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# Electron Reconstruction in BeamCal

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# Overview

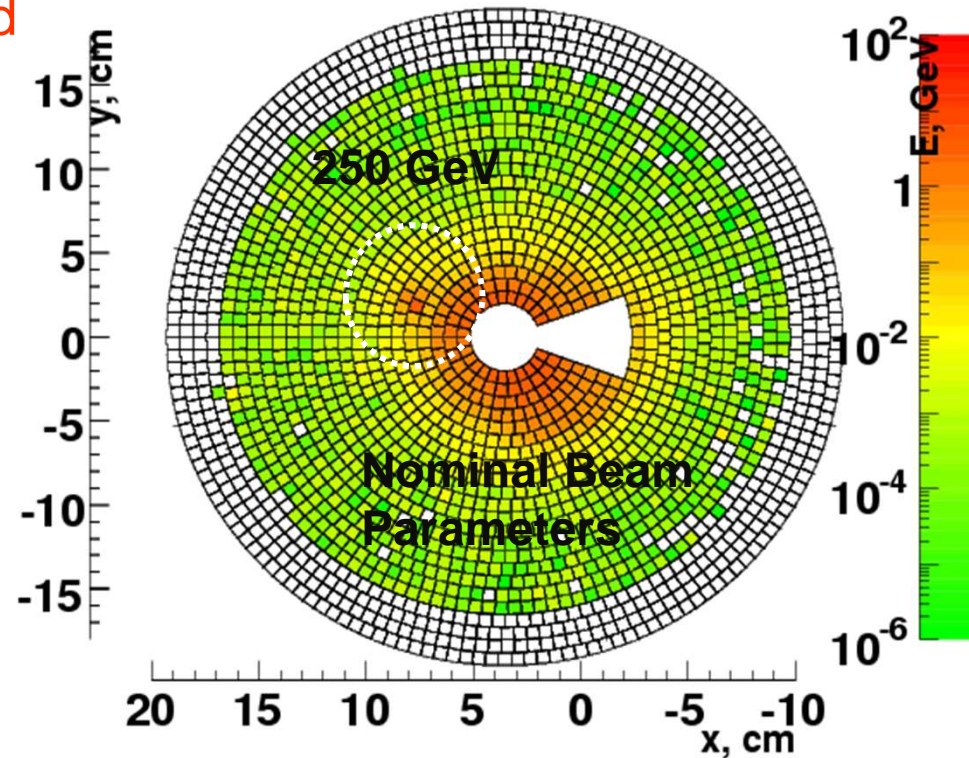
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- BeamCal reconstruction algorithm – a short reminder.
- Background subtraction procedure implemented in Marlin.
- Marlin processor for the BeamCal reconstruction.
- Some results.

# BeamCal Reconstruction

Difficult, due to large background from Beamstrahlung pairs:

- Background subtraction
- Cluster search



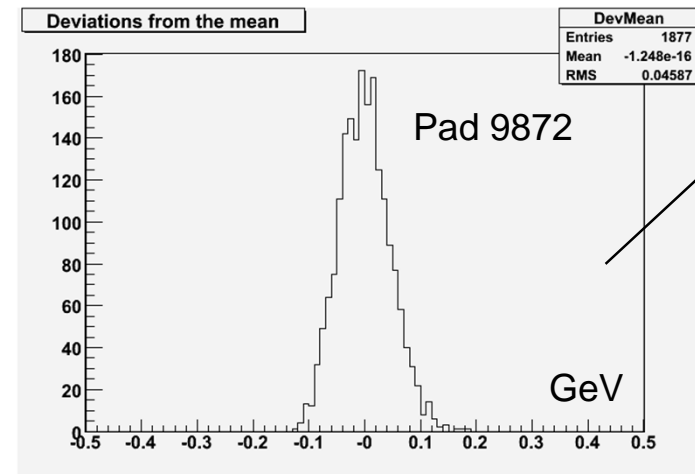
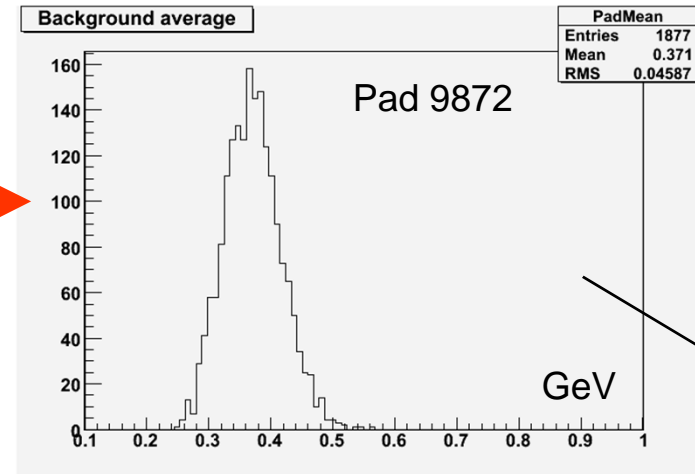
# Background Subtraction

