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Status report

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ZDC Internal

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Overview

- Check the energy dump with different settings in the ZDC Sim
- Check the distribution of parameters in the ZDC Sim output

ZDC Sim: Material test

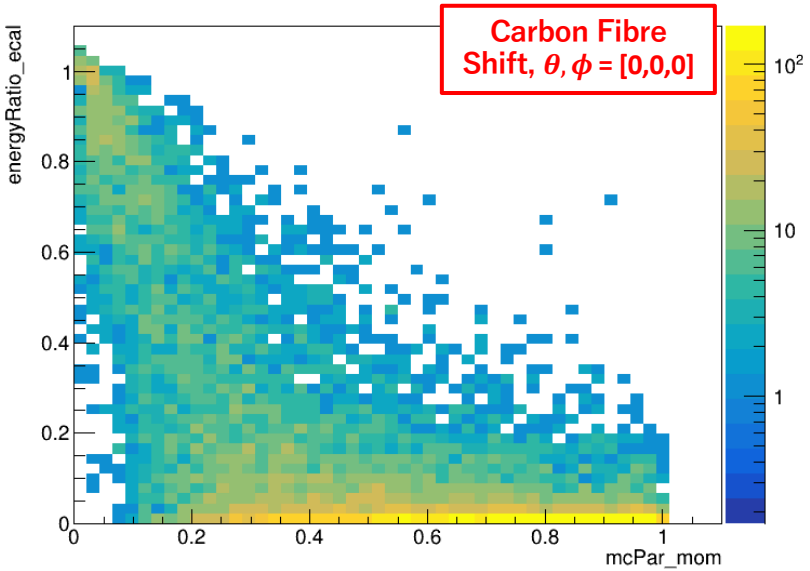
Introduction

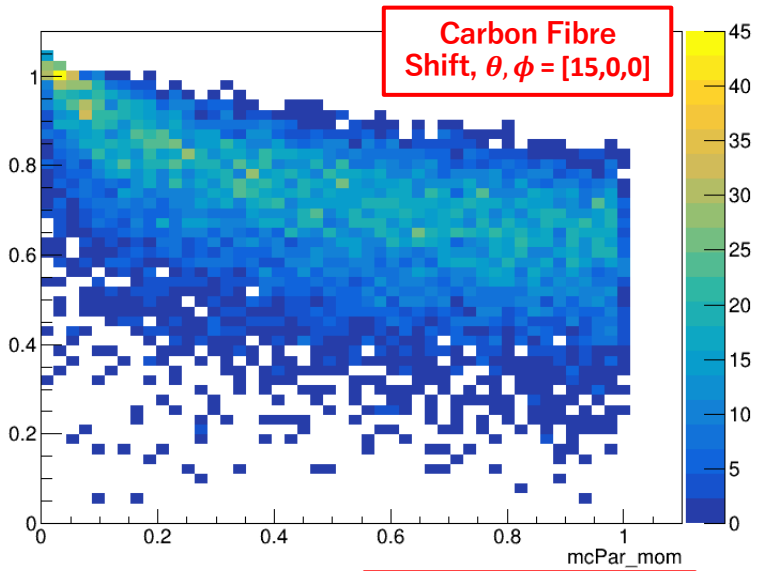
- Checking the effect of beam position and spread in the ZDC Sim
- Comparing samples with the following conditions:

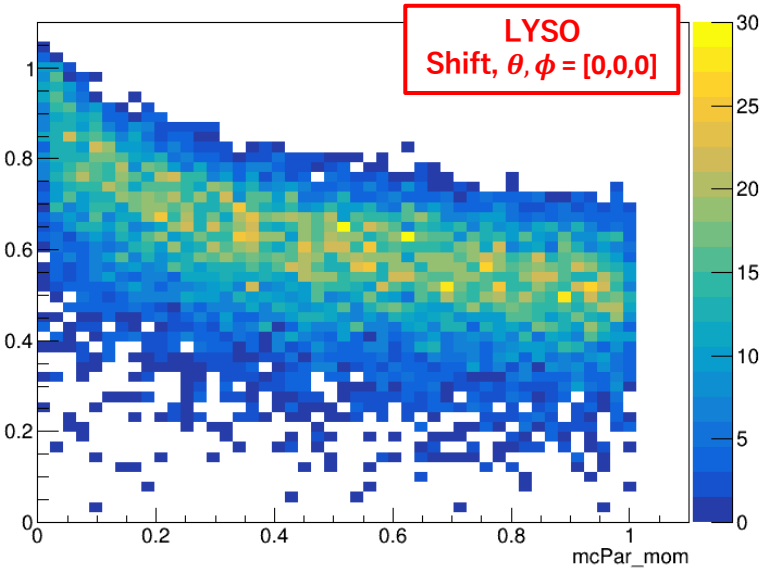
Material	θ, ϕ	Shift [mm]
Carbon fiber	0,0	0
Carbon fiber	0,0	15
LYSO	0,0	0
Carbon fiber	20,180	0
Carbon fiber	20,180	15
LYSO	20,180	0

