Calorimeter Noise Measurement & Topocluster Performance

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Thanks to
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Adam Yurkewicz[2], Bernhard Meirose[3], Andre Nepomuceno[4], Travis Bain[1], Luciano Filho[4],
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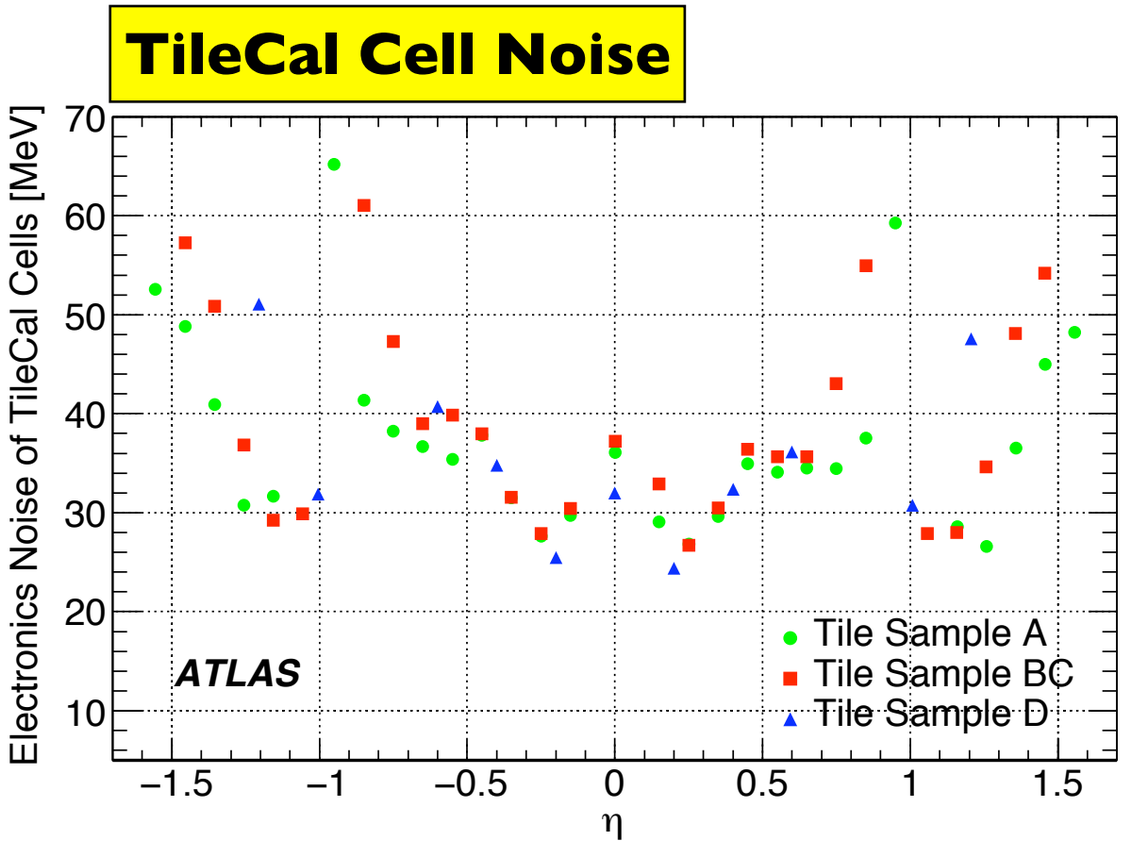
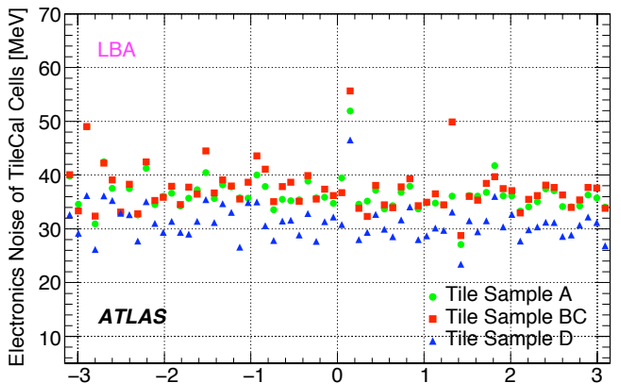
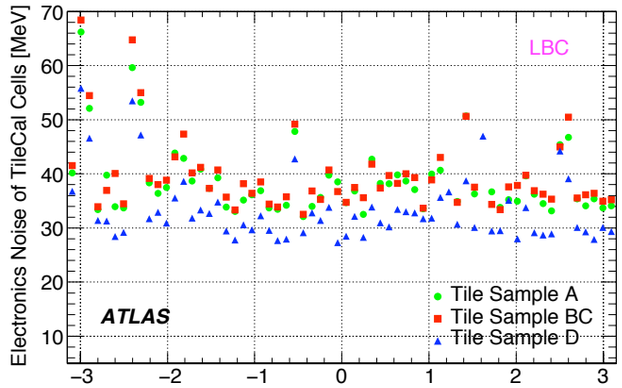
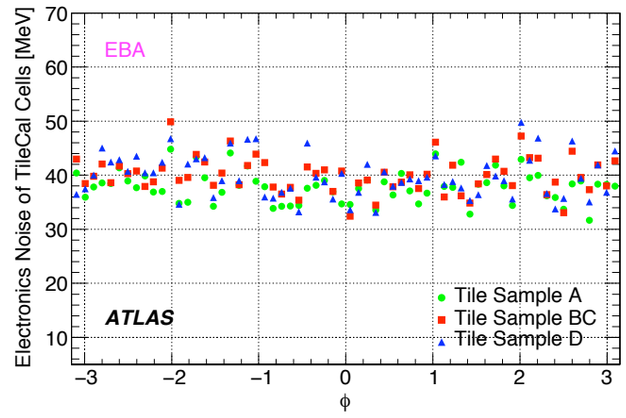
University of Toronto[1], State University of New York at Stony Brook[2],
Albert-Ludwigs-Universitat Freiburg[3], Federal University of Rio de Janeiro[4]

