EF calorimeter performance

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Contents

A) Software validation for EF-tau :

Status of TrigCaloRec
Comparison between EF and offline

B) EF calorimeter performance :

EF topo optimization
MIP energy in cosmic data

EF calo software status

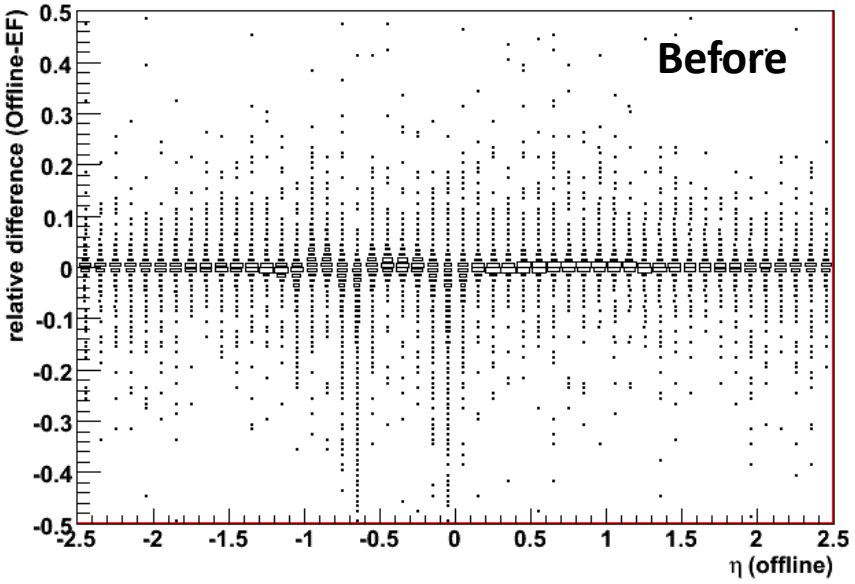
Reprocessed data

- 14.2.25.x
- ⋮
- 14.5.0 — Missing HEC 4th layer, tile cells around phi=±pi(TrigCaloRec-00-02-91)

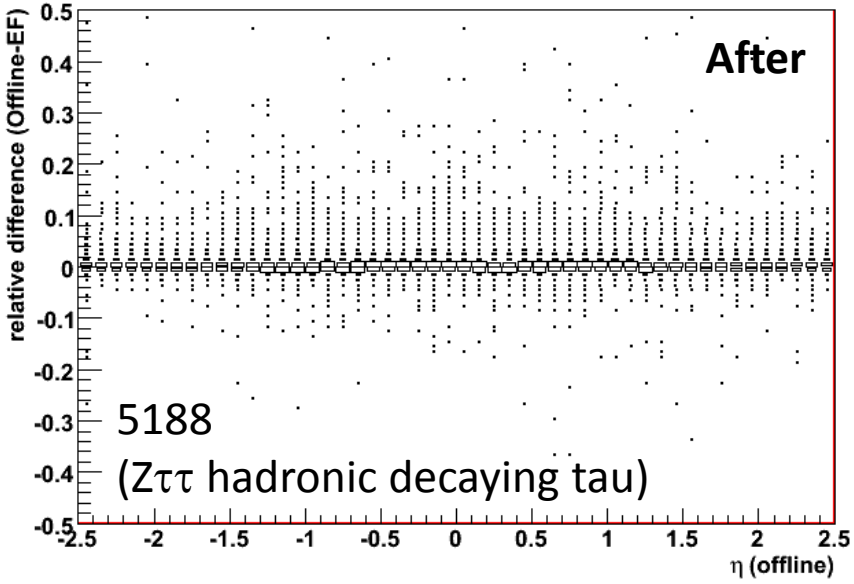
Next round

- 14.5.1.1 — All known bugs are fixed (TileByteStream-00-07-11)
- 15.0.0 — Synchronize db folder as used in offline (TrigCaloRec-00-03-08, CaloRec-02-10-03)

EtEM scale (14.2.25 TTP)



EtEM scale (15.0.0 TTP)



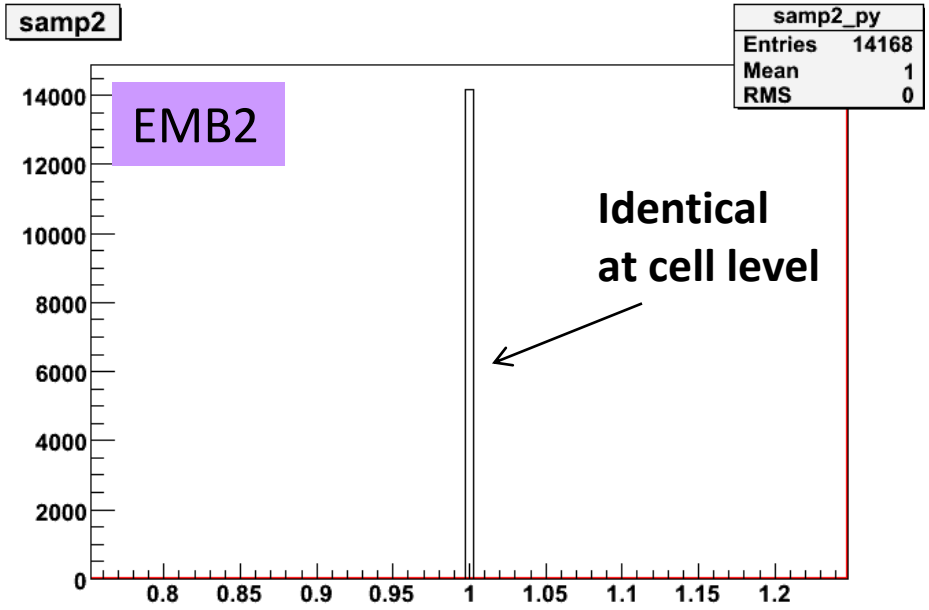
Comparison between HLT and offline

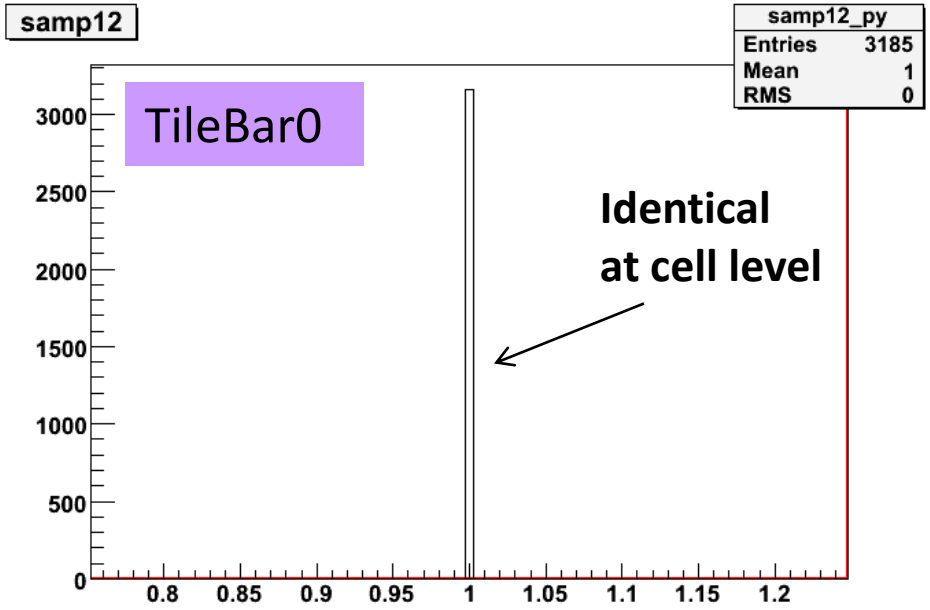
Comparison at cell level

5200 (CSC 14TeV sample) processed in 15.0.0 (250events)

For cells with energy/noise>10

$(Ecell^{HLT} - Ecell^{Offline})/Ecell^{Offline}$





Basically no difference between EF and offline CaloCell

exception: Mask, HV correction, elec. noise (MC).

