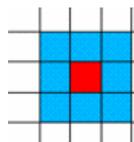


-- AdamMatyja - 10-Nov-2010 Unfolding of ALICE EMCAL clusters.

- weight: $w = \max(0; 4.5 + \log(E_i/E_{clus}))$
- distance: $r = \sqrt{(dy)^2 + (dz)^2}$
- fitting function: $f(r) = p_0 \exp(-r^{p_2} (1/(p_2 + p_3 r^{p_1}) + p_4/(1 + r^{p_5} p_6)))$

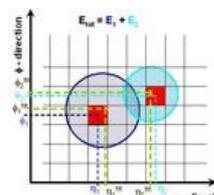
Method of unfolding:

- The first step to begin unfolding is to determine the number of maxima in the cluster. It is done by checking neighbours cell by cell. A neighbour is defined as being two cells which share an edge or a corner (see figure).



It is different from what we have during cells association to cluster. There is already build cluster now and there is no danger to expand the cluster to whole the EMCAL super-module. The method uses the minimum energy difference between two local maxima (neighbour cells). In other words, there must be the pronounced maximum to be treated as the maximum. In the particular case when two neighbouring cells have a similar energy deposit (the difference between energy of two cells is below a certain value) the cluster is treated as a flat one with zero maxima. Such a case corresponds either to very energetic neutral particle decaying to two photons with very small opening angle or one photon coming in between two cells or simply a noise. The outcome is divided on two cases. In the case there are no pronouncing maxima or there is only one maximum unfolding is not applied. If there are at least two maxima the procedure of unfolding starts running.

- The next step is the fit.



The energy distribution within the cluster with several maxima is fitted as a superposition of single clusters. The initial parameters are coming from number of maxima. Each maximum has three degrees of freedom. Two of them are cell coordinates on the plane (cell indices in the float row-column coordinate system). The third one is the energy deposited in that cell. The shape of energy distribution in the single gamma is fixed during the fit. TMinuit package is called to minimize the χ^2 between the shower shape function and the energy deposit in each cell in the cluster with respect to the distance to the center-of-gravity of the cluster which is being unfolded. The outcome of the fit is the set of parameters which describe positions of maxima and energies of unfolded clusters. The idea of fit is illustrated on the figure.

- The last step is to create unfolded clusters. At first the energy deposited in each cell in accordance with the fit (without fluctuations) is calculated. Later this number is corrected to fluctuations in accordance with actual energy deposition so that energy deposited in each cell is distributed between new clusters proportionally to theirs contribution to the fit. There are as many new clusters as many local maxima found in the cluster. When unfolding succeeded the cluster before unfolding is replaced by new clusters.

Technical info:

The class AliEMCALUnfolding was written for the purpose of unfolding. The unfolding can be called during reconstruction. One has to set the flag fToUnfold to value kTRUE to proceed with the unfolding (this flag is set in OCDB). The procedure is initialized once (in the AliEMCALClusterizer class). During the initialization parameters of the function which describes the shower shape are set (also from OCDB). There is also set the value of fLocalMaxCut as the minimum energy difference between two local maxima. Then the routine is called (via MakeUnfolding) in each event (in the method Digits2Clusters of both classes AliEMCALClusterizerV1 and AliEMCALClusterizerNxN) just after clusterization (via MakeClusters) and before the calculation of cluster's features like, for example, a value of the main axis of a cluster. As the input of the unfolding we take EMCAL digits (AliEMCALDigit) array and EMCAL reconstructed points (AliEMCALRecPoint) array. Then for the calculation of the number of local maxima in the cluster the method

GetNumberOfLocalMax (in AliEMCALRecPoint) is called. In the just mentioned method AreNeighbours is called. It is worth to stress that the implementation of the function in AliEMCALRecPoint class is different from the function in the AliEMCALClusterizer class. After that TMinuit is called to do the fit. The MIGRAD option is used for minimization. Then energy in each cell is split in accordance to the fit. In the output new reconstructed points are stored together with fraction energy of digits belonging to the cluster.

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