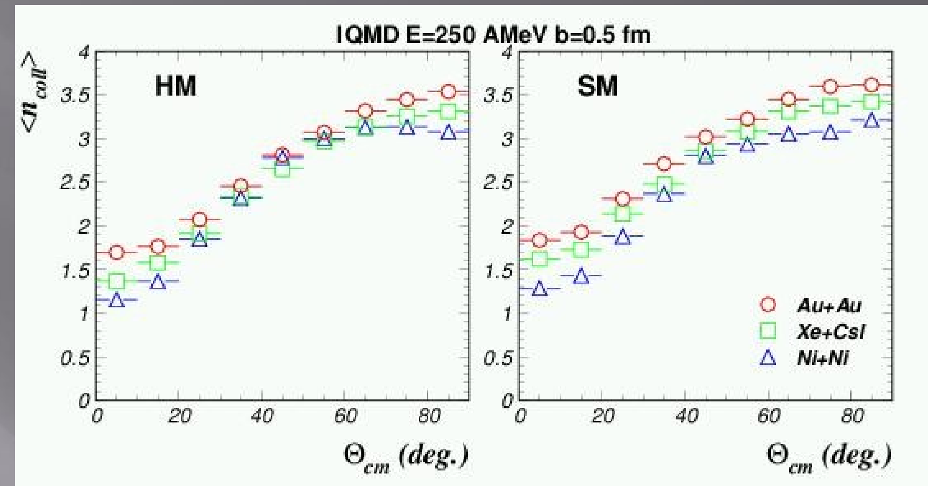


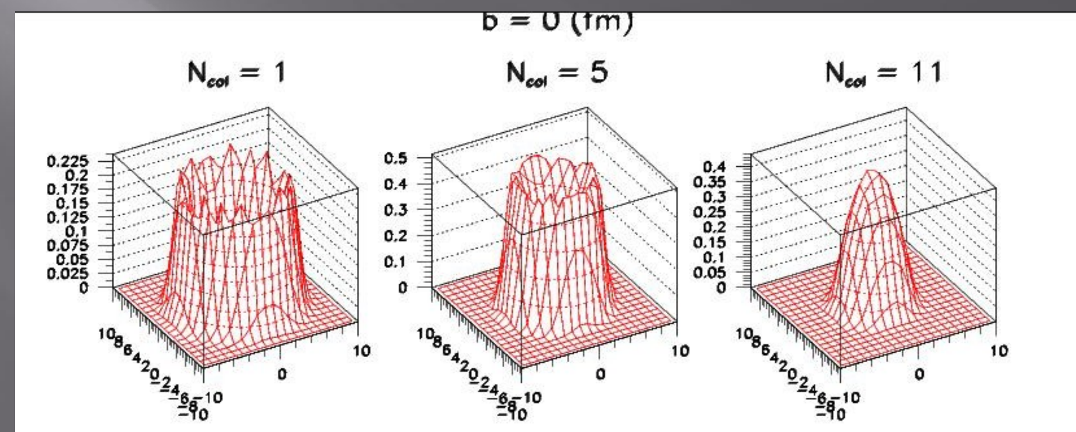


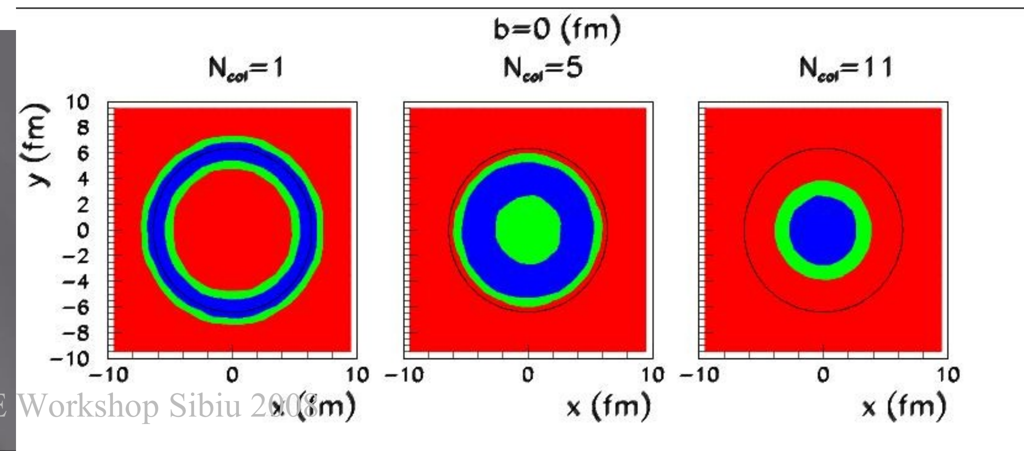
M.Petrovici & A.Pop, **Selected Aspects of Flow Phenomena in Heavy Ion Collisions**, AIP Conf. Proc. 972, pg 98 and refs. that are in

Why transversal direction @ mid rapidity ?



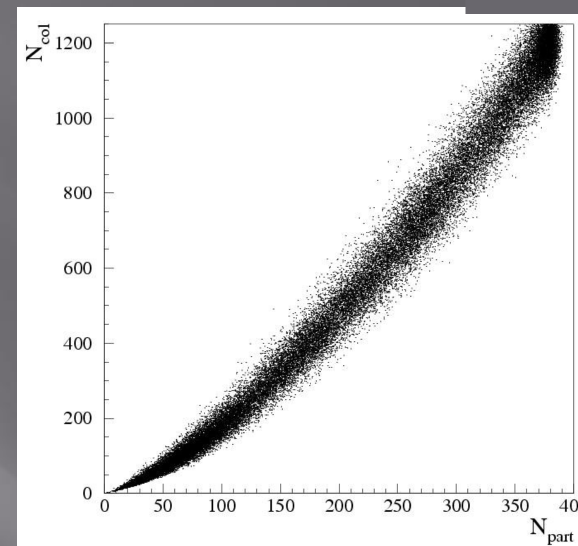






How to select highly azimuthally isotropic central collisions ?

RHIC 200GeV



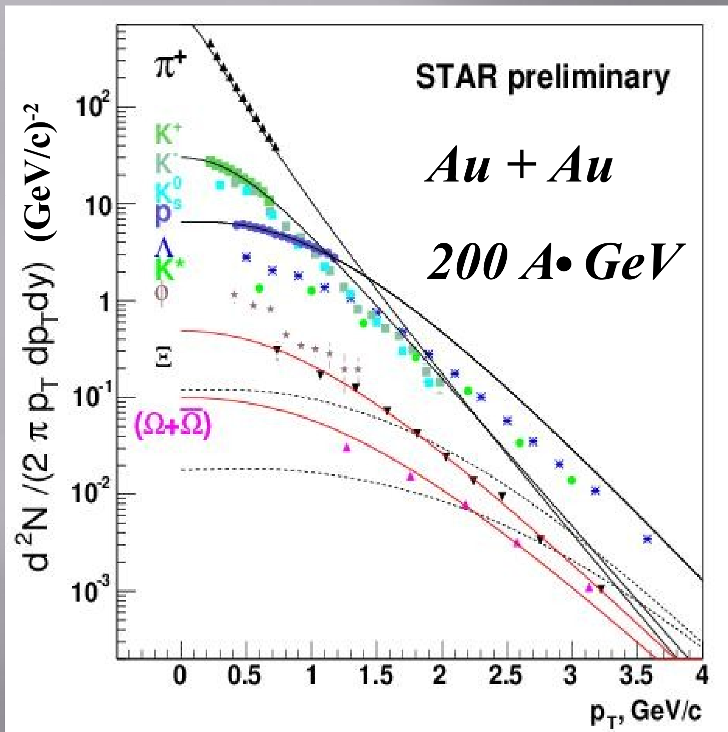
- charged particle multiplicity

- $E_{rat} = \dfrac{E_{\perp}}{E_{\parallel}}$

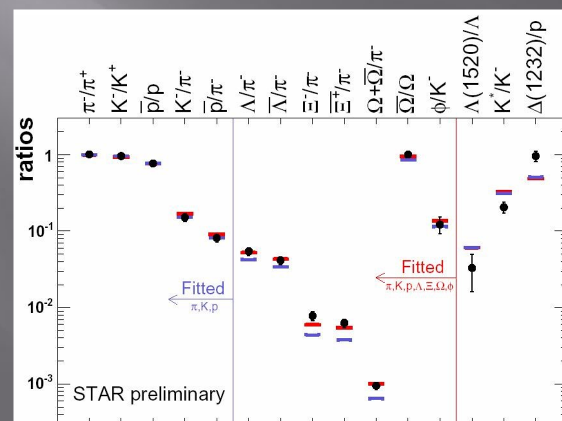
- $Directivity = \left. \dfrac{\left| \sum_{i=1}^{n} p_t^i \right|}{\sum_{i=1}^{n} \left| p_t^i \right|} \right|_{\eta_i \quad \eta_{cm}}$

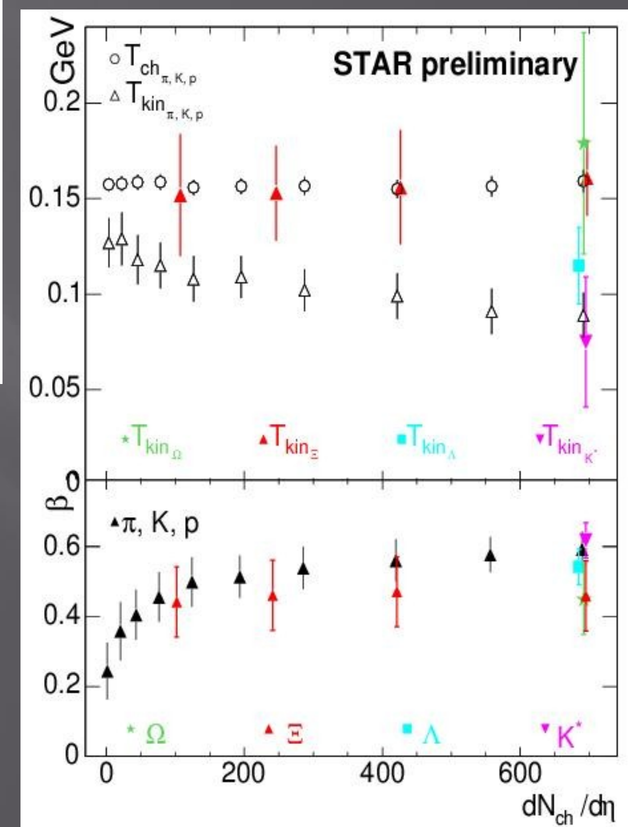
Transverse Flow @ RHIC

nucl-ex/0403014



Particle	T_{kin} (MeV)	$\langle\beta\rangle$ (c)
π, K, p	89 ± 10	0.59 ± 0.05
K^*	75 ± 35	0.62 ± 0.05
Λ, $\bar{\Lambda}$	115 ± 20	0.54 ± 0.05
Ξ^-, $\bar{\Xi}^+$	161 ± 20	0.46 ± 0.10
Ω, $\bar{\Omega}$	179 ± 60	0.45 ± 0.10



