



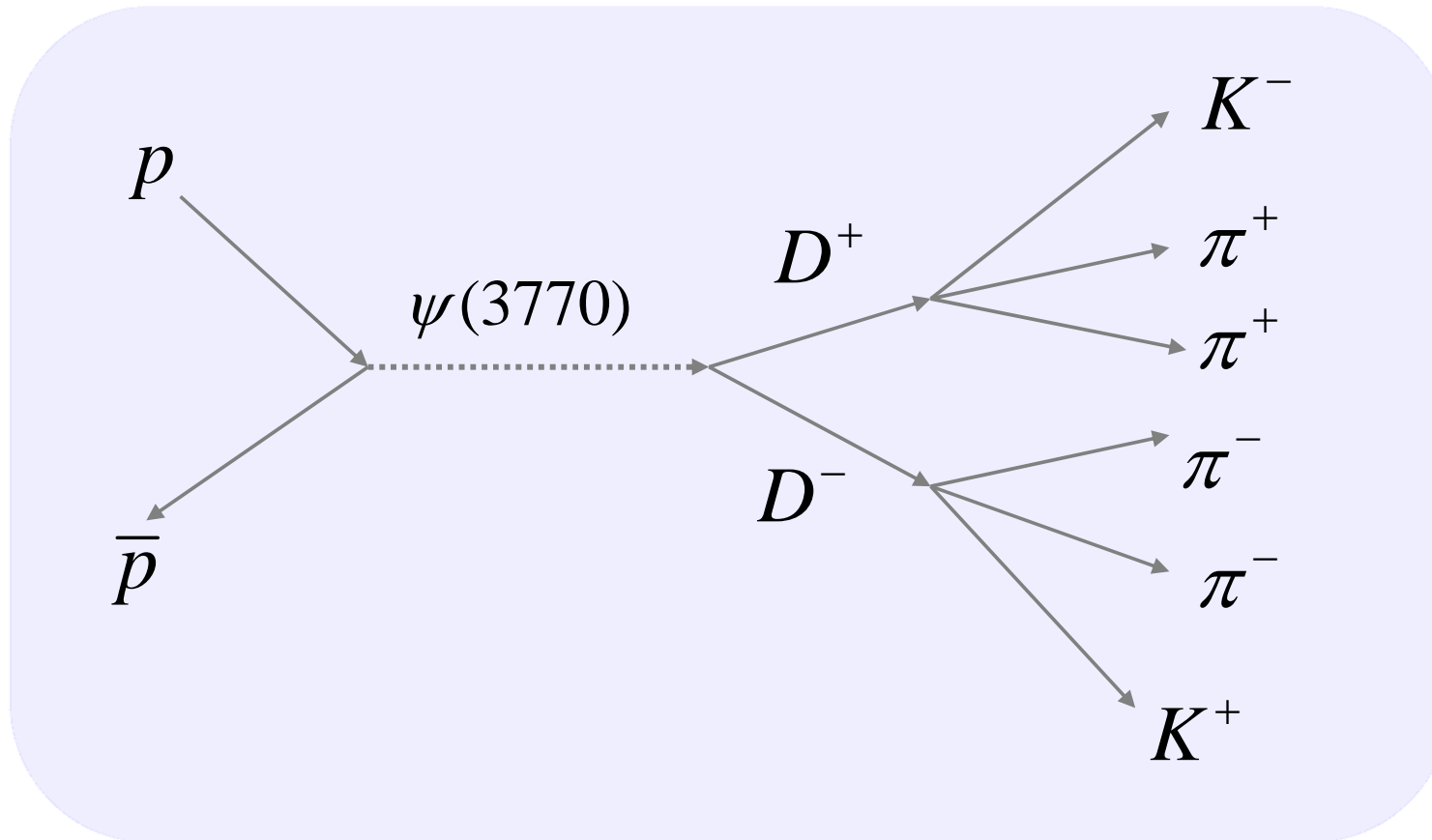
# $\Psi(3770)$ study w. central tracking @ PANDA cross-check

**Donghee Kang**

**Helmholtz Institut Mainz, Universität Mainz**



Benchmark channel :  $\psi(3770) \rightarrow D^+ D^- \rightarrow K^- \pi^+ \pi^+ K^+ \pi^- \pi^-$

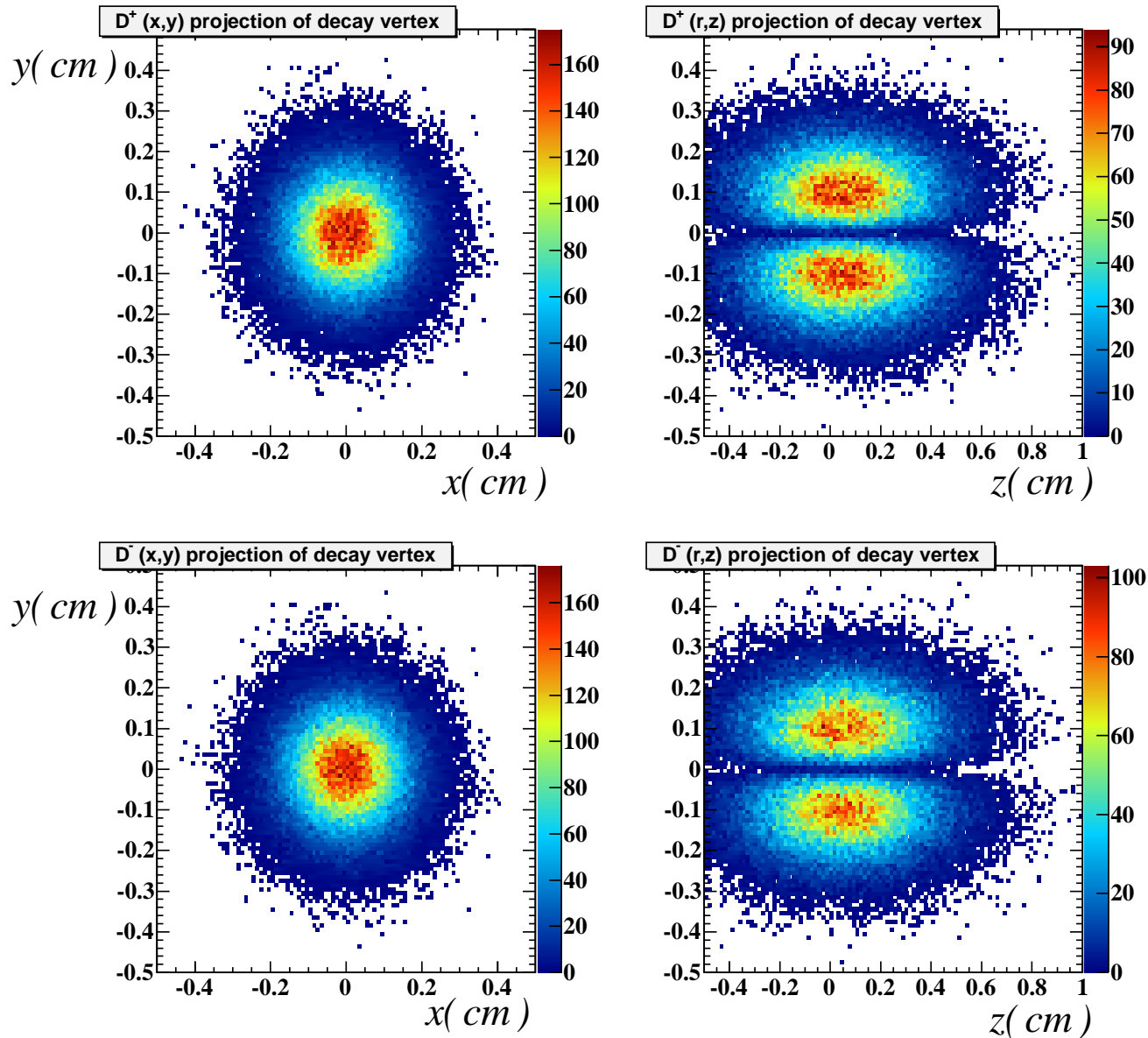


MC simulation on the PandaGrid

- TPC mode : run984
- STT mode : run934oldnocu



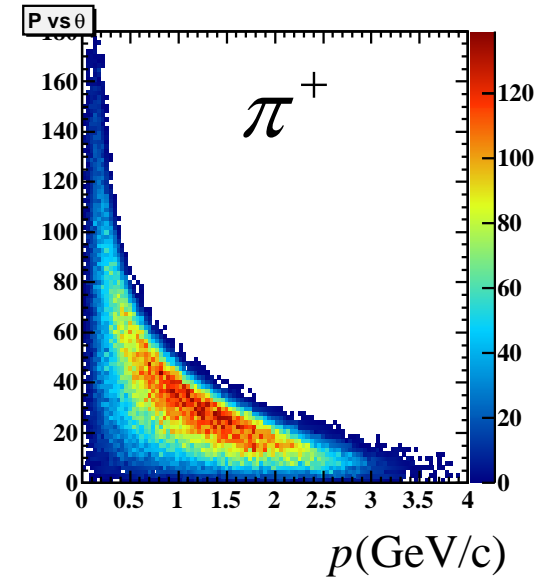
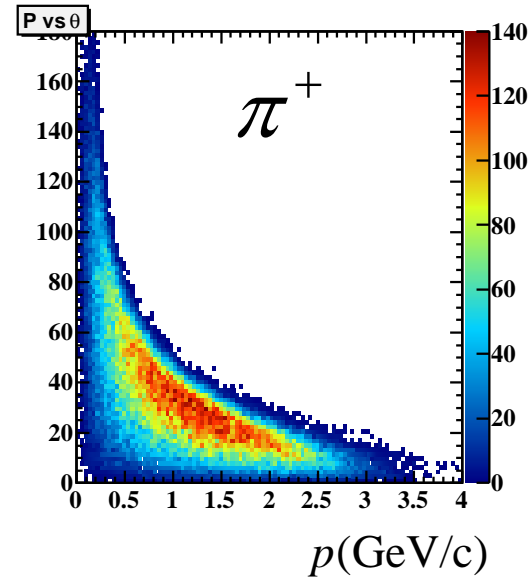
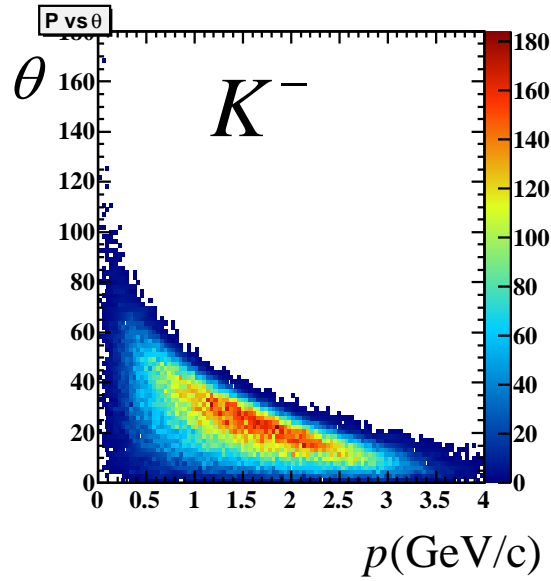
- Generated  $\psi(3770)$  event : vertex distribution of  $D^+$  and  $D^-$



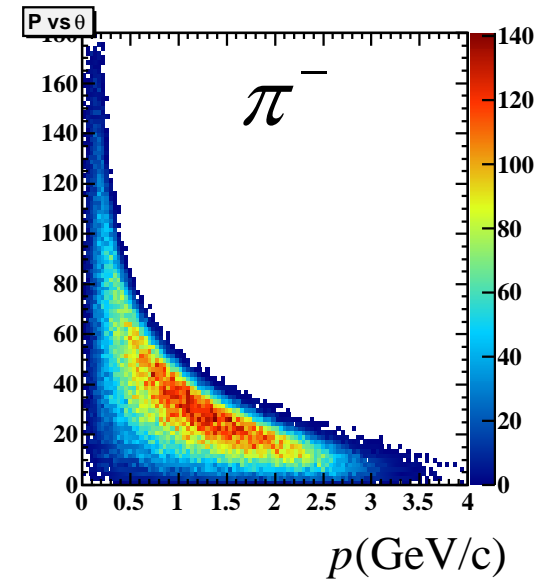
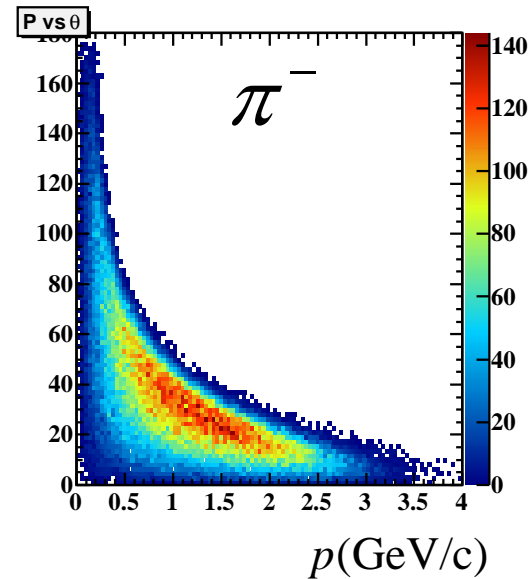
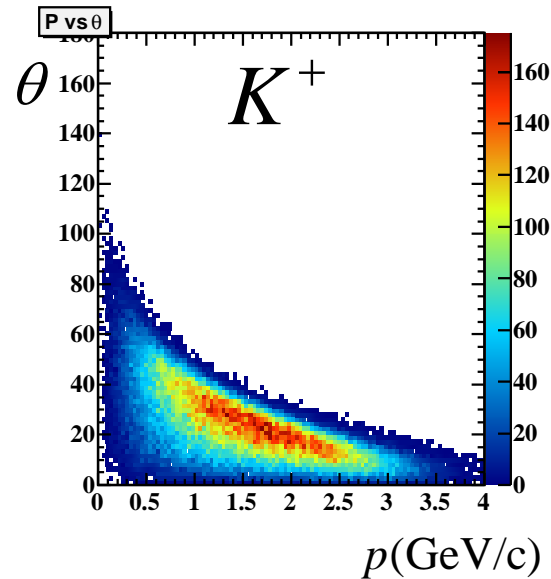


- Generated  $\psi(3770)$  event : Momentum and Theta distribution for  $D^+$  and  $D^-$  decay

