

TMS Areal Density Update

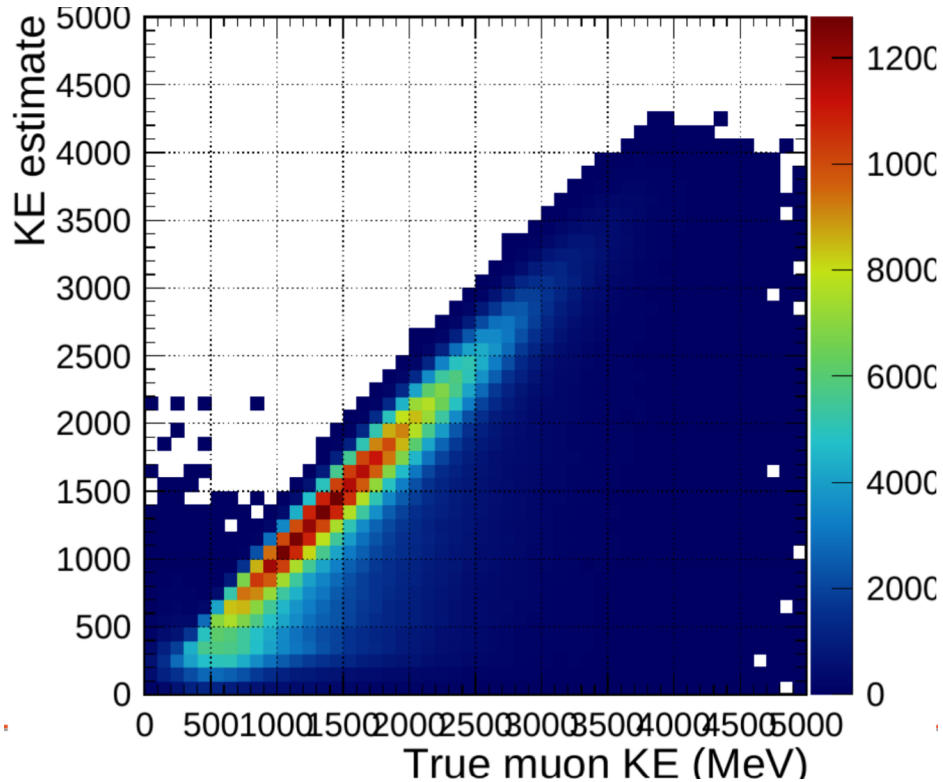
Jeffrey Kleykamp

2023-11-16

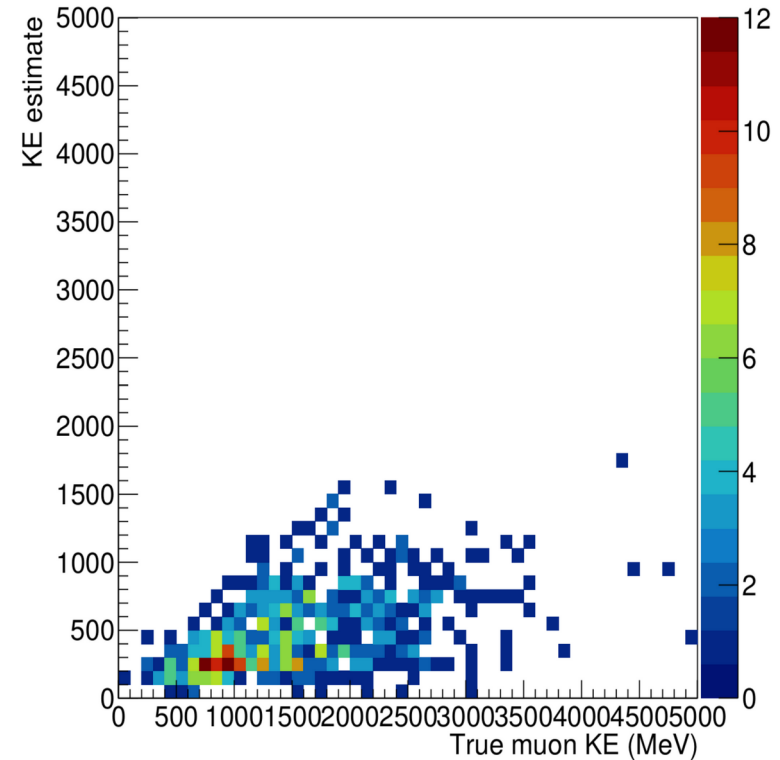


Comparison of muonke.cpp Script

Clarence 2022



Recent



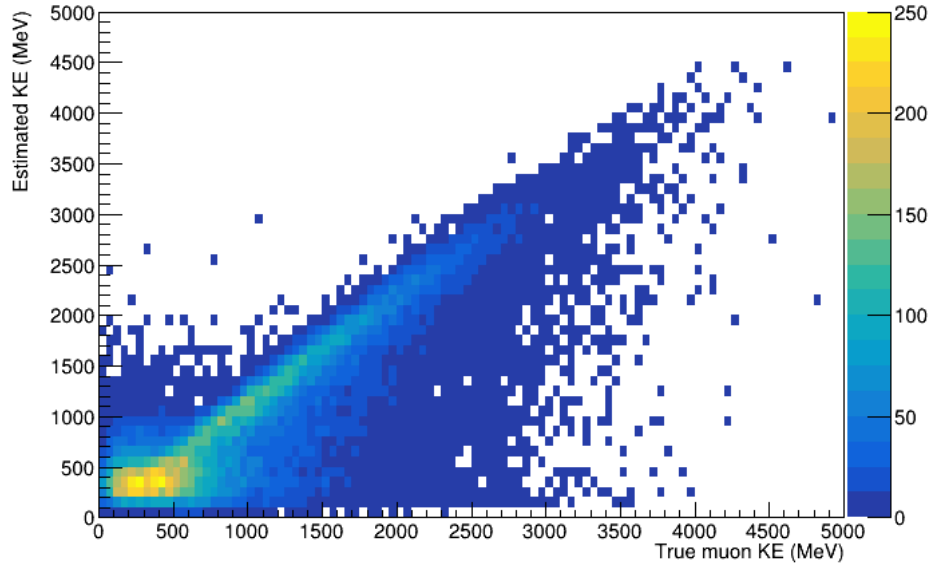
Geometry Versions

- There were some issues with the geometry used in production
- This lead me to some checking of the other versions
 - <https://github.com/DUNE/dunendggd/blob/master/CHANGELOG.md>
- TDR_Production_geometry_v_1.0.1
 - First versioned geometry
- TDR_Production_geometry_v_1.0.2
 - Removes overlap between planes
- TDR_Production_geometry_v_1.0.3
 - Slight changes, not sure exactly

