

Simulation and Reconstruction of Particle Guns in nHCal at EPIC

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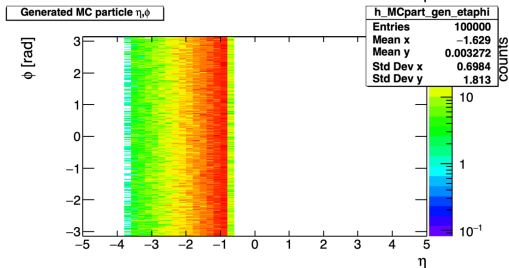
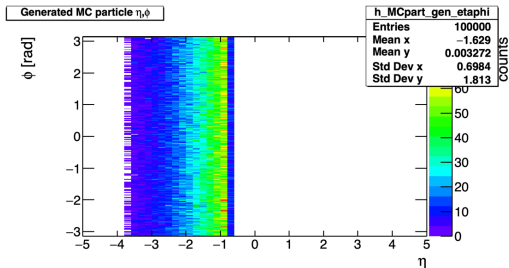
September 29, 2022



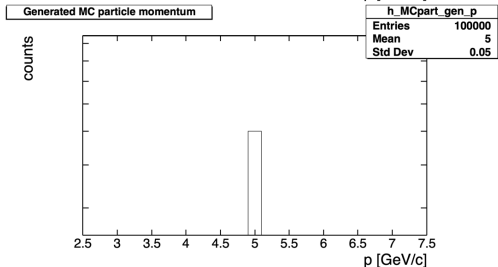
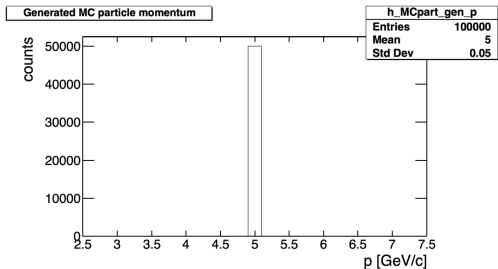
- ▶ Particles are generated using the particle gun of ddsim
- ▶ Gun energy 5 GeV
- ▶ Generated particles are distributed uniformly within the range $130^\circ < \theta < 177^\circ$
- ▶ 100000 events in total and 1 generated particle in each event
- ▶ Updated nHCal with segmentation based on STAR EEMC
 1. Thickness of the nHCal = 44 cm.
 2. nHCal is a 10 layer steel and scintillator sandwich (4 cm/4 mm layer structure)
 3. We used the eta bins mentioned in the STAR EEMC and converted those to the R bins to do the segmentation. 12 bins in R and 60 bins in theta has been implemented here.
https://www.star.bnl.gov/webdata/dox/html/EEmcGeomSimple_8cxx_source.html



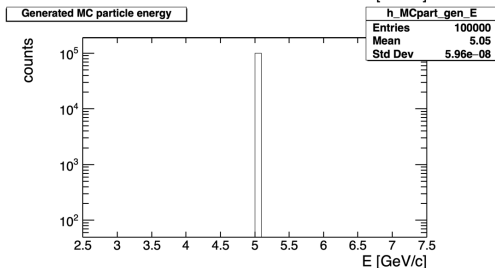
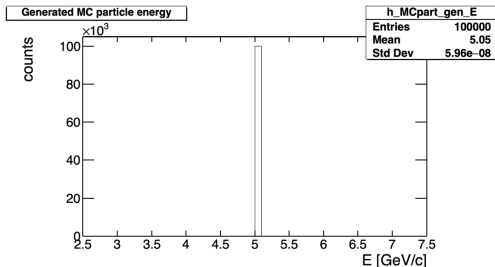
$\eta - \phi$ distribution of generated particles : Neutron Gun



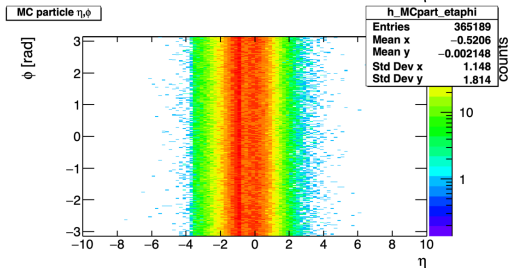
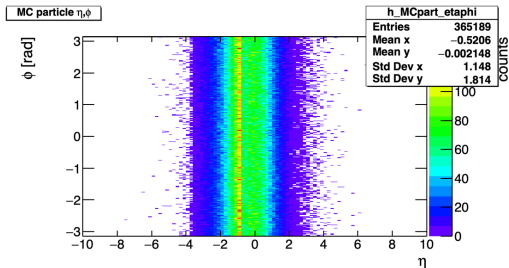
Momentum distribution of generated particles : Neutron Gun



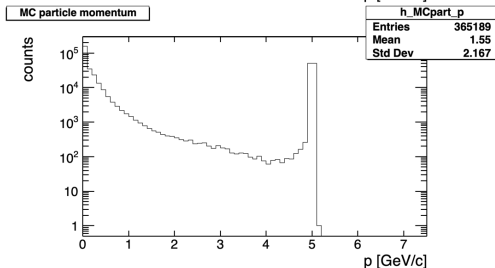
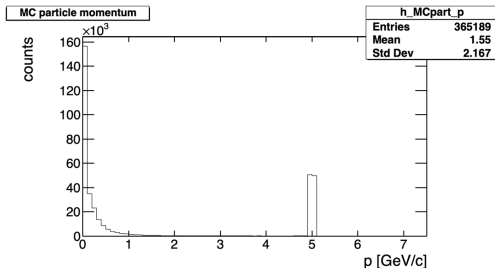
Energy distribution of generated particles : Neutron Gun



