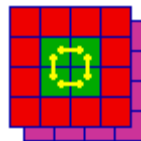


L1Calo EM Efficiencies

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L1Calo Joint Meeting, Cambridge
24/03/2011



Contents

- Intro to EM efficiencies
- Turn-on Curves
- Efficiency maps
- Plans for 2011

Calculating Efficiencies

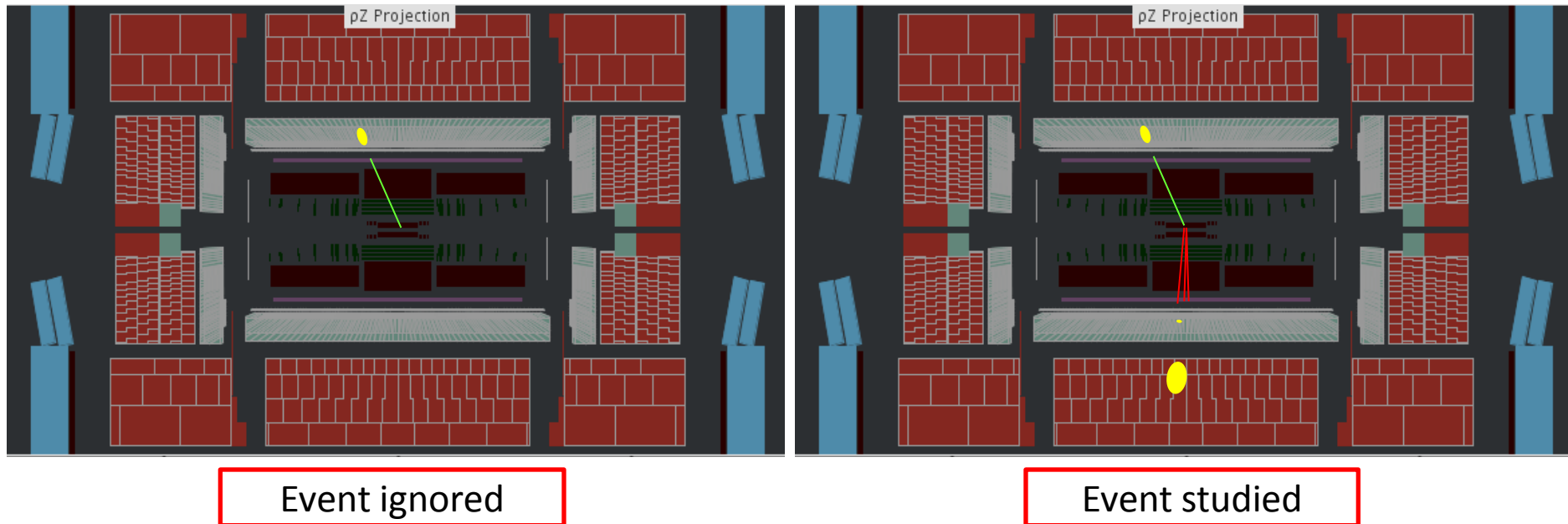
- Efficiencies calculated for L1 electromagnetic trigger items as to determine L1Calo (CPM) performance
- Calculated by using raw offline clusters of electrons and photons and matching them to EmTau Rols (using recommendations of egamma group)

$$\epsilon(L1_EMx) = \frac{\text{Offline Cluster \& } \Delta R \text{ to RoI} < 0.15 \text{ \& RoI passes L1_EM}x}{\text{Offline Cluster}}$$

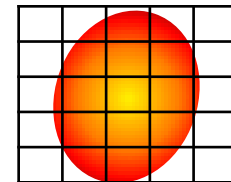
- Done two different ways
 - Function of E_T – turn on curve
 - Function of η and ϕ – efficiency map
- Also as a function of each data taking period (similar to most offline analyses)
- LAr OTX cuts can be applied
- Transition region between EM barrel and endcap excluded ($1.37 < |\eta| < 1.52$)

Method

- Using AthenaProduction-16.0.2.4
- Using JetTauEtmisss stream ESDs (reprocessed)
- Sample obtained with Jet Tag and Probe method
 - EM objects also reconstructed as jets so need to find another L1_J* Rol in the event ($\Delta r > 0.4$ away) so that they can be studied

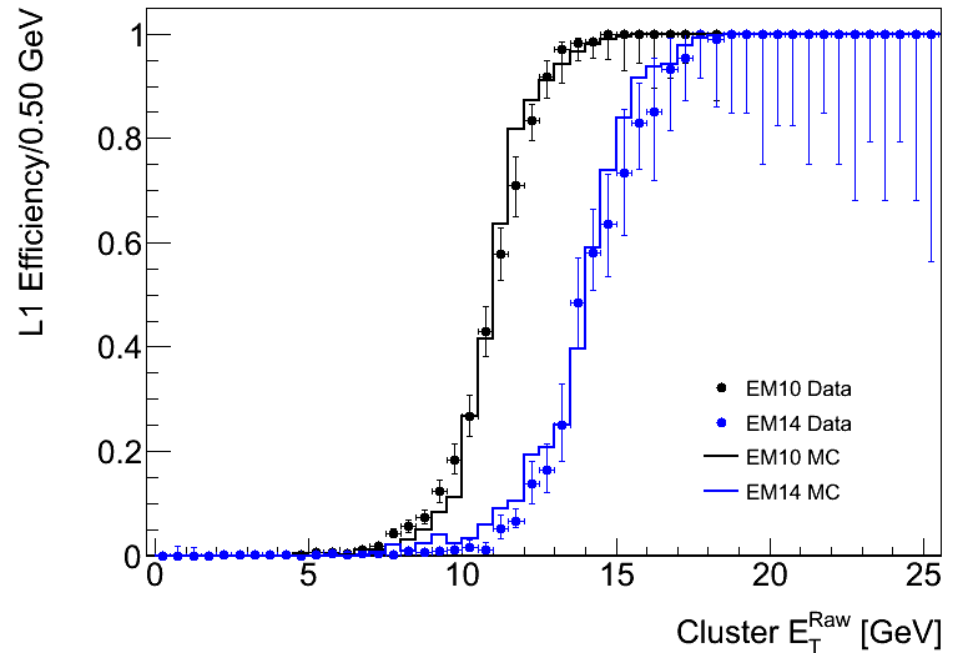


- Raw cluster E_T , η , ϕ using energy weighting of CaloCells that make up CaloCluster



Turn-on Curves

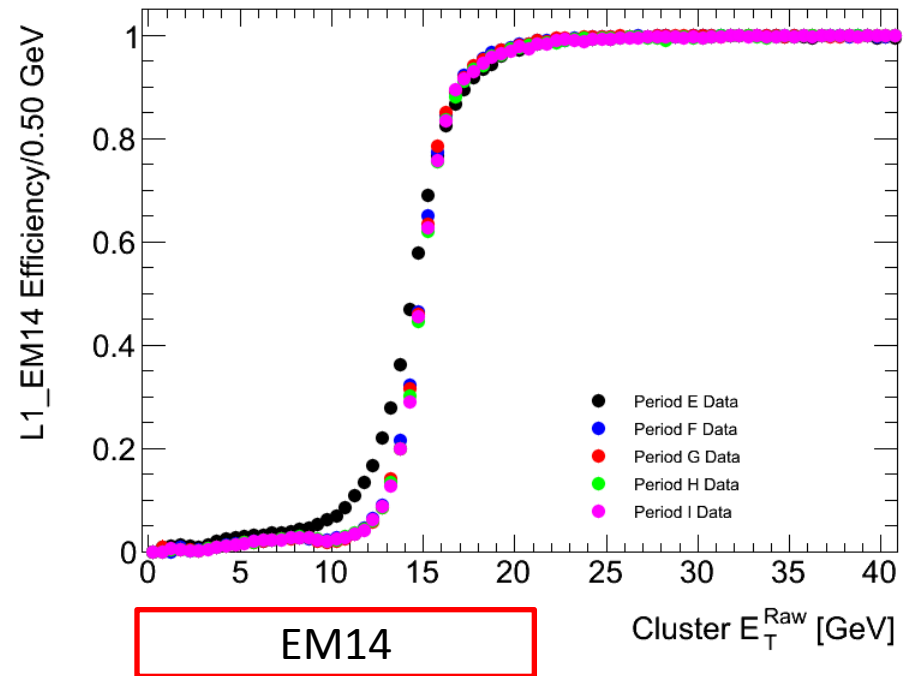
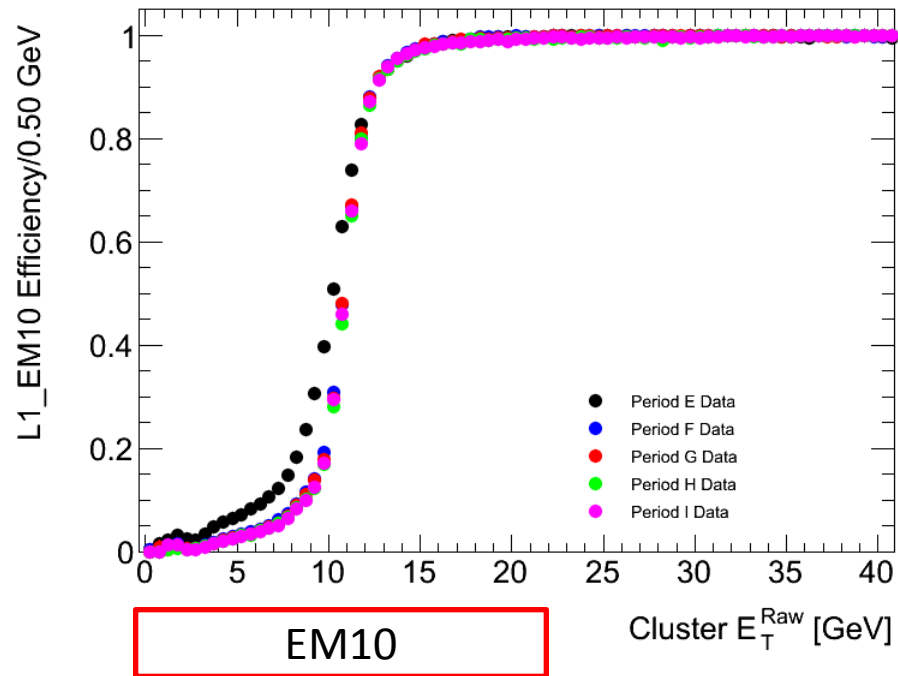
- EM10 and EM14 as a function of offline raw cluster E_T with MinBias Monte Carlo



