Hcal & Ecal RecHit Energy (Noise) in Data/MC

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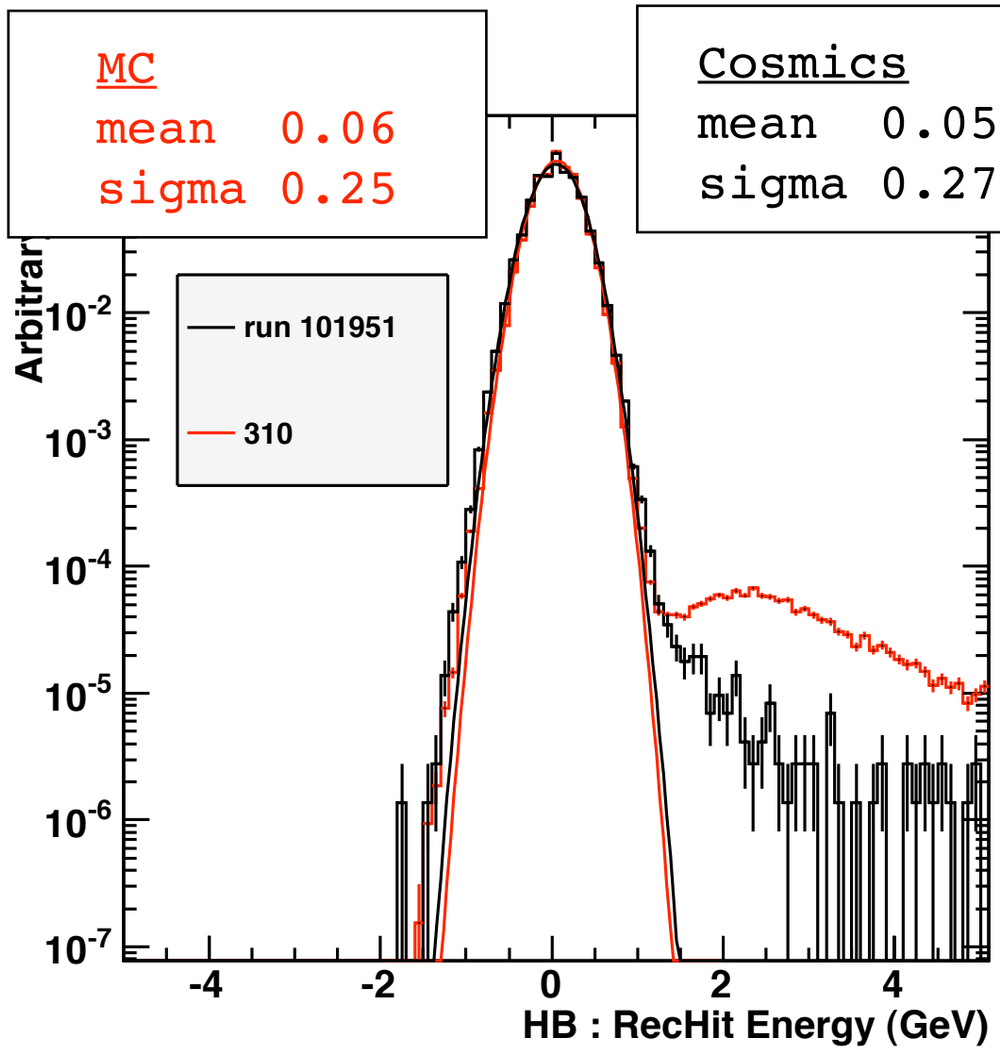
Study Summary

