

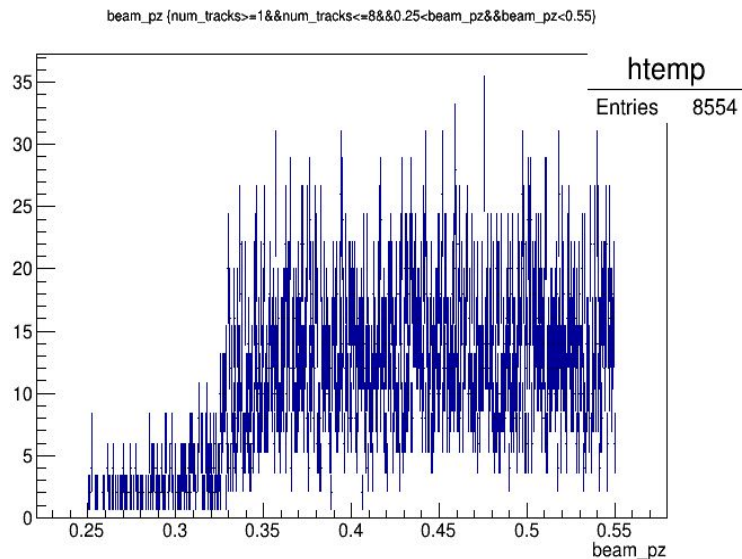
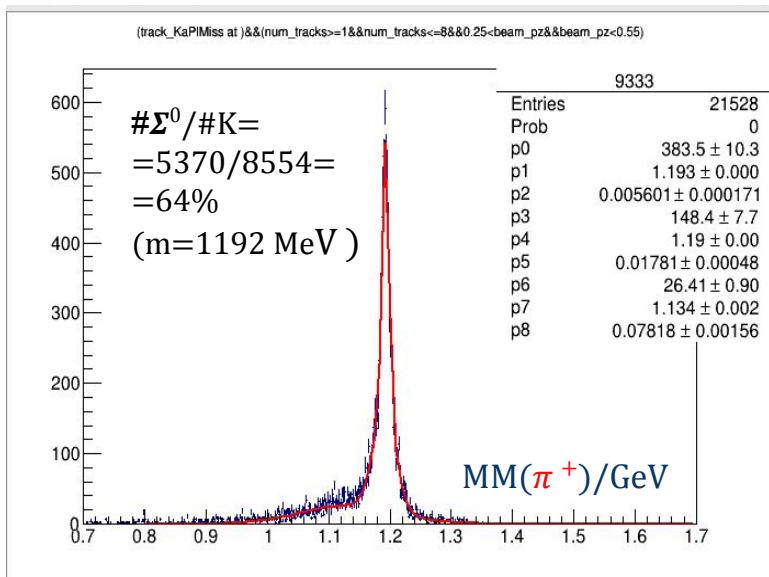
Effect of  $\pi^+$  vertex reconstruction

in

Reaction  $K_L + p \rightarrow \pi^+ + \Sigma$  at  $p_{\text{beam}} < 6$  GeV/c.

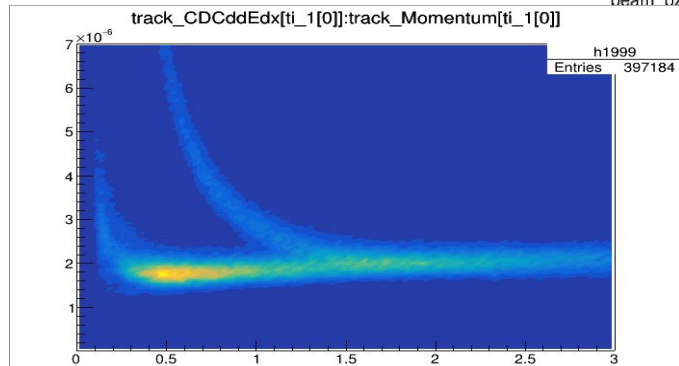
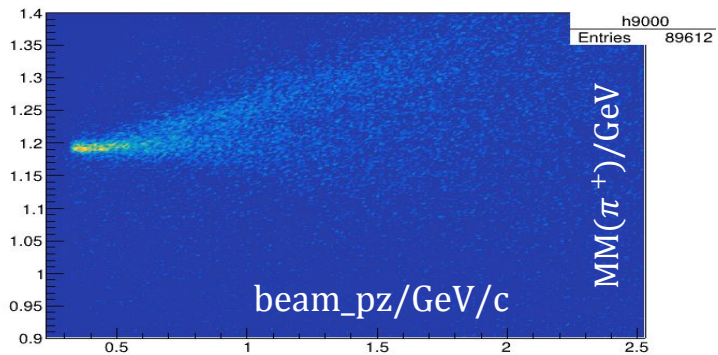
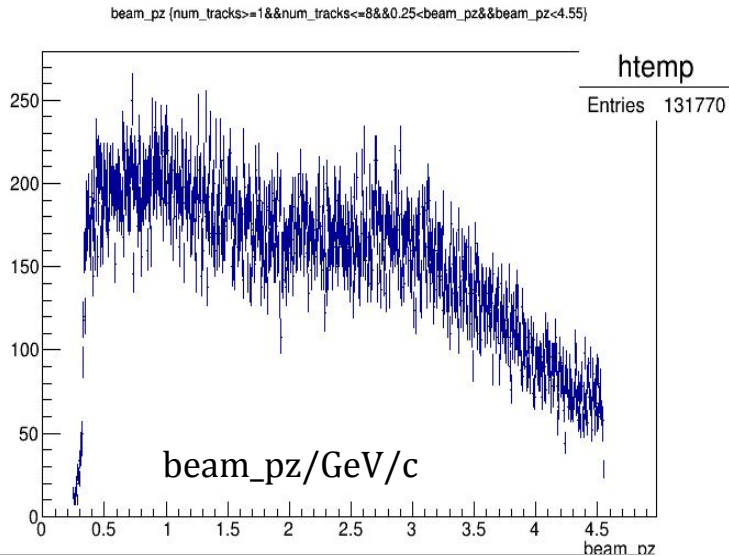
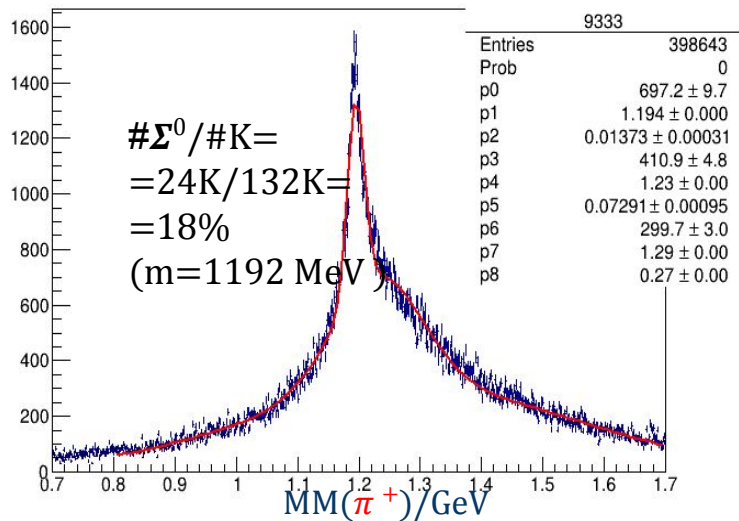
Example