- Ways of measuring performance
 - Where does the rise of the curve start?
 - How sharp is the turn-on curve?
 - How early does it plateau and at what level? (Ideally at 100%)
 - Does the efficiency drop off anywhere?
- Provides representation of the overall ability of L1Calo / EM trigger items with increasing energy

Turn-on Curves

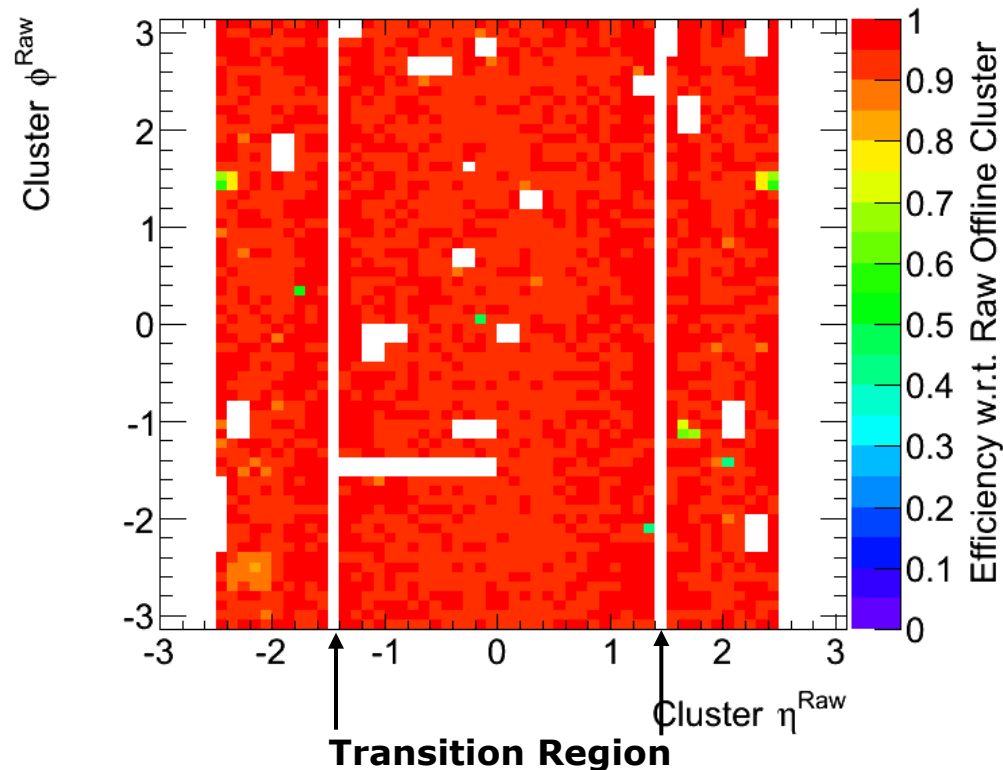
- EM10 and EM14 as a function of offline raw cluster E_T for periods E-I
 - Running over whole data periods means statistical errors are tiny



- Big improvements in calibration and timing since period E

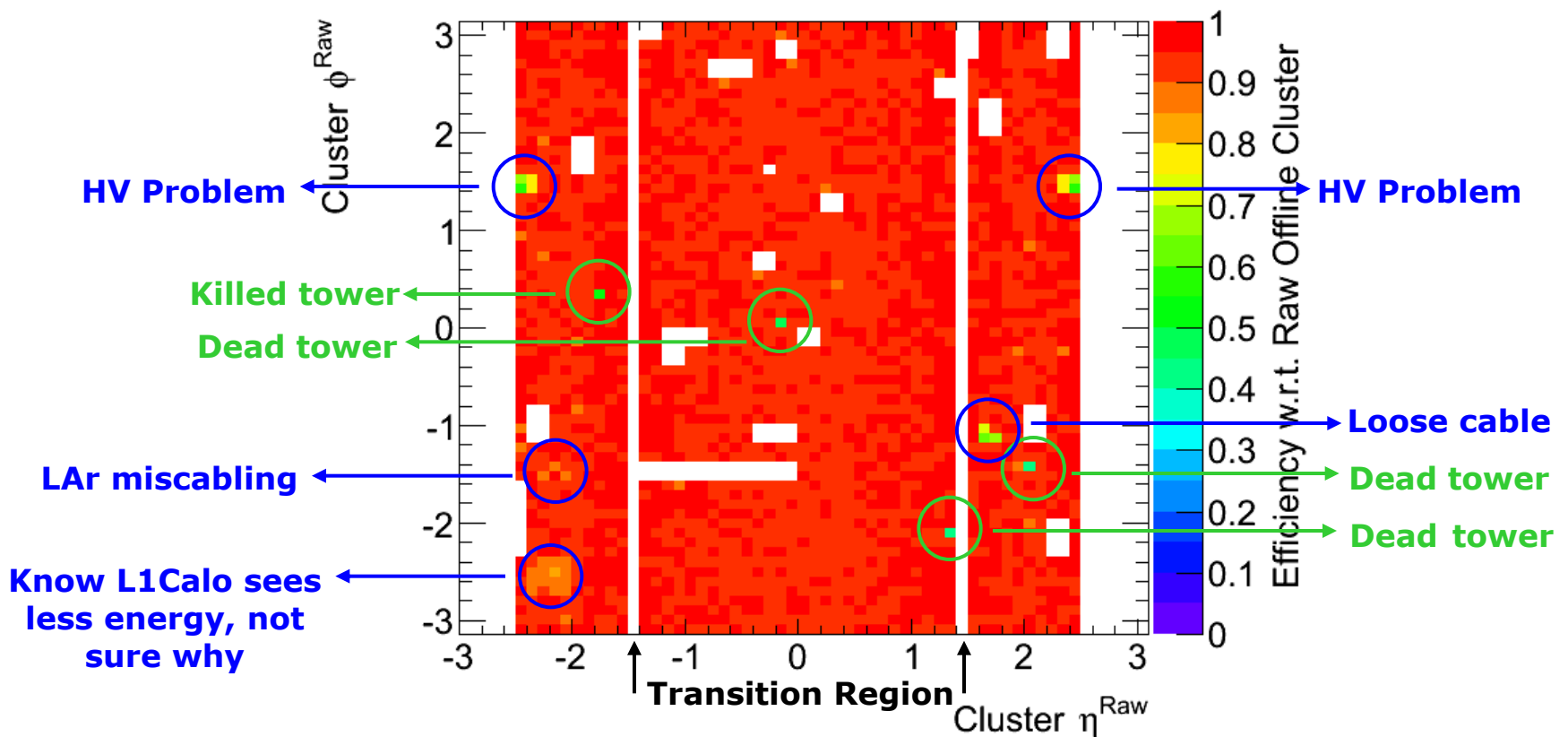
A Typical Efficiency Map

- η - ϕ efficiency map for EM3 with OTX cuts for offline clusters with raw $E_T > 5$ GeV
- Done in **offline coordinates**, ϕ shift from L1Calo coordinates
- With OTX/fiducial cuts an area has **zero efficiency**
- Towers with issues generally have **low but non-zero efficiency**
- Provides representation of the ability of individual trigger towers to ‘trigger’
- Also identifies problem channels (dead/killed) and other regions to investigate



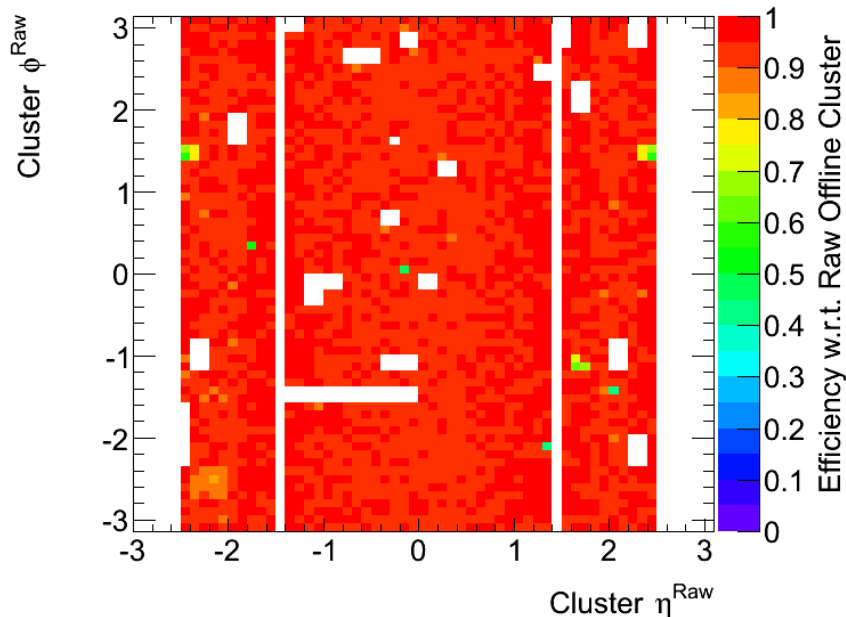
Identifying Issues – Period E

- η - ϕ efficiency map for EM3 with OTX cuts for offline clusters with raw $E_T > 5$ GeV
- Areas with reduced efficiency are identified and problems (attempted to be) understood \rightarrow most understood to some level, some not

