EICrecon in the Calorimeter insert and the ZDC

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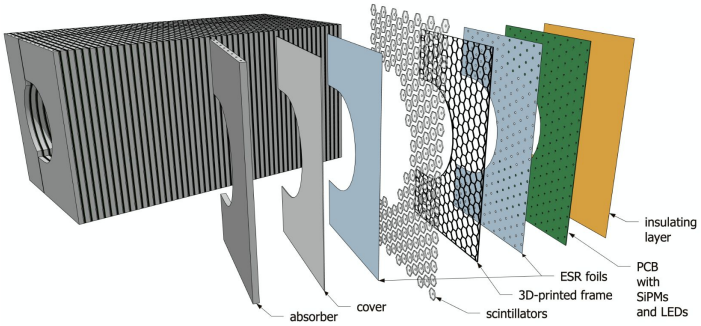
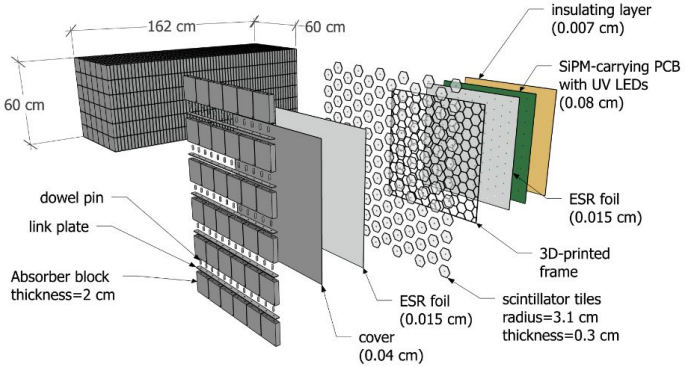
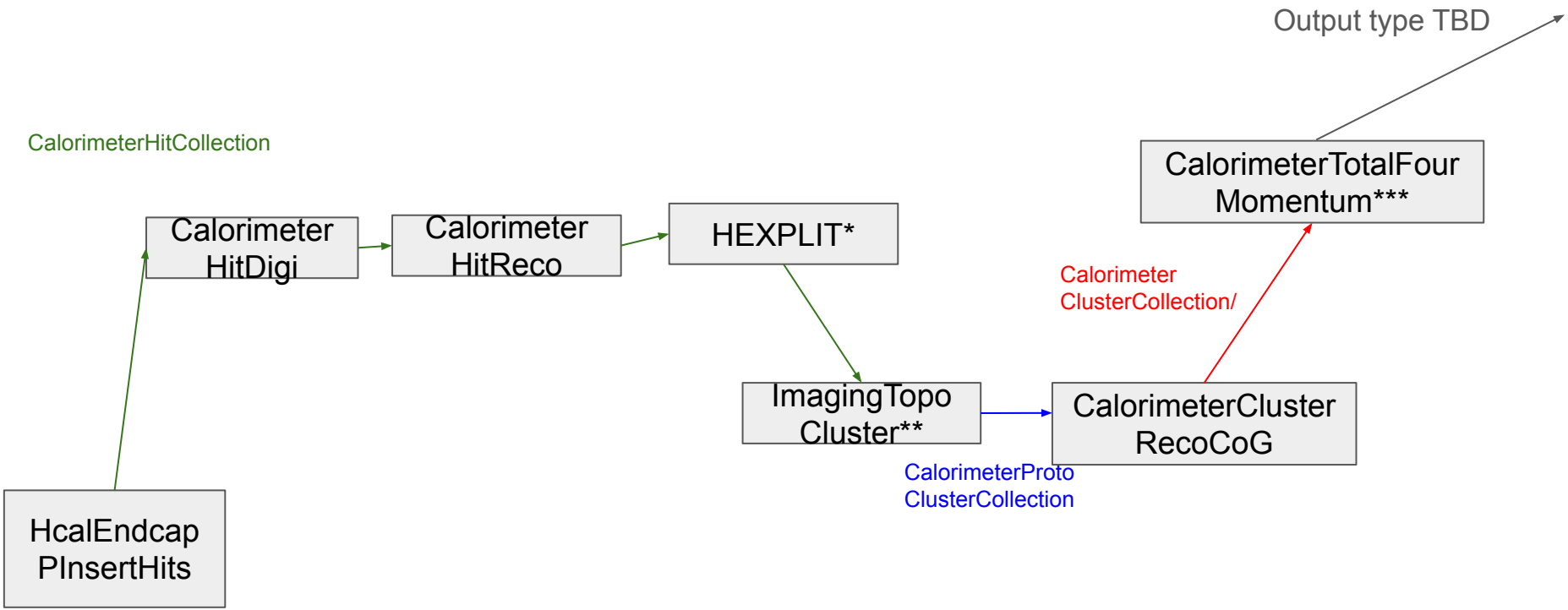
6/12/2024



