First Cherenkov detector geometry results

Luca Hartman
DESY, 04.08.2022

HELMHOLTZ

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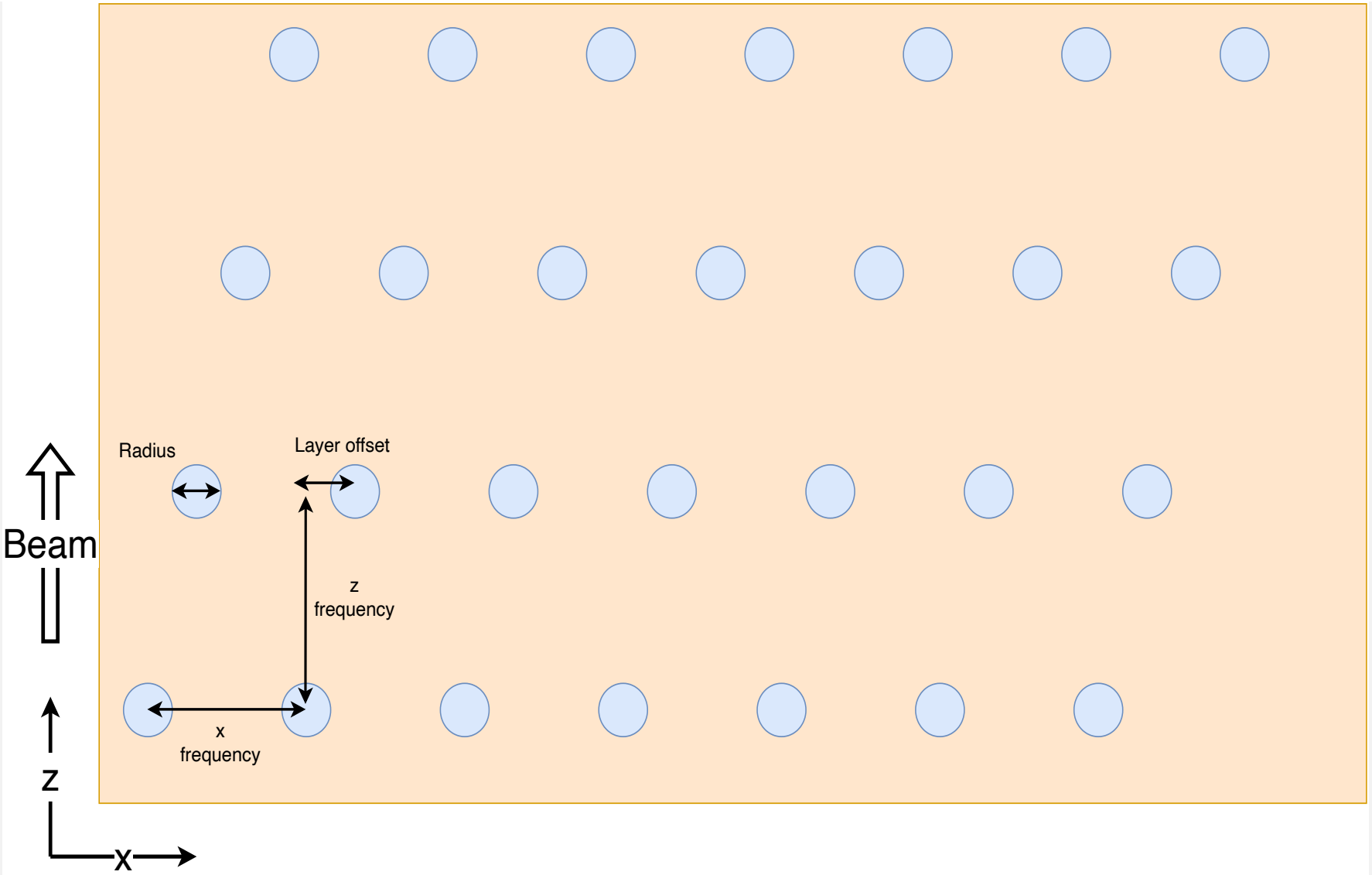
Layout illustration



The project

Finding the optimal layout of the Cherenkov straws

The layout parameters

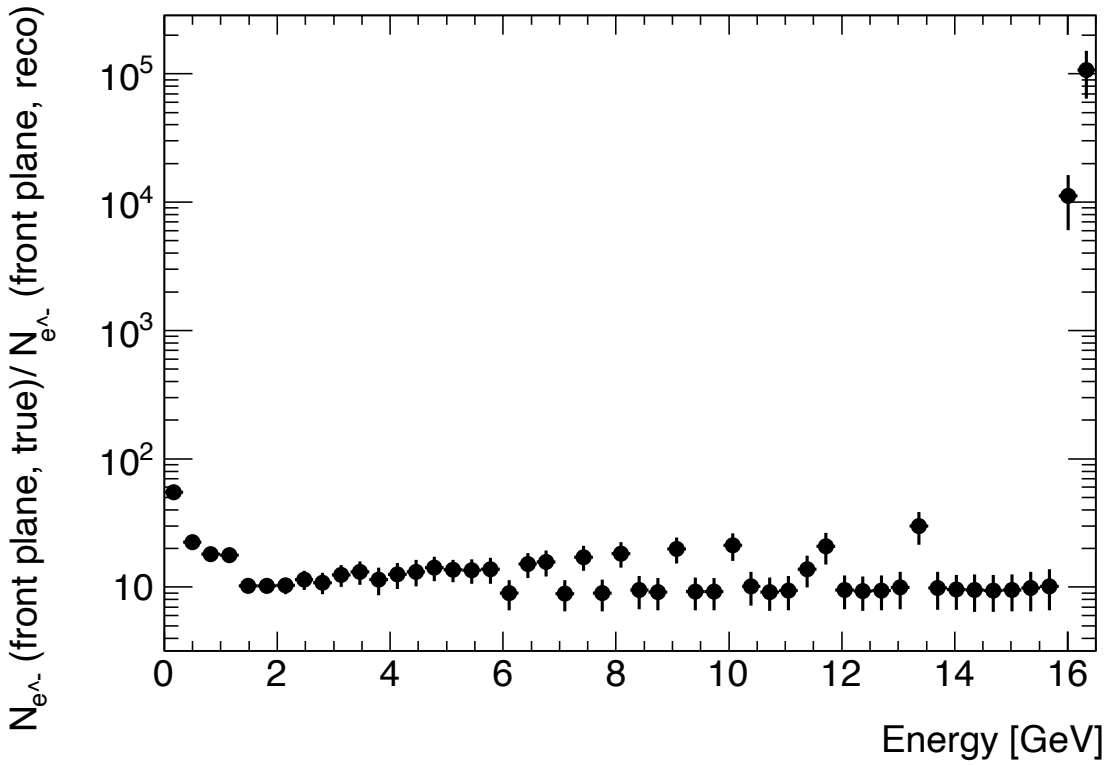
- Multiple layers, each slightly offset to the right, repeating pattern
  - Number of layers
  - X frequency: distance between two adjacent straws of the same layer
  - Z frequency: distance between two adjacent straws of different layers
  - Layer offset: offset between two adjacent layers
  - (Straw radius, non-repeating layout)

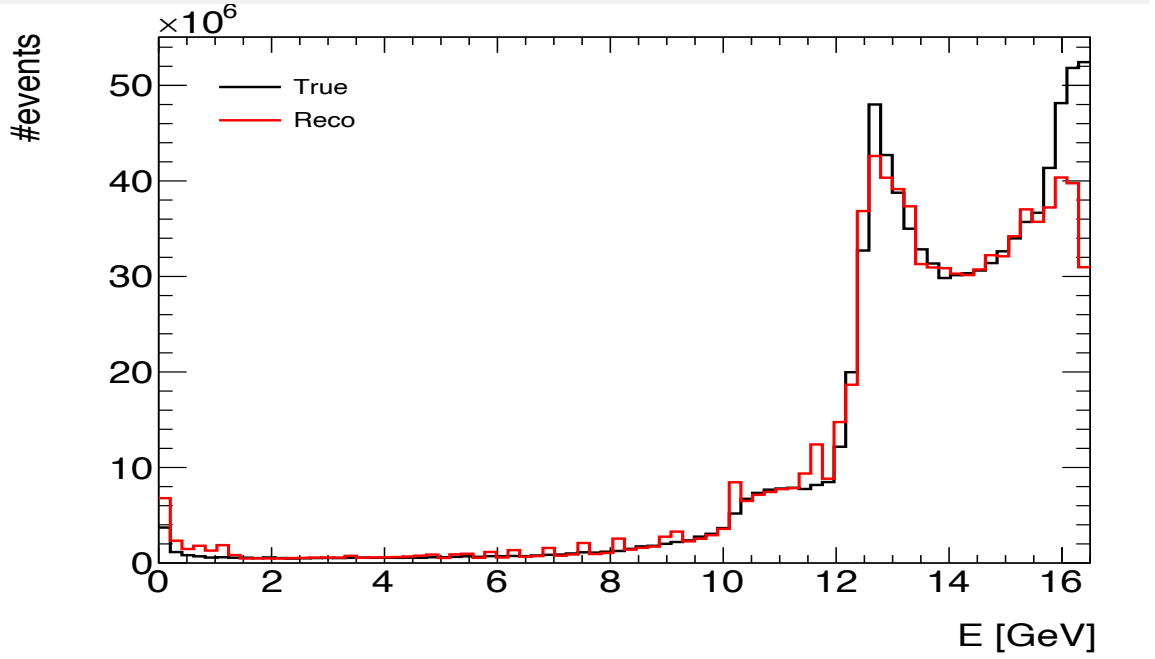
What is “optimal” ?

