Study of the clustering algorithm for the calorimeter energy reconstruction in Shoe

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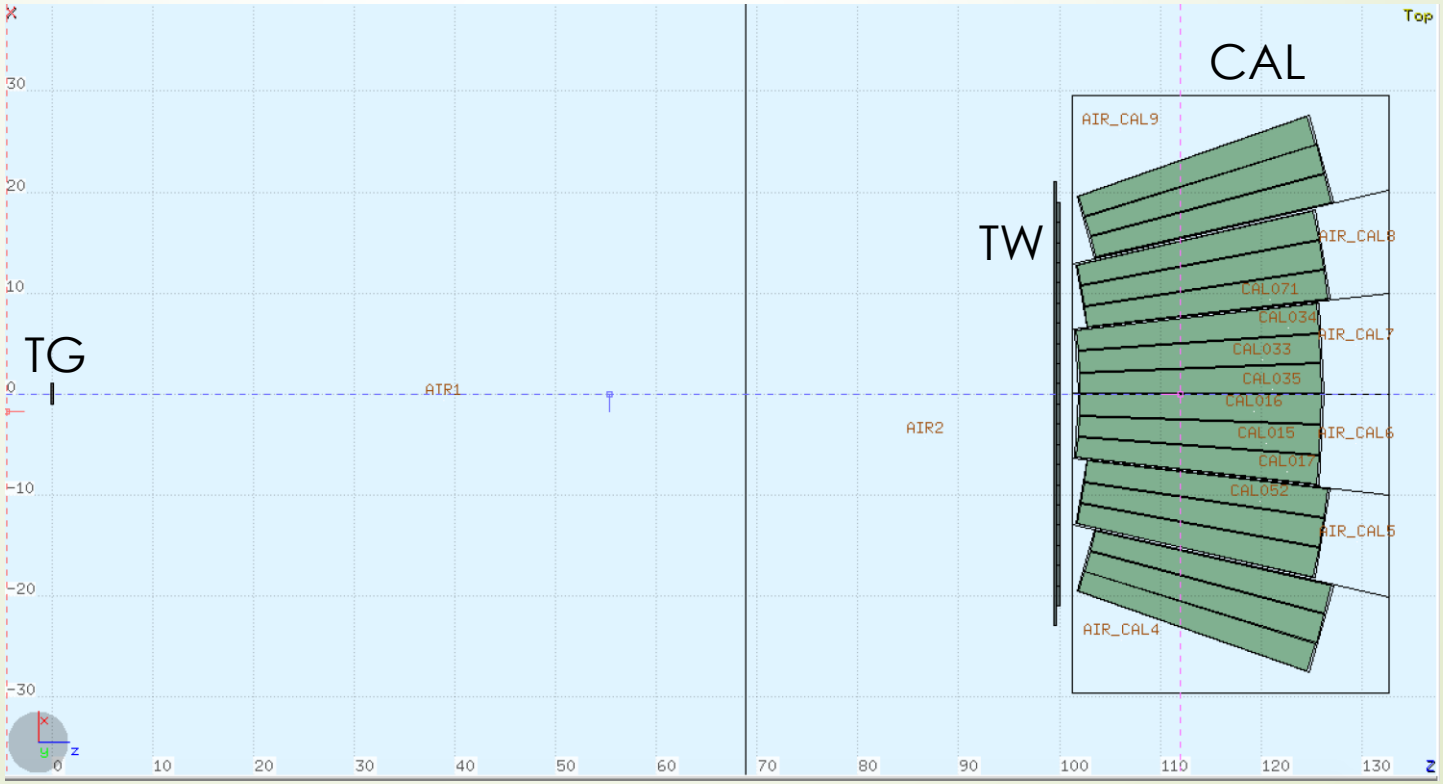
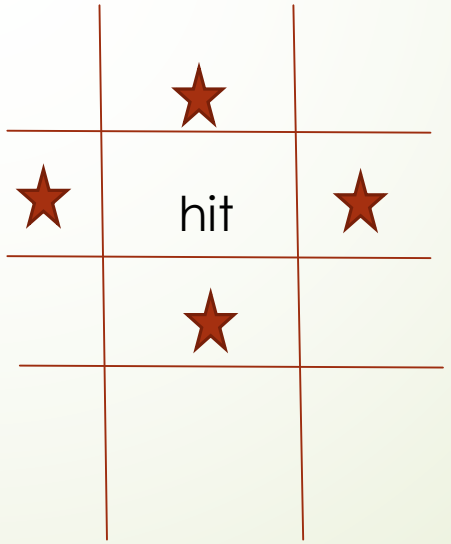
Study on MonteCarlo simulations

