

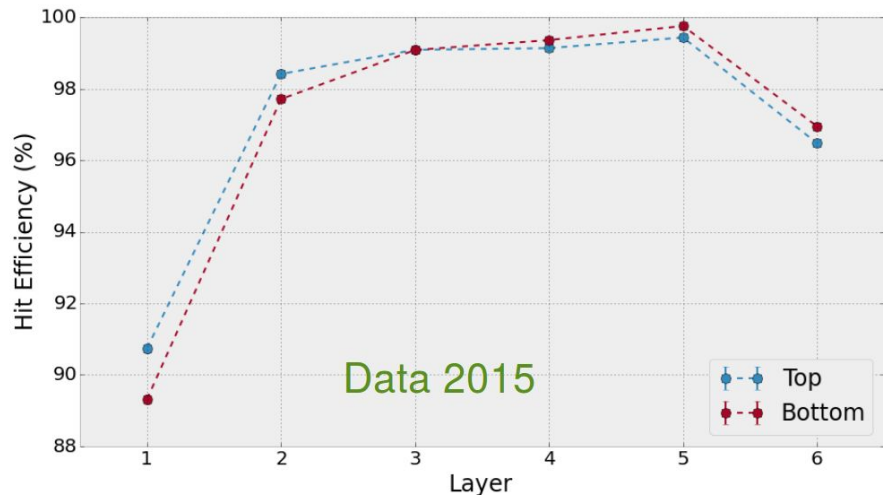
# SVT Hit Efficiencies

Matt Solt

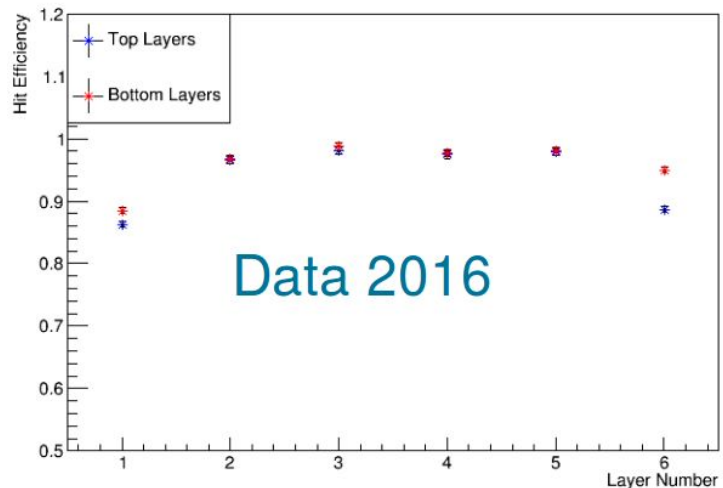
Dec. 11 2017

# Previous Efforts

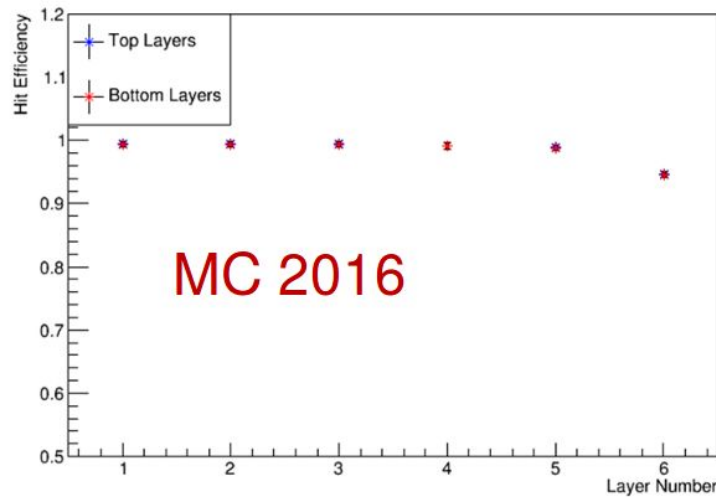
SVT Hit Efficiencies were given as a function of layer (Omar + Matt S.)



Hit Efficiency for Electrons Layers 1-6



Hit Efficiency for Electrons Layers 1-6



# Previous Hit Efficiency Method

Run the recon with different tracking strategies to isolate the layer of interest (3 seed, 1 confirm, and 1 extend) creating 6 different recon Lcio files

Run again over all files to find the unbiased residuals (sigma and mean) at each layer. Input (hard-coded) for each file type for all sensors

Extrapolate track to missing layer and see if it lies with acceptance (number of reconstructed tracks)

Search for a stereo hit within a narrow region of the extrapolated track – about 5 sigma of the unbiased residual (number of tracks with hits on all layers)

**This method was painful...**

# Current Efforts and Goals

SVT Hit Efficiencies could have a major effect on analysis

It is important to both understand them and **input them into MC** (for the big sample)

We currently find hit efficiency as function of layer, but we need as **function of sensor and channel**

**Developed a new method** for doing this. It is much cleaner and can be done in a **single step** (run over readout files for MC and evio files for data)

I have preliminary plots using pure tritrig MC (will run over data soon)

# New Hit Efficiency Method

Run the recon up to helical track hits

Remove a helical track hit at each layer, output each into a new collection

Run the standard tracking strategies on these new helical track hit collections with missing hits (except L3 need new strategy) and then do a GBL refit

Extrapolate track to missing layer and see if it lies with acceptance (number of reconstructed tracks)

