Backgrounds to $K_L + p \rightarrow K^+ + n$

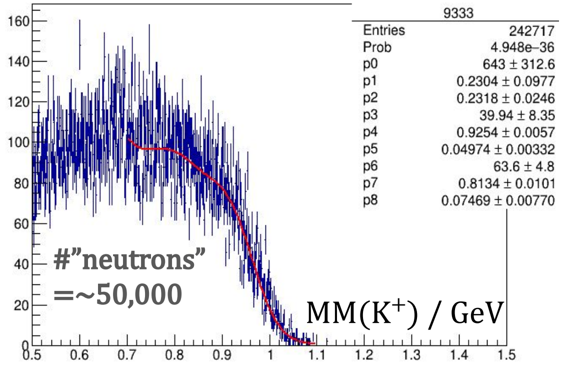
(1) $K_L + p \rightarrow \pi^+ + \boldsymbol{\Sigma}^0$

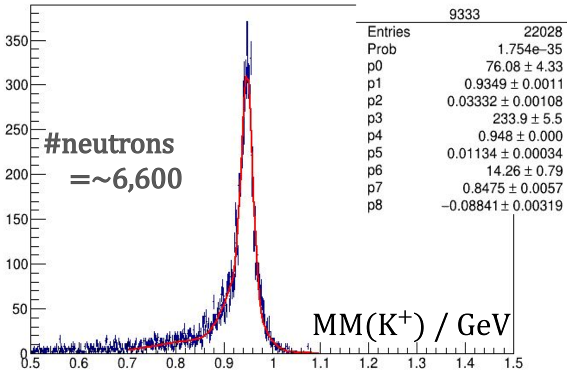
(2) $n + p \rightarrow K_s(\pi^+\pi^-) + \boldsymbol{\Sigma}^+ + n$ threshold 2.6 GeV/c.

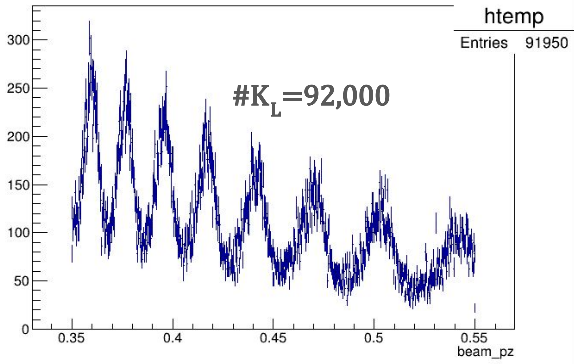
(3) Beam leak from other halls and reconstruction of $K_L + p \rightarrow K^+ + n$

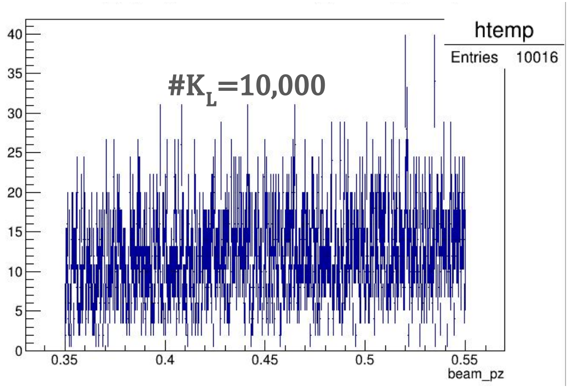
MM(K^+) from $K_L+p \rightarrow K^+ +n$ at beam momentum (0.35,0.55) GeV/c.

Beam leak into Hall D line (left) vs normal beam (right).



