

# Current Status

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# Items

- Scaling factors
  - Trigger and DAQ page.4
  - Beam Line Analysis (Number of kaon) page.7
- Detector performance
  - CDS page.14
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# Scaling Factor

- Luminosity

$$L = N_{beam} N_{target} Eff_{DAQ} Eff_{Trigger} = 5870 \pm 150$$

$$N_{target} = I(10\text{cm}) \times \rho(0.169\text{g/cm}^3) \times N_A/N_d$$

$N_{beam}$ ,  $N_{DAQ}$ ,  $N_{trigger}$  were estimated run-by-run.

- Neutron Efficiency

$Eff_{NC} = 0.317 \pm 0.016$  by  $K^- d \rightarrow K^0 n$  reaction (RUN62)

$Overkill_{CVC \cup PC} = 0.081 \pm 0.007$  (RUN78)

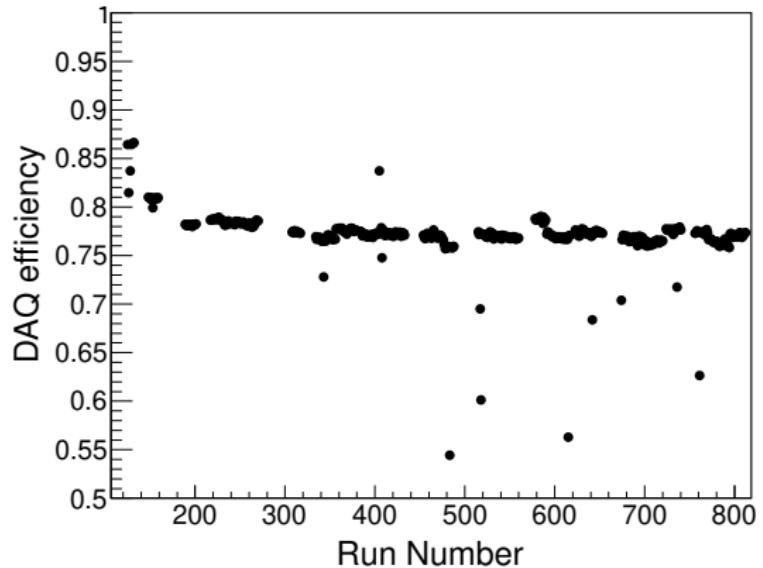
- CDC efficiency

RUN68 IH and CDH was used as trigger counters  $\sim 0.977 \pm 0.004$

RUN78 was estimated from the value that CDC layer1 was used instead of IH.

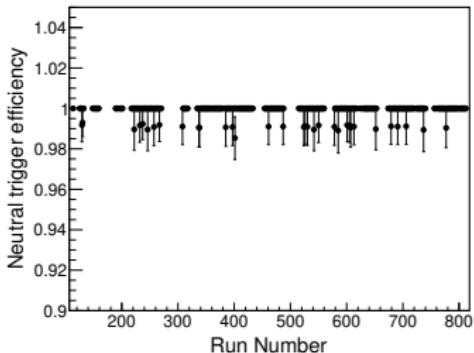
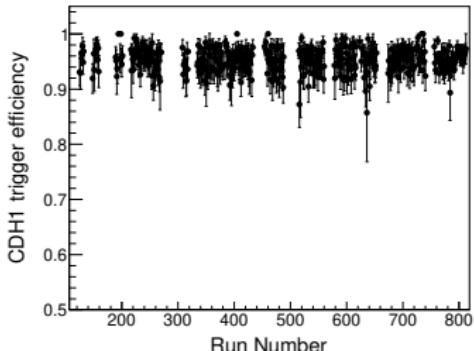
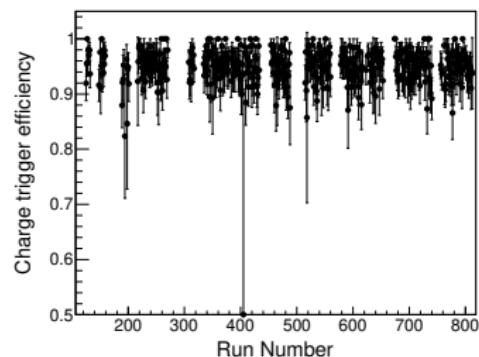
# Trigger and DAQ eff.

# DAQ efficeincy



# Trigger efficiency

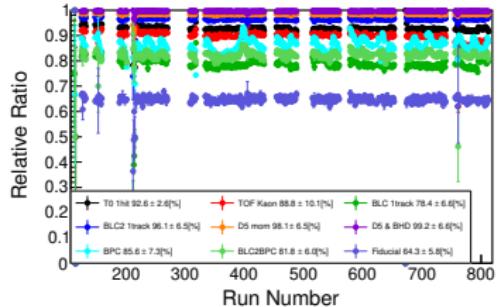
$$d(K^-, n) = \text{Neutral} \otimes \text{CDH1}$$
$$d(K^-, p) = \text{Charge} \otimes \text{CDH1}$$



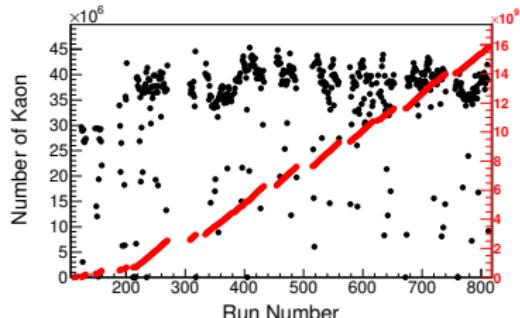
# Beam Line Analysis (Number of Kaon)