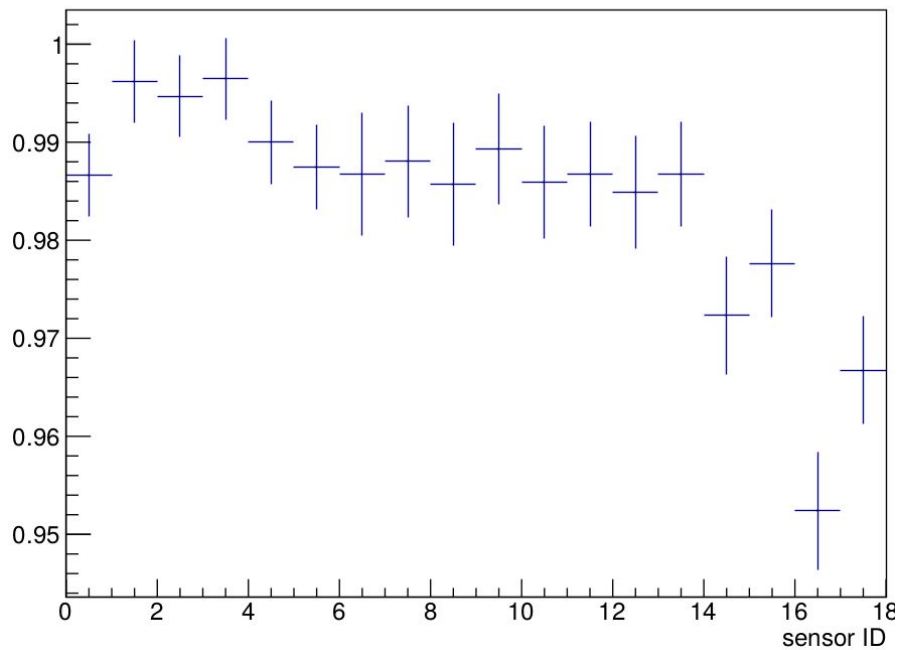
Search for a stereo hit within a narrow region of the extrapolated track – 5 sigma of the **unbiased extrapolated u error** (number of tracks with hits on all layers)

Apply a correction factor for multiple scattering (shown in a few slides)

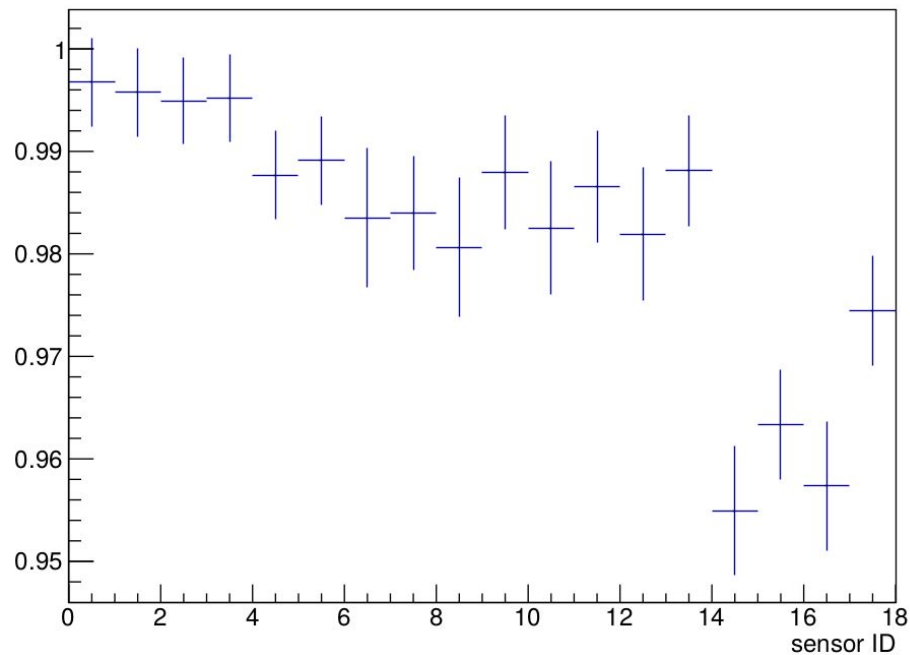
# Hit Efficiencies

All plots are pure tritrig MC (should be pretty clean)