Reco vs True Muon KE

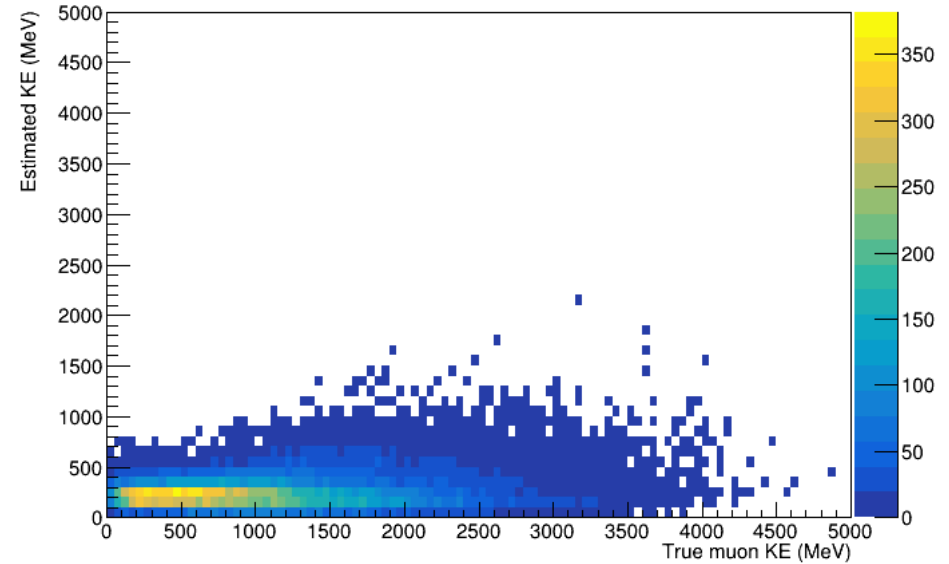
Geometry v1.0.1

True KE vs $82+1.75^*(\text{areal density})$



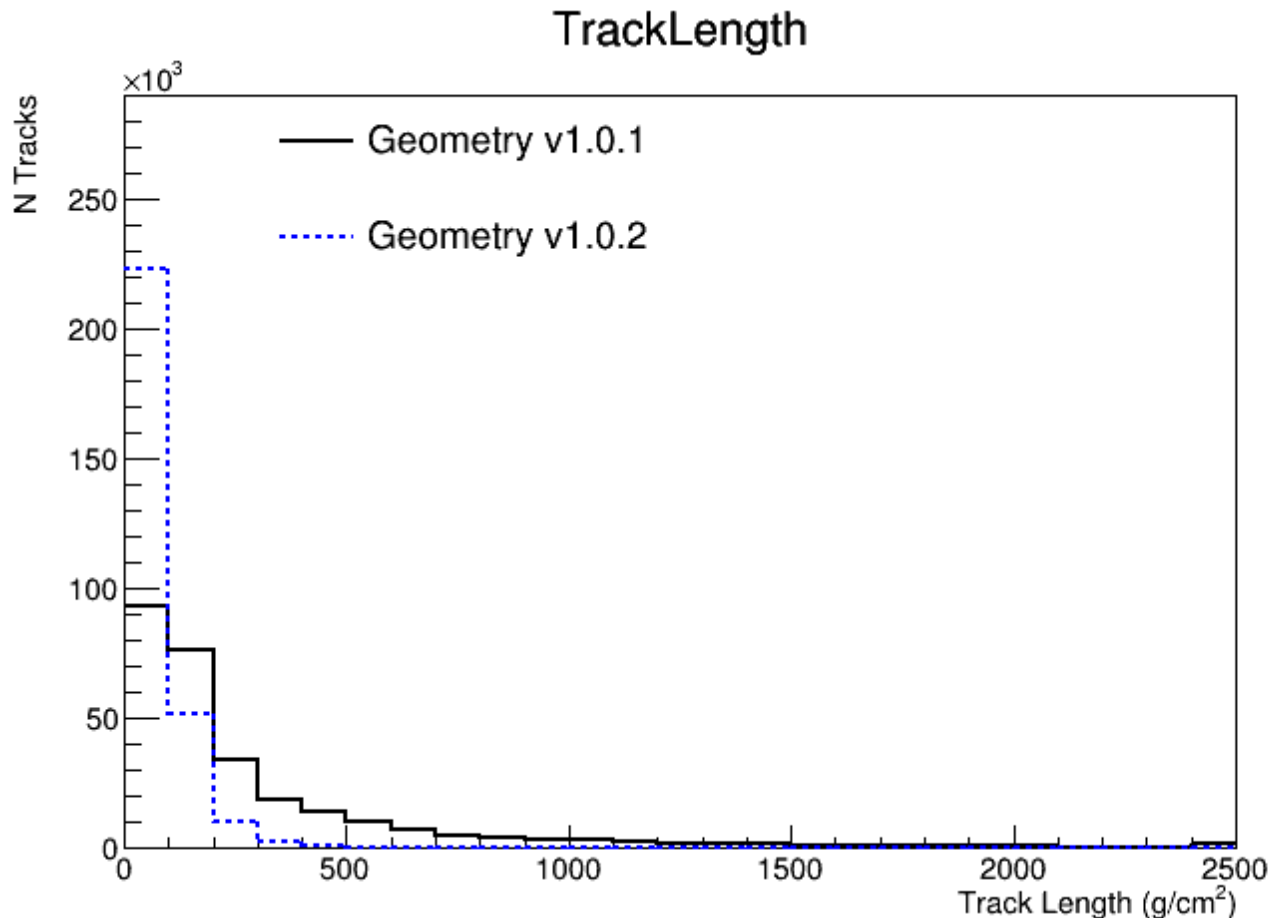
Geometry v1.0.2

True KE vs $82+1.75^*(\text{areal density})$



Areal density = sum of track segment density * track segment length
Previously found best fit of reco KE = $82 * 1.75$ areal density