# Kaon Number

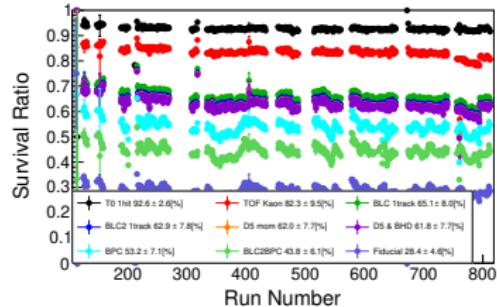
## Relative Ratio



## Irradiated Kaon Number

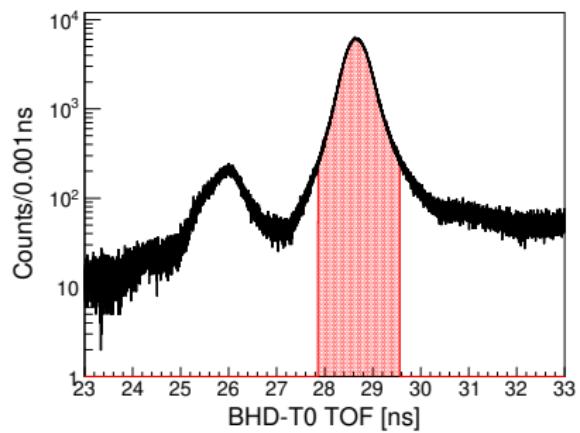
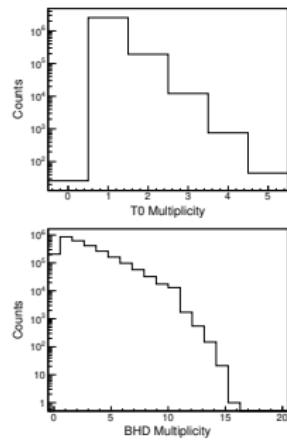


## Survival Ratio

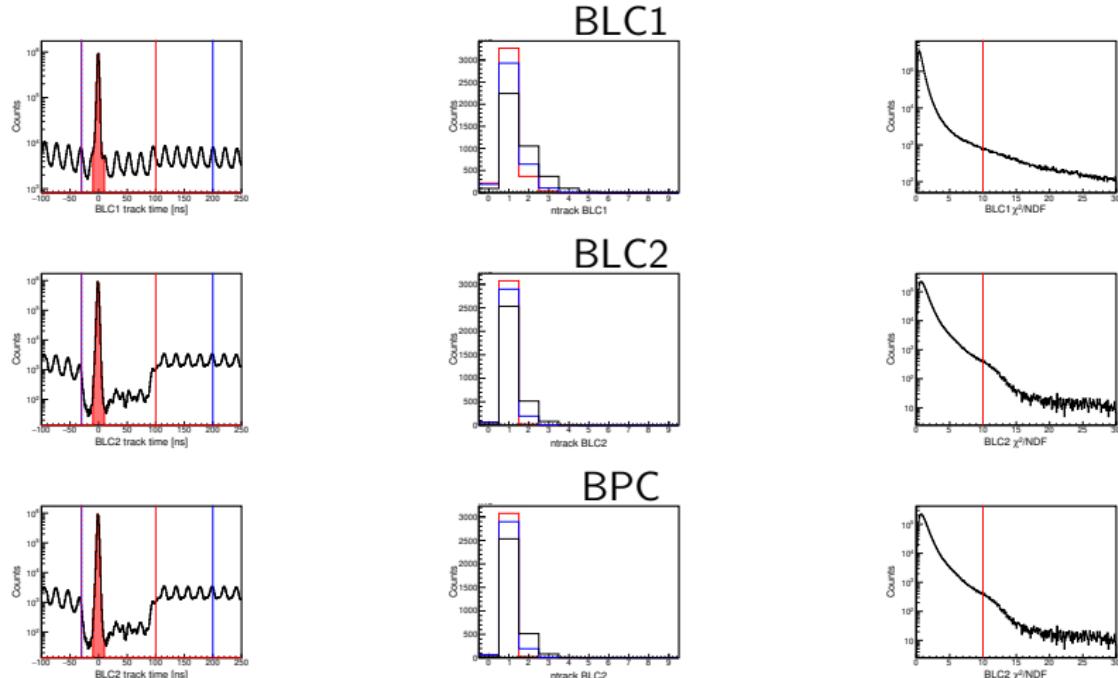


$15.8 \pm 0.3$  G kaon were irradiated on liquid-deuterium target.

# BHD-T0 analysis

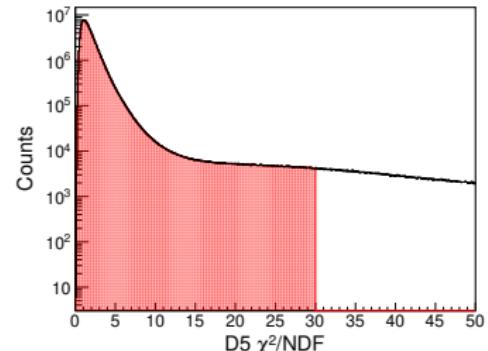
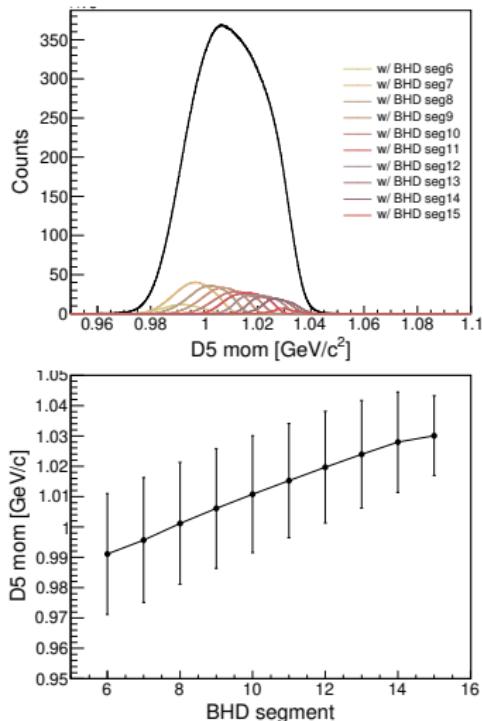


