

Pid based on SciTil

Dominik Steinschaden

On behalf of the Panda SciTil group

GSI Darmstadt, 8.6.2016

Summary of the last meeting

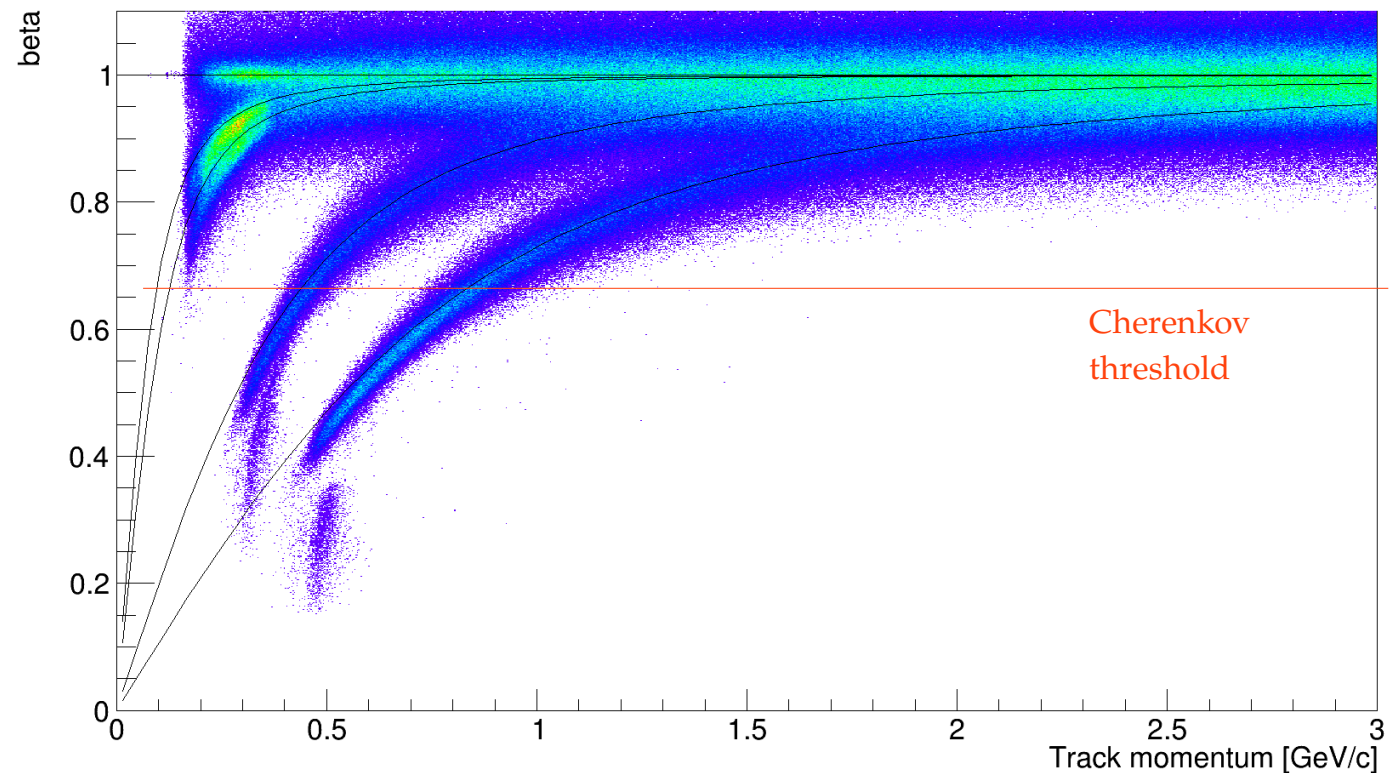
- Pid based on beta:

$$- \text{beta} = \frac{\text{track length}}{\text{time of flight} * c}$$

- Reference:

$$- \text{beta} = \sqrt{\frac{p^2}{m_0^2 * p^2}}$$

TOF based PID (sigma = 100ps)

