Preliminary study for Δ^{++} (Δ^{--}) measurement in p-p collisions

Quinto Convegno Nazionale sulla Fisica di ALICE
Trieste, 12 Settembre 2009

Francesca Bellini

INFN - Sez. di Bologna
Centro Studi e Ricerche “E.Fermi” - Roma

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Δ BARYONS
$(S = 0, I = 3/2)$

$\Delta^{++} = uuu, \quad \Delta^{+} = uud, \quad \Delta^{0} = udd, \quad \Delta^{-} = ddd$

$\Delta(1232)\ P_{33}$

$I(J^P) = \frac{3}{2}(\frac{3}{2}^+)$

Breit-Wigner mass (mixed charges) = 1231 to 1233 ($\approx$ 1232) MeV

Breit-Wigner full width (mixed charges) = 116 to 120 ($\approx$ 118) MeV

$\Delta(1232)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	100 %	229
$N\gamma$	0.52–0.60 %	259
$N\gamma$, helicity=1/2	0.11–0.13 %	259
$N\gamma$, helicity=3/2	0.41–0.47 %	259

Motivations

First physics with resonances

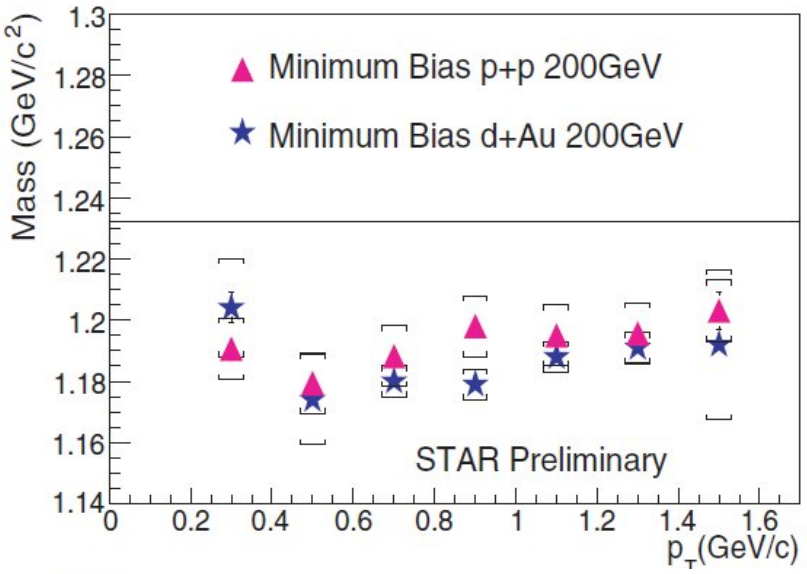
- multiplicity estimation
- identified particle spectra
- test of detectors performances

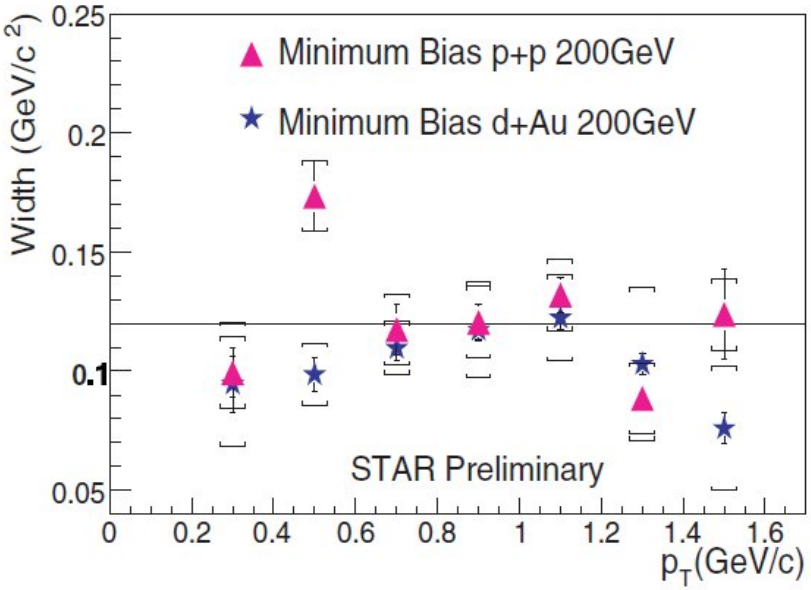
Heavy-ions collisions physics

- Resonances mass and width shift observed at RHIC:
  - re-scattering of decay products (p-p, d-Au)
  - chiral symmetry restoration hypothesis (Au-Au) for mesons (i.e. ρ)

  … but what about baryons?

- Resonances in-medium formation mechanism studies
- Δ life-time (~1.6 fm/c) comparable with the freeze-out time of QGP





J. Phys. G: Nucl. Part. Phys. 35 (2008) 044032

The Δ^{++} challenge

$$\Delta^{++} \rightarrow \pi^{+} + p$$
$$\Delta^{--} \rightarrow \pi^{-} + \bar{p}$$

- doubly charged resonance
- no close doubly charged resonances
- very efficient PID for decay products
- low invariant mass, close to π+p threshold
- no secondary vertex
- “smart” background estimation needed

Input

Data sample from PDC_09/LHC09a4 on GRID

p-p minimum bias events with $s^{1/2}$= 10 TeV

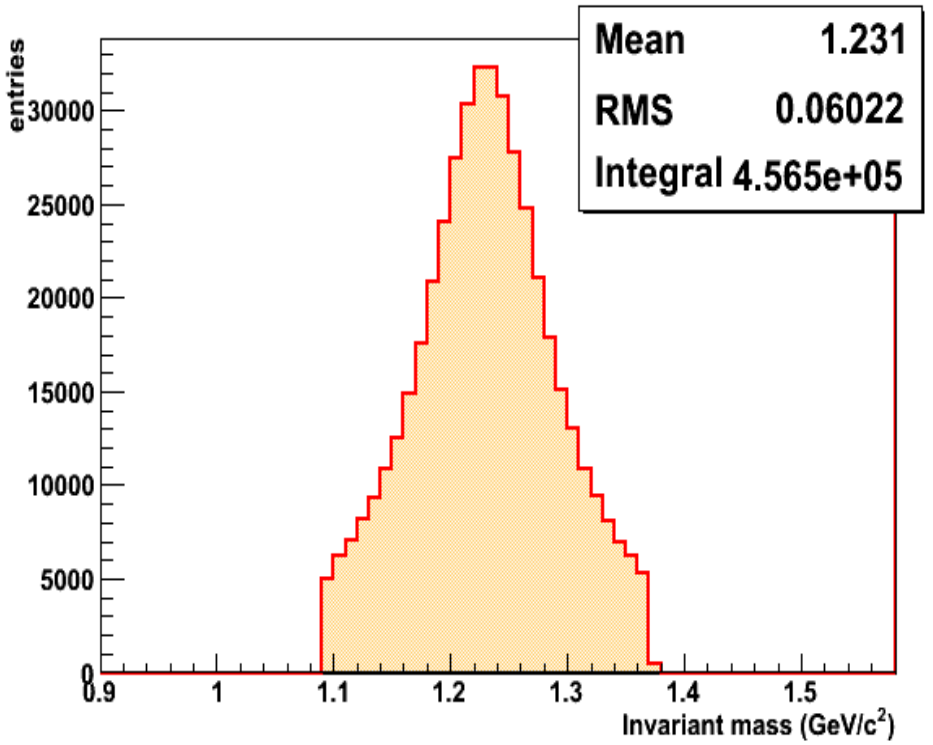
~ 4.8x10^6 ESD events analysed

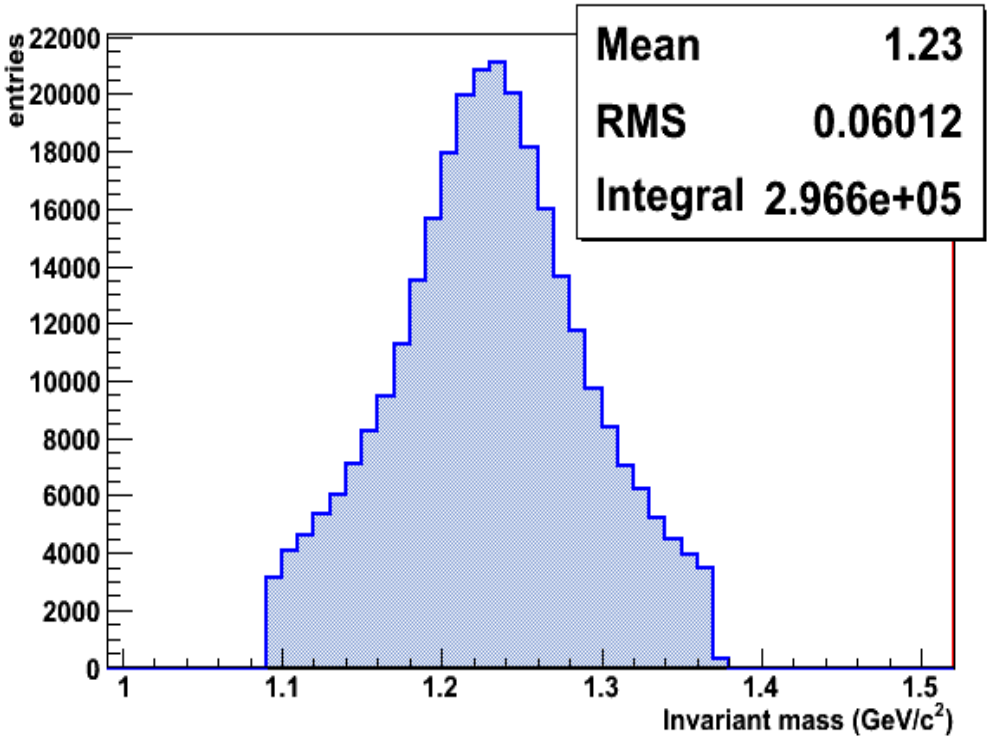
Root v5-23-02

AliRoot v4-16-Rev06

Montecarlo invariant mass for Δ^{++} and Δ^{--}

4.8x10^6 minimum bias events contain
~ 4.5 x 10^6 $(\Delta^{++})_{MC}$ + 2.6 x 10^6 $(\Delta^{--})_{MC}$