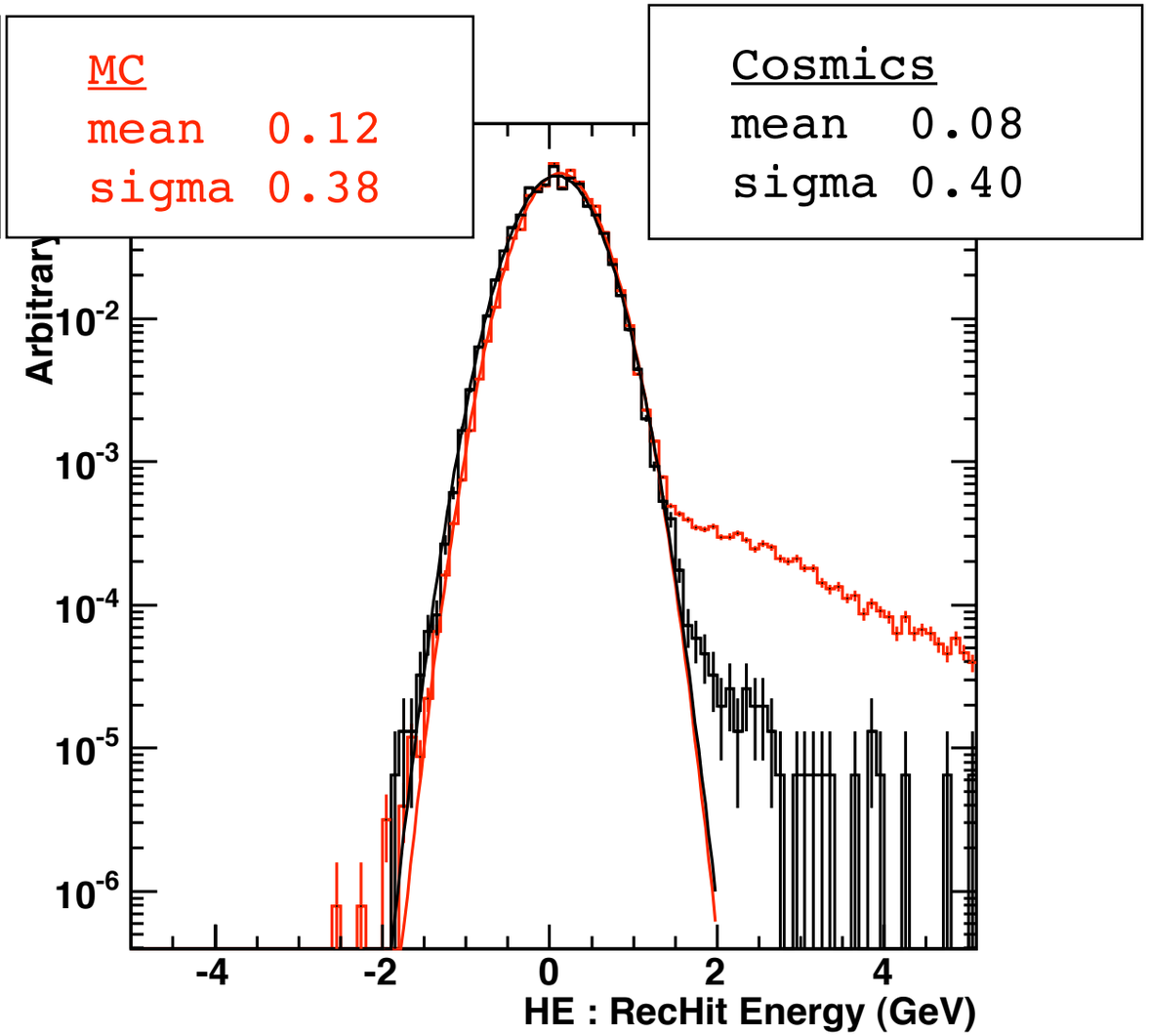
- Starting point for Marek and Vasu`s SchemeB threshold optimization.
- Data and MC (all samples of 1000 events):
  - `Commissioning09/Cosmics/RAW/v2/000/101/018/ (EB ZS threshold 9/4 ADC = 78.75)`
  - `CMSSW_3_1_0/RelValSingleMuPt100/GEN-SIM-RECO (EB ZS threshold 9/4 ADC = 78.75)`
  - `Vasu's Noise-only MC (EB ZS threshold 9/4 ADC = 78.75 MeV)`
  - `Vasu's Noise-only MC (EB ZS threshold 11/4 ADC = 96.5 MeV)`
- Reconstruction:
  - Raw data were reco`ed offline in 3_1_0.
  - Noise-only MC in 3_1_0_pre10, RelValSingleMu MC in 3_1_0.
- Compare RecHit Energy (noise) in:
  - HB, +HE, -HE.
  - EB, +EE, -EE.