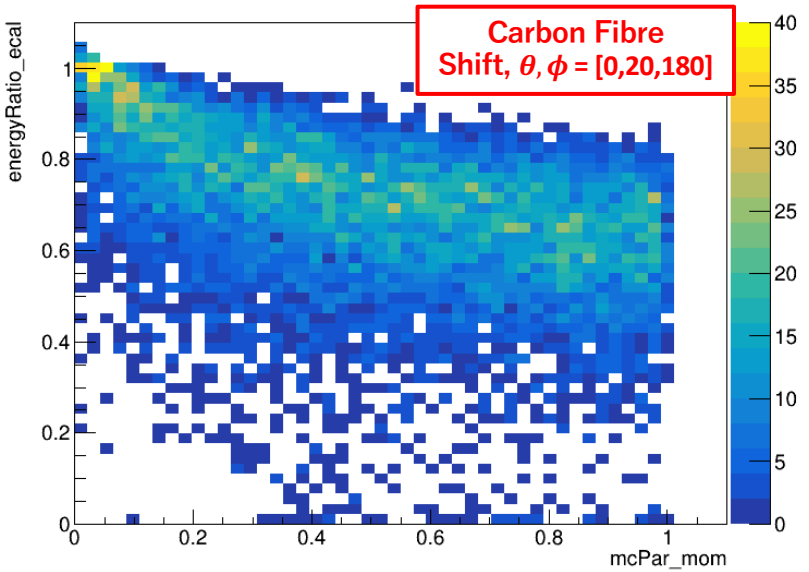
- 10k events within 0.01 GeV – 1 GeV positron beam are generated per sample.
- Energy dump in ECal and HCal are separately plotted.

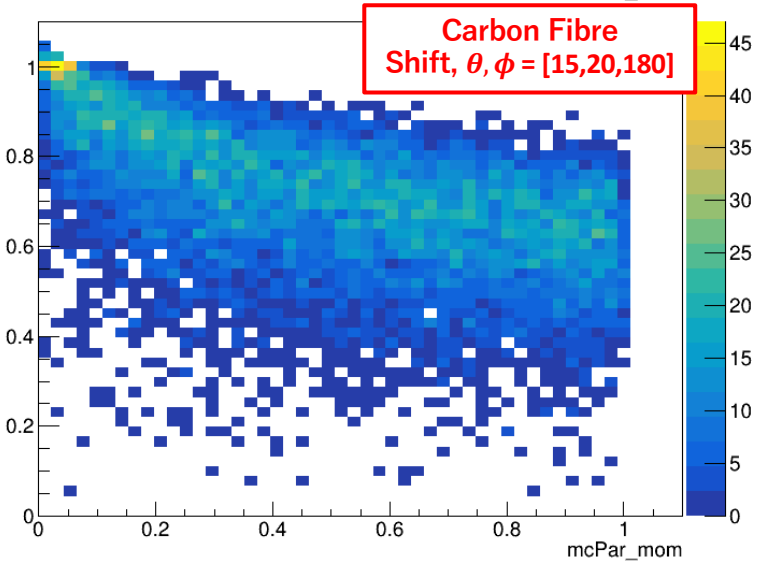
Results (ECal)