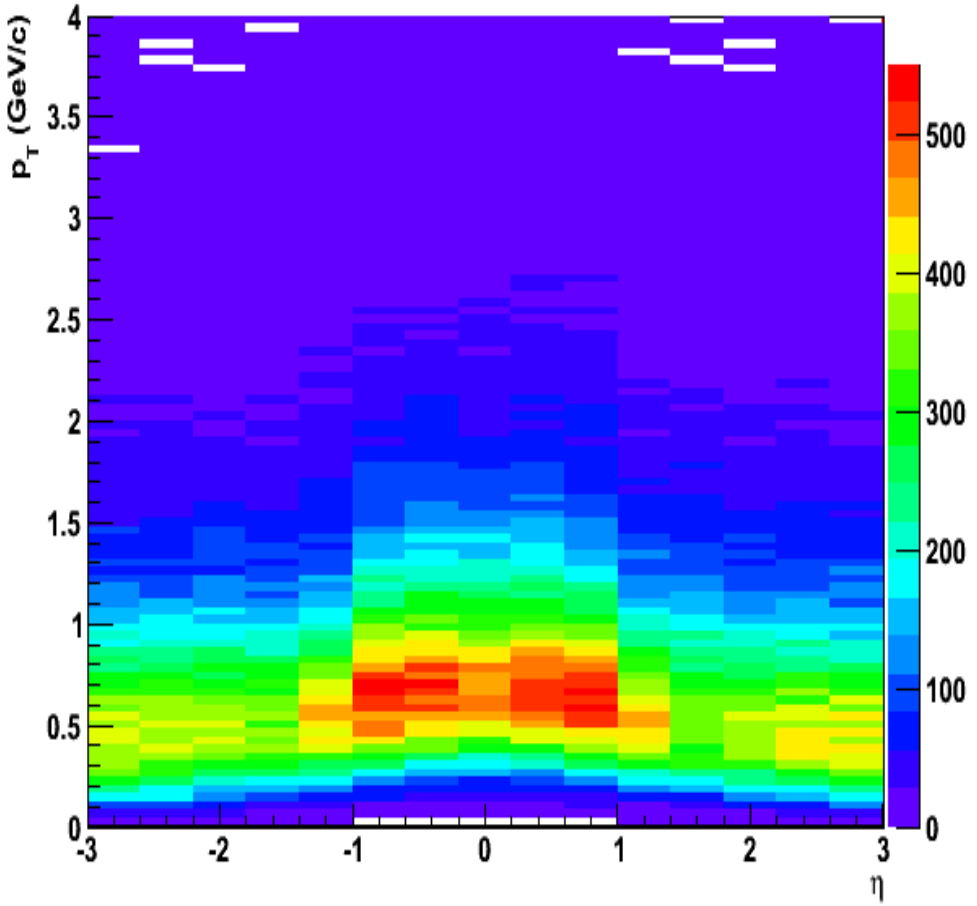




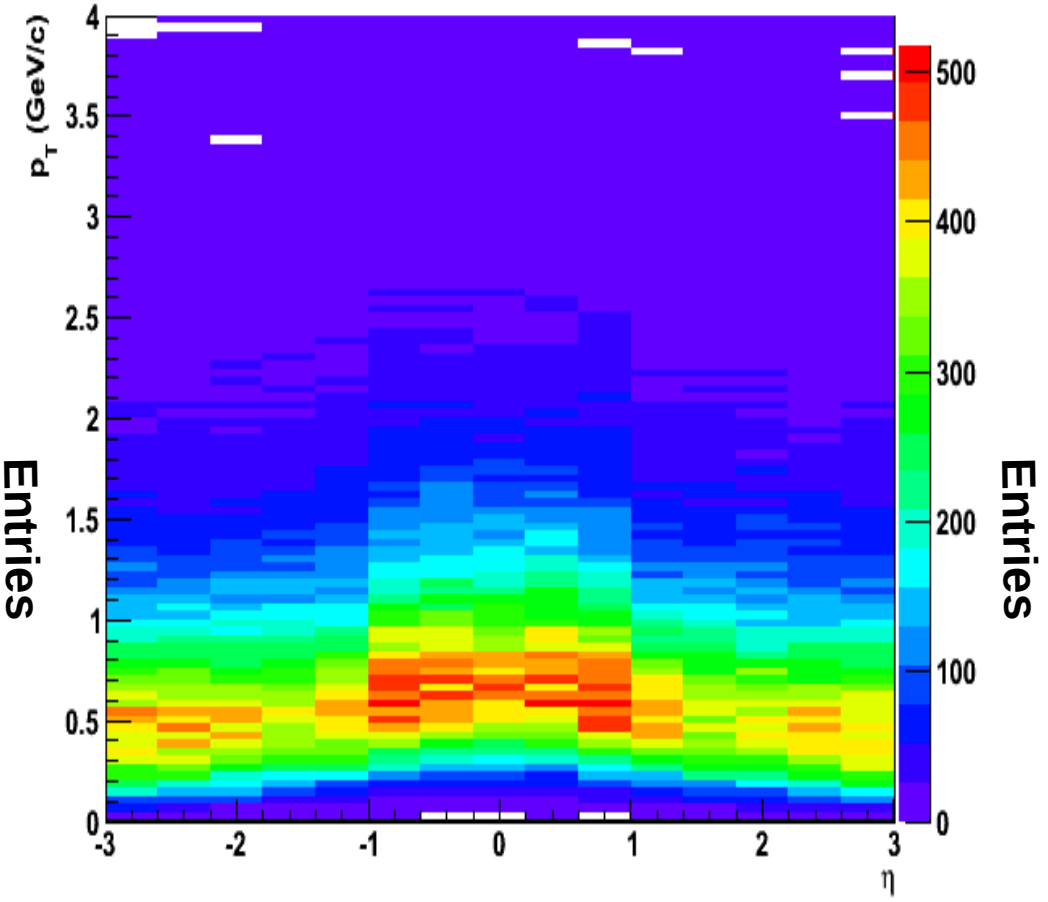
Note: histograms refer to a sample of events with a number of reconstructed tracks lower than 20.

Here: 4.56 x 10^5 $(\Delta^{++})_{MC}$ + 2.966 x 10^5 $(\Delta^{--})_{MC}$

Montecarlo p_T and η spectra for Δ^{++} and Δ^{--}



Δ^{++}



Δ^{--}

ESD analysis

- **Same-event like-sign** pairs: **(π^+, p)** and **$(\pi^-, \bar{p})$** → **$(S+B)_{se}$**
- Selection of events with at least 1 pion and 1 proton
- Combined PID
- Primary tracks selection with standard ALICE cuts on track quality
- Single identified tracks kinetical cuts

$$|\eta| < 3$$

$$p_T > 0.5 \text{ GeV/c}$$

- Positive and negative cases studied separately to take into account different particle-antiparticle production
- Comparison with MC to estimate efficiency
- Subtraction of background

The background issue

Two possible techniques to estimate background :

- **Same-event opposite-sign** pairs: **(π^-, p)** and **$(\pi^+, \bar{p})$** → **$(B)_{se}$**

  - easiest and less expensive to compute

  - not “good” enough to extract signal: Δ^0 belongs to the same multiplet of Δ^{++}

  → **irreducible background contribution**

- **Event-mixing like-sign** pairs: **(π^+, p)** and **$(\pi^-, \bar{p})$** → **$(B)_{me}$**

  - larger computational efforts required
  - better estimation of background with uncorrelated pairs
  - careful selection of events for mixing technique

  → take into account **event topology** in p-p collisions

Similarity classes of events

The ESD events topology has been studied by looking at:

- average transverse momentum
- average transverse mass
- charged multiplicity

The events have been classified in **3 “similarity” classes according to the identified charged multiplicity (N)**

