Towards background rejection (Particle Identification)

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Plan de Recuperación, Transformación y Resiliencia
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Goals

Particle identification for background rejection in NPOD's ECAL

Particles to study:

- Pions
- Neutrons
- Photons

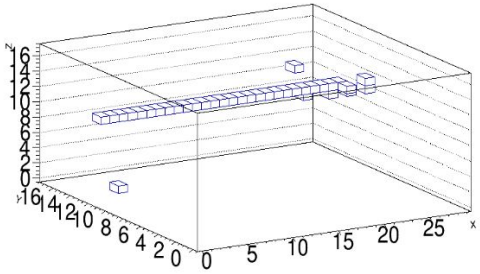
These neutral particles can mimic the expected signal photons in the ECAL, we have to be able to reject them.

The beam dump absorbs most background particles that could come from IP.

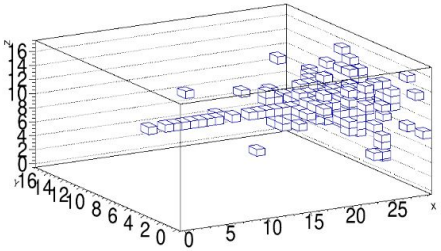
Basic principles of PID in High granularity CAL

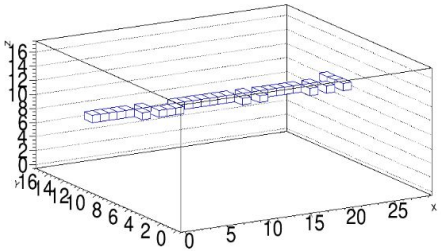
- Different particles have different behaviors when interacting with the detector material
- EM vs Hadron showers in ECAL have different “shapes” and deposit energy differently