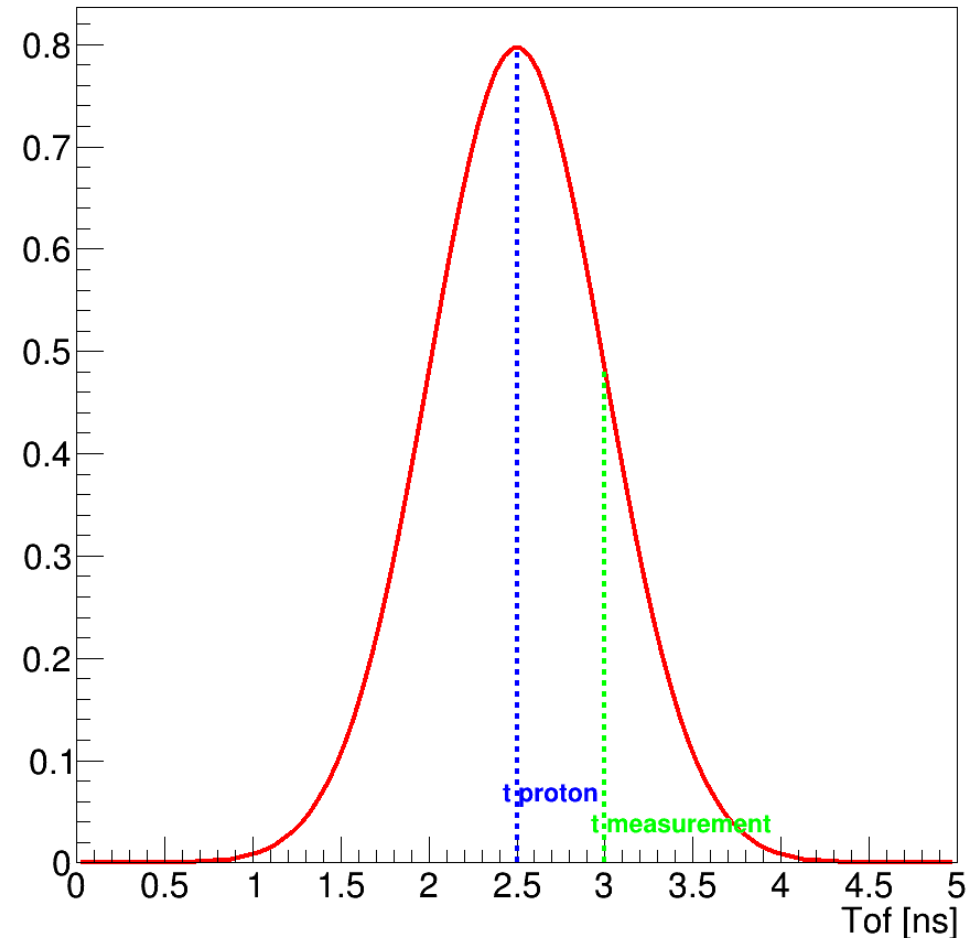


Definition of TOF-PID Probability

- Derive the corresponding
calculated/expected time-of-flights
 - l → reconstructed track length
 - p → reconstructed momentum
 - m_i → mass assumption
 - Proton, kaon, pion, muon, electron

$$t_i \equiv l \cdot \sqrt{\left(\frac{m_i}{p}\right)^2 + 1}$$

- Generate a normalized Gaussian
 - Around calculated time-of-flight
 - Time-of-flight resolution corresponding to the parameters of the track
- Probabilities are derived from the gaussian at measured time-of-flight
- Pdfs has to be normalized



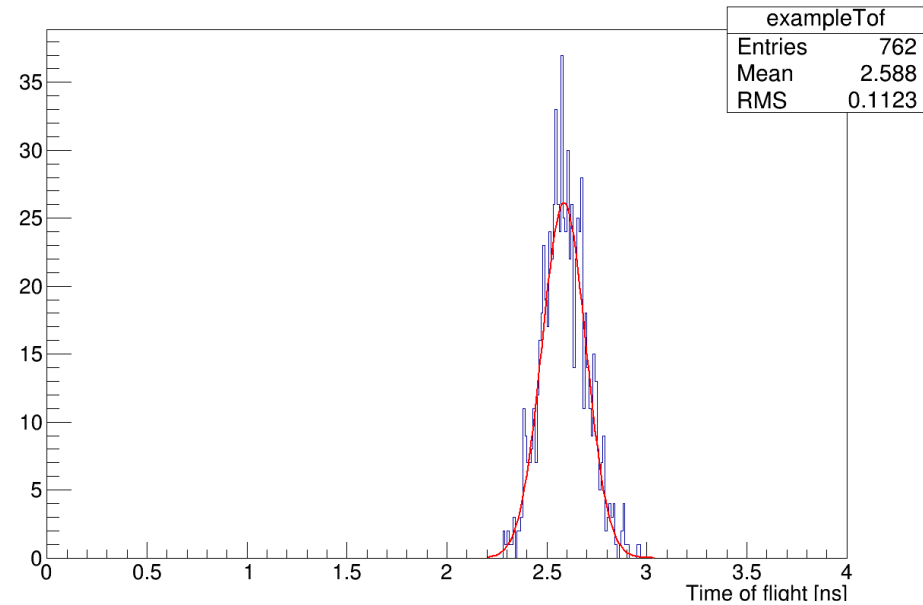
Determination of Time-of-flight resolution