# Reaction $K_L + p \rightarrow \pi^+ + \Sigma^0$ at $p_{\text{beam}} (0.23, 0.53) \text{ GeV}/c$

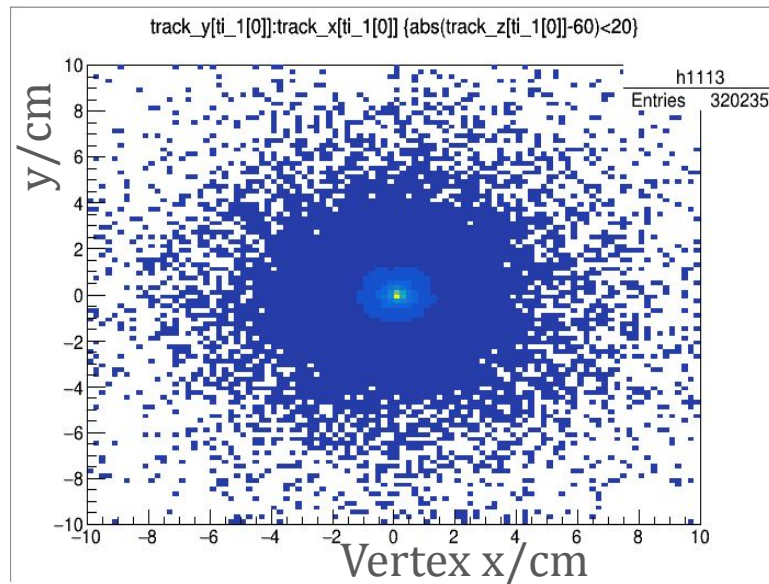
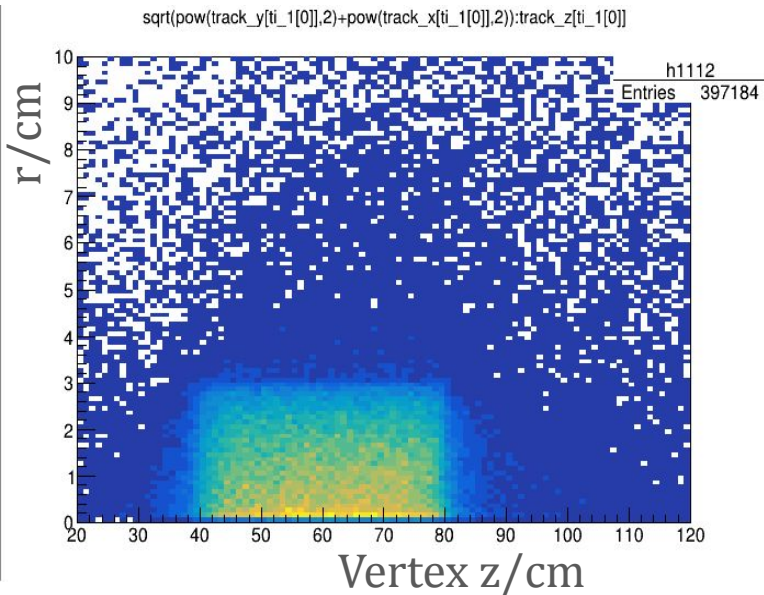


- TCut TID0="track\_CDChitused[ti\_1[0]]>=10&&1.75>track\_VBTPID[ti\_1[0]]&&track\_VBTPID[ti\_1[0]]<1.76";
- T Cut BEAM= "num\_tracks>=1&&num\_tracks<=8&&0.25<beam\_pz&&beam\_pz<0.55";
- TCut SP0="abs(track\_z[ti\_1[0]]-60)<20&&sqrt(pow(track\_y[ti\_1[0]],2)+pow(track\_x[ti\_1[0]],2))<=3";

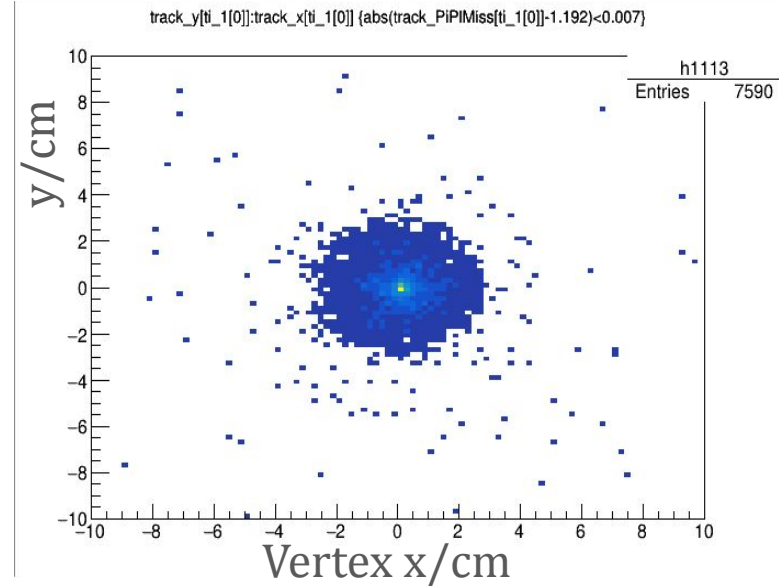
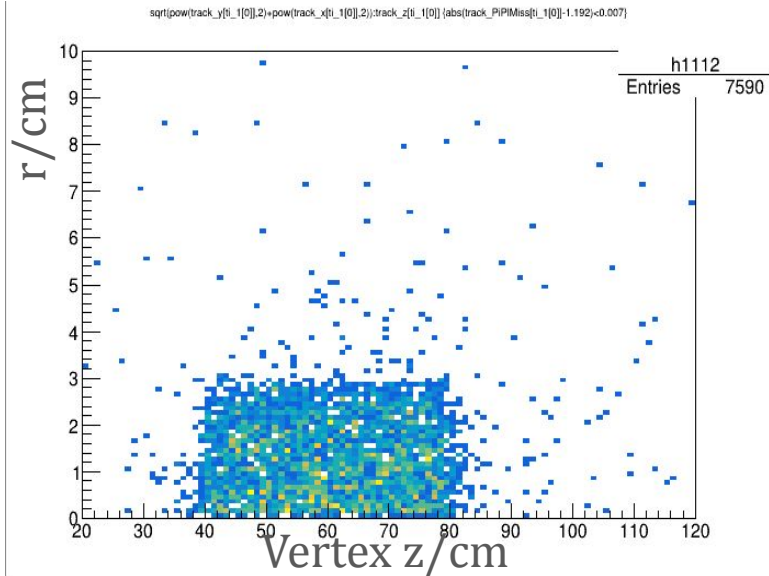
# Reaction $K_L + p \rightarrow \pi^+ + \Sigma$ at $p_{\text{beam}} (0.23, 4.53) \text{ GeV}/c$ .