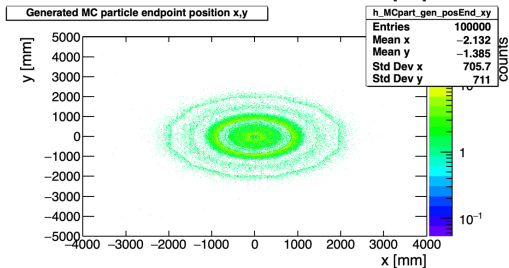
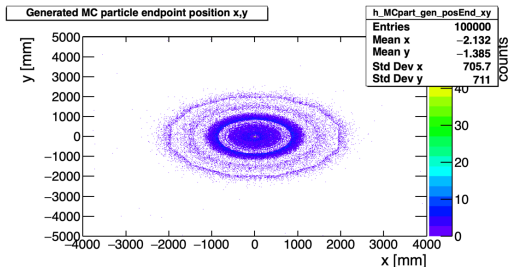
$\eta - \phi$ distribution of MC particles : Neutron Gun



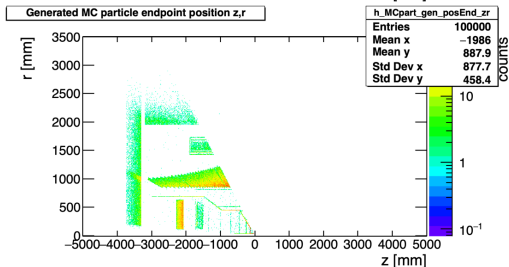
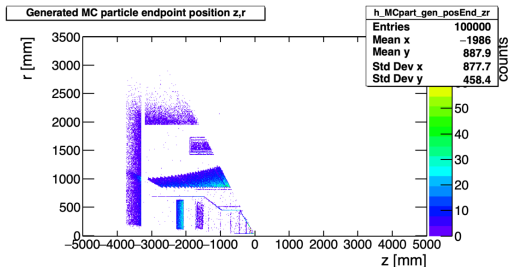
Momentum distribution of MC particles : Neutron Gun



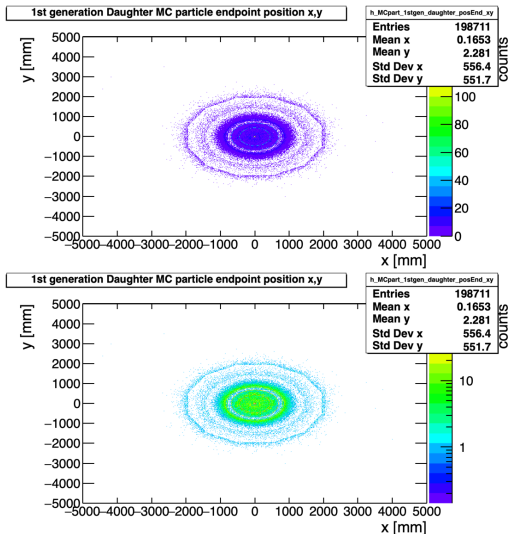
End point of the generated particles : Neutron Gun



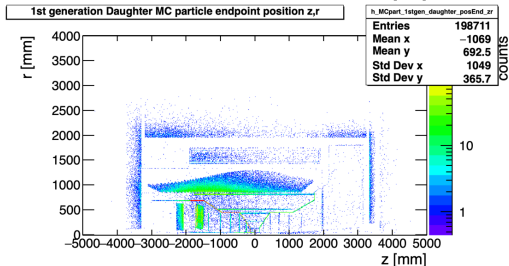
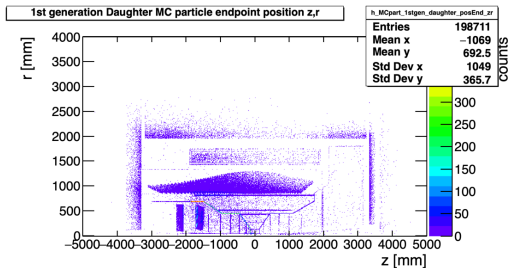
End point of the generated particles : Neutron Gun



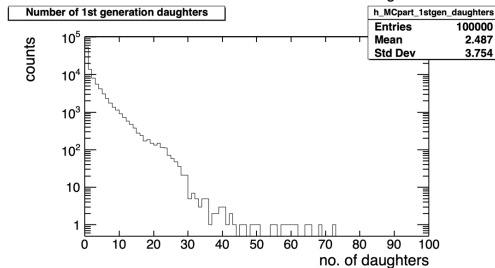
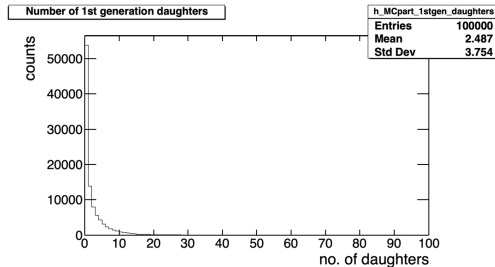
End point of the 1st generation daughter MC particles : Neutron Gun



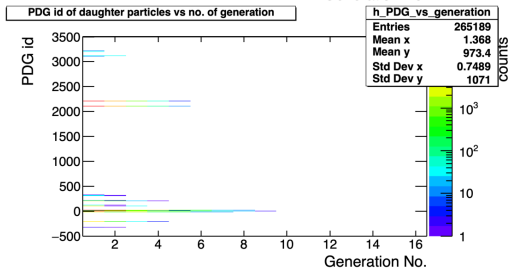
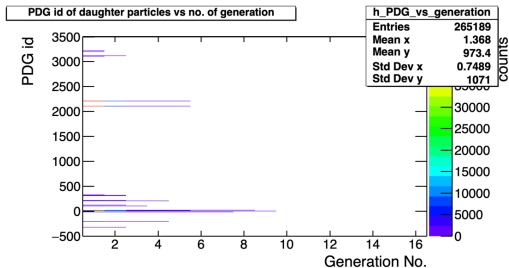
End point of the 1st generation daughter MC particles : Neutron Gun



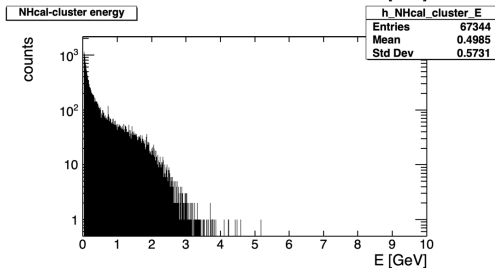
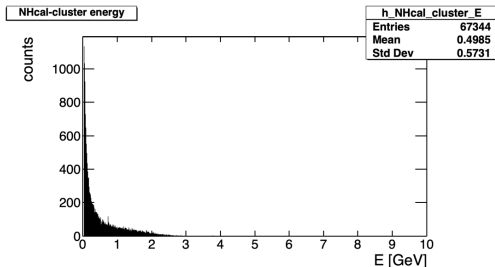
Number of 1st generation daughter MC particles : Neutron Gun