# Beam Line Chamber Condition



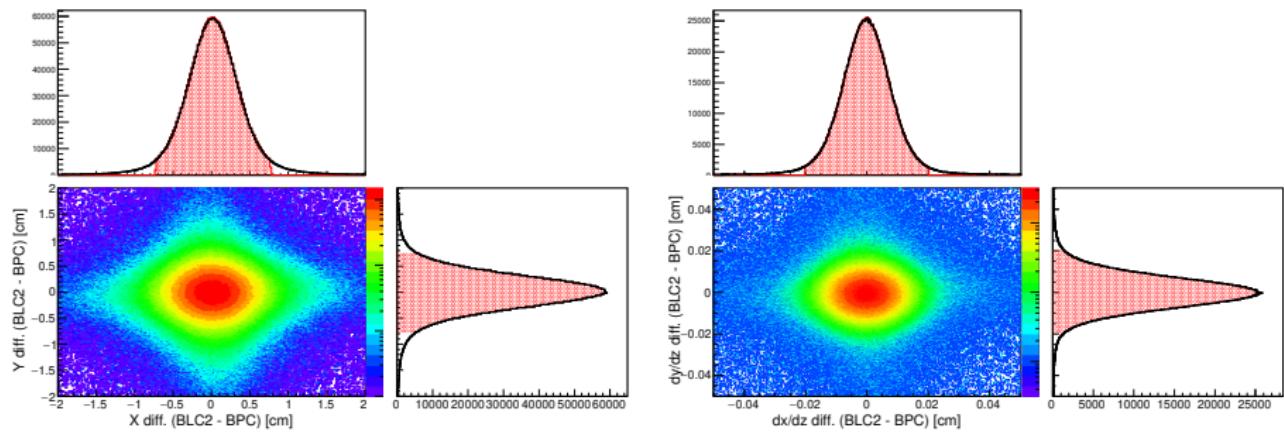
BLC was selected  $-30 \sim 100$  time window.  
BLC  $\chi^2/NDF < 10$  was selected.

# Beam momentum analysis by D5



D5 momentum has a correlation about BHD segment.

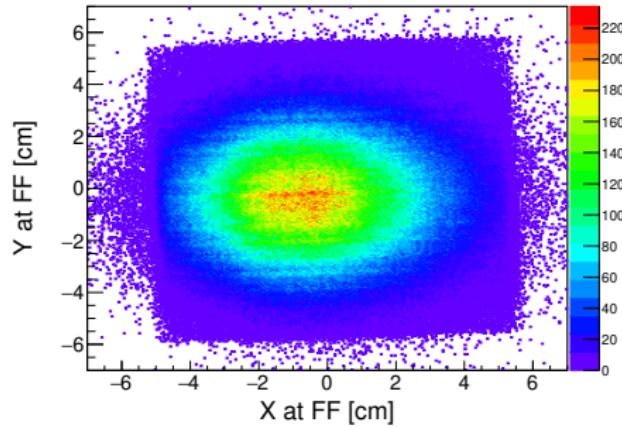
# BLC2 and BPC connection



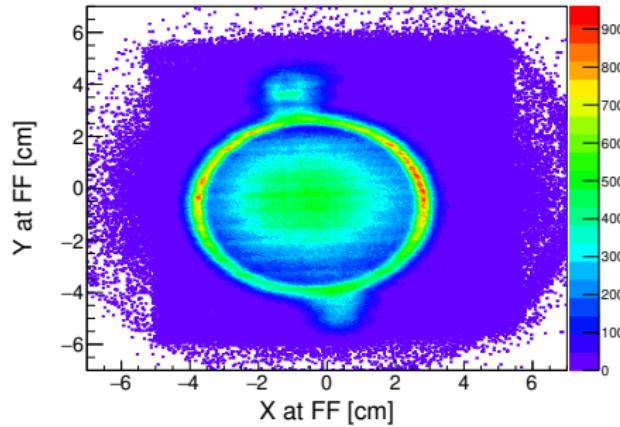
BLC2 and BPC position was connected at center of both.

# Profile at Final Focus

Unbiased Kaon Trig.

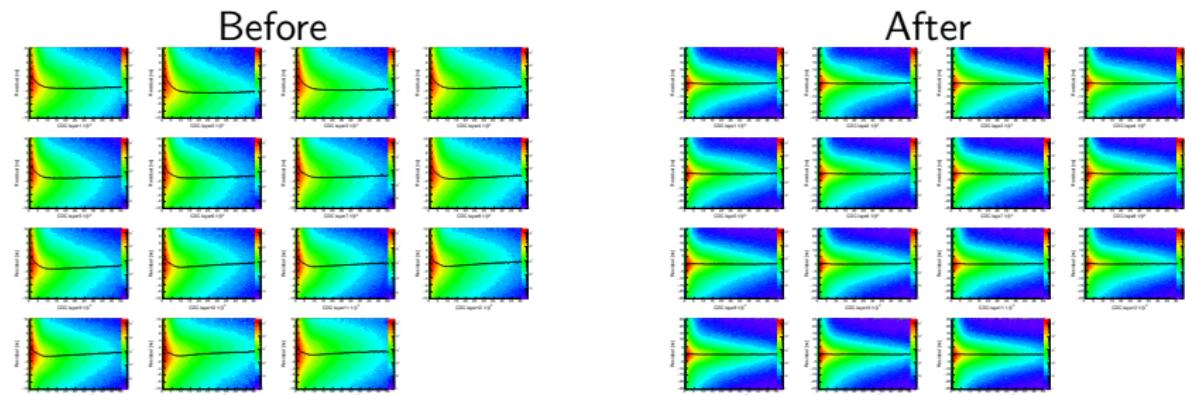


CDH2 Trig.



