# Study of noise in the TileCal with the TopologicalClustering Algorithm

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# Upgrade of the last talk:

http://indico.cern.ch/getFile.py/access?contribId=5&sessionId=0&resId=0&materialId=slides&confId=59722

I used two kinds of data:

**1) REAL DATA: Noise from the detector**

**Run 91890 Random** with 5.761 processed events from:

/castor/cern.ch/grid/atlas/tzero/prod1/perm/data09_cos/physics_RNDM/0122129/data09_cos.00122129.physics_RNDM.recon.ESD.f128/

**2) MC DATA: Simulation W-> lnu**

**Run 106020** with 11.812 processed events.

- We saw **two contributions from the noise of the detector**: Topo-Moments study
- When real and MC datas are compared, **there are large clusters with low energy in real data but aren't in MC data**.

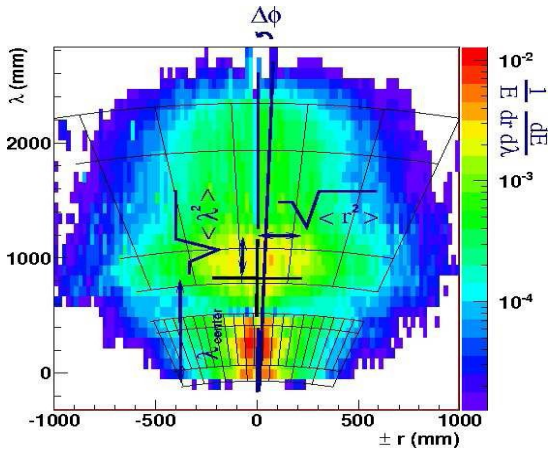
- Now we're going to know which part of the detector produces this coherent noise.

# Topo-moments study

## 1) REAL DATA: Noise from the detector

Recall: Topo-Moments

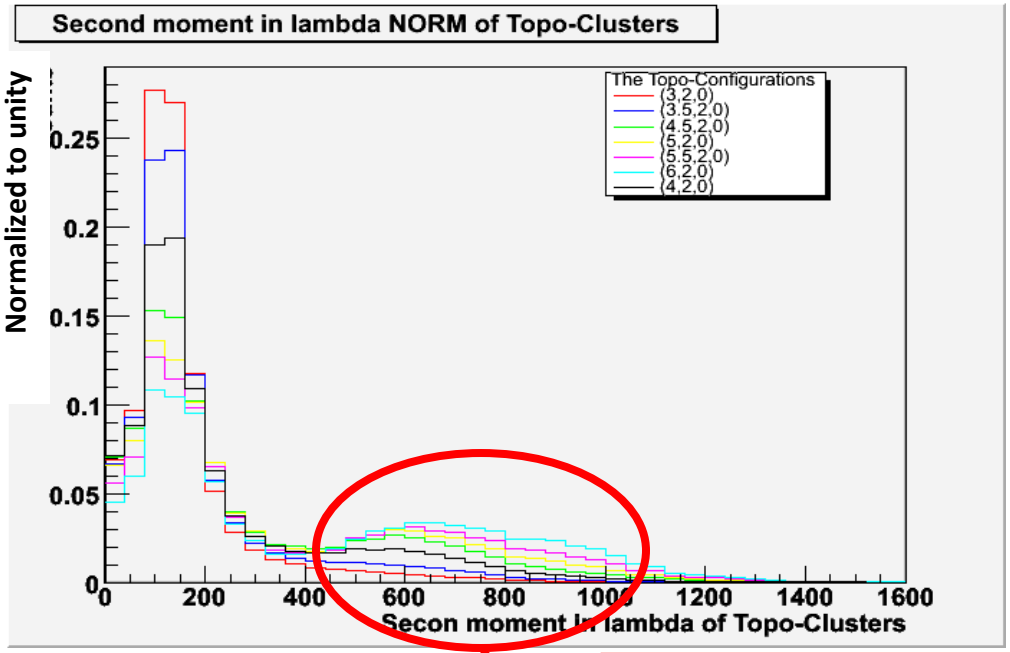
https://twiki.cern.ch/twiki//bin/view/Atlas/ClusterMoments




$$< x^n >= \frac{1}{E_{norm}} \times \sum_{i|E_i>0} E_i x_i^n$$

where $E_{norm} = \sum_{i|E_i>0} E_i$

## <λ^2>: second moment in lambda




We can see **two contributions** for the noise from the detector.