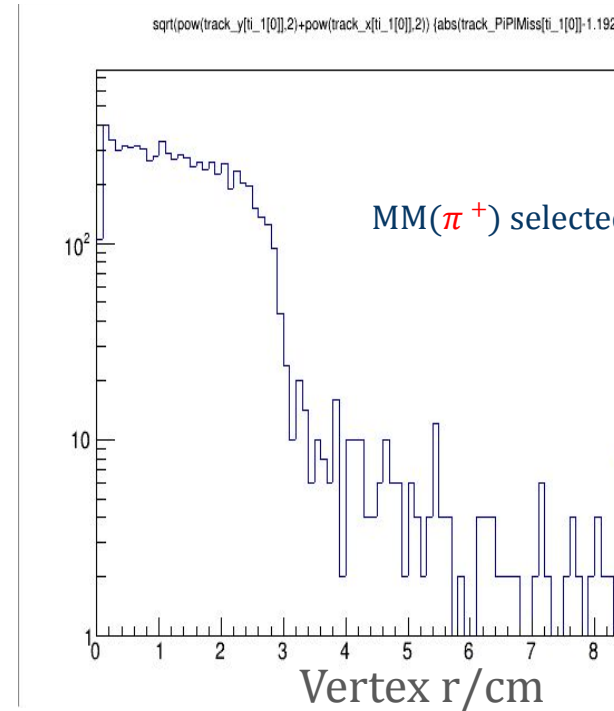
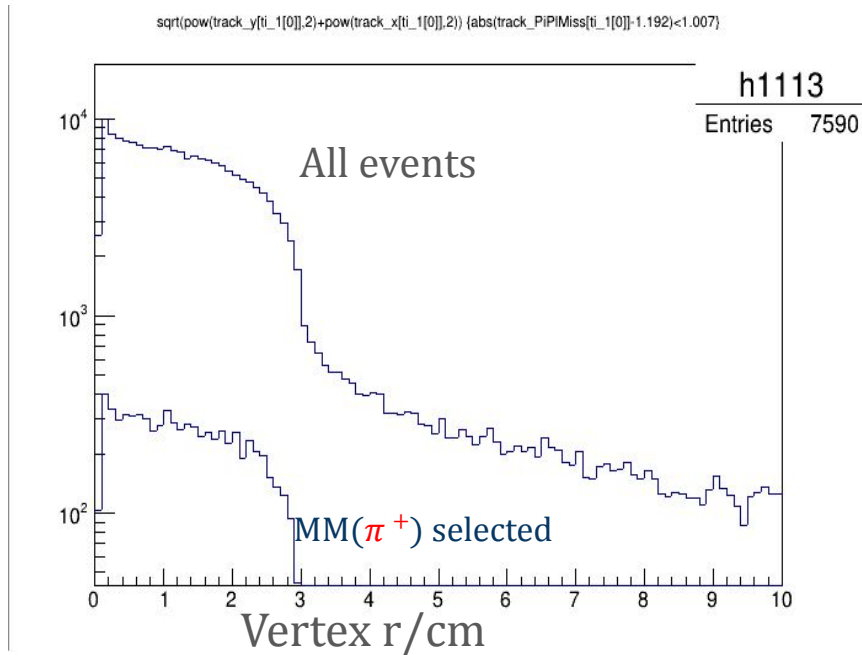
# Reaction $K_L + p \rightarrow \pi^+ + \Sigma$ at $p_{\text{beam}} (0.23, 5.53) \text{ GeV}/c$



Reaction  $K_L + p \rightarrow \pi^+ + \Sigma$  at  $p_{\text{beam}} (0.23, 5.53) \text{ GeV}/c$   
 $MM(\pi^+) = 1192 \pm 7 \text{ MeV}$



Reaction  $K_L + p \rightarrow \pi^+ + \Sigma$  at  $p_{\text{beam}}$  (0.23, 5.53) GeV/c  
Effect of  $MM(\pi^+) = 1192 \pm 7$  MeV selection.



Effect of  $\pi^+ \pi^- (K_s)$  vertex reconstruction

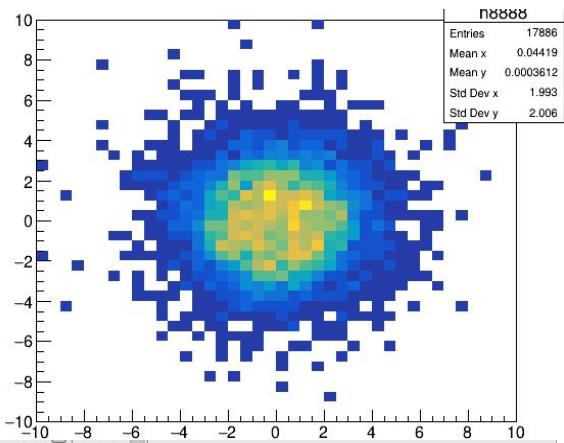
in

Reaction  $n+p \rightarrow K_s(\pi^+ \pi^-) + \Sigma + n$  at  $p_n < 6$  GeV/c.