Full Study here:

`http://home.fnal.gov/~jhirsch/hcal/ecal_noise/`

HB & HE


MC
mean 0.06
sigma 0.25
Cosmics
mean 0.05
sigma 0.27
run 101951
310
Arbitrary
HB : RecHit Energy (GeV)


MC
mean 0.12
sigma 0.38
Cosmics
mean 0.08
sigma 0.40
Arbitrary
HE : RecHit Energy (GeV)

Ecal Issues

- Reconstruction of RecHit amplitude:
  - Fixed-shaped fit with timing free.
    - Used in Cosmics reco, unstable for noise.
  - Fixed-weights synchronous with LHC clock.
    - Used in MC reco, will be used in collision data reco.

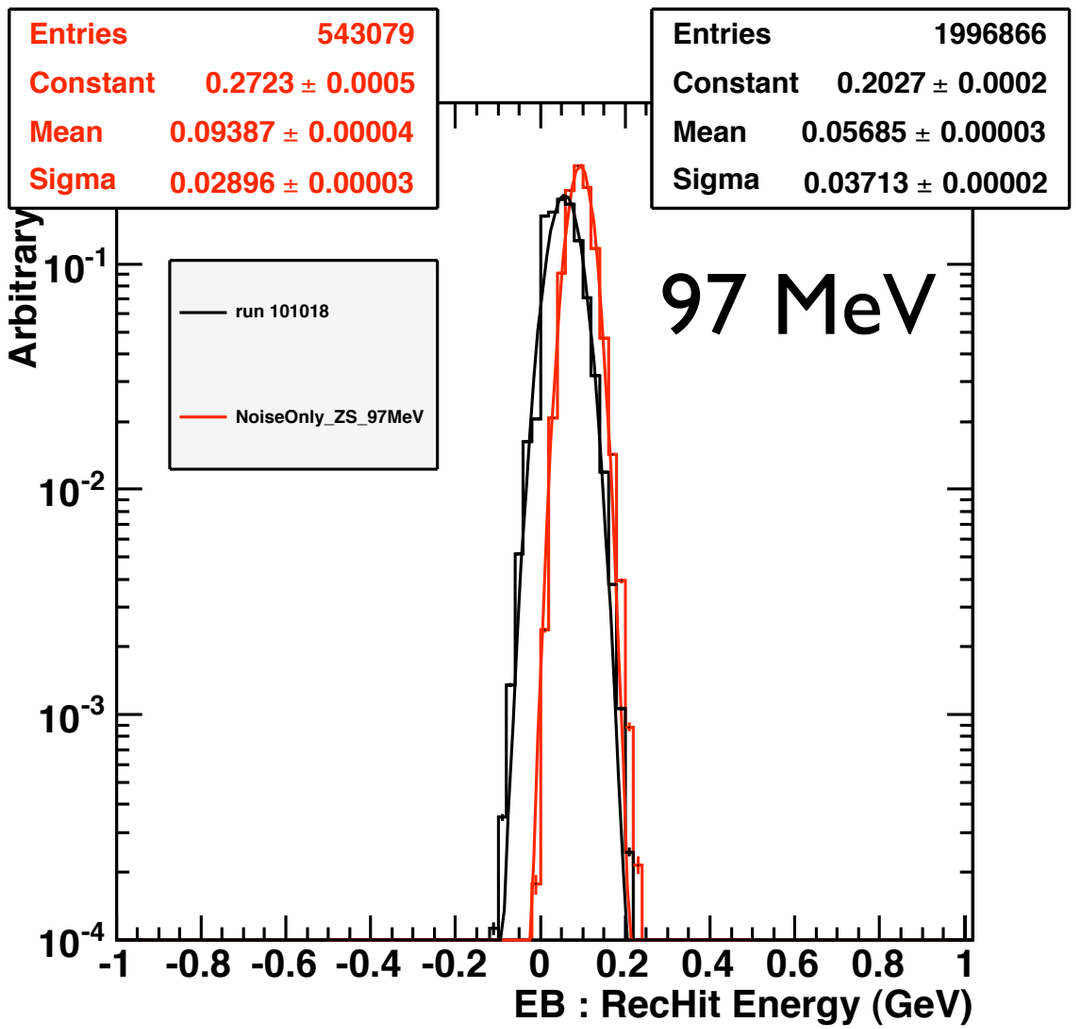
- Noise simulation:
  - Coherent noise is not simulated.
  - Uncorrelated noise is increased in MC to reproduce total noise in real data downstream (assuming reco with weights).
    - Effects of ZS on noise may not be accurate in MC.

