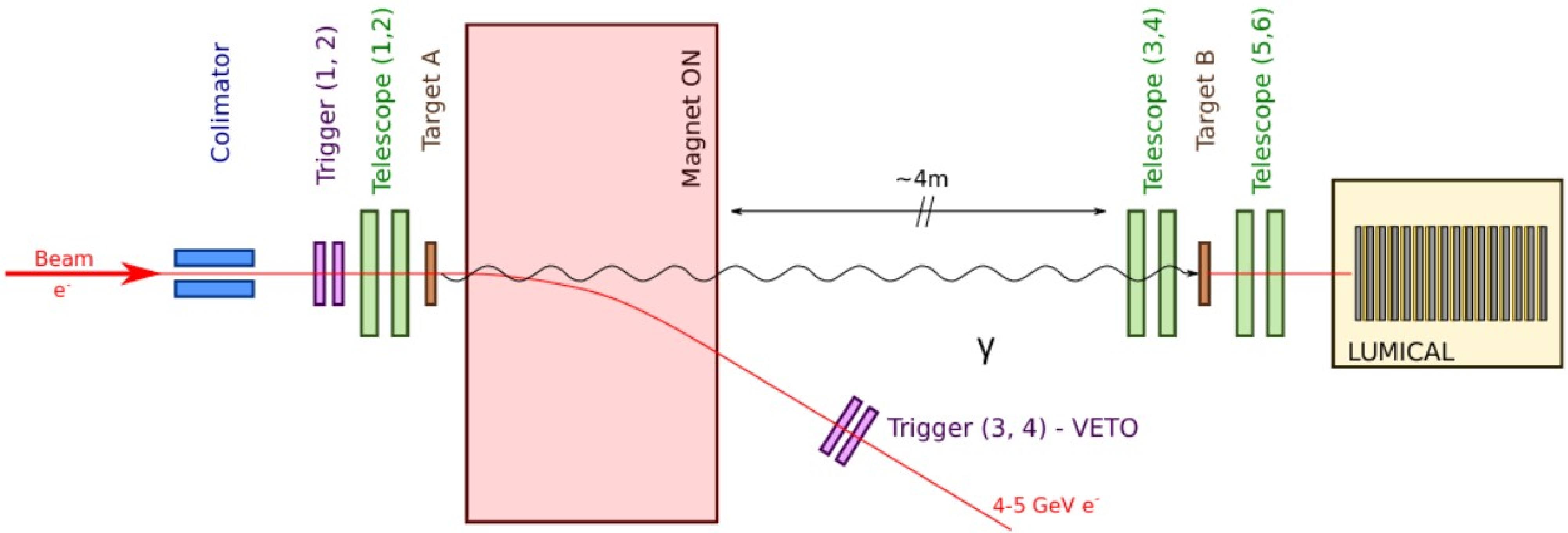
# TB2020 Bremsstrahlung Study

John Hallford

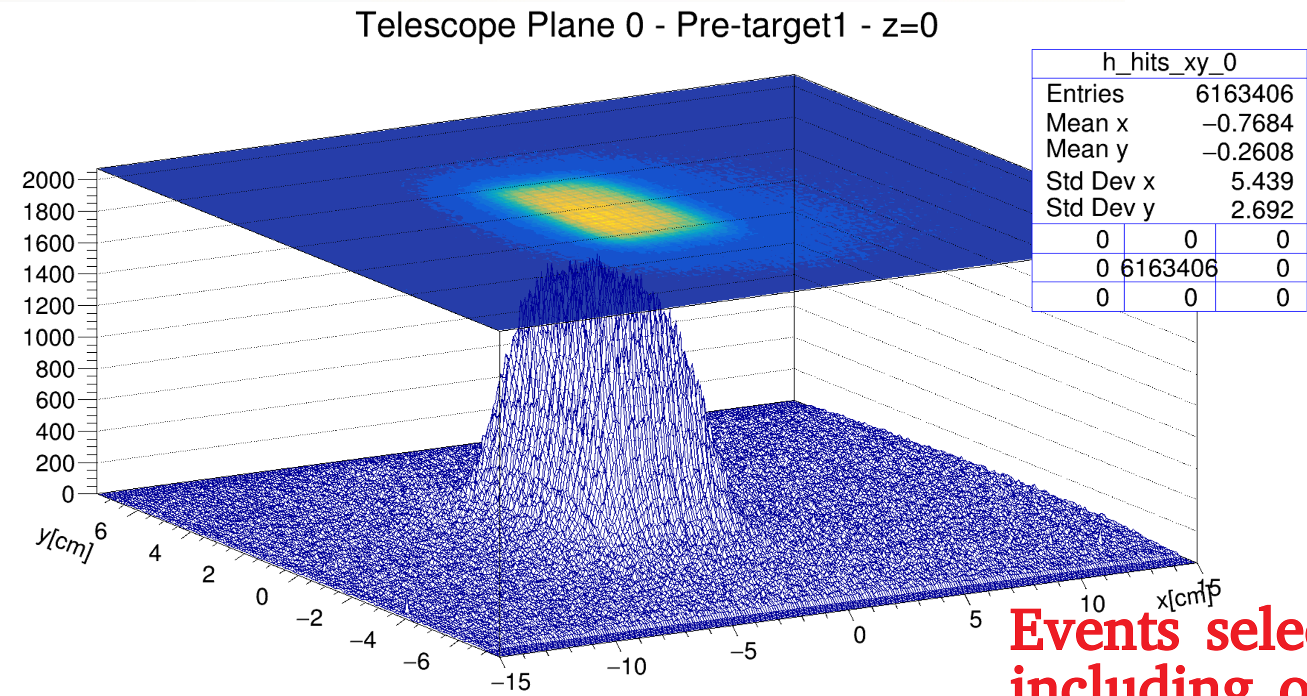
University College London

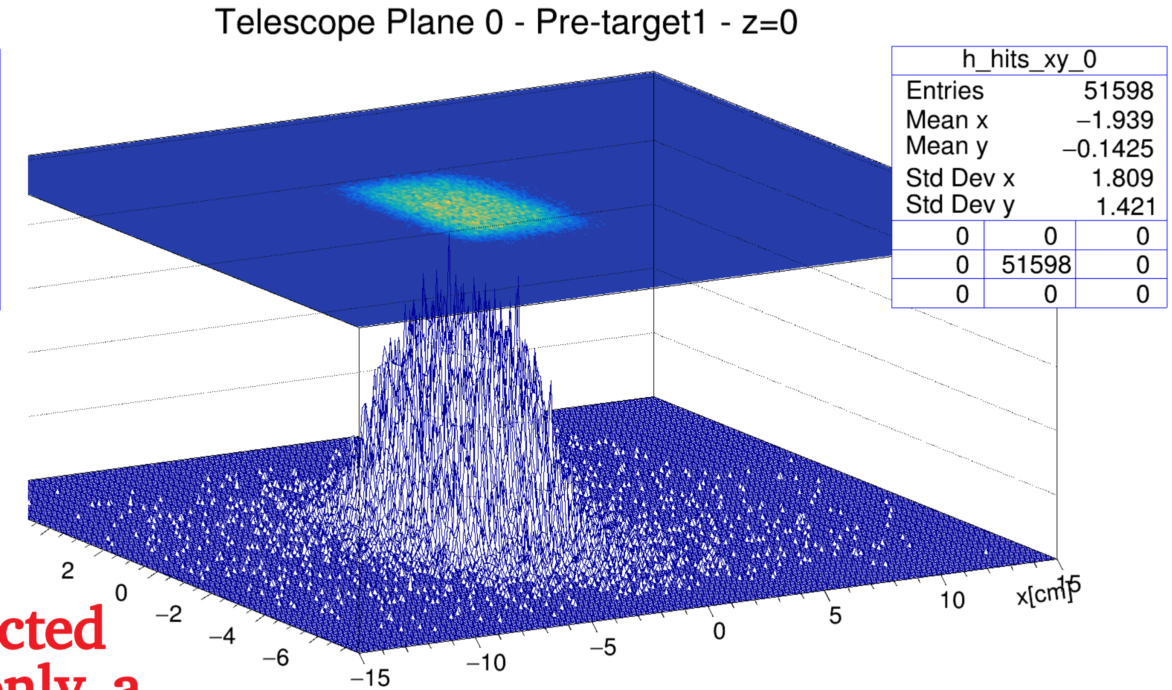
14/07/2022

# TB2020 Alpide Telescope Alignment

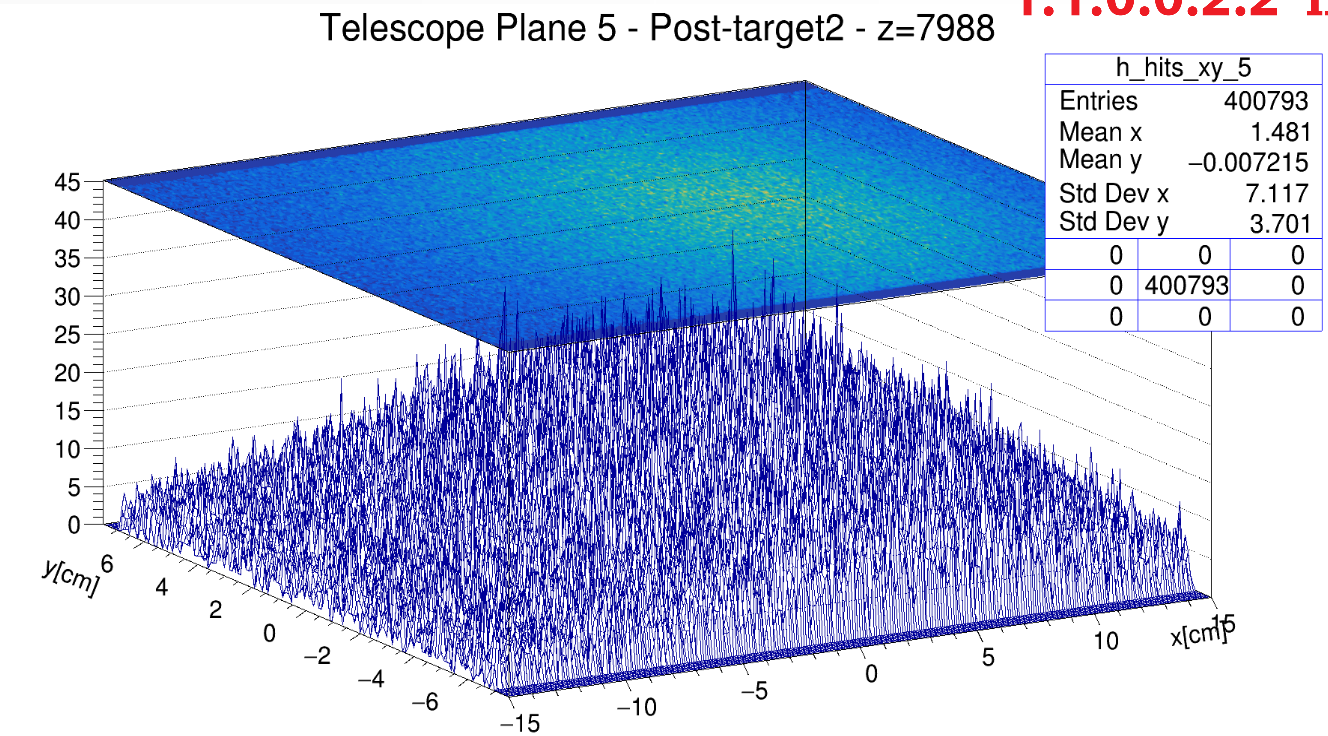


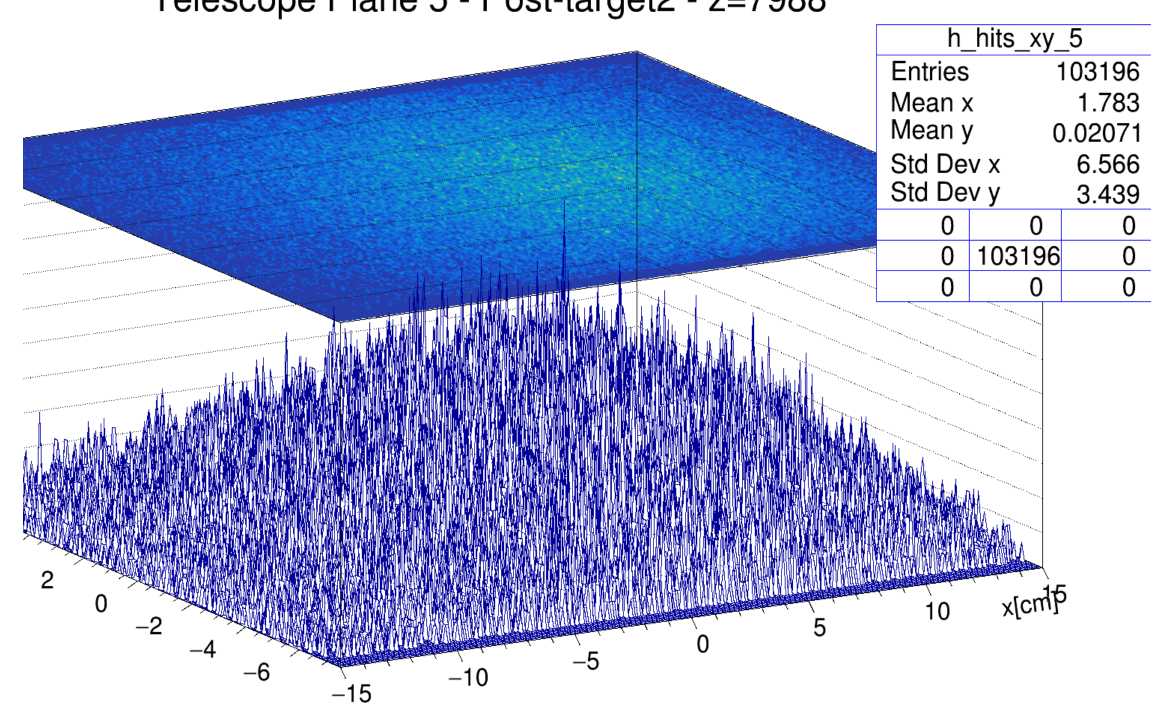

Idea is to use this data to reconstruct the dispersion of bremsstrahlung photons, in particular the polar angle.