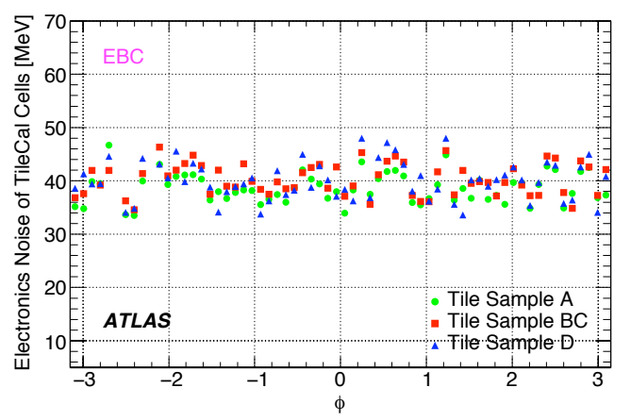
TileCal Cell Noise





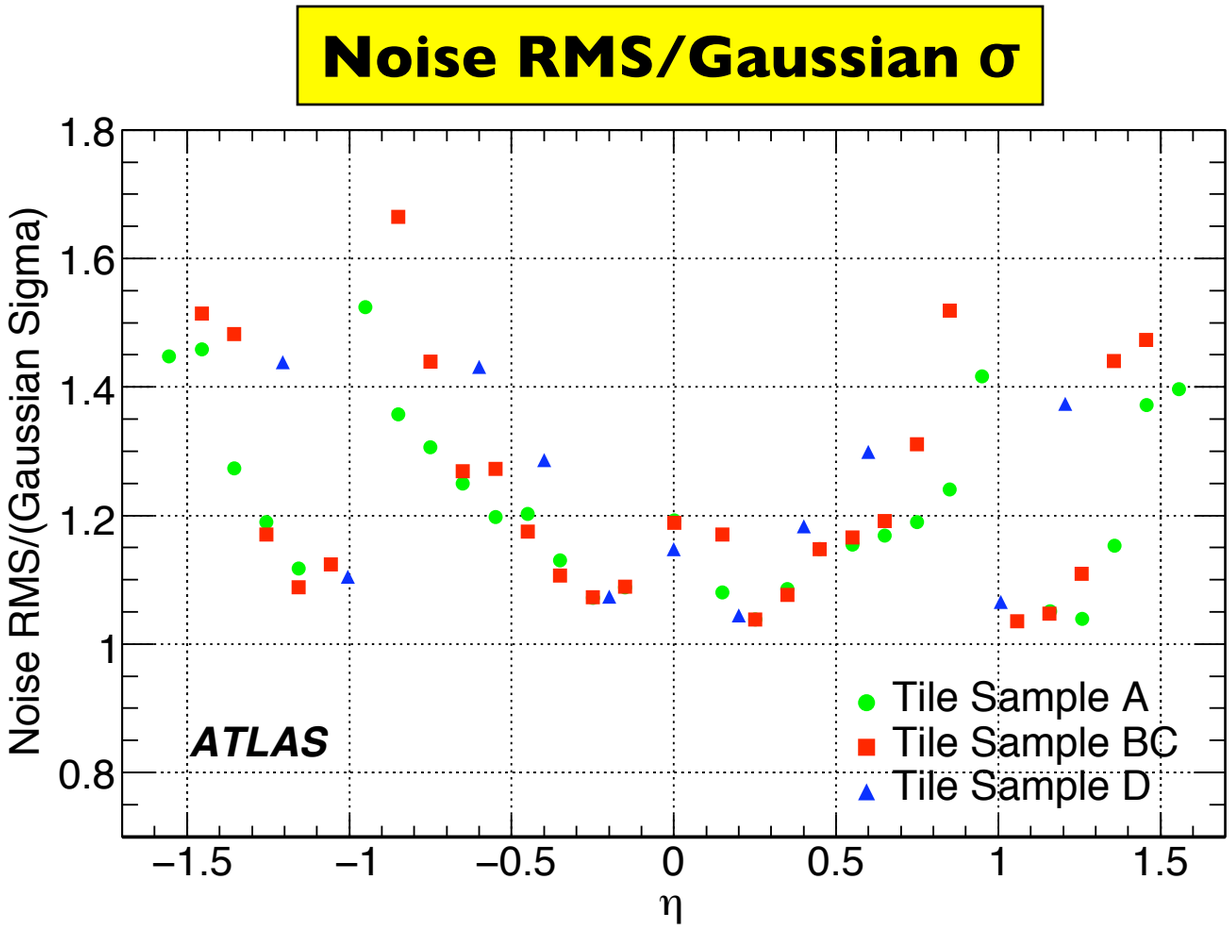




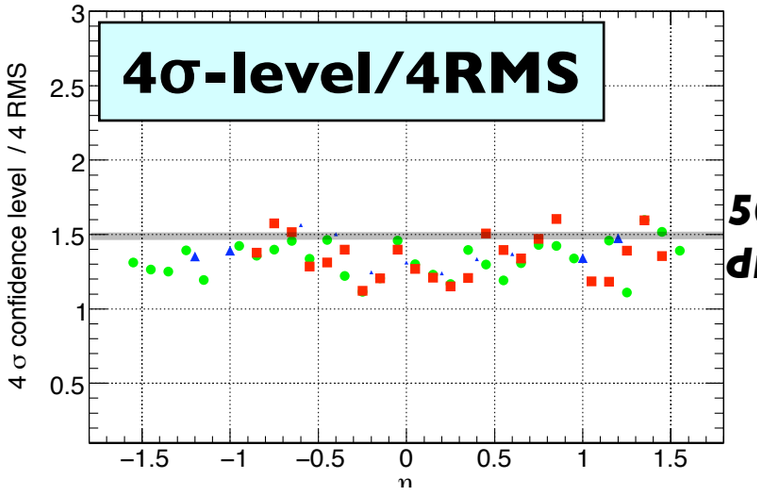


- TileCal has η-dependence of noise, which can be explained by the power distributions (but basically uniform in Φ), *in-situ measurement since M5 Week*
- Discrepancy with what was assumed in the Monte Carlo simulation (see backups)