Total Eff Top



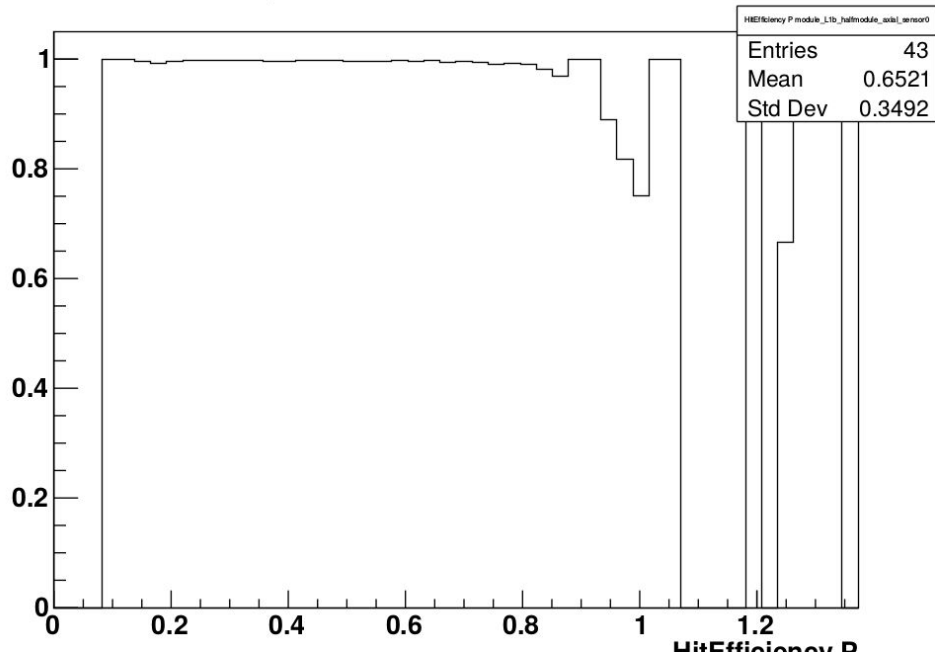
Total Eff Bottom



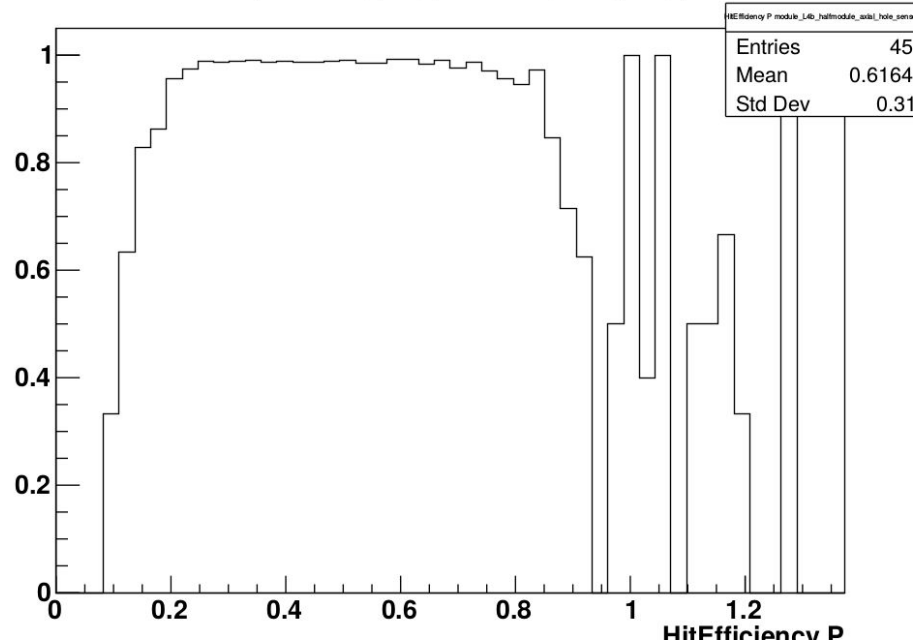
# Hit Efficiency as Function of Momentum

L1-3 looks fairly flat in momentum. L4-6 seems to dip for low/high momentum

HitEfficiency P module\_L1b\_halfmodule\_axial\_sensor0



HitEfficiency P module\_L4b\_halfmodule\_axial\_hole\_sensor0



# Computing Extrapolated U Error

Get Jacobian for CL to Perigee transformation and vice-versa  $J_{CLtoPer}$   $J_{PeritoCL}$

Get Jacobian for extrapolating tracks in CL  $J_{stepCL}$

Get covariance matrix in perigee  $Cov_{Per}$

Compute covariance matrix at extrapolated layer in perigee

$$Cov_{ExPer} = J_{CLtoPer} J_{stepCL} J_{PeritoCL} Cov_{Per} J_{PeritoCL}^T J_{stepCL}^T J_{CLtoPer}^T$$

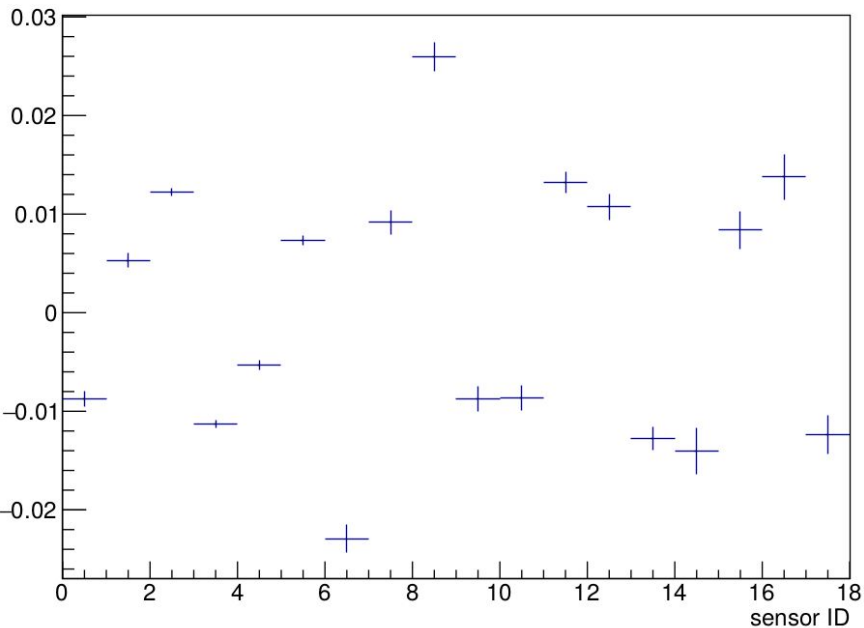
Rotate covariance into sensor frame to get errors



