First look to the Test Beam data from 2018

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Contents

Setup

- All the programs were run in machines at CIEMAT using ILCSoft v02-00-01 with a local copy of the data files.
- The ROOT trees used in the análisis were extracted from the SLCIO files using Antoine's Trivent processor.
- The algorithms used for the particles selection, efficiency and multiplicity are based on the ones used in 2012.

Test Beam

2018 vs 2012

- Lower high voltage. Previously 6.9 kV and 7.1 kV, now 6.7 kV.
- 37 working GRPCs, 11 less than before.
- Higher charge thresholds: 1) 114 fC → 120 pC, 2) 5 pC → 350 pC, 3) 15 pC → 500 pC.
- The gas mixture stays the same (93% TFE, 5% CO_2 and 2% SF_6).

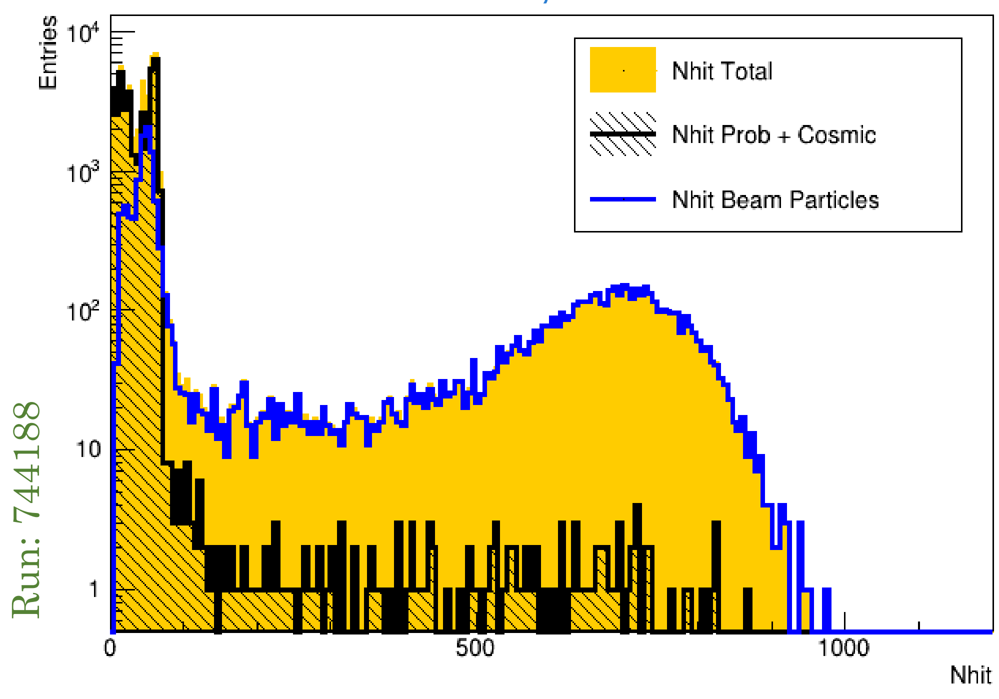
↓

Less hits recorded per event meaning a shift of the distributions.

HCal beam particles selection

- To reconstruct a physical process: $Nhits > 7$.
- We assume that there is signal in the first 2 layers.
- It is required 4 layers with signal between the first 10 and 3 among the first 6.
- To reconstruct the trace we require at least 5 close (less than 3 layers without signal in between) GRPCs with signal.
- No more than 5 layers without signal between two sets of close GRPCs and no more than 3 sets.

70 GeV Π^+, no ECal



no ECal ⟶ the beam was shots in an area of the SDHCal without the Ecal in front.

Prob ⟶ problems with the electronics and noise.

HCal muons selection 1)

Density: $\rho = \frac{nHit}{nLayers}$

$\boldsymbol{nHit} \rightarrow$ total number of hits in the detector.

$\boldsymbol{nLayers} \rightarrow$ number of layers with signal.

