TB2020 Bremsstrahlung Study

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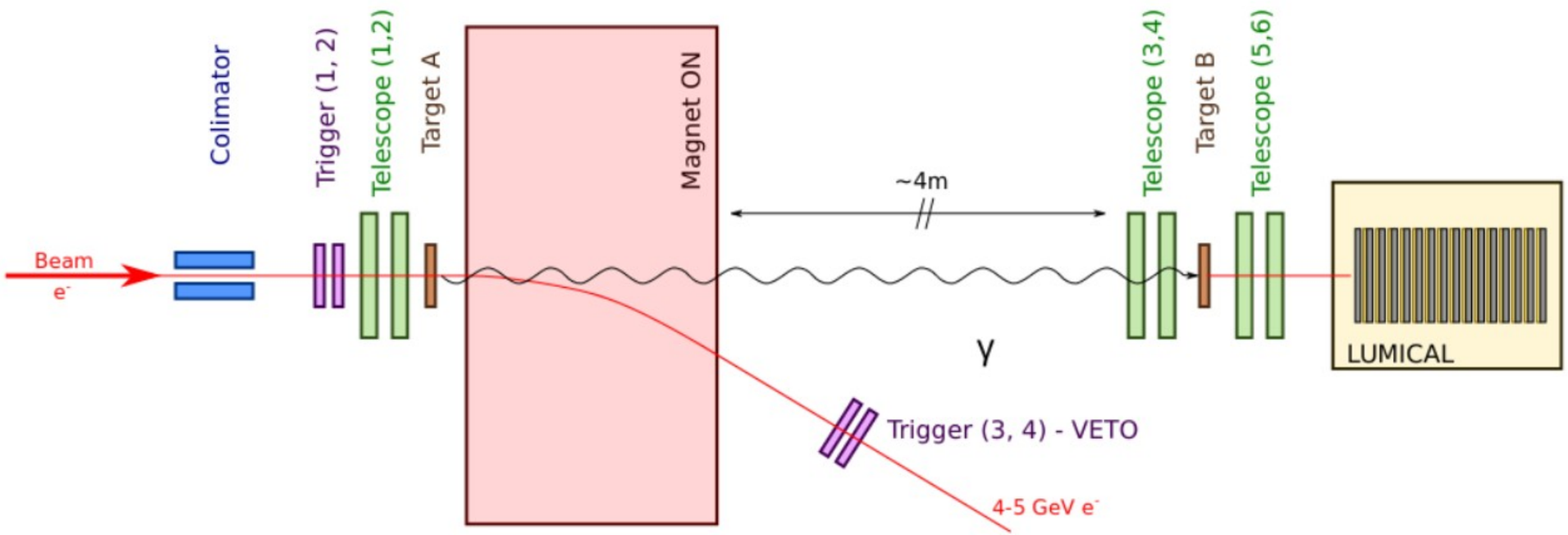
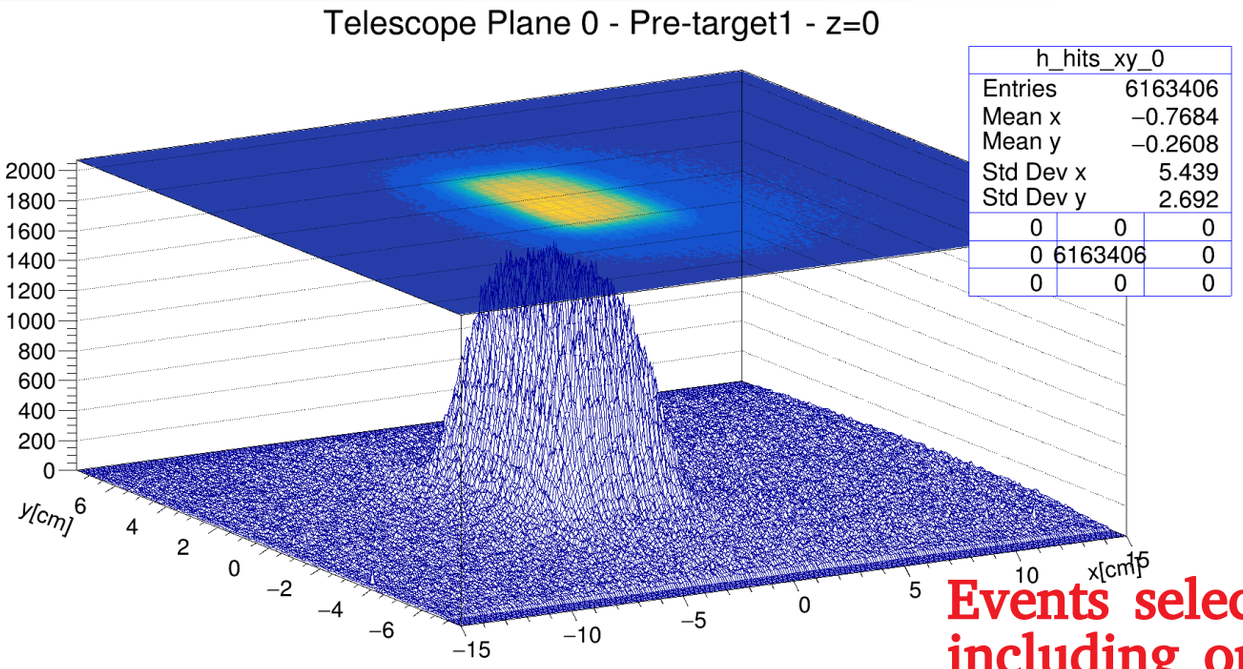
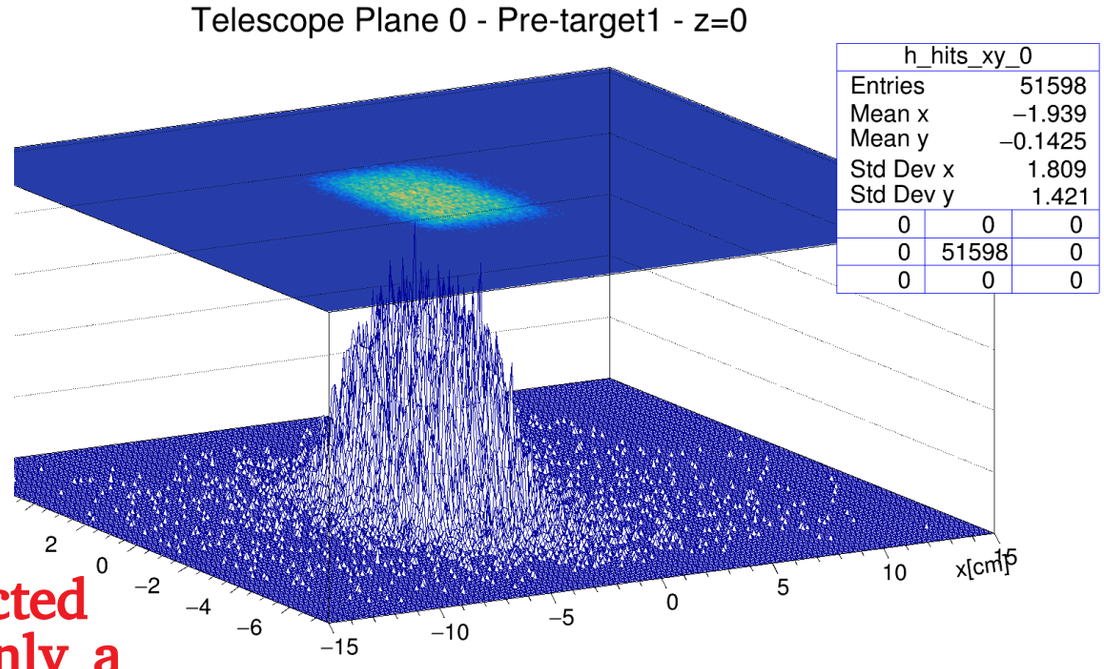
TB2020 Alpide Telescope Alignment

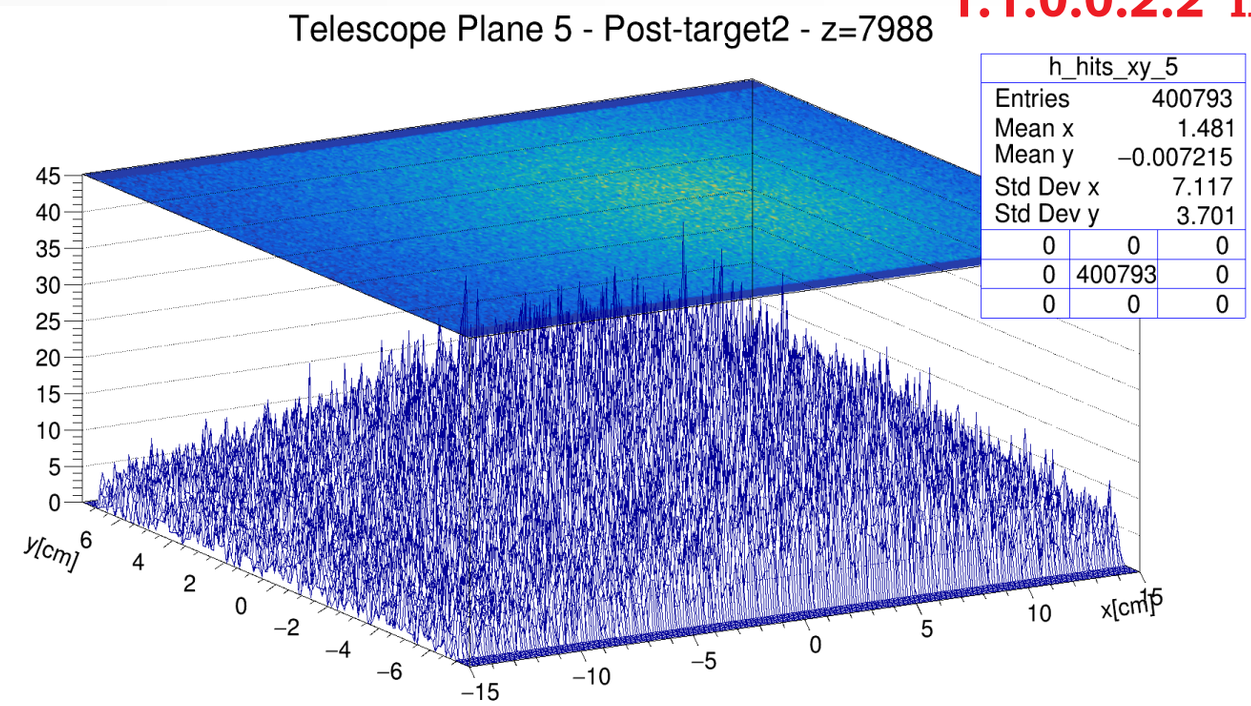


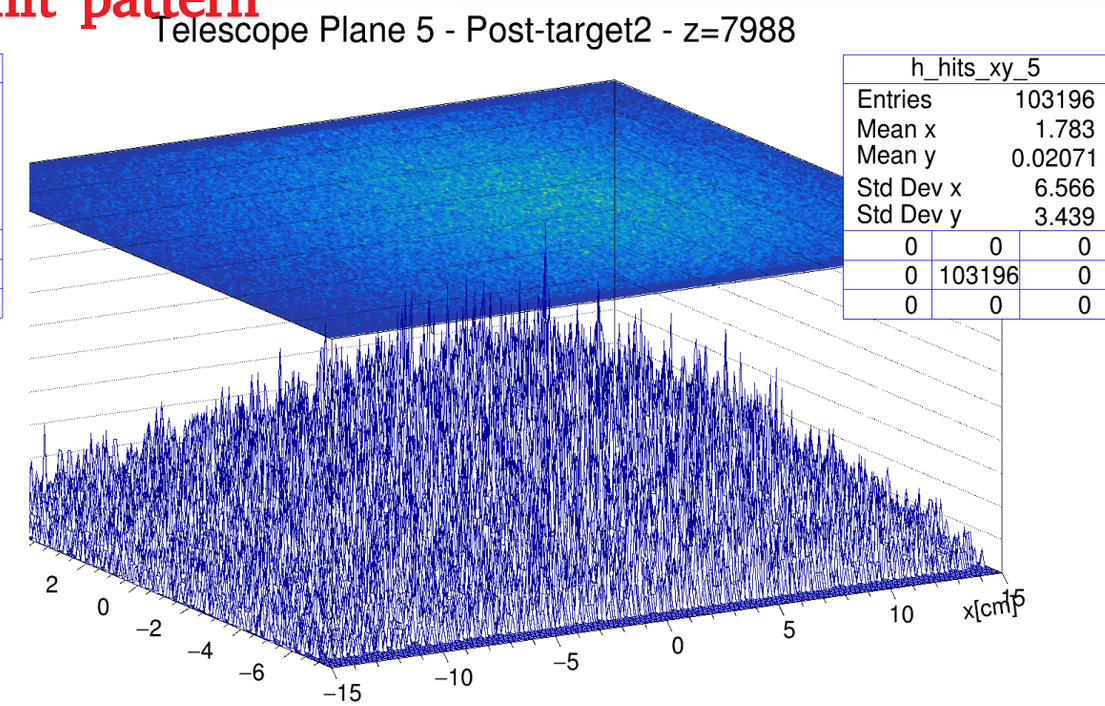
Idea is to use this data to reconstruct the dispersion of bremsstrahlung photons, in particular the polar angle.