Background fluctuates from one BX to the other.

1877 BX

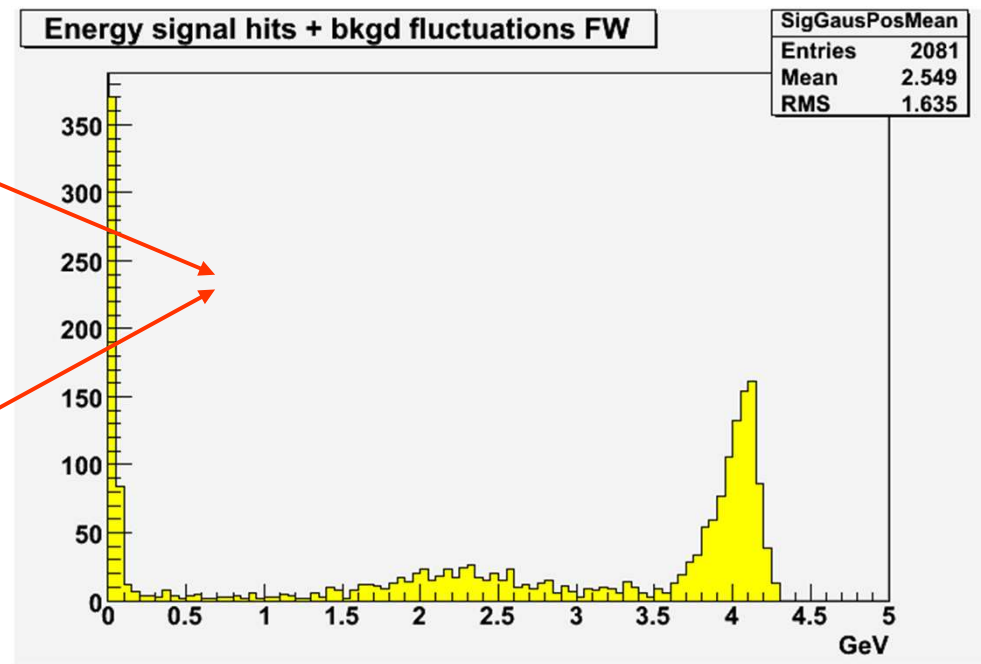
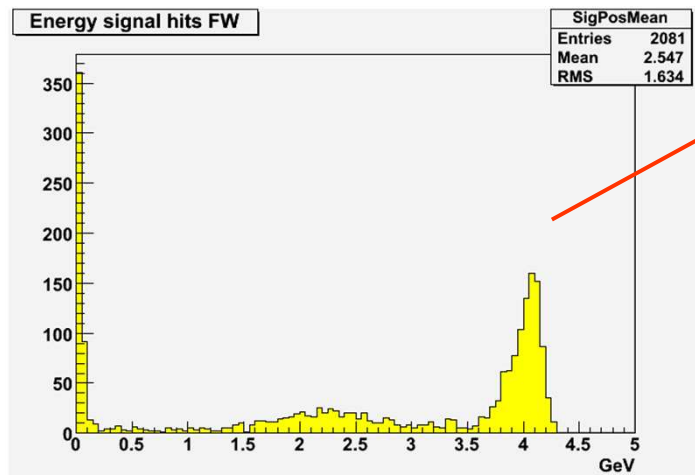
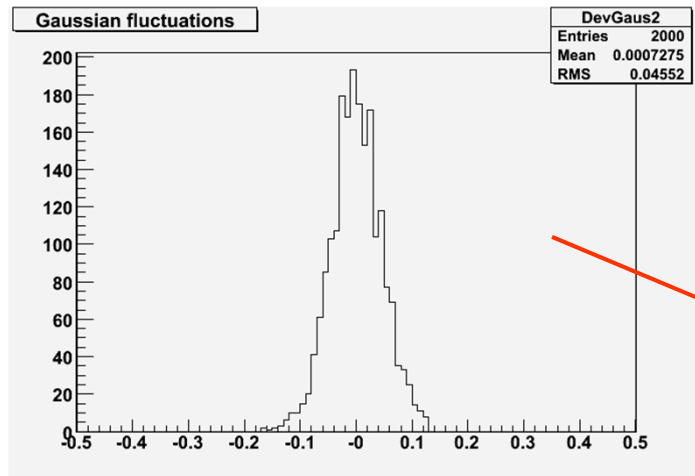