Second maximum of hits in a single layer: Hit_{Max2}

Penetrability Condition (P.C.):

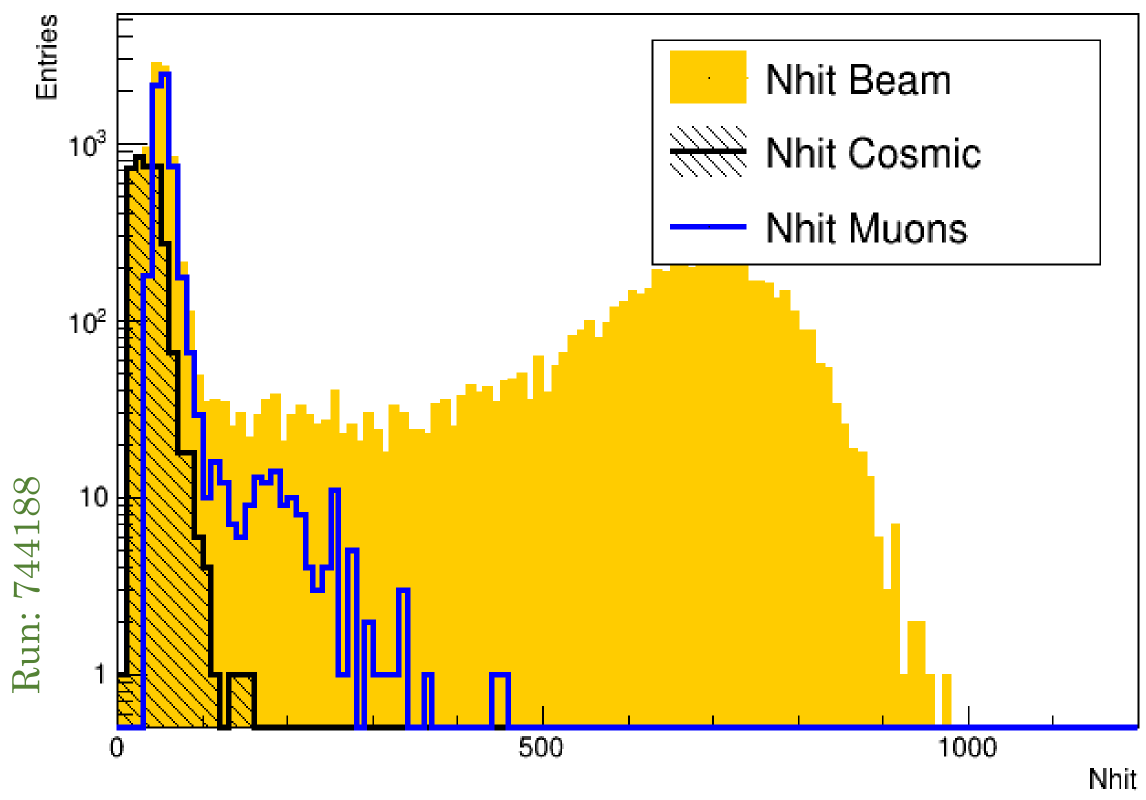
- Layers 01-08: at least 6 with signal.
- Layers 09-16: at least 6 with signal.
- Layers 17-28: at least 7 with signal.
- Layers 29-37: at least 6 with signal.

HCal muons selection 2)

Muons → $(\rho < 2.5\ or\ Hit_{Max2} < 5) + P.C.$

Muons with shower → $\rho < 5 + P.C.$

70 GeV Π⁺, no ECal



GRPCs efficiency and multiplicity

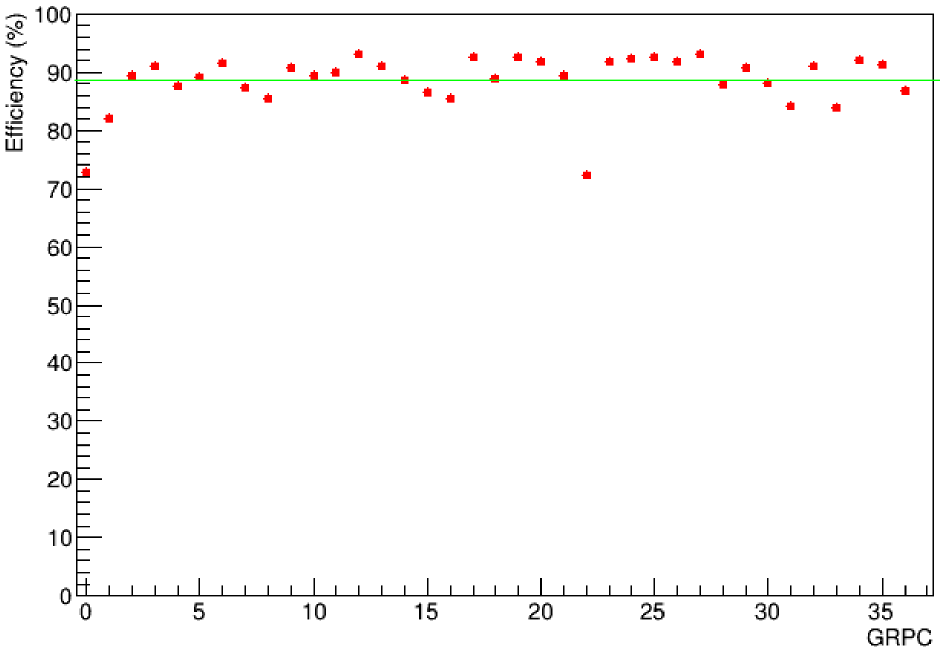
Trace reconstructed in multiple stages:

- The mean position of all the clusters.
- Fit to a straight line with the clusters < 20 cm.
- Final fit with the clusters < 10 cm and requesting > 7 layers with signal and slope < 0.1.

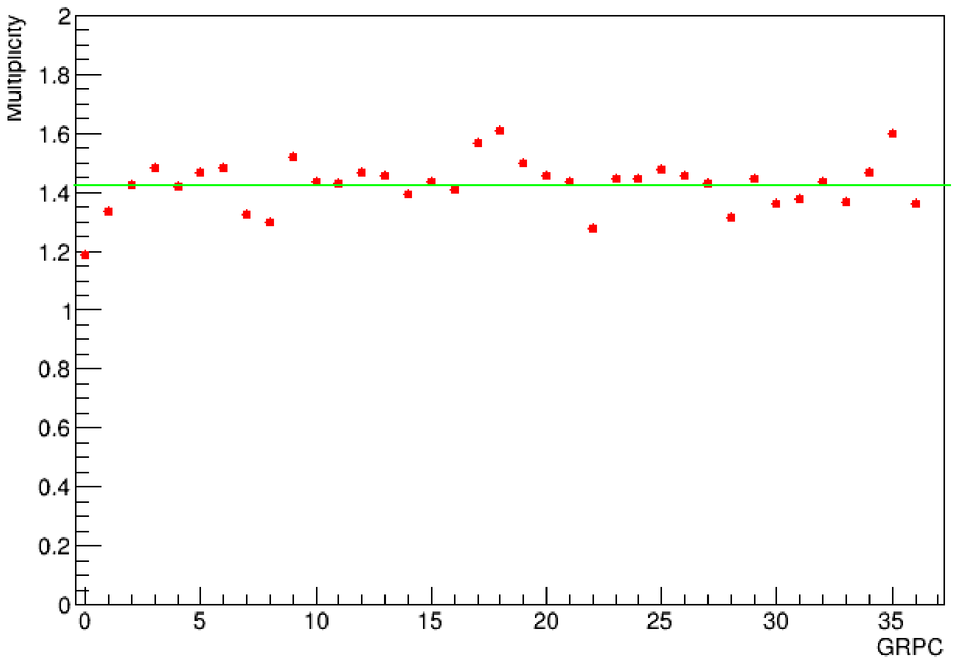
Cluster distance < 3 cm → GRPC is efficient.

Cluster size = multiplicity.