- Reference: TileCal public plots: https://twiki.cern.ch/twiki/bin/view/Atlas/ApprovedPlotsTile
  H.Okawa, R.Teuscher et al., ATL-COM-CAL-2008-007
  H.Okawa, TileCal DQ & Performance Meeting, 16 Mar., 2009

Non-Gaussian Feature

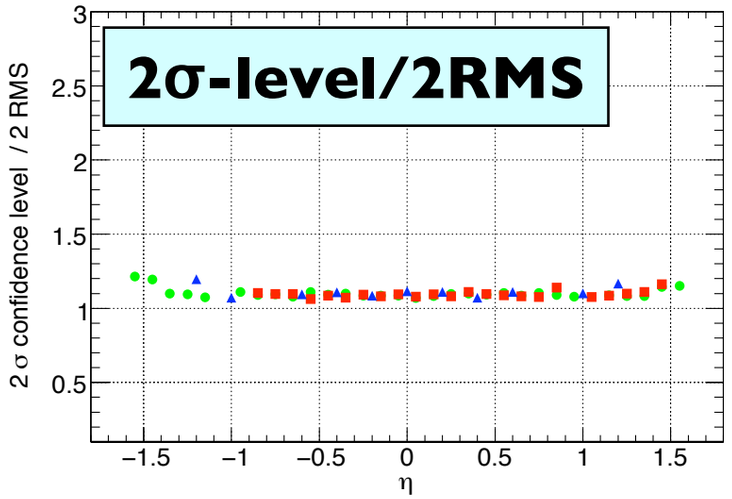


Noise RMS/Gaussian σ



Example from a drawer

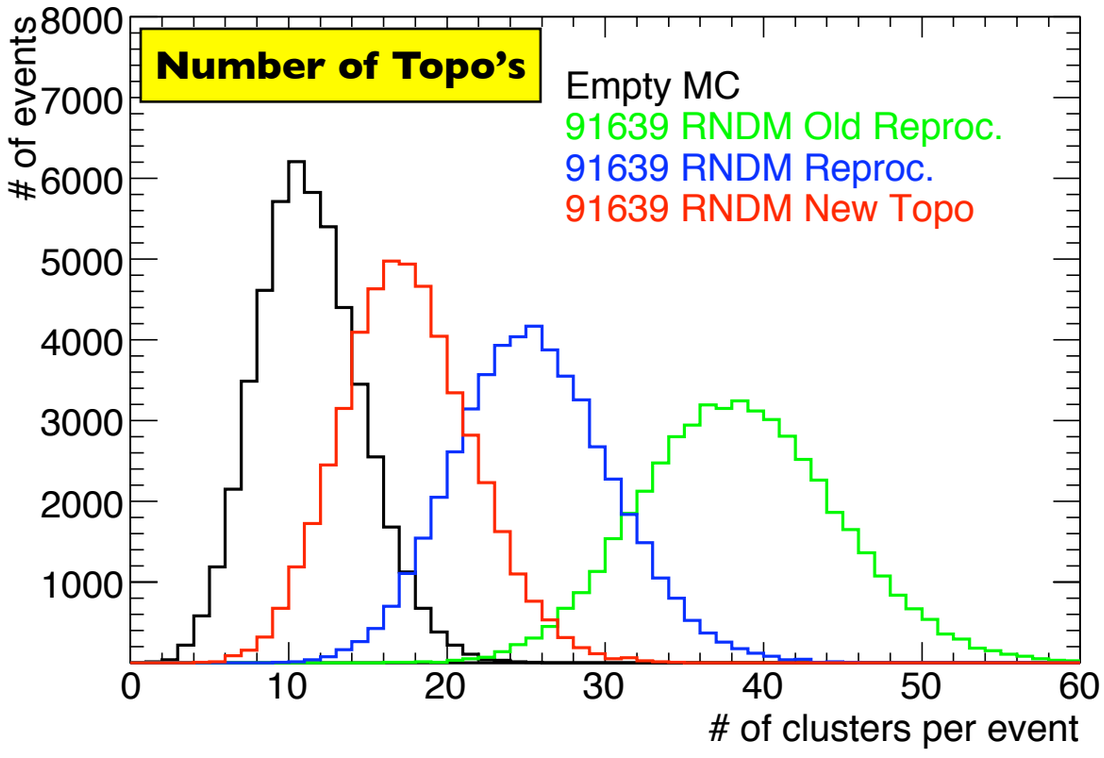
50% diff.