- FLUKA simulation:
  - Beam: ^{16}O @ 400 MeV/A
  - Target (TG), TofWall (TW) and Calorimeter (CAL)
  - 10k primaries



The Clustering algorithm

- A cluster is created starting from a crystal hit inside the calorimeter
- Loop over four adjacent crystals (above, below, right and left) to current crystal
- If an energy release in one of the hits is found, a new crystal is added to the cluster
- The ShapeCluster function is called in an iterative way



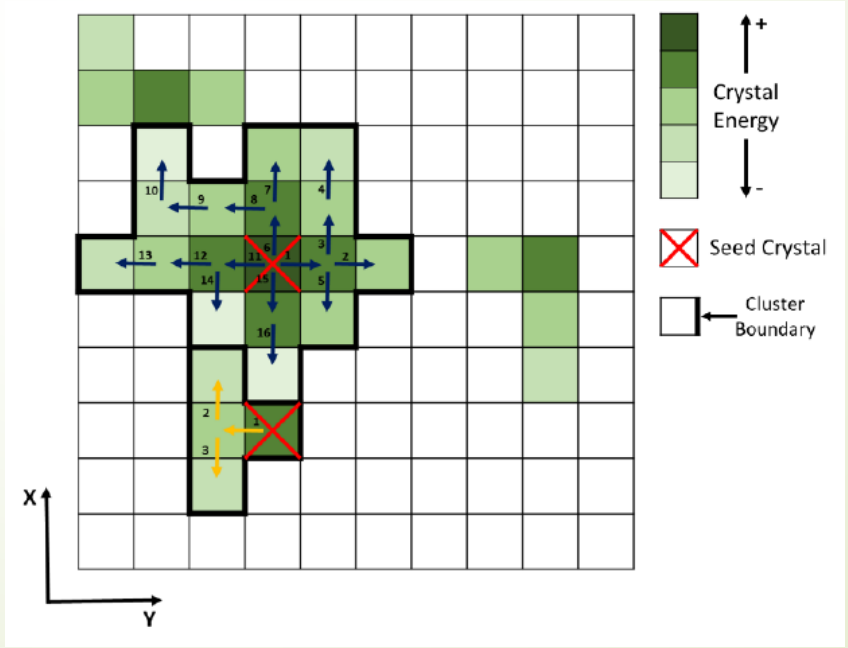
The Clustering algorithm

- Computation of the centroid of the cluster and the total charge:

- $pos = \left(\frac{\sum_{cry} x(cry) charge(cry)}{\sum_{cry} charge(cry)}, \frac{\sum_{cry} y(cry) charge(cry)}{\sum_{cry} charge(cry)}, \frac{\sum_{cry} z(cry) charge(cry)}{\sum_{cry} charge(cry)} \right)$
- $charge_{tot} = \sum_{cry} charge(cry)$
- The crystal id corresponding to the maximum energy release is recorded (seed of the cluster)