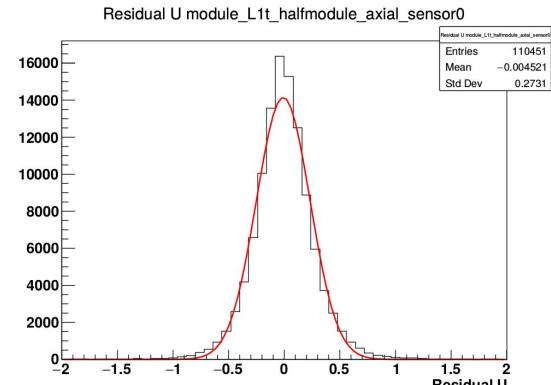
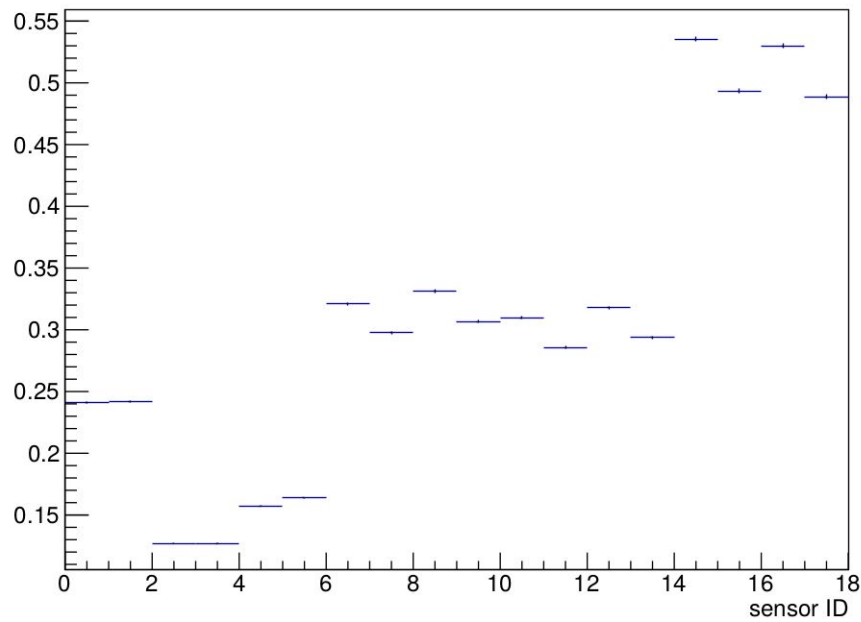
# Unbiased U Residuals Top

Fitted unbiased residuals mean/sigma top

Residual U Mean Top

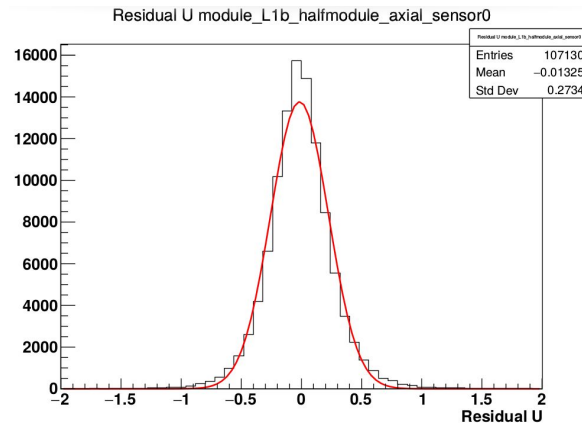


Residual U Sigma Top

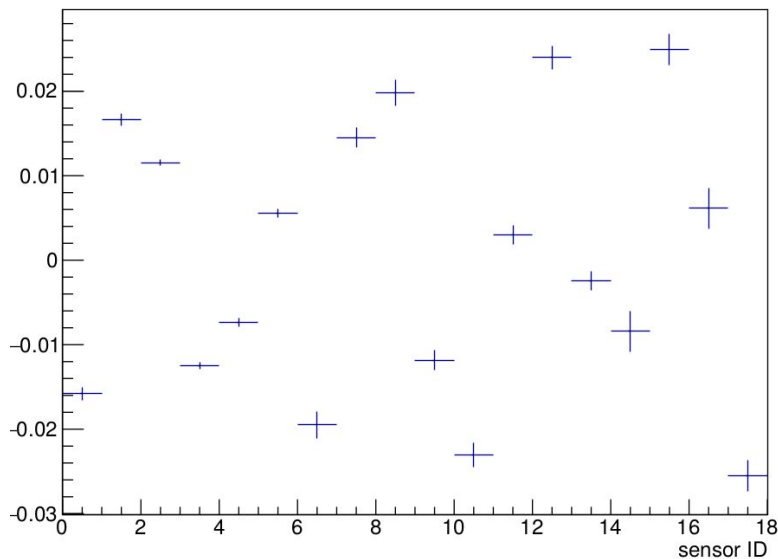


# Unbiased U Residuals Bottom

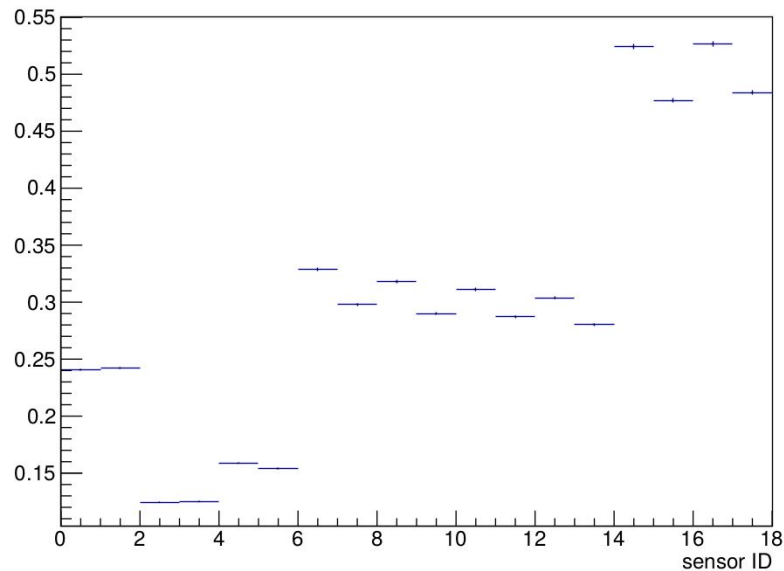
Fitted unbiased residuals mean/sigma bottom