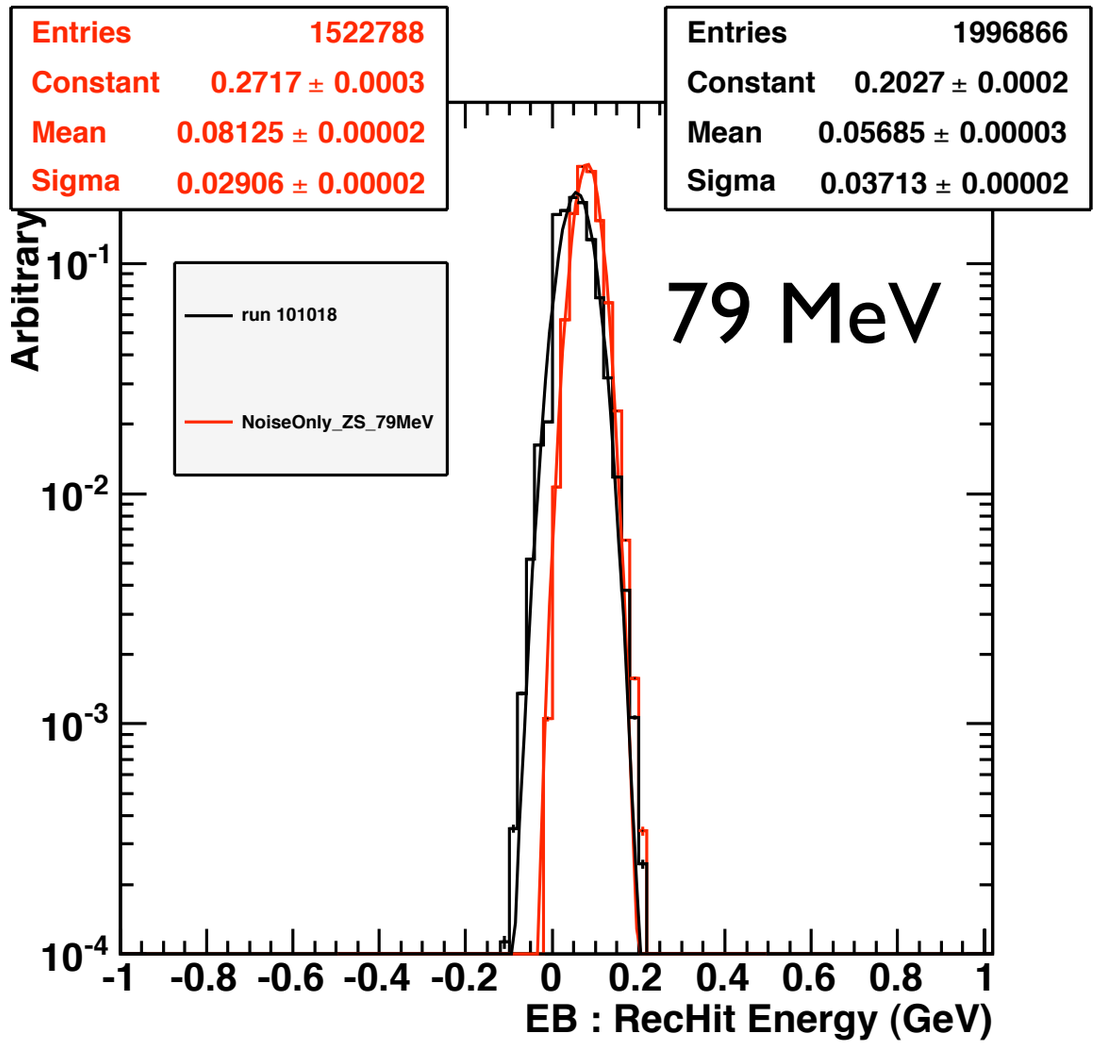
- ZS thresholds:
  - Standard MC and cosmics readout use different numbers.
  - This issue addressed today.