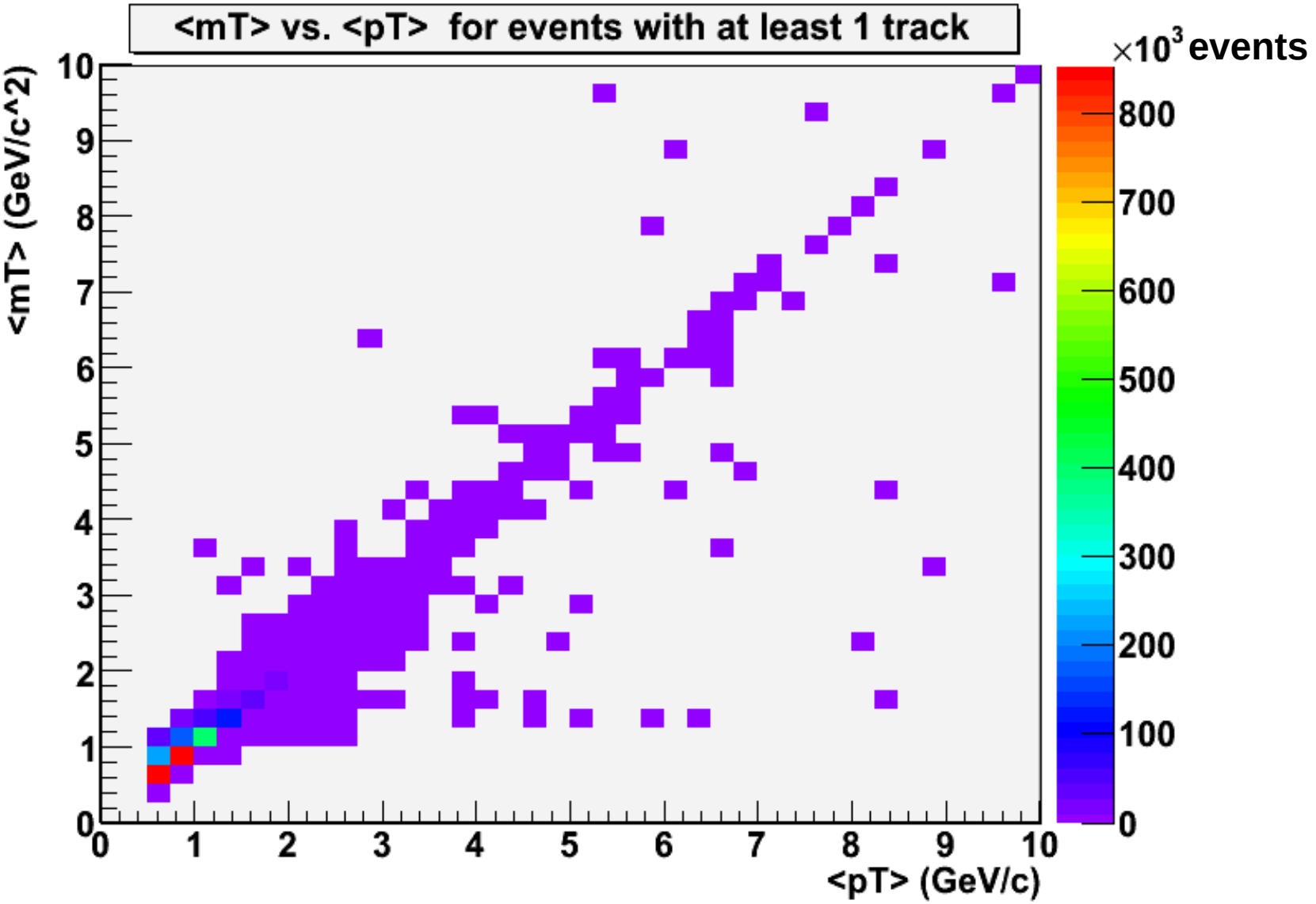
class A: 1≤N≤20

class B: 21≤N≤40

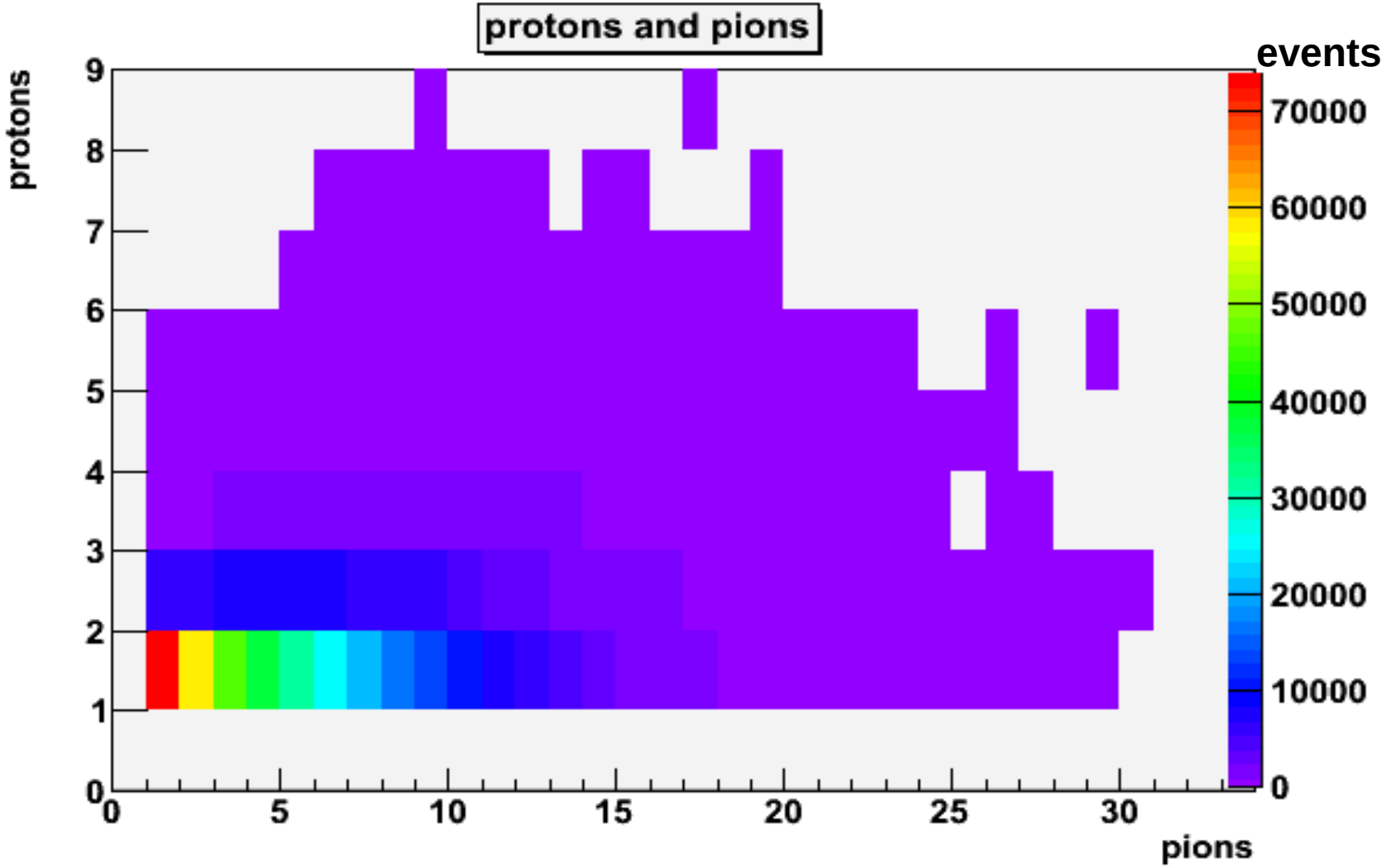
class C: N>40

to perform the event-mixing tecnique.

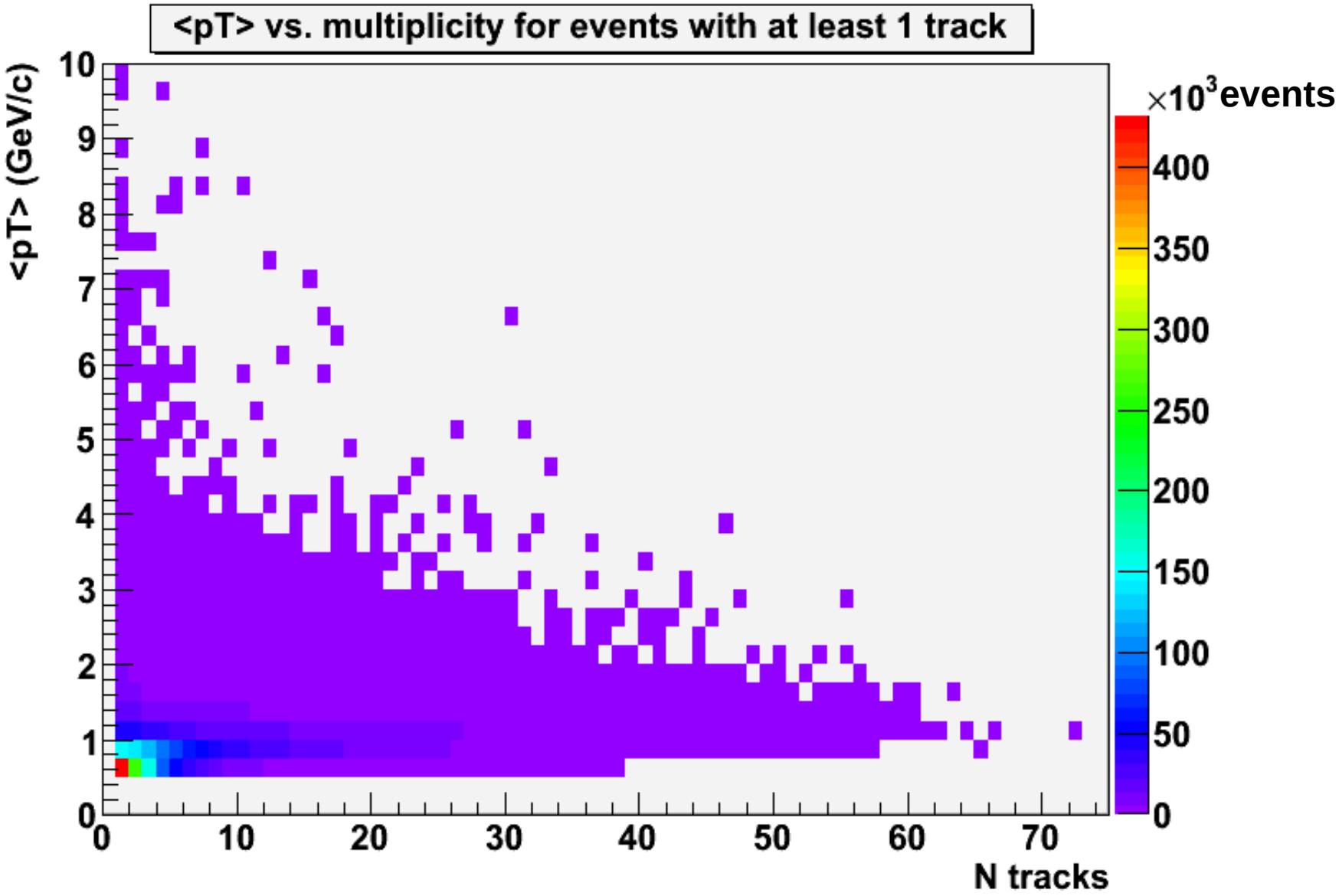
$\langle m_T \rangle$ vs. $\langle p_T \rangle$