Residual U Mean Bottom



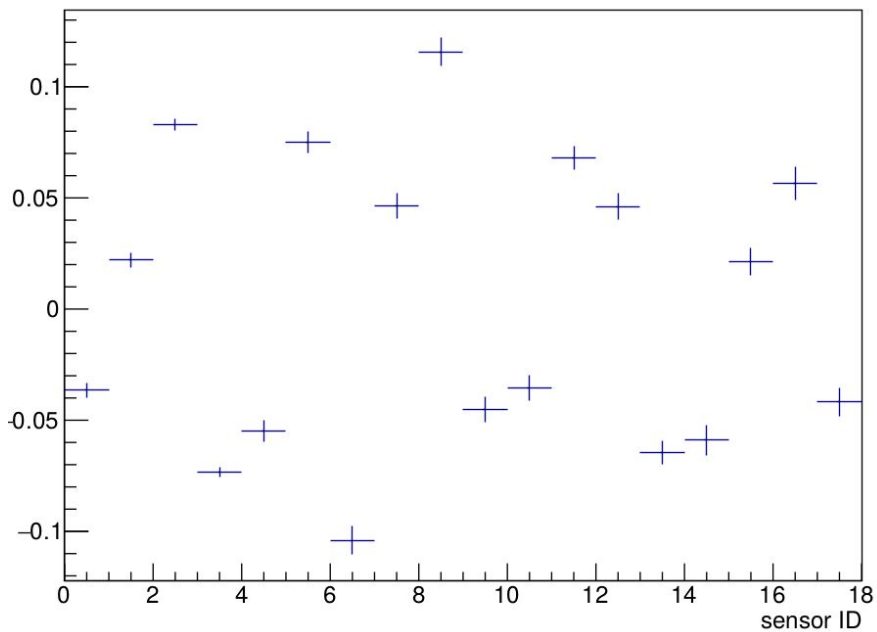
Residual U Sigma Bottom



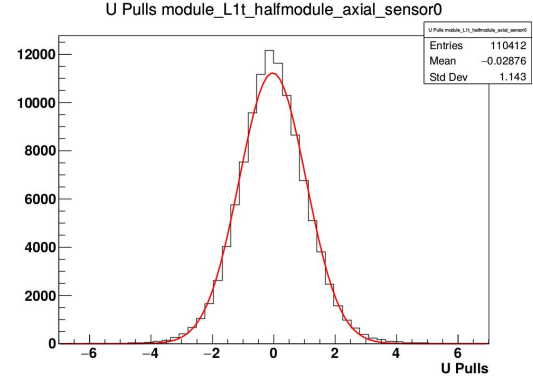
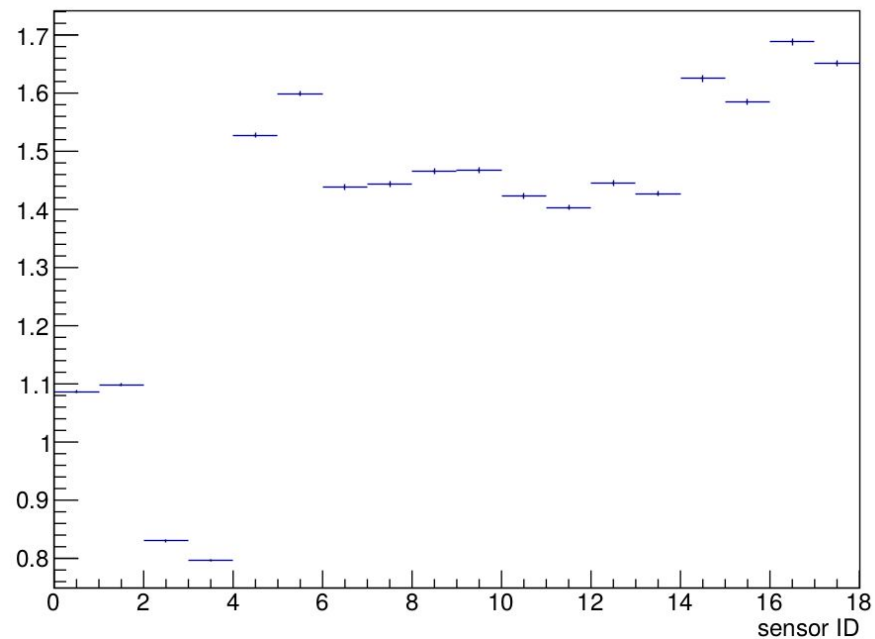
# U Pulls Top