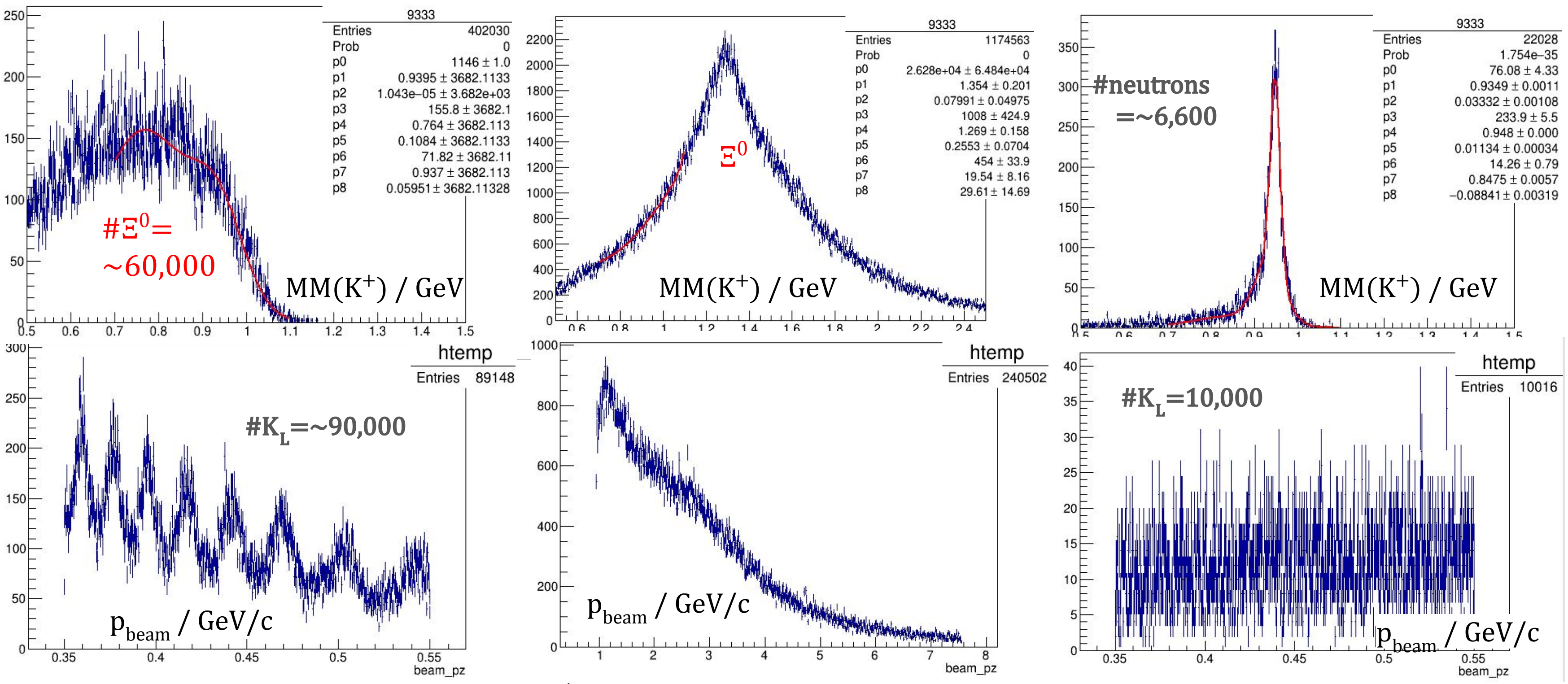






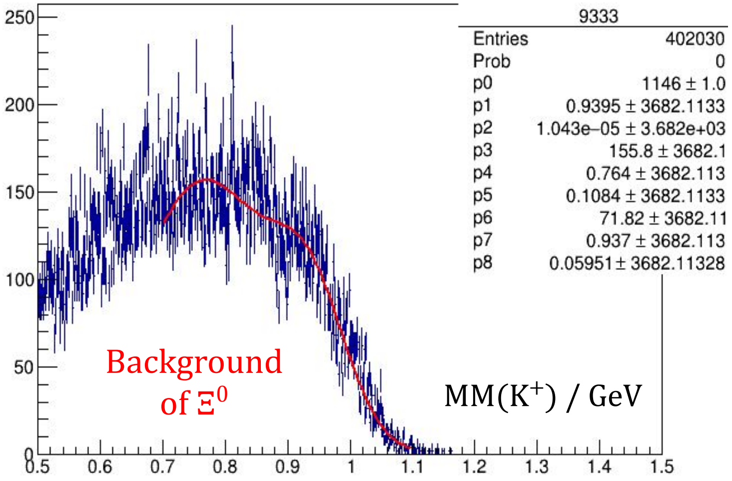
- NO structures in Missing Mass of K^+ !
- At p_{beam}=0.45 GeV/c the "leak" to "beam" ratio = ~120/12=~10; we expect lower ~2 .
- The ratio of neutron_peak to leak of "neutrons" =~300/50=6; expected ratio is of 30.

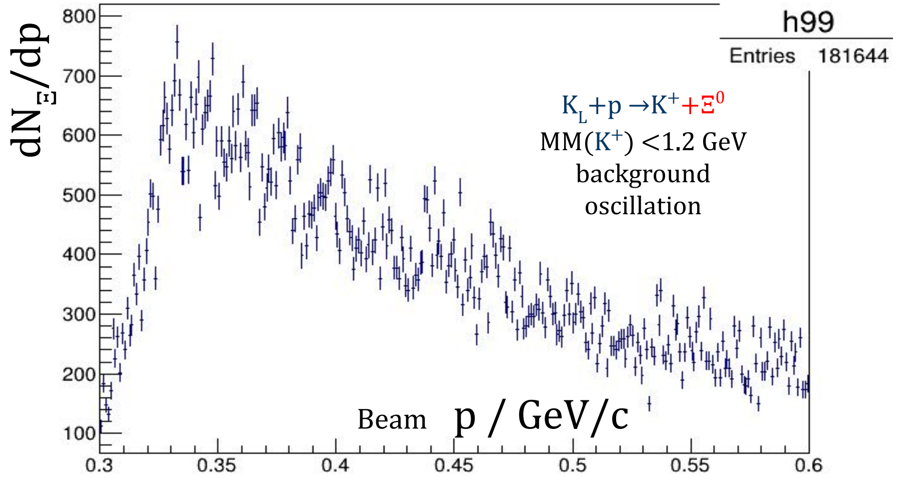
$K_L + p \rightarrow K^+ + \Xi^0$ at $0.35 < p_K < 0.55$ GeV/c . Missing Mass of K^+ and e-beam leak from other halls (left) vs normal Hall D beam (right)



- No structures in Missing Mass of K^+ !
- At p_{beam}=0.45 GeV/c the "leak" /"beam" ratio = ~100/10=~10; we expect ~2 (factor 5).
- The ratio of neutron_peak to leak of "Ξ^0" =~300/75=~4; we expect ~5*4=20, i.e. ~**5% background.**

$K_L + p \rightarrow K^+ + \Xi^0$. Background oscillation caused by beam leak.