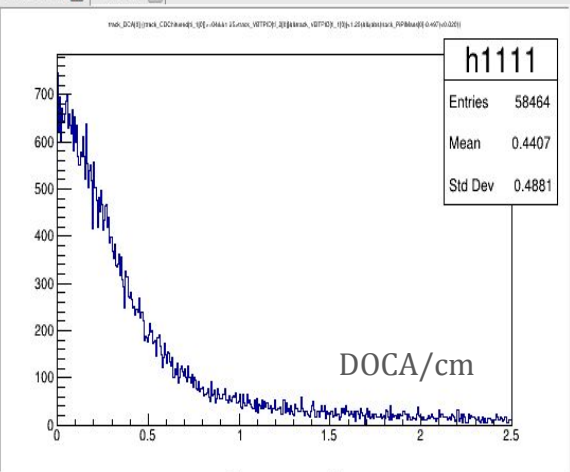
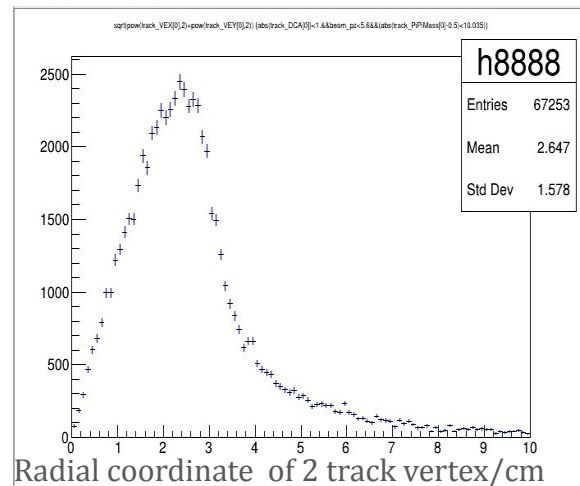
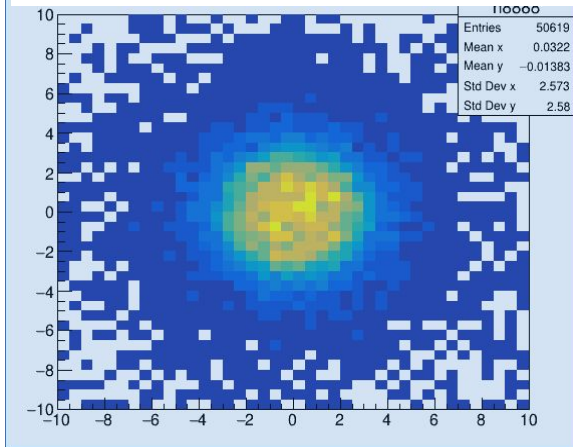
Example

Example:  $\pi^+ \pi^-$  Vertex, DOCA and XY-profile. Reaction  $n+p \rightarrow K_s(\pi^+ \pi^-) + \Sigma + n$  at  $p_n < 6$  GeV/c.

X%Y profile of Kshort DOCA<0.25 cm



X%Y profile of Kshort DOCA<0 cm

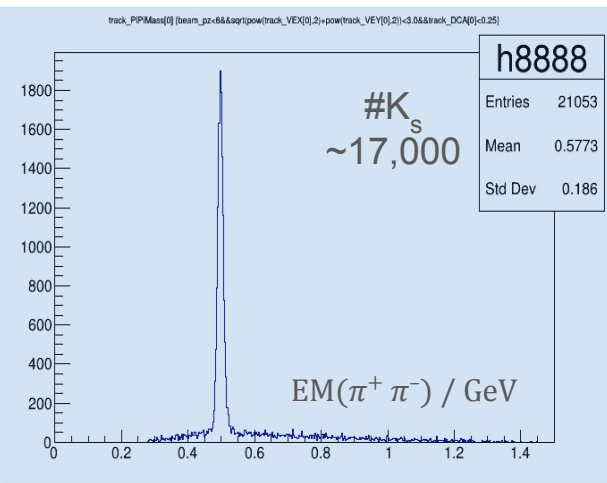


- Vertex coordinate resolution sigma is of  $\sim 0.25$  cm.

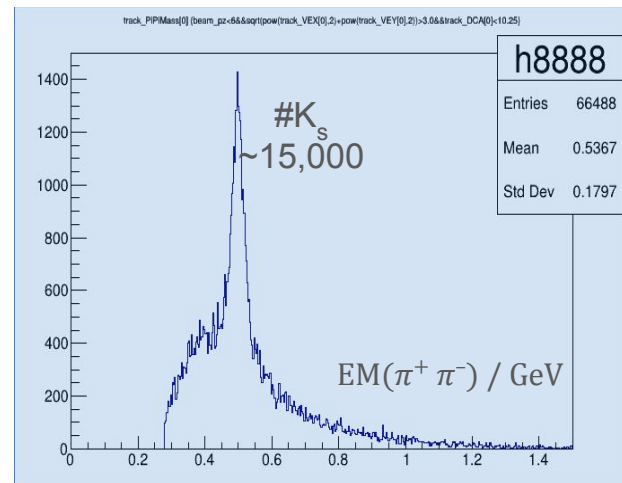
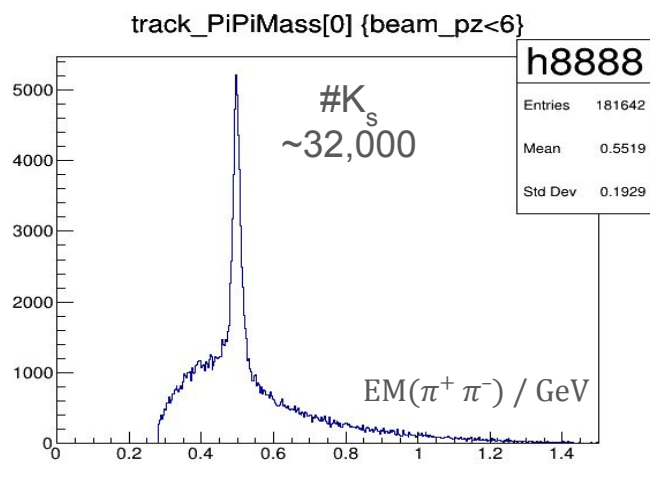