- TileCal has non-Gaussian noise, so the RMS is currently stored in the database instead of Gaussian σ
- However, RMS values are not enough when we use 4σ threshold in Topoclusters (underestimating the actual confidence level by **60% at most**)
- Not much effect on 2σ threshold, thus does not effect MET_Base so much

Number of Topoclusters

- Quick try with privately-updated Topocluster algorithm with storing **separate noise values for 4σ & 2σ threshold**
- PDF will be used in v15, and database will be updated by experts

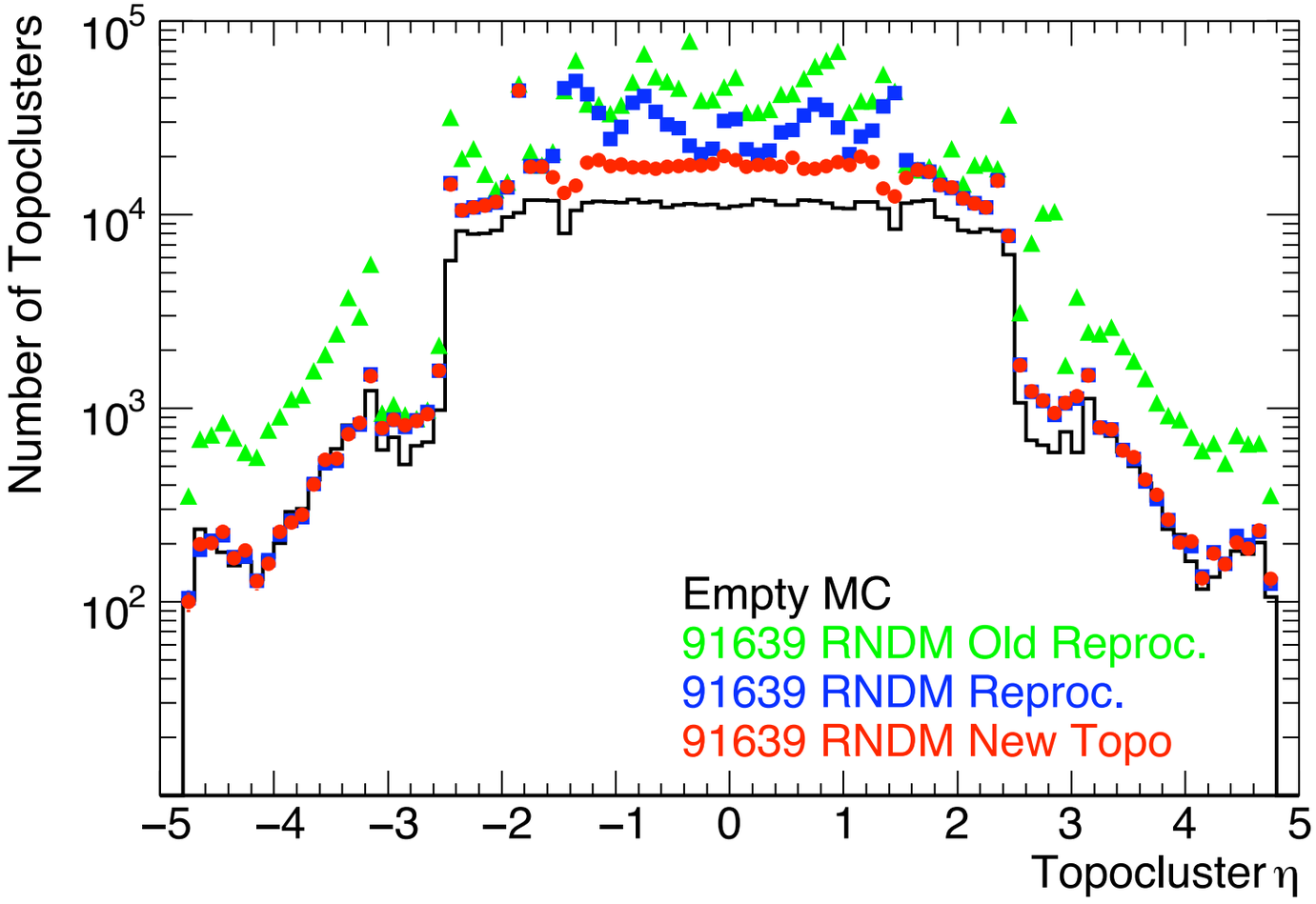


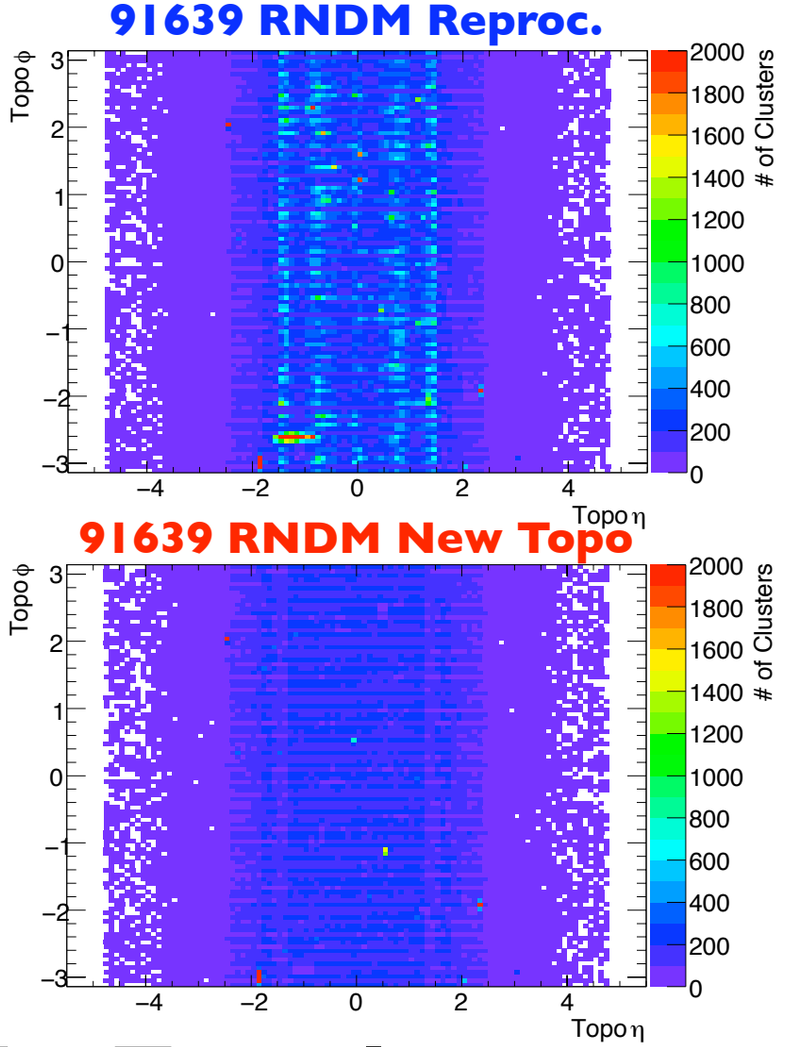
Mean Number of Reconstructed Topoclusters

	MC	Old Reproc	Dec08 Reproc	New Topo