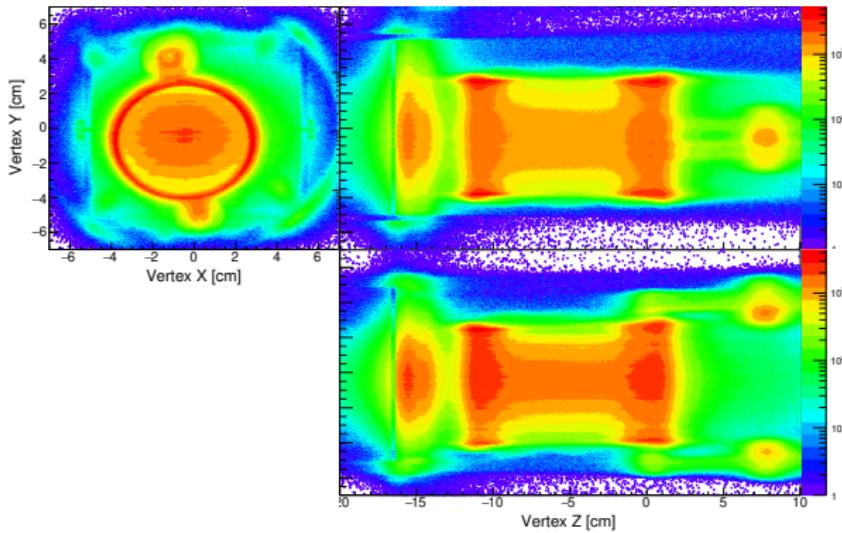
# CDS Analysis

# CDC fine turning

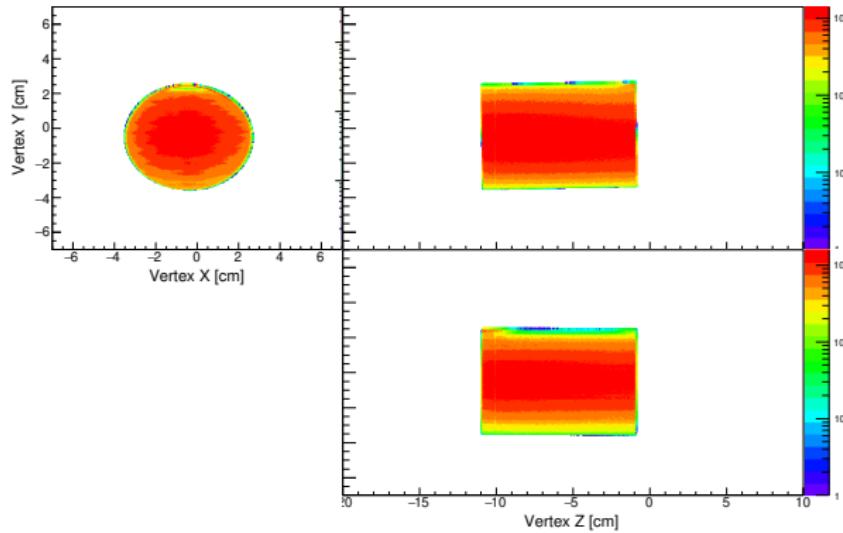


$\beta$  and residual has correlation, which was calibrated wire-by-wire.

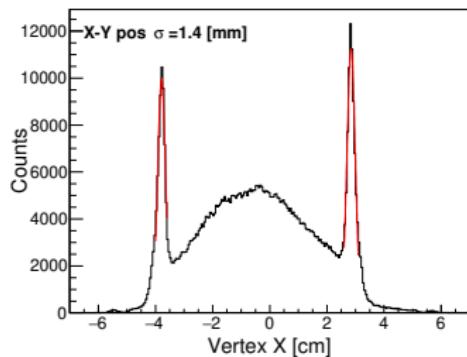
# Vertex image by CDS and BPC



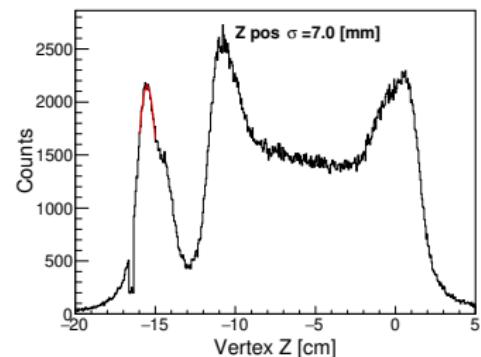
# Vertex image by CDS and BPC (Vertex cut)



# Vertex resolution

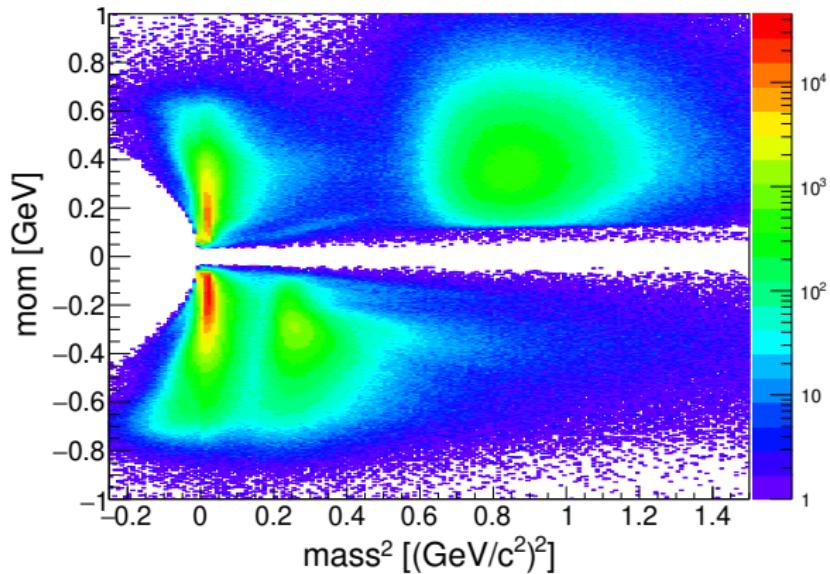


Y range was selected  
 $-5.5 \sim -5$  [mm]

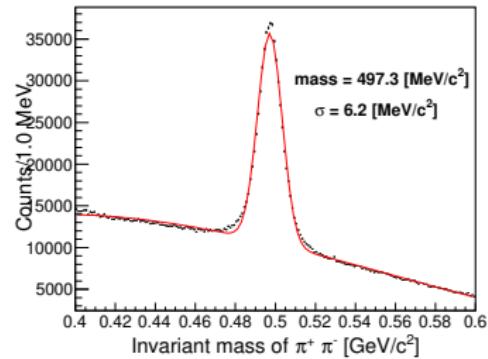
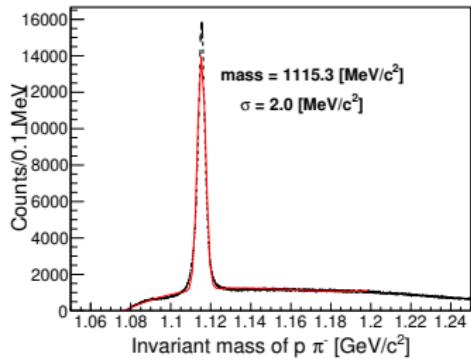


$Z = 0$  was selected [mm]  
resolution was evaluated by DEF.

