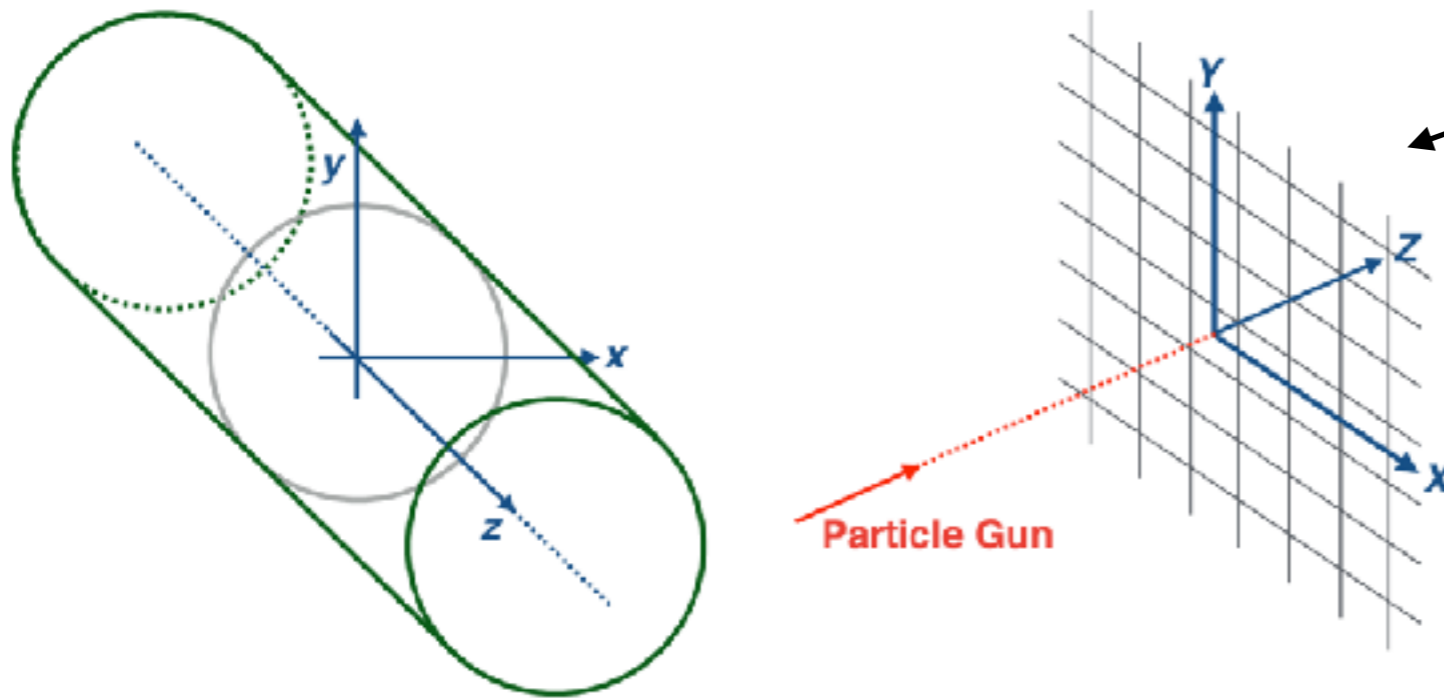# BDT VARIABLES

MATT ZHANG

A bug in ECAL and HCAL variable calculation (axes swapped)

Separate issue - are x and y swapped in this plot?

Particle pT is given in cartesian coordinates, with z along the beam axis, as shown on the left.

ECAL and HCAL pixel coordinates, given as [x, y, z], are in cylindrical coordinates, with z perpendicular to the calorimeter. These coordinates can be thought of as [z, r*phi, r].

When a particle is shot at (60, 0, 0), it goes in the x direction. In this case, ECAL and HCAL pixels correspond to global cartesian coordinates [z, y, x], assuming both figures above are given correctly. These coordinates were treated incorrectly in the code.