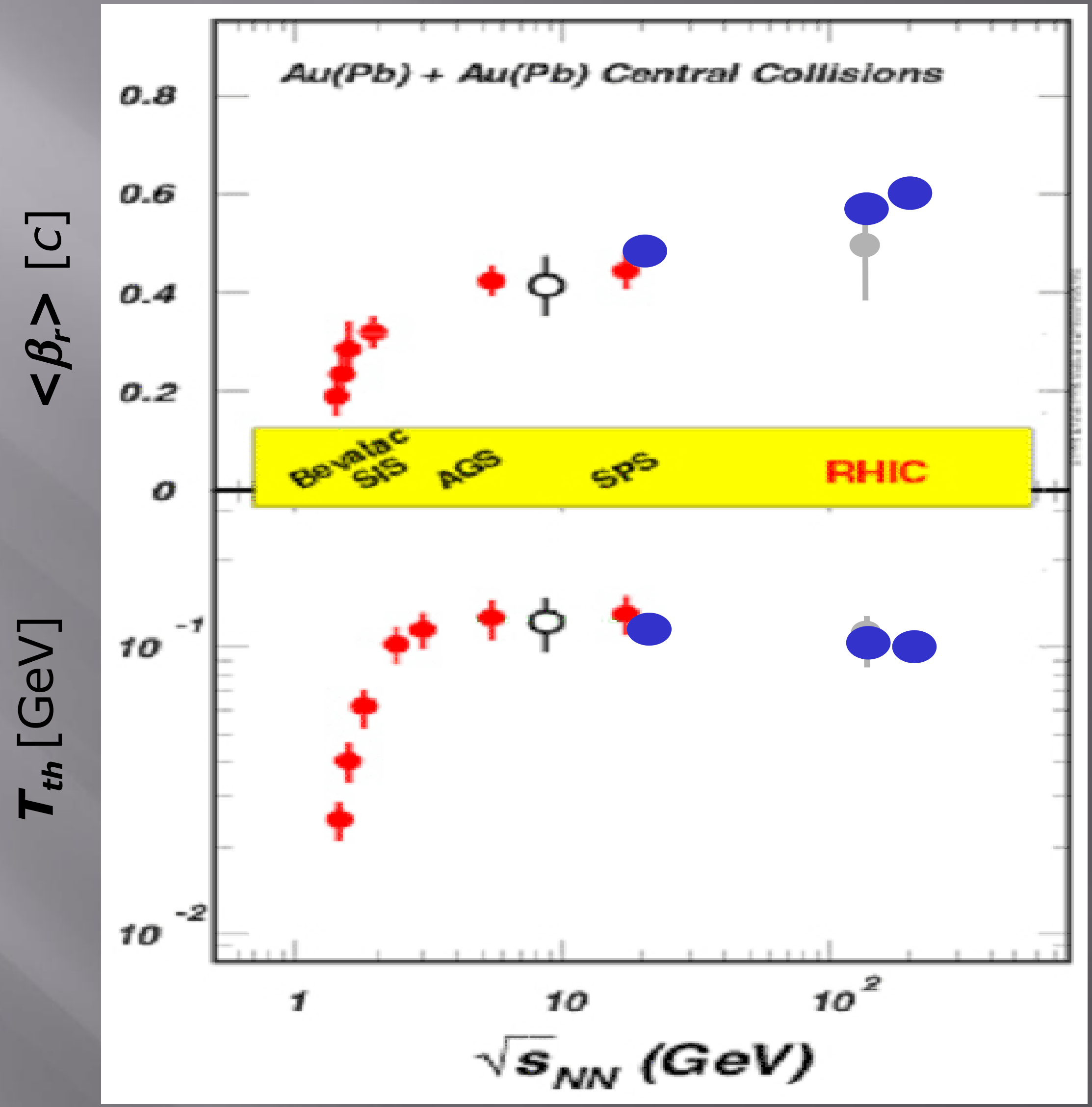


$$\frac{dN}{m_t dm_t} \sim \int_0^R r dr\, m_T K_1\left(\frac{m_t \cosh\rho}{T_{f0}}\right) I_0\left(\frac{p_t \sinh\rho}{T_{f0}}\right)$$

$$\rho = \tanh^{-1}\beta_r \qquad \beta_r = \beta_s \left(\frac{r}{R}\right)^{\alpha} \quad \alpha = 0.5, 0.7, 1, 2$$

