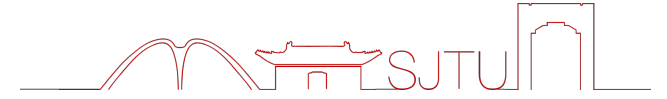




上海交通大学
SHANGHAI JIAO TONG UNIVERSITY



MC - Data Validation

Siyuan SONG

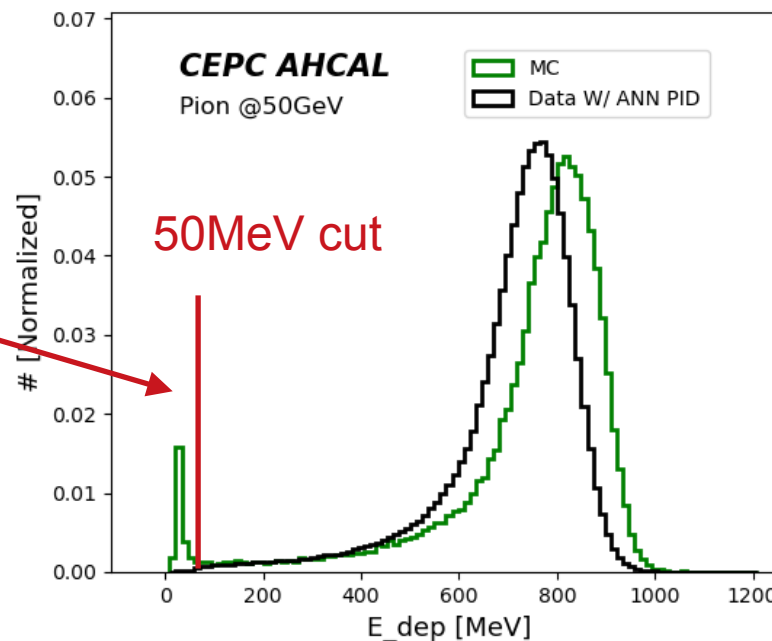
2023/11/13 13:38

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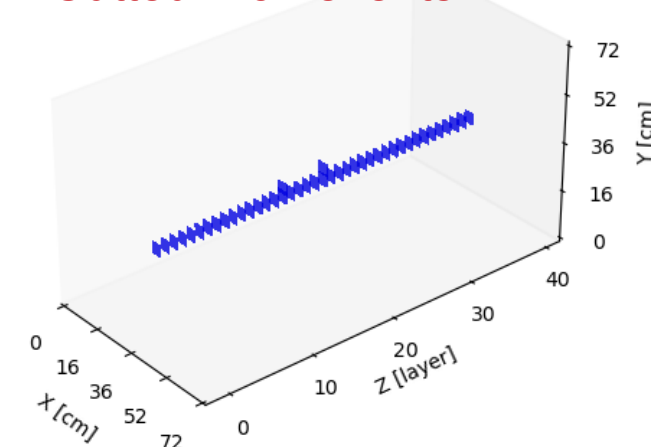
Samples

- MC validation has been done on E_{dep} , E_{max} , E_{mean} , Hits_num, X_width, Y_width, Z_depth, Shower_radius, from 10 - 80 GeV (presented in previous meeting, see in backup).
- A brief talk on observed tails in data shower profile variable distribution.
- MC samples: /cefs/higgs/dudejing/Beamtest/2023_CERN_SPS/SimValidation/Sim_data/SinglePhCalib_cha_cut_new. (With digitization on each channel)
- Data samples: SPS_2023/HCAL_alone/normal/pi-_V4.1.
- MC and Data have 0.5 MIP threshold.
- Data samples are classified by ANN.
- Include: $E_{\text{dep}} > 50 \text{ MeV}$.
 - On MC & Data.



CEPC AHCAL

Cuttet Pion events

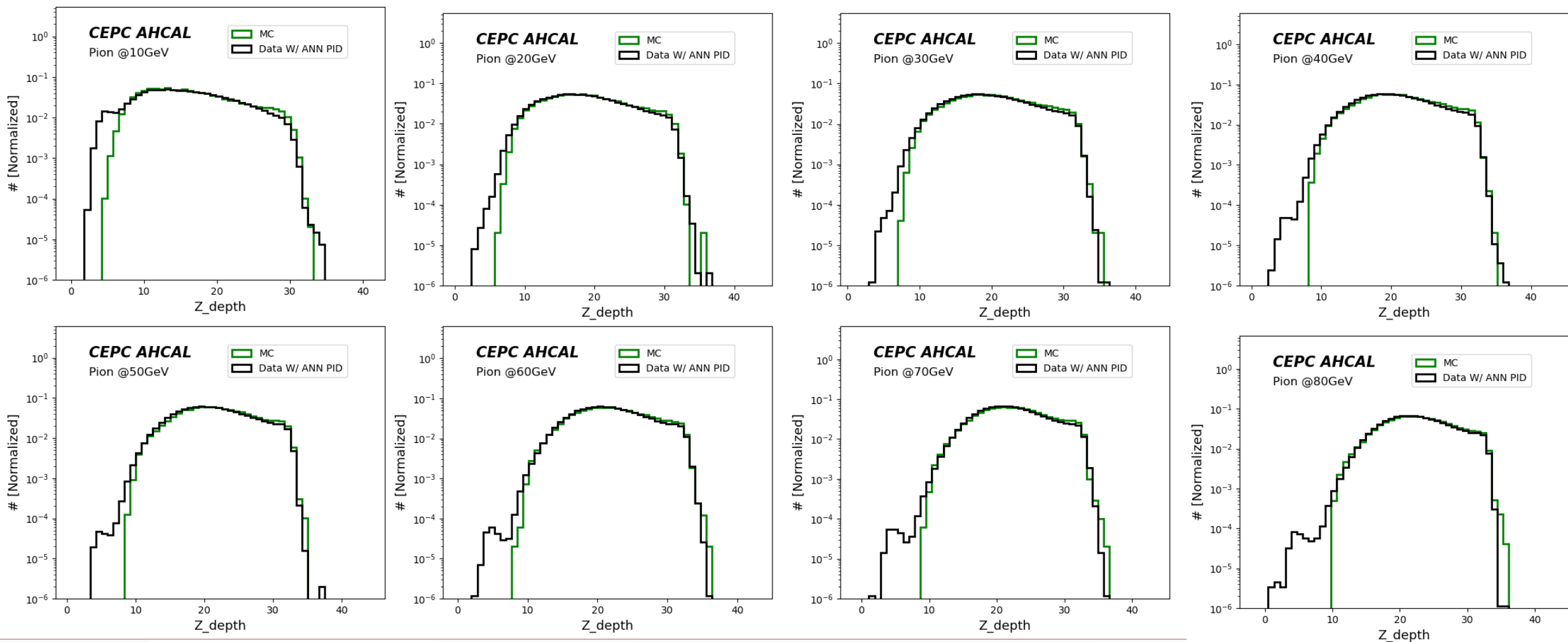




Z_depth



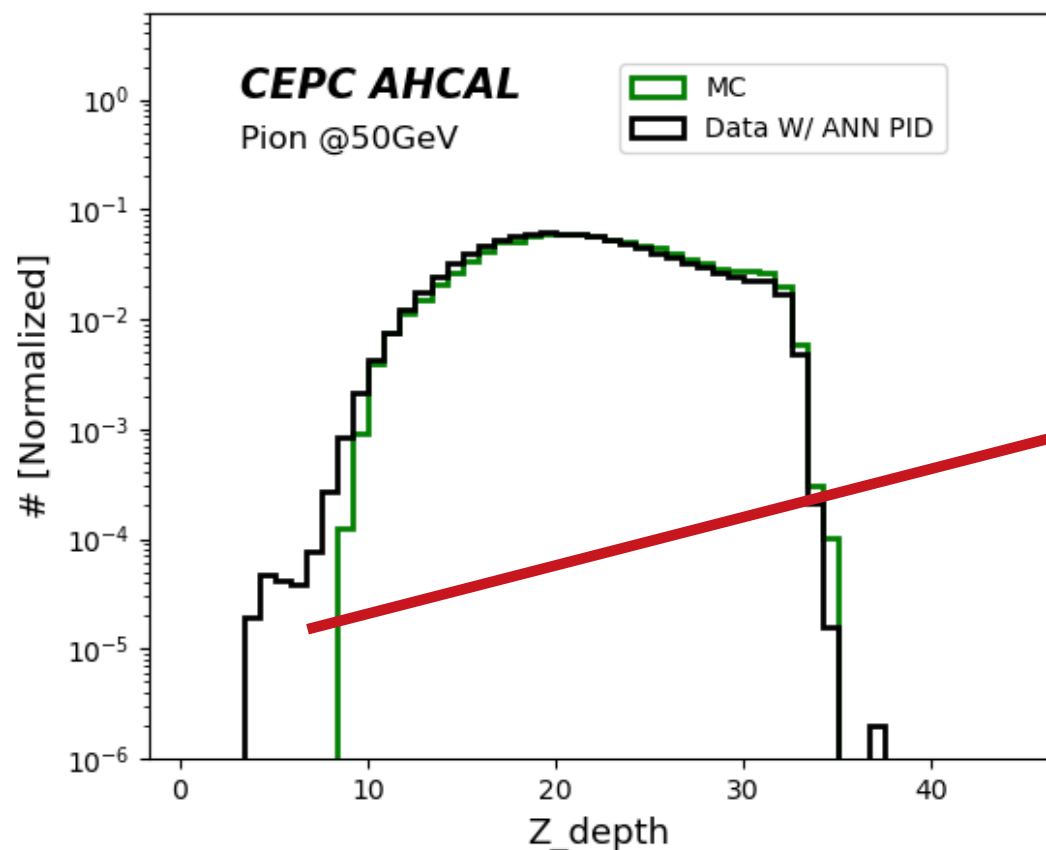
- Pion Z_depth: RMS of Z coordinates [layer].
- Show Difference in tail.