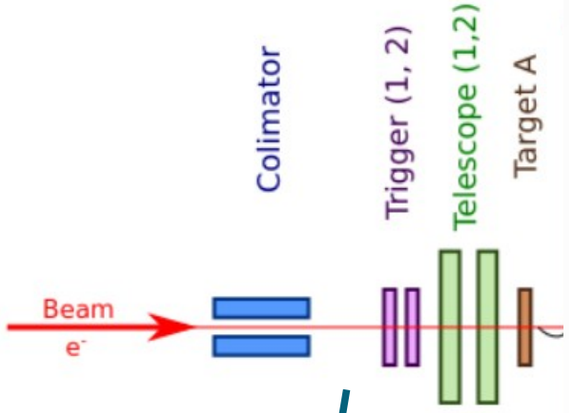




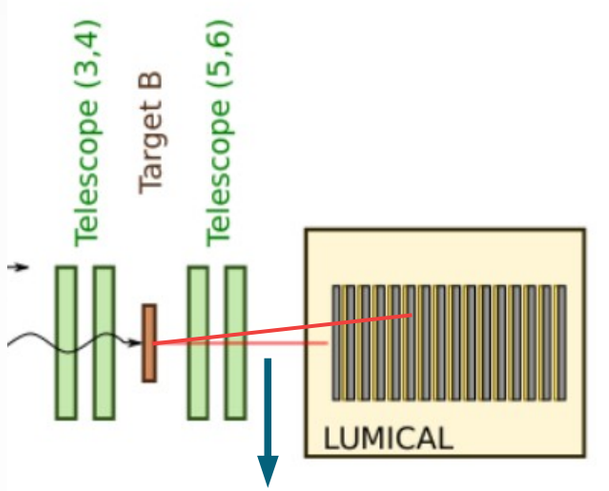
Events selected including only a 1:1:0:0:2:2 hit pattern







Alignment is important! and this has been attempted with a multitude of techniques

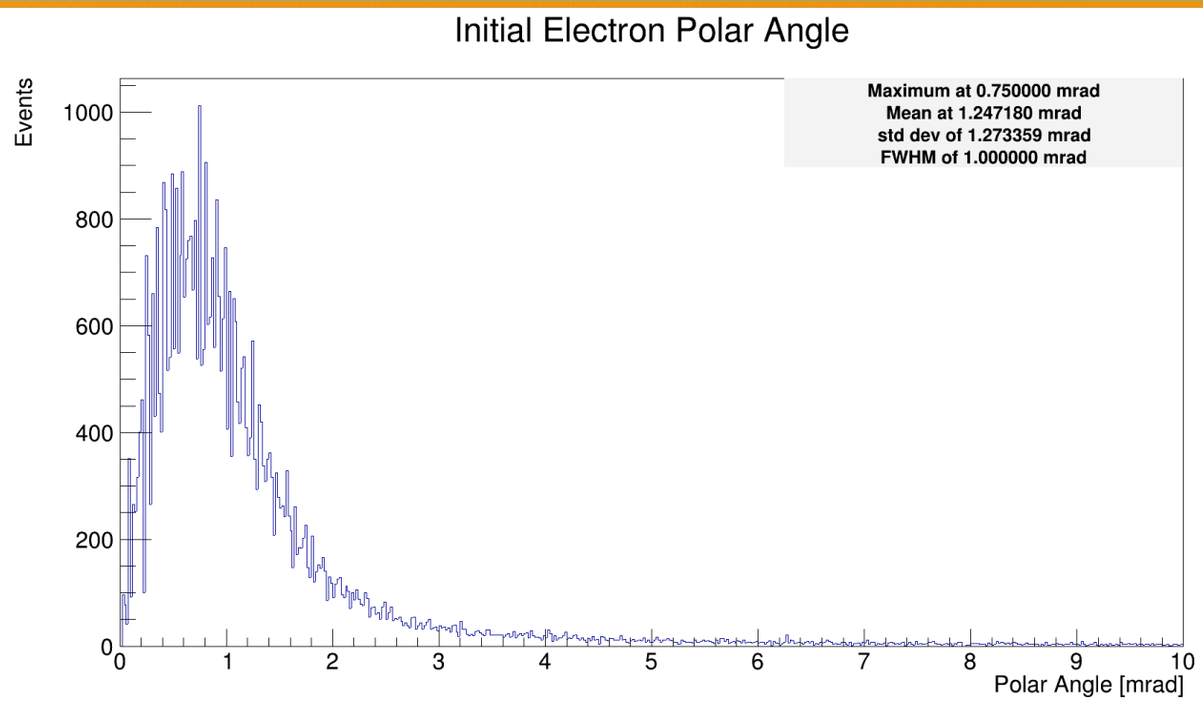


Trace trajectory from hitpoints in planes 1,2 to reconstruct incidence of target 1

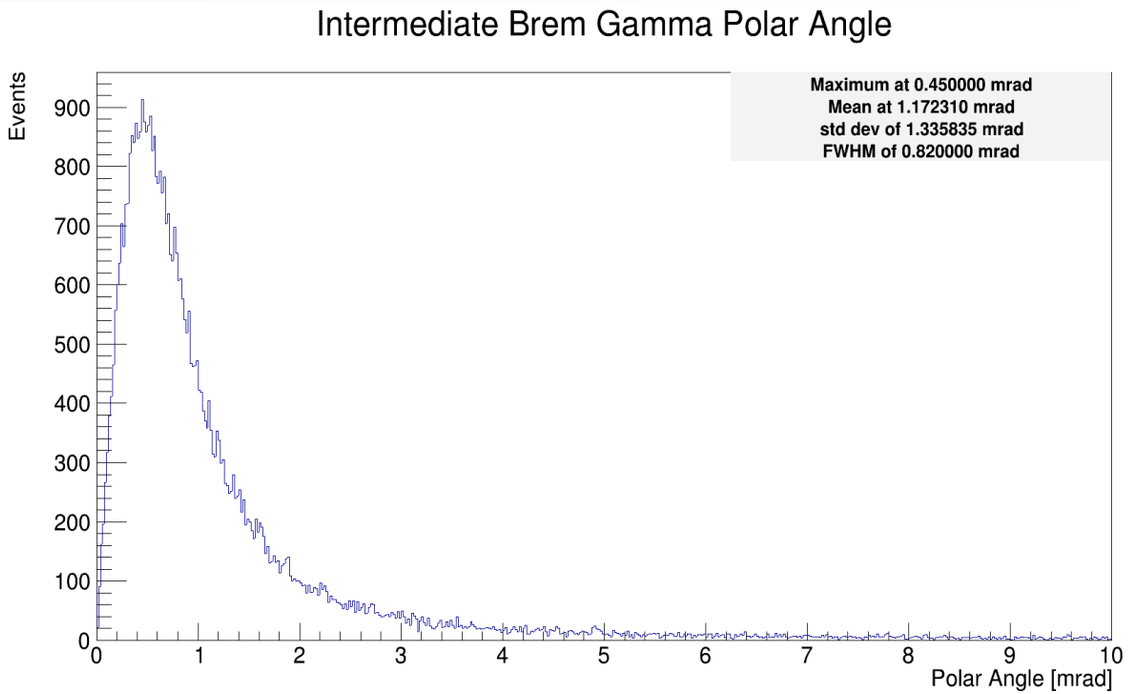
Reconstruct gamma incidence on target 2 using two hits of each of e-/e+ pair

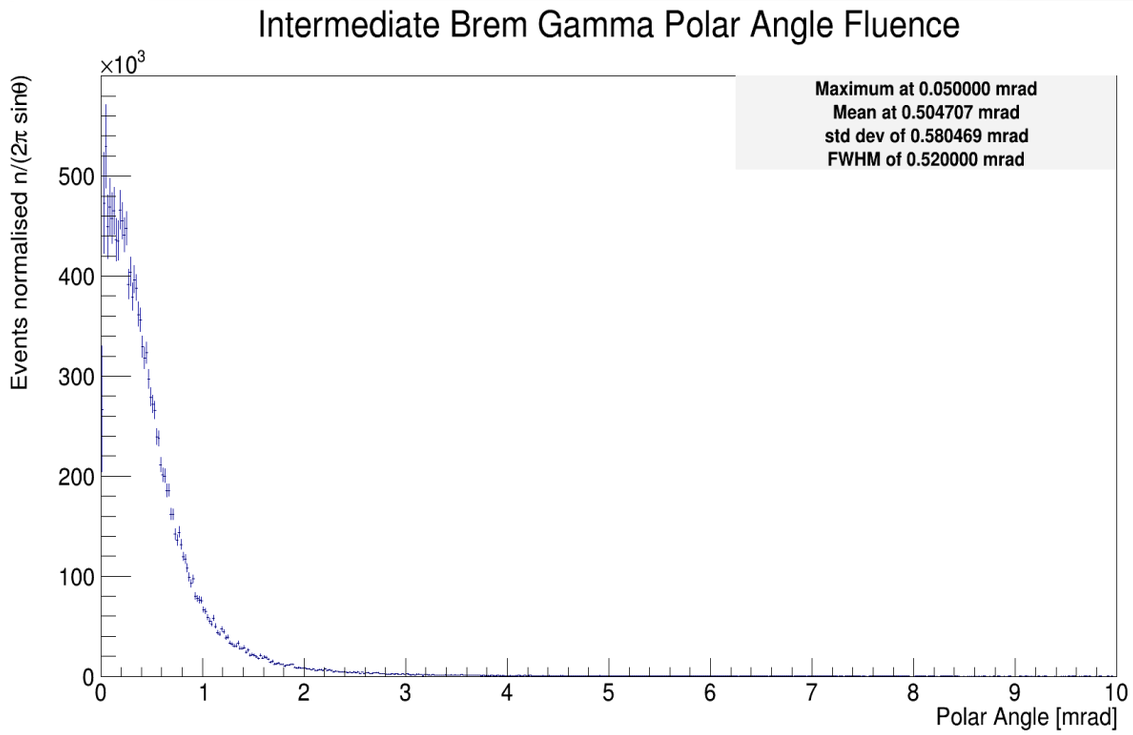
Track + correlate hits to correct tracks by extrapolating to target 2, choosing minimal distance between tracks

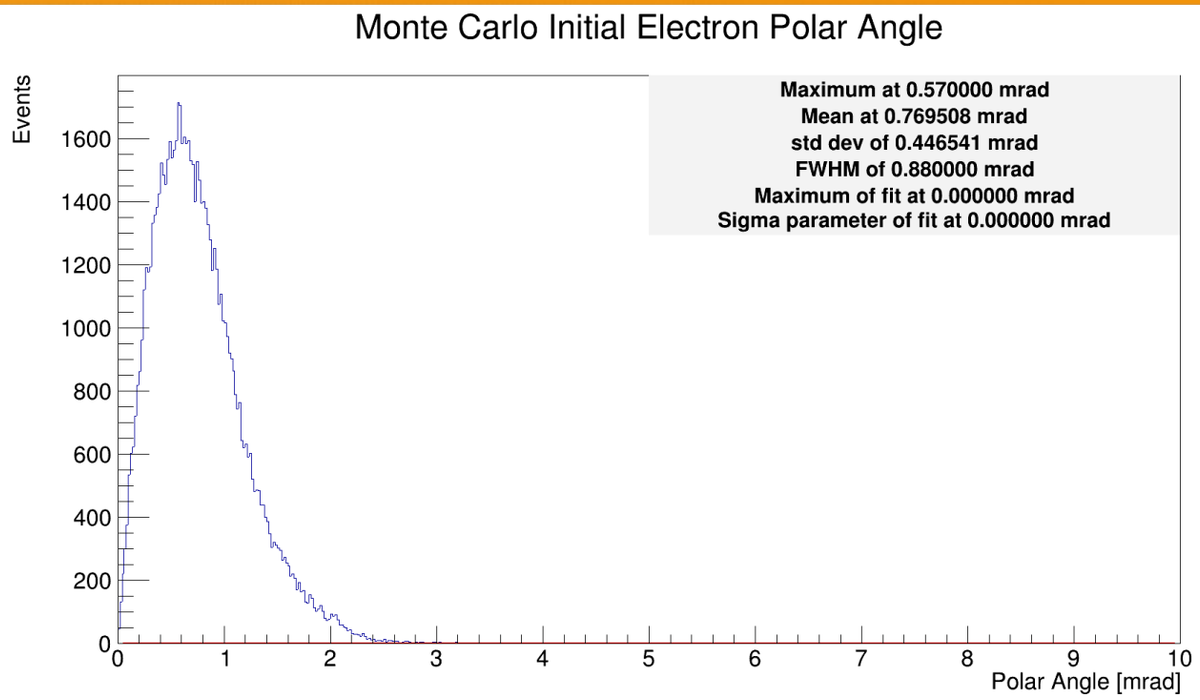
Reconstruct Bremsstrahlung gamma momentum vector, compare to incident e- vector