Efficiency



Multiplicity

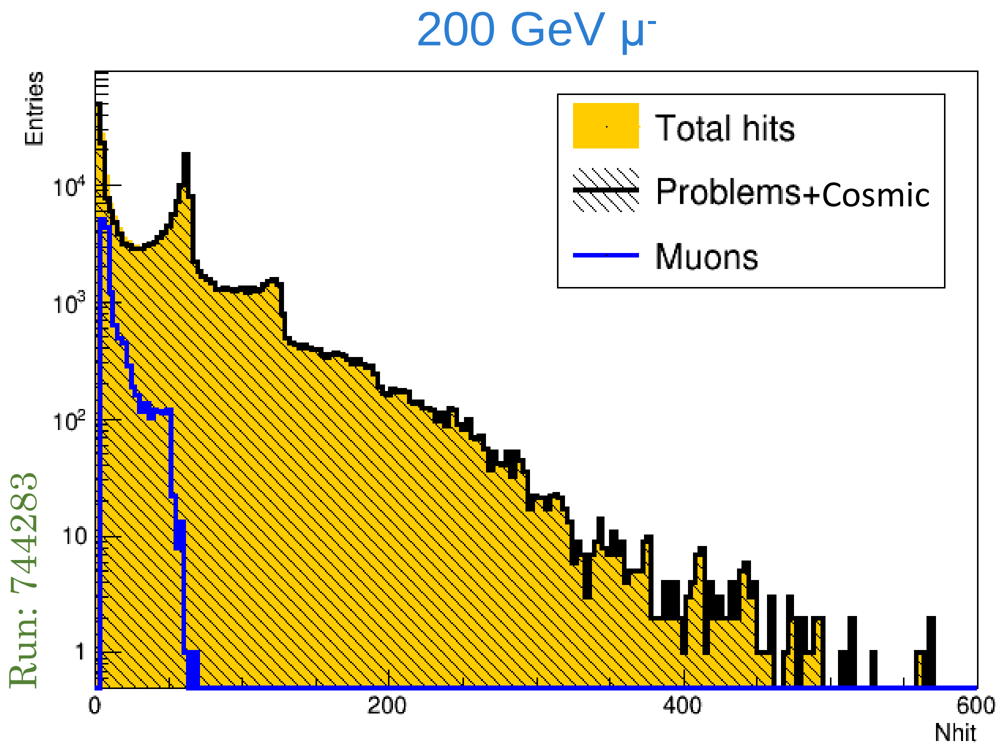


ECal muon selection

Data files taken from: /eos/project/s/siw-ecal/TB2018-09/Common/ECAL/Muon_200GeV/*__build.root

Following a similar procedure than the Hcal:

- Signal in the first 2 layers required.
- At least 4 layers with signal.
- Equal to the Hcal we require at least 5 close layers with signal.
- Density < 10.



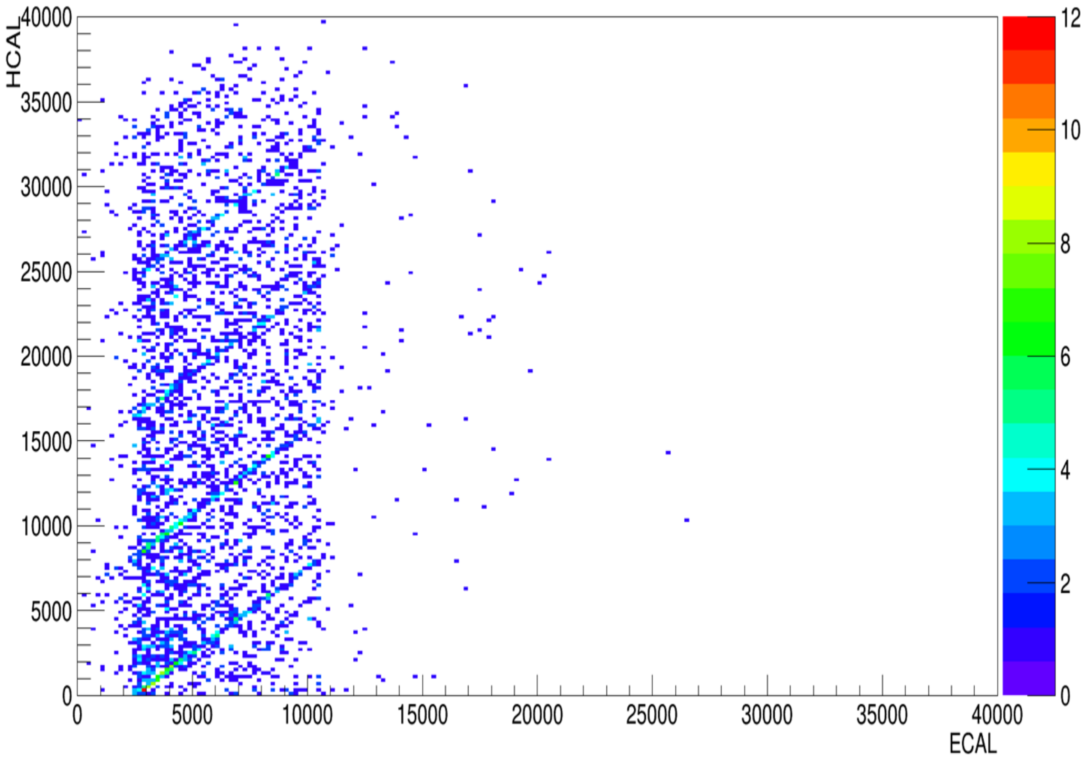
ECal-HCal synchronization

Matching of muon traces in both detectors:

$1 \text{ BCID} = 200 \text{ ns}$

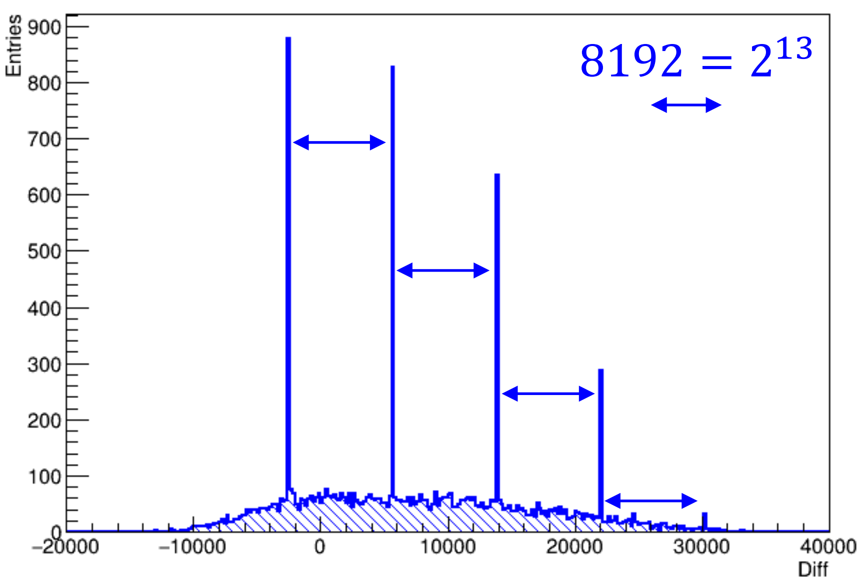
- Same muon run and events in the same spill.
- Taken a fit from the HCal we find the closest fit parameters among all in the ECal.

HCal BCID vs ECal BCID



$$Diff = BCID_{HCal} - BCID_{ECal}$$

BCID Difference



Summary and prospects

Efficiencies and multiplicities have been computed for the 2018 data:

- Seems like there is a loss in efficiency in the firsts layers
- Was layer 22 malfunctioning?
- New optimized cuts and selections rules may be needed

Still no clear synchronization between ECal and HCal:

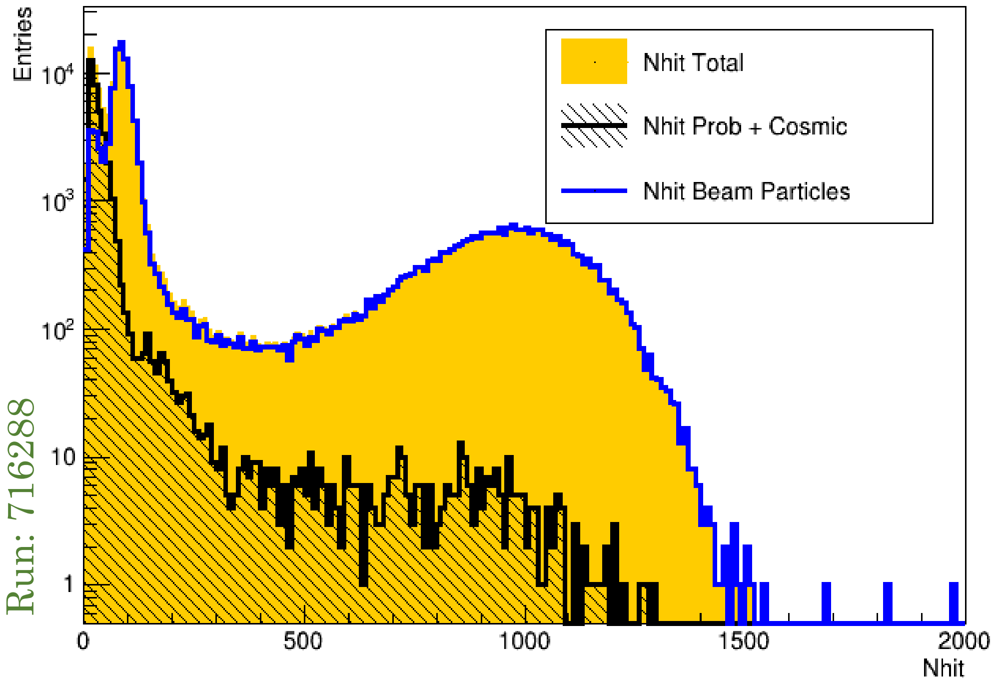
- More work is needed to understand the correlation in the BCIDs.