$D^+$



$D^-$

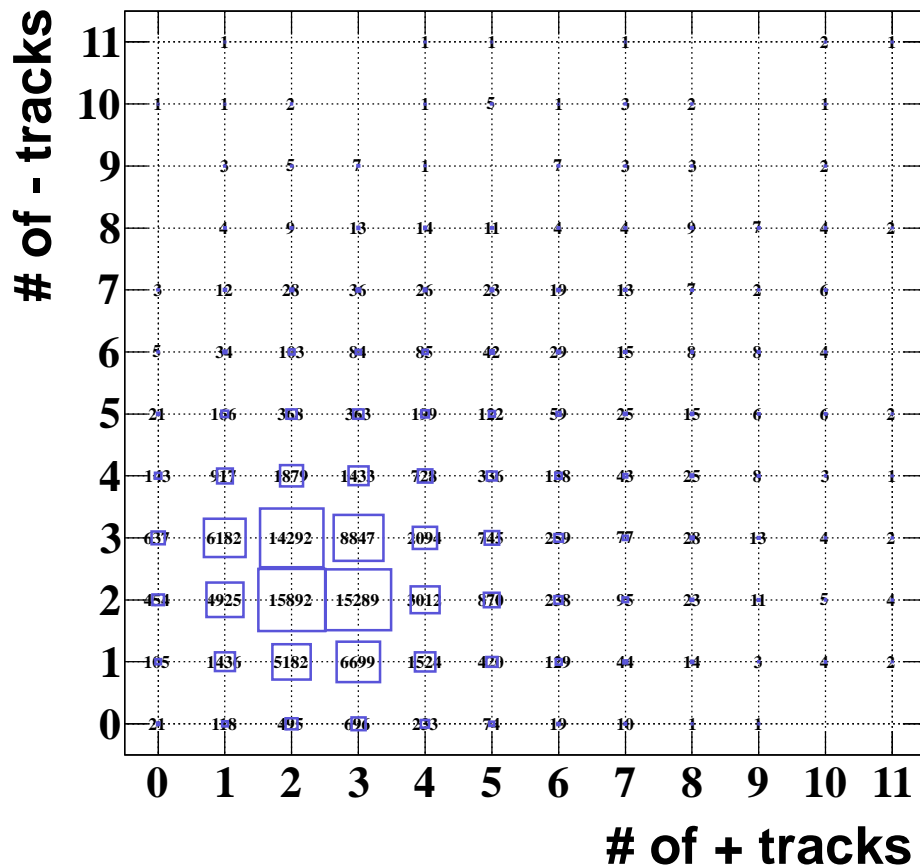




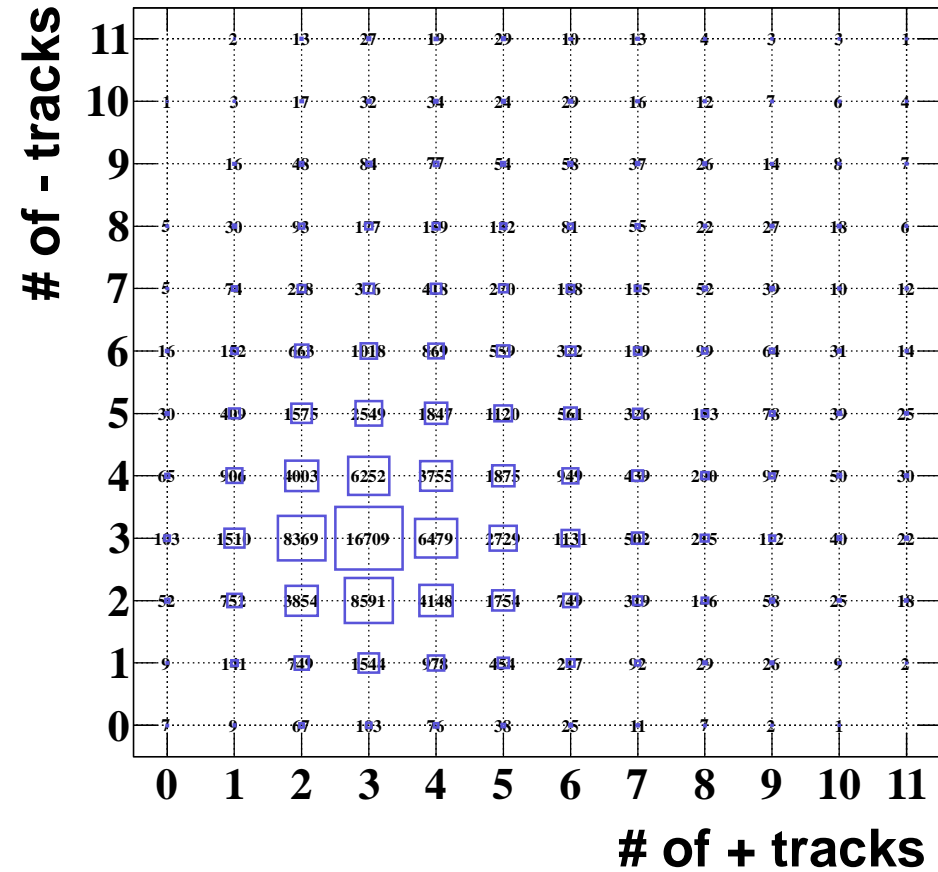
# Event selection I

Reconstruction of charged tracks by TPC and STT :  
required at least 3 positive and 3 negative tracks.

TPC(run984) : 99000 evt.



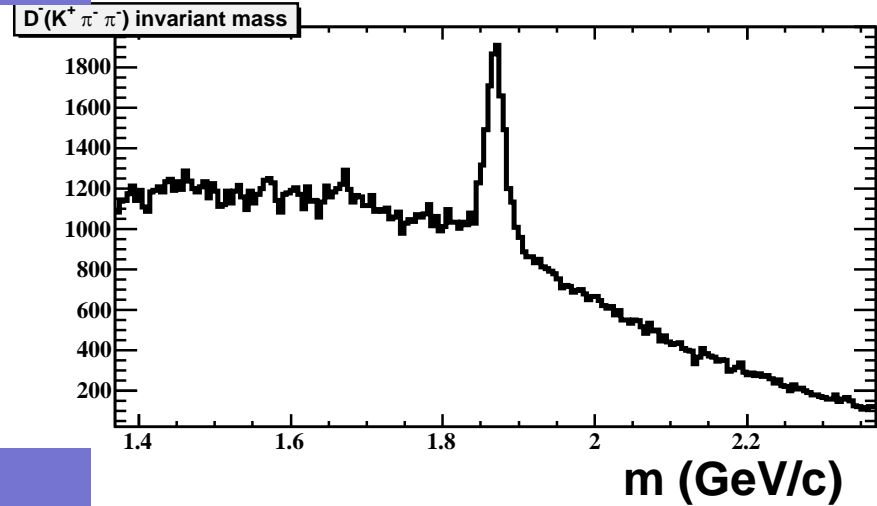
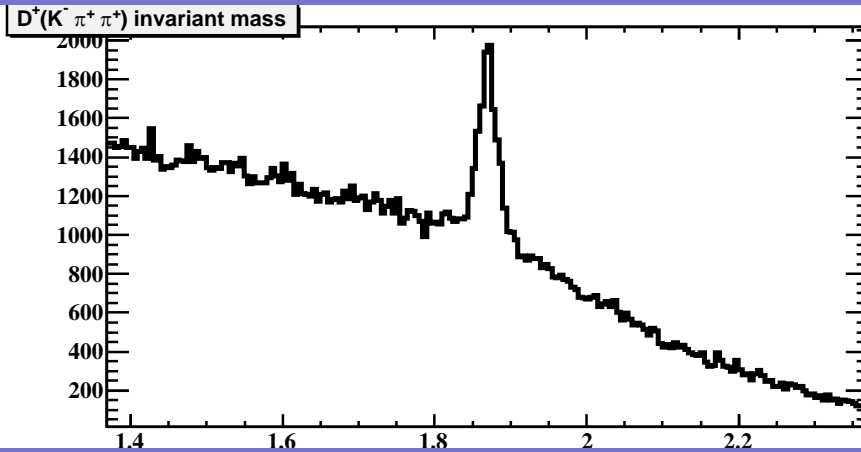
STT(run934oldnocu) : 98000 evt.



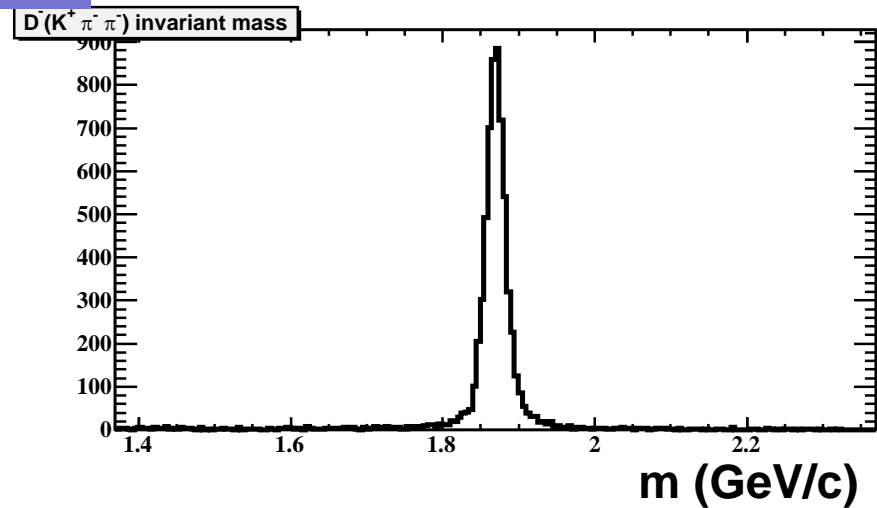
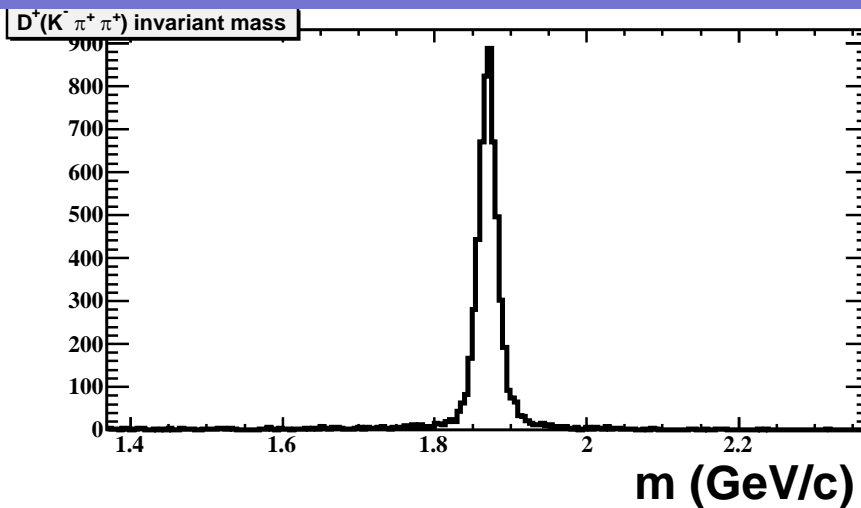


# Event selection II

## TPC mode : D+ and D- reconstruction



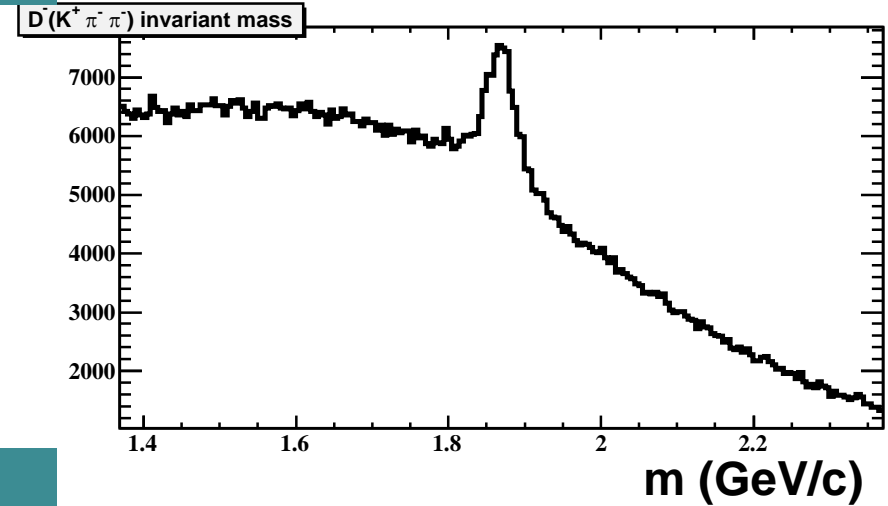
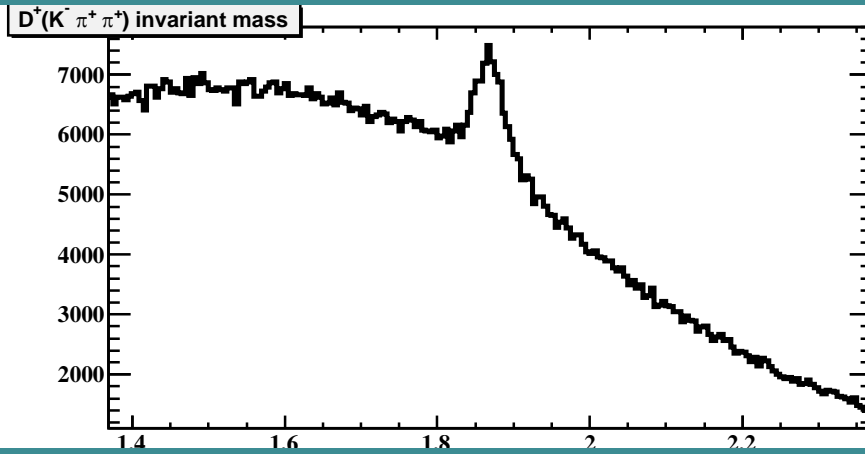
## TPC mode : MC true matched D+ and D-



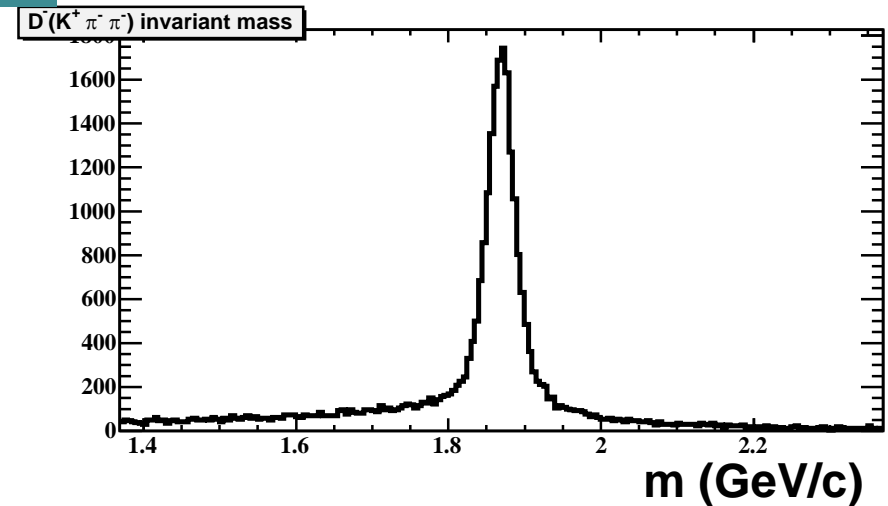
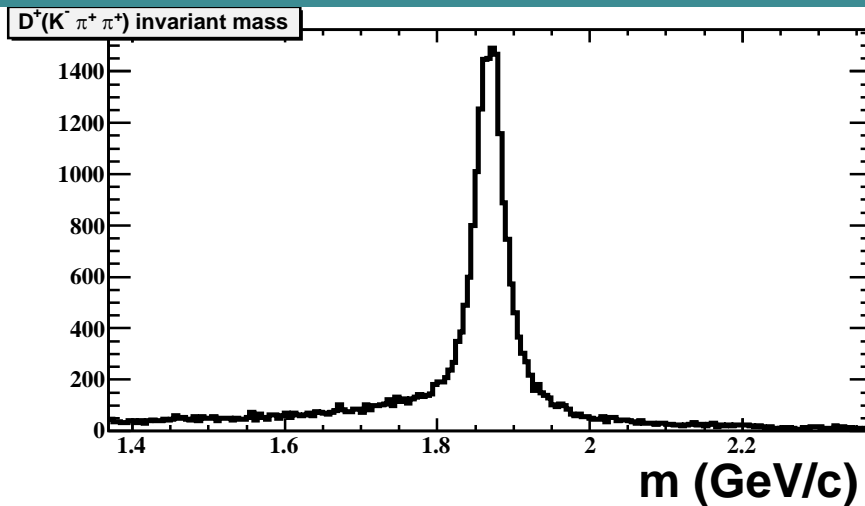