- Tof resolution of effected by:
 - Intrinsic time resolution
 - $\sigma = 100$ ps (current implementation)
 - Track length resolution
 - Momentum resolution
- Evaluation of Tof resolution using MC simulations
 - Investigation of Tof σ as a function of the tracking parameters

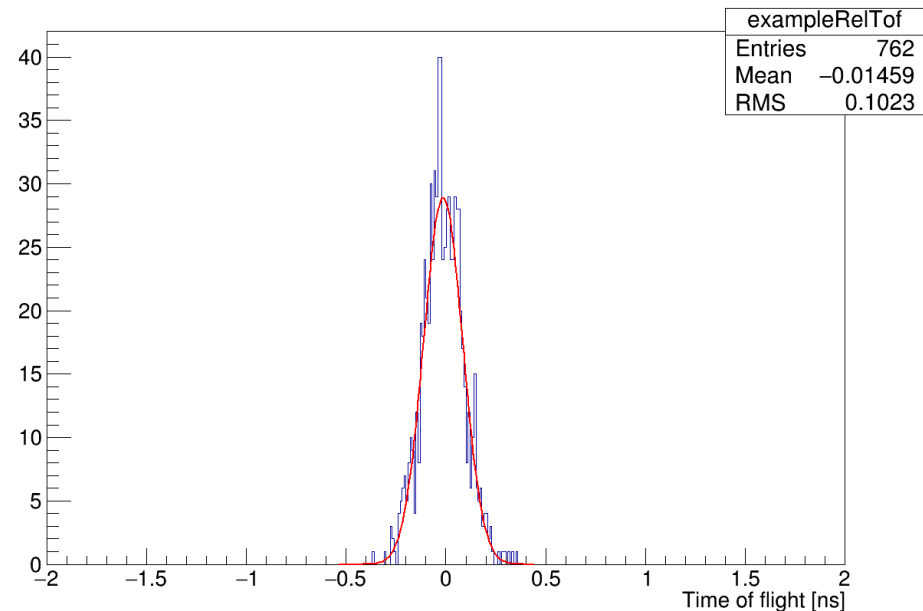
- Pandaroot, trunk 28975
- Full Geometry
- Boxed Generator
 - Proton, kaon, pion, muon, electron
 - 10^6 events
 - 0.05 – 3 GeV/c
 - $\Theta = 20 - 140$
- Perfect T0 estimated

- Evaluation of ToF resolution effected by binning effects
 - e.g.: momentum range, track length range, ...
- “residual ToF” instead
 - $t_{\text{res}} = t_{\text{measured}} - t_{\text{calculated}}$