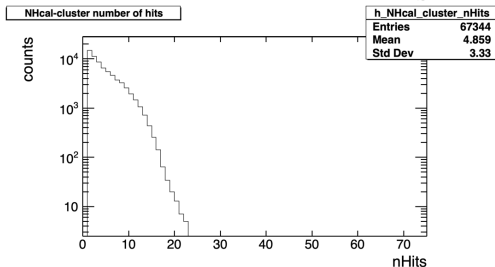
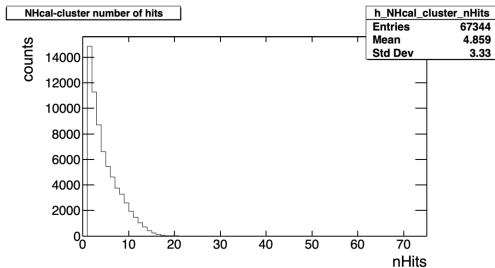
PDG Id of daughter MC particles vs. Generation No. : Neutron Gun



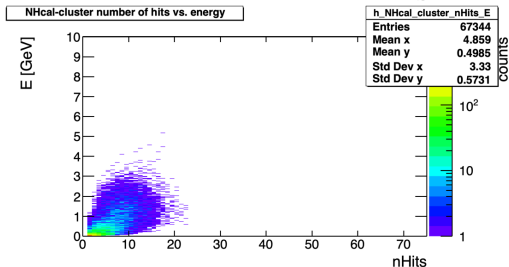
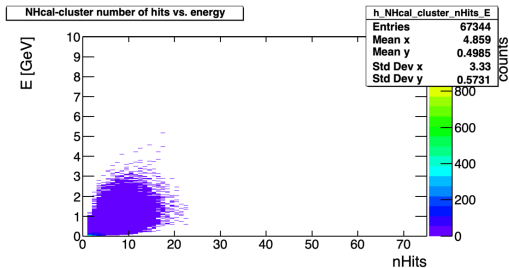
Reconstructed nHCal cluster energy : Neutron Gun



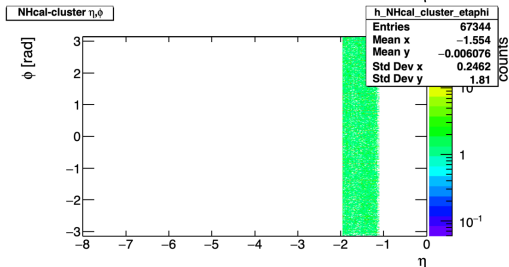
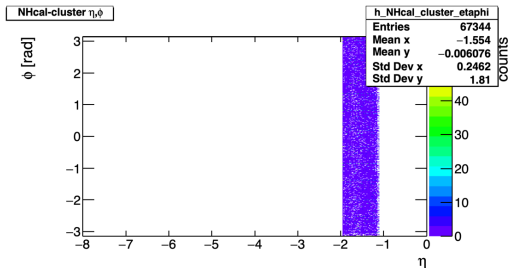
Reconstructed nHCal cluster nHits : Neutron Gun



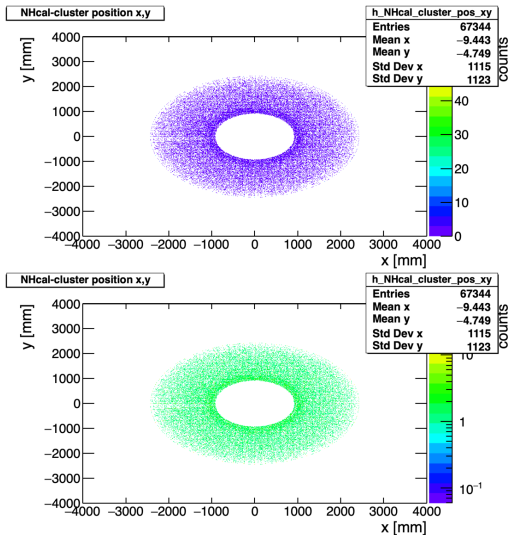
Reconstructed nHCal cluster Energy vs. nHits : Neutron Gun



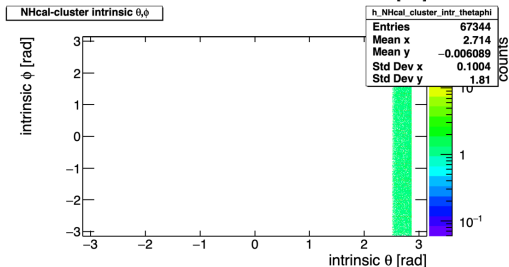
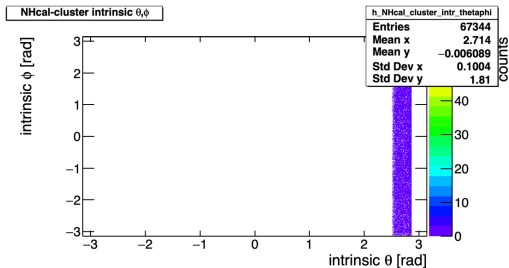
Reconstructed nHCal cluster $\eta - \phi$ distribution : Neutron Gun