# Event selection II

## STT mode : D+ and D- reconstruction



## STT mode : MC true matched D+ and D-

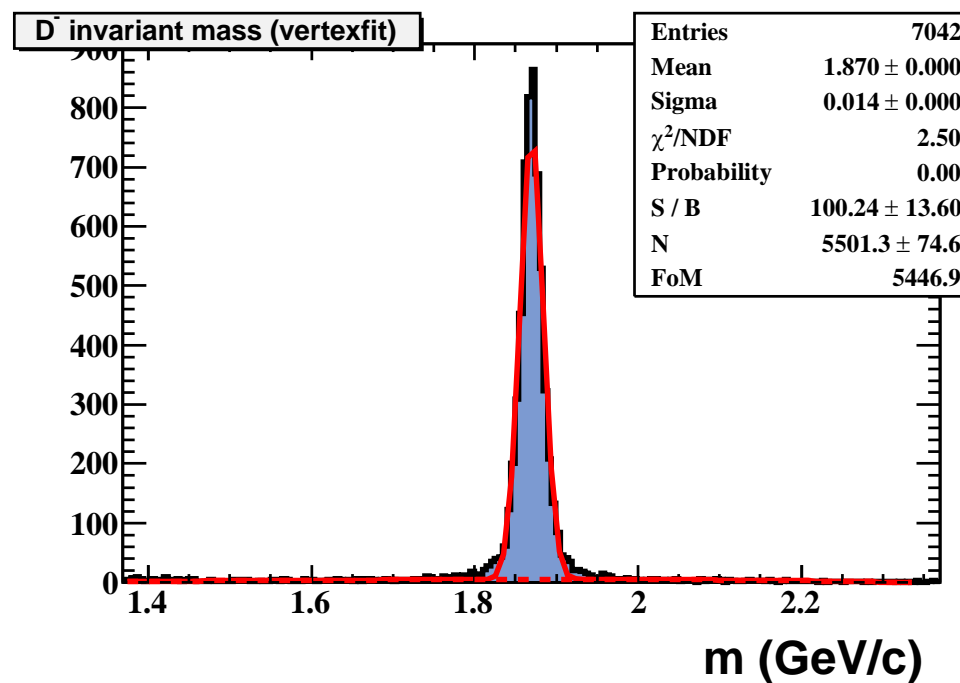
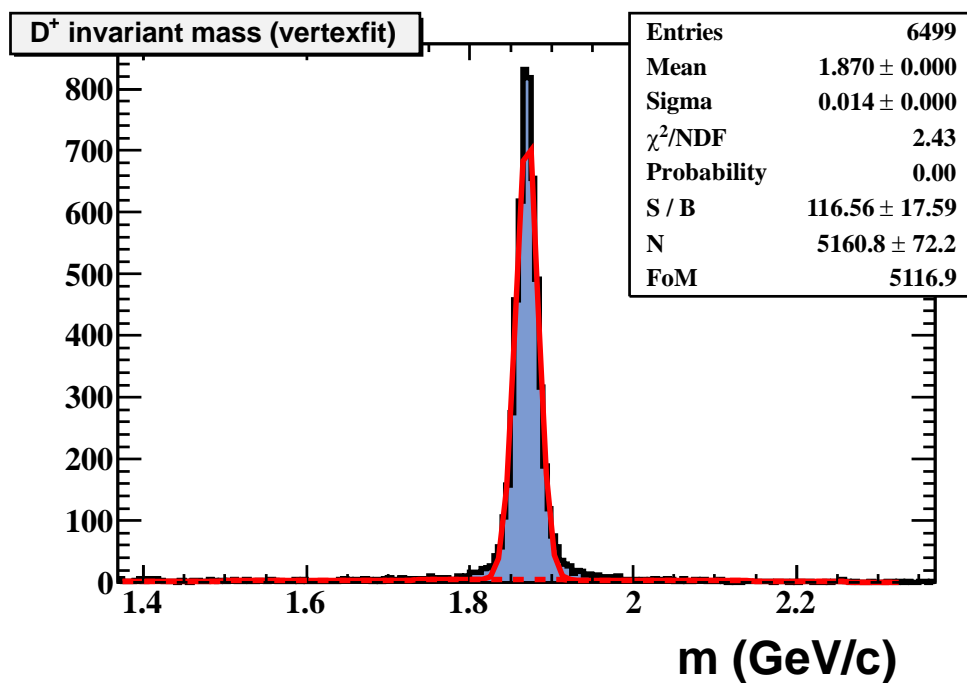




## Event selection III

- MC true matching with kaon id=321 and pion id=211 (no index matching)
- 1 D<sup>+</sup> and D<sup>-</sup> candidate in 1 event, is identified from PndKinVertex fit with best probability
- mass window  $1.8093 < m_D < 1.9293$  GeV

### TPC mode : Fitted D<sup>+</sup> and D<sup>-</sup>



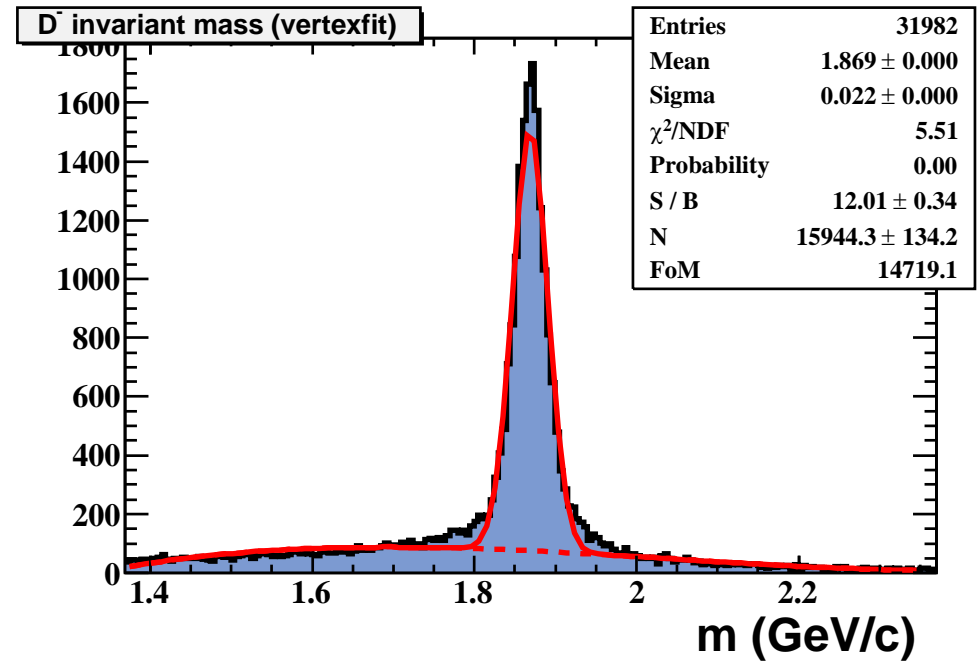
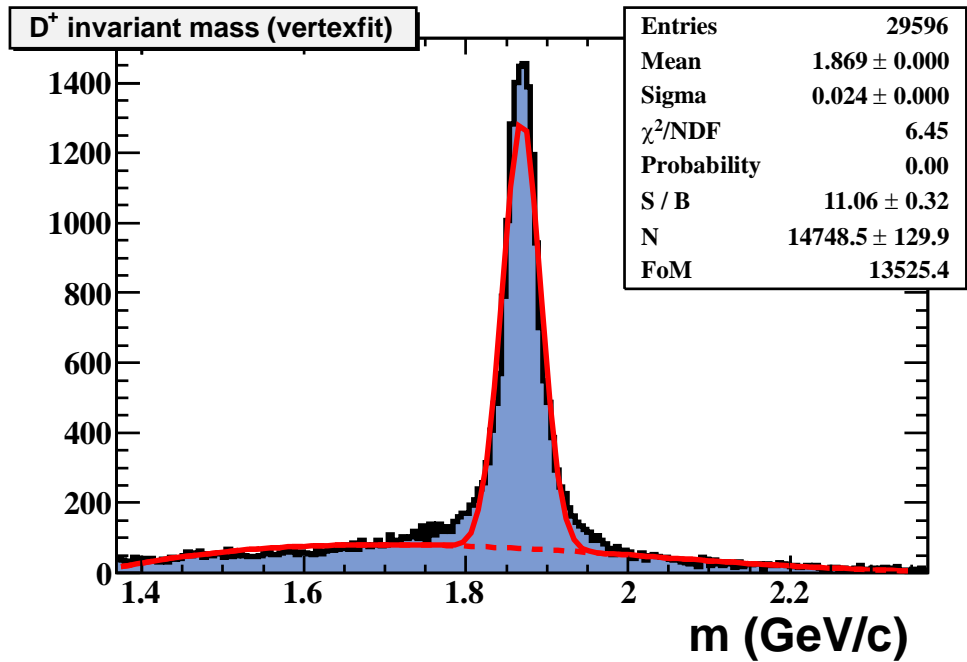




## Event selection III

- MC true matching with kaon id=321 and pion id=211 (no index matching)
- 1 D<sup>+</sup> and D<sup>-</sup> candidate in 1 event, is identified from PndKinVertex fit with best probability
- mass window  $1.8093 < m_D < 1.9293$  GeV

### STT mode : Fitted D<sup>+</sup> and D<sup>-</sup>

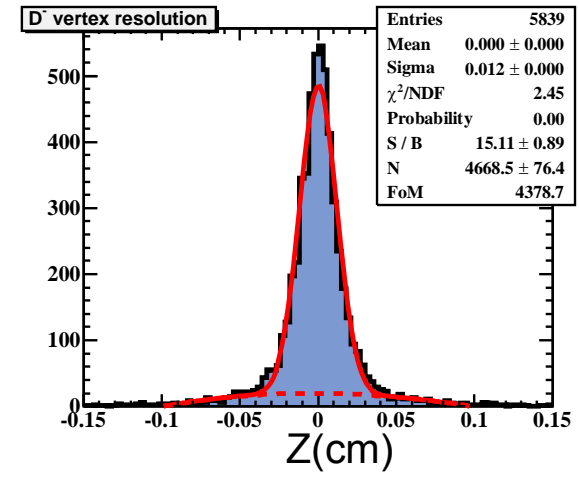
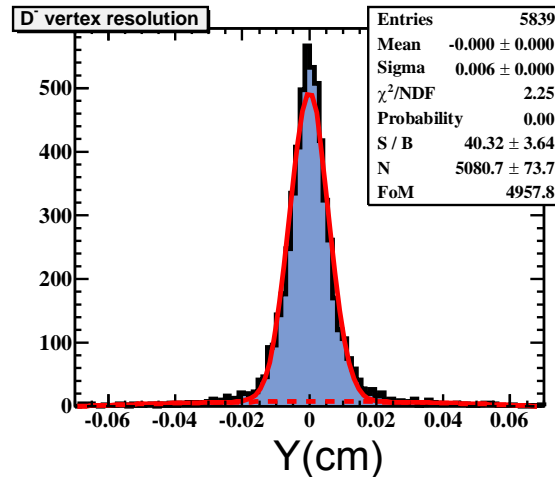
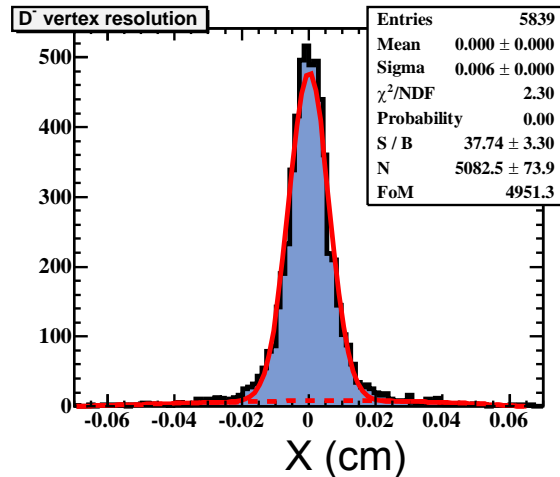
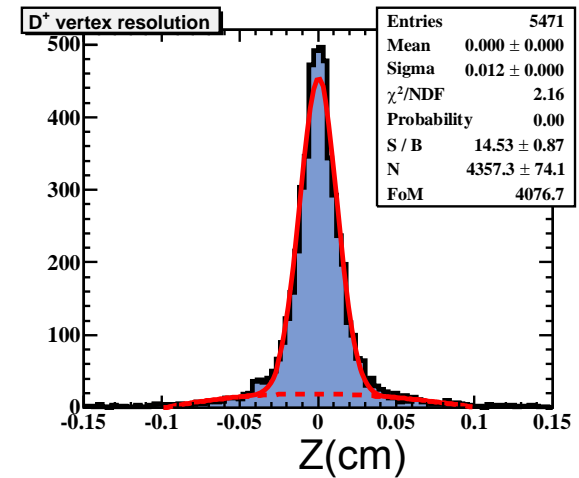
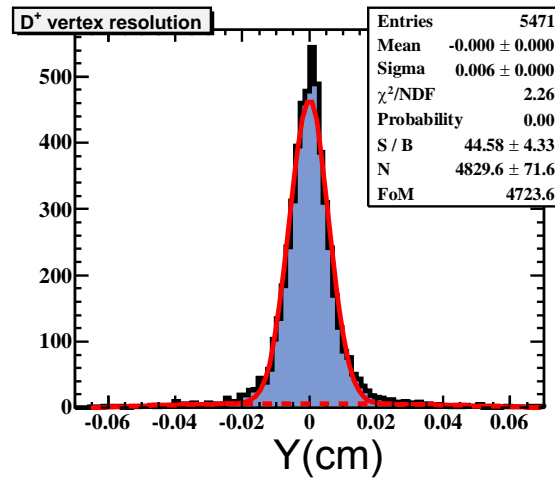
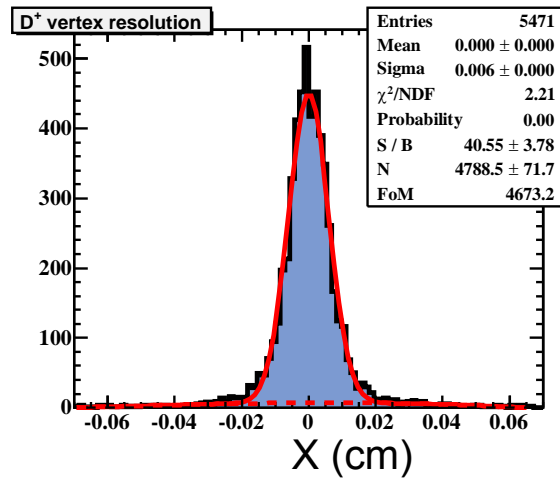