- Calculate average and rms of the background energy deposition in each of the detector pads and produce a map of the background depositions;
- Subtract the value of the average background energy from the deposition in each pad;
- Equivalent with adding background fluctuations to the signal energy deposition.



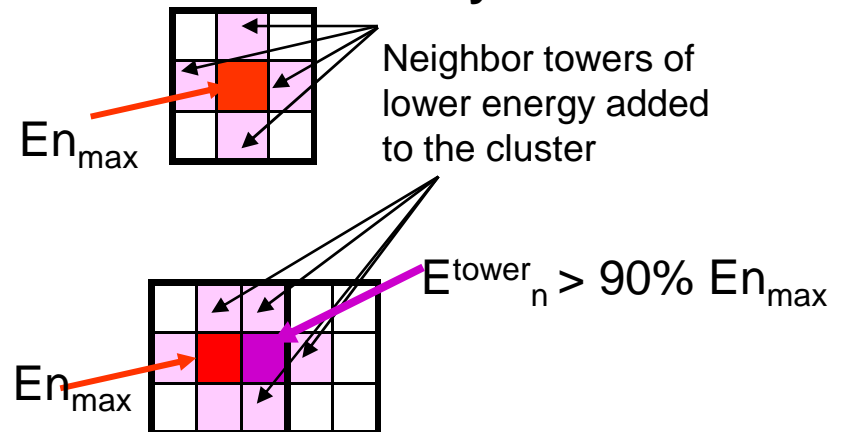
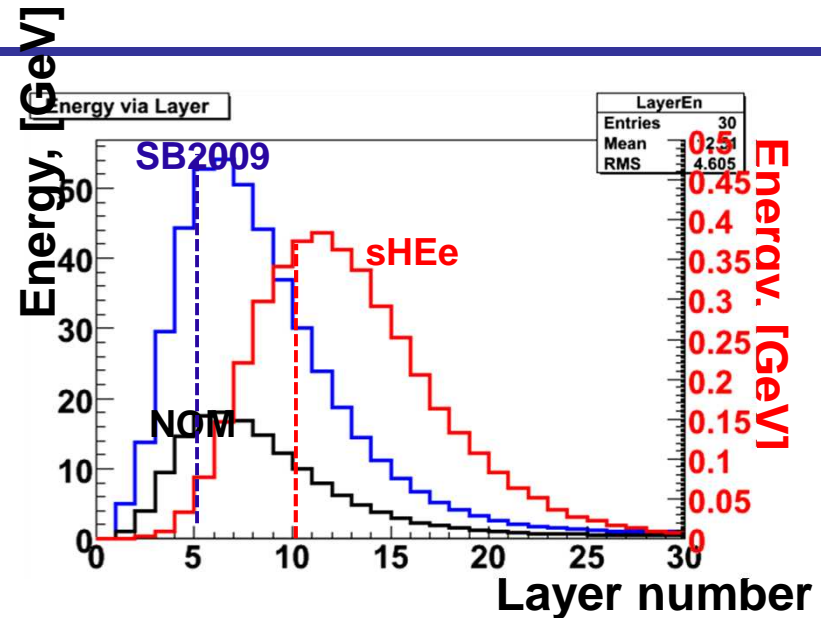
Bkgd. map