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



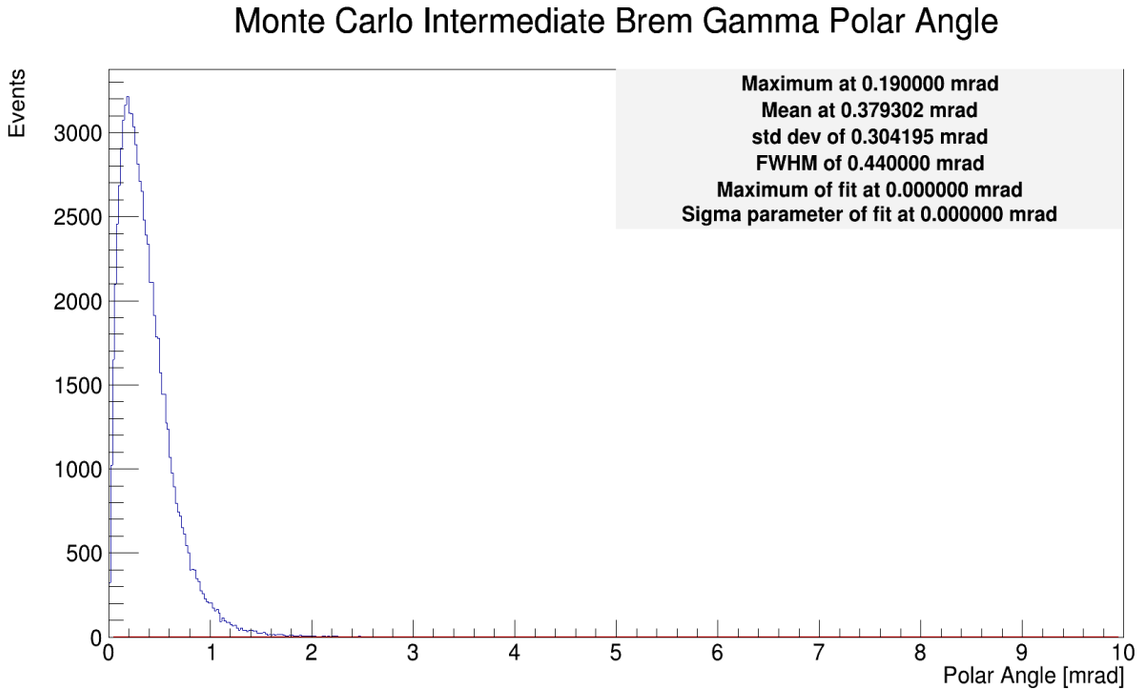


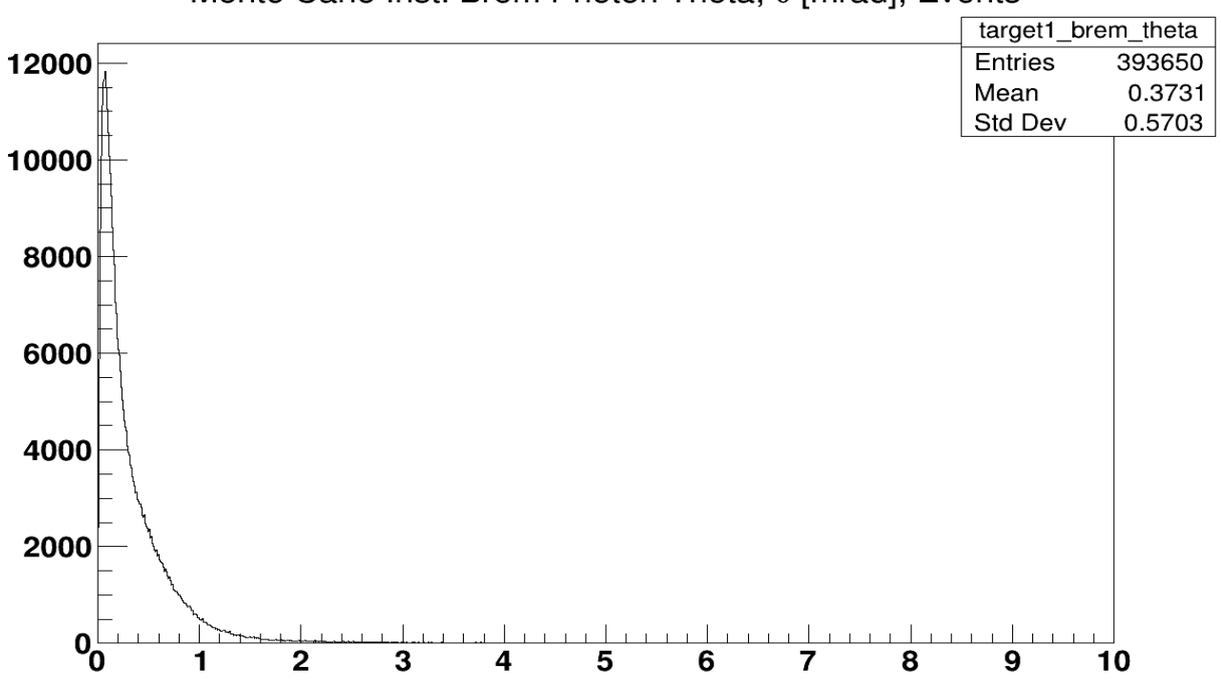


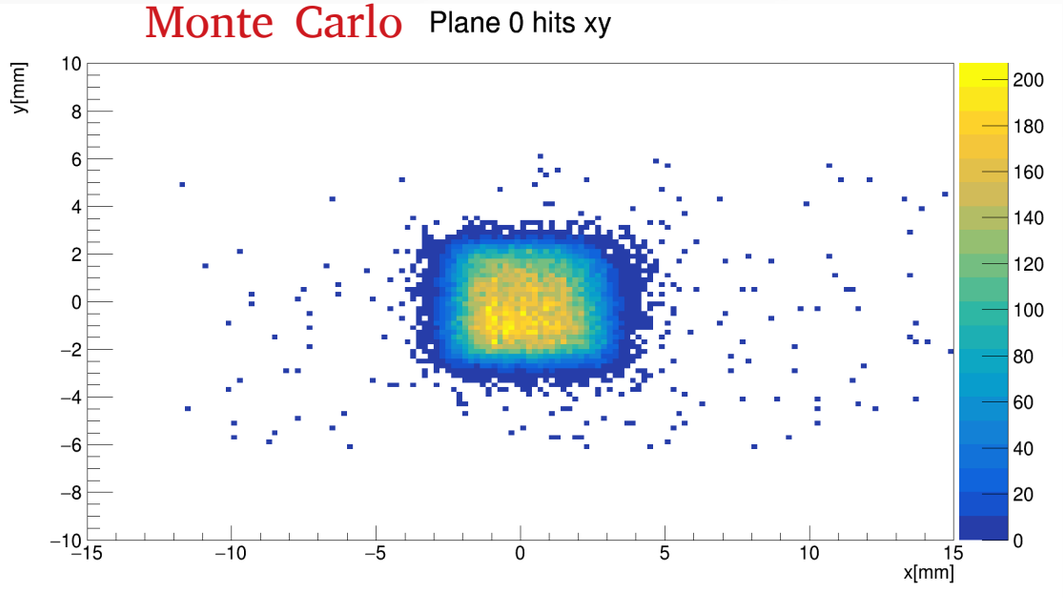
But we also have a more complete Monte Carlo! Including measurement of the plane hits (e-,e+ with E>2MeV), a complete reconstruction using the same analysis technique is performed

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

Reconstructed theta distribution is half the size of the real data



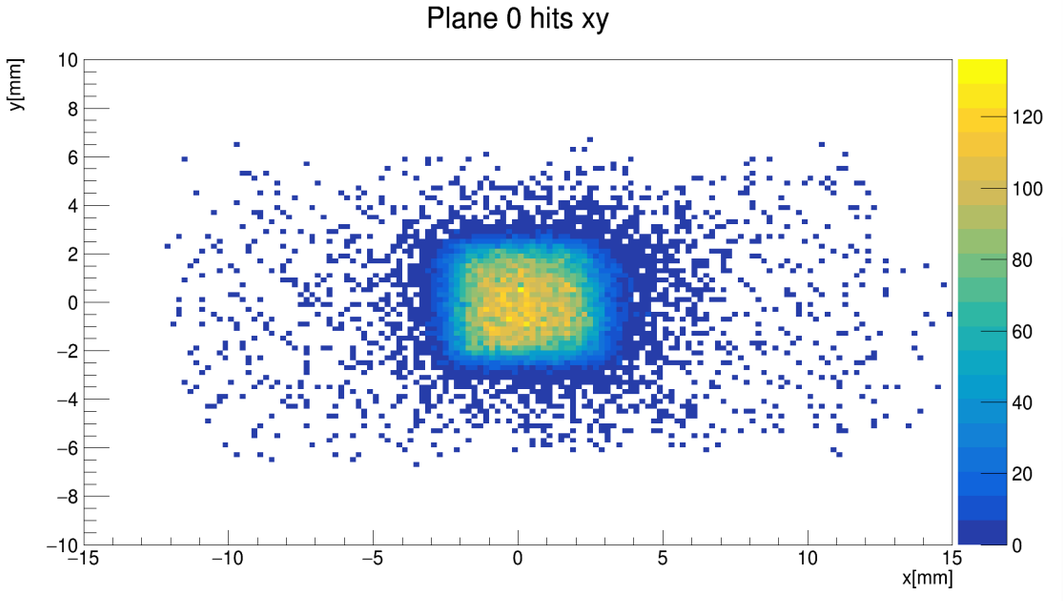




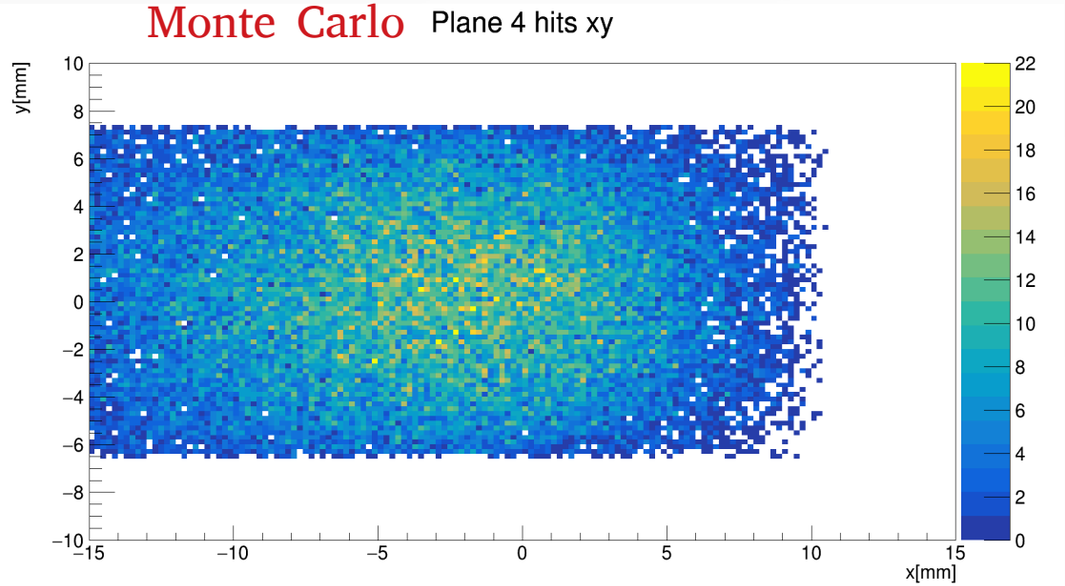
Was trying to remove all other variables by using the initial e- beam direct from the data in simulation

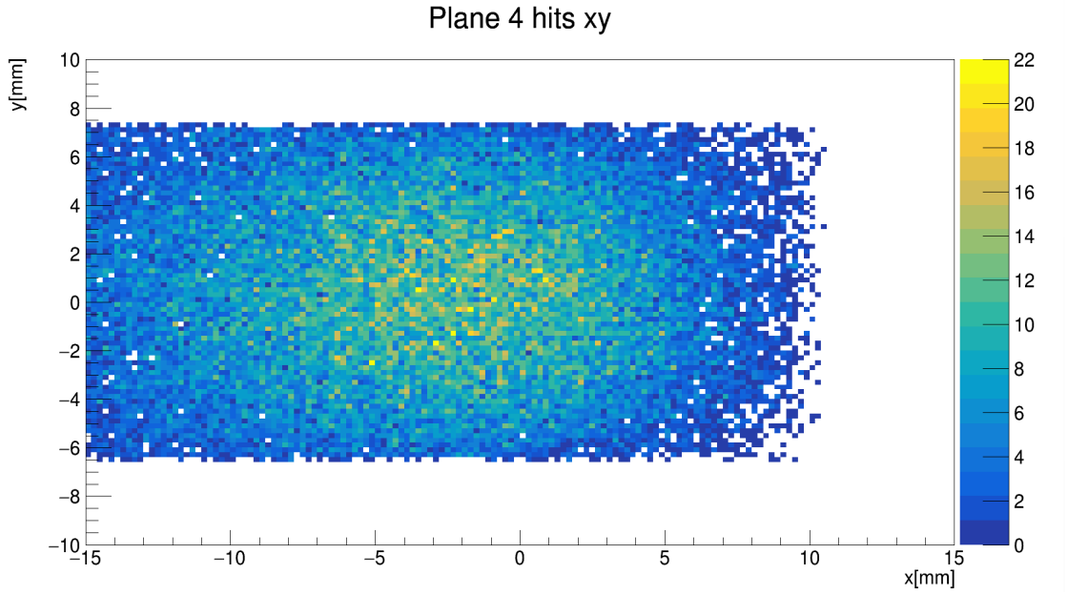
In this setup, we can fix the alignment of the first two planes, so those correlate perfectly

Another alignment technique of forcing the x,y, maximum of data to meet that of the MC is possible