# CDS mass<sup>2</sup> vs momentum

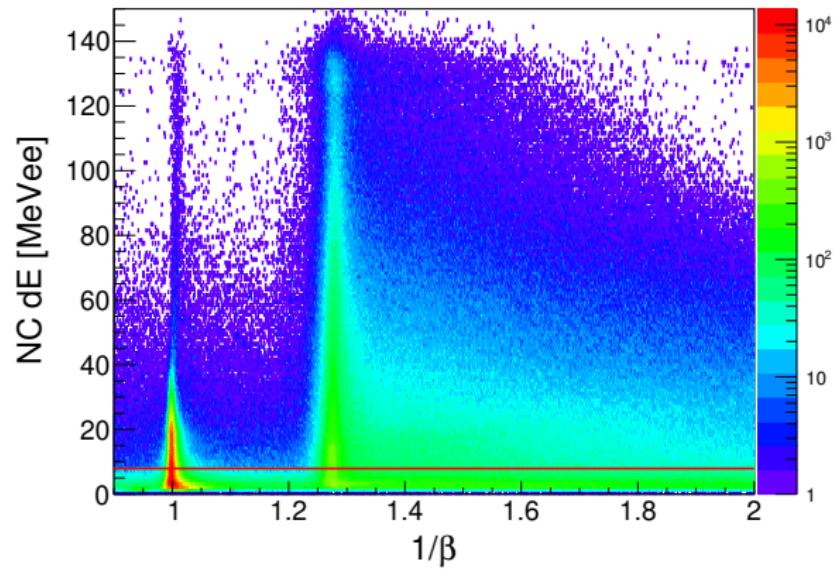


# Invaraint mass by CDS

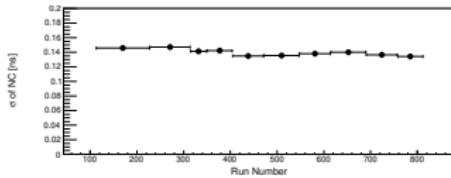
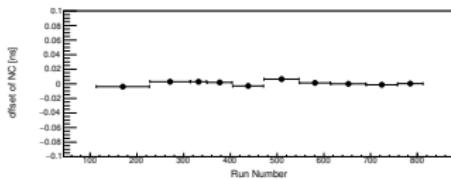
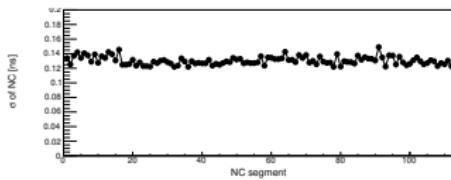
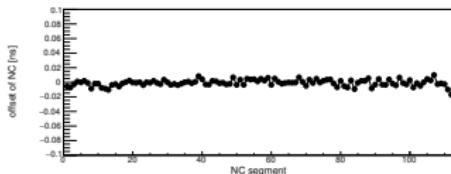
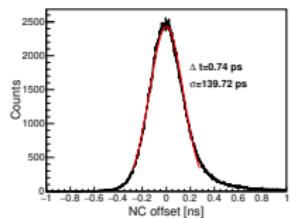


# NC Analysis

# $1/\beta$ vs dE



# NC offset

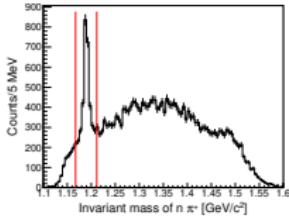
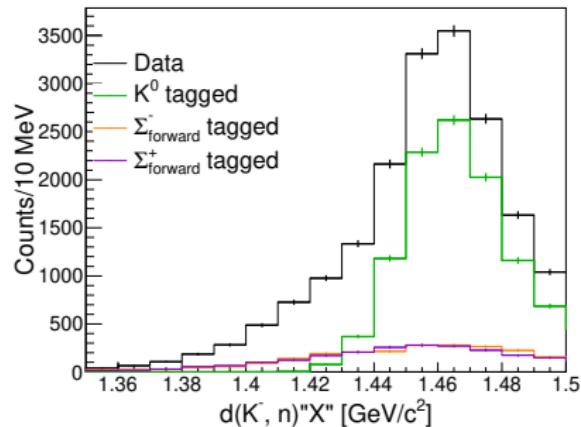
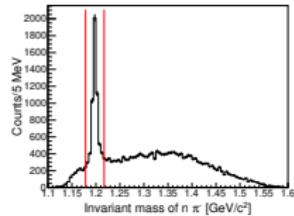
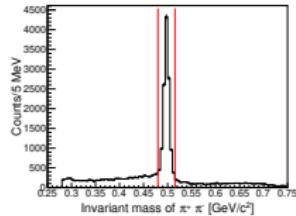
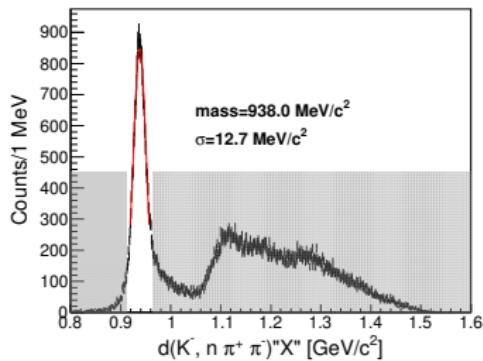


# $d(K^-, n)'' \pi^\pm \Sigma^\mp$ event selection

$d(K^-, n\pi^+\pi^-)'' n''$  was selected by  $2\sigma$ .