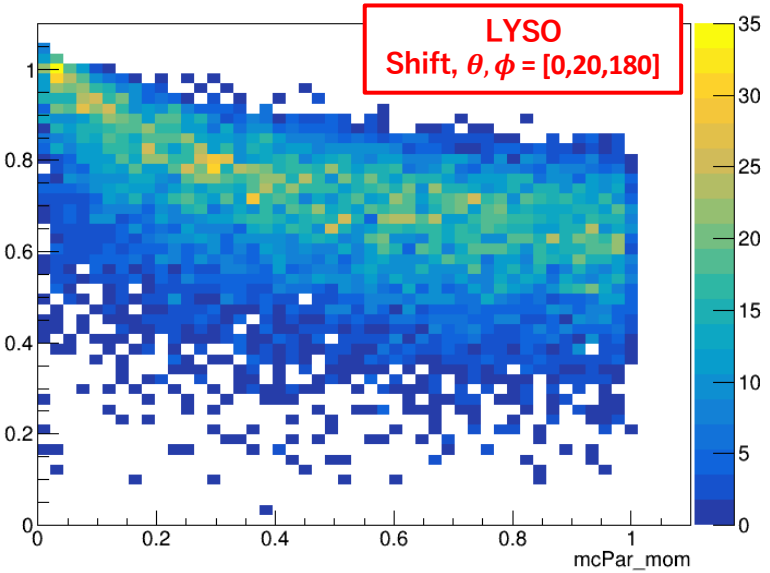




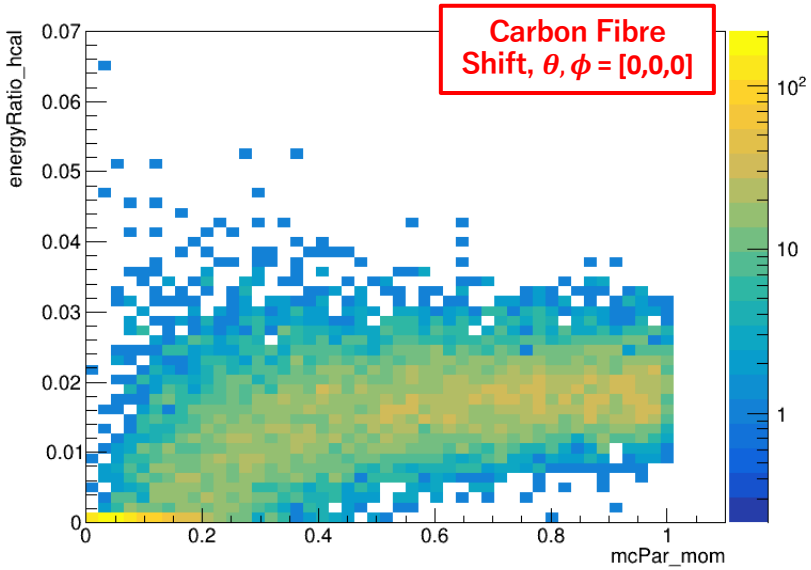


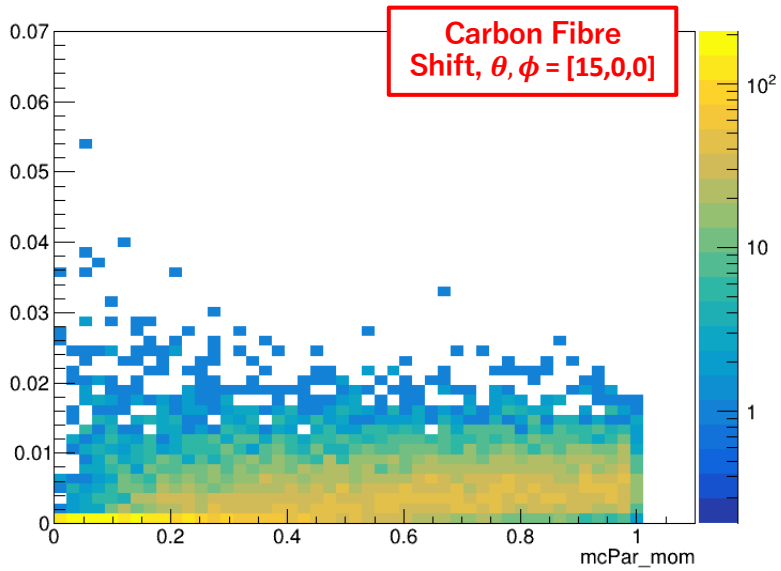


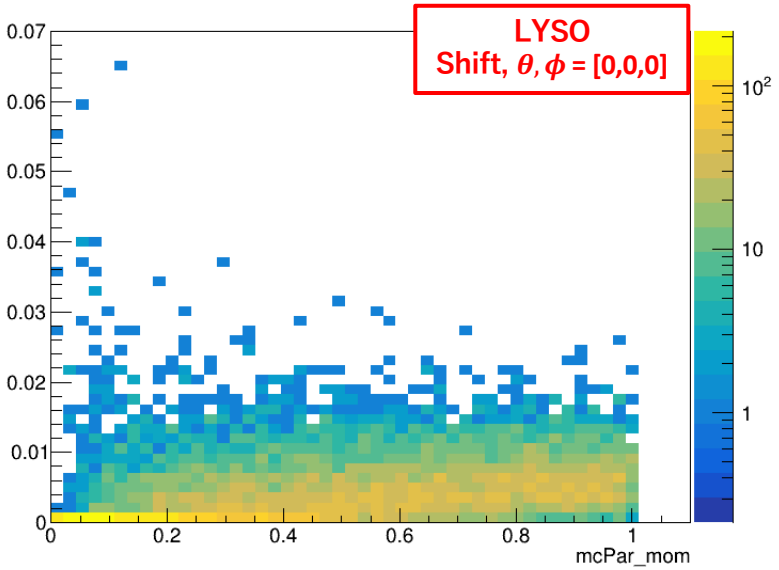


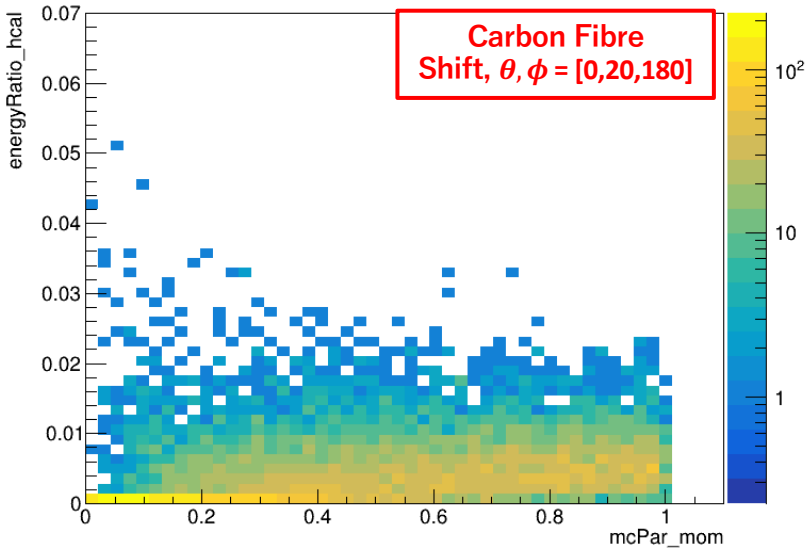


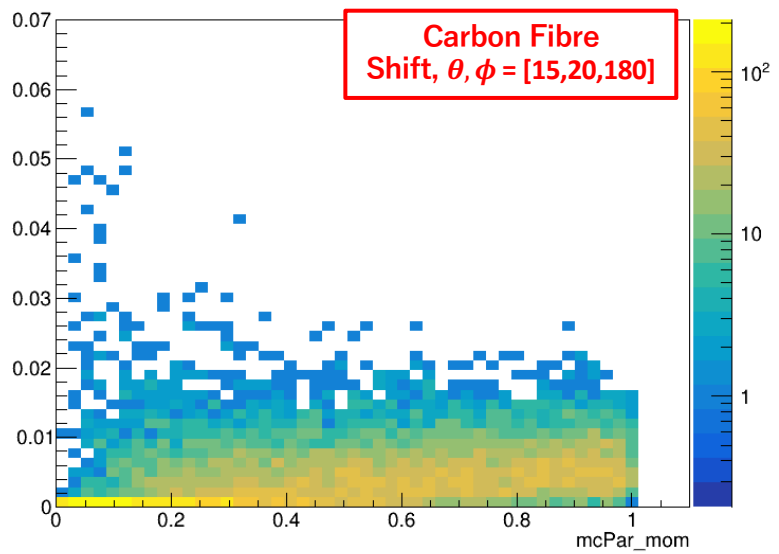
Results (HCal)

