

# News on "System size dependence"

Centrality determination in C+C and Si+Si

Data analysis for  $\pi$ , K,  $\phi$

- systematic checks
- feeddown correction from weak decays for pions

# Centrality

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methods for determination:

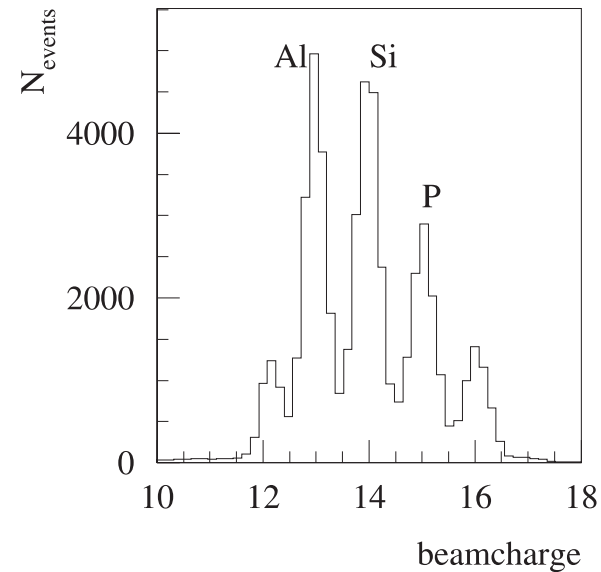
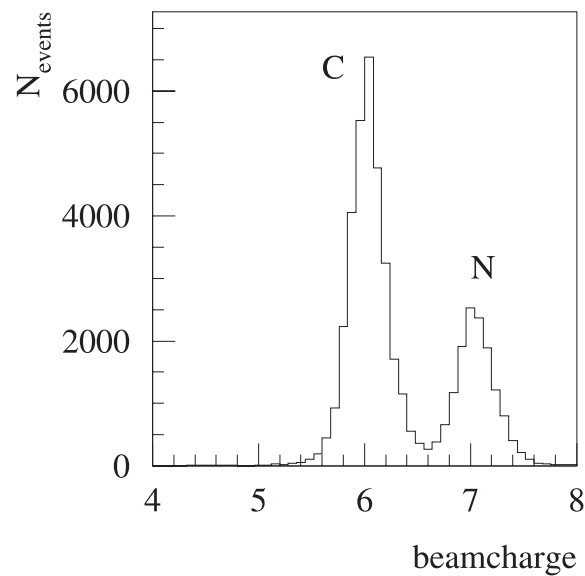
- measured trigger cross section in experiment  
total cross section from "literature"  
calculate  $N_{part}$ ,  $b$ , ... with help of VENUS (FRITIOF) simulations
- mean multiplicity in data compared to FRITIOF calculations
- mean energy deposited in Veto Calorimeter

# Centrality

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trigger cross section/ total cross section

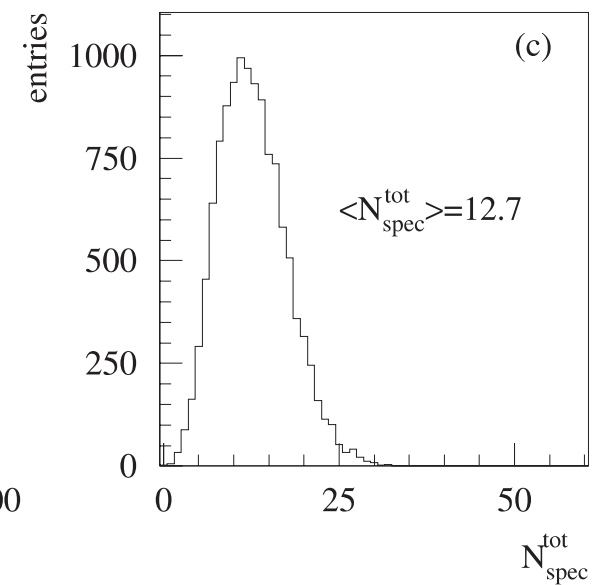
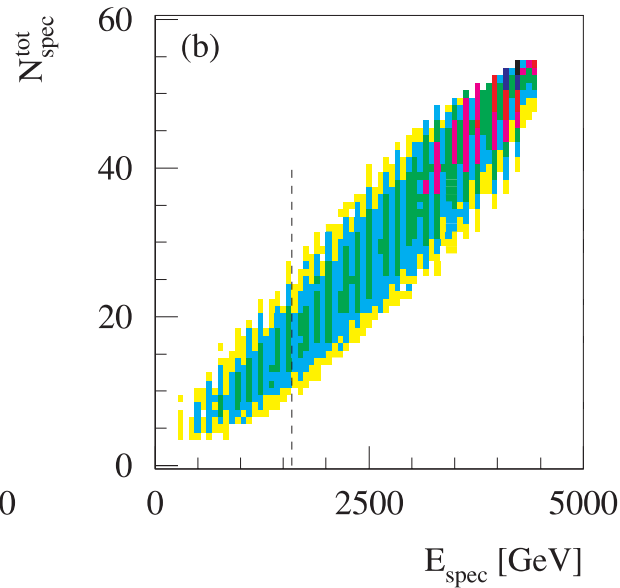
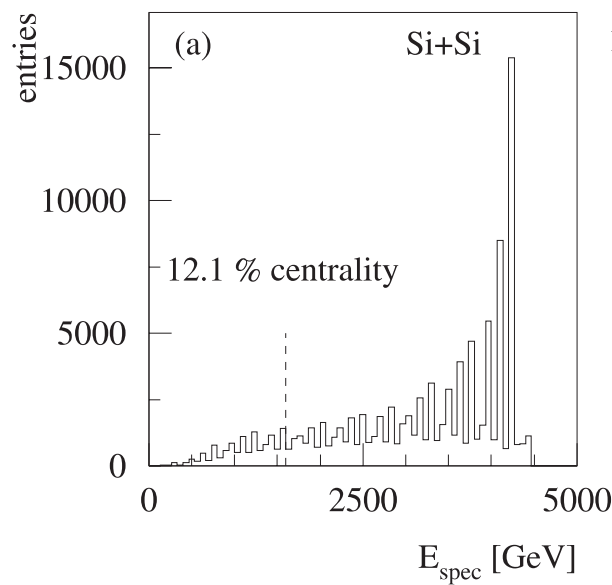
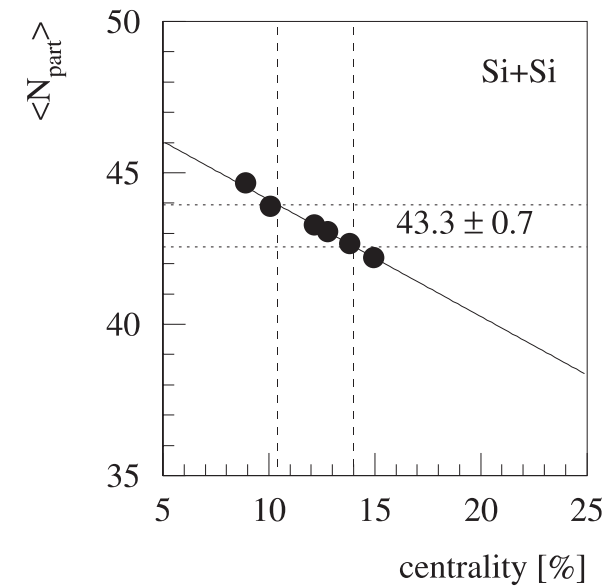
- take target out run into account
- ... and beam composition of different nuclei