$K^- d \rightarrow K^0 nn$  was selected by  $3\sigma$ .

$K^- d \rightarrow \Sigma^\pm \pi^\mp n_{miss}$  was rejected by  $3\sigma$ .



# Reaction Identification

We expect these three reactions.

- $K^- d \rightarrow \pi^\pm \Sigma^\mp n_{forward}$  (Signal)
- $K^- d \rightarrow K^0 nn$  (Quasi-elastic)
- $K^- d \rightarrow "n" \pi^\pm \Sigma^\mp_{forward} \Sigma^\mp_{forward} \rightarrow n_{forward} \pi^\mp$

Identification method procedure.

- Three invariant mass fitting of  $\pi^+ \pi^-$ ,  $n \pi^\pm$ .  
→ In this fitting,  $K^- d \rightarrow \pi^\pm \Sigma^\mp n_{forward}$  was fixed.
- Missing mass of  $d(K^-, n \pi^\pm) \Sigma^\mp$  fitting.  
→ In this fitting,  $K^- d \rightarrow K^0 nn$ ,  $K^- d \rightarrow "n" \pi^\pm \Sigma^\mp_{forward}$  were fixed.  
→ This fitting was performed bin-by-bin of  $d(K^-, n) X$ .
- These fitting was performed iterative.

Fitting method was adopted below method.

R. Barlow and C. Beeston, Comp. Phys. Comm. 77 (1993) 219-228

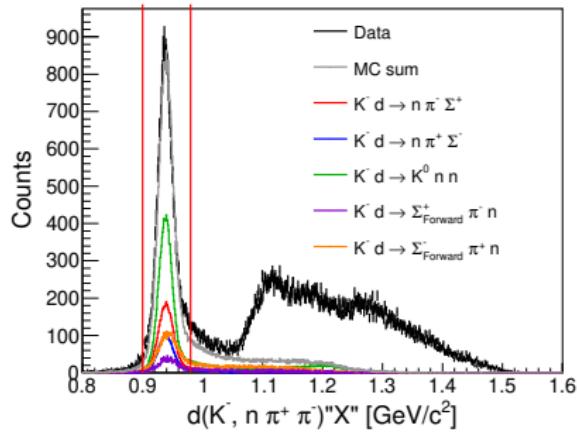
"Fitting using finite Monte Carlo samples"

A.Nappi, Comp Phys. Comm. 180 (2009) 269-275

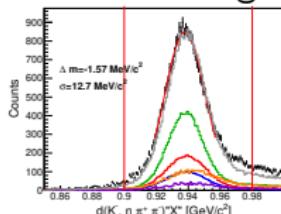
"A pitfall in the use of extended likelihood for fitting fractions of pure samples in a mixed sample"

# $d(K^-, n\pi^+\pi^-)''X''$ data and MC (NC $\sigma = 170ps$ )

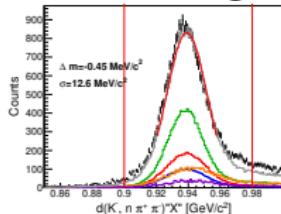
- $K^- d \rightarrow (\pi^\pm \Sigma^\mp)_{backward} n_{forward}$  (Signal)
- $K^- d \rightarrow K^0 nn$  (Quasi-elastic)
- $K^- d \rightarrow n\pi^\pm \Sigma^\mp_{forward}$



Data fitting



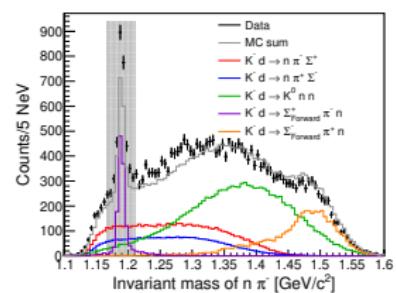
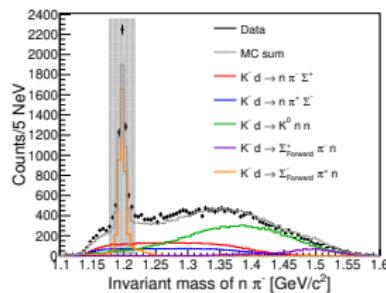
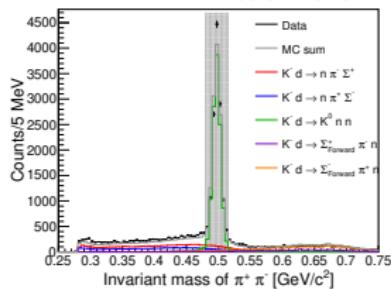
MC fitting



# Fitting of invariant masses

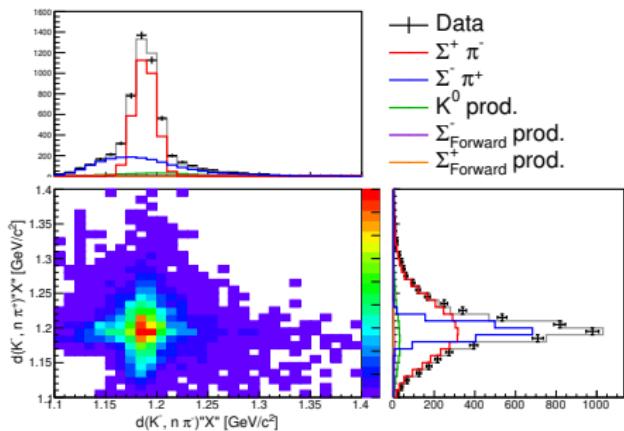
- $K^- d \rightarrow (\pi^\pm \Sigma^\mp)_{\text{backward}} n_{\text{forward}}$  (Signal)
- $K^- d \rightarrow K^0 nn$  (Quasi-elastic)
- $K^- d \rightarrow n \pi^\pm \Sigma^\mp_{\text{forward}}$

These three IM spectra was fitted to estimate BG in  
 $d(K^-, n) \pi^\pm \Sigma^\mp_{\text{backward}}$ "

