

# Forward Wall performance in April 2012 beam run

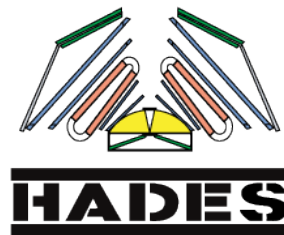
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*sadovsky@inr.ru*

*Institute for Nuclear Research RAS,  
Moscow*

***Technical report***  
***Preliminary analysis results***  
***Backup***



**HADES collaboration meeting XXIV**  
**May 14-19, 2012**  
**Krakow, Poland**



# Forward Wall in HADES

- determination of event plane
- flow analysis
- beam position monitoring

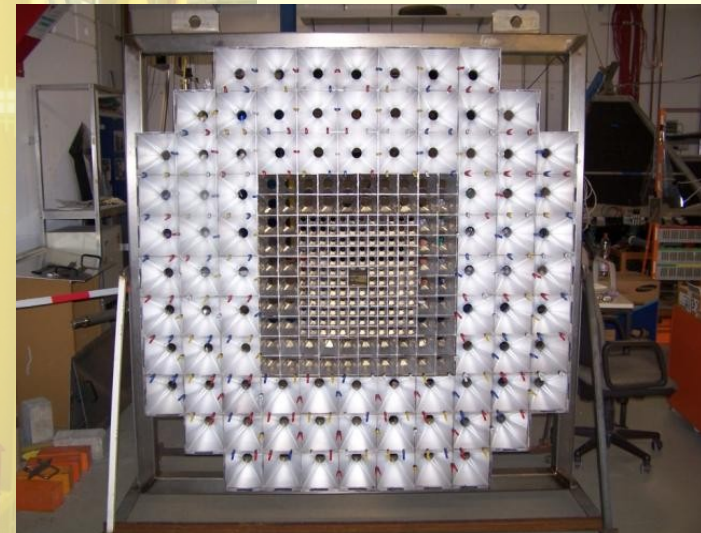


Cells in FW:

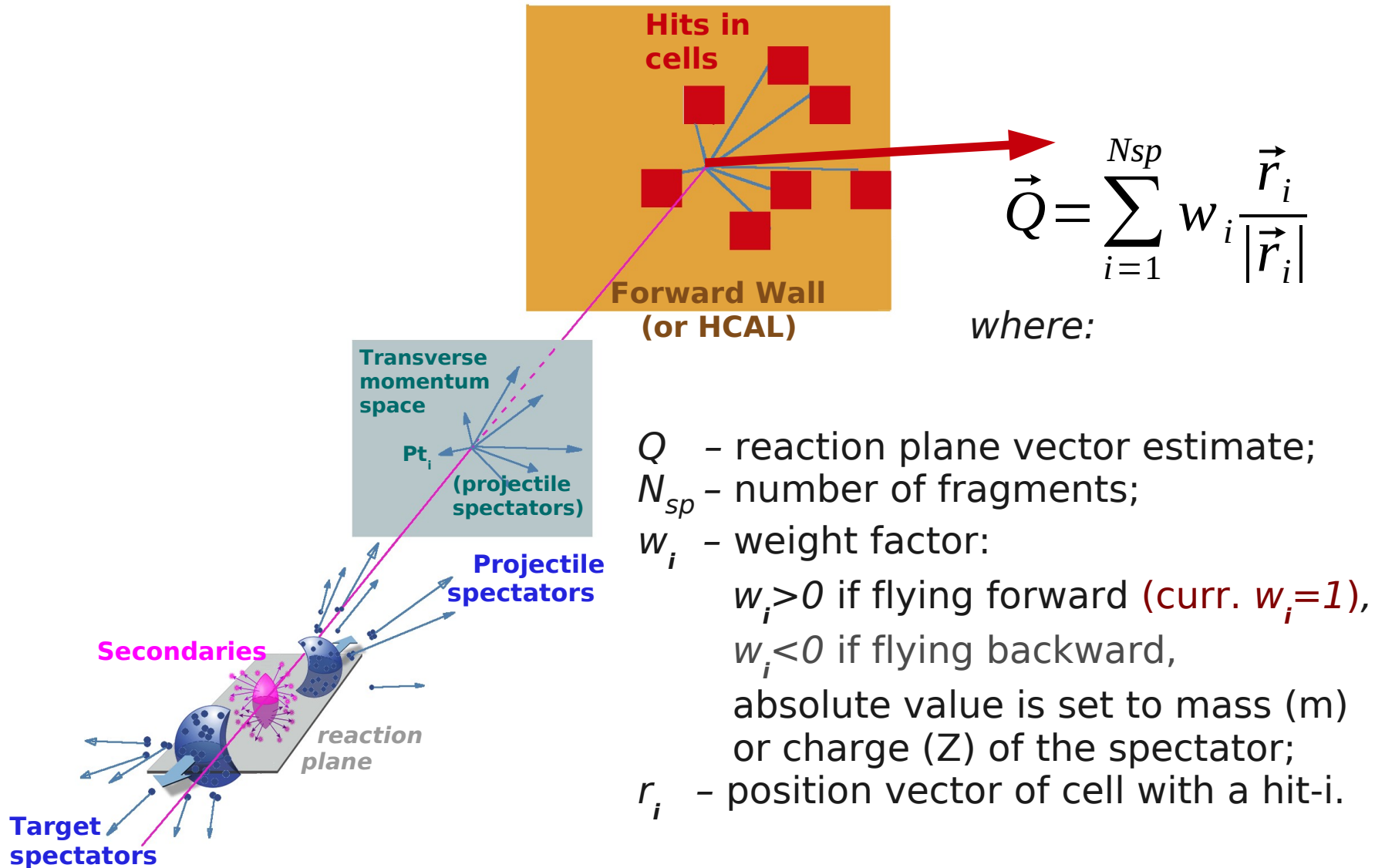
140 small 4x4cm  
( $0^\circ < \theta < 2^\circ$ )

64 middle 8x8cm  
( $2^\circ < \theta < 3.3^\circ$ )

84 large 16x16cm  
( $3.3^\circ < \theta < 7.2^\circ$ )



# Reconstruction of reaction plane (modified transverse momentum method)



# Flow analysis and azimuthal angular distributions

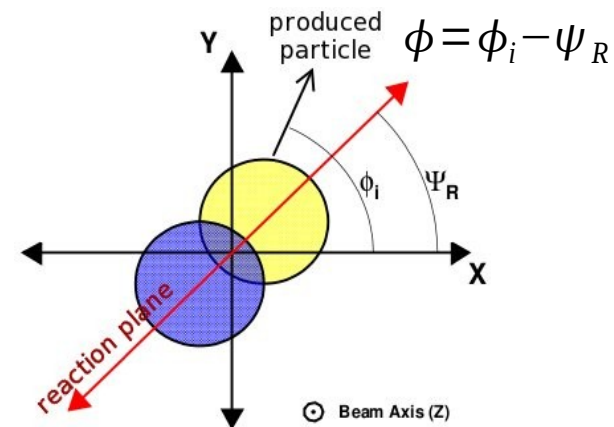
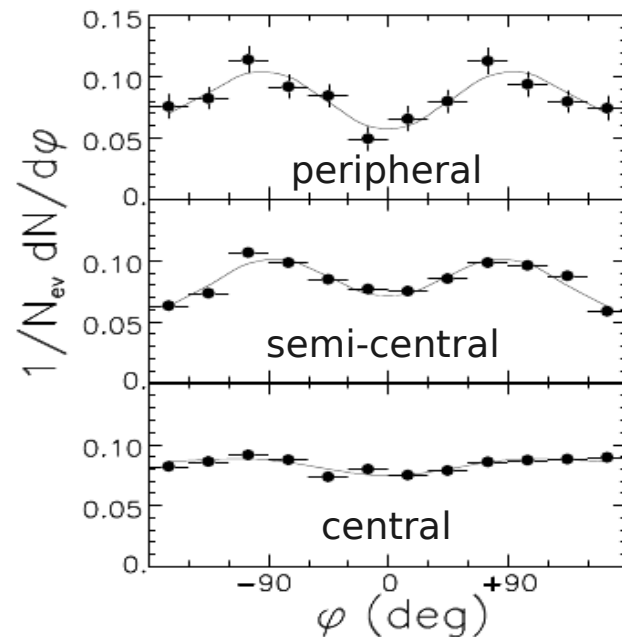
Azimuthal angular distribution of  $K^+$  for peripheral, semi-central and central events in collisions of  $(Au@1A\text{GeV})+Au$  by KaoS collaboration. *PRL.81(1998)1576-1579*

In the frames of Fourier decomposition of obtained azimuthal distributions:

$$\frac{dN}{d\phi} = C(1 + 2v_1 \cos(\phi) + 2v_2 \cos(2\phi))$$

which allows determination of directed ( $v_1$ ) and elliptic ( $v_2$ ) flows one may draw conclusions about the in-plane and out-of plane emission of  $K^+$ , in-medium potential...

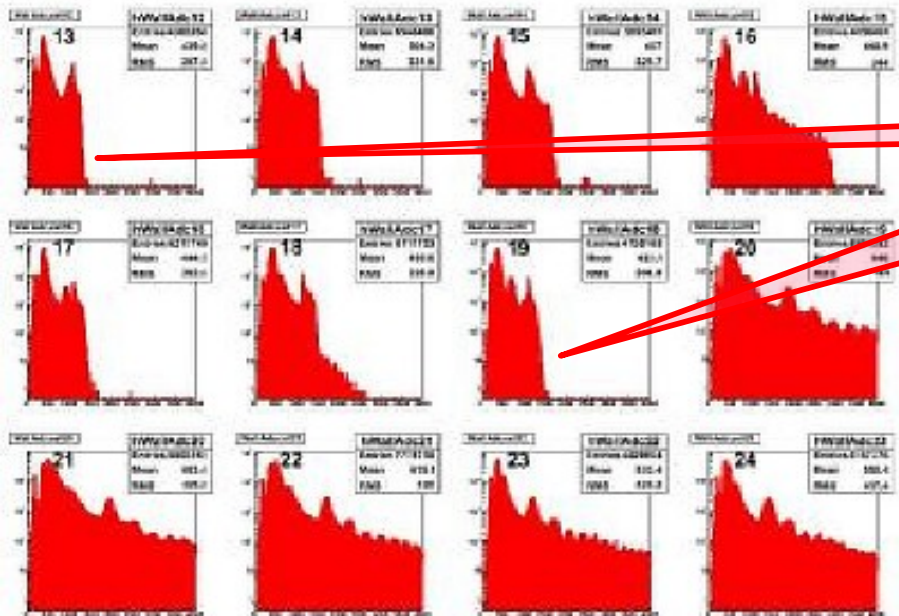
$K^+$  in  $(Au@1A\text{GeV})+Au$  by (KaoS)



# Forward Wall tuning

- Add-On thresholds were optimized
- PMT HV tuned up with cosmics
- ToT (amplitude) calibration with cosmics
- Comparison of cosmics and beam data
- Helium bag and plastic wall installed ( $\delta e^-$  suppression)

# Beam test August 11

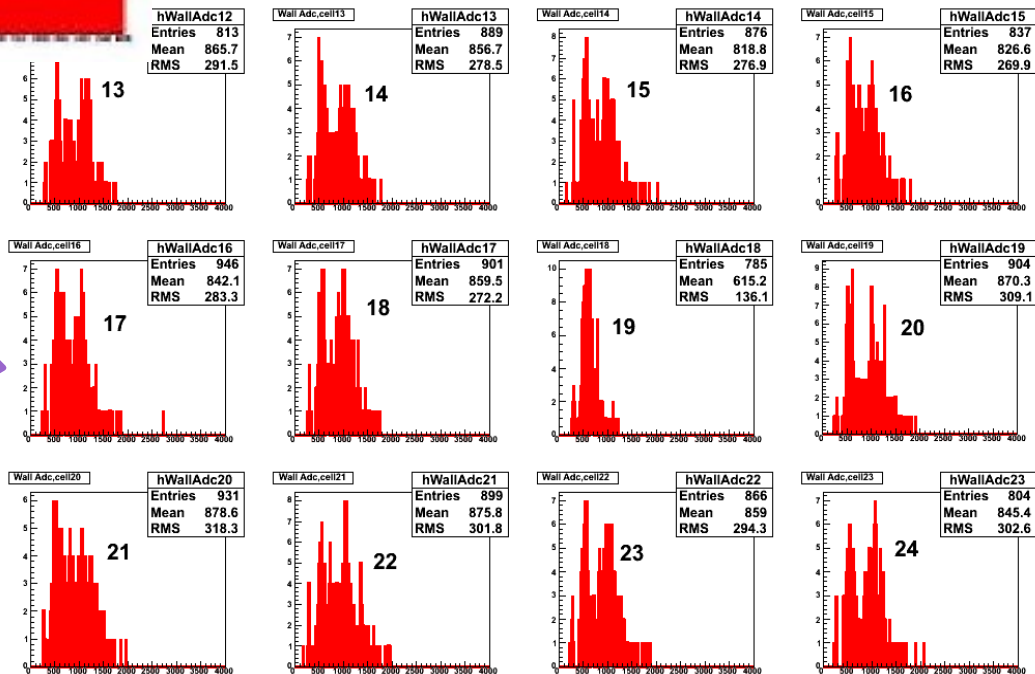


dE/dx [chan.]

