

---

# PID for the FTOF detector

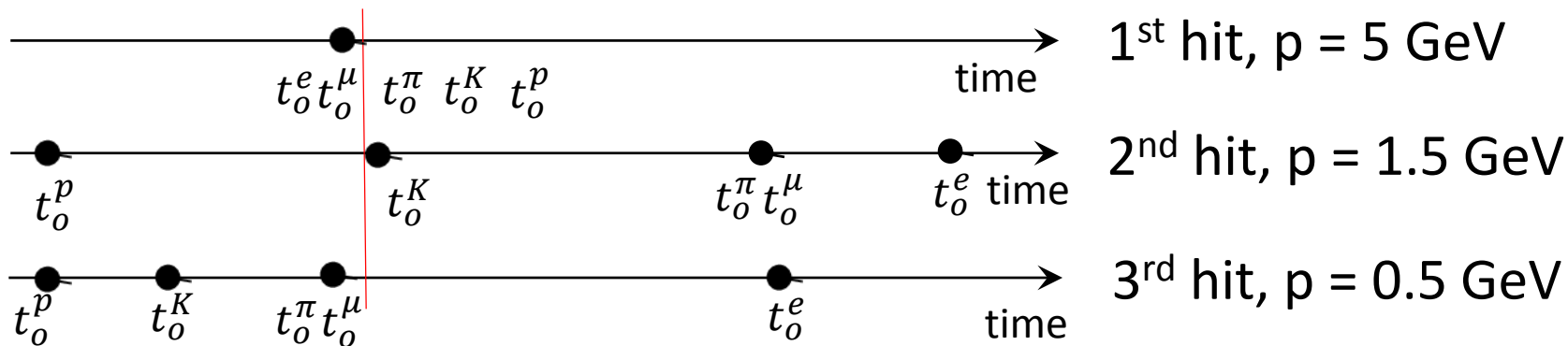
Denis Veretennikov

# T0 and PID determination

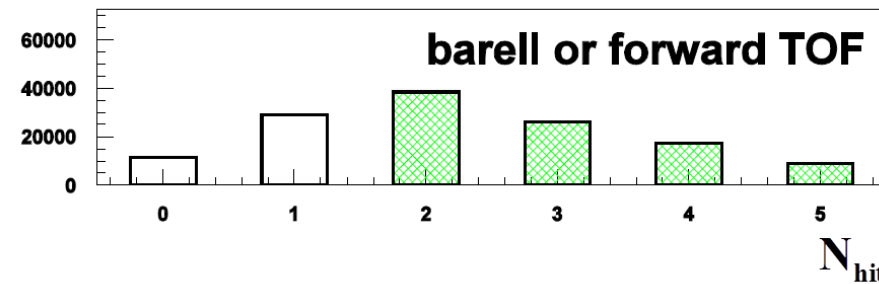
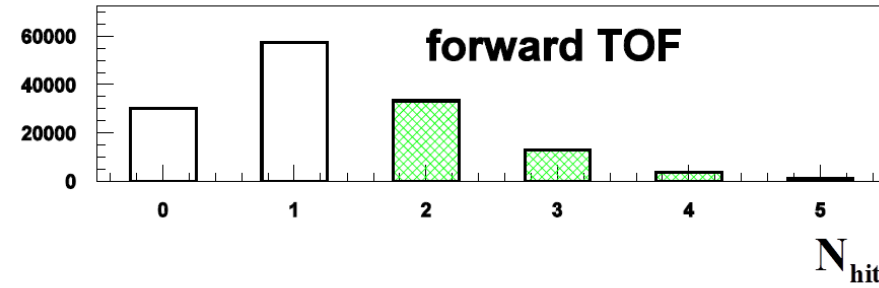
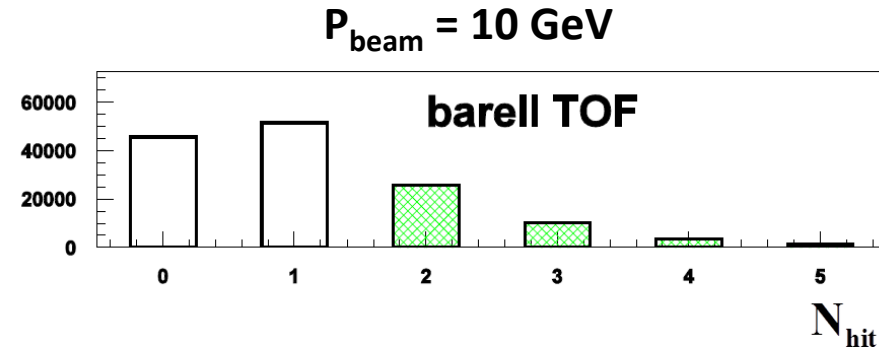
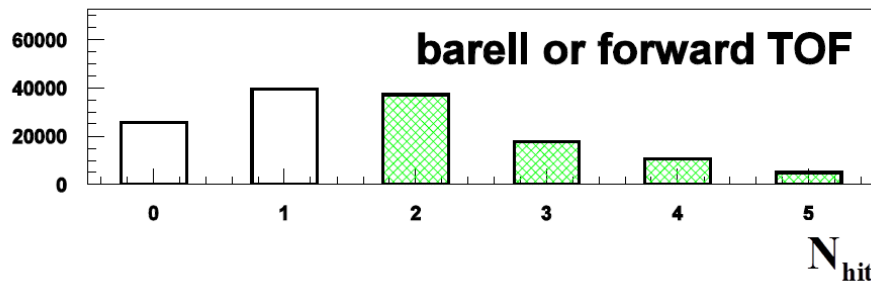
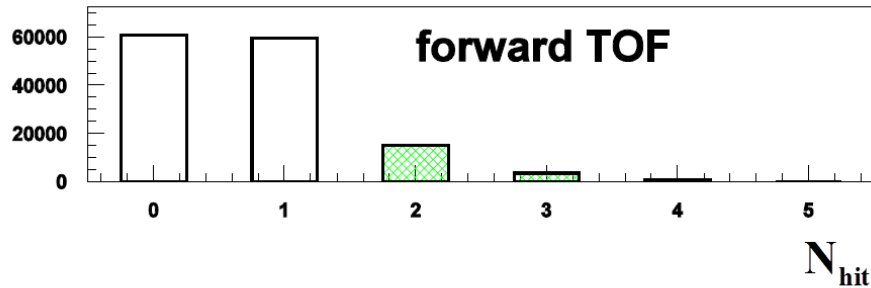
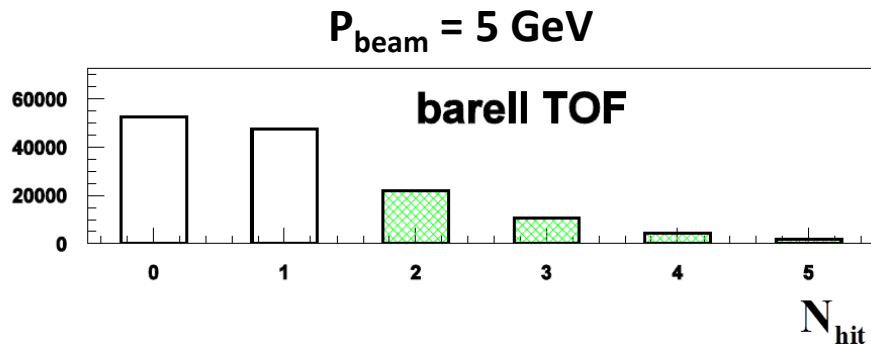
$$\begin{aligned}
 t_1^{TOF} &= t_0 + \frac{L_1}{c\beta_1} = t_0 + \frac{L_1}{c} \frac{\sqrt{p_1^2 + m_1^2}}{p_1} \\
 t_2^{TOF} &= t_0 + \frac{L_2}{c\beta_2} = t_0 + \frac{L_2}{c} \frac{\sqrt{p_2^2 + m_2^2}}{p_2} \\
 &\dots\dots\dots \\
 t_n^{TOF} &= t_0 + \frac{L_n}{c\beta_n} = t_0 + \frac{L_n}{c} \frac{\sqrt{p_n^2 + m_n^2}}{p_n}
 \end{aligned}$$