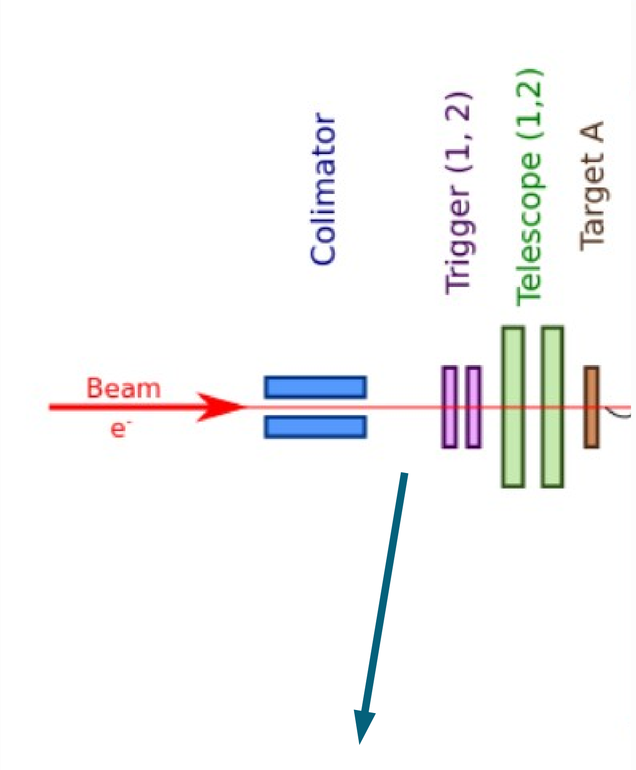


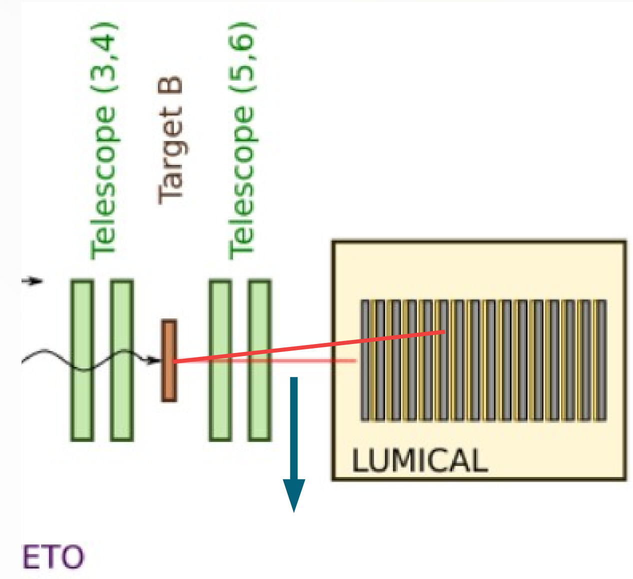

Events selected including only a 1:1:0:0:2:2 hit pattern






Alignment is important! and this is found by minimisation of straight-line fits chi-squared sum for data with targets removed, magnet off

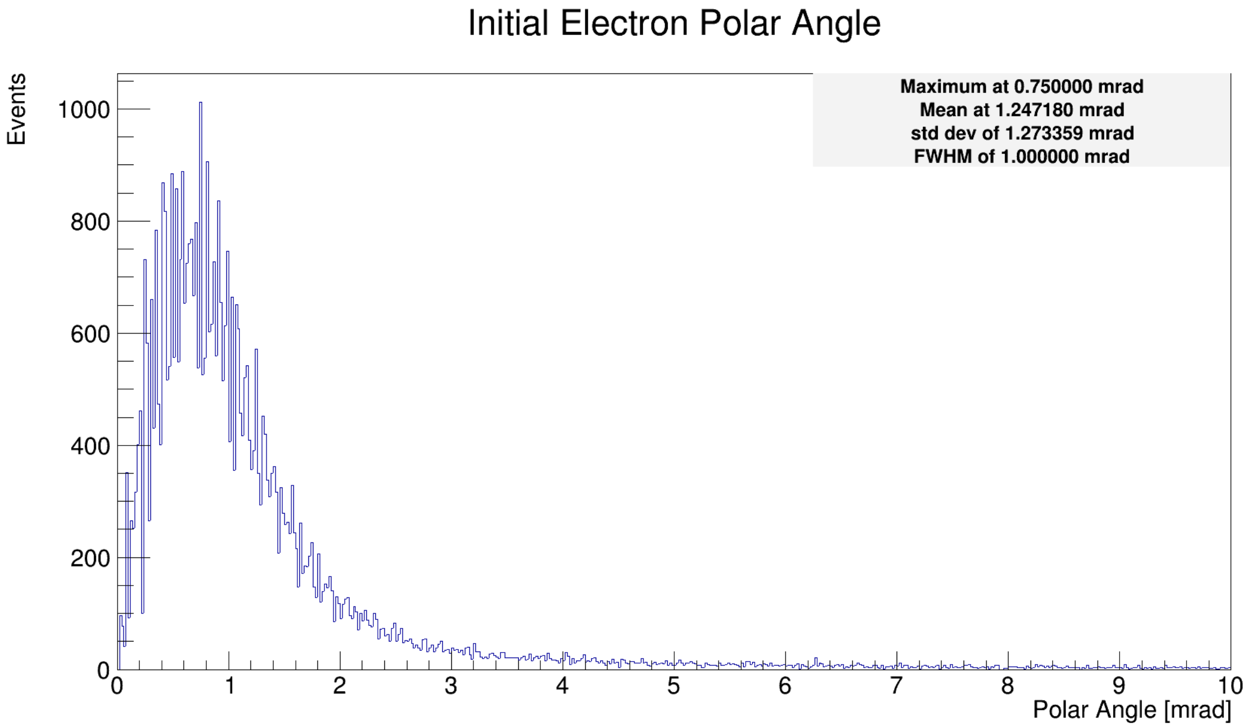



Reconstruct gamma incidence on target 2 using two hits of each of e-/e+ pair

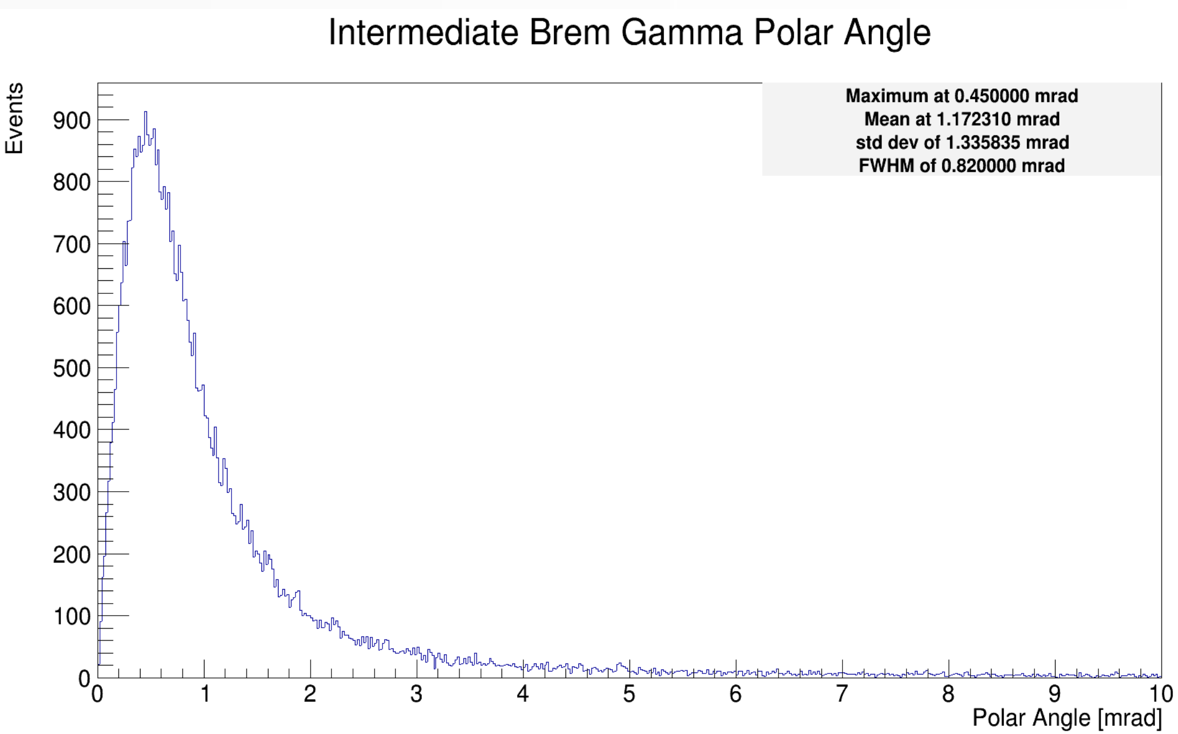
Trace trajectory from hitpoints in planes 1,2 to reconstruct incidence of target 1

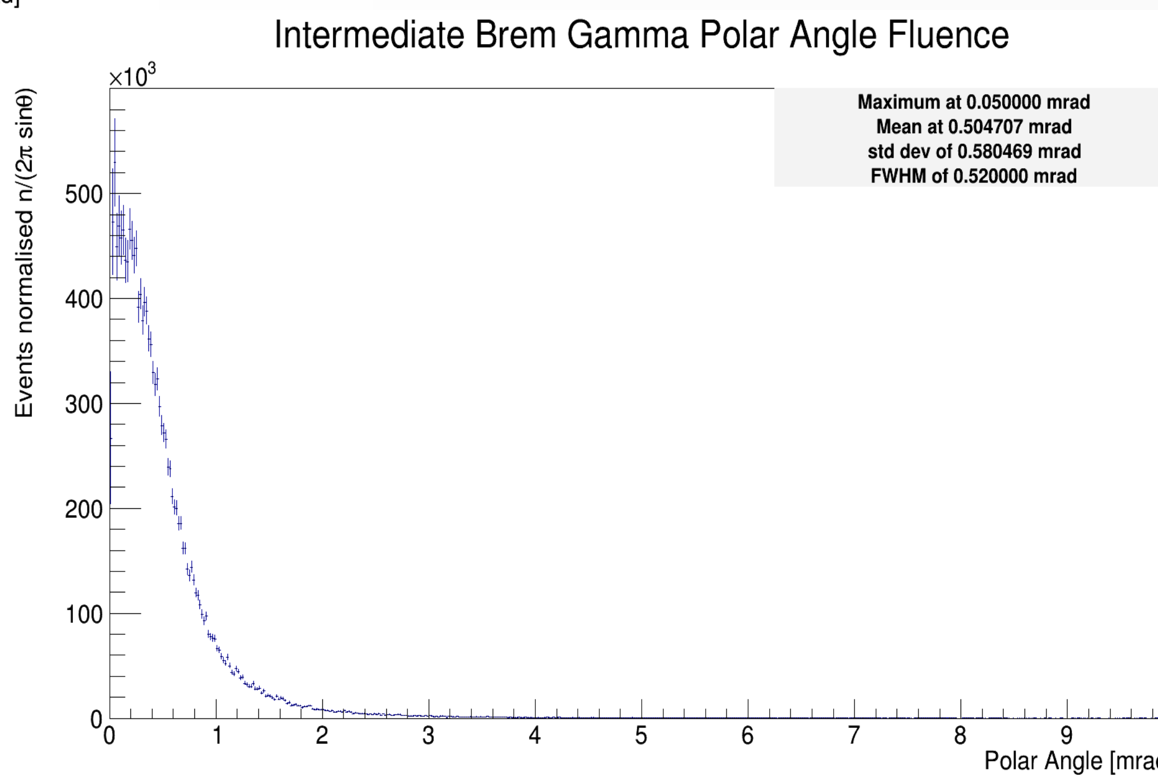
Track + correlate hits to correct tracks by extrapolating to target 2, choosing minimal distance between tracks

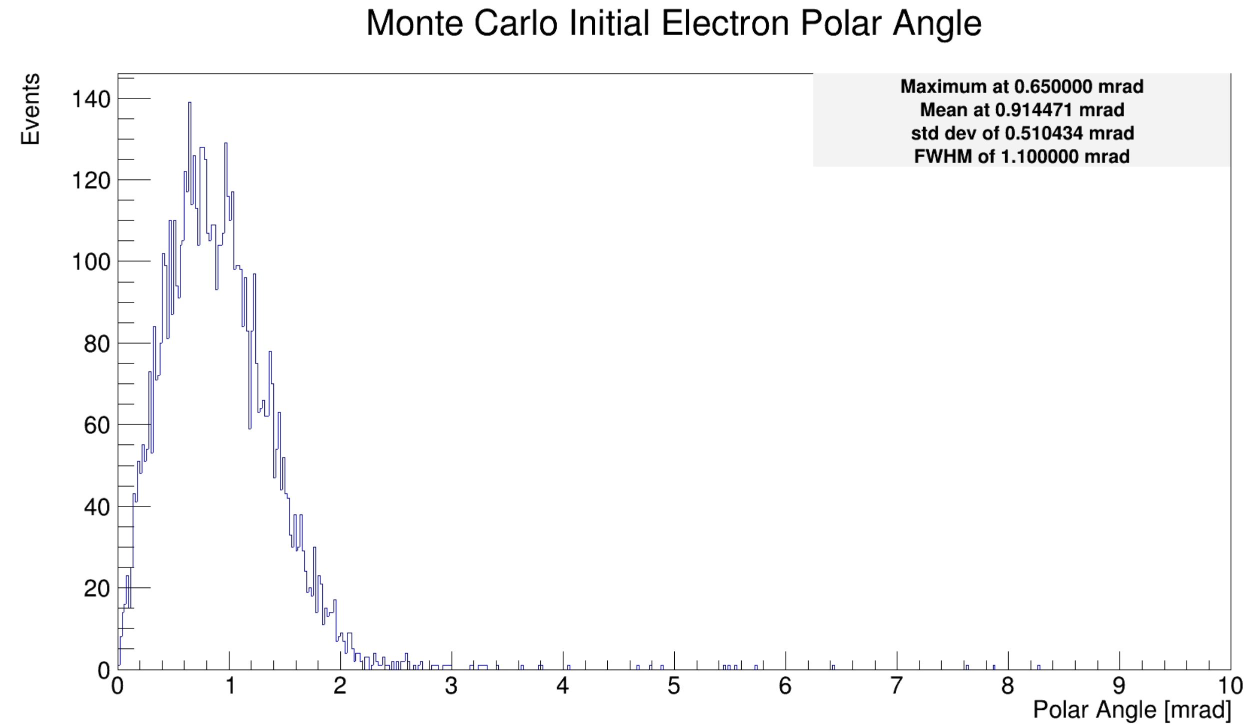
Reconstruct Bremsstrahlung gamma momentum vector, compare to incident e- vector