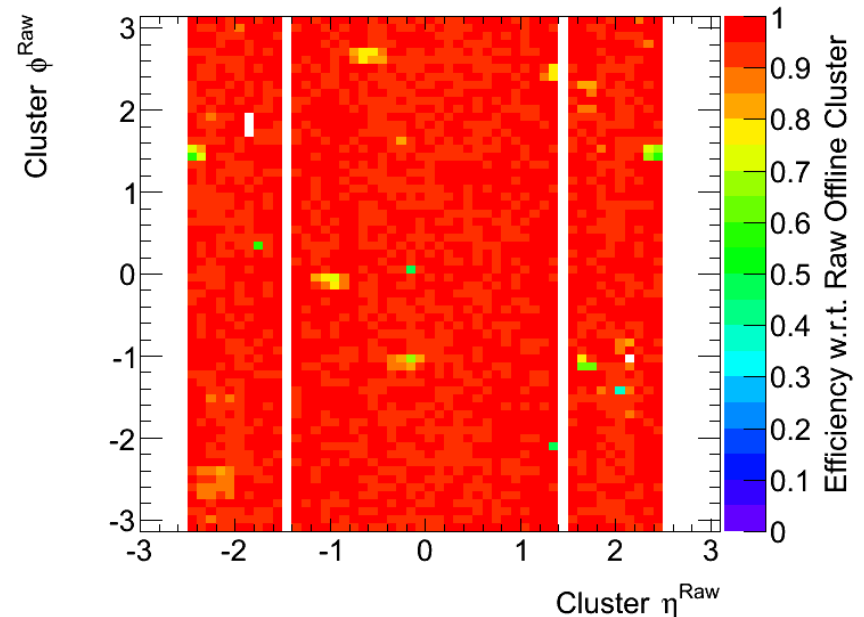


Effect of LAr OTX cuts

- Faulty OTXs affect readout of analogue signal from calorimeter to DAQ
 - Where OTX problem is in second layer, $e\gamma$ reconstruction poor and trigger tower efficiency drops
 - In other places, OTX cuts are conservative
- Will show plots from now on without OTX cuts
 - Mix of L1Calo and OTX info



With OTX cuts

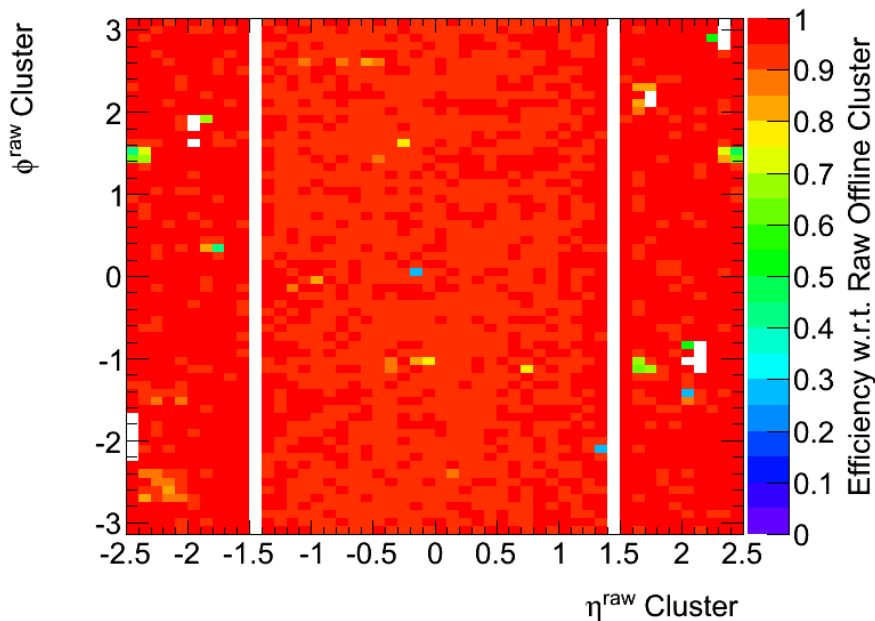


Without OTX Cuts

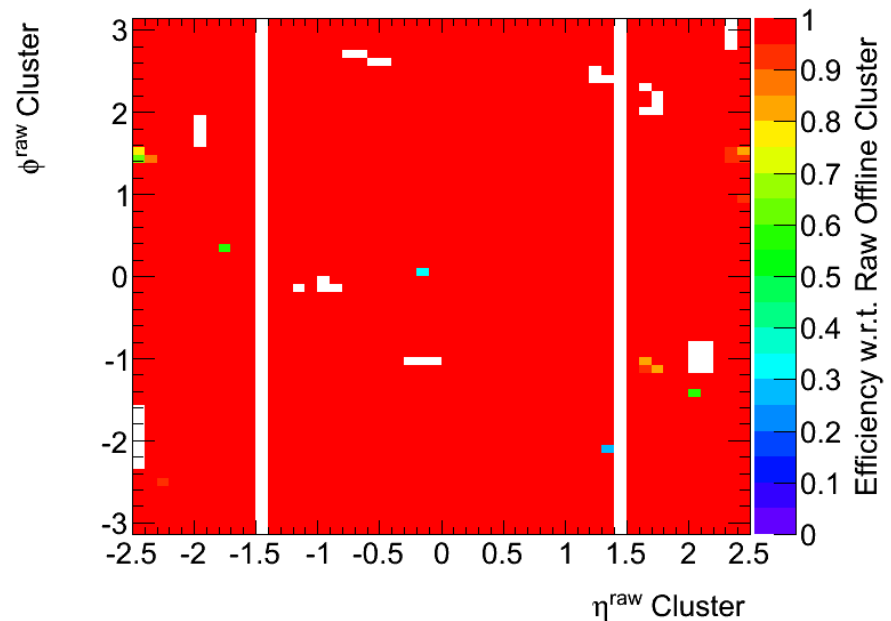
Effect of Raw Cluster E_T

- The higher the cluster energy becomes, the less sensitive the efficiency map is to regions with lower efficiency ($\approx 80\%$)
- Mainly picks out dead/killed channels
- Higher E_T will be important in future to identify areas with very low efficiency
 - Possible to use some intermediate cluster energy or higher energies (20 GeV clusters with EM10 produces similar results to EM5 plot)

See backup



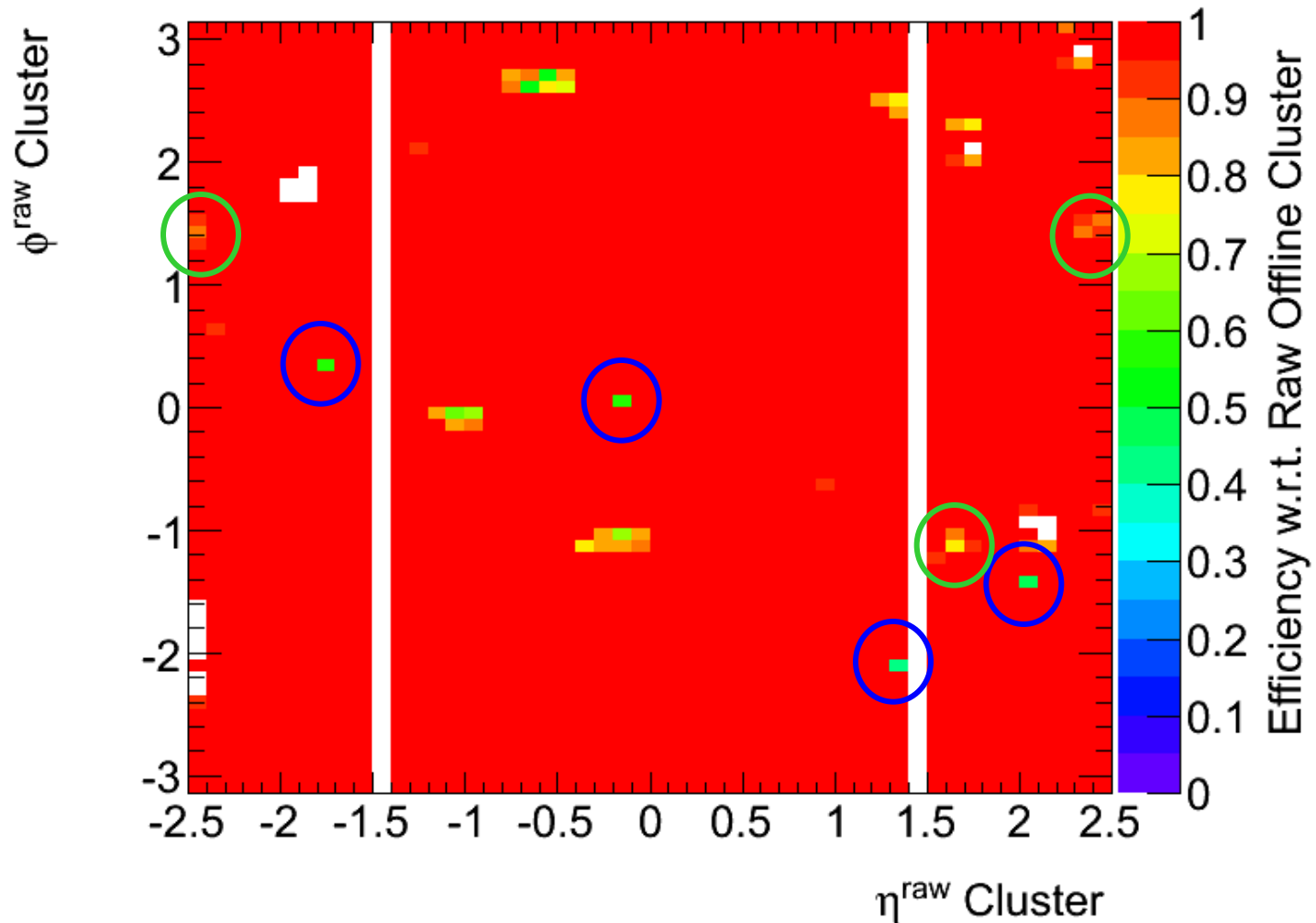
Clus $E_T^{\text{Raw}} > 5$ GeV (EM3)