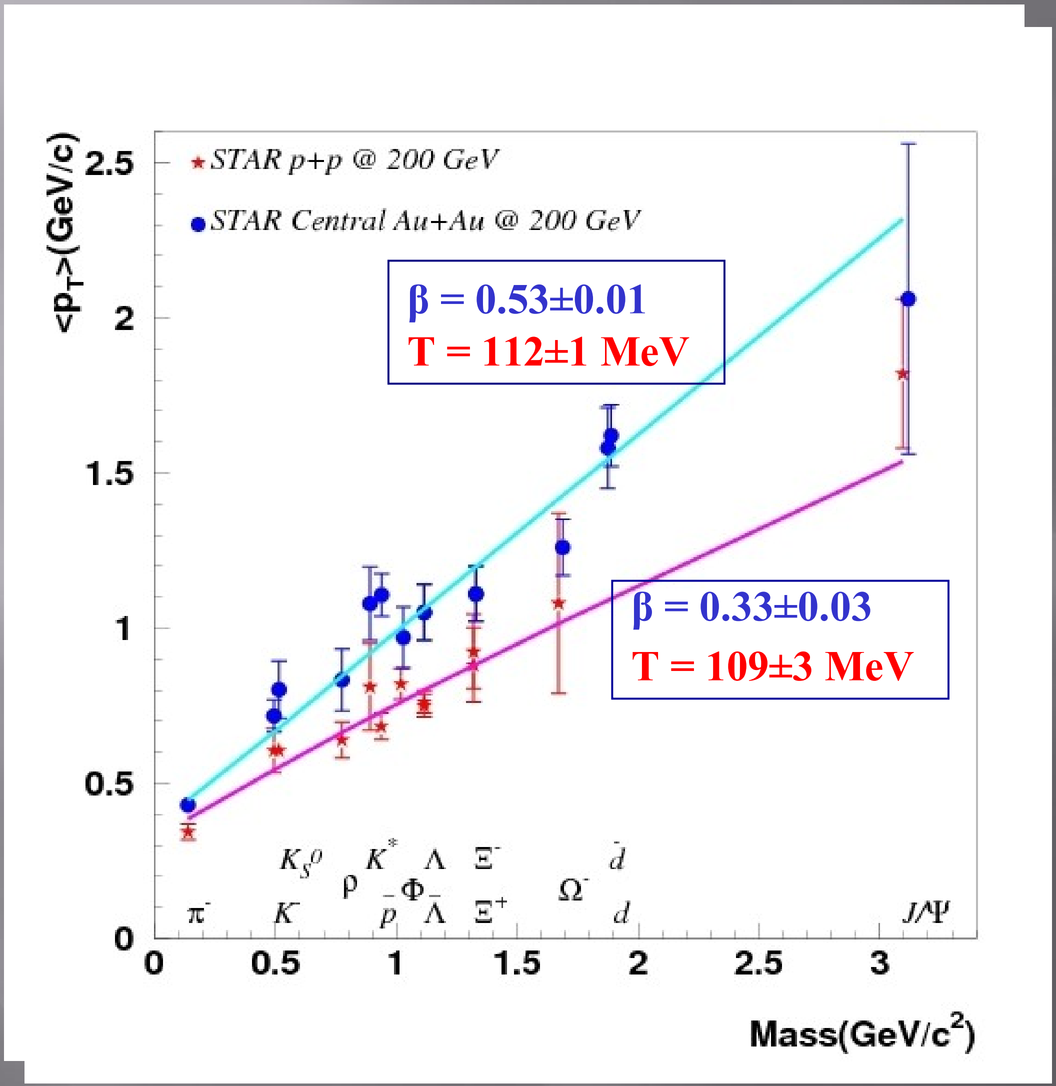
Schnedermann et al nucl-th/9307020

Transverse Flow excitation function



Xu N and Kaneta M 2002 *Nucl. Phys. A* ***698 306***

Transverse Flow



Λ, $\bar{\Lambda}$, $\Xi^{\pm}$, Ω^{-}, J/ψ

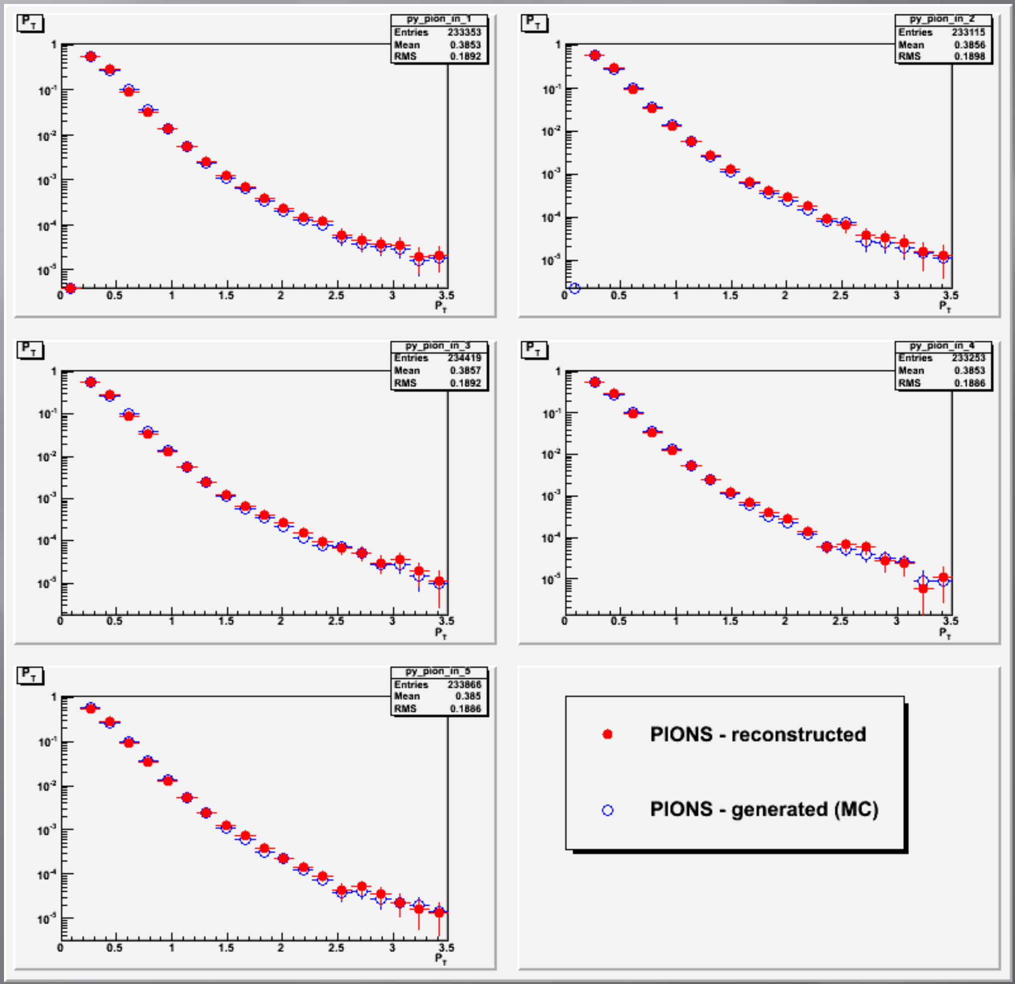
β = 0.36, T = 172 MeV

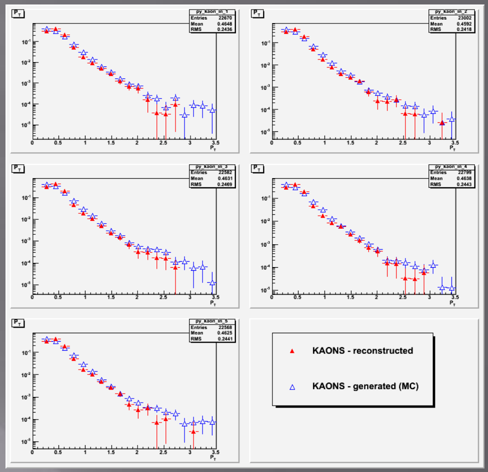
π, K, $\bar{p}$, d, $\bar{d}$

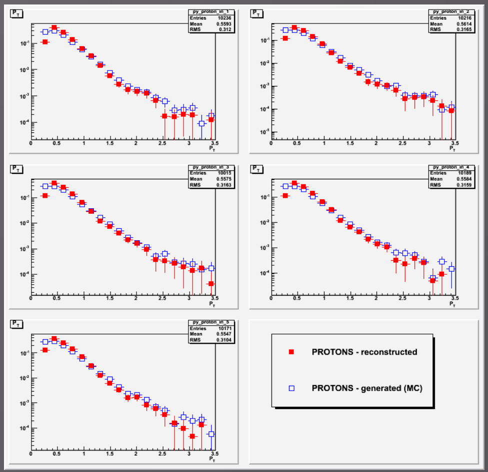
β = 0.59, T = 104 MeV

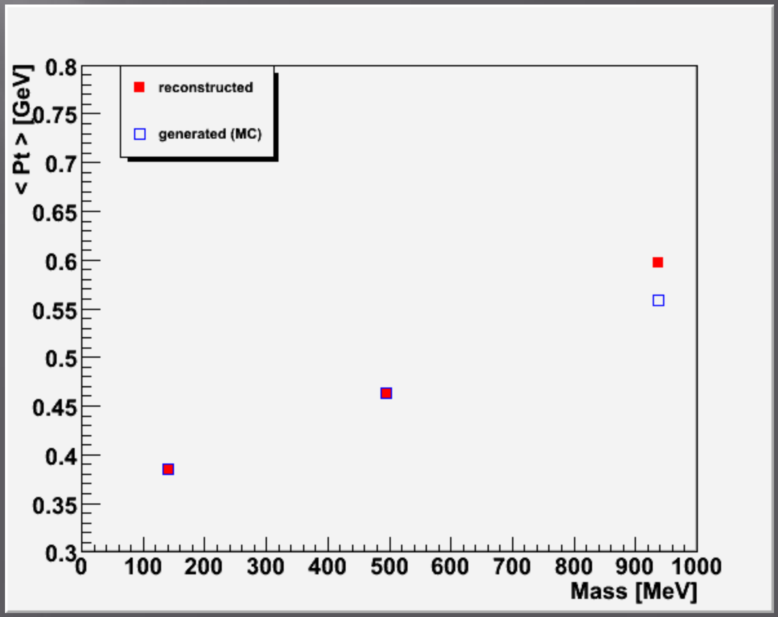
p_t spectra for π, K, p - HIJING

5.5 TeV





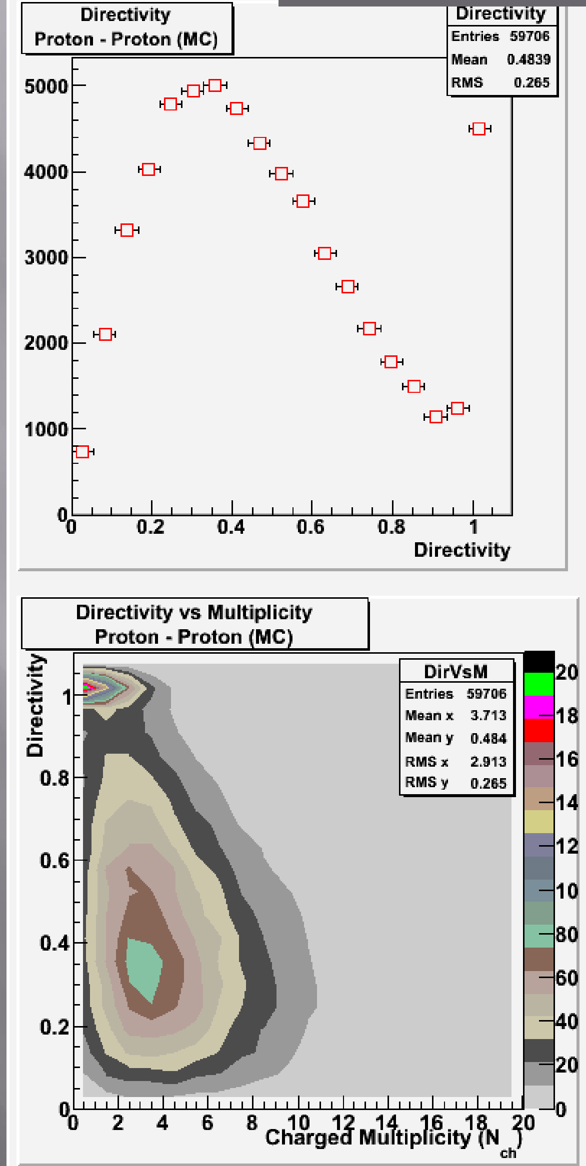




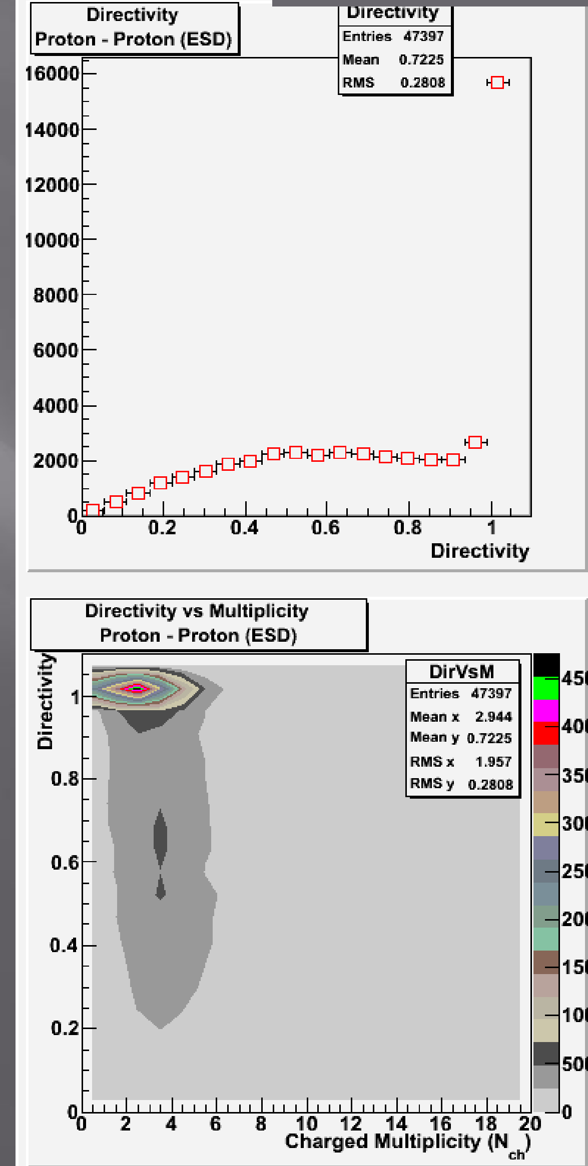
Directivity vs. Multiplicity
Proton –Proton PYTHIA

5.5 TeV

Generated (MC)