Main problem - "cutoff" problem,

was solved with choosing all individual thresholds equal to 0x0700

# Cosmics March 12



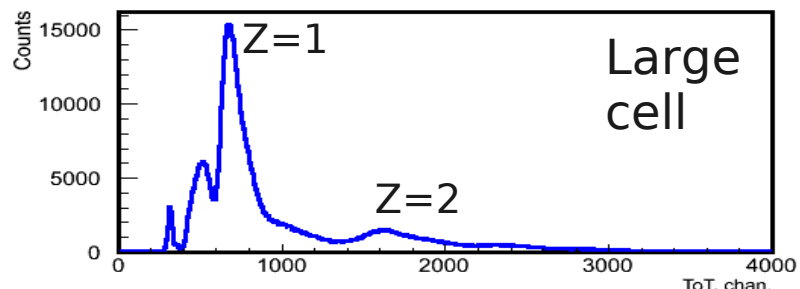
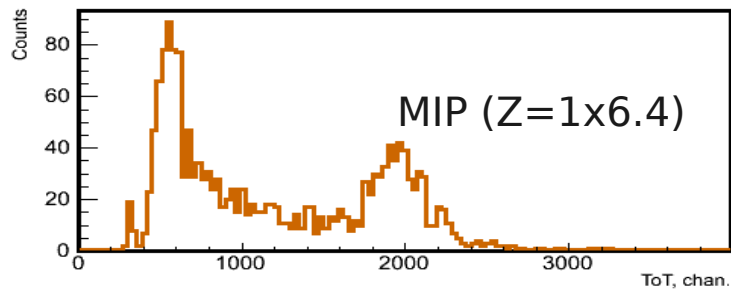
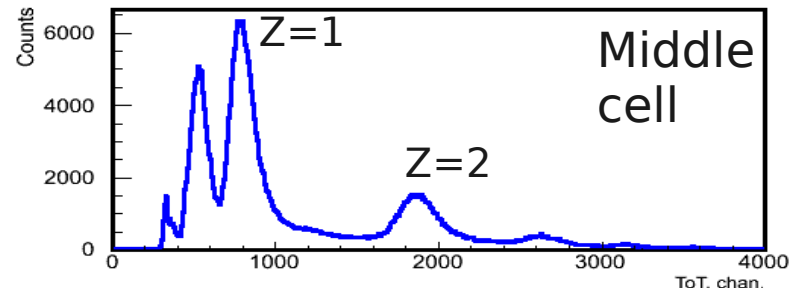
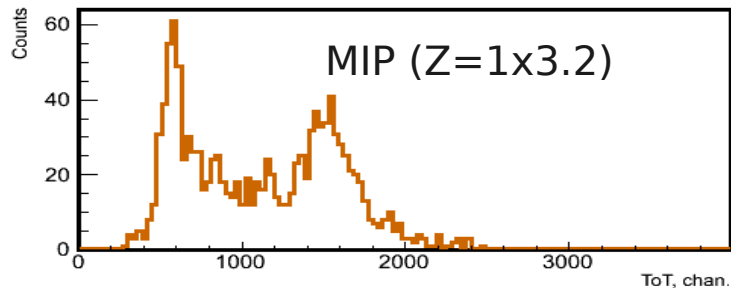
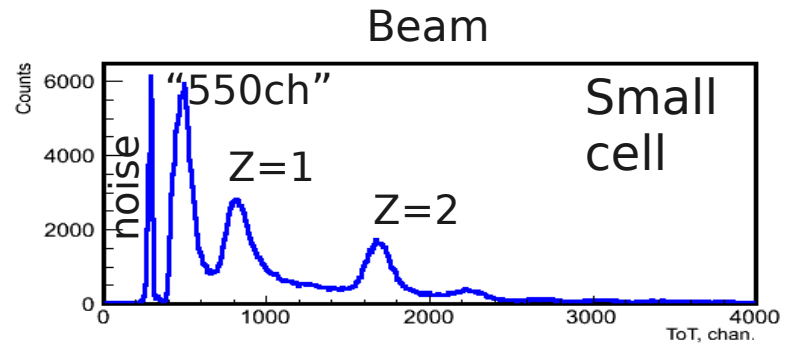
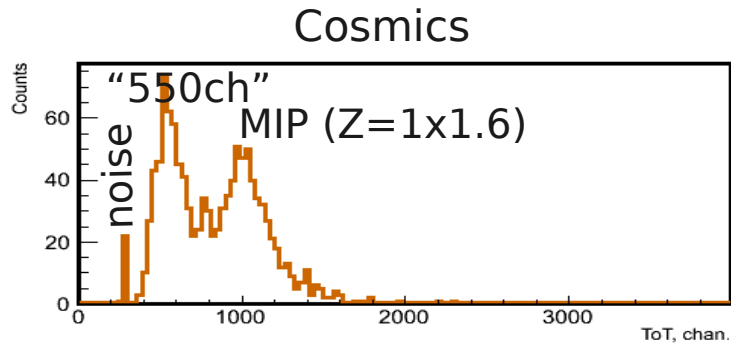
dE/dx [chan.]

Optimal tuning starting from February 2012:

Global fast thresholds 0x3100  
Global slow thresholds 0x3100

Stretching fast 0x5000  
Stretching slow 0x5000

# Comparison of ToT distributions from cosmics and beam data [7]



Comparing data from Aug11 test we see much less number of particles in range of “magic peak” due to He box and shield before F-Wall (Wolfgang)

# What does “magic peak” mean?

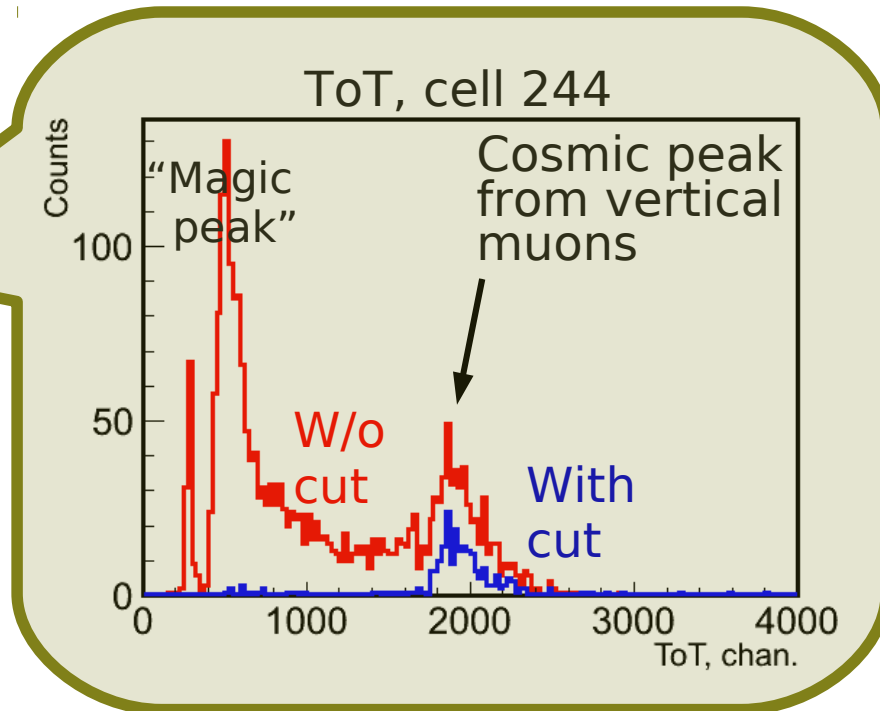
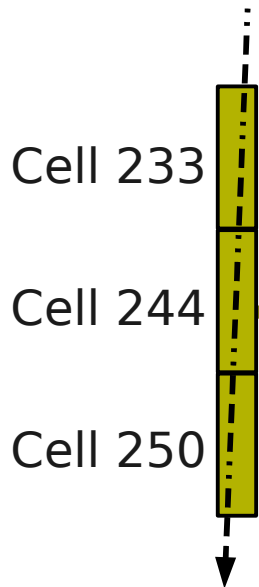
[8]

It was found that peak in 550 chan. of ToT distribution (“magic peak”) did not move with changing PMT HV.

Cosmics with 6 cells in trigger



Select high amplitudes at cells 233 and 250 and look at ADC distribution at cell 244



“magic peak” at 550 chan. corresponds to low energy deposition (cosmic muons which only partially intersect cells, background in the cave, ...)

The decision:

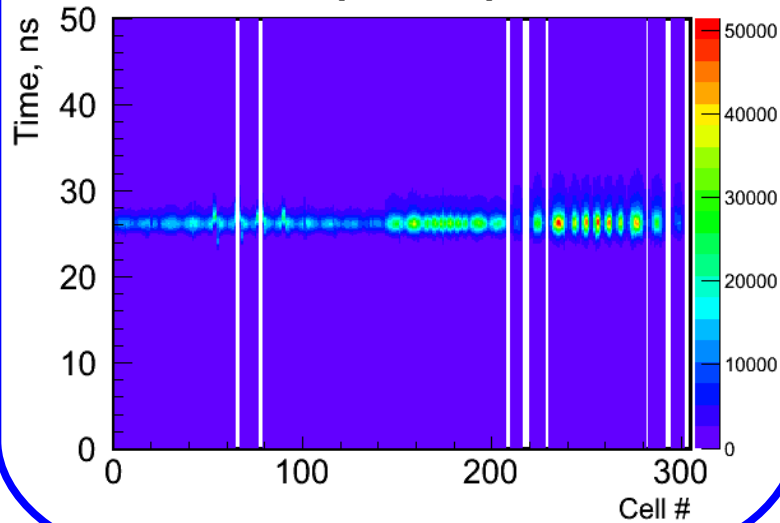
put MIP peak to higher channels to be well separated from 550 chan.