- Best energy distribution reconstruction
  - Especially in the zone of interest: 8 GeV → 16 GeV
  - Visually and using the chi-square test
- Perfect acceptance
  - Acceptance = # true electrons / # electrons hitting the straws

Starting layout

16 mm X frequency, 16 mm Z frequency, 4 mm layer offset, 4 layers ➔ chi^2 = 156

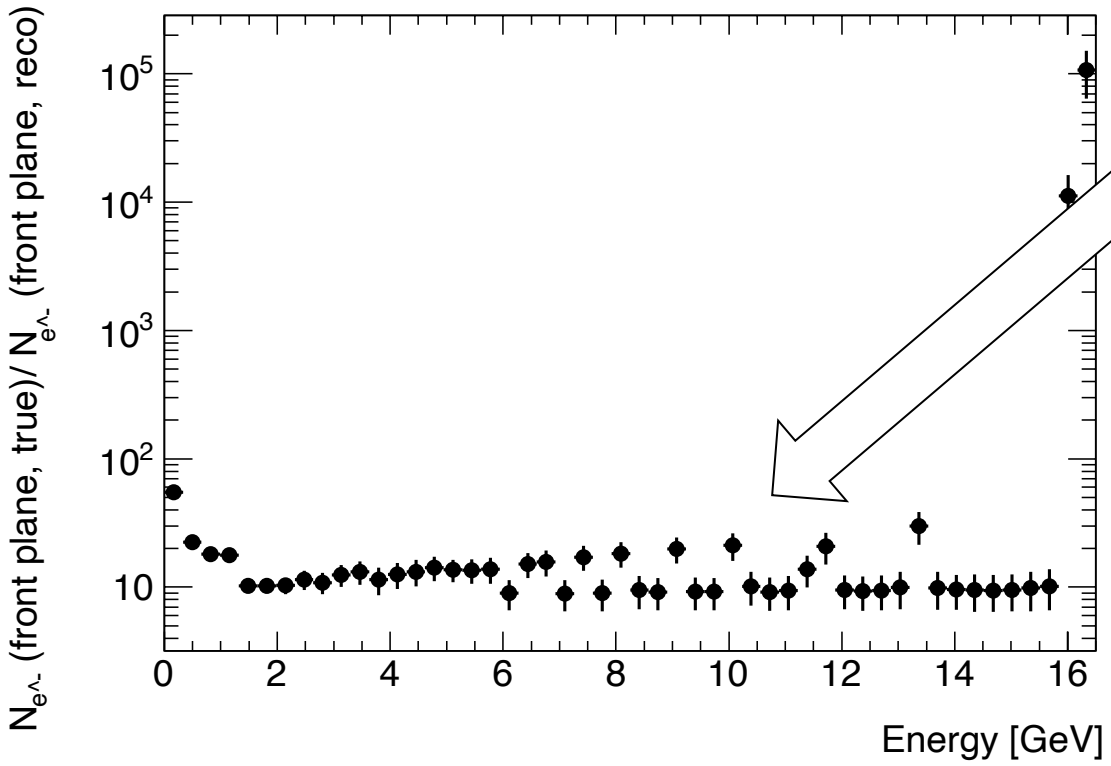


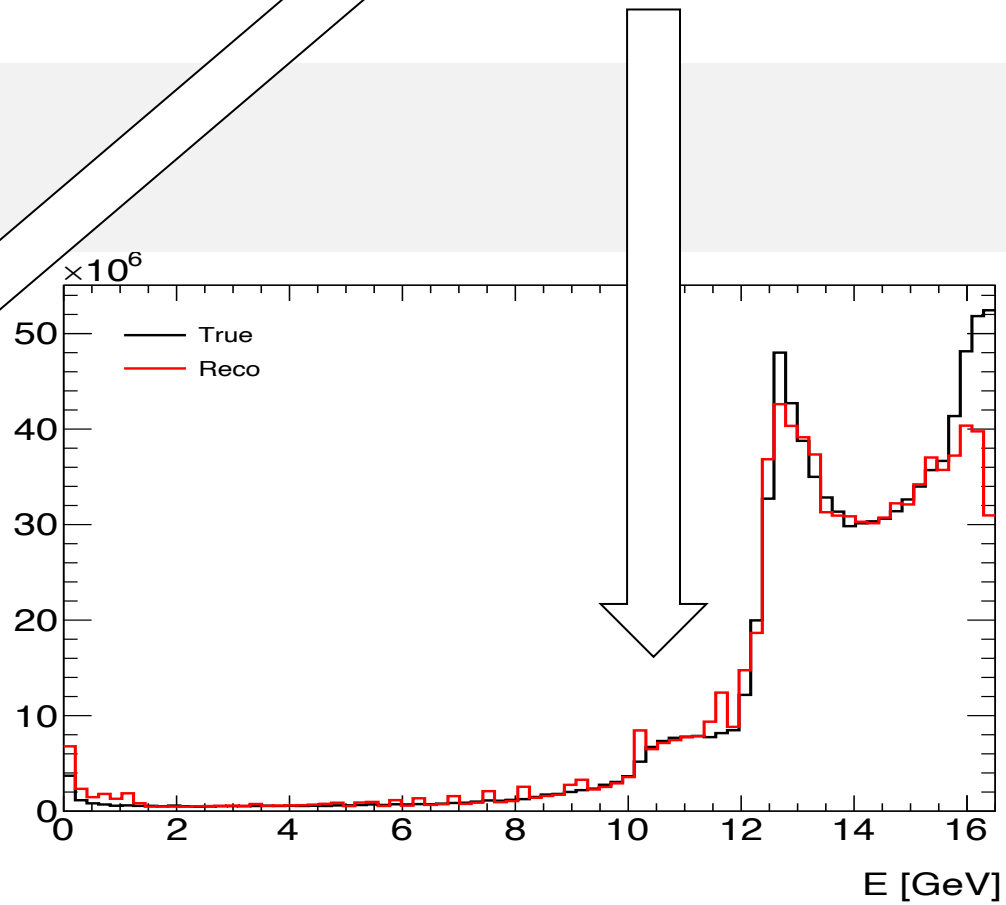


Starting layout

16 mm X frequency, 16 mm Z frequency, 4 mm layer offset, 4 layers

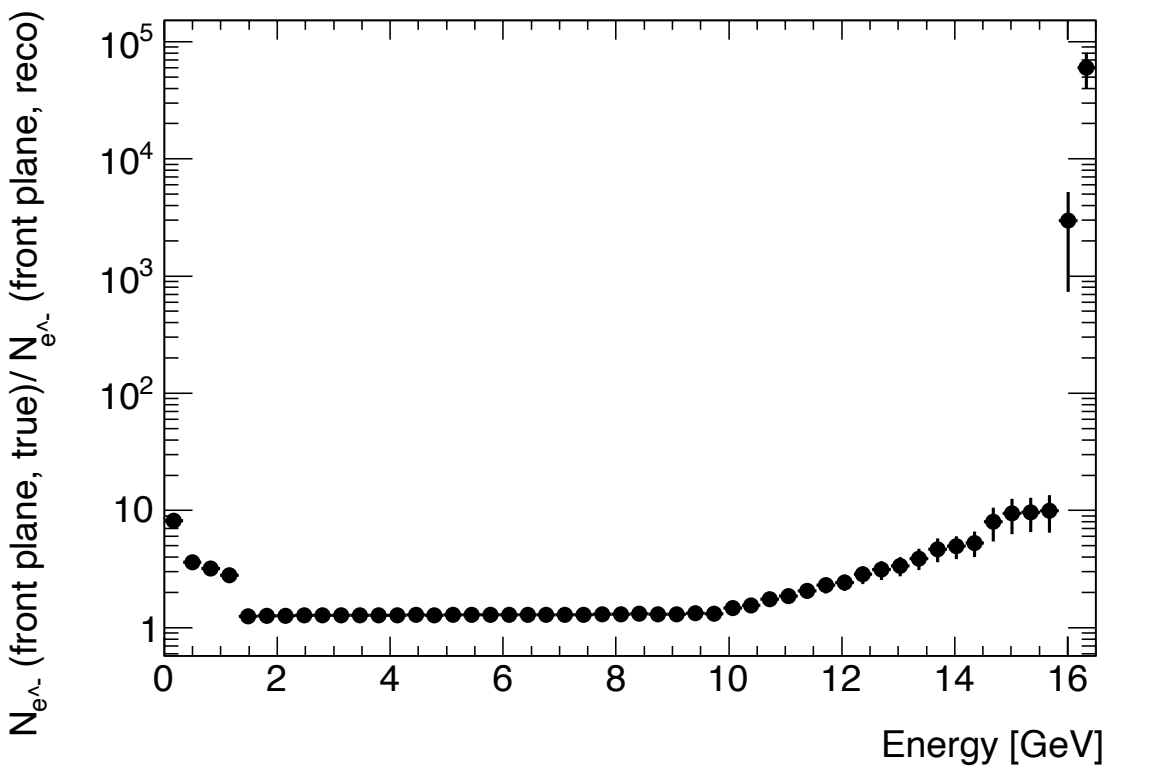
Spikes when electrons miss all the straws