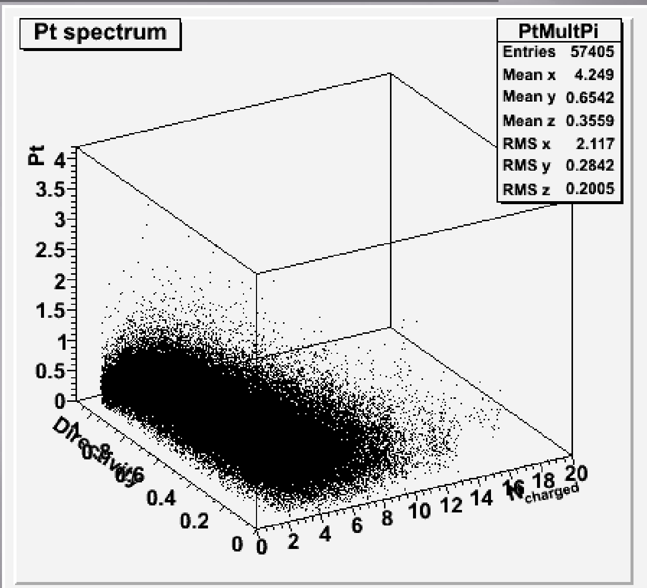


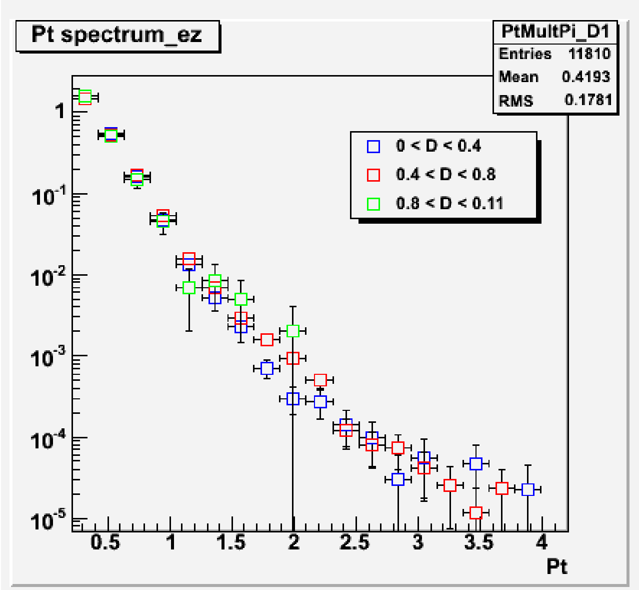
Reconstructed (ESD)



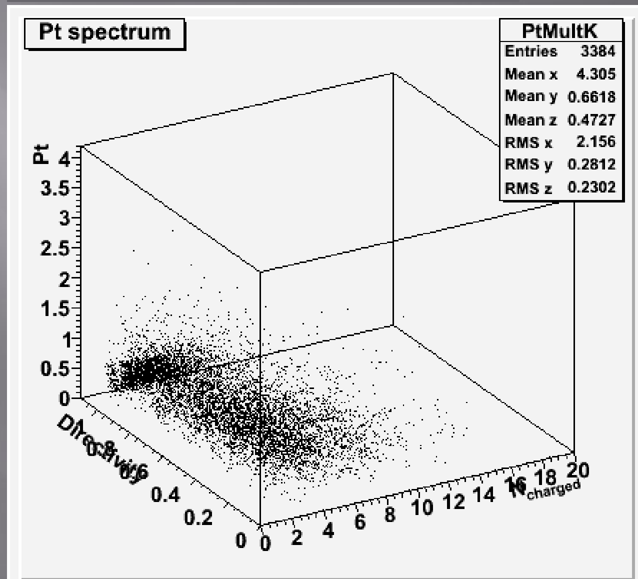
p_t spectra for π, K, p – conditioned by cuts in Directivity, multiplicity or both Proton – Proton PYTHIA

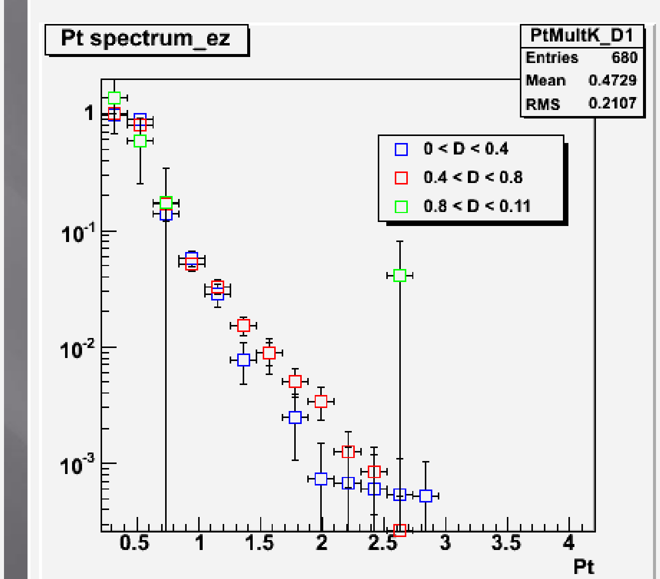
pions reconstructed (ESD)



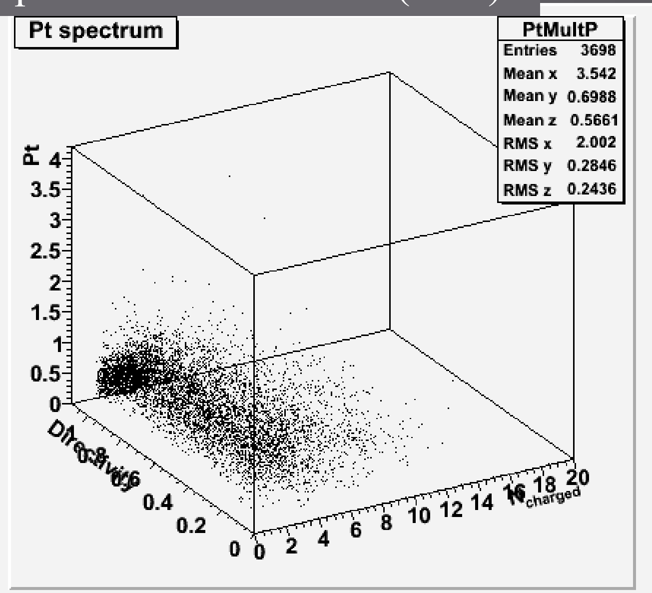


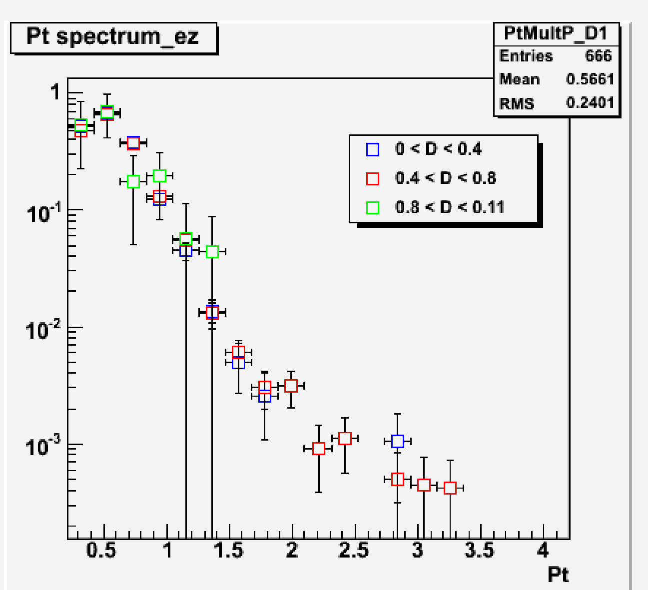
kaons reconstructed (ESD)



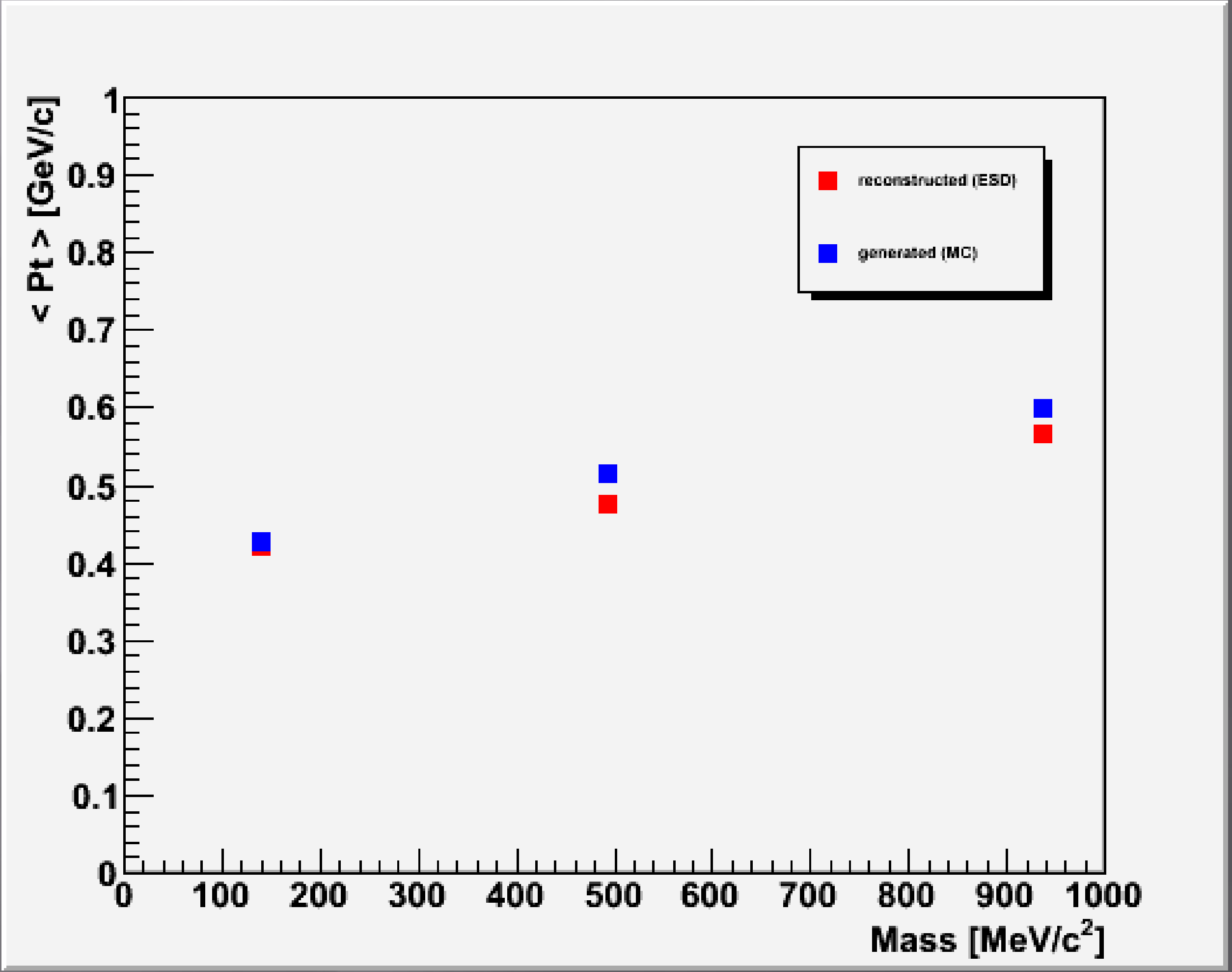


protons reconstructed (ESD)