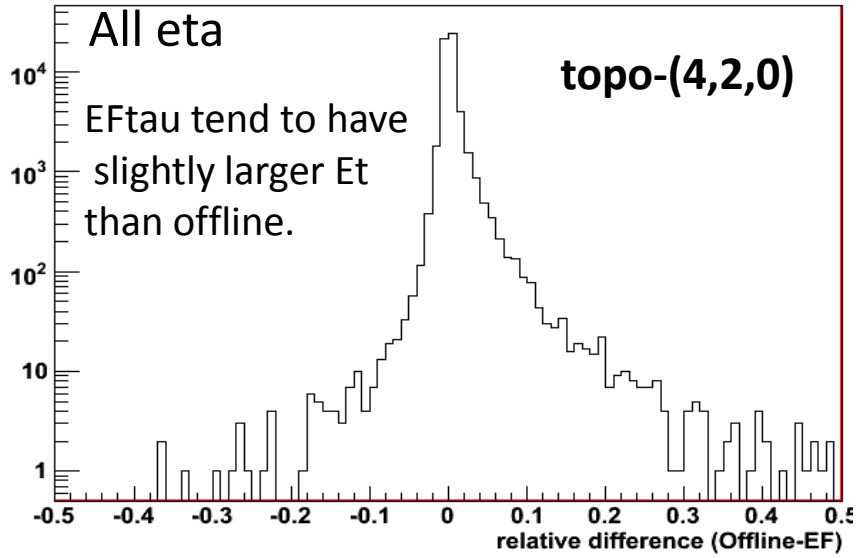
Comparison between HLT and offline

Comparison at tau reconstruction.

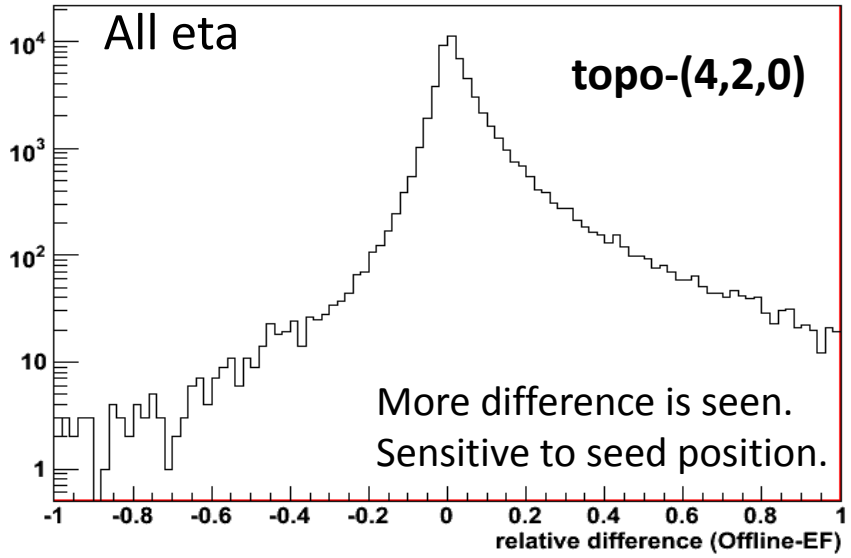
TTP12 : 5188 (CSC 14TeV sample) processed in 15.0.0

- matched to truth hadronic decaying tau with $|\eta_{vis}|<2.5$, pT>0GeV
- $dR_{matching}=0.1$ among truth(vis), offline and EF taus

$(EtEM^{EF}-EtEM^{Offline})/EtEM^{Offline}$ ▪



$(EMRad^{EF}-EMRad^{Offline})/EMRad^{Offline}$ ▪



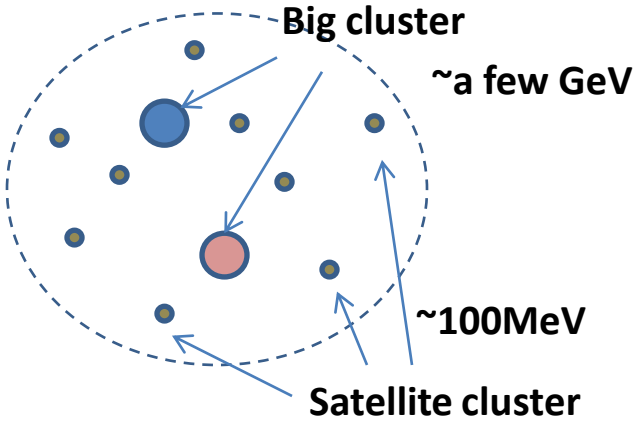
Be aware that EF tau is not identical with Offline tau at the level of ~1-5% (asymmetric).
Several reasons may be considered. (different corrections / RoI region etc.)
For instance, EMRadius is collected "R<0.4", while region selector draws "0.8x0.8" rectangular region, so that some of cells are not considered at EF and its seed center is biased.

EF Cluster optimization in Tau

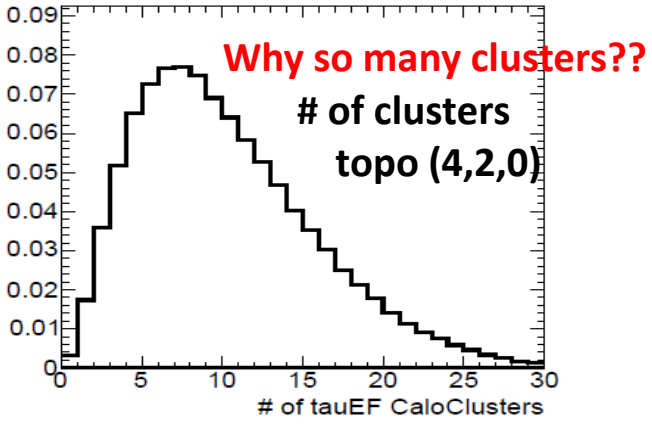
Clusters are formed by topo-clustering (4,2,0).

For tau candidate, we see lots of clusters in tau ;
Some “big clusters” and many “satelite clusters”

The “satellite clusters” are due to the calo. noise.



MC: decayType= 3 Pt= 65219.6
eta= 2.45897, phi= -2.54276, EmCellEt= 28280.2, HadCellEt= 23097.2
Cluster 0: e= 16224.7, eta= 2.47345, phi= -2.41197, nCells= 76
Cluster 1: e= 11275, eta= 2.36851, phi= -2.49583, nCells= 140
Cluster 2: e= **533.698**, eta= 2.08754, phi= -2.12206, nCells= 21
Cluster 3: e= 2598.59, eta= 2.38538, phi= -2.83906, nCells= 64
Cluster 4: e= **356.088**, eta= 2.19232, phi= -2.44165, nCells= 14
Cluster 5: e= **578.896**, eta= 2.21516, phi= -2.92205, nCells= 25
Cluster 6: e= **105.901**, eta= 2.28249, phi= -2.70399, nCells= 21
Cluster 7: e= 1494.42, eta= 2.04706, phi= -2.14722, nCells= 40
Cluster 8: e= **472.35**, eta= 2.02315, phi= -2.39132, nCells= 16
Cluster 9: e= 14161.9, eta= 2.45696, phi= -2.39141, nCells= 116
Cluster 10: e= **627.767**, eta= 2.14333, phi= -2.76401, nCells= 14
Cluster 11: e= 2951.69, eta= 2.62081, phi= -2.16898, nCells= 39
Cluster 12: e= **250.983**, eta= 2.24141, phi= -2.09017, nCells= 11
Cluster 13: e= **199.794**, eta= 2.22712, phi= -2.54517, nCells= 8



We need to tune “noise insensitive clustering“ to be a stable operation of triggering.

Note: at trigger level, we do not need to reconstruct pi0 clusters.