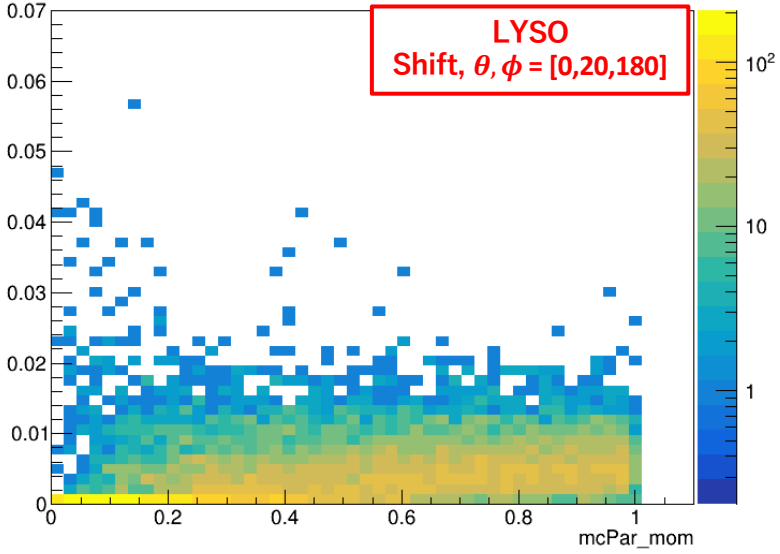












ZDC Sim: ML input sample

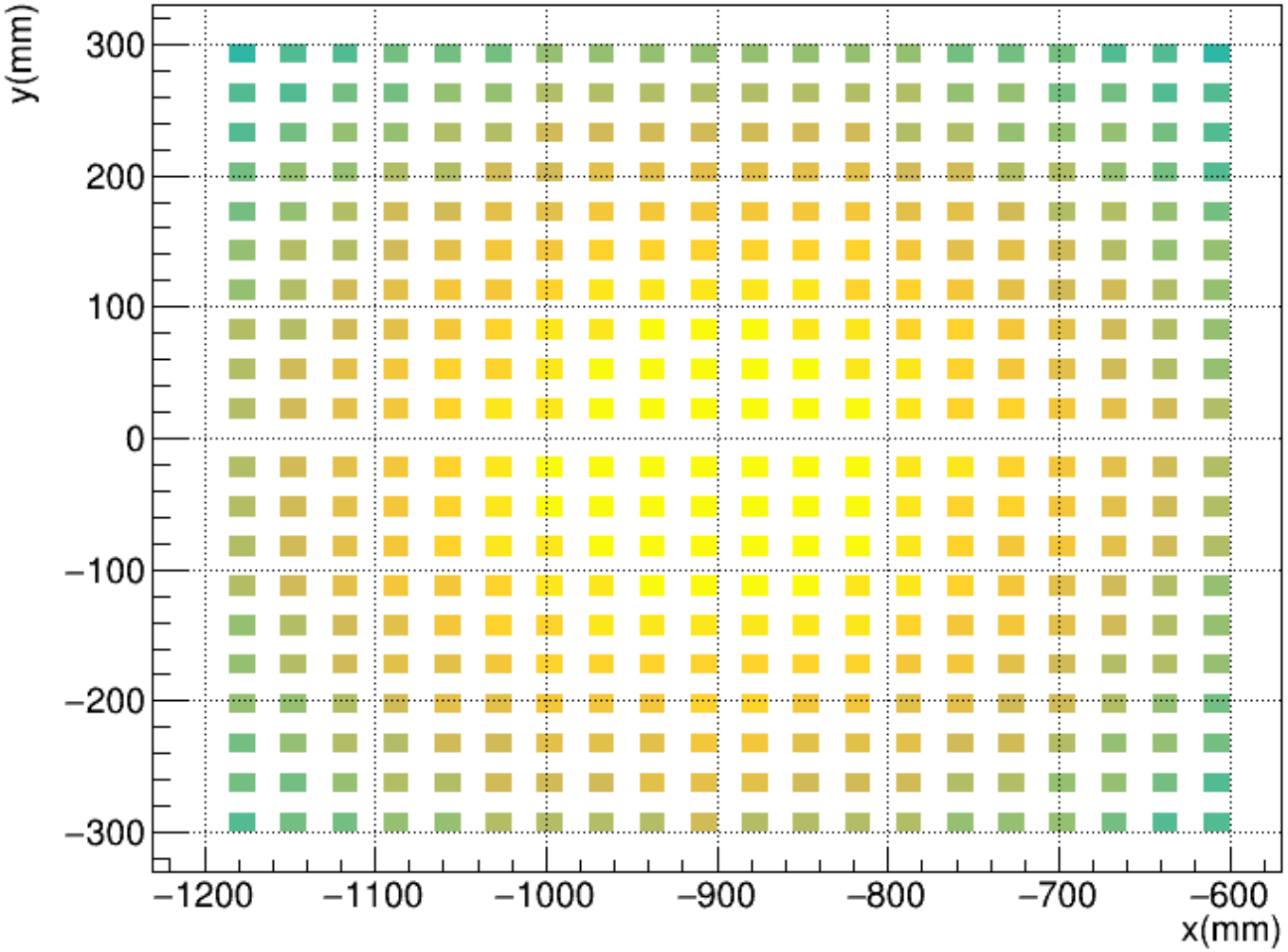
- Need a larger sample which contain the following info:

Ecal hit related	Position X	Position Y	Position Z	Cell ID	Energy (Sum)
MC particle related	Momentum X	Momentum Y	Momentum Z		

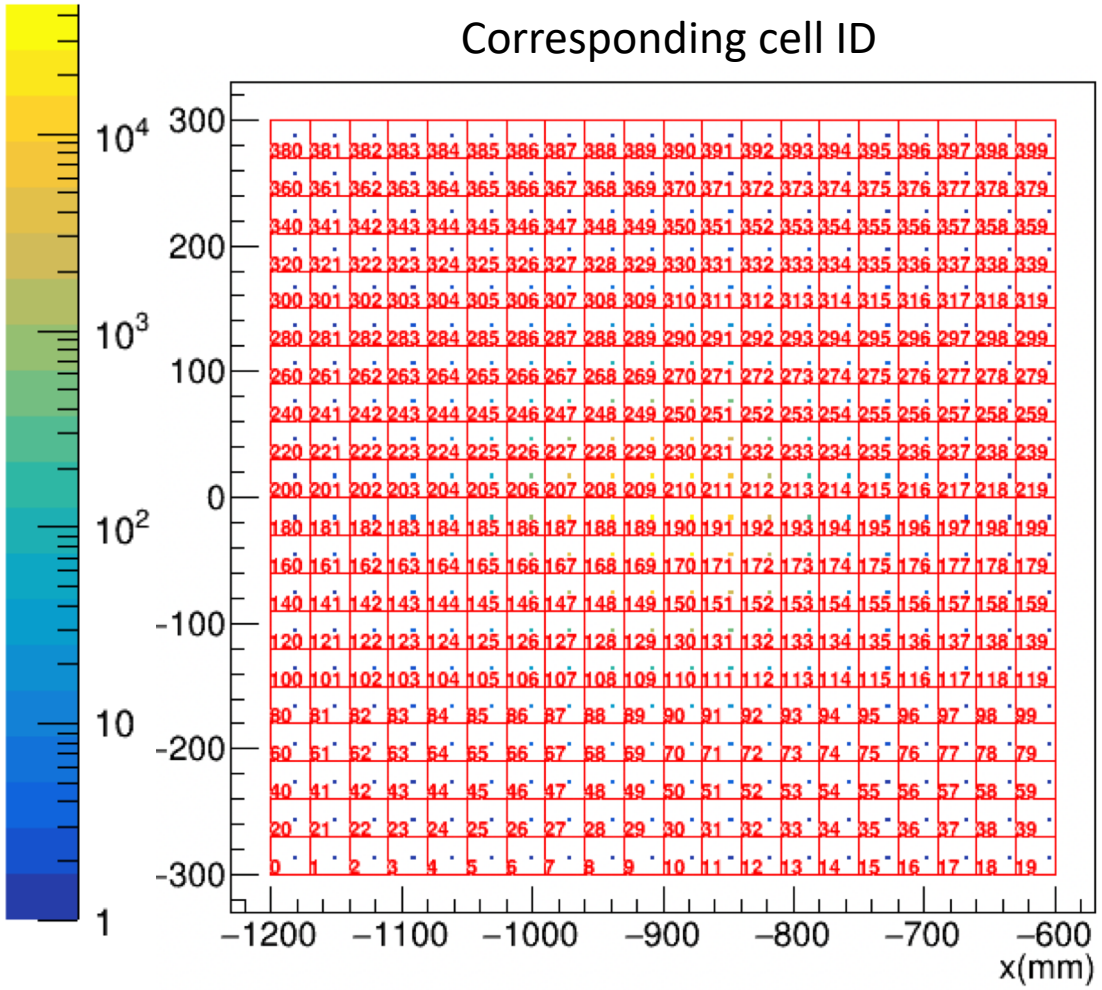
- Fixed vertex (position fixed at [-902.408,-15.000,35488.907])
- $\boldsymbol{\theta}$, $\boldsymbol{\phi}$,shift = [20,180,15]
- Material at the center: Carbon fiber
- 50k events within 0.01 GeV – 20 GeV positron beam are generated.
- First step: modify the input, link up the energy distribution and the Cell ID.