Clus $E_T^{\text{Raw}} > 10$ GeV (EM5)

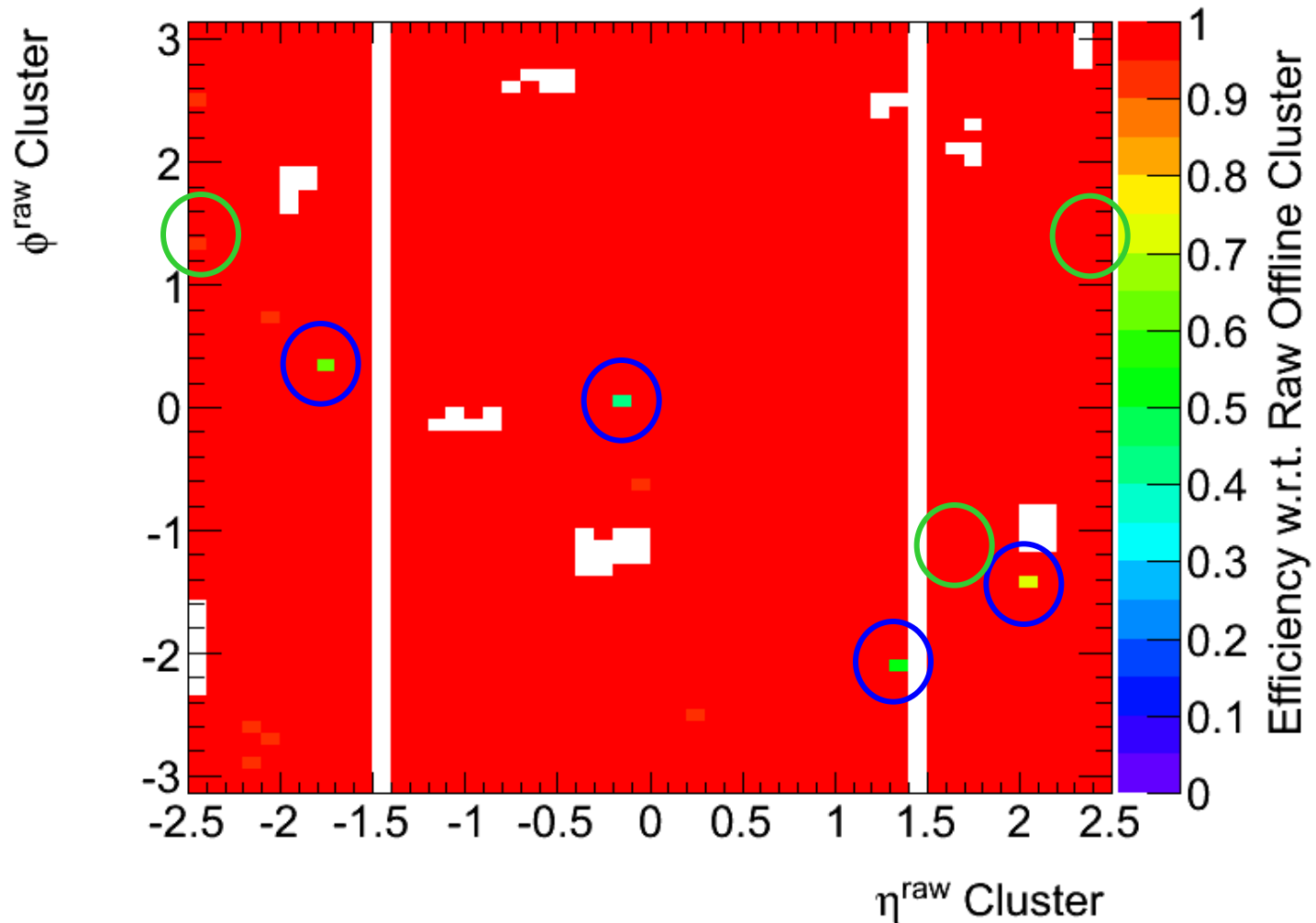
Going from Period E ...

- η - ϕ map for EM3 for offline clusters with raw $E_T > 10$ GeV



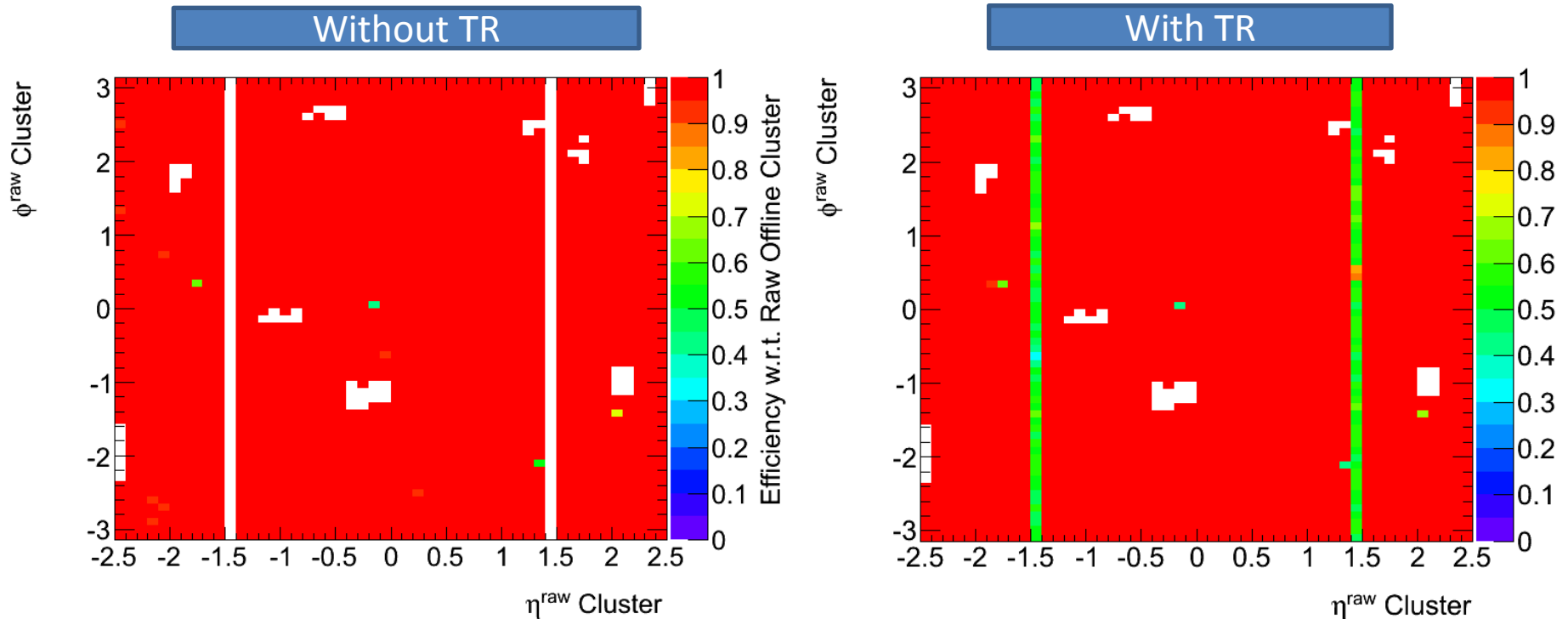
... to Period I

- HV problems and loose cable disappear (Period G)
- Dead/killed EM channels are the same, OTX probs are worse