- total cross section calculated as mean of various methods (soft spheres model of Karol, parametrizations) which are checked by comparison to data

# Centrality

calculate corresponding centrality parameters with VENUS (FRITIOF) simulations for various centralities



$$\sigma_{trig} = \rho_{trig} \cdot \left( \rho \cdot d \cdot \frac{N_A}{M} \right)^{-1}$$

$$S_{trig} = \frac{N_{trig}}{N_{beam}}$$

target	d	$\rho$	$\rho_{trig}$	$\sigma_{trig}$ [mb]
C	3.05 mm	1.84 g/cm <sup>3</sup> ± 0.5%	4.116 · 10 <sup>-3</sup>	146
C <sub>with target out</sub>			3.676 · 10 <sup>-3</sup>	131 ± 15
Si	5.02 mm	2.33 g/cm <sup>3</sup>	5.445 · 10 <sup>-3</sup>	216 ± 24

projectile	target	$\sigma_{inel}$ [mb]	fraction [%]	$\sigma_{inel}^{combined}$ [mb]
<sup>12</sup> C	C	839	68	856 ± 88
<sup>14</sup> N	C	894	30	
<sup>24</sup> Mg	Si	1665	9	1768 ± 180
<sup>27</sup> Al	Si	1725	28	
<sup>28</sup> Si	Si	1765	32	
<sup>31</sup> P	Si	1827	19	
<sup>32</sup> S	Si	1880	10	

centrality	
C+C	(15.3 ± 2.4) %
Si+Si	(12.2 ± 1.8) %

QM02

17.5 ± 1.5 %  
12.5 ± 1.5 %

		$\sigma_{trig}^{VENUS}$	$\sigma_{trig}^{FRITIOF}$	$N_{ch}^{data}$	$E_0$	combined
C+C	$\langle N_{part} \rangle$	16.6 ± 0.4			16	16.3 ± 1
	$\langle N_{wound} \rangle$	13.9 ± 0.4	15.9 ± 0.4	15.8		14 ± 2
	$\langle \nu \rangle$	1.71 ± 0.01	1.8 ± 0.01			1.75 ± 0.05
	$\langle b \rangle$	1.88 ± 0.07	1.51 ± 0.08			1.9 ± 0.2
	$b_{max}$	2.02 ± 0.16	1.95 ± 0.16			2 ± 0.2
Si+Si	$\langle N_{part} \rangle$	43.3 ± 0.7			39.4	41.4 ± 2
	$\langle N_{wound} \rangle$	37.0 ± 0.8	39.9 ± 1	40.5		37 ± 3
	$\langle \nu \rangle$	2.16 ± 0.01	2.25 ± 0.01			2.2 ± 0.05
	$\langle b \rangle$	2.0 ± 0.1	1.81 ± 0.12			2 ± 0.2
	$b_{max}$	2.6 ± 0.2	2.54 ± 0.18			2.6 ± 0.2

16 ± 1

1.7

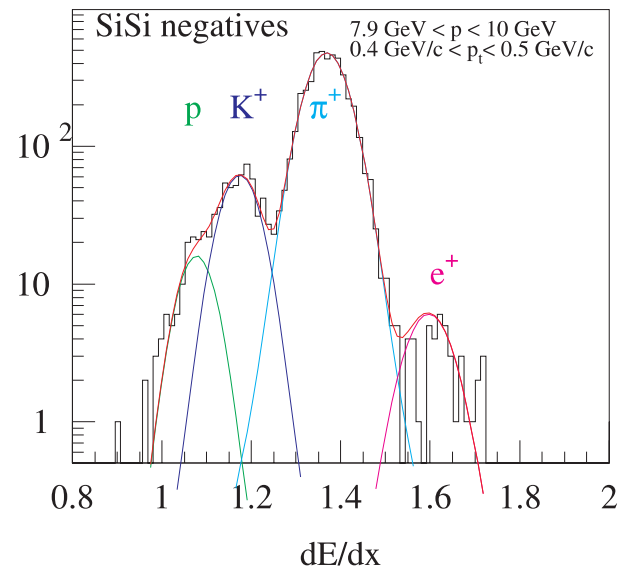
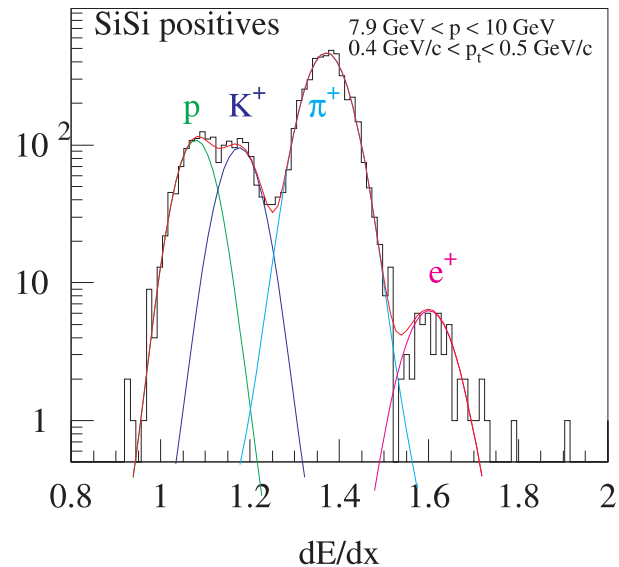
41.5 ± 1.5

2.2

# Data analysis: $\pi$ , K

study of systematic uncertainties:

- Npoints cut
- correction for kaon decay
- kaon position
- pt extrapolation
- treatment of electrons