# Event selection III

- Vertex position within mass window  $1.8093 < m_D < 1.9293$  GeV

## TPC mode : Vertex resolution

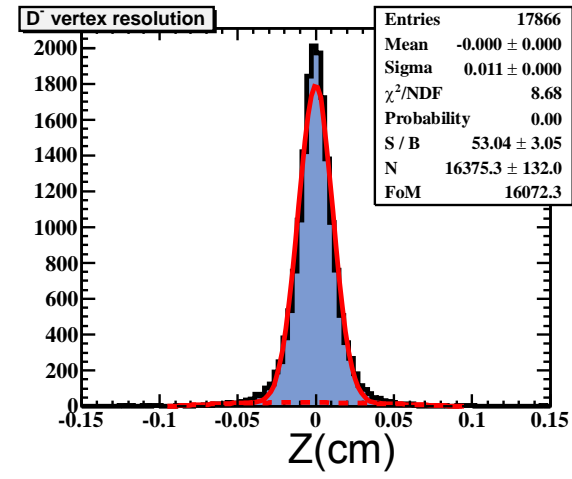
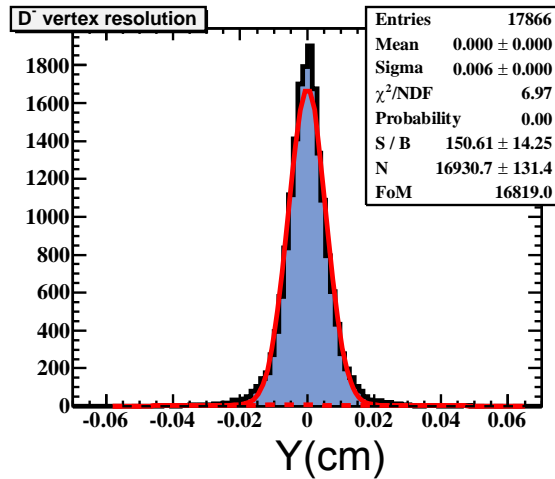
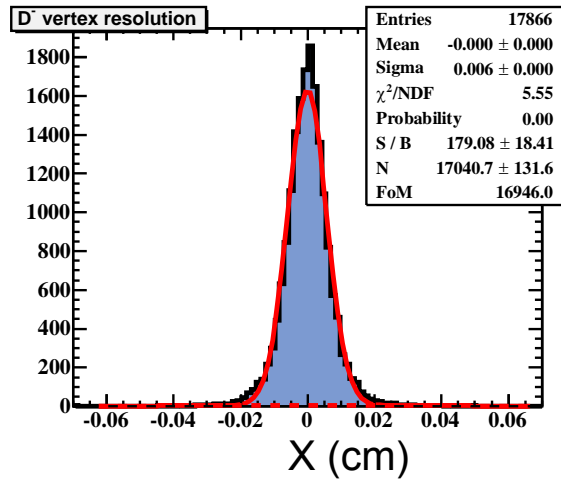
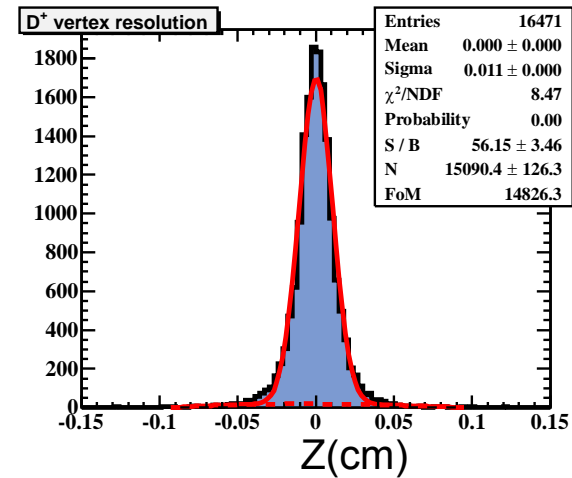
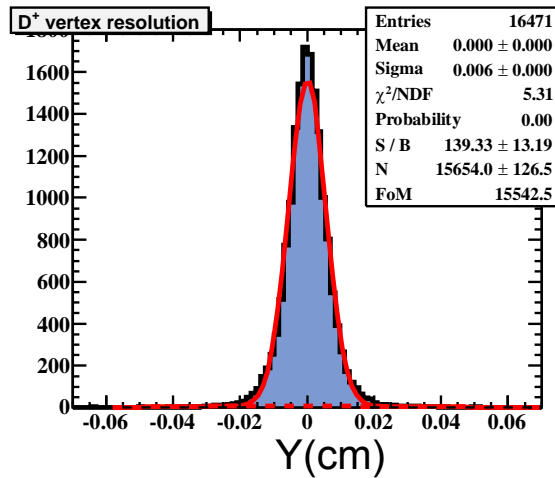
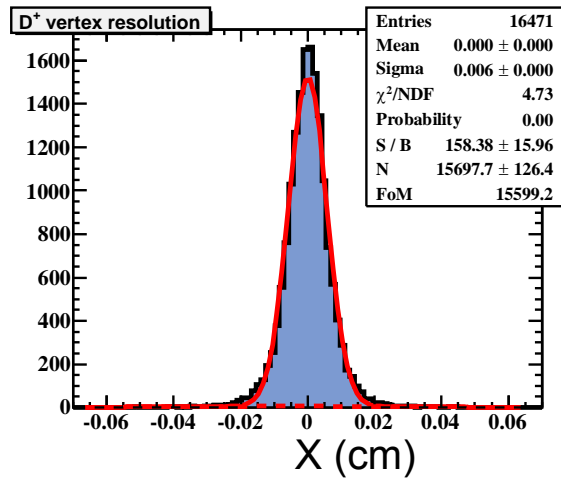




# Event selection III

- Vertex position within mass window  $1.8093 < m_D < 1.9293$  GeV

## STT mode : Vertex resolution

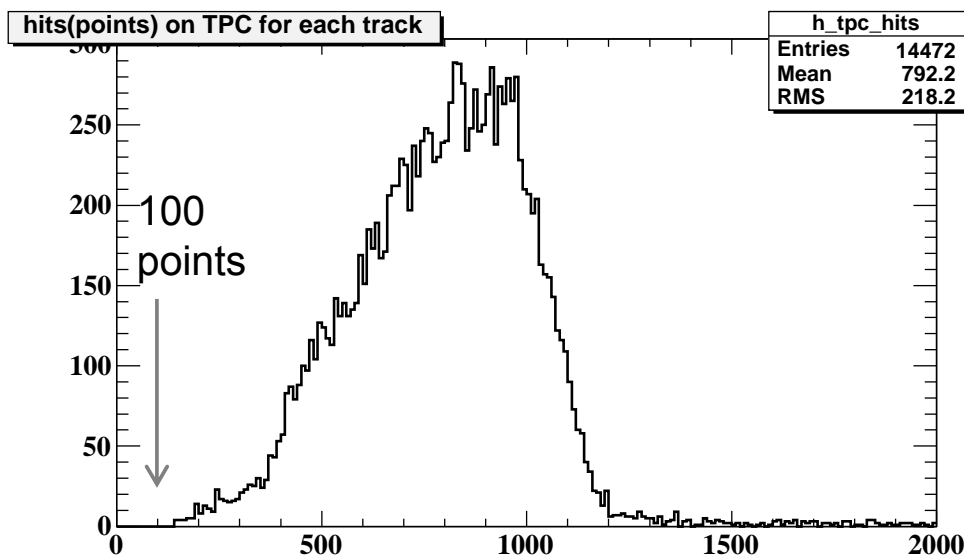




## Event selection for $\psi(3770)$

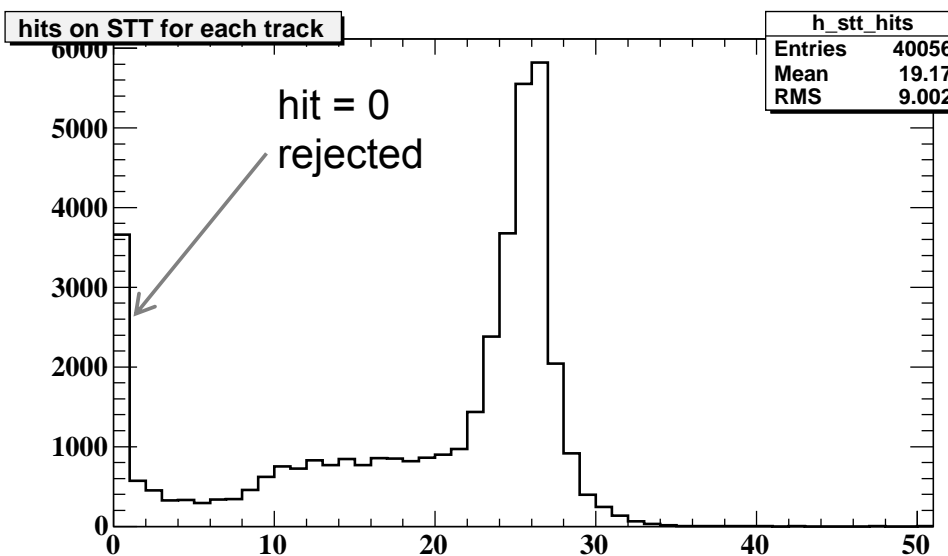
- combined D+ and D- to  $\psi(3770)$
- only 1 best candidate of  $\psi(3770)$  in 1 event, identified by highest probability (chi2) from vertex fit
- hit in the fiducial volume required to compare both detectors in same level
  - STT must have at least 1 hit in the volume
  - TPC have more than 100 hits(points) which corresponds to 7.5cm track length

### TPC points



No effect : All tracks have more than 100 points in final  $\psi(3770)$  sample

### STT hits



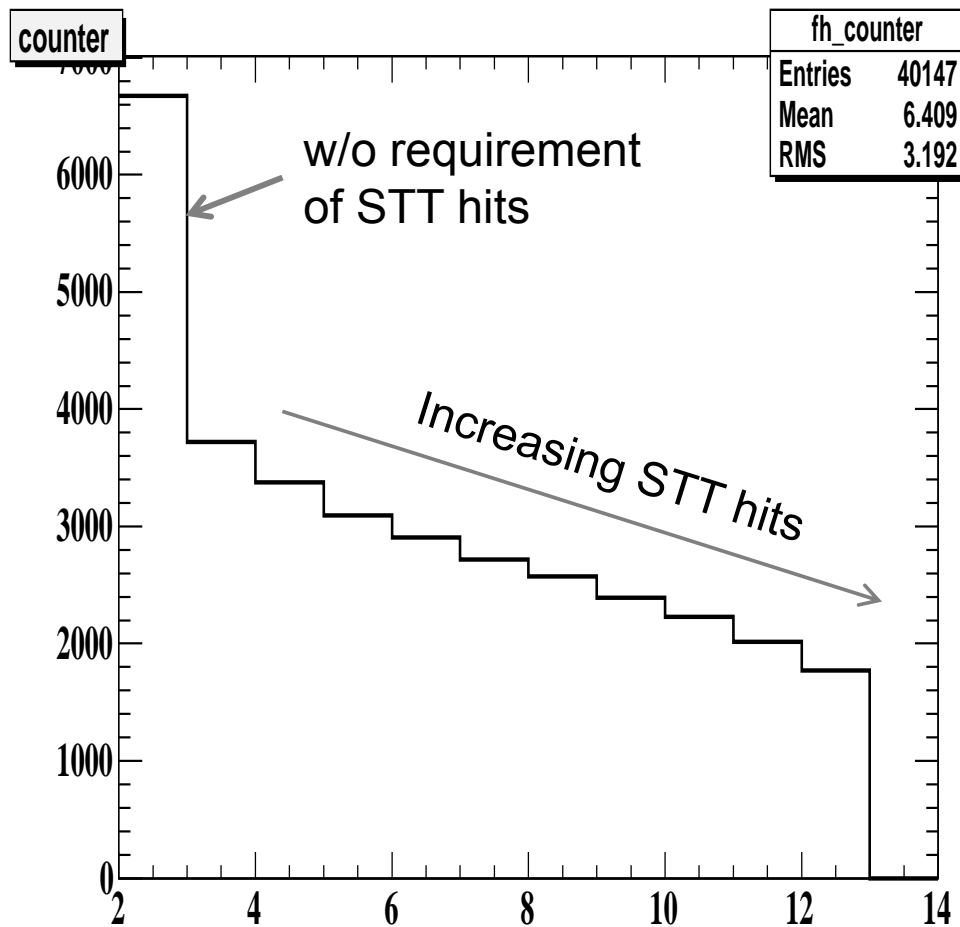
50% events have no STT hits (pure GEM, MVD)





## Dependence of rec. efficiency on the STT hits

- apply the cut (STT hits  $\geq$  #) on each individual track i.e., for all 6 track candidates



Cut	Evt. (98000)	Glo. eff.
stt hits $\geq$ 0	6676	6.8 %
stt hits $\geq$ 1	3720	3.8 %
stt hits $\geq$ 2	3373	3.4 %
stt hits $\geq$ 3	3091	3.2 %
stt hits $\geq$ 4	2904	3.0 %
stt hits $\geq$ 5	2717	2.8 %
stt hits $\geq$ 6	2573	2.6 %
stt hits $\geq$ 7	2391	2.4 %
stt hits $\geq$ 8	2226	2.3 %
stt hits $\geq$ 9	2014	2.1 %
stt hits $\geq$ 10	1774	1.8 %