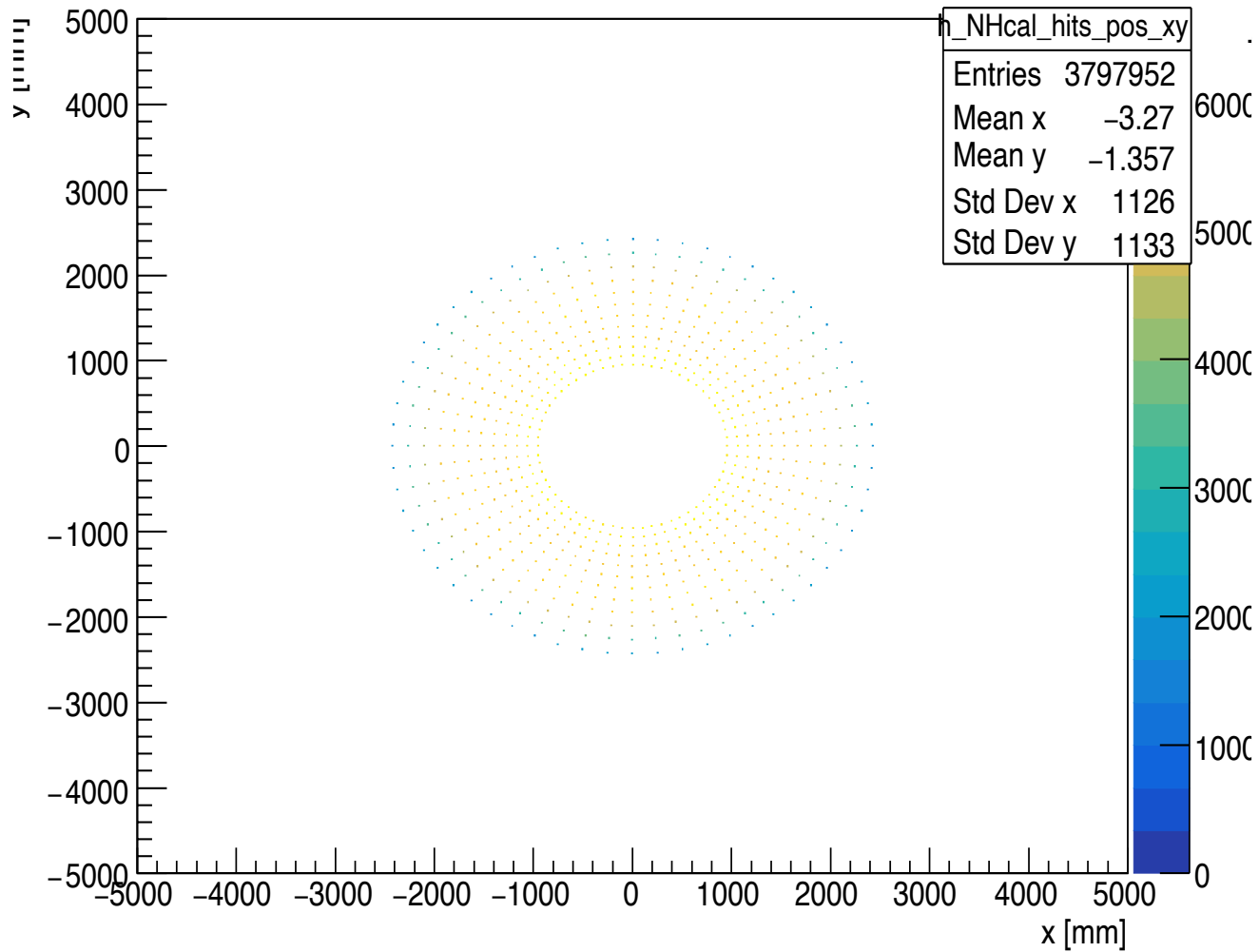
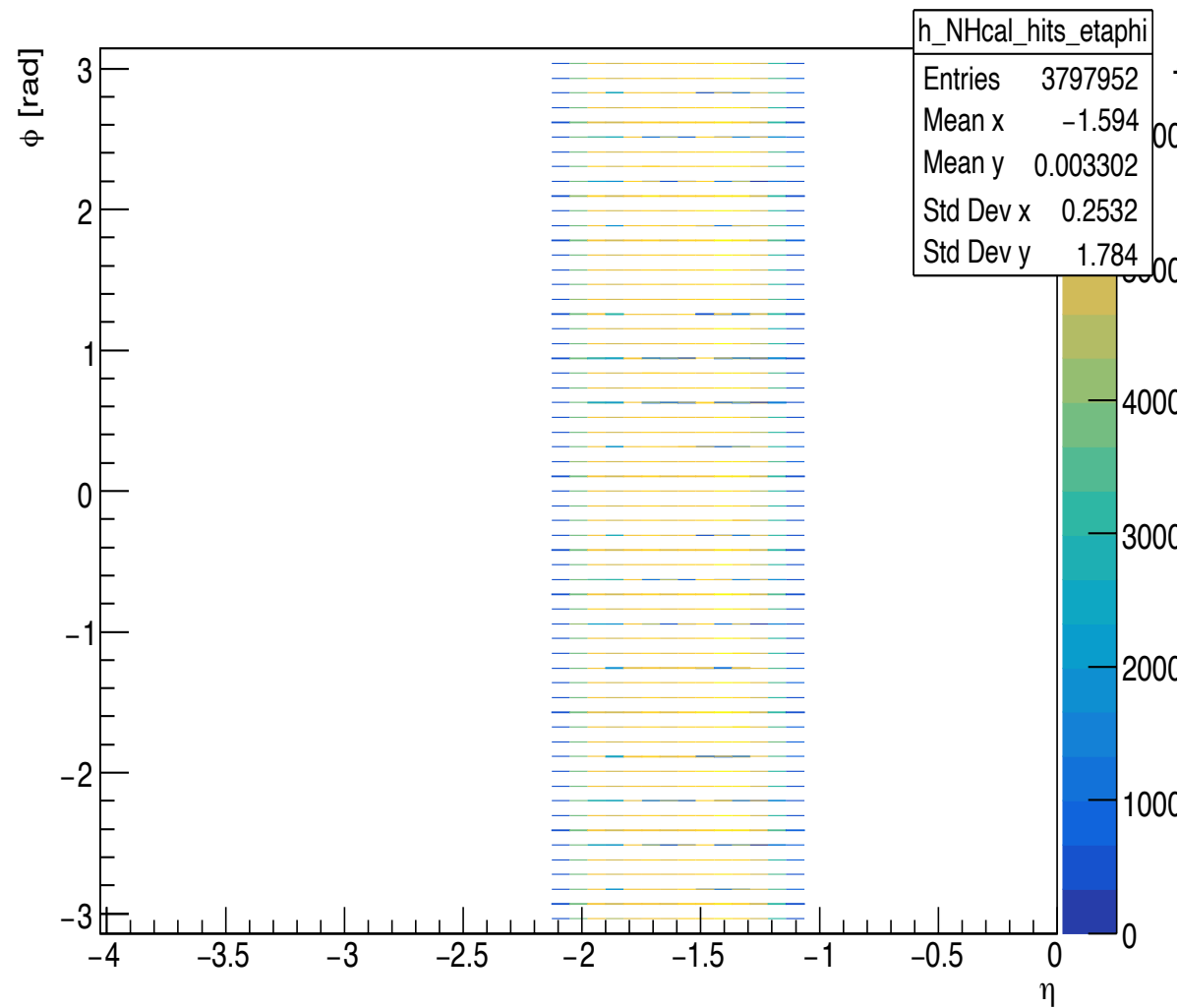
Reconstructed nHCal cluster x-y distribution : Neutron Gun