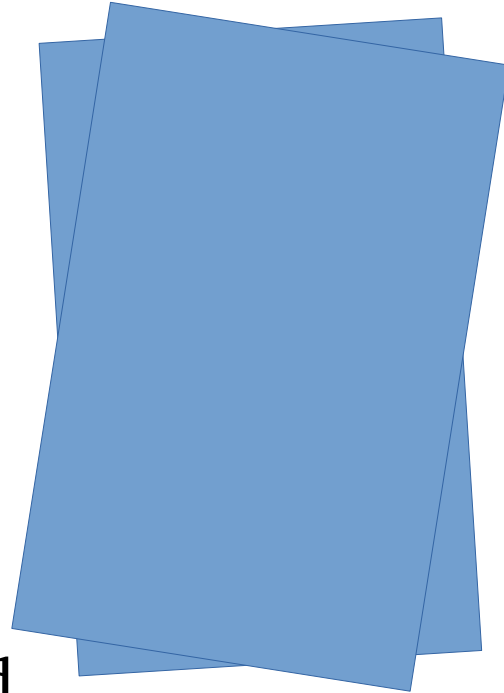
Areal Density Comparison



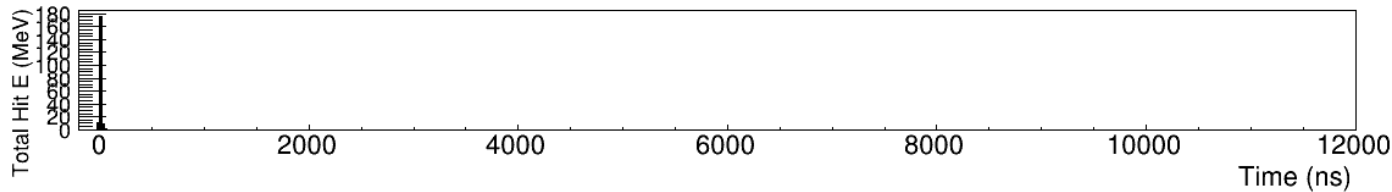
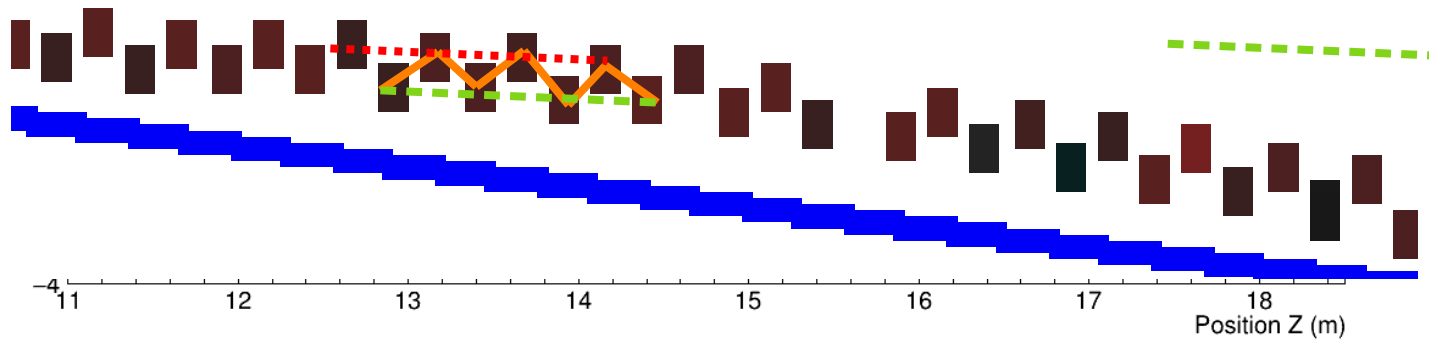
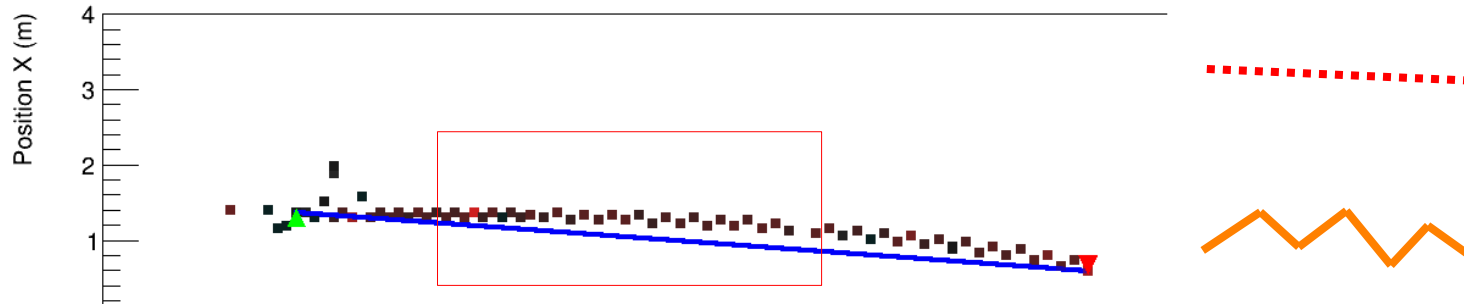
Exhaustively checked the material densities and other properties in the geometry gdml files. They all look correct and are correct while running.

TMS Scintillator Plane Orientations

- Each plane in the stack is either +3 deg rotated or -3 deg rotated
 - Called Y view or V view
 - This gives low resolution 3d reconstruction (see Asa's work)
- In Geom v1, planes were stacked so all hits were Y views only since only first plane was used for hit purposes