EM	9.5	23.9	15.9	15.9
TILE	**0.6**	10.3	8.3	**0.2**
HEC	0.4	2.5	0.4	0.4
FCAL	0.2	0.8	0.2	0.2
TOTAL	10.8	38.0	25.0	17.0

- Improvement & more consistency with expectation observed in TileCal after the new Topo reconstruction
  (empty MC should be replaced with CaloCellRandomizer for more precise comparison)
- Remaining discrepancy is coming from EM, which has already been understood and reported by D. Varouchas et al.

Topocluster η, η-φ

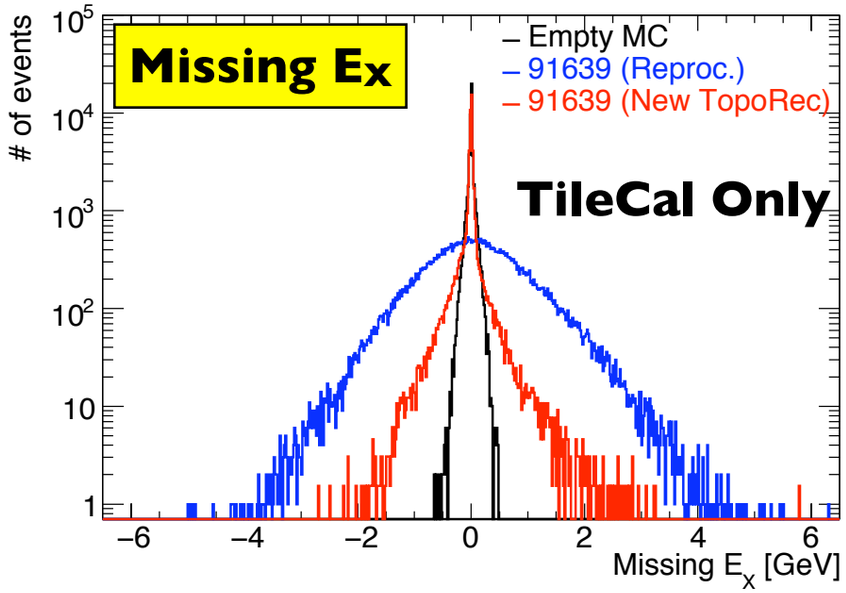


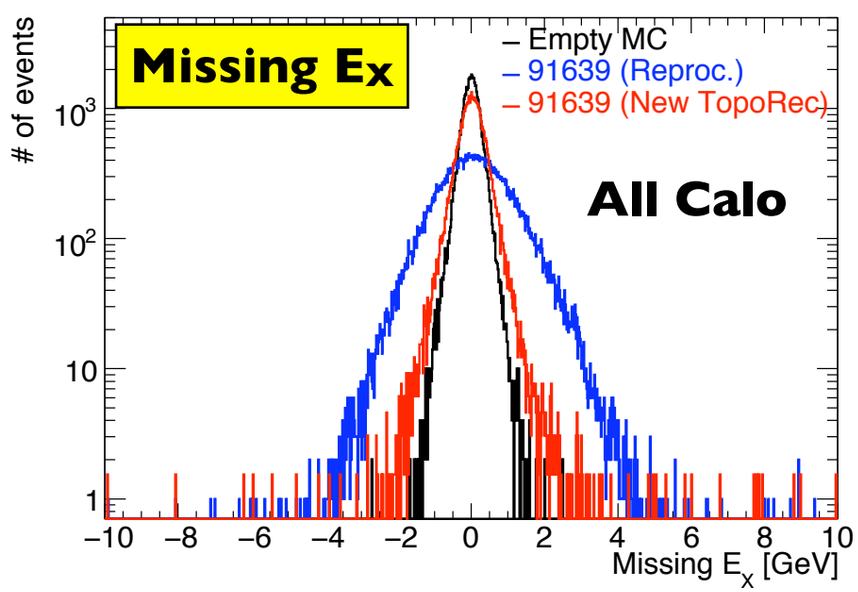


- **The "2 W's" shape is observed in the Topocluster η distribution as well** (expected from the η-dependence of non-Gaussian noise)