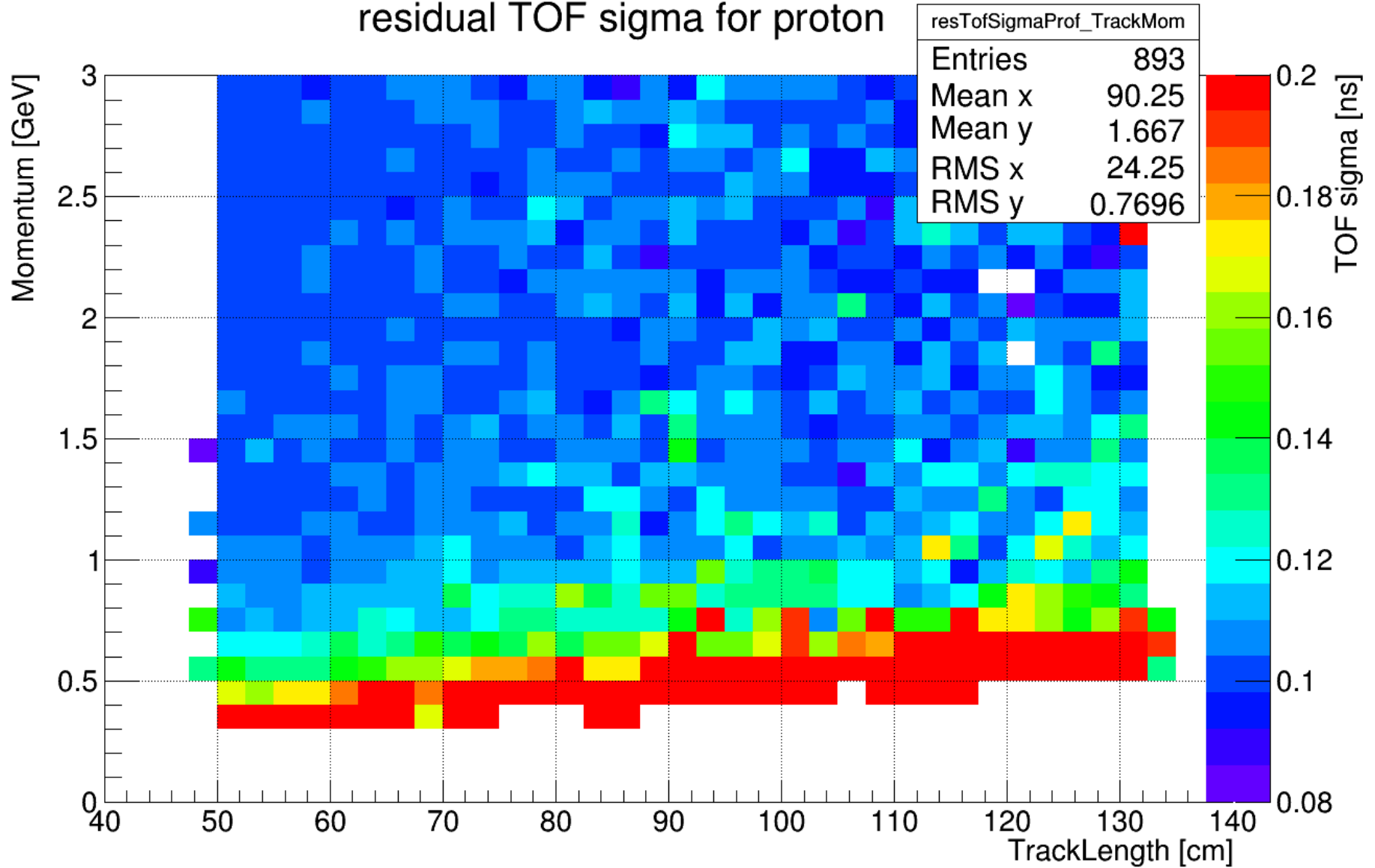
TOF distribution for protons (pTrans = 1.5-1.6 GeV/c HitPosition = 40-46cm)