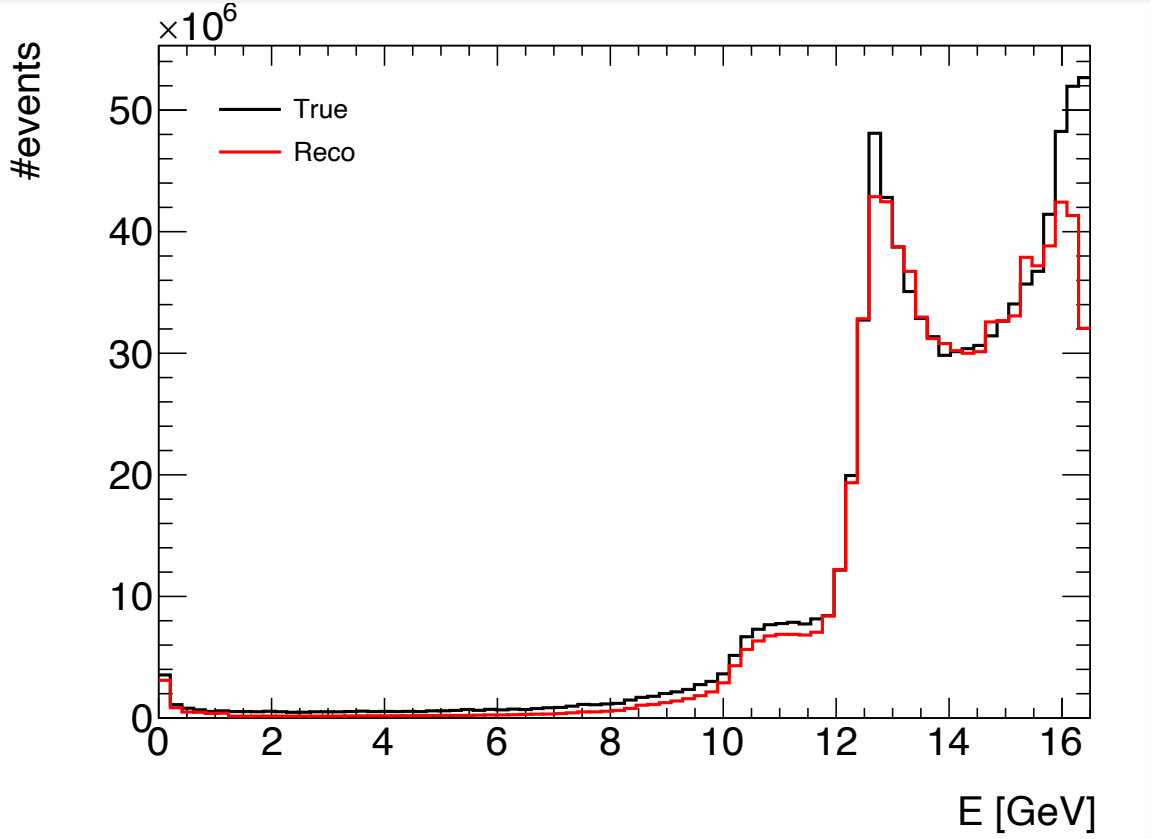




Dense layout

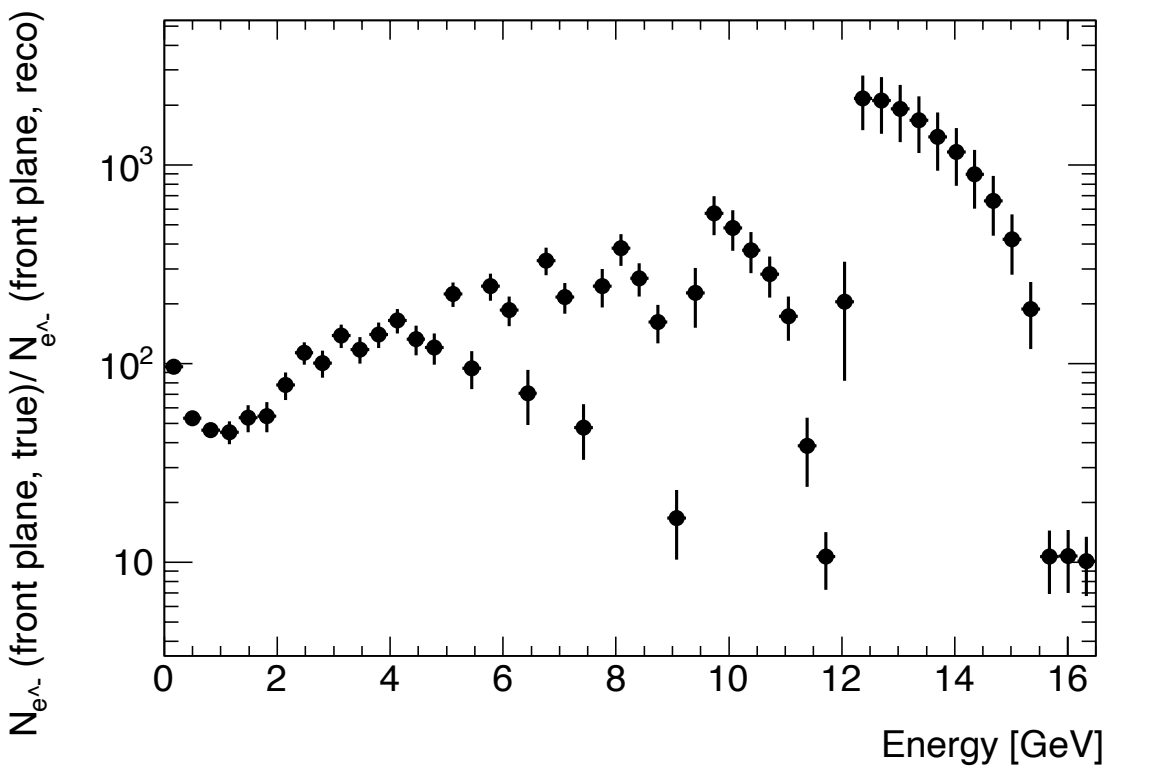
8 mm X frequency, 16 mm Z frequency, 4 mm layer offset, 16 layers ➔ chi^2 = 3952