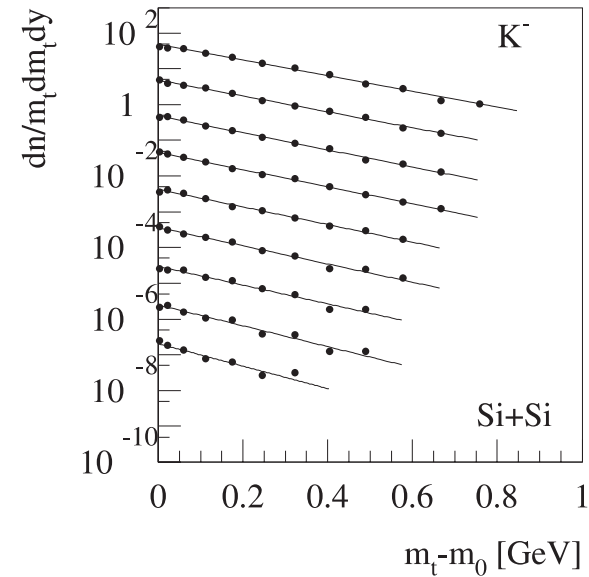
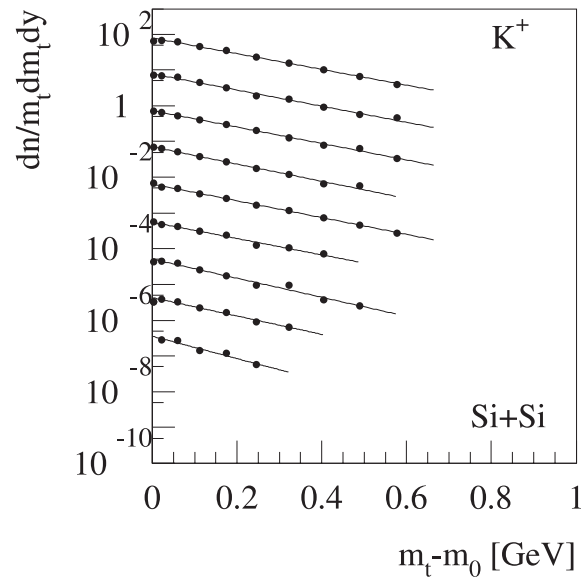
# Data analysis: $\pi, K$

extract yields in bins of (y,pt)

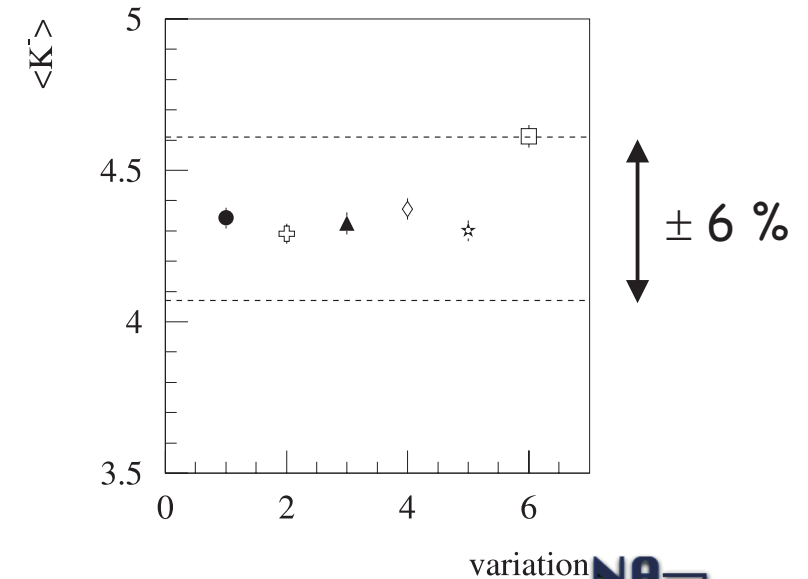
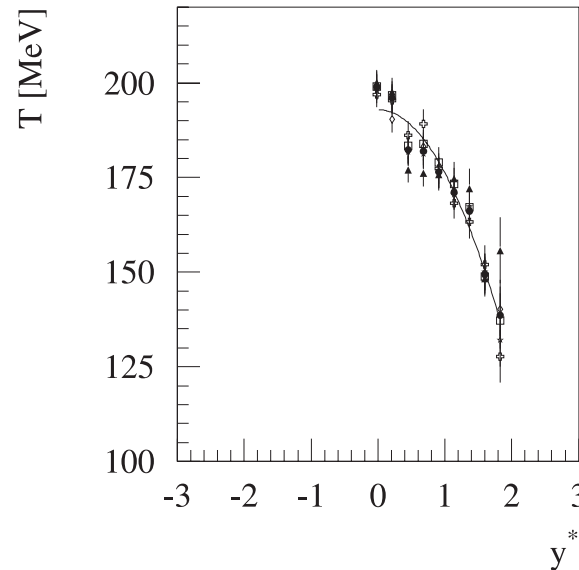
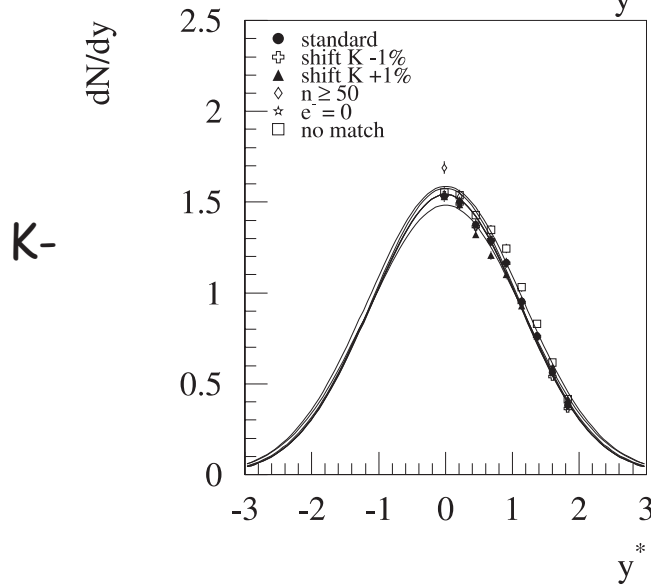
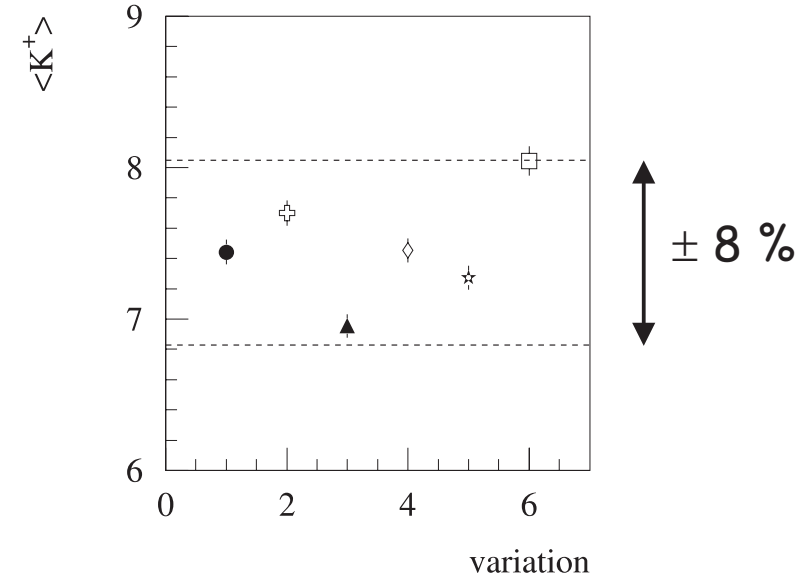
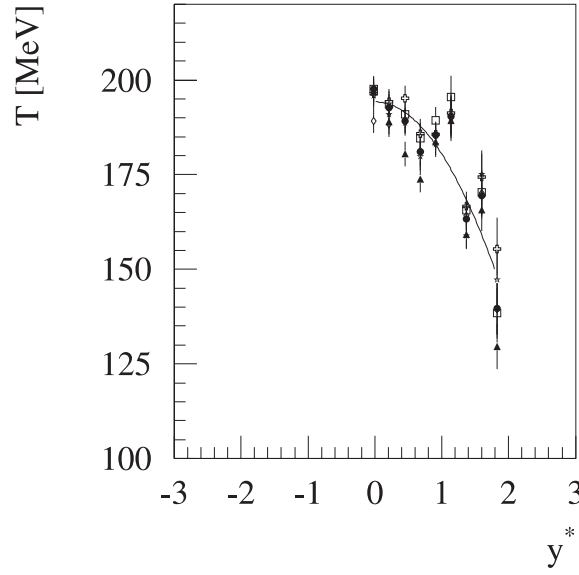
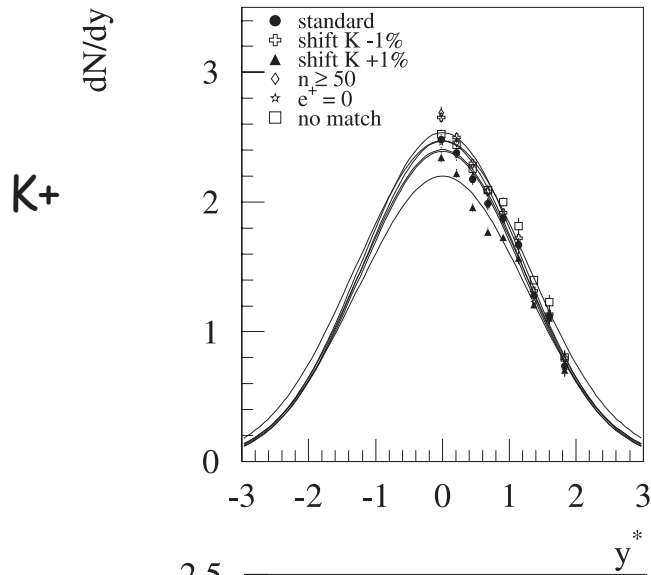
fit thermal function  $pt = c pt \exp(-mt/T)$