# Forward Wall calibration

[9]

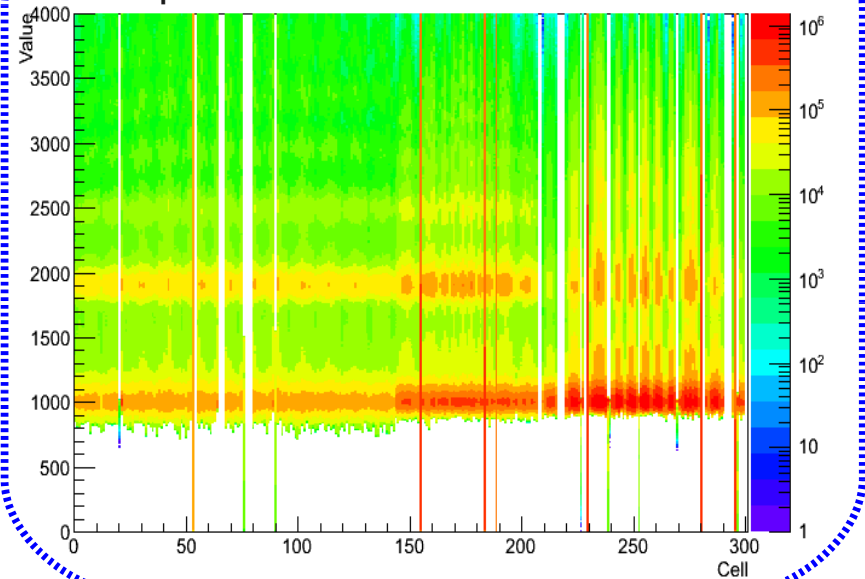
Time calibration done  
(Oracle)



ToT calibration:

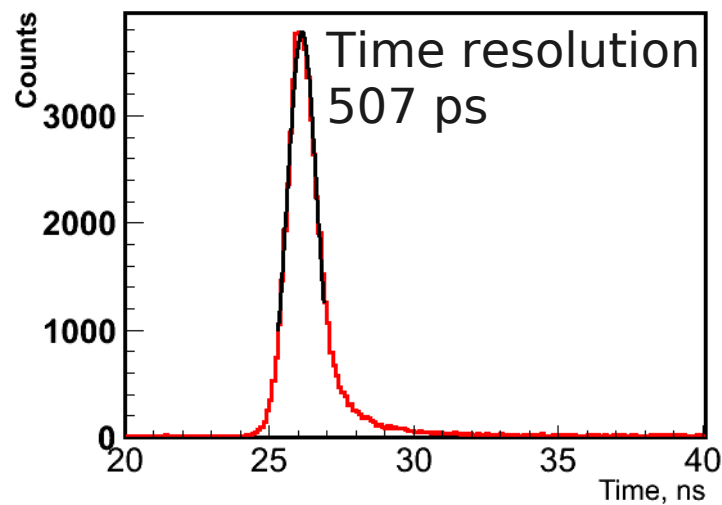
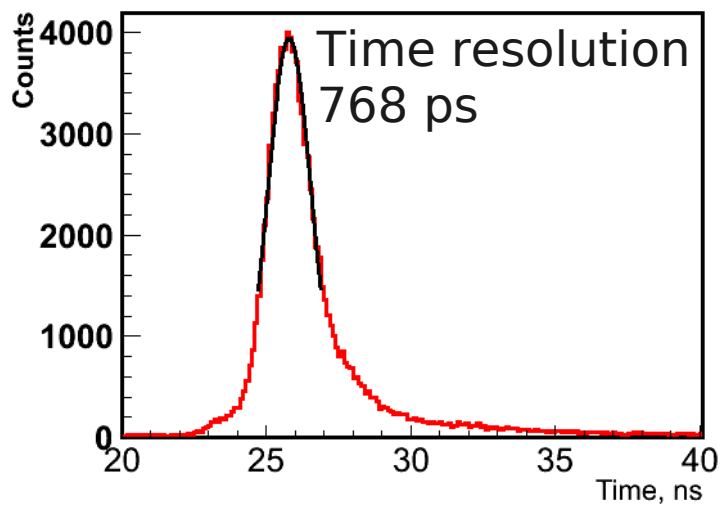
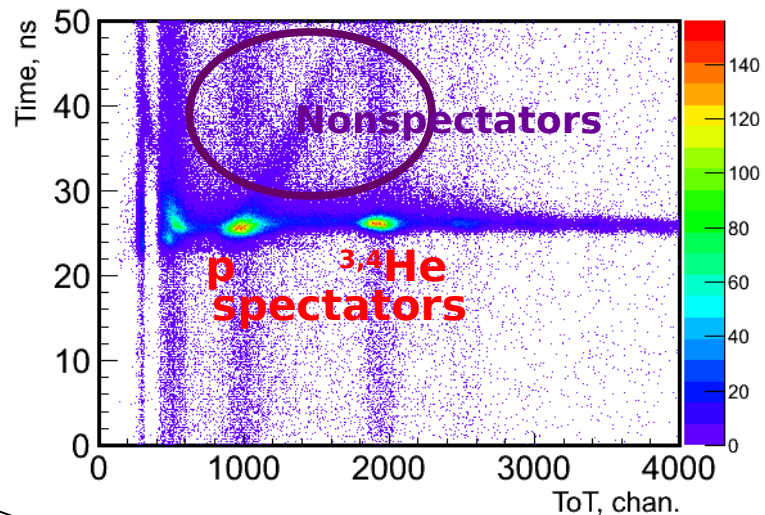
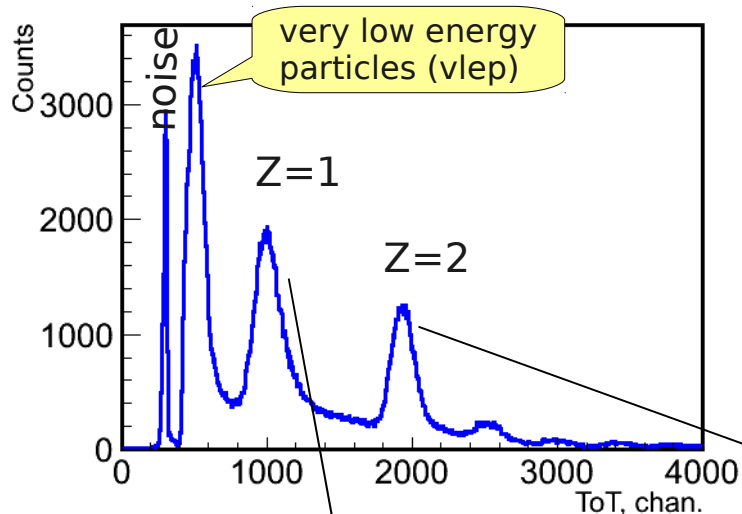
ASCII table with individual  
limits for each Z peak

Investigation for possible  
improvement of ToT calibration

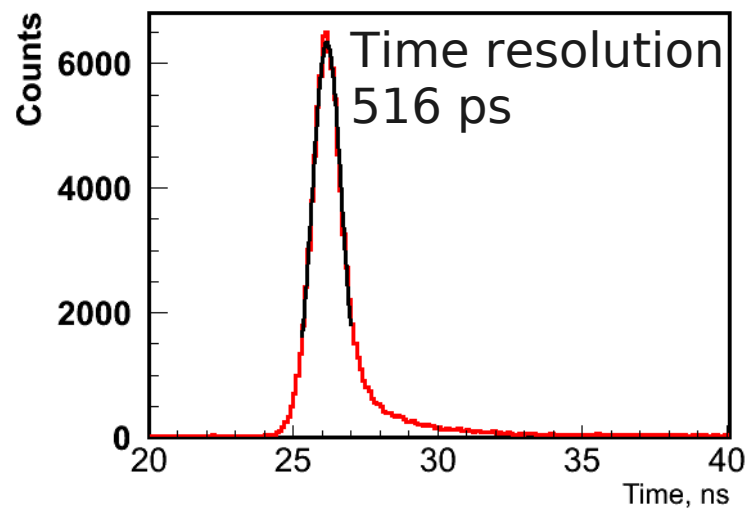
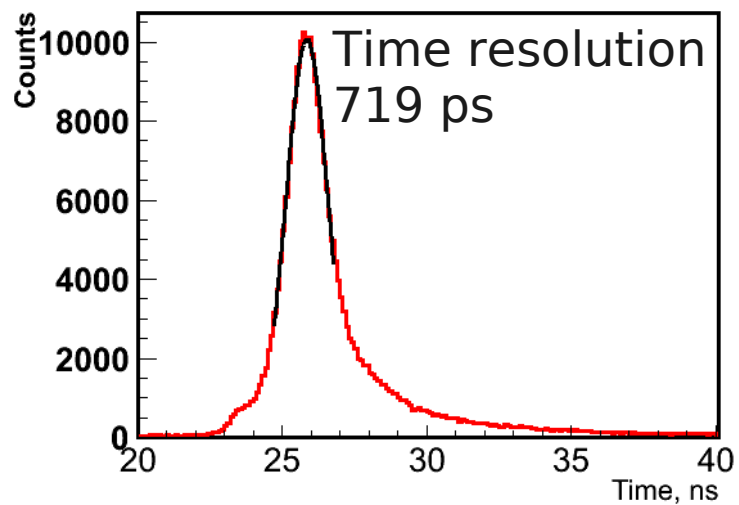
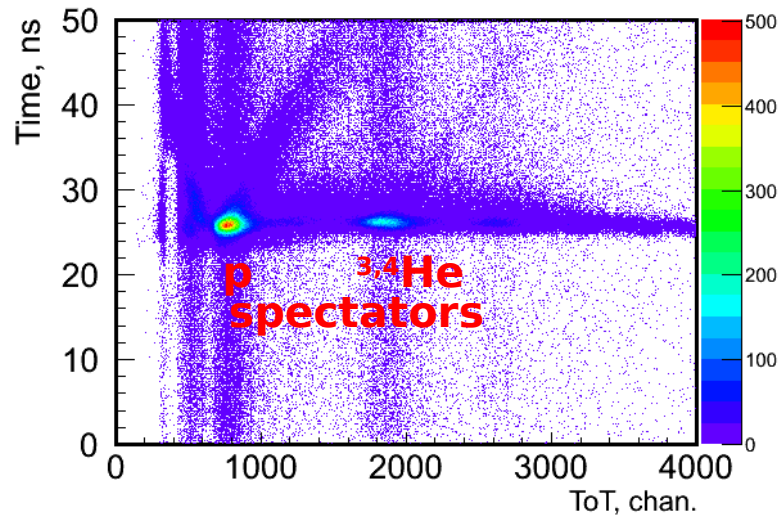
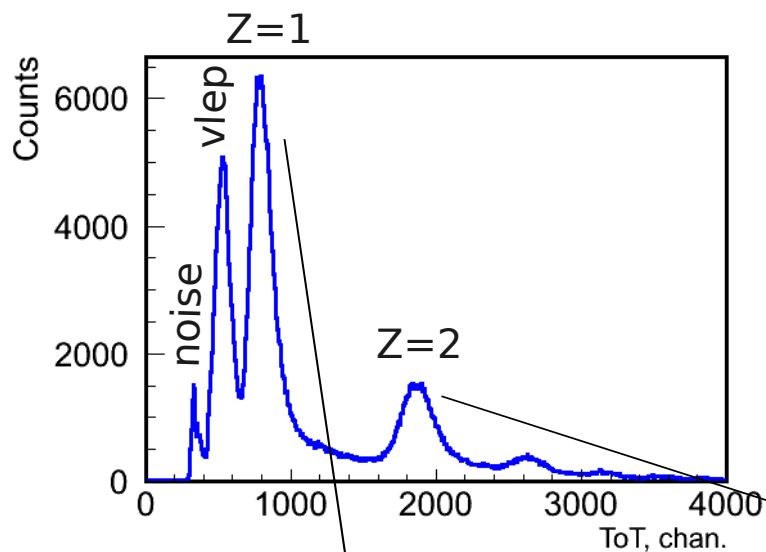


# Statistics from day 102: small cell 36

[10]