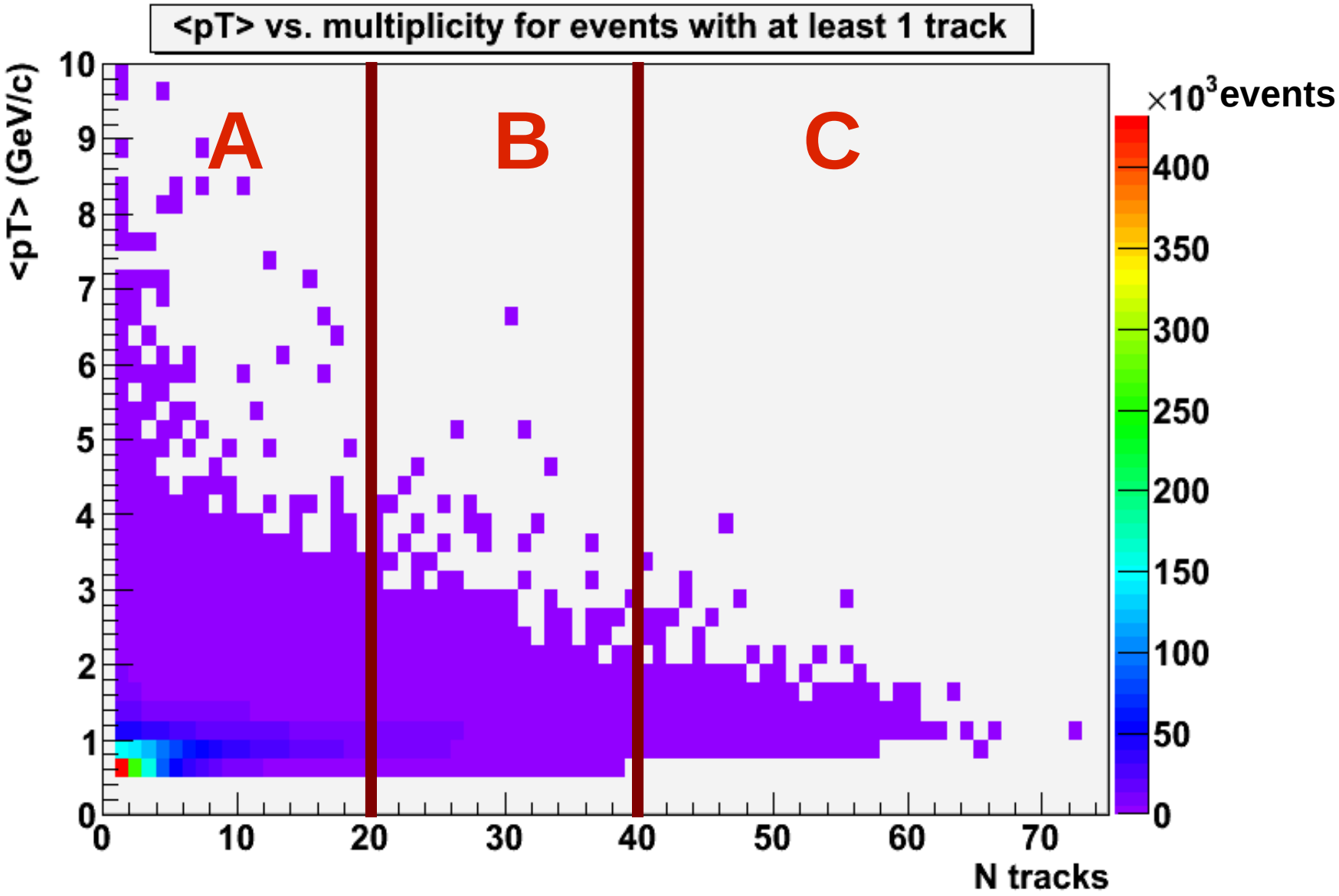
Protons and pions abundancies



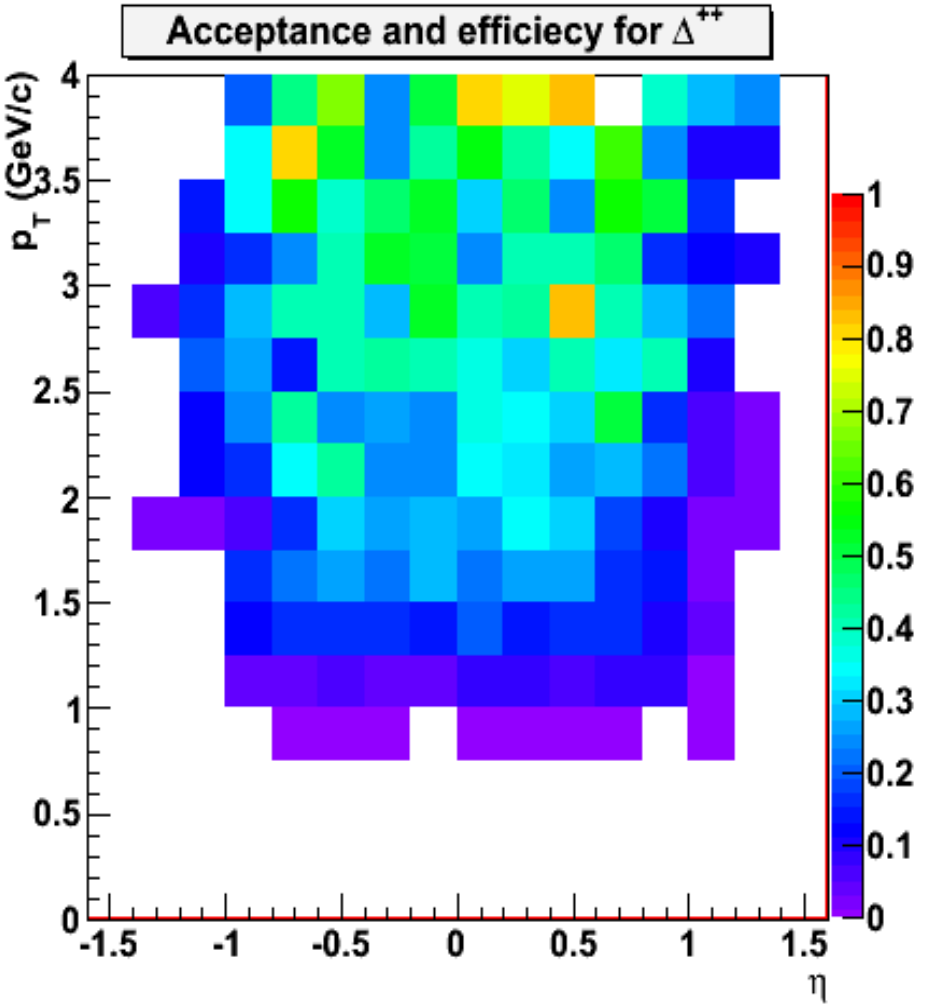
$\langle p_T \rangle$ vs. multiplicity

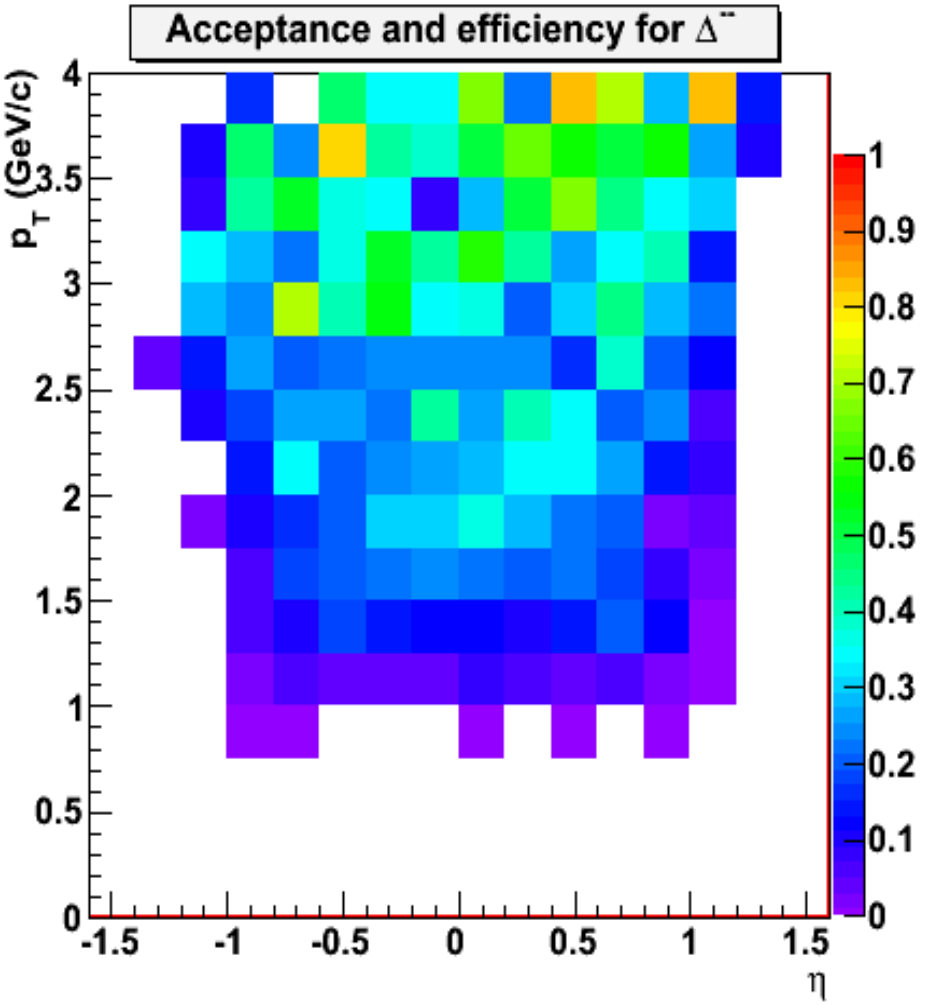


<p_T> vs. multiplicity – similarity classes



Geometrical acceptance and efficiency