$dN/dy$ : sum data and extrapolate using T

K in Si+Si



# Data analysis: K

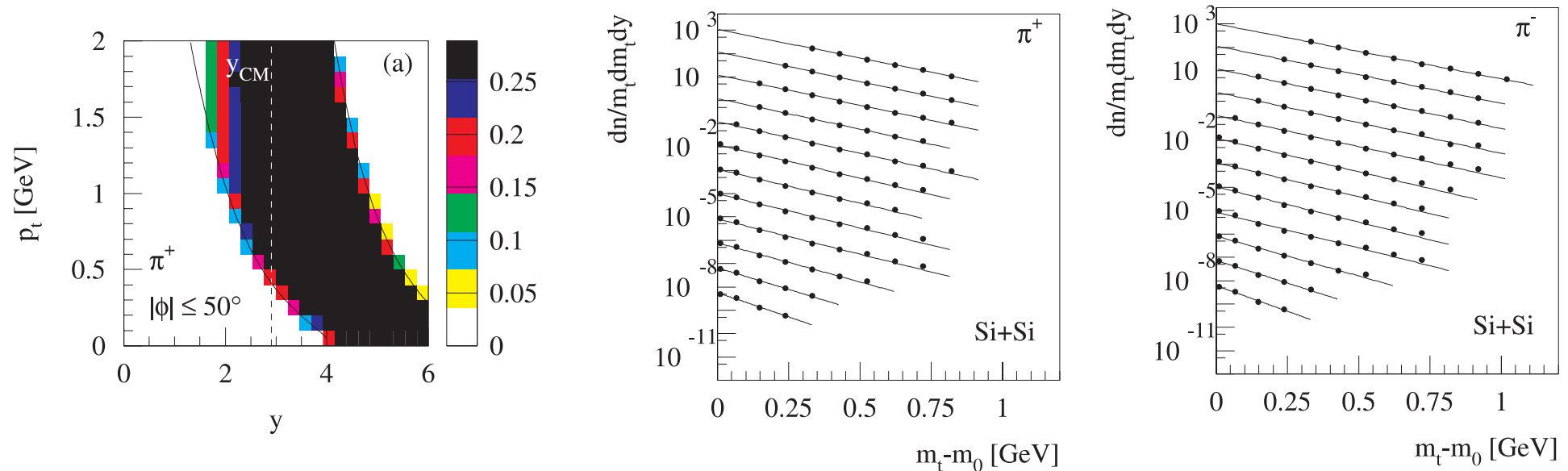




# Data analysis: $\pi$

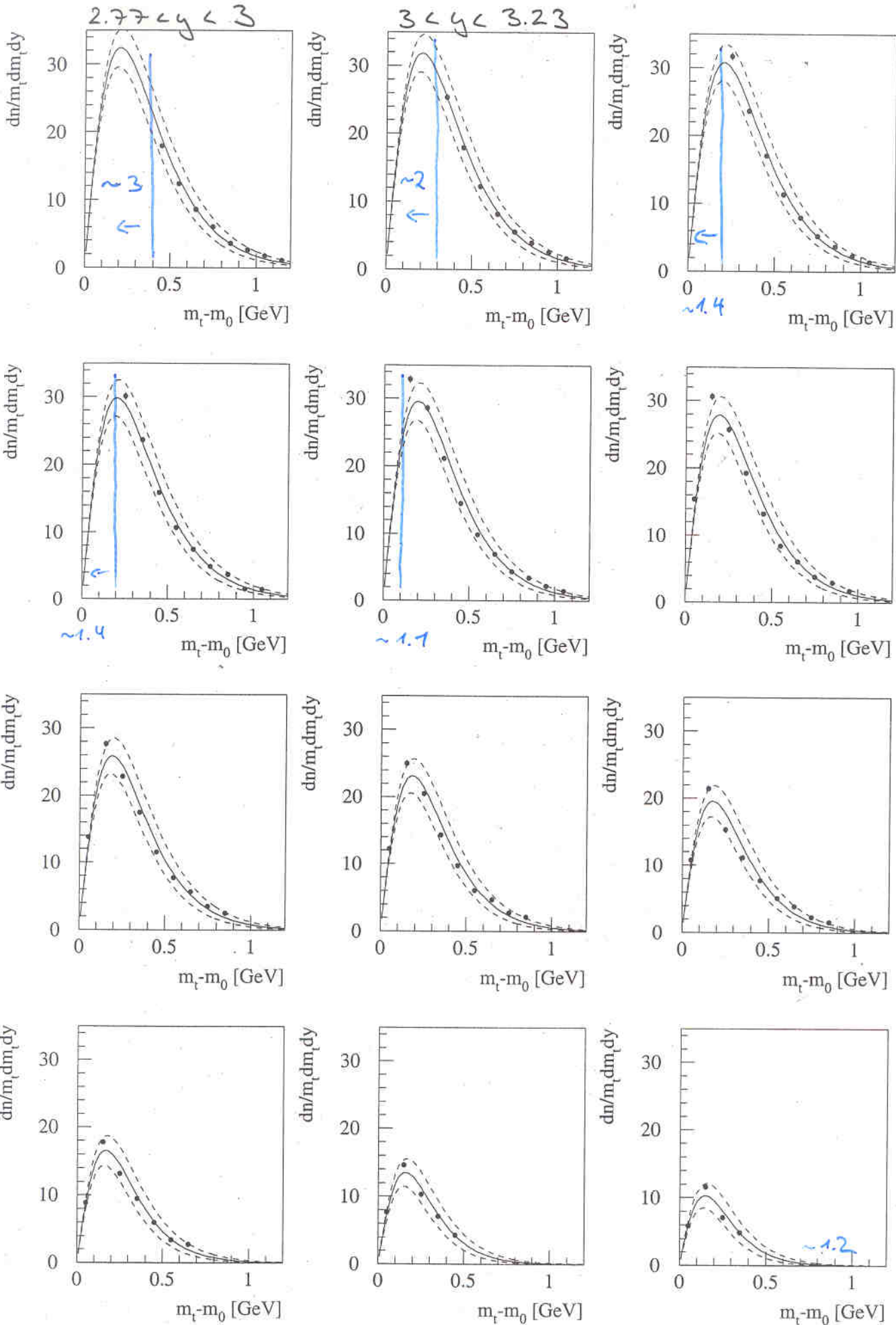
$\pi$  in Si+Si

problem: small  $p_t$  missing at midrapidity due to lower  $p$ -cut ( $4\text{GeV} < p$ )  
