Time of Flight (TOF) Analysis Update

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Outline

- Board selection criteria and measured TOF with/without ϕ-cut
- Back-reconstructed raw elevation angle, θ_{raw}, distribution
- 2D measured TOF vs θ_{raw} distribution
- 1D Measured TOF and θ_{raw} distribution with forward/backward selection
- Resolution power calculation
- Some considerations

[Note: For all the plots in this work 4 stations golden track selected data from runs 915 to 934 was used.]

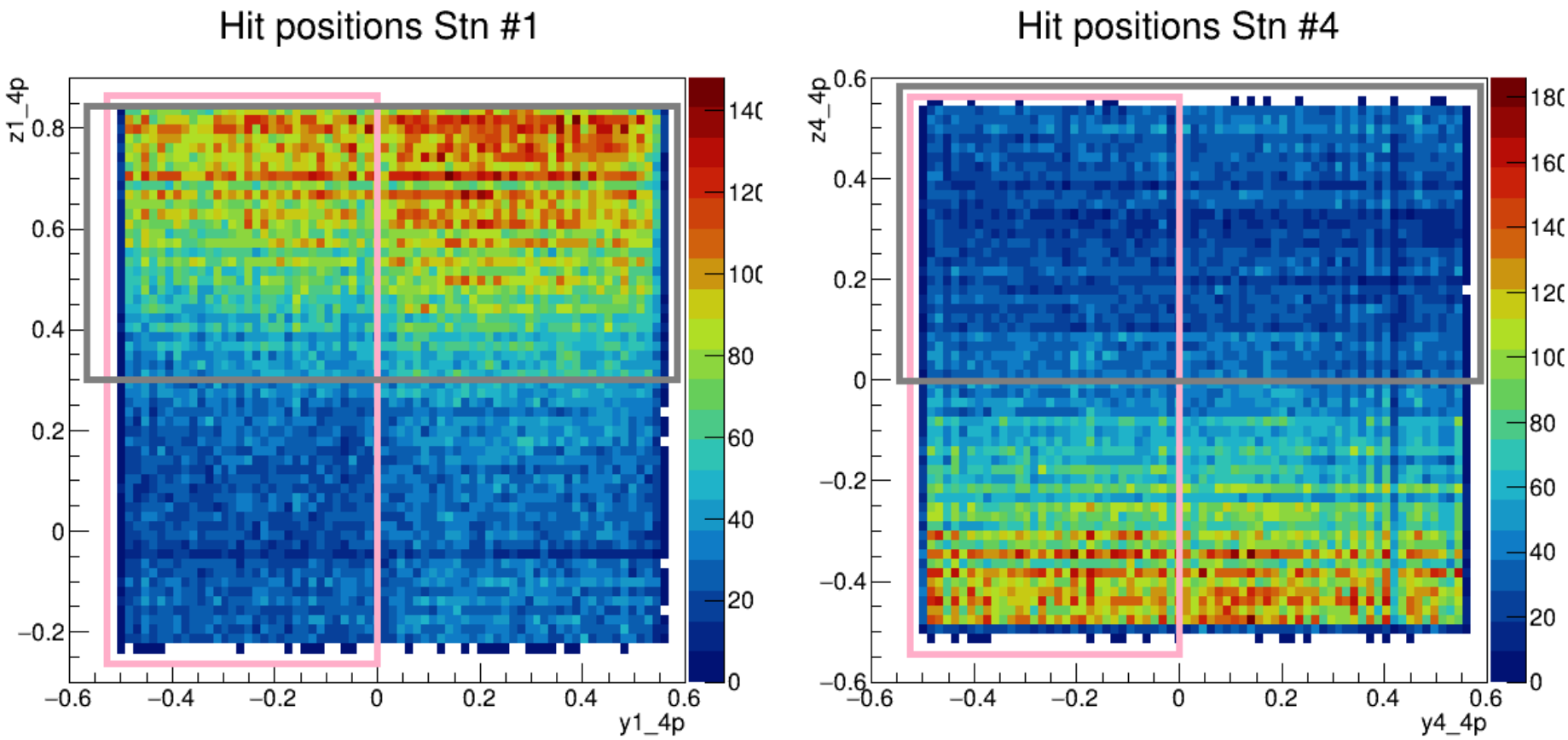
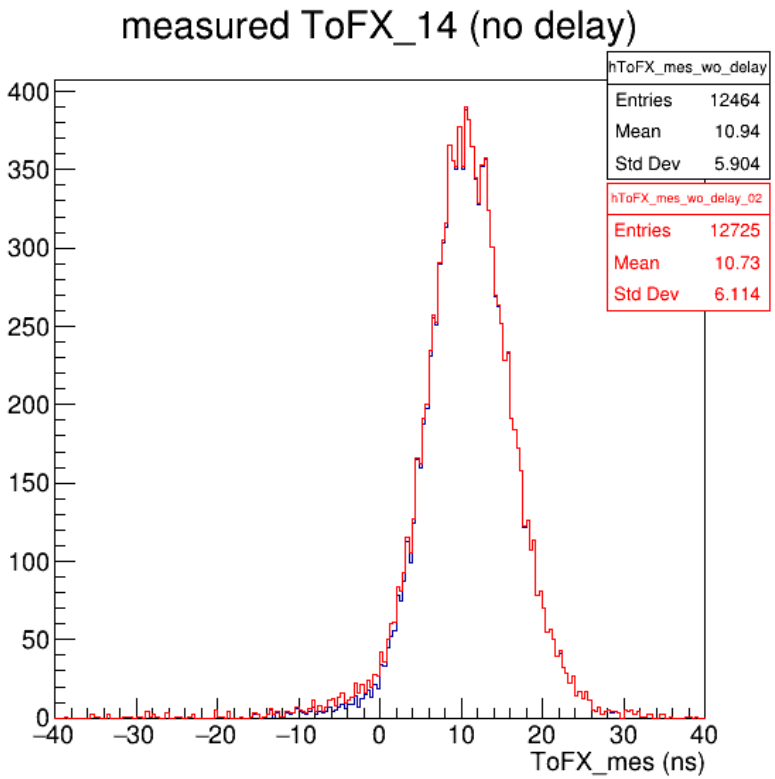