**There is a noise contribution which makes large clusters**

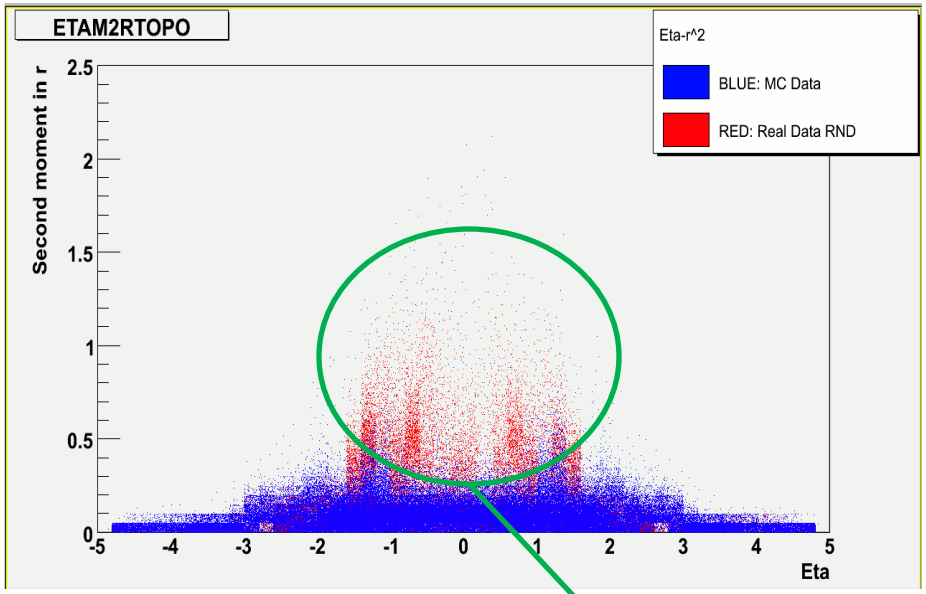
**COHERENT NOISE**

# Run 106020MC vs Run 91890RND

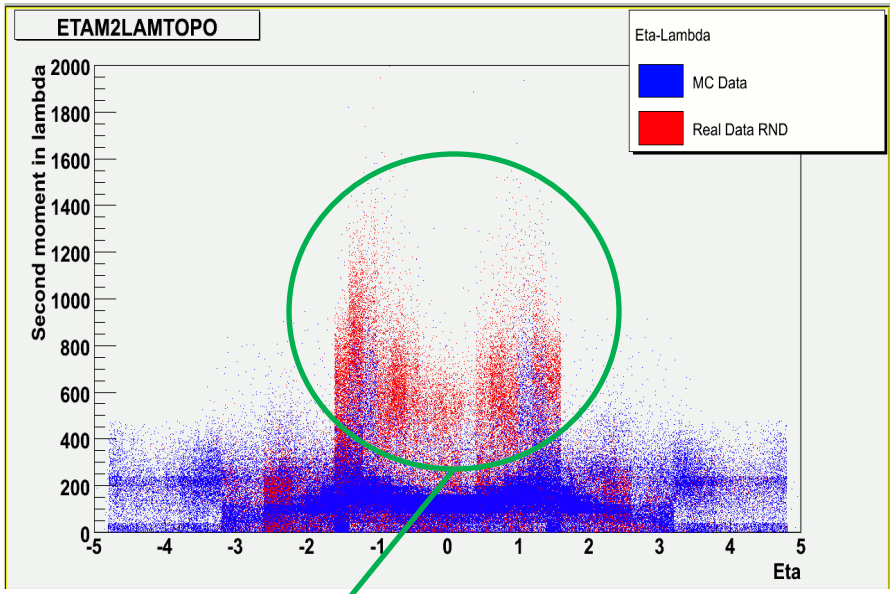
## 2) REAL DATA vs MC DATA

## Configuration (4,2,0): Eta-Moments

### Distribution: Eta-r^2




### Distribution: Eta-λ^2

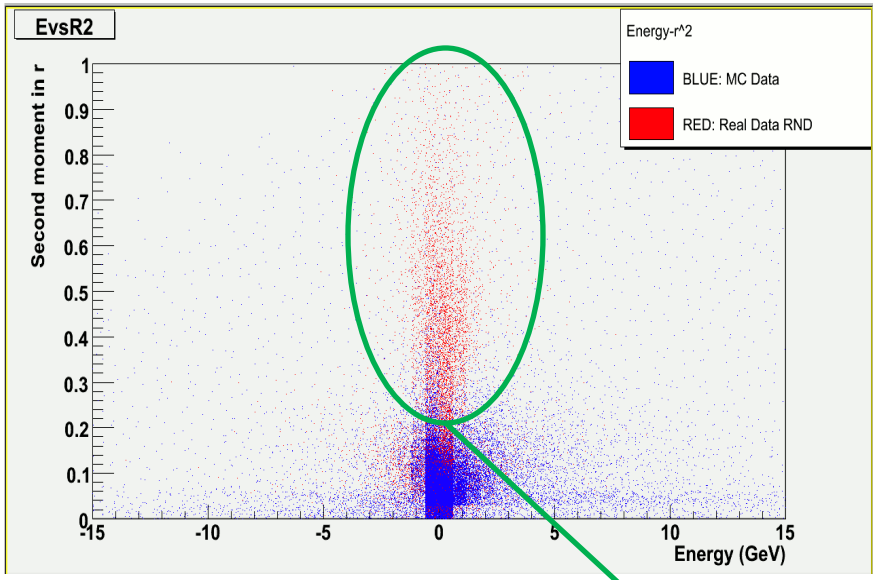



**The two moments in real data are greater than in MC data for same configuration of topoclusters: (4,2,0)**

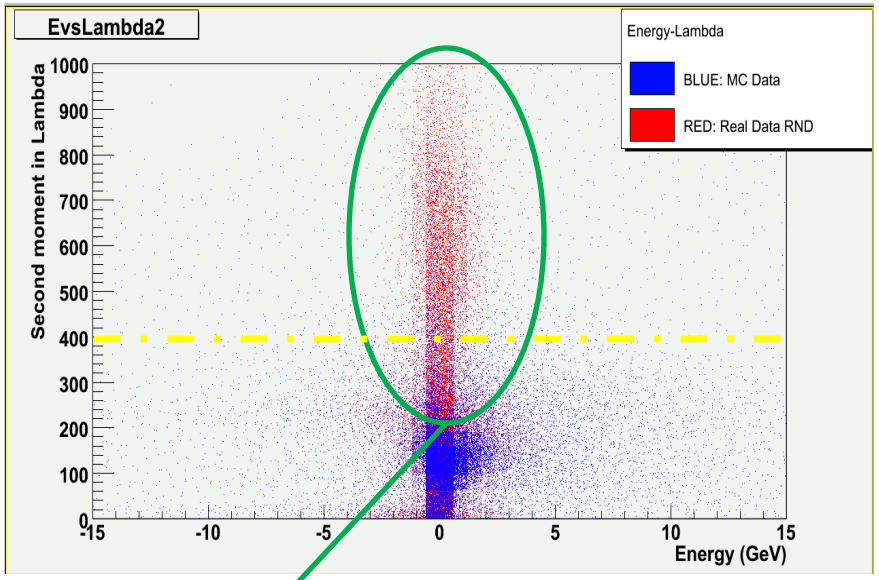
# Run 106020MC vs Run 91890RND

## Configuration (4,2,0): Energy-Moments

### Energy-r^2




### Energy-λ^2




**The two moments in real data are greater than in MC data for same configuration of topoclusters: (4,2,0)**

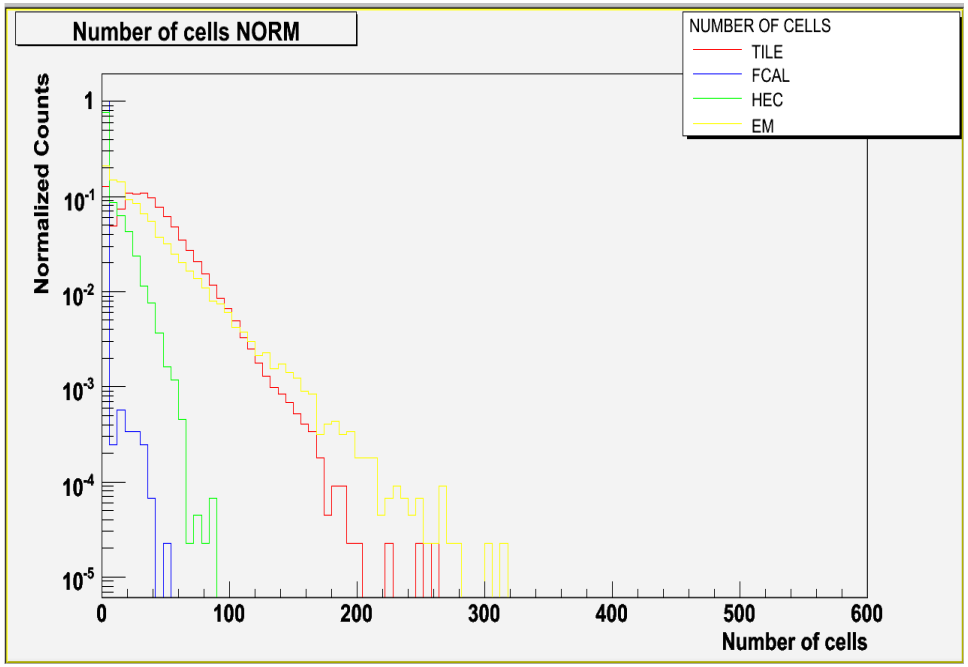
Let's go to study the distributions of the topos with large moments:

**CUT IN THE SECOND MOMENT IN LAMBDA: λ > 400**

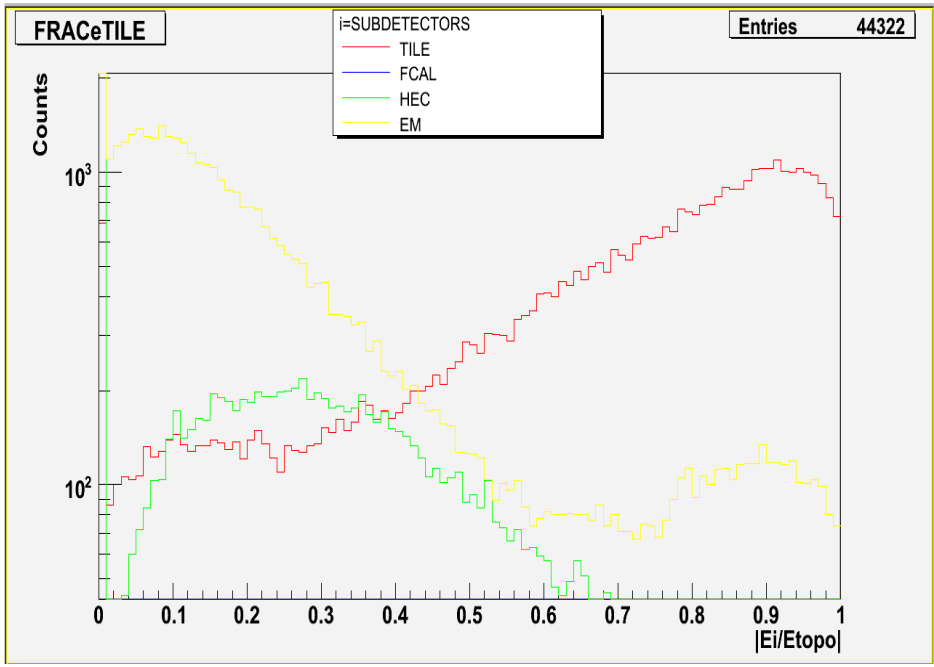
# Run 91890RND

## 1) CUT: Clusters with second moment in lambda > 400

### Number of cells of each part




### Energy fraction of each part




**Number of TILE cells 34.564**
Number of FCAL cells 0.0390777
Number of HEC cells 4.37683
Number of EM cells 26.1841

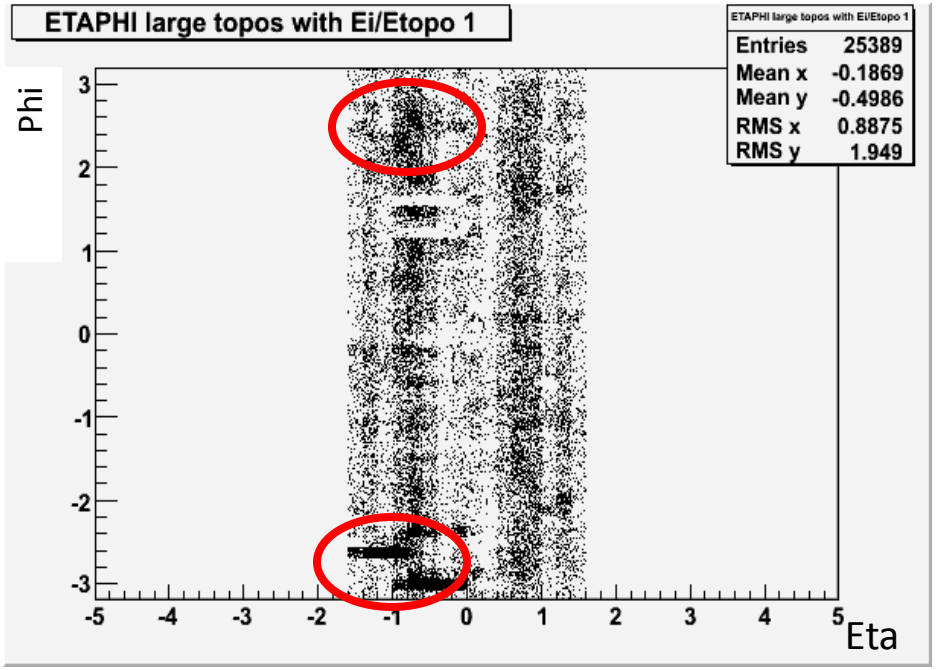
**Ratio energy TILE 0.695223**
Ratio energy FCAL 0.000298931
Ratio energy HEC 0.0677417
Ratio energy EM 0.204918

