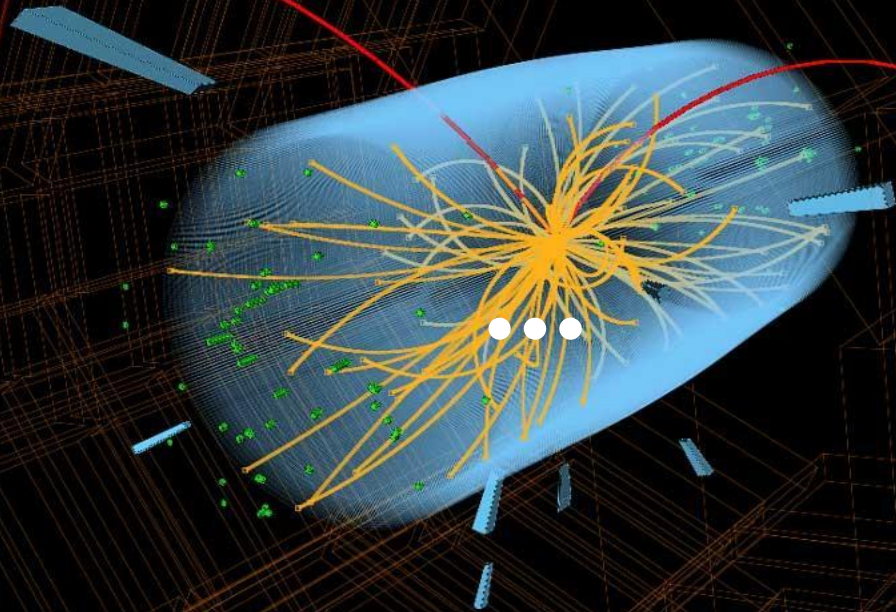


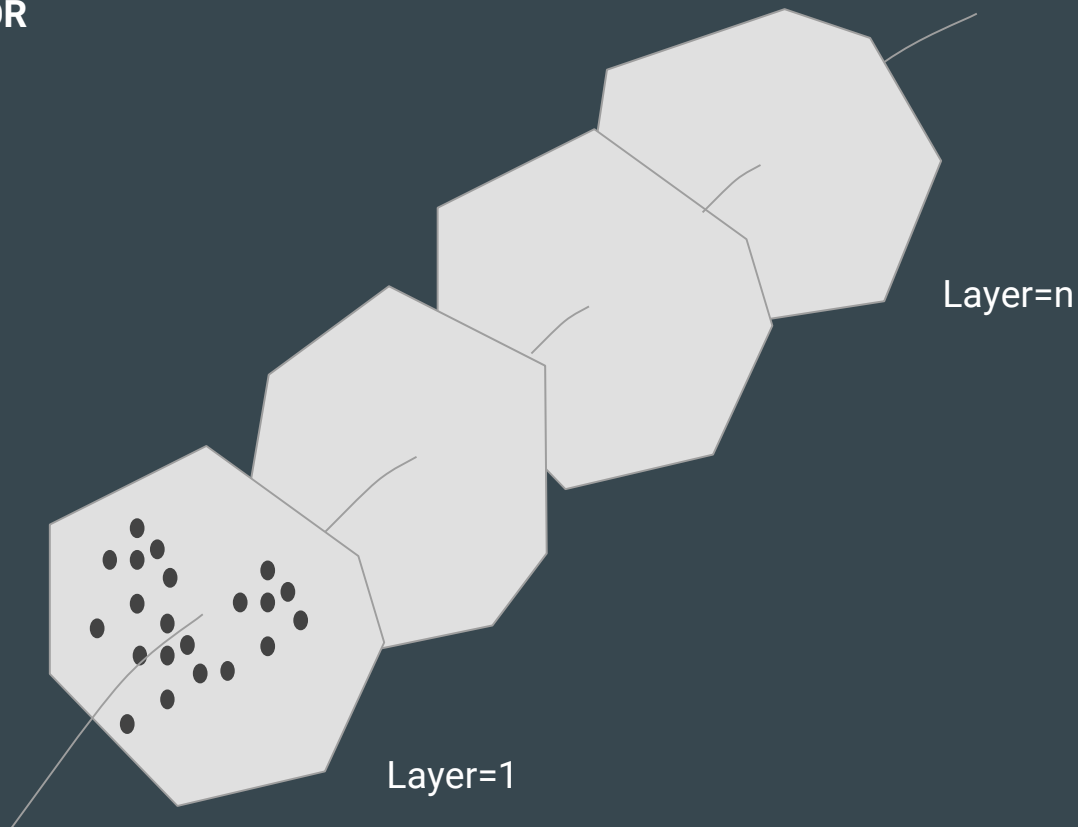
9th CERN Patatrack Hackathon @TU/e

CMS Particle Trajectory Reconstruction



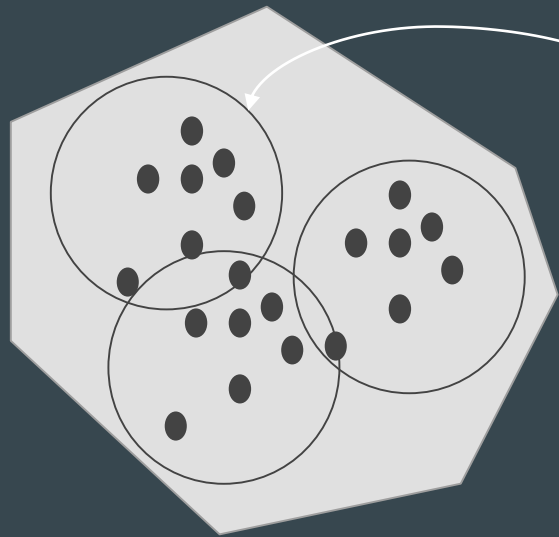
Auditorium 14 Group

CMS DETECTOR



Motivation

- Energy is important, but not as a dimension.
- KMean : allows for weights.
- HDBScan: better in multiple particle scenarios.
 - density based
 - does not require number of cluster
- Results are comprehensible.