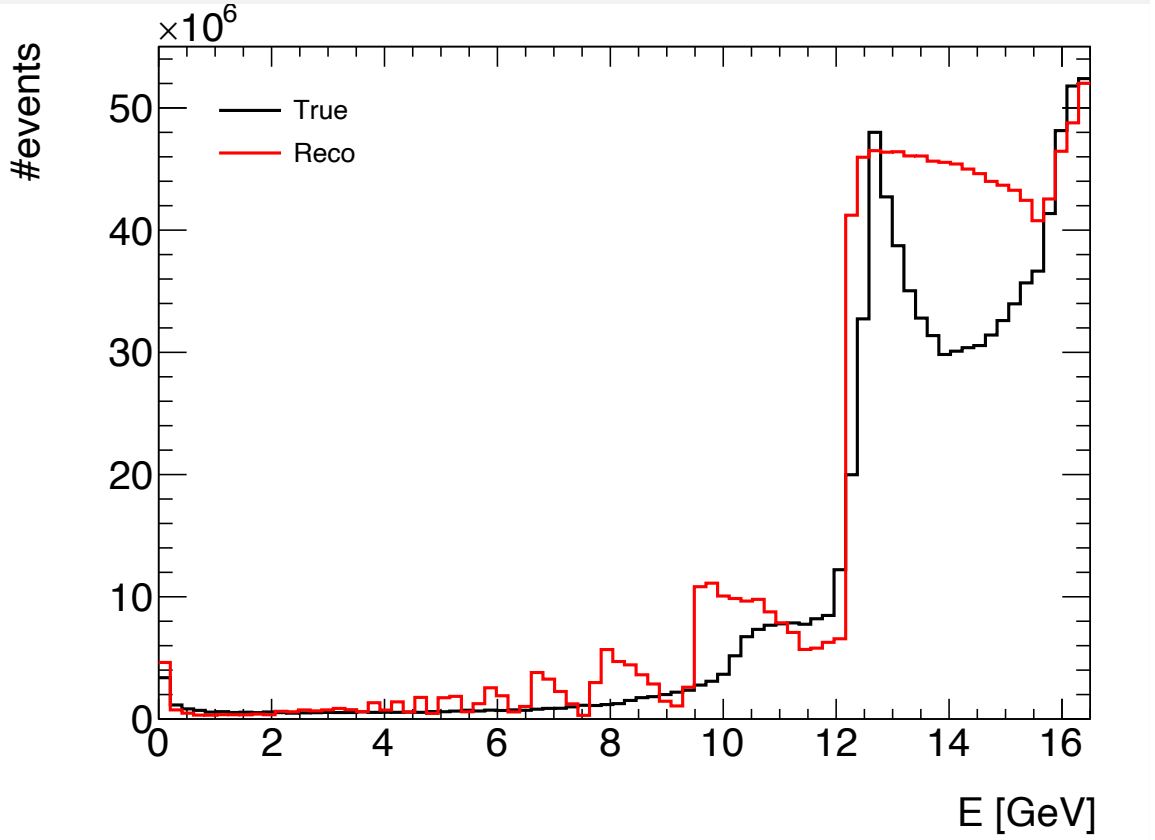




Sparse layout

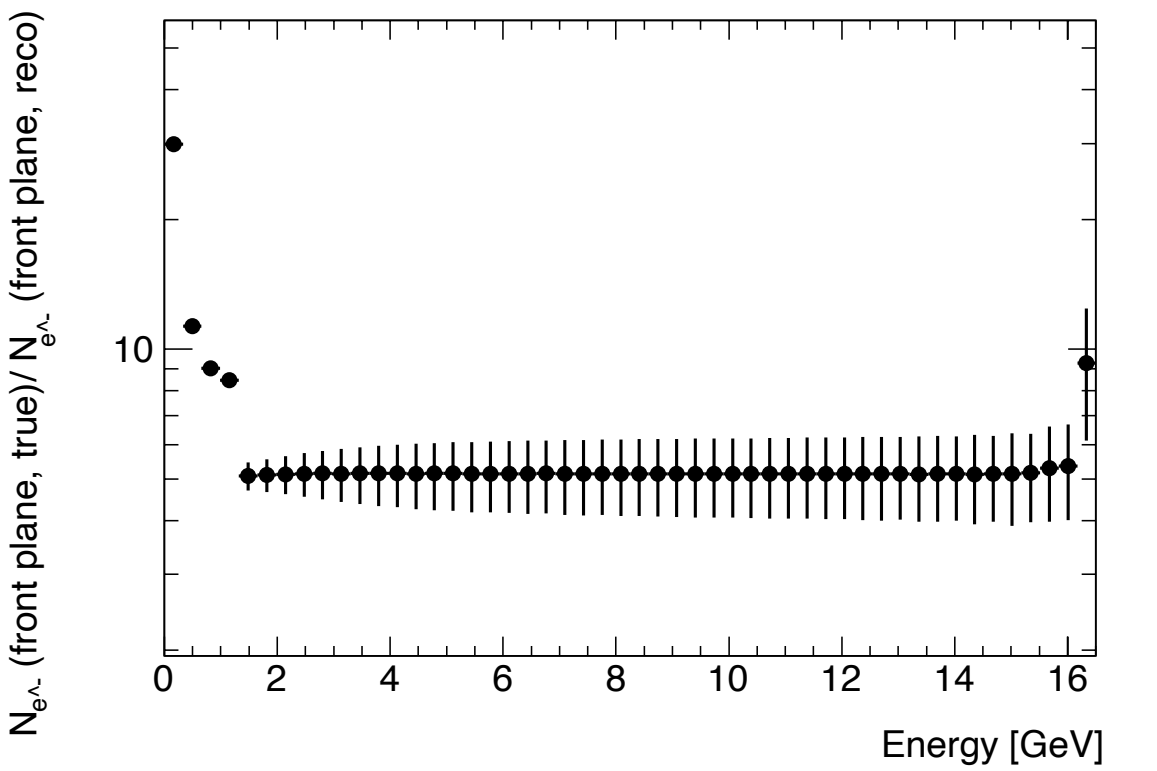
32 mm X frequency, 16 mm Z frequency, 4 mm layer offset, 2 layers ➔ chi^2 = 415