**TOF hits**

- n equations and n+1 unknown variables  $t_0, m_1, \dots, m_n$
- $m$  can be only  $m_p, m_K, m_\pi, m_\mu$  or  $m_e$
- $L$  and  $p$  provided by tracking
- Loop over all possible ( $5^n$ ) combination and find right one



# FTOF and SciTil hit multiplicity



Need at least 2 hits for PID

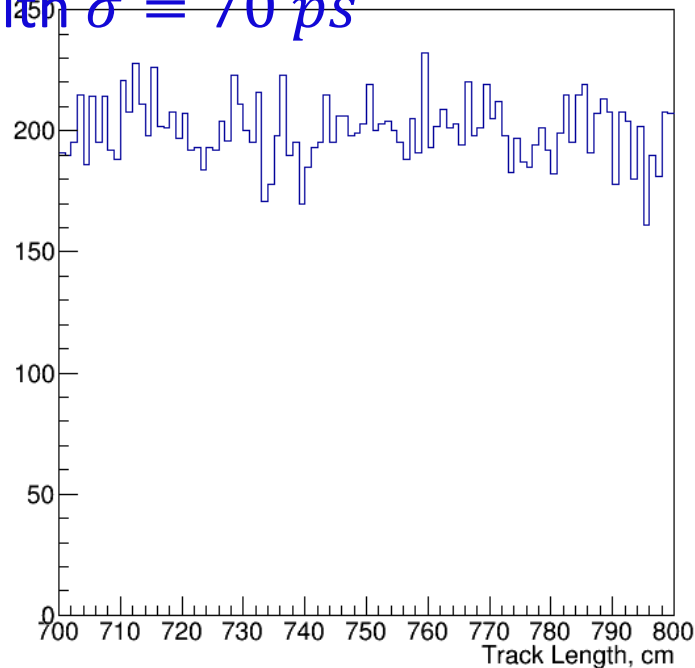
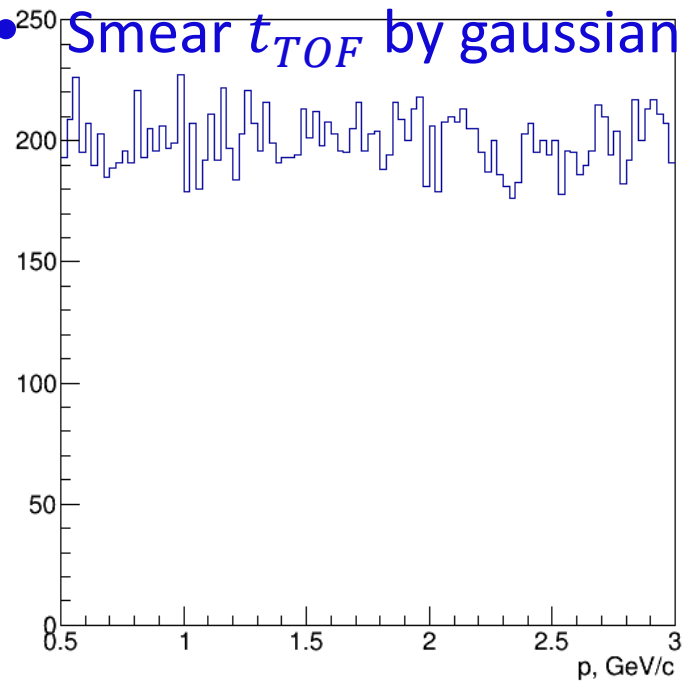
70% of events has at least 3 hits on FTOF or BTOF

# T0 and PID algorithm check with ToyMC

- Generate 10 000 events with 2(3) particle with momentum 0.5 GeV – 3 GeV and track length 700 cm – 800 cm