Topo optimization

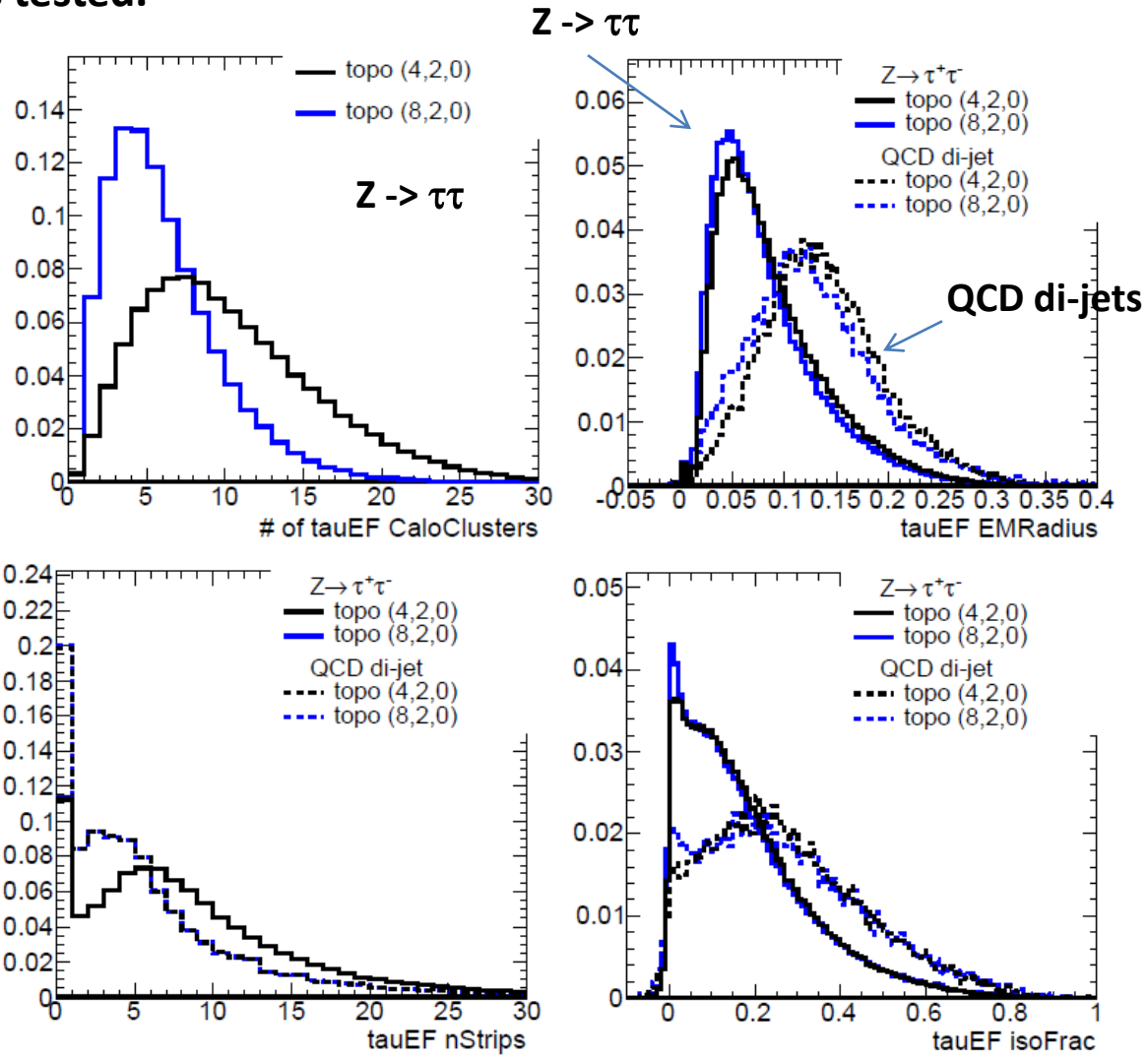
Following configuration was tested.

Put higher seed threshold.

Def:(4,2,0) ==> (8,2,0)

Roughly, comparable to set fixed threshold of ~1GeV.

- Number of clusters are drastically reduced.
- No big change in the shower shapes.



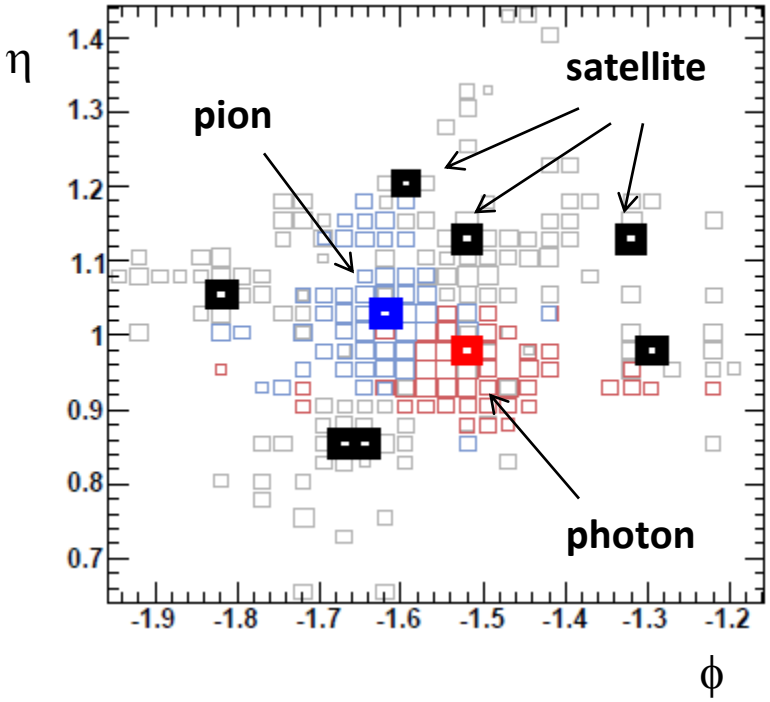
1-prong tau

See ϕ–η view.

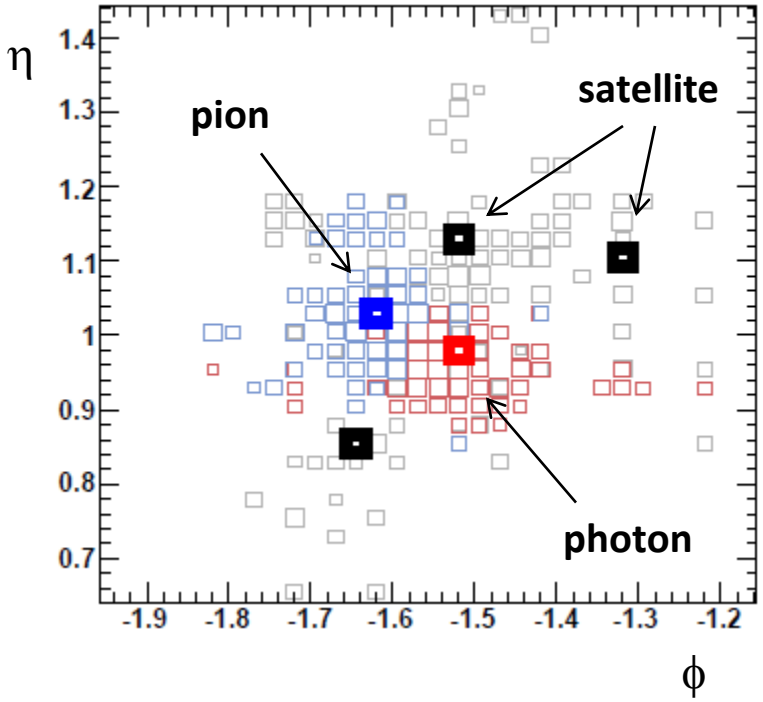
For same tau candidate,

$Z \rightarrow \tau\tau$

Def: topo(4,2,0)



topo(8,2,0)