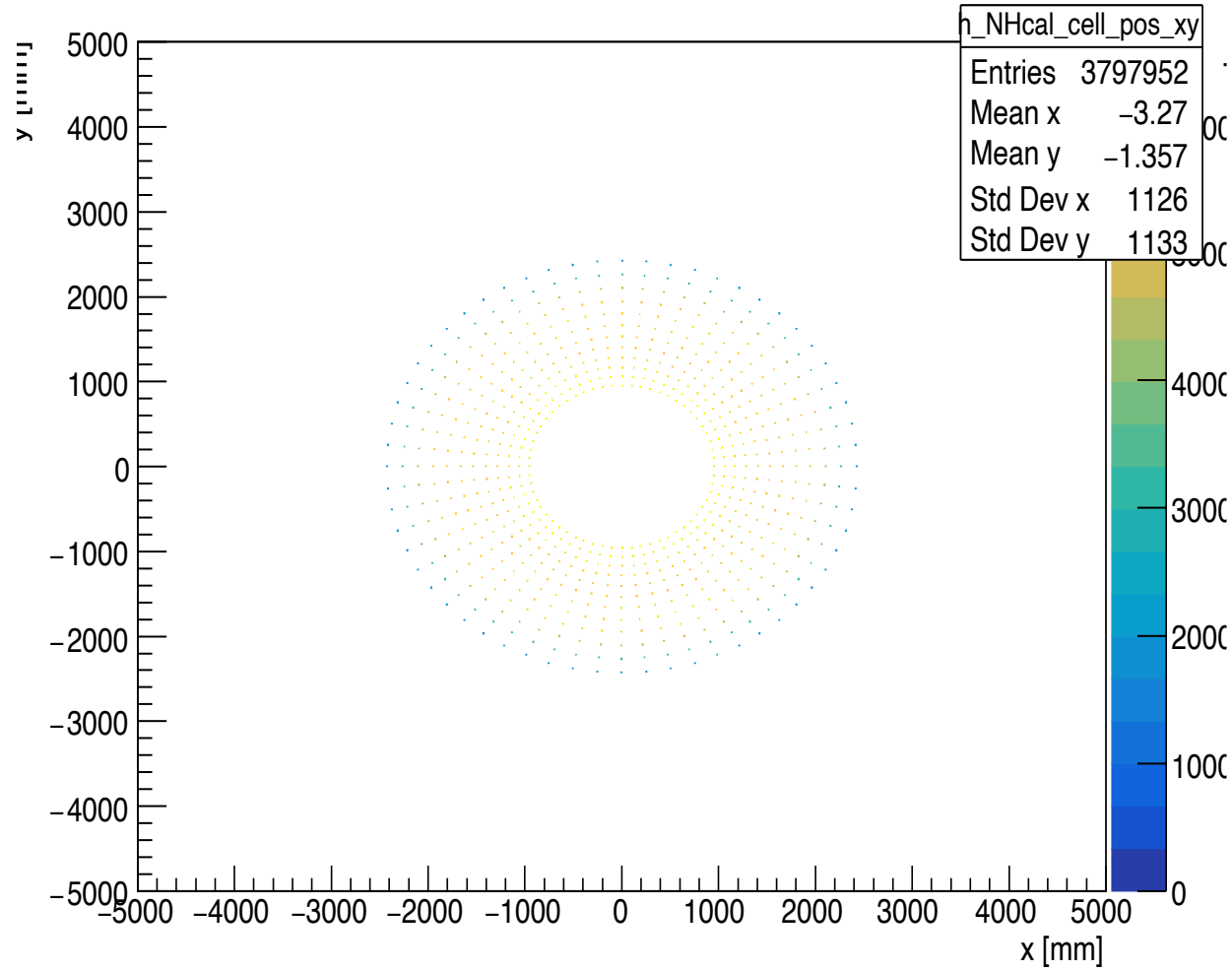
Reconstructed nHCal cluster intrinsic $\theta - \phi$ distribution : Neutron Gun