# Background Subtraction, cont.

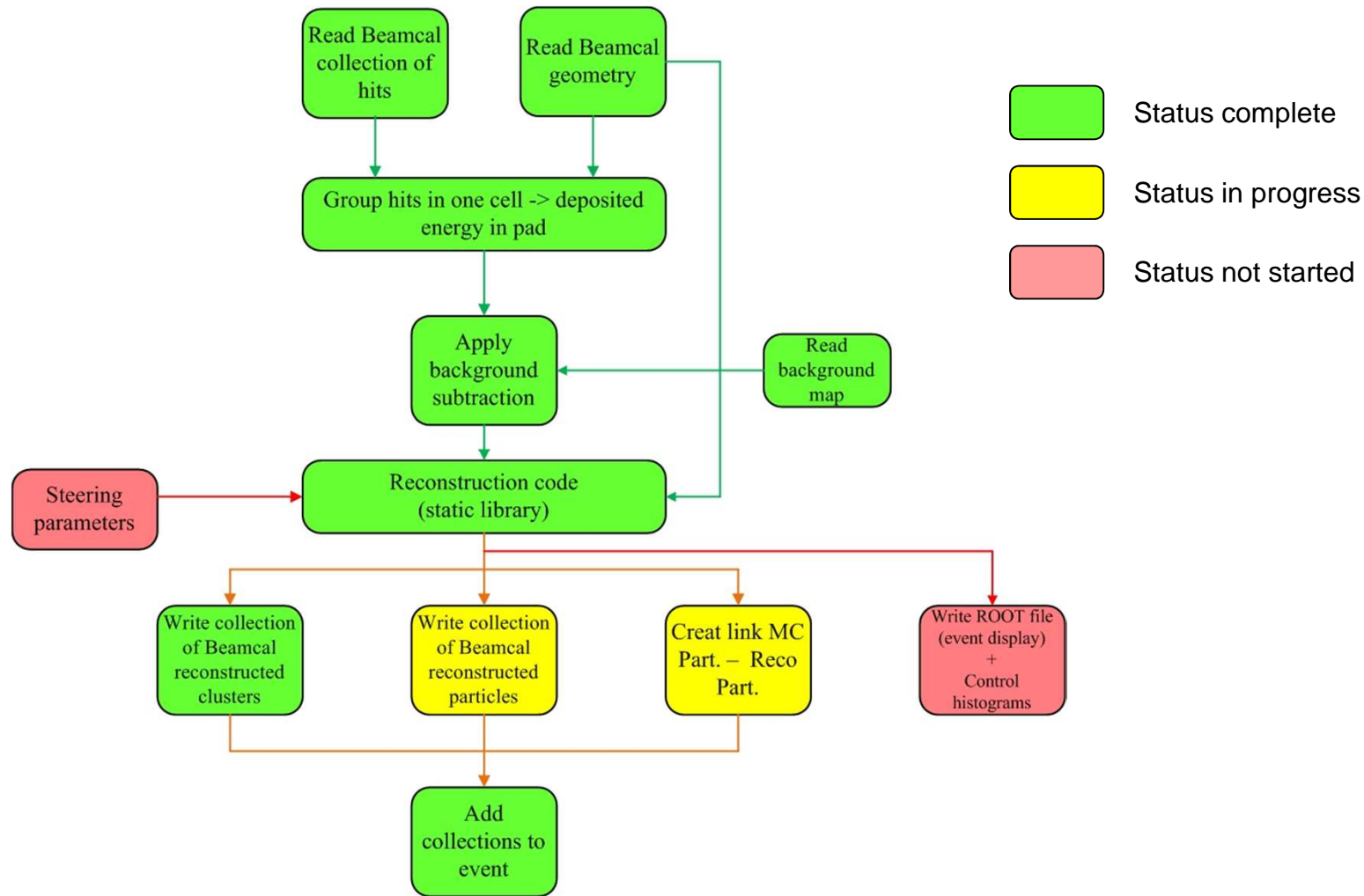


# Cluster Search

- Start from the 5-th layer
- Identify chains of 10 consecutive fired pads; energy deposition in each pad should be higher than 1 SD of the background.
- Find the tower with the maximum deposited energy;
- Add all neighbor towers adjacent to the tower with the highest energy;
- If such a neighbor tower has an energy larger than 90% of the energy of the central tower, add this tower neighbors as well;