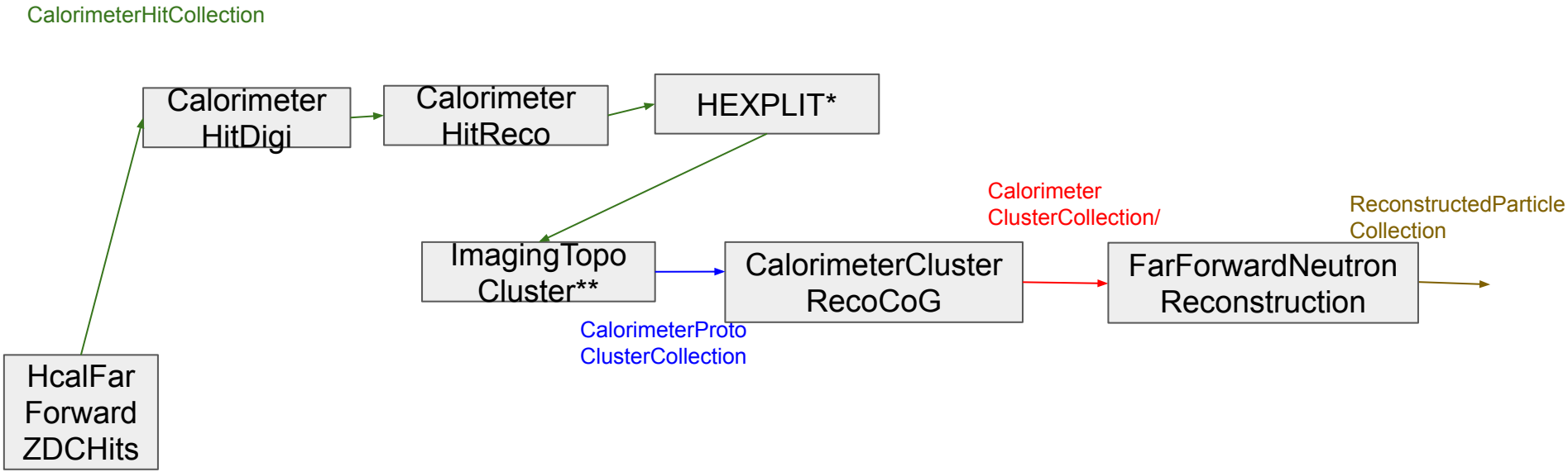


Reconstruction in the Insert in EICrecon



* https://doi.org/10.1016/j.nima.2023.169044
**https://doi.org/10.1140/epjc/s10052-017-5004-5
***Pull request draft: https://github.com/eic/EICrecon/pull/1504