in  $dE/dx$  method



# $\pi^-$ in $Si+Si$

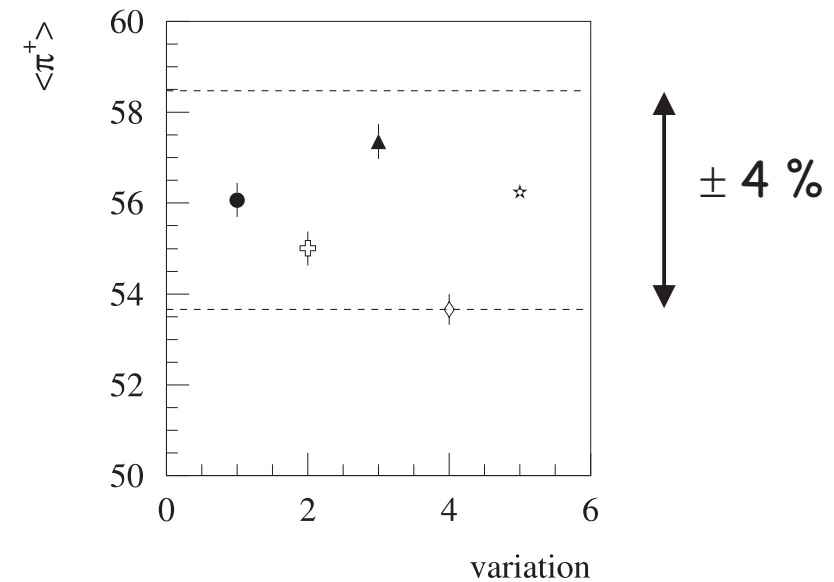
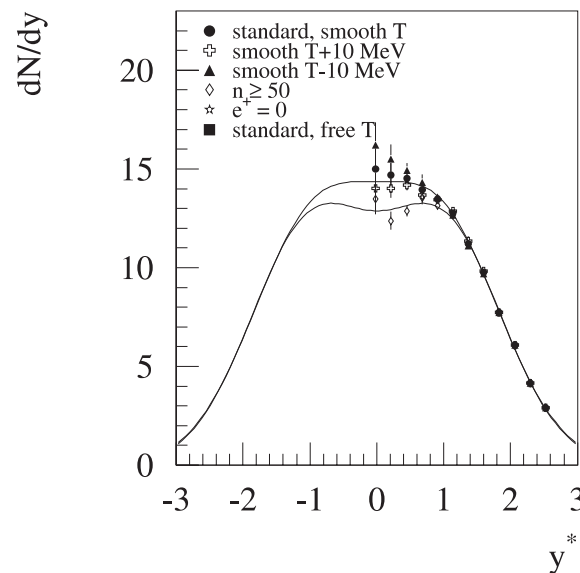
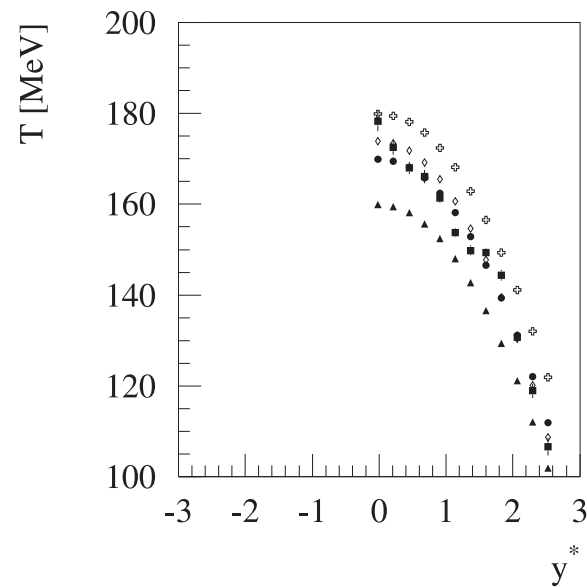
— smooth  $T$   $\frac{dN}{dp_t} \propto P_t \exp(-\frac{m_t}{T})$   
 $\sim T = 40 \text{ MeV}$   
 2003/03/27 15.31



