EMCal Cluster Position Dependent Correction

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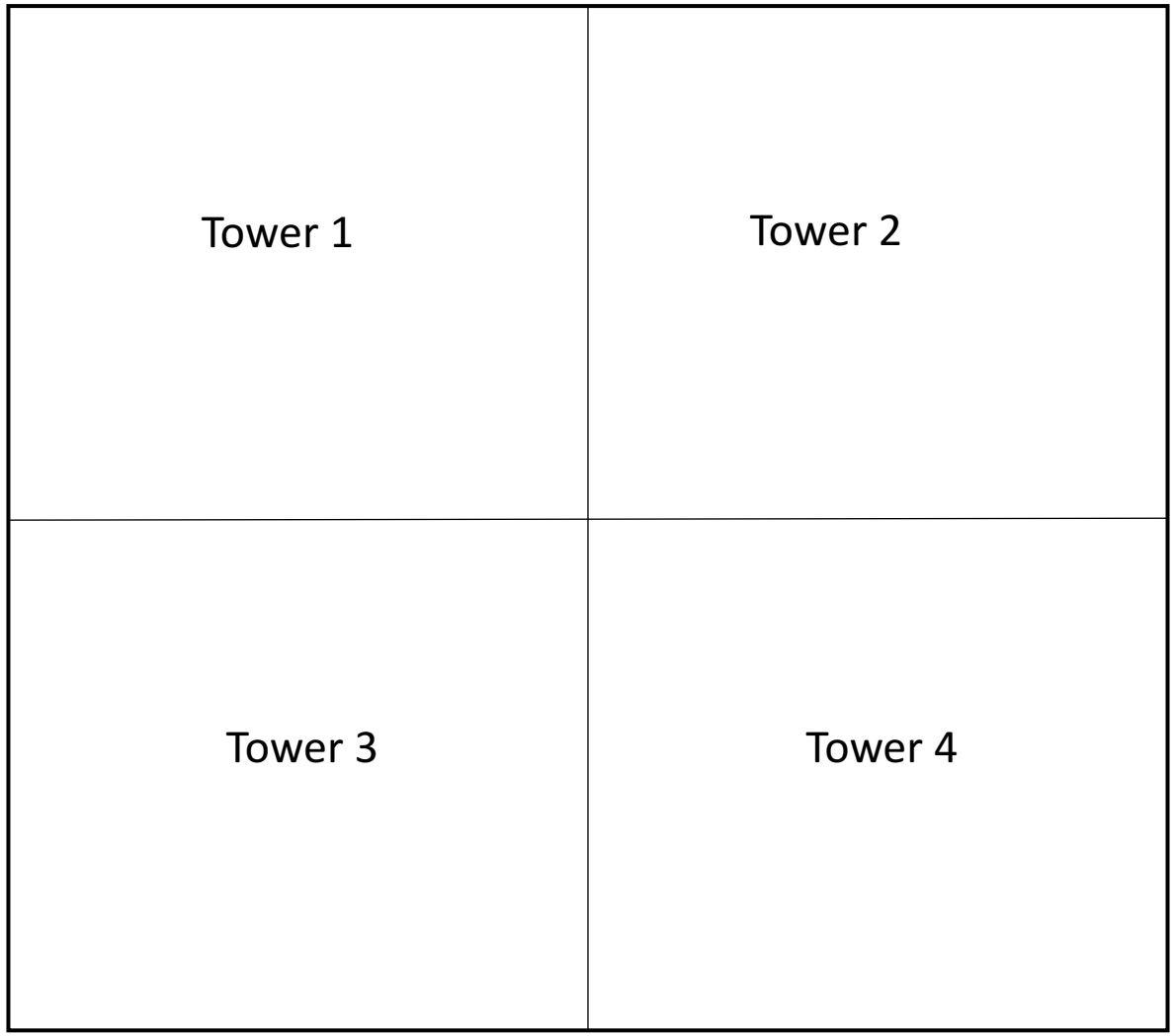
Motivation

- Use a position dependent energy correction to improve constant term of energy resolution of EMCal in simulation
- This occurs because, e.g., a photon/electron which showers in the center of a tower vs. near the edge of a block will have different energy response
- Wrote a calibration module and submitted via pull requests for coresoftware #314, updated G4_CEMC macro #61, calibrations #24