Single neutron reconstruction in the SiPM-on-tile ZDC In EICrecon



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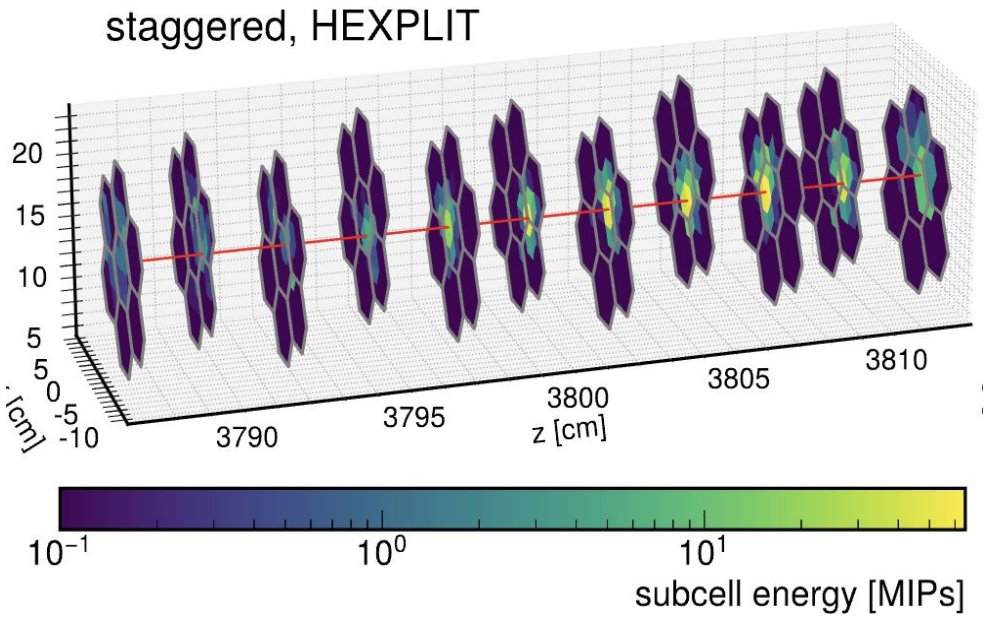
HEXPLIT algorithm*

- Takes advantage of overlapping cells**
- Redistributes energy within a given hit into “subcell hits” in regions defined by overlap between cells.
- Feeds into the clustering algorithm

Cuts:

- t<150 ns +(z at front face of ZDC or Insert)/(speed of light)
- E>0.5 MIP



https://github.com/eic/EICrecon/blob/main/src/algorithms/calorimetry/HEXPLIT.cc

https://github.com/AIDASoft/DD4hep/blob/master/DDCore/src/segmentations/HexGrid.cpp

https://doi.org/10.1016/j.nima.2023.169044

Topological clustering

Using pre-existing ImagingTopoClustering algorithm implemented by Chao Peng.

Starts with a definition of a neighbor:

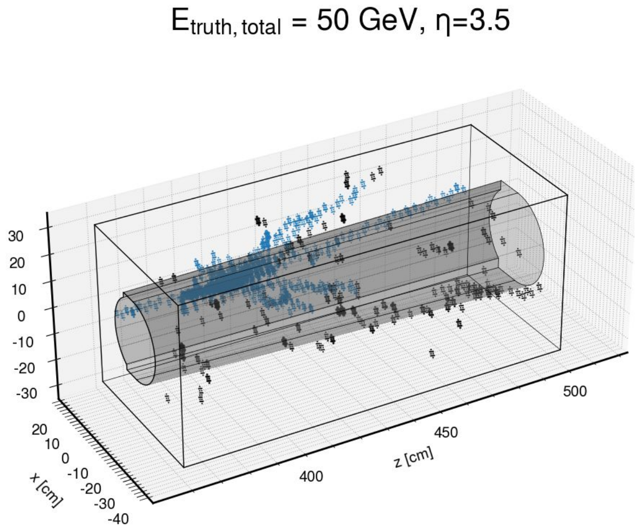
- Same layer: Δx and Δy cut
- Adjacent layers: Δx and Δy cut
  - Default is Δη, Δφ, created option to use Δx and Δy in https://github.com/eic/EICrecon/pull/1502

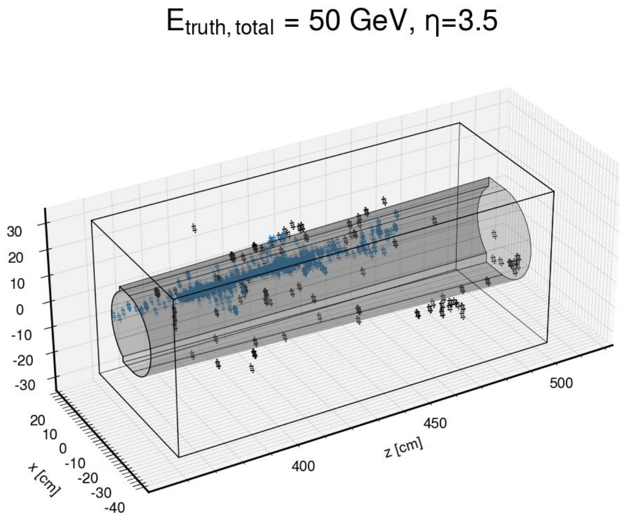
Algorithm:

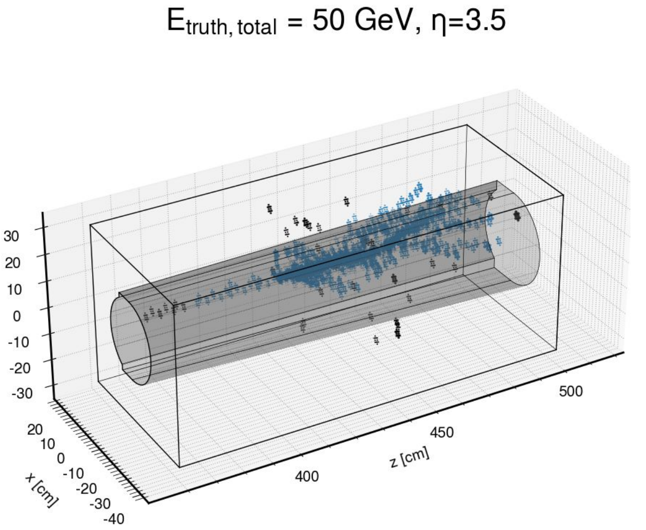
- 3 thresholds are defined for cell energy: *S* for seeding proto-clusters, *N* for growth of proto-clusters, and *P* for the minimum energy of any hit included
- Define seed hits for proto-clusters as those above threshold *S,* and include their neighboring hits in the protoclusters that are above threshold *P*
- For any hit with energy greater than *N,* include all of that hit's neighbors above *P*. (and merge if it has neighbors in more than one protocluster)
- Reject cluster if it does not have a sufficient number of hits:
  - Minimum number of hits changed from 10 to 100

https://github.com/eic/EICrecon/blob/main/src/algorithms/calorimetry/ImagingTopoCluster.h