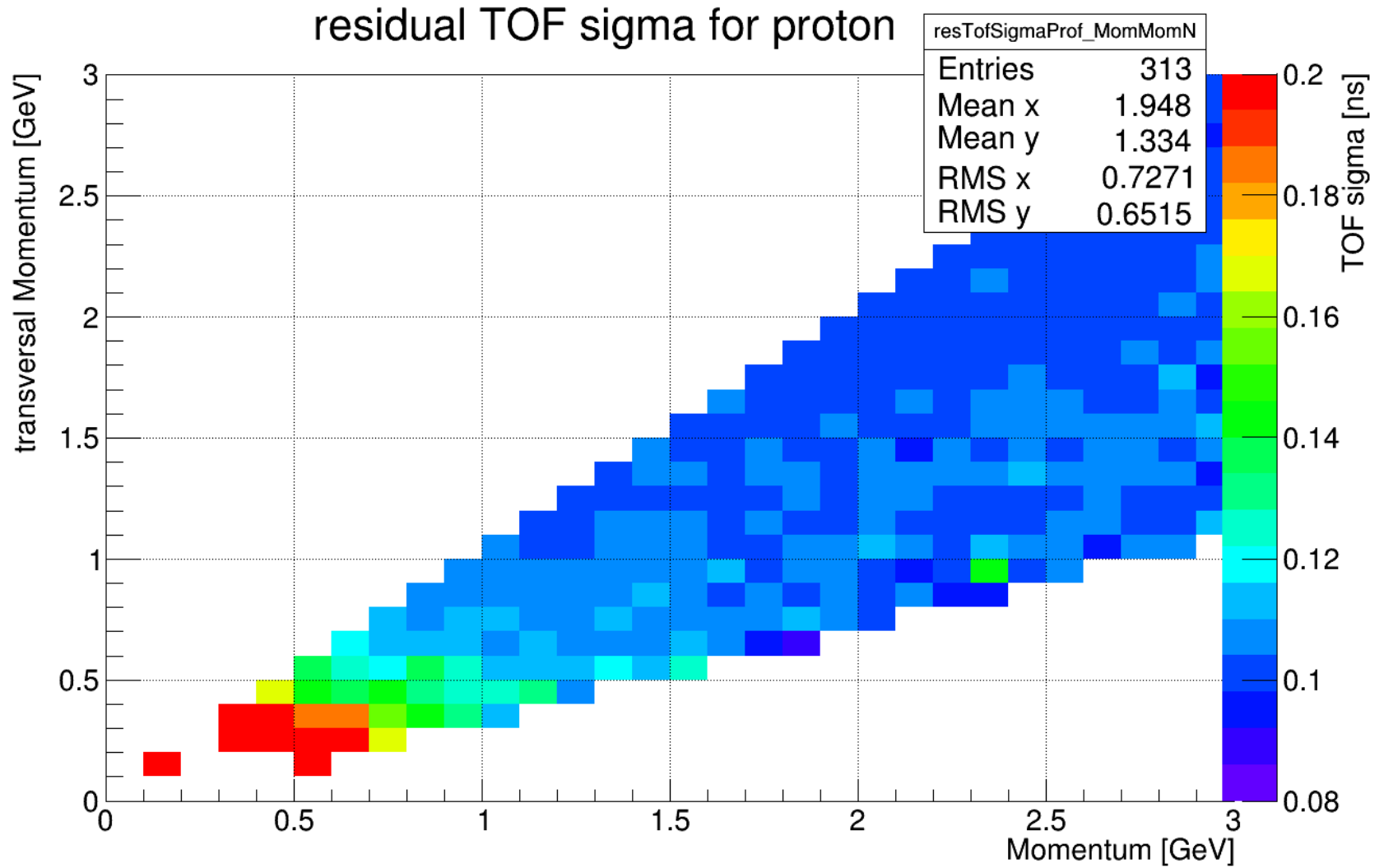


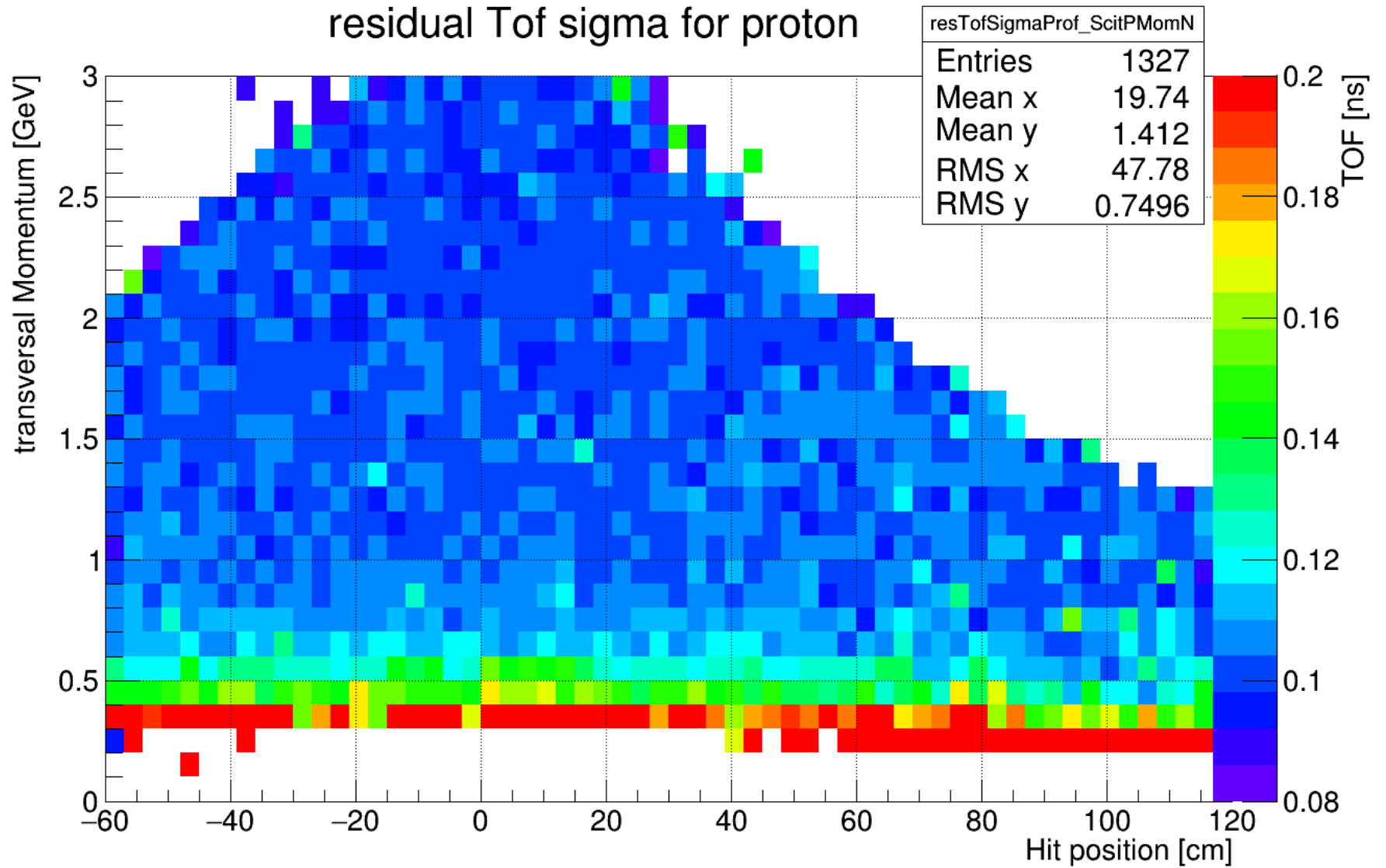
residual TOF distribution for protons (pTrans = 1.5-1.51 GeV/c HitPosition = 40cm)