Methods

- Using Chris' single particle photon/$e^{\pm}$ G4 hits files
- Collect energy response in 16x16 bins in eta-phi space for the 2x2 block
- Determine position of a particular cluster in this binning and apply energy response correction
- Example 1D energy responses are in back ups

Divide this 2x2 block into 16x16 bins and determine energy response



Calibration Module

- Calibration module takes the node CLUSTER_CEMC and calculates and applies correction, creating a new node "CLUSTER_POS_COR_CEMC"

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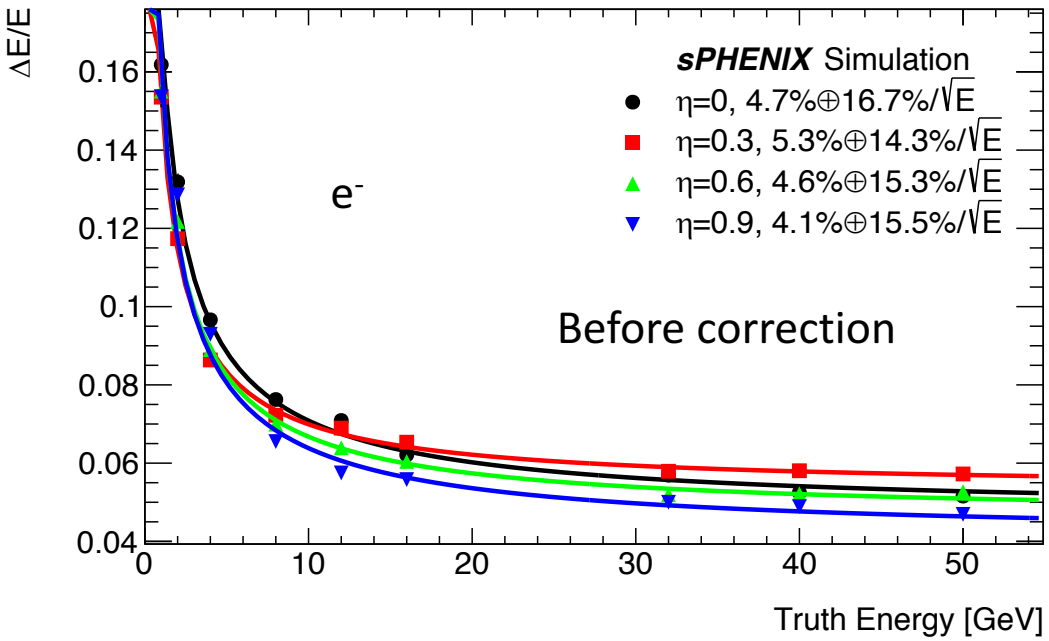
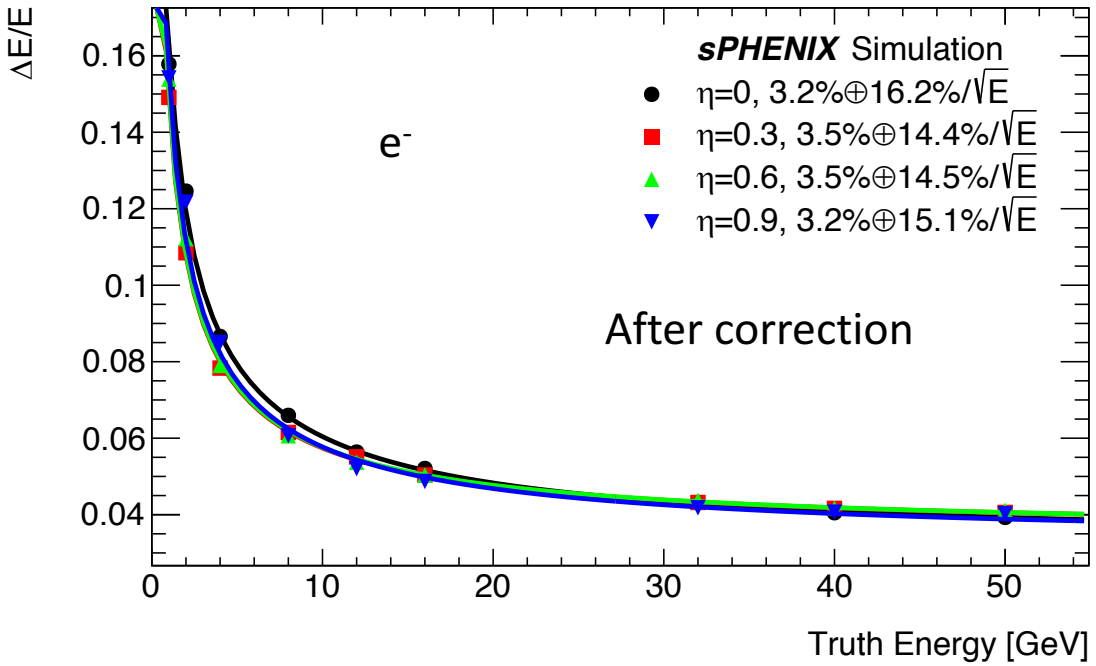
List of Nodes in Fun4AllServer:
Node Tree under TopNode TOP
TOP (PHCompositeNode)/
   DST (PHCompositeNode)/
      CEMC (PHCompositeNode)/
         CLUSTER_POS_COR_CEMC (IO,RawClusterContainer)
         G4CELL_CEMC (IO,PHG4CellContainer)
         TOWER_SIM_CEMC (IO,RawTowerContainer)
         TOWER_RAW_CEMC (IO,RawTowerContainer)
