

Update on HPS Ecal in slic & lcsim

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SLAC

What has been done?

- added LCDD converter for HPSEcal type
 - material, crystal dimensions, layout, placement
 - uses coordinate system matching Matt's trackers
- created compact detector XML including HPSEcal and the test run tracker
- ran thru slic with 10k A' @ 100 MeV events from Matt Graham (no backgrounds yet)
- created a Driver with simple diagnostic plots
- implemented clustering algo from proposal
- ran events through lcsim using batch system w/ XML job description
 - clustering
 - simple analysis
 - plots

Compact Description

```
<detector id="13"  
  name="HPSEcalTest"  
  type="HPSEcal"  
  insideTrackingVolume="false"  
  readout="EcalHits">
```

```
<material name="LeadTungstate"/>
```

← crystal material

```
<dimensions x1="ecal_front"  
  y1="ecal_front"  
  x2="ecal_back" ← crystal dimensions  
  y2="ecal_back"  
  z="ecal_z"/>
```

```
<layout beamgap="20.0*mm" ← beam line gap  
  nx="46" ← number crystals in X (one section)  
  ny="5" ← number crystals in Y (one section)  
  dface="120.0*cm"/> ← distance to front face from beam origin
```

```
</detector>
```

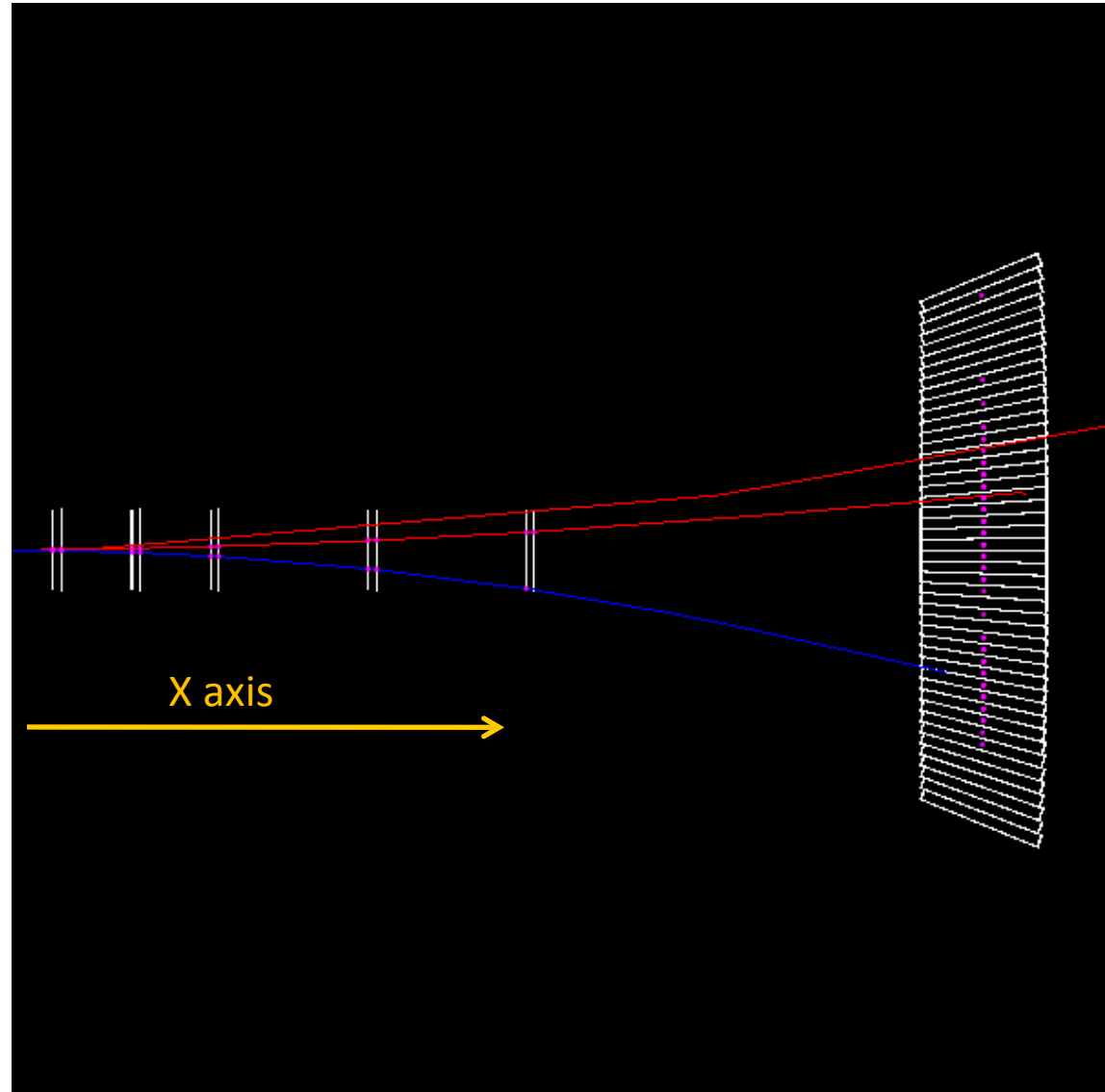
Compact Description (contd)

```
<readout name="EcalHits">  
  <segmentation type="GridXYZ" gridSizeX="0.0"  
    gridSizeY="0.0" gridSizeZ="0.0"/>  
  <id>system:6,side:-2,layer:4,ix:-8,iy:4</id>  
</readout>
```

```
<field type="Solenoid"  
  name="GlobalSolenoid"  
  inner_field="1.0"  
  outer_field="1.0"  
  zmax="17.78*cm"  
  inner_radius="0.0"  
  outer_radius="101.44*cm"/>
```

What's it look like in Geant4?

- OpenGL viewer
- Test Proposal geom
- top view
- three tracks in each event
- hits in pink, which includes very low energy depositions (can be cut in analysis & clustering)
- mag field stops before Ecal (exact extent needs to be verified)
- tracking region stops before Ecal



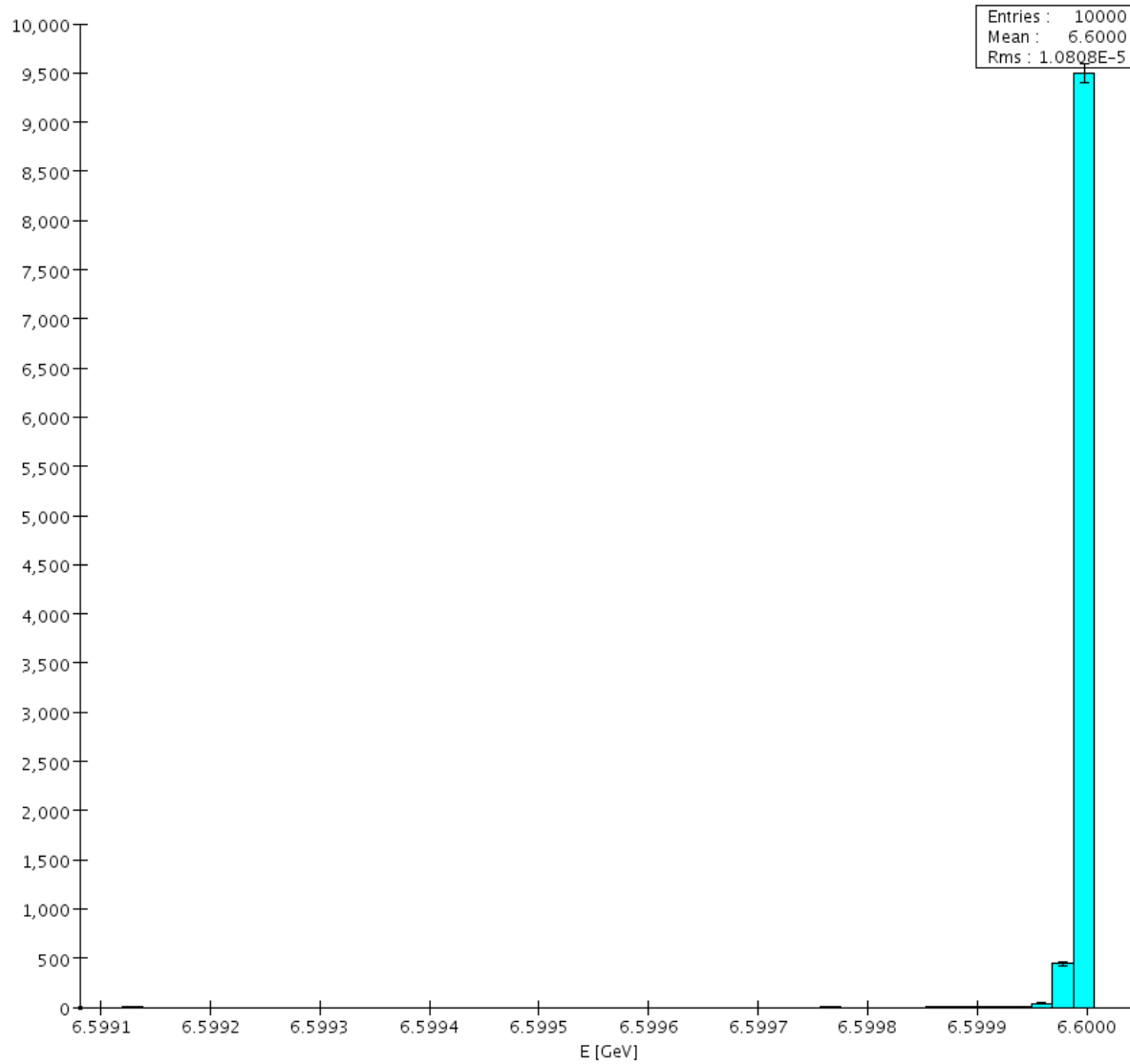
LCSim Batch Job

```
<driver name="EcalClusterer"  
    type="org.lcsim.contrib.jeremym.hps.HPSEcalClusterer">  
    <ecalName>HPSEcalTest</ecalName> <ecalCollectionName>EcalHits</  
    ecalCollectionName>  
</driver>
```

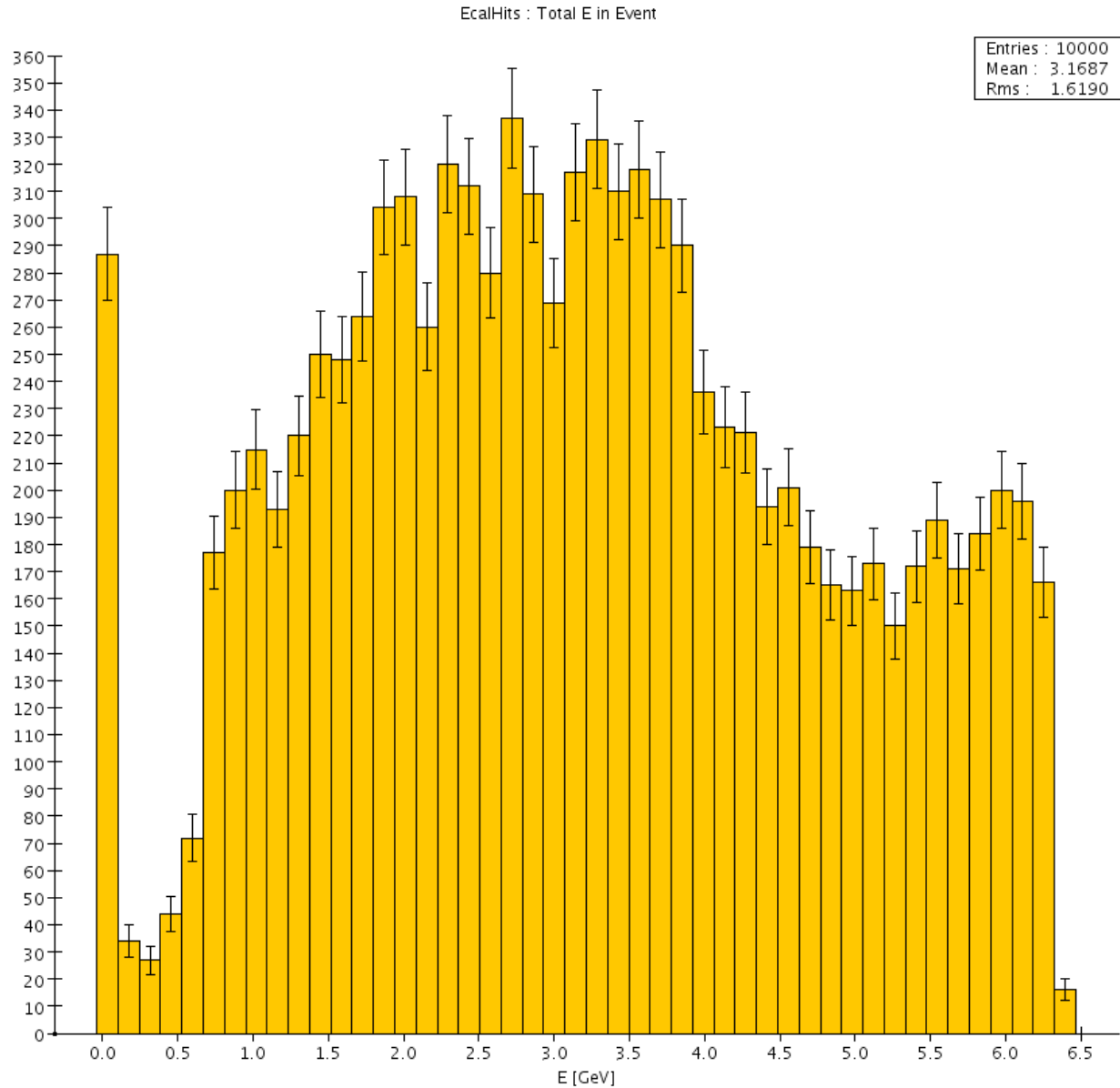
```
<driver name="HPSECalPlotsDriver"  
    type="org.lcsim.contrib.jeremym.hps.HPSECalPlotsDriver">  
    <ecalCollectionName>EcalHits</ecalCollectionName>  
</driver>
```

MC Gen Total E

MCParticle: Total Gen FS Electron E in Event

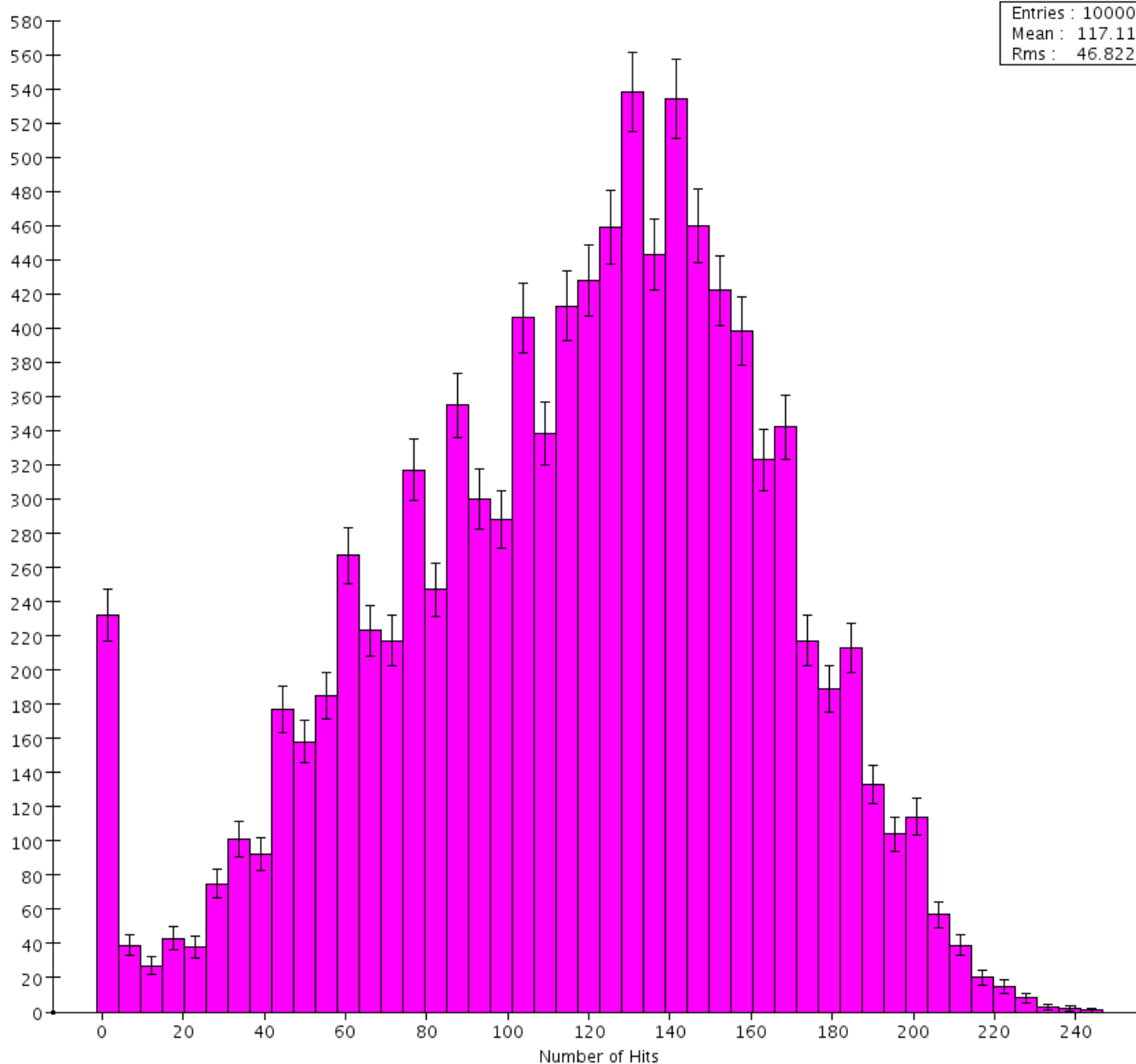


Total Cal E in Event



Number of Hits (no threshold)

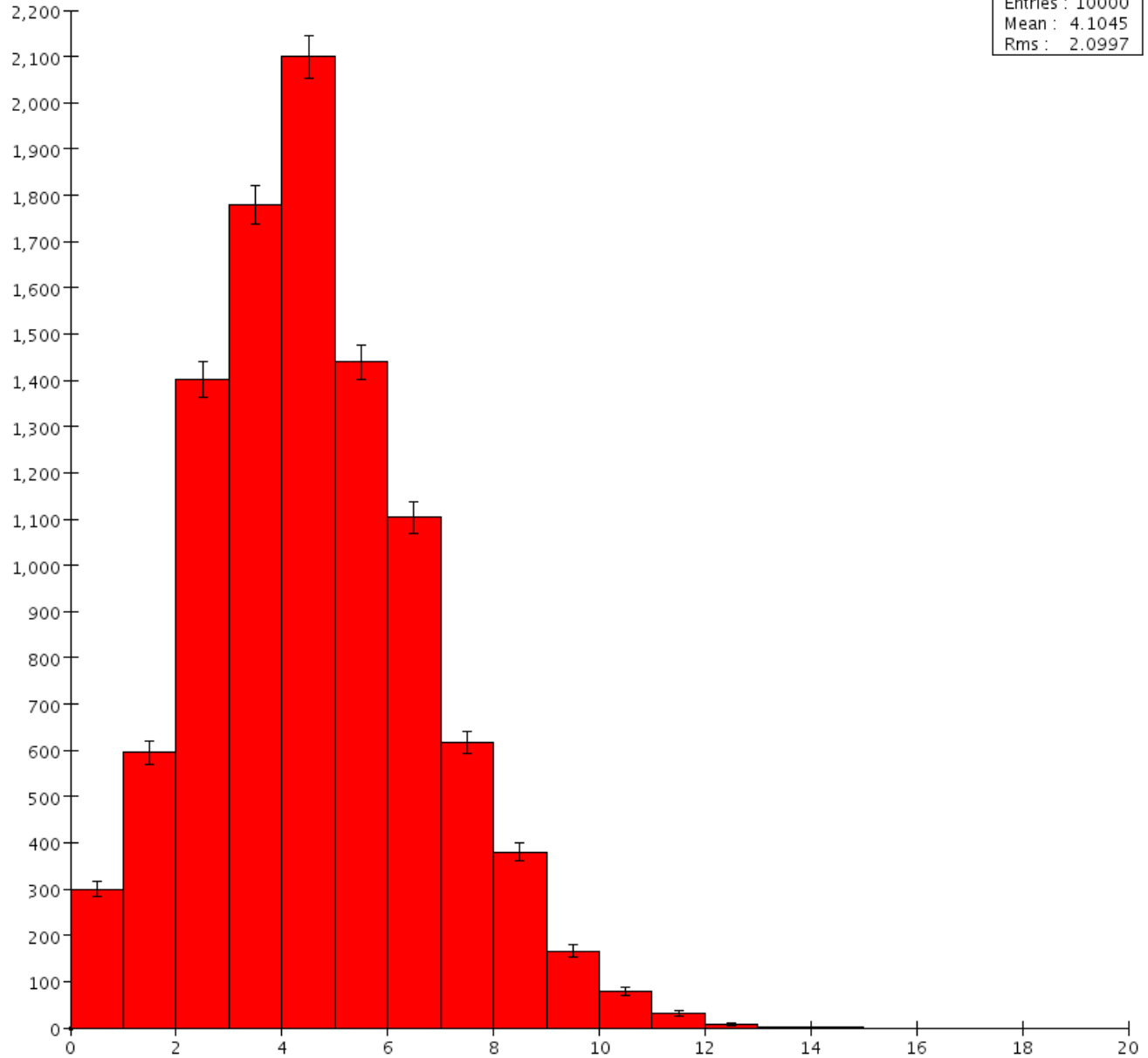
EcalHits : Hit Count



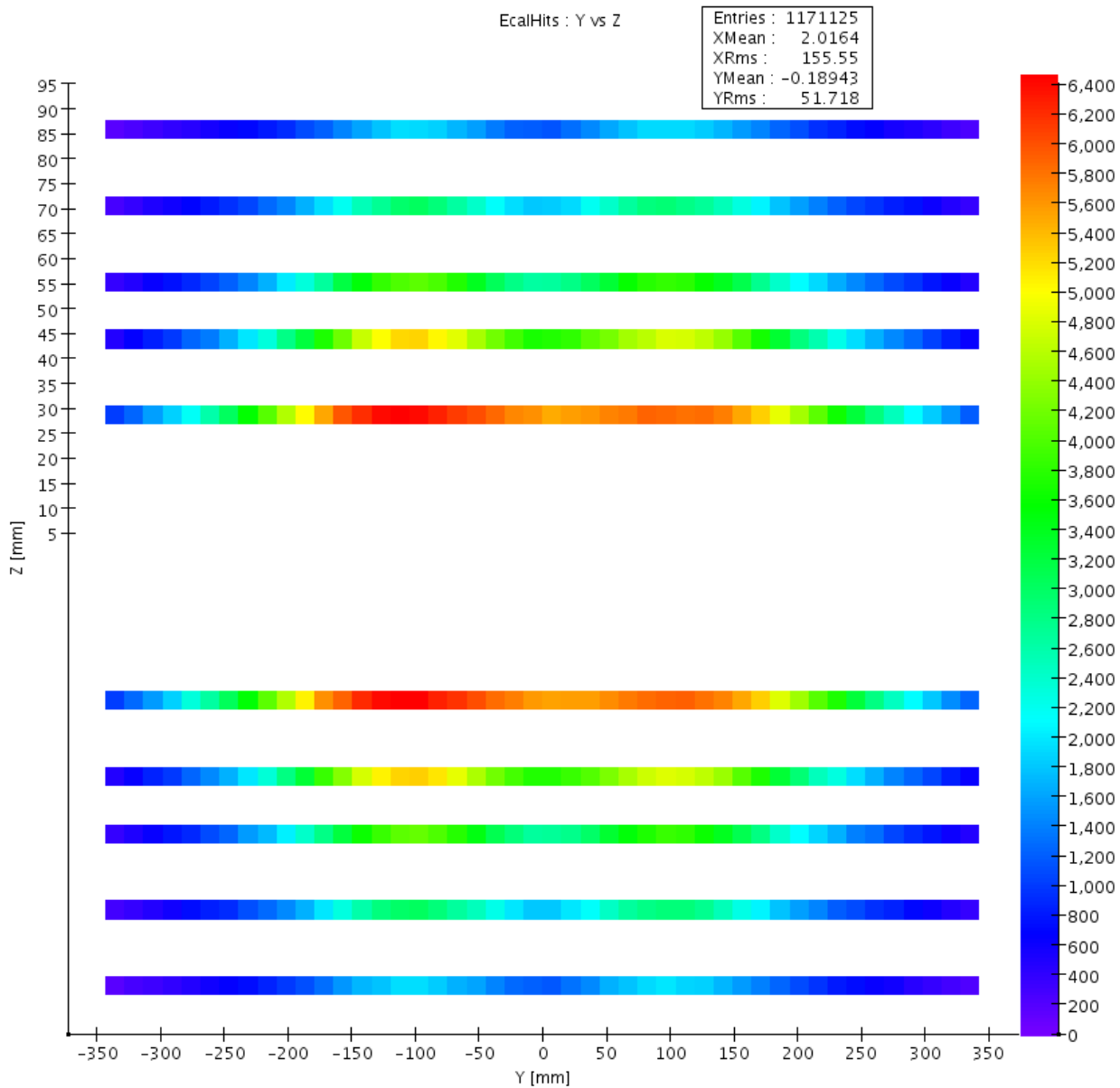
Number of Hits ($E \geq 100$ MeV)

EcalHits : Hits with $E \geq 100$ MeV

Entries : 10000
Mean : 4.1045
Rms : 2.0997

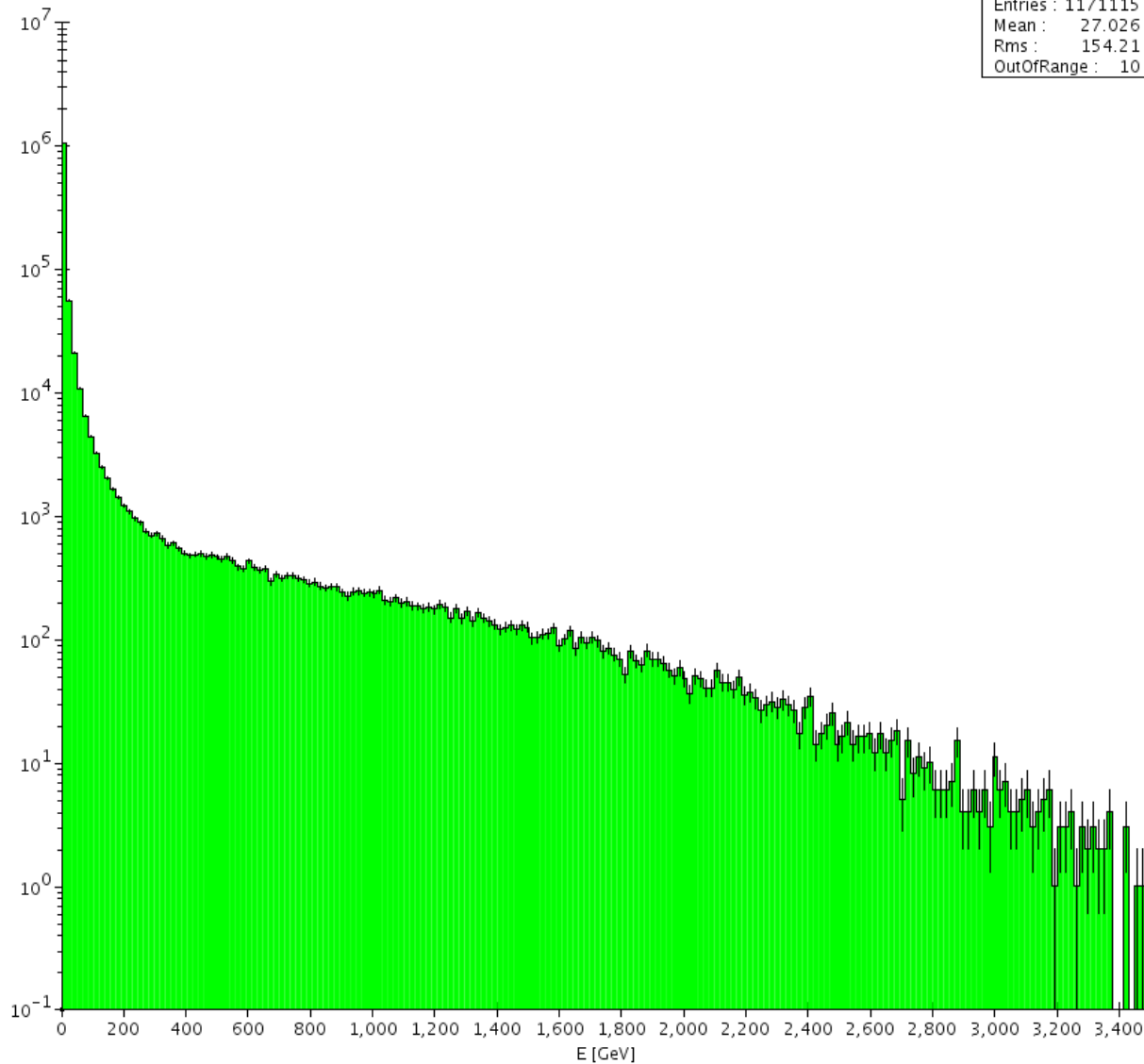


Hit Position



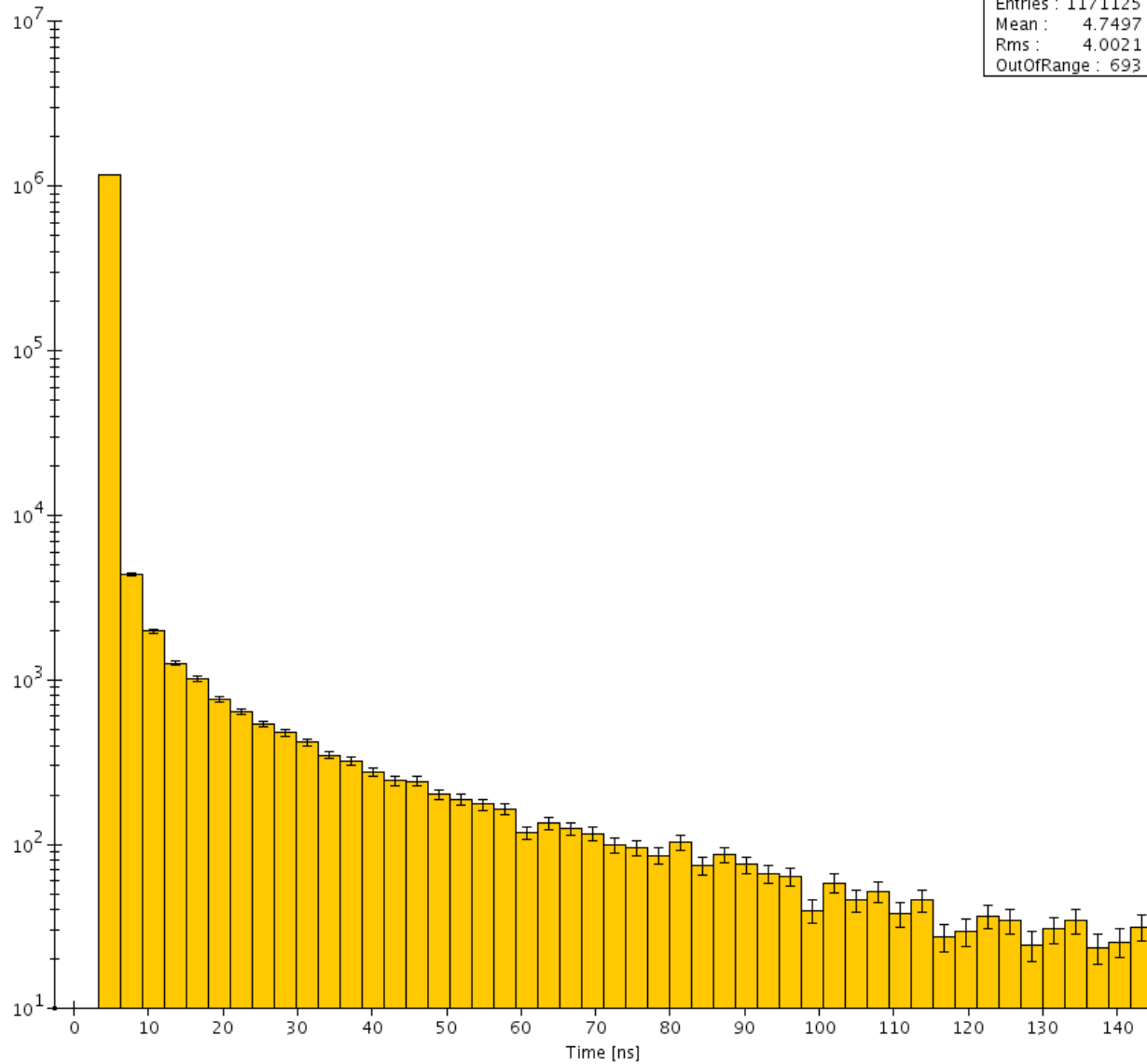
Hit E (no threshold)

EcalHits : Hit Energy



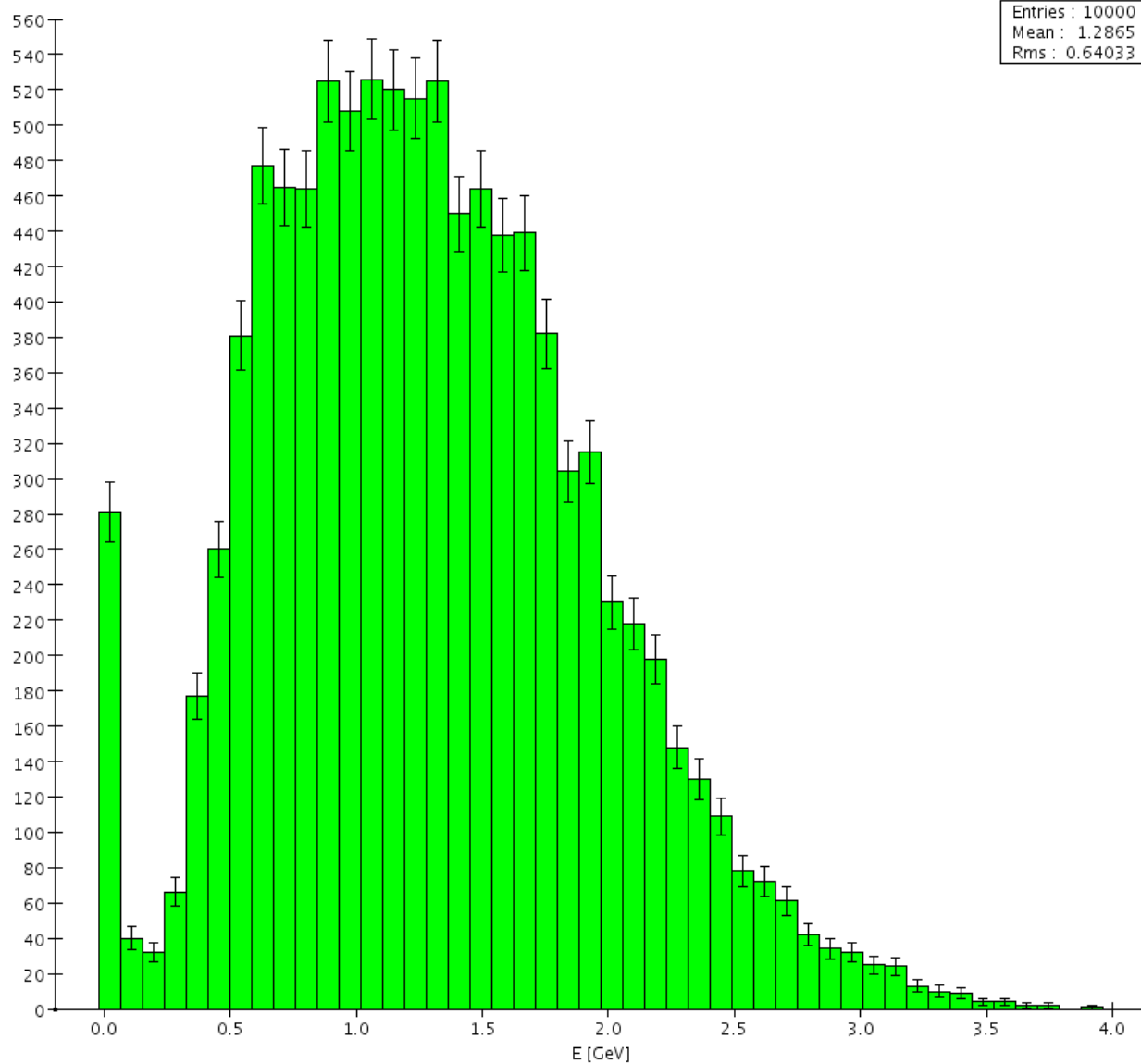
Hit Time

EcalHits : Hit Time



Greatest Hit E in Event

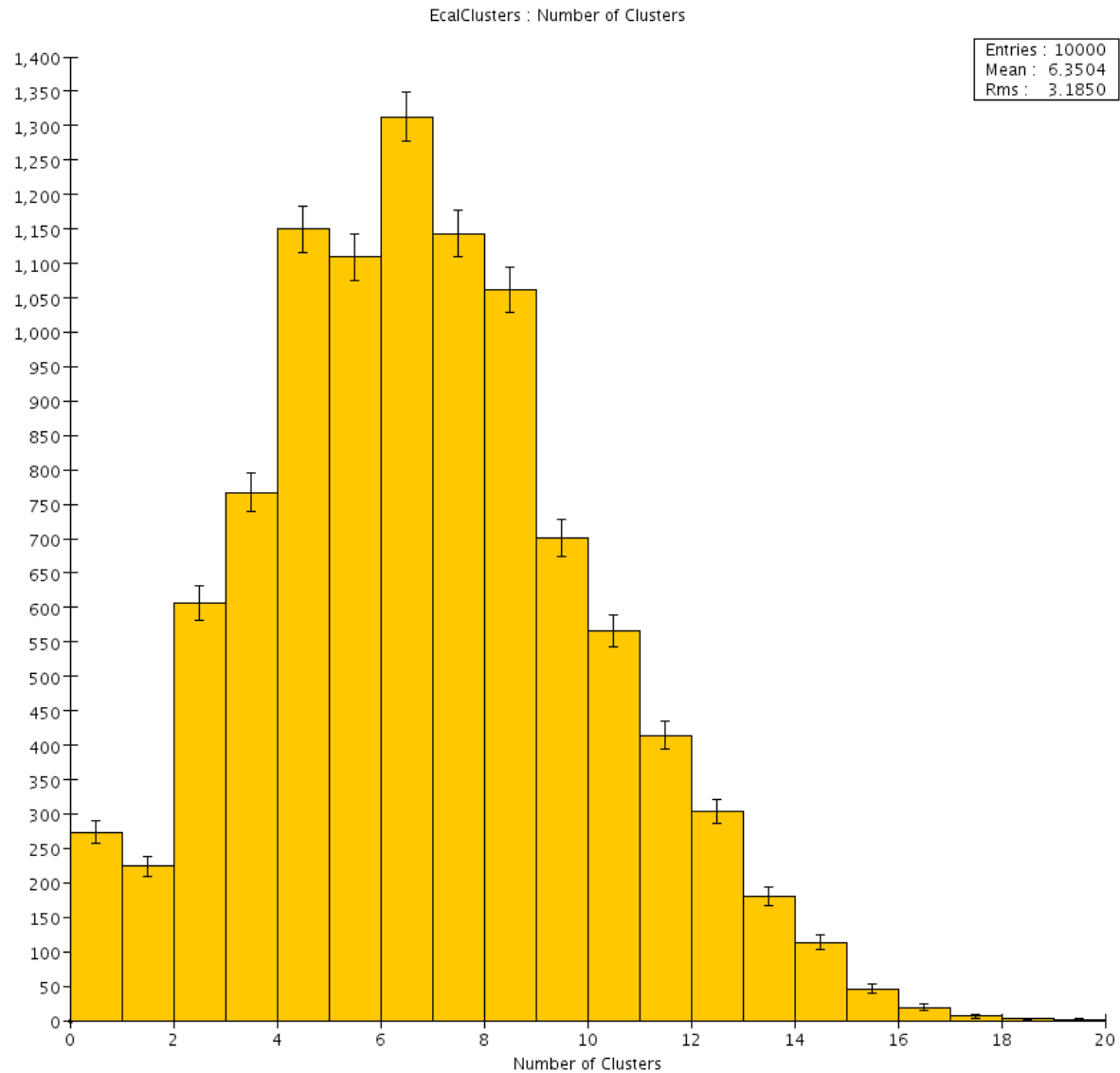
EcalHits : Max Hit E in Event



Clustering Algo (Reminder)

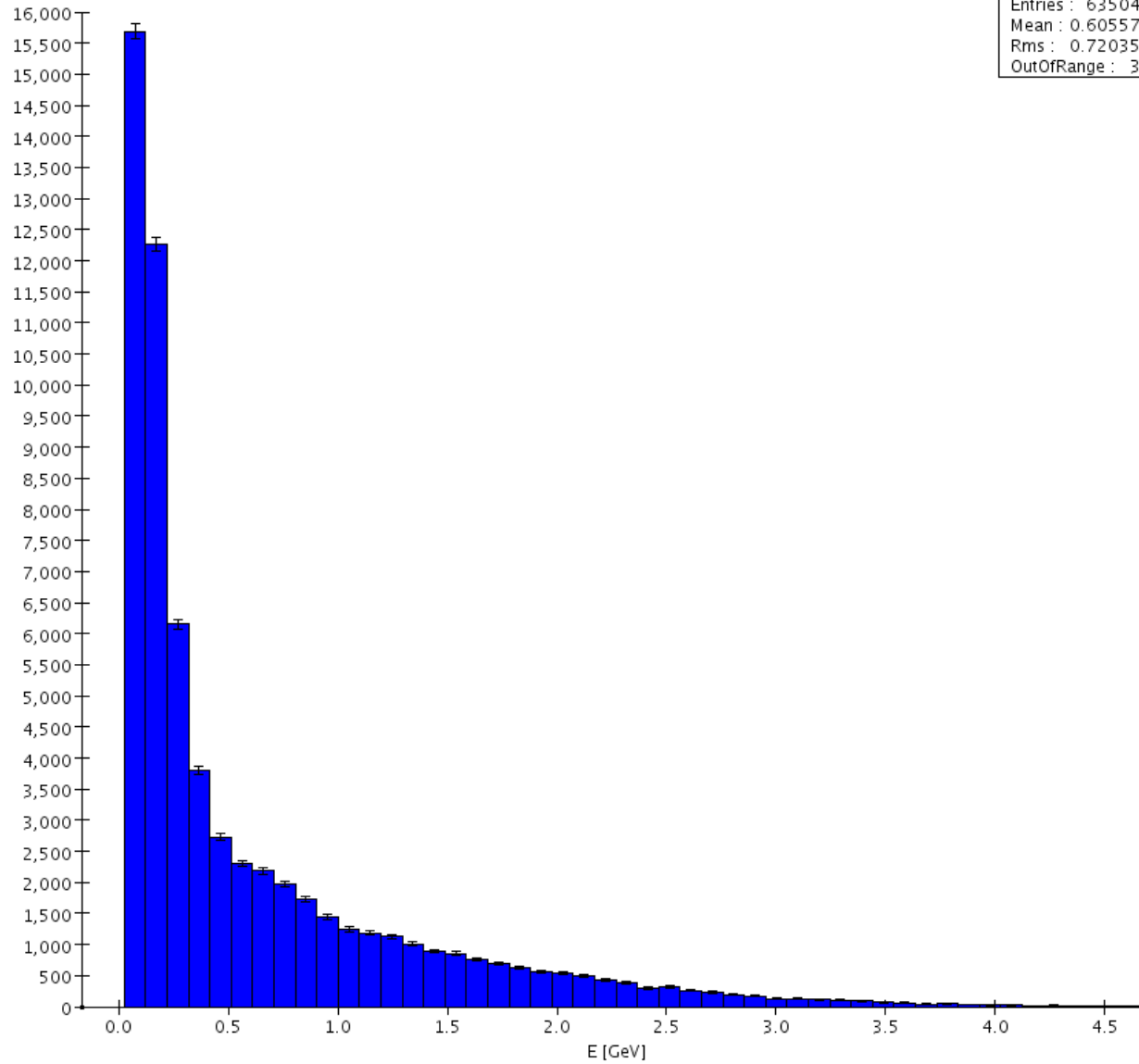
- 1) For each hit in the calorimeter with at least 50 MeV of energy,
- 2) Search the 3x3 square around the hit for other hits (smaller regions for hits on borders).
- 3) If a hit with more energy is found, the original hit is not the cluster center,
- 4) Else add up the energies of the hits over threshold of 30 MeV, in the 3x3 square if these hits were within 8 ns of the center hit

Number of Clusters



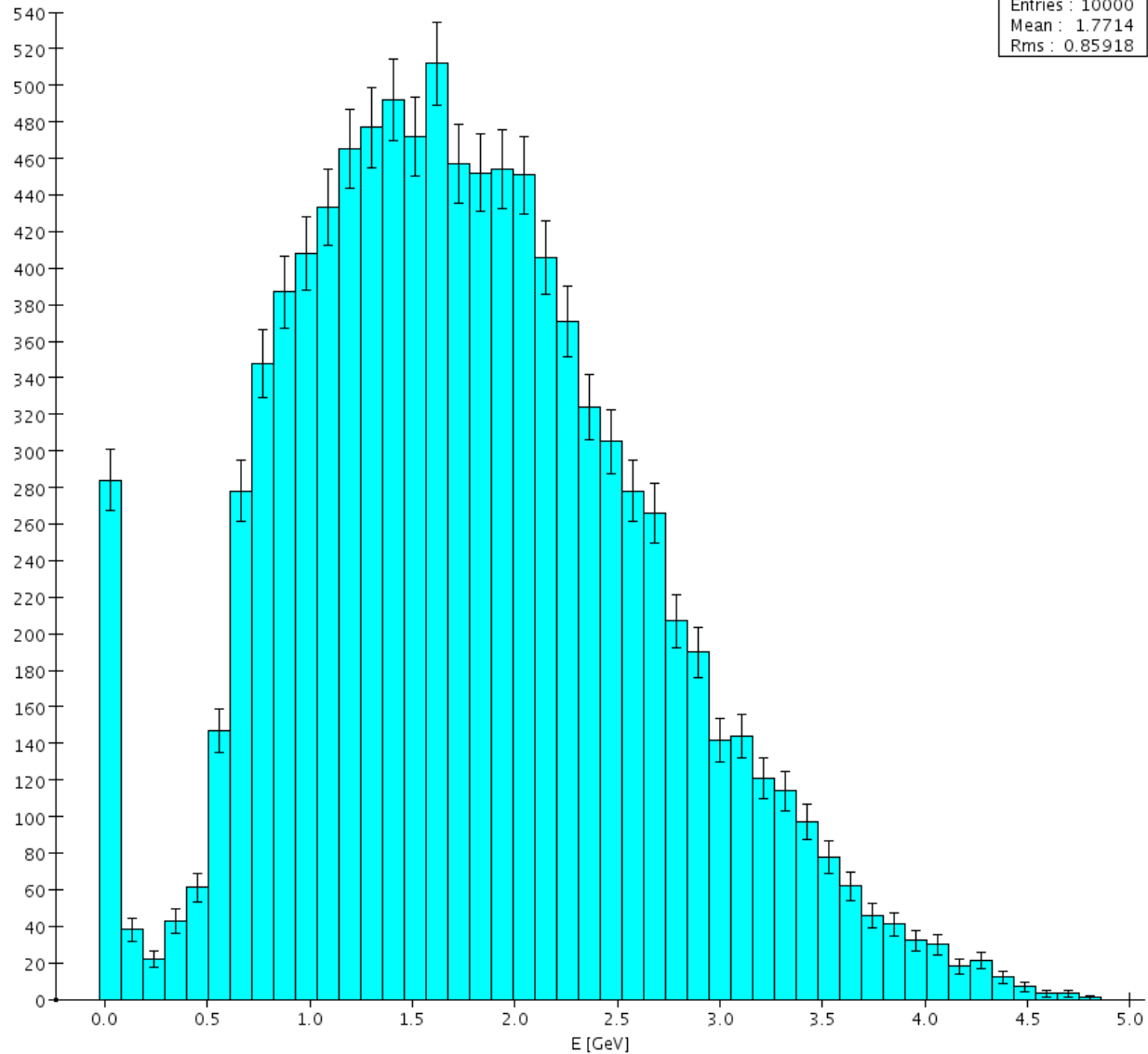
Cluster E

EcalClusters : Cluster E



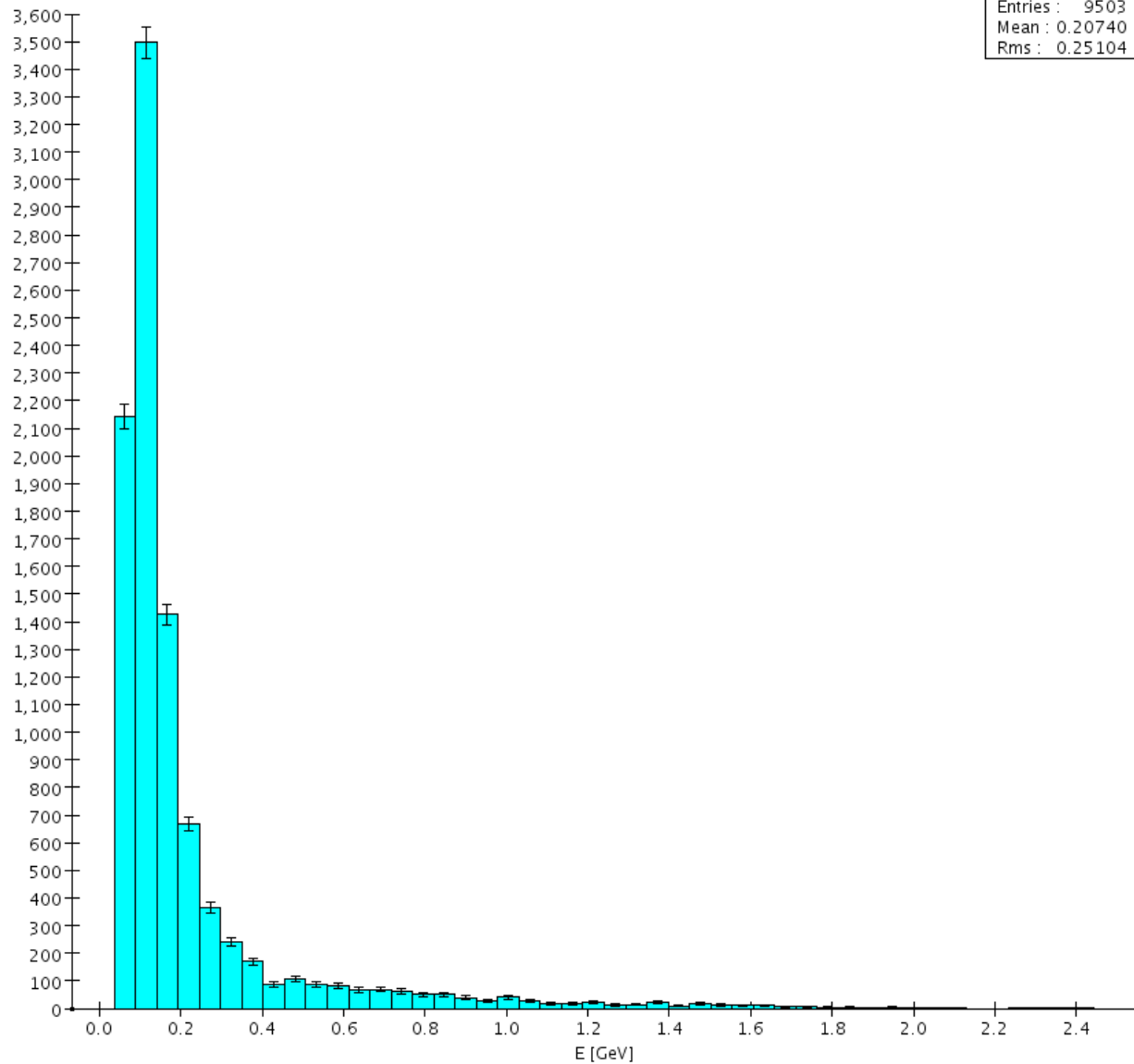
Leading Cluster E

EcalHits : Leading Cluster E



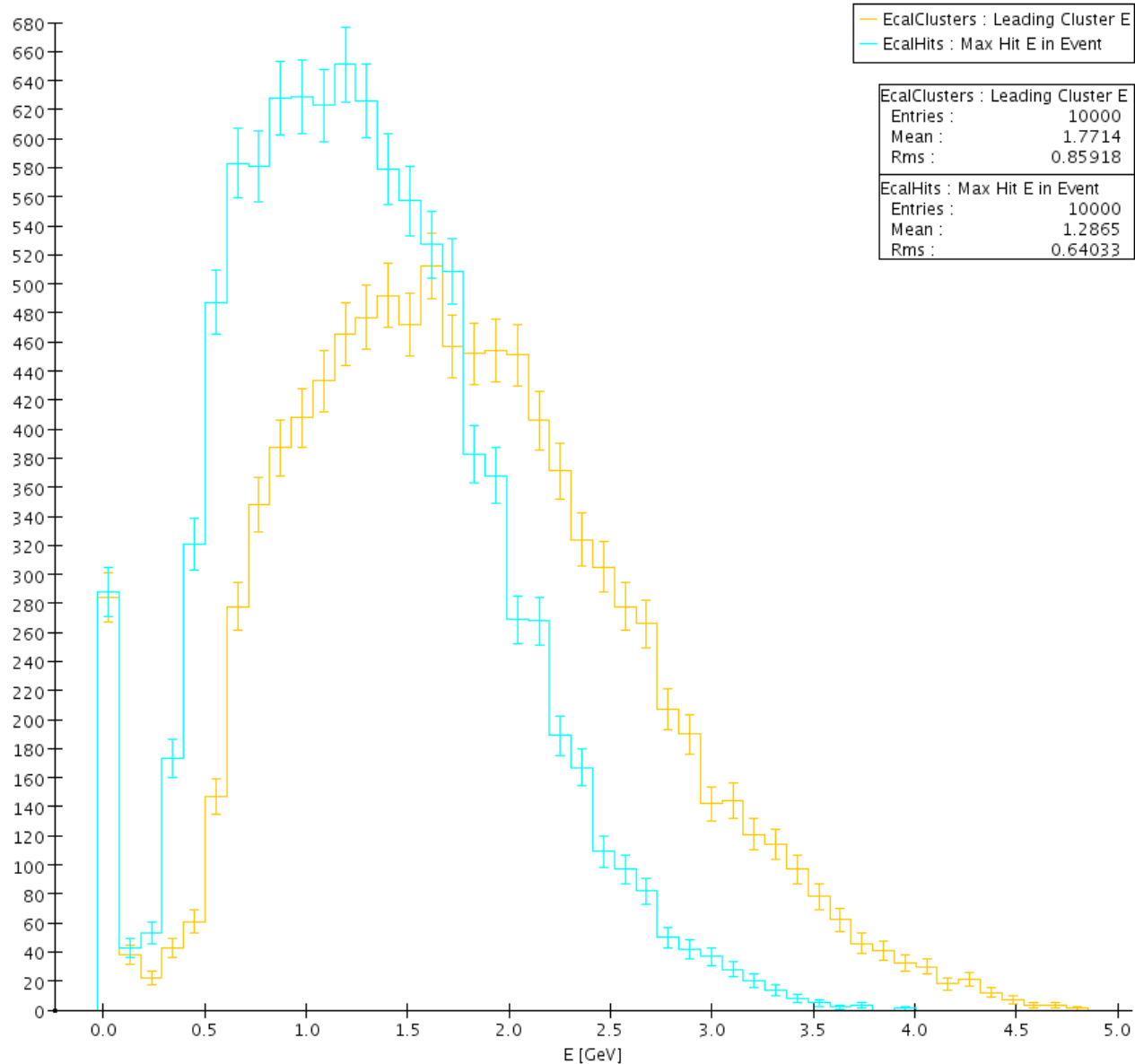
Second Leading Cluster E

EcalClusters : Second Leading Cluster E

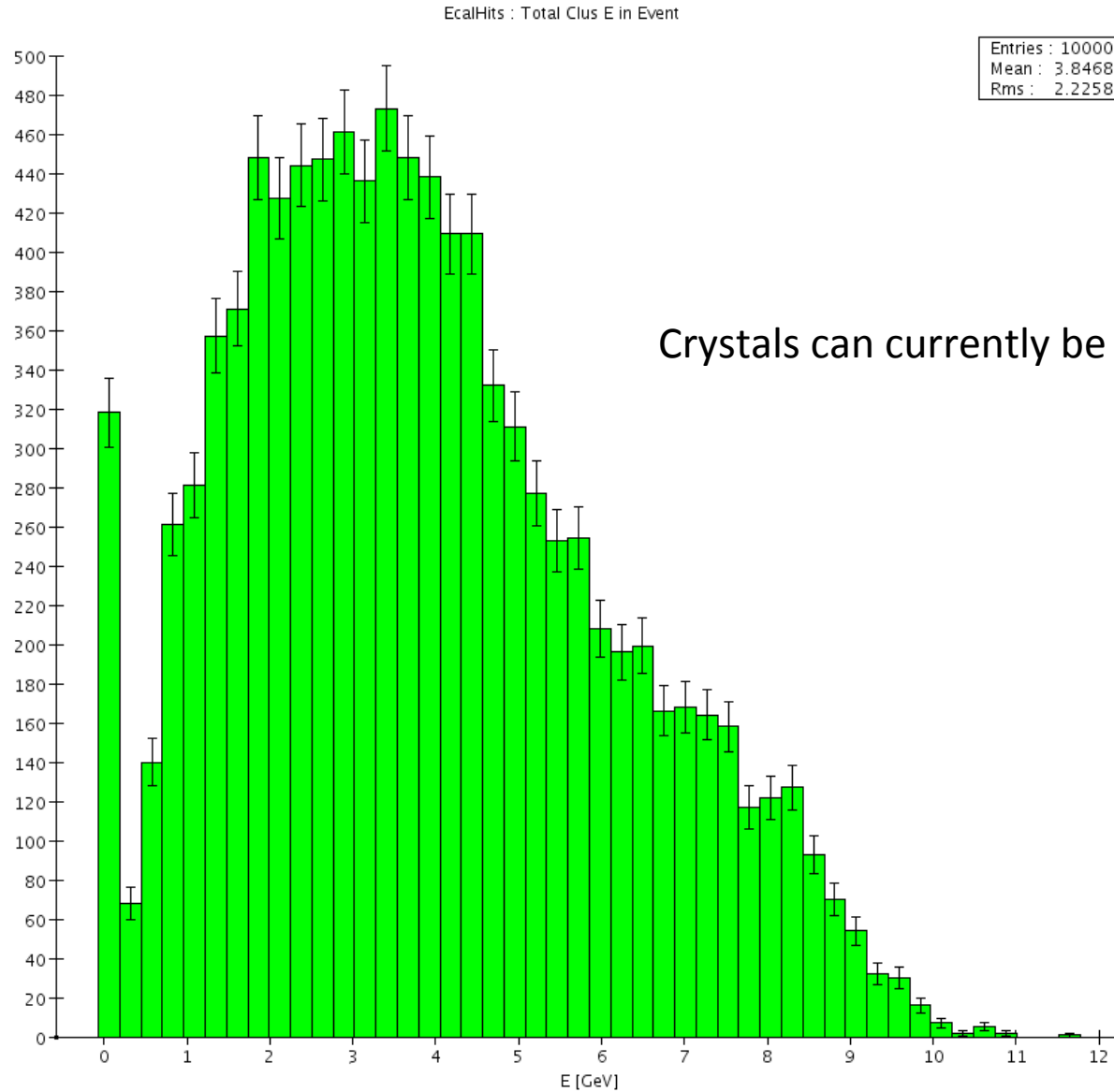


Lead Cluster & Max E Hit

Leading Cluster E vs Max Hit E



Total Cluster E



TODO

- implementation of detailed geometry description in Java
- improve performance of clustering algorithm
- include beam pipe and other dead material in the Geant4 simulation
- additional testing and validation plots
- trigger simulation