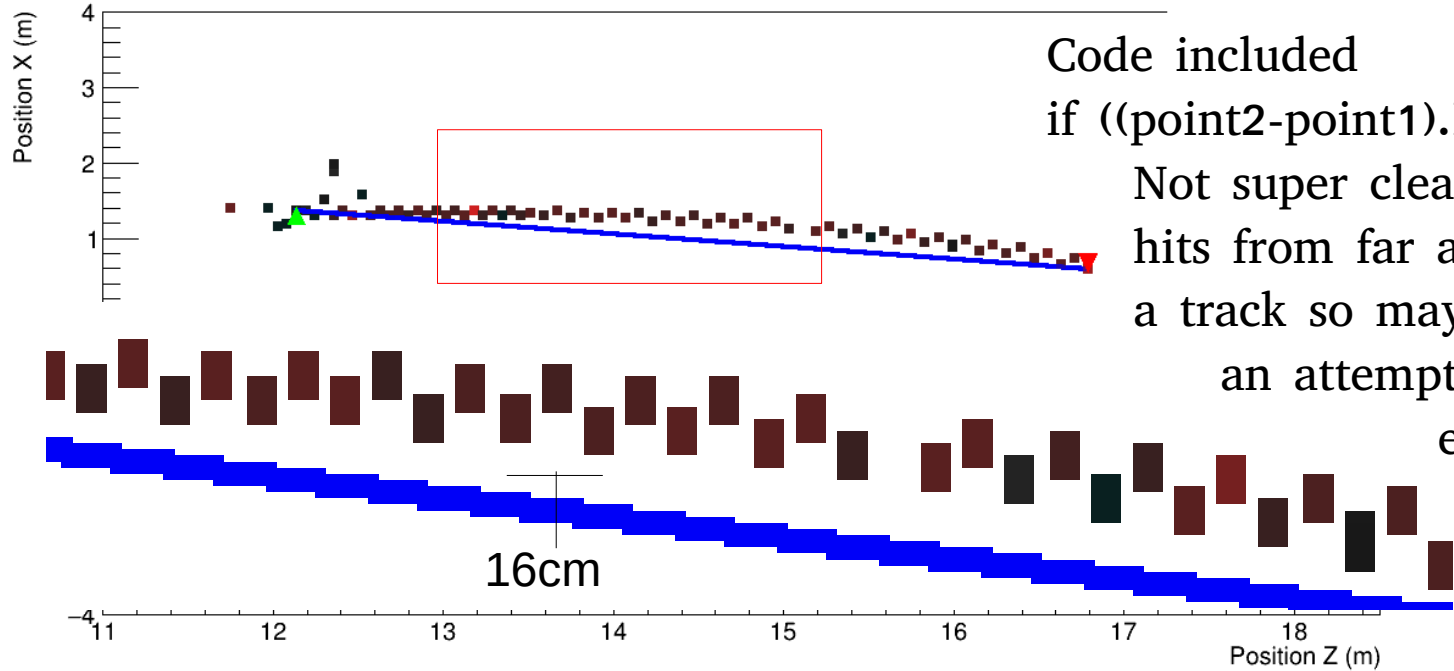


Problem 1: Overestimating Areal Density



The zig-zag path is too long. This wasn't an issue in Geom v1 because all hits were y view

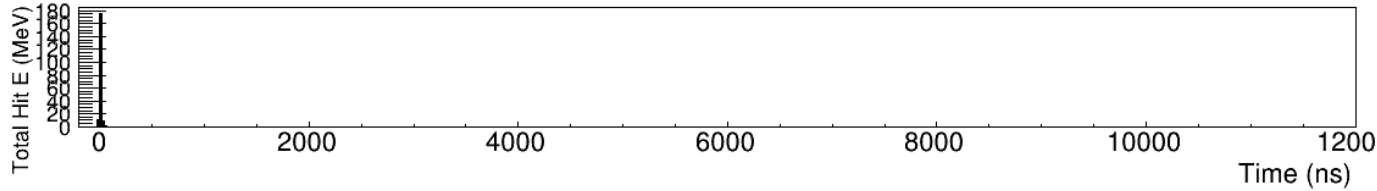
Problem 2: Skipping Distance Points



Code included `100mm`
if `((point2-point1).Mag() > 100)` continue;
Not super clear why, but in some cases hits from far away can be included in a track so maybe this was an attempt to remove the effect of bad reco.