- The background part shows oscillations (10% amplitude) due to beam leak.

What to do with beam leak background?

1. FLUKA shows that **minum energy of K_L** at LH2 target T=0.1 GeV.

   => K_L **momentum** p_K= 0.33 GeV/c => $\boldsymbol{\beta}_K = p_K/(T+m_K)$ = 0.33/0.597=0.554

   TOF_K =2400[cm]/(30[cm/ns]*0.554)=**144 ns**

   TOF_γ =2400[cm]/(30[cm/ns]*1.000)= **80 ns**

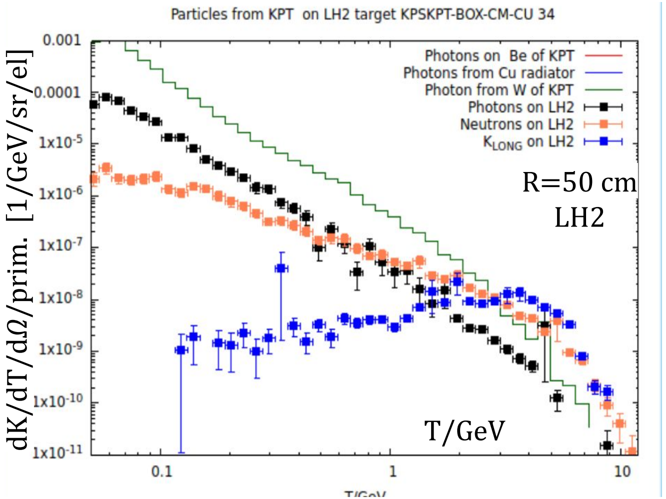
2. The difference TOF_K- TOF_γ = **64 ns** , therefore

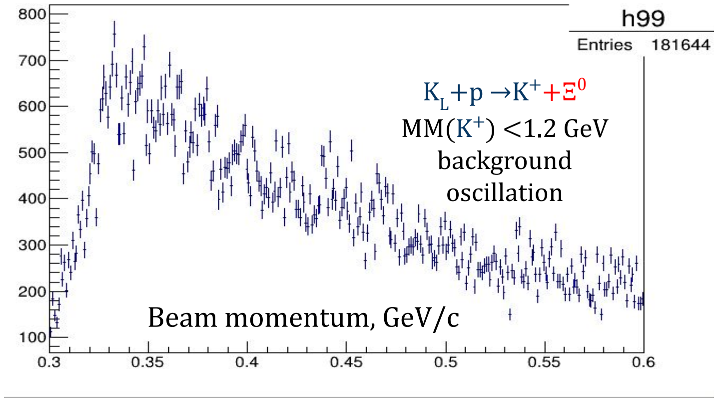
   all **beam K_L**'s with p>0.33 GeV/c do **fit into (0,64) ns** interval!

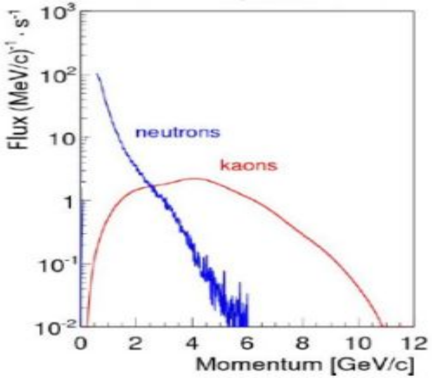
3. **Provided 128 ns** between bunches the following (64,128) ns interval

   is **filled by beam leak** only. Therefore this interval may be used

   to **permanently measure** /subtract the **background** .







Conclusion

Final state (FS)	#FS/#K_L/ Resol.	#FS/#K_L/ Resol.
K_L beam mom.	0.3-0.6 GeV/c	0.5-5.0 GeV/c
$\rightarrow K_s + \ldots$	53 % / 10 MeV	14 % / 20 MeV
$\rightarrow K_s+p$	44 % / 20 MeV	2 % / 25 MeV
$\rightarrow K^+ + n$	50 % / 15 MeV	6 % / 50 MeV

- GlueX CDC is an **ideal detector** at K_L beam momentum (0.3, 0.6) GeV/c.
- Overage **reconstruction efficiency** ~50% in this region.
- **Advantage** of $K_L + p \rightarrow K_s(\pi^+\pi^-) + p$ is that it has **3 charged particles** of low momenta, hence - better **resolution** and **vertex** localisation; good cross check for $K_L + p \rightarrow K^+ + n$.
- **Beam leak** background **does not create problems** for neutron rec. via MM(K^+).