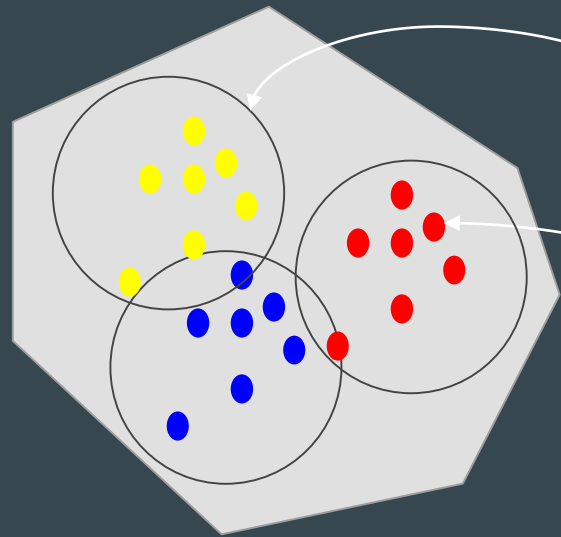


Layer=1

Determine the number of
clusters in a layer

HBDSscan

KMeans with elbow
method



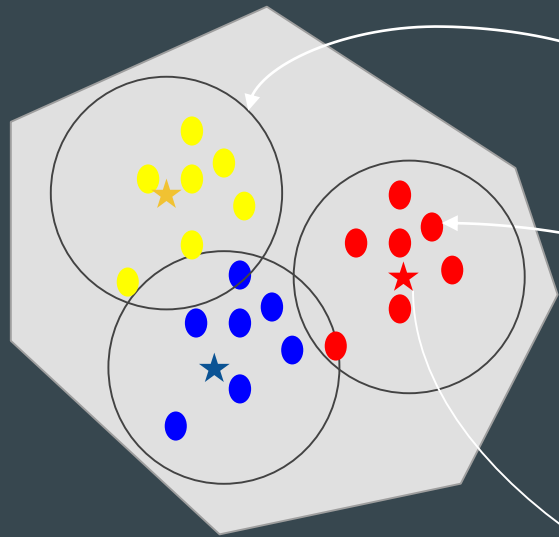
Layer=1

determine the number of clusters in a layer

cluster points on each layer



KMeans



Layer=1

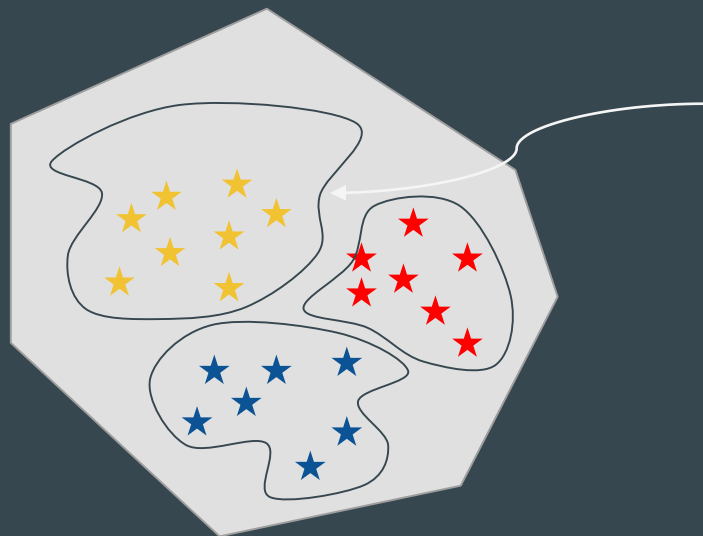
determine the number of clusters in a layer