Figure: Y and Z hits positions in Station 1 and Station 4

- Boards in the X-views (i.e., #1, #13) were selected a logical "AND" of gray boxes
- Similarly, a logical "AND" of pink boxes was used to select Y boards (i.e., #2, #14)

measured TOF distributions for X and Y views



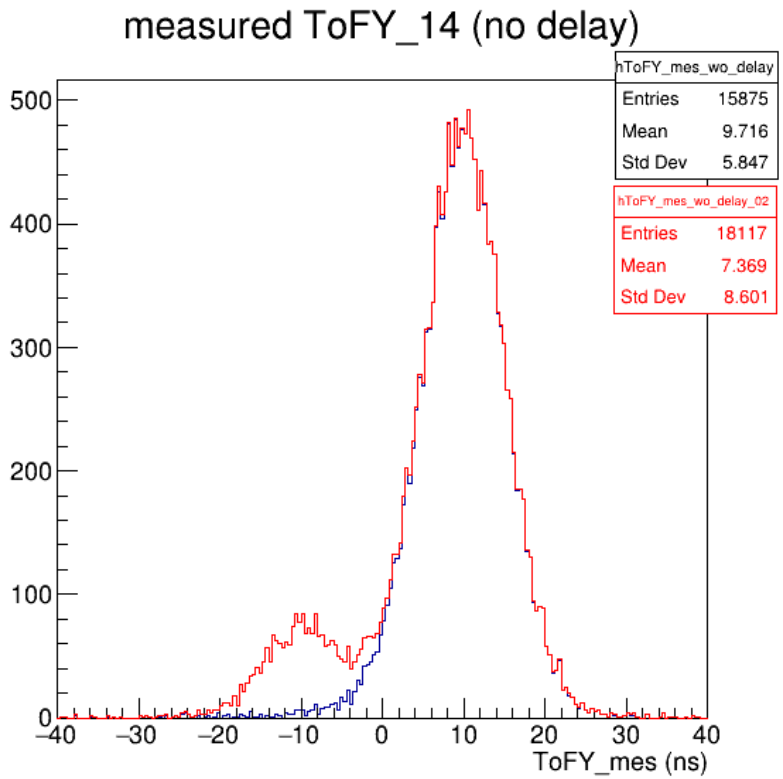


Figure: measured TOF (without delay) for both views after relevant boards selection with and without the ϕ-cut: $(90 < \phi < 270)$