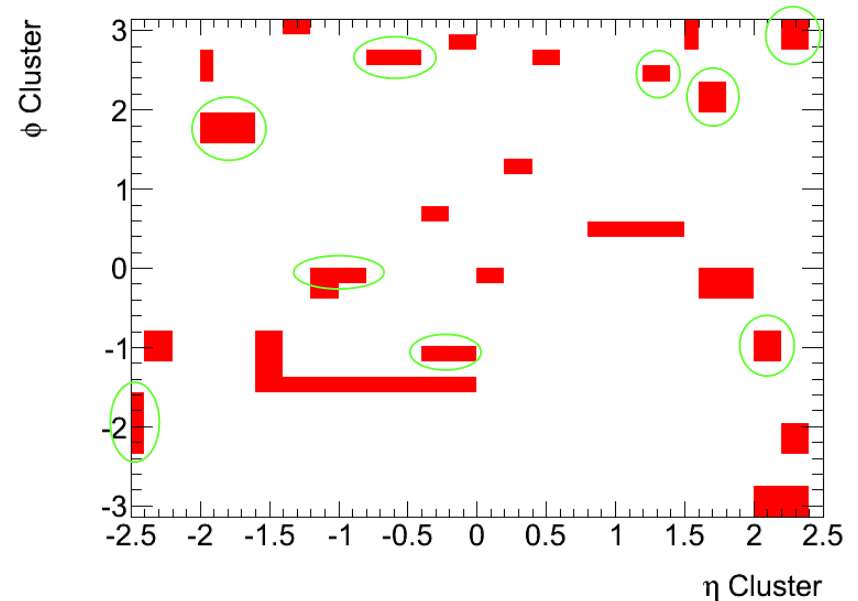
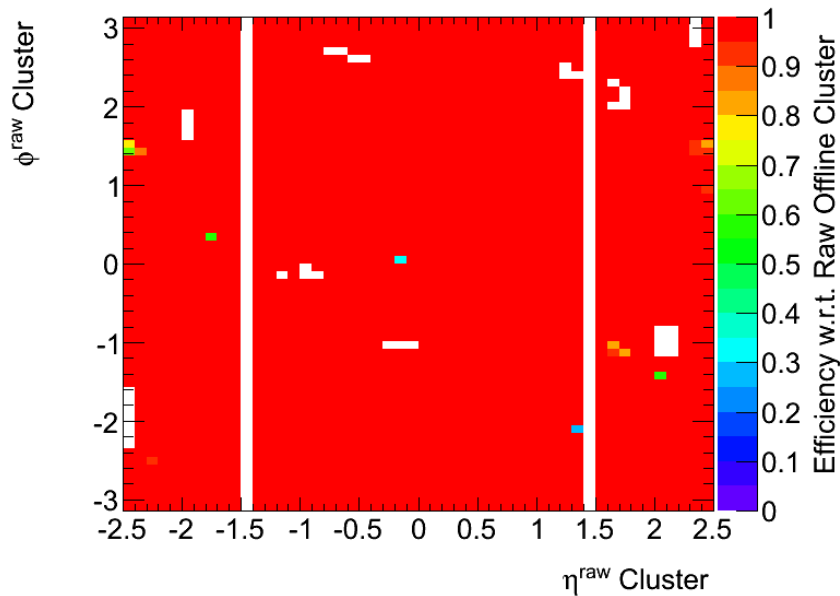
Period I – With/Without TR

- Cluster $E_T^{\text{Raw}} > 10$ GeV (EM5)
- Still manages to get 50% efficiency in transition region towers
- Interesting to see how this improves in 2011



Comparison with LevelOneCaloOfflineMappingTool

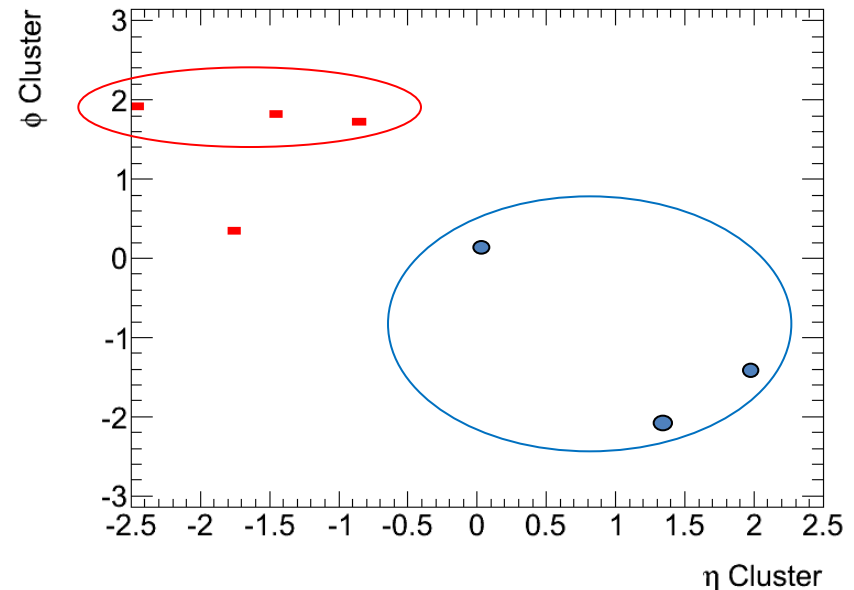
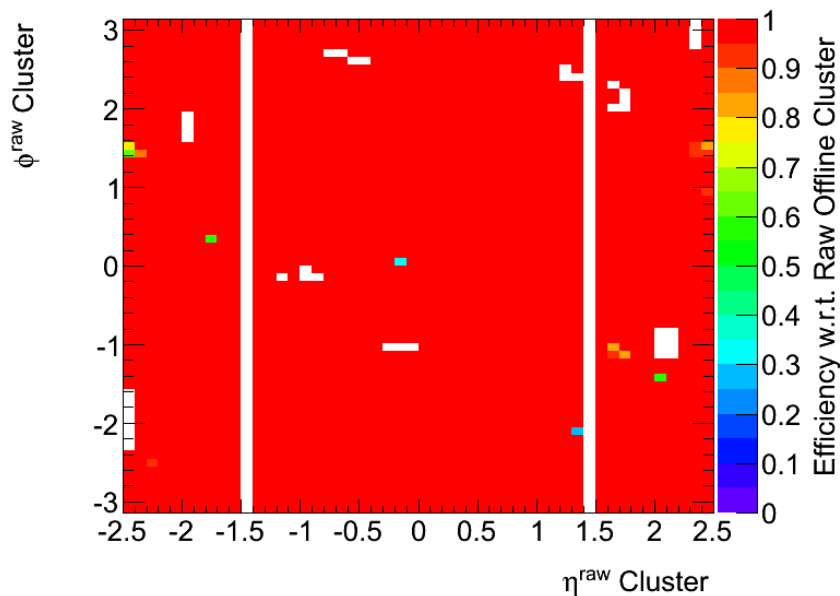
- Used LevelOneCaloOfflineMappingTool for comparison
- Selected configurations that correspond to each period and plotted `emBadCalo()` info



- Agrees very well – although maps will only show effects of OTX when the problem is in **second layer** of LAr calorimeter

Comparison with LevelOneCaloOfflineMappingTool

- Used LevelOneCaloOfflineMappingTool for comparison
- Selected configurations that correspond to each period and plotted `emDead()` info



- `emDead` Channels disagrees with map (database issue?)
- **Red** – show up for all periods in tool but not in maps
- **Blue** – show up in all maps but not in tool until period H

How to make best use of these in 2011?

- Want maps to be able to support existing tools in terms of **identifying towers with reduced performance** and making information available to those are interested in it
- How often to run on data & where to store results
 - Possibility of producing these at Tier 0
 - If done offline, should be able to run on DESD_CALJET files
 - Stick to running every period or every run if statistics are good
- Adjust databases retrospectively if there are disagreements?
- Fiducial cuts – OTX? Transition region?
- Shift ϕ coordinate to L1Calo system rather than offline?
- Maps for all trigger items and at what cluster energy? τ items?
 - Are there going to be any changes to L1 EM/TAU Trigger items?
- Efficiency turn on curves in E_T also useful?

Suggestions welcome!