So we find a Brem emission profile of theta with peak 0.45 mrad, FWHM 0.82 mrad



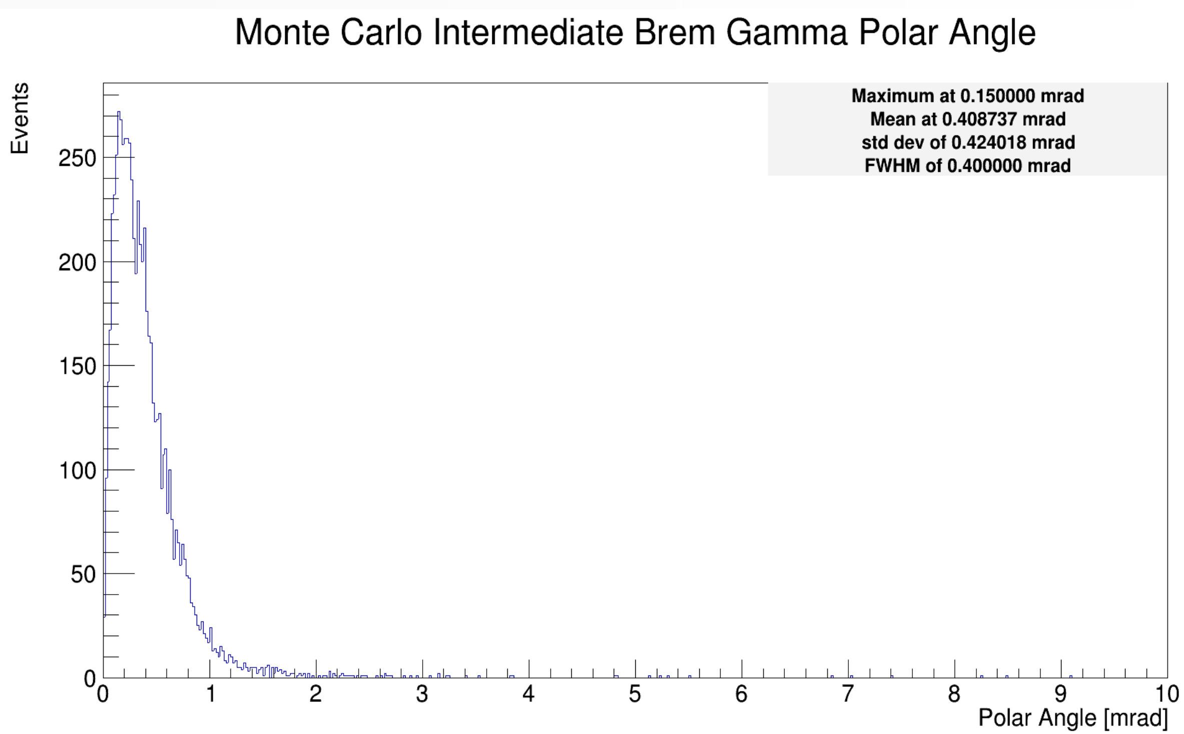



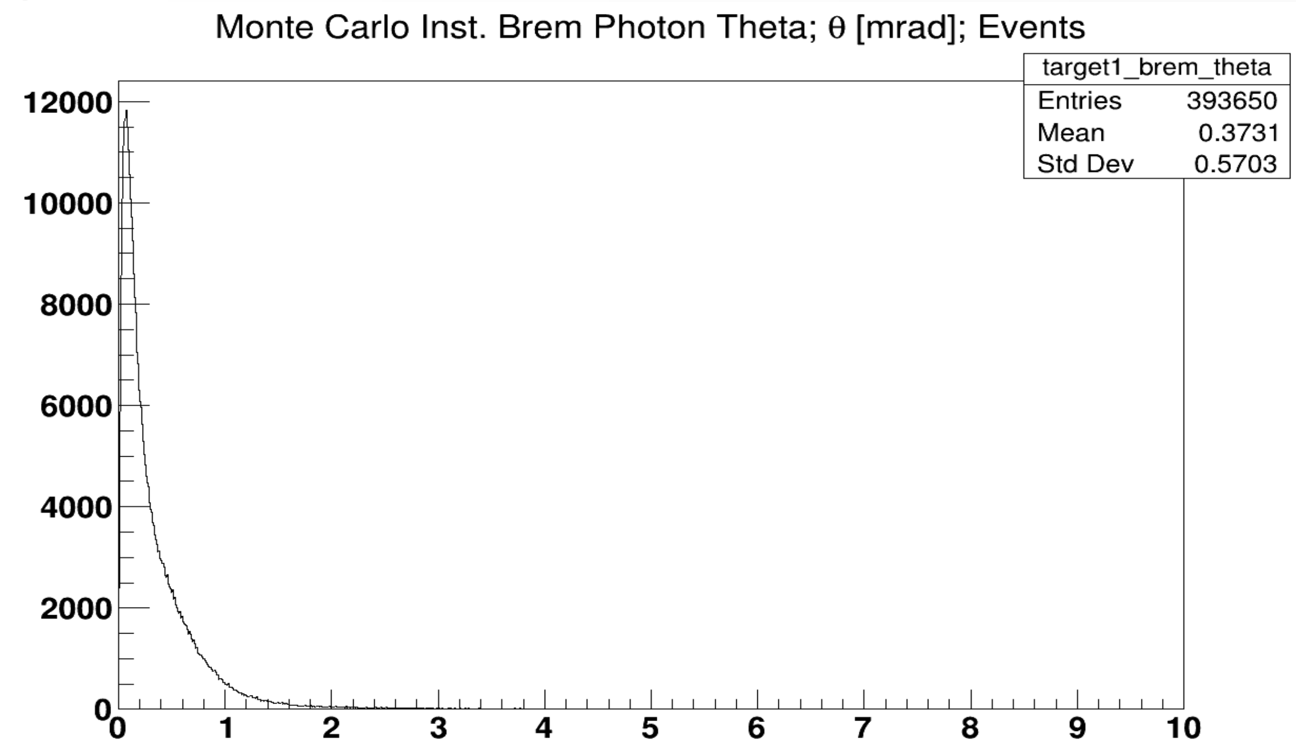


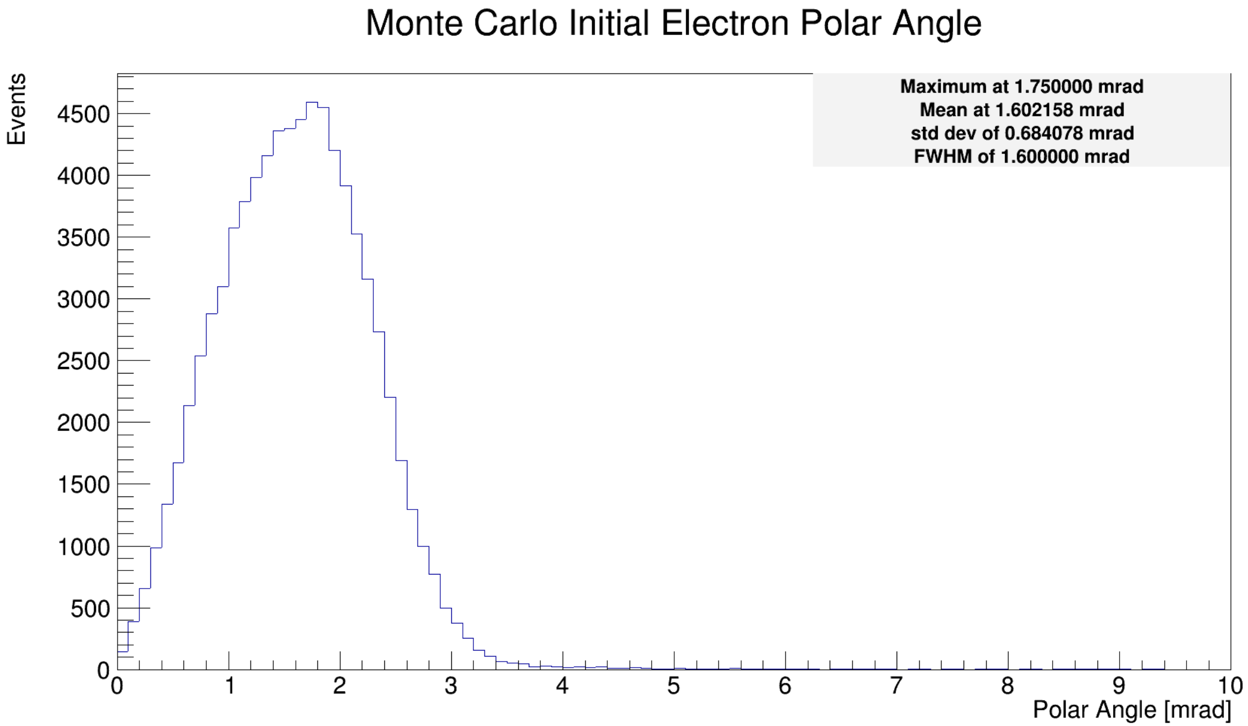

But we also have a more complete Monte Carlo! Including measurement of the plane hits (e-,e+ with E>2MeV), a complete reconstruction using the same analysis technique is performed

Specifically telescope resolution (~2.88μm) and multiple scattering in the environment are modelled