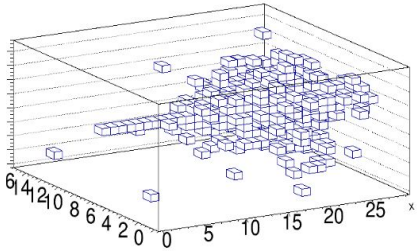
MUON



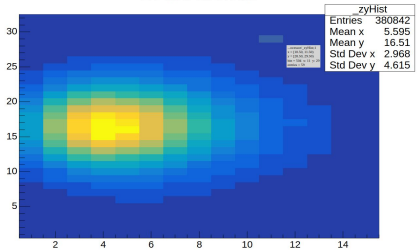
PION



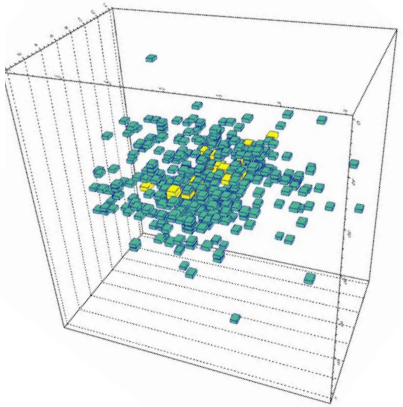




PHOTON