- Do Ecal experts plan to reco Cosmics using fixed-weights?
  - This would give us one handle to deconvolve these issues.

EB : ZS Threshold

- Cosmics: Cosmics-SR, ZS threshold = 78.75 MeV
- MC ZS threshold 97 → 79 MeV:
  - 14% (0%) change in mean (sigma).
  - 180% change in occupancy.

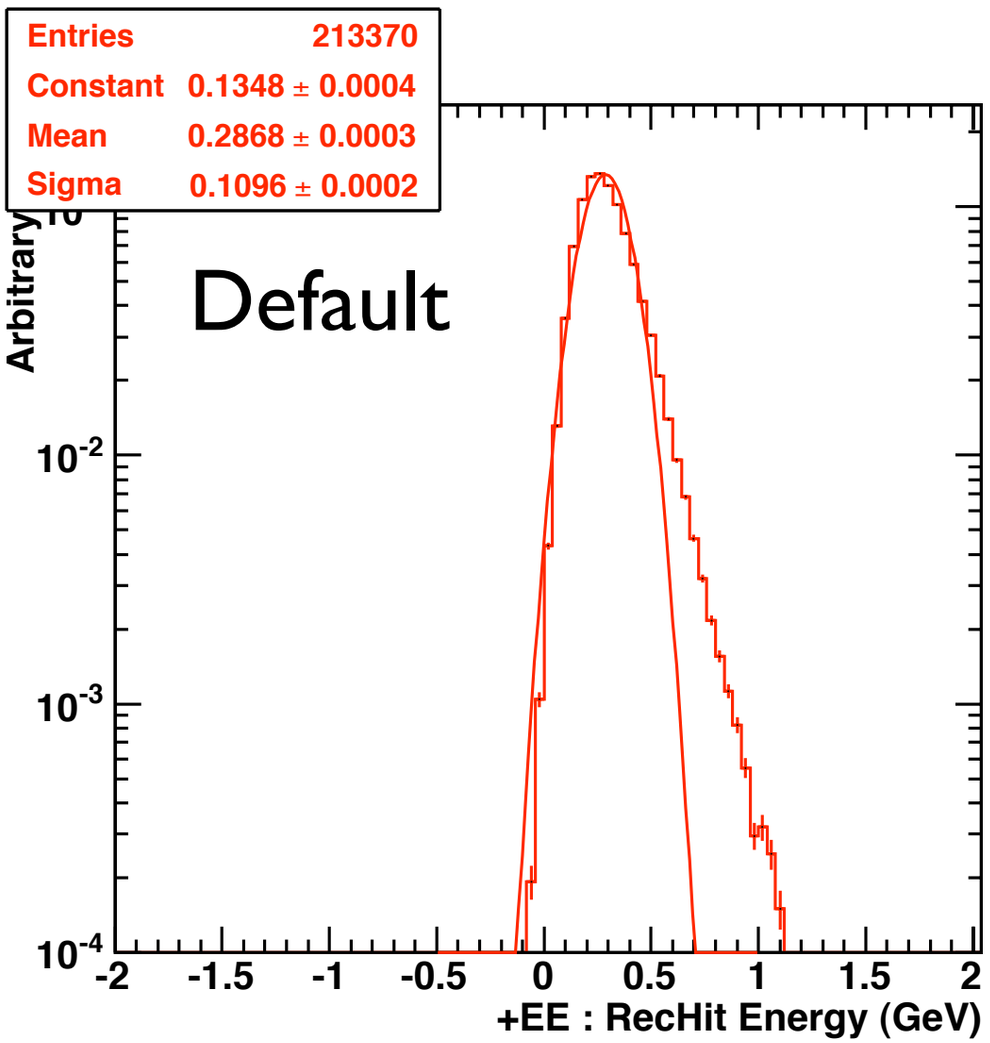


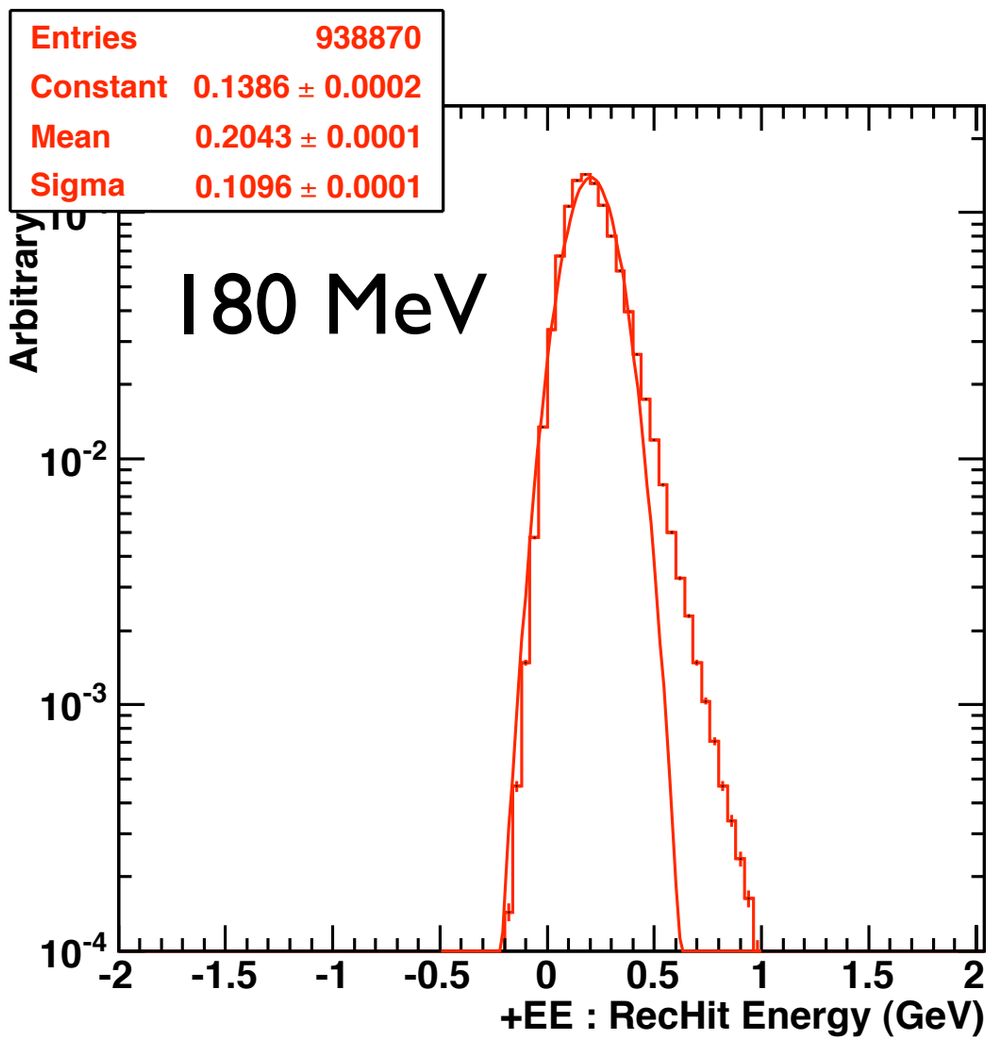


+EE : ZS Threshold

- +EE absent from run 101018.
- MC ZS threshold Default → 180 MeV:
  - 30% (0%) change in mean (sigma).
  - 340% change in occupancy.

Default ZS threshold = 300 MeV ?