Backup slides

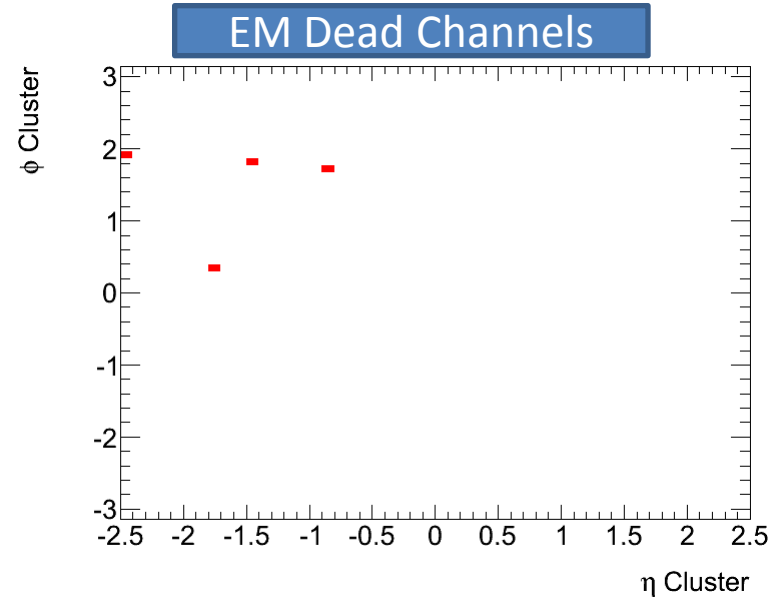
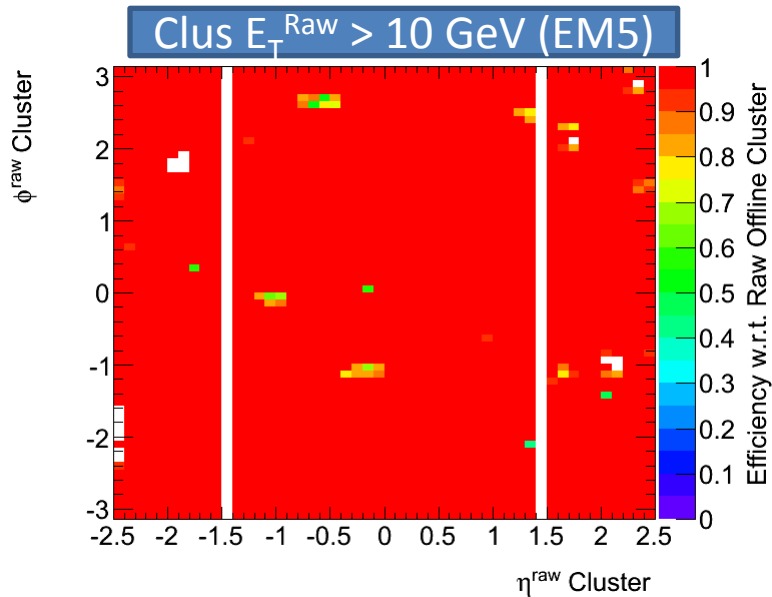
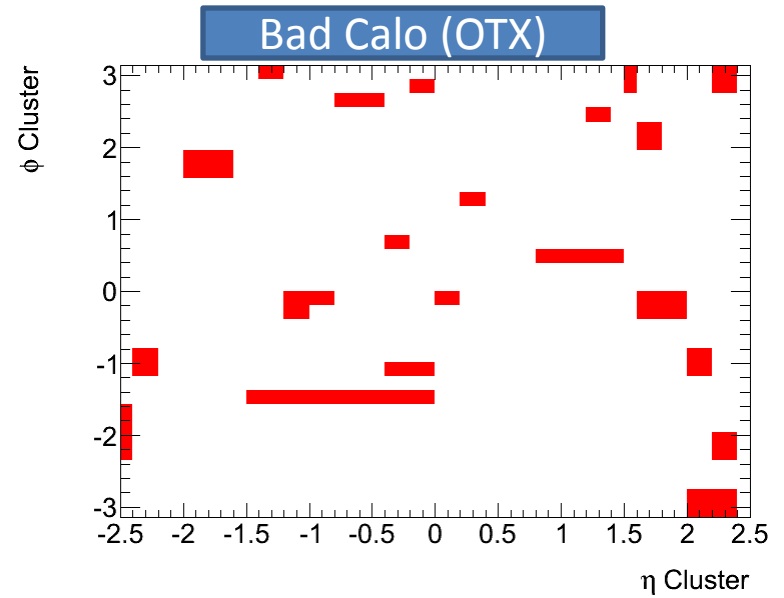
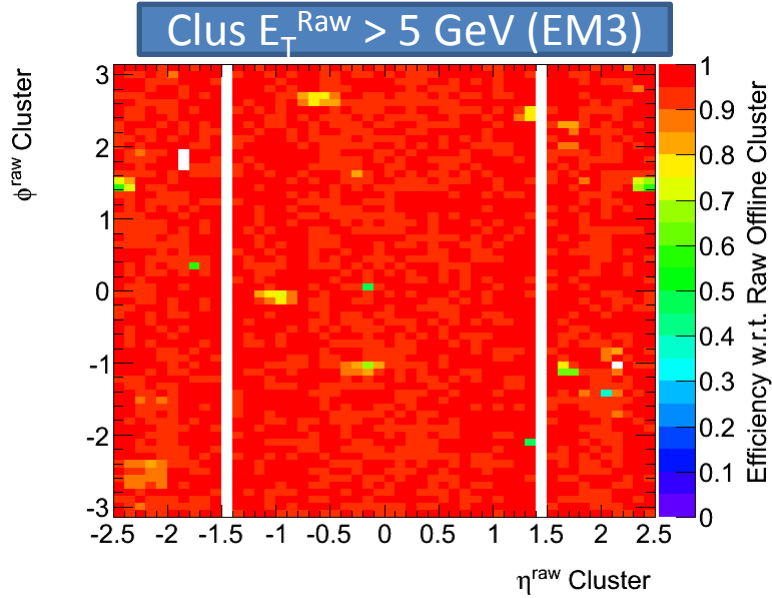
Efficiency Maps for Periods E-I with corresponding EM Dead
Channel & Bad Calo (OTx) information from JM's
LevelOneCaloOfflineMappingTool

+

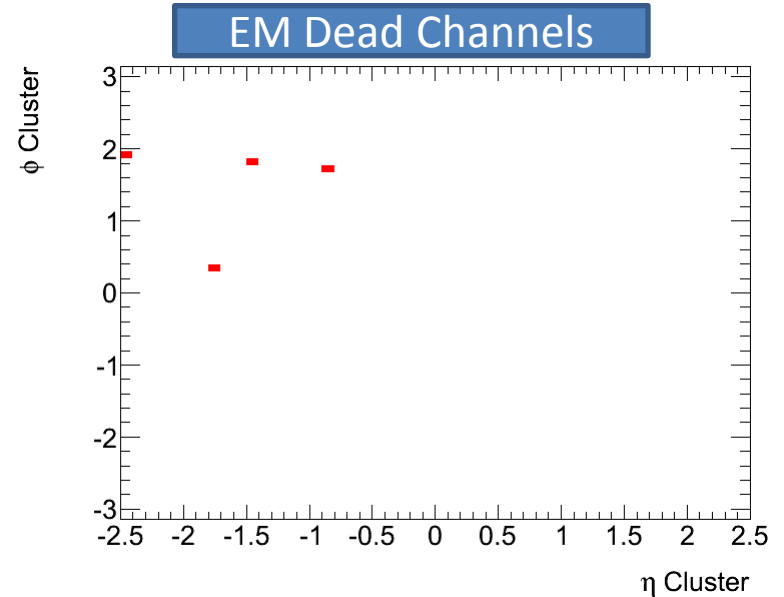
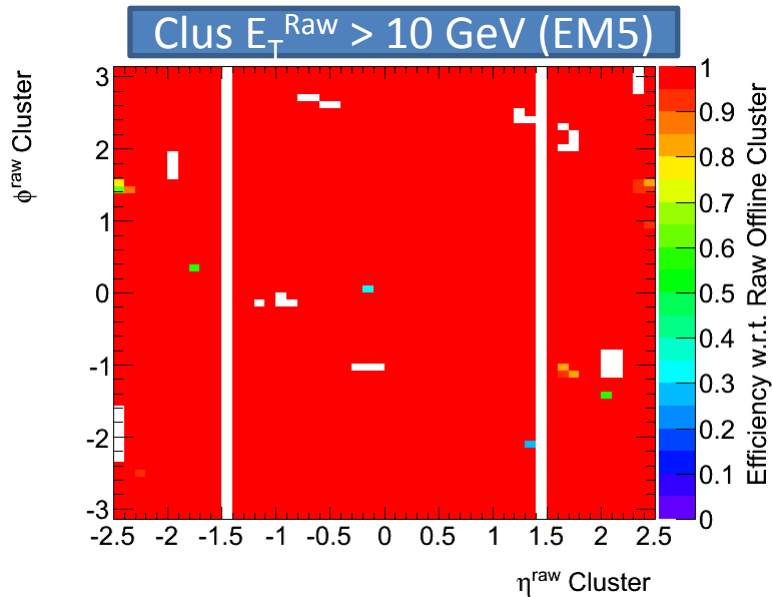
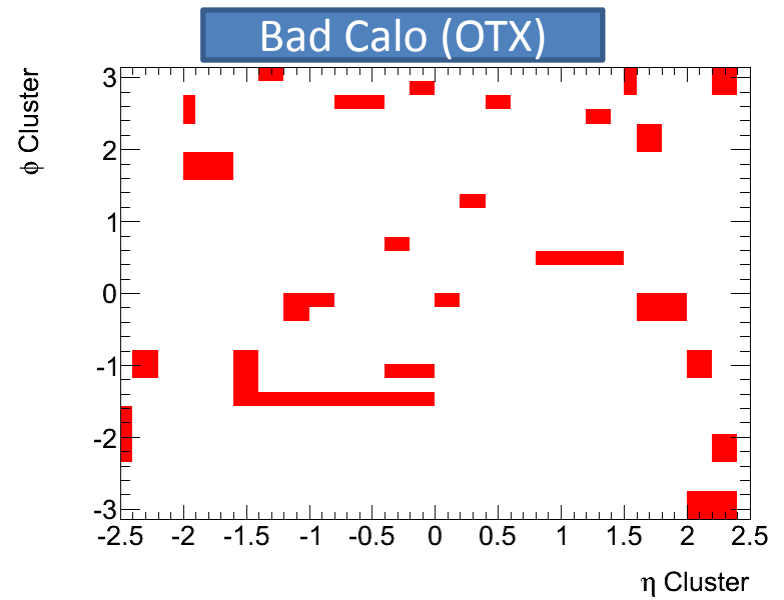
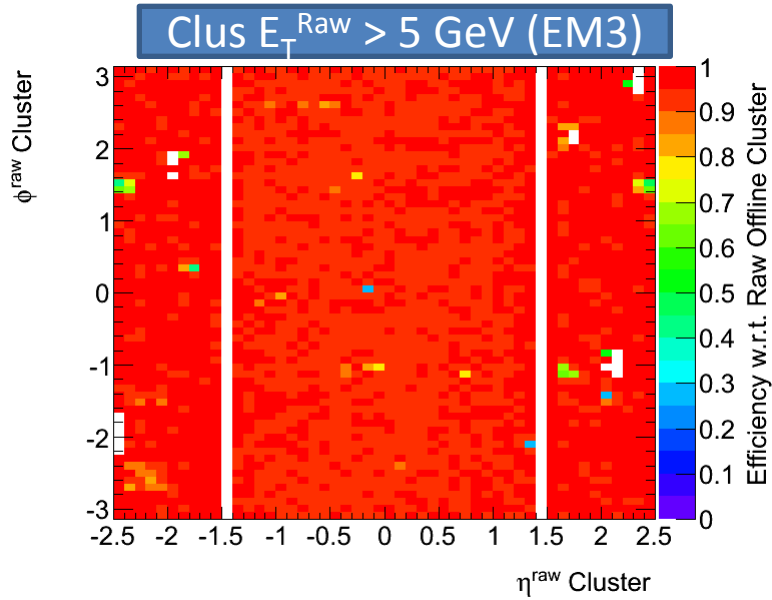
20 GeV plot