# Implementation into central reconstruction



# New Marlin processor

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- New Marlin processor, BCalReco, to perform the following tasks:
  - read the BeamCal collection of hits and puts the information into a 3D dynamic array of structures, CellType \*\*\*info\_detector:
    - `typedef struct {`
      - `double sRin,sRout,sZstart,sZend,sSphi,sDphi,sEdepNeg,sEdepPos;`
      - `int sPos[3];`
    - `} CellType;`
  - call the reconstruction code (linked to the processor as a static library, libbcreco.a):
    - `bcal_reco = new BCalReconstruction();`
    - `bcal_electron = bcal_reco->GetReconstrCoordinates(nLayers,nRings,nbPhis,cells);`
  - output the relevant collections (clusters, reconstructed particles)



# Redesign of the reconstruction code

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- Develop a BeamCal reconstruction class, BCalReconstruction:

- Destructor: ~BCalReconstruction()

- Functions:

- RecCorr GetReconstrCoordinates (int number\_layers, int number\_rings, int number\_pads[], CellType \*\*\*info\_detector);

- typedef struct {

- int side; // 0,1,-1 -> no, FW, BW reconstruction

- double RecEne, ErrEne, CoordX, CoordY, CoordZ, RecRad, RecPhi;

- } RecCorr;

- Protected member functions:

- vector SearchTowers (int the\_Chains[maxrings][maxphis][maxlayers]);

- RecCorr SearchClustersFW (CellType \*\*\*info\_detector);

- RecCorr SearchClustersBW (CellType \*\*\*info\_detector);

- double GetEnergyCalib (double energy);

- double GetEnergyErr (int ring, int pad);

- double GetCoordRotX (int ring, int pad, float IP, float angle);

- double GetCoordY (int ring, int pad);

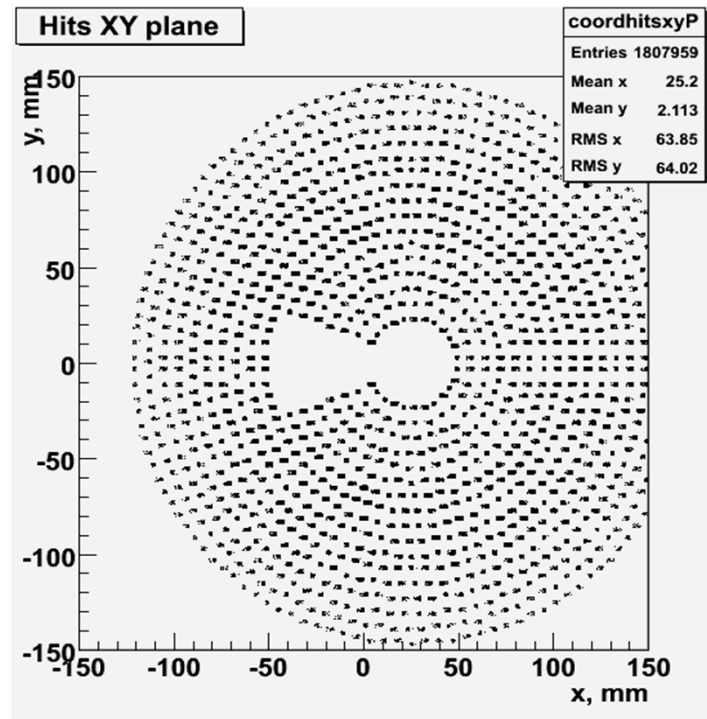
- double GetCoordRotZ (int ring, int pad, float IP, float angle);

- void Free2DArray (int \*\*p2DArray), void Free3DArray (CellType \*\*\*p3DArray);

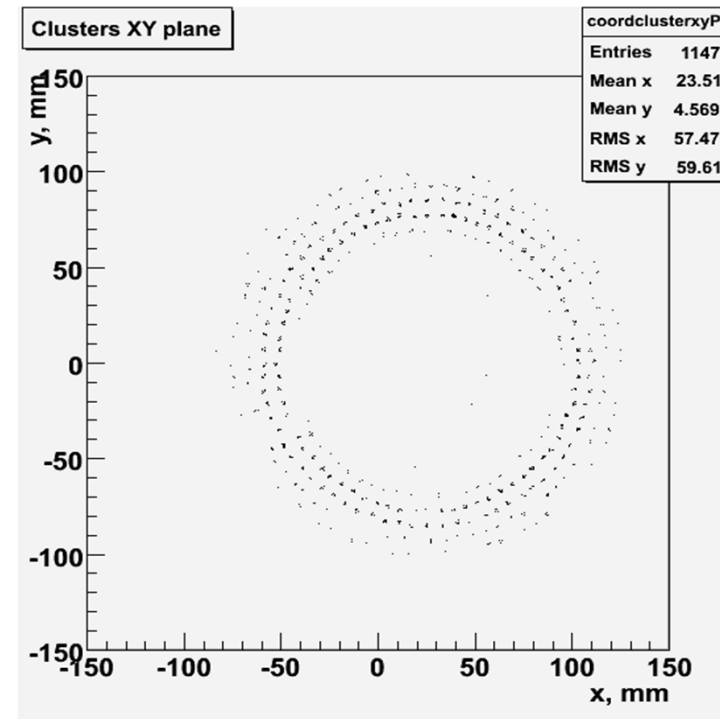
# Hits and Clusters in BeamCal (Bhabbha events)