$<p_t>$ as a function of mass conditioned by cuts in Directivity, multiplicity or both Proton – Proton PYTHIA

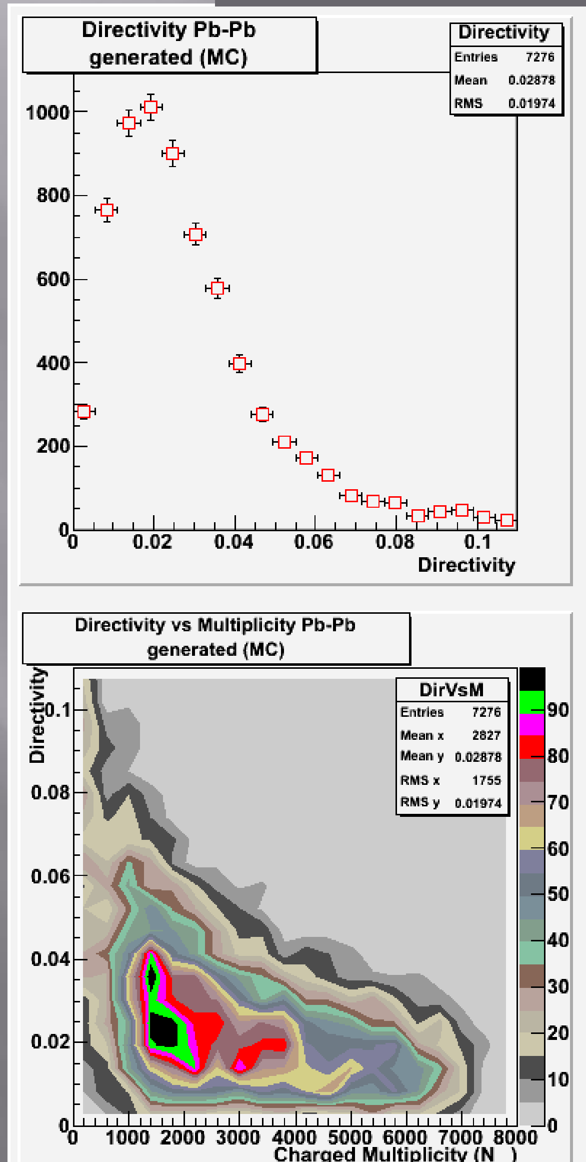


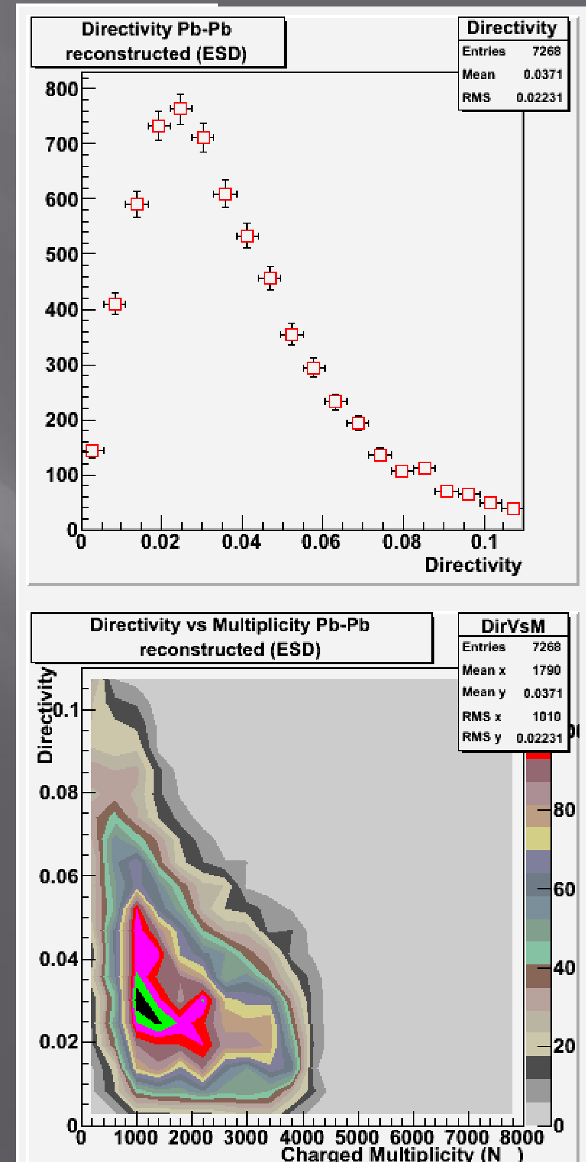
Directivity vs. Multiplicity
Pb –Pb HIJING

5.5 TeV

Generated (MC)

Reconstructed (ESD)



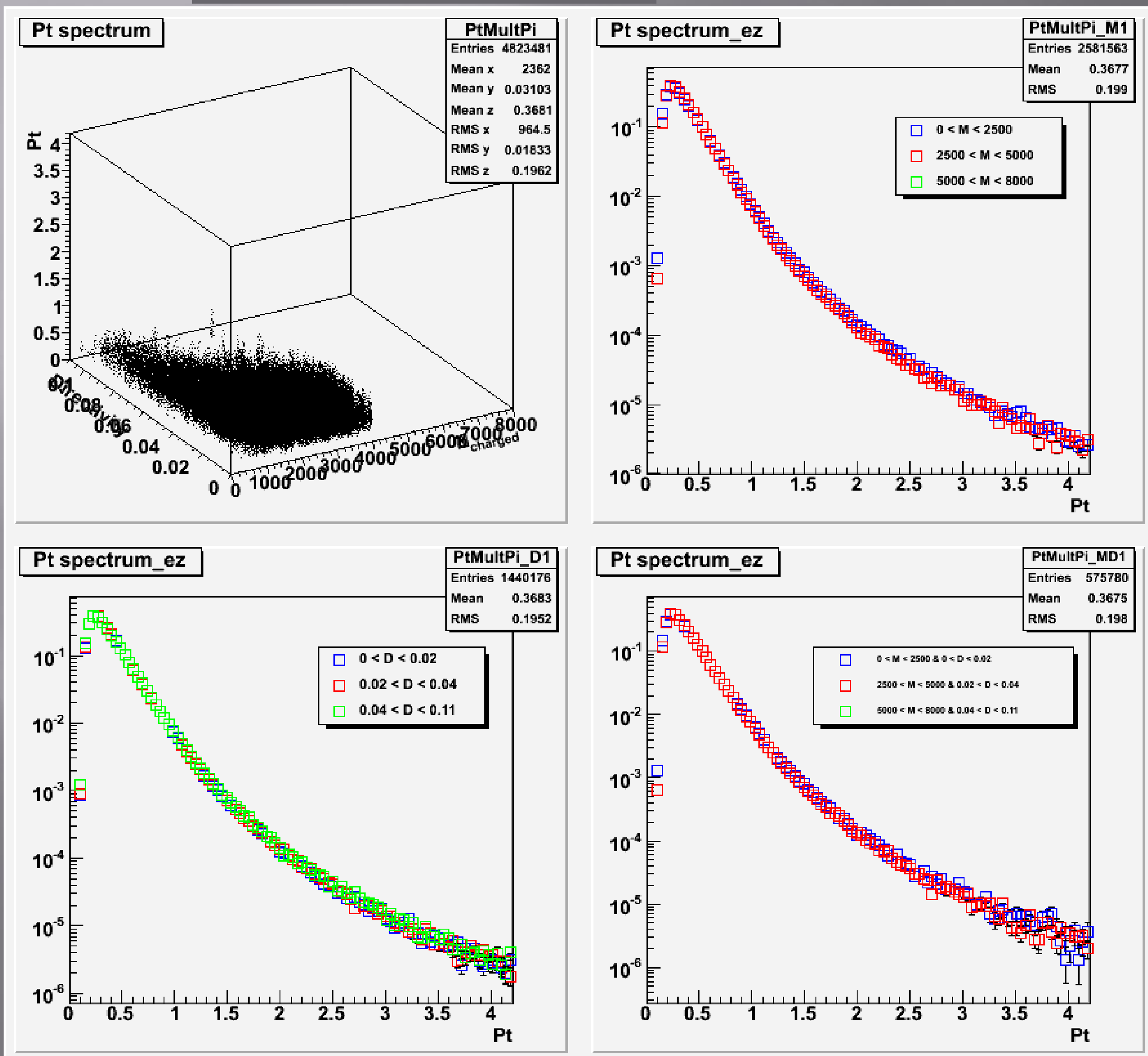


p_t spectra for π, K, p – conditioned by cuts in Directivity, multiplicity or both