U Pulls Top = residual/error

U Pulls Mean Top



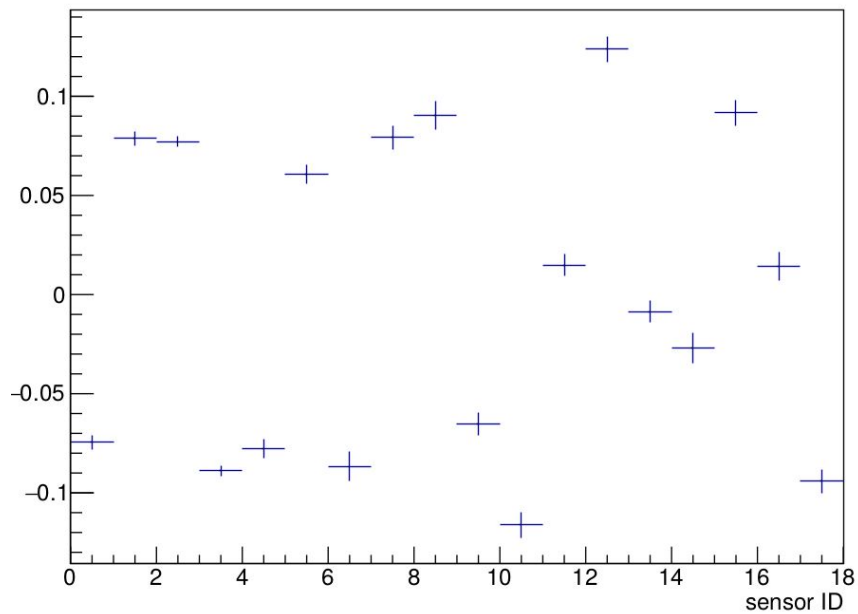
U Pulls Sigma Top



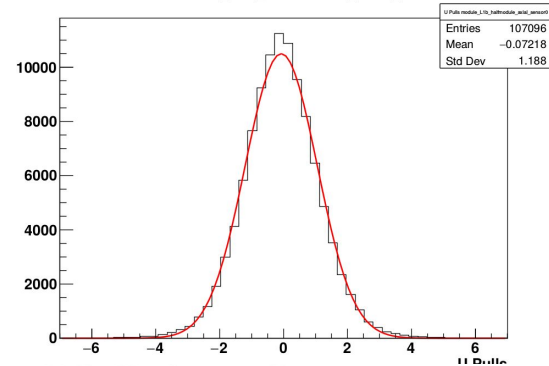
# U Pulls Bottom

U Pulls Bottom = residual/error

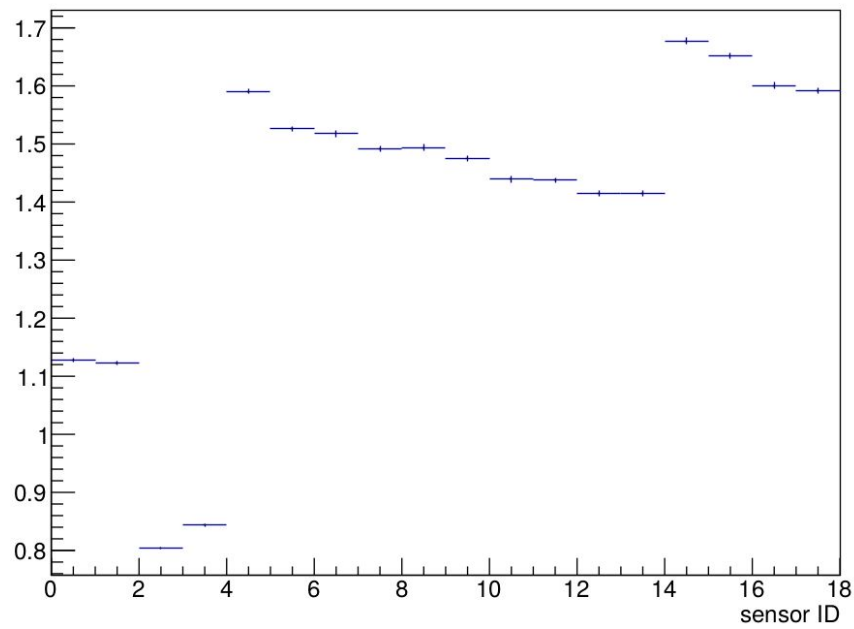
U Pulls Mean Bottom



U Pulls module\_L1b\_halfmodule\_axial\_sensor0