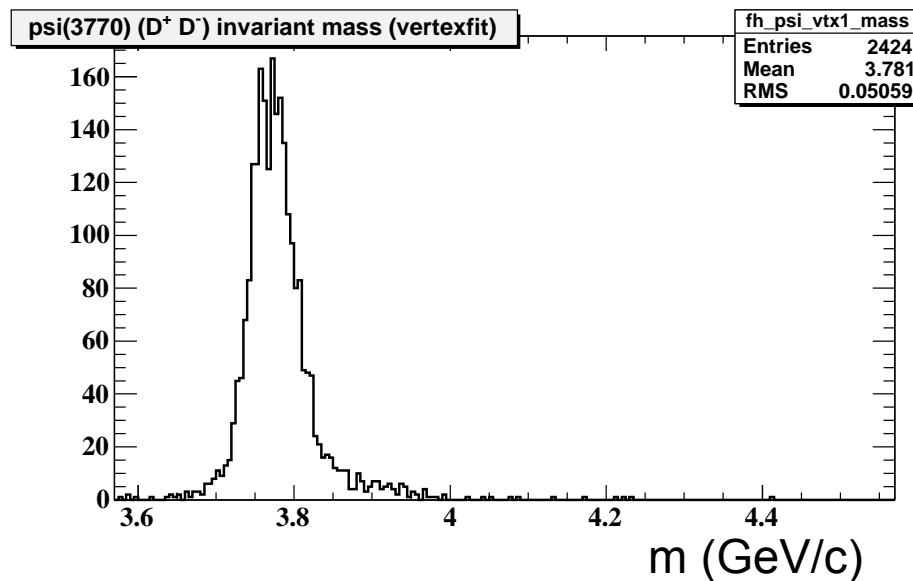




## Event selection for Psi(3770)

- combined D+ and D- to psi(3770)
- only one best candidate of psi(3770) in one event, identified by highest probability(chi2) from vertex fit
- hit in fiducial volume required to compare both detectors in same level

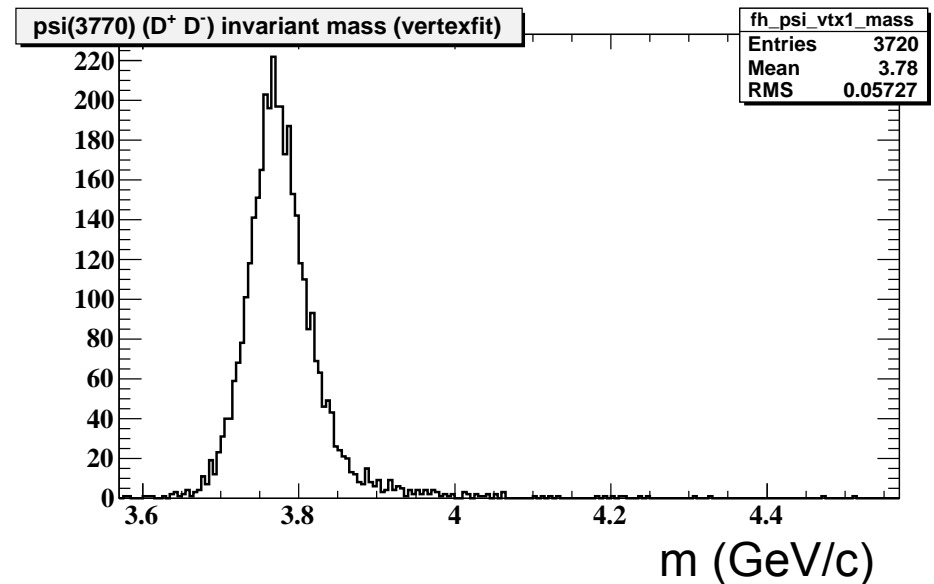
### TPC $\Psi$ mass distribution



Global efficiency

$$\varepsilon = \text{rec.} / \text{gen.} = 2424 / 99\text{K} \\ = 2.5 \%$$

### STT $\Psi$ mass distribution



Global efficiency

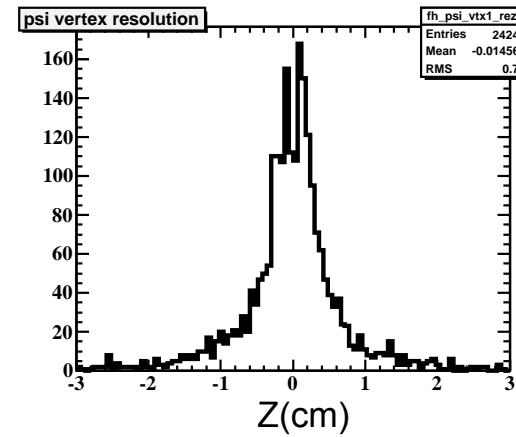
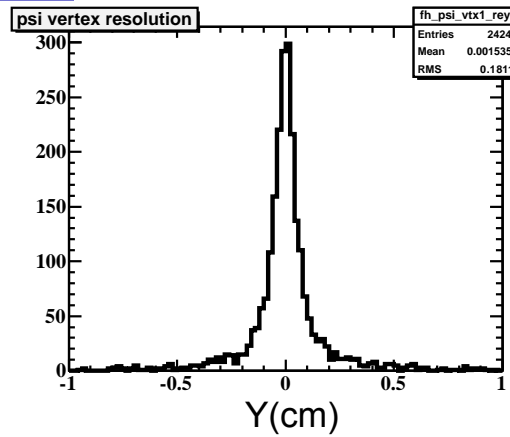
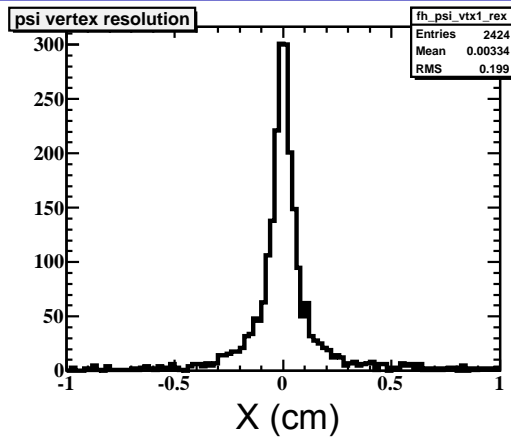
$$\varepsilon = \text{rec.} / \text{gen.} = 3720 / 98\text{K} \\ = 3.8 \%$$



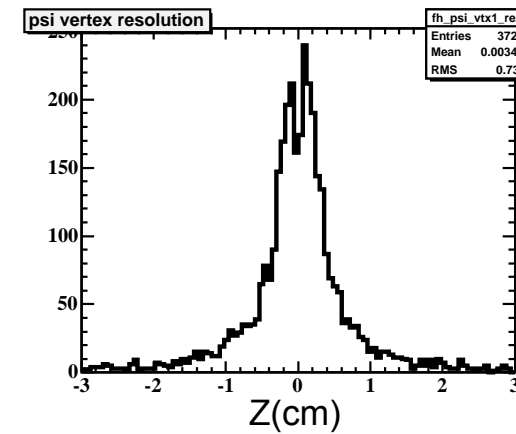
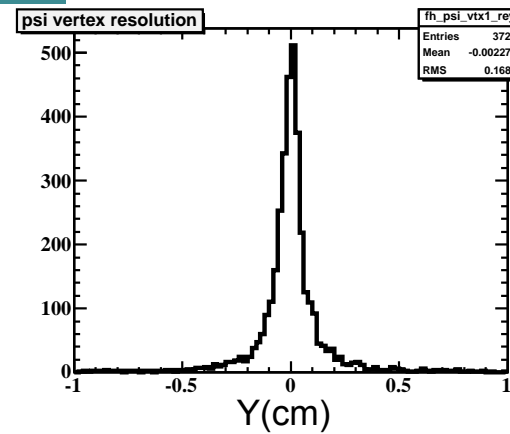
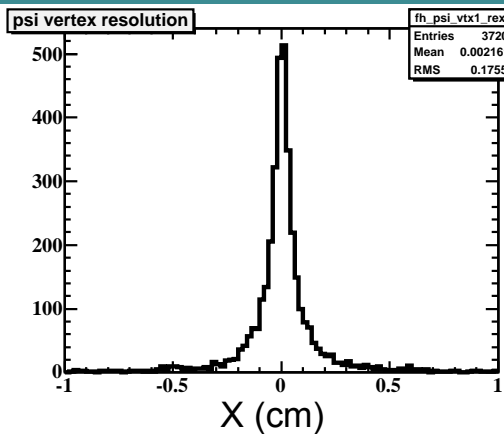
# Event selection for Psi(3770)

- combined D+ and D- to psi(3770)
- only one best candidate of psi(3770) in one event, identified by highest probability(chi2) from vertex fit
- hit in fiducial volume required to compare both detectors in same level

## TPC : $\Psi$ vertex resolution

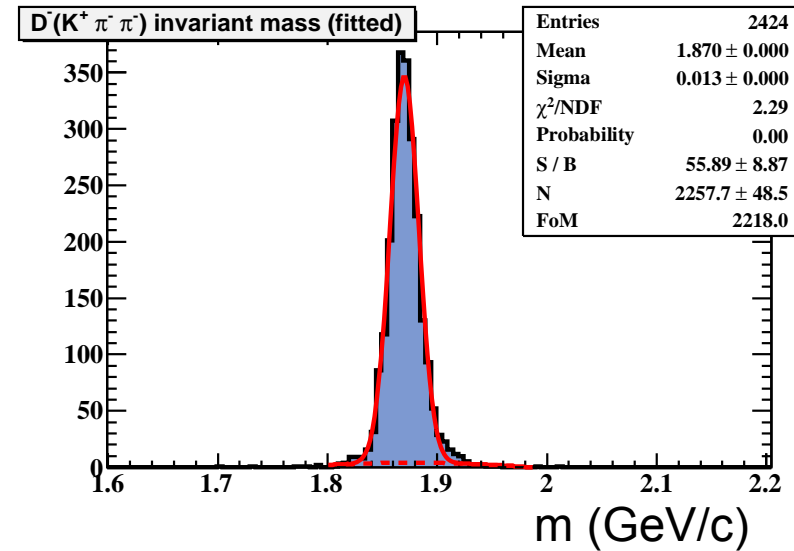
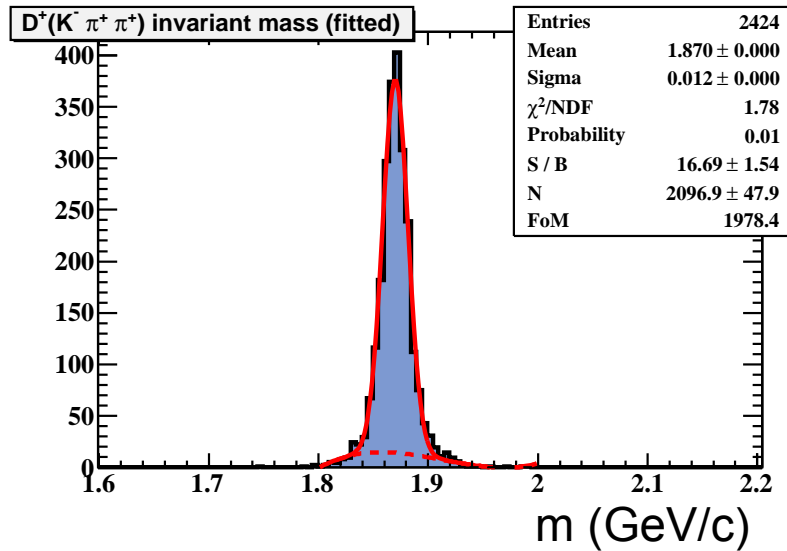


## STT : $\Psi$ vertex resolution

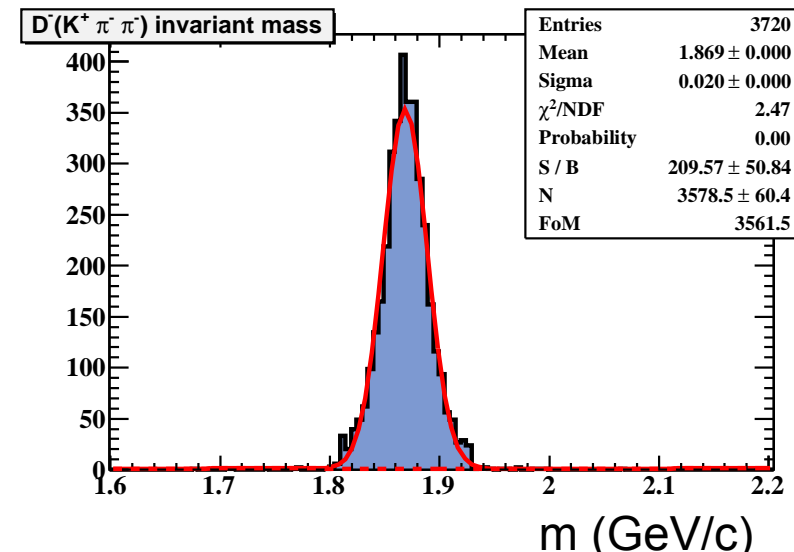
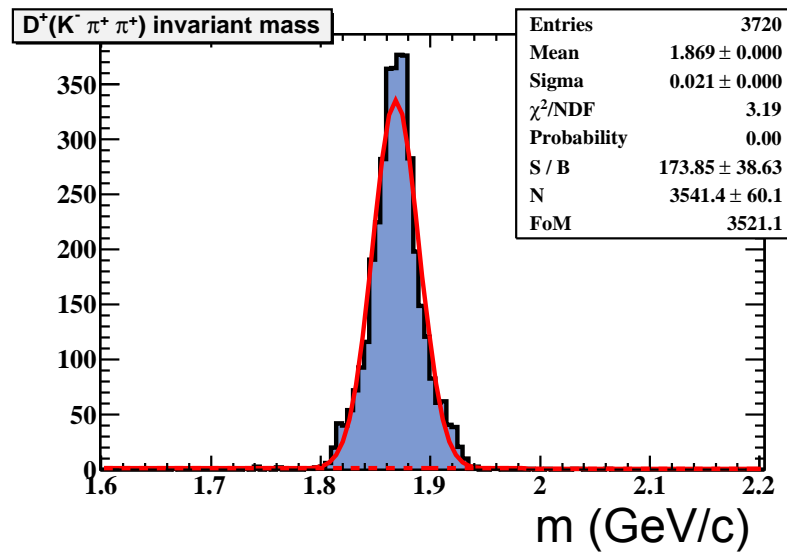