# Example. EM( $\pi^+\pi^-$ ) and Vertex. Reaction $n+p \rightarrow K_S(\pi^+\pi^-)+\Sigma+n$ at $p_n < 6$ GeV/c.

Inside LH2 target  $r < 3$  cm, DOCA  $< 0.25$  cm

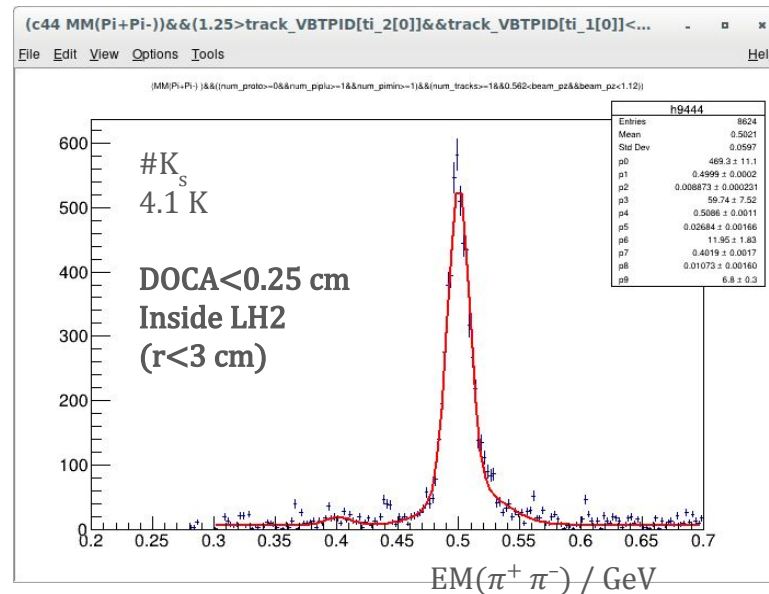
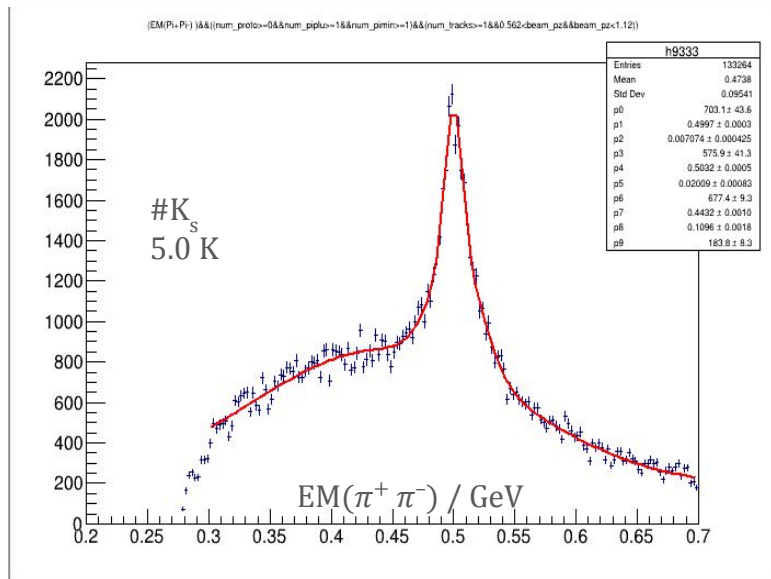


Outside LH2 target  $r > 3$  cm, DOCA  $> 0$  cm



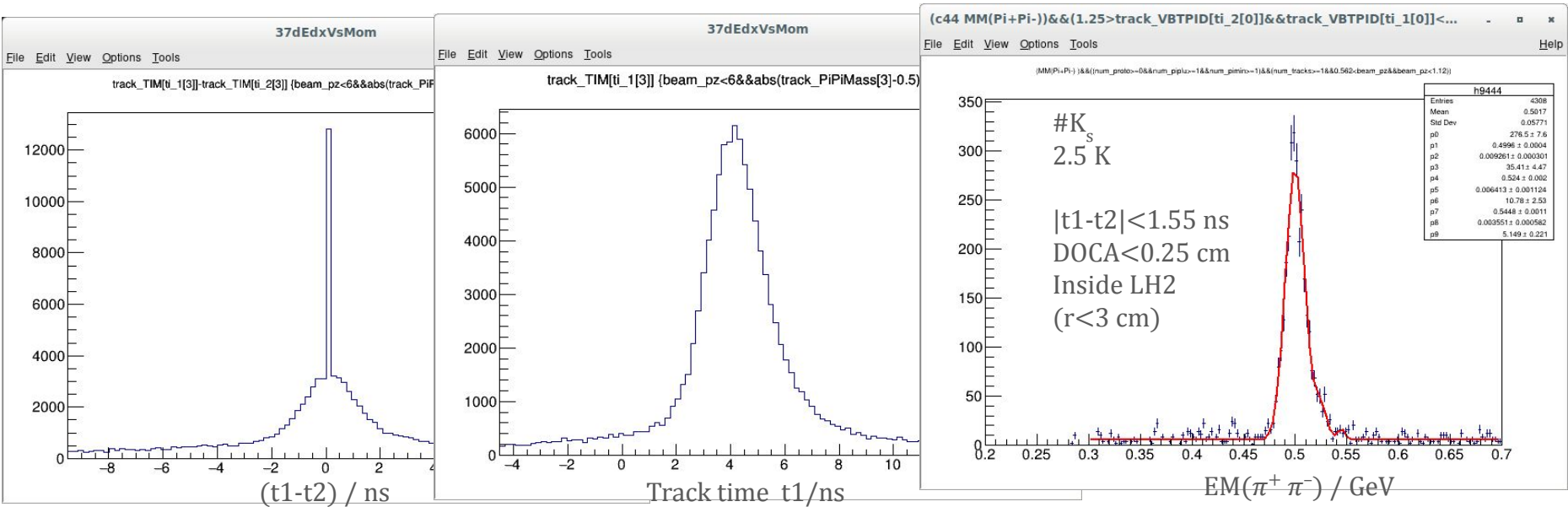
- Maximum/Pedestal ratio improves from  $\sim 4$  to  $\sim 20$  due to vertex cut

# Background and $\pi^+ \pi^-$ vertex. Reaction $n+p \rightarrow K_s(\pi^+ \pi^-) + \Sigma^+ + n$ at $0.562 < p_n < 1.12$ GeV/c.



- The combinatorial background drops to practical zero using DOCA and LH2 volume cuts.
- Cuts for Left plot: "num\_tracks >= 1 & 0.562 < beam\_pz < 1.12 "
- Right: Left & abs(track\_DCA[0] < 0.25) && sqrt( pow(track\_VEX[0],2) + pow(track\_VEY[0],2) ) < 3.0

# Effect of the cut on the time between two pion tracks.



- Timing of two tracks within  $\pm 1.55 \text{ ns}$  does not help with the background, while
- Statistics drops twice.