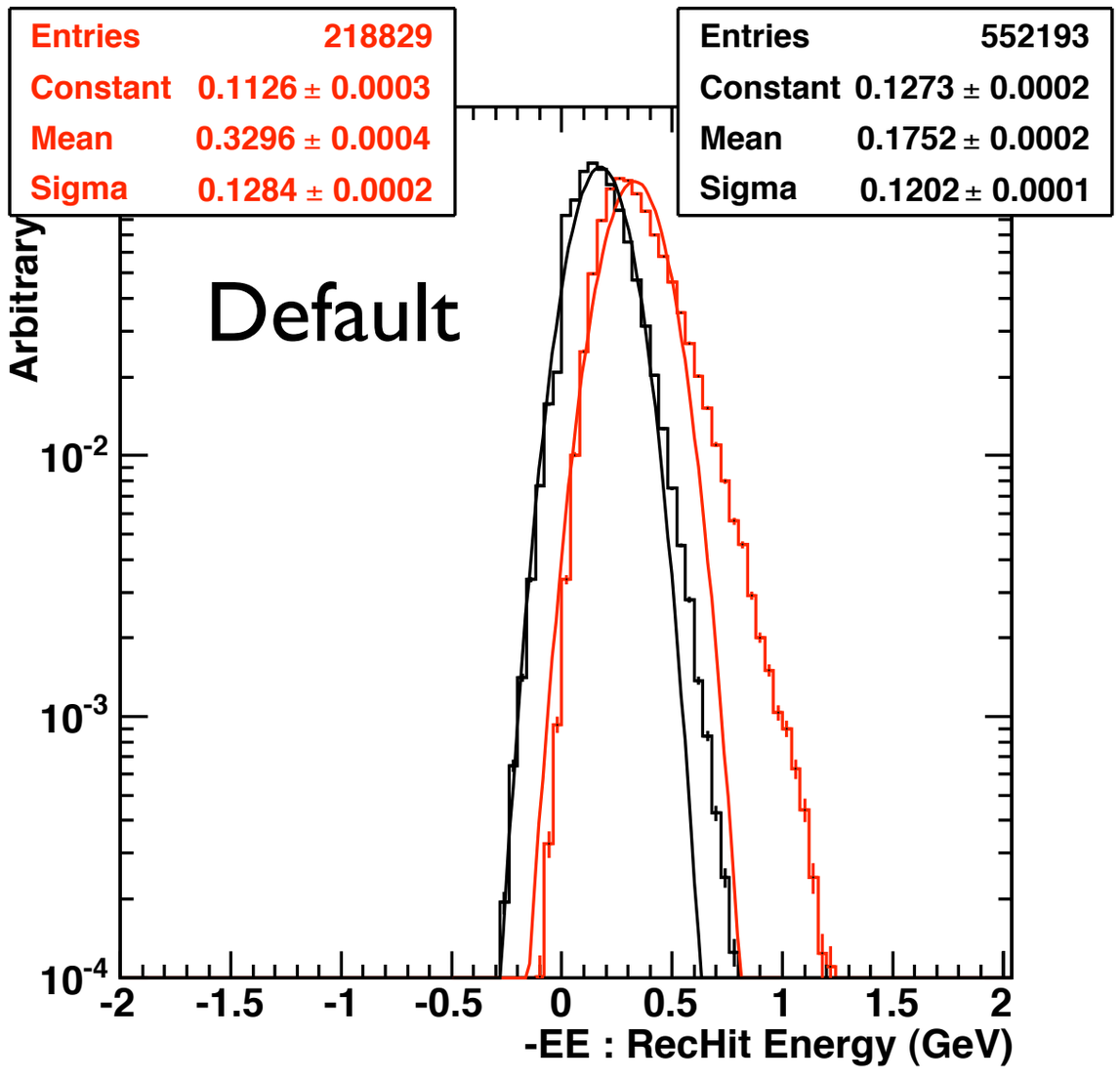


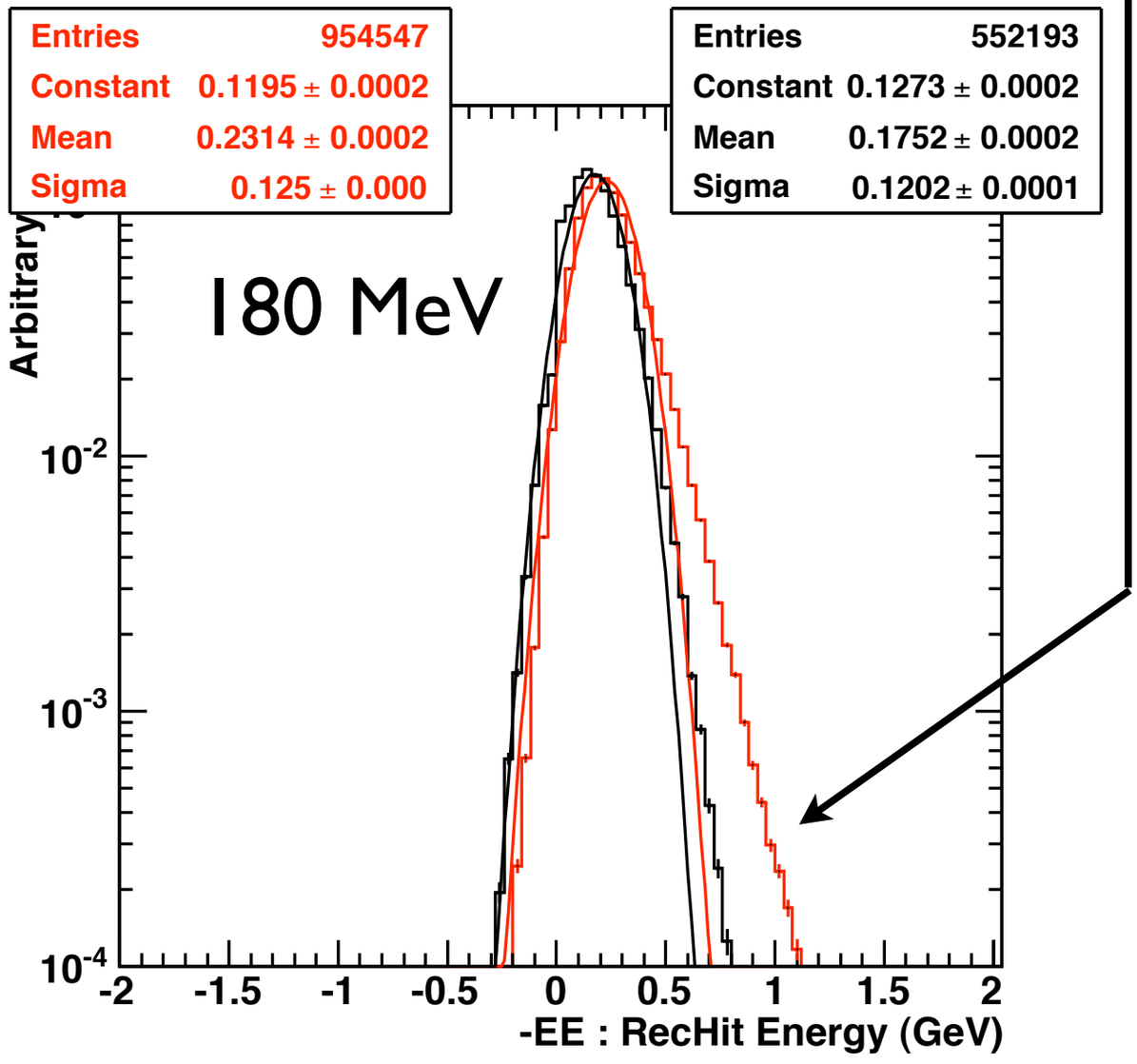


-EE : ZS Threshold

- -EE noise simulation known to be buggy.
- MC ZS threshold Default → 180 MeV:
  - 30% (0%) change in mean (sigma).
  - 340% change in occupancy.

Notice large tail in MC.
Also present in RelValSingleMu MC.





Summary

- MC ZS threshold Startup → Cosmics.
  - Factor of a 2-3 change in occupancy.
  - 15-30% change in mean of noise.
- Occupancy potentially much more important than noise sigma for noise-in-cone number.

Sample	ZS threshold	EB			+EE		
		Entries (10^6)	μ (MeV)	σ (MeV)	Entries (10^6)	μ (MeV)	σ (MeV)
Noise MC	97 MeV	0.543	94	29	0.213	287	110
Noise MC	79 MeV	1.524	81	29	0.939	204	110
noise MC	0 MeV	60.950	0	43	7.351	0	160
Run 101018	79 MeV	1.997	57	37	–	–	–

- Entries = number of channels readout per 1000 events.

Final Questions

- Do our observed changes in noise and occupancy make sense?
- How can we modify data or MC reconstruction to further improve data/MC agreement for Ecal?
    - Matthieu Marionneau has been a big help in understanding the ZS issue.
    - Any hope for Cosmics reco`ed with fixed-weights?

Extra Slides

EB : 3_1_0 vs. 2_2_X Reco

- Black histograms are cosmics data (mostly noise, of course). Ignore red MC histos for now.
- Ecal Run Key = Cosmics-SR for both runs.
- Any changes between 3_1_0 and 2_2_X?