cluster points on each layer

determine the centroid of the clusters



KMeans



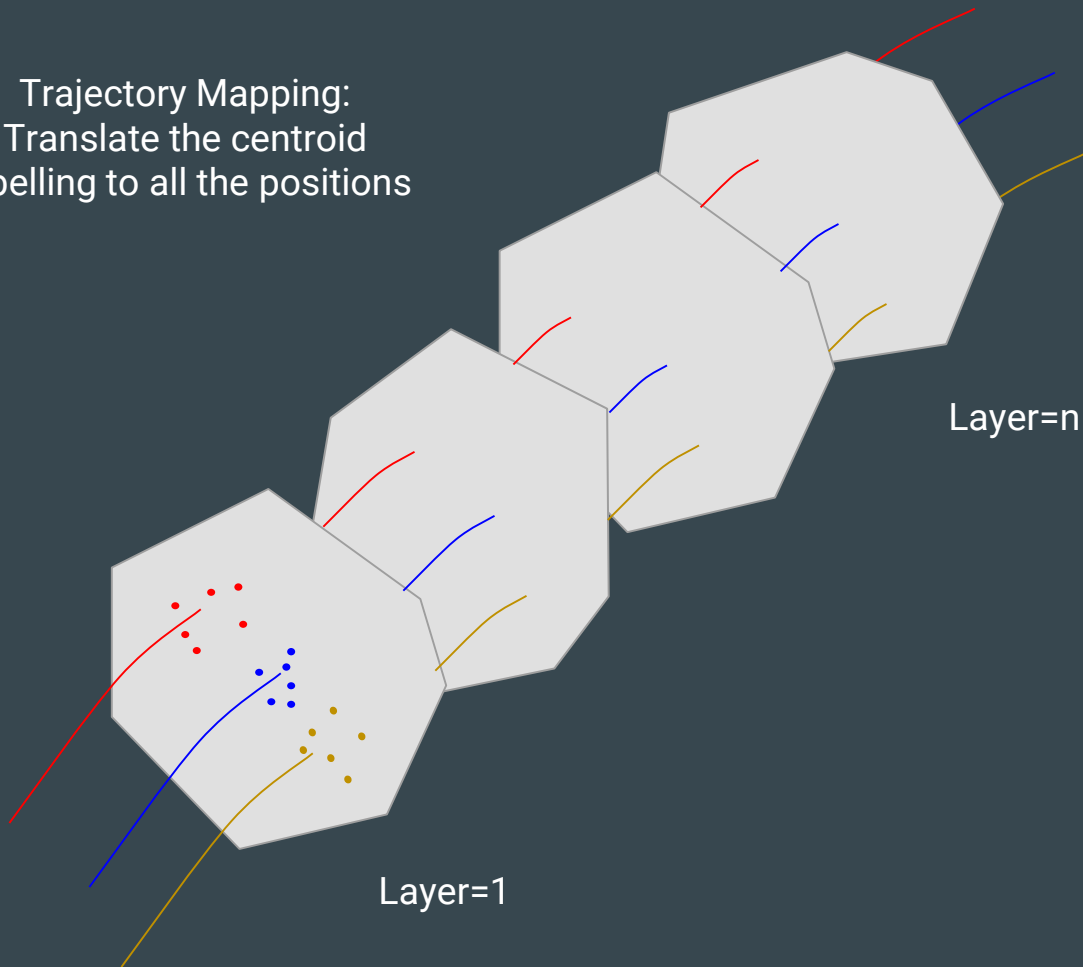
Layer=1...n

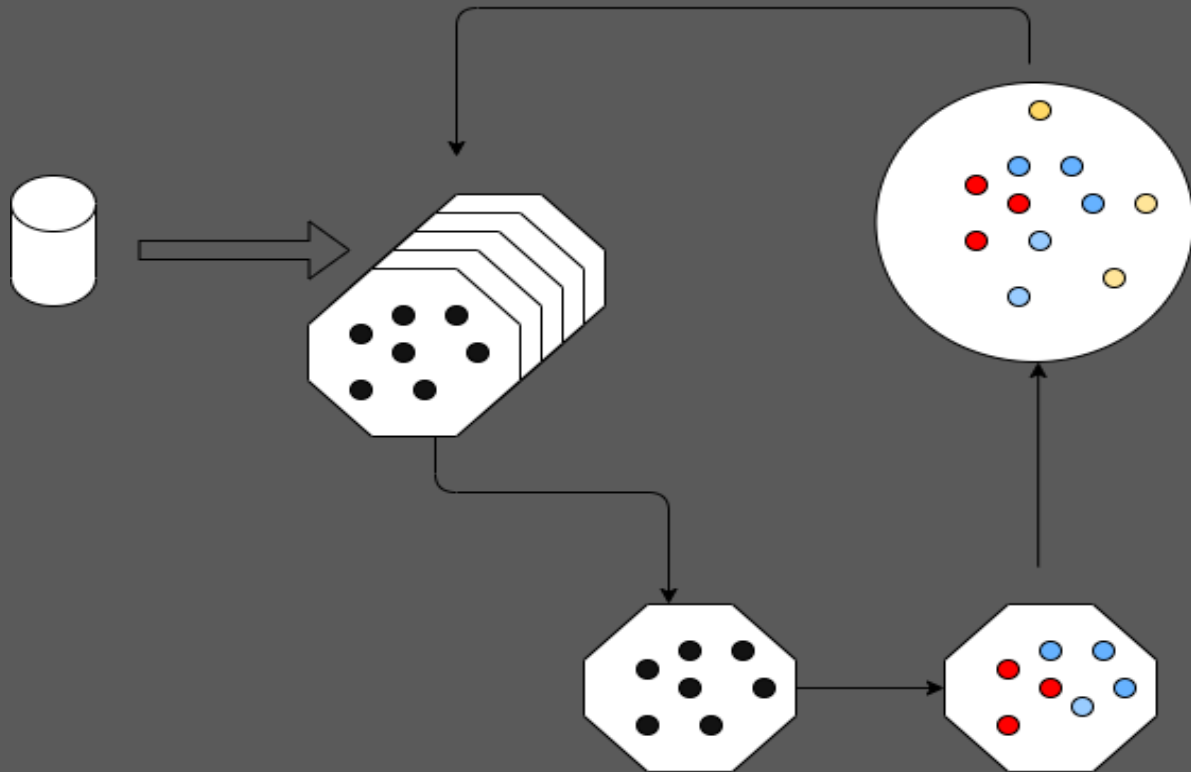
cluster the centroids
according to particle



HBDScan
using euclidean distance
to assign outliers to
clusters

Trajectory Mapping:
Translate the centroid
labelling to all the positions





ARCHITECTURE

Weighted Unsupervised Parallelized Spatial Clustering (WUPSC)

Future Possible Improvements

- Automatically select the appropriate methods(HDBScan/Elbow method) for choosing the number of clusters (k) instead manually
- Including pos_z when doing layer level clustering, considering the discrepancy of the distances between the layers
- Using grid search for the hyper parameter tuning
- Using weighted(energy) HDBscan
- Considering multiple particles contribution (energy fraction) to a layercluster