         TOWER_CALIB_CEMC (IO,RawTowerContainer)
         CLUSTER_CEMC (IO,RawClusterContainer)
```

Results

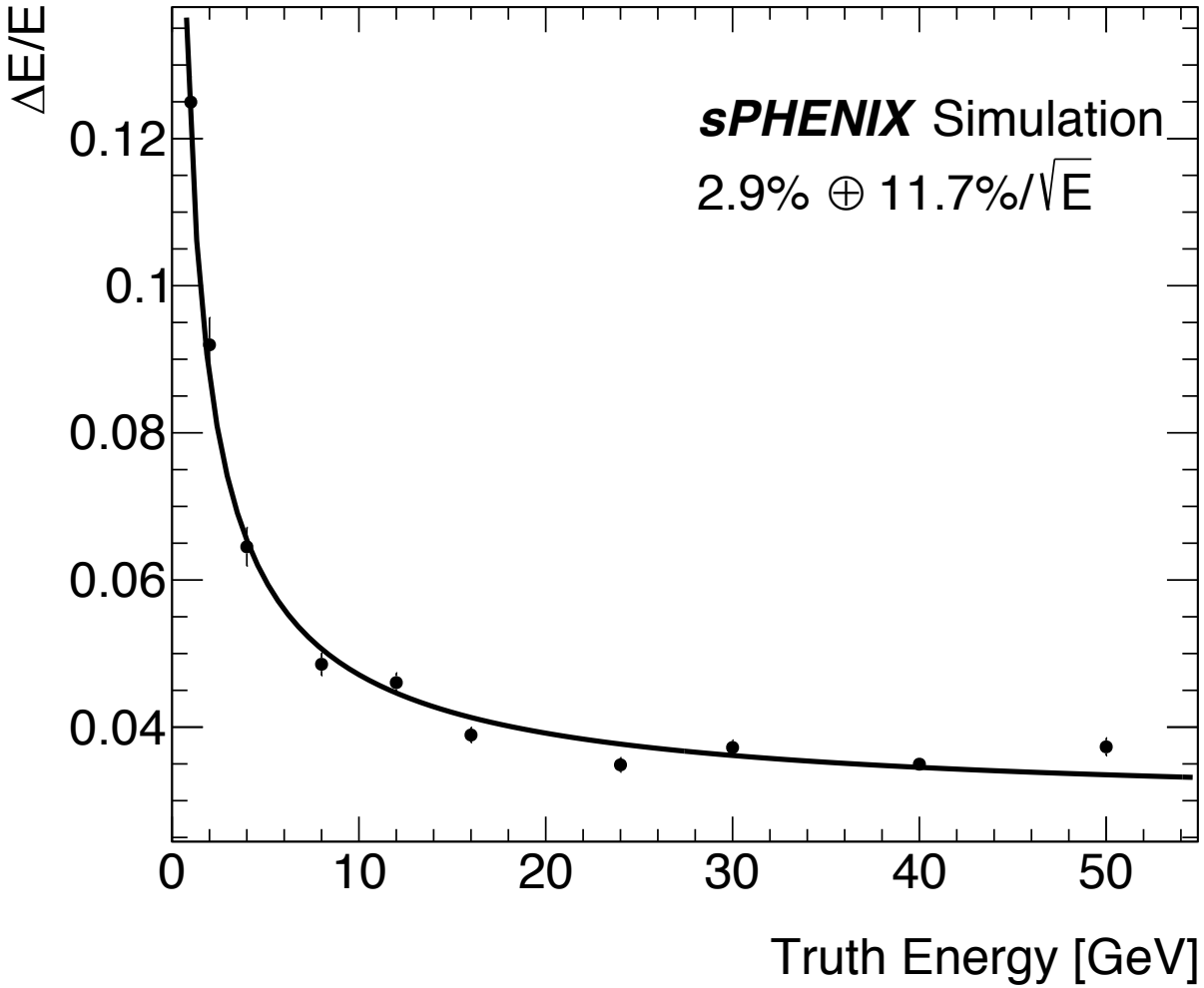
- Before position dependent correction, see η dependence and not very good constant term
- After correction, η dependence is minimal and constant term is more reasonable based on test beam data



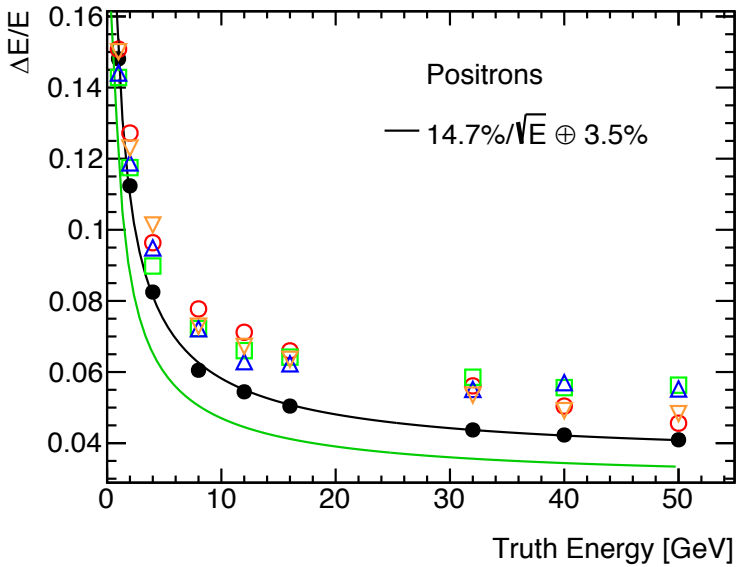


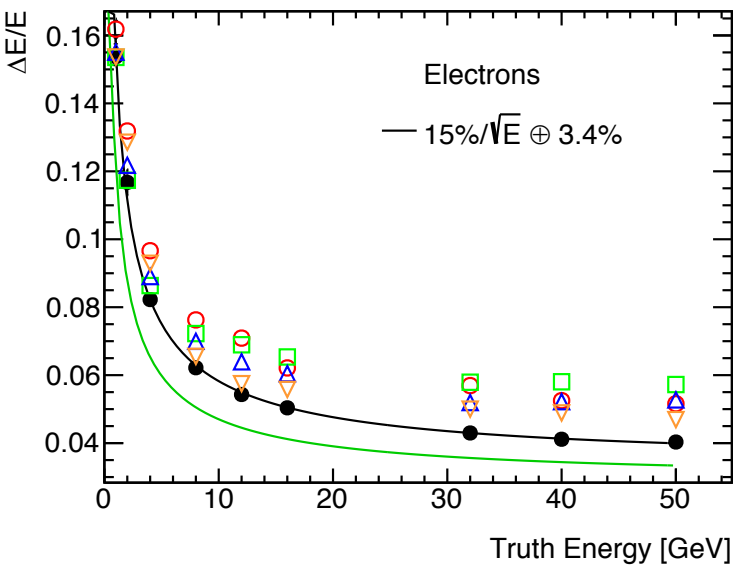
Perfect EMCal Simulation

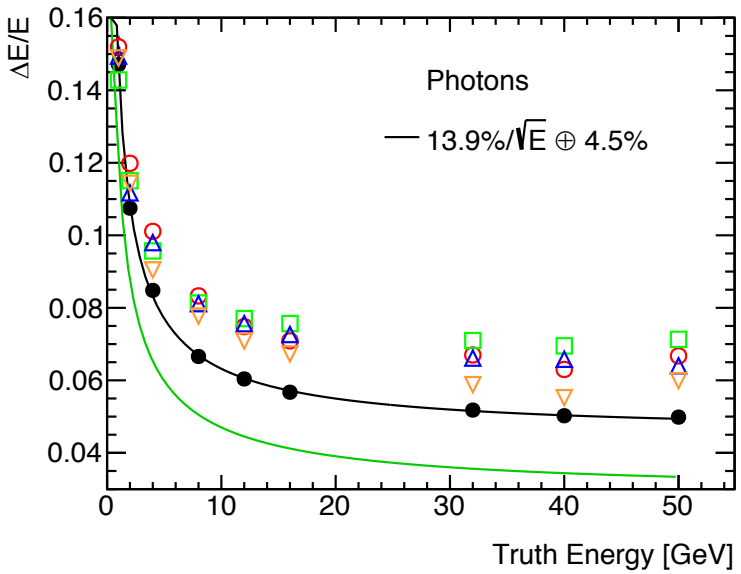