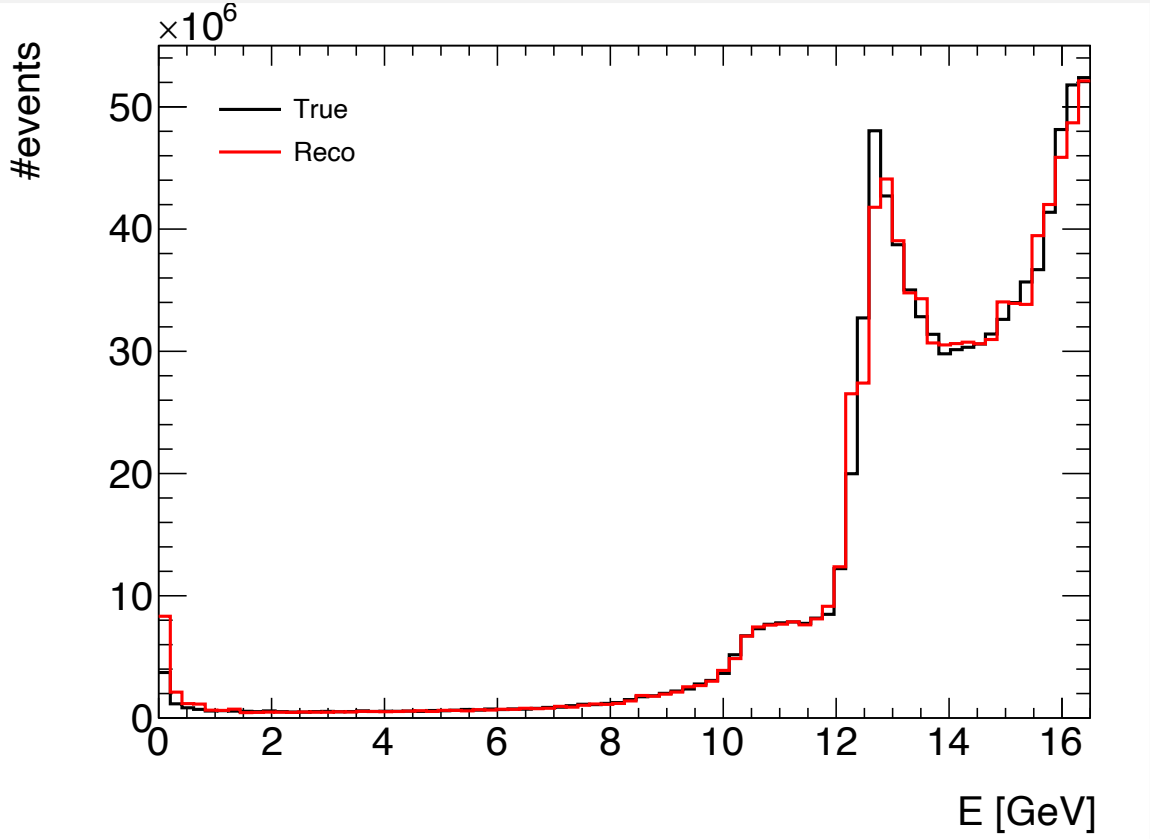




Mono-dimensional layout

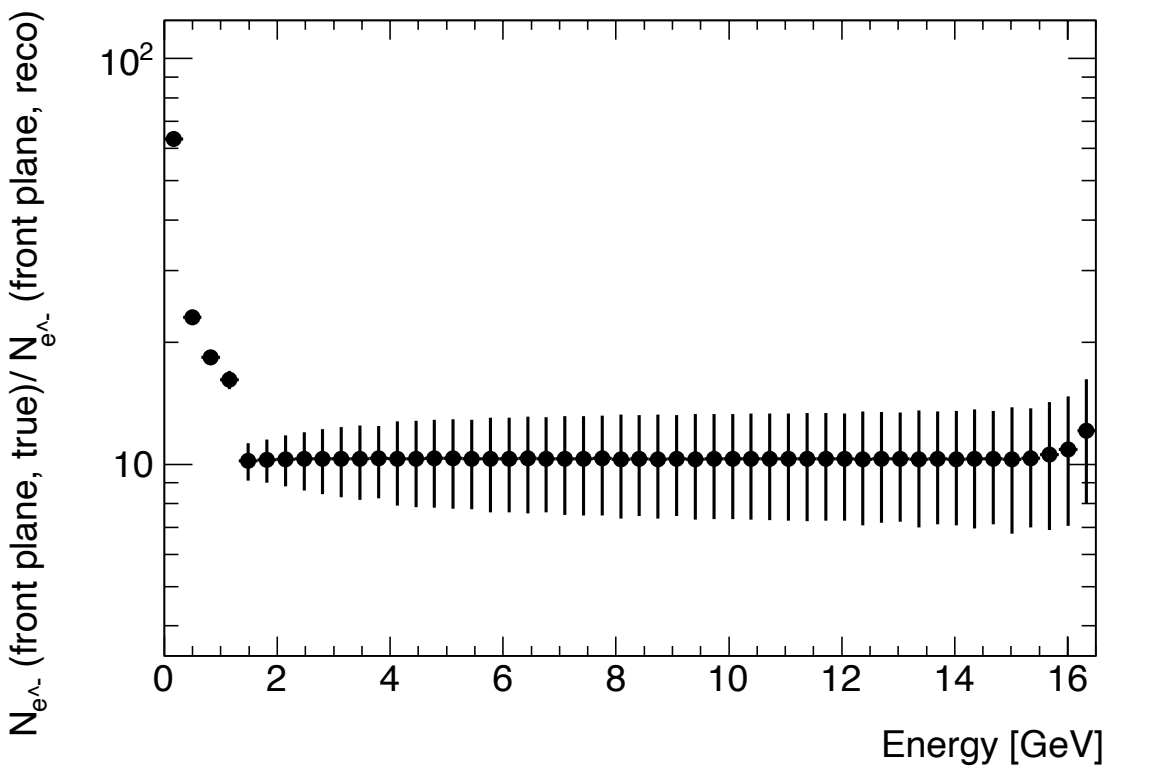
4.02 mm X frequency, 16 mm Z frequency, 4 mm layer offset, 2 layers ➔ chi^2 = 73

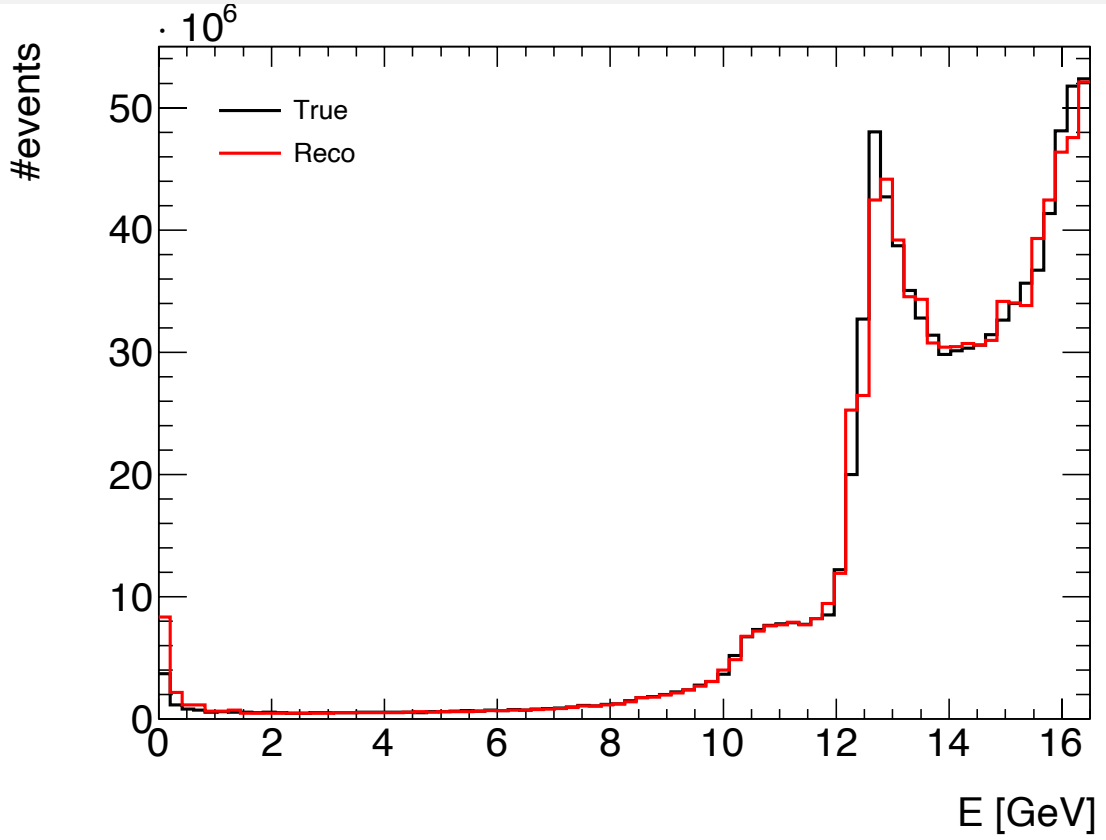




Mono-dimensional layout

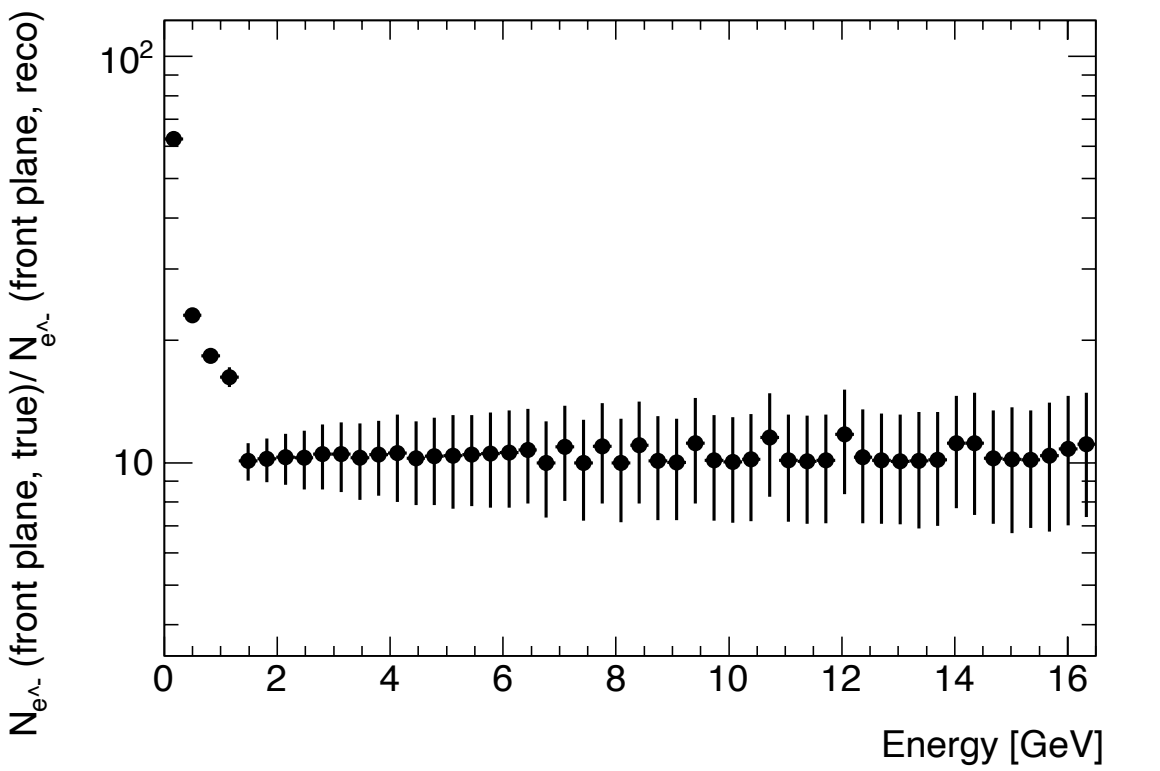
4.02 mm X frequency, 16 mm Z frequency, 4 mm layer offset, 1 layers ➔ chi^2 = 73