**The most energy fraction is from the TileCal**

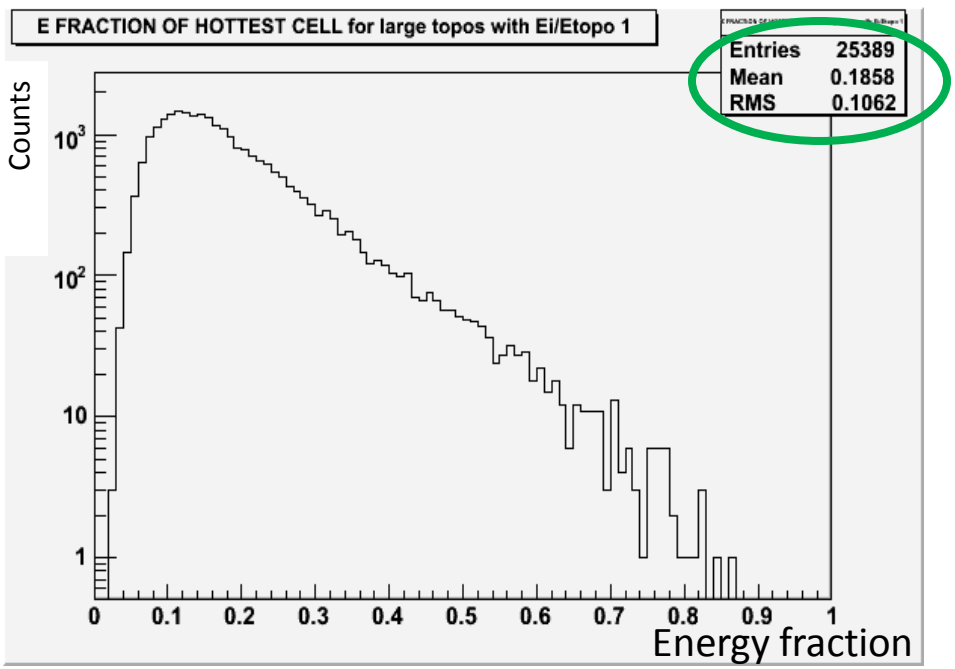
# Run 91890RND

## 2) CUT: Clusters with second moment in lambda > 400 && Etile/Etopo > 85 %

### Eta-phi




### Energy fractionof the hottest cell of the cluster




1) The distribution shows the region of clusters with large tile contribution: **eta [-1.5, 1.5]**
2) There are **hot spots** in this region, but…

The **most energetic cell has ONLY 20 % of total energy of the cluster.**

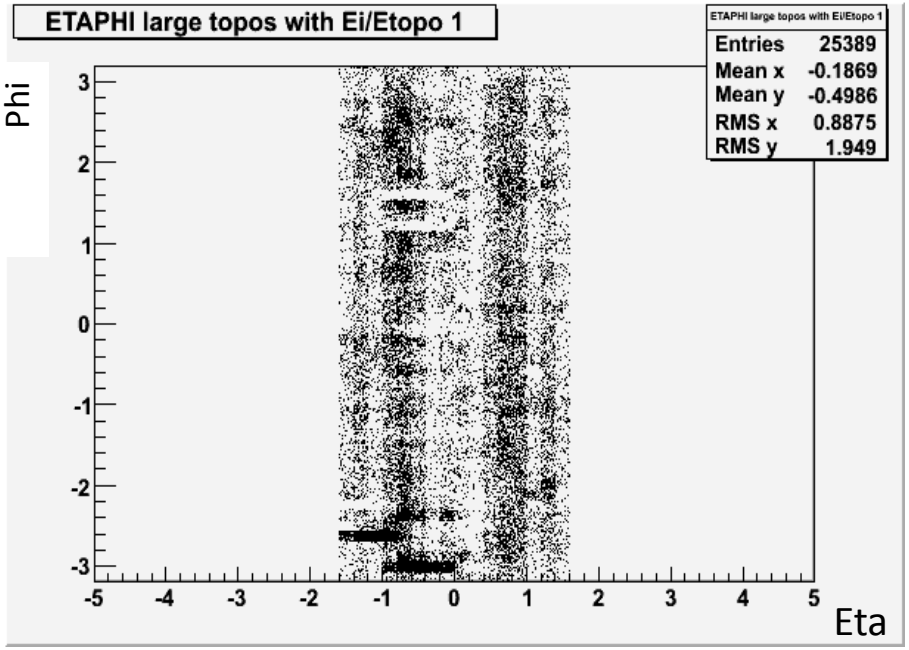
**The noise is coherent**.