Consistency check

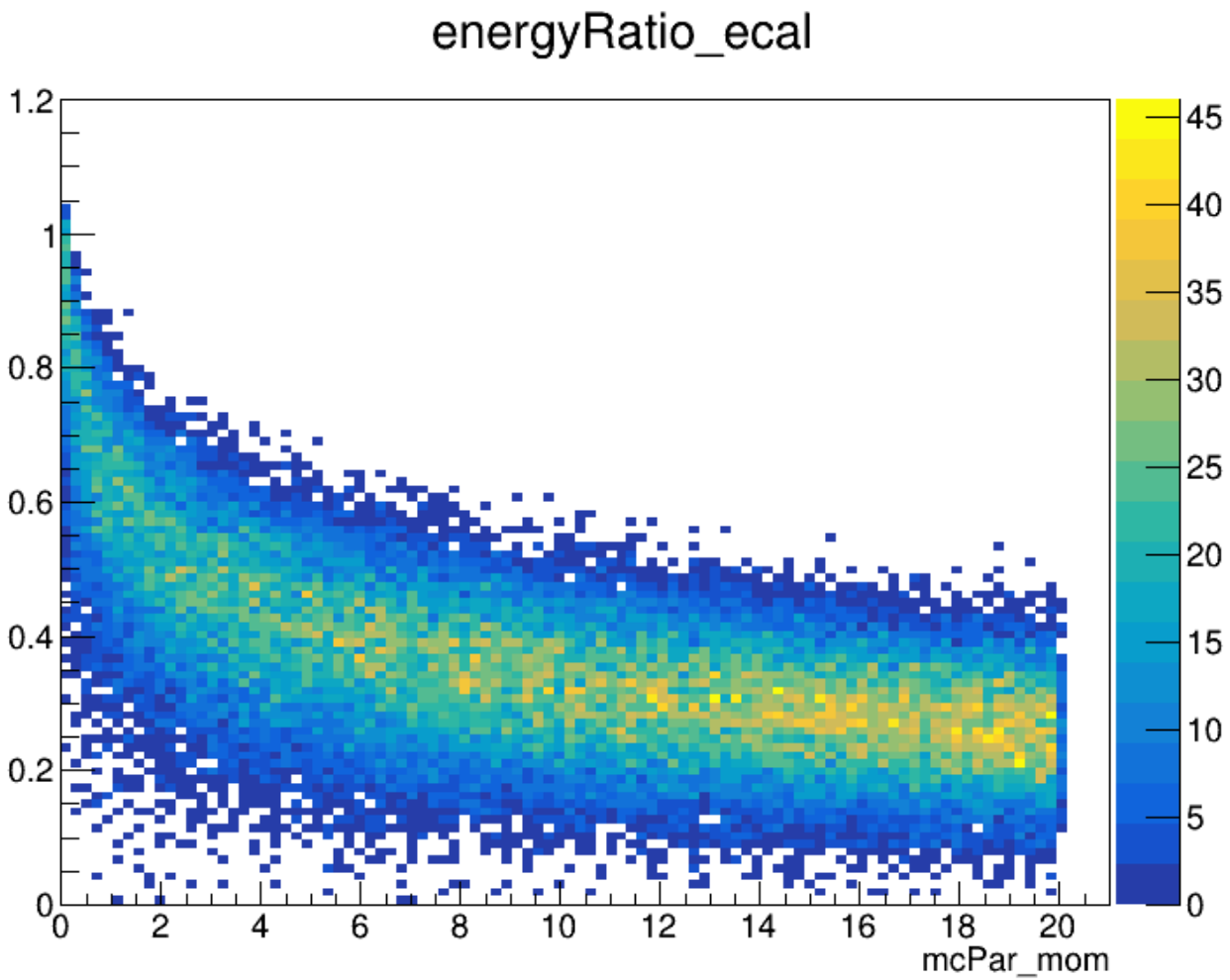
#Event count per cell

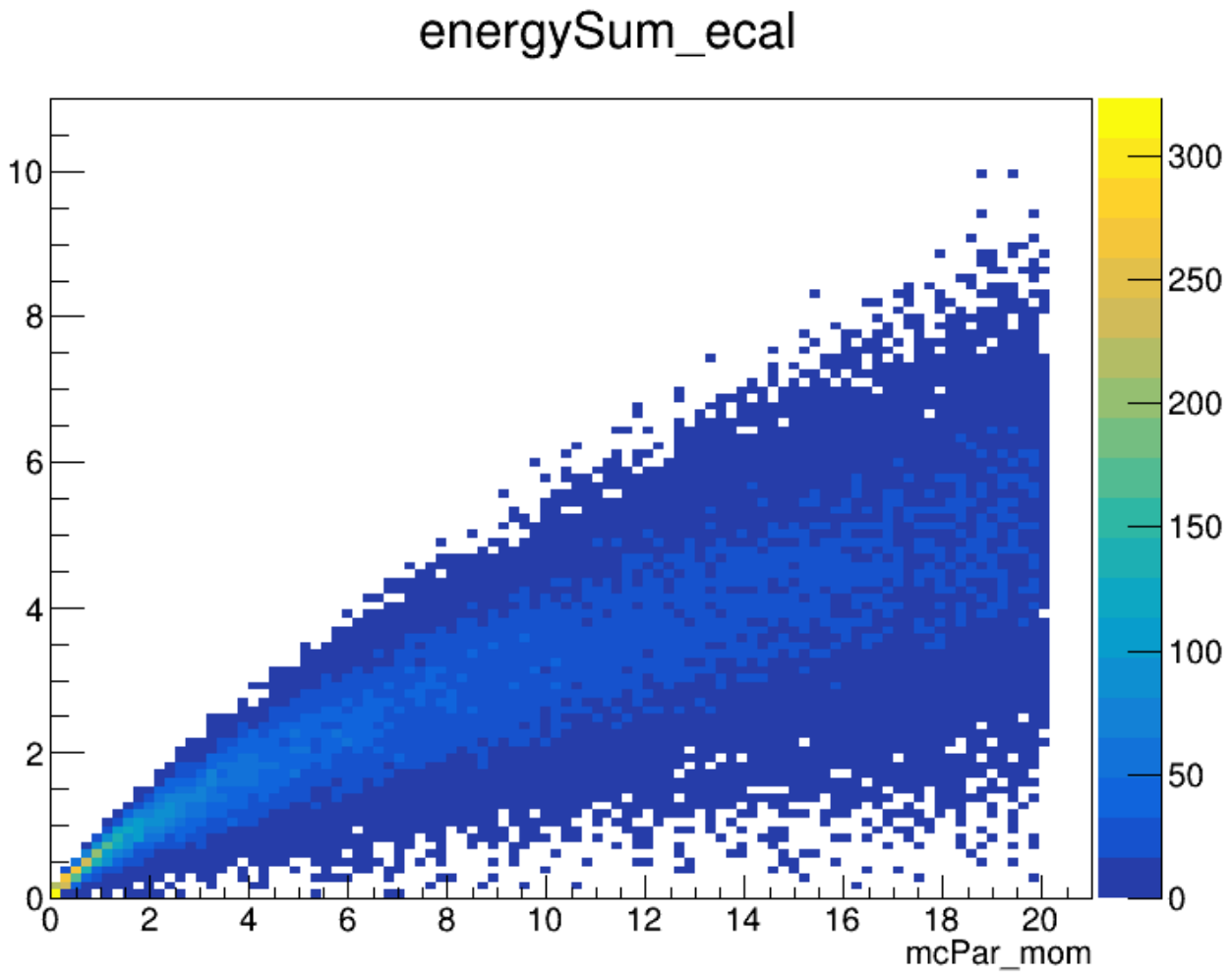


Corresponding cell ID

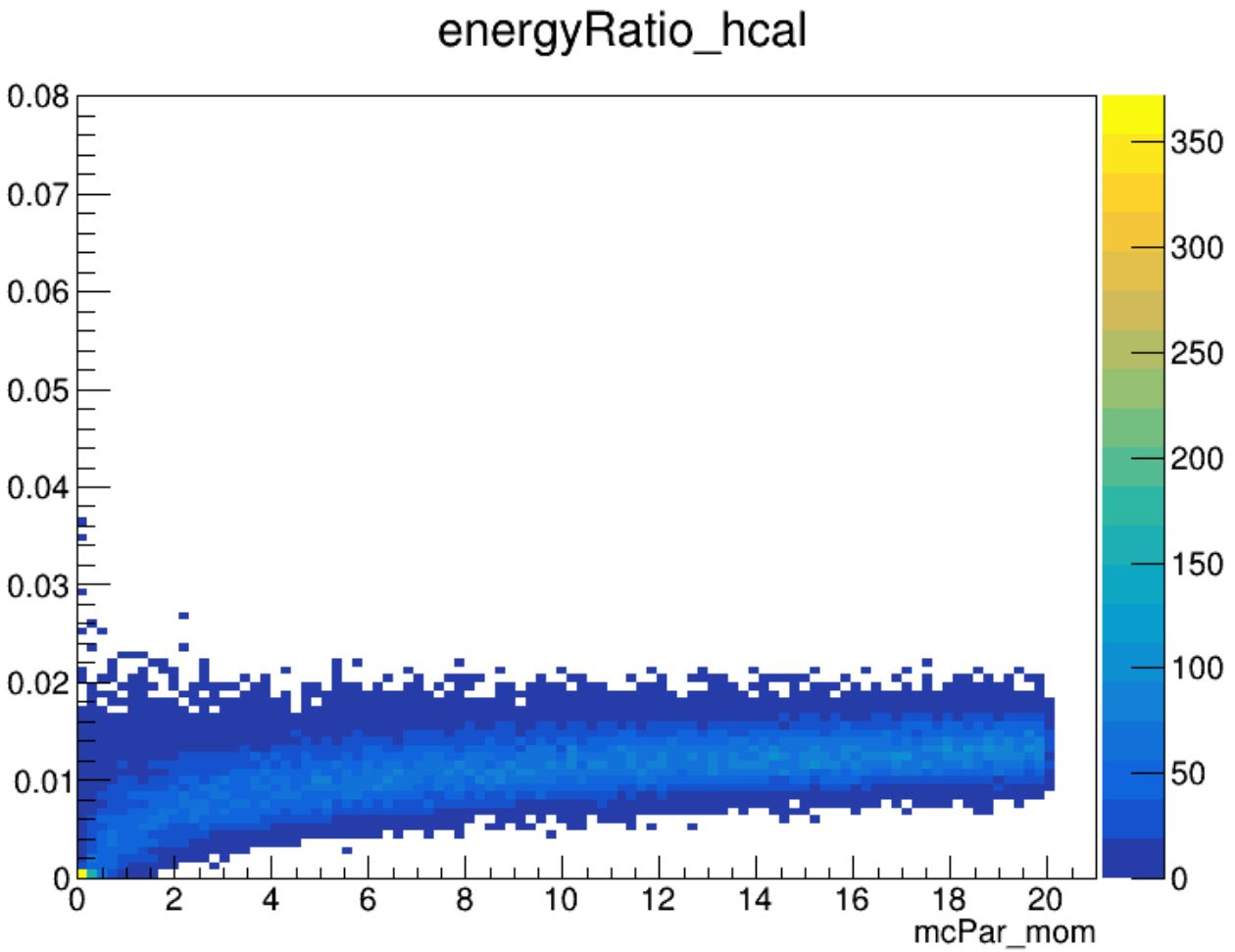


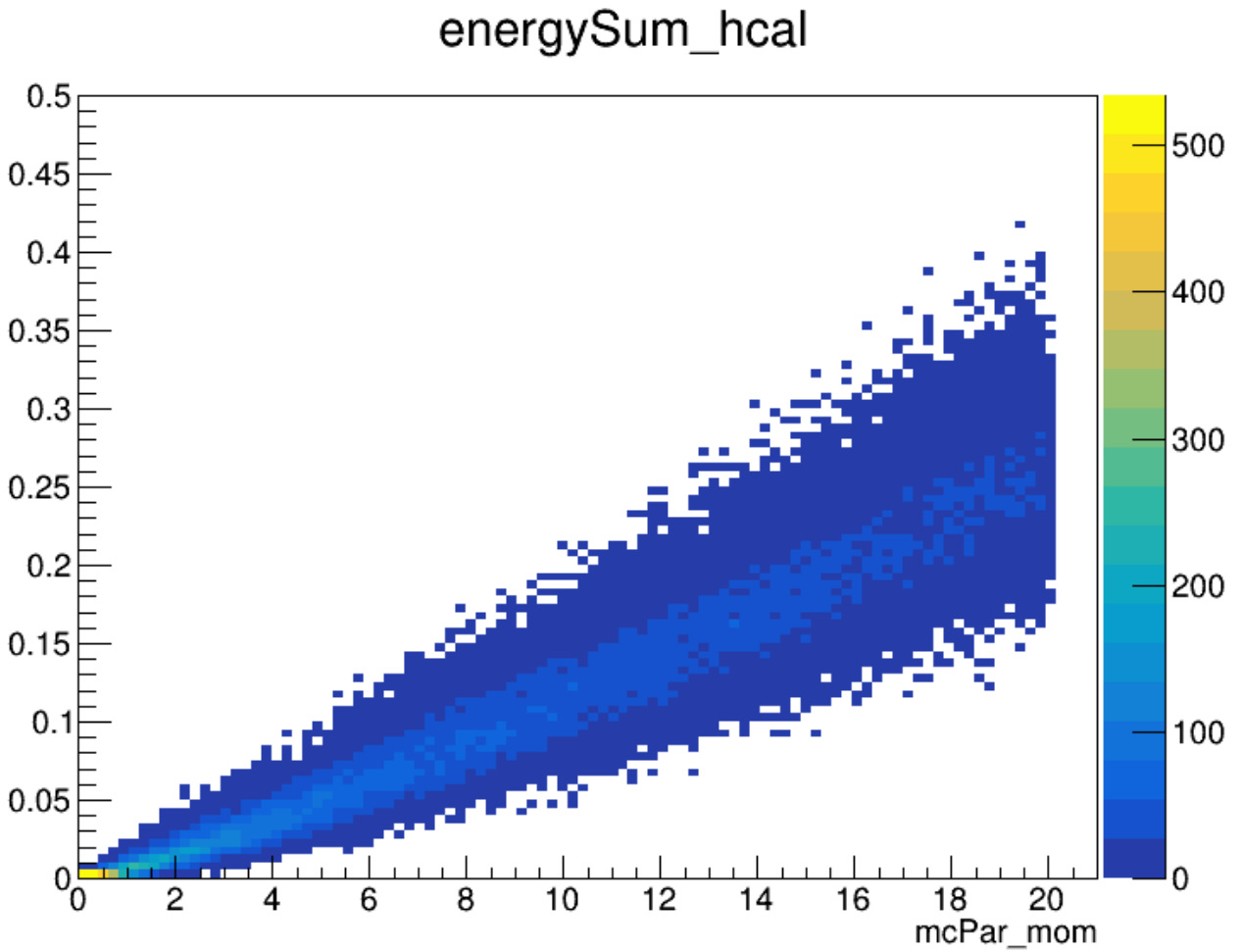
Consistency check





Consistency check





Linking up the energy and cell ID

- We make use of the ROOT file structure (looping over entries), we can make a 20x20 2D array to store the energy per cell.
- A print out with energy per cell (amplified by 10000 times for visual purpose) in 1 example event has been shown as a 2D array:

```
[[  0   0   0   0   0   0   0   0   0   0  10   3  12   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   7  37   4   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   1   0   0]
 [  0   0   0   0   0   0   0   0   0   3   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   5   0   0  14   2   0   0   0   0   0]
 [  0   0   0   0   0   0   5   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   8  25   0   0   5   0   0   6   0   6]
 [  0   0   0   0   0   0   0   0   0   0  12  13  33  14   4   3  18   0   0   0]
 [  0   0   0   0   0   0   0   0   5   1  47 163 141  39  36  12   3   0   0   0]
 [  0   0   0   0   0   0   0   2   0  13 196  33 210  81   8   7   3   0   0   0]
 [  0   0   0   0   0   0   0   2   0  13  60 196 217  47  22   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   5   2  12  34  29   6   9   7   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   4   0  89  28  51   6   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   1  11   0   5  50   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   1   0   0   3   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   6   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]]
```

Outlook

- We can make 2D histograms (#Event per cell) per energy range and do a 2D profile to get the $\sum E / N$, as a cross check
- In the ML code, each event contain their own 2D array.
- We will use the momentum from MC particle to set the training target (truth).