Clustering in the literature

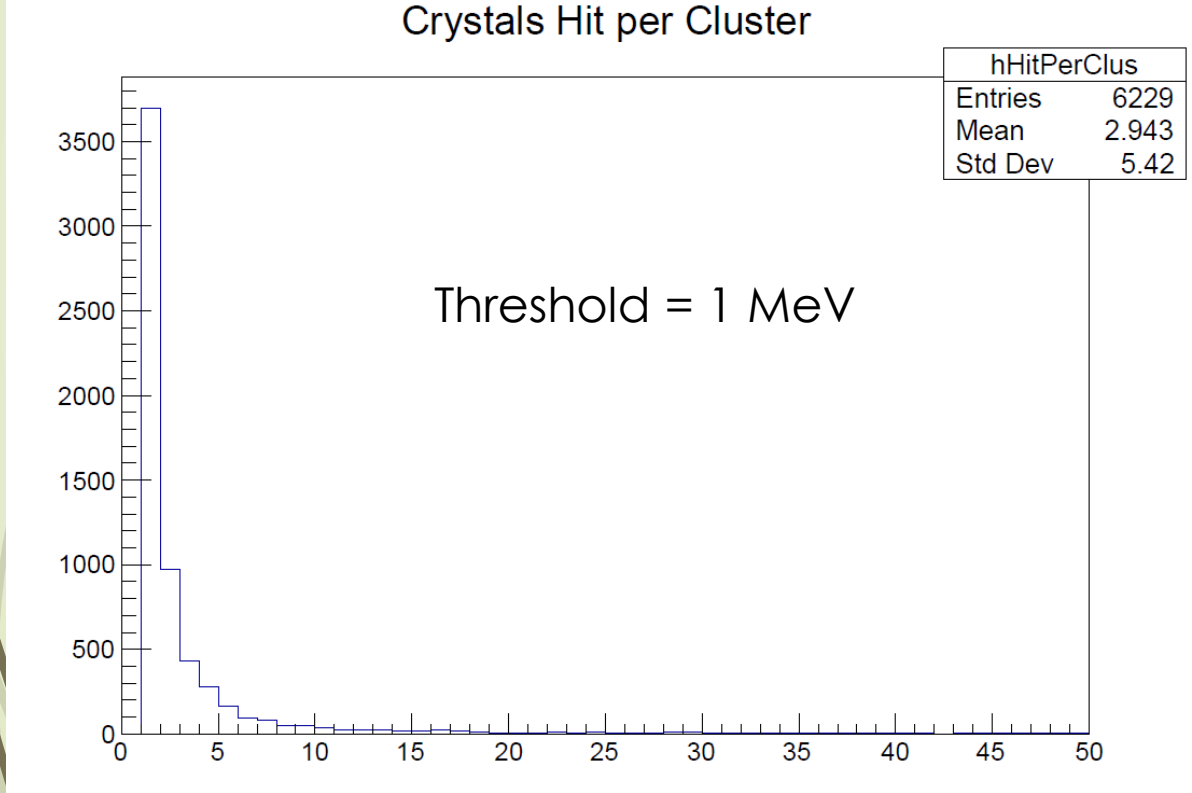
- PADME Island algorithm:
- The algorithm starts by looking for a local energy maximum: cluster seed
- Neighboring crystals are then attached to the cluster by applying a recursive search
- Requirement: the energy of the neighbor should be below that of the current crystal