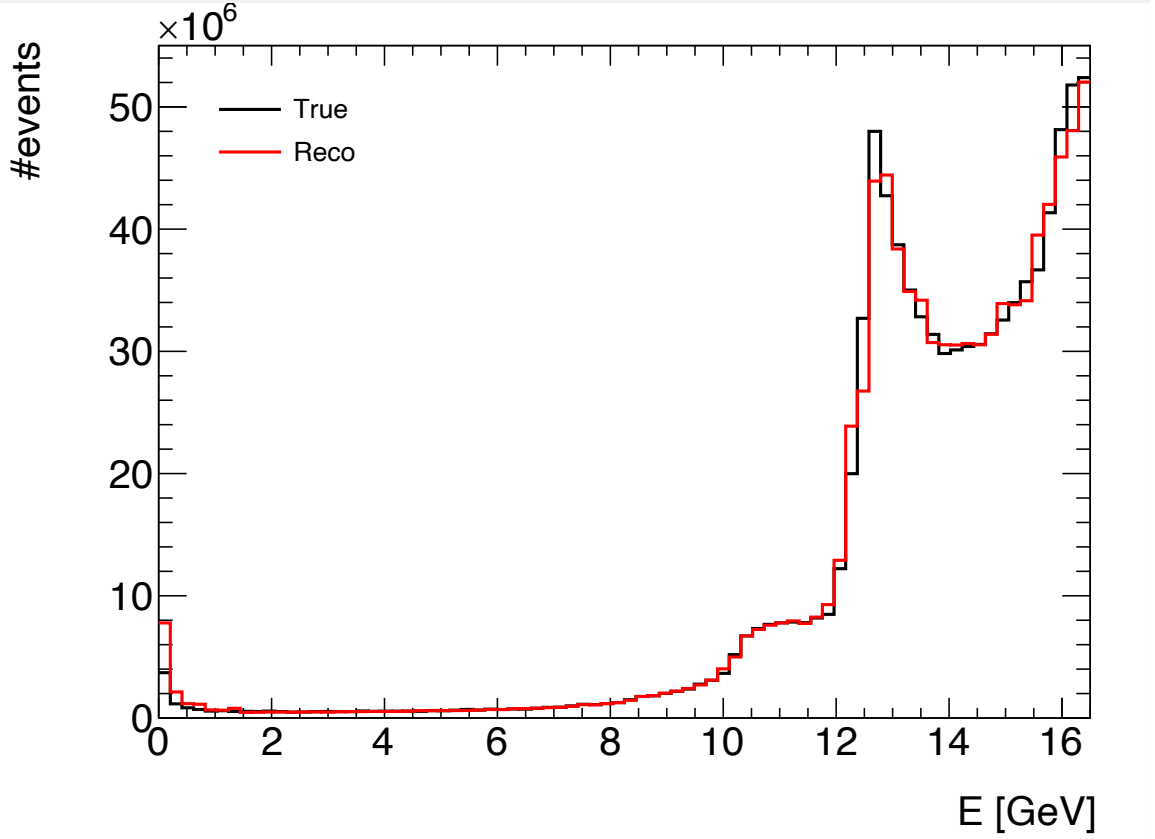




Tightly packed along the Z direction

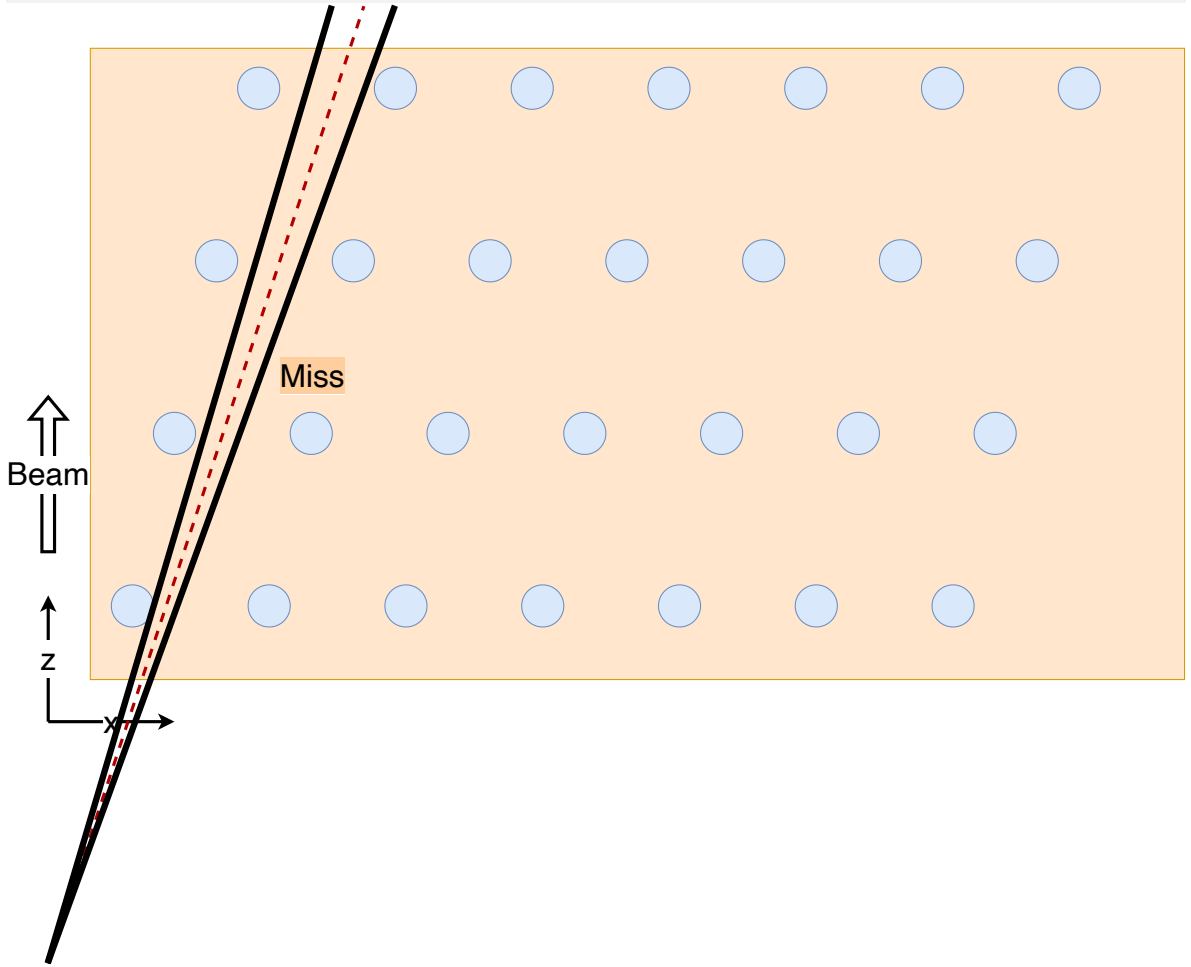
16 mm X frequency, 8 mm Z frequency, 4 mm layer offset, 4 layers ➔ chi^2 = 47