- Randomly assign masses from  $m_e, m_\mu, m_\pi, m_K, m_p$  and calculate  $t_{TOF} = \frac{L}{c} \frac{\sqrt{p^2 + m^2}}{p}$

- Smear  $t_{TOF}$  by gaussian with  $\sigma = 70$  ps

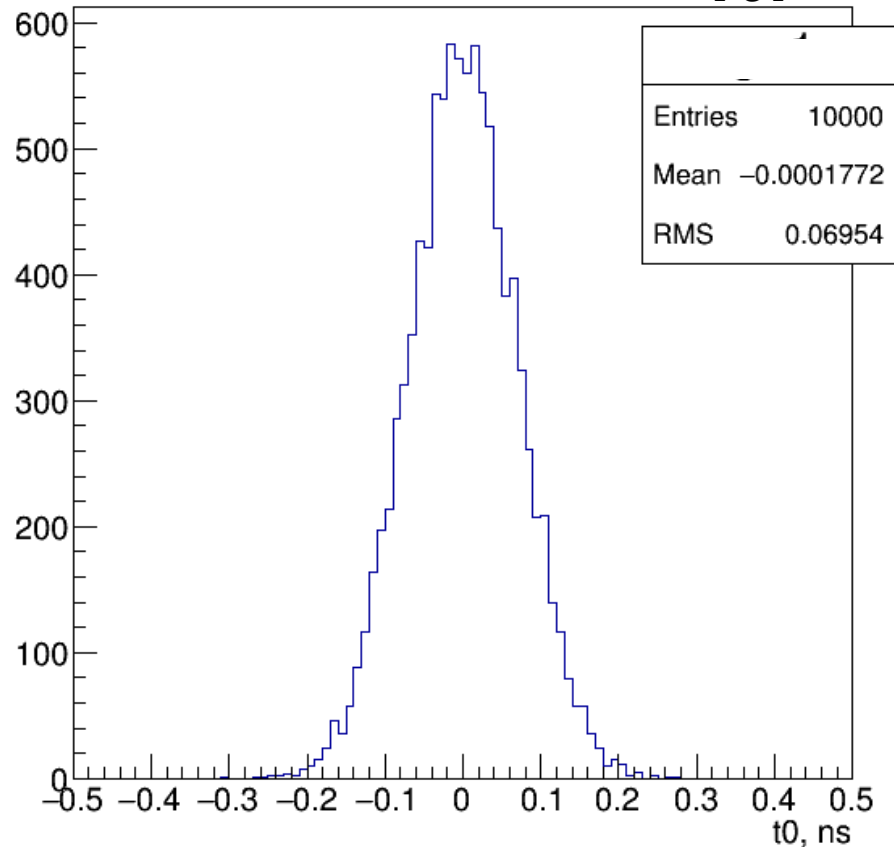


Use algorithm from previous slide to calculate t0 and PID

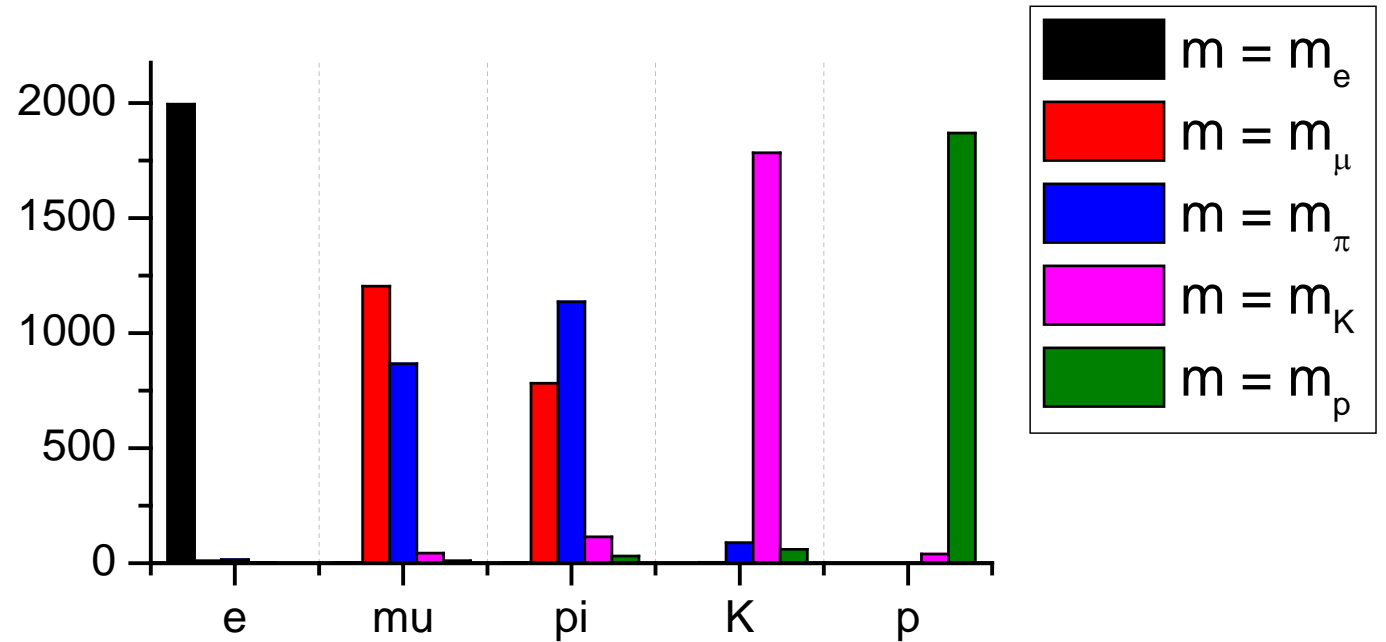
Because this MC is “eventbase” t0 should be 0