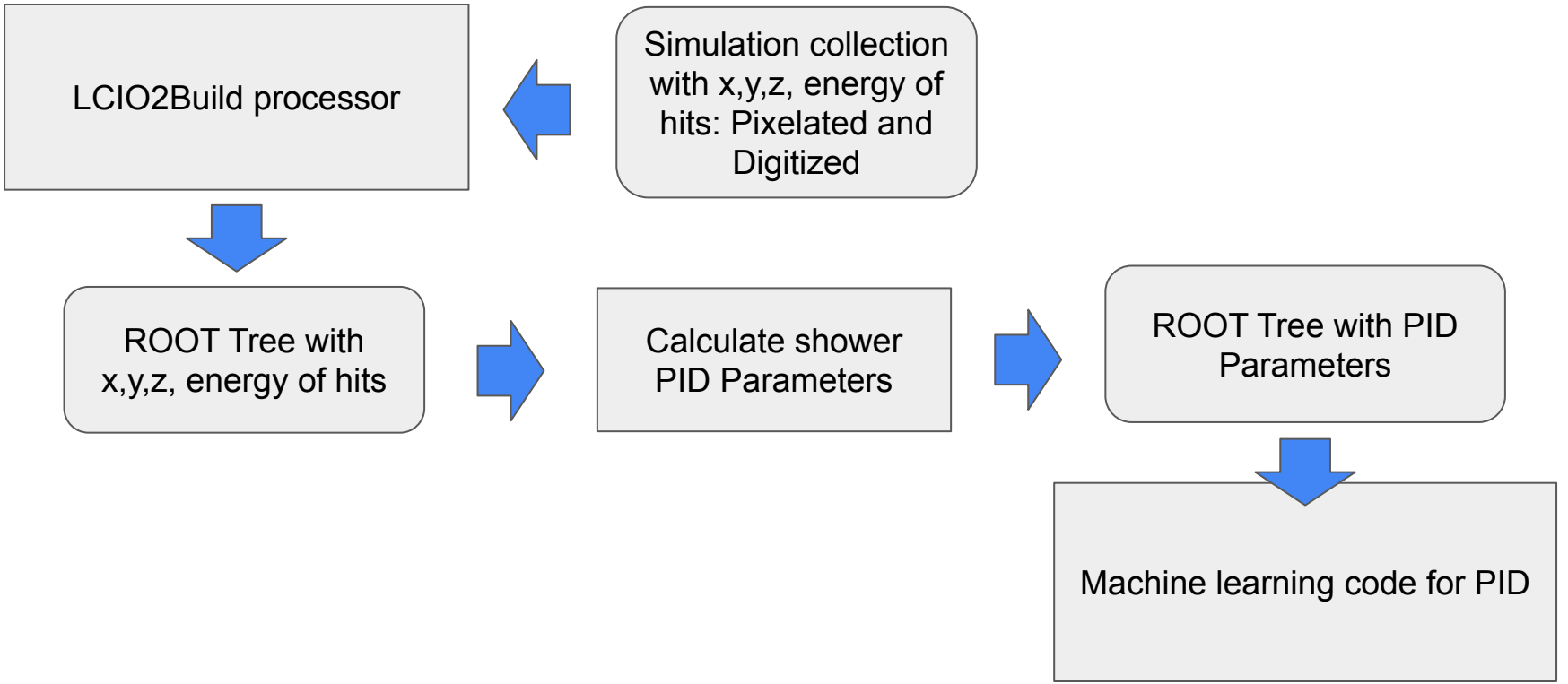
NEUTRON



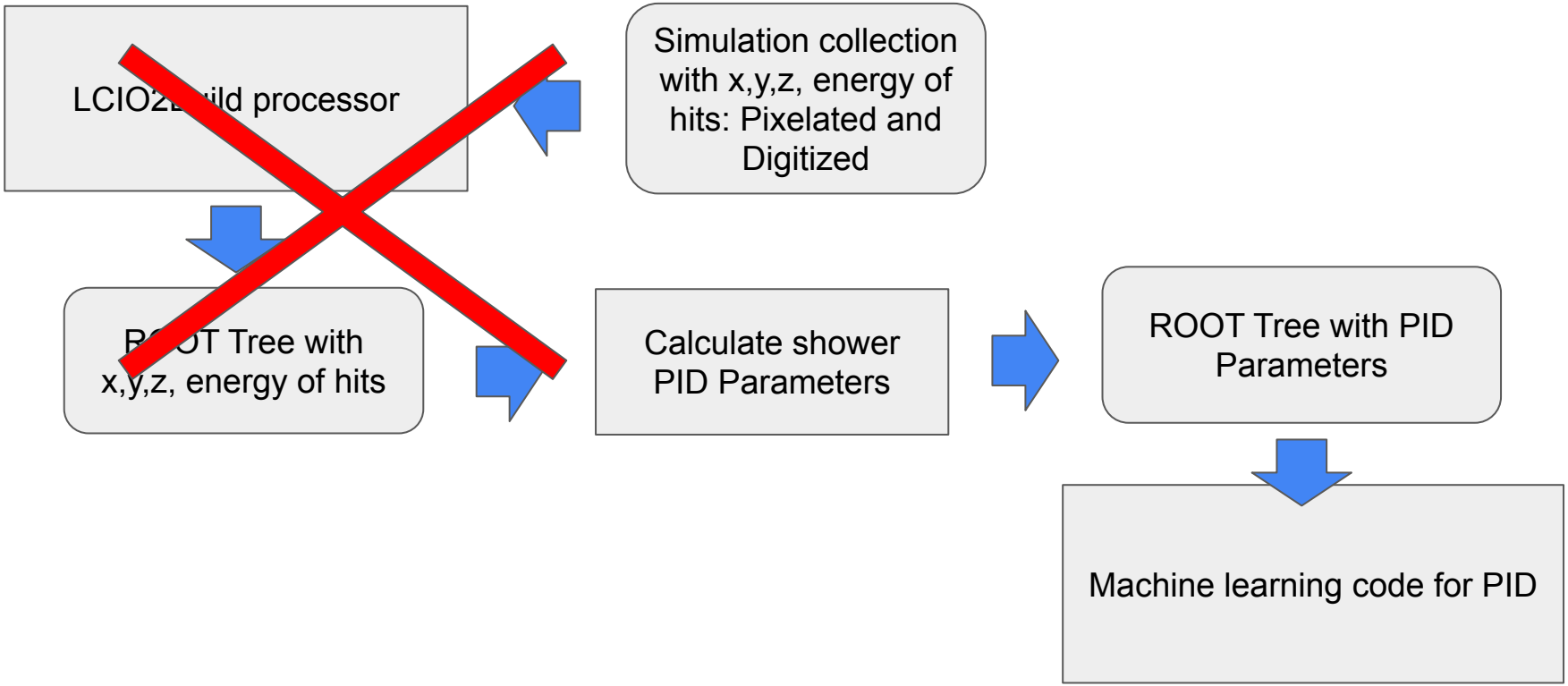
Examples of useful event parameters for PID
Making use of the high granularity