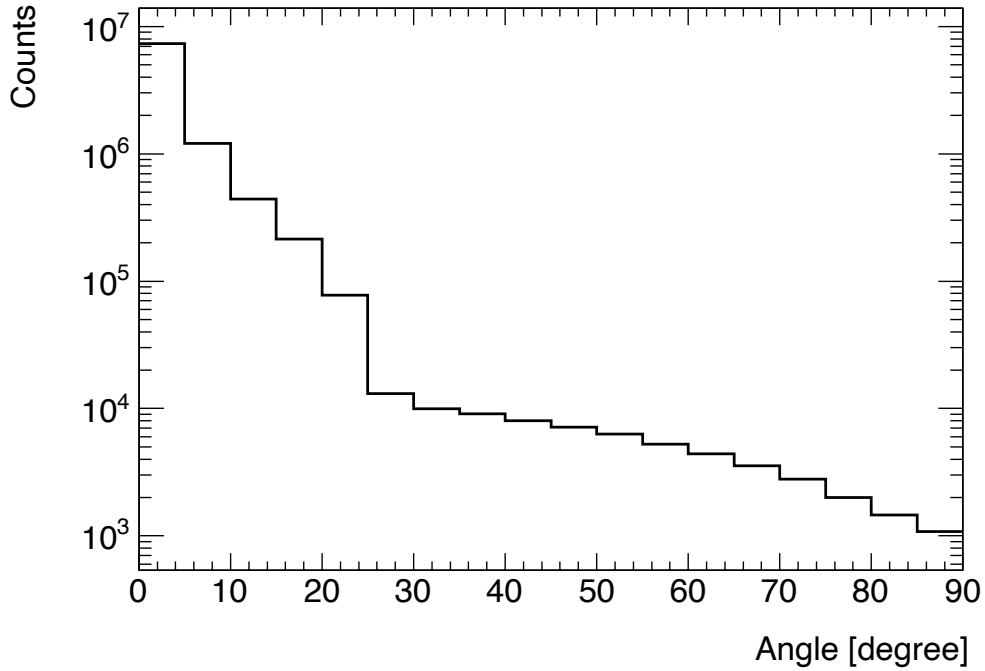




How electrons miss the straws

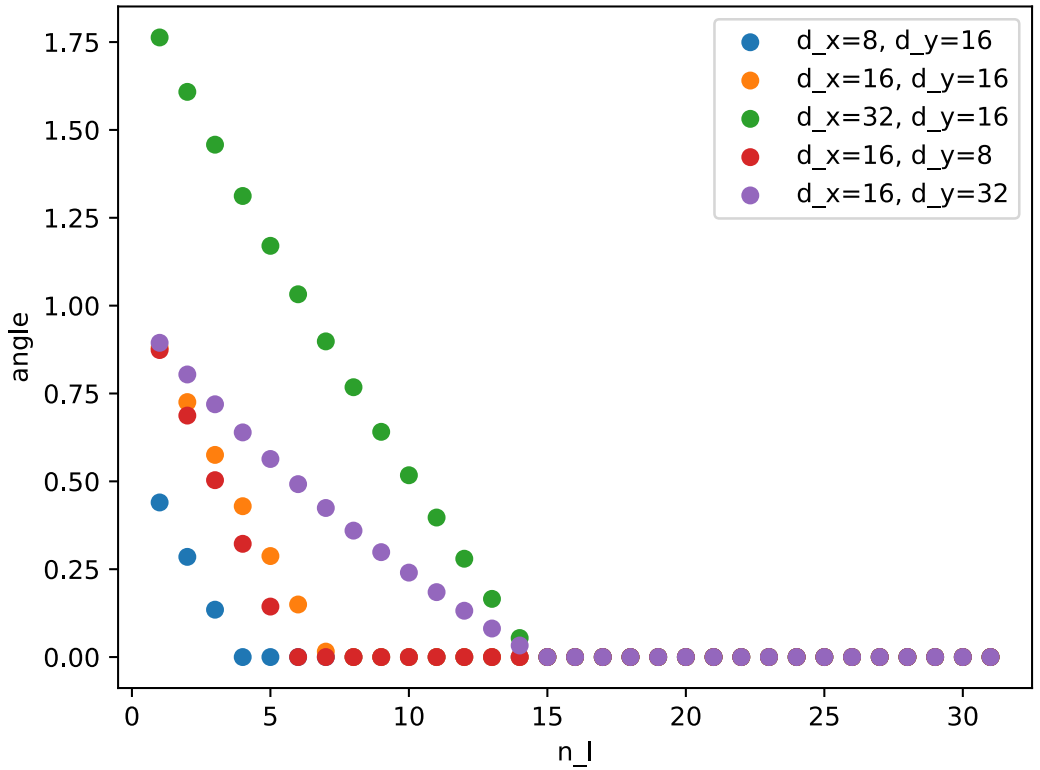
Angle of the electrons as a function of the energy

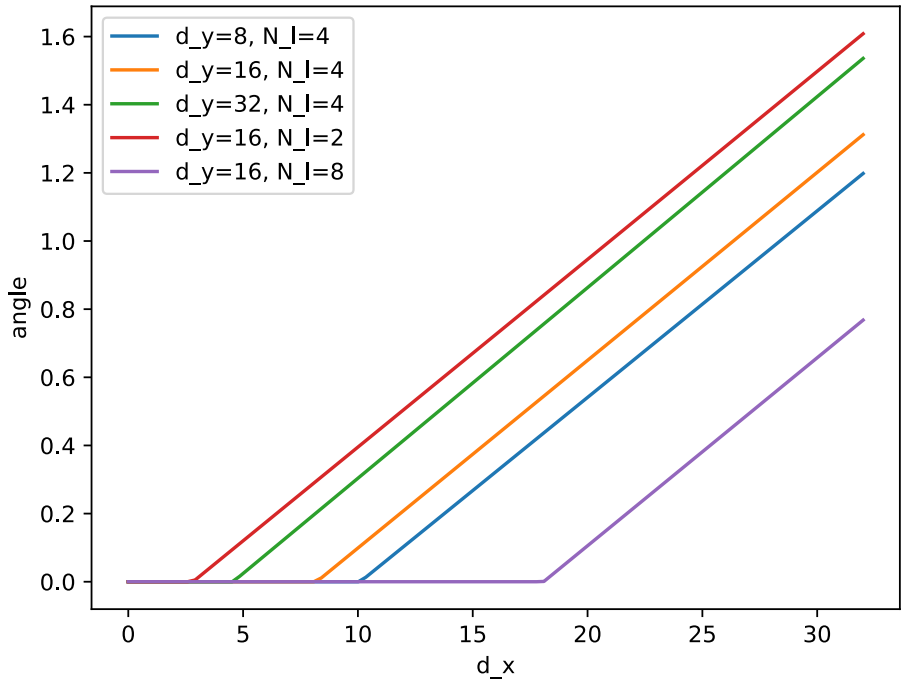




How electrons miss the straws

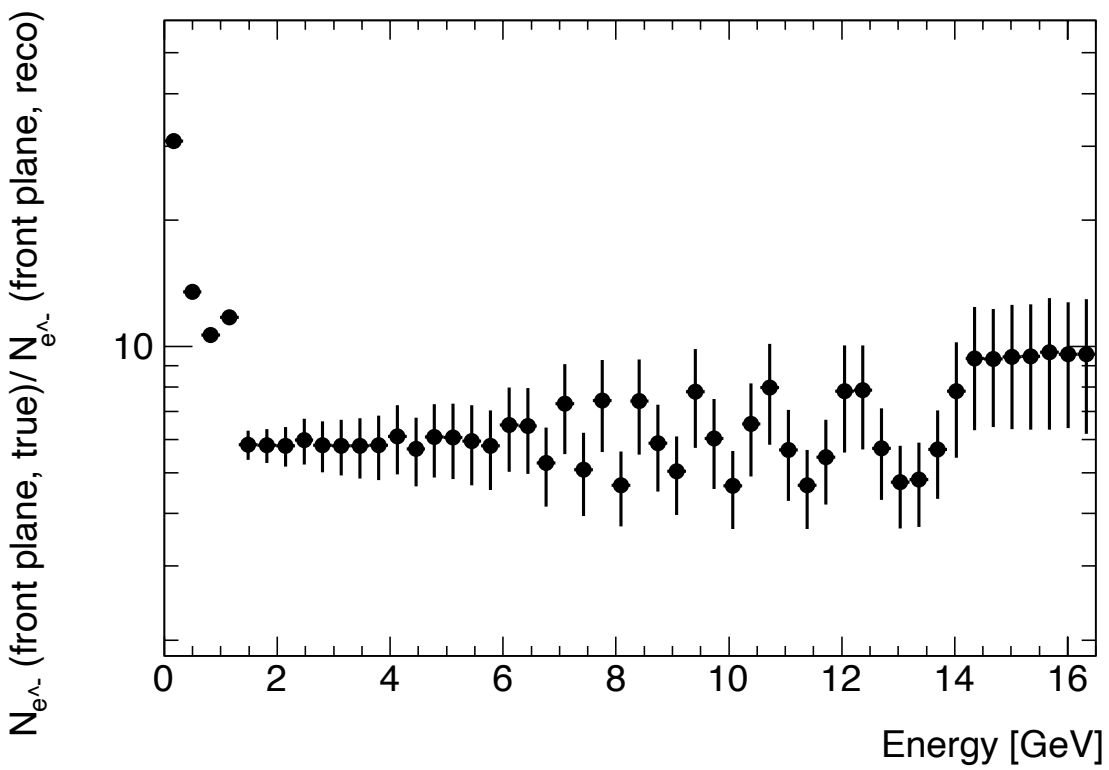
Angle of the electrons as a function of the energy (*preliminary* results)