Z_depth

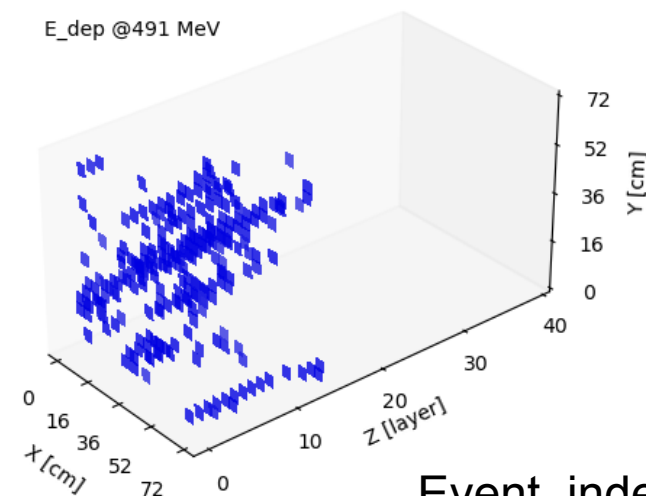
- **Pion** Z_width: RMS of Z coordinates [cell].
- Abnormal events (dominate), $E_{\text{dep}} < \text{normal one}$ (~700 MeV) @50 GeV.



Z_depth < 7.5

CEPC AHCAL

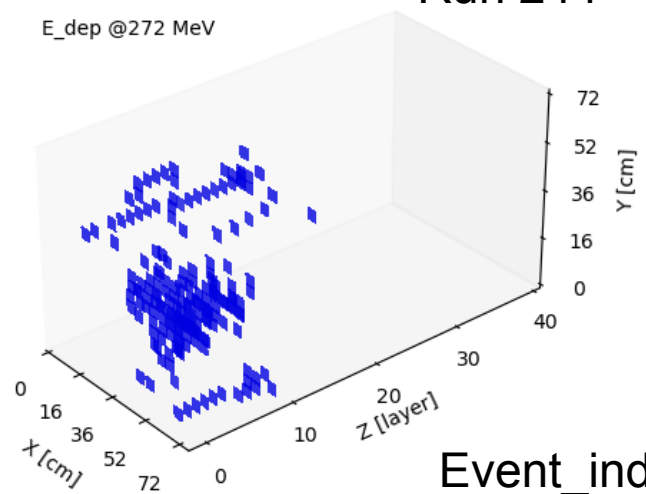
E_{dep} @491 MeV



Event_index: 18163
Run 244

CEPC AHCAL

E_{dep} @272 MeV



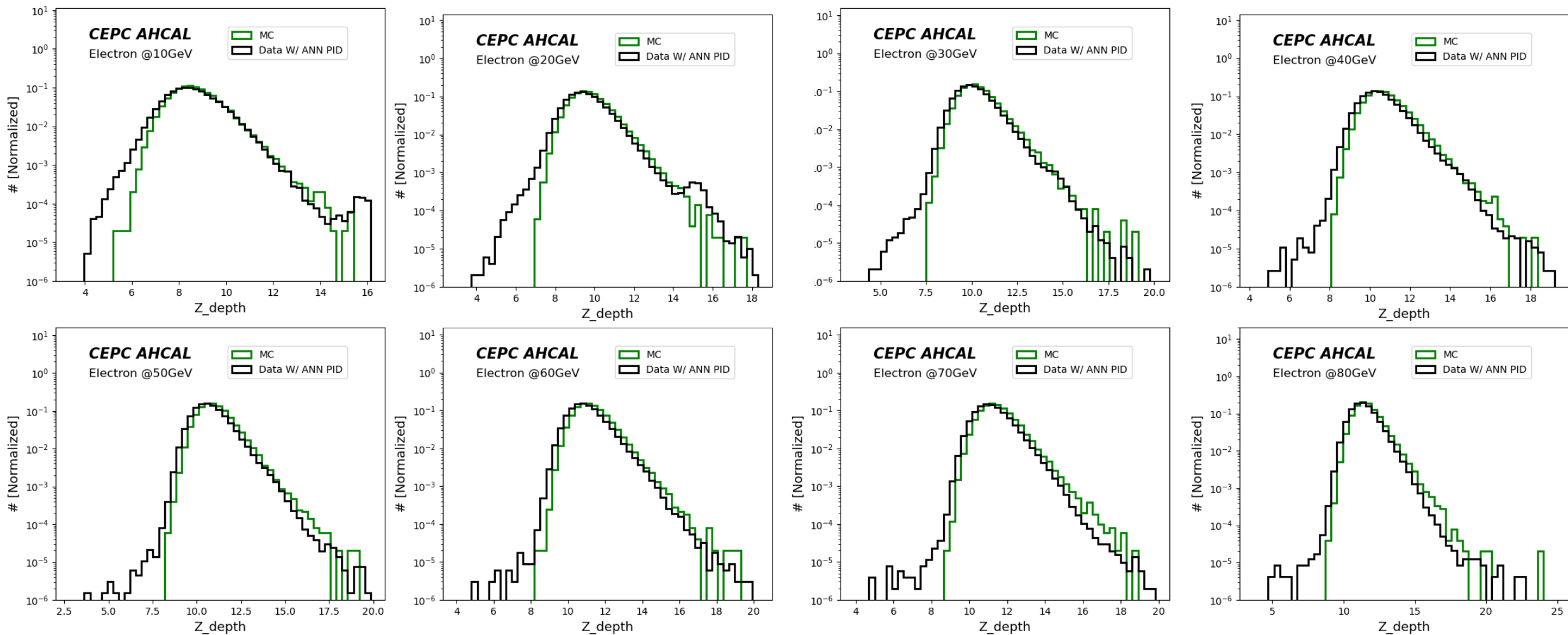
Event_index: 32086
Run 244



Z_depth



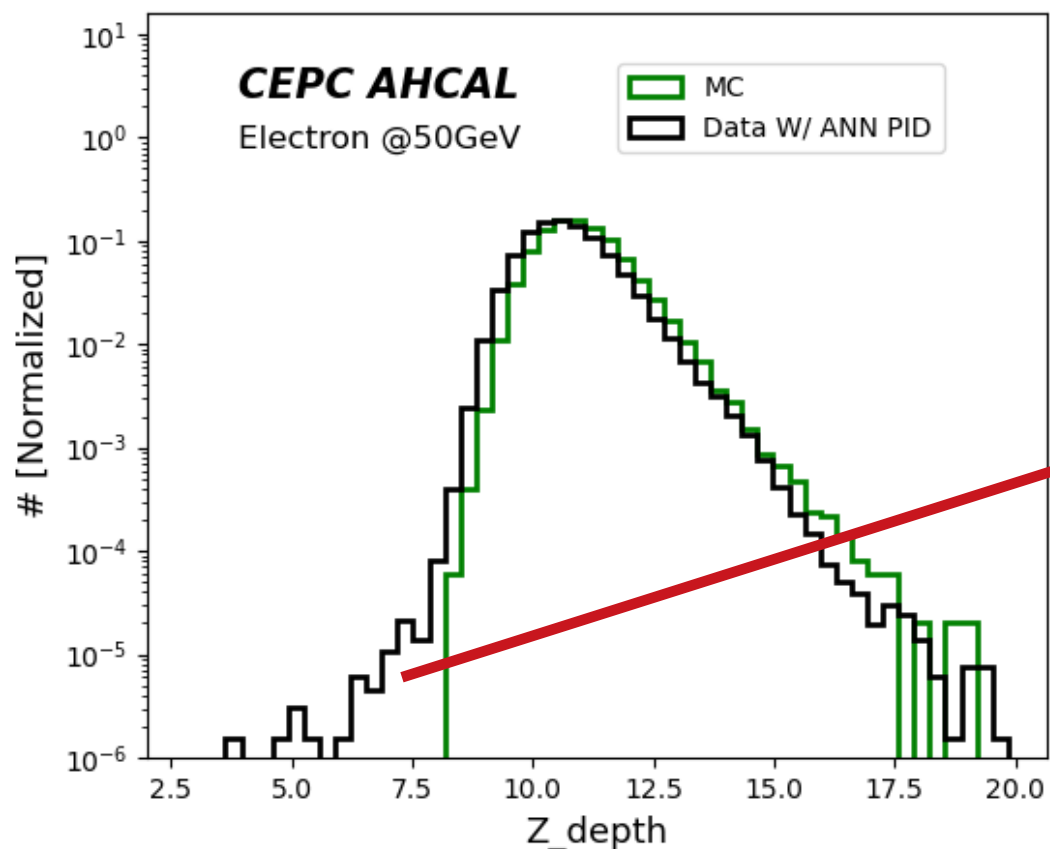
- **Electron** Z_depth: RMS of Z coordinates [layer].
- Show Difference in **tail**.





Z_depth

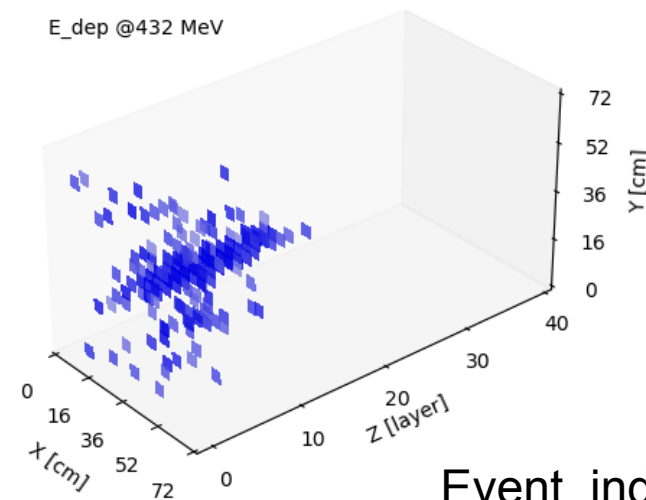
- **Electron** Z_width: RMS of Z coordinates [cell].
- Abnormal events (dominate), $E_{\text{dep}} < \text{normal one}$ (~800 MeV) @50 GeV.