# Event selection for Psi(3770)

## TPC : D+ and D- after psi selection and psi vertex fit



## STT : D+ and D- after psi selection and psi vertex fit



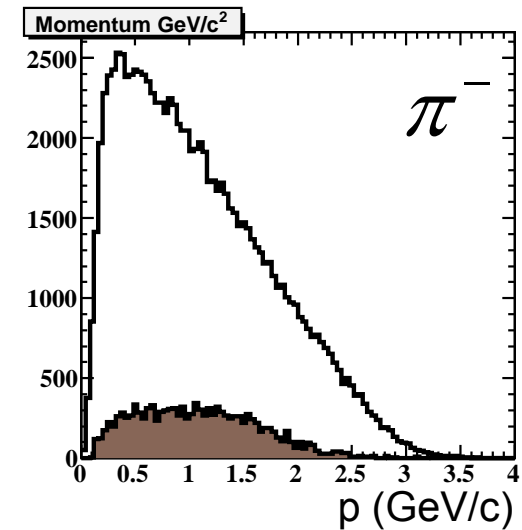
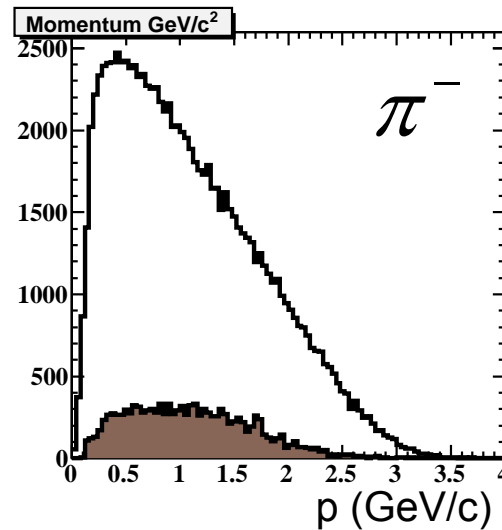
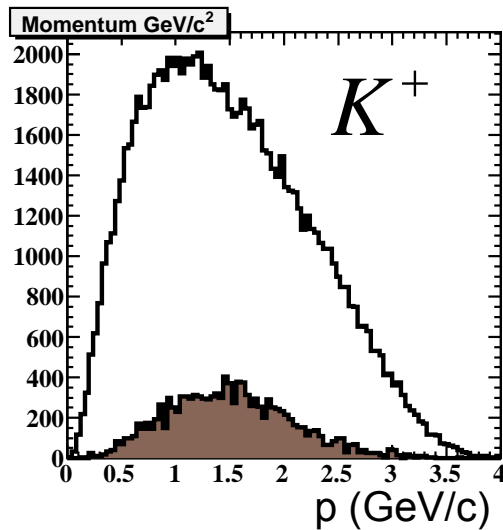
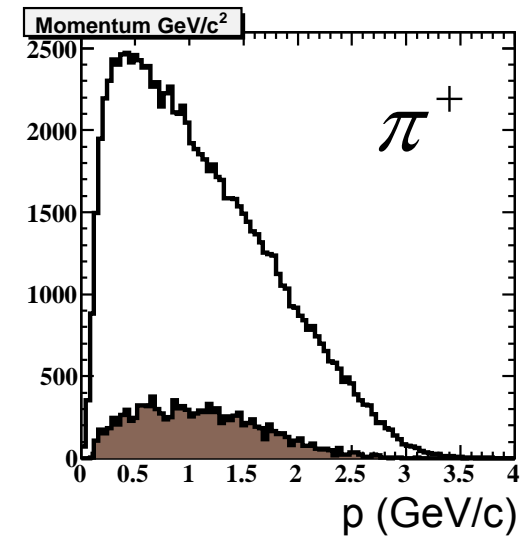
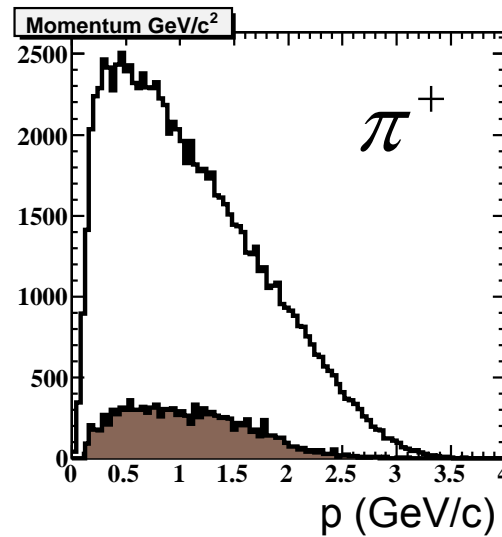
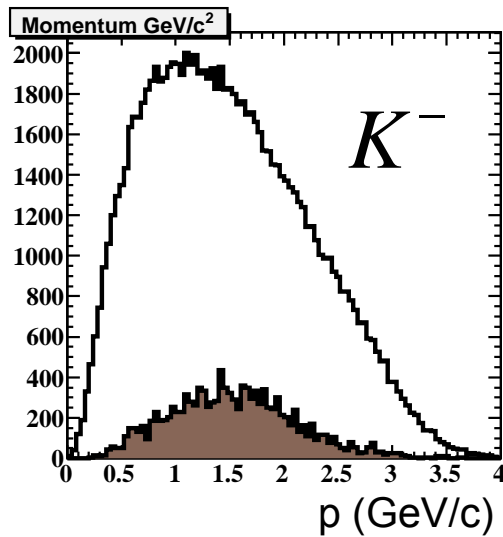




# Event selection for Psi(3770)

- psi(3770) momentum : generated vs reconstructed (rec. scaled by factor 5)

TPC mode : momentum p

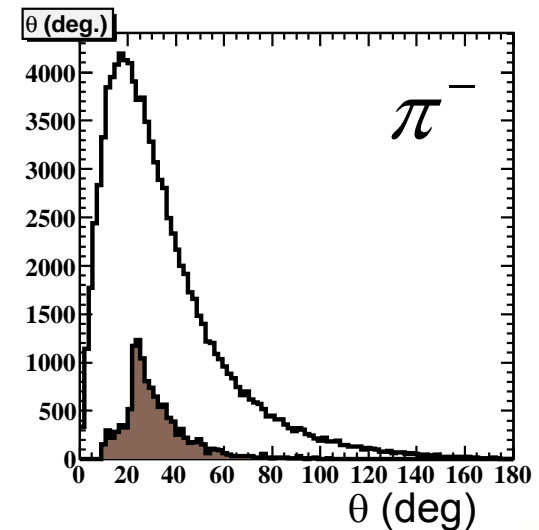
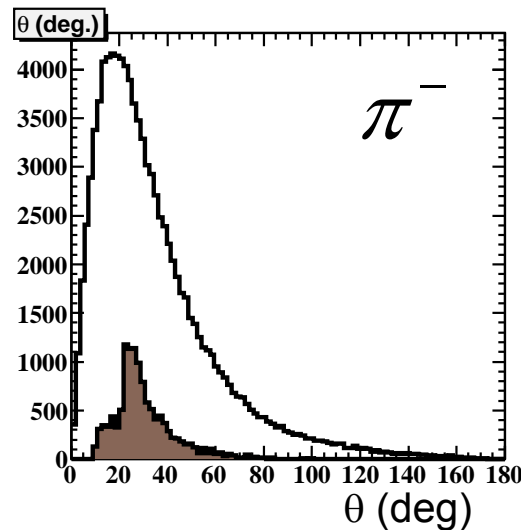
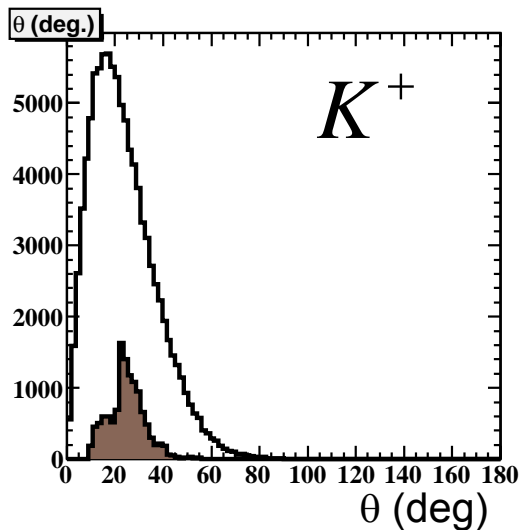
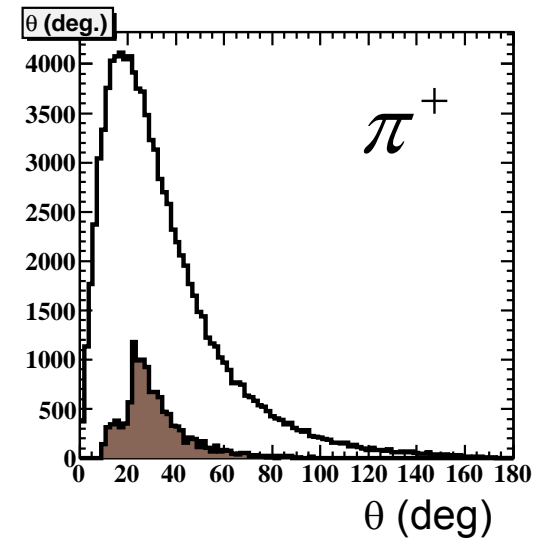
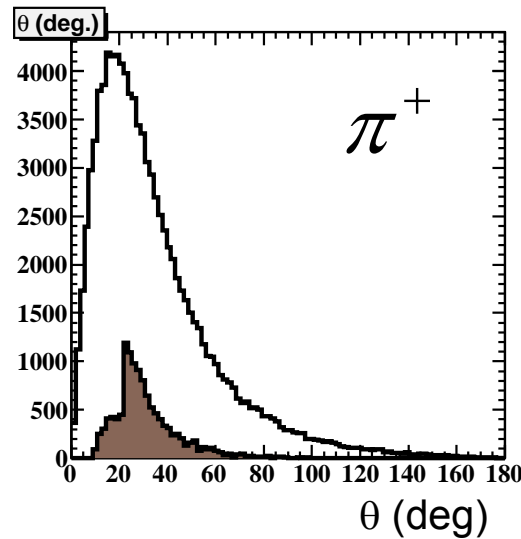
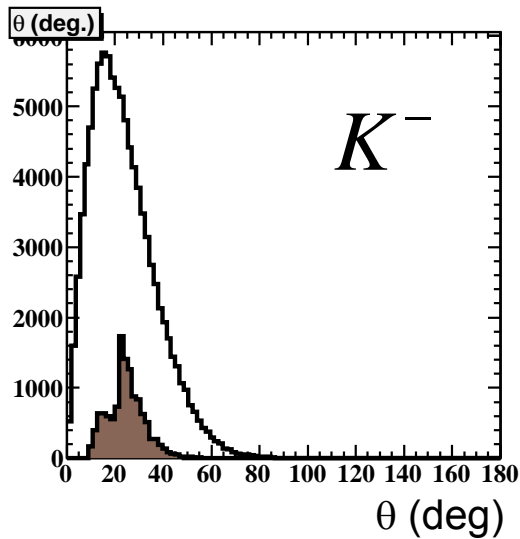




# Event selection for Psi(3770)

- psi(3770) momentum : generated vs reconstructed (rec. scaled by factor 5)

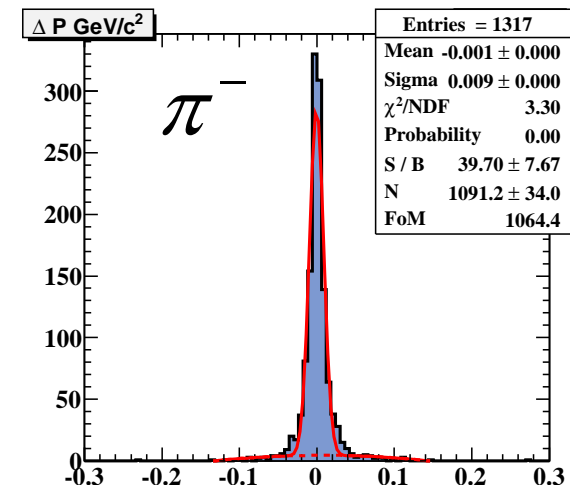
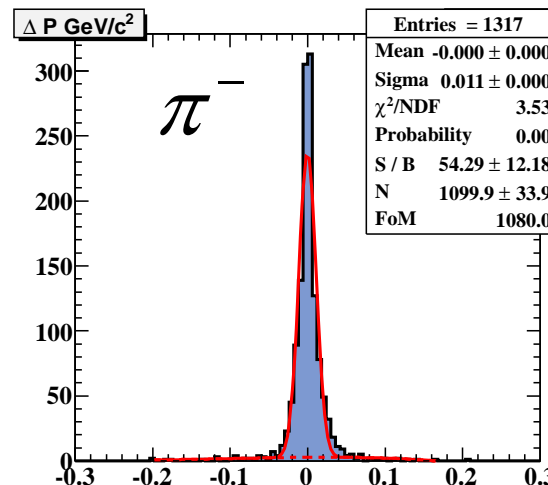
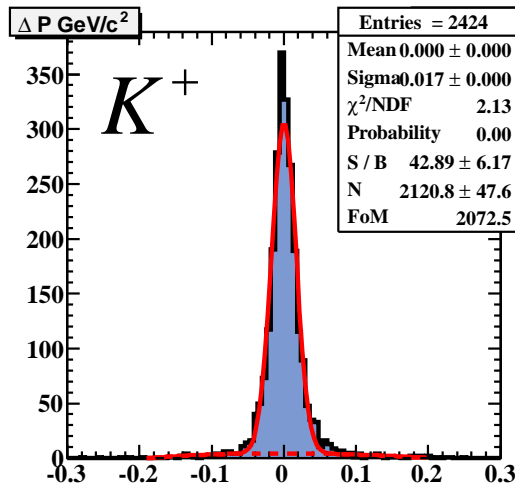
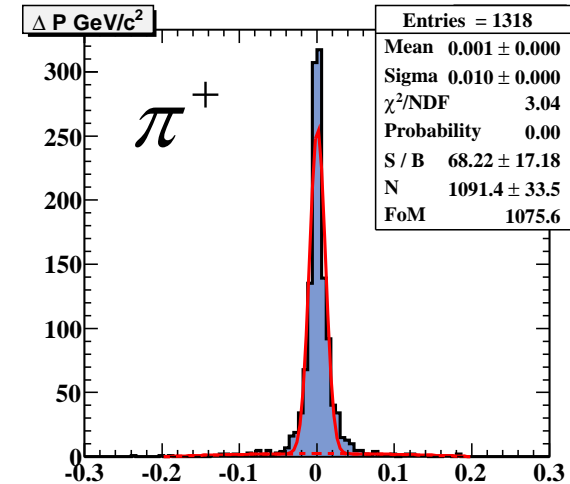
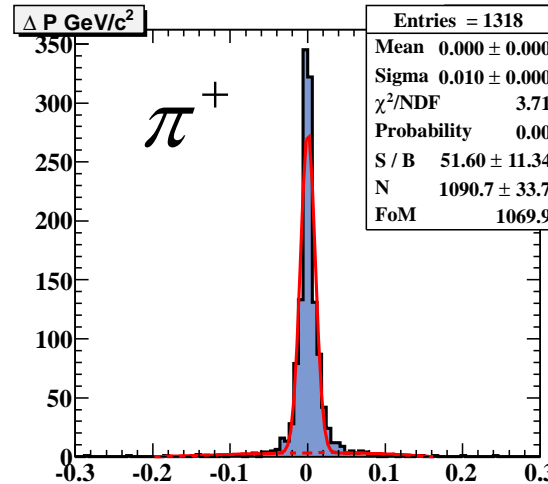
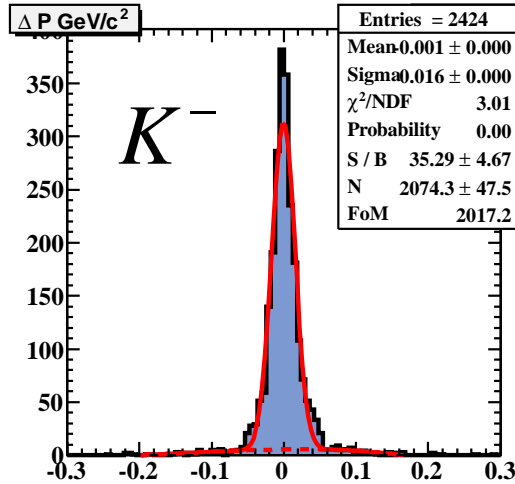
TPC mode : theta  $\theta$