Monte Carlo





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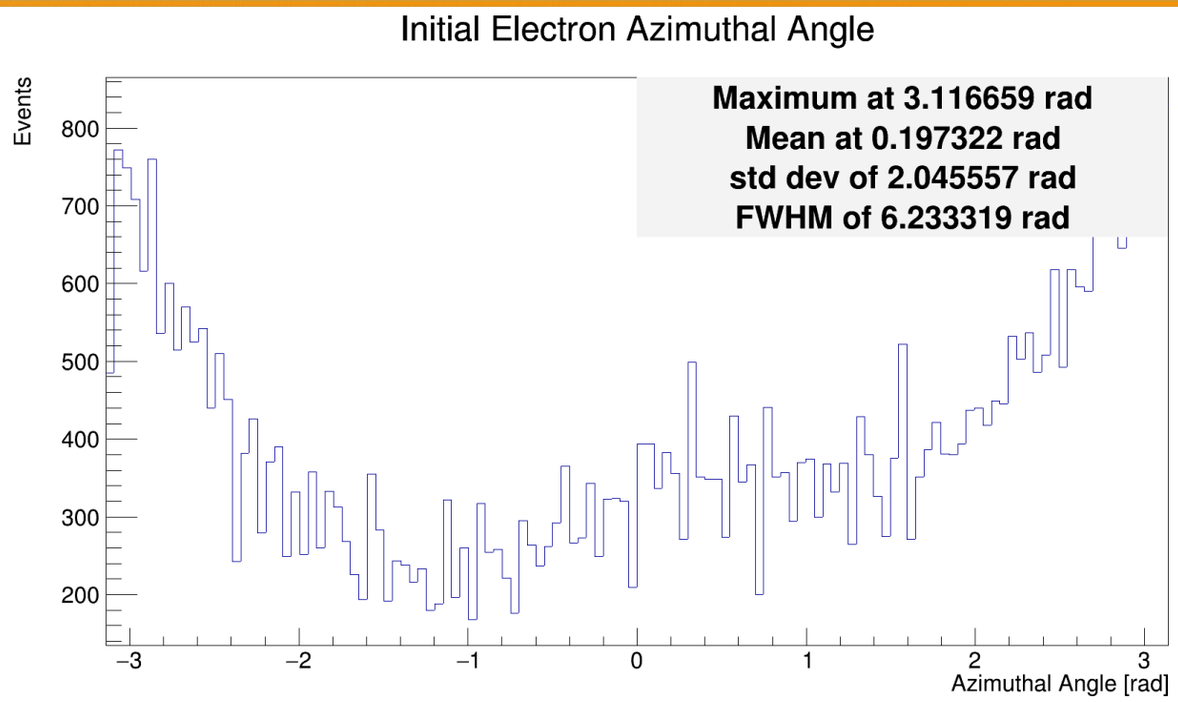
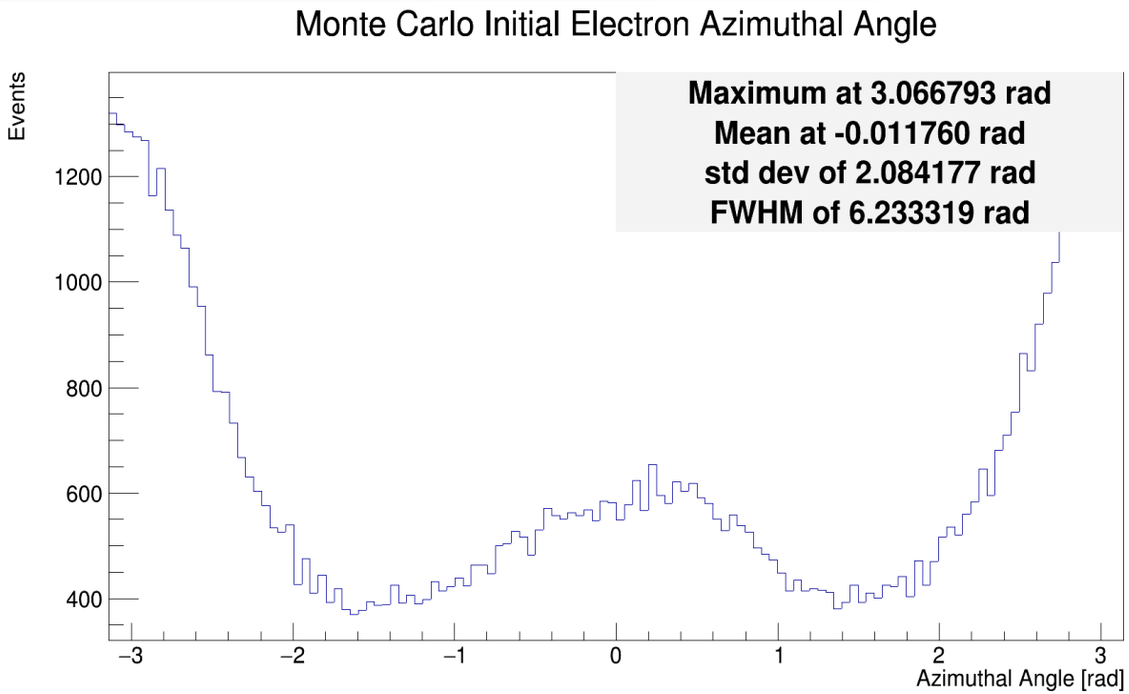
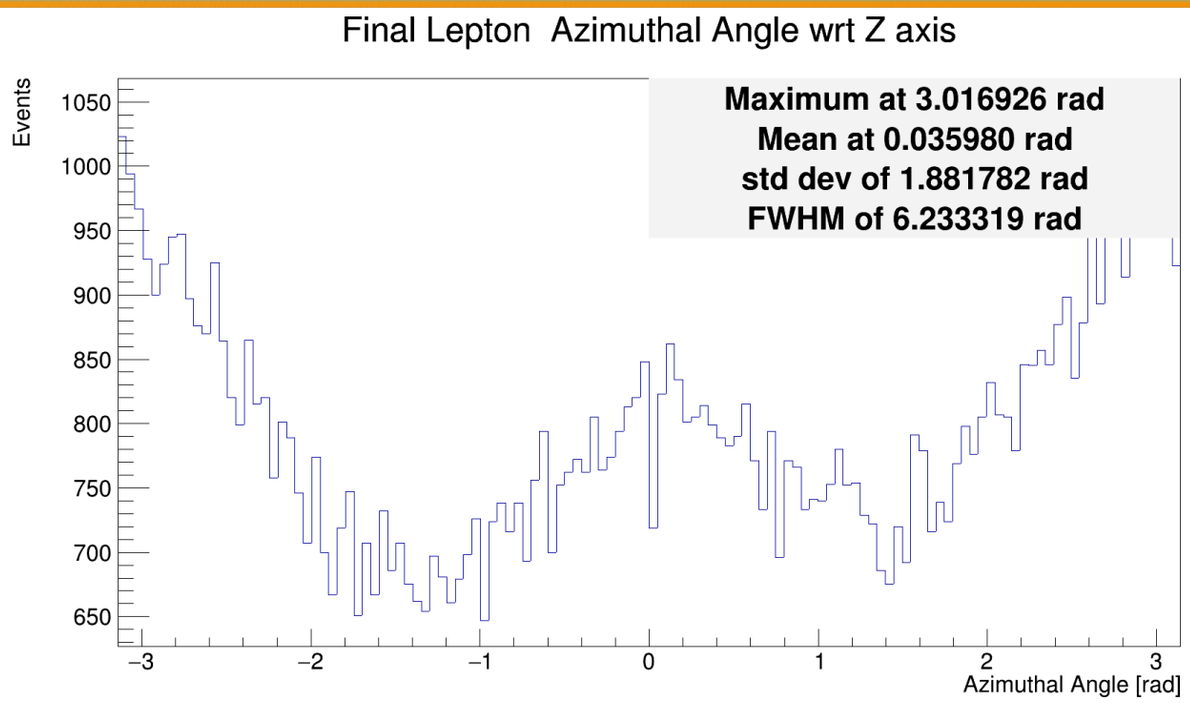
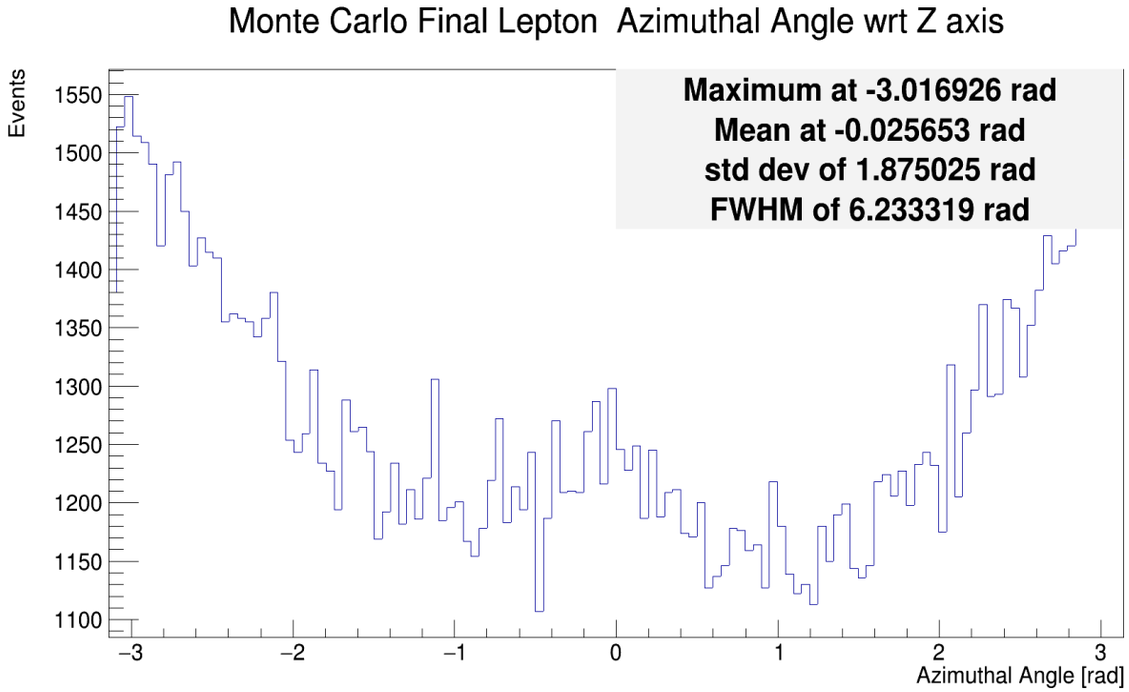




Was looking to match e.g. distributions in azimuthal angle to have data match MC





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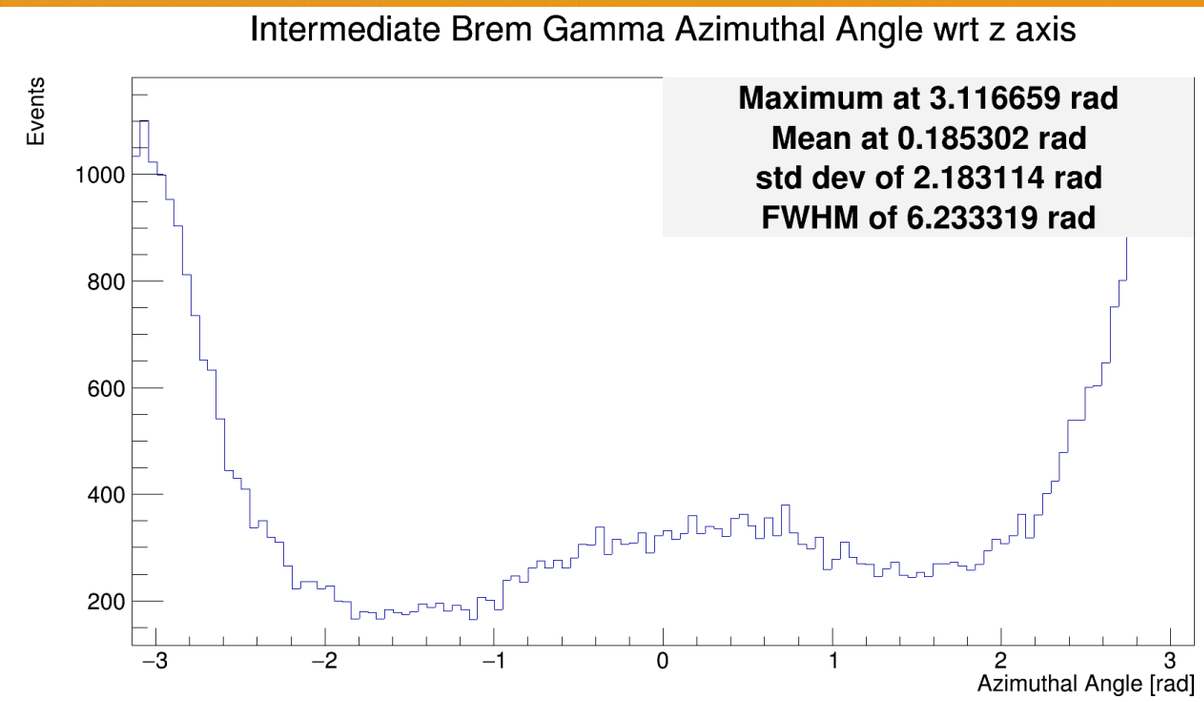

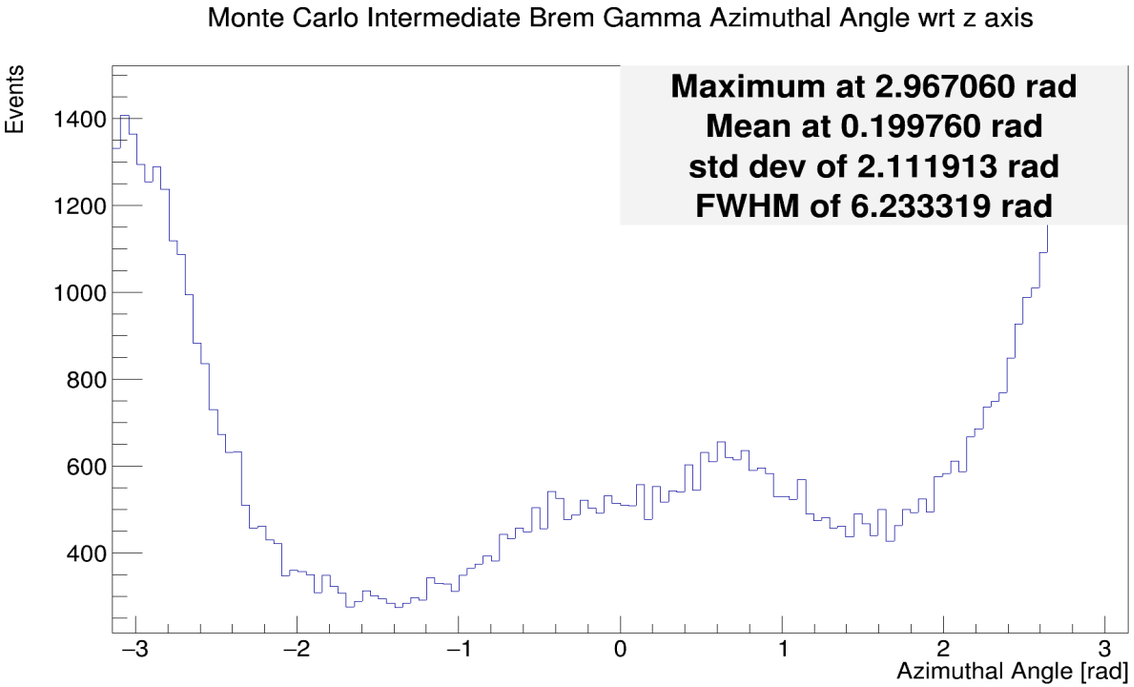

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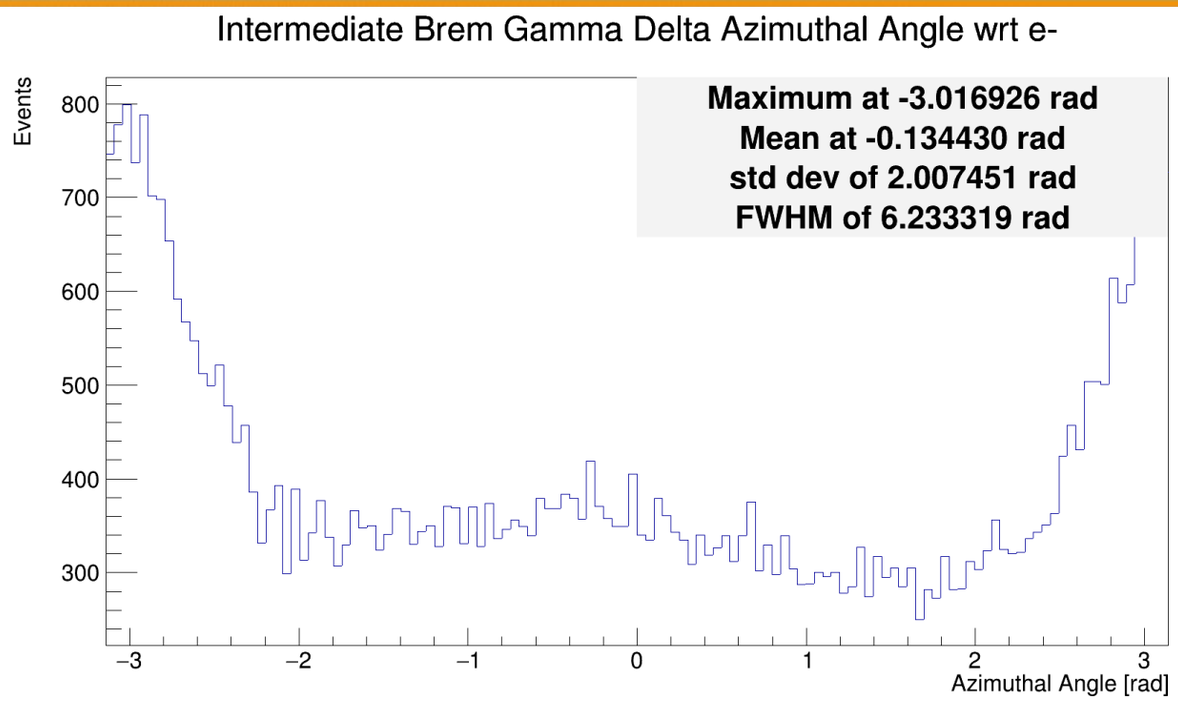
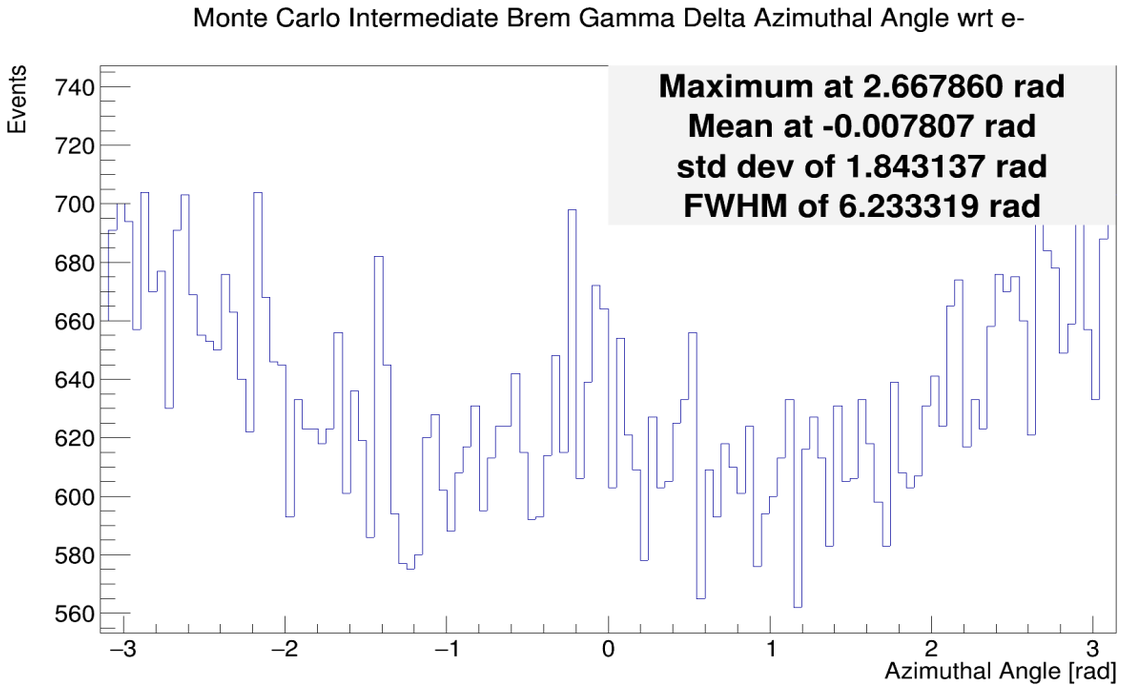