$Z_{\text{depth}} < 7.5$

CEPC AHCAL

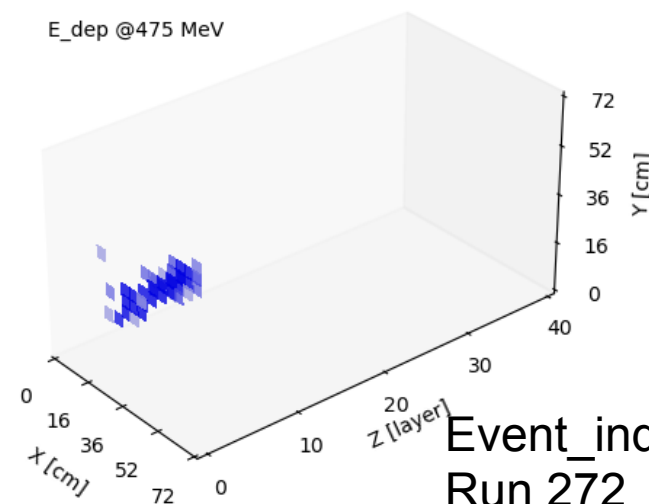
E_{dep} @432 MeV



Event_index: 126848
Run 272

CEPC AHCAL

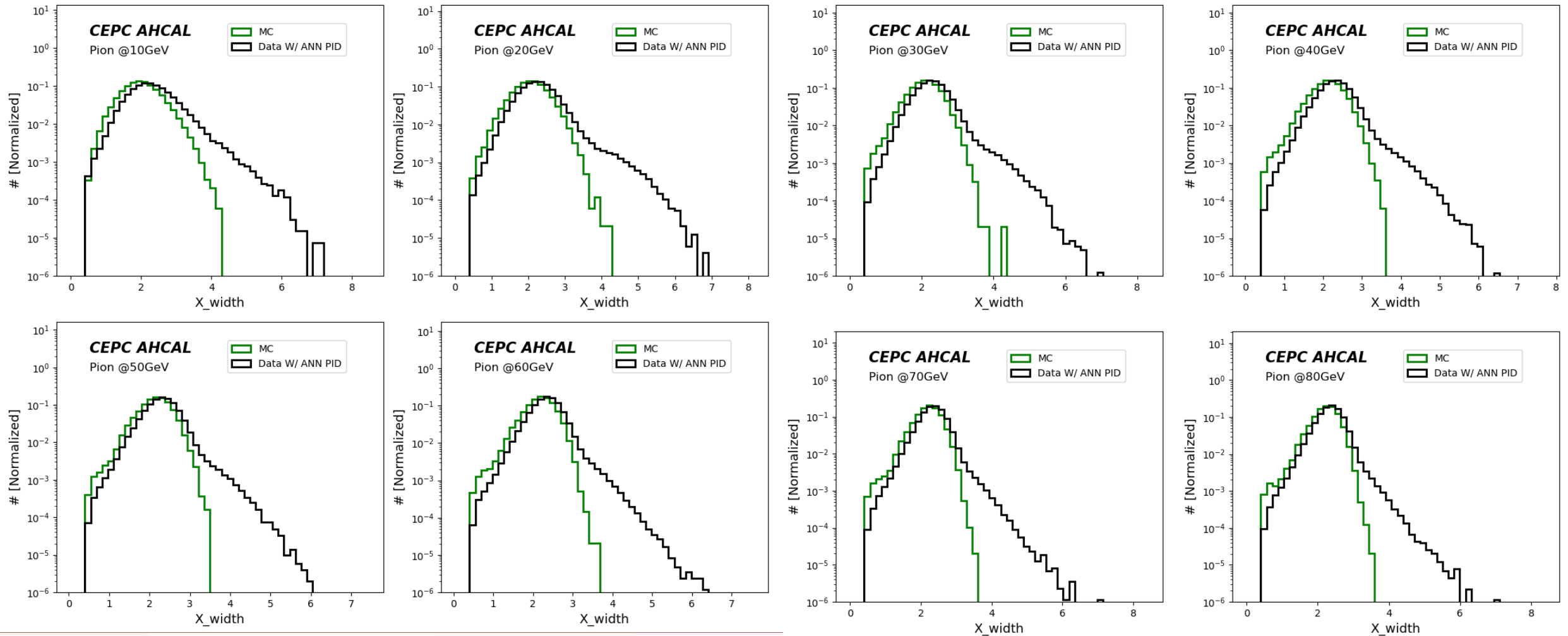
E_{dep} @475 MeV



Event_index: 14548
Run 272



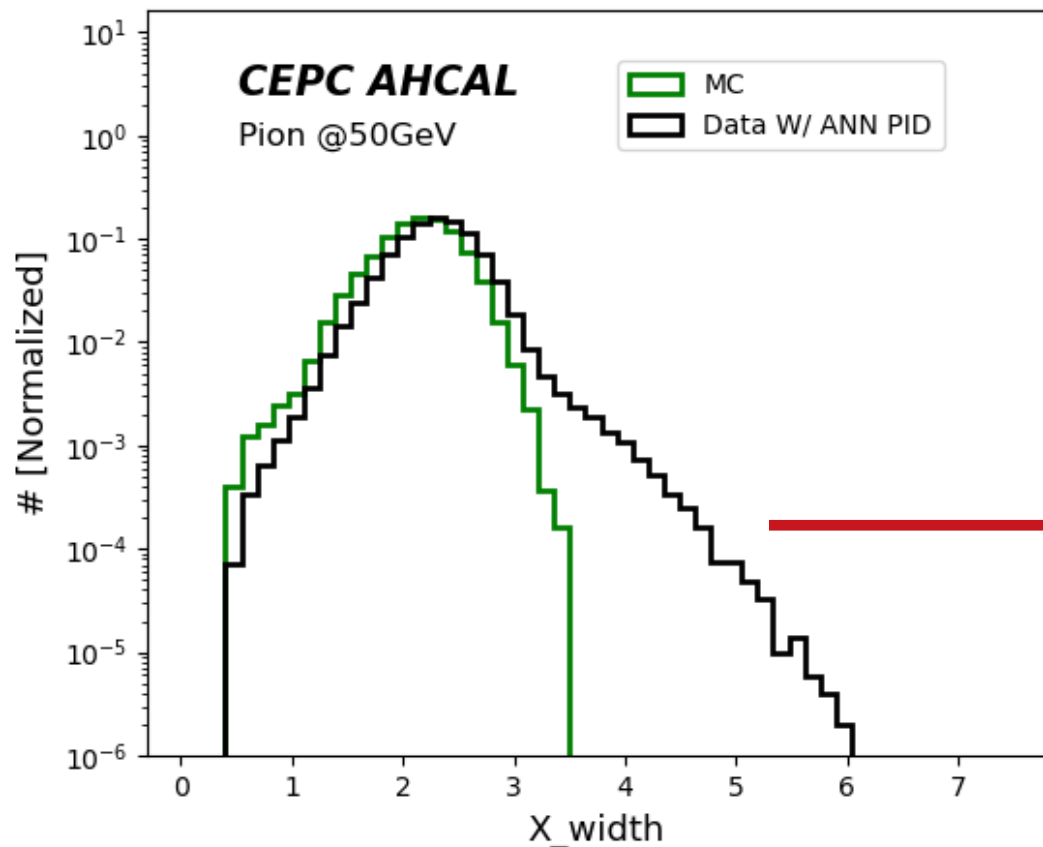
- **Pion** X_width: RMS of X coordinates [cell].





X_width

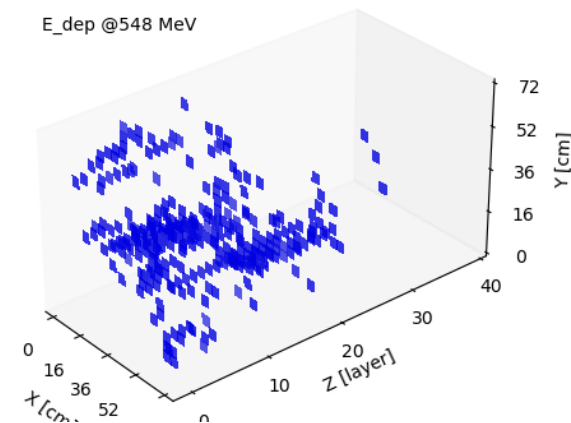
- **Pion** X_width: RMS of X coordinates [cell].
- Abnormal events (dominate), $E_{\text{dep}} < \text{normal one}$ (~800 MeV) @50 GeV.