- Additionally run single photon gun for “perfect” EMCal in simulation
- Only used EMCal and beam pipe in simulation
- Constrained photon gun to center of one single (2D projective) tower at η=0.325 and ϕ=1.00
- Energy responses in back up



All Energy Resolutions







- 1 perfect tower simulation, 11.7%/√E ⊕ 2.9%
- Position uncorrected, η=0
- Position uncorrected, η=0.3
- Position uncorrected, η=0.6
- Position uncorrected, η=0.9
- Position corrected

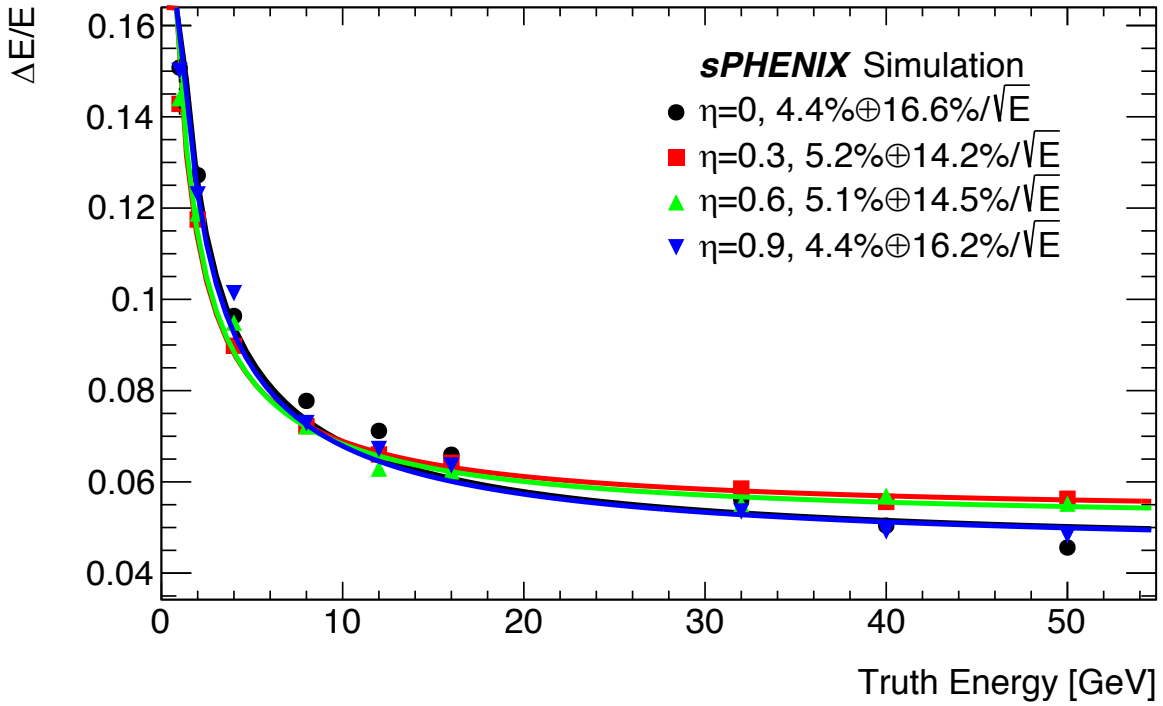
Conclusions