Satellite clusters are removed. ==> "noise toughness"

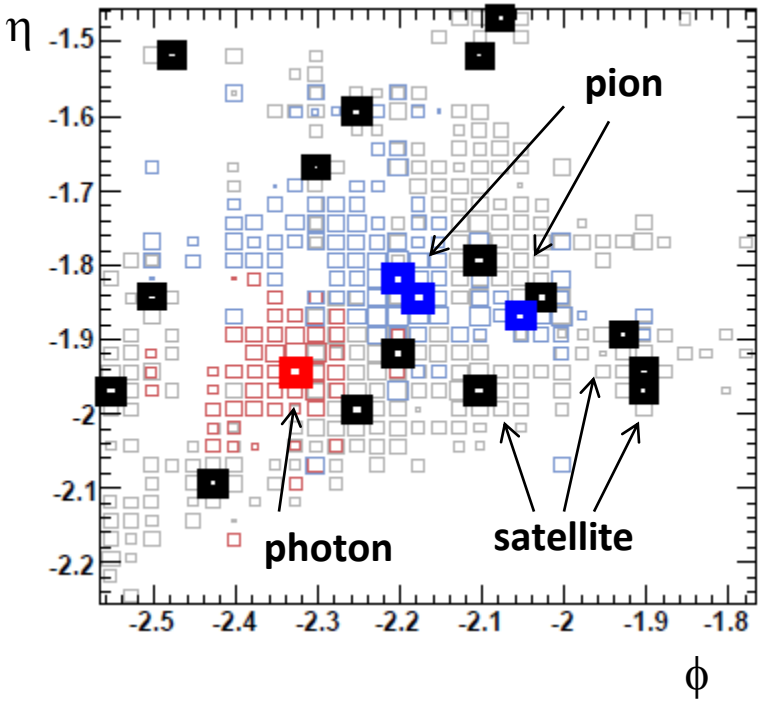
3-prong tau

See ϕ–η view.

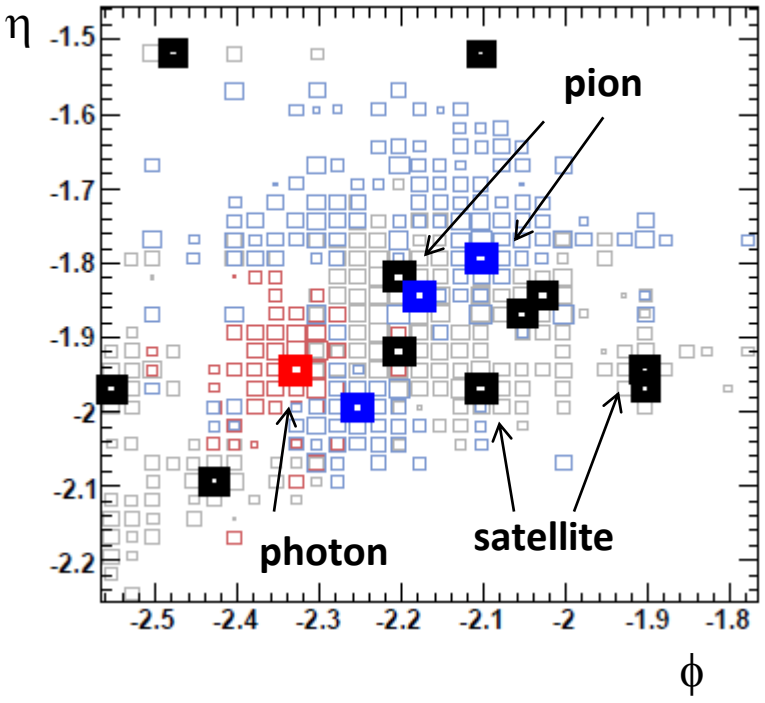
For same tau candidate,

Z -> $\tau\tau$

Def: topo(4,2,0)



topo(8,2,0)



Satellite clusters are removed. ==> "noise toughness"

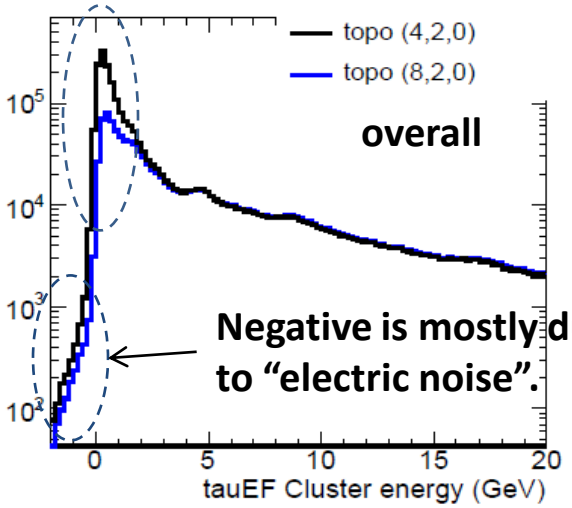
Cluster energy distributions

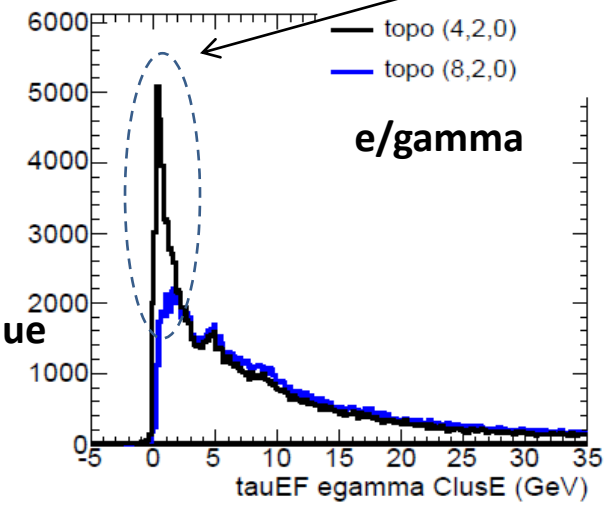
Z -> ττ

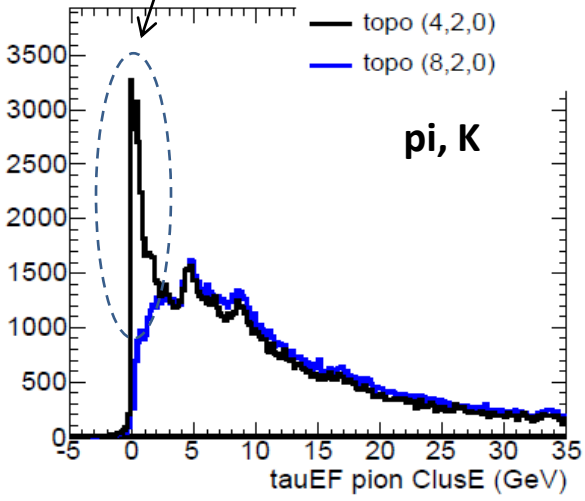
Low energy clusters are suppressed by topo(8,2,0).

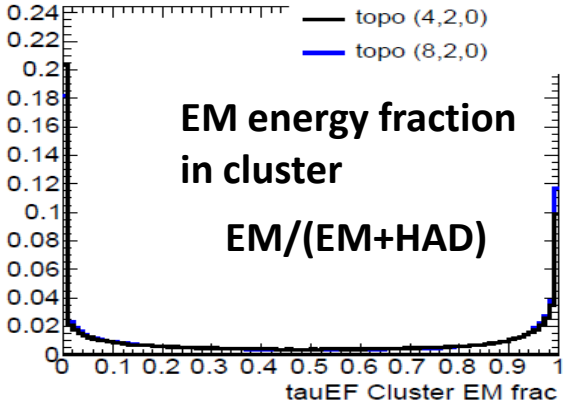
Clusters are matched with truth particle.