# Event selection for Psi(3770)

TPC mode : momentum resolution

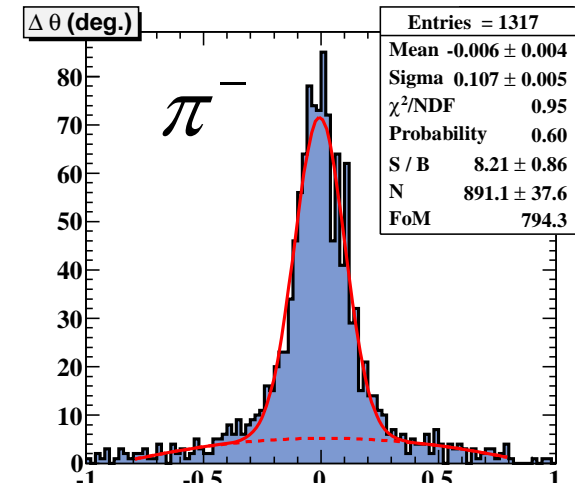
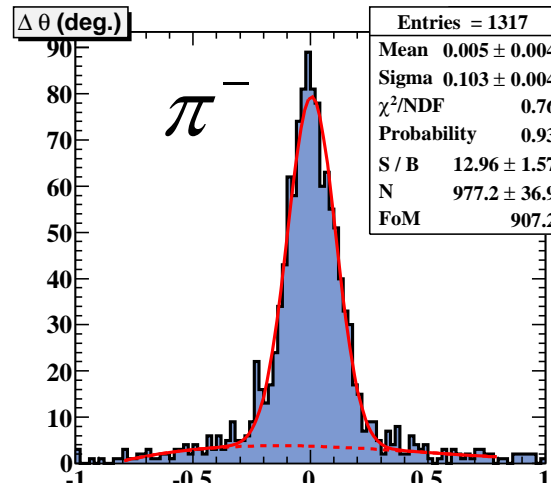
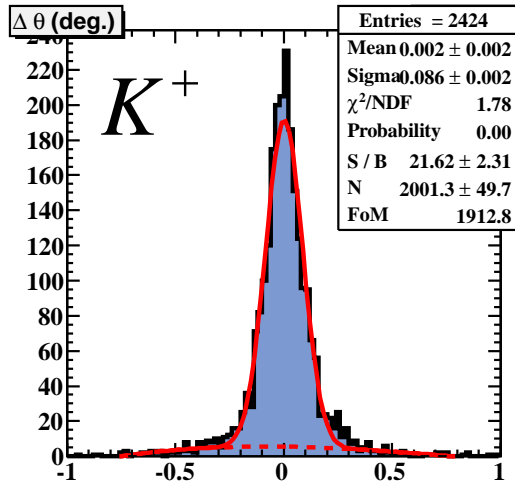
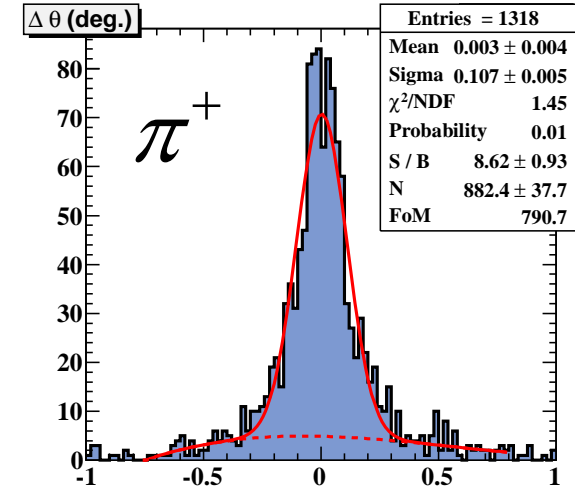
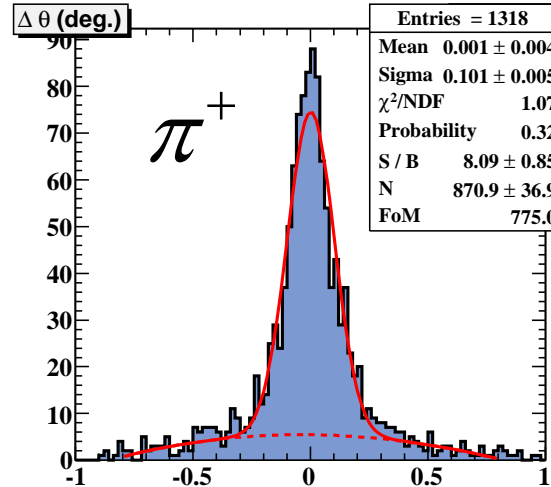
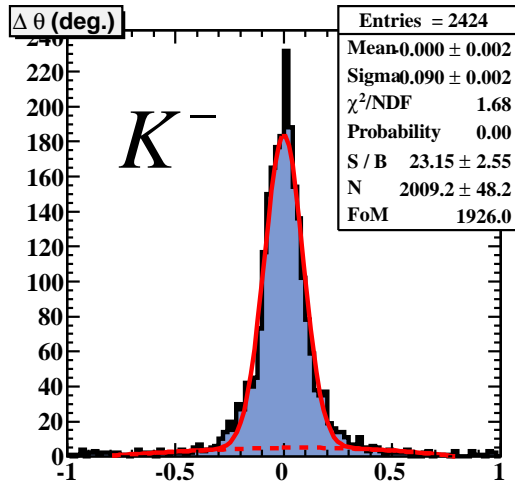


$\pi^\pm$  resolutions are showing here with 50% of data sample



# Event selection for Psi(3770)

TPC mode : theta resolution



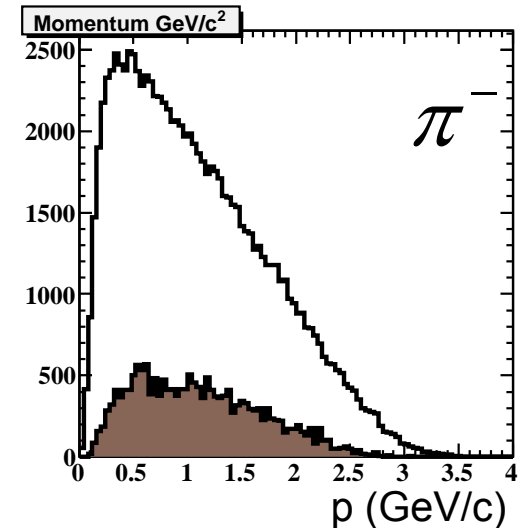
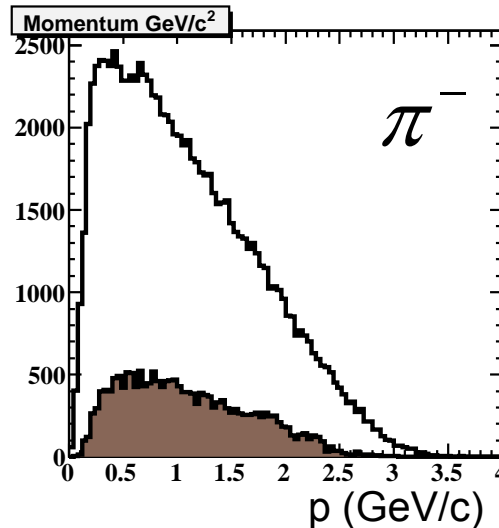
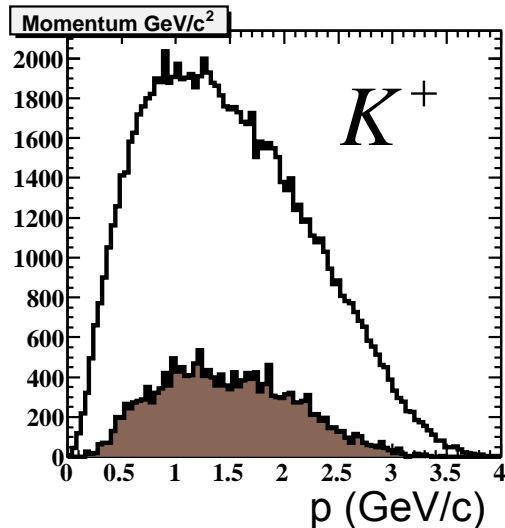
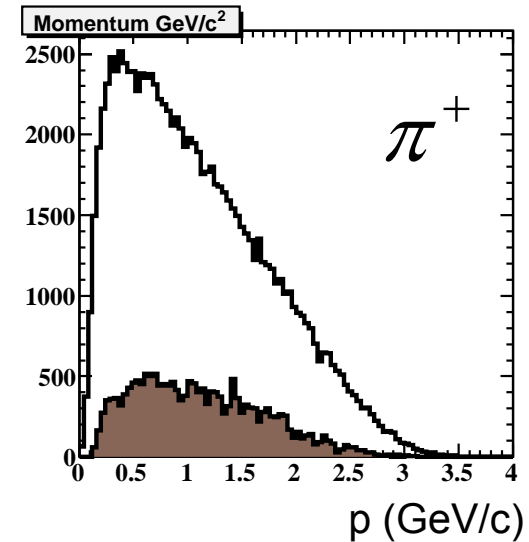
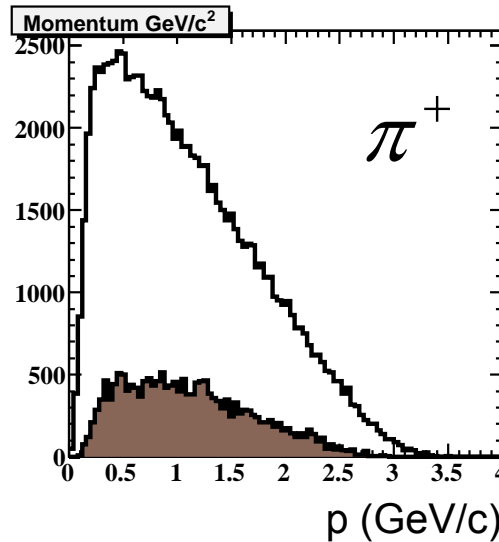
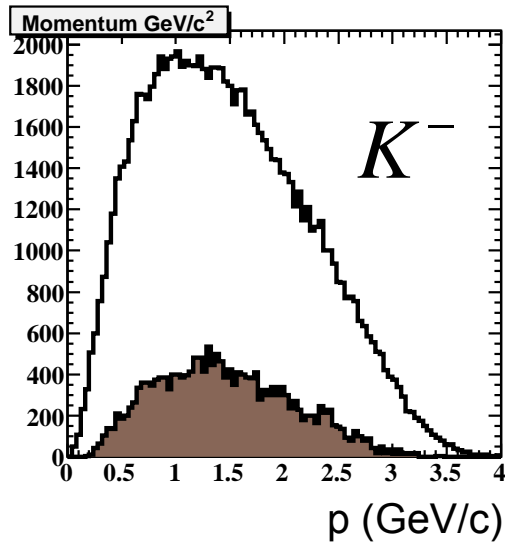
$\pi^{\pm}$  resolutions are showing here with 50% of data sample



# Event selection for Psi(3770)

- psi(3770) momentum : generated vs reconstructed (rec. scaled by factor 5)

STT mode : momentum p

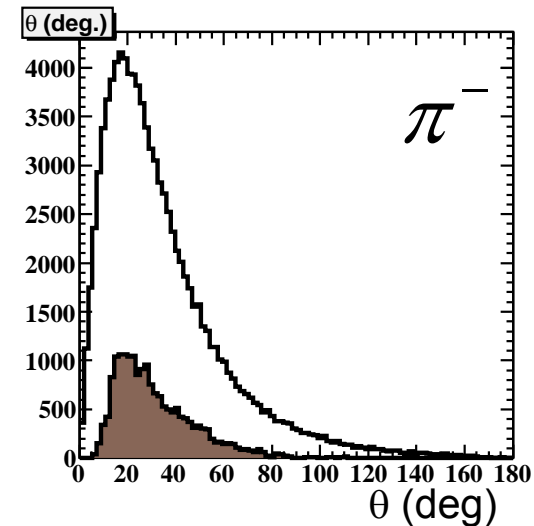
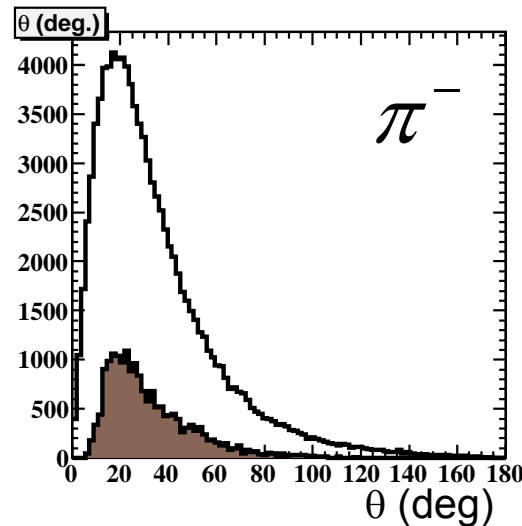
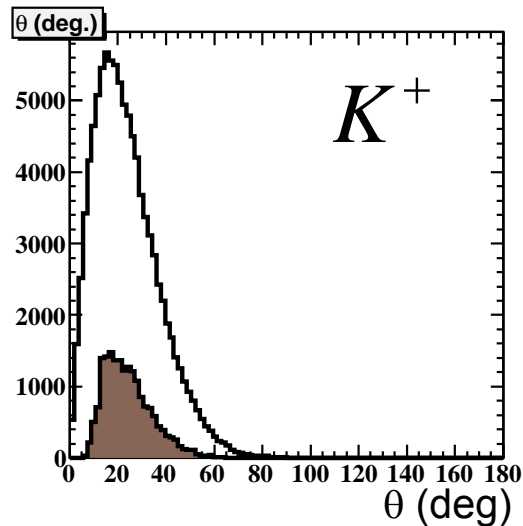
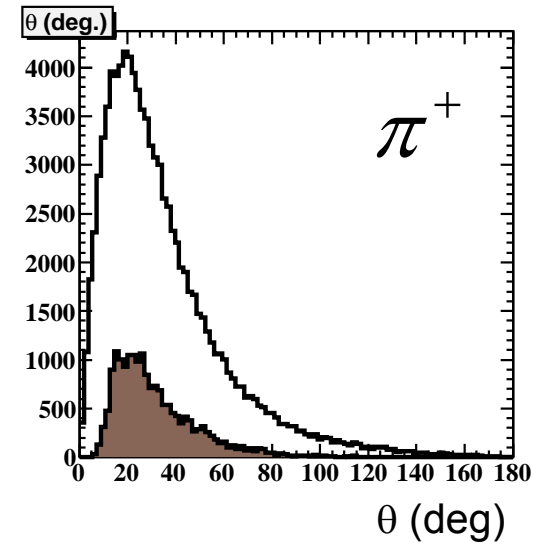
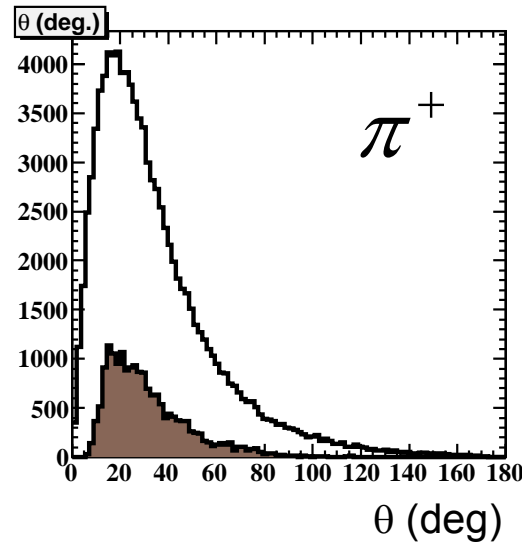
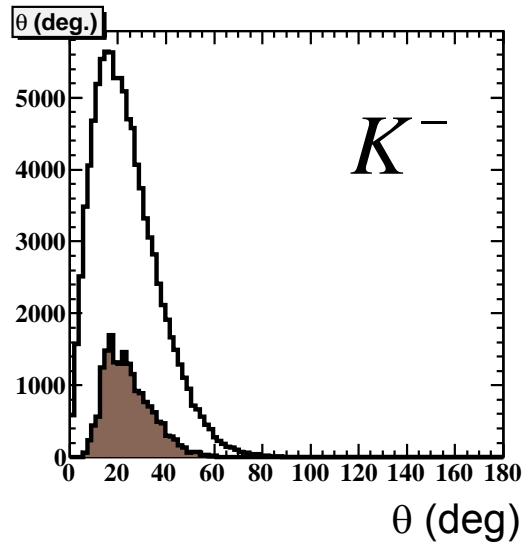