$\rightarrow$ We were puzzled by the "shoulder" and the mismatch of minimization results for Y-view.

$\rightarrow$ Then we realized that our selection was not really the same: we were missing a $90 < \phi < 270$ cut that she applies for the purpose of this study!

Back-reconstructed raw θ

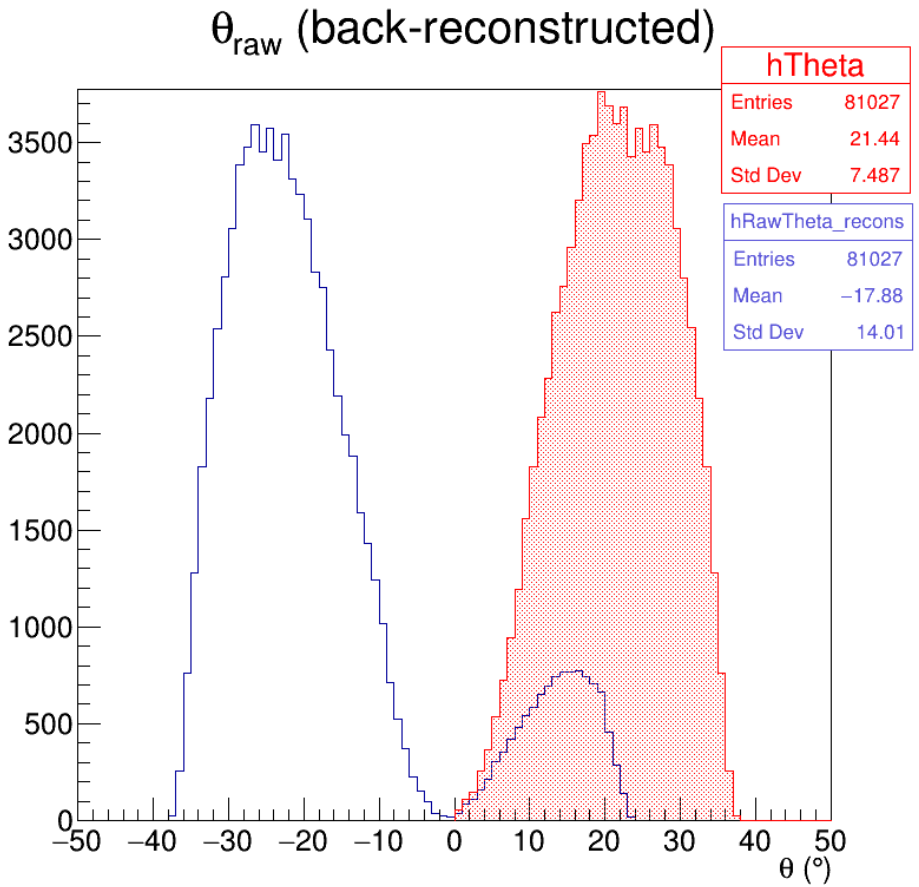


Figure: Red histogram represents reconstructed θ_{reco} from the ntuples; Back-reconstructed θ_{raw} is given by blue histogram.