$X_{\text{width}} > 4$

CEPC AHCAL

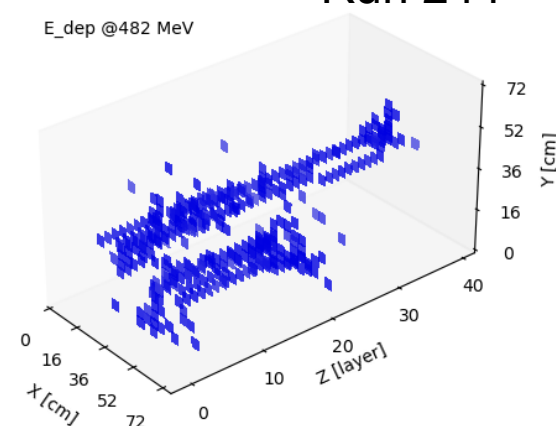
E_{dep} @548 MeV



Event_index: 2769
Run 244

CEPC AHCAL

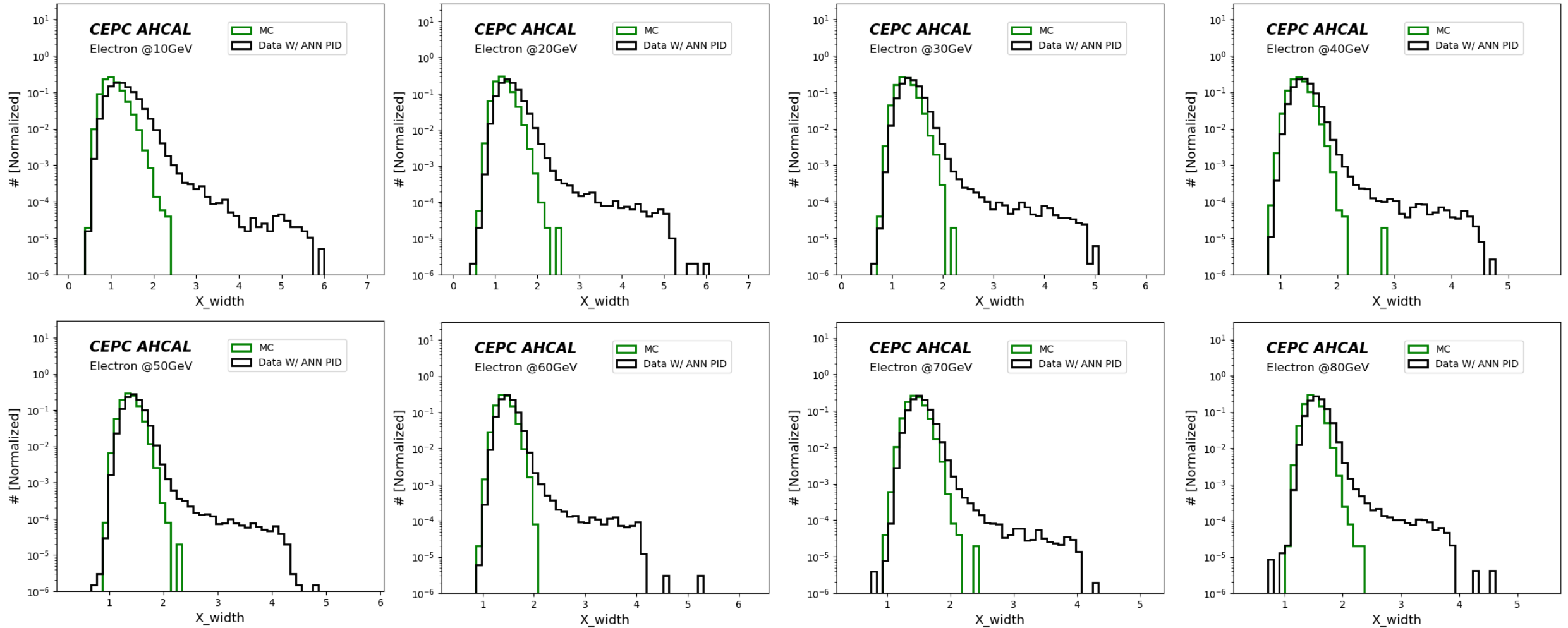
E_{dep} @482 MeV



Event_index: 14973
Run 244



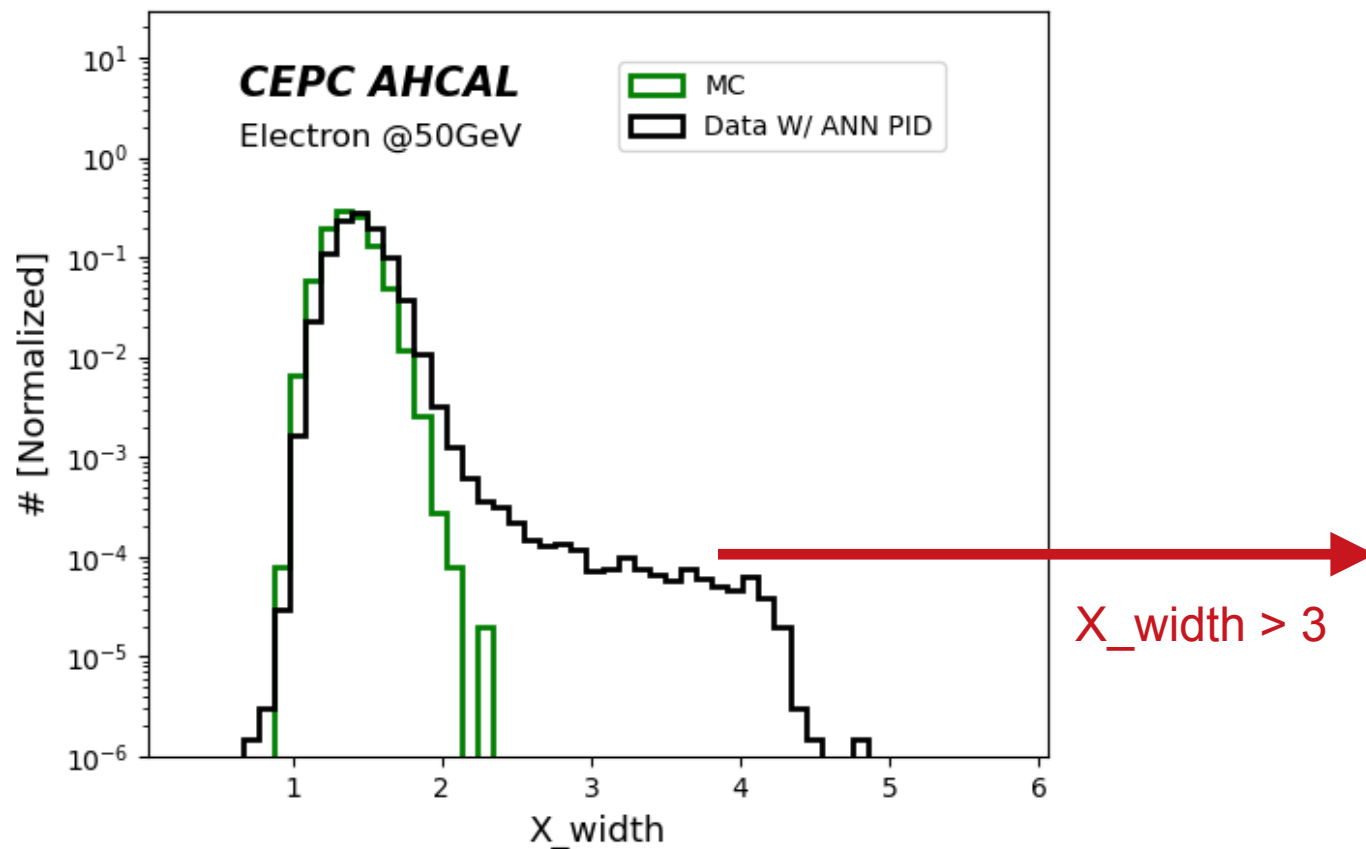
- **Electron** X_width: RMS of X coordinates [cell].



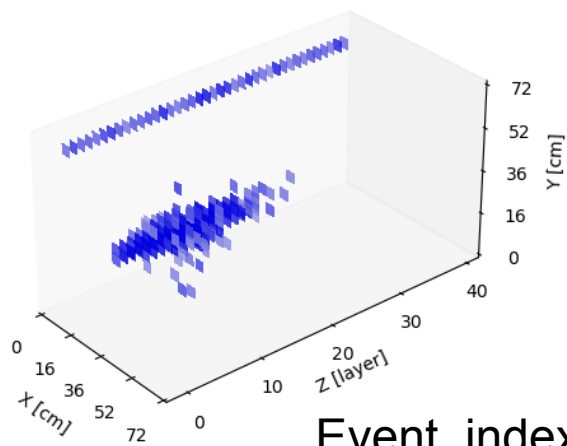
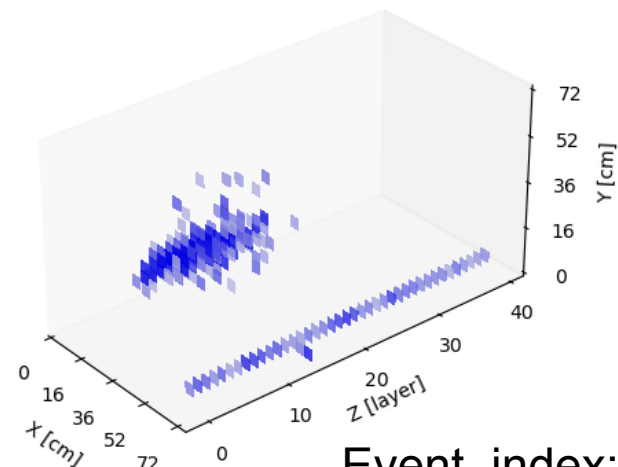


X_width

- **Electron** X_width: RMS of X coordinates [cell].
- Electron + muon events when X_width > 3 (dominate) @50 GeV.