Variables affected: ECAL_E_firstLayer, HCAL_E_firstLayer, ECAL_E_secondLayer, HCAL_E_secondLayer, ECAL_ratioFirstLayerToTotalE, HCAL_ratioFirstLayerToTotalE, ECAL_ratioFirstLayerToSecondLayerE, HCAL_ratioFirstLayerToSecondLayerE, n-subjettiness variables.
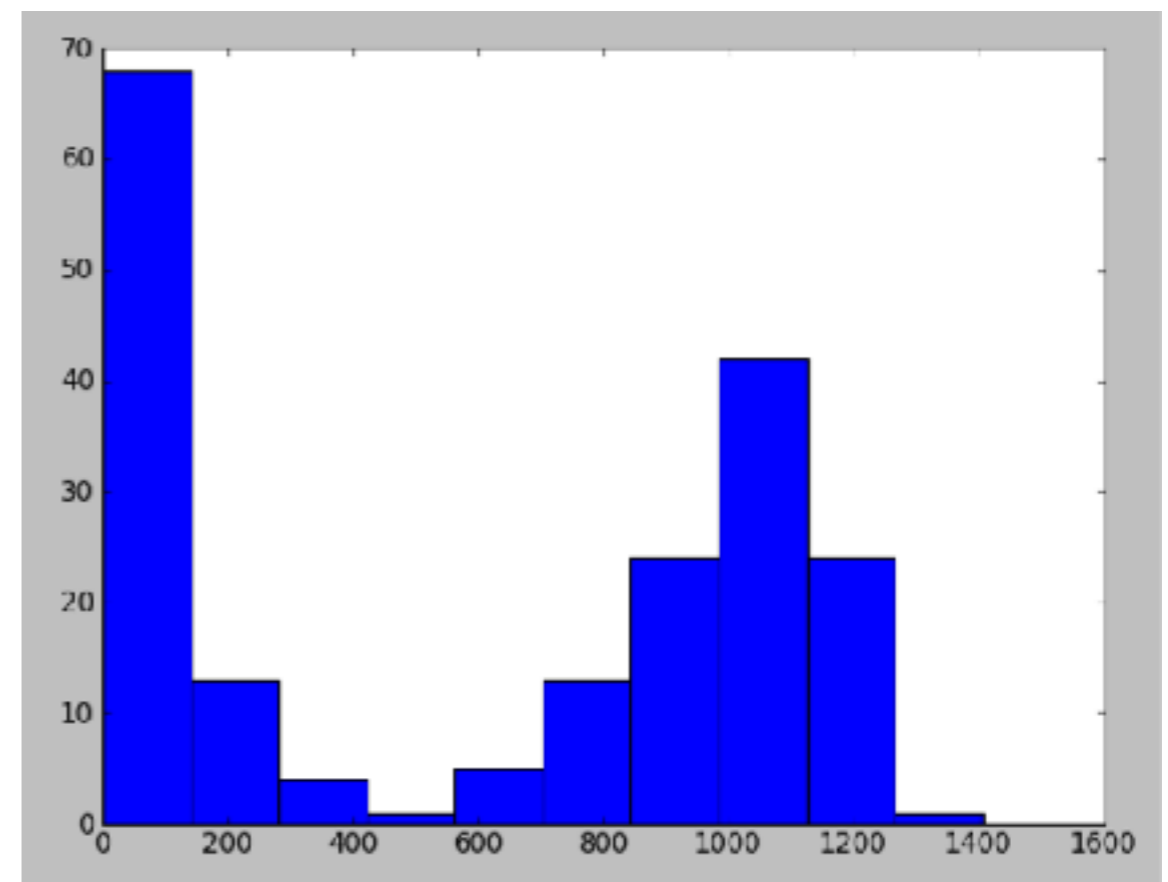
N-subjettiness bug fix

Before we were seeing that 90% of events had so few hits in the ECAL that they could not produce three jets. This is because I was using samples without the HCAL/ECAL < 0.2 cut. It turns out that most of these events have no hits at all in the ECAL! After skimming, 90% of events were removed, leaving most events with at least 3 hits.