- Total number of hits (fired cells)
- Total energy
- Hits per layer
- Energy per layer
- Moliere radius
- Shower start layer (if there is a shower)
- Shower end layer
- Shower length
- Max layer reached
- Transversal distribution per layer and total

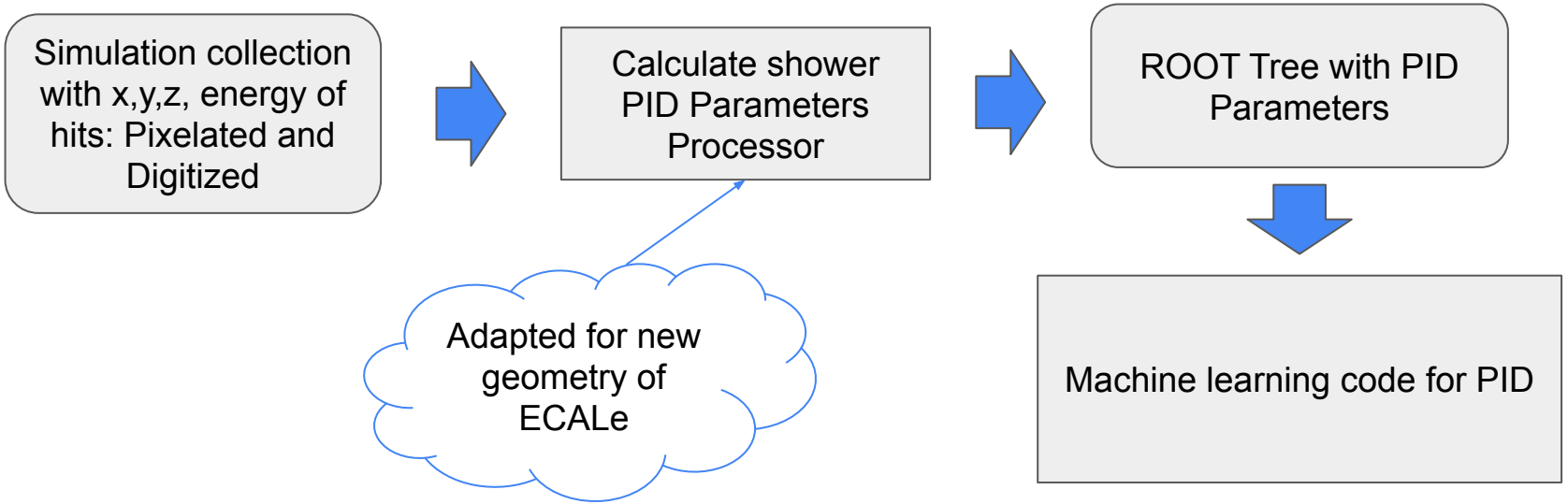
Previous work by J.P. Marquez



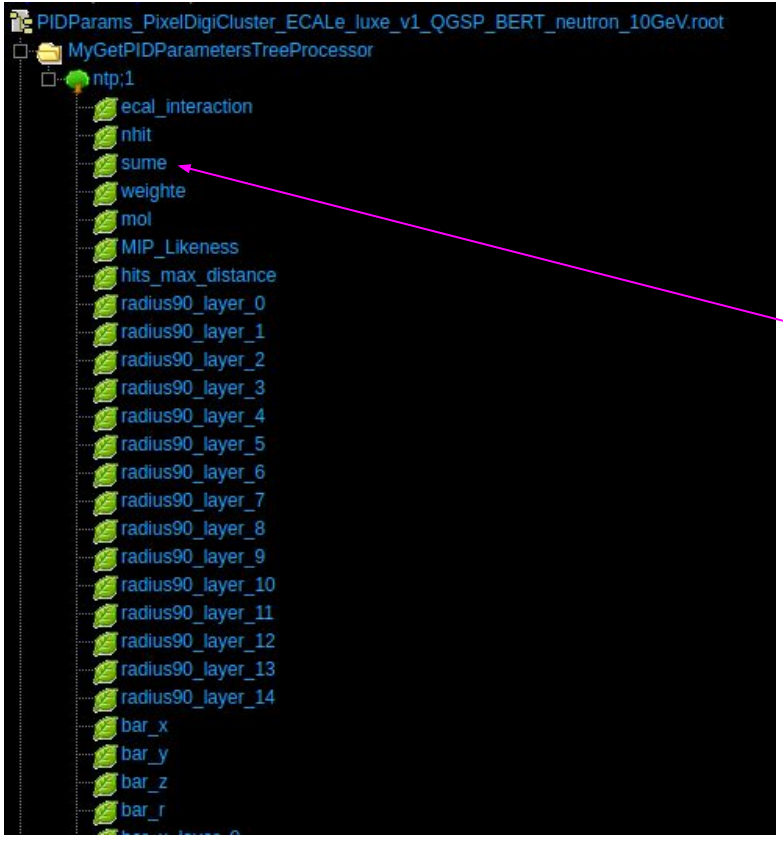
Previous work by Jesus + my work to use with CALORIMETERHIT