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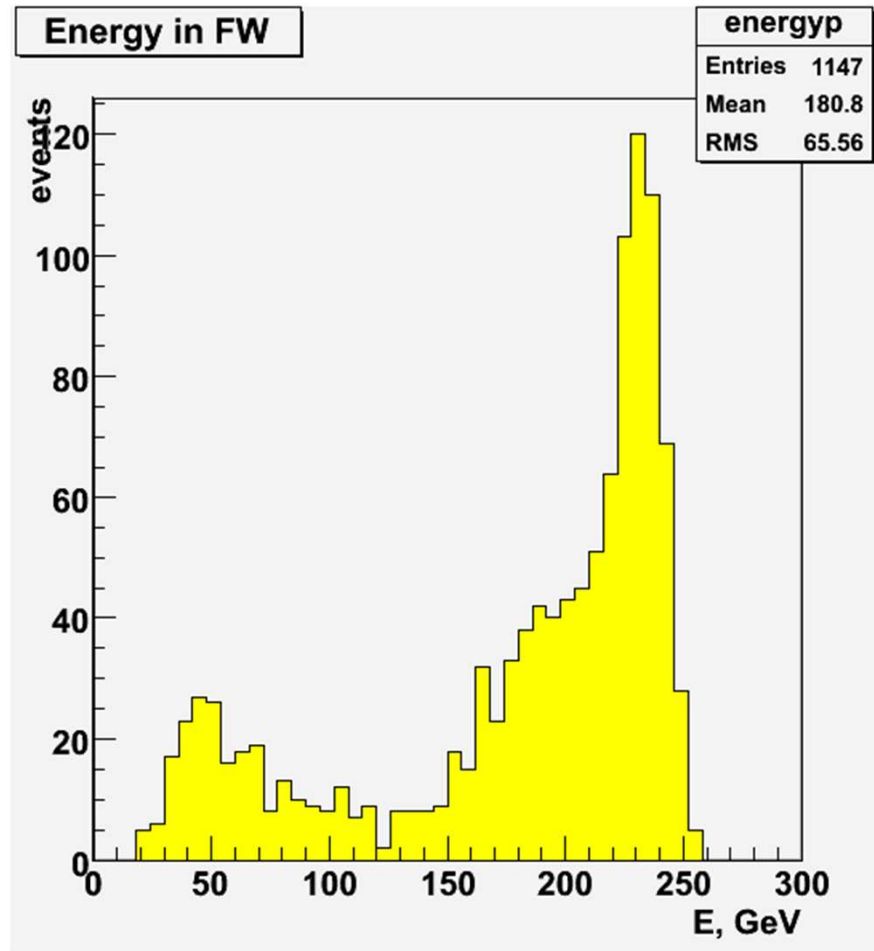
**X-Y Coordinates of hits in BeamCal**



**X-Y Coordinates of clusters in BeamCal**



# Electrons in the BeamCal



# Next steps to be done

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- Include the processor into the official release (ilcsoft v01-11).
- Redo the studies for energy calibration, energy resolution and reconstruction efficiency and fake rate.
- Eventually extend the quantities in the BeamCal cluster collection (following users' feedback).
- Eventually extend the algorithm to accommodate the case when more than one single cluster is found in each BeamCal.
- Generate documentation from the source code (LC Note ?).

# Summary

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- Electron reconstruction algorithm for BeamCal was redesigned to be included into the central reconstruction software; soon will be part of the official release.
- New Marlin processor exists, BCalReco.
- Several issues to be addressed in the near future: recover the results obtained with the standalone reconstruction software.