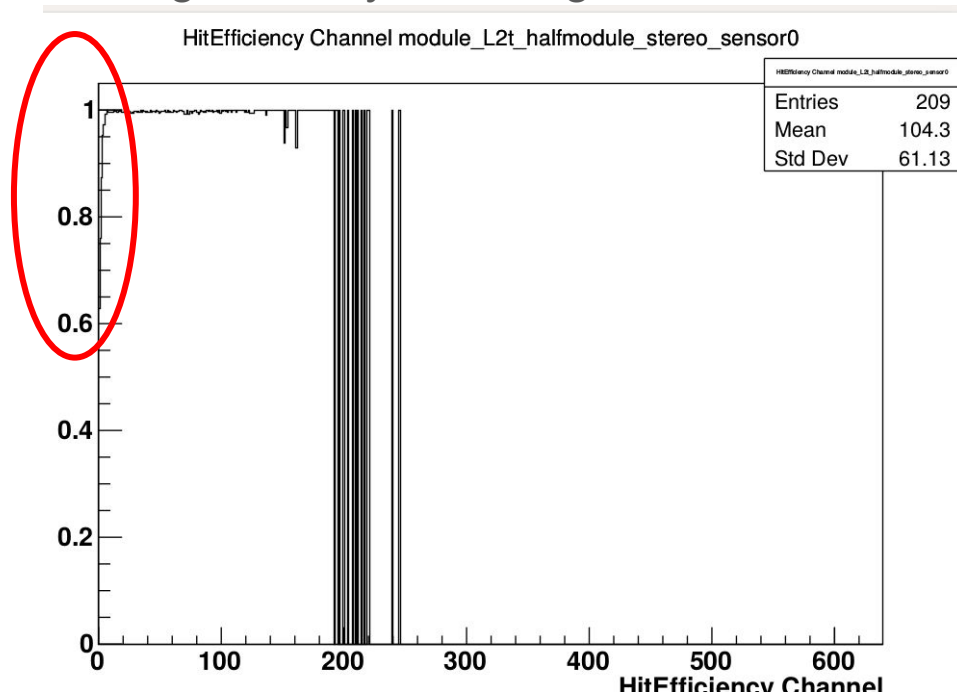
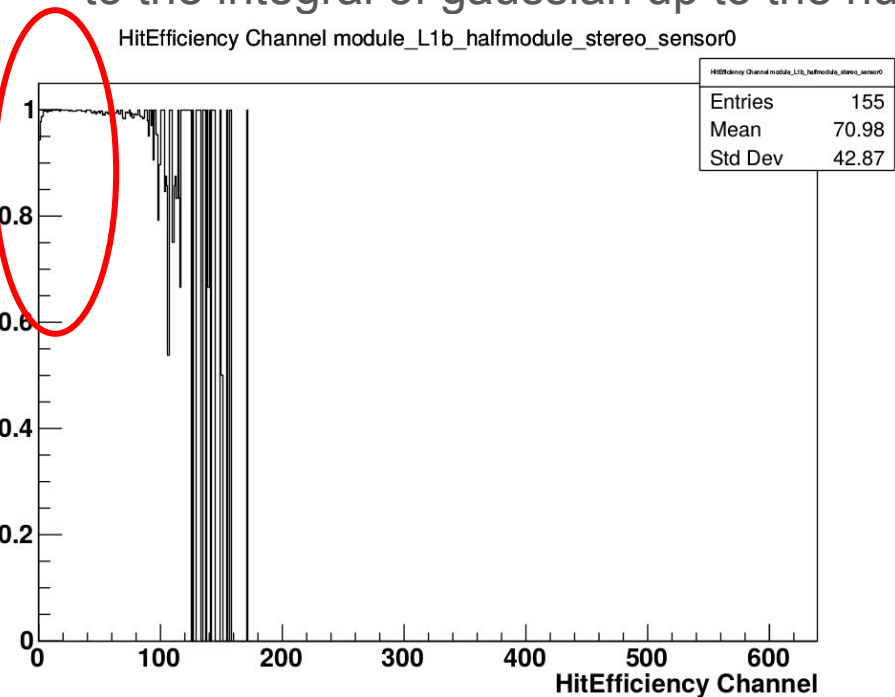


U Pulls Sigma Bottom



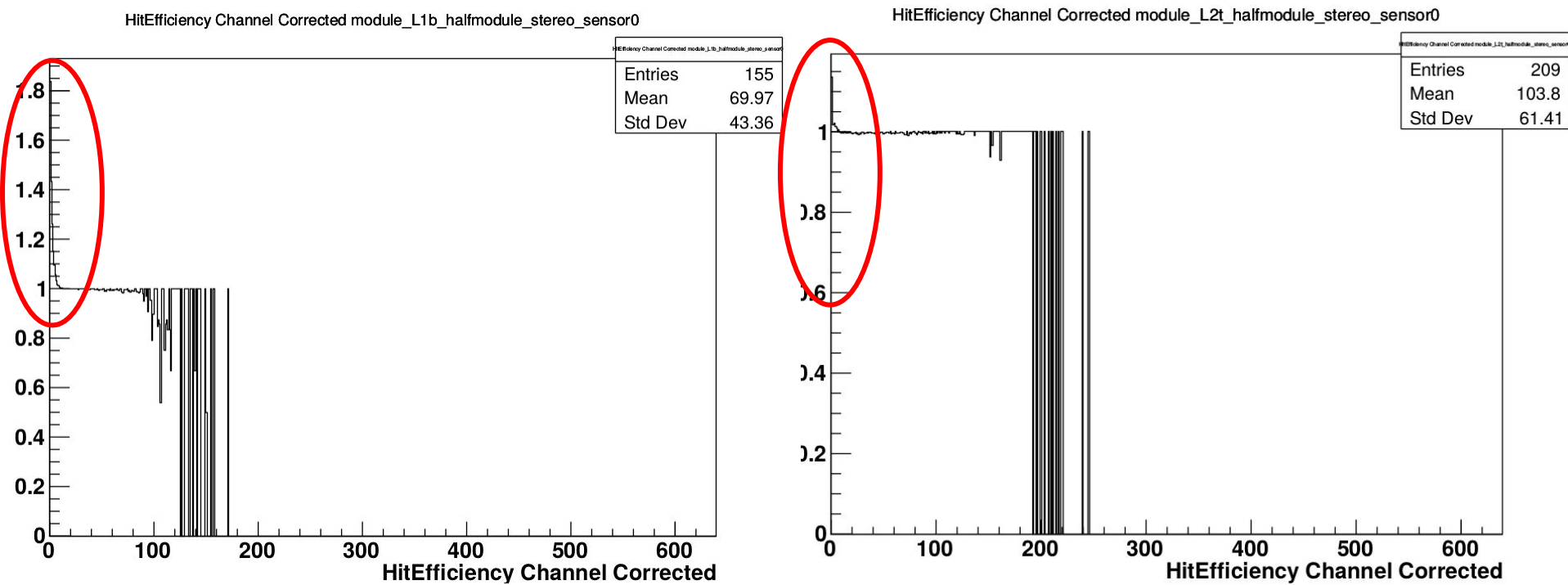
# Corrected Efficiencies

Apply correction factor to denominator of efficiency (these are uncorrected) equal to the integral of gaussian up to the number of sigma away from edge