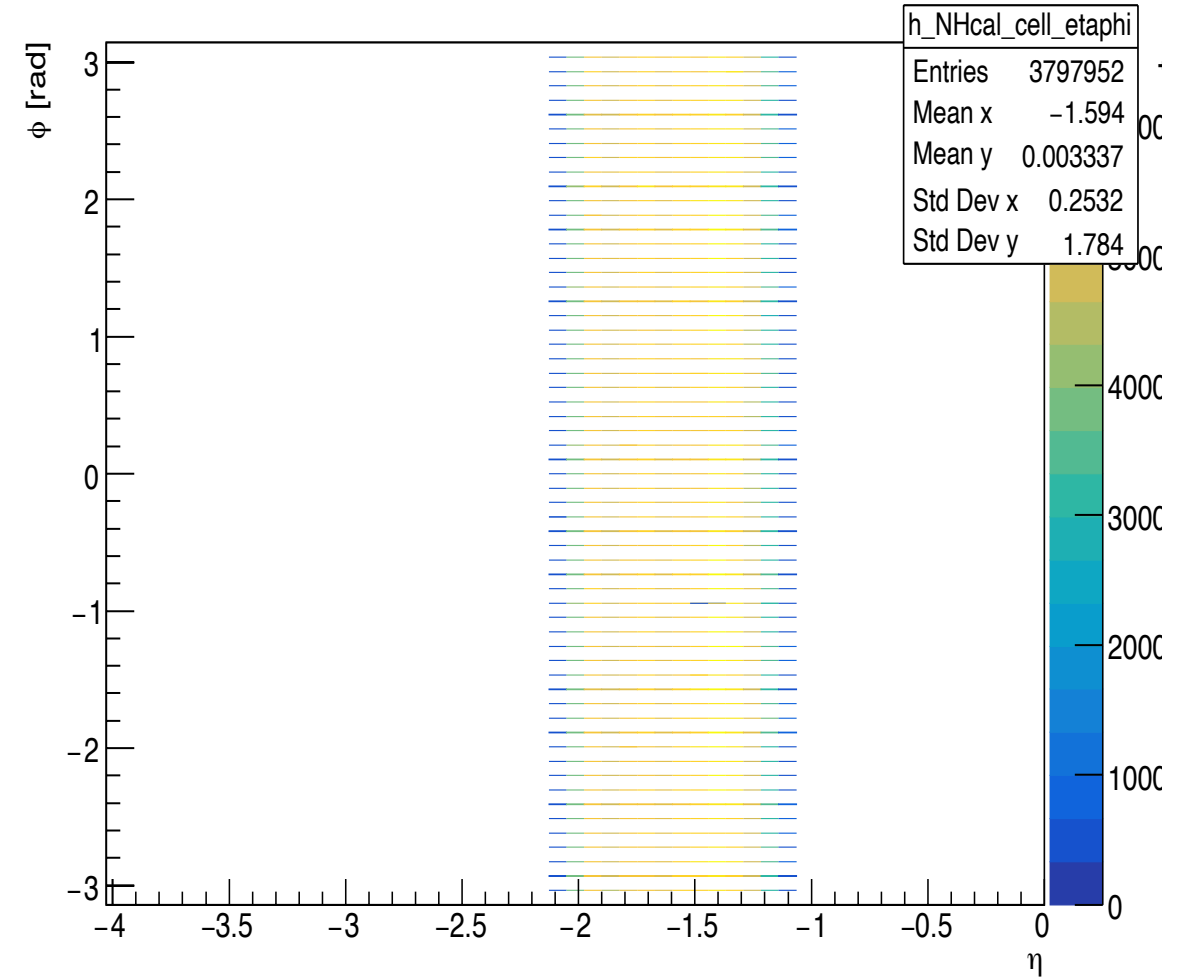
NHcal-hits position x,y

NHcal-hits η, ϕ 

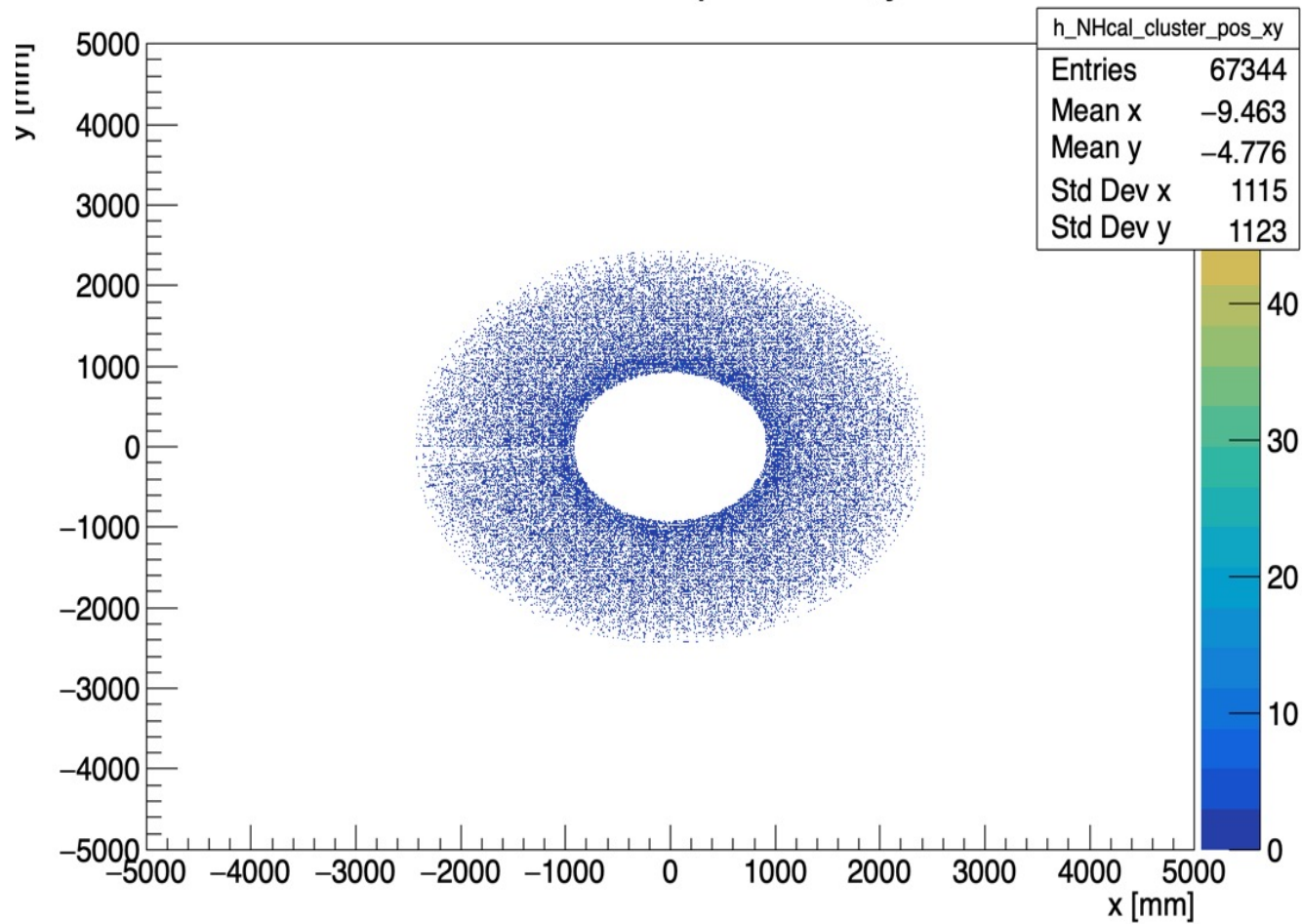
NHcal-cell position x,y



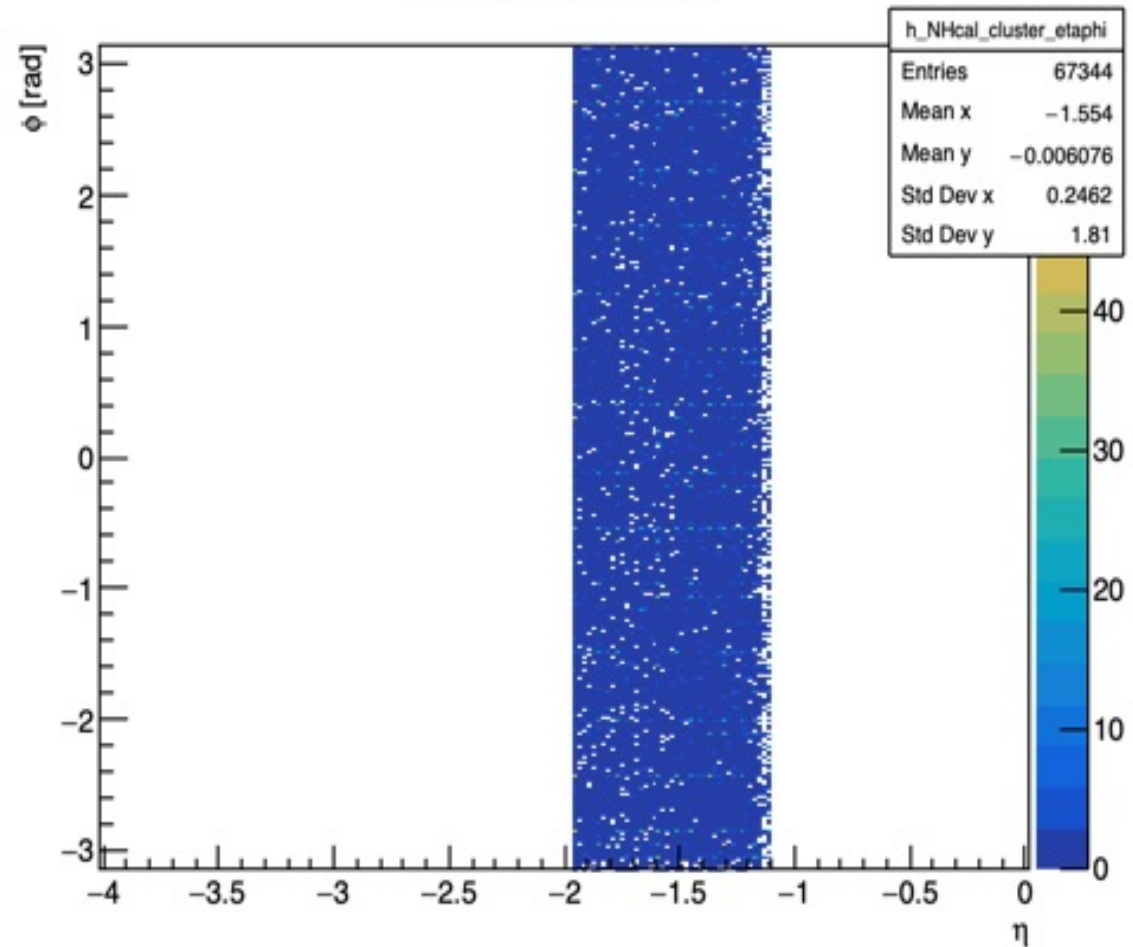
NHcal-cell η, ϕ



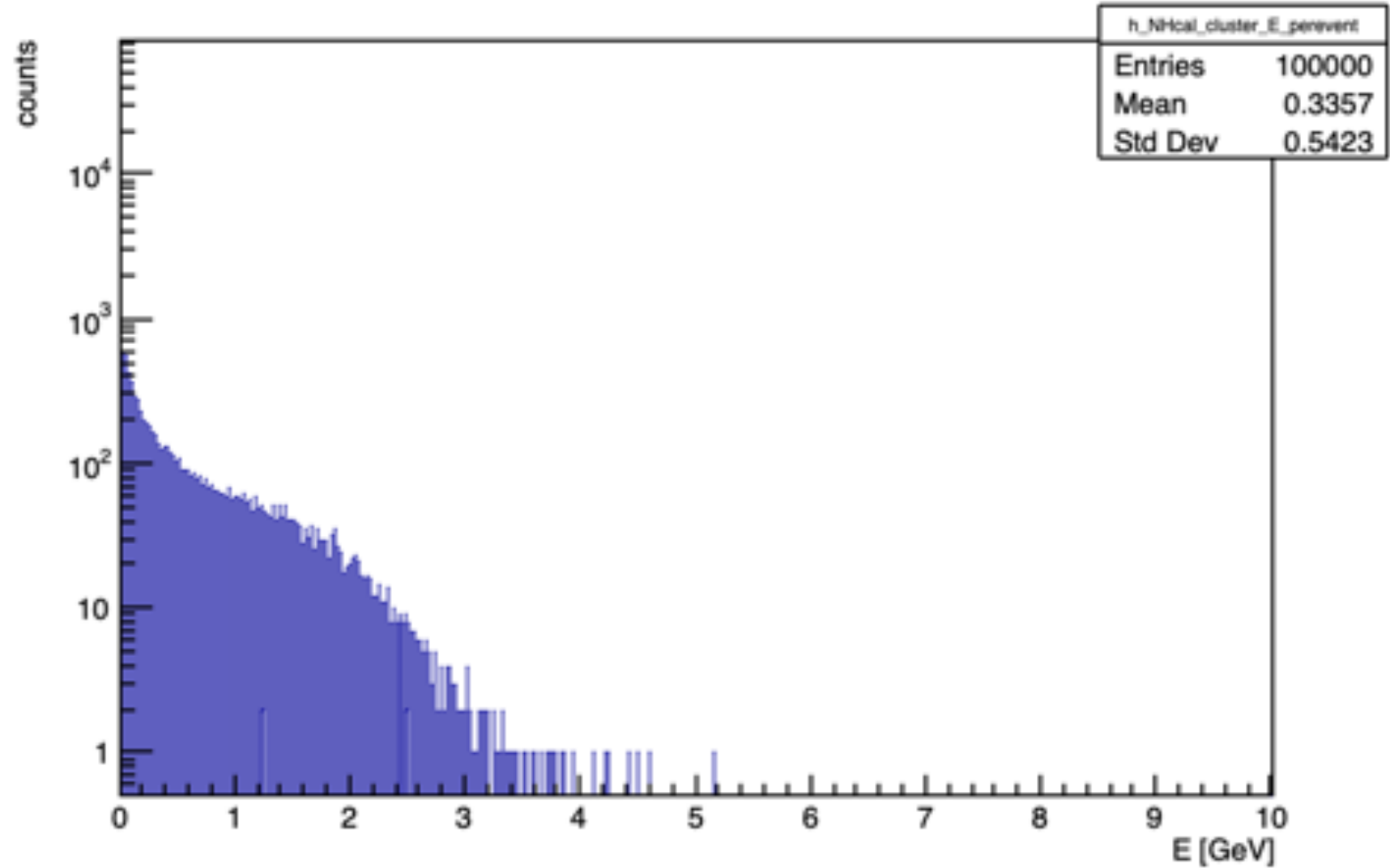
NHcal-cluster position x,y



NHcal-cluster η, ϕ



NHcal-cluster energy per event



Sum of the energy of the nhcal clusters in each event did not add up to the energy of the particle gun (5 GeV)

cell id	6755420932801137	cell_bin	335	R	153.063	cm	Phi	0.523599	dR	129.66mm	R*dPhi	160.288mm	dim	129.66 mm, 160.287 mm,
cell id	6755420932833905	cell_bin	335	R	153.063	cm	Phi	0.523599	dR	129.66mm	R*dPhi	160.288mm	dim	129.66 mm, 160.287 mm,
cell id	6755425227768433	cell_bin	395	R	166.351	cm	Phi	0.523599	dR	136.09mm	R*dPhi	174.202mm	dim	136.09 mm, 174.202 mm,
cell id	6755416637801073	cell_bin	275	R	140.405	cm	Phi	0.523599	dR	123.51mm	R*dPhi	147.032mm	dim	123.51 mm, 147.031 mm,
cell id	7036895909511793	cell_bin	334	R	153.063	cm	Phi	0.418879	dR	129.66mm	R*dPhi	160.288mm	dim	129.66 mm, 160.287 mm,
cell id	6755425227735665	cell_bin	395	R	166.351	cm	Phi	0.523599	dR	136.09mm	R*dPhi	174.202mm	dim	136.09 mm, 174.202 mm,