# Data analysis: $\pi$

vary T for extrapolation to learn about the influence on  $dN/dy$ :  
 $T \pm 10$  MeV changes  $dN/dy$  by 8%, 5%, 3% starting from midrapidity  
influence on total yield less than  $\pm 5\%$

e.g.  $\pi^+$  in Si+Si

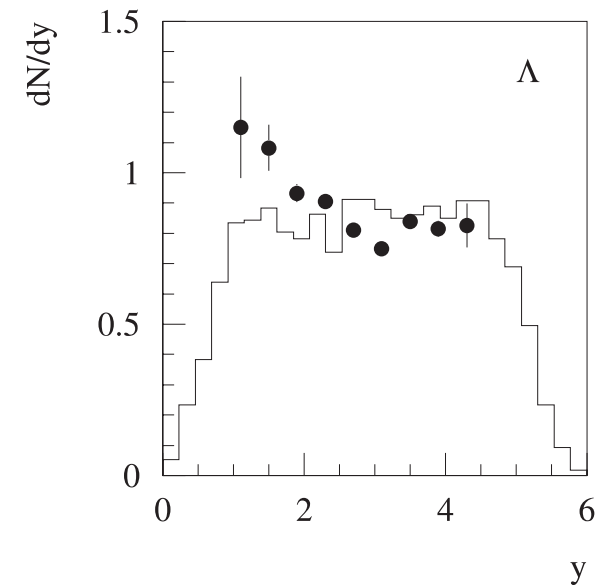
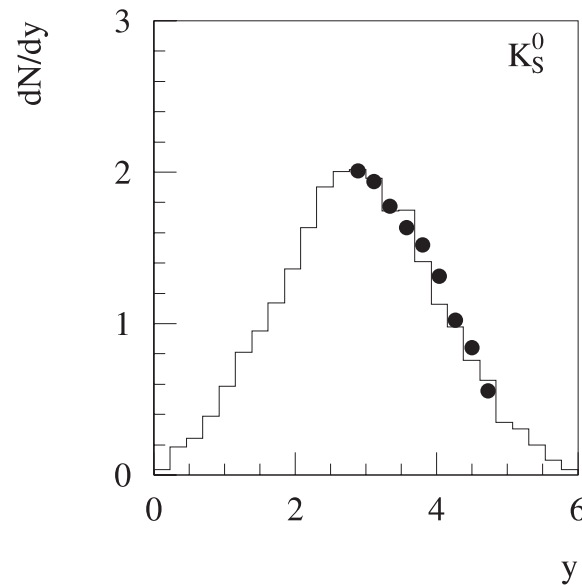
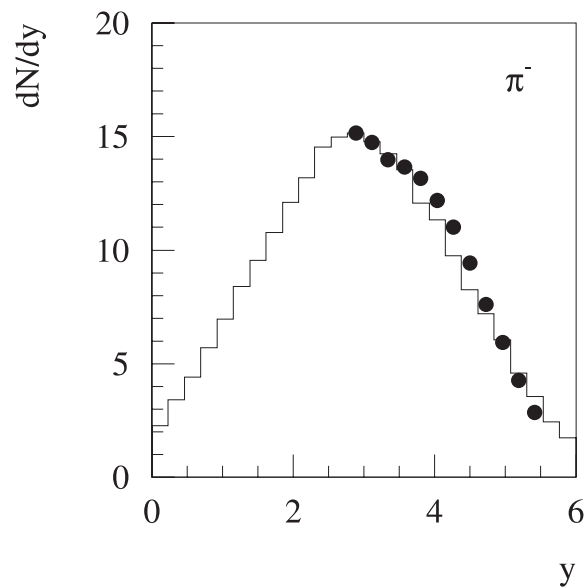


## Data analysis: $\pi$

feeddown correction for pions from weak decays of  $K^0_S$ ,  $\Lambda$  ...

VENUS simulation + reconstruction (M. Mitrovski): 2000 central Si+Si events  
up to now 1200 events used

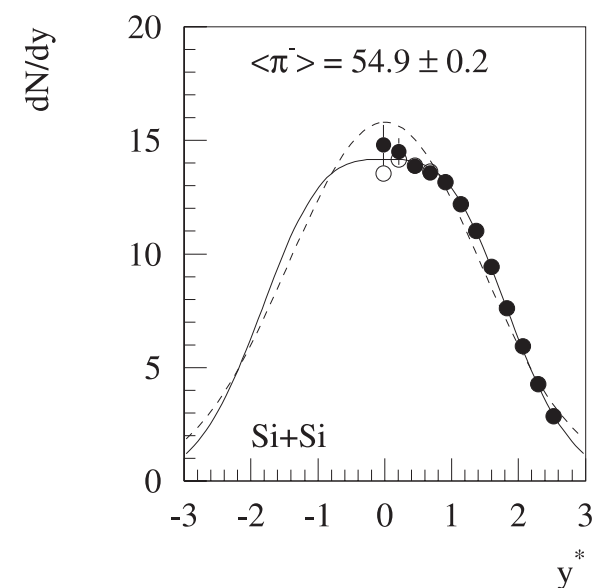
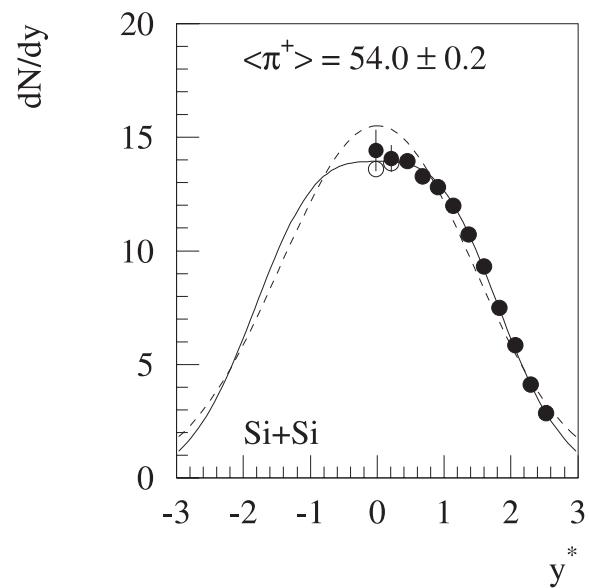
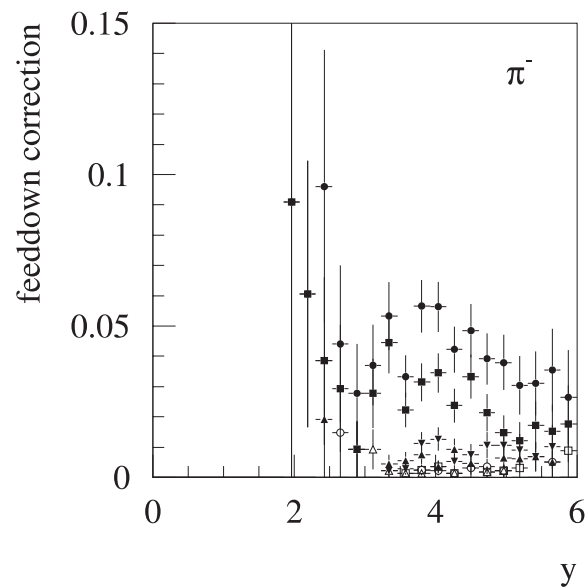
agreement satisfactory for particle distributions:  
scaling according to data for C+C