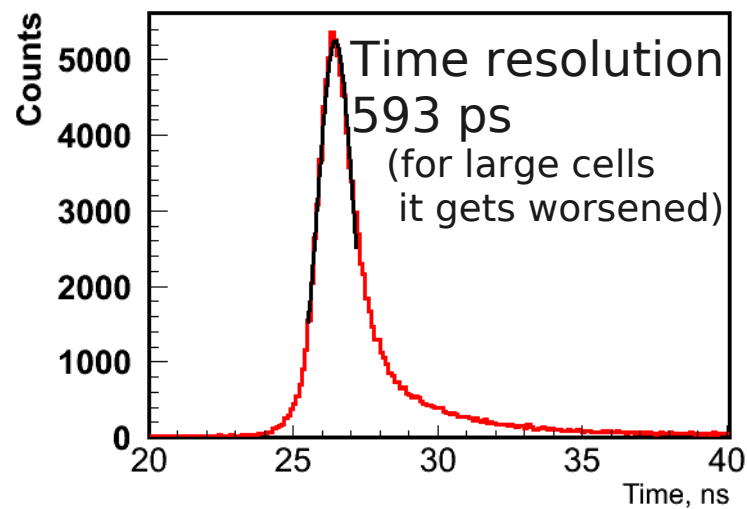
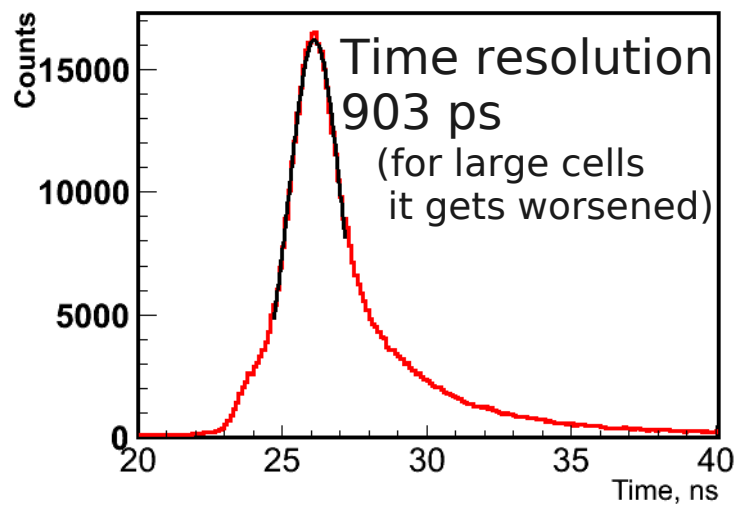
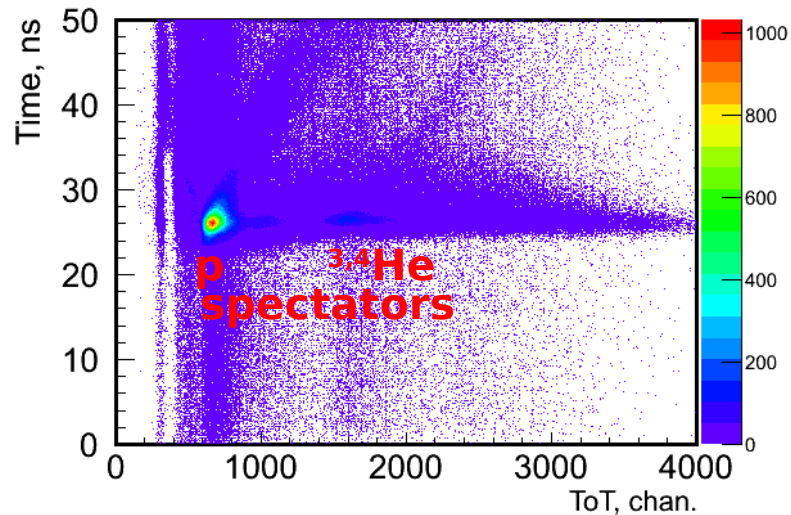
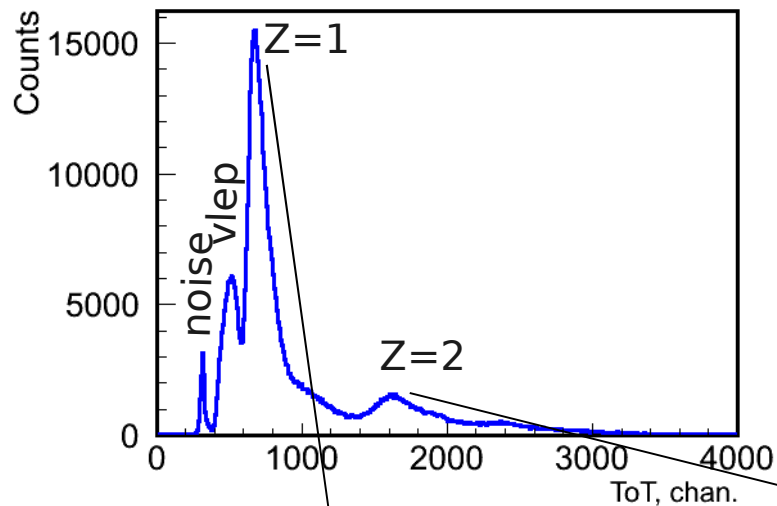


# Statistics from day 102: middle cell 188 <sup>[11]</sup>



# Statistics from day 102: large cell 288

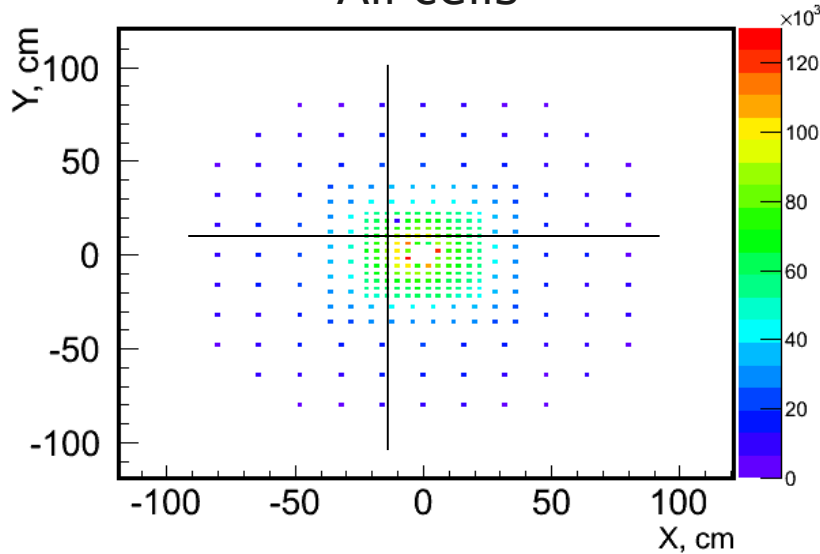
[12]



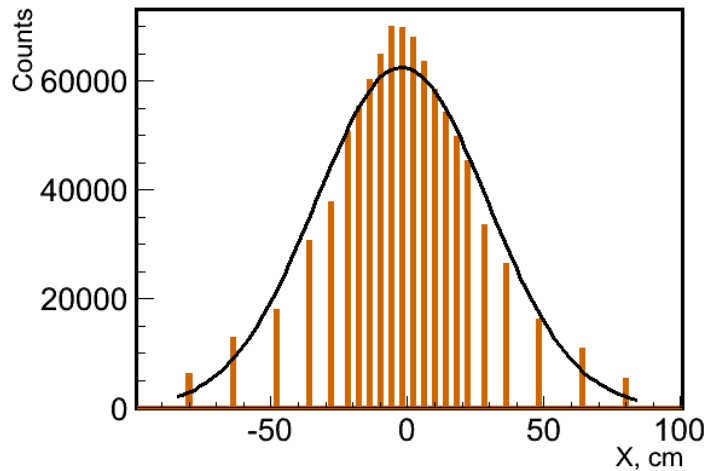
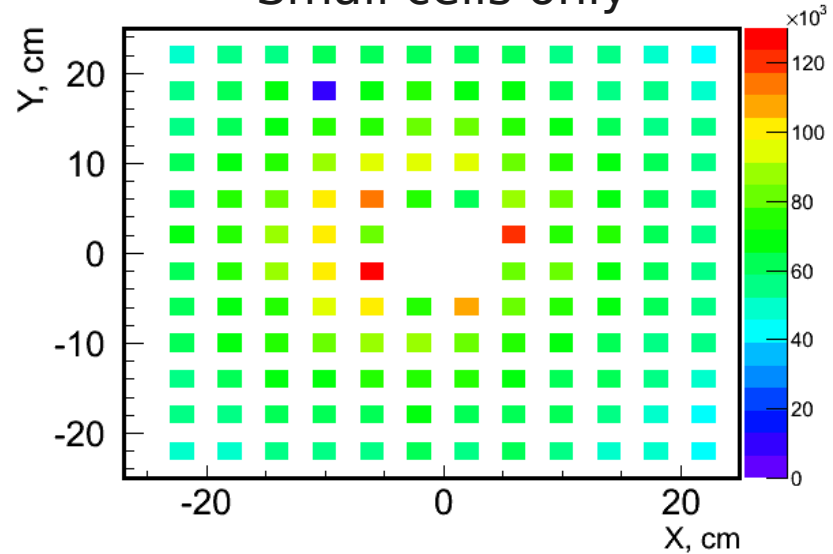
# Beam spot at FW

Cuts: Time < 50 ns && ToT > 550 chan.

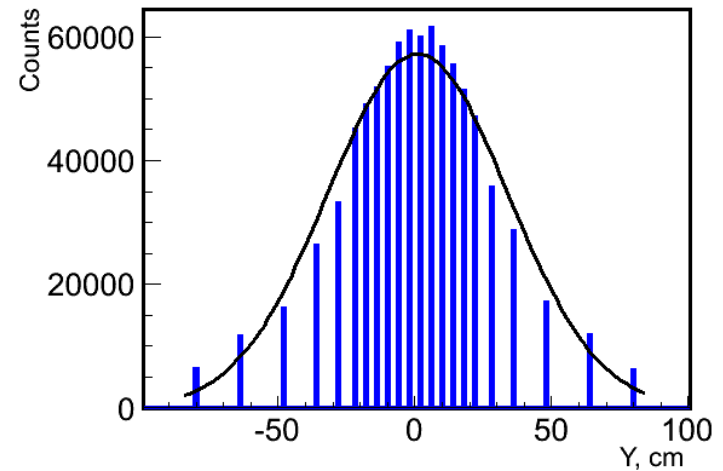
## All cells



## Small cells only



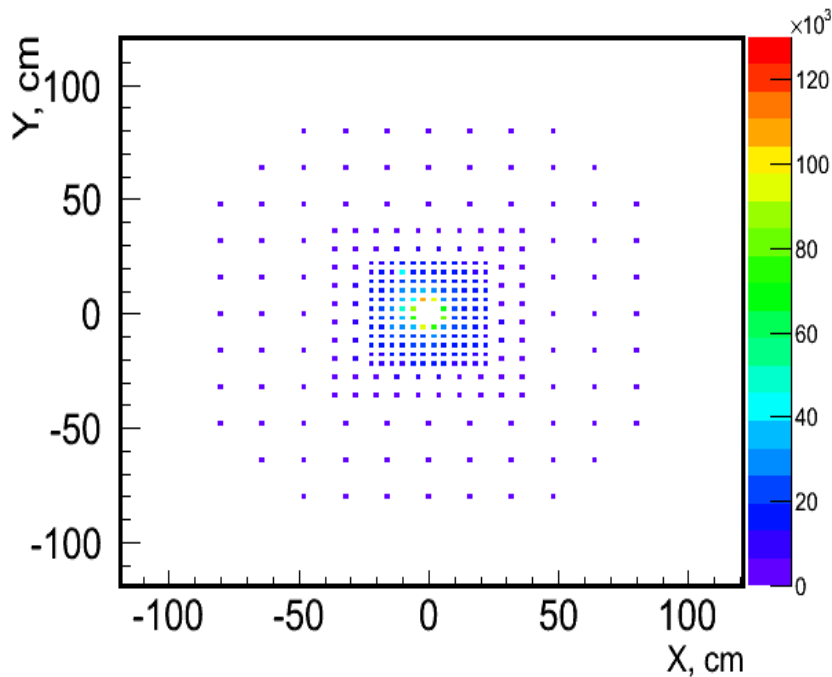
Profiles  
X and Y



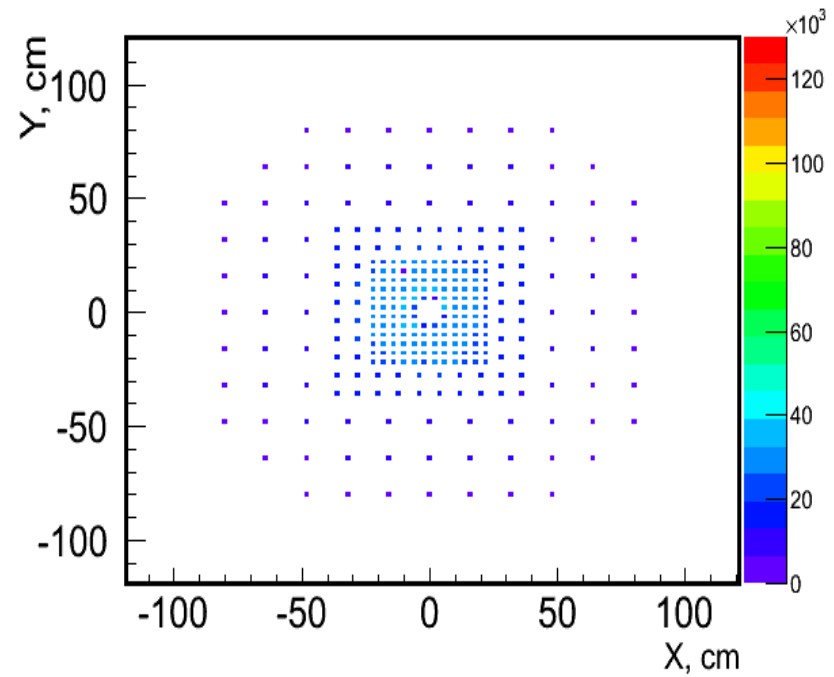
# Difference between Z=1 and 550 chan.