Reconstructed theta distribution is half the size of the real data

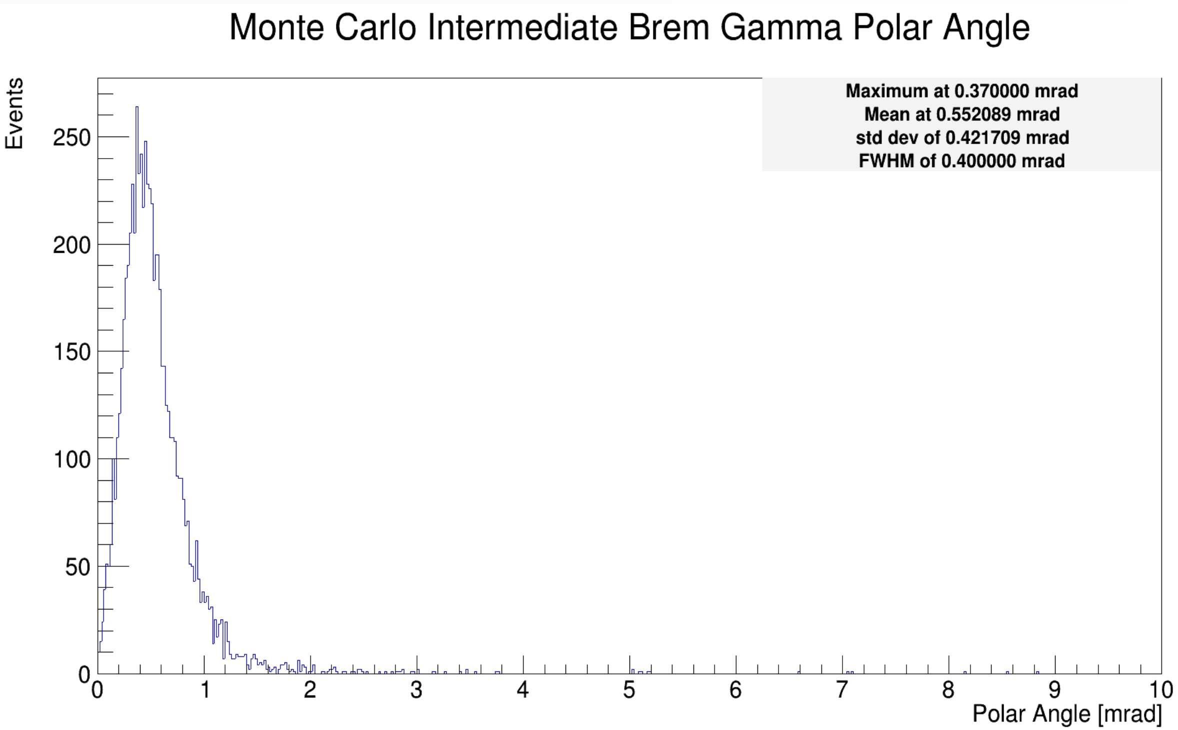


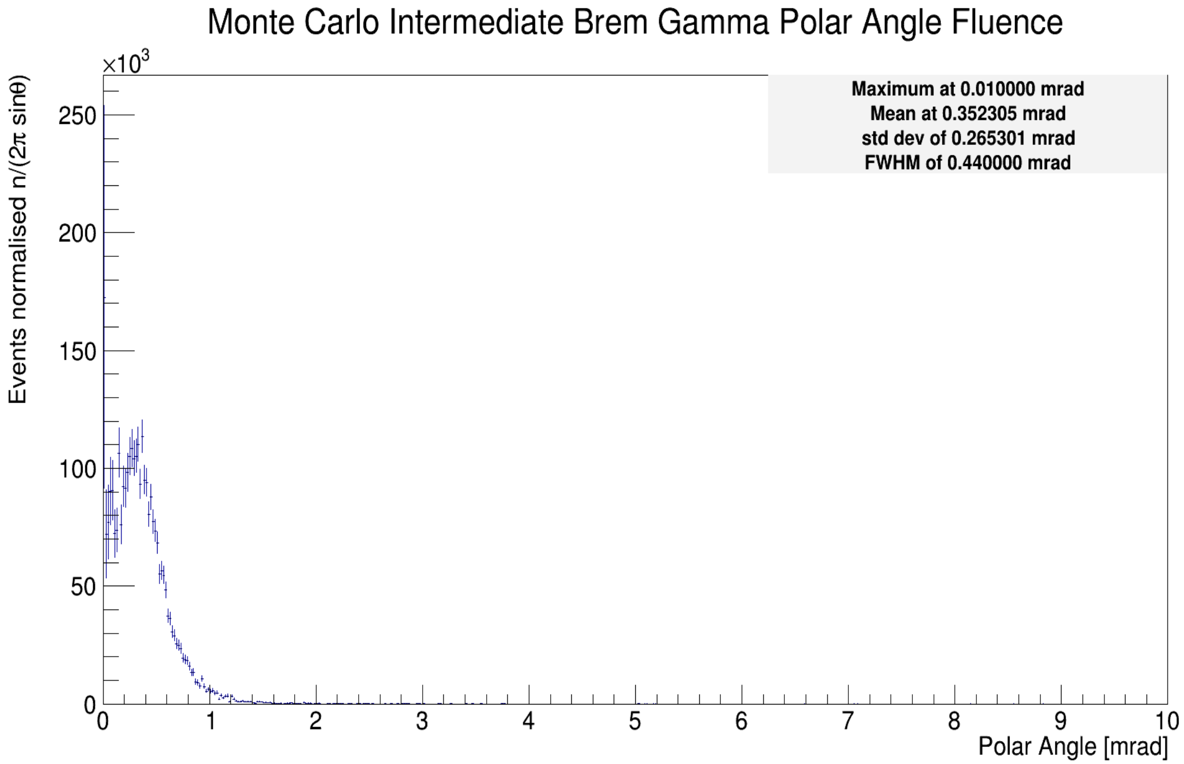



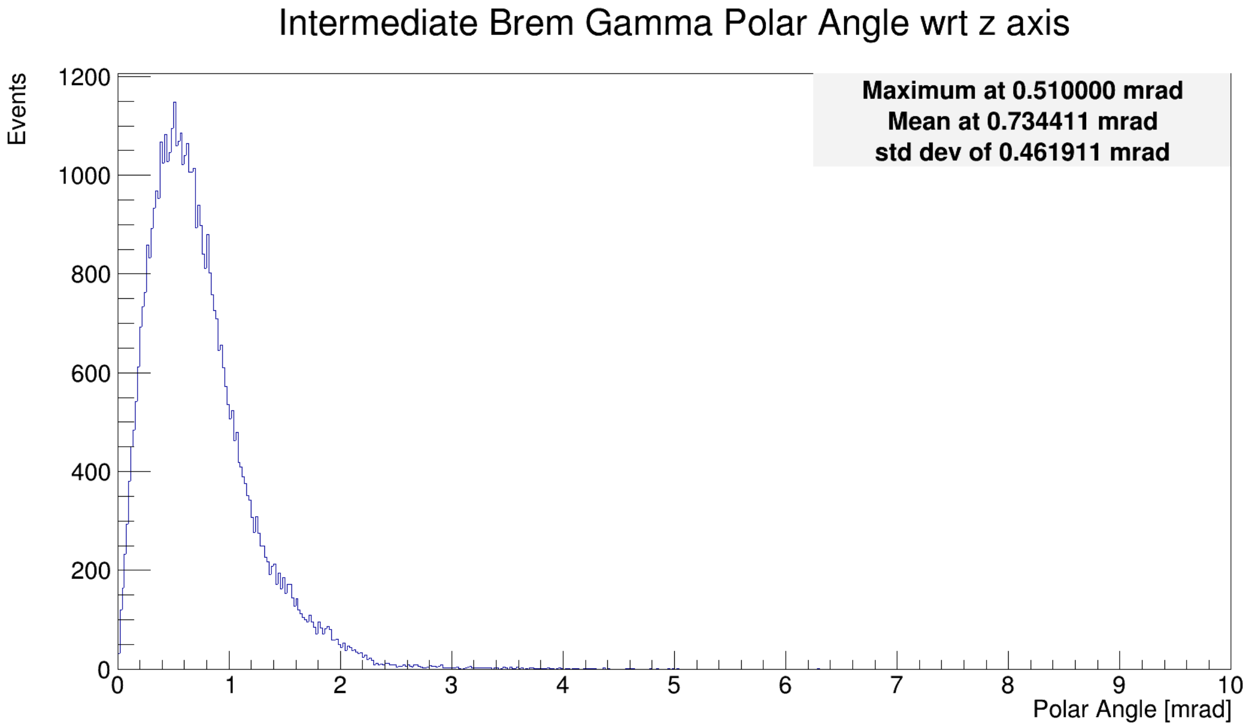



With a Monte Carlo at our disposal we can try an intentional misalignment…

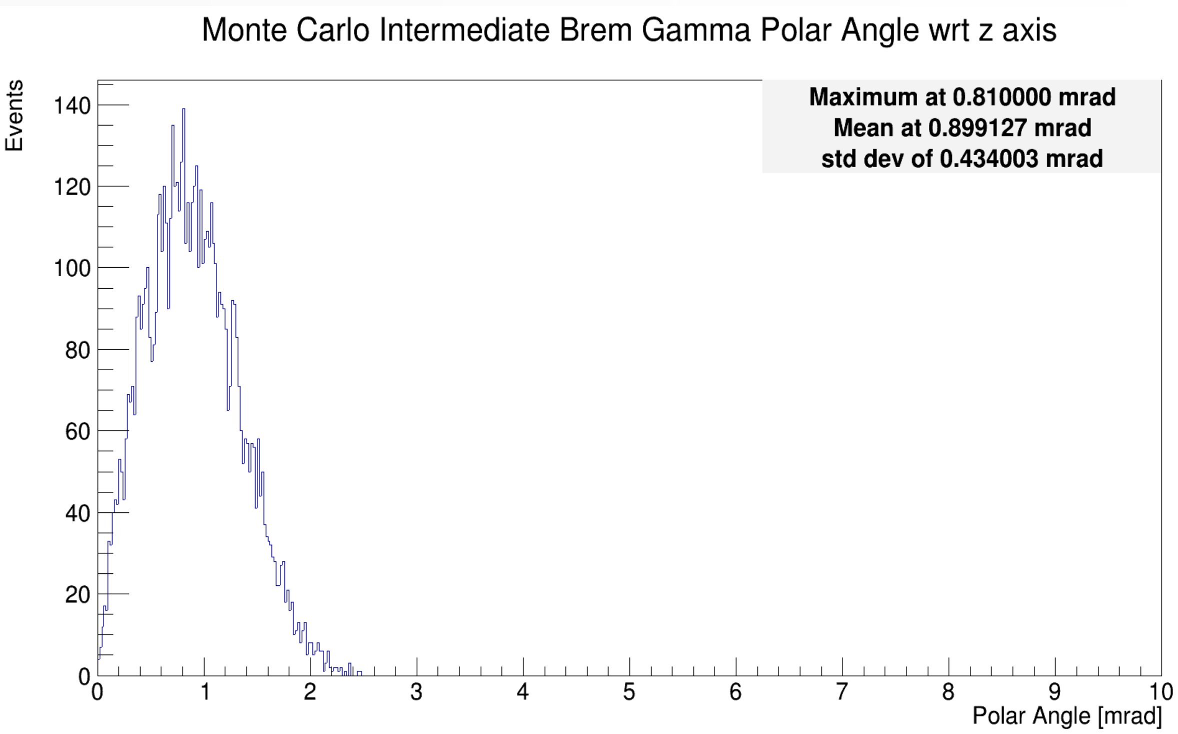
Misaligning each plane by some random value in x,y between **+-0.03mm** …

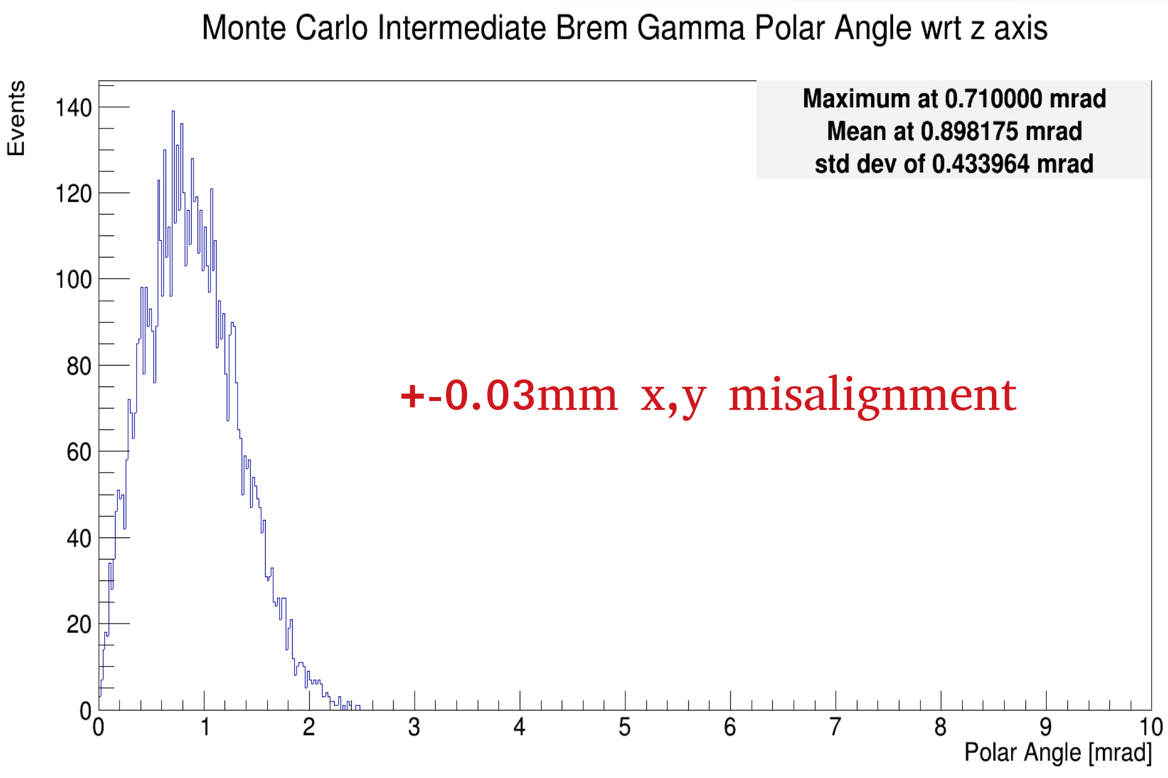


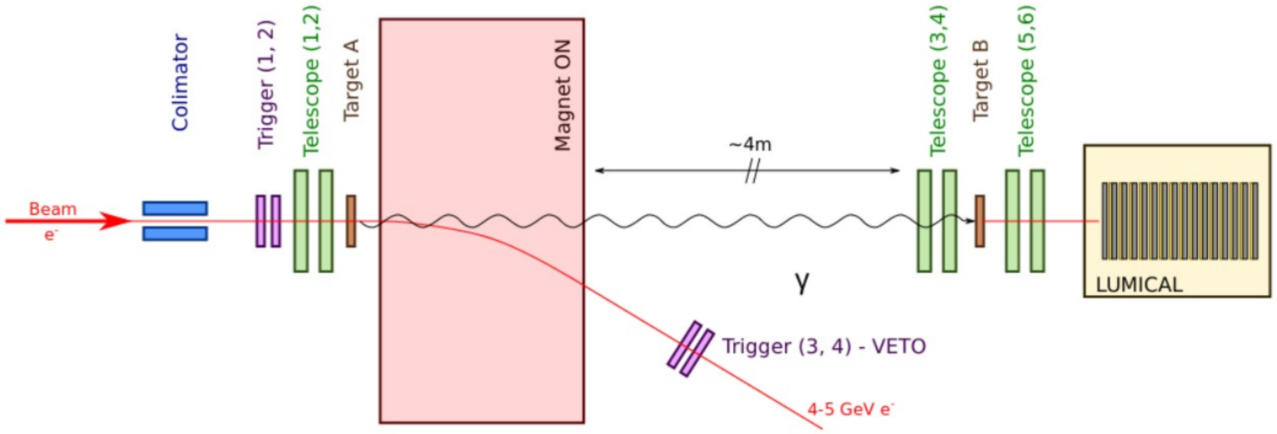



We can use the polar angle of the Brem. Photons w.r.t. a Z axis to get a measurement dependent less on misalignment, but more on initial electron beam distribution



# TB2020 Alpide Telescope Alignment

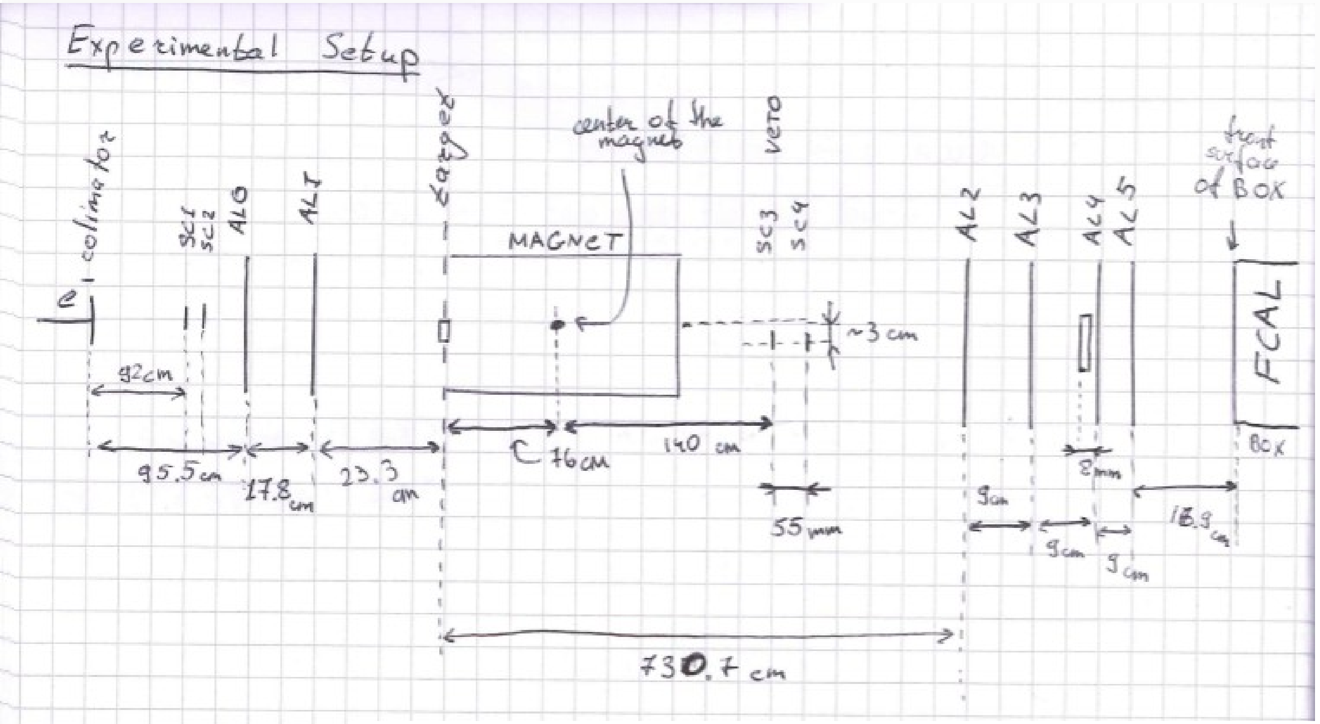


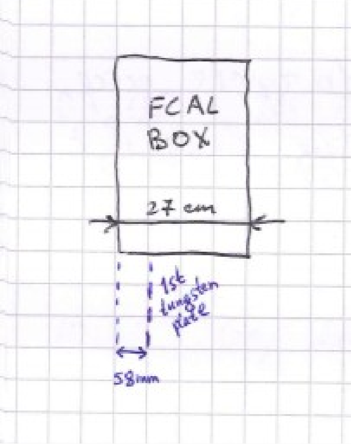

- Continue realignment, especially with 1st two planes
- Try 4-5 GeV e- veto
- Calorimetry analysis