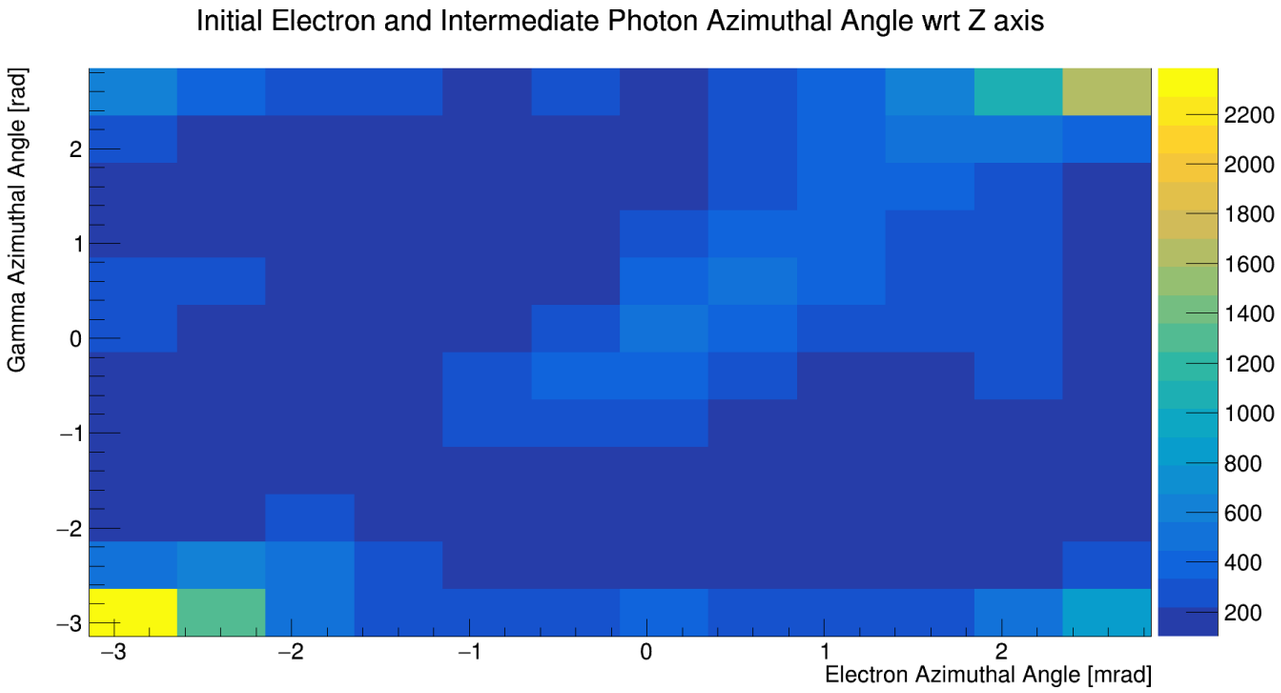


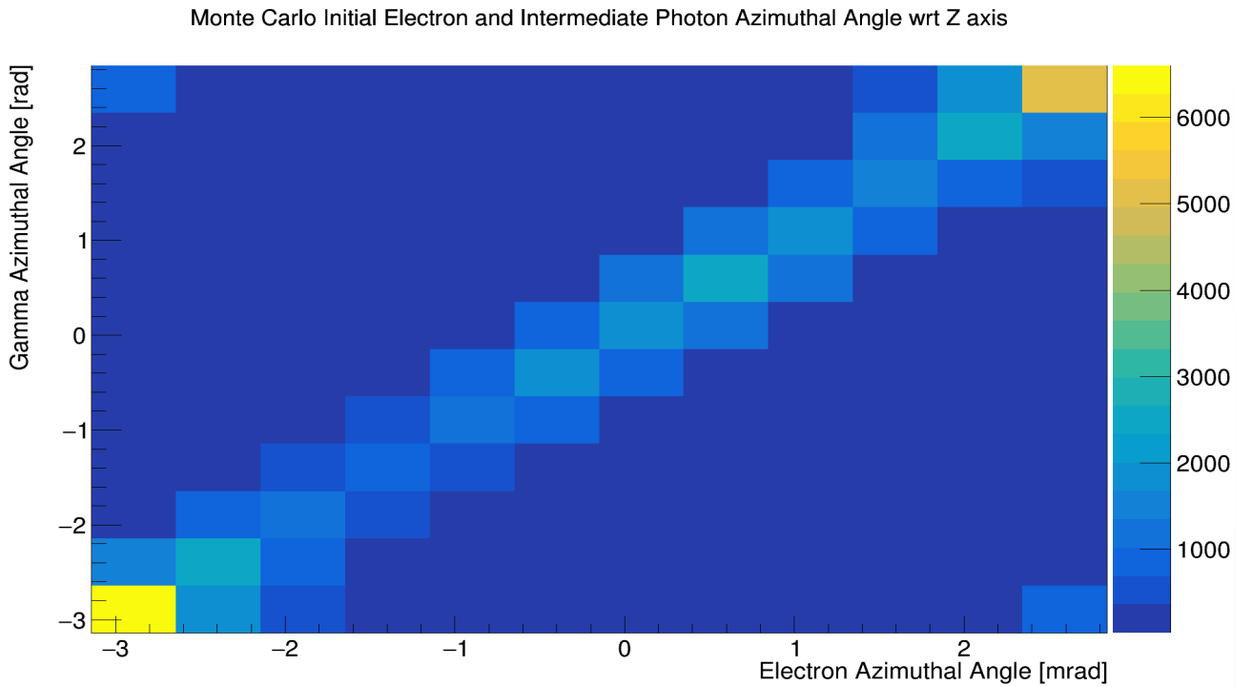
Was looking to match e.g. distributions in azimuthal angle to have data match MC

This is the azimuthal angle with respect to initial e- vector

This is the only difference, to my eye, between MC and TB data

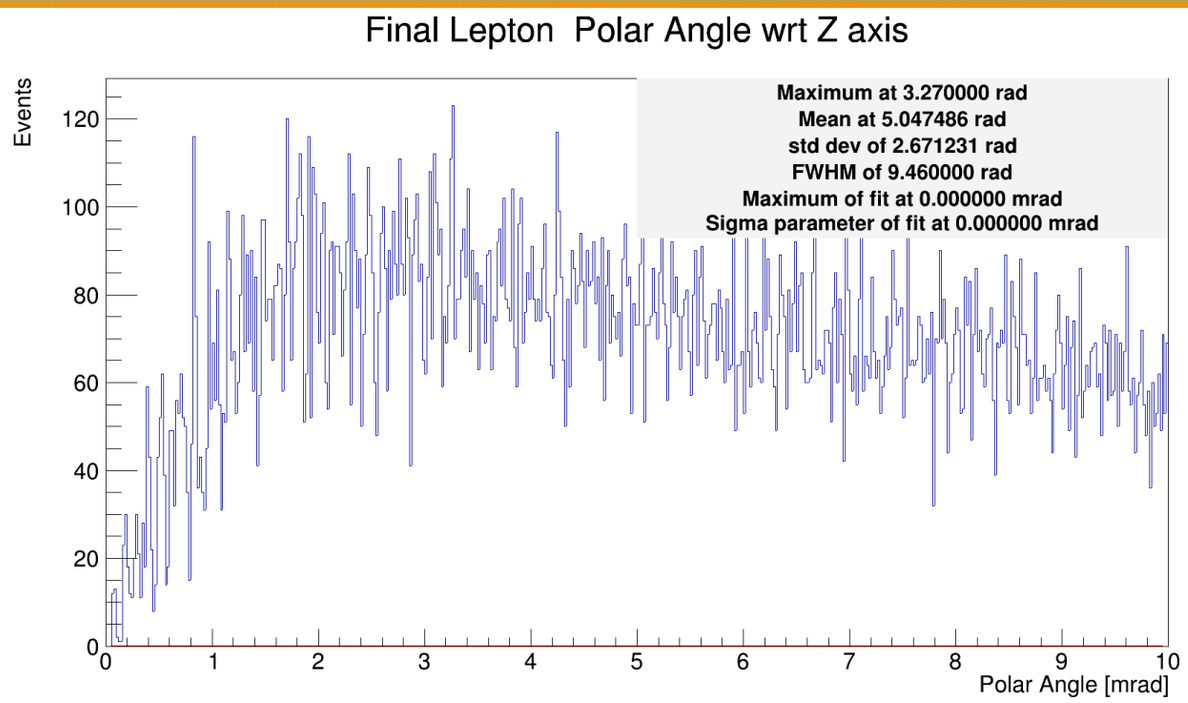
Could be explained by real brem emission, generally higher theta, preferring the ‘x’ dircetion where the acceptance is larger

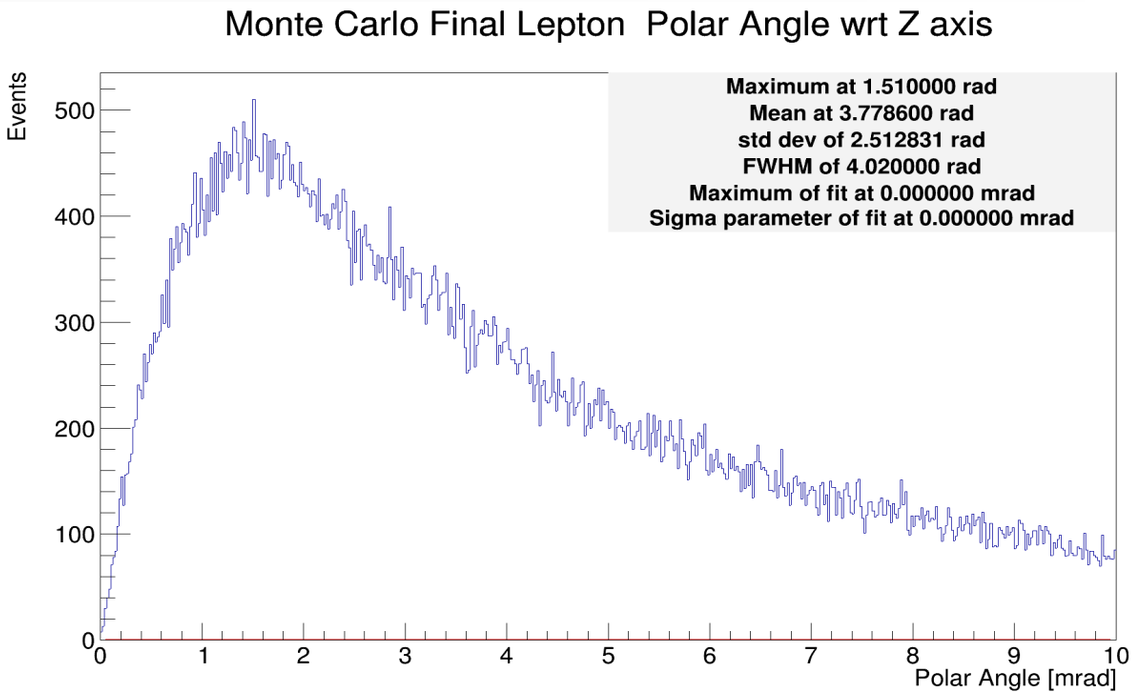




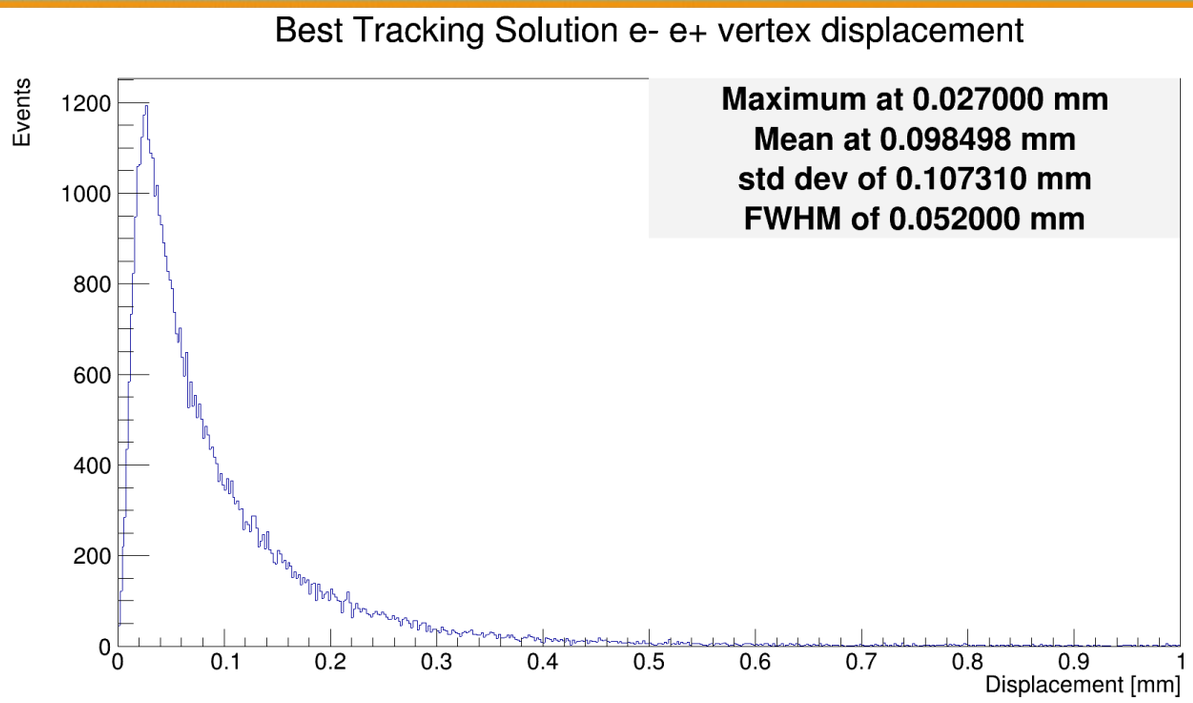
Looking at correlation between azimuth (w.r.t. z axis) of initial electron and photon