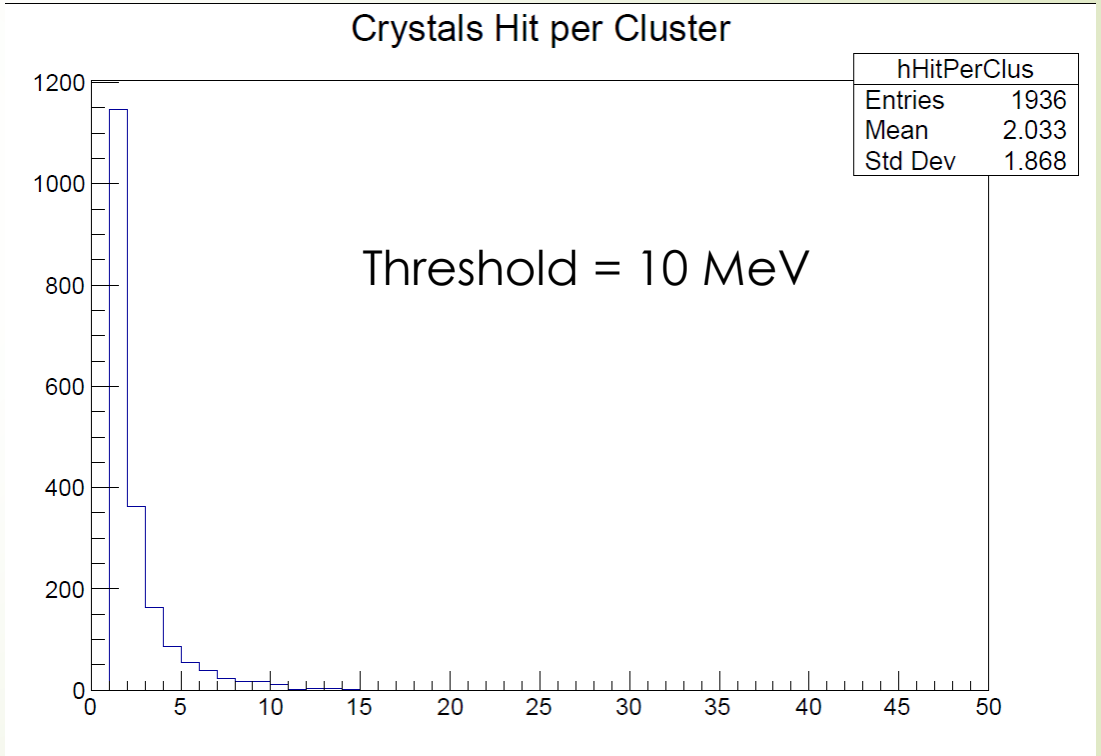


Differences between the two approaches

- The PADME algorithm starts from a seed crystal
- In the PADME algorithm new crystals are added only if they are above a certain threshold, in the FOOT algorithm all the energy release are included (this is now changed, see next slide for a preliminary test)
- In the PADME algorithm adjacent crystals are added only if the energy release is lower compared to the current crystal to avoid overlapping clusters
- In the FOOT algorithm there's no check for overlapping clusters