# T0 and PID algorithm check with ToyMC

PID and t0 with  $t_{TOF}$  smearing and 2 particle in events

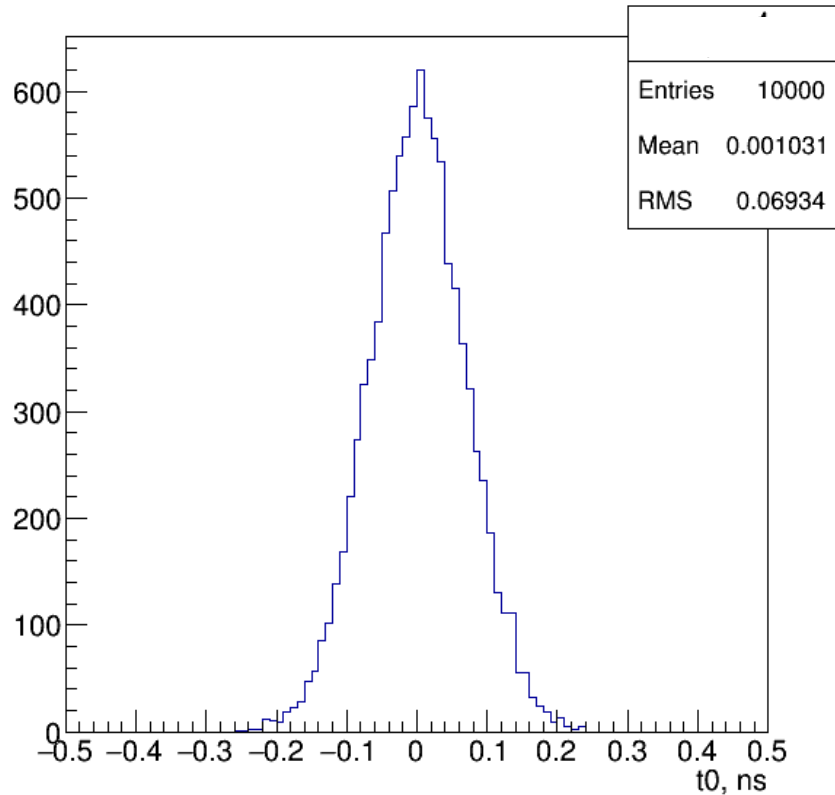


Number of particle detected as e, mu, pi, K or p

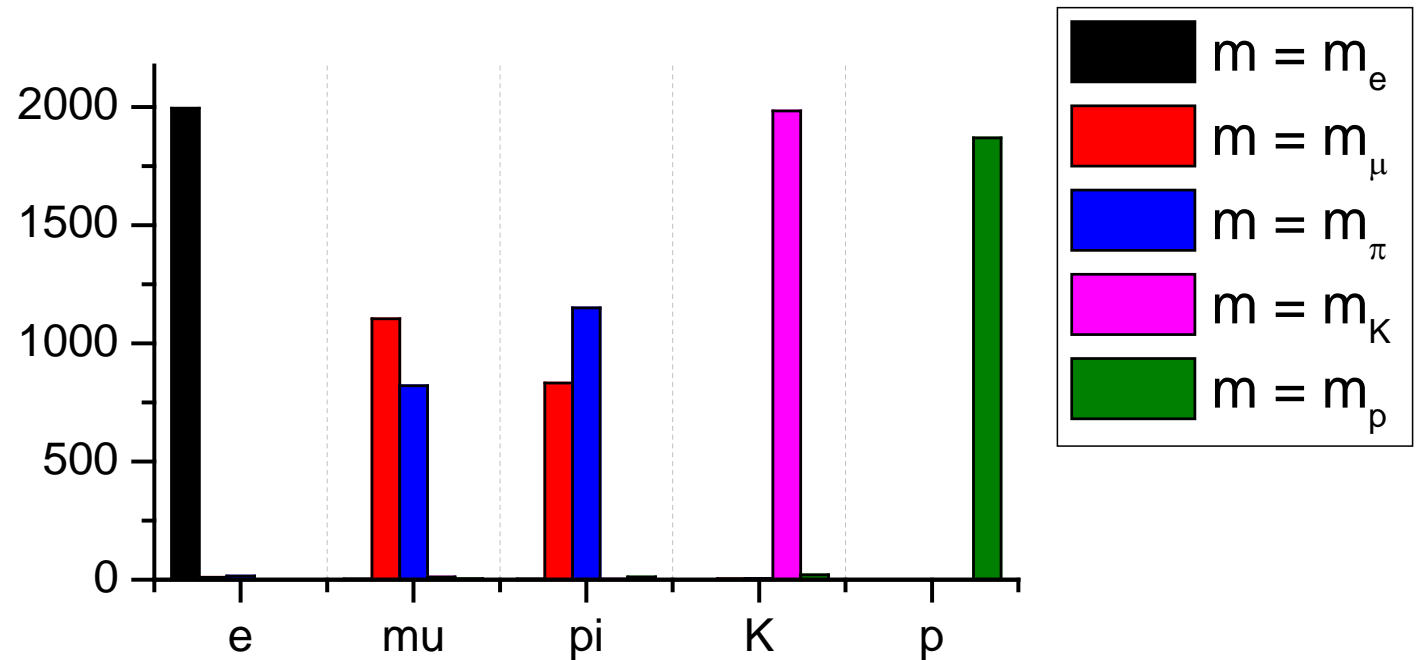


# T0 and PID algorithm check with ToyMC

PID and t0 with  $t_{TOF}$  smearing and 3 particle in events

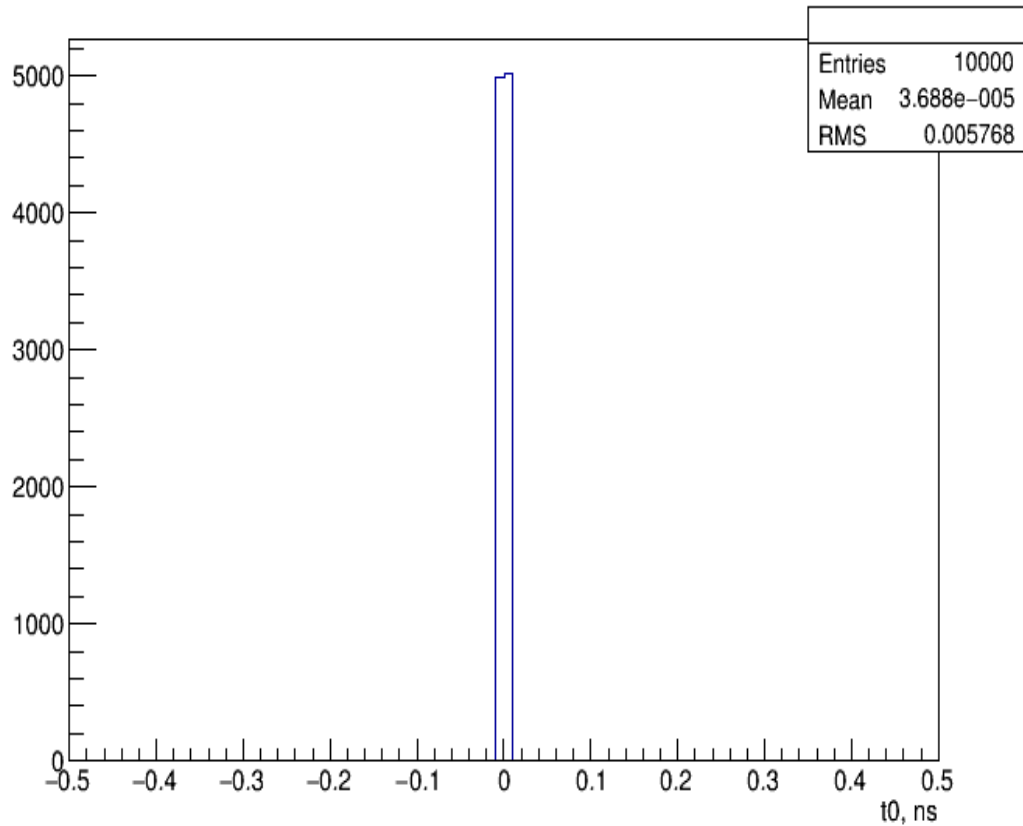


Number of particle detected as e, mu, pi, K or p

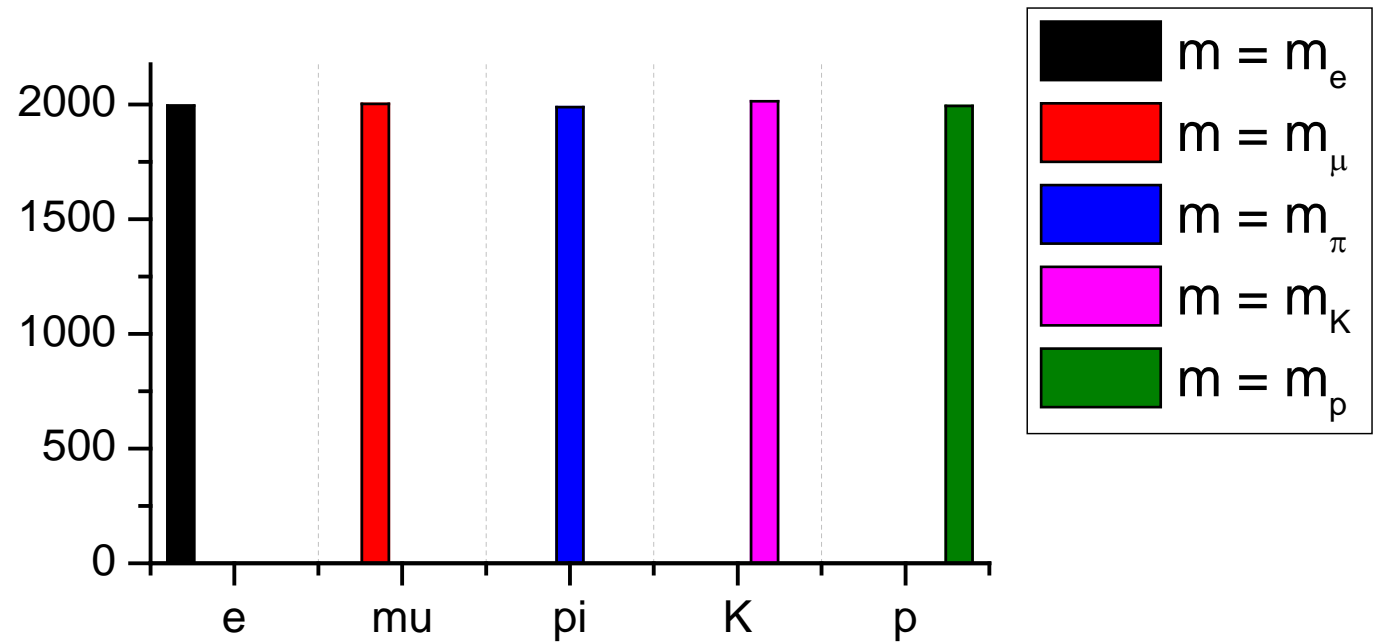


