SHMS calorimeter coding in hcana

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Hall C calorimeter classes

class THcShower : public THaNonTrackingDetector, public THcHitList { …

- Defines geometry of HMS/SOS type calorimeter (number of layers, block dimensions, positions…).
- Comprises hits, clusters of hits, shower tracks (energy clusters associated with spectrometer tracks) of HMS/SOS type calorimeter.
- Can comprise fly's eye (Array) part if present.
- Defines total energy deposition, Etot/P, per track energy depositions for the whole calorimeter (including fly's eye part).

class THcShowerPlane : public THaSubDetector { …

- Describes planes of HMS/SOS calorimeter modules (of 1 or 2 PMTs).
- Comprises ADC signals, pedestals, energy depositions. FADC functionality is added here.

class THcShowerArray : public THaSubDetector {

- Describes fly's eye part. Similar to THcShower (geometry, hits,clusters, energy depositions, tracks,).

Hall C calorimeter classes continued

class THcShowerHit {   //HMS calorimeter hit class

- Describes calorimeter hits (column, row, X and Z coordinates, Emean, Epos, Eneg).
- Reused to describe THcShowerArray hits.

typedef set<THcShowerHit*> THcShowerHitSet;   //Container (collection) of hits.
typedef THcShowerHitSet THcShowerCluster;

- To describe isolated clusters of hits.

typedef vector<THcShowerCluster*> THcShowerClusterList;

- Container of clusters. Useful for cluster-to-track association.

The skeleton for THcShowerArray class and fADC capability were introduced by Steve. The fADC functionality was checked with cosmic ray data from SHMS calorimeter.

Use of SOS data for testing

To test code in the SHMS mode :

- Used real data on the SOS calorimeter from run 52949.
- Configured SHMS calorimeter in the hcana input parameter files (scal.param, scal.pos, hcana.param).
- 1-st (1pr) SOS layer imitated the SHMS Preshower.
- 2-nd (2ta) SOS layer (positive side) imitated the fly's eye (Array) part.
- Used same gains (calibration constants) for both cases.

Fly’s eye’s pedestal calculations

```
Debug output from THcShowerPlane::CalculatePedestals for S.cal.:
  ADC pedestals and thresholds for calorimeter plane 2ta
  element 0:   Pos. pedestal = 553.766  Pos. threshold = 563.766
  element 1:   Pos. pedestal = 510.029  Pos. threshold = 520.029
  element 2:   Pos. pedestal = 520.902  Pos. threshold = 530.902
  element 3:   Pos. pedestal = 511.671  Pos. threshold = 522.713
  element 4:   Pos. pedestal = 635.969  Pos. threshold = 645.969
  element 5:   Pos. pedestal = 559.131  Pos. threshold = 569.131
  element 6:   Pos. pedestal = 497.625  Pos. threshold = 509.707
  element 7:   Pos. pedestal = 686.814  Pos. threshold = 698.989
  element 8:   Pos. pedestal = 592.019  Pos. threshold = 602.019
  element 9:   Pos. pedestal = 504.892  Pos. threshold = 517.741
  element 10:   Pos. pedestal = 514.3  Pos. threshold = 524.529
```

SOS 2ta pedestals and thresholds

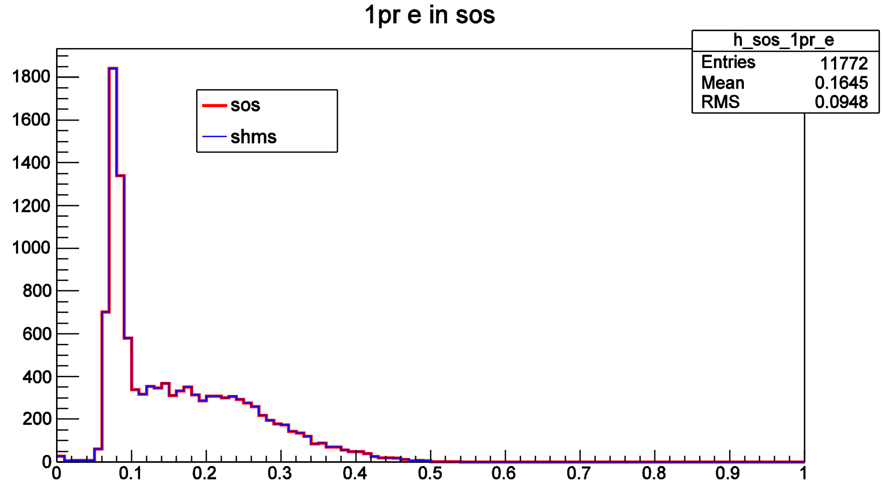
```
Debug output from THcShowerArray::CalculatePedestals for S.cal.:
  ADC pedestals and thresholds for calorimeter plane 2ta
  element 0:   Pedestal = 553.766  threshold = 563.766
  element 1:   Pedestal = 510.029  threshold = 520.029
  element 2:   Pedestal = 520.902  threshold = 530.902
  element 3:   Pedestal = 511.671  threshold = 522.713
  element 4:   Pedestal = 635.969  threshold = 645.969
  element 5:   Pedestal = 559.131  threshold = 569.131
  element 6:   Pedestal = 497.625  threshold = 509.707
  element 7:   Pedestal = 686.814  threshold = 698.989
  element 8:   Pedestal = 592.019  threshold = 602.019
  element 9:   Pedestal = 504.892  threshold = 517.741
  element 10:   Pedestal = 514.3  threshold = 524.529
```