cell id	6755425227702897	cell_bin	395	R	166.351	cm	Phi	0.523599	dR	136.09mm	R*dPhi	174.202mm	dim	136.09 mm, 174.202 mm,
cell id	7036900204446321	cell_bin	394	R	166.35	cm	Phi	0.418879	dR	136.09mm	R*dPhi	174.202mm	dim	136.09 mm, 174.202 mm,
cell id	7036895909544561	cell_bin	334	R	153.063	cm	Phi	0.418879	dR	129.66mm	R*dPhi	160.288mm	dim	129.66 mm, 160.287 mm,
cell id	6755420932735601	cell_bin	335	R	153.063	cm	Phi	0.523599	dR	129.66mm	R*dPhi	160.288mm	dim	129.66 mm, 160.287 mm,
cell id	7036891614511729	cell_bin	274	R	140.405	cm	Phi	0.418879	dR	123.51mm	R*dPhi	147.032mm	dim	123.51 mm, 147.031 mm,
cell id	7036891614478961	cell_bin	274	R	140.405	cm	Phi	0.418879	dR	123.51mm	R*dPhi	147.032mm	dim	123.51 mm, 147.031 mm,
cell id	7318362296353393	cell_bin	213	R	128.373	cm	Phi	0.314159	dR	117.13mm	R*dPhi	134.432mm	dim	117.13 mm, 134.431 mm,
cell id	7036891614610033	cell_bin	274	R	140.405	cm	Phi	0.418879	dR	123.51mm	R*dPhi	147.032mm	dim	123.51 mm, 147.031 mm,
cell id	6755446702572145	cell_bin	695	R	242.898	cm	Phi	0.523599	dR	170.91mm	R*dPhi	254.363mm	dim	170.91 mm, 254.363 mm,