# T0 and PID algorithm check with ToyMC

PID and t0 without  $t_{TOF}$  smearing and 2 particle in events



Number of particle detected as e, mu, pi, K or p



# T0 and PID algorithm with PandaROOT

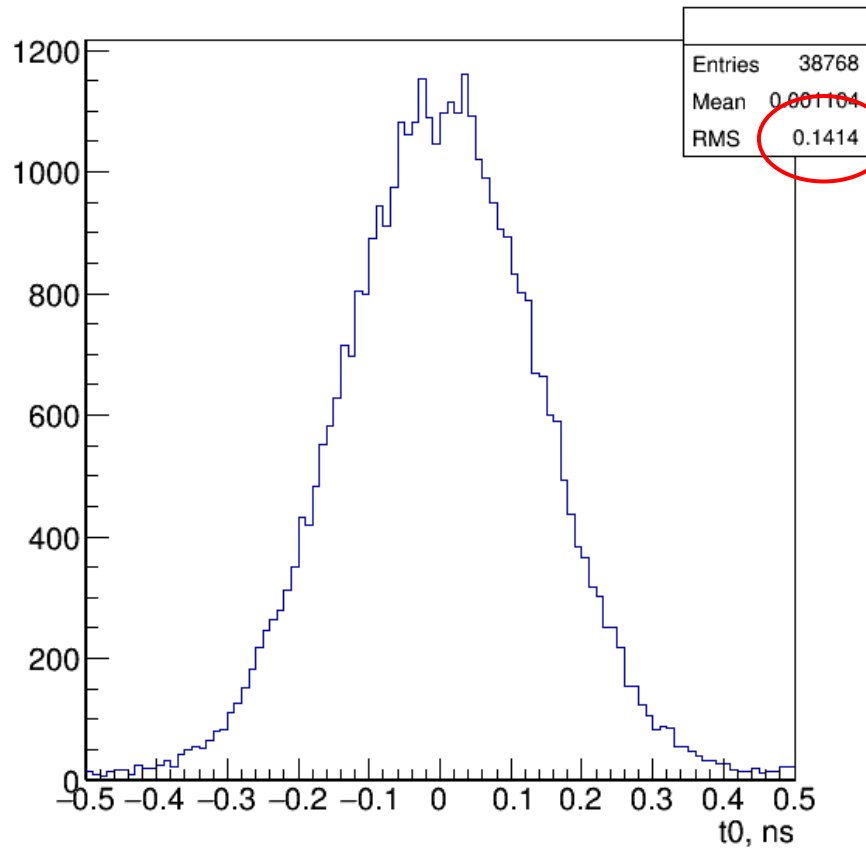
---

- Generate 1M DPM events
- FTOF time resolution set to 70 ps
- FtsIdealTrack reconstruction
- Use tracking info for momentum,  $t_{TOF}$  and track length
- Event base simulation -> t0 should be 0
- Cut on momentum  $p < 4$  GeV
- Events with only 2 FTOF hits
- Events with 3 and more FTOF hits