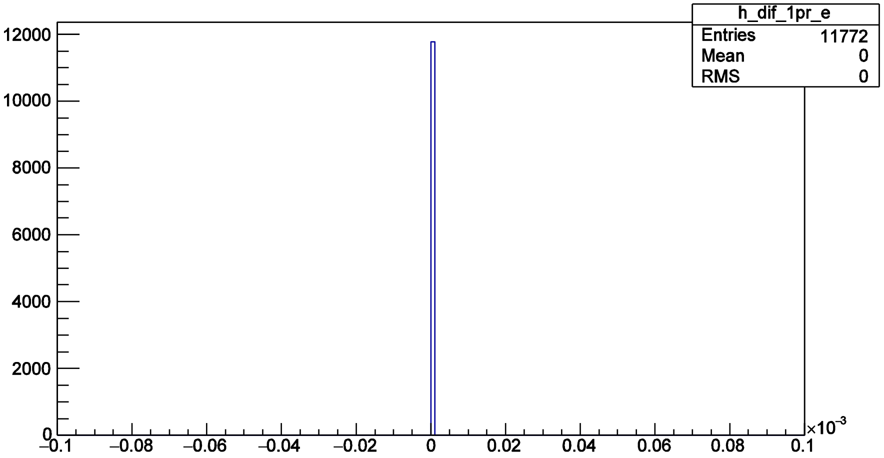
“SHMS” Array pedestals and thresholds

Perfect match.