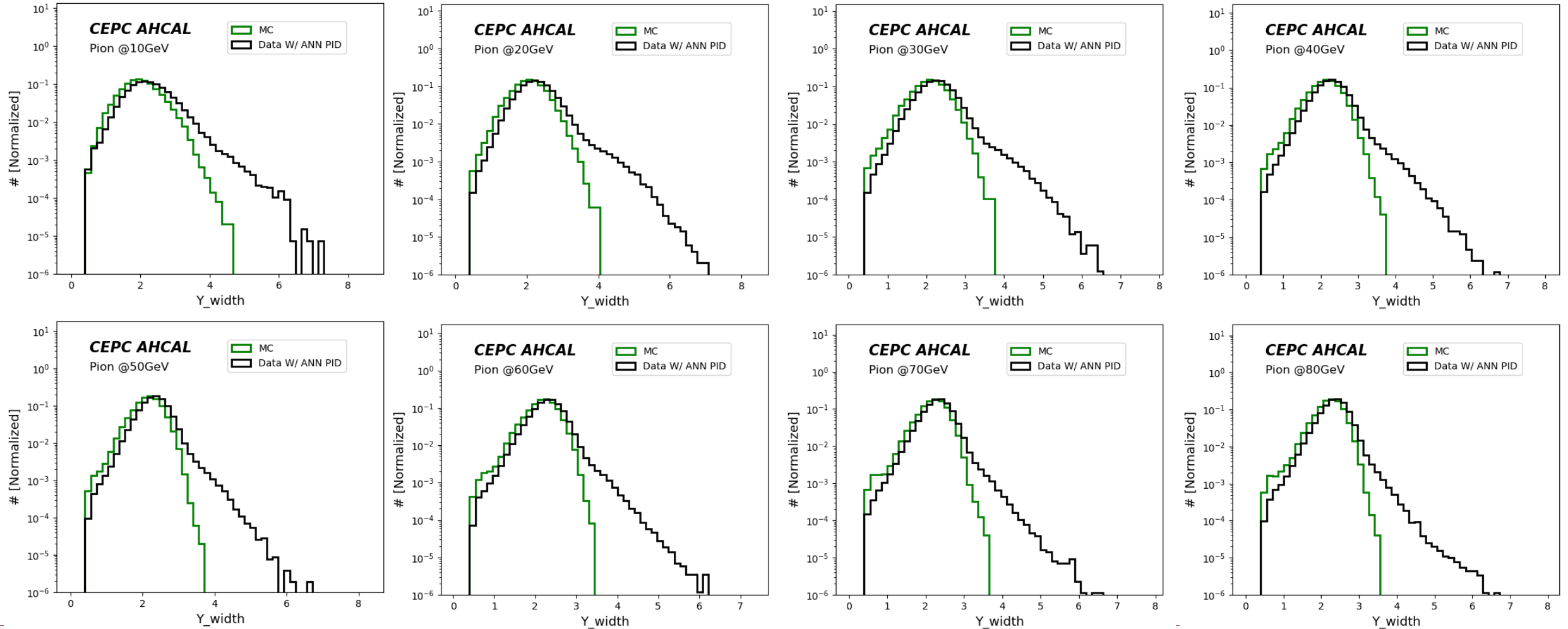


CEPC AHCAL



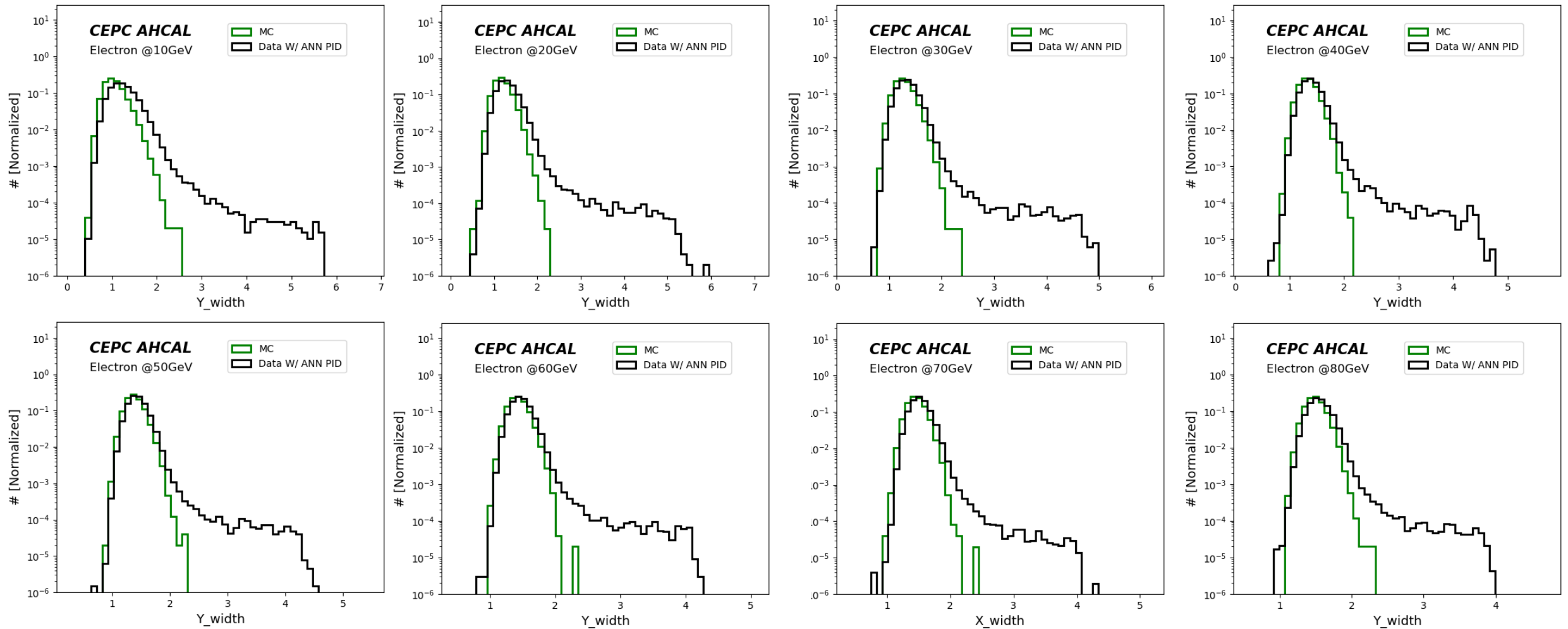


- Pion Y_width: RMS of Y coordinates [cell].



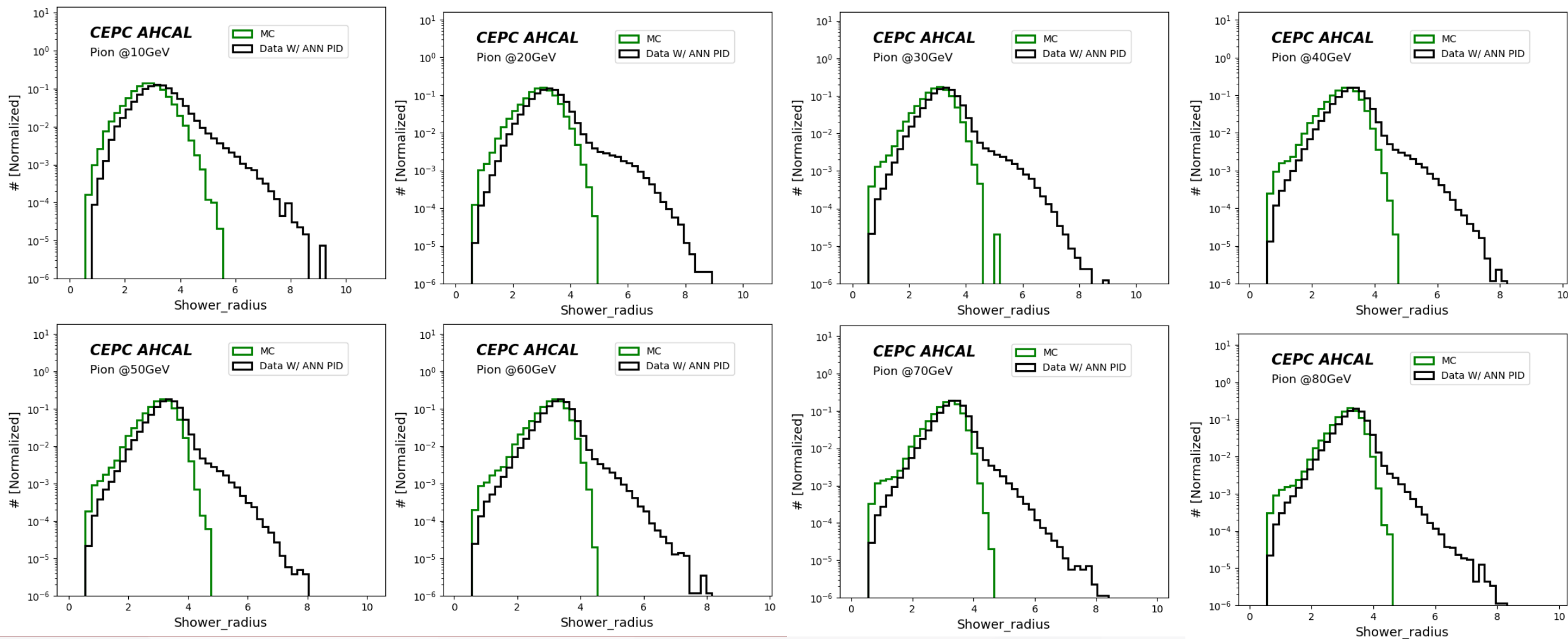


- **Electron** Y_width: RMS of Y coordinates [cell].





- **Pion** Shower radius: RMS of transversal coordinates ($\sqrt{x^2 + y^2}$) [cell].

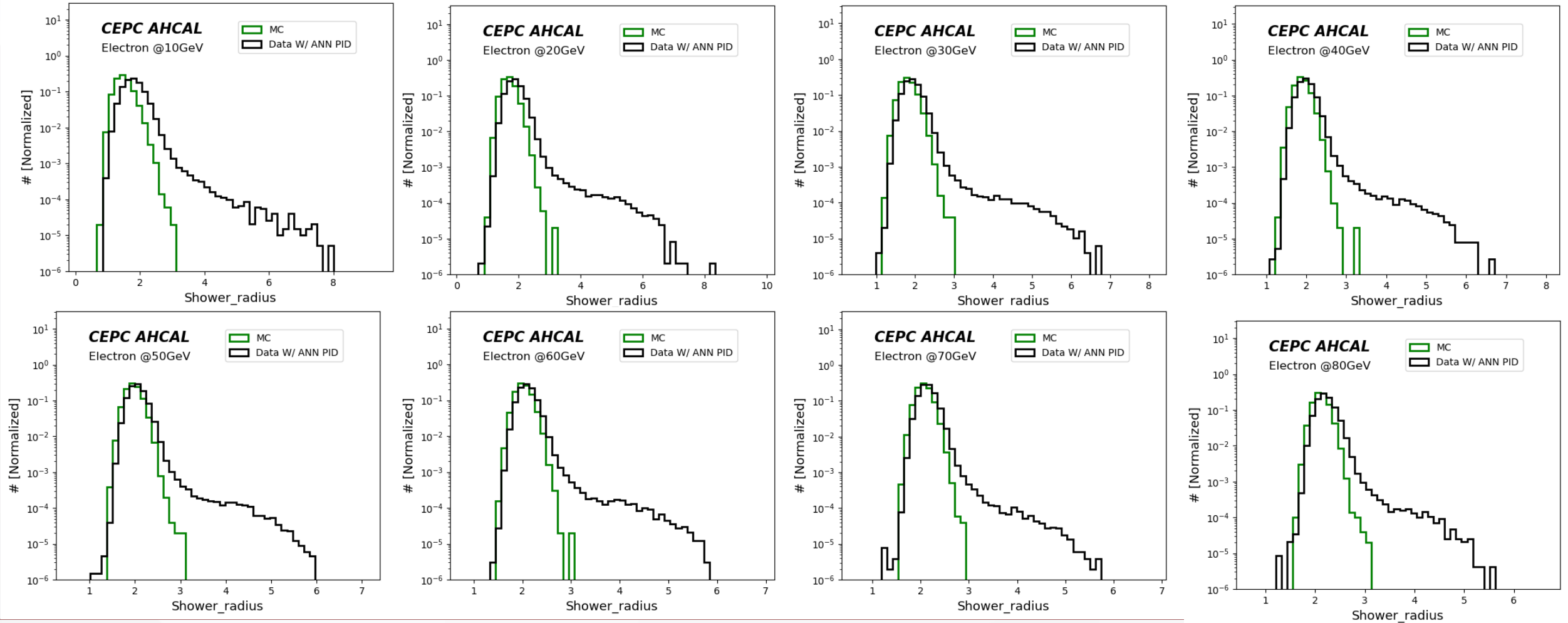




Shower radius



- **Electron** Shower radius: RMS of transversal coordinates ($\sqrt{x^2 + y^2}$) [cell].