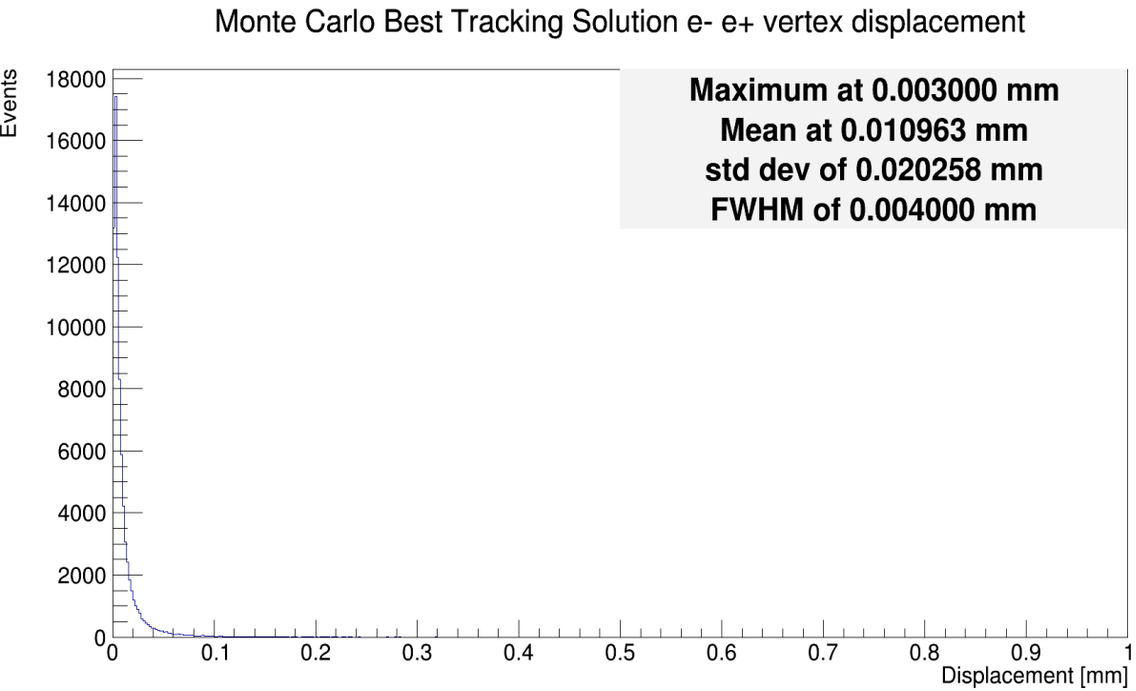
This tells us in the real data the photon emission is less preferentially emitted in same direction as initial electron





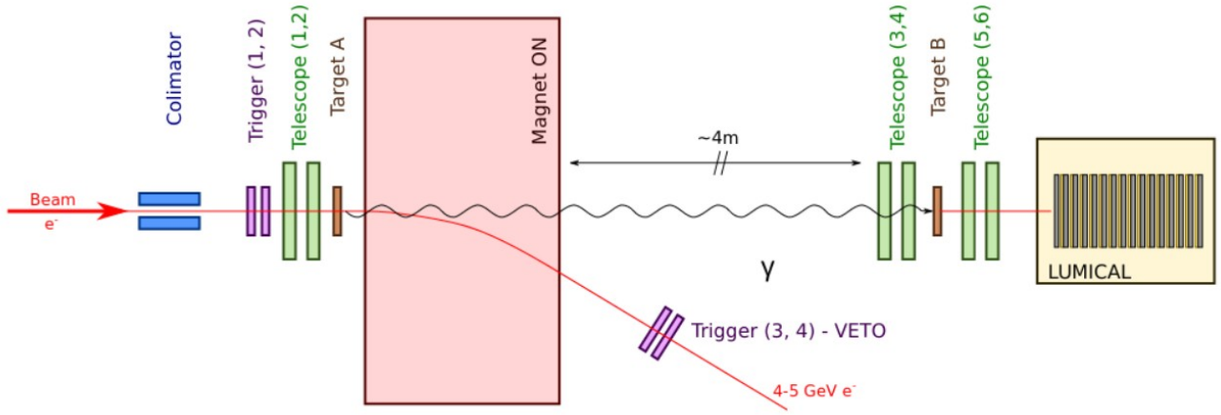
Final lepton theta w.r.t. z axis, looks like the real data again is larger, making sense with the brem divergence





Stranger asymmetry.. when matching tracks for the final leptons, the MC reconstruction gives much closer track vertices

TB2020 Alpide Telescope Alignment



- Accounting for the discrepancy in short future:

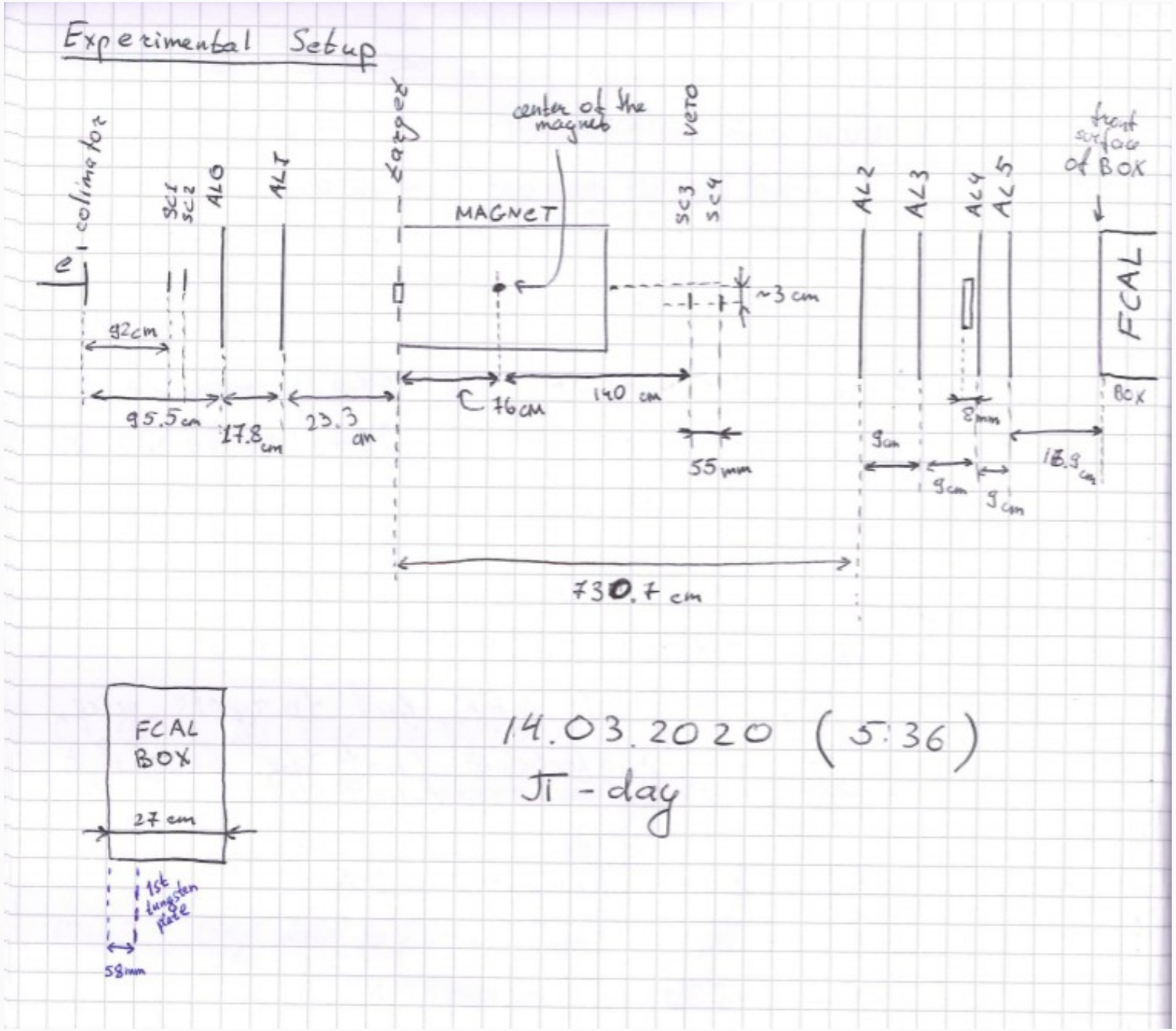
- Uncertainty in hit position due to detector uncertainty

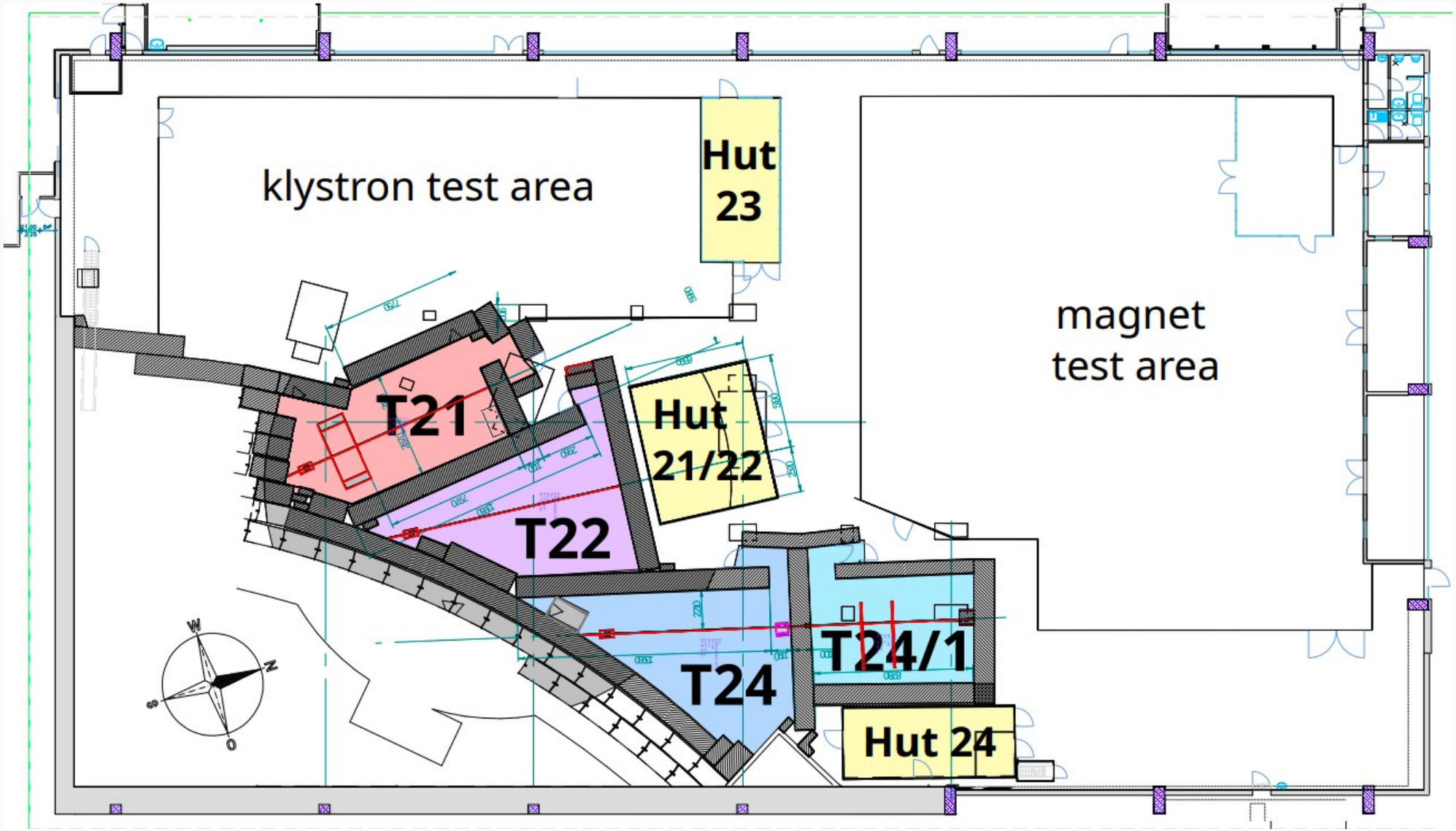
- Possible simple mistakes in model e.g. target thickness (but not z distance)