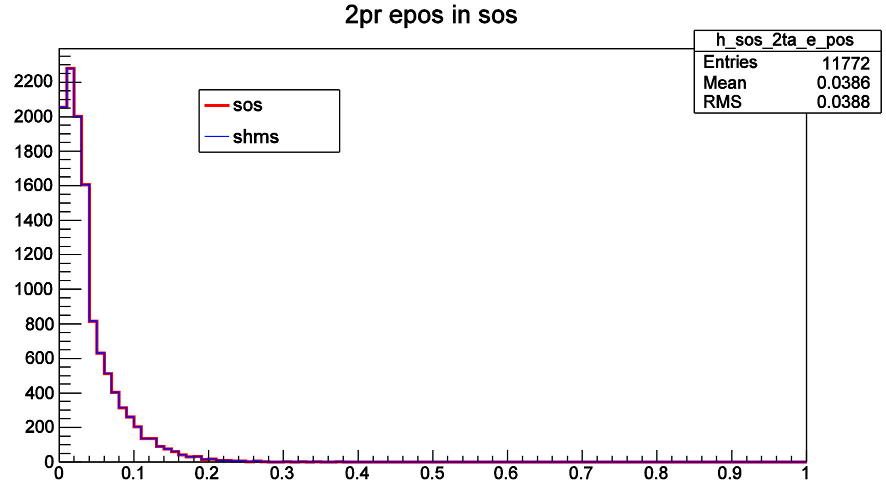
Raw energy depositions

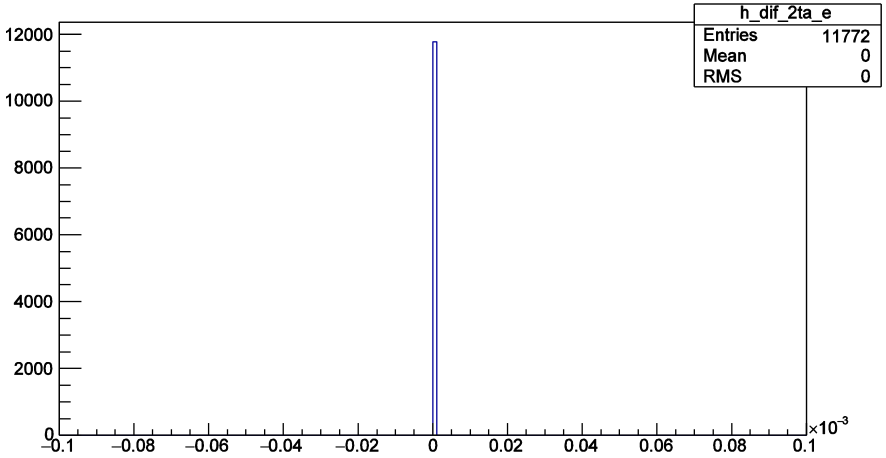
SOS Preshower vs SHMS Preshower





SOS 2-nd layer vs SHMS Array

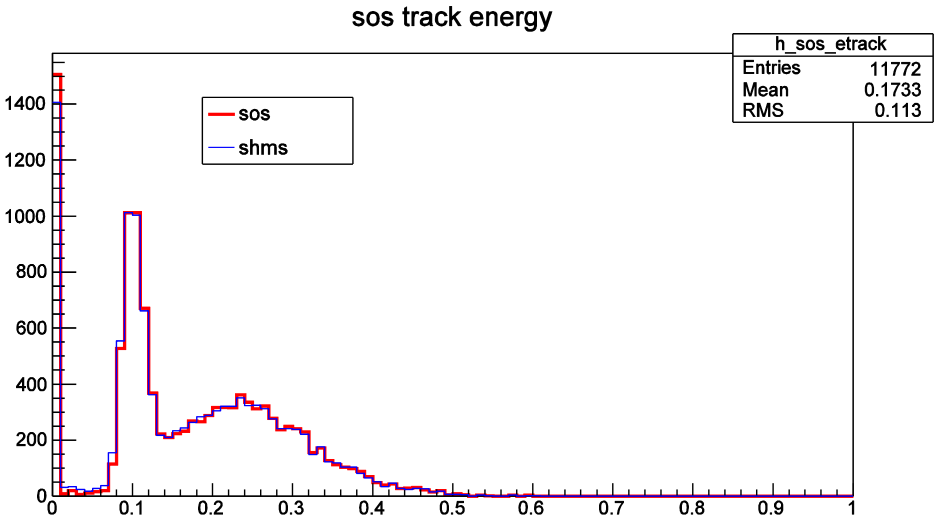




No differences.

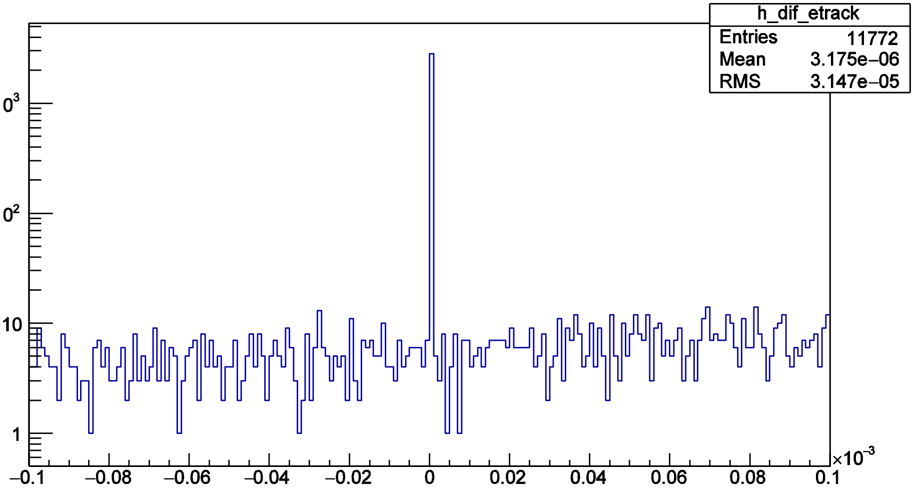
Tracking in the SHMS calorimeter

Energy of the best track ins SOS and “SHMS”



Differences due to:

- Different track to cluster distances
- Different coordinate corrections
- Different hit clustering



Outlook

Code optimization (OOP, easy reading….)? Not for now, leave for future.

Extensive checkout with beam will be needed., especially for the tracking part.