ECAL_nHits before skimming
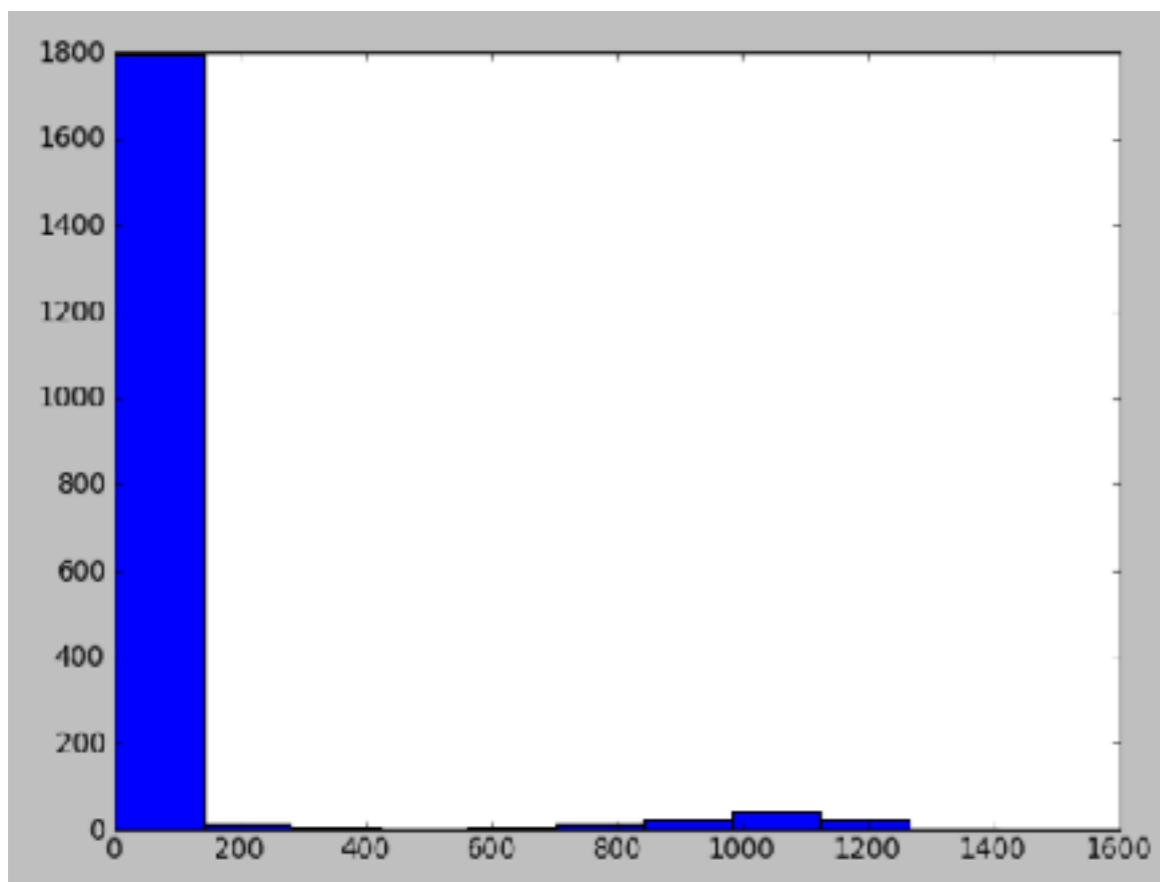
ECAL_nHits after skimming

N-subjettiness (another bug)

The samples I ran n-subjettiness calculations on were not generated with an incident particle of pT = (60, 0, 0) as I had assumed. Therefore the reconstructed jets didn't make any sense. I have to regenerate a small set of samples and retest the n-subjettiness variables.