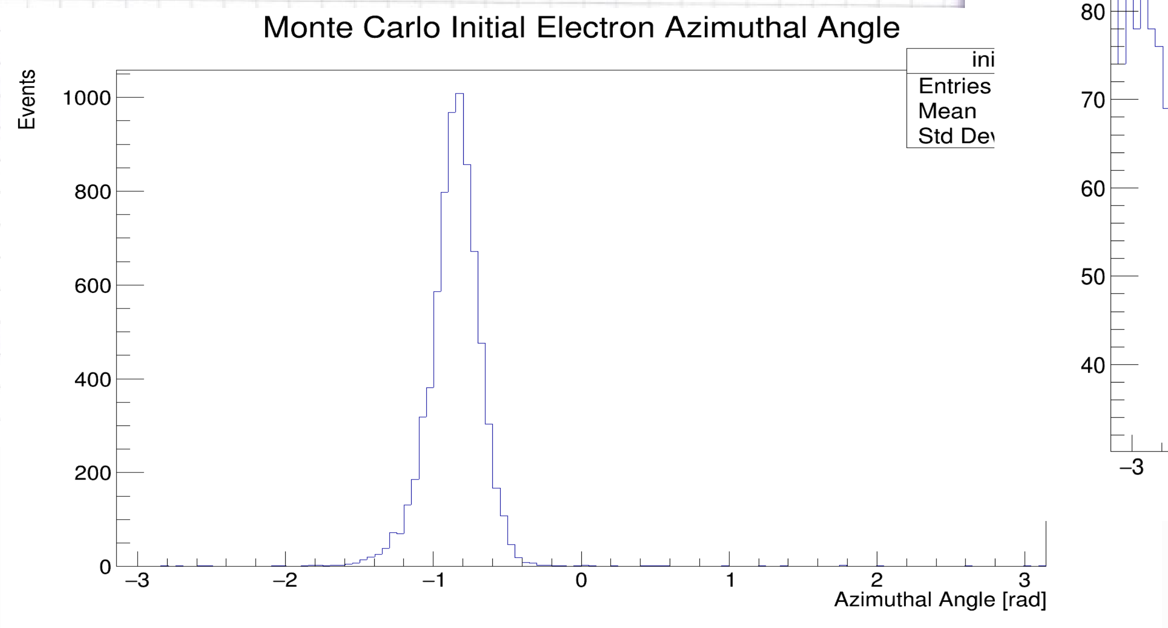
# backup

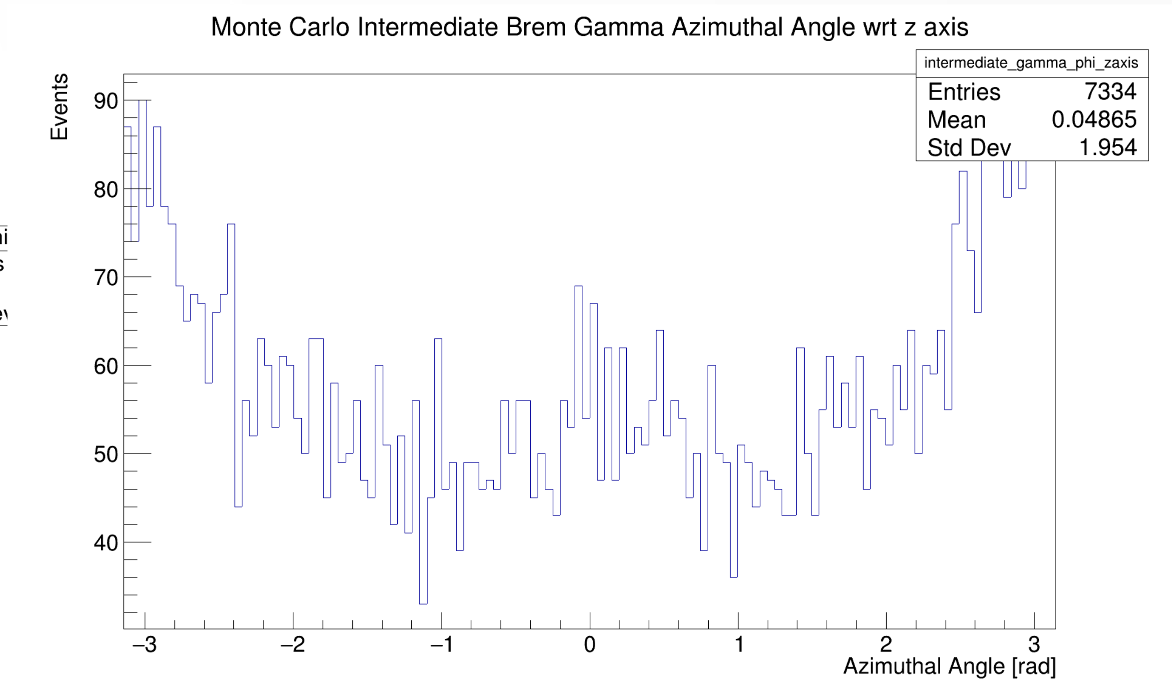
Misaligning each plane by some random value in x,y between +- 0.25mm ...

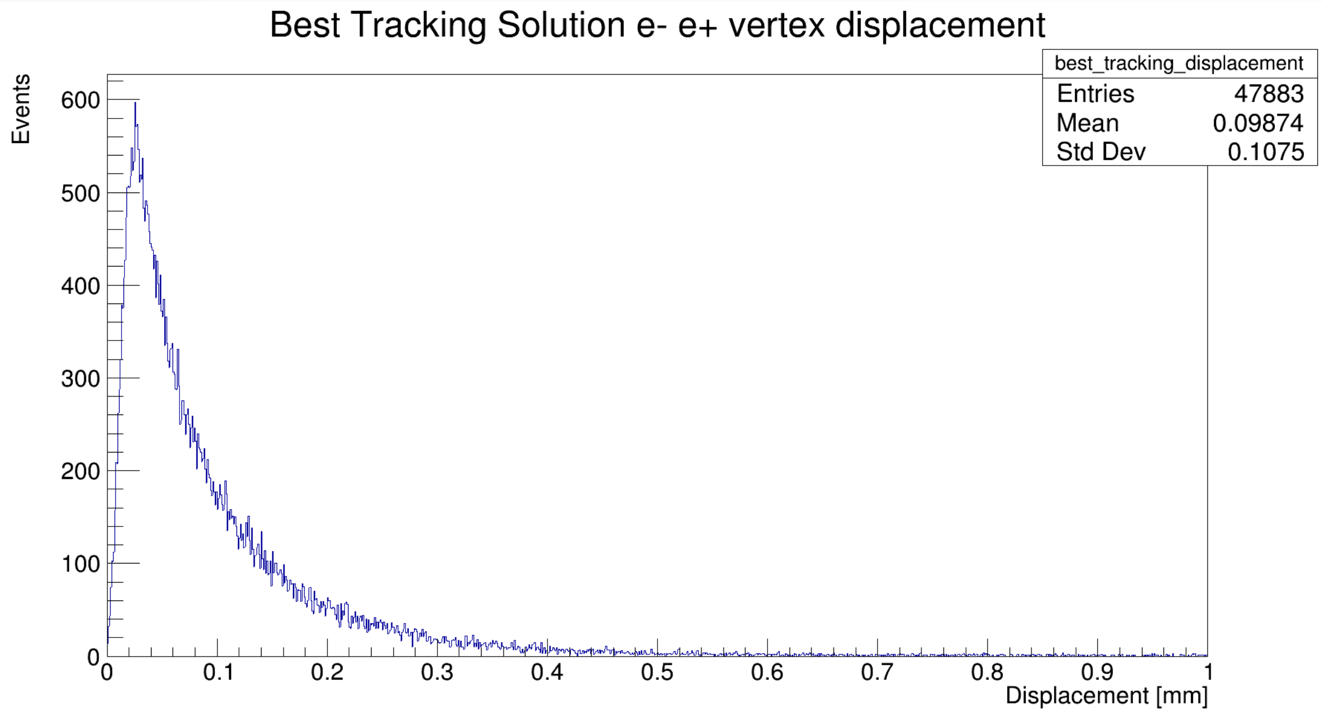
Initial electron vector seems particularly affected; likely because of the far smaller displacement between planes 1 & 2

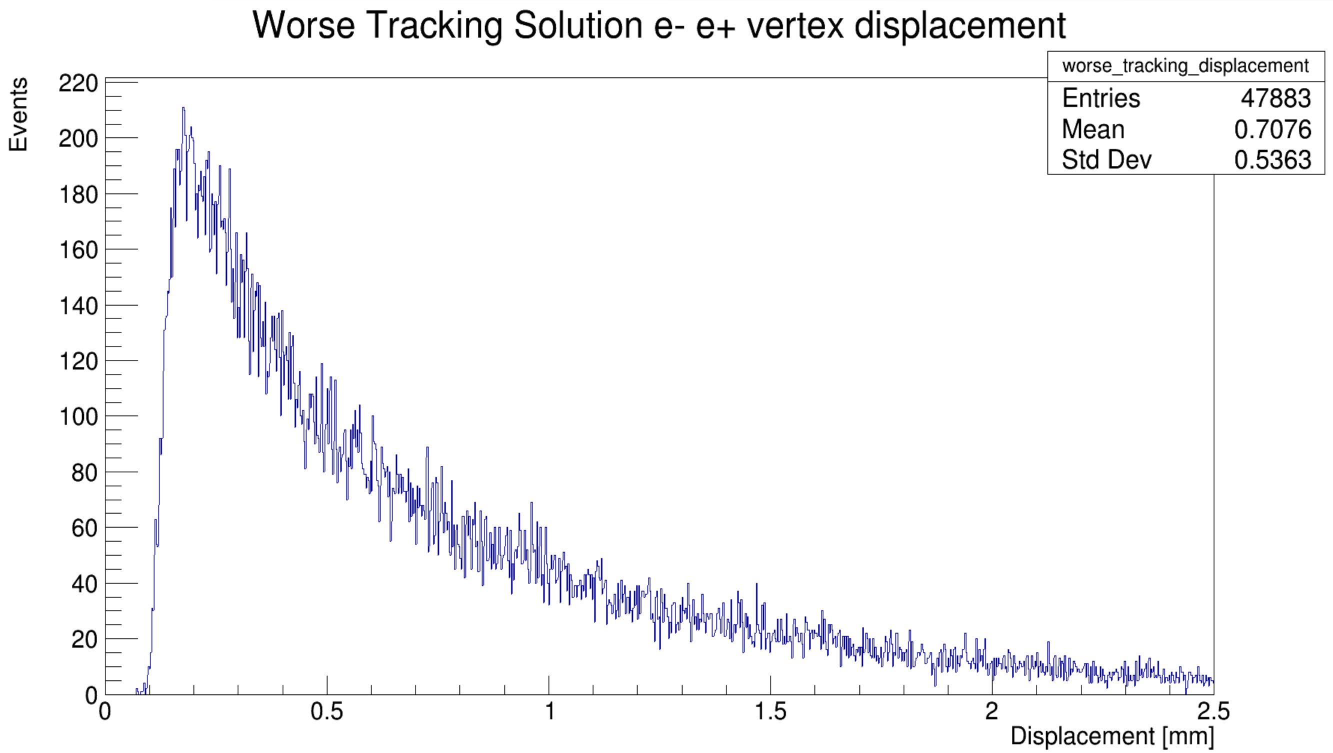


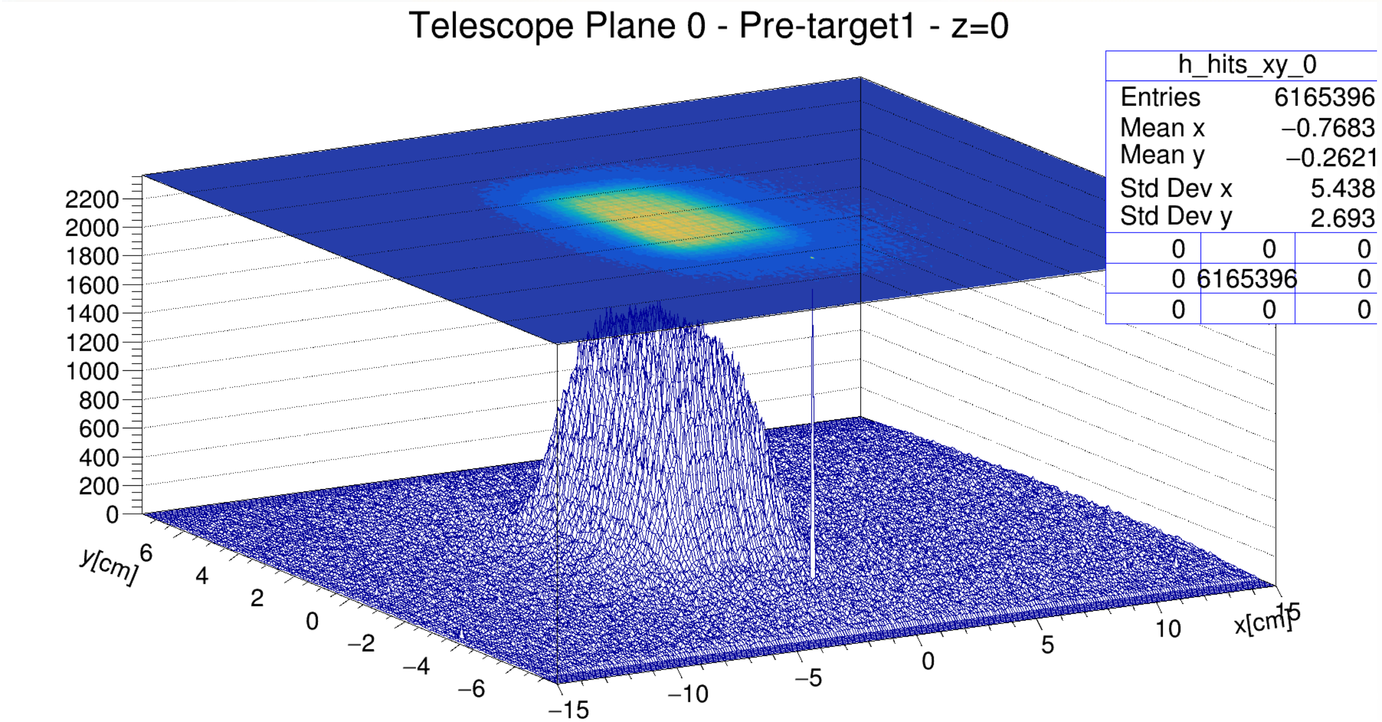



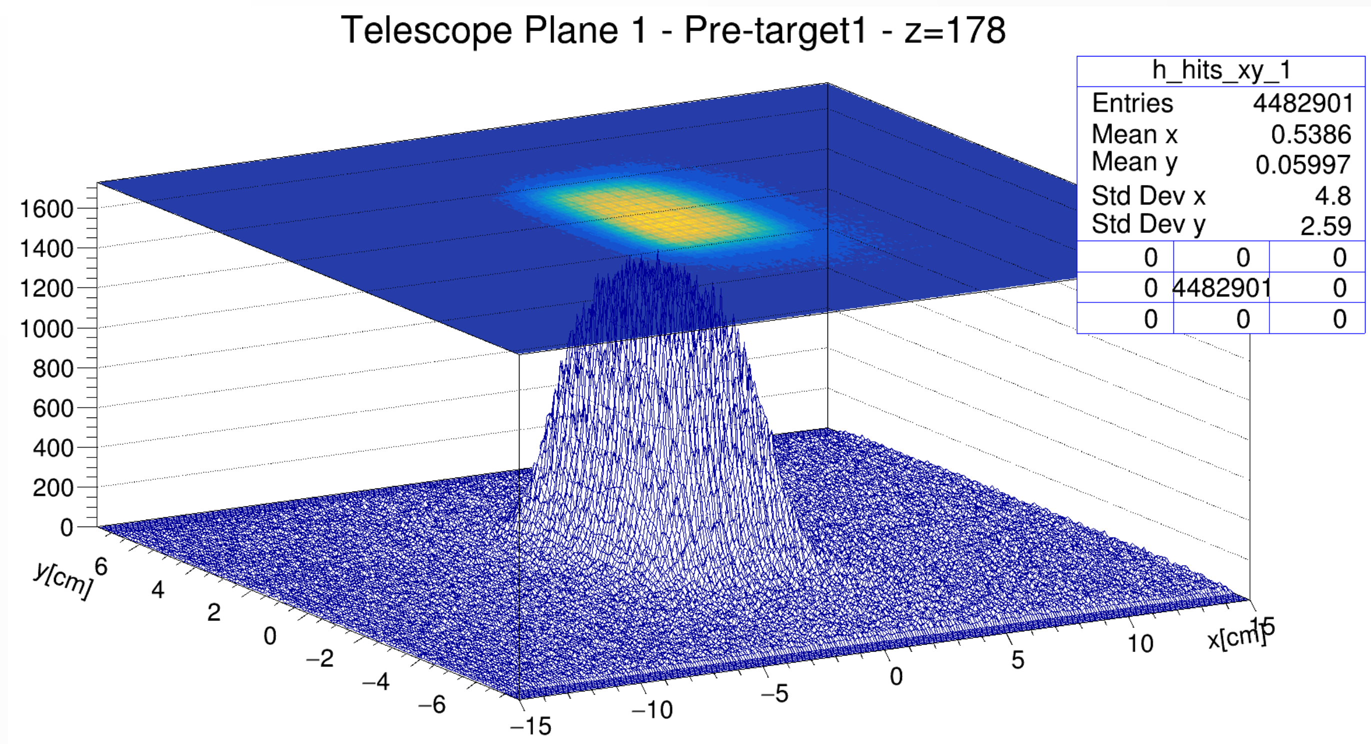

Best Tracking Solution e- e+ vertex displacement
best_tracking_displacement
Entries 47883
Mean 0.09874
Std Dev 0.1075
Events
Displacement [mm]