# Data analysis: $\pi$

subtract correction in rapidity

fit rapidity distributions of pions with double Gaussian  
( $\sim 3\text{-}4\%$  lower yields compared to the usage of a single Gaussian)



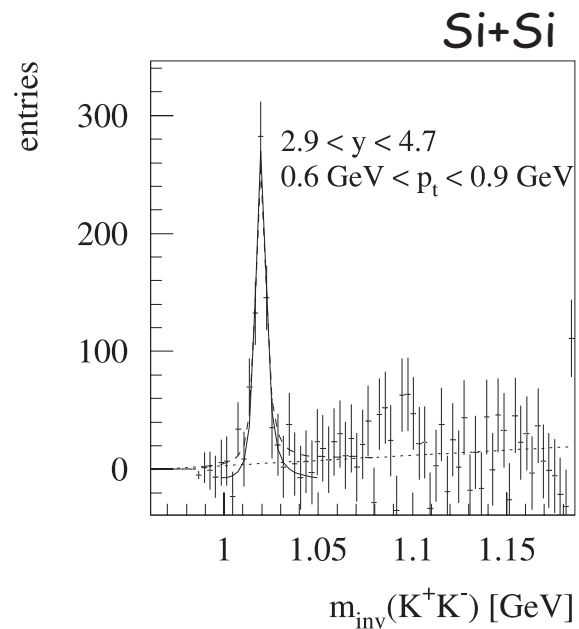
- total feeddown correction
- contribution from KOS
- ▲ contribution from  $\Lambda$

# Data analysis: $\phi$

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study of systematic uncertainties:

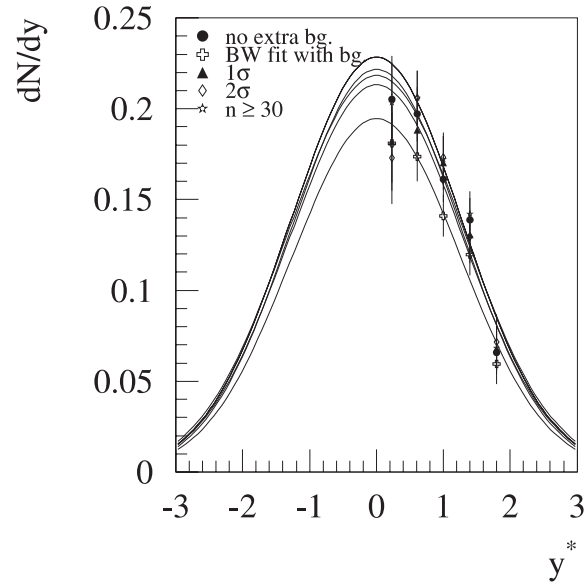
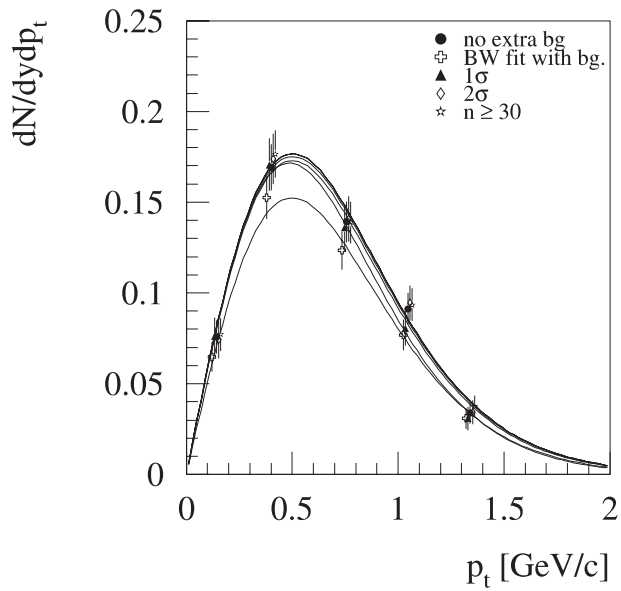
- Npoints cut
- $\sigma$  cut for kaon identification
- background treatment



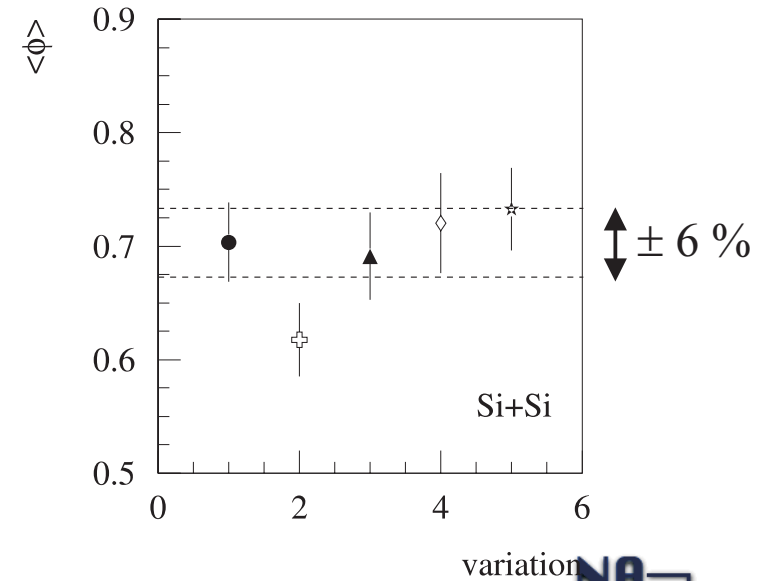
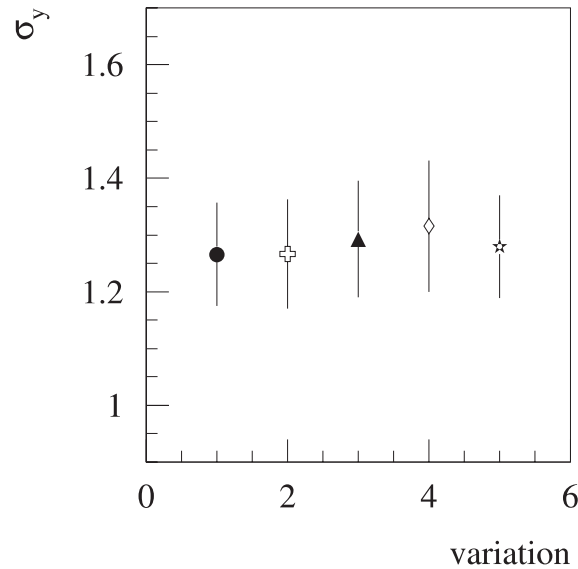
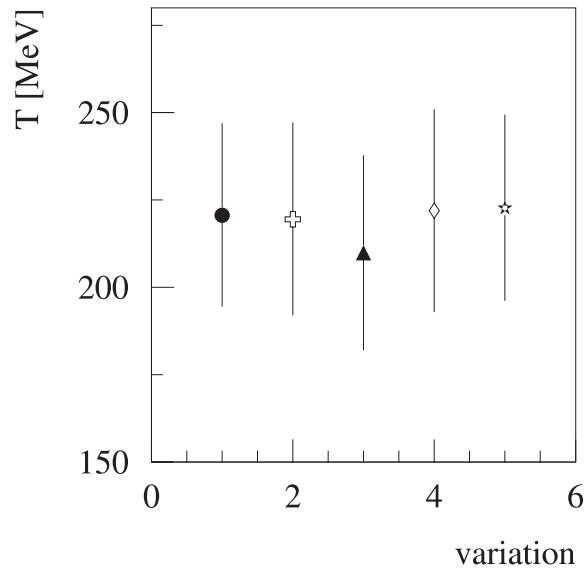
10-20 % difference in yield due to background treatment