$\rightarrow$ Back-reconstruction was done with the following condition:

IF $90 < \phi < 270$, THEN, $\theta_{raw} = -\theta_{reco}$

measured TOF vs θ_{raw}

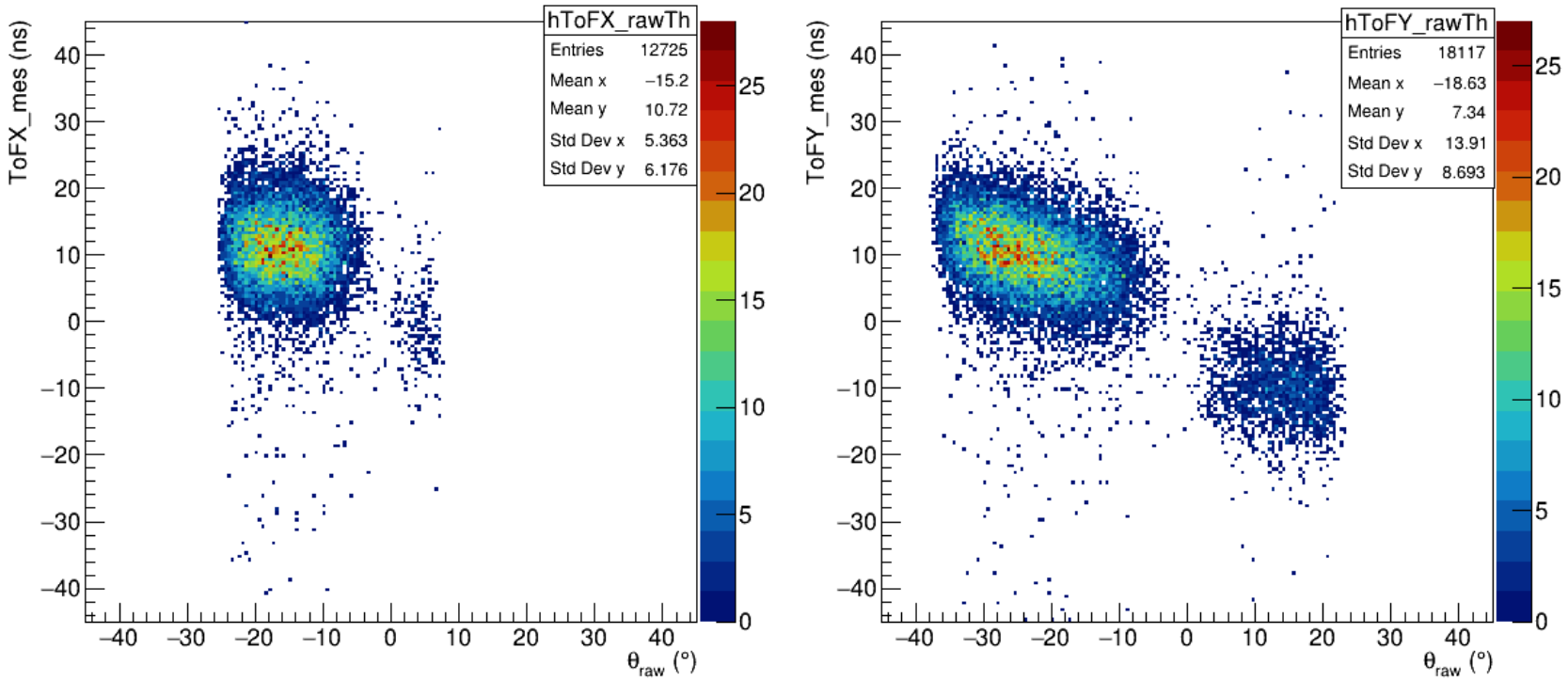


Figure: Right Panel: messured TOF (X-view) vs θ_{raw} Left Panel: messured TOF (Y-view) vs θ_{raw}

$\rightarrow$ We believe the two islands (more clear in Y-view) represent "forward" and "backward" muons

