

# LumiCal Clustering Algorithm

Oleksandr Borysov, Tel Aviv University

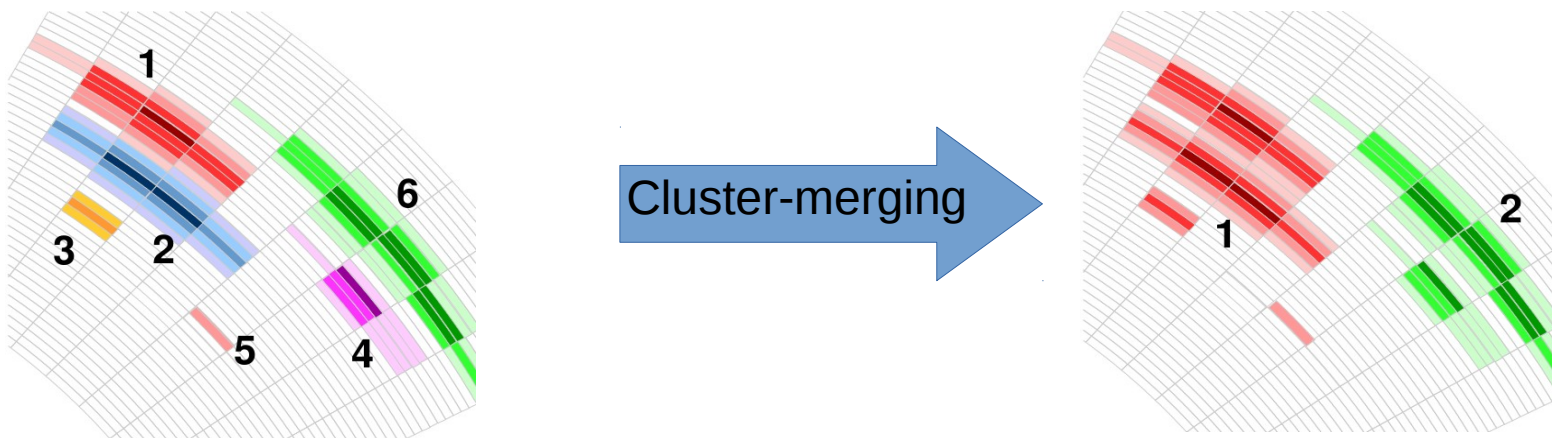
Clustering WG Meeting, 28 July 2014

# LumiCal Clustering Algorithm

- The goal is to measure polar and azimuthal angles
- Studied by Iftach Sadeh at TAU
- Code reworked by Andre
- Reconstruction stages:
  - 2D clustering;
  - Composing 3D clusters;
  - Correcting the parameters of the cluster based on their energy density distribution.

# LumiCal 2D Clustering Algorithm

- There are only a few hits from the shower in the first layers of LumiCal
- In the first layer may also be contributions from the backscattered particles or background processes
- Clustering algorithm starts by considering the information in the shower-peak layers
- Near-neighbor clustering approach uses gradient of energy around local shower-centers (figure in the bottom)
- Cluster-merging based on the weights proportional to energy and inverse proportional to the distance. Several approaches to the weight calculation were implemented.



# LumiCal Shower Shape

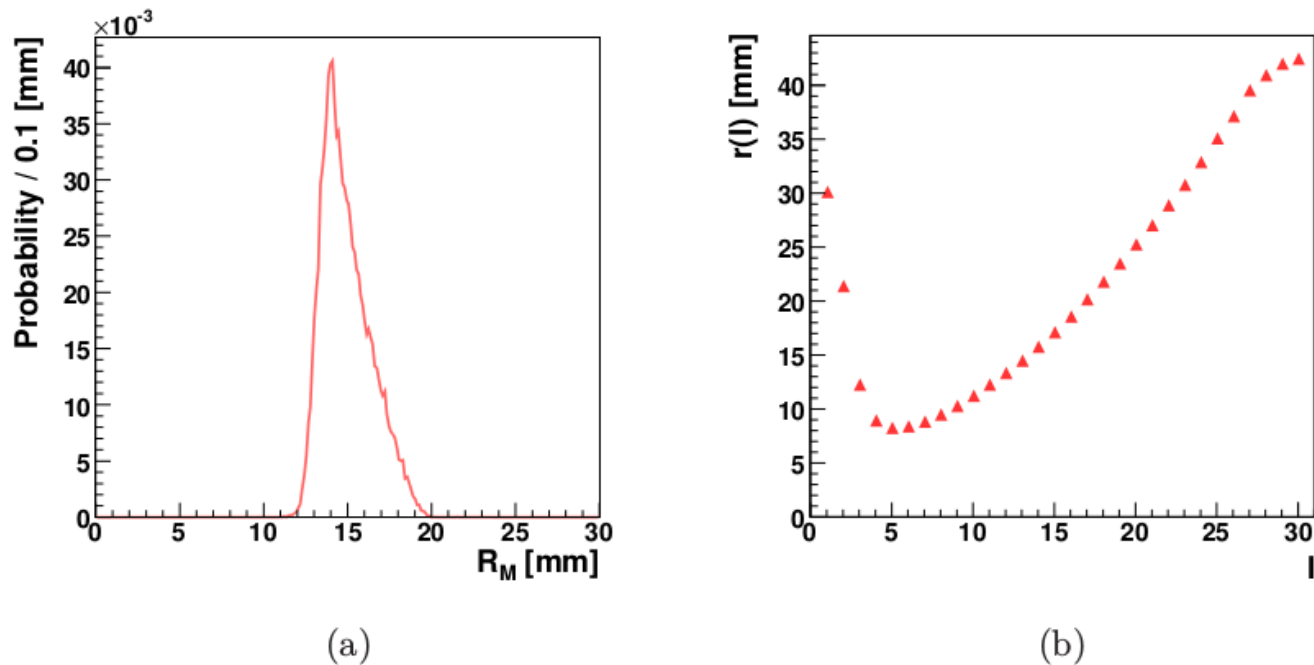


Figure 3.5: (a) Distribution of  $R_M$ , the distance around the global-shower center, in which 90% of the integrated shower energy may be found. (b) Dependence on the layer number,  $\ell$ , of the layer-radius,  $r(\ell)$ , which is the distance around the local shower-center in which 90% of the energy of a layer is deposited.

# LumiCal 3D Clustering Algorithm

- The aim is to determine the total number and position of the showers.
- The number of showers is determined as the most frequent value of the layer-cluster number in the collections in the shower-peak layers
- Propagation of each shower through LumiCal, using the information from the shower-peak layers and association of the cells from non-shower-peak layers with one of the global showers.
- Weighing method is used, similar to the one in the 2D reconstruction.

# Implementation

- <https://svnsrv.desy.de/public/FCAL/Software/FcalClusterer/trunk>
- LumiCalClustererClass::processEvent( EVENT::LCEvent \* evt )
- Practically each step of the algorithm is implemented as a method of LumiCalClustererClass class extensively using c++ standard containers.

# Summary and Plans

- Use LumiCal cluster reconstruction with LuCaS for tracking detector study.