[14]

Particles from "550chan"  
(narrow spot)  
mainly contribution from  
delta electrons



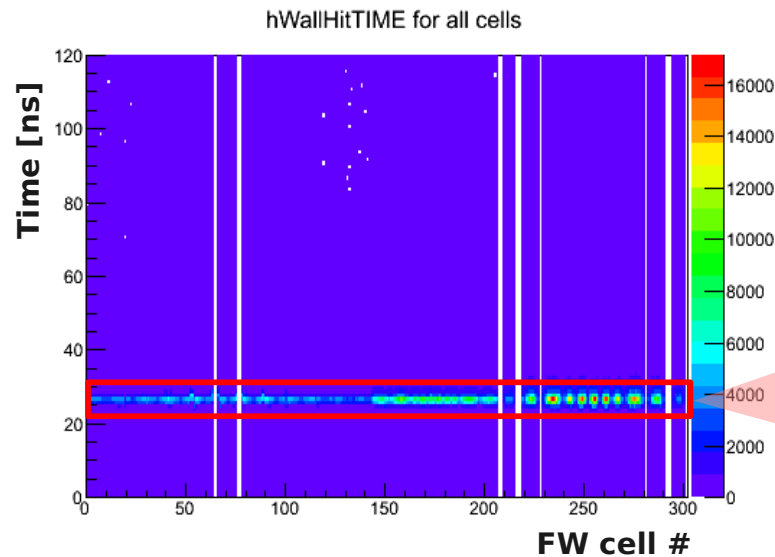
Particles with Z=1  
(wide spot)



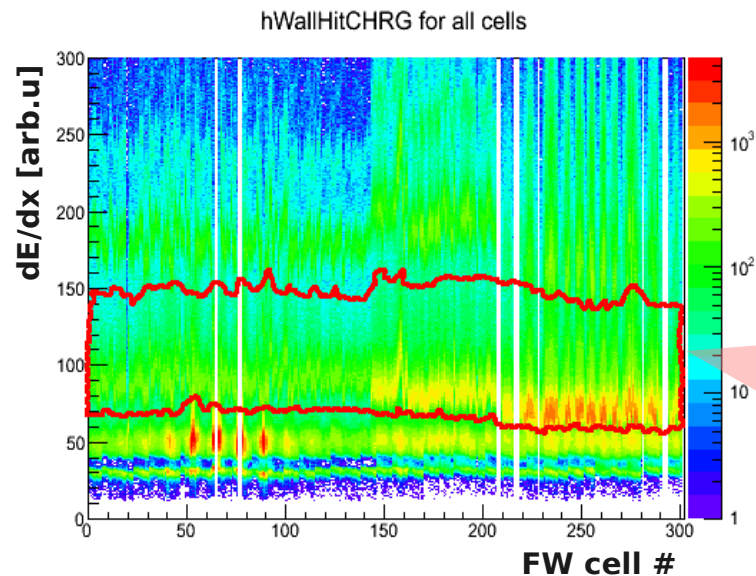
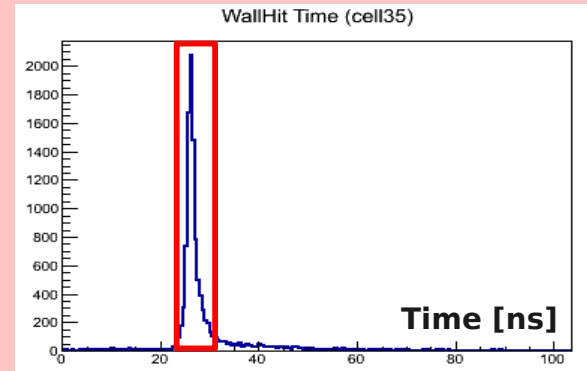
# First look into the data (Apr12 online DST)

- Spectator selection
- Target selection
- Charged pion selection
- Centrality selection
- Pion flow pattern for different centrality selection
- $p_t : y$  selection
- Pion flow pattern within different  $p_t : y$  regions

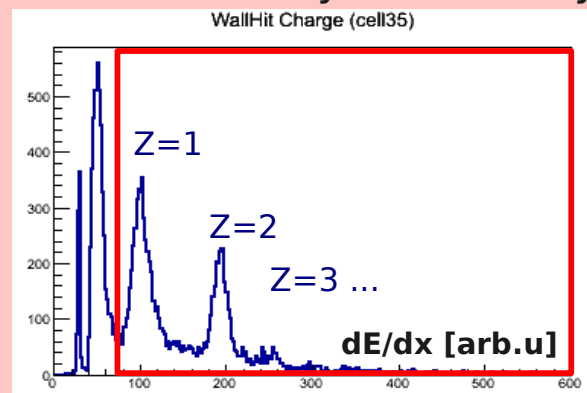
# (Au@1.25AGeV)+Au HADES 2012 test beam<sup>[16]</sup> (spectator selection by FW information)



Time-of-flight needed by spectators to travel from target to FW cell is selected



All charges accepted, but noise and magic peak are taken away individually



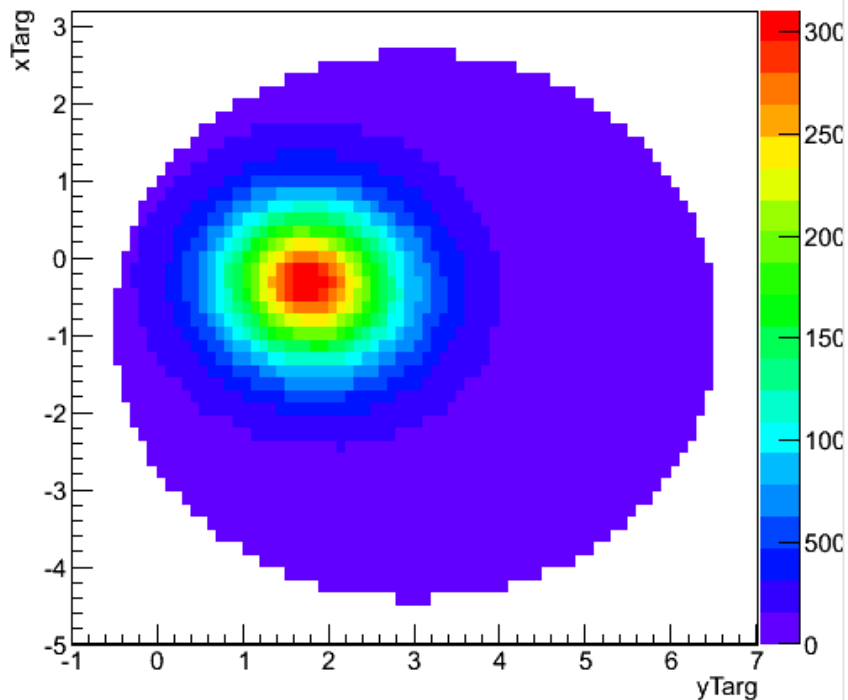


# Vertex selection (not perfect)

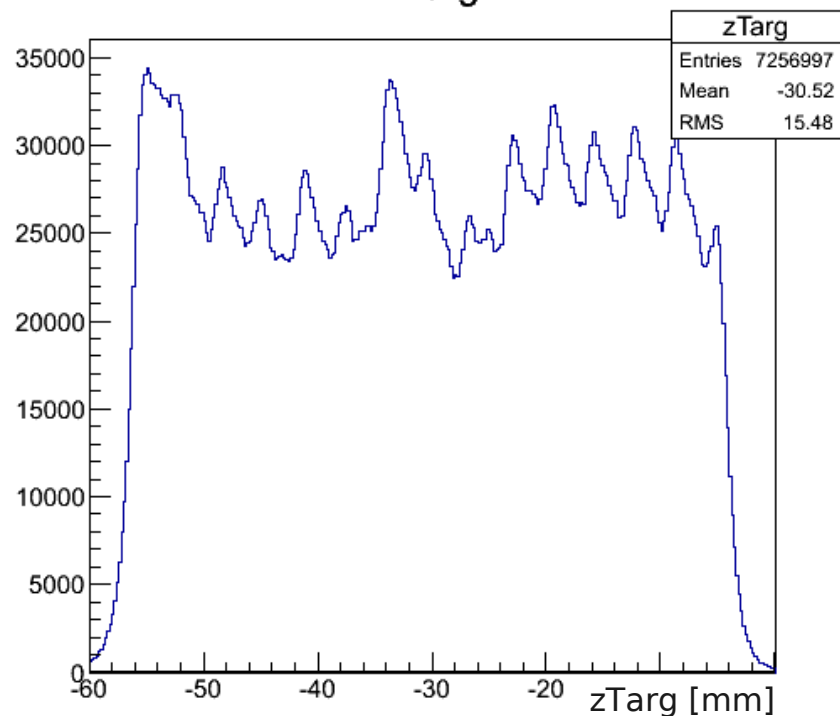
## 7.2 Million events

(day 104 be121040{7,8,9,10}\*.root)

xTarg:yTarg



zTarg



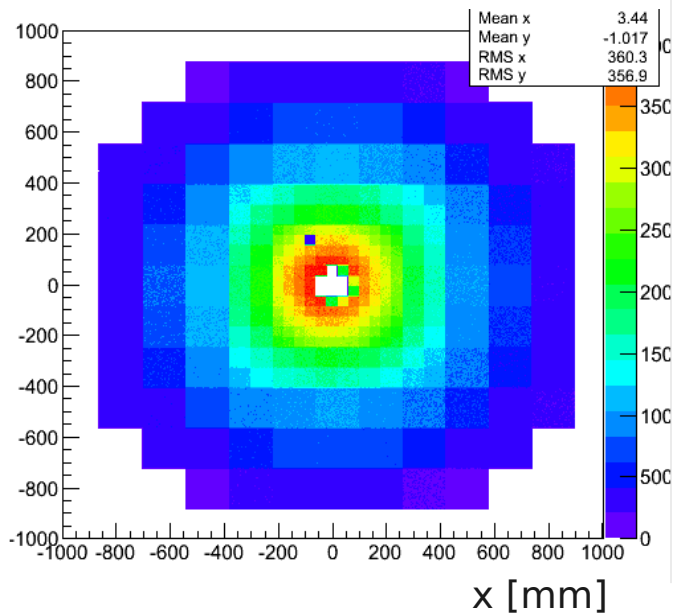
# Event plane angular isotropy

(day 104 be121040{7,8,9,10}\*.root)

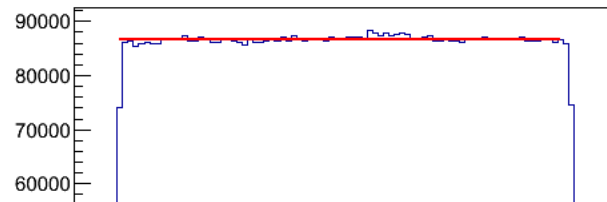
(shifted  $x=x-19.9\text{mm}$ ,  $y=y+6.1\text{mm}$ ,  $R_{\text{min}}=60\text{mm}$ )

Cell occupancy  
(for spectators)