Jet reconstruction messing up because particle was not at pT = (60, 0, 0) as assumed.
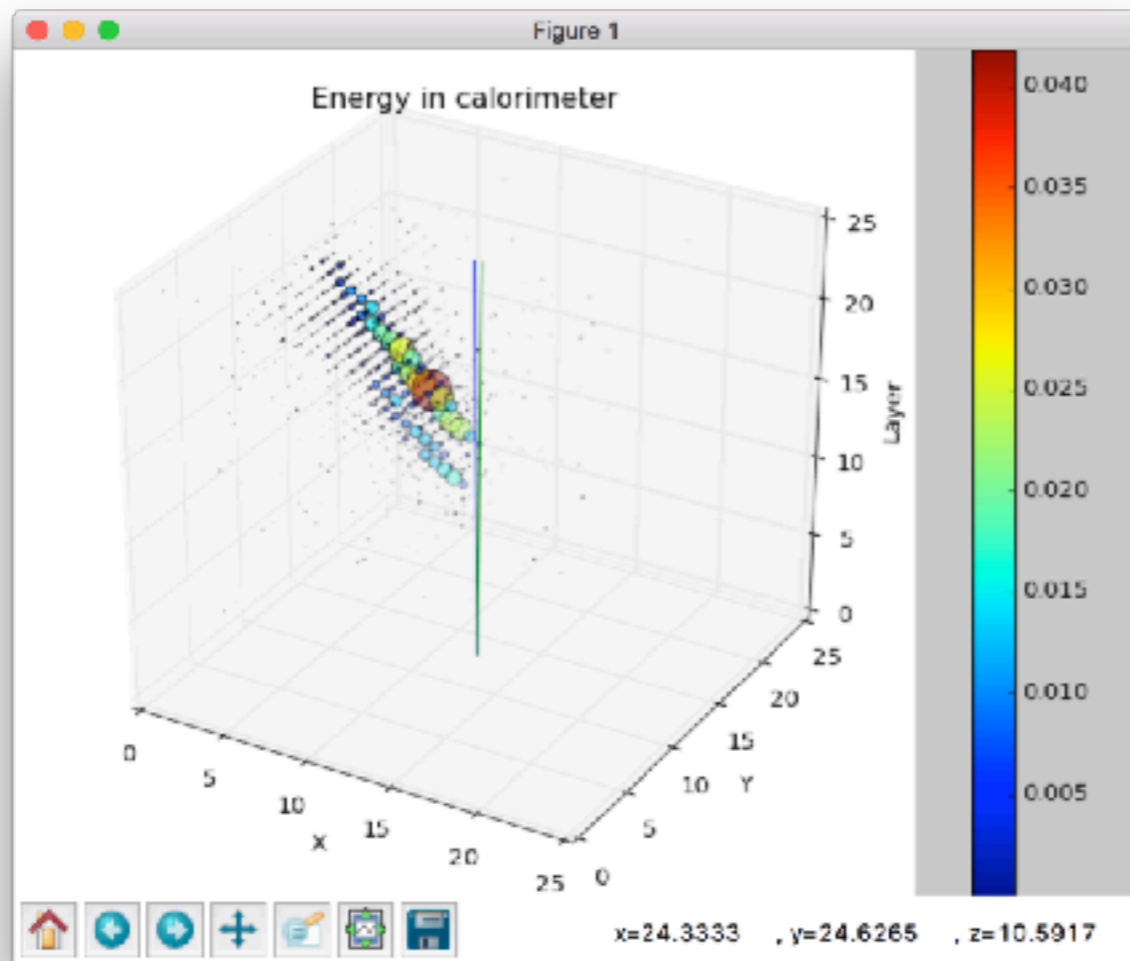
This is what an event should look like (without reconstructed jets).
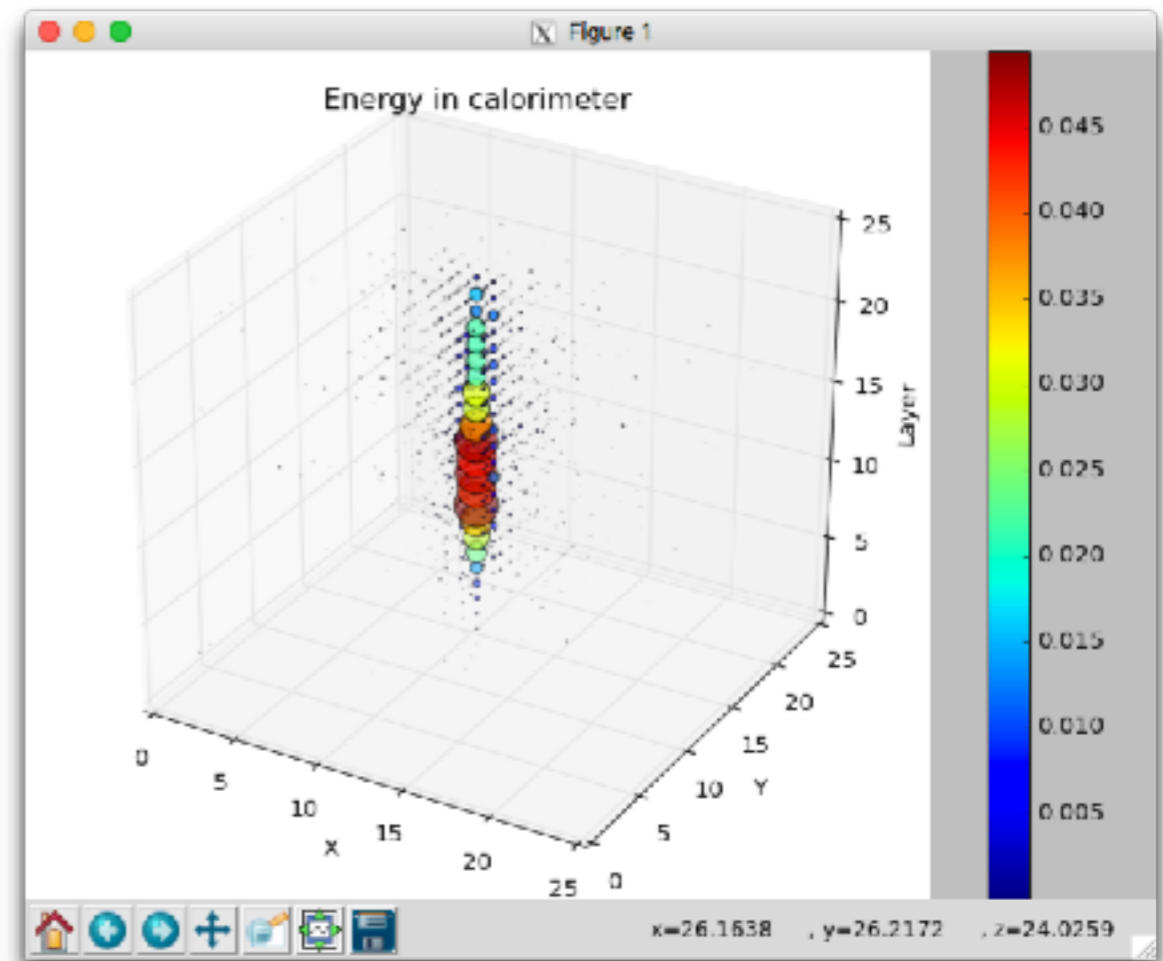
To Do

- Double-check CLIC detector geometry and cell IDs

- Create script to overwrite incorrect BDT variables

- Regenerate samples with BDT variables fixed and rerun BDT

- Recreate event plots with overlaid jets

- Generate particles at a variety of angles, and make sure cell IDs deal with wrap-around at x=0 (phi)

- Test output models with samples run at angles other than 90 degrees

- Optimize neural net and BDT scripts to run on Blue Waters, and submit jobs for hyperparameter scans