1. In energy term, I observe difference in higher-energy tail.
 - Probably need more saturation correction.
2. In Z_depth, X_width, if remove abnormal events, MC can be close to Data.
3. Cross check is necessary.



感谢聆听

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Check list

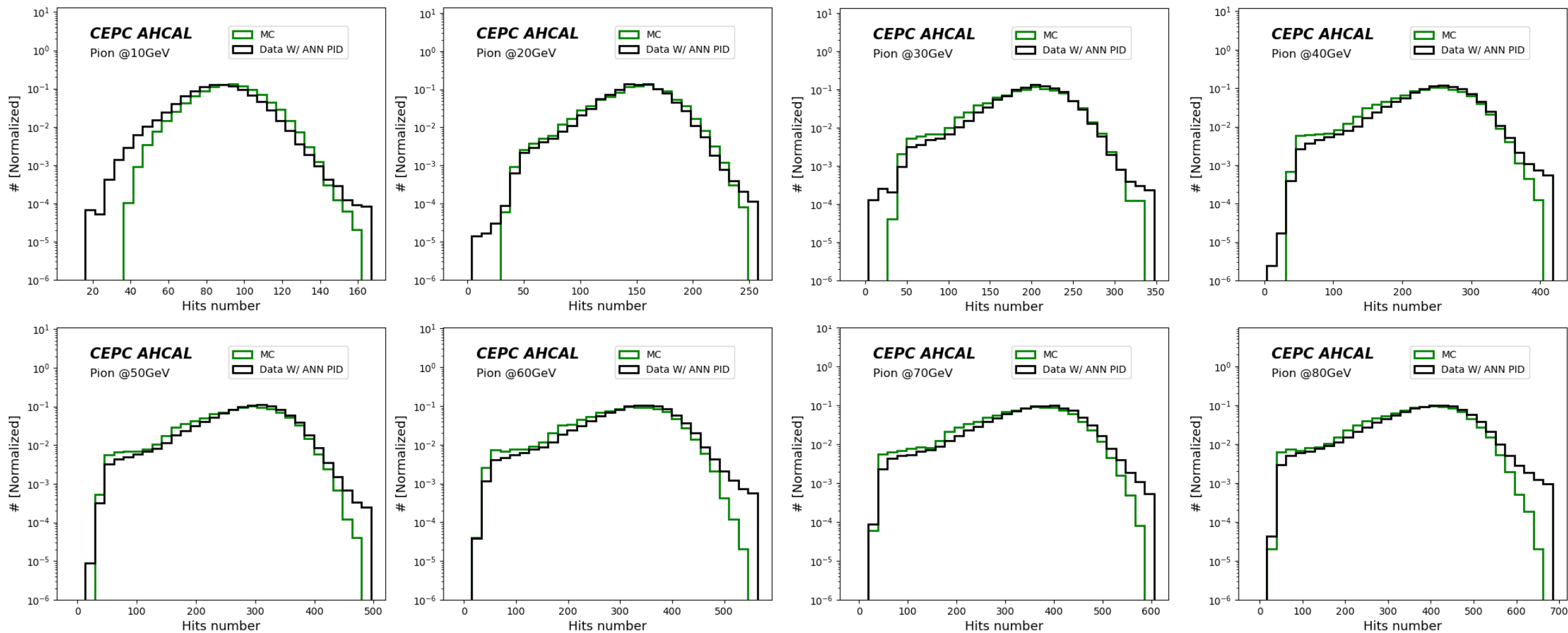


MC validation has been done on E_dep, E_max, E_mean, Hits_num, X_width, Y_width, Z_depth, Shower_radius, from 10 - 80 GeV.

Energy [GeV]	10	20	30	40	50	60	70	80
E_dep								
E_max								
E_mean								
Hits_num								
X_width								
Y_width								
Z_depth								
Shower_radius								



- **Pion** Hits number: The number of hits.

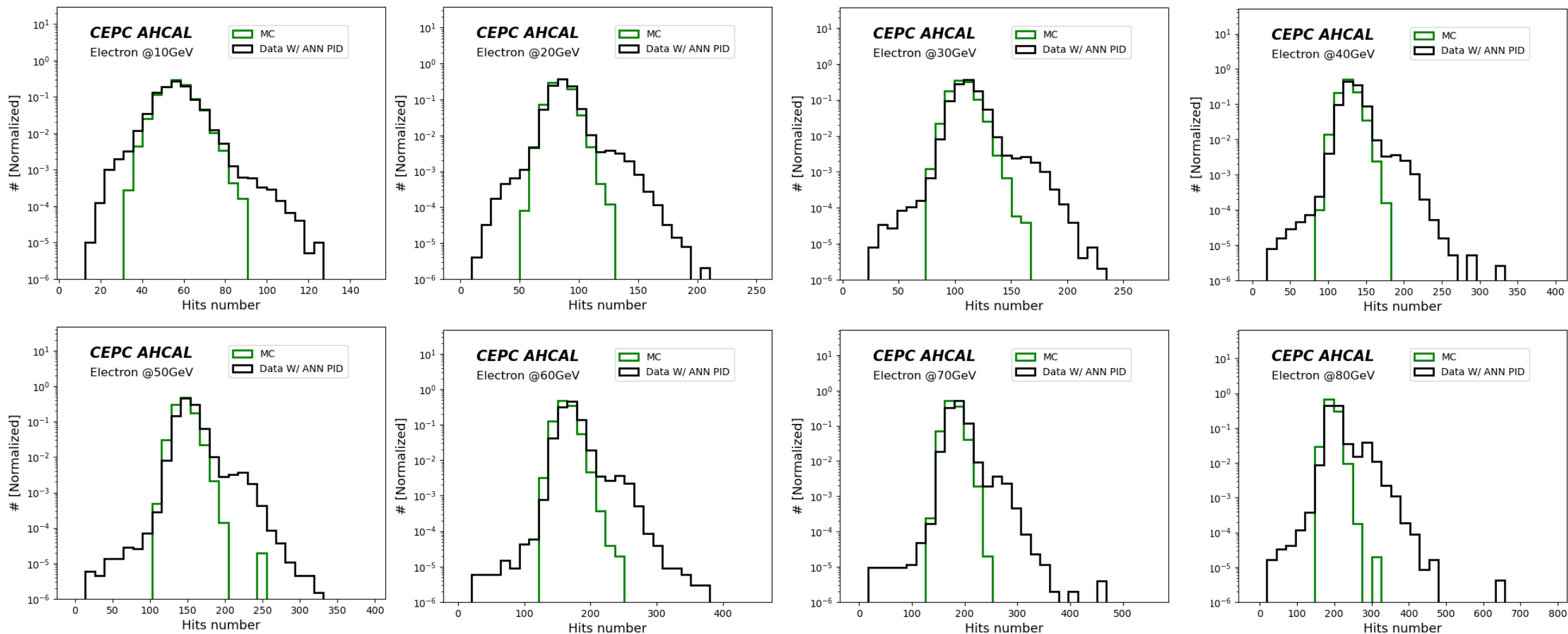




Hits_number

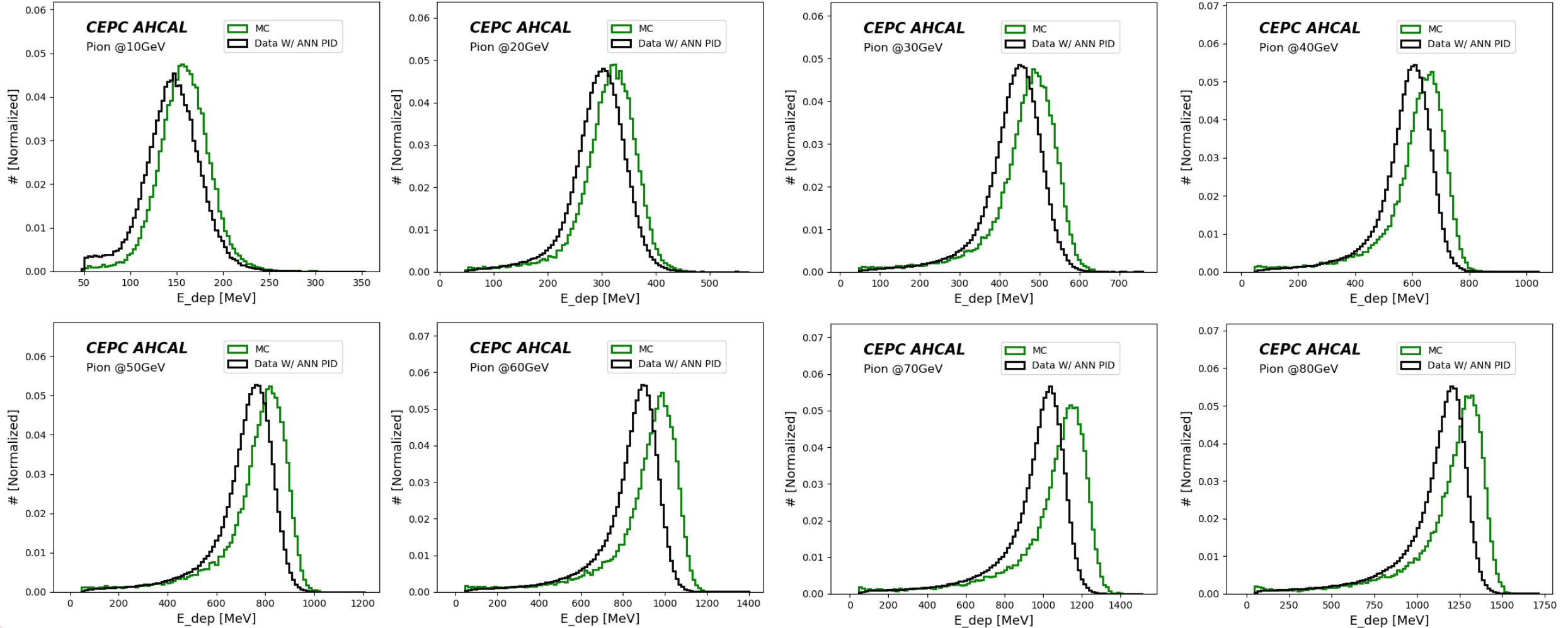


- **Electron** Hits number: The number of hits.
- Observe dual-peak in data, Perhaps: 1) problems in data; 2) misclassification by ANN.