residual TOF sigma for proton

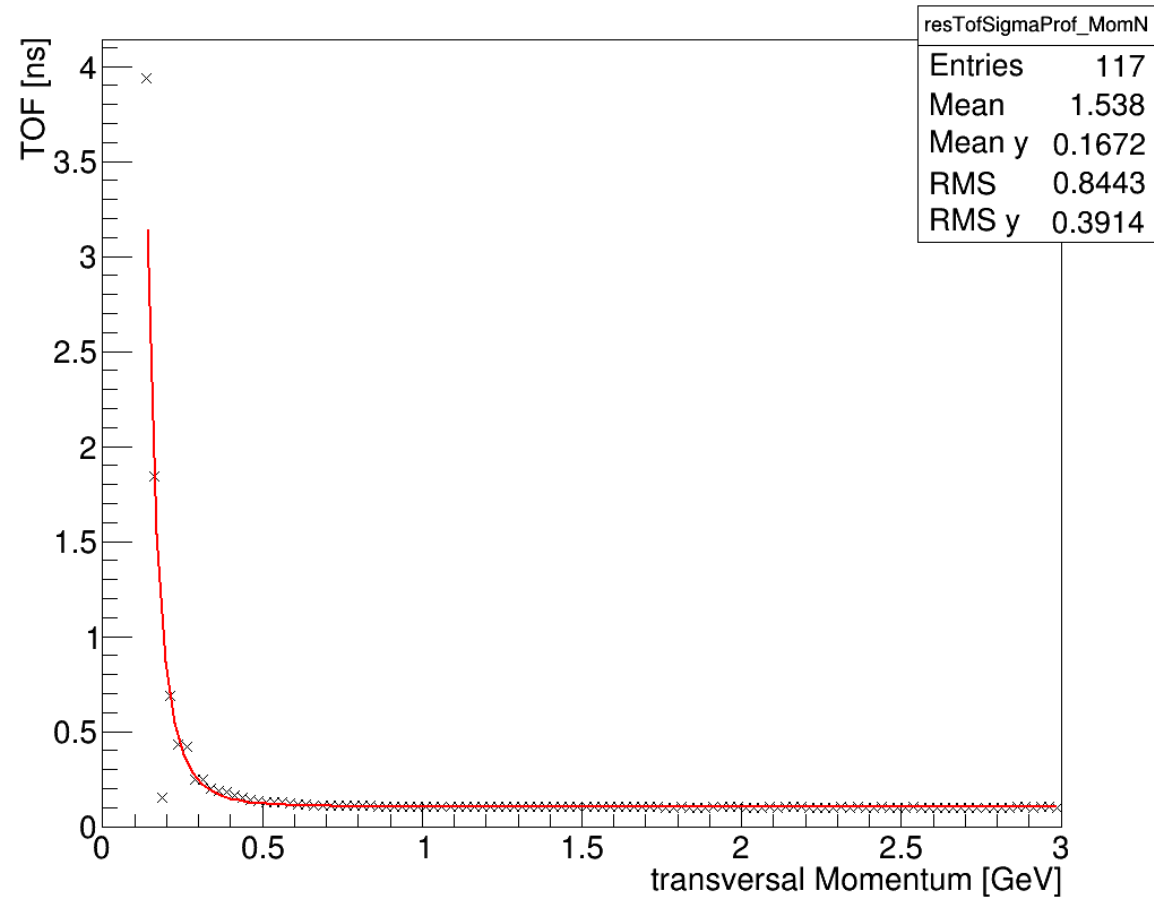






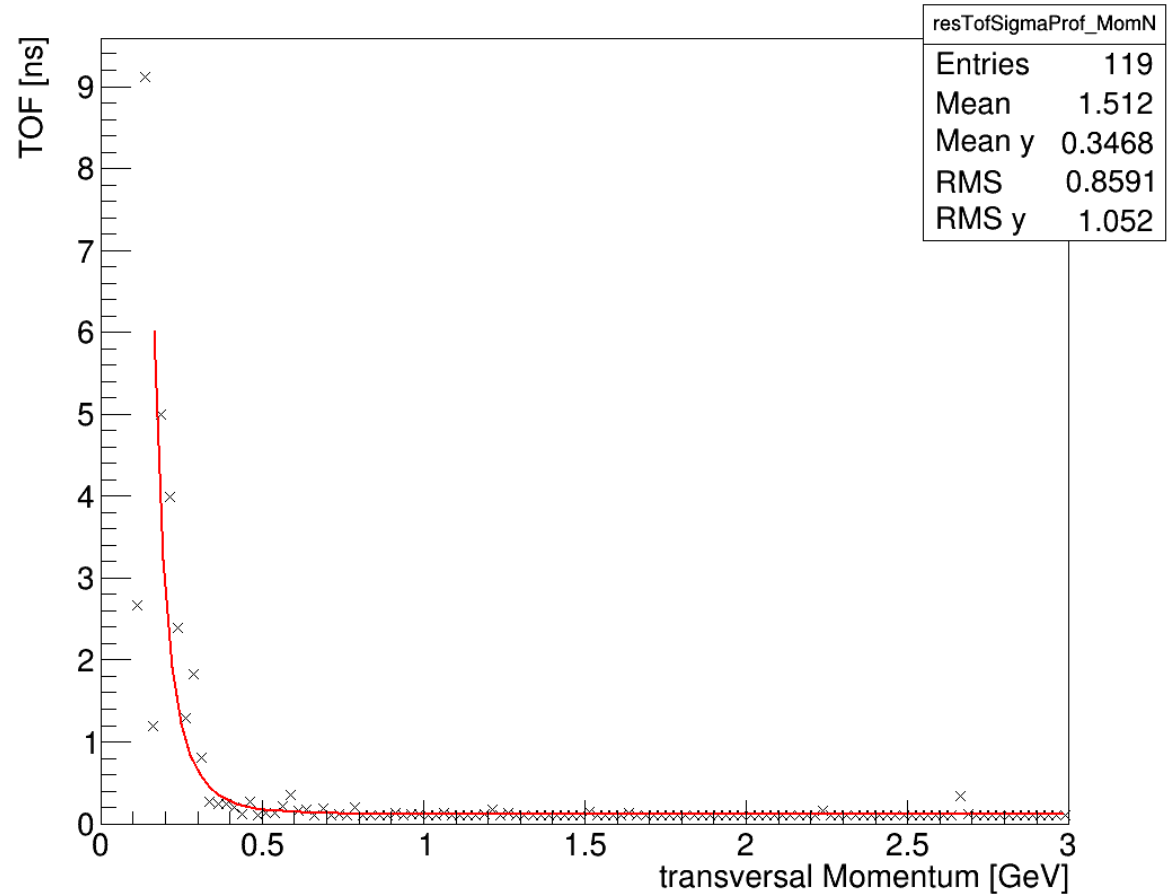
- $P_{\text{trans}} > 0.5 \text{ GeV}/c$
 - $\sigma_{\text{Tof}} = 110 \text{ ps}$
- $P_{\text{trans}} < 0.5 \text{ GeV}/c$
 - Particle with low p_{trans} can't reach the SciTil directly
 - $\text{Tof } \sigma = \frac{1.4 * 10^{-3}}{P_{\text{trans}}^4} + 0.103$
 - Statistic for low p_{trans} is rather low