use mean of two methods shown in picture

# Data analysis: $\phi$



$\phi$  in Si+Si



Q702

Sys. error

8%  
5%

	C+C	
	$\pi^+$	$\pi^-$
$T _{y_{CM}}$	$165 \pm 4 \pm 10$	$163 \pm 4 \pm 10$
$\sigma_y$	$0.99 \pm 0.01$	$1.0 \pm 0.01$
$y_0$	$0.924 \pm 0.008$	$0.909 \pm 0.009$
$dN/dy _{y_{CM}}$	$5.77 \pm 0.56 \pm 0.46$	$5.88 \pm 0.5 \pm 0.47$
$\langle \pi \rangle$	$21.2 \pm 0.1 \pm 1.06$	$21.3 \pm 0.1 \pm 1.07$

23.3 24.1

	Si+Si	
	$\pi^+$	$\pi^-$
$T _{y_{CM}}$	$170 \pm 3 \pm 10$	$172 \pm 3 \pm 10$
$\sigma_y$	$0.96 \pm 0.01$	$0.96 \pm 0.01$
$y_0$	$0.936 \pm 0.006$	$0.938 \pm 0.006$
$dN/dy _{y_{CM}}$	$14.86 \pm 1.08 \pm 1.19$	$15.15 \pm 1.08 \pm 1.21$
$\langle \pi \rangle$	$54.0 \pm 0.2 \pm 2.7$	$54.9 \pm 0.2 \pm 2.7$

61.2 61.5

change: feeddown +  $\frac{dN}{dy}|_{y_{CM}}$  + double gaussian  
~10%

	C+C	
	$K^+$	$K^-$
$T _{y_{CM}}$	$188 \pm 4 \pm 10$	$187 \pm 5 \pm 10$
$\sigma_y$	$1.2 \pm 0.02 \pm 0.08$	$1.1 \pm 0.04 \pm 0.09$
$dN/dy _{y_{CM}}$	$0.848 \pm 0.015 \pm 0.085$	$0.529 \pm 0.014 \pm 0.05$
$\langle K \rangle$	$2.5 \pm 0.03 \pm 0.25$	$1.49 \pm 0.05 \pm 0.15$

2.48 1.45

	Si+Si	
	$K^+$	$K^-$
$T _{y_{CM}}$	$195 \pm 3 \pm 10$	$198 \pm 3 \pm 10$
$\sigma_y$	$1.24 \pm 0.02 \pm 0.08$	$1.12 \pm 0.01 \pm 0.07$
$dN/dy _{y_{CM}}$	$2.431 \pm 0.03 \pm 0.24$	$1.517 \pm 0.02 \pm 0.15$
$\langle K \rangle$	$7.44 \pm 0.08 \pm 0.74$	$4.34 \pm 0.03 \pm 0.43$

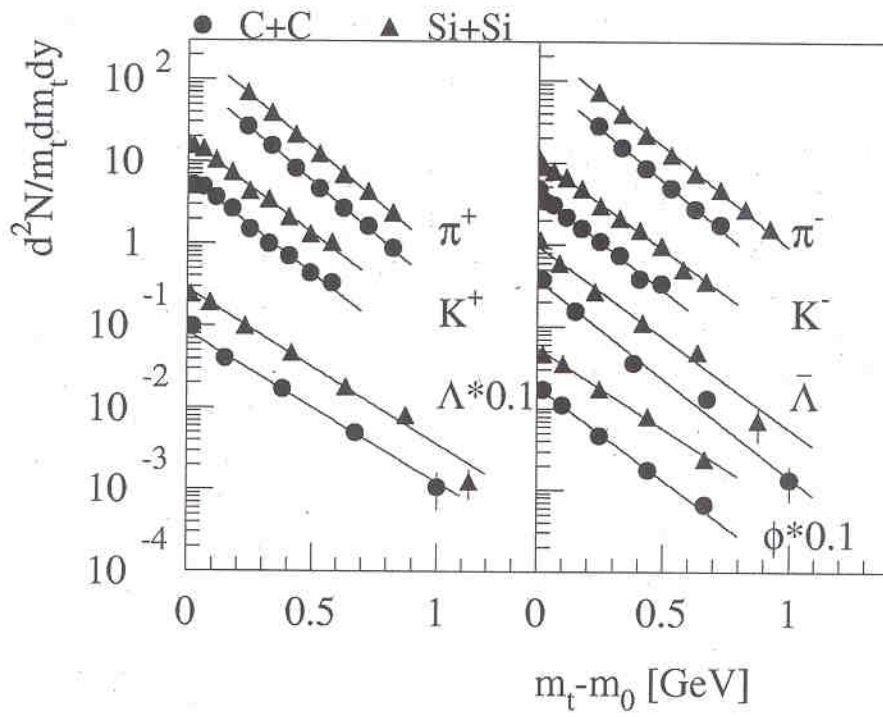
7.28 4.4

	C+C	Si+Si
$m_0$	$(1019.8 \pm 1.2) \text{ MeV}$	$(1019.6 \pm 1.1) \text{ MeV}$
$\Gamma_0$	$4.43 \text{ MeV (fixed)}$	$4.43 \text{ MeV (fixed)}$
$\sigma_m$	$(0.71 \pm 2.12) \text{ MeV}$	$(1.41 \pm 1.79) \text{ MeV}$
$T$	$(189 \pm 28 \pm 10) \text{ MeV}$	$(220 \pm 28 \pm 10) \text{ MeV}$
$\sigma_y$	$1.16 \pm 0.1 \pm 0.05$	$1.27 \pm 0.1 \pm 0.05$
$\langle \phi \rangle$	$0.178 \pm 0.011 \pm 0.021$	$0.661 \pm 0.032 \pm 0.079$
$\frac{dN}{dy} _{y_{CM}}$	$0.0622 \pm 0.0078 \pm 0.008$	$0.193 \pm 0.022 \pm 0.02$

0.18 0.65

12%  
10-13%





at midrapidity

Fig. 1