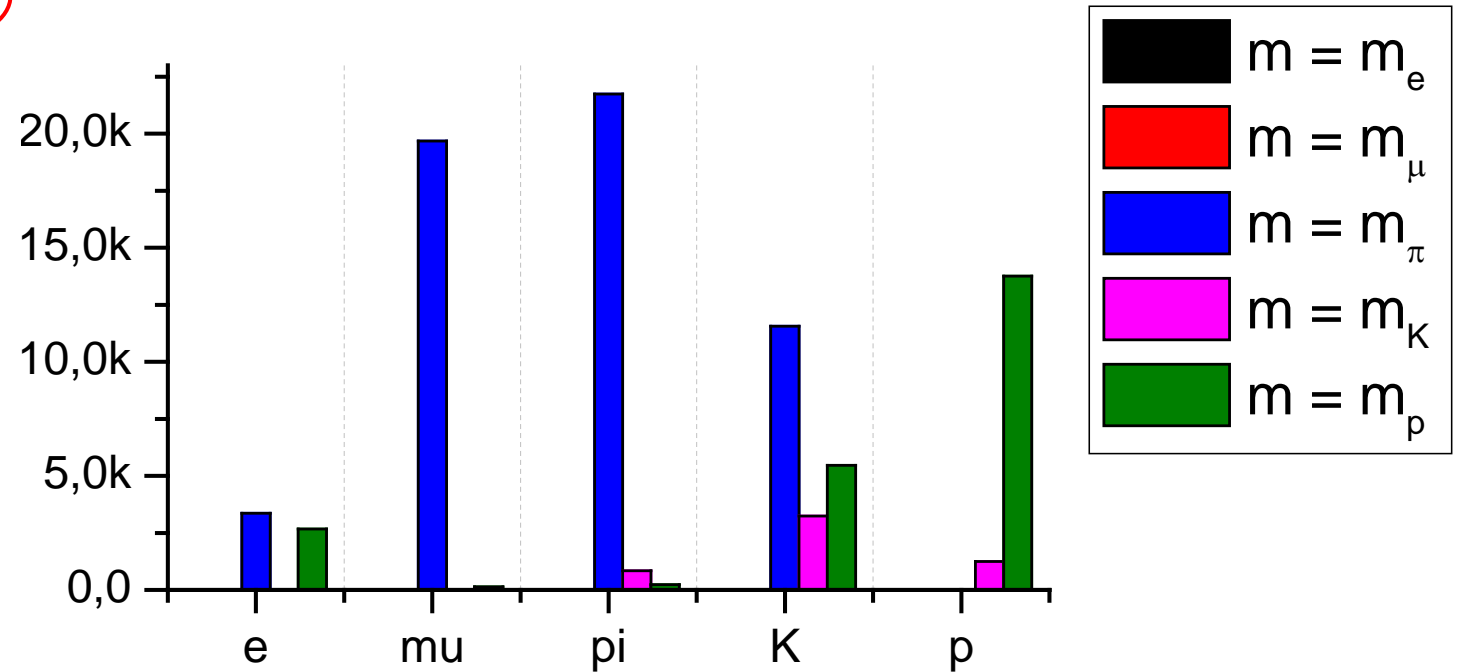


# T0 and PID algorithm with PandaROOT

PID and t0 for events