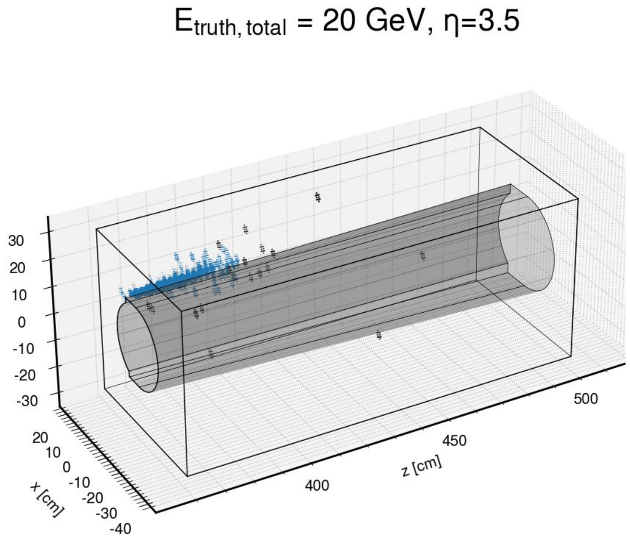
Some pion showers in the Insert

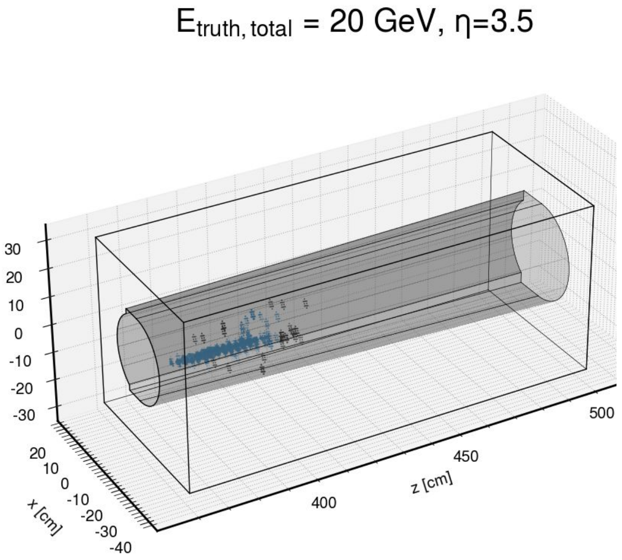


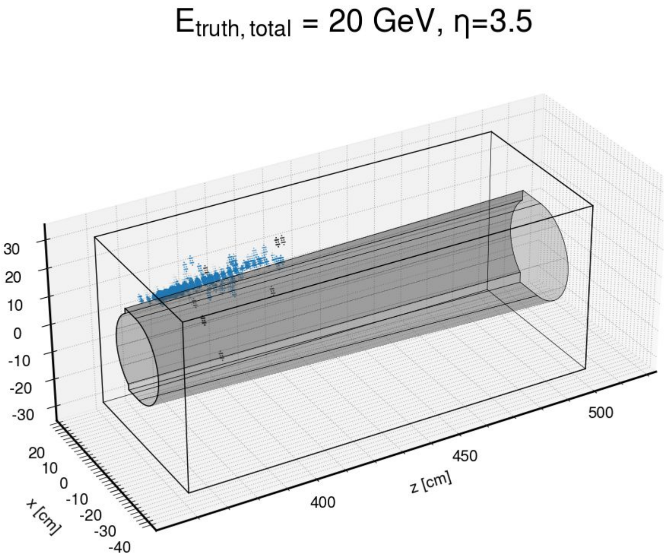




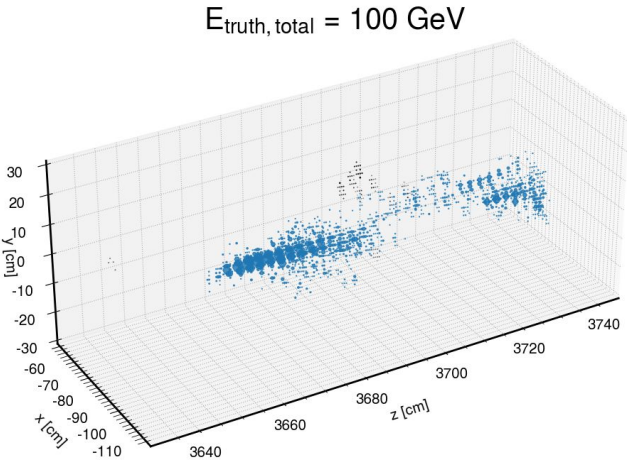
Some photon showers in the insert

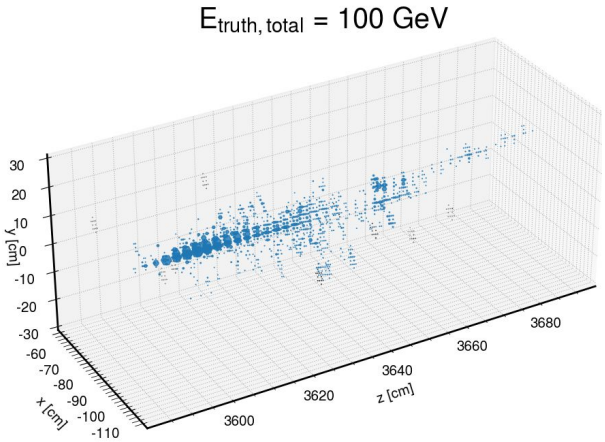


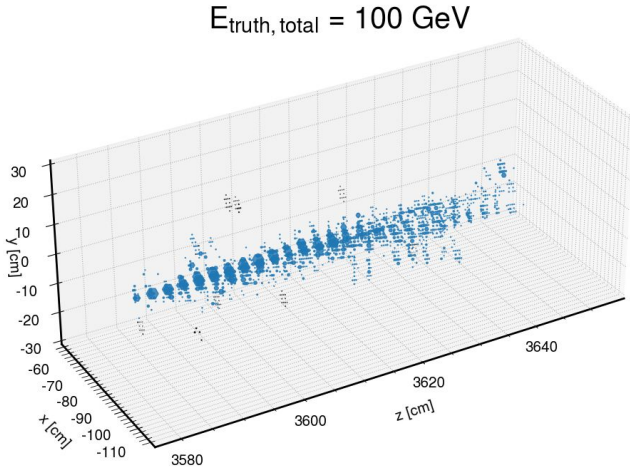




Some neutron showers in the ZDC







Conclusions

- Topo clustering has been modified for both ZDC and insert
- Use Δx and Δy for hits in different layers, rather than using Δη, Δφ.
- Require at least 100 subcell hits per cluster, since the previous threshold, 10, could be exceeded in using a single hit
    - Cleans up isolated hits that don’t belong in a cluster