residual Tof sigma for proton



- For light particles
 - σ_{ToF} depends also on p_{total}
 - Scattering length
- Investigations are ongoing

residual ToF sigma for electron



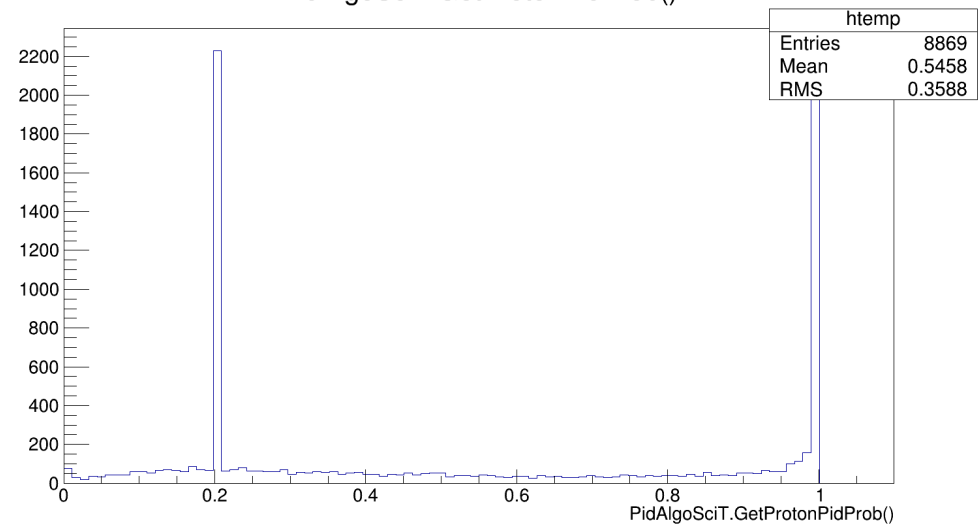
Implementation in Pandaroot

- Tof based PID implemented in Pandaroot
 - Using the “residual TOF method”
 - Resolution of the TOF system set to a fixed value
 - $\sigma_{\text{Tof}} = 110 \text{ ps}$
 - Correction for low P_{trans} will be added soon
 - Still perfect T0 estimated

PID stage

- Add new task
 - `PndPidSciTAssociatorTask *assSciT= new PndPidSciTAssociatorTask();`
 - `fRun->AddTask(assSciT);`

PidAlgoSciT.GetProtonPidProb()



Work in progress

- Updating implementation according to current detector development
 - Intrinsic time resolution → 54 ps
- Check (and improve) the track propagation to the SciTil
 - Low P_{trans}
 - Tracklength underestimated
- Evaluating σ_{Tof} function for all particle species
 - Implementation in Pandaroot
- Investigate the separation power in σ

Thank you for your attention