cell id	6755446702539377	cell_bin	695	R	242.898	cm	Phi	0.523599	dR	170.91mm	R*dPhi	254.363mm	dim	170.91 mm, 254.363 mm,
cell id	6755442407572081	cell_bin	635	R	226.186	cm	Phi	0.523599	dR	163.34mm	R*dPhi	236.862mm	dim	163.34 mm, 236.861 mm,
cell id	6755442407539313	cell_bin	635	R	226.186	cm	Phi	0.523599	dR	163.34mm	R*dPhi	236.862mm	dim	163.34 mm, 236.861 mm,
cell id	3096237645660785	cell_bin	228	R	128.373	cm	Phi	1.88496	dR	117.13mm	R*dPhi	134.432mm	dim	117.13 mm, 134.431 mm,
cell id	3096233350693489	cell_bin	168	R	116.955	cm	Phi	1.88496	dR	111.21mm	R*dPhi	122.476mm	dim	111.21 mm, 122.476 mm,
cell id	3377708327404145	cell_bin	167	R	116.956	cm	Phi	1.78024	dR	111.21mm	R*dPhi	122.476mm	dim	111.21 mm, 122.476 mm,
cell id	15762628777378417	cell_bin	423	R	180.289	cm	Phi	-2.82743	dR	142.69mm	R*dPhi	188.799mm	dim	142.69 mm, 188.799 mm,
cell id	15762628777411185	cell_bin	423	R	180.289	cm	Phi	-2.82743	dR	142.69mm	R*dPhi	188.799mm	dim	142.69 mm, 188.799 mm,

The dimensions (in dR and R*dPhi) of the segmentation cells matched with the hard-coded values that we started with.

Thank You