Period E

160387, 160472, 160479, 160530,
160613, 160736, 160800, 160801,
160879, 160899, 160953, 160954,
160958, 160963, 160975, 160980,
161118, 161379, 161407, 161520

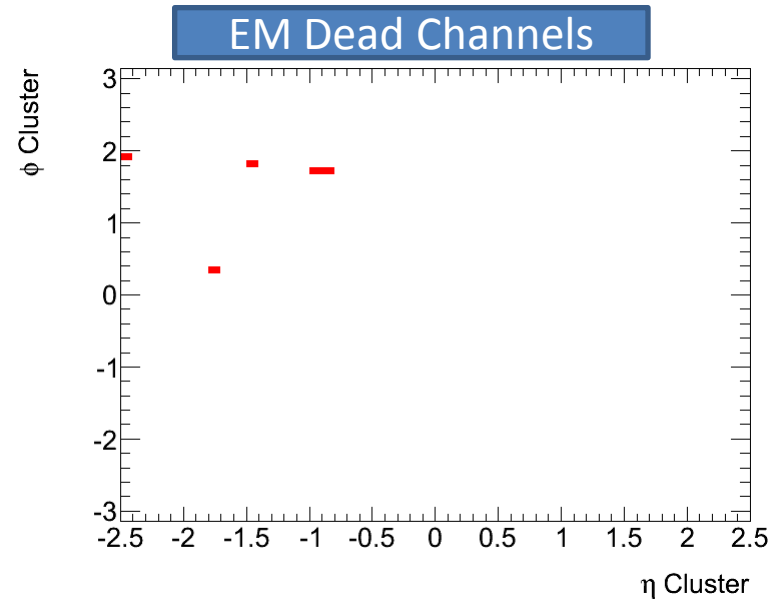
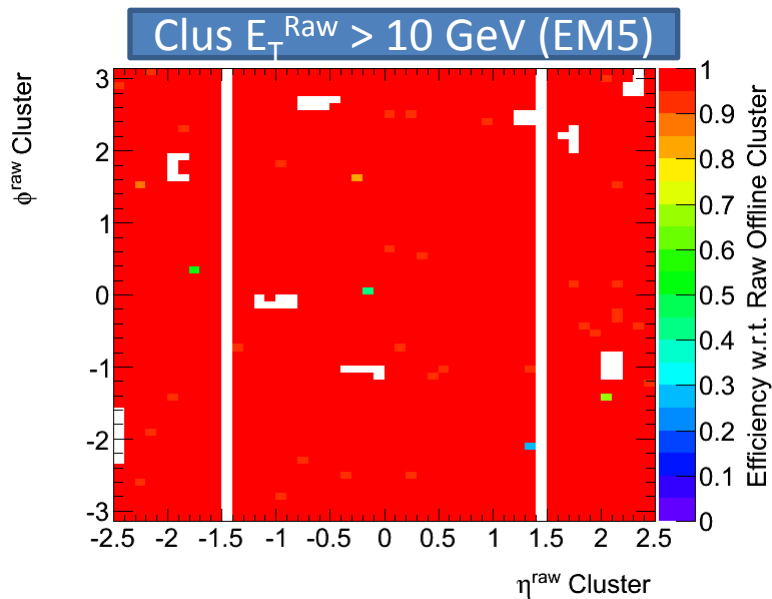
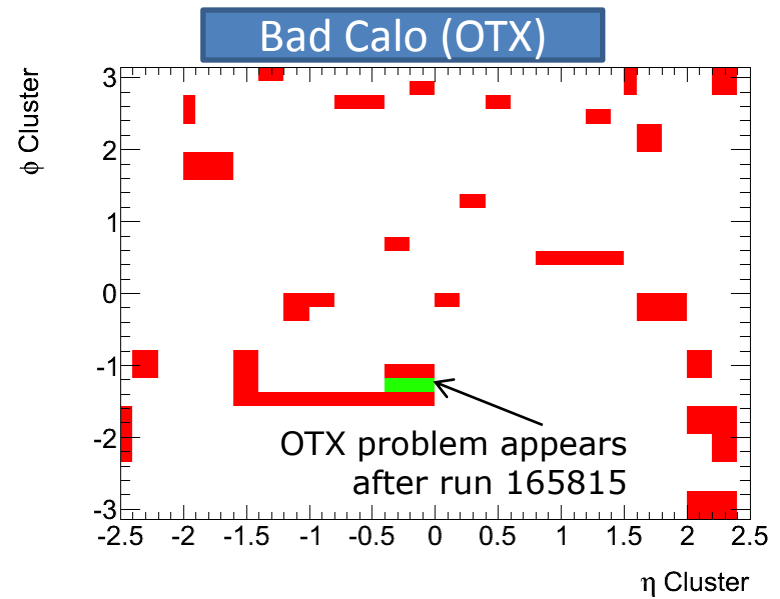
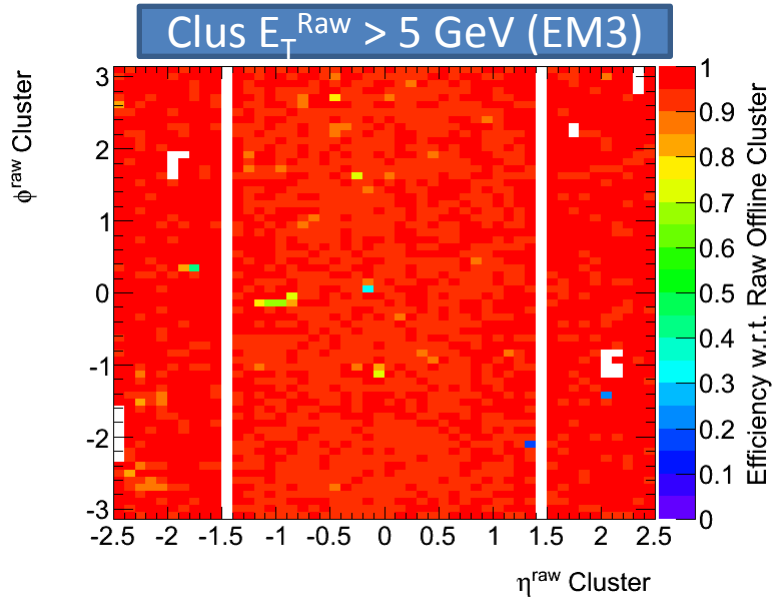


Period F

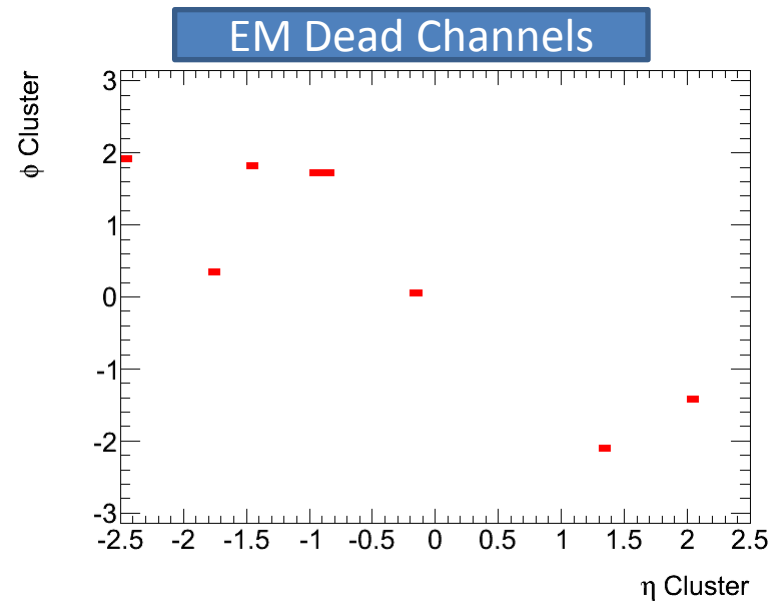
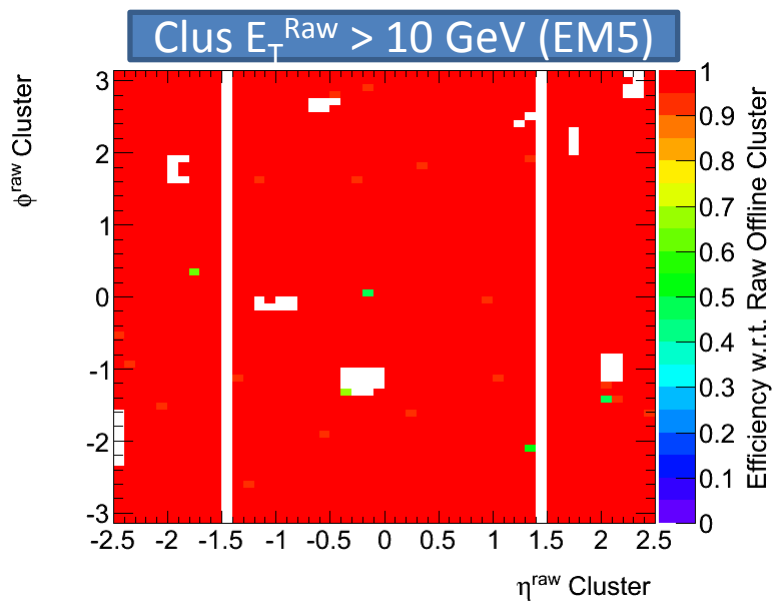
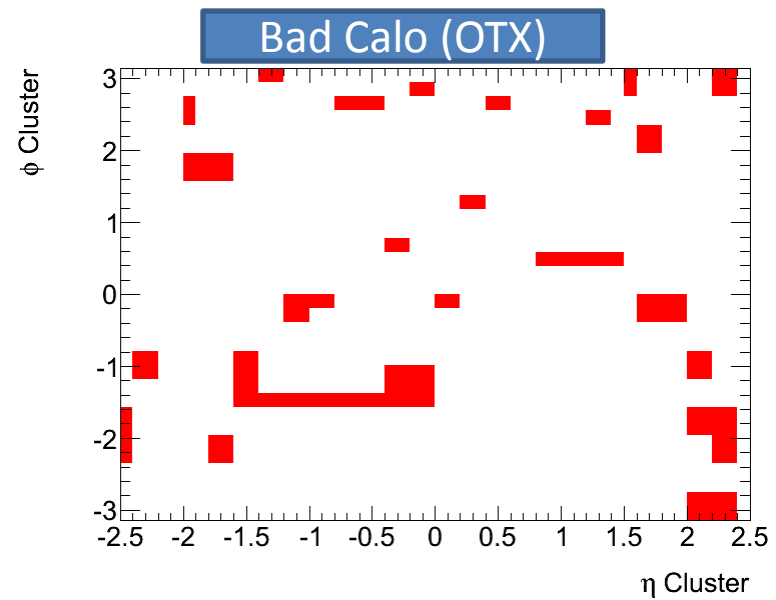
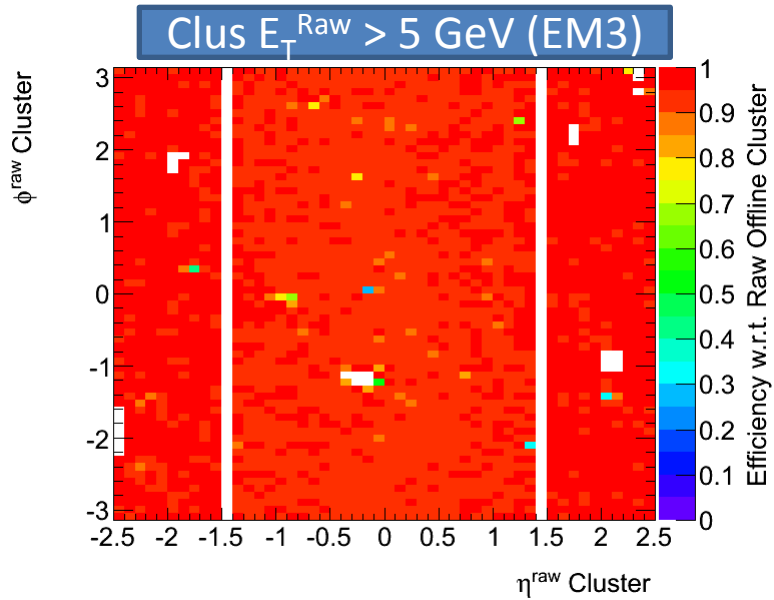