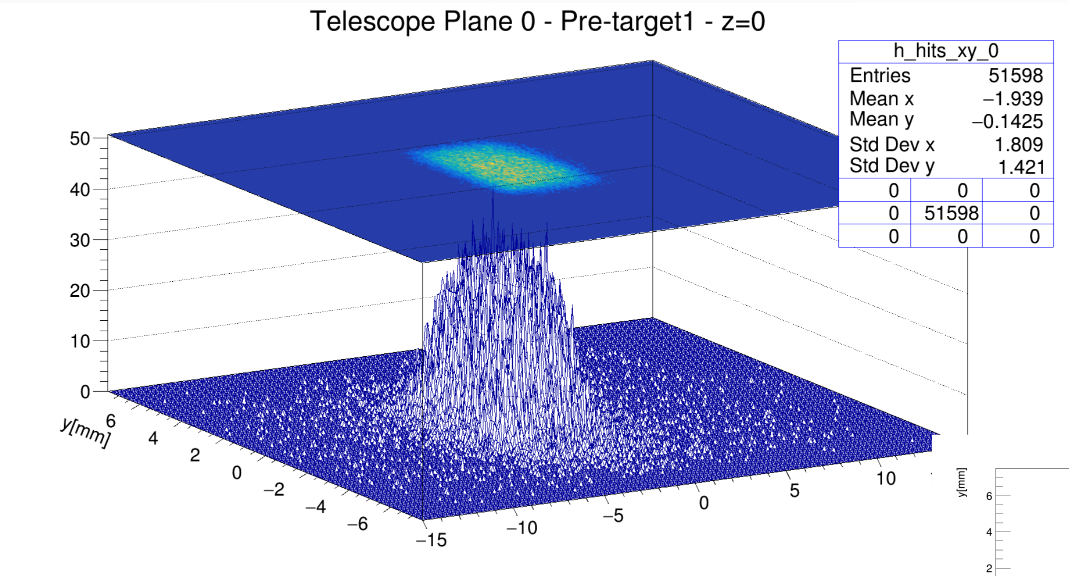

Worse Tracking Solution e- e+ vertex displacement
worse_tracking_displacement
Entries 47883
Mean 0.7076
Std Dev 0.5363
Events
Displacement [mm]

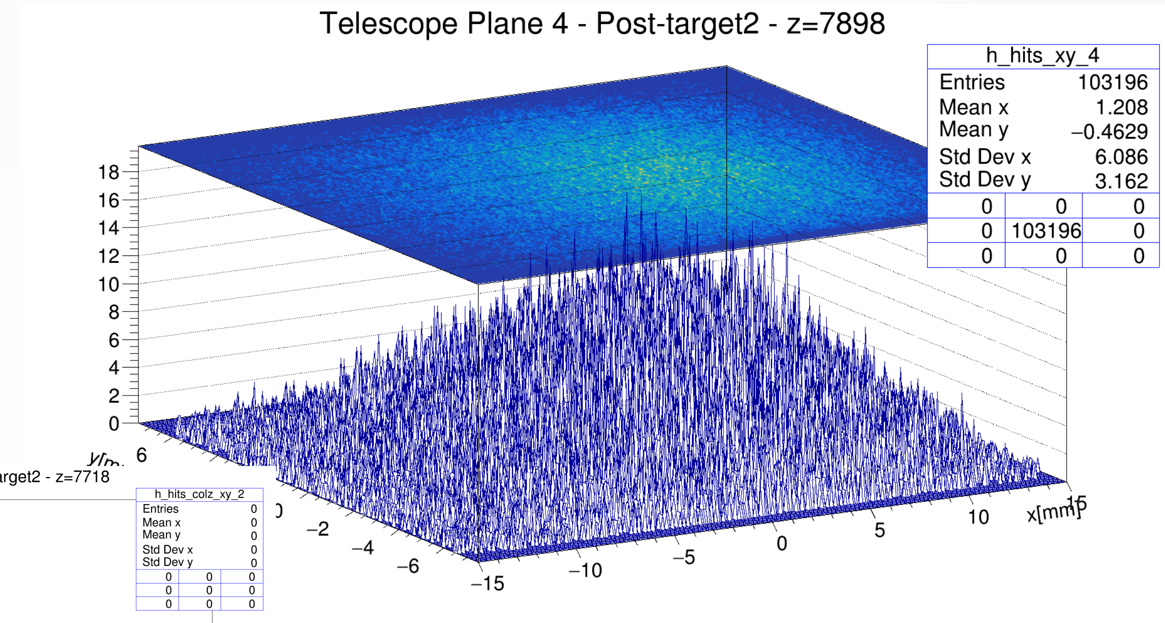


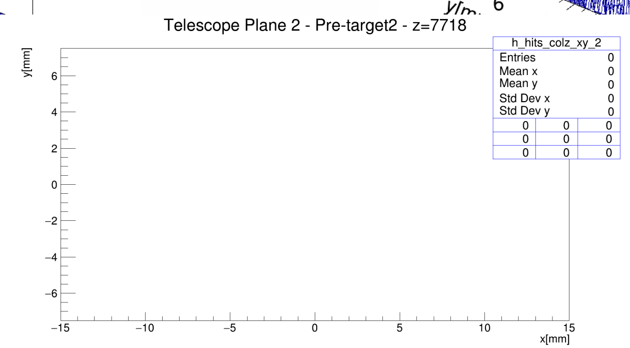

Have cleaned data of hot pixels

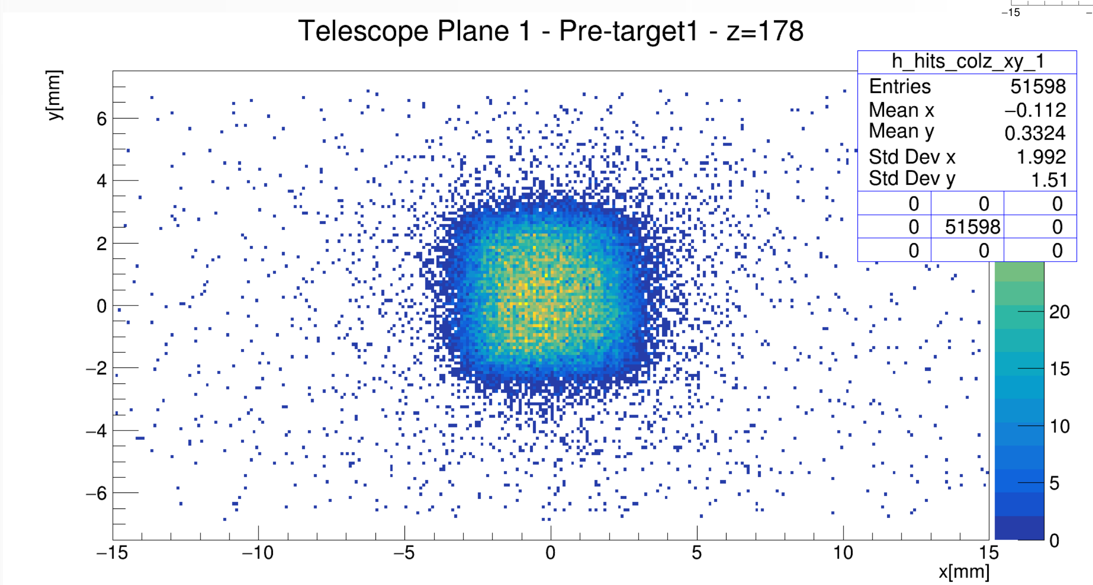
Resulting analysis could exclude real data within these 'hot' pixels but this result is likely small