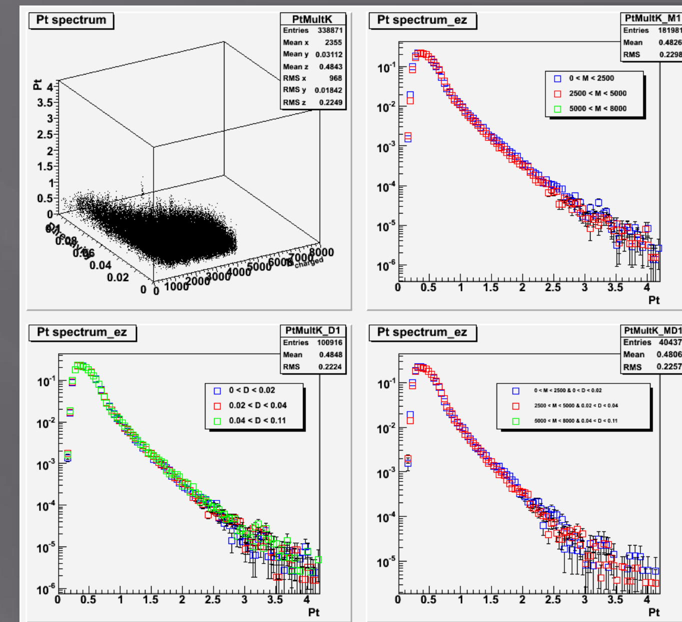
Pb-Pb HIJING

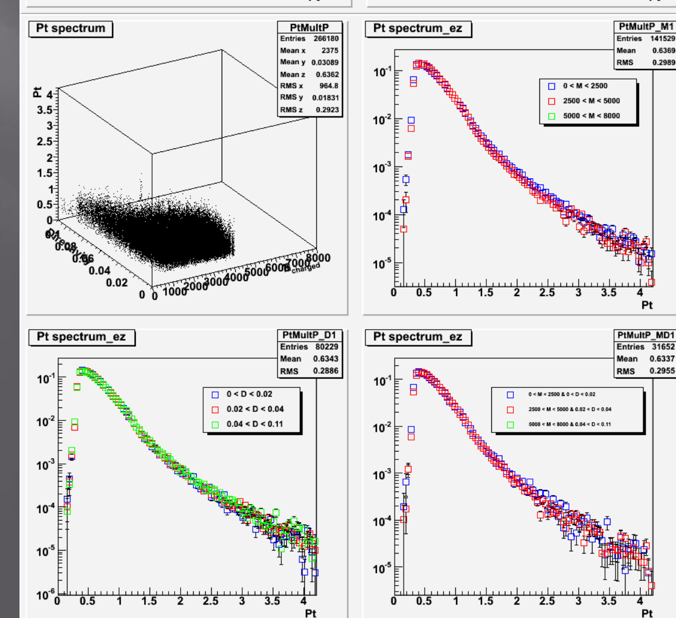
Without cuts

pions reconstructed (ESD)



kaons reconstructed (ESD)



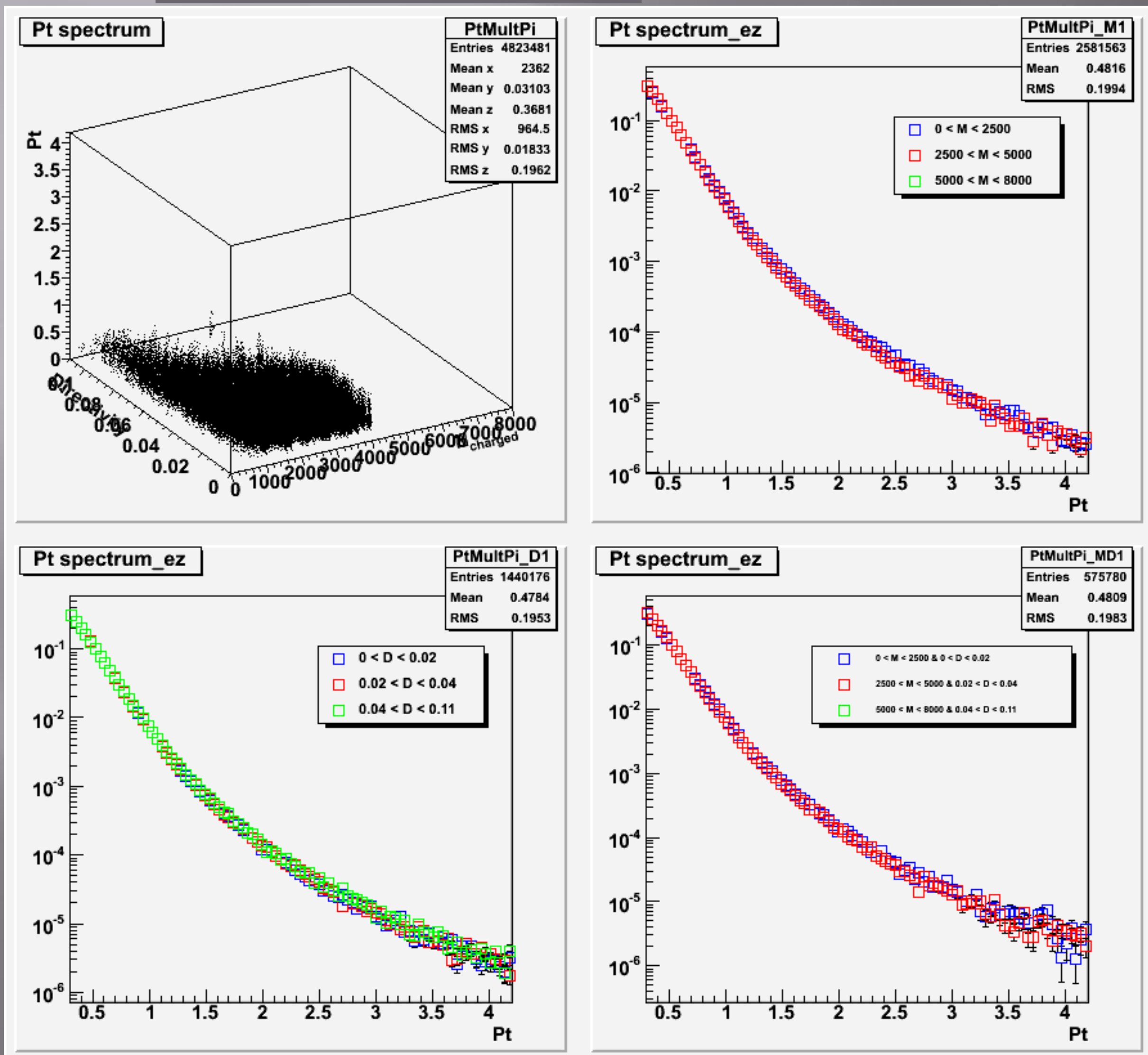


protons reconstructed (ESD)

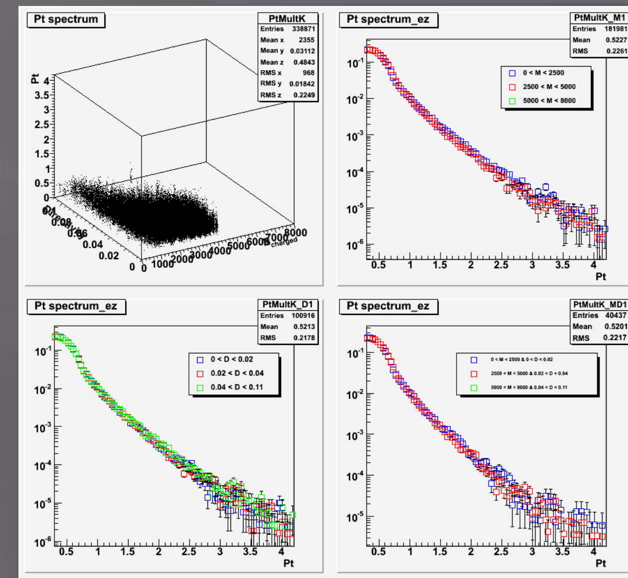
p_t spectra for π, K, p – conditioned by cuts in Directivity, multiplicity or both Pb-Pb HIJING

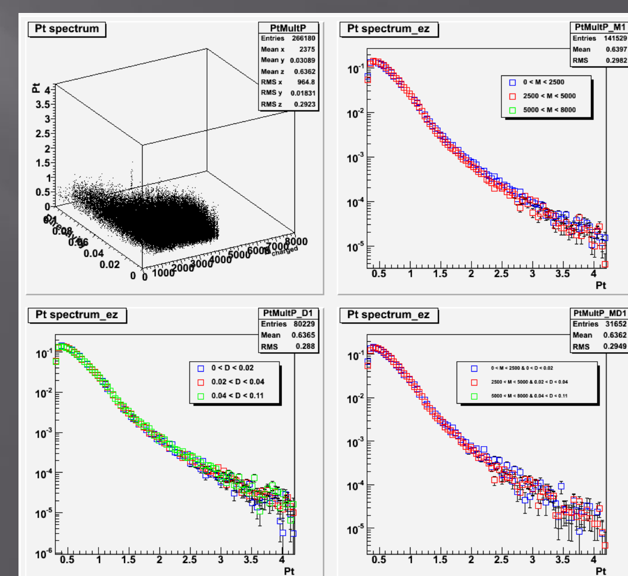
Cut: pt > 0.3 GeV

pions reconstructed (ESD)



kaons reconstructed (ESD)