Effect of  $\pi^+ \pi^- (K_s)$  vertex reconstruction

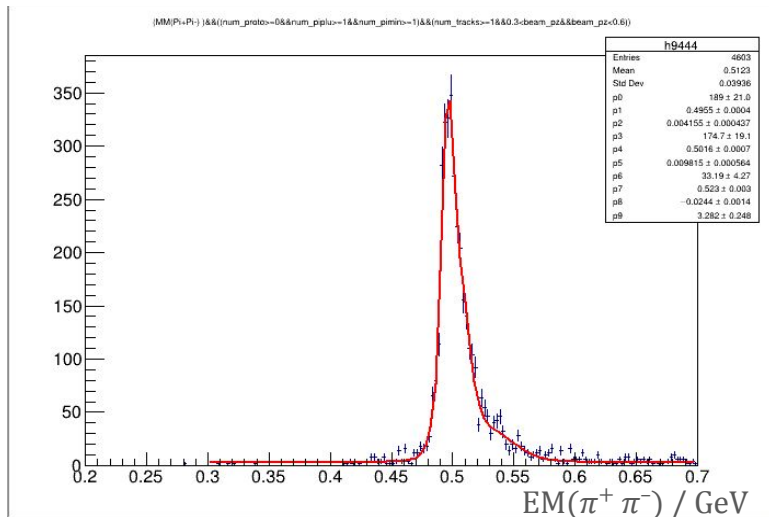
in

$K_L + p \rightarrow K_s(\pi^+ \pi^-) + p$  at  $K_L$  momentum (0.3,0.6) GeV/c.

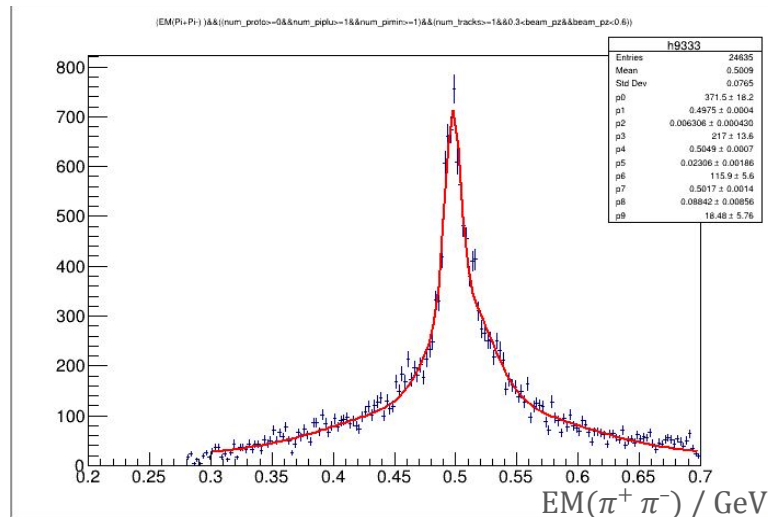
Total reconstruction efficiency of  $K_s + p$  state.

# $K_S(\pi^+\pi^-)$ Vertex in $K_L + p \rightarrow K_S(\pi^+\pi^-) + p$ at $K_L$ momentum (0.3,0.6) GeV/c.

Inside LH2 target  $r < 3$  cm,  $DOCA < 0.45$  cm



No vertex cuts

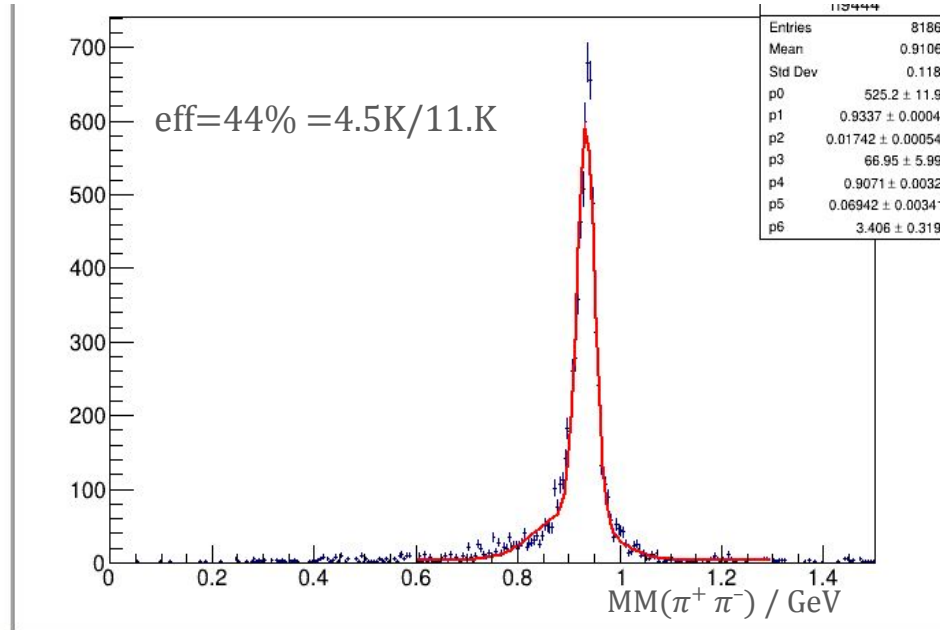
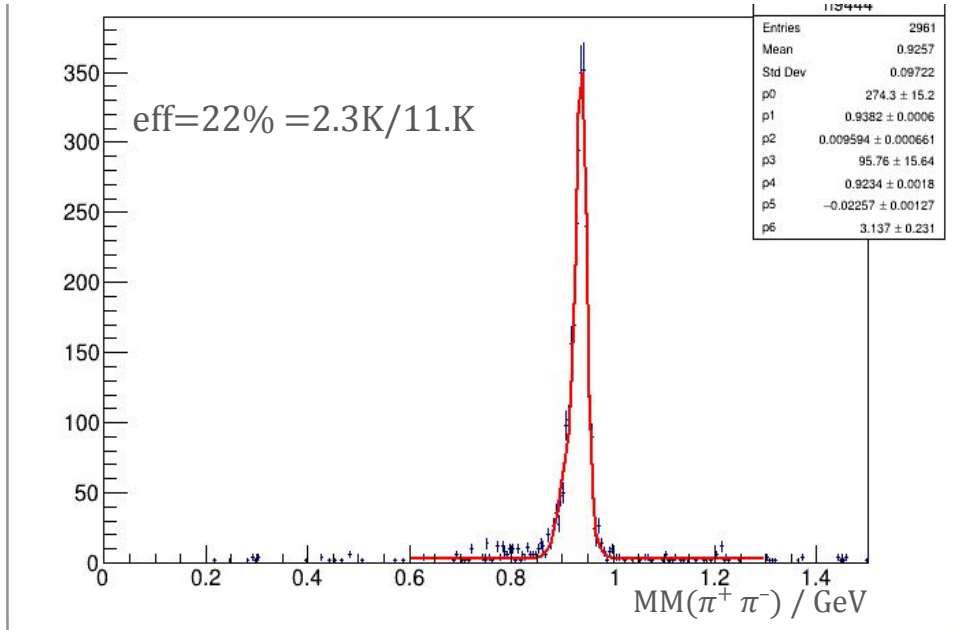


- With **vertex cuts** (left) Rec. Efficiency  $\sim 25\%$ , while the sensitivity (peak/pedestal) =  $\sim 100$ .
- No cuts (right) the efficiency up to  $\sim 40\%$  (depends on the fit); the sensitivity  $\sim 10$  times lower.