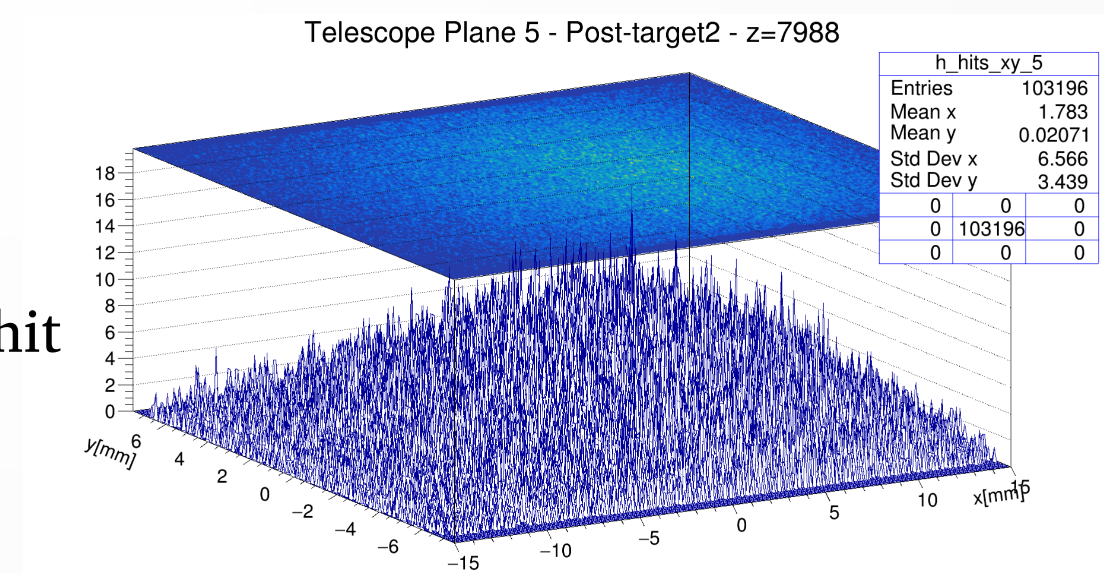


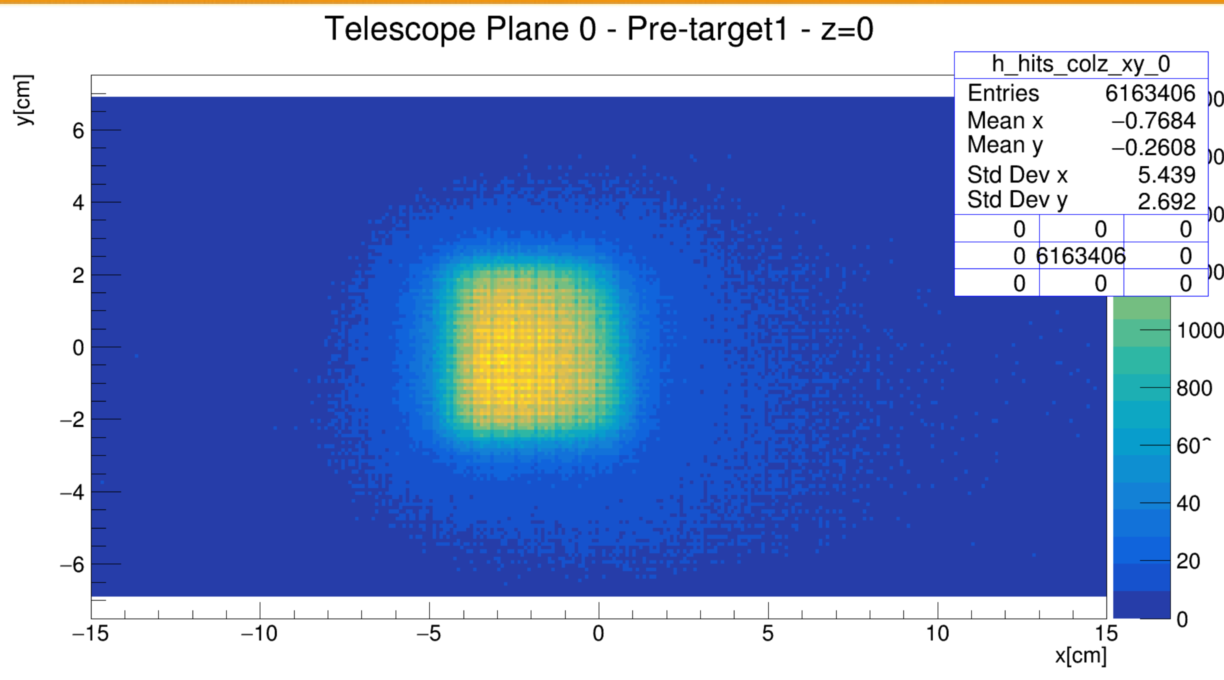



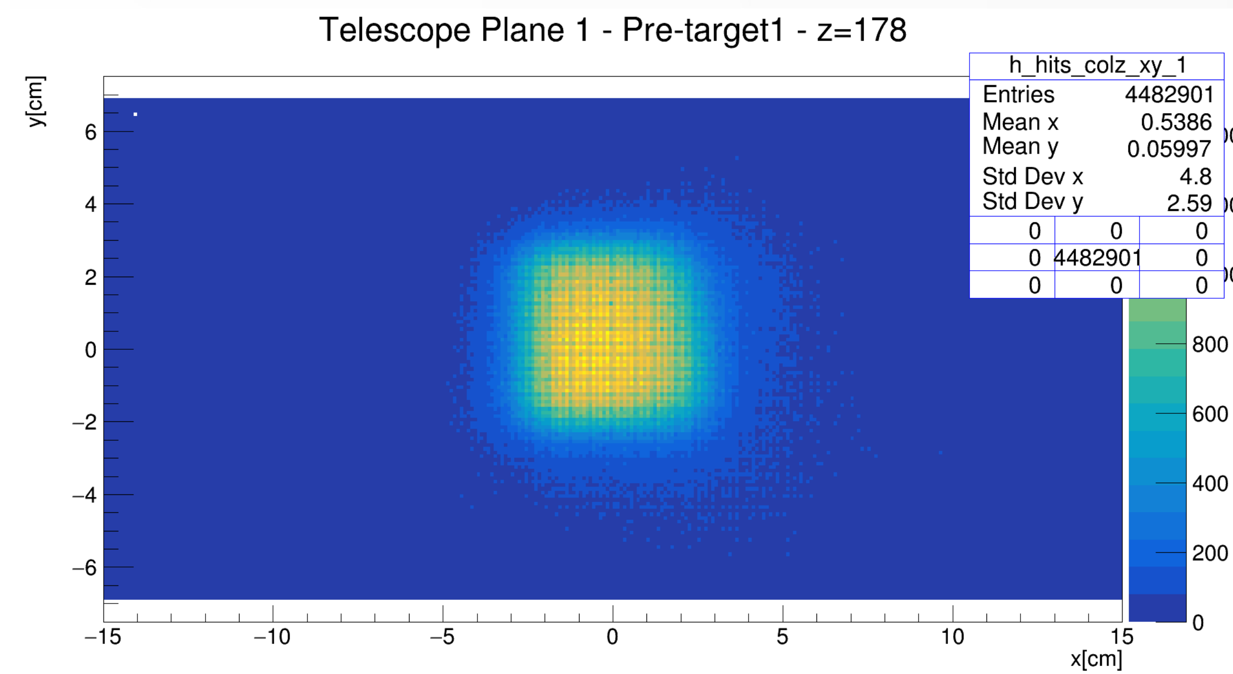



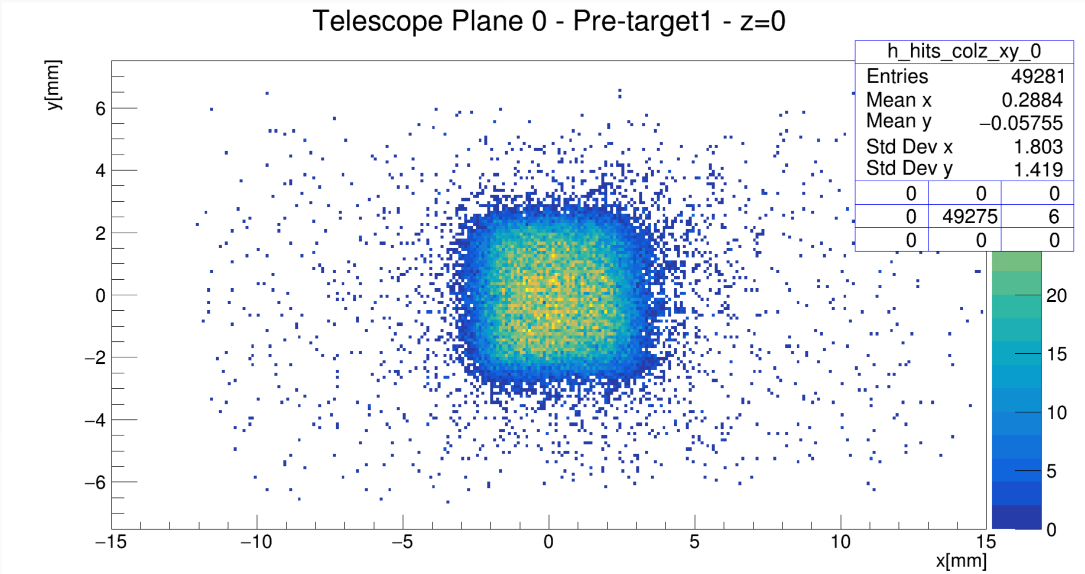

Look for **110022** hit pattern

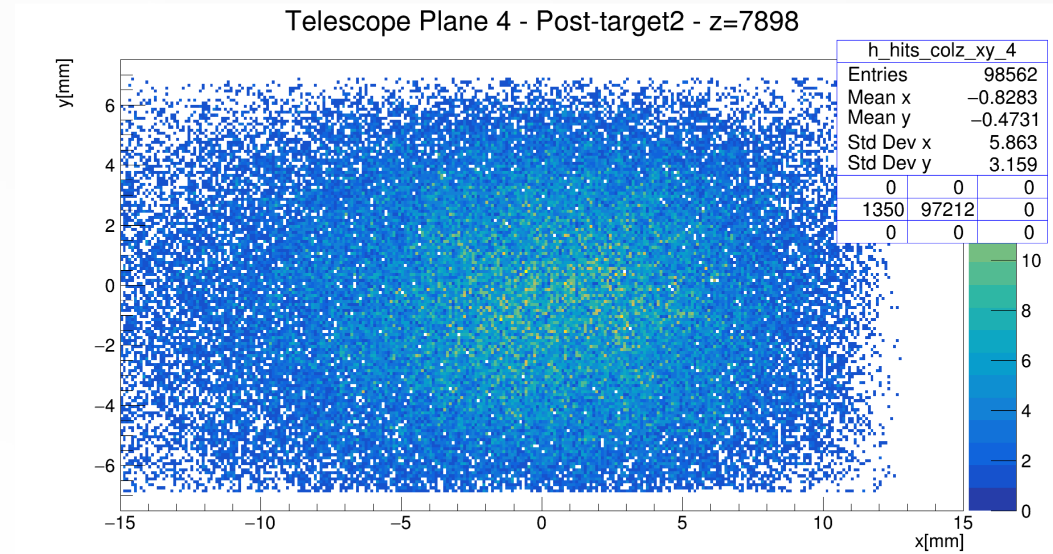


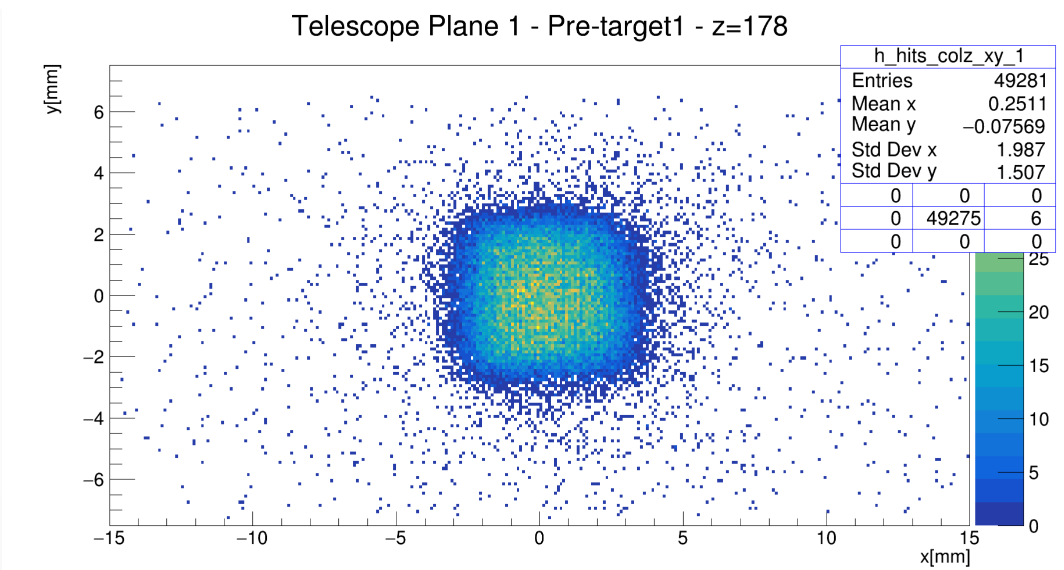


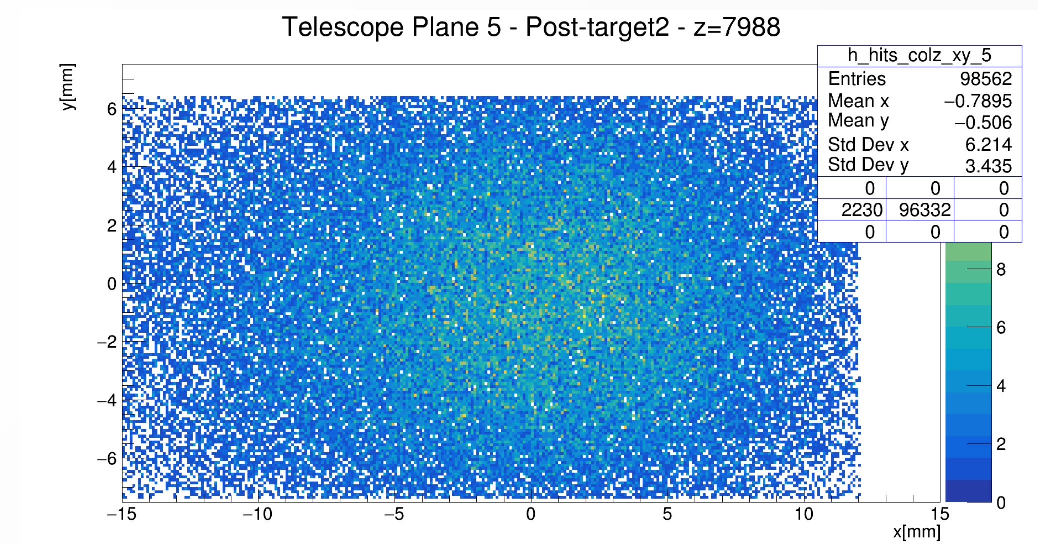




This needs above all,
good alignment!