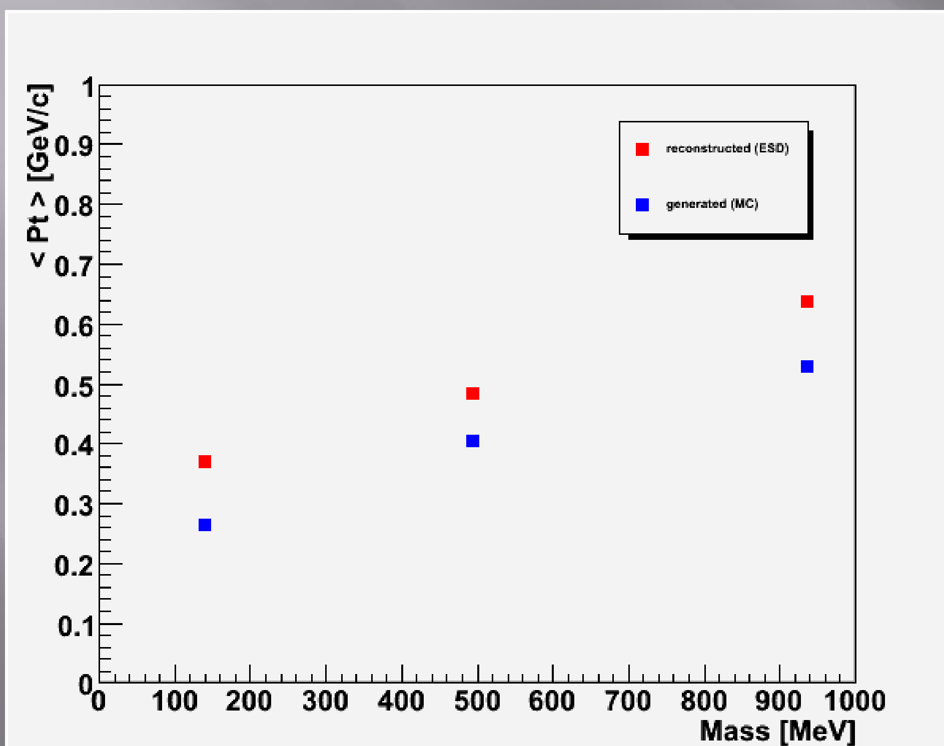




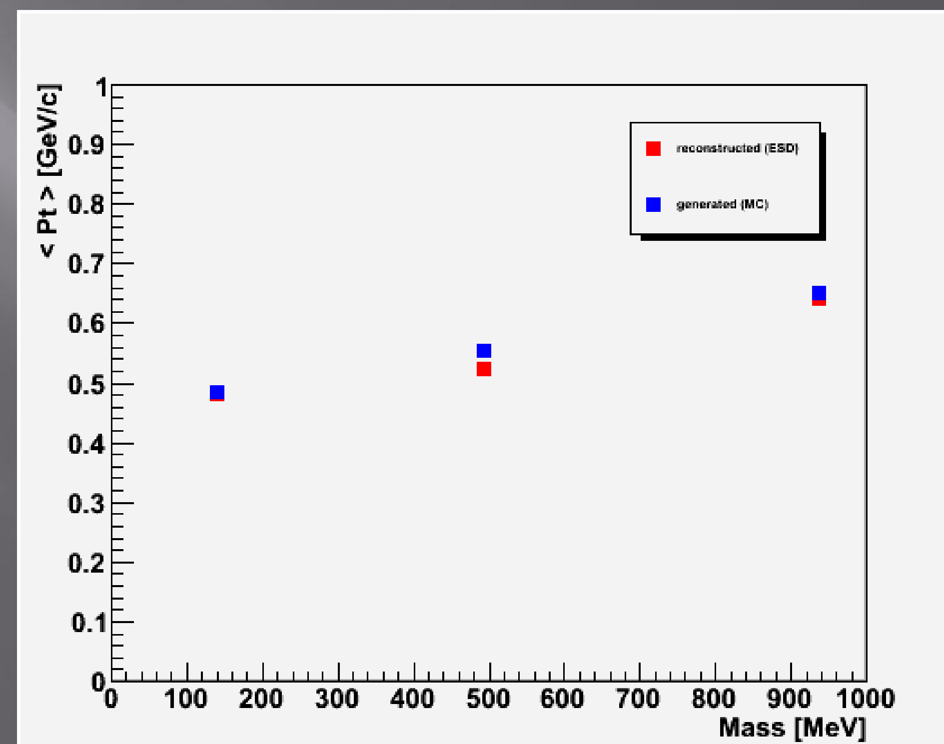
protons reconstructed (ESD)

$\langle p_t \rangle$ as a function of mass conditioned by cuts in Directivity, multiplicity or both Pb-Pb HIJING

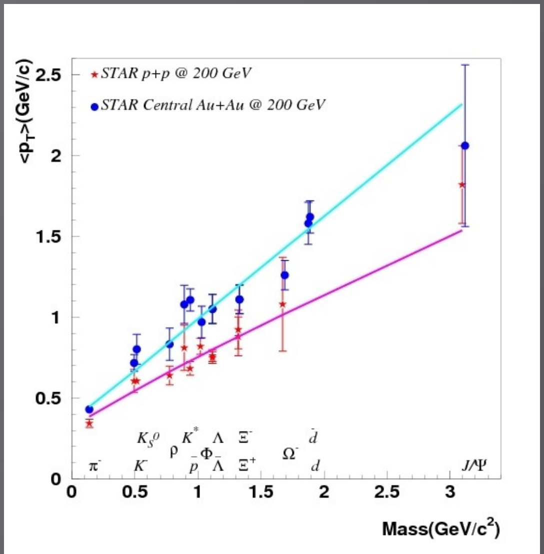
Without cuts



Cut: pt > 0.3 GeV



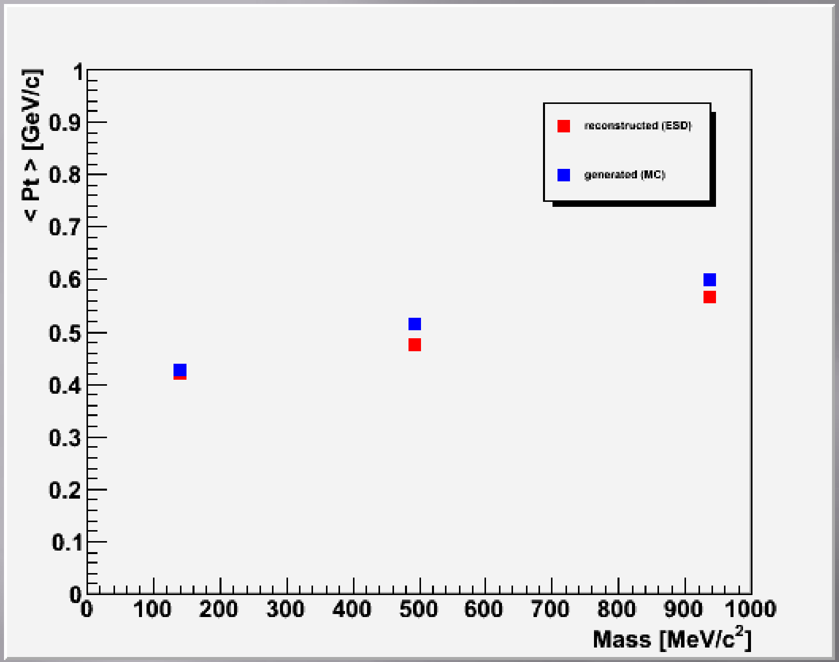
Conclusions



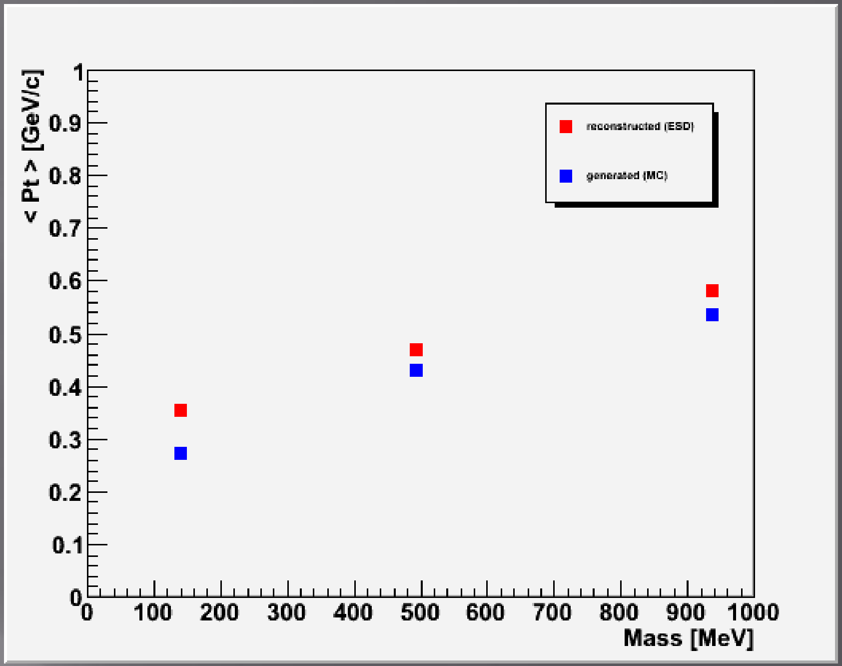
- Very preliminary results
- pt spectra are well reconstructed
- This analysis will be expanded for multistrange baryons and J/ψ
- $<p_t>$ -> T