Effect of  $\pi^+ \pi^-$  Vertex in Reconst. of **proton** in final states  $K_s(\pi^+ \pi^-) + p$   
 at **beam momentum (0.3,0.6) GeV/c**.

Ks-mass cut, ver. inside target  $r < 3$  cm,  $DOCA < 0.45$  cm .

Ks-mass cut via  $EM(\pi^+ \pi^-)$ . NO vertex cuts.



- Reconstruction efficiency drops twice; little change of the background.

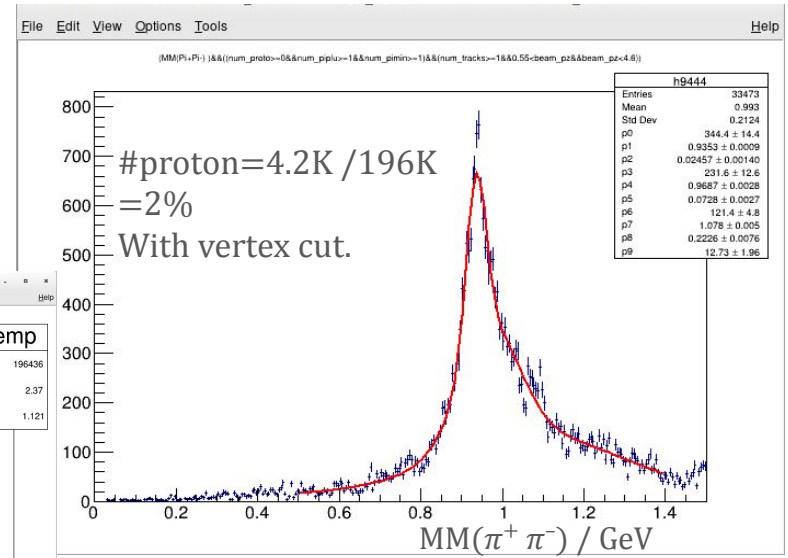
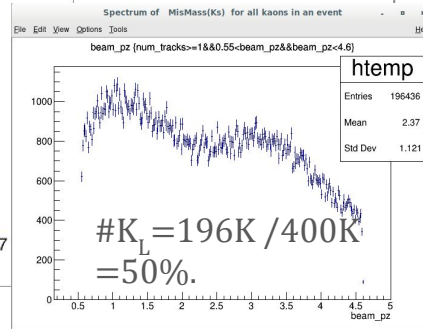
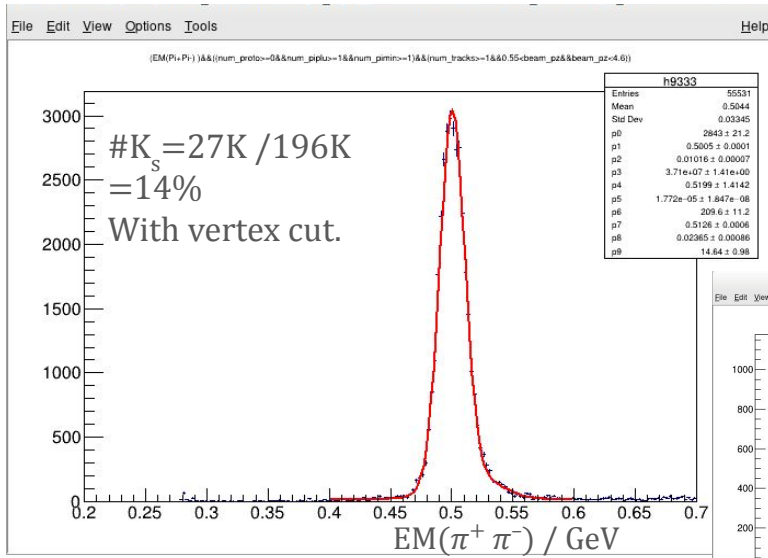
Effect of  $\pi^+ \pi^-$  ( $K_s$ ) vertex reconstruction

in

$K_L + p \rightarrow K_s(\pi^+ \pi^-) + p$  at  $K_L$  momentum (0.55, 4.55) GeV/c.

Total reconstruction efficiency of  $K_s + p$  state.