However, many hits are `> 100 mm` apart if you only consider y or v view

Thin modules 5-6cm apart
Y views are 11cm apart
Thick 8cm apart
Y views are 16cm apart

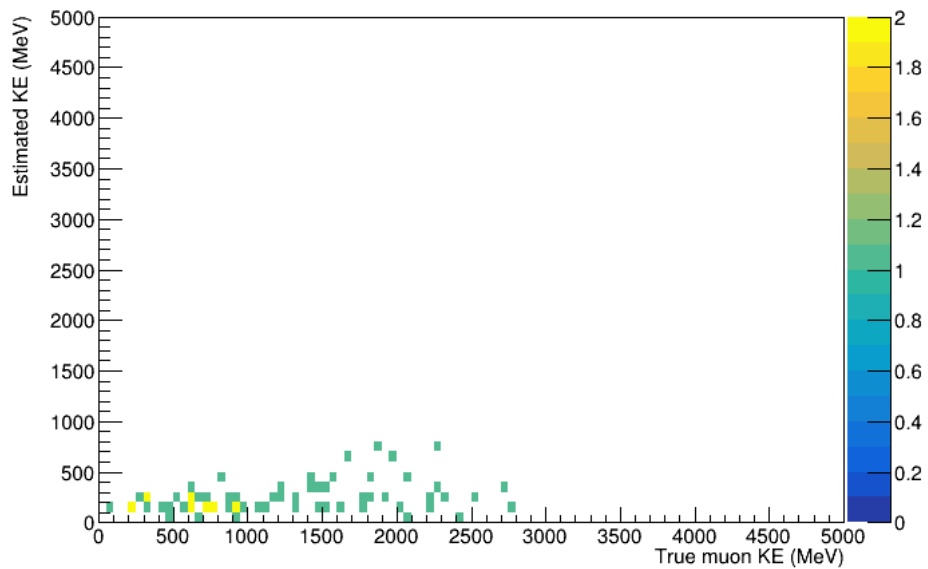


Fixes

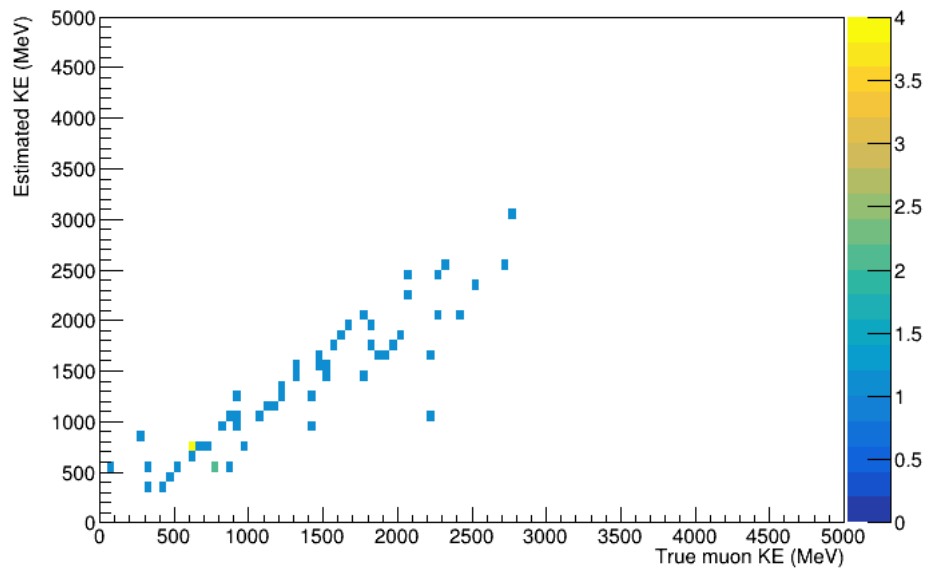
- Add bar orientation information
 - When creating hits, all were labeled y view. But we can use the geometry node names to find out the view
 - modulelayervol1 are y view
 - modulelayervol2 are v view
 - This does have knock-on effects. Currently, the reco has ProjectHits function everywhere which filters to Y-view only
- Remove that if $\text{dist}(P1, P2) > 100$, continue statement

KE Estimator, Before/After

True KE vs $82+1.75^*(\text{areal density})$



True KE vs $82+1.75^*(\text{areal density})$



Conclusion

- All this is hot off the presses
- Will make PR once I clean everything up
 - And some new files