Period G

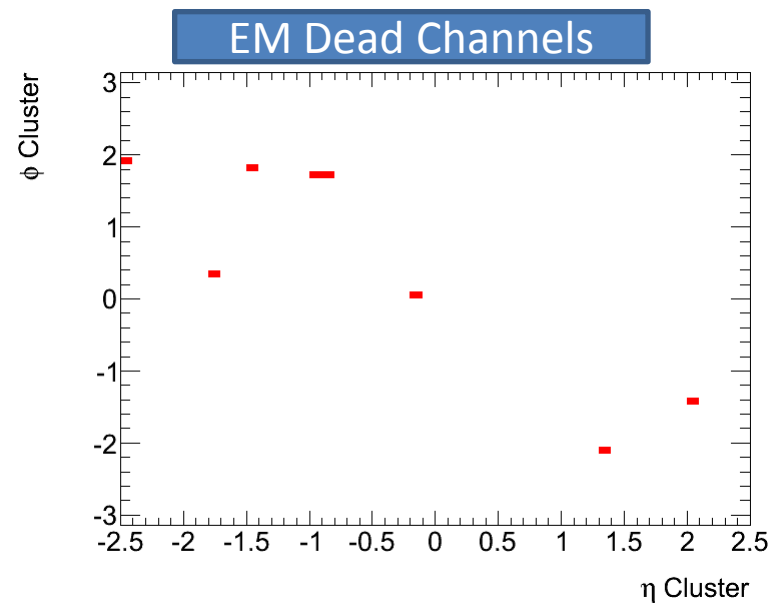
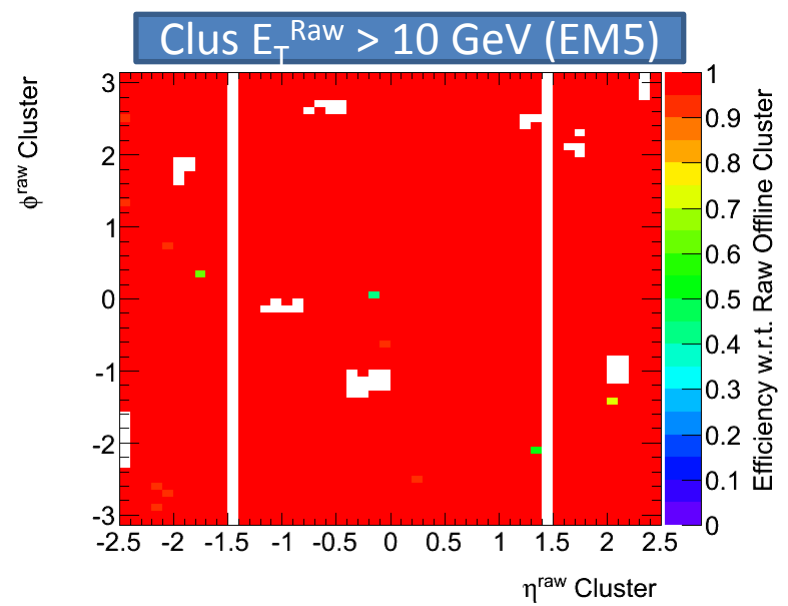
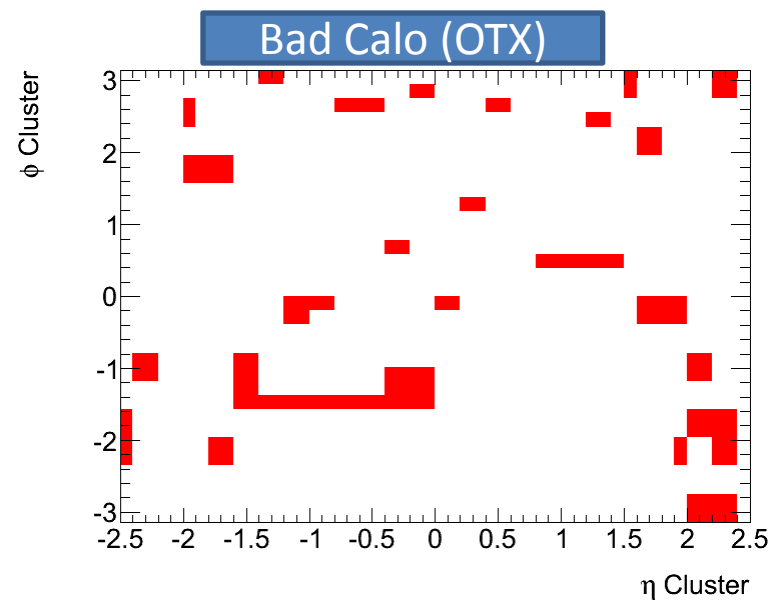
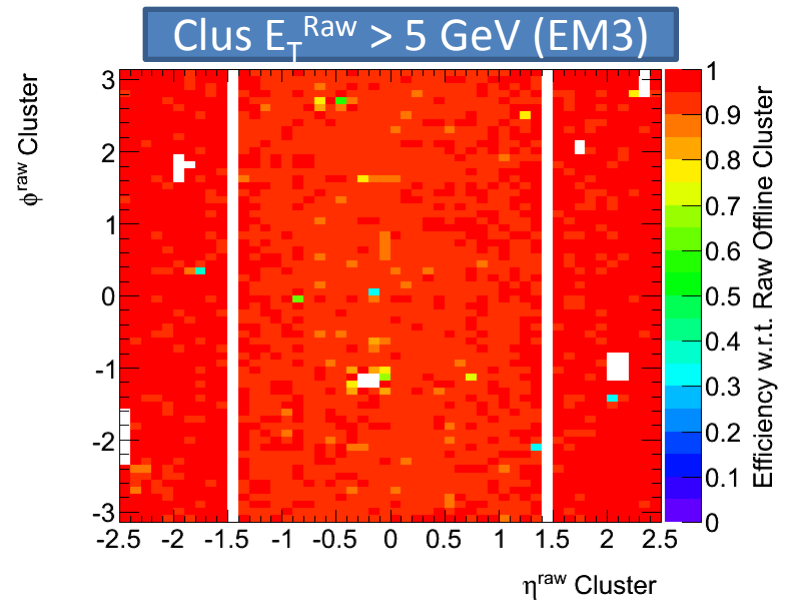
165591, 165632, 165732,
165767, 165815, 166142,
166143, 166198, 166383



Period H



Period I



Efficiency map at higher energies

- Efficiency map for offline clusters ($E_T^{\text{raw}} > 20$ GeV) for EM10 and Period E data
- Like plots for EM5 with 10 GeV clusters, well in plateau so it mainly picks out dead/killed towers and other serious issues with reduced efficiency
- A few towers dotted around with 90-95% efficiency but need to check if it is specific to period E