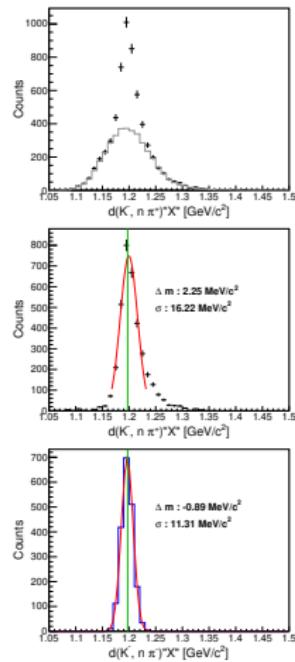
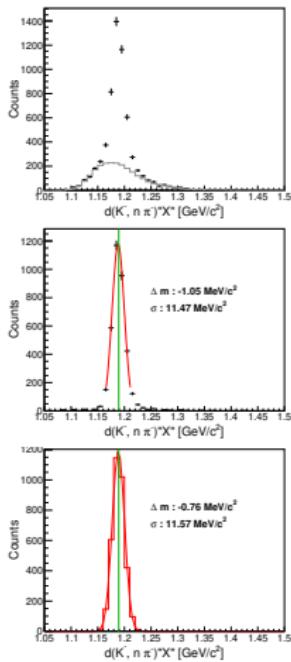


# Template Fittig (All result summed) (NC $\sigma = 170\text{ps}$ )

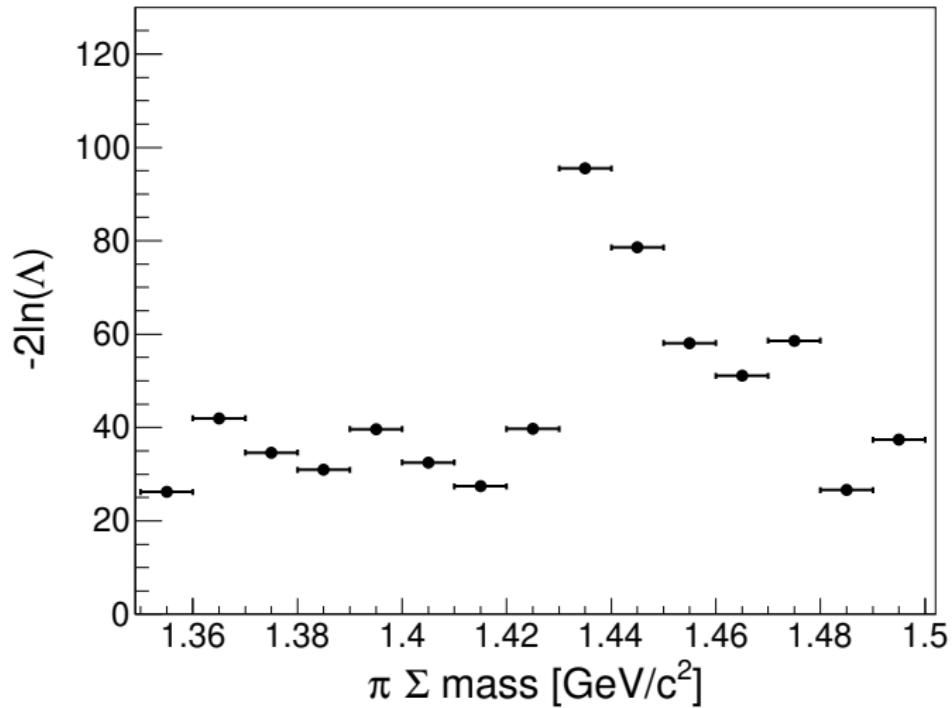
$\pi^-\Sigma^+$  and  $\pi^+\Sigma^-$  modes were separated by fitting of  $d(K^-, n\pi^\pm)''\Sigma^\mp''$ . This fitting was performed bin-by-bin.



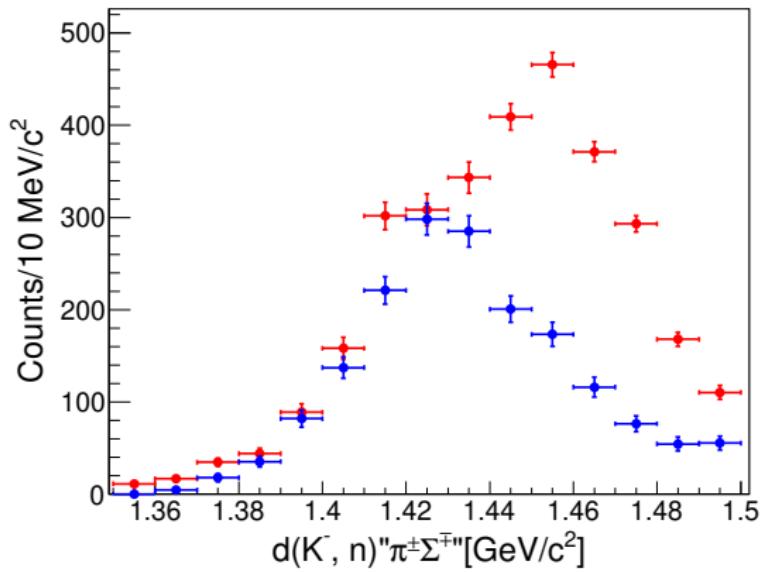
# $d(K^-, n\pi)^*\Sigma^*$ Fitting (NC $\sigma = 150ps$ )