Backup

Beam particles selection. 2012 vs 2018

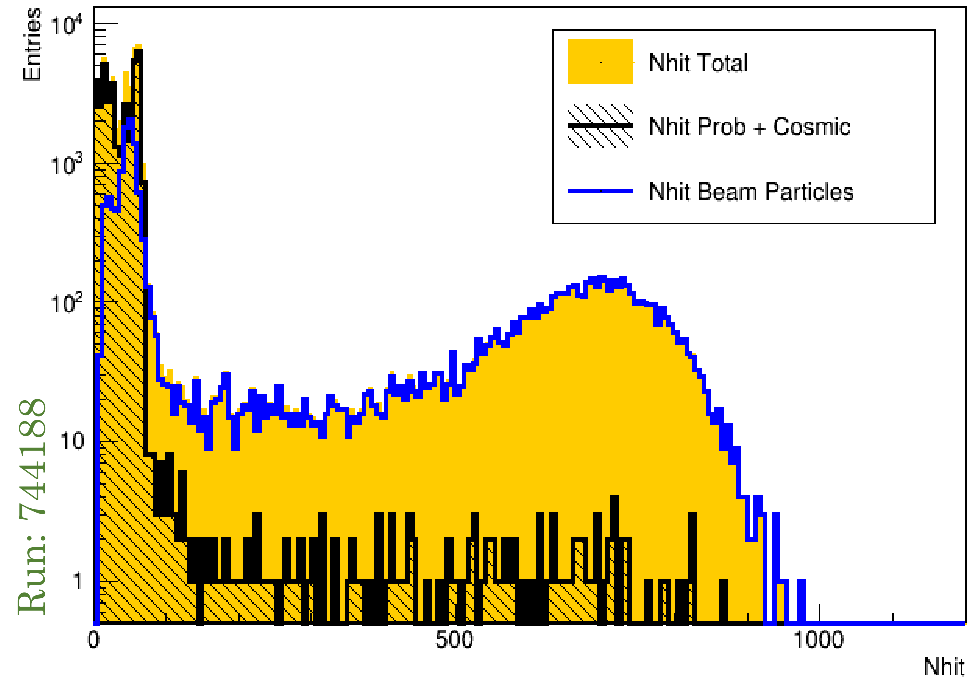
2012

70 GeV Π⁻



2018

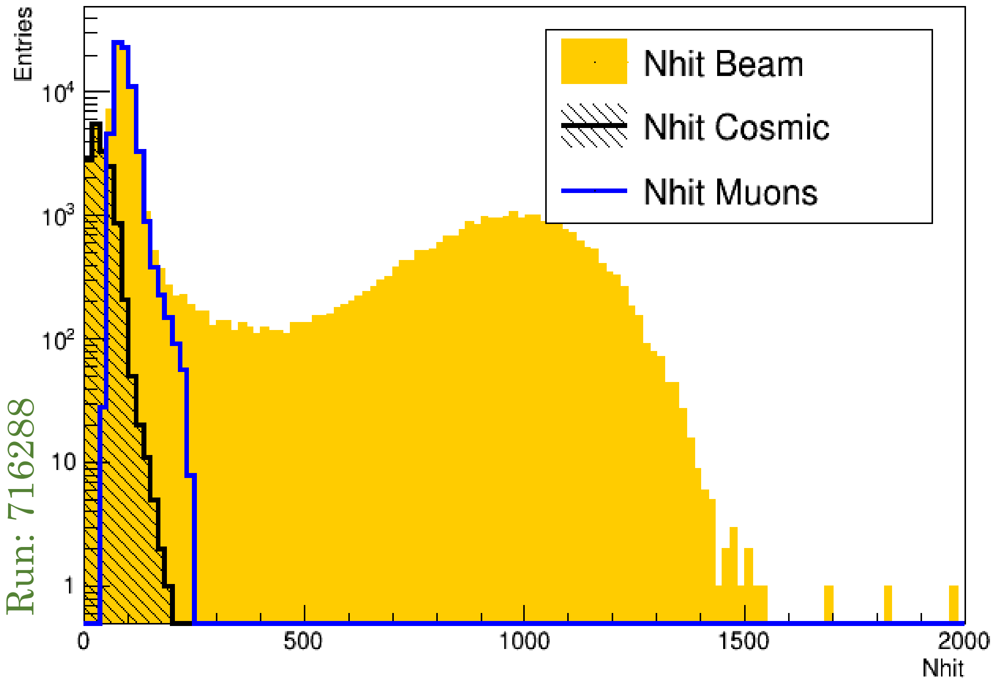
70 GeV Π⁺, no ECal



Muons selection. 2012 vs 2018

2012

70 GeV Π⁻



2018

70 GeV Π⁺, no ECal