# Corrected Efficiencies

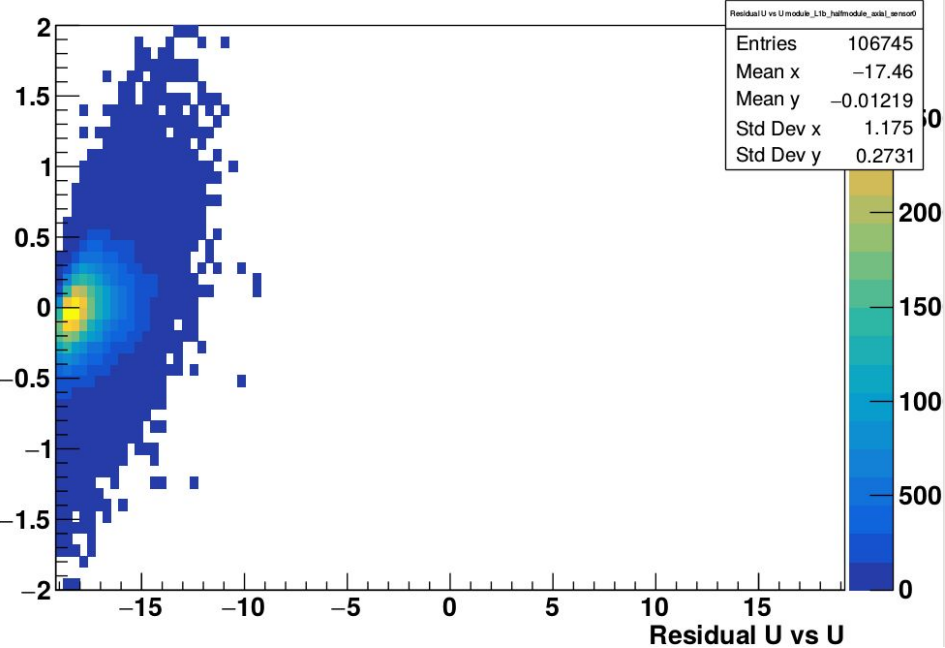
Correction factor is overcorrecting near the edges! Why?



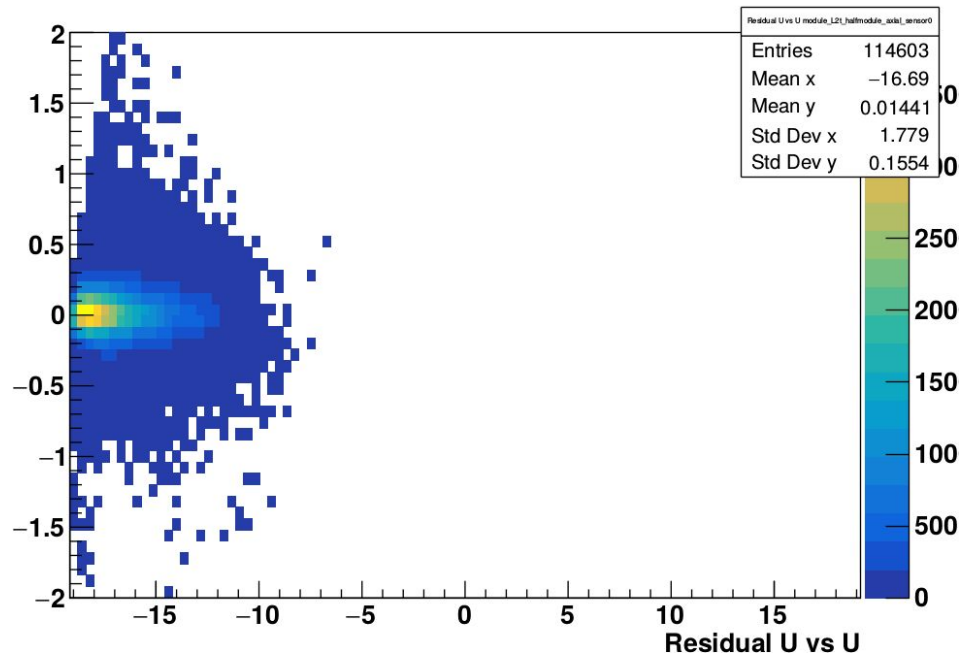
# Residual U vs U

Trend in Residual U vs U in L1, but not much in other layers

Residual U vs U module\_L1b\_halfmodule\_axial\_sensor0



Residual U vs U module\_L2t\_halfmodule\_axial\_sensor0



# Near Future Work

The goal for me is to **get the hit efficiencies as function of channel correct, so I can put them in the large MC sample**

Need to make sure u error and correction factors are done correctly (very important near the edges). **Potentially use MC to determine this correction factor.**

Run over data.

Input efficiencies in MC (work with Jeremy)

Access the U error using the tuple so we can make track extrapolation cuts for L1L2 and L2L2



# Far Future Work

There are many, many studies we could do with this new analysis code

Efficiencies as function of time, looking at unbiased track parameter errors at each sensor, incorporating truth info to check errors/pulls, understanding the nature of the inefficiencies, etc...

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...But I am unwilling to do these...

...**But I am willing to teach people** how to use this code (maybe setup a confluence page)