Preliminary tests changing the threshold

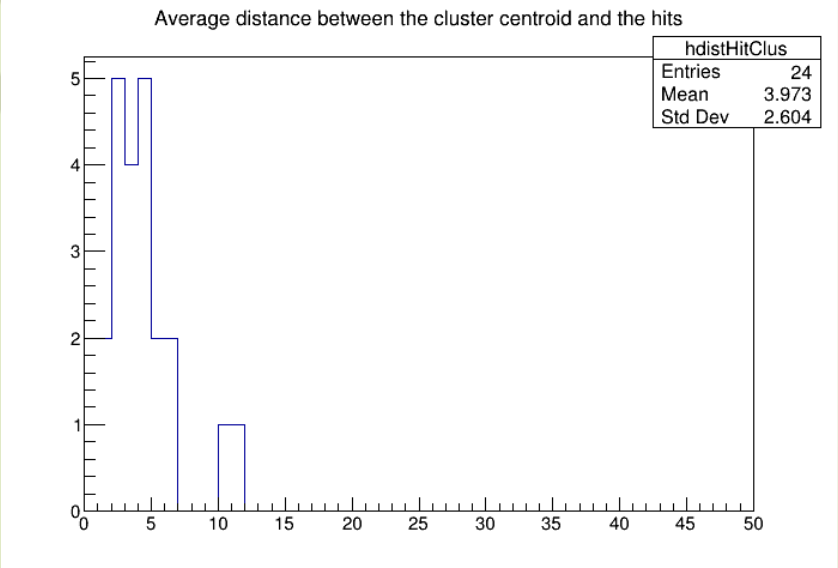


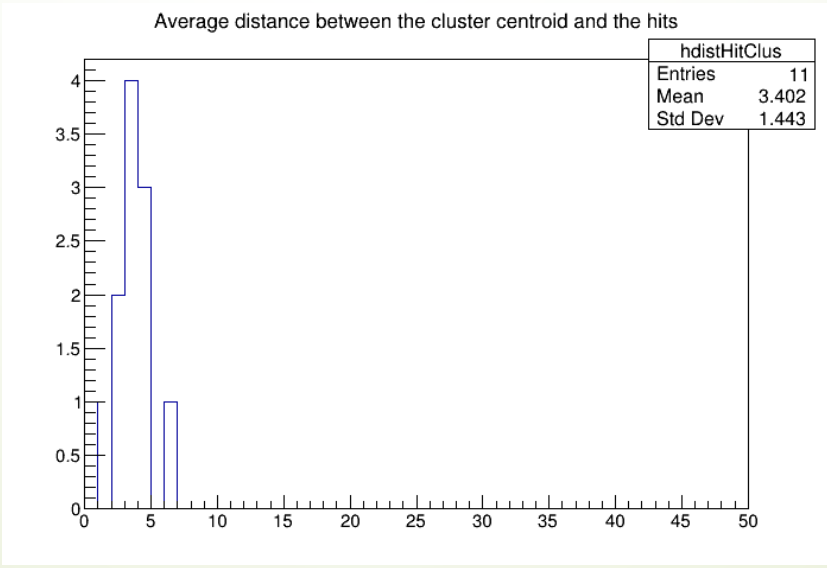


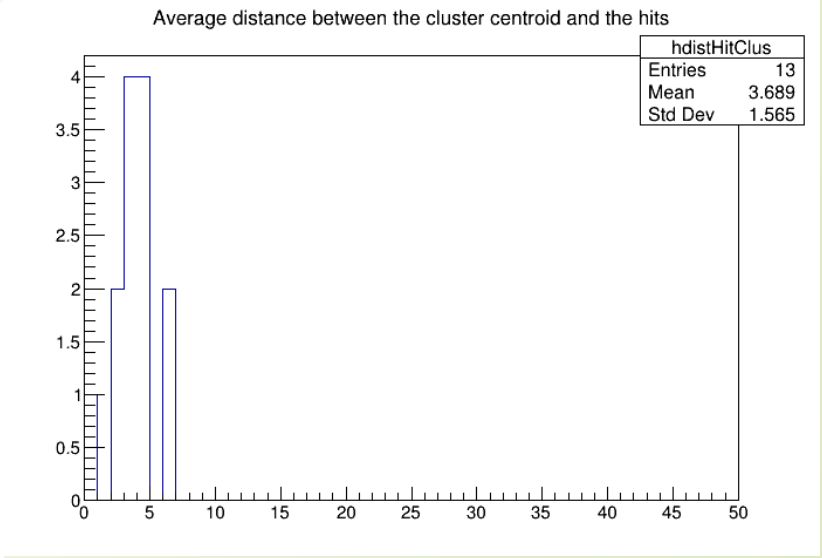
If the hit is below the threshold, a flag is associated with the hit to identify it as not valid; we should discuss if it's better to remove the hit

Overlapping clusters

- Ongoing tests to understand if there are overlapping clusters; from preliminary results the average distance between the cluster centroid and the hits of the cluster is approximately 4 cm
- Ongoing tests to quantify how often independent particles are mixed in the same cluster







Total energy reconstruction in the calorimeter

- Clustering alghoritm
- Temperature reading of the crystals integrated in the DAQ and temperature correction
- Particle range correction, probably available after Heidelberg data taking