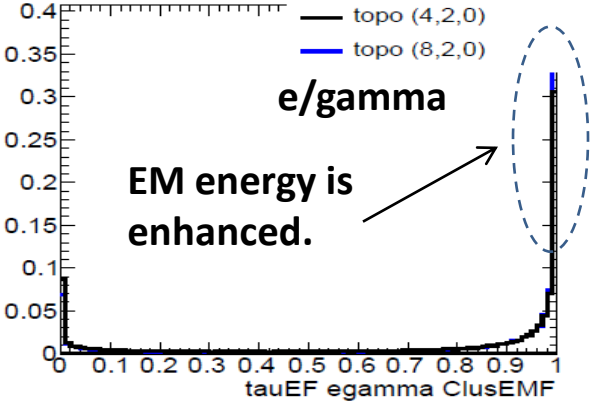
Many ~a few 100MeV clusters in topo (4,2,0).

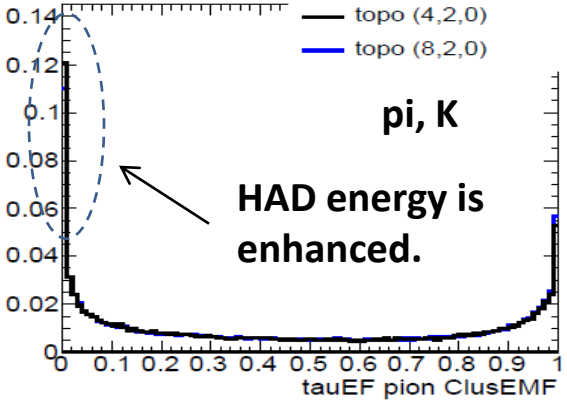












EF tau trigger efficiency

No degradation of efficiency/rejection in topo (8,2,0).

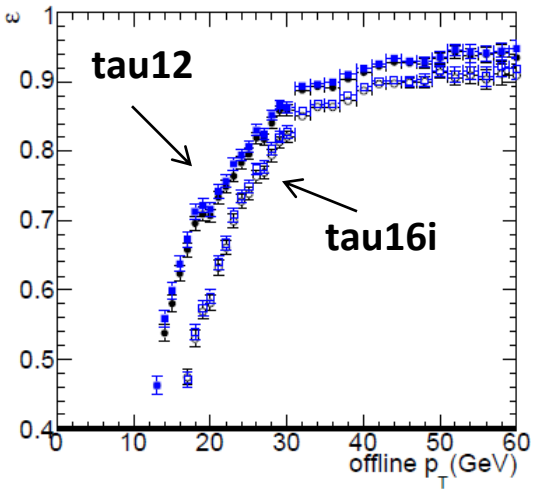
Z -> ττ

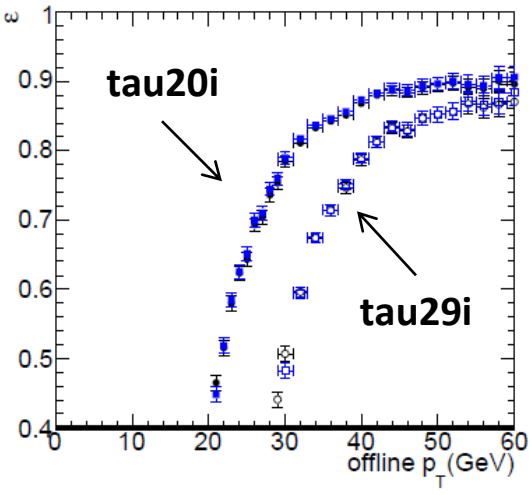
Eff. = EF tau / offline.id.tau

(event efficiency)

- No degradation in eff/rejection.
- No bias in pT/eta

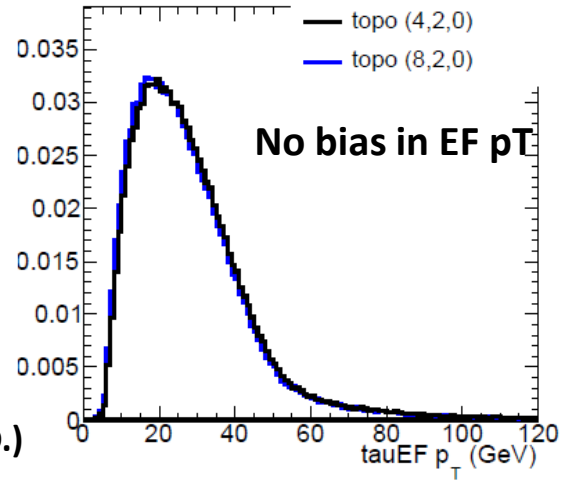
Since calibration constant is different in topo(8,2,0), energy Is biased around +2% w/ σ~4%.

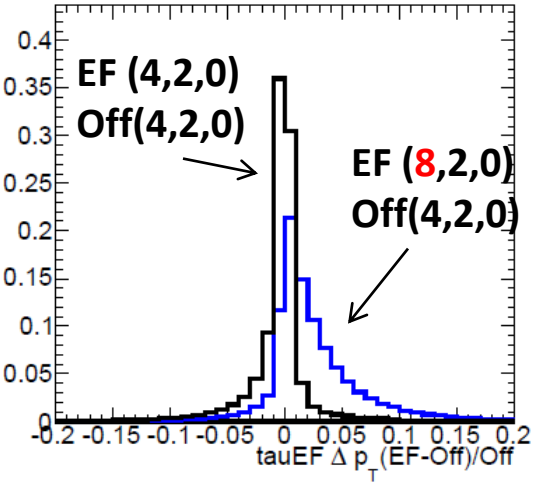




EF	Z->ττ (4,2,0)	Z->ττ (8,2,0)	QCD (4,2,0)	QCD (8,2,0)
tau12	44.8%	45.2%	0.093	0.099
tau16i	38.2%	38.4%	0.039	0.040
tau20i	32.2%	32.2%	0.019	0.019
tau29i	19.3%	19.1%	0.006	0.006

(Note: min.bias 5001 was used for QCD.)



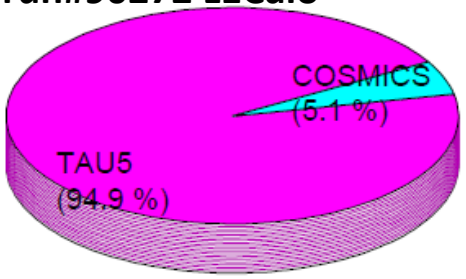


MIP energy in Cosmic data

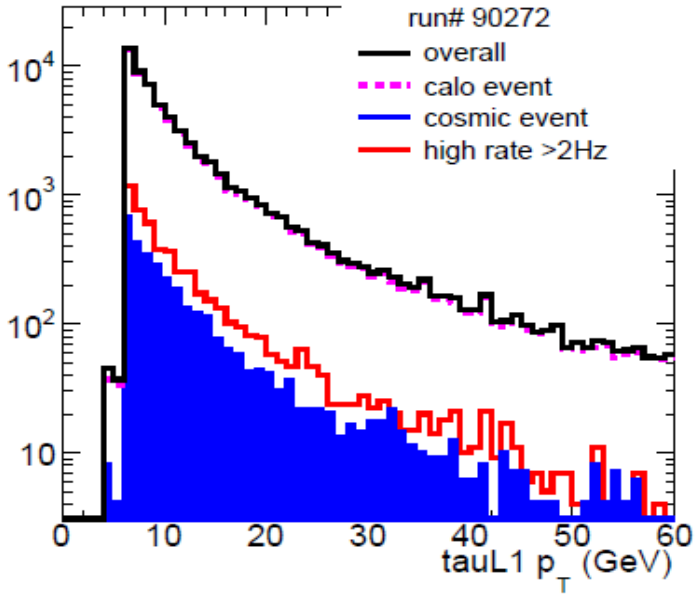
Find a coincidence event with TAU & MUO.