- Calibration module put into git, updated default Fun4All macros to give users option to use the calibration
- Calibration improves single photon/electron constant energy resolution by 1-2%

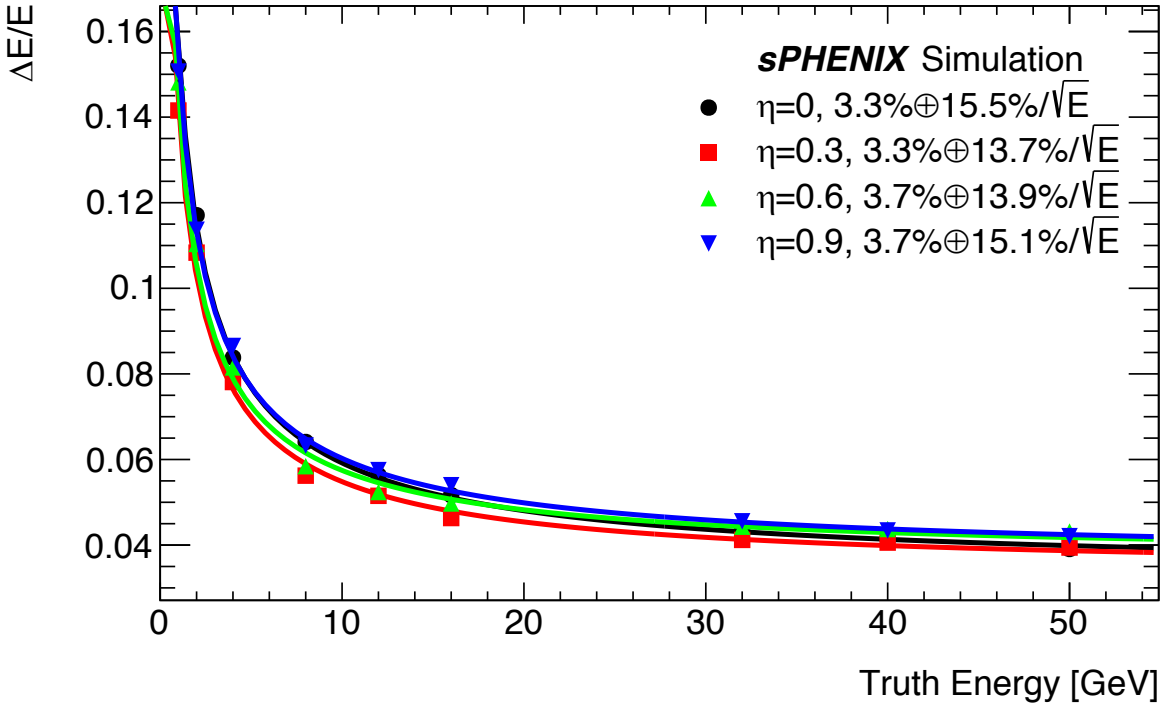
Back Up

Positron

Before Correction

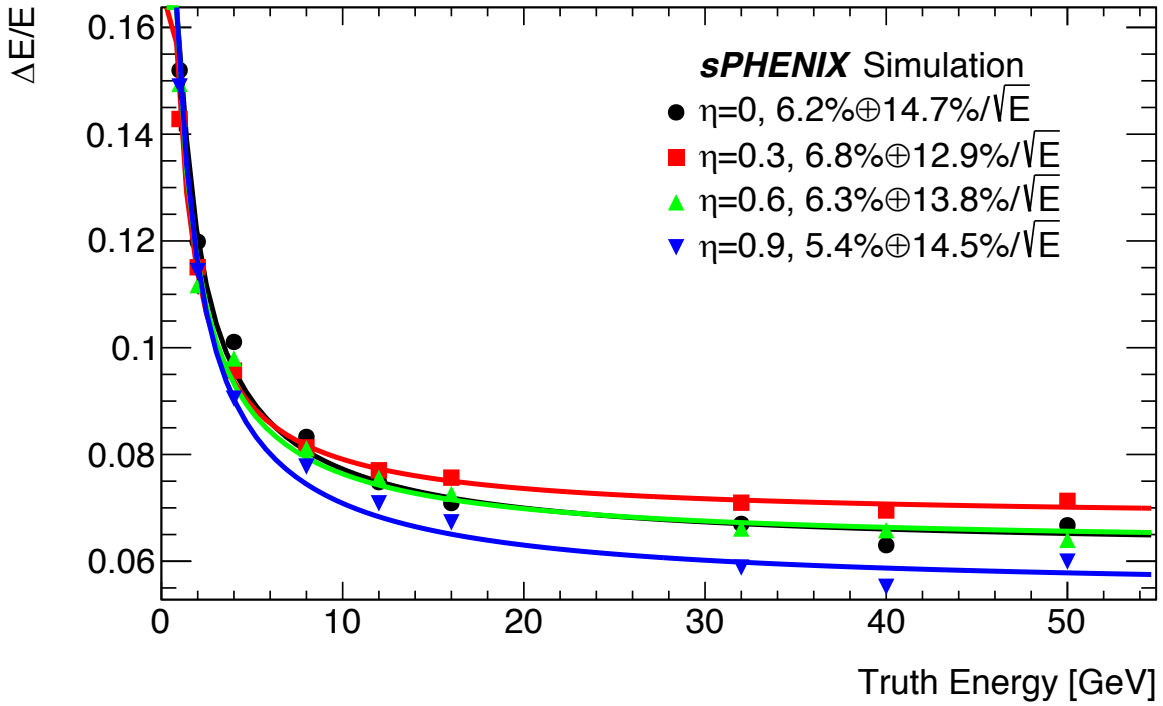


After Correction

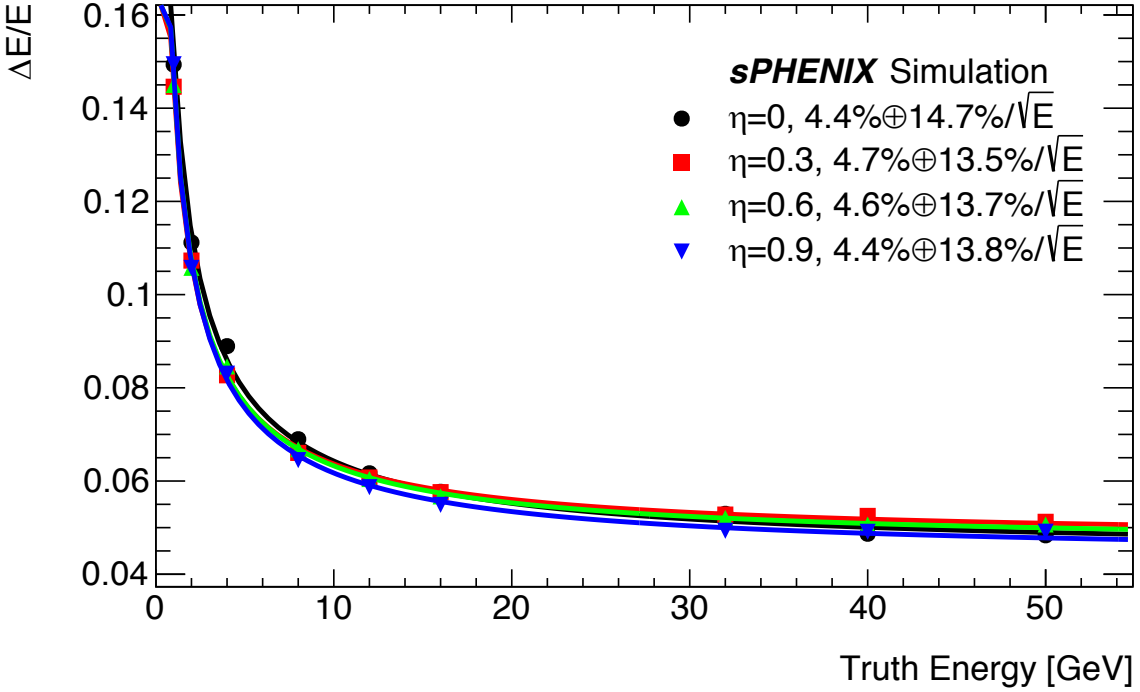


Photon

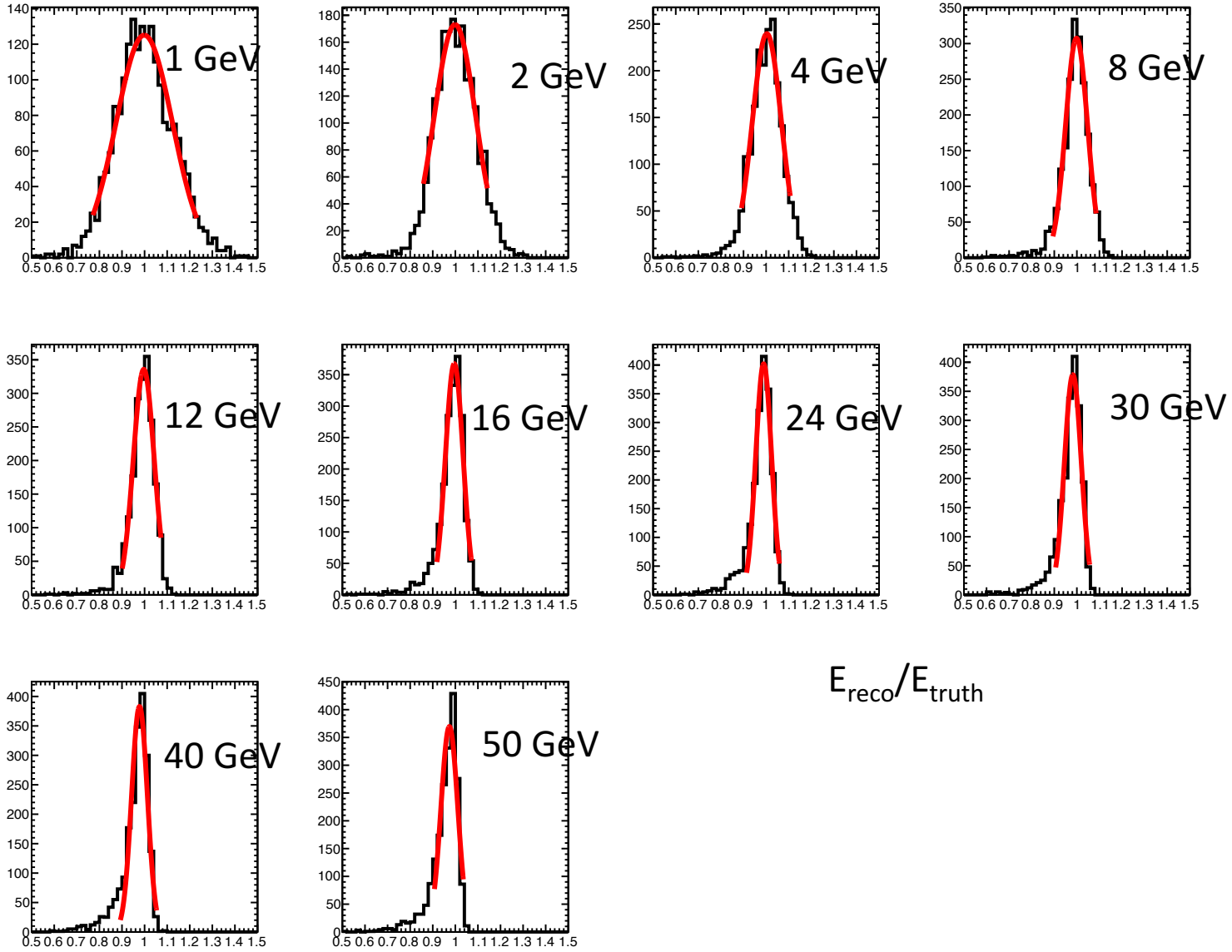
Before Correction



After Correction



Energy Responses for “perfect” EMCal sim