FW Y vs. X

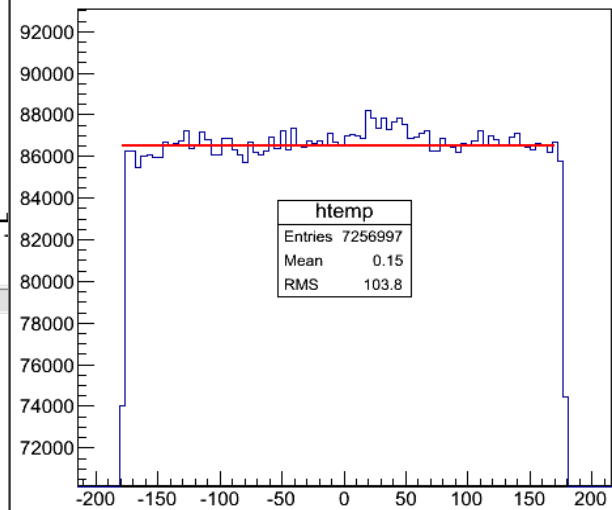


rp\_phi {Q>0}



File Edit View Options Tools Help

rp\_phi {Q>0}

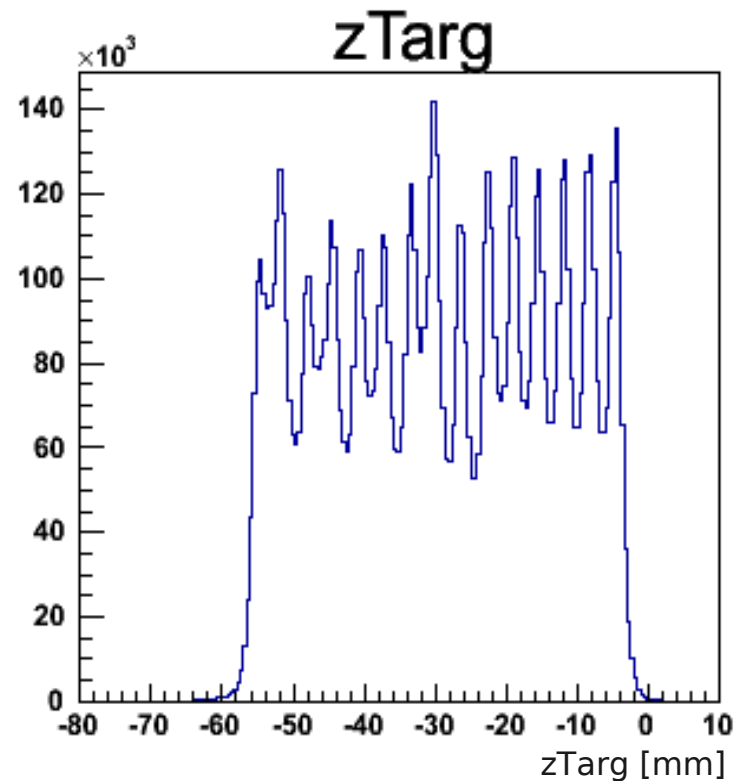
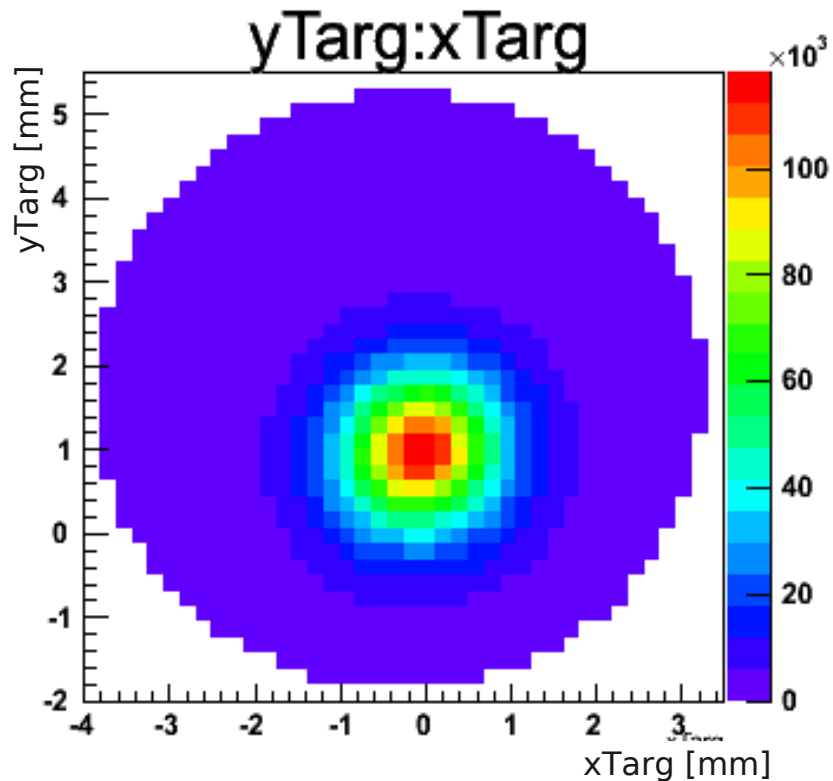


$\Psi_{\text{EP}} [^\circ]$

# Vertex selection

## 10 Million events

(day 108 be121081{6,7}\*.root)



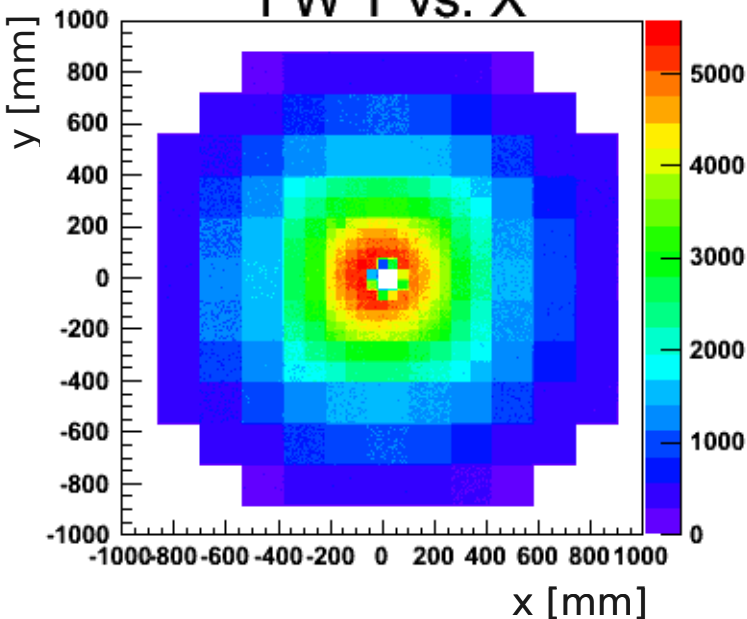
# Event plane angular isotropy

(day 104 be121040{7,8,9,10}\*.root)

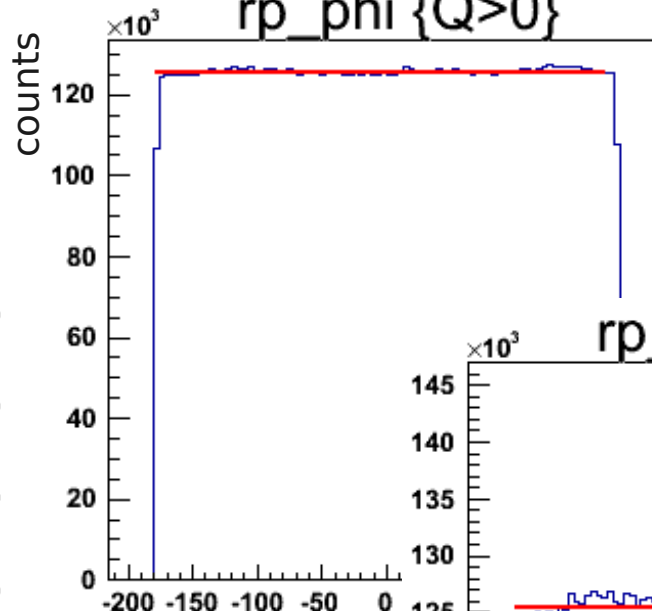
(shifted  $x=x-23\text{mm}$ ,  $y=y+6\text{mm}$ ,  $R_{\text{min}}=0\text{mm}$ )

FW cell occupancy  
(for spectators)

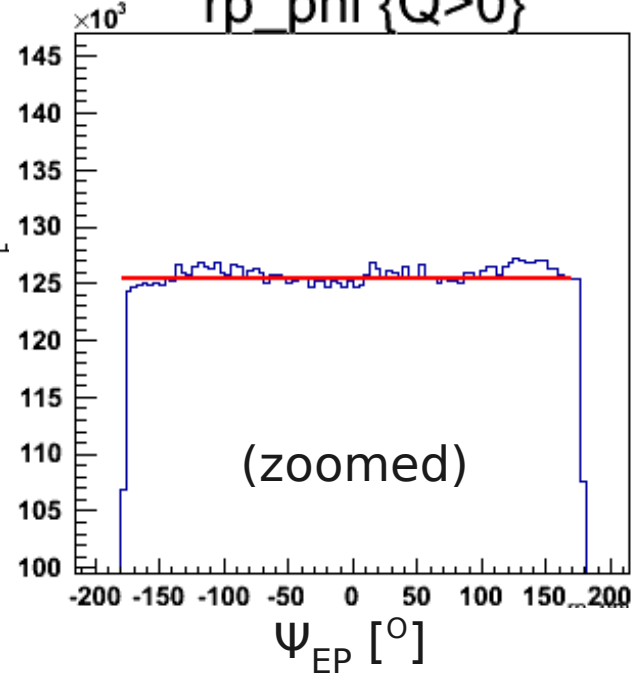
FW Y vs. X



rp\_phi {Q>0}



rp\_phi {Q>0}

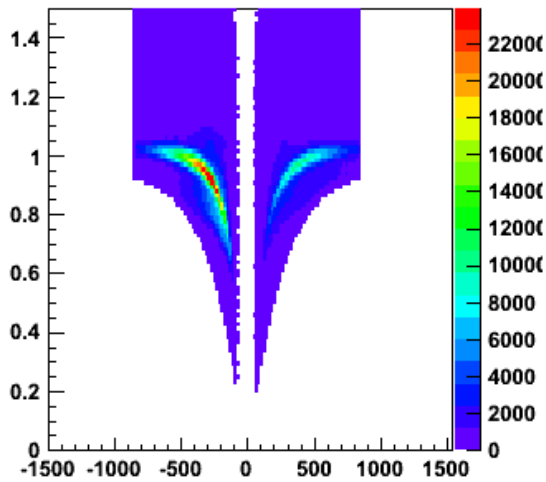


# Charged pions selection (sys=0,1 all 6 sectors)

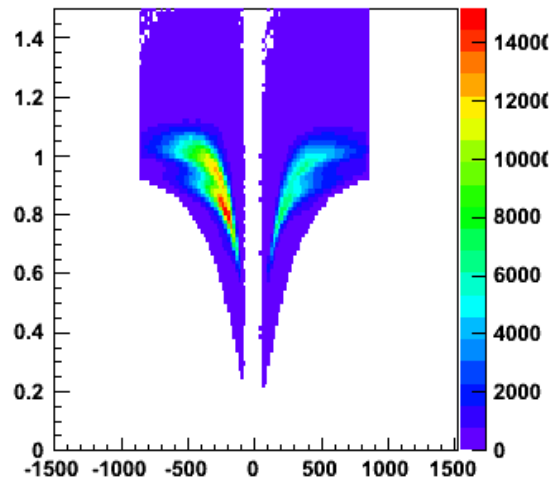
[21]

$\beta$

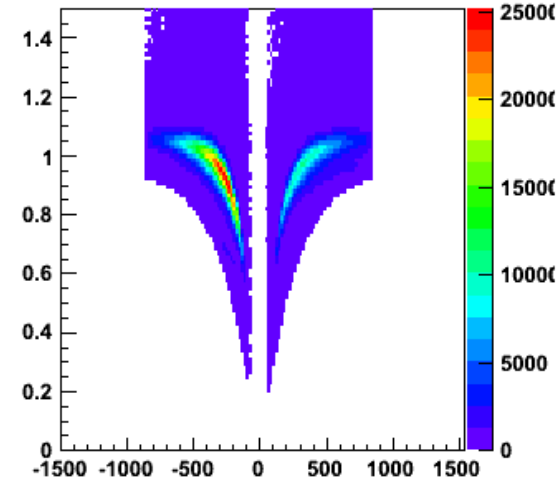
Particle Candidate beta vs. momentum S=0 (selected)



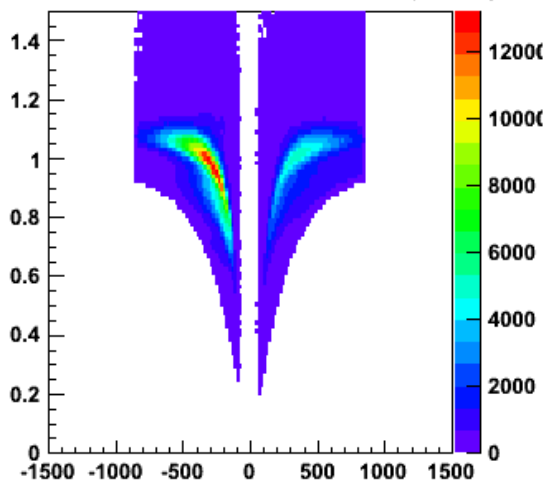
Particle Candidate beta vs. momentum S=1 (selected)