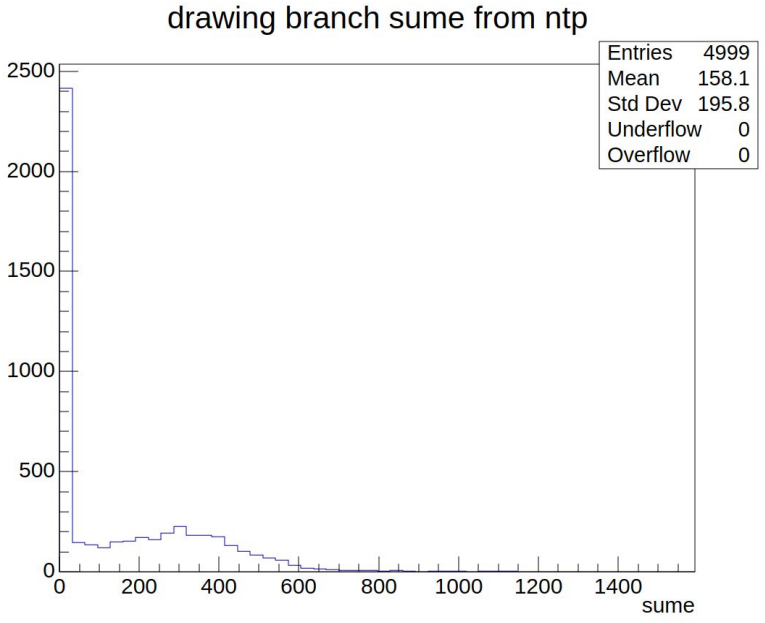


Previous work by Jesus + my work to use with CALORIMETERHIT

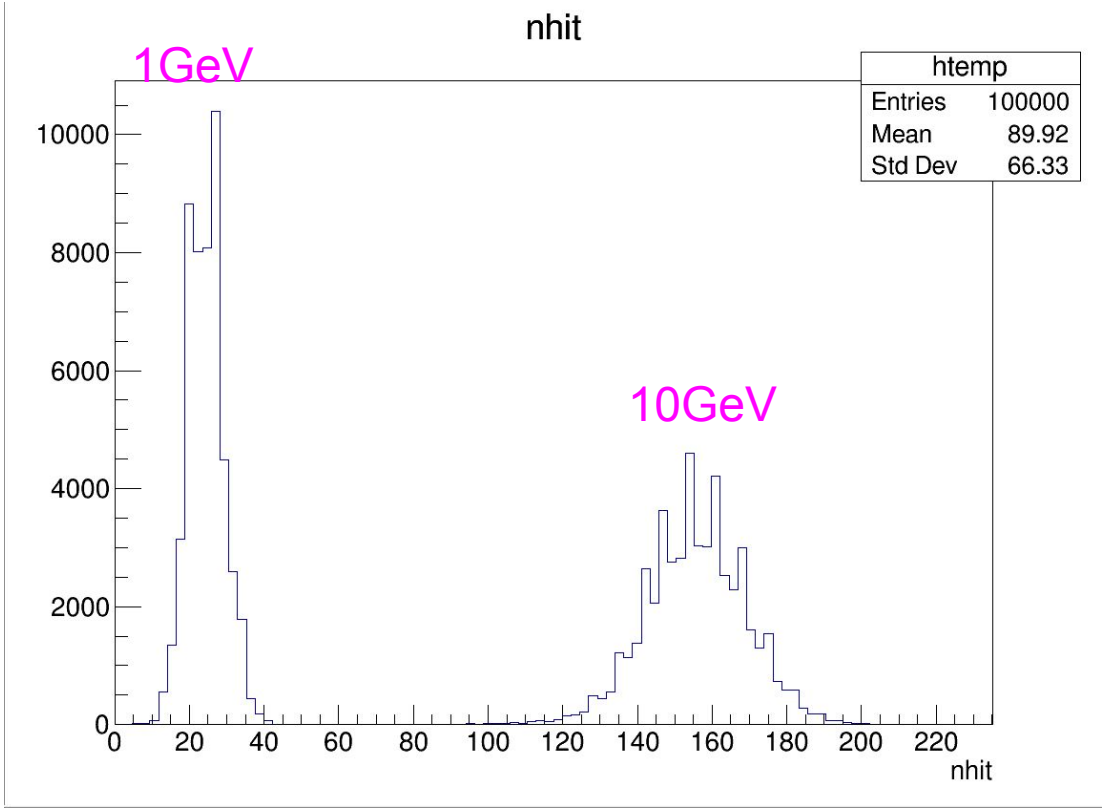


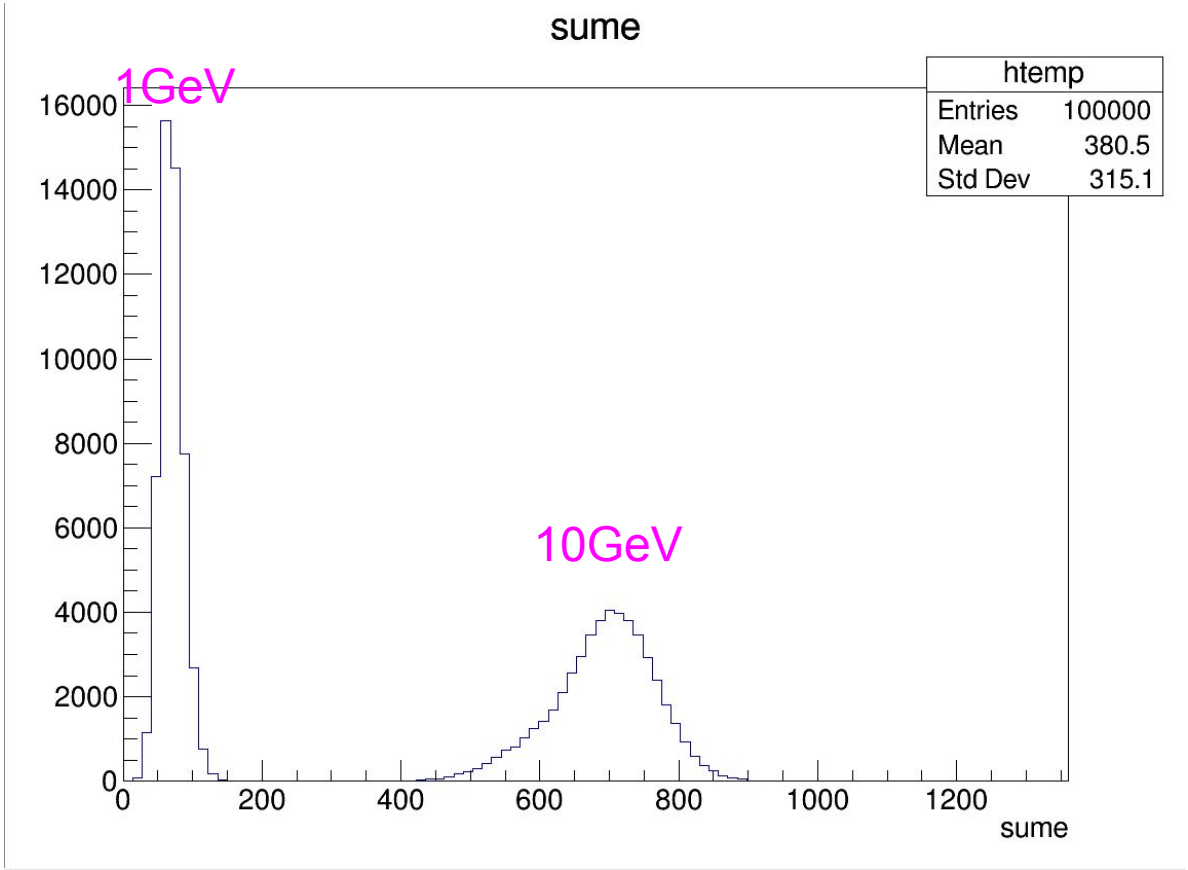