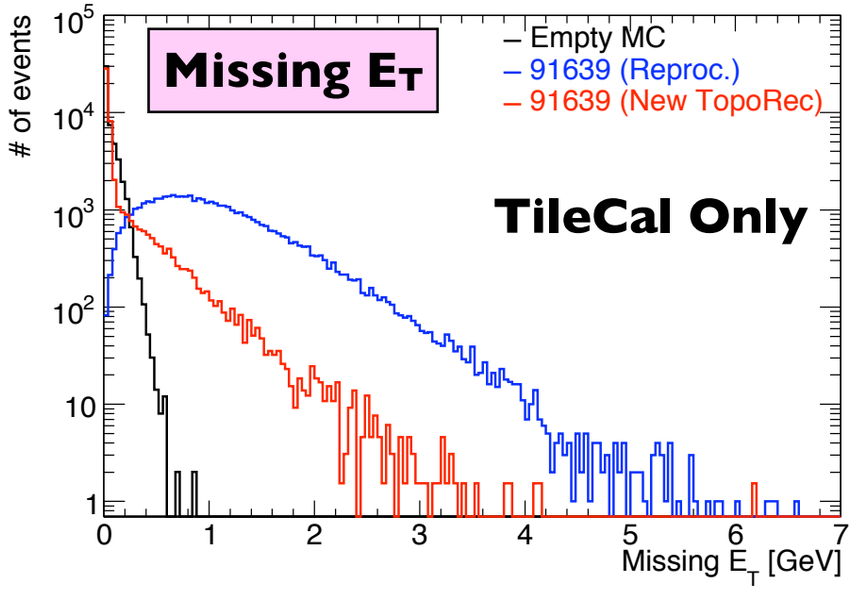
- **Such feature is removed with non-Gaussian treatment**

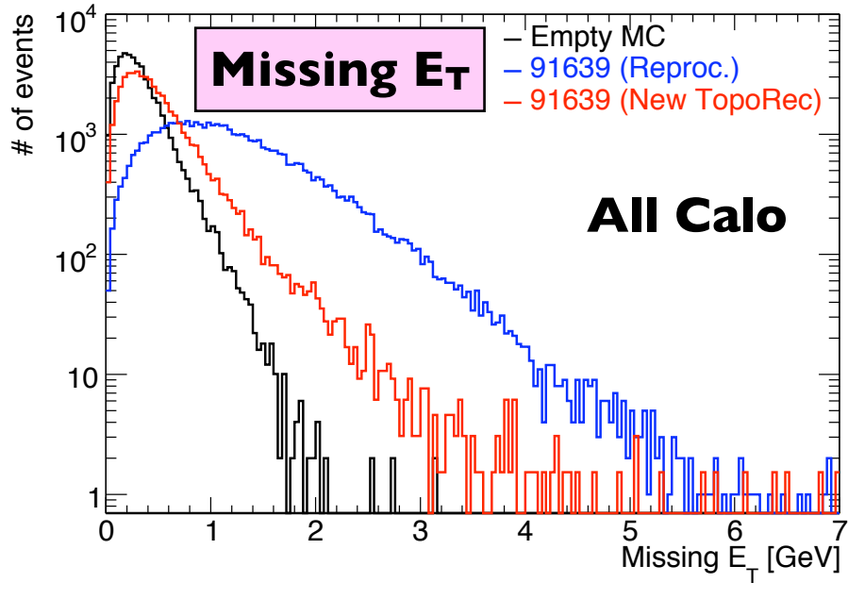
Missing Ex, E_T (MET_Topo)





	MEX RMS [GeV]	MEX Mean [GeV]
TileCal Only	0.957 0.233 0.063	0.077 -7e-3 -2e-4
All Calo	1.111 0.553 0.284	0.118 0.021 8e-4





	MET RMS [GeV]	MET Mean [GeV]
TileCal Only	0.70 0.31 0.071	1.09 0.15 0.055
All Calo	0.914 0.609 0.232	1.24 0.514 0.328

- There used to be a big discrepancy in MET_Topo performance
- Core shape is now pretty consistent in the updated reconstruction (remainig tail may be removed by using the Q-Factor)