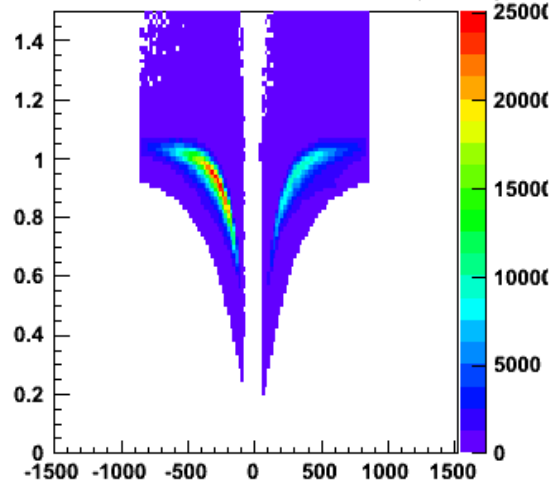
Particle Candidate beta vs. momentum S=2 (selected)



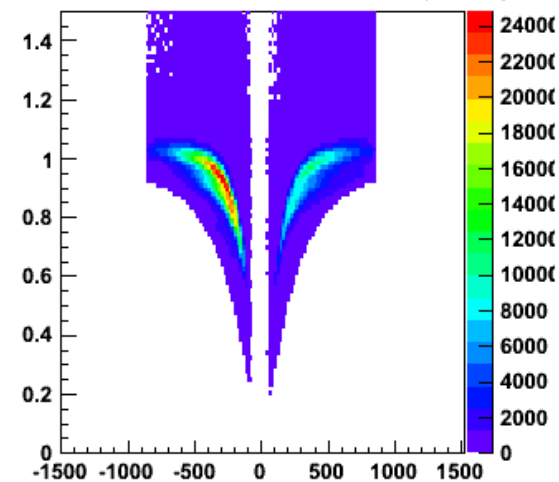
Particle Candidate beta vs. momentum S=3 (selected)



Particle Candidate beta vs. momentum S=4 (selected)



Particle Candidate beta vs. momentum S=5 (selected)

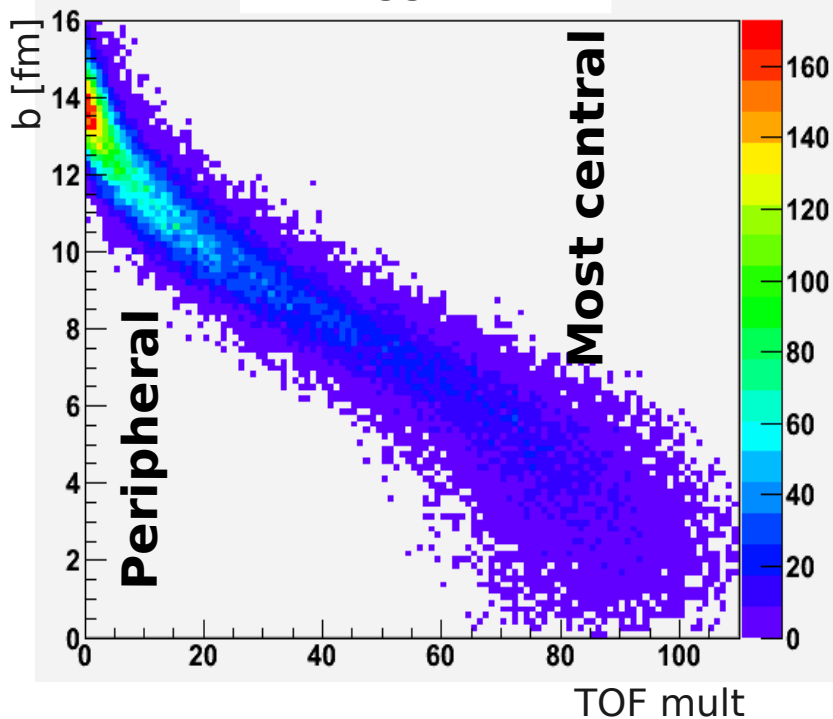


p [MeV/c]

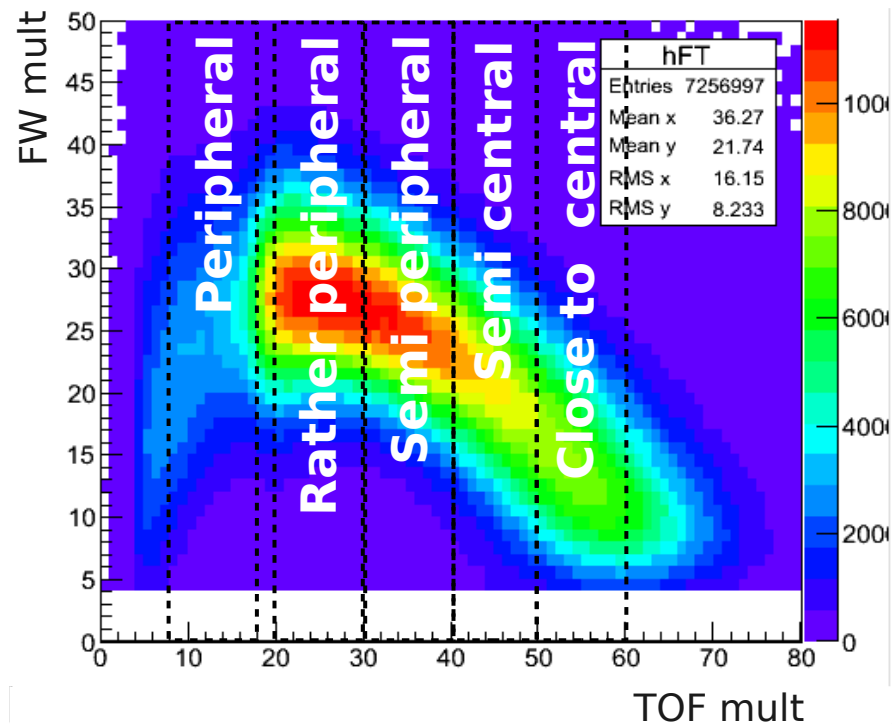
# Multiplicity in TOF as centrality selection

[22]

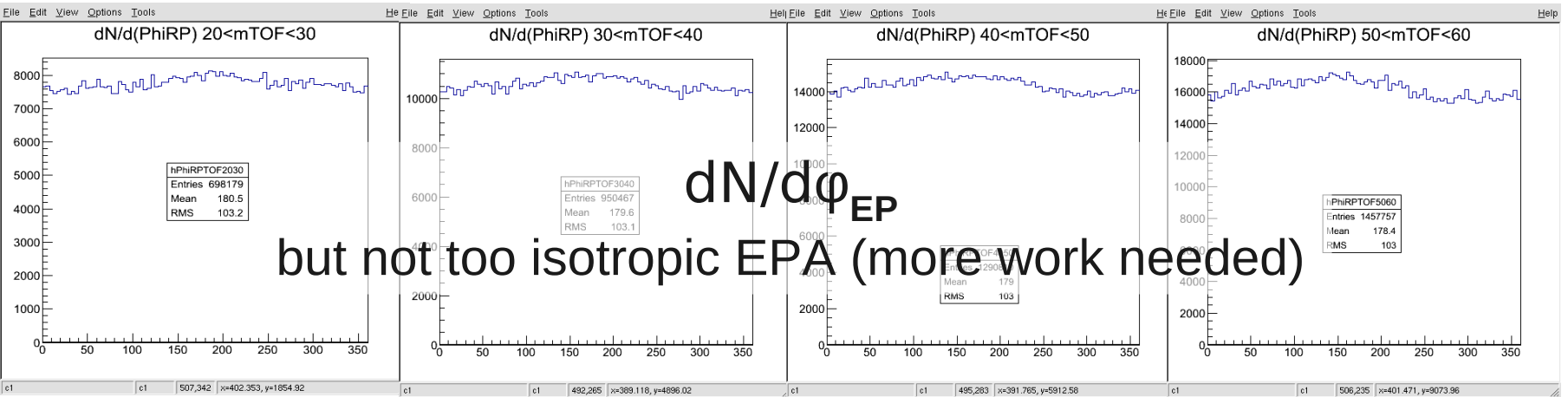
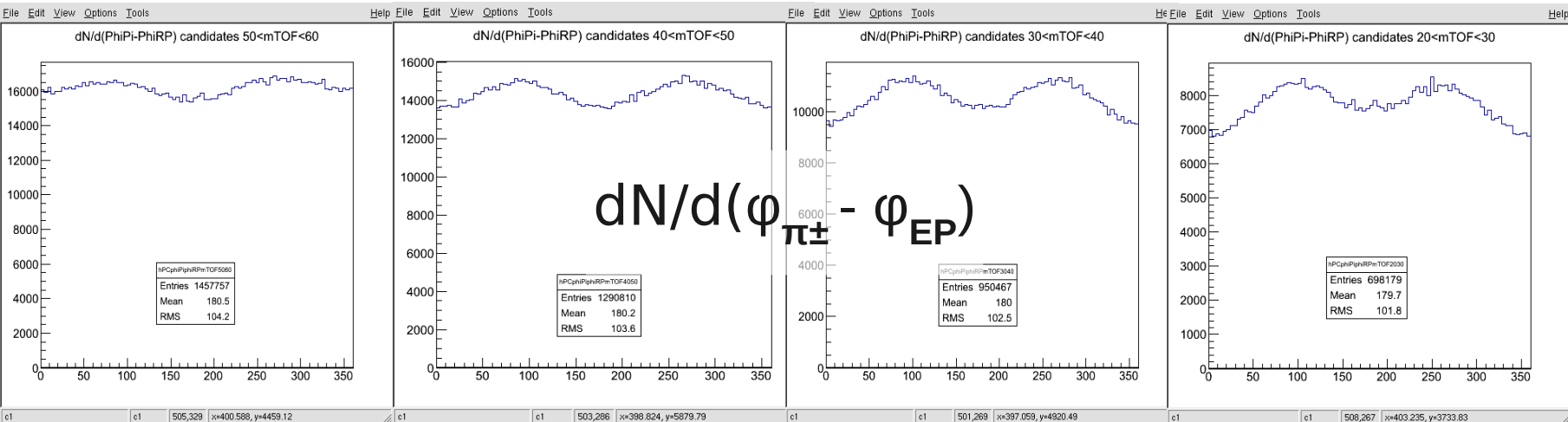
Simulation Au+Au@1.25GeV  
SHIELD, hGeant, reconstr.  
w/o mult. trigger simulation



Apr 2012 Au+Au@1.25GeV  
real data (online DST)



# $\pi^\pm$ flow patterns for different centrality selection [23]



but not too isotropic EPA (more work needed)

50 < Mtof < 60

40 < Mtof < 50

30 < Mtof < 40

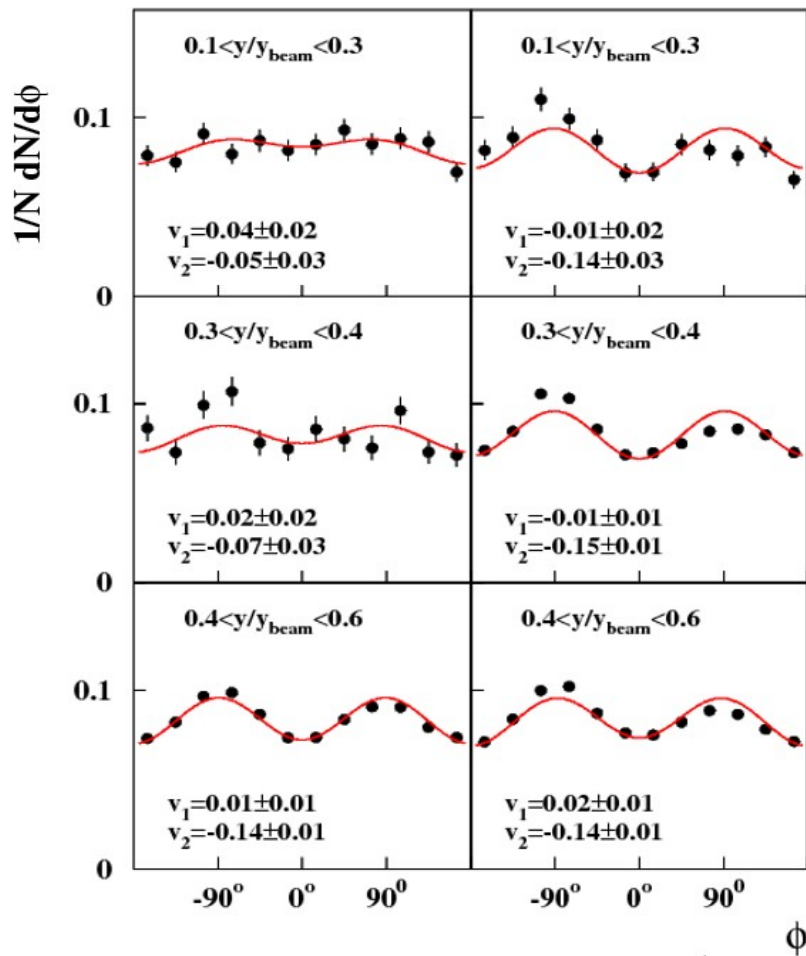
20 < Mtof < 30

<----- more central -----> more peripheral ----->

# $\pi^\pm$ flow patterns for different $p_t$ and rapidity<sup>[24]</sup>

KaoS  $\pi^+$  (Ph.D. A.Foerster)