with only 2 FTOF hits

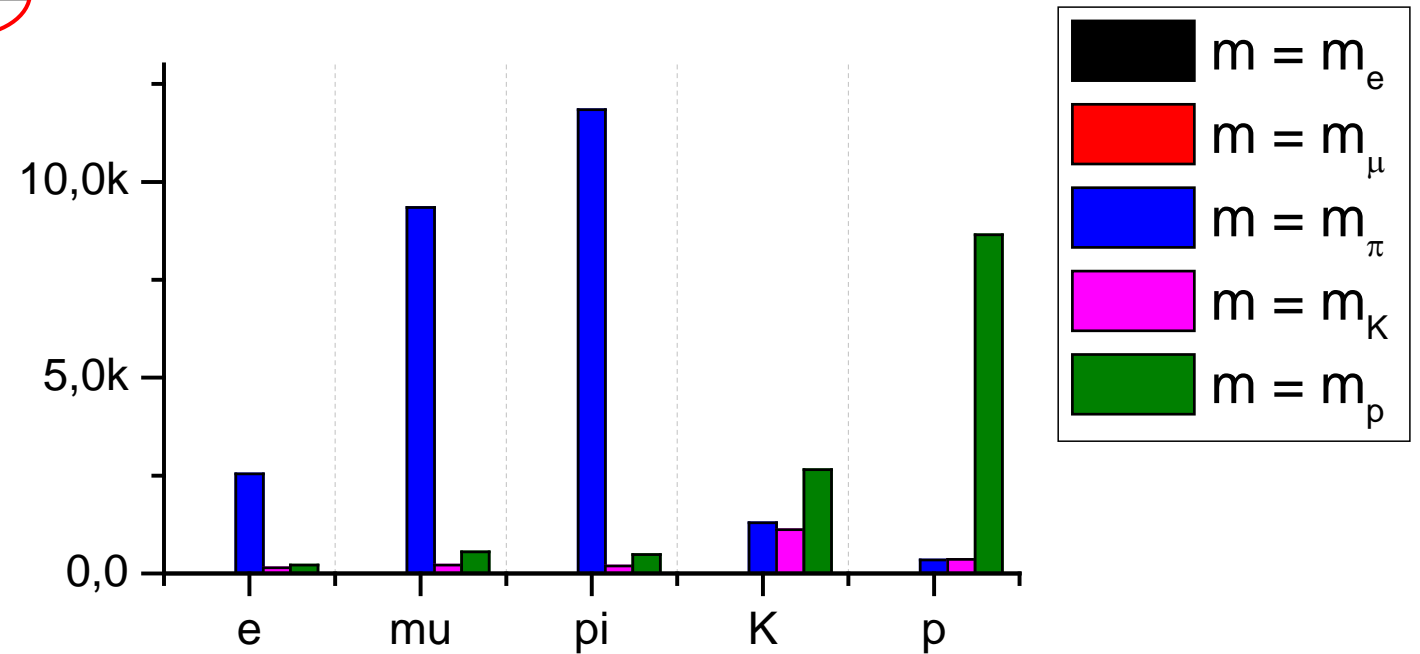
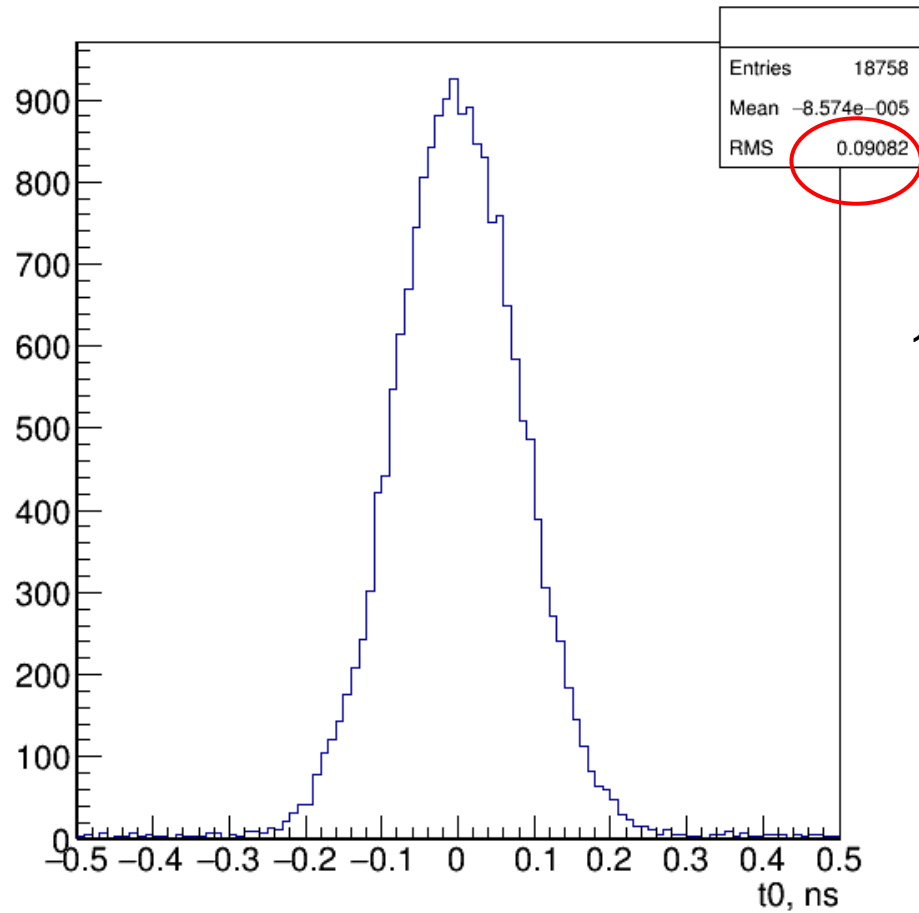