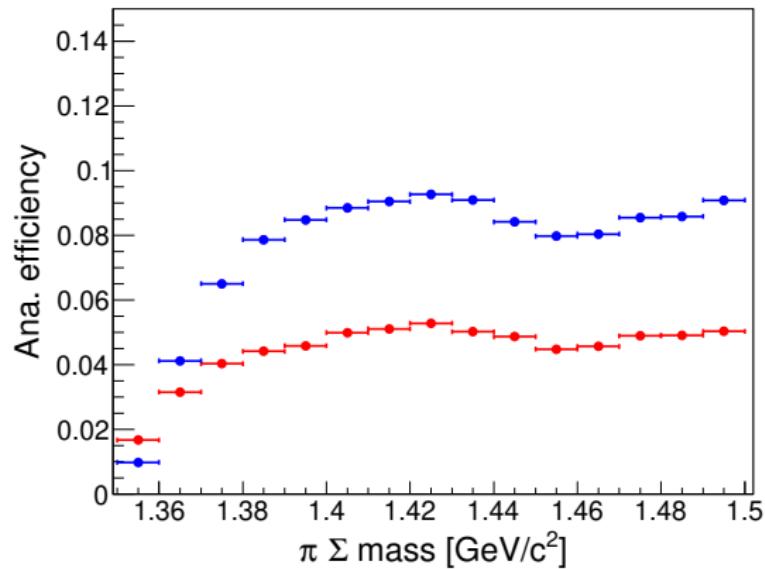
$\ln(\Lambda)$



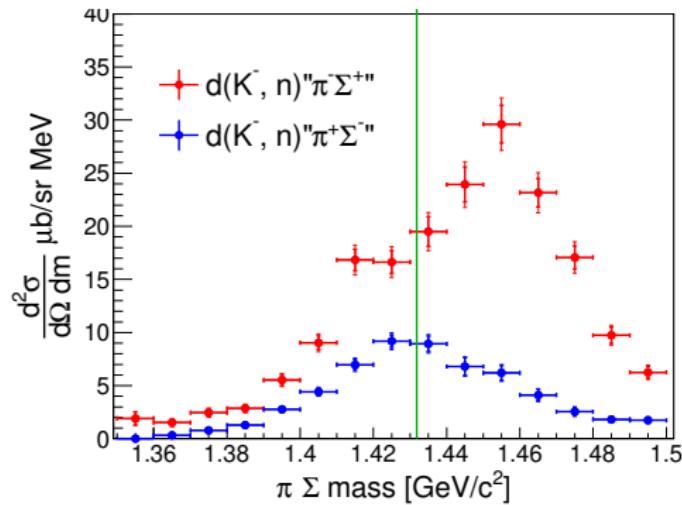
# Separated $\pi^\pm \Sigma^\mp$ Number



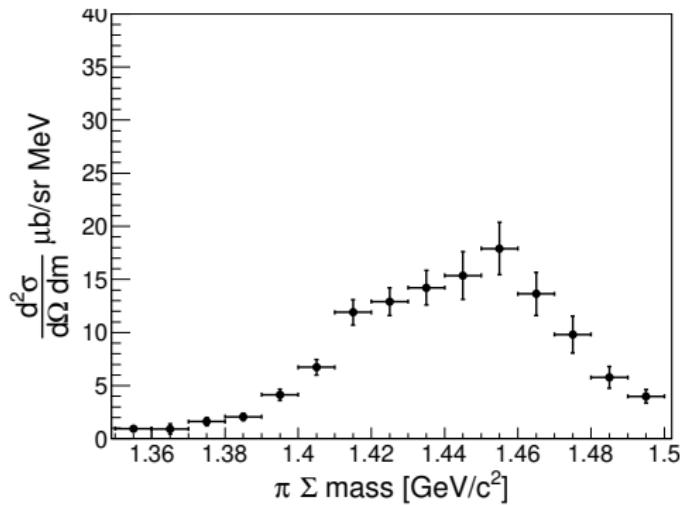
# Acceptance of $\pi^\pm \Sigma^\mp$



# $\pi^\pm \Sigma^\mp$ Cross Section



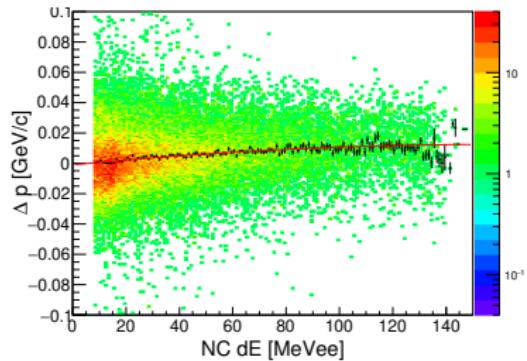
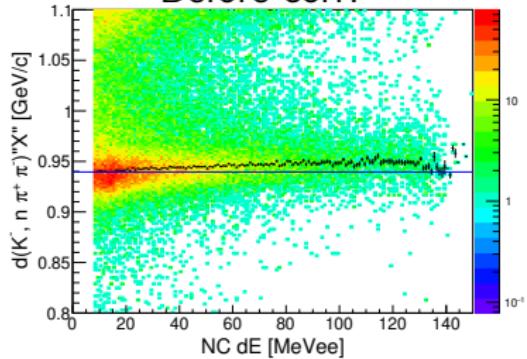
# $\pi^\pm \Sigma^\mp$ Average Cross Section



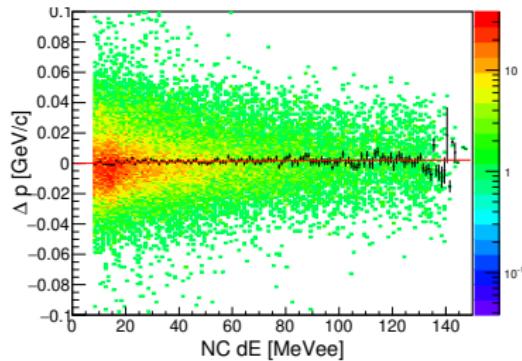
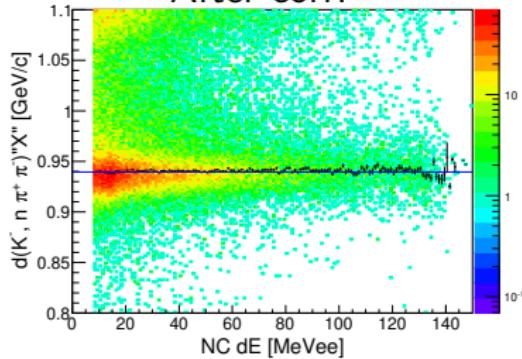
Back up

# NC dE higher order correction

Before corr.



After corr.



# Spectrum diff. by NC dE higher order corr.

Before

After