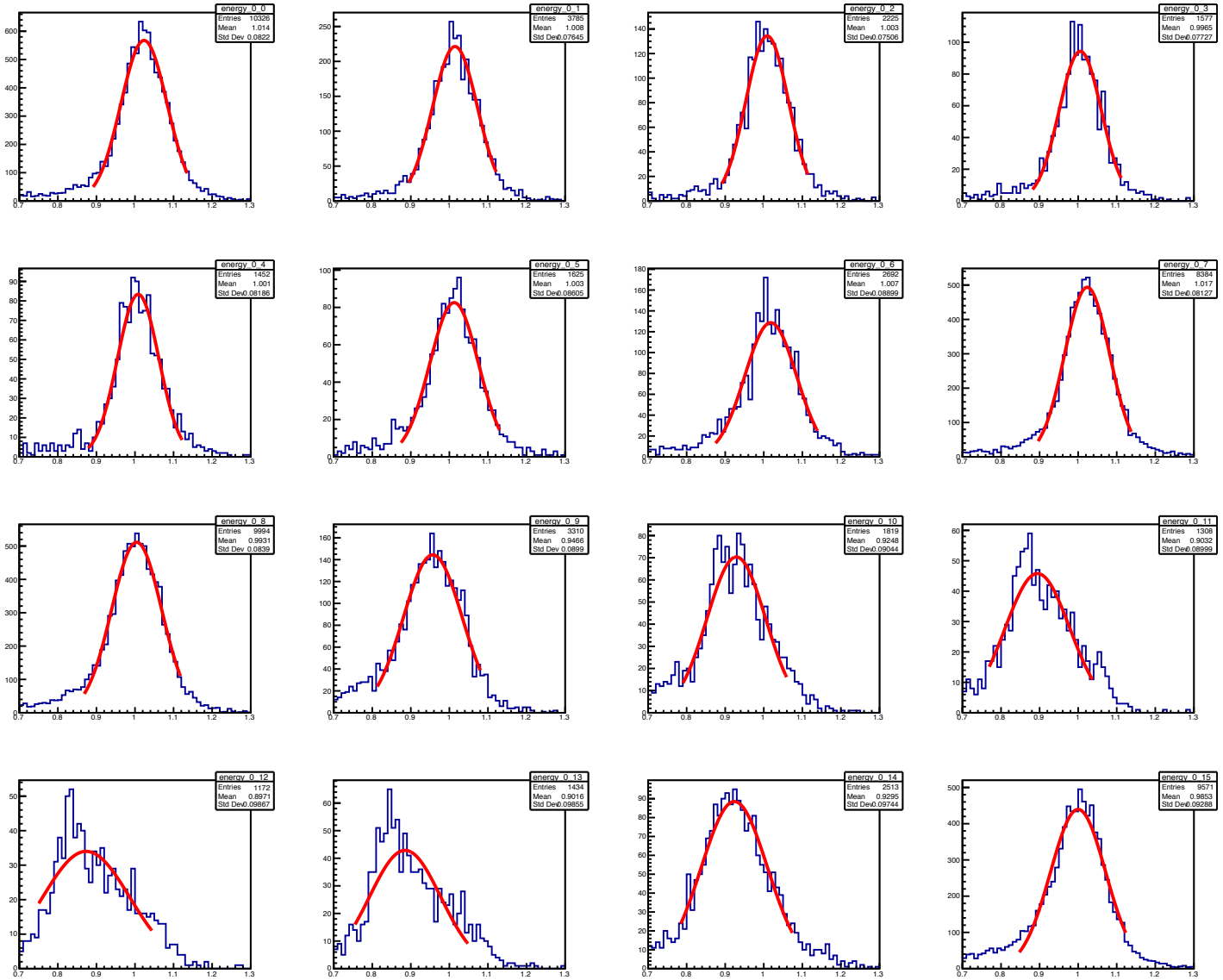
Example 1D Energy Responses

- Responses are laid out as follows
- Each slide corresponds to one fmodeta bin, i.e. one eta bin in the 2x2 block
- Each slide has 16 panels, which each correspond to one fmodphi bin, i.e. one phi bin in the 2x2 block, laid out like the cartoon to the right
- Note the ones here are for electrons, but the responses for positrons/photons are similar

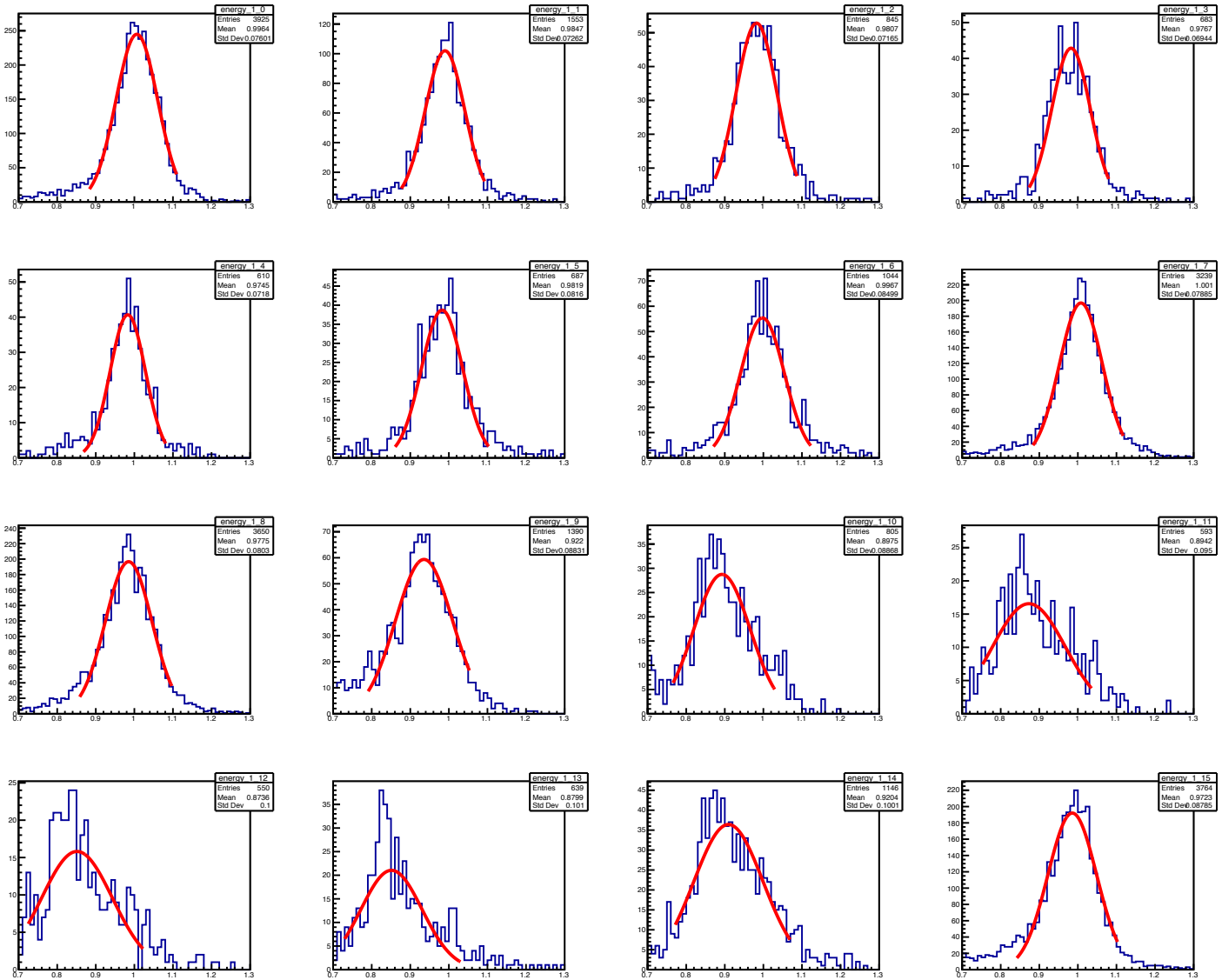
1 fmodeta bin (e.g. 0<fmodeta<0.125)