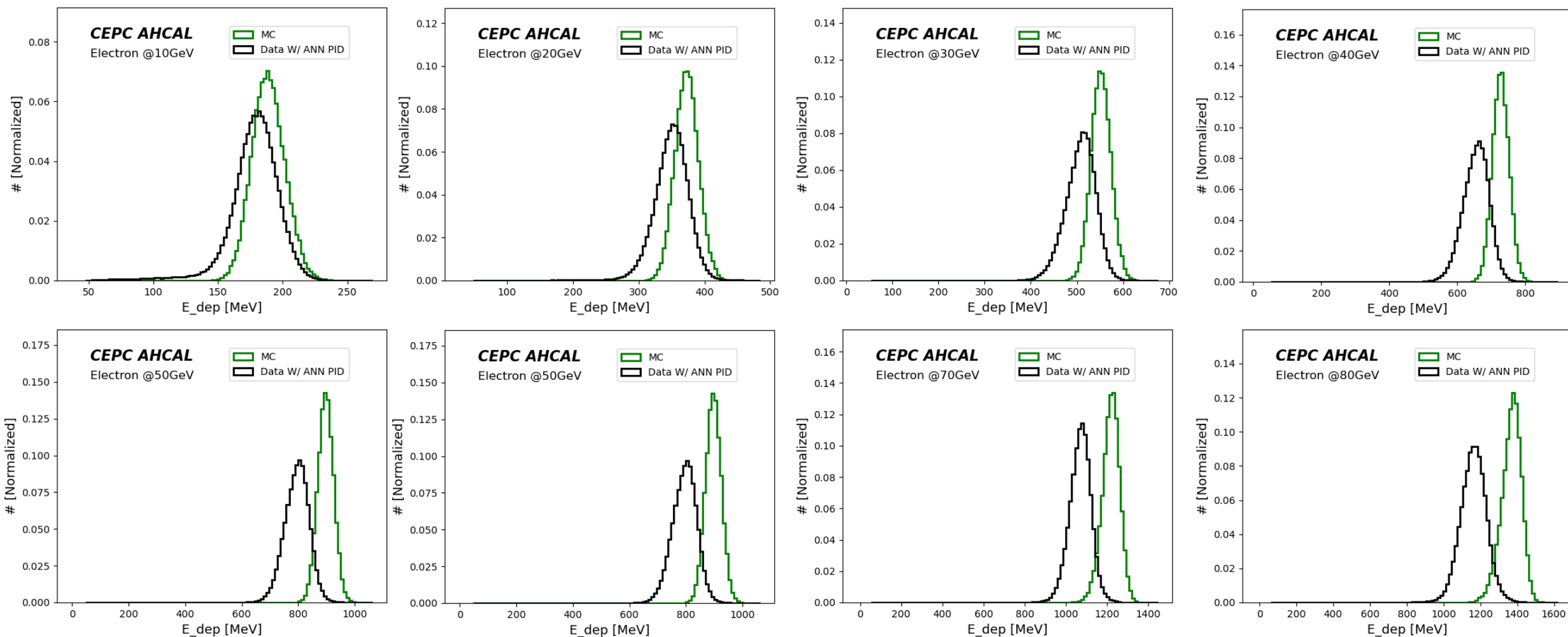


- **Pion** E_dep: The total energy deposited in AHCAL.



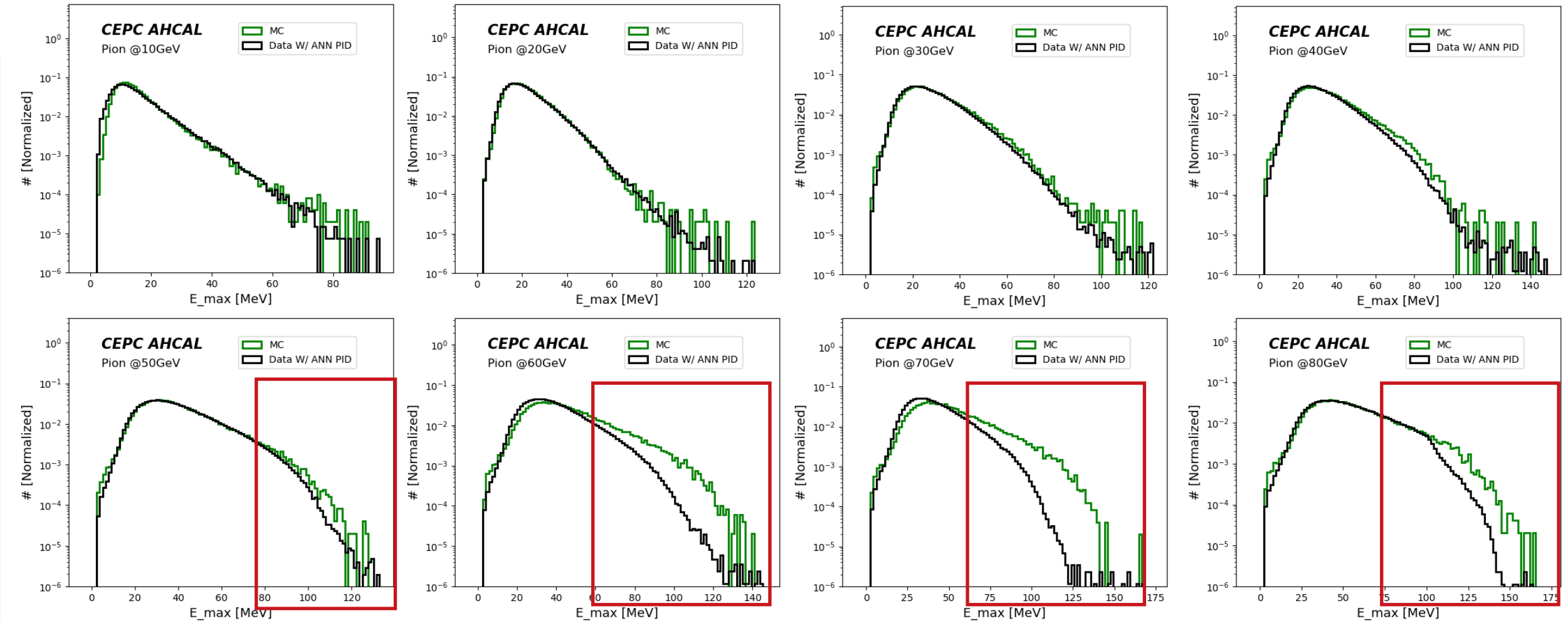


- **Electron** E_dep: The total energy deposited in AHCAL.