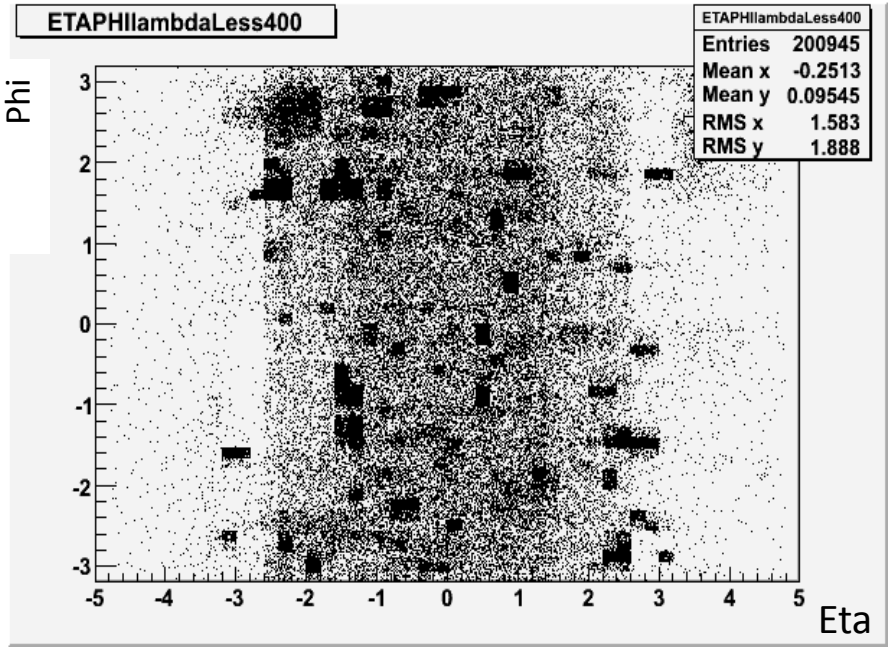
# Run 91890RND

**2) CUT: Clusters with second moment in lambda > 400 && Etile/Etopo > 85 %**

**3) CUT: Clusters with second moment in lambda < 400**

**How is the distribution of eta-phi of each kind of clusters?**



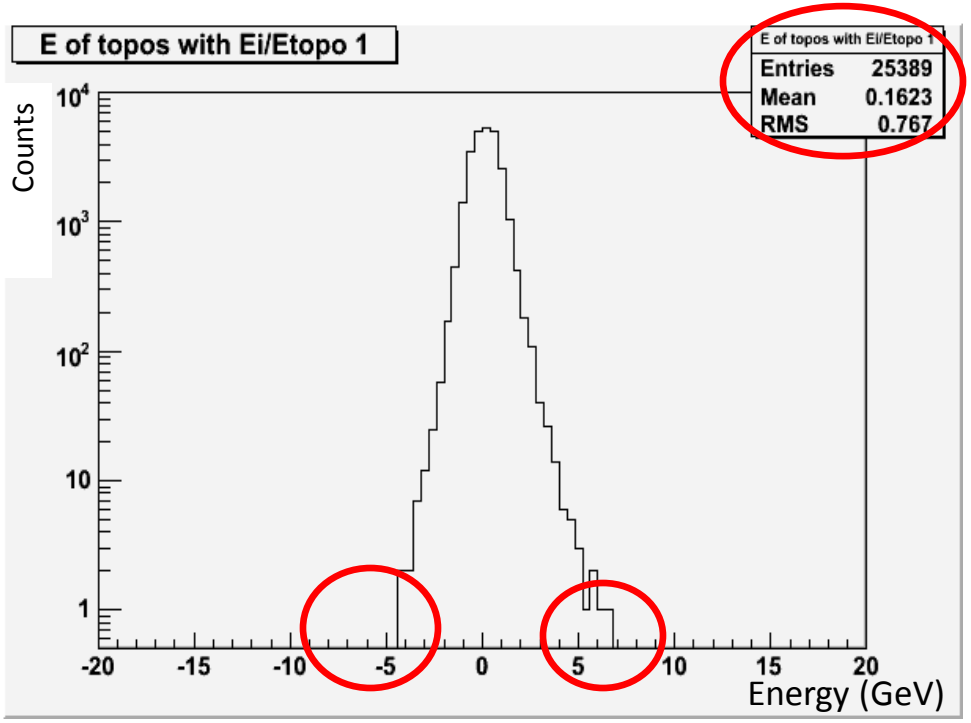

The **coherent noise** is produced in the **TileCal, eta region [-1.5, 1.5]** while the **electronic noise** is produced **in all the detector, all eta region.**

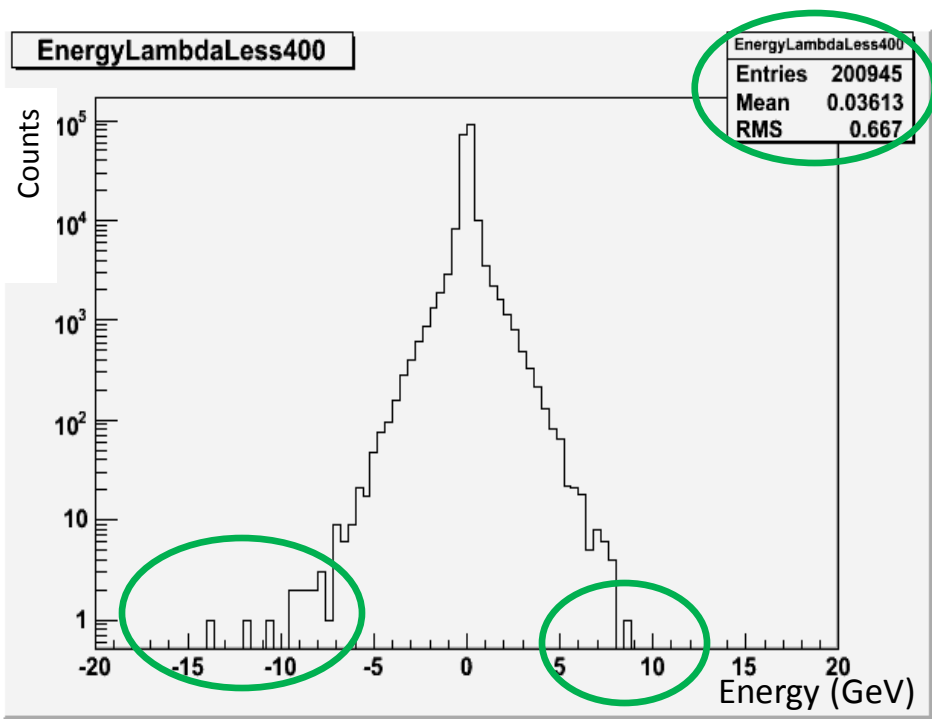
# Run 91890RND

## 2) CUT: Clusters with second moment in lambda > 400 && Etile/Etopo > 85 %

## 3) CUT: Clusters with second moment in lambda < 400

**How is the distribution of the energy of each kind of clusters?**




- **Large clusters have less tails than small clusters**, so **large clusters can't make MET tails**.
- The **distribution of the energy** of the **large clusters has a RMS value next to the RMS of the energy distribution** of the **small clusters**.

# Future tasks…

To **quantify** the **coherent noise**:

What is the probability to found coherent noise in a physic success?

Are needed cuts in the second moment in lambda?