measured TOF with θ_{raw} cuts

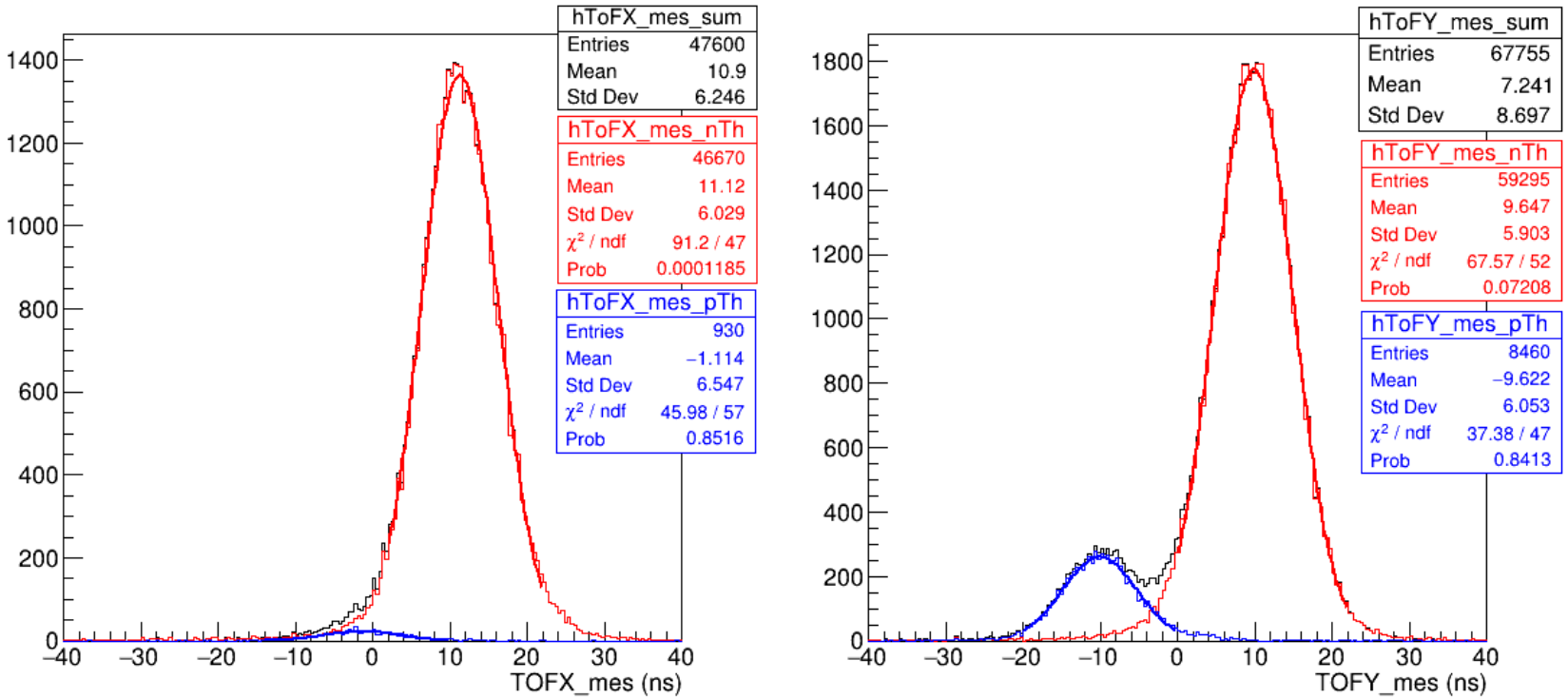


Figure: TOF Distribution (both views). The red curves/histos represent TOF distribution with $\theta_{raw} < 0$, and the blue curves/histos represent TOF distribution with $\theta_{raw} \geq 0$.

$\rightarrow$ The curves are Gaussian functions fitted to the relevant histograms