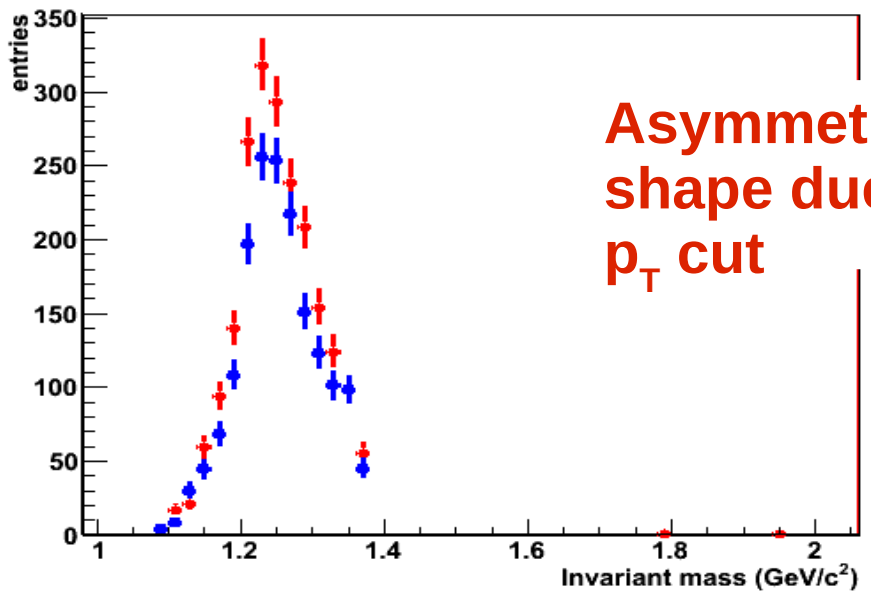


Efficiency in color scale.

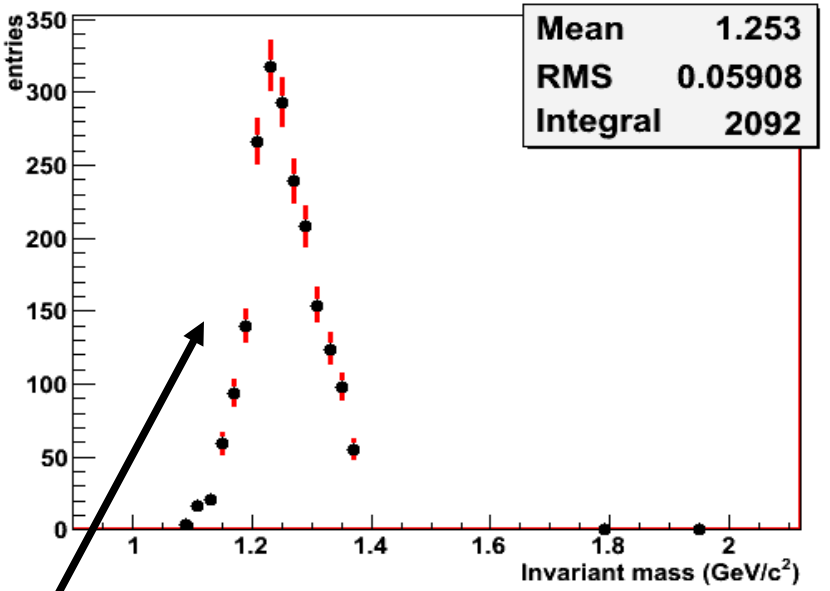
Expected signal shape

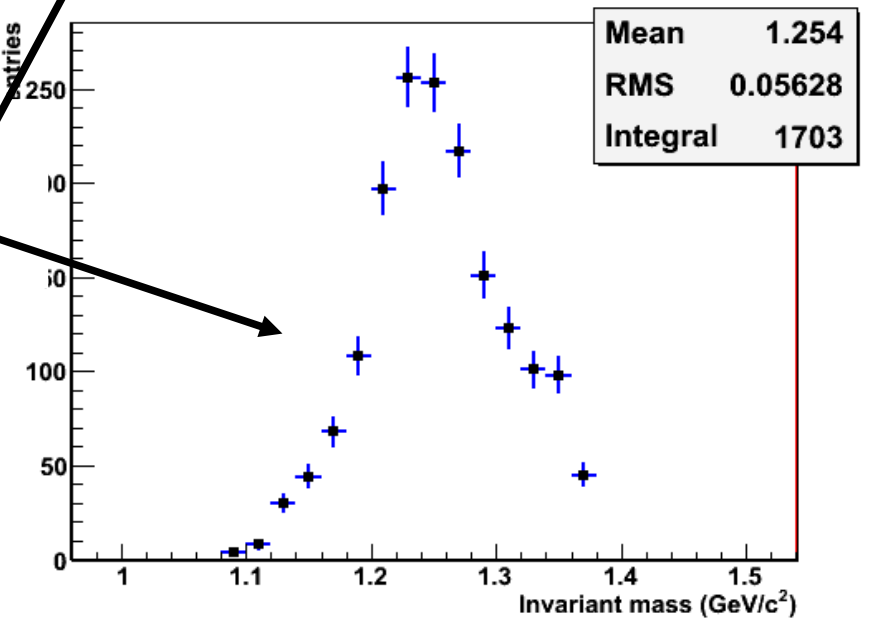
Event Class A
pT>0.5 GeV/c

"True" pairs $(S)_{true}$:
Invariant mass spectra computed from ESD and compared with MC