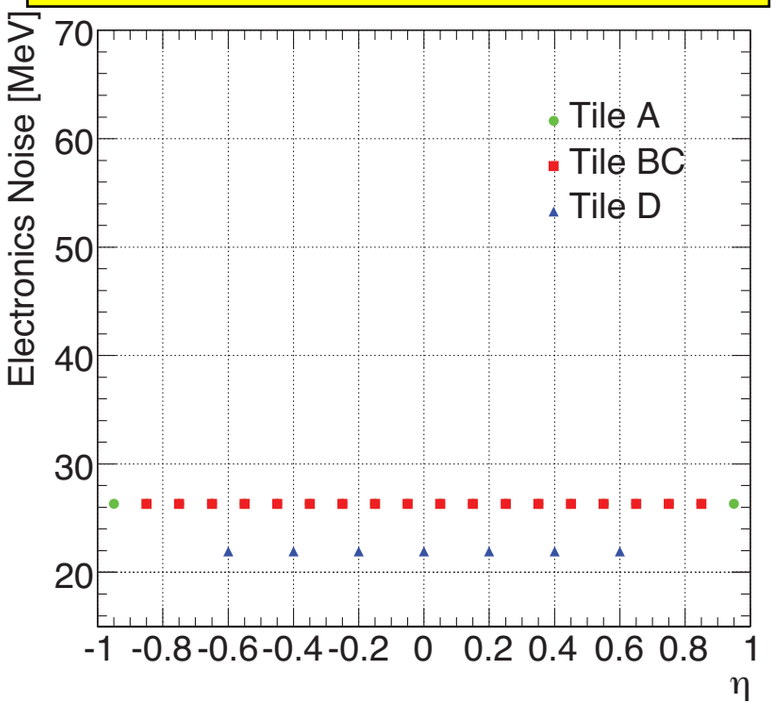
Summary

- In-situ noise measurements have been performed since M5 Week (observation of η-dependence & non-Gaussian feature)
- Topocluster performance is greatly influenced by the non-Gaussian tails, and should be treated
- Investigations were done with an updated Topocluster algorithm by storing separate values for expected noise 4/2σ (PDF will be implemented in v15 developed by experts)
- Resolution was improved with the update, and closer to expectation (CaloCellRandomizer should be used for more precise comparison)
- Remaining tails may be removed by the use of Q-Factor (under investigation)

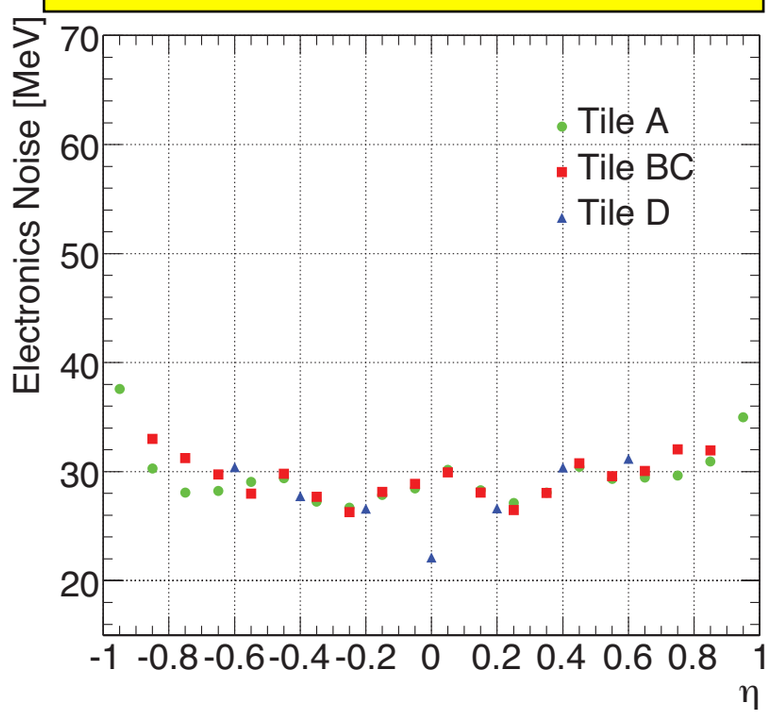
backups

Noise in M5 Week

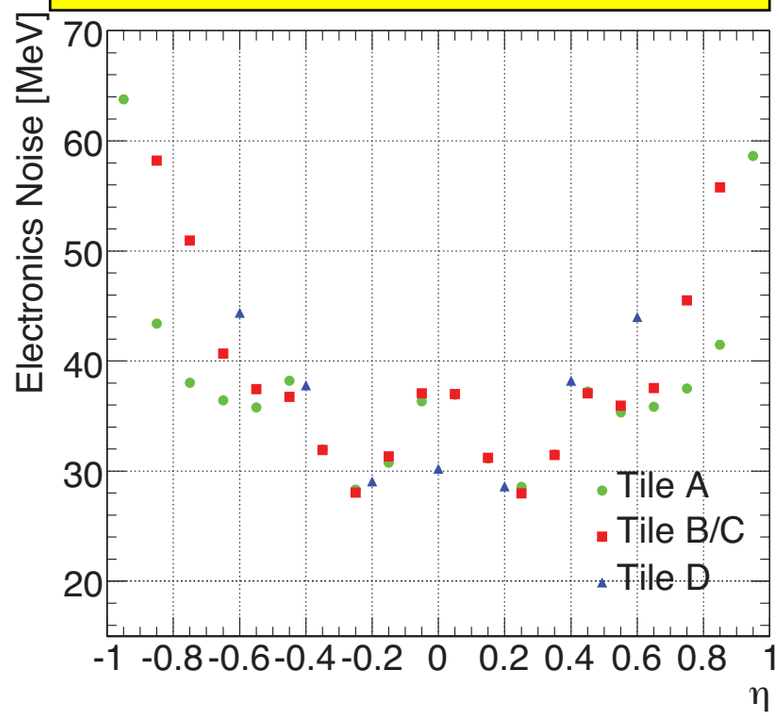
TileCal Cell Noise (MC)