θ_{raw} with measured TOF cuts

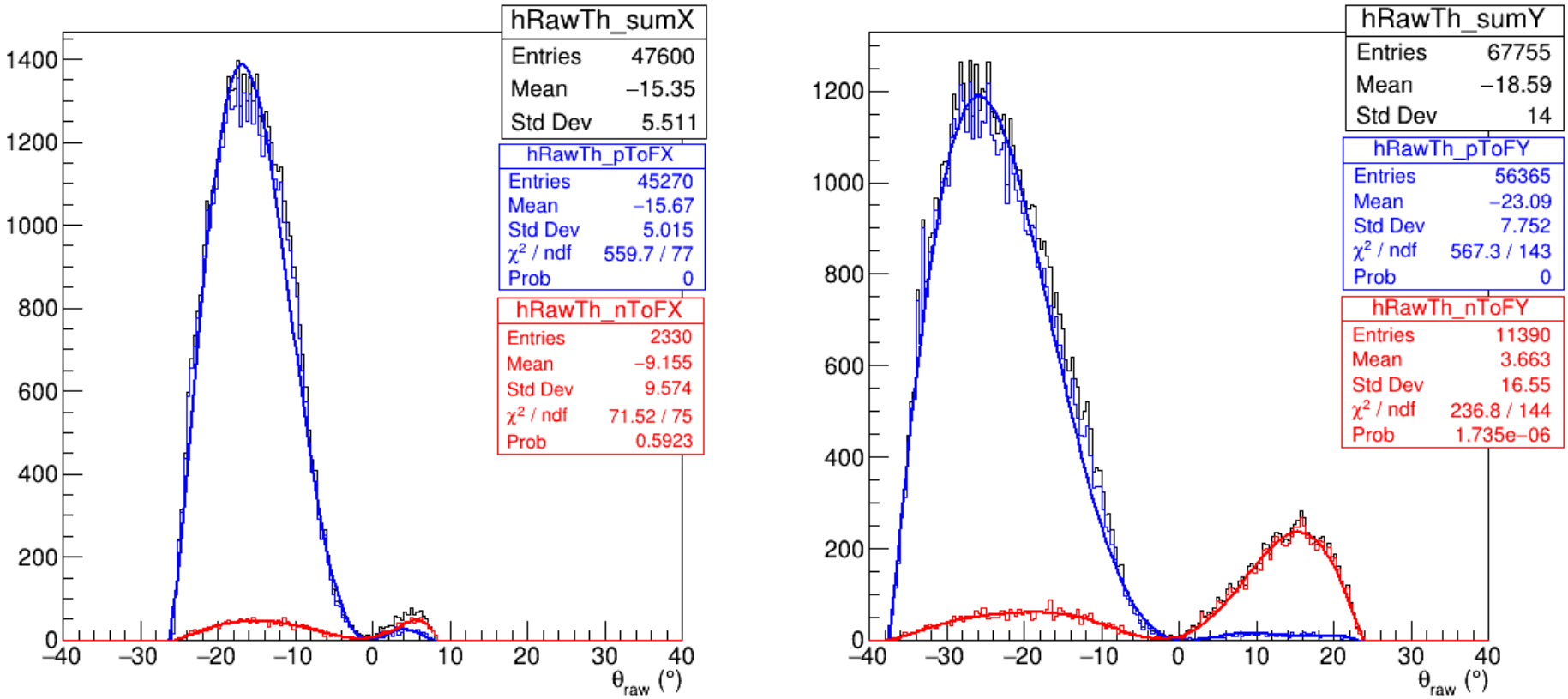


Figure: θ_{raw} Distributions. The red curves/histos represent θraw distribution with $TOF < 0$, and the blue curves/histos represent θraw distribution with $TOF \geq 0$.

$\rightarrow$ The curves are polynomial functions (rank=5) fitted to the relevant histograms

Some considerations

- In this short study, an estimation of resolution powers calculation for two TOFs and two θ_{raw} was done
- Among all the distributions studied here, TOF in Y-view discriminates the best between "forward" and "backward" muons as it has the best resolution power
- However, it will be ideal to combine all four of these quantities to help separate out forward and backward muons

- Any comments, feedback, and suggestions are most welcome.

- Thank you for your attention

Resolution power: which quantity discriminates better?

$$Resolution\ Power = \frac{m_{fwd} - m_{bck}}{\sqrt{(\sigma_{fwd})^2 + (\sigma_{bck})^2}} \quad (1)$$

Distributions	Resolution power
mes ToF (X-view)	1.85
mes ToF (Y-view)	2.85
θ_{raw} (with ToFX)	0.56*
θ_{raw} (with ToFY)	1.46*

Table: Resolution power estimation

$\rightarrow$ * Not fitting parameters are used for mean and σ calculation for these distributions.