Asymmetrical shape due to p_T cut

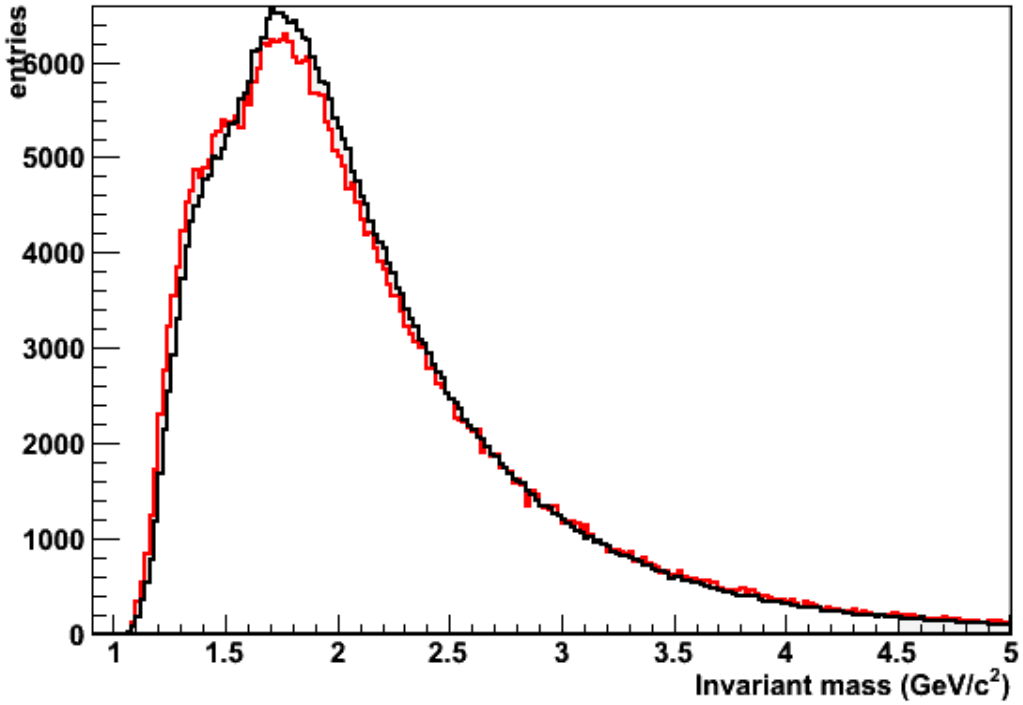


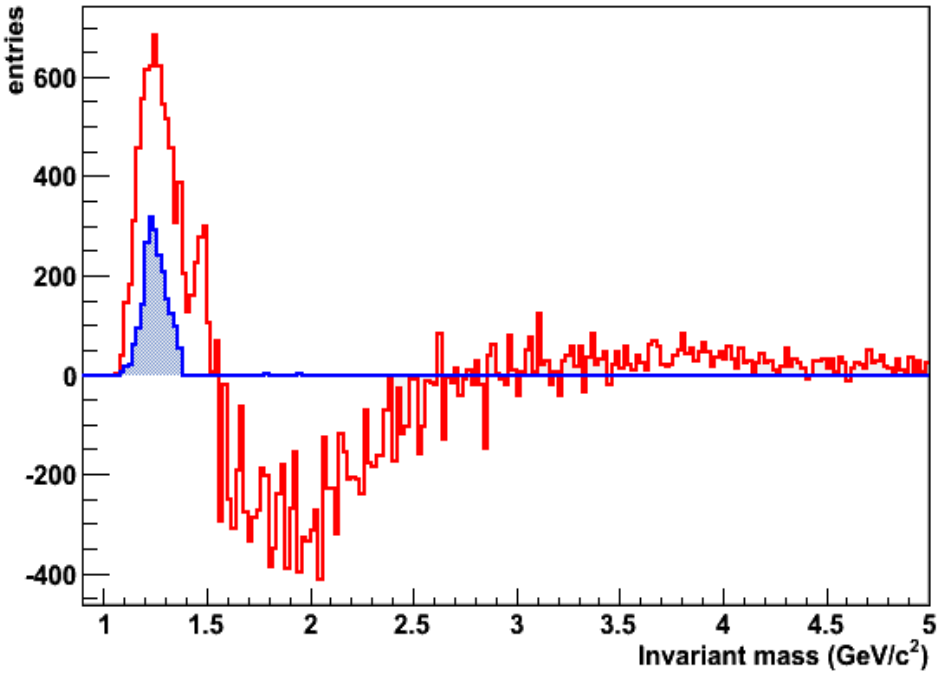


Preliminary results for Δ^{++}

Event Class A
pT>0.5 GeV/c

***A priori* normalization factor**

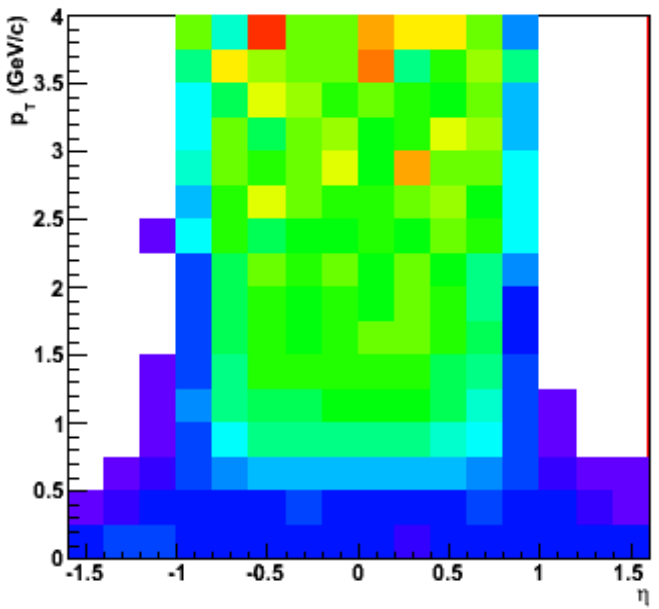


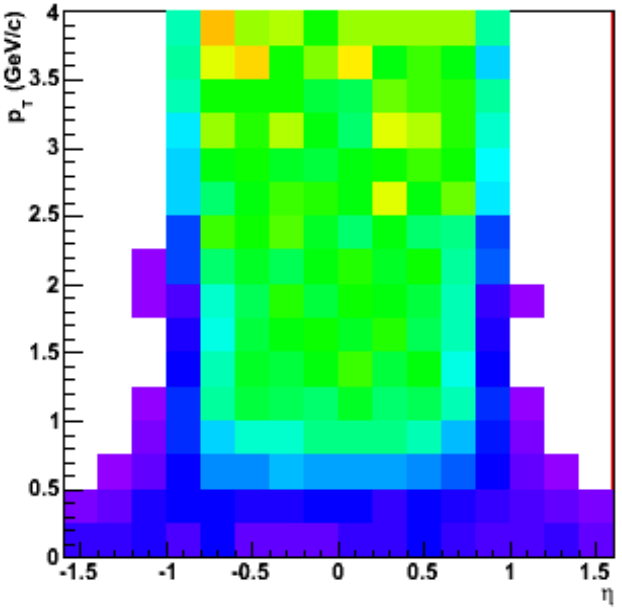


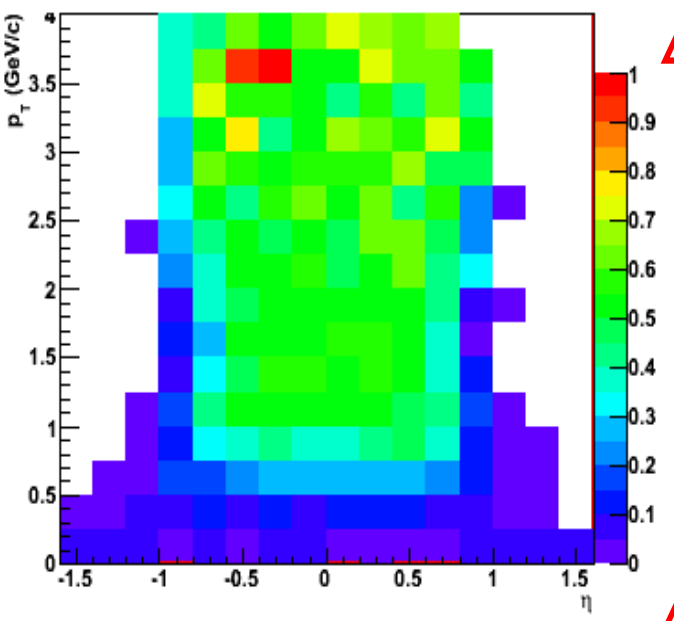
(S+B)se
(B)me