Output root file: neutron





Calculation of parameters from simulation: Photon example

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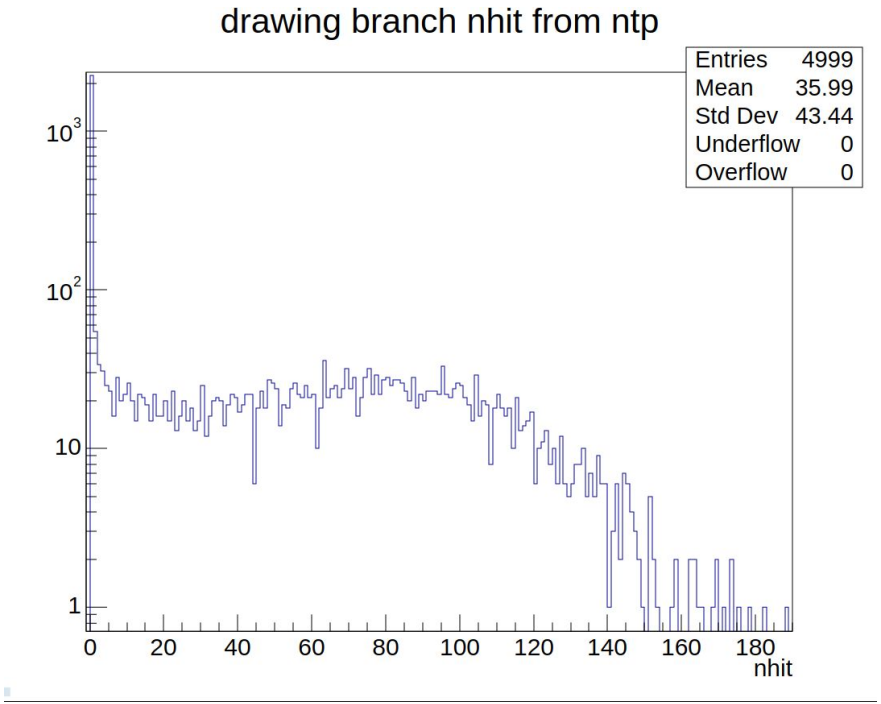
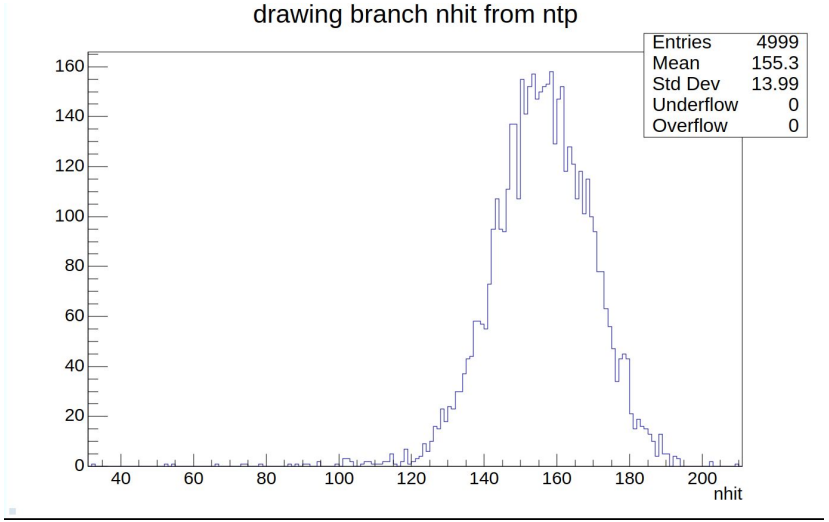