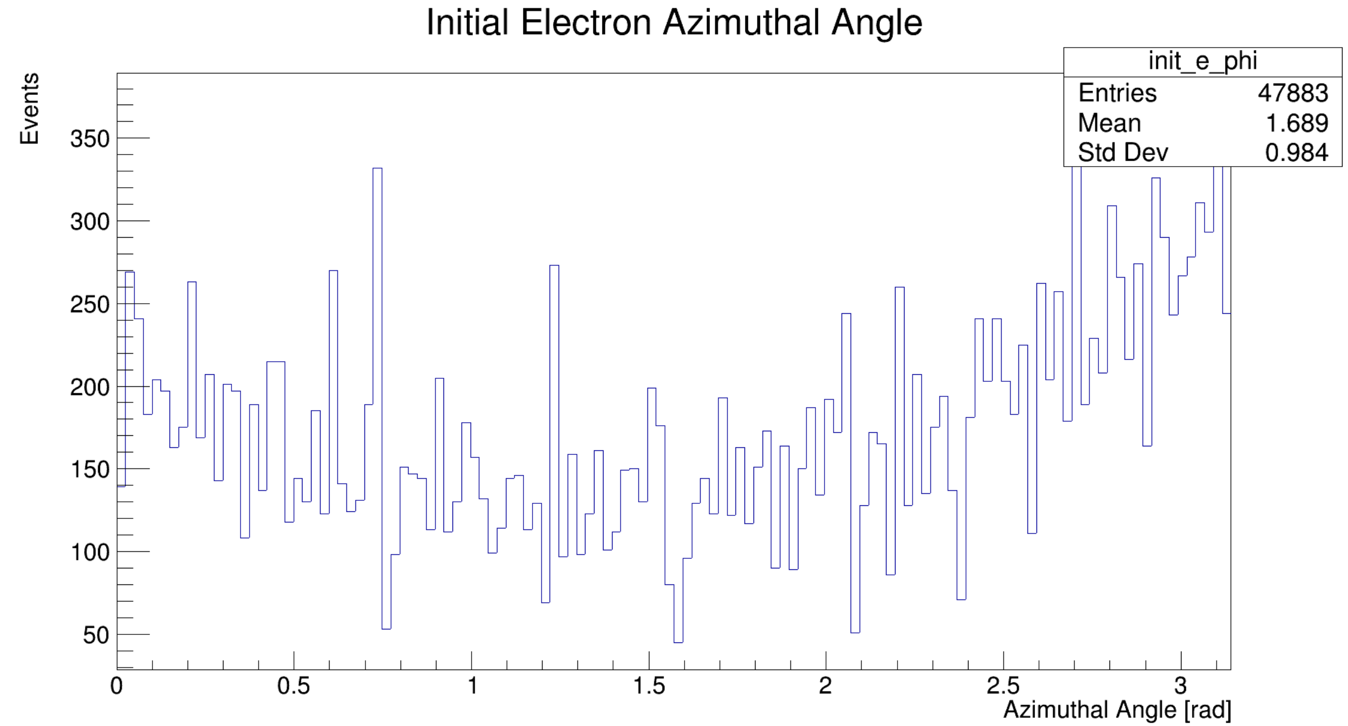


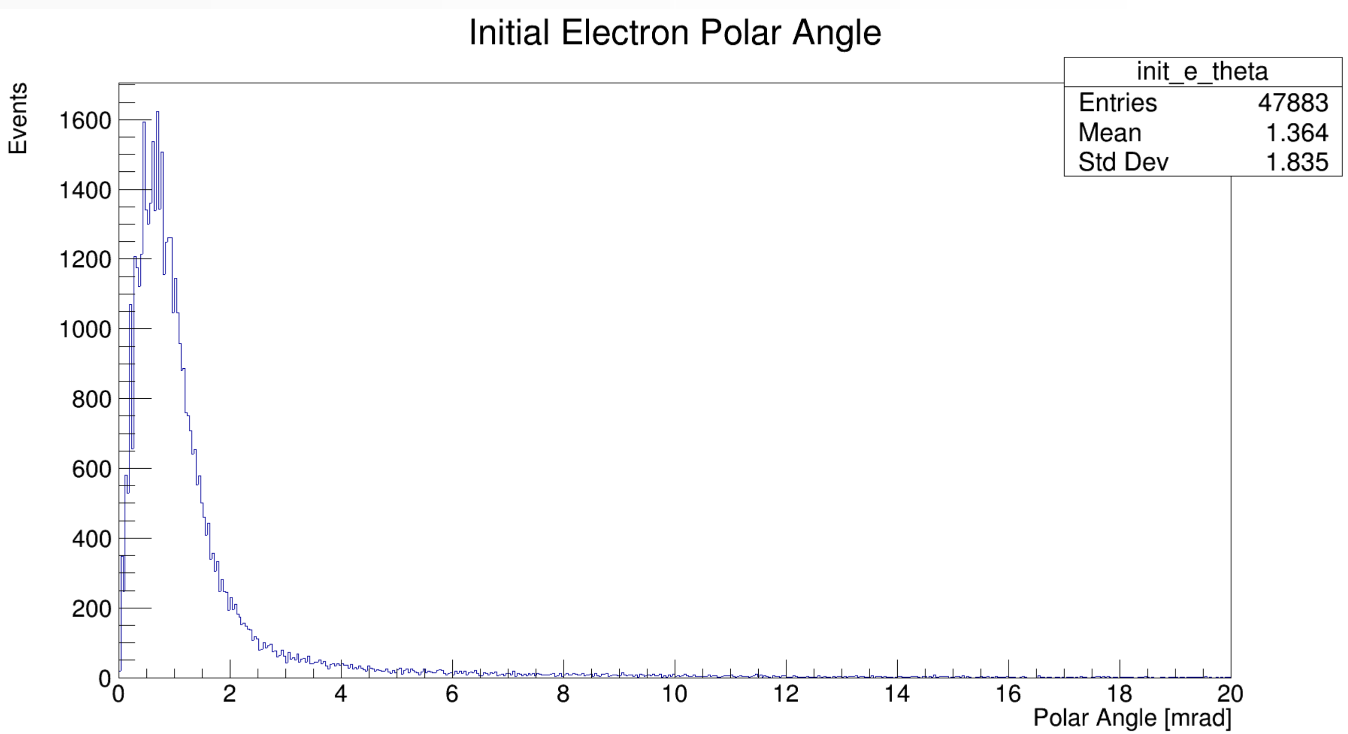



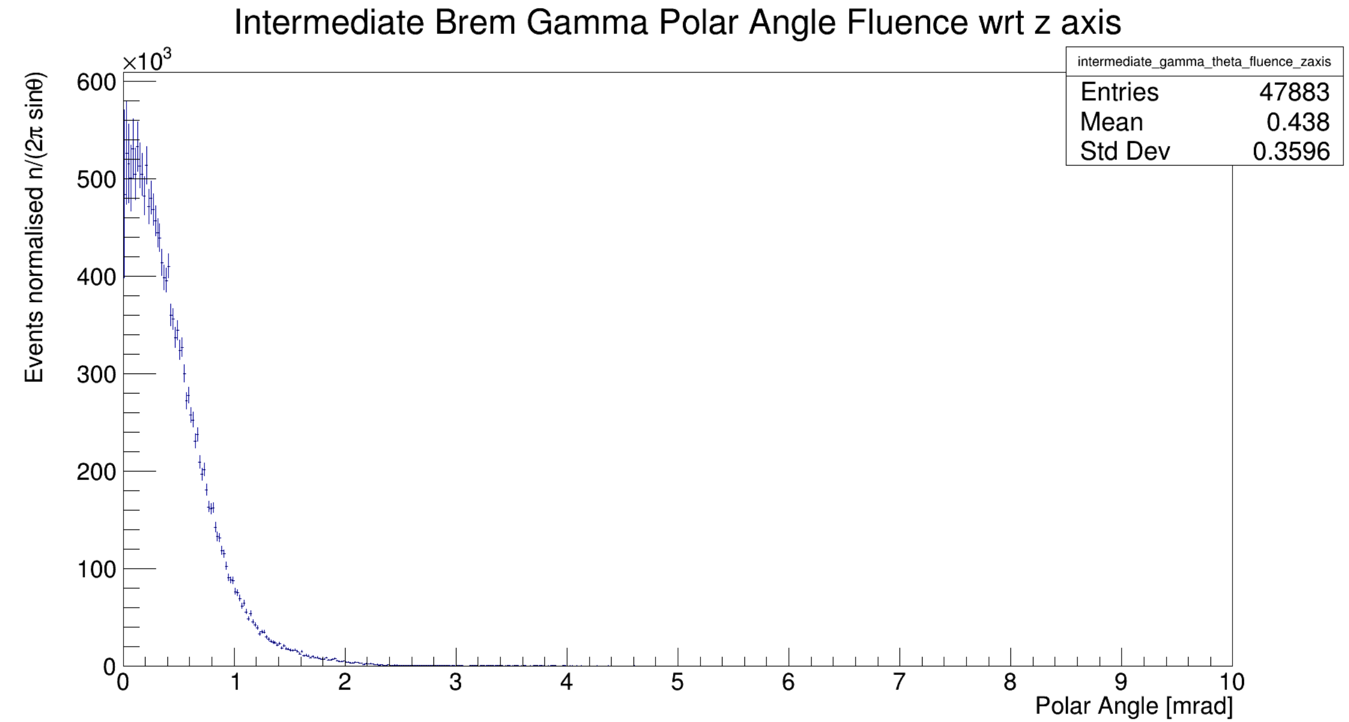

There are runs with no targets, no B-field, with telescope planes in place; use mean position of distribution for alignment




← Unclear with statistics, but Azimuthal distribution does not look flat. Can be explained by pixelated telescope structure, and selection of tracks where all are incident within the rectangular detector plane



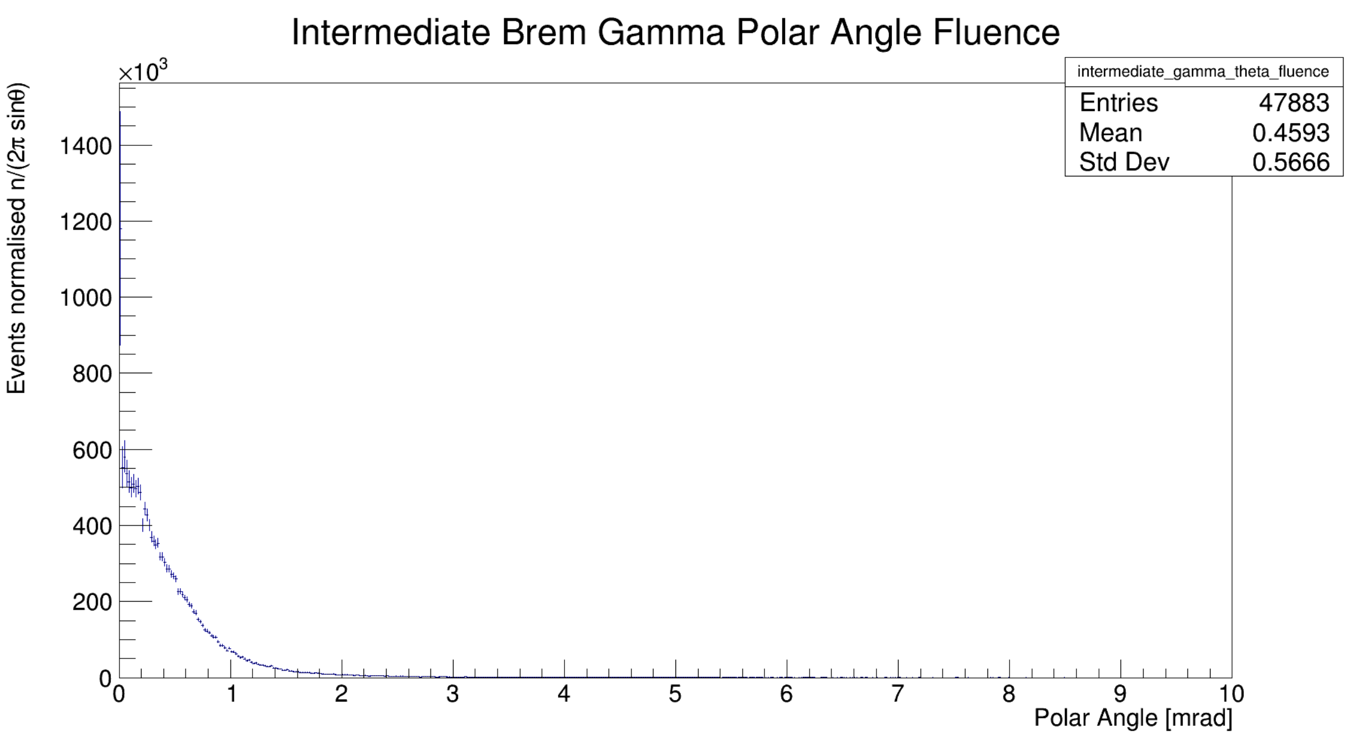

← Polar angle distribution of initial electron w.r.t. center of aligned detector planes. The DESY-II test beam itself is actually created using Brem-radiation then pair-production.

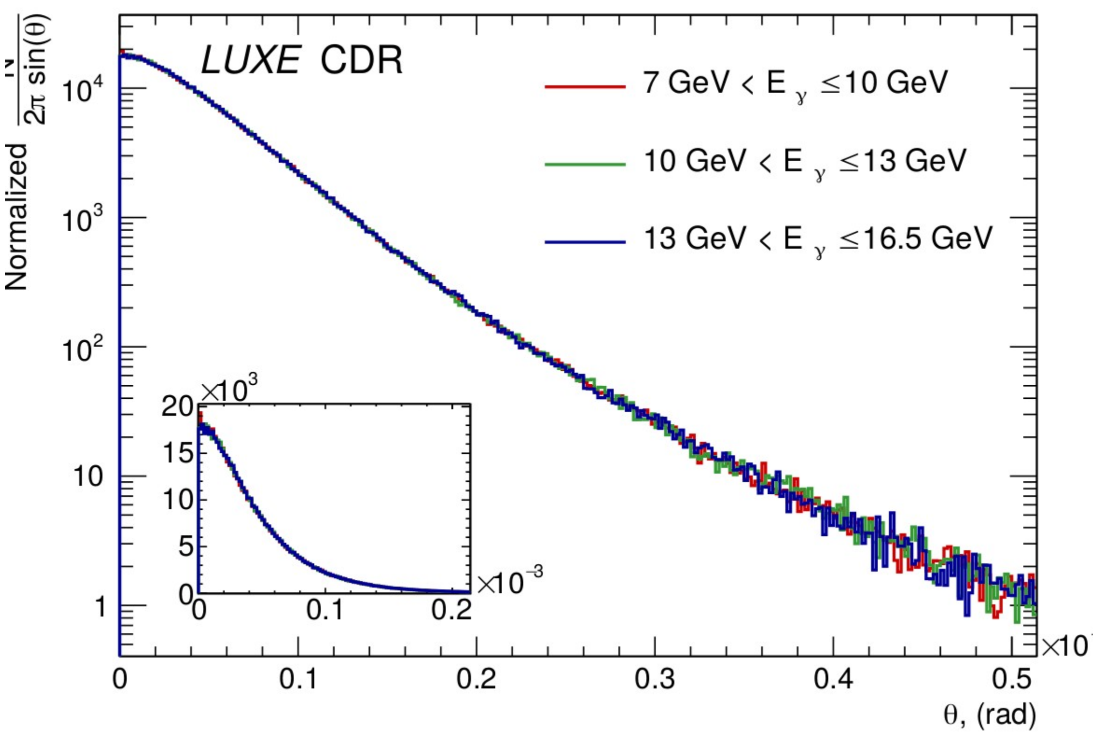


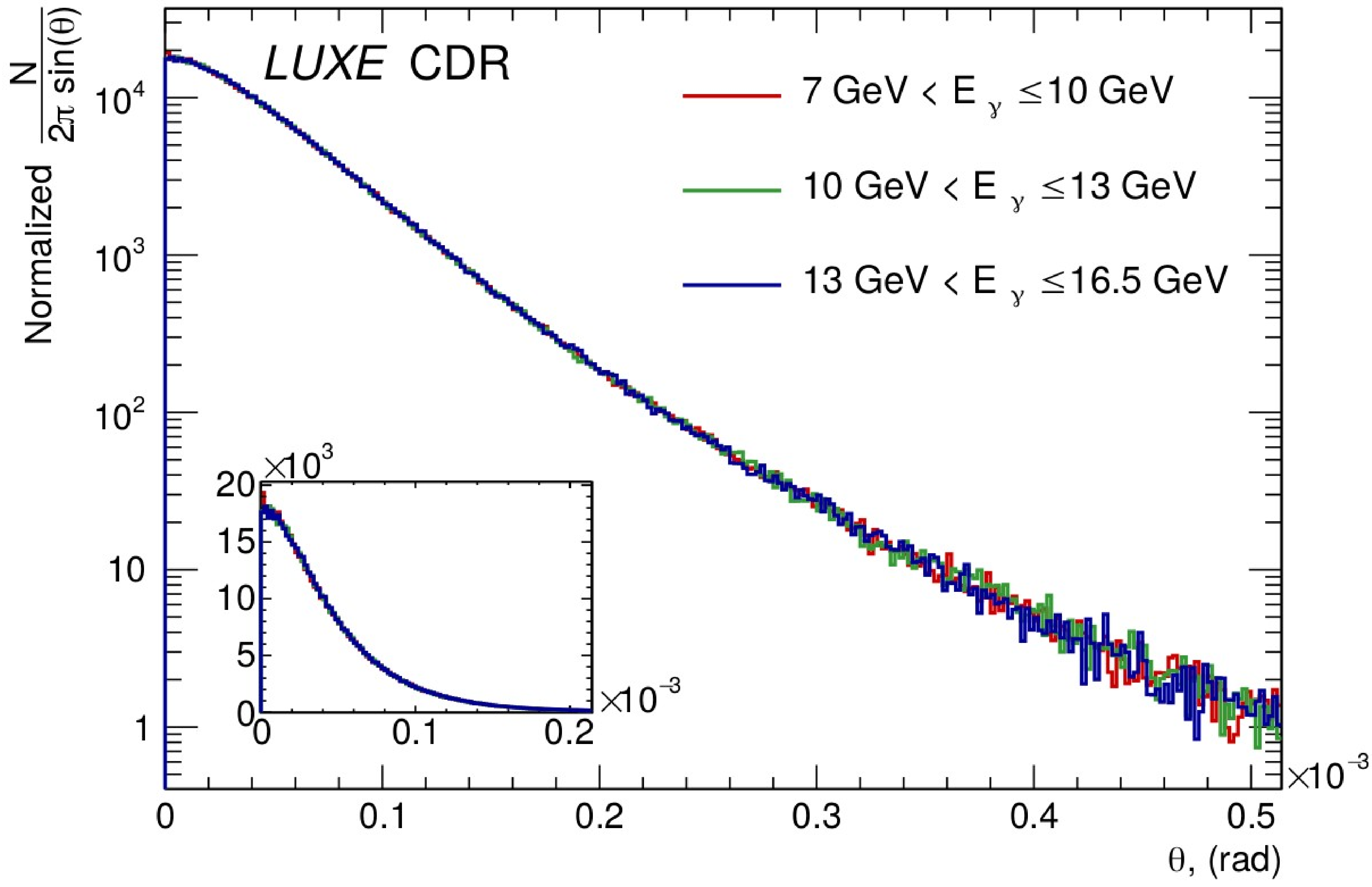

← Reconstructed photon track polar angle vs. (somewhat arbitrary) z axis… results in steeper trend?

Alignment must be bettered… previously just used mean position.

Have thought about a more involved event-by-event alignment strategy




LUXE CDR
7 GeV < E γ ≤10 GeV
10 GeV < E γ ≤13 GeV
13 GeV < E γ ≤16.5 GeV
Normalized N / 2π sin(θ)
θ, (rad)
×10^-3
×10^3
0
0.1
0.2
0.3
0.4
0.5
1
10
10^2
10^3
10^4
0
5
10
15
20