(S)true

New cut on single reconstructed tracks
p_T>0.2 GeV/c

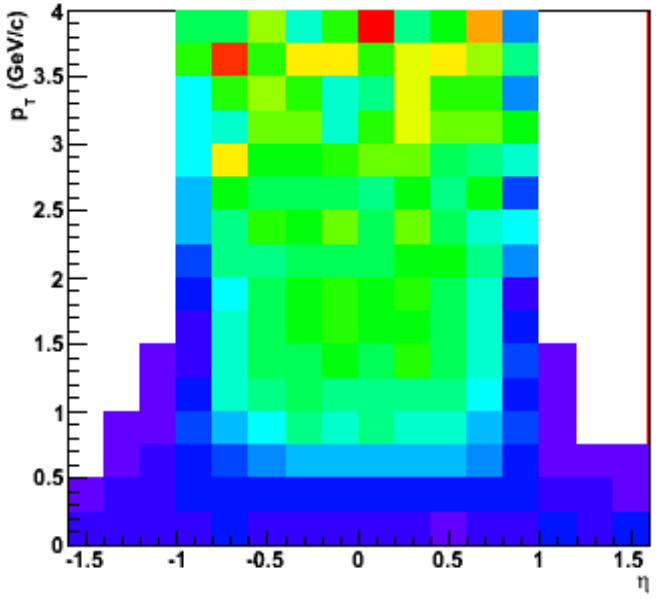
Geometrical acceptance and efficiency

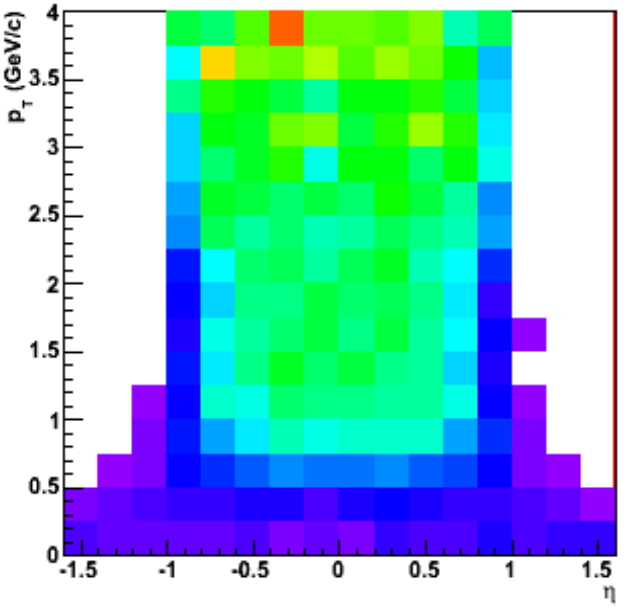


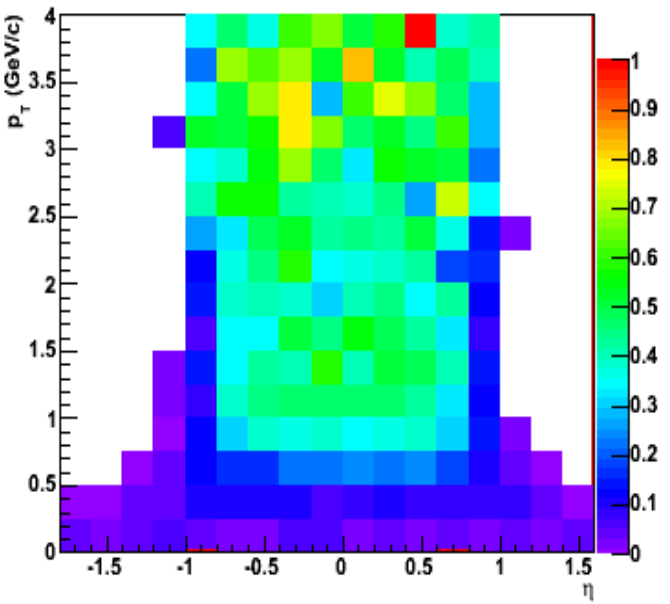




Δ^{++}







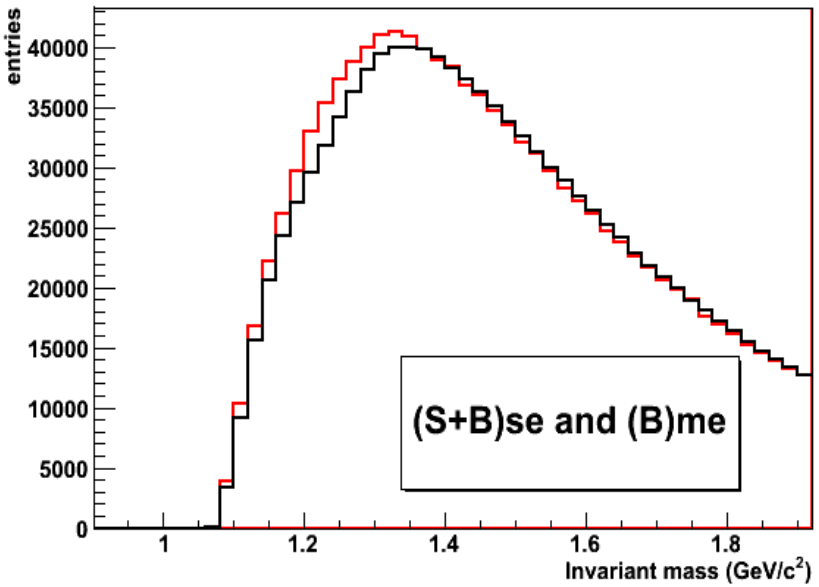
Δ^{--}

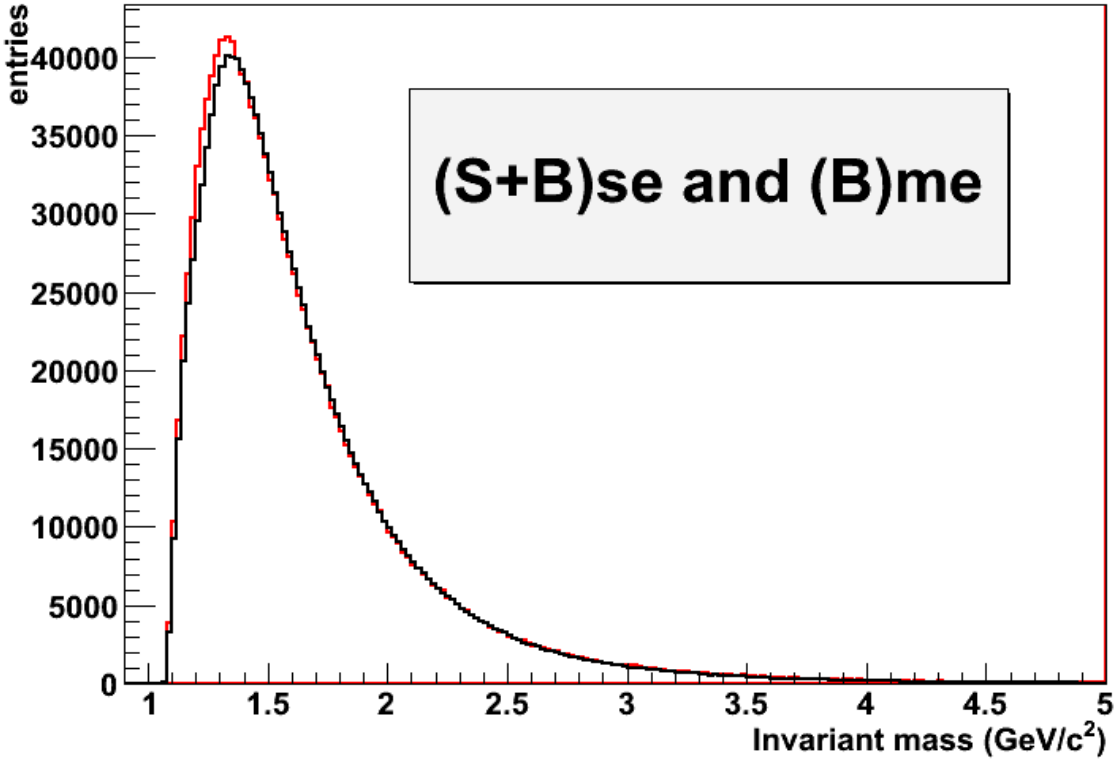
Efficiency in color scale.