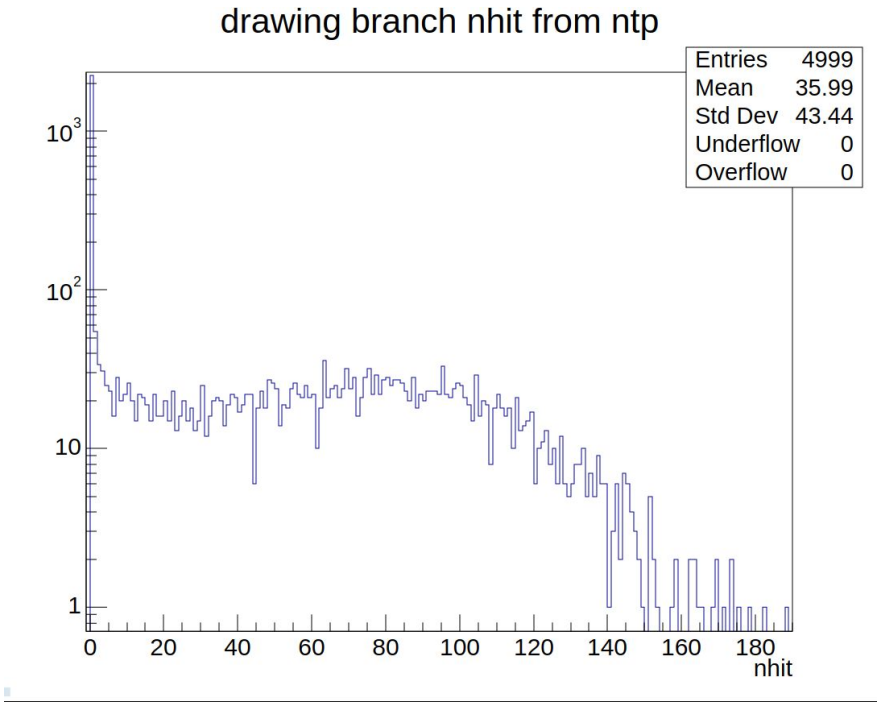
1GeV
10GeV
htemp
Entries 100000
Mean 380.5
Std Dev 315.1
16000
14000
12000
10000
8000
6000
4000
2000
0
0
200
400
600
800
1000
1200
sume