# Event selection for Psi(3770)

- psi(3770) momentum : generated vs reconstructed (rec. scaled by factor 5)

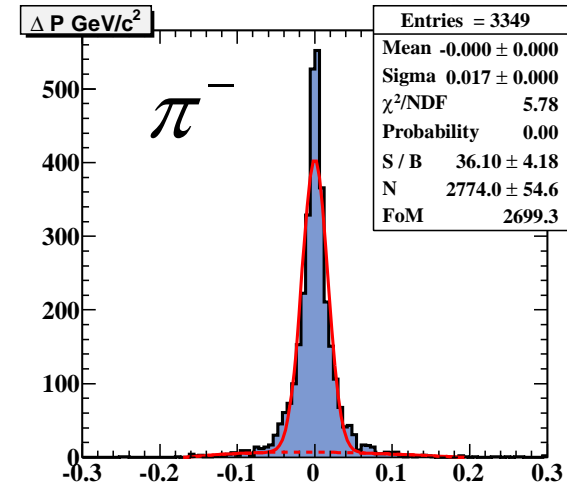
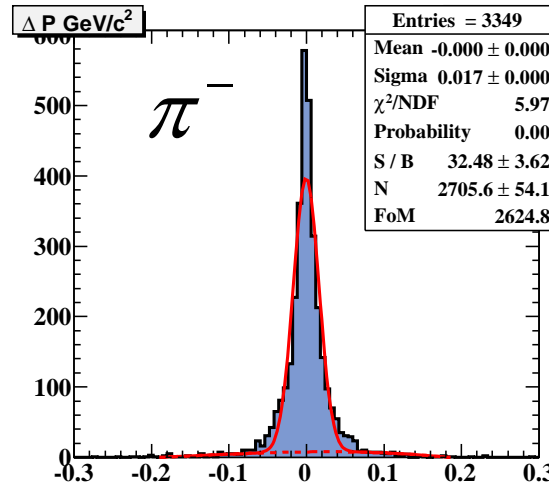
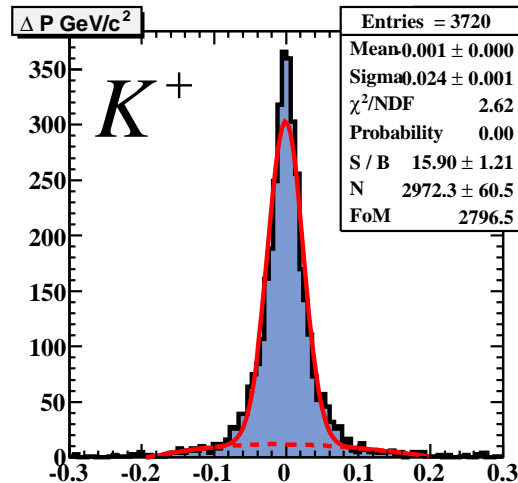
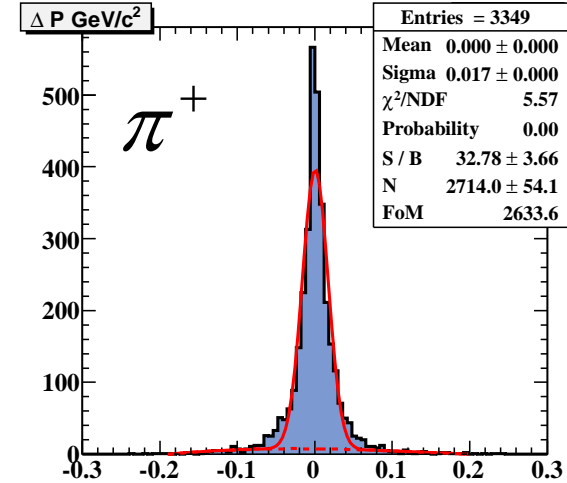
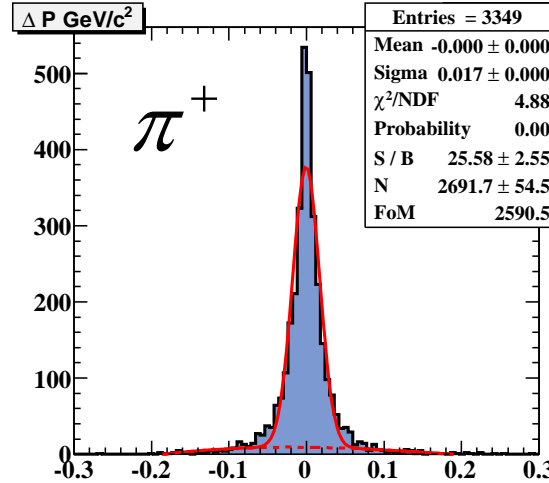
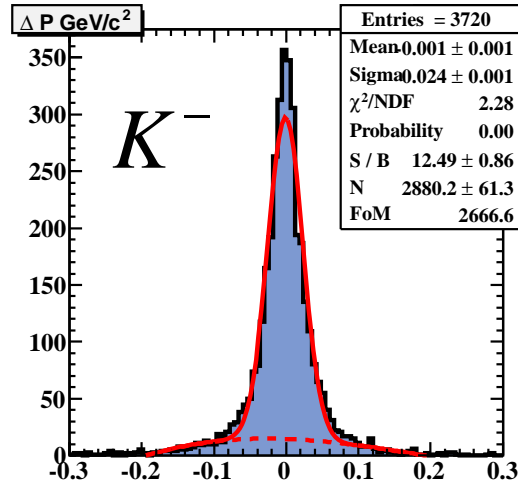
STT mode : theta  $\theta$





# Event selection for Psi(3770)

STT mode : momentum resolution

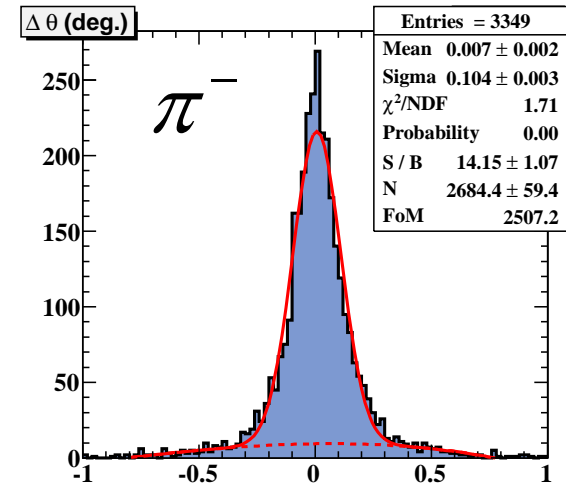
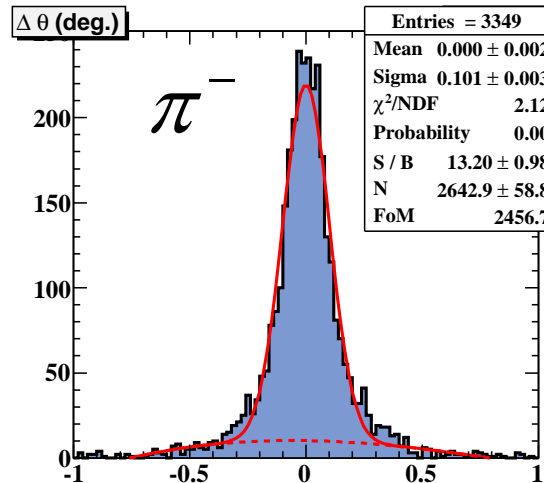
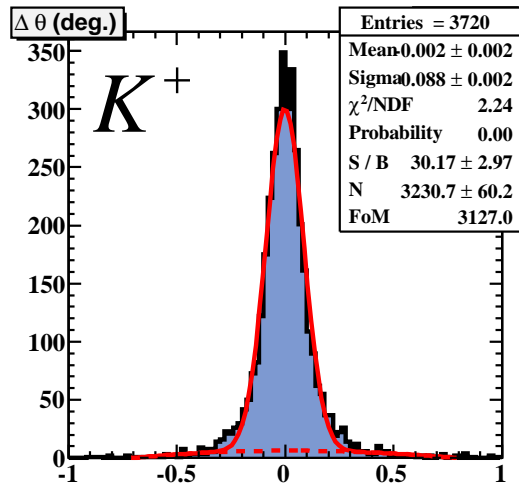
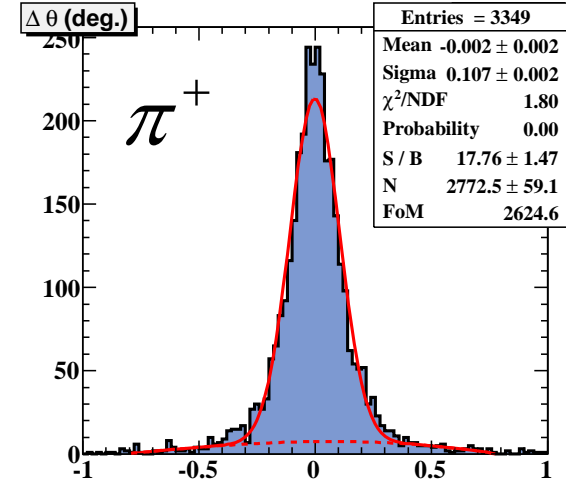
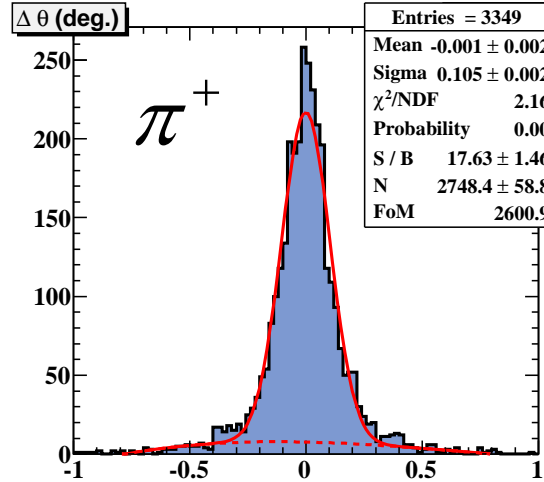
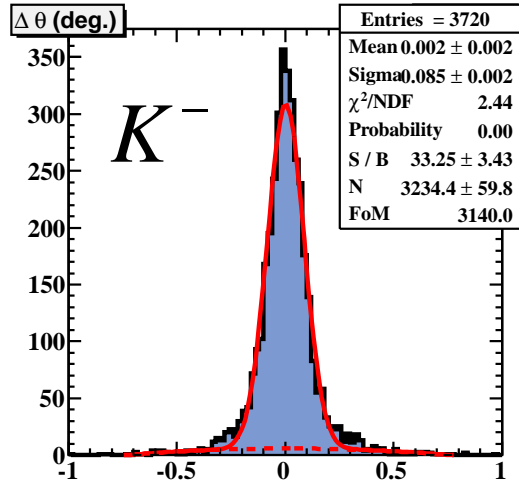


$\pi^\pm$  resolutions are showing here with 90% of data sample



# Event selection for Psi(3770)

STT mode : theta resolution



$\pi^{\pm}$  resolutions are showing here with 90% of data sample





## Comparison of $\psi$ (3770) benchmark channel with TPC and STT

	TPC	STT
global efficiency. $\epsilon$	2.5 %	3.8 %
$D^\pm$ vertex resolution X,Y( $\mu\text{m}$ )	60 ( $\mu\text{m}$ )	60 ( $\mu\text{m}$ )
$D^\pm$ vertex resolution Z ( $\mu\text{m}$ )	120 ( $\mu\text{m}$ )	110 ( $\mu\text{m}$ )
$D^\pm$ mass resolution	12 (MeV/c)	20 (MeV/c)
$\psi(3770)$ vertex resolution X,Y (mm)	$\sim 0.6$ (mm)	$\sim 0.6$ (mm)
$\psi(3770)$ vertex resolution Z (mm)	$\sim 2.2$ (mm)	$\sim 2.2$ (mm)
$\psi(3770)$ mass resolution	$\sim 80$ (MeV/c)	$\sim 100$ (MeV/c)
$K^\pm$ p momentum resolution	17 (MeV/c)	24 (MeV/c)
$K^\pm$ $\theta$ theta resolution	0.090 (deg)	0.088 (deg)
$\pi^\pm$ p momentum resolution	11 (MeV/c)	17 (MeV/c)
$\pi^\pm$ $\theta$ theta resolution	0.107 (deg)	0.107 (deg)

0.1 deg = 1.75 (mrad)