~20% protons as kaons and ~13% pions as kaons



# T0 and PID algorithm with PandaROOT

PID and t0 for events with only 3 FTOF hits

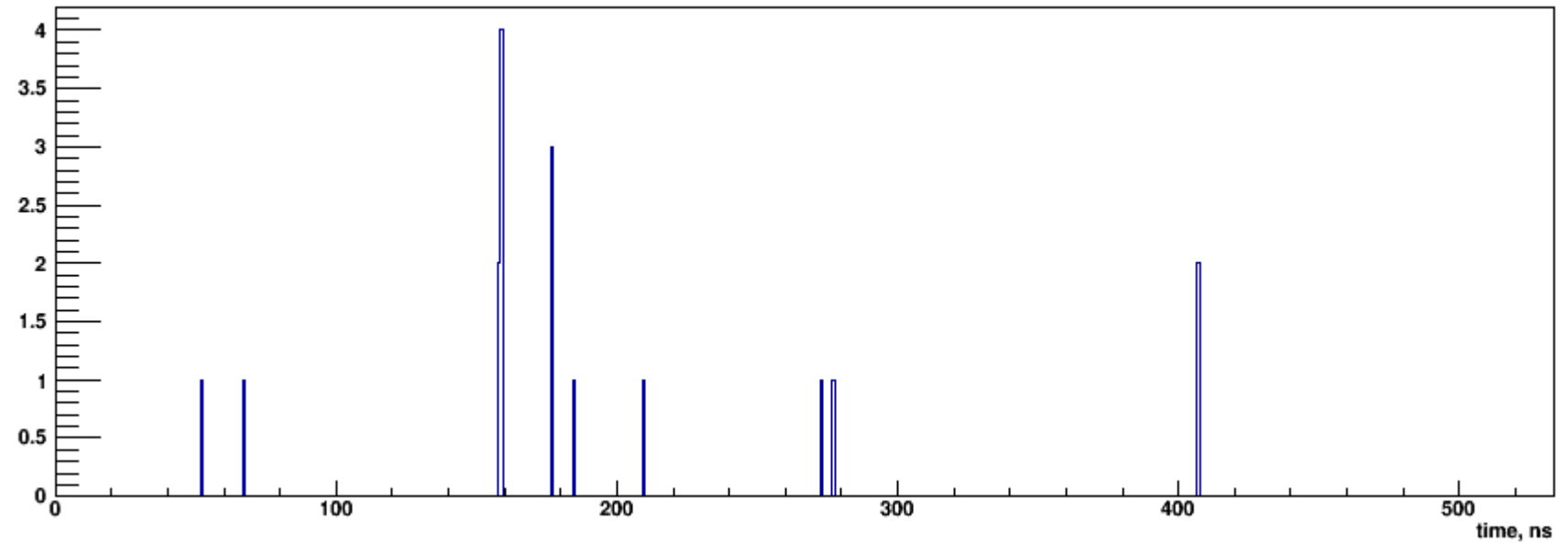


# Timebase simulation

DPM generator

High lumi mode

$P_{beam} = 5 \text{ GeV}$

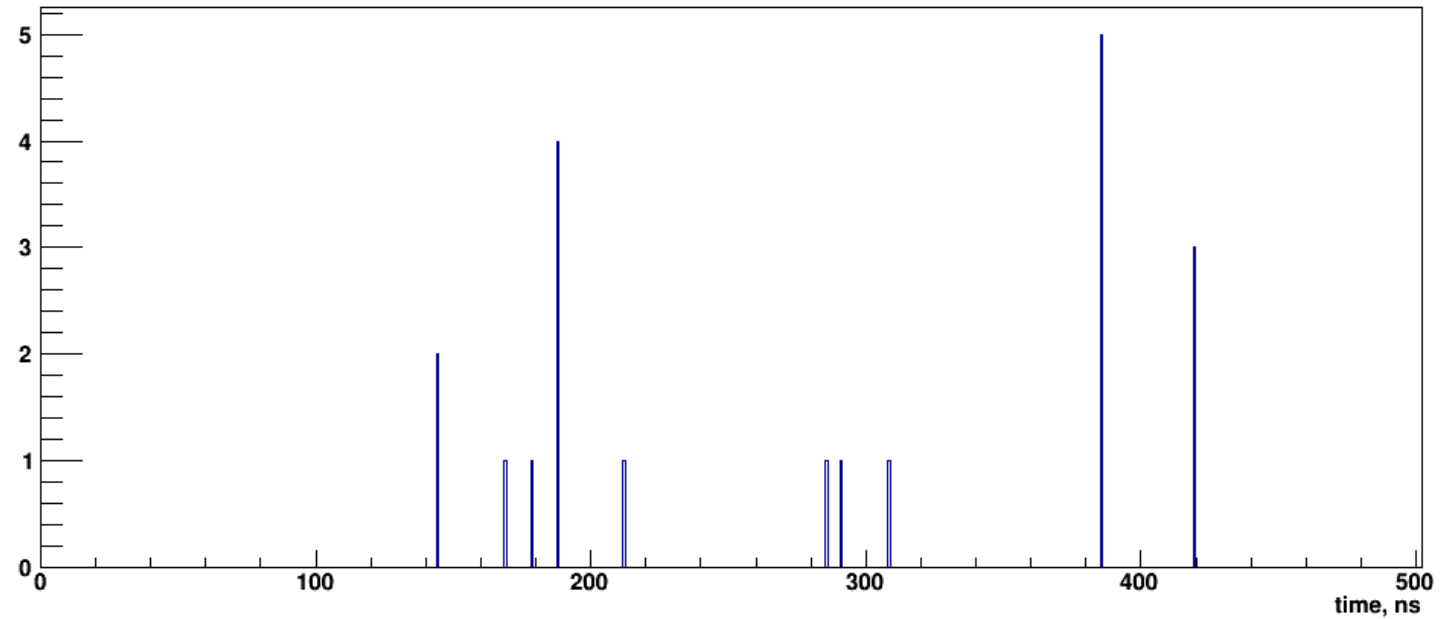


# Timebase simulation

DPM generator

High lumi mode

$P_{beam} = 15 \text{ GeV}$



# Outlook

---

- Update geometry, include PMTs and support structure
- T0 and PID algorithms with timebase simulation:
  - Event mixing
- Combine FTOF and SciTil
- Calibration using binary reaction like  $p\bar{p} \rightarrow \Lambda\bar{\Lambda}$