# Reconstruction of $K_S$ and $p$ in $K_L + p \rightarrow K_S + p$ at $K_L$ momentum (0.55,4.55) GeV/c. Vertex cuts.



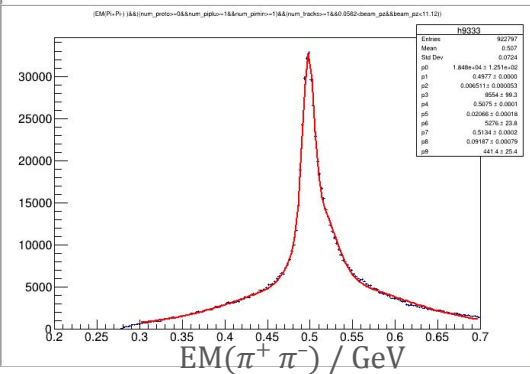
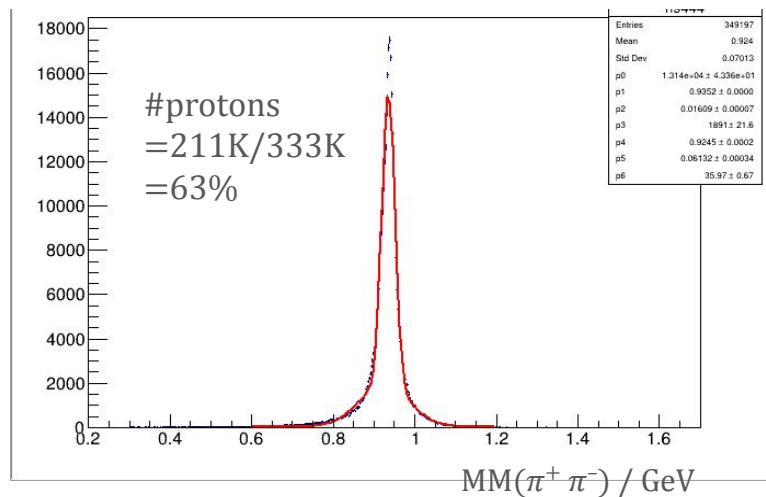
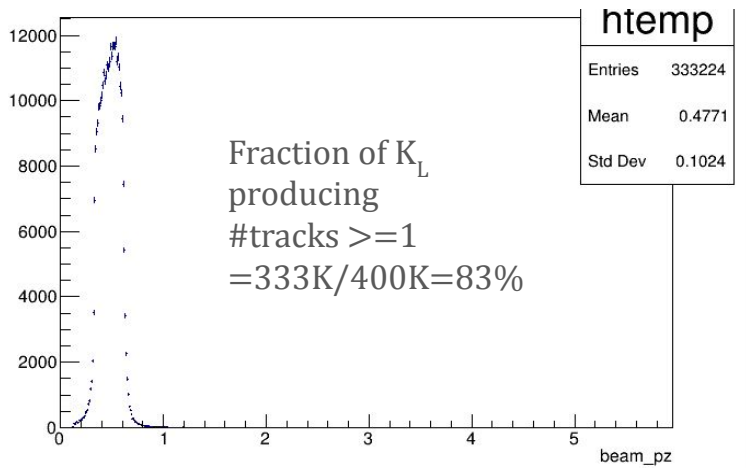
- **In wide** domain of beam momentum Overall Reconstruction efficiencies are 7% for  $K_S$  and 1% for protons.
- **In low** momentum 5q domain - 22% and 44% times 0.83, i.e. 18% and 37%.



Overall reconstruction efficiency of  $K_s + p$  state in  
 $K_L + p \rightarrow K_s(\pi^+ \pi^-) + p$  generated at  $K_L$  momentum  
(0.3,0.6) GeV/c.

# Reconstruction of final **proton** in $K_L + p \rightarrow K_S(\pi^+ \pi^-) + p$ at $K_L$ energies generated in (0.1,0.3) GeV interval (5q region).

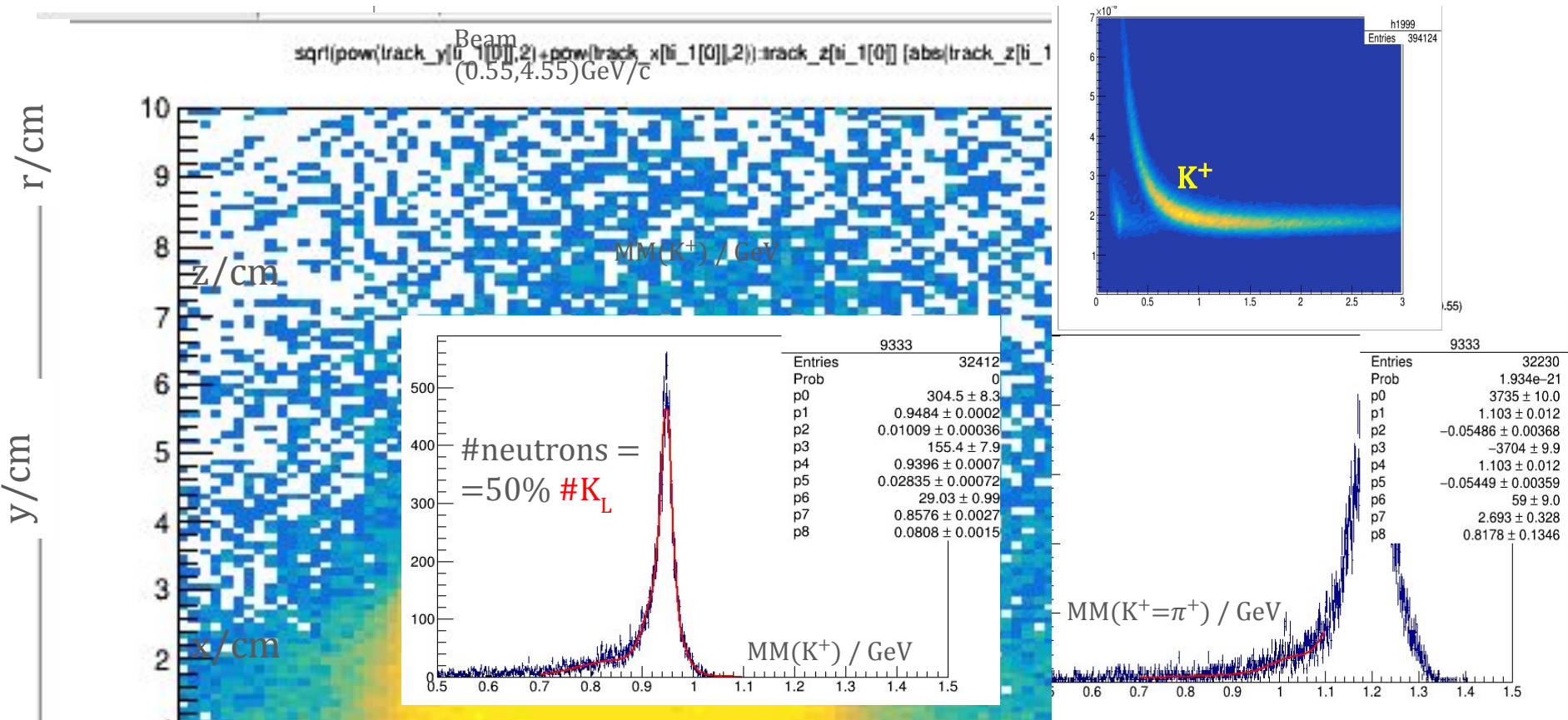
No vertex cuts.



- Selected: #tracks  $\geq 1$  &  $|EM(\pi^+ \pi^-) - m_K| < 20$  MeV. **No vertex** related cuts.
- Overall Rec. Efficiency =  $0.83 * 0.63 = 53\%$ .

Overall reconstruction efficiency of  $K_s + n$  state in  
 $K_L + p \rightarrow K^+ + n$  at  $K_L$  momentum (0.35,0.55) GeV/c.

Reconstruction of final **neutron** in  $K_L + p \rightarrow K^+ + n$  at  $K_L$  momentum in  $(0.35, 0.55)$  GeV/c interval of  $5q$  region, with vertex cuts.



● Overall reconstruction efficiency of neutrons is of  $\sim 50\%$ .