In L1Calo stream, ~5% of events have both triggers (TAU5 && COSMICS)

run#90272 L1Calo



COSMICS:
- MU0_TGC_HALO
- MU0_TGC
- MU6_TGC
- MU0_LOW_RPC
- MU6_RPC
- MU0_HIGH_RPC

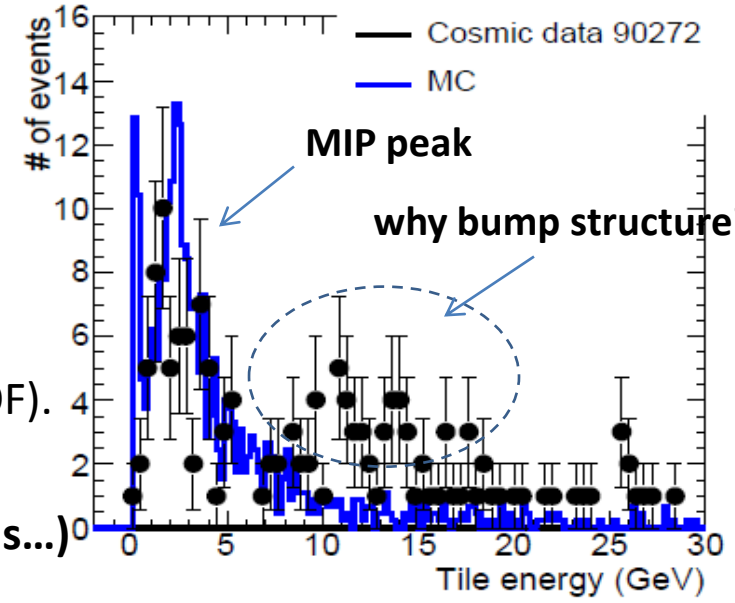


Number of tracks (cosmic) is extremely low in L1Calo data...

MIP energy is taken by matching with "offline Staco Muon" and "CalCaloCluster".

Since cosmic timing is unclear (for me) in LAr. only take cluster energy in Tile (dynamic range of OF).

Note: MC is not "CosmicMC", it is Z->ττ .
(might be possible to explain up/downward muons…)



Summary

Plan of TrigCaloRec :

1) Bug (long standing issue) was removed. Fixes are available in rel.15.0.0 or later.

EF topo optimization :

1) Confirm the “noise insensitive” topo cluster configuration.
   topo (8,2,0) (first digit) kills many low energy cluster which come from noise,
   where noise includes electric, soft particles from secondary or underlying activity.

2) There is no bias in shower shape by setting tighter threshold for topo configuration (up to 8). Revisit again topo v.s. SW.

3) No change in the trigger efficiency and rejection.
   (Probably, the second digit affects in the trigger rate, need to check future.)

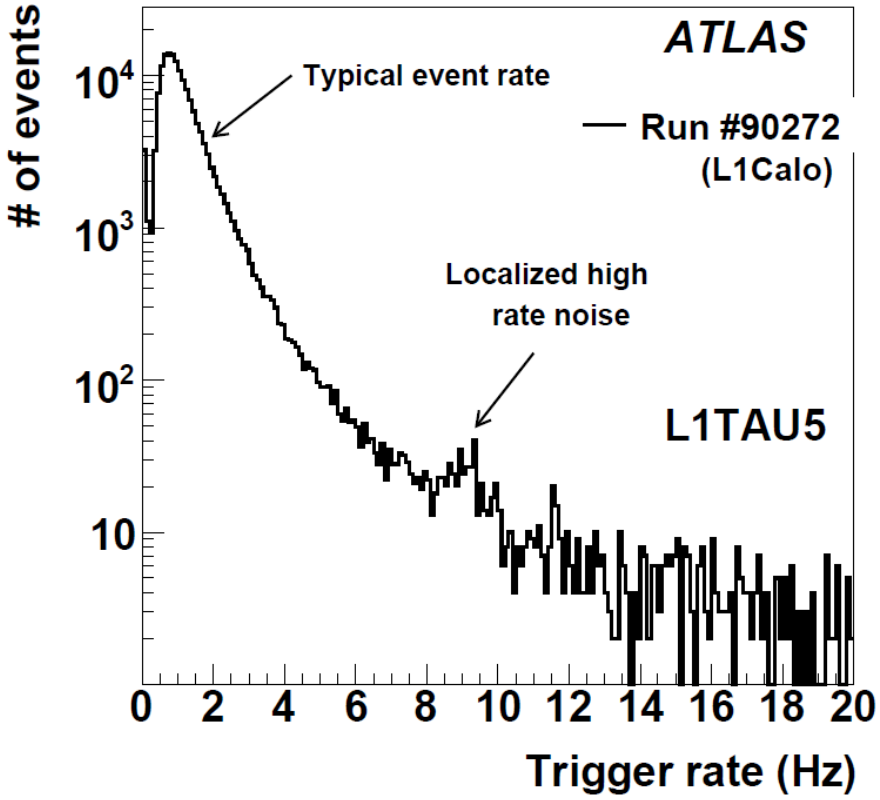
MIP energy in cosmic data :

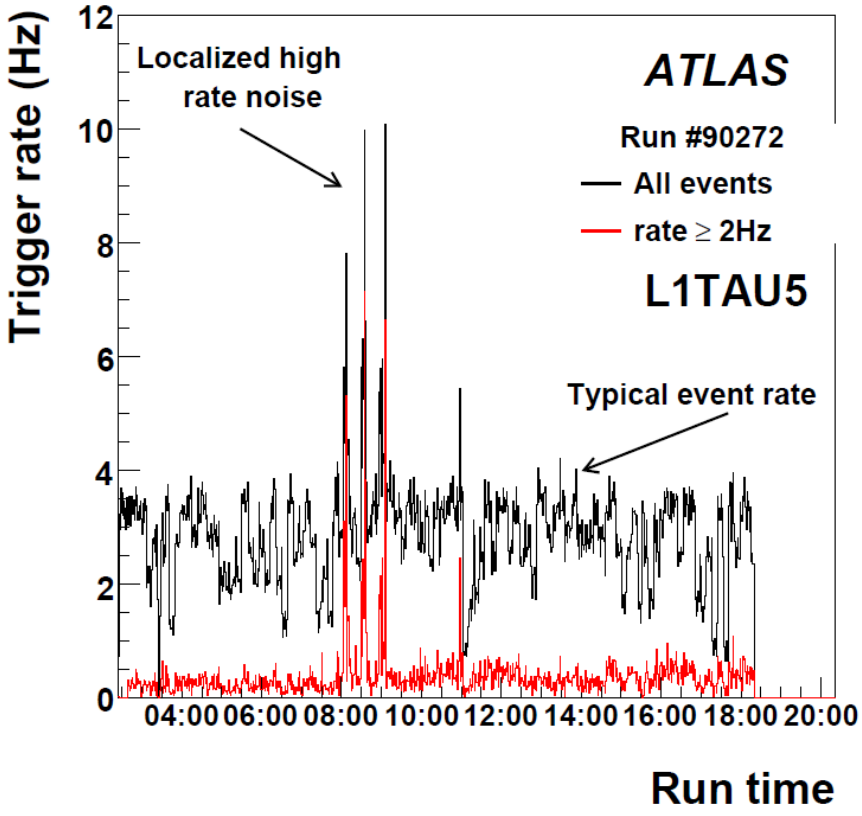
1) MIP cluster associated with cosmic(muon) track is taken.
   The peak position is consistent with MC.
   Need to check muon momentum dependence.

Backup

High rate noise monitoring

Localized high rate noise can be identified estimating the trigger rate event-by-event basis. If this noise seriously affects the trigger bandwidth, they can be masked during the clustering step. Note that this type of noise should not be masked during the whole run.