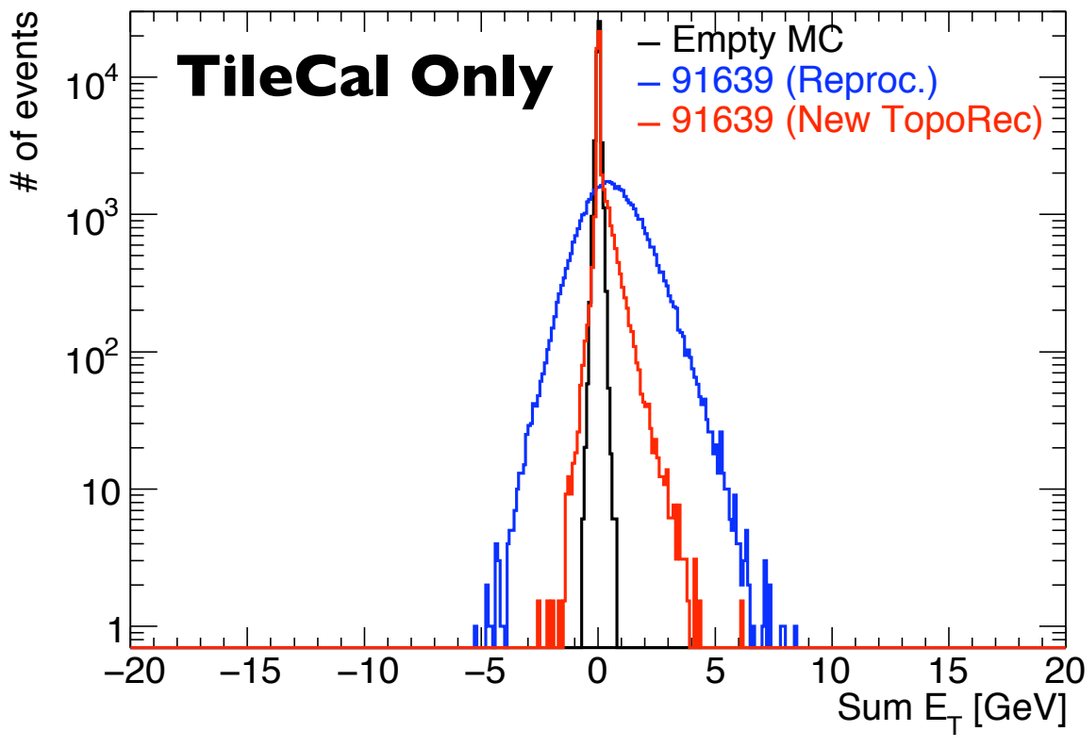
TileCal Cell Noise
(2σ iterative fit; in M5 Week)

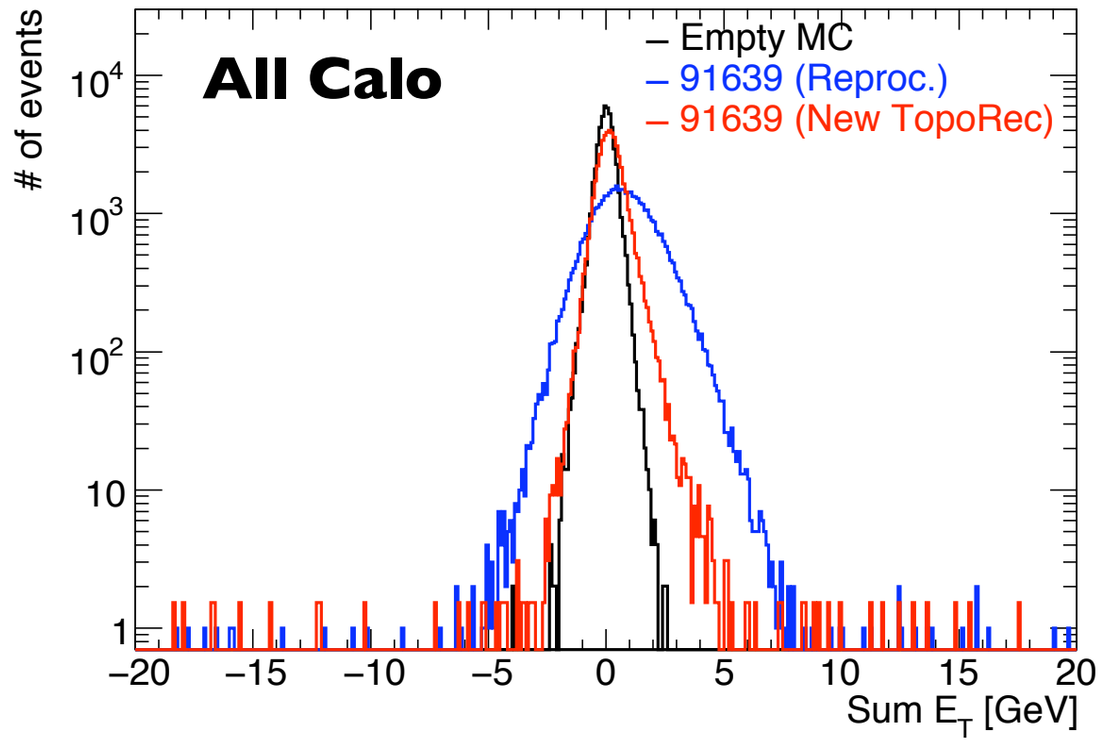


TileCal Cell Noise
(RMS; in M5 Week)



$\mathbf{SumE_T}$ (MET_Topo)





- Great improvement, but slight asymmetry observed (under investigation)

	SumET RMS [GeV]	SumET Mean [GeV]
TileCal Only	**1.29** Reproc **0.35** NewReco **0.090** Empty MC	0.65 0.11 9e-4
All Calo	**1.54** **0.81** **0.406**	0.79 0.23 3e-3