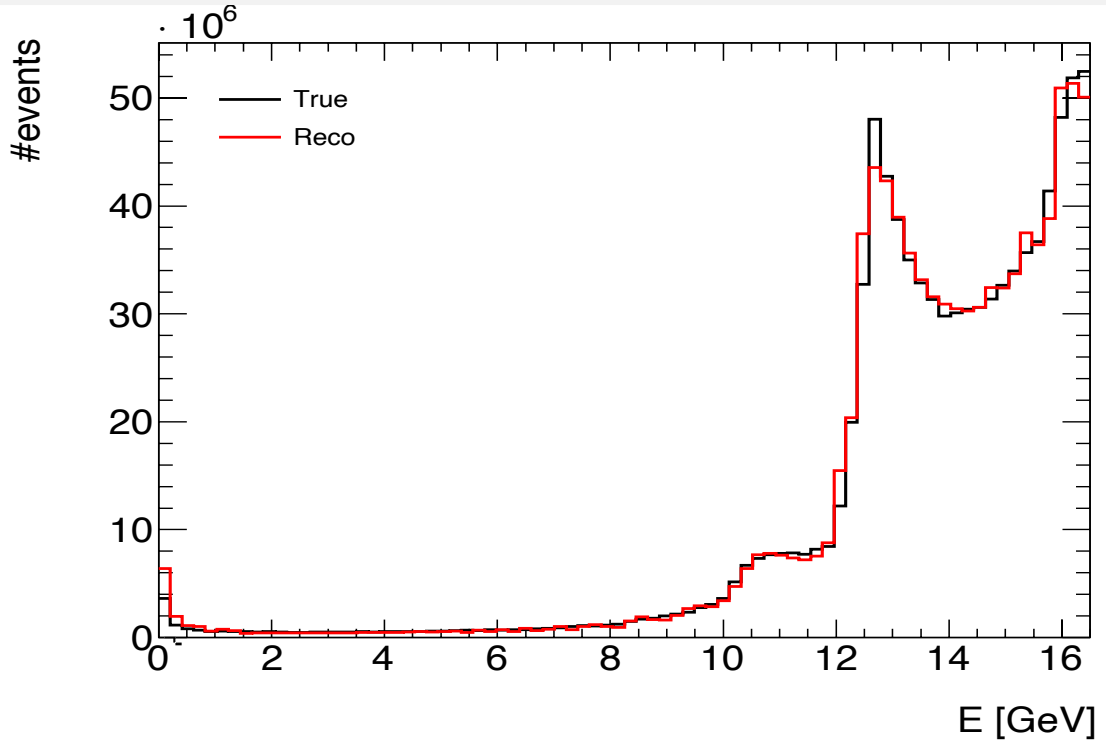




Minimal number of layers to avoid misses

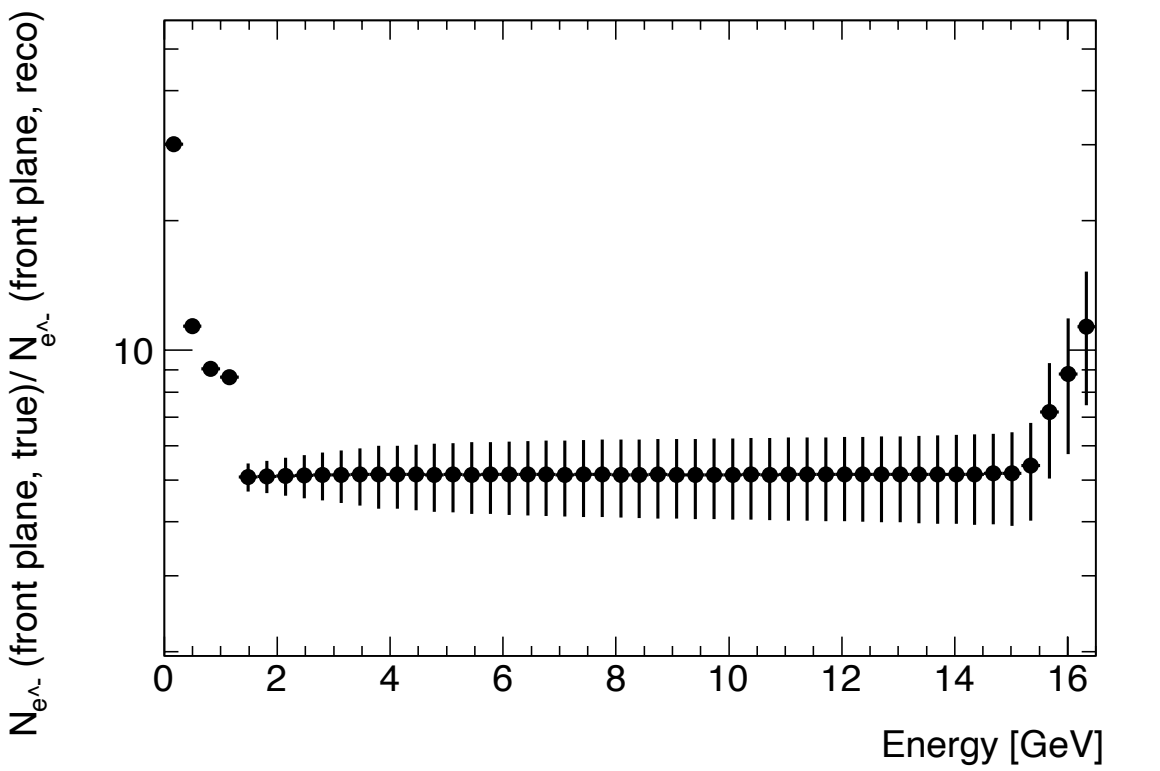
16 mm X frequency, 16 mm Z frequency, 4 mm layer offset, 7 layers ➔ chi^2 = 133.23

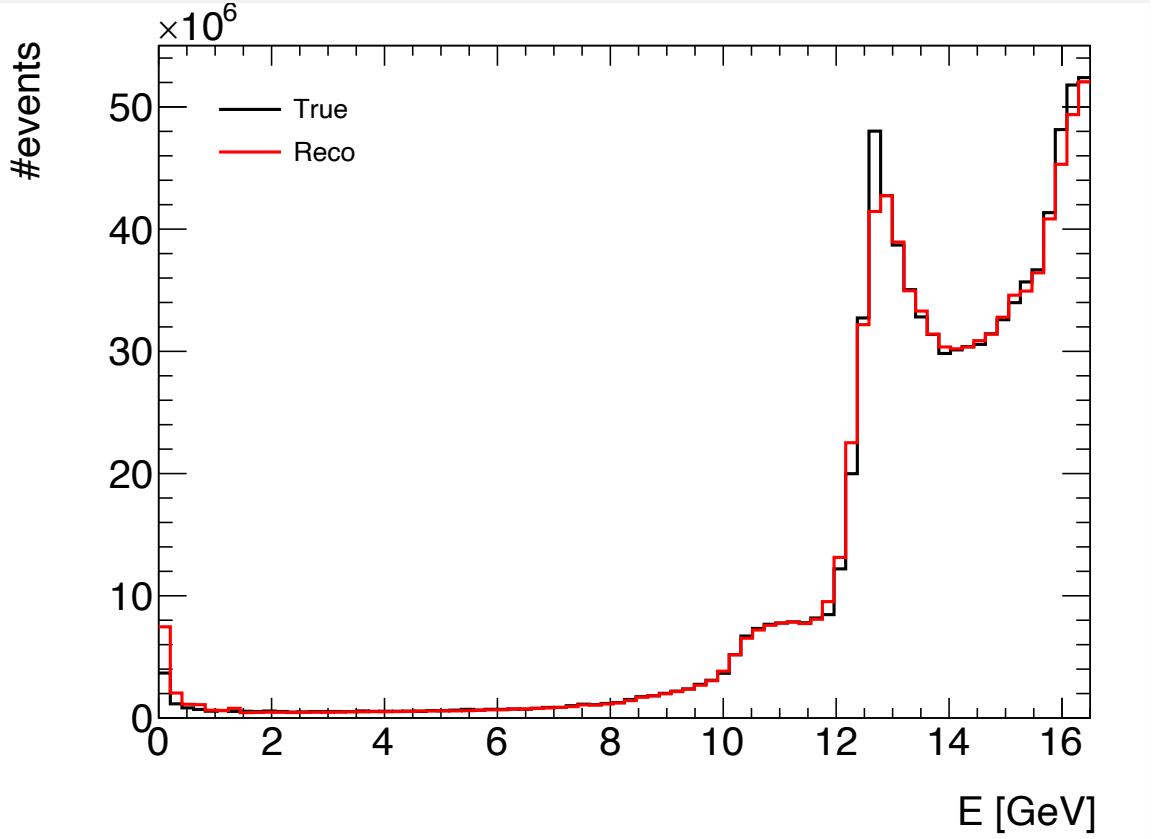




Two layers with optimal offset

4.02 mm X frequency, 16 mm Z frequency, 6.76 mm layer offset, 2 layers ➔ chi^2 = 72





Next ideas

Open to hear your ideas :)

Finding optimal layer offset

- 2 layers
- “holes” caused by the 0.2 mm thickness of the straws
- Ultimately would need increasing distance between straws in the second layer

Considering the finite energy resolution

- Could play a role in the reconstruction of the energy distribution
- Would require to completely redo the reconstruction code

Sparsely packed along the X direction, large angle

- Using tightly packed straws along the Z direction
- Offsetting the layers enough that the electrons necessarily hit a straw
- Requires computing the ”angle of escape”