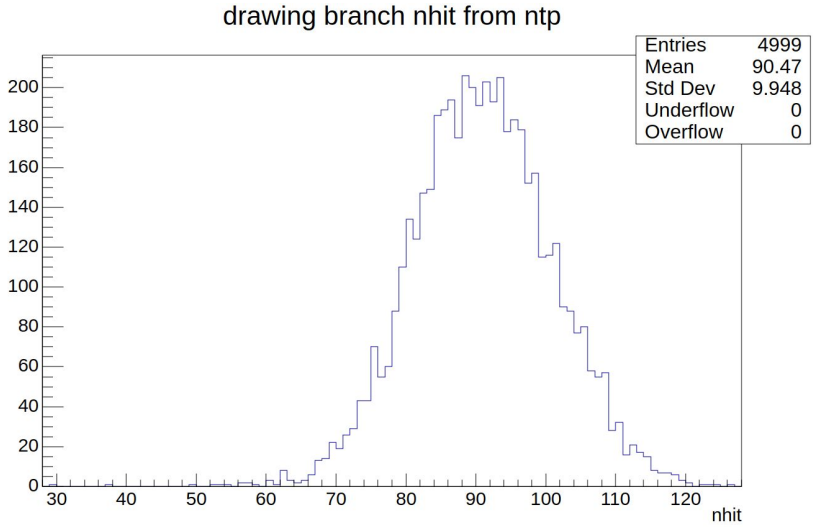
Neutron vs photon: 10 GeV





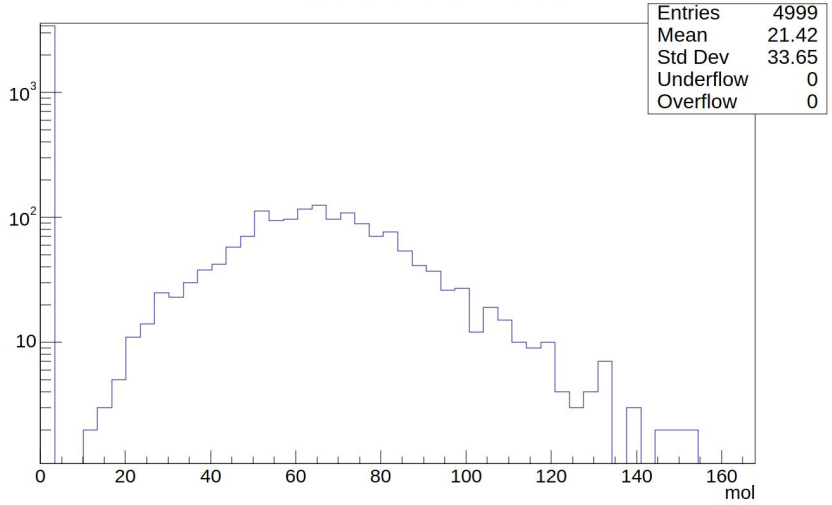
Neutron 10 GeV vs photon 5 GeV



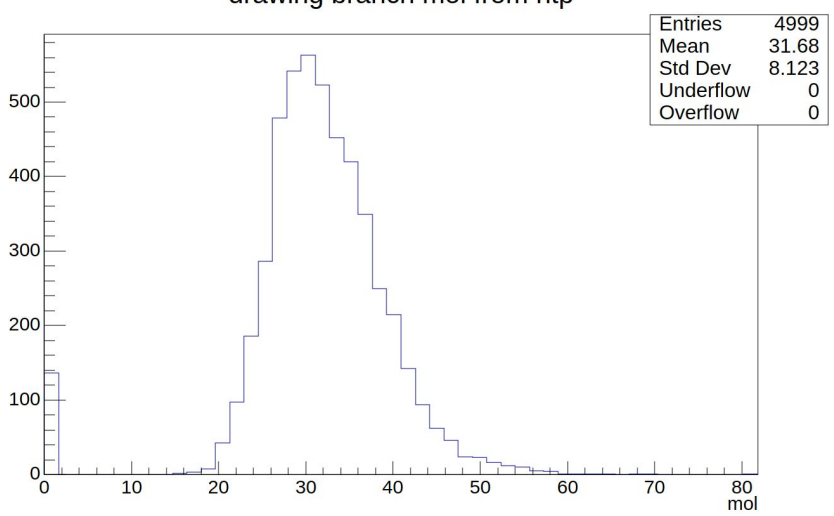


Moliere radius: Neutron vs photon 10 GeV

NEUTRON



PHOTON



Work to do

- Immediate
  - Produce samples for the three particle types for many energies to train ML algorithm
- Long run but not too long
  - Actually use J.P.’s machine learning program and get results/numbers for background rejection