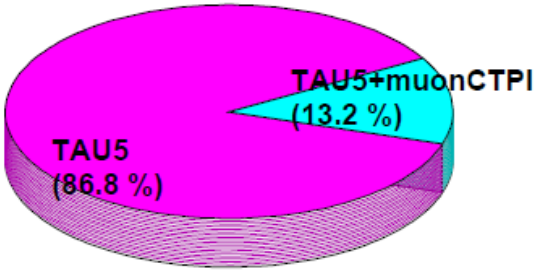


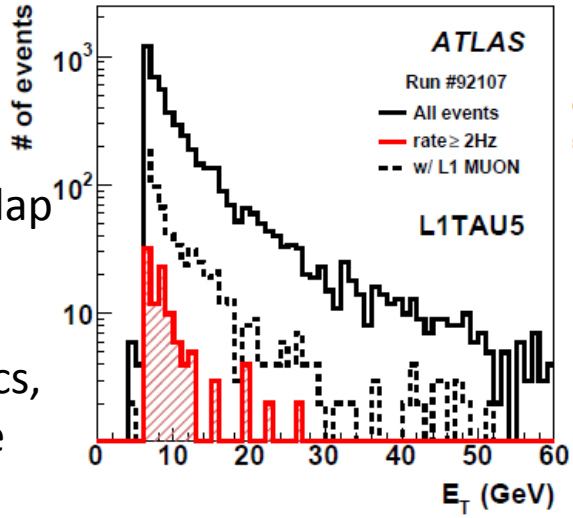


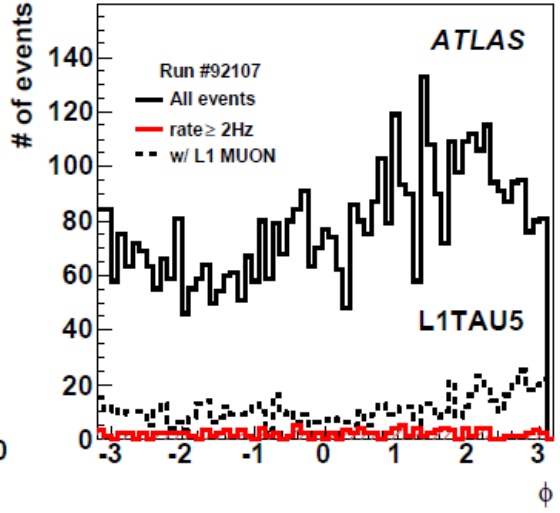
L1Calo

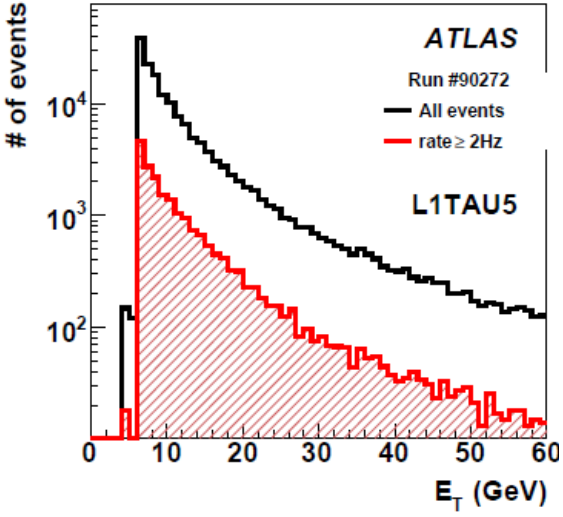
L1Calo stream consists of real cosmic events and detector noise events. Roughly 12% of events overlap with the muon triggered events. The rest of them may also include events with unreconstructed-cosmics, and air shower events as well as the detector noise.

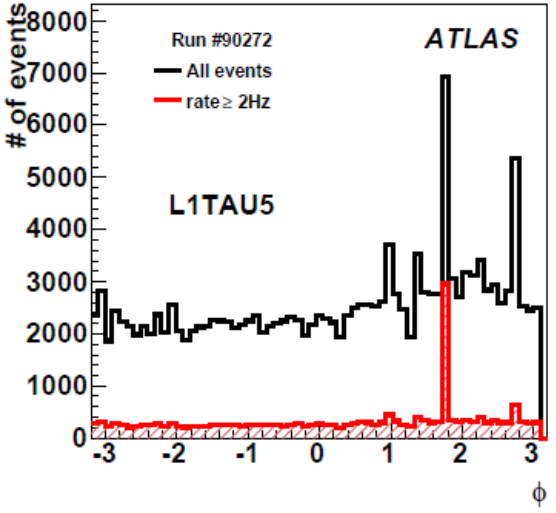
The event rate is about 1Hz on average at L1TAU5. So that this type of events do not affect the trigger rate.









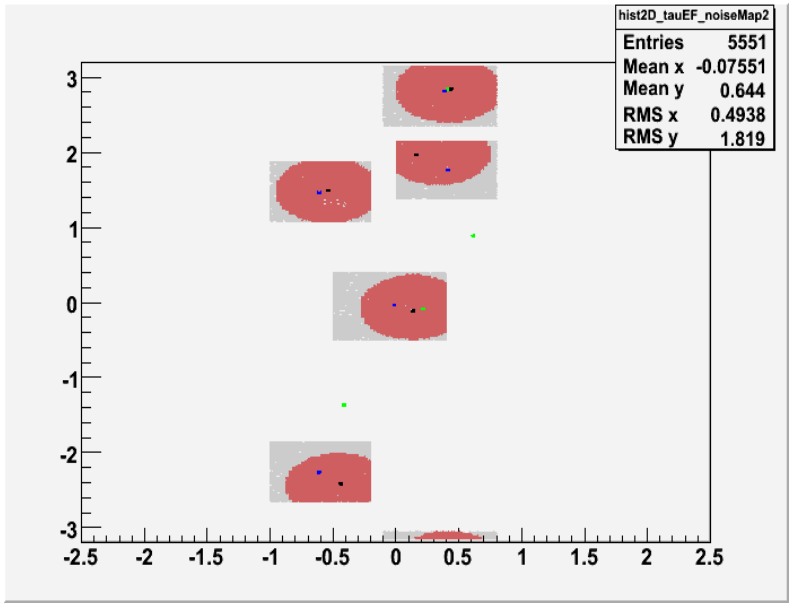


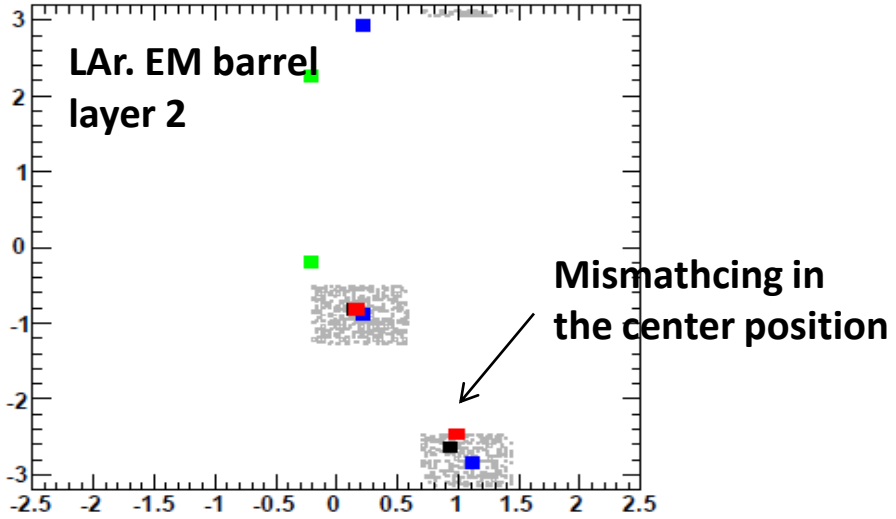
Bias in Sliding Window algorithm in Trigger

Trigger RoI is defined in the fixed size of rectangular window.

The bias will happen when RoI is small enough to be compared with the mismatching in at L1 RoI center and the seed tower in EF.