New preliminary results for Δ^{++}

Event Class A
pT>0.2 GeV/c

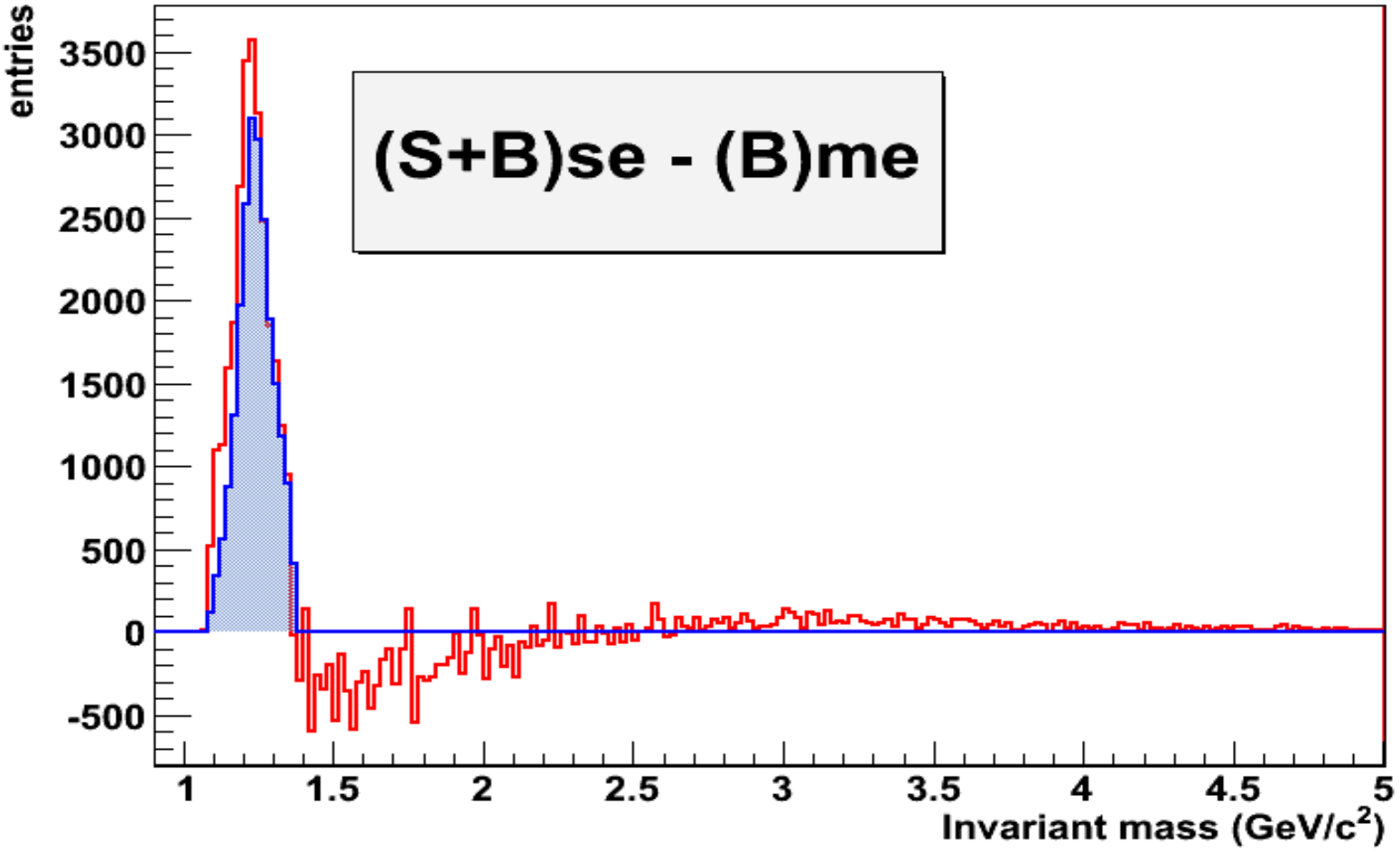
***A priori* normalisation factor**





(S+B)se
(B)me

Direct subtraction of background



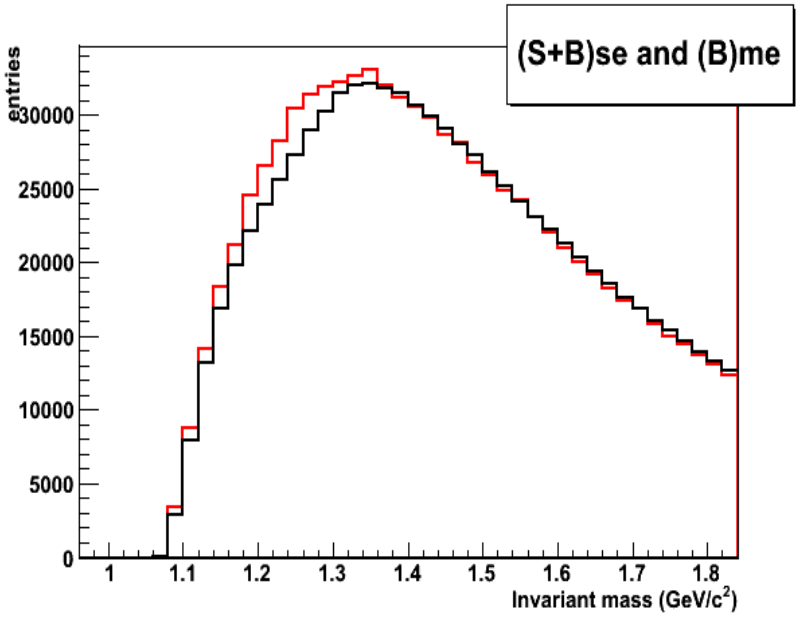
(S+B)se - (B)me

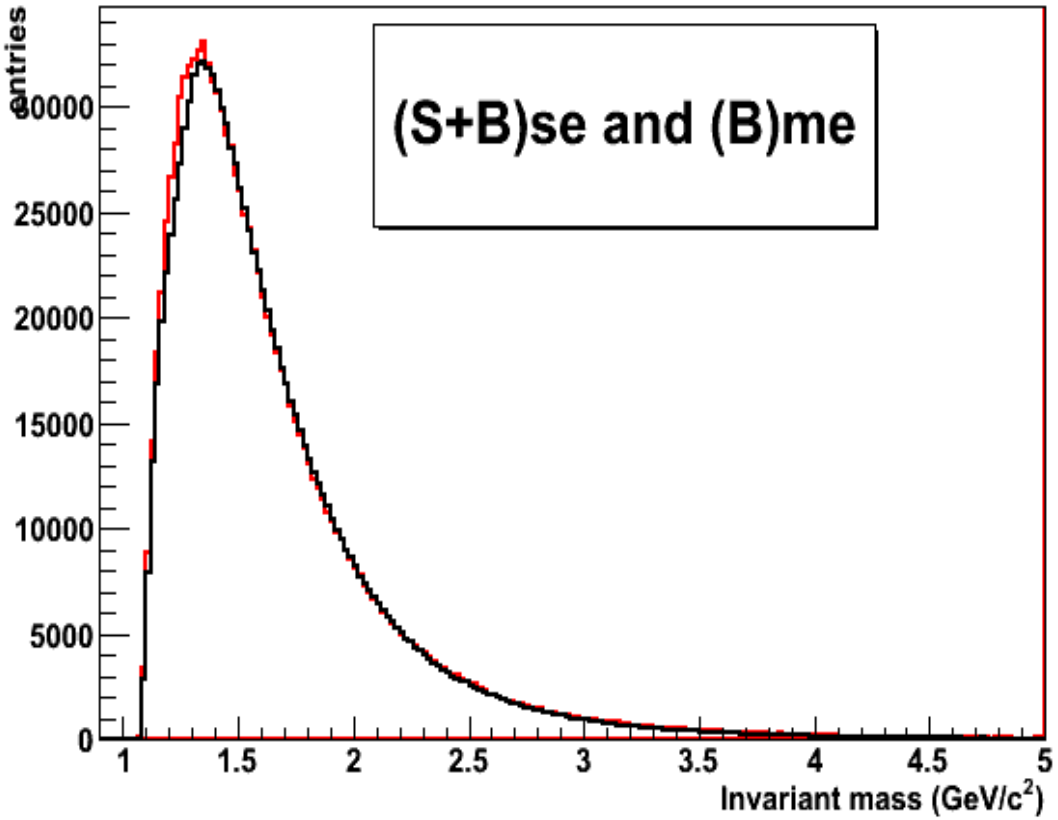
(S)true

New preliminary results for Δ^{--}

Event Class A
pT>0.2 GeV/c

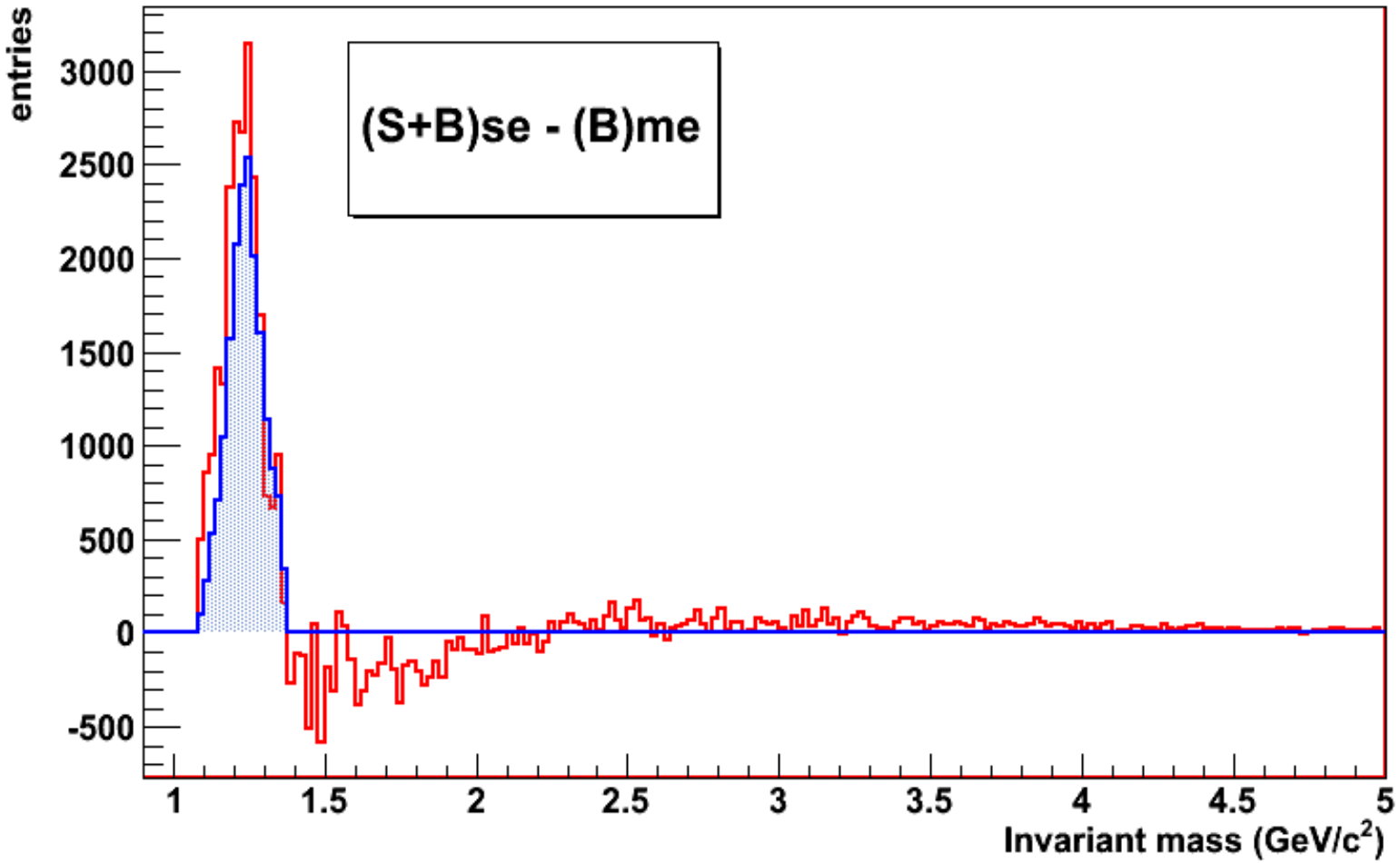
***A priori* normalisation factor**





(S+B)se
(B)me

Direct subtraction of background



(S+B)se - (B)me

(S)true

Conclusions

Estimation of background is a key point for the Δ^{++} and Δ^{--} signal extrapolation.

The event-mixing tecnique has been performed but the results after background subtraction are still very preliminary

...there is still some work to do...