0<fmodphi<0.125	0.125<fmodphi<0.25	0.25<fmodphi<0.375	0.375<fmodphi<0.5
0.5<fmodphi<0.625	0.625<fmodphi<0.75	0.75<fmodphi<0.875	0.875<fmodphi<1
1<fmodphi<1.125	1.125<fmodphi<1.25	1.25<fmodphi<1.375	1.375<fmodphi<1.5
1.5<fmodphi<1.625	1.625<fmodphi<1.75	1.75<fmodphi<1.875	1.875<fmodphi<2

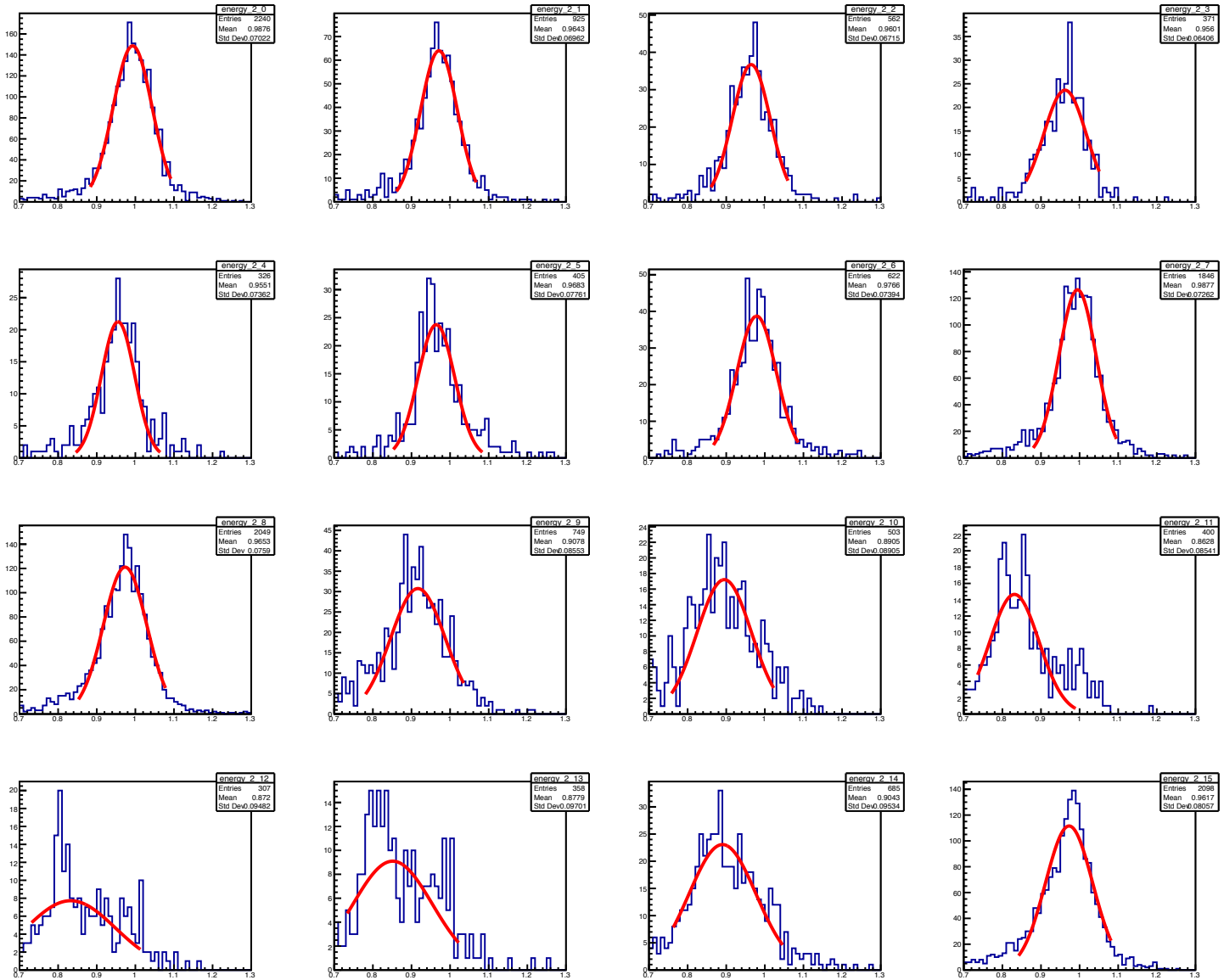
0<fmodeta<0.125



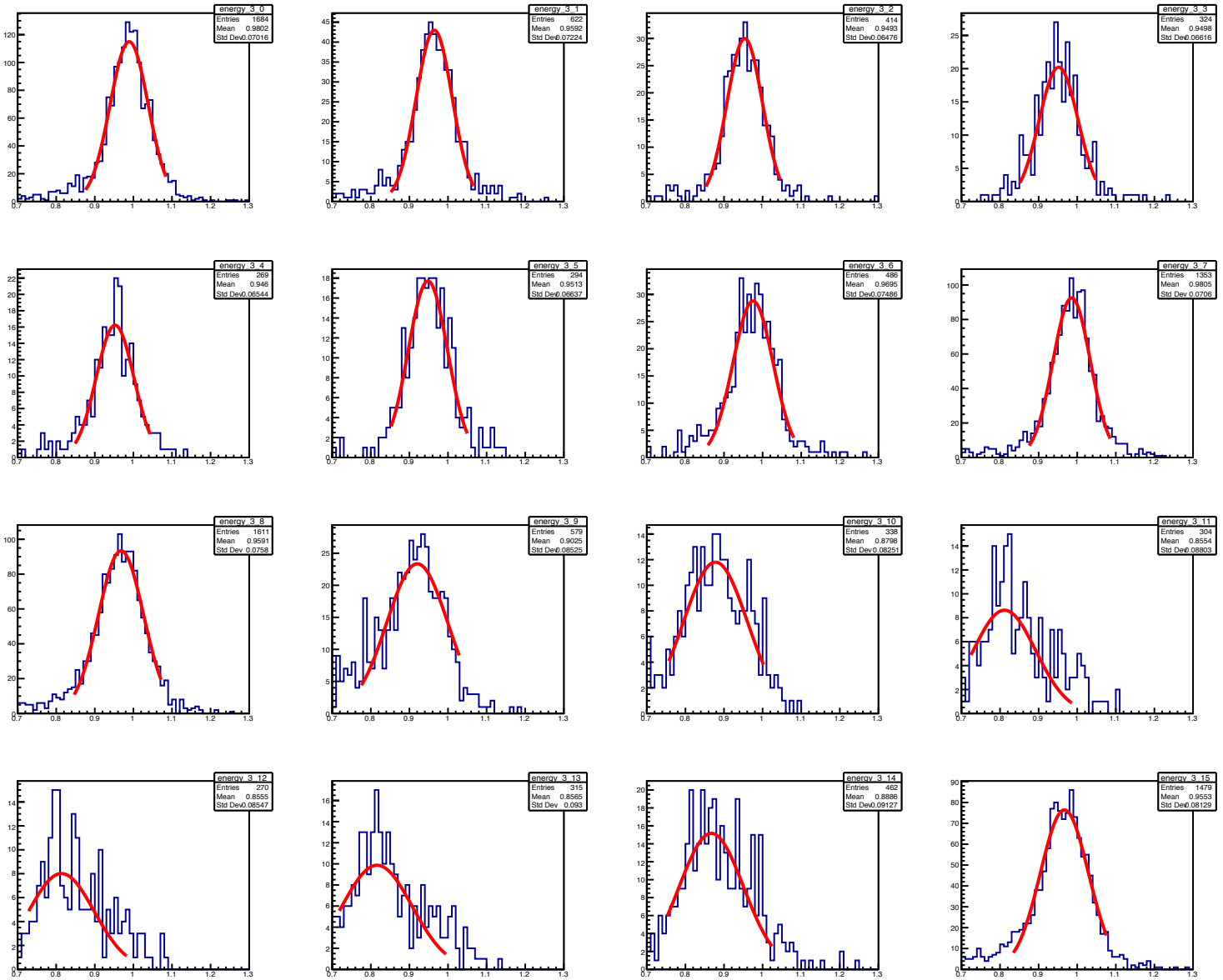
0.125<fmodeta<0.25



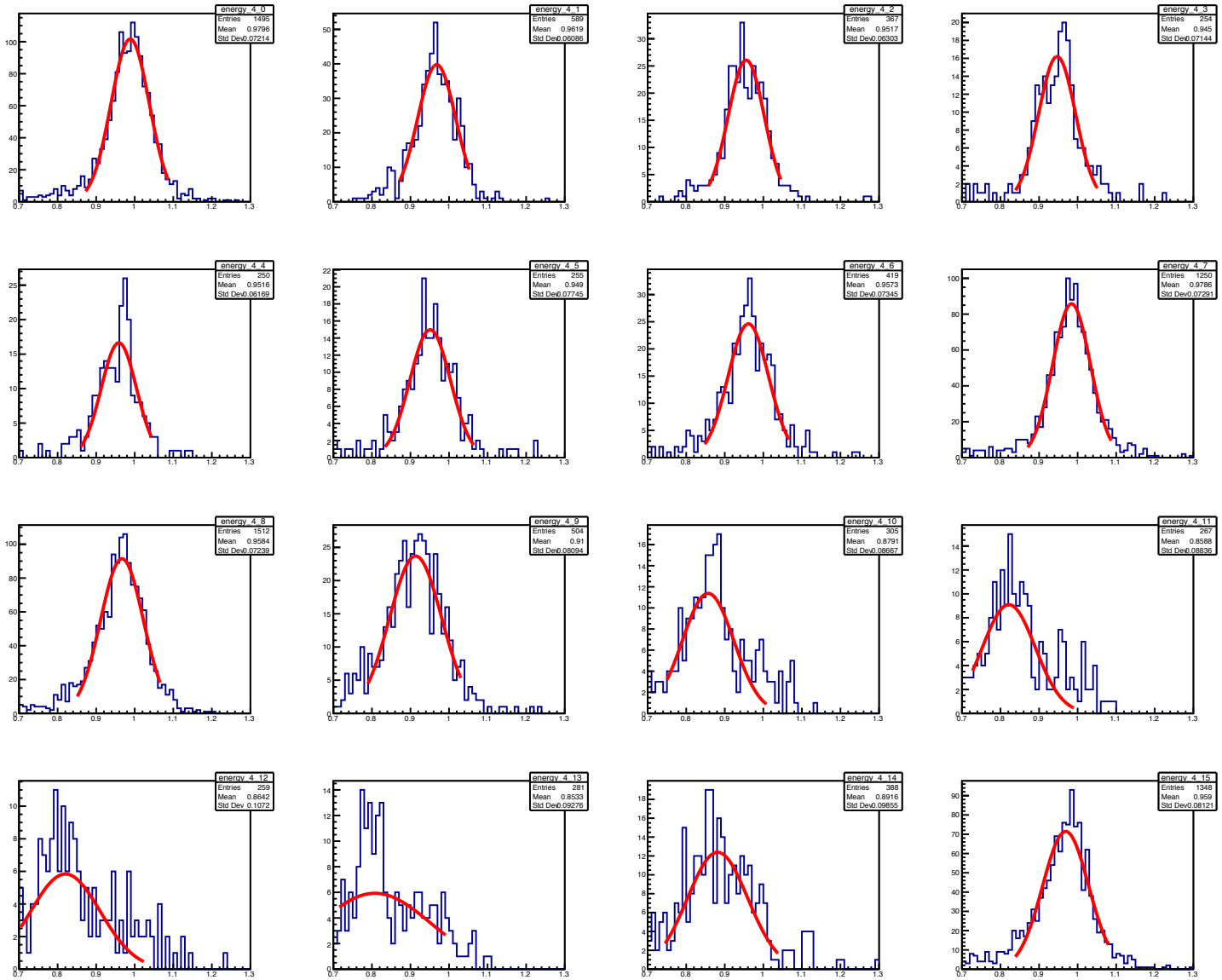
0.25<fmodeta<0.375



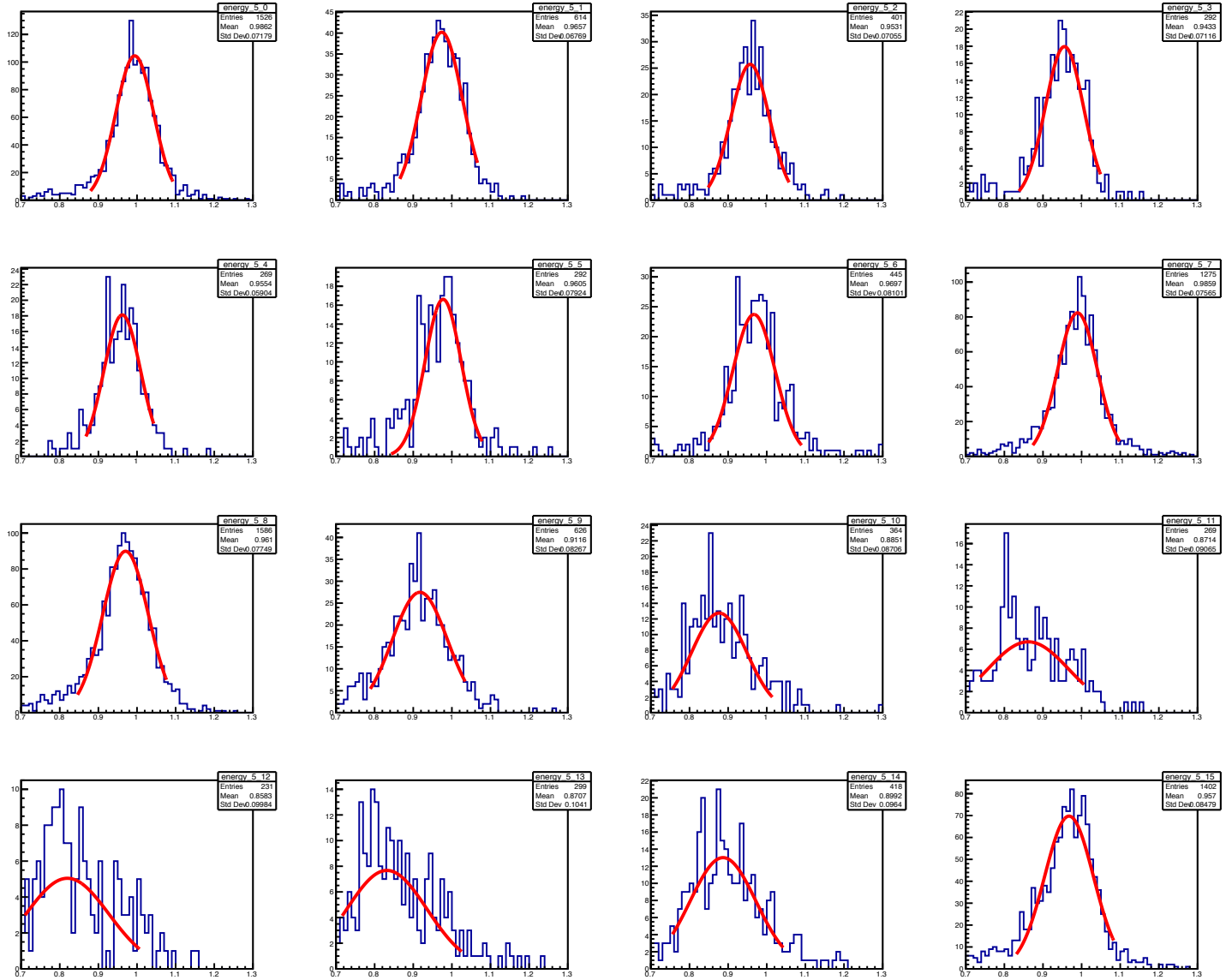
0.375<fmodeta<0.5