<pt> vs mass

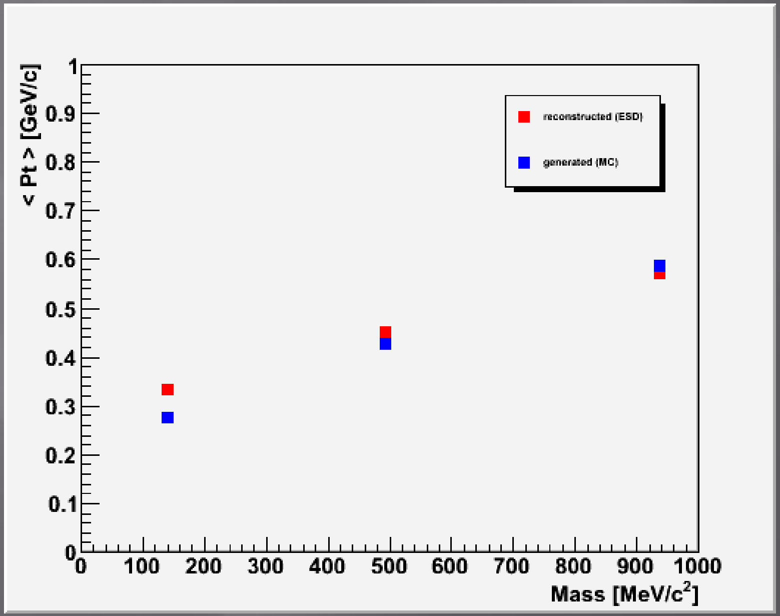
p – p Dir cut 1



p – p Dir cut 2

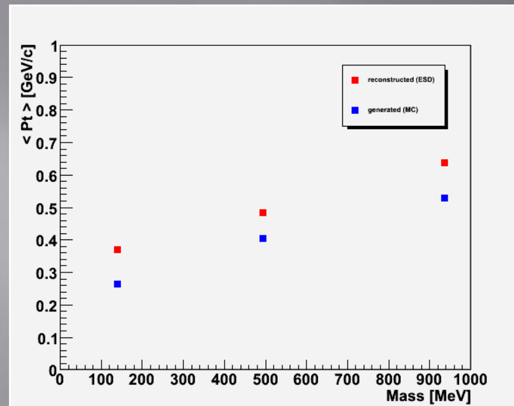


p – p Dir cut 3

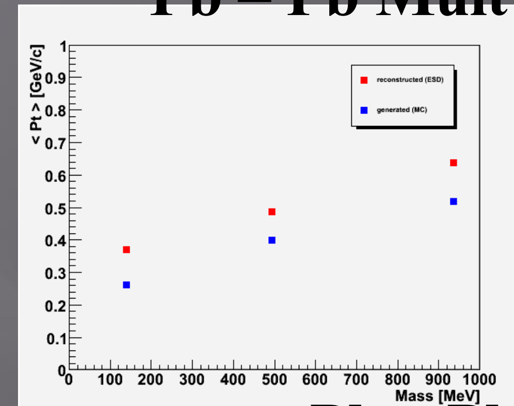


<pt> vs mass –without pt cut

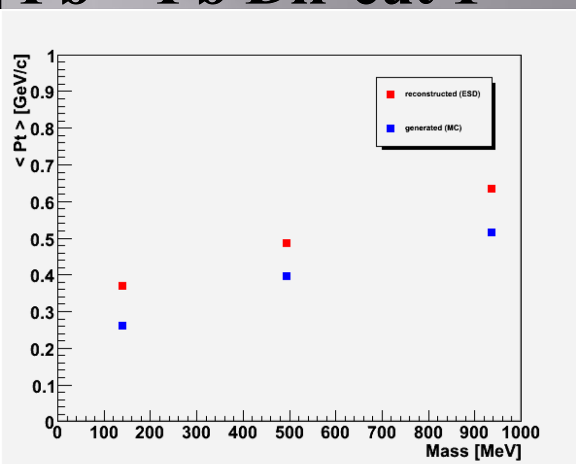
Pb – Pb Mult cut 1



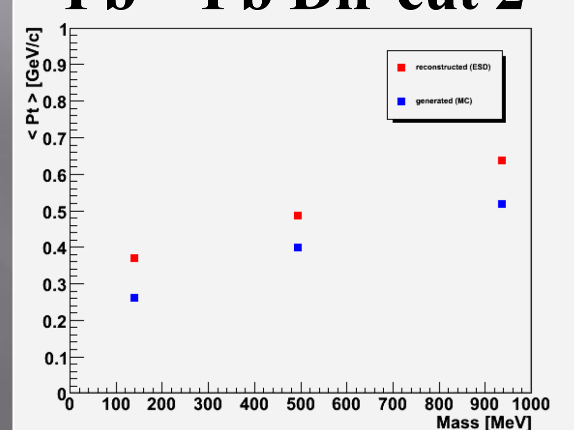
Pb – Pb Mult cut 2



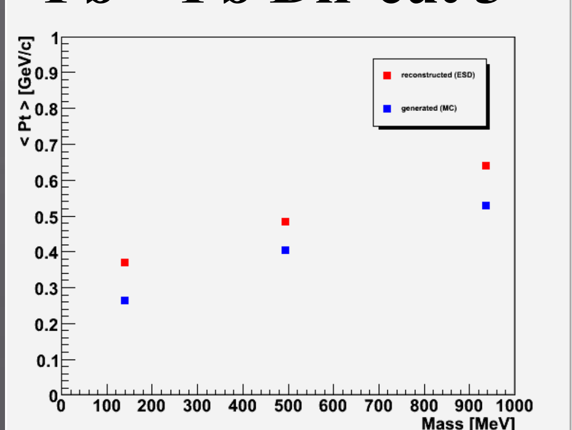
Pb – Pb Dir cut 1



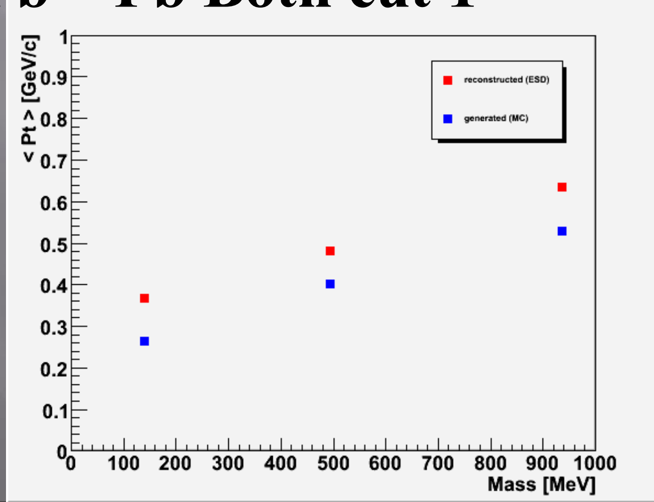
Pb – Pb Dir cut 2



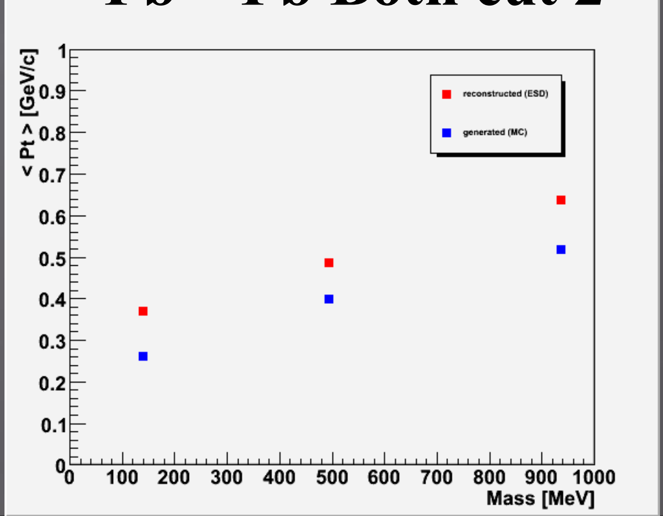
Pb – Pb Dir cut 3



Pb – Pb Both cut 1

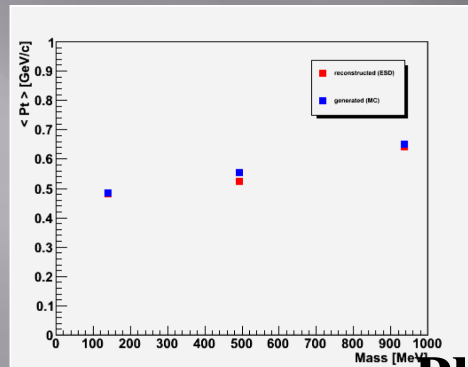


Pb – Pb Both cut 2

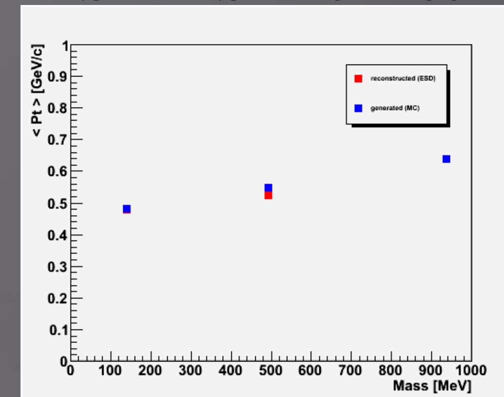


<pt> vs mass –with pt cut

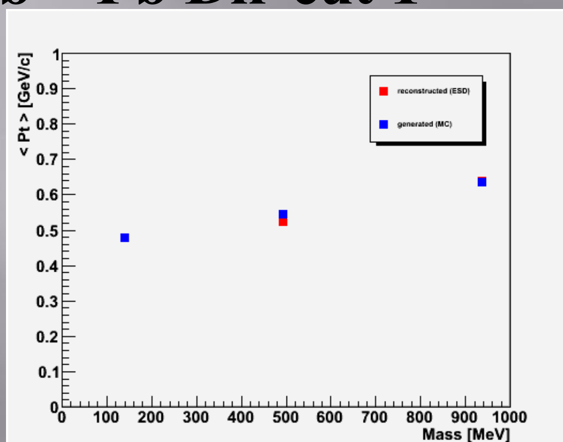
Pb – Pb Mult cut 1



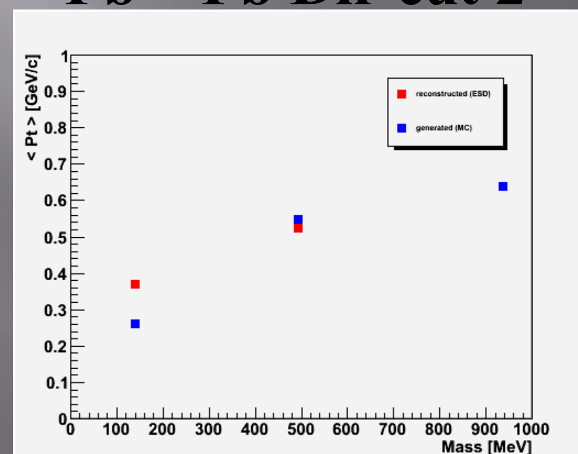
Pb – Pb Mult cut 2



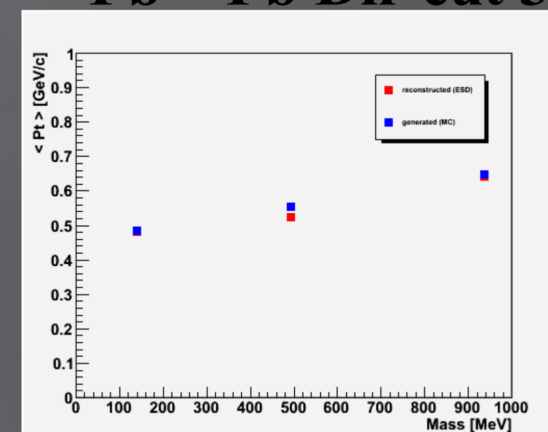
Pb – Pb Dir cut 1



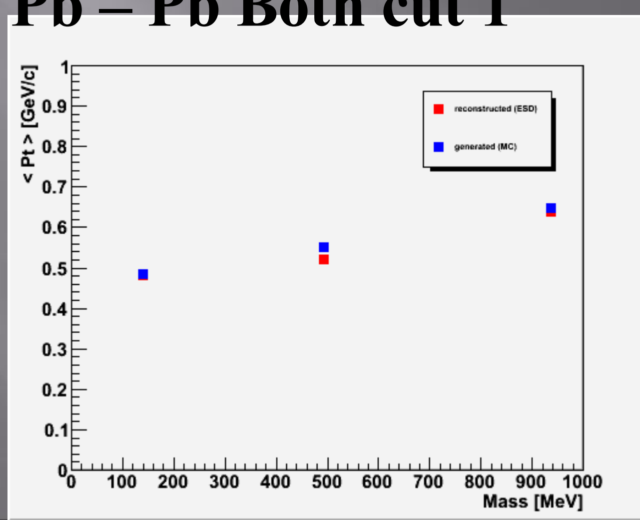
Pb – Pb Dir cut 2



Pb – Pb Dir cut 3



Pb – Pb Both cut 1



Pb – Pb Both cut 2