$0.2 \text{ GeV} < p_\perp < 0.5 \text{ GeV}$     $0.5 \text{ GeV} < p_\perp < 0.8 \text{ GeV}$



$\pi^\pm$  HADES online DST  $8 < M(\text{TOF}) < 40$

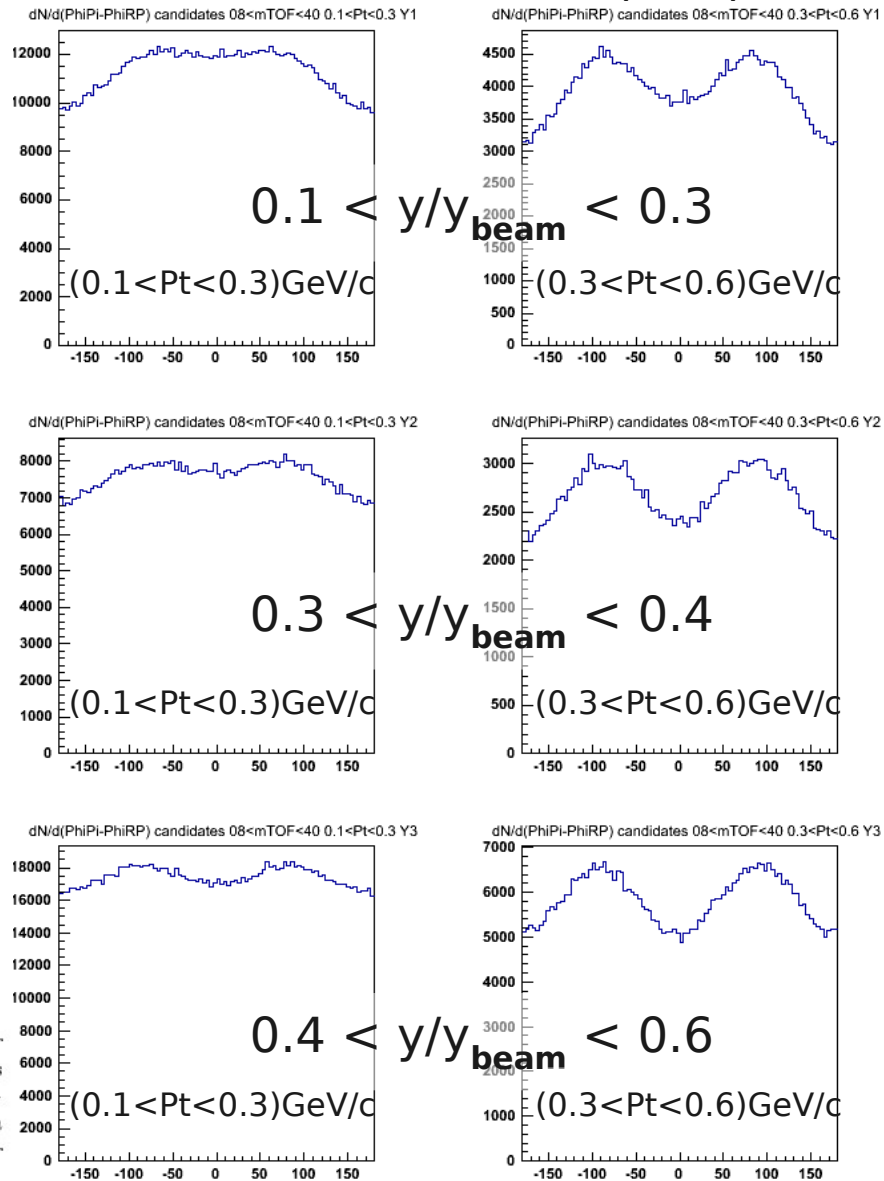


Abbildung 4.17: Azimutale Verteilungen der  $\pi^+$ -Emission für drei Intervalle in normierter Rapidität  $y/y_{\text{beam}}$  (von oben nach unten) und zwei Intervalle im Transversalimpuls  $p_\perp$  (links und rechts) für Stöße mit  $b > 5.9 \text{ fm}$ , für  $B_D = 0.6 \text{ T}$  und  $B_D = 0.9 \text{ T}$  bestimmt aus reduziert gemessenen Triggerereignissen in den  $K^+$ -Messungen. Die Linien stellen Anpassungen nach Gleichung 4.26 dar, die resultierenden Koeffizienten  $v_{1,2}$  sind auf die Auflösung der Reaktionsebene korrigiert.

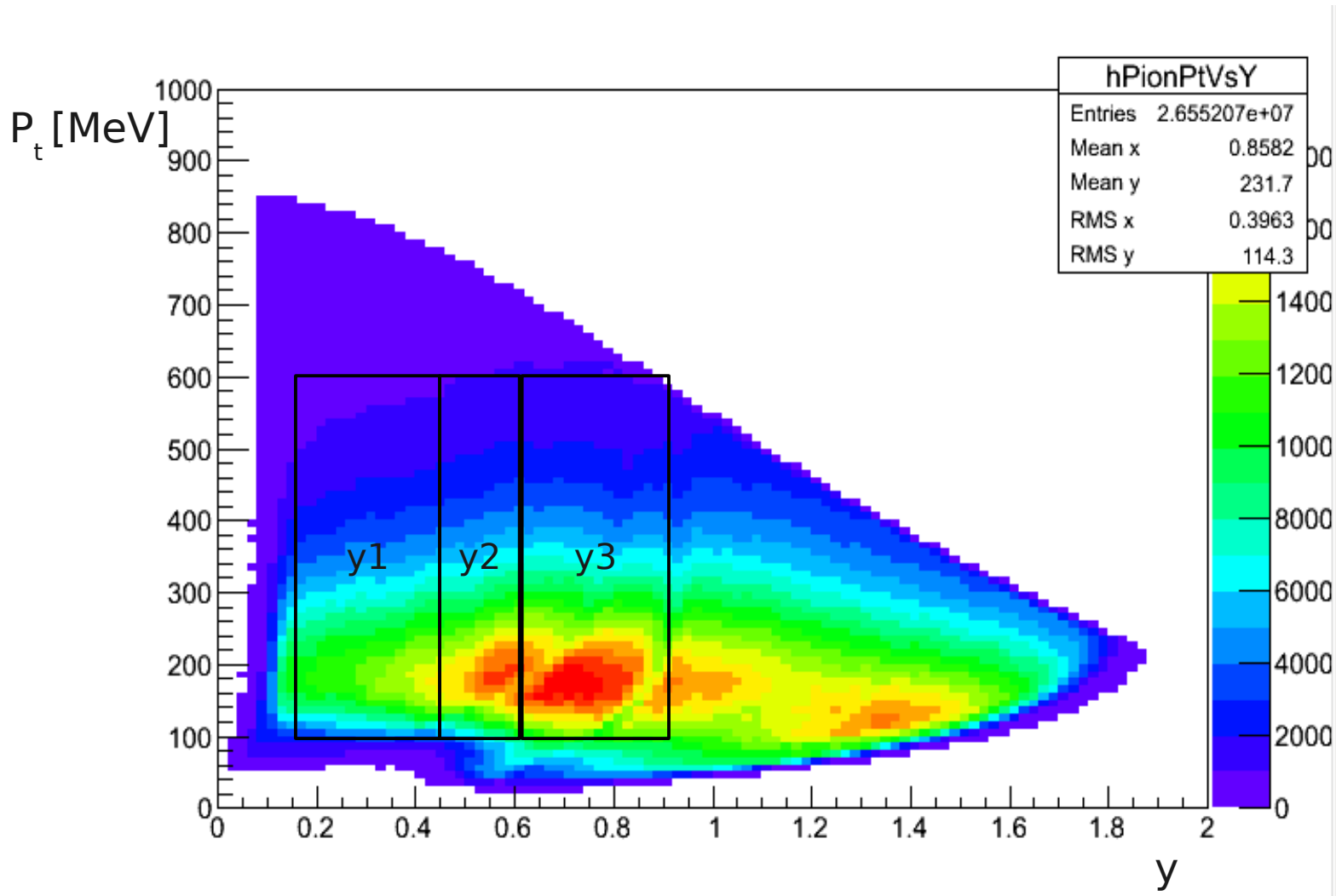


# Summary

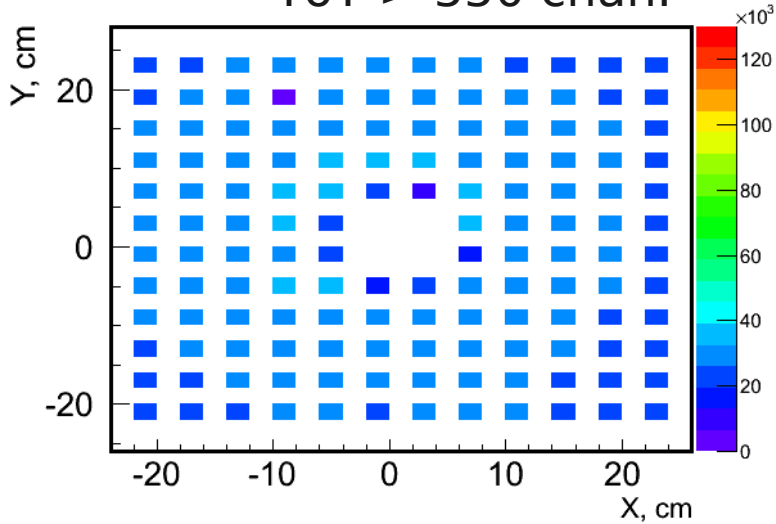
- FW hardware (PMT HV and electronics) were tuned before the physics run
- Time (@Oracle) and ToT (ASCII file) calibration of FW was made (Apr12)
- Re-centering of beam spot on FW gives isotropic distribution of the event plane angle
- Analysis of online-DST'Apr12 demonstrates qualitative agreement with previous experiments

# Backup slides

# $\pi^\pm$ $p_t$ vs. rapidity acceptance (TOF+RPC)

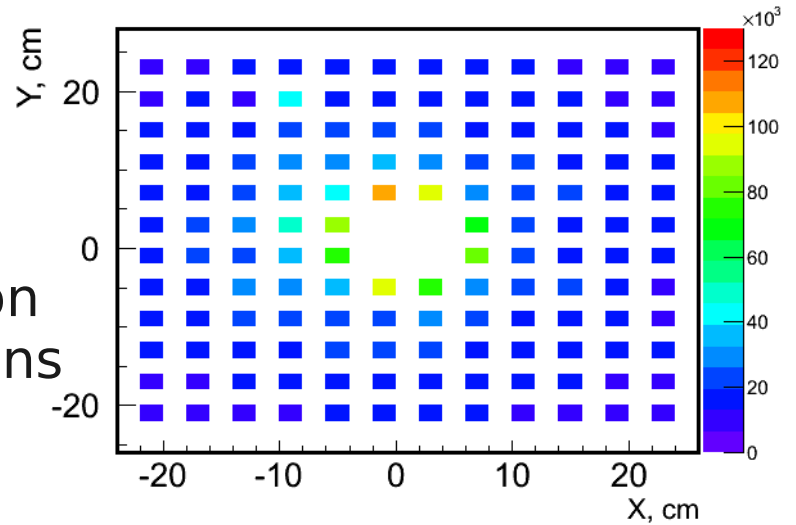


Cuts: Time < 50 ns  
ToT > 550 chan.



For particles  
with  $Z=1$   
(wide spot)

For particles from  
“550chan”  
(narrow spot)  
mainly contribution  
from delta-electrons



# What is explanation of magic 550 ch. peak?

We see the only reason - located at the slope change.