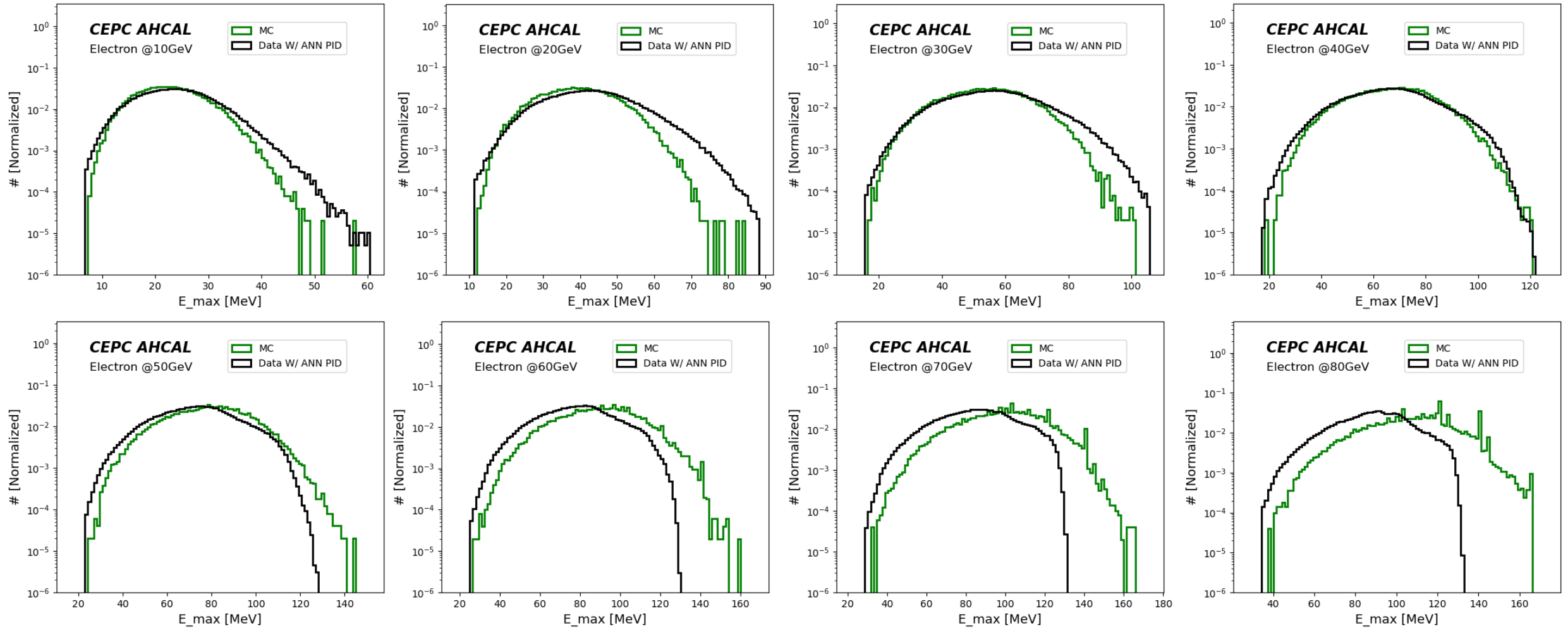




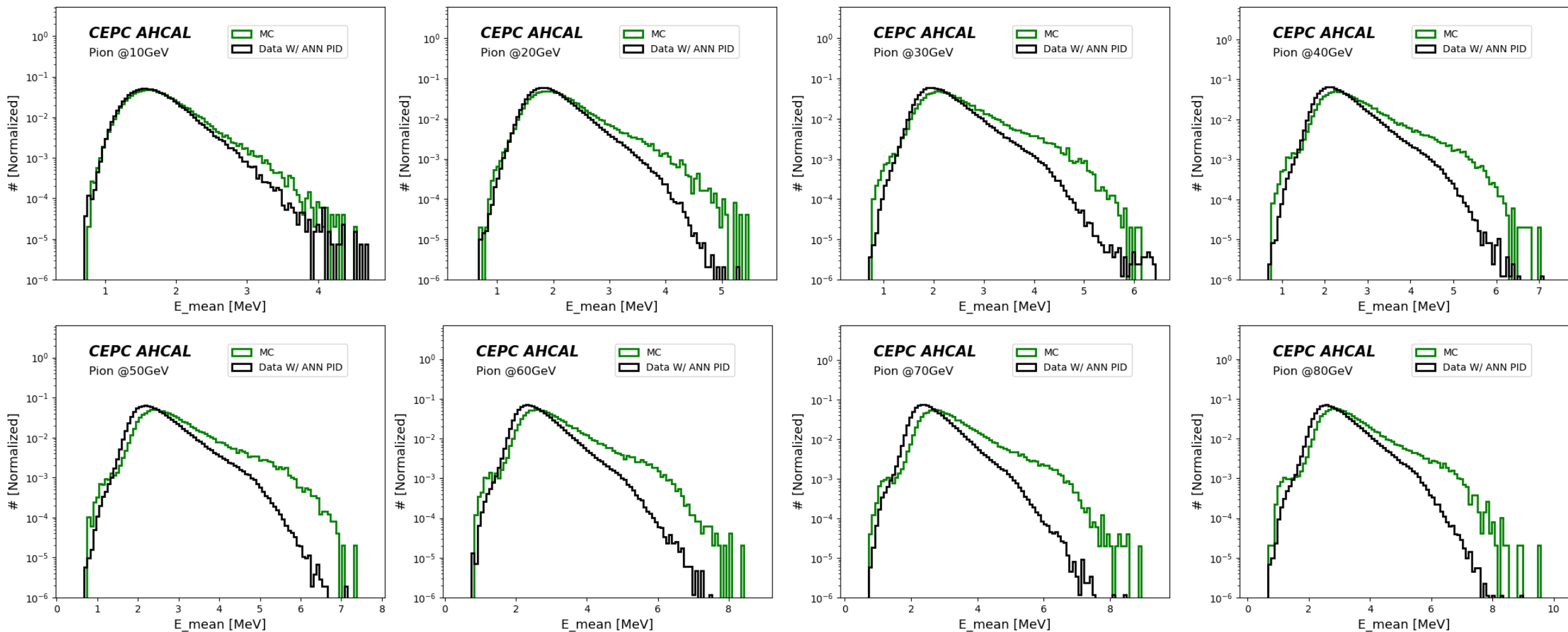
- **Pion** E_max: the highest value of energy deposited on the cell.
- Observe difference in **E_max > 60 MeV** range when event energy is over 50 GeV.



- **Electron** E_max: the highest value of energy deposited on the cell.
- **40 GeV** is a turning point.



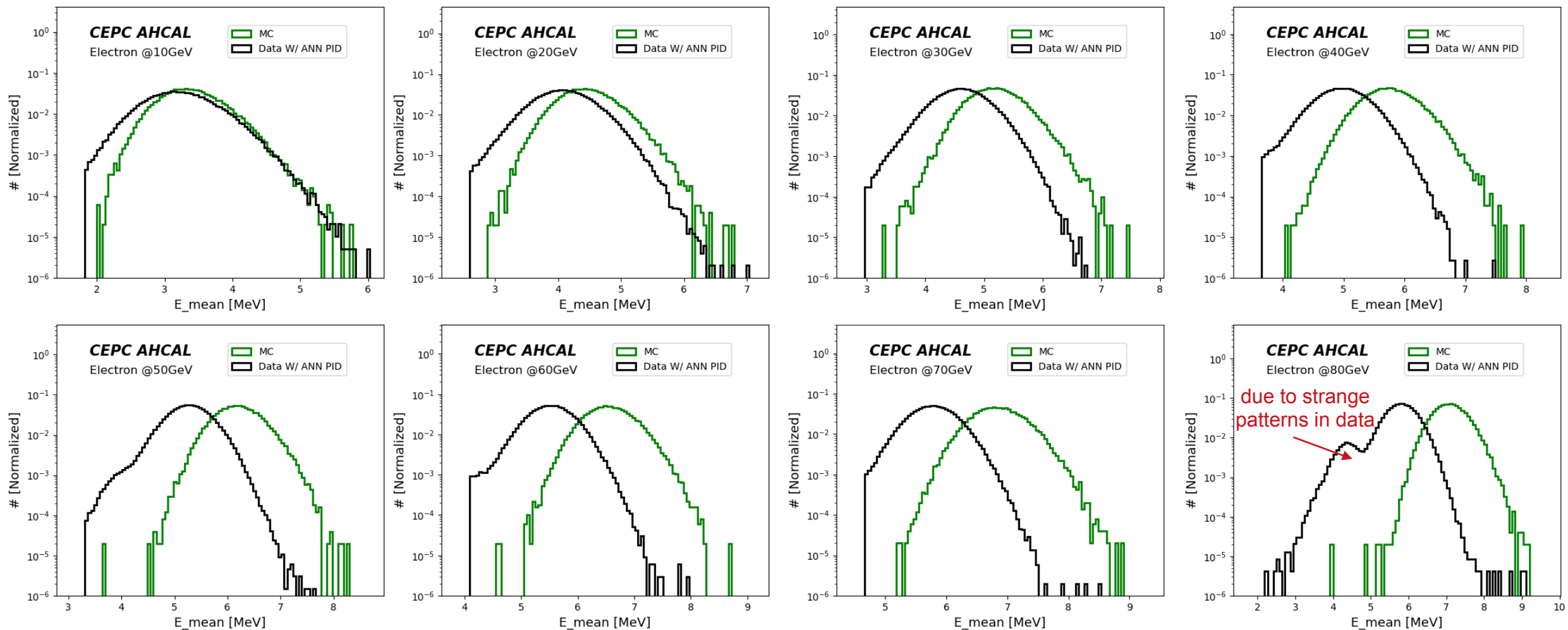
- **Pion** E_{mean} : the mean energy deposited on an cell.
- Observe difference in $E_{\text{mean}} > 2 \text{ MeV}$ range.





E_mean

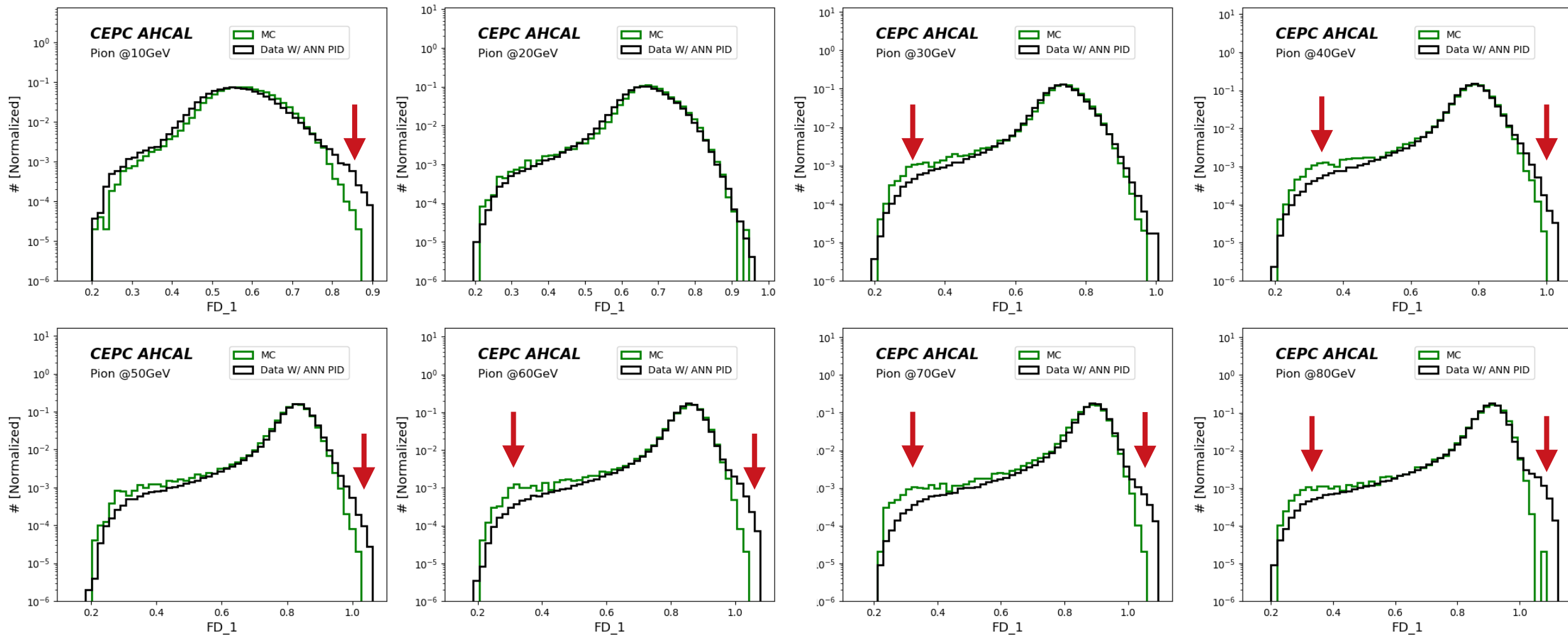
- **Electron** E_mean: the mean energy deposited on an cell.
- Observe difference in **E_mean > 2 MeV** range.





$$FD_1 = \left\langle \frac{\log(R_{\alpha,1})}{\log(\alpha)} \right\rangle, \text{ where } R_{\alpha,1} = N_1/N_\alpha$$

- Difference in **tail**.



➤ Use cut-based PID method, analyze data taken at SPS H2

- Observe different components
- Calculate fractions by artificial cut (see backup)