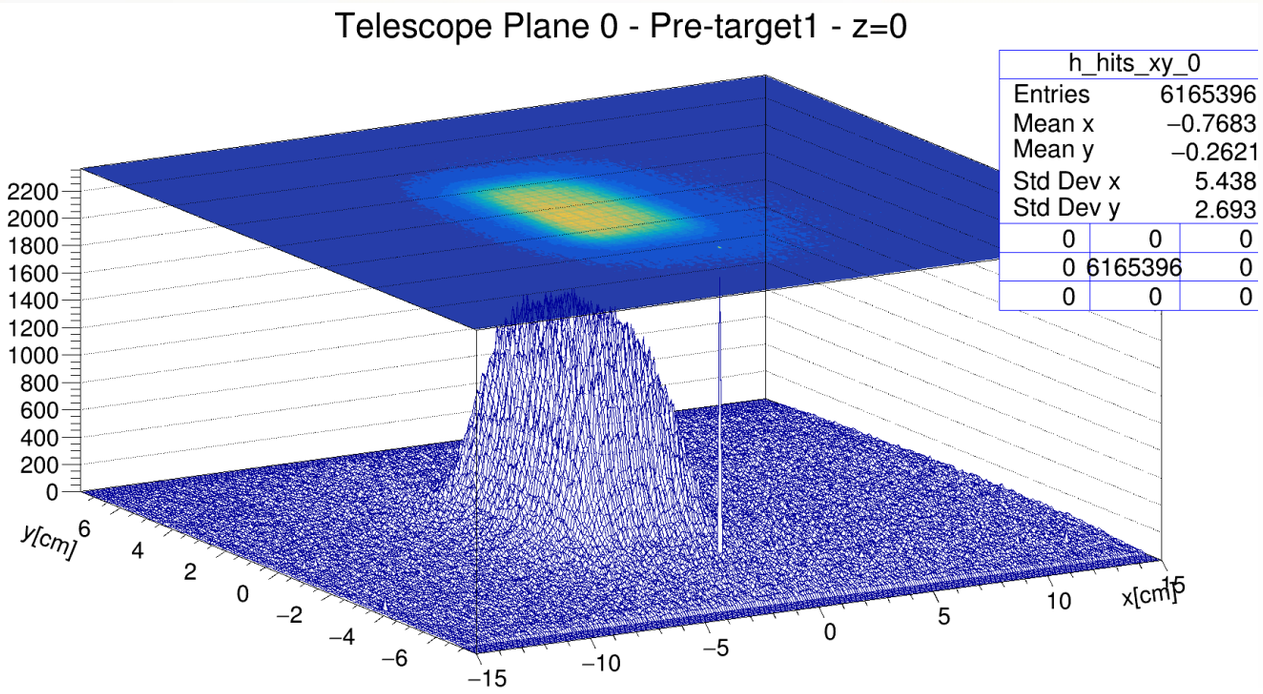
- Differing physics lists

- no-target runs – comparison to MC could be useful, evaluate effect of air-scattering on e-

backup

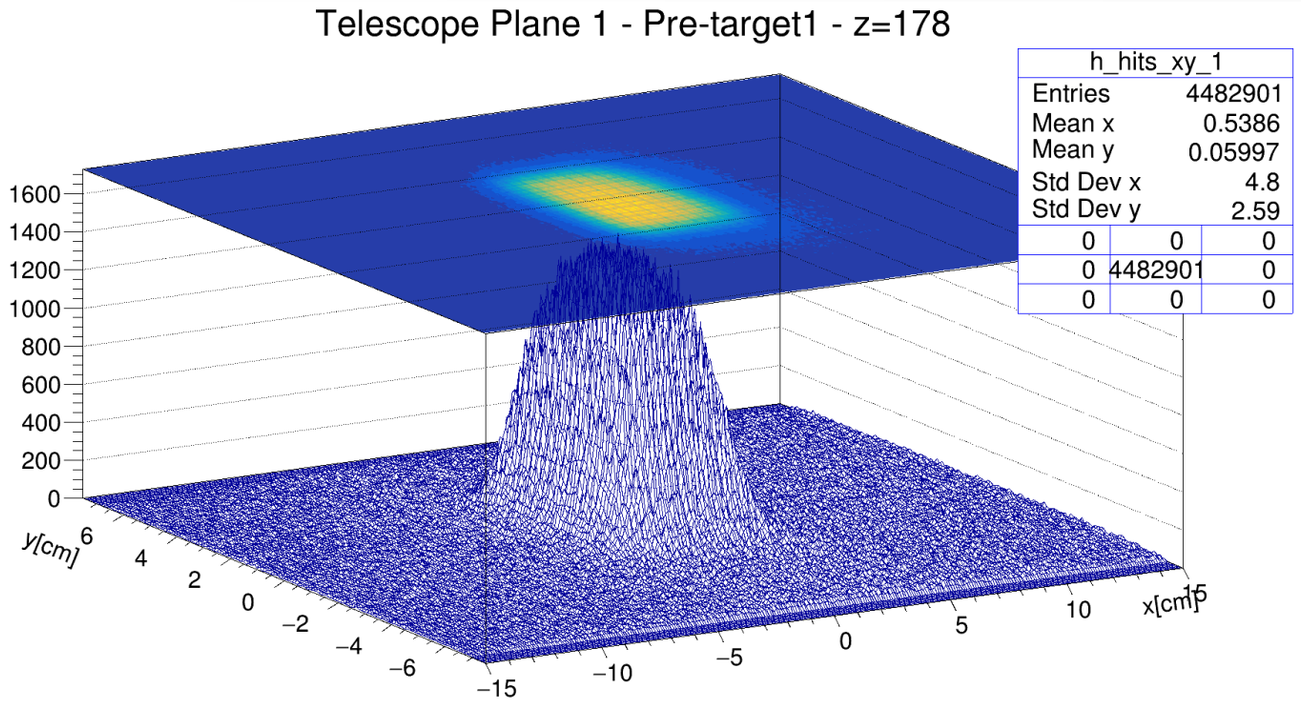

Experimental Setup
e⁻ collimator
SC1
SC2
AL0
AL1
target
center of the magnet
MAGNET
VETO
SC3
SC4
AL2
AL3
AL4
AL5
front surface of BOX
FCAL
BOX
92cm
95.5cm
17.8cm
23.3 cm
76cm
140 cm
~3 cm
55 mm
8mm
9cm
9cm
9cm
18.9cm
730.7 cm
FCAL
BOX
27 cm
1st tungsten plate
58mm
14.03.2020 (5:36)
Ji - day

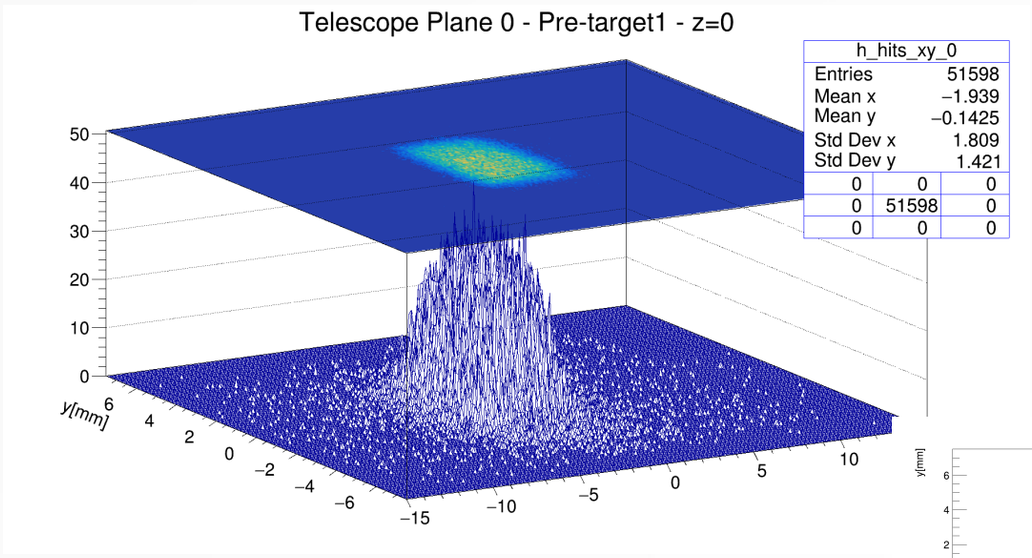

klystron test area
Hut 23
magnet test area
T21
Hut 21/22
T22
T24
T24/1
Hut 24

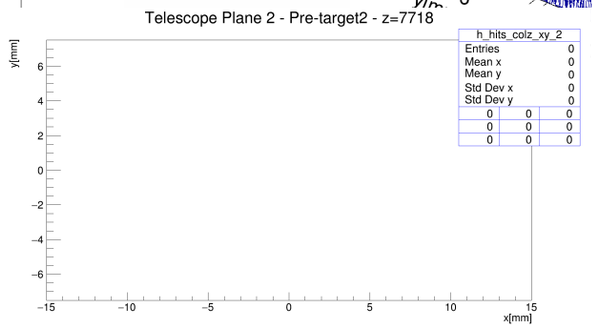


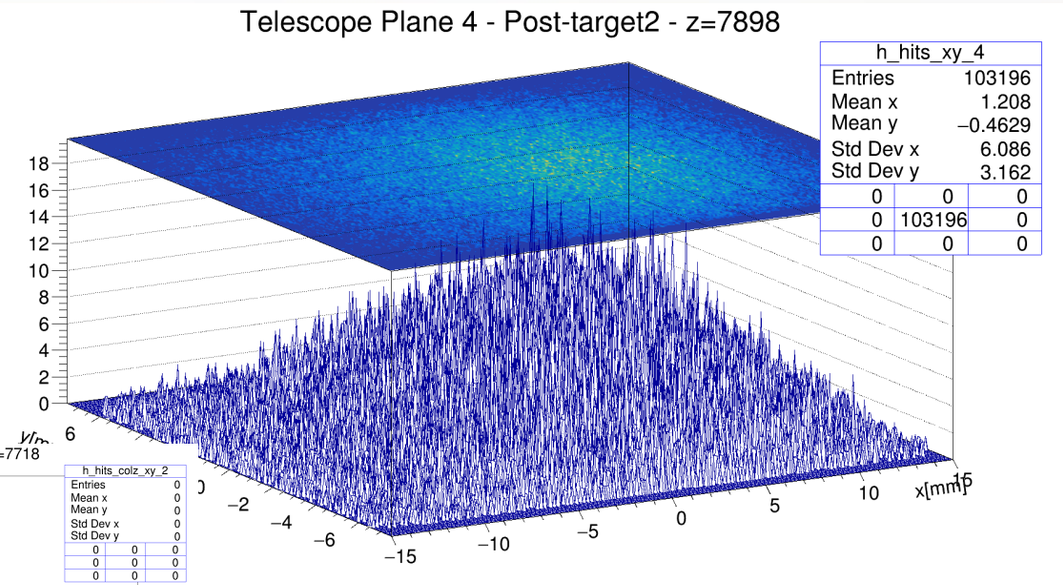
Have cleaned data of hot pixels

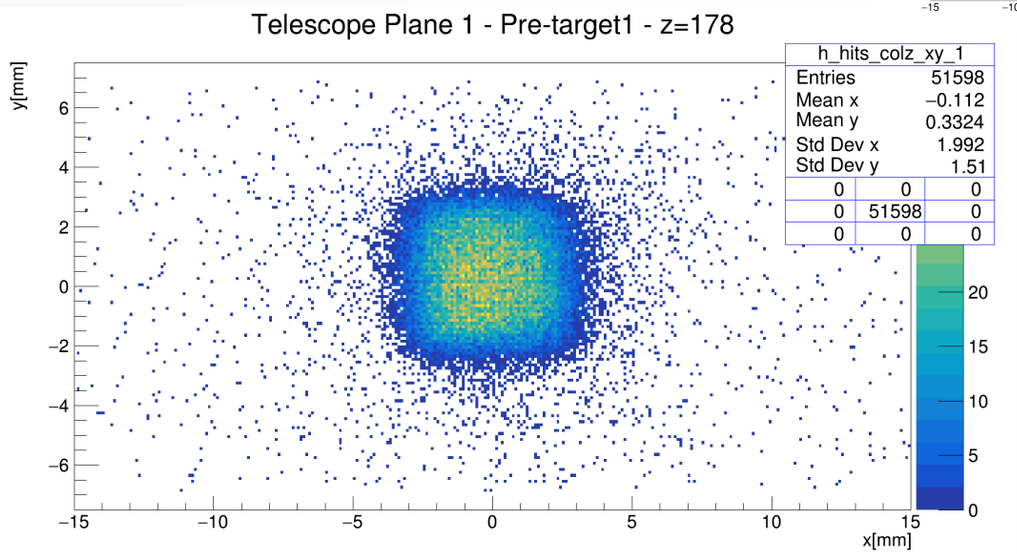
Resulting analysis could exclude real data within these ‘hot’ pixels but this result is likely small



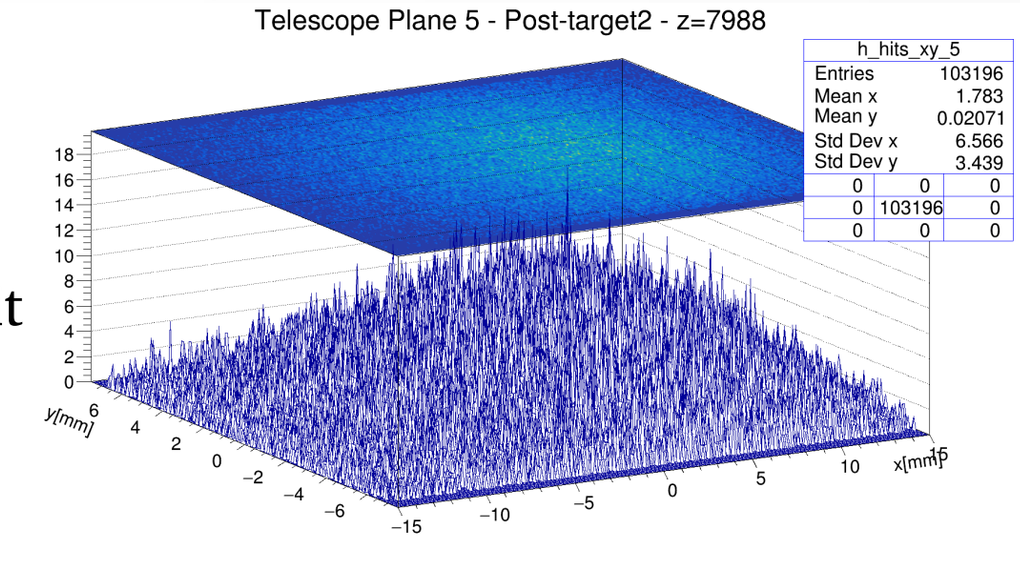


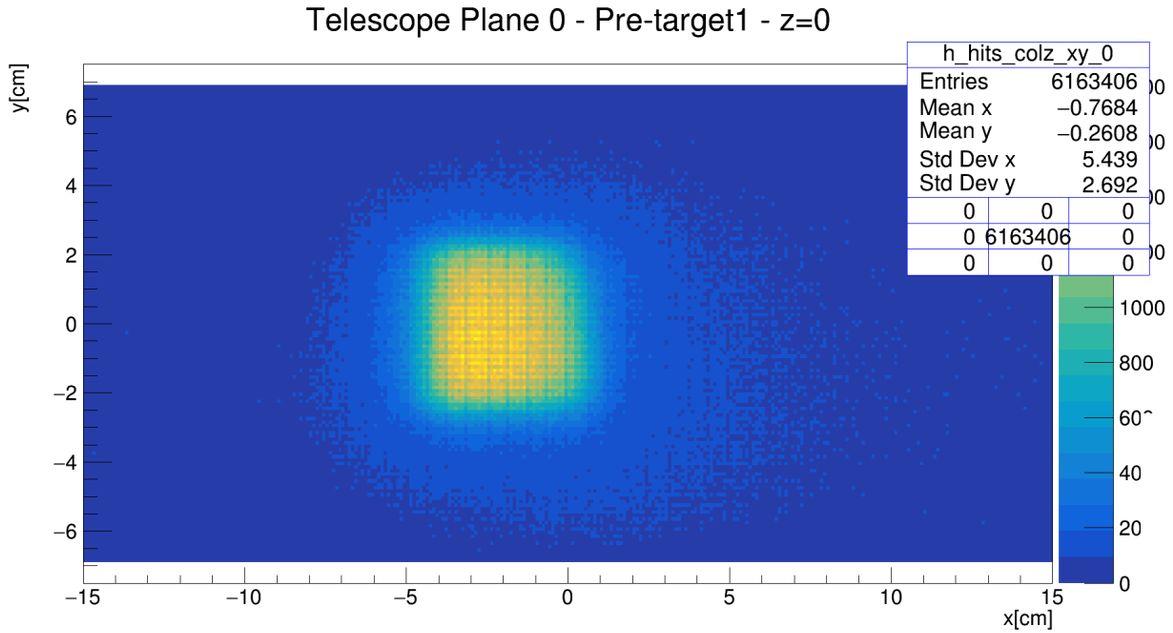


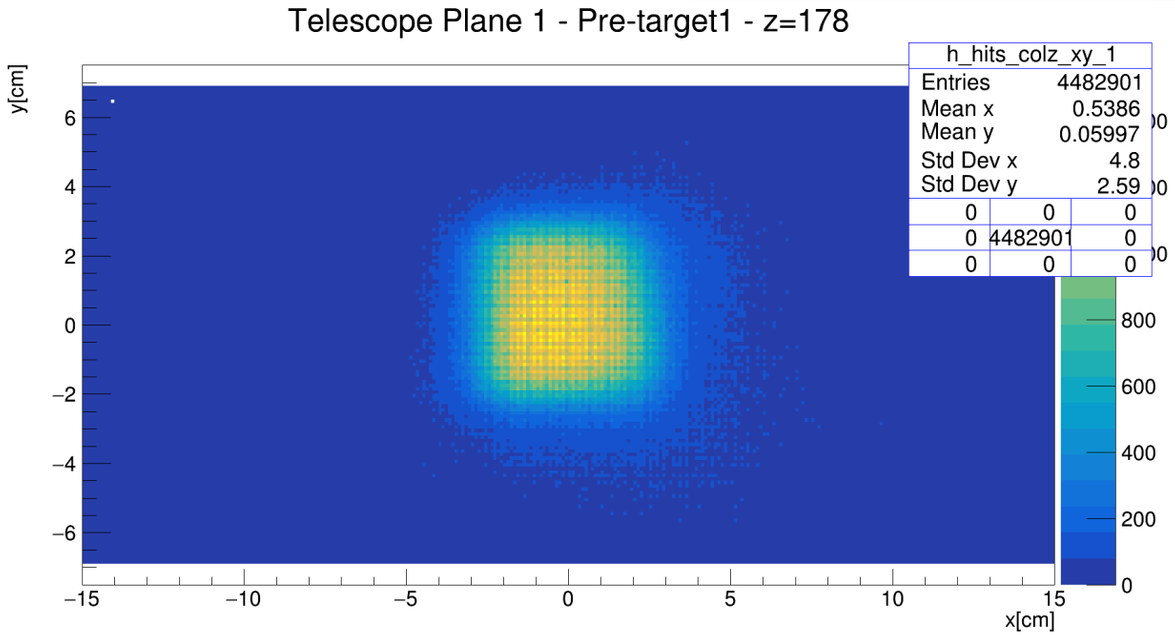




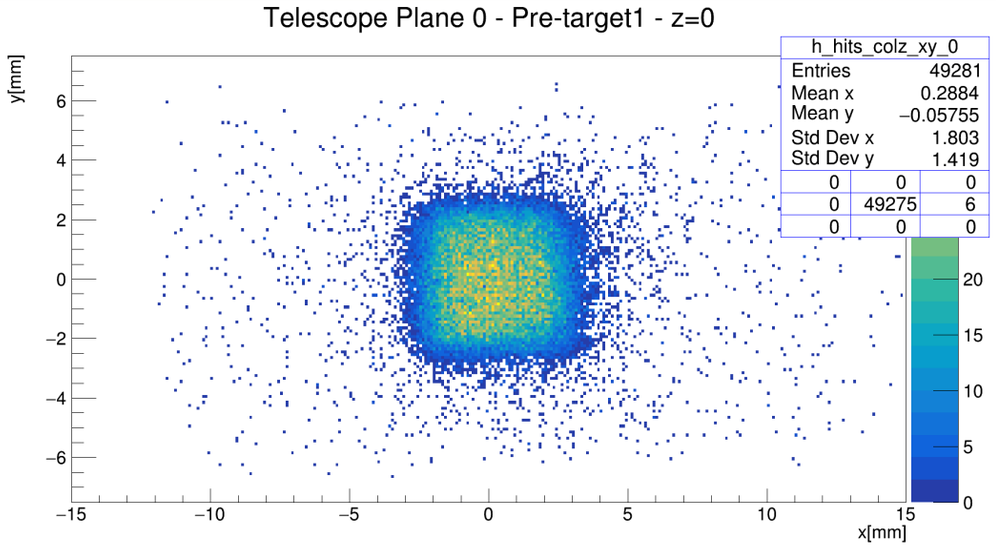
Look for 110022 hit pattern

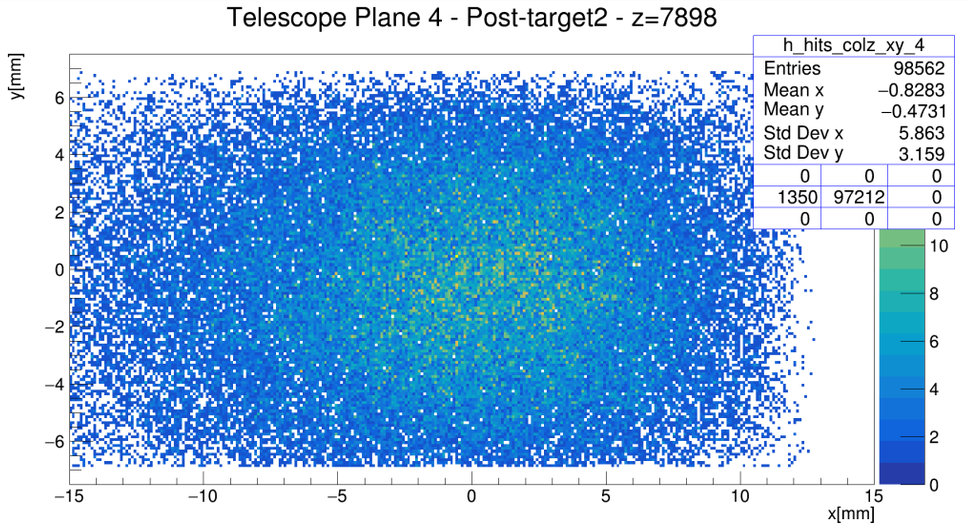


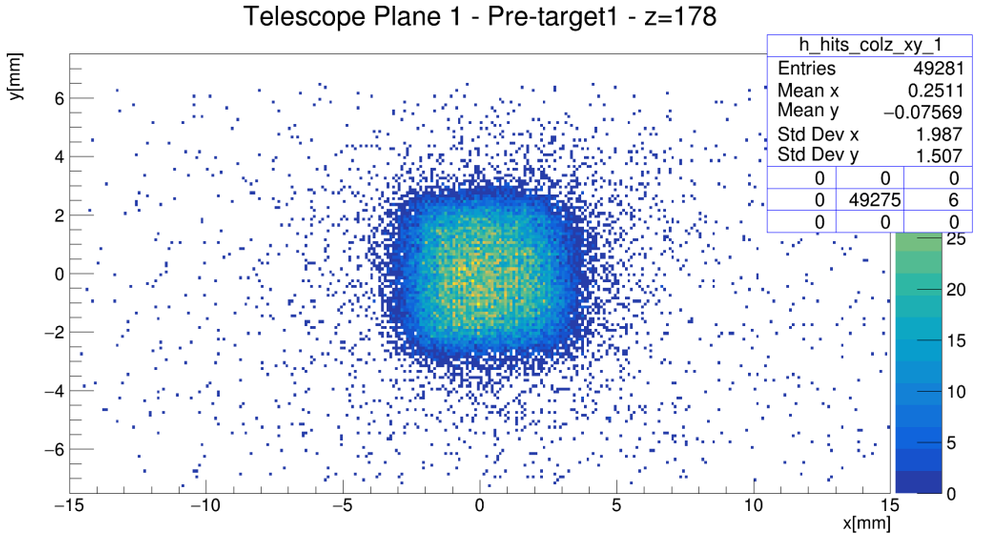


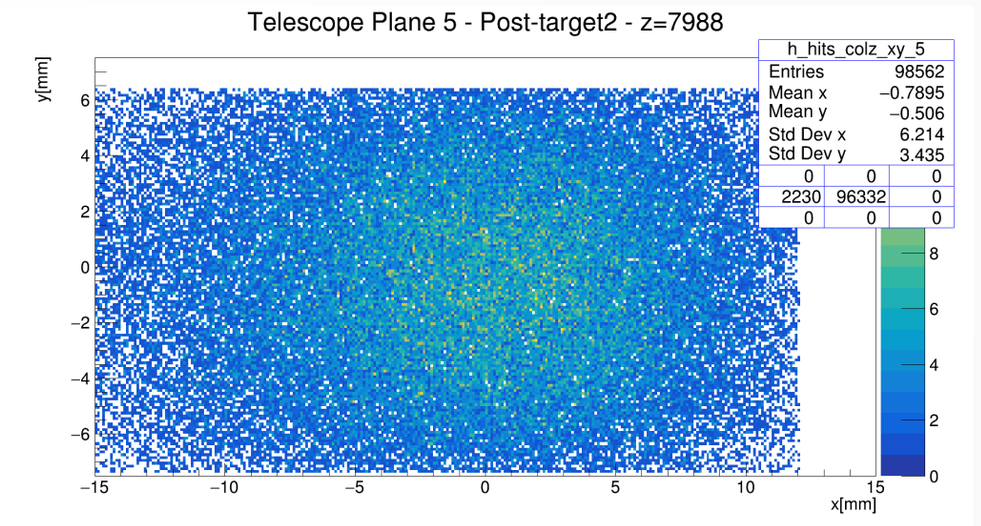


This needs above all, good alignment!

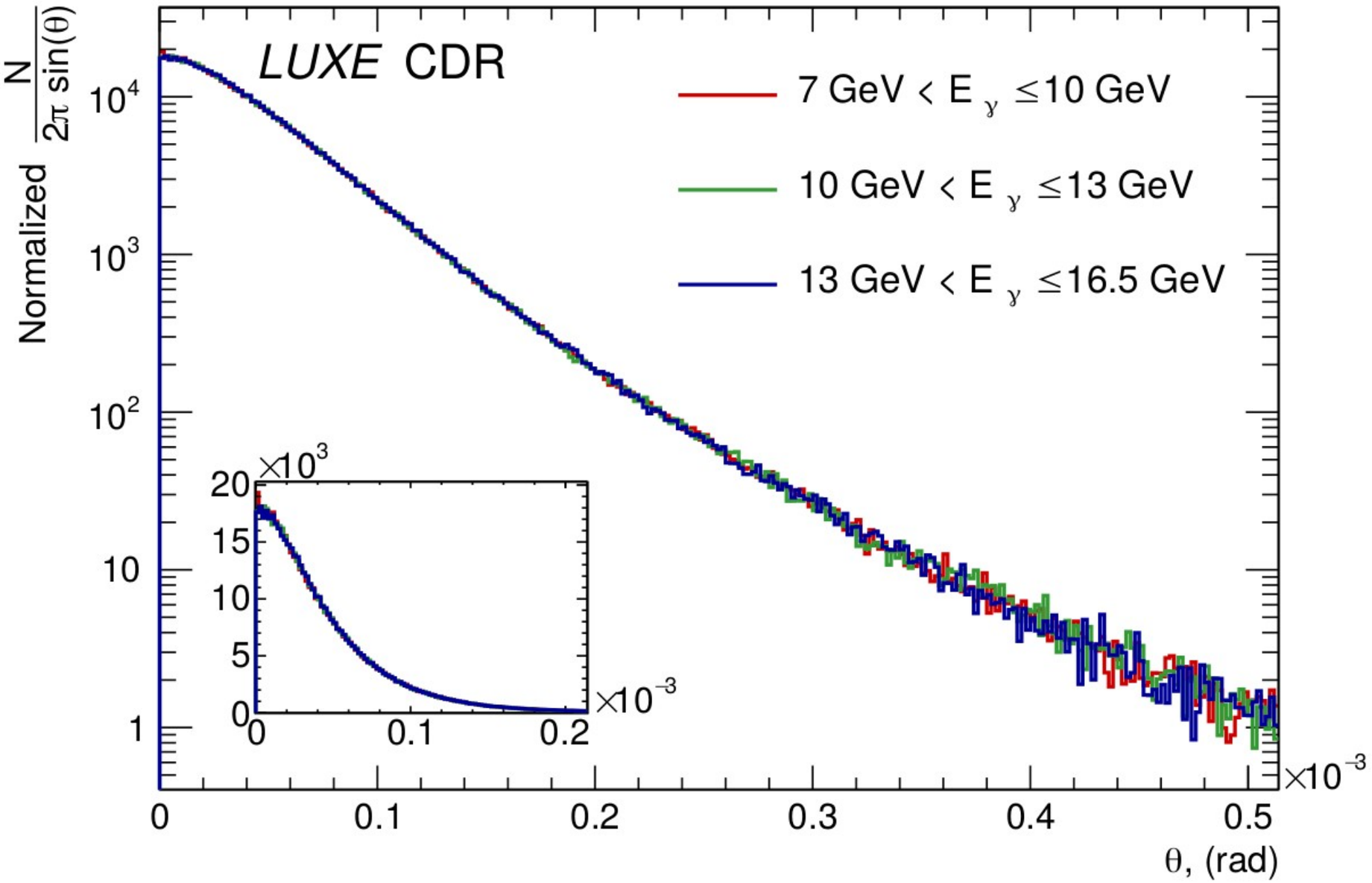








There are runs with no targets, no B-field, with telescope planes in place; use mean position of distribution for alignment


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
×10³