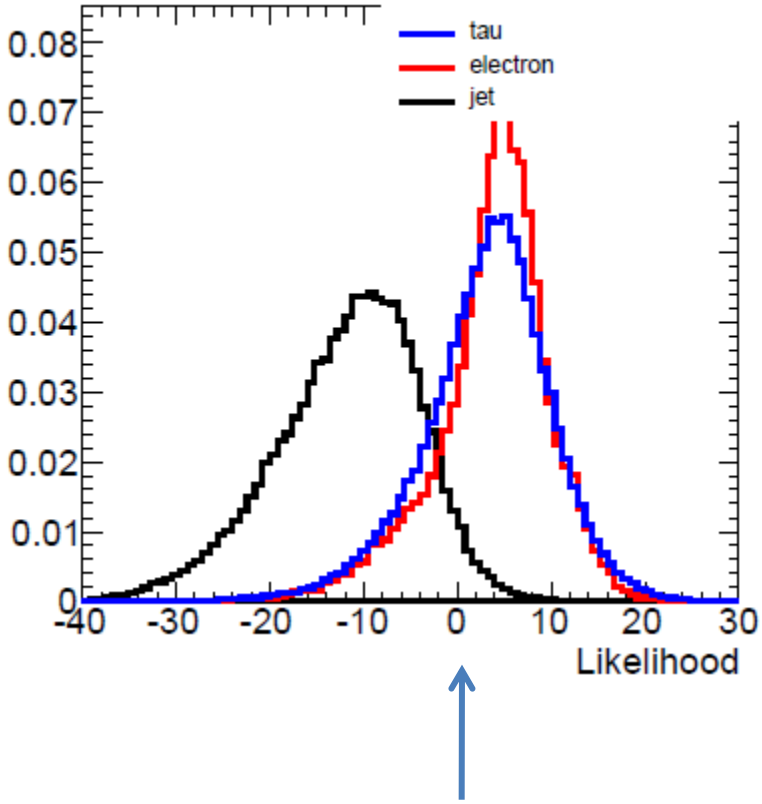
For instance, in tau, RoI is 0.8x0.8, regardless as the cone size is R=0.4.

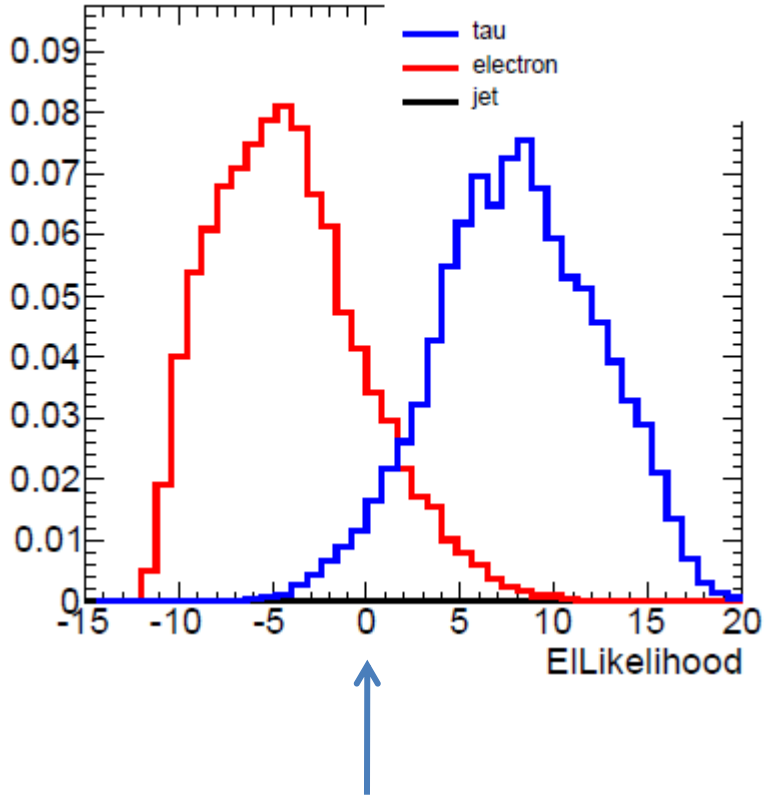




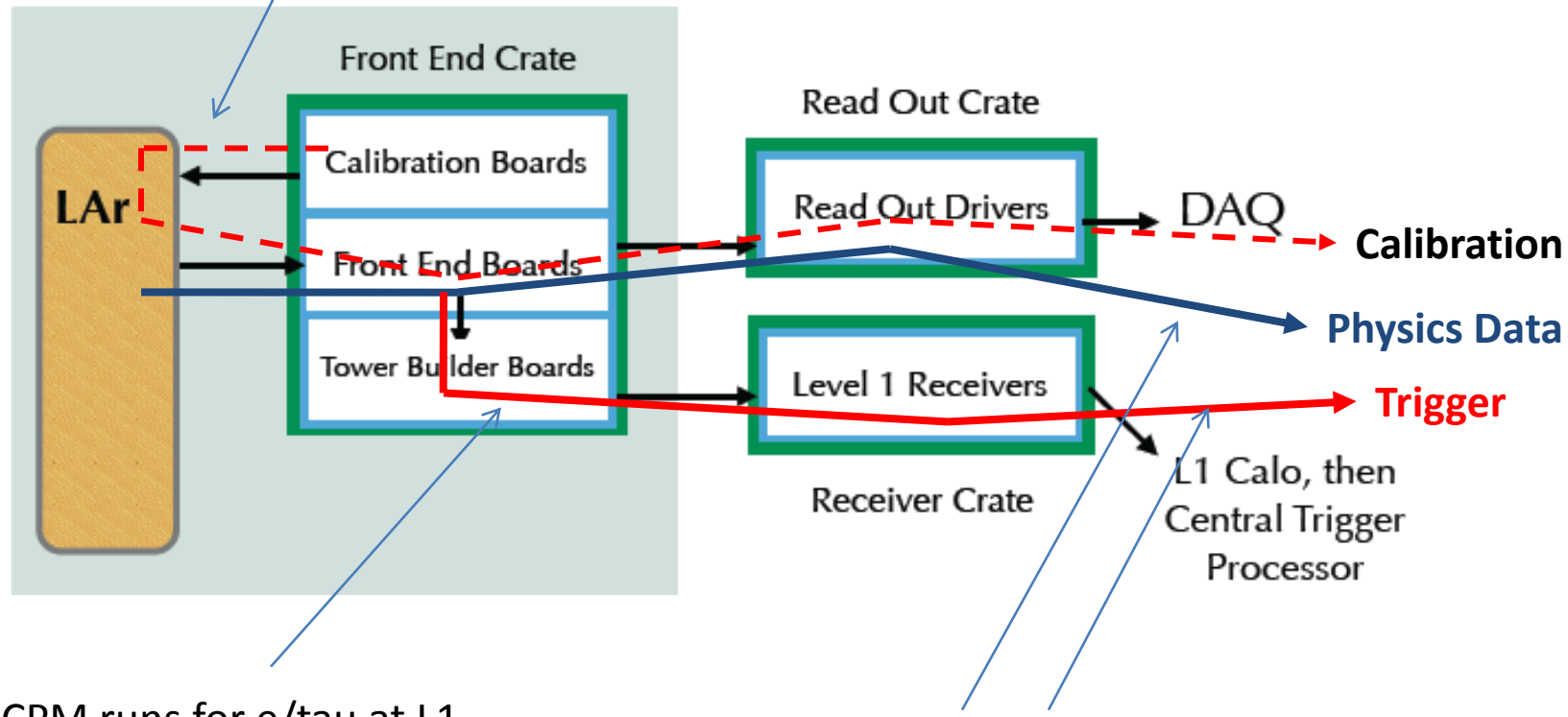
Offline tau identification

|Charge| = 1, && 1 or 3 tracks,
LLH>0 && ElLLH>0





ELECTRONIC noise is only considered.



CPM runs for e/tau at L1.
While, JEM is responsible for jet.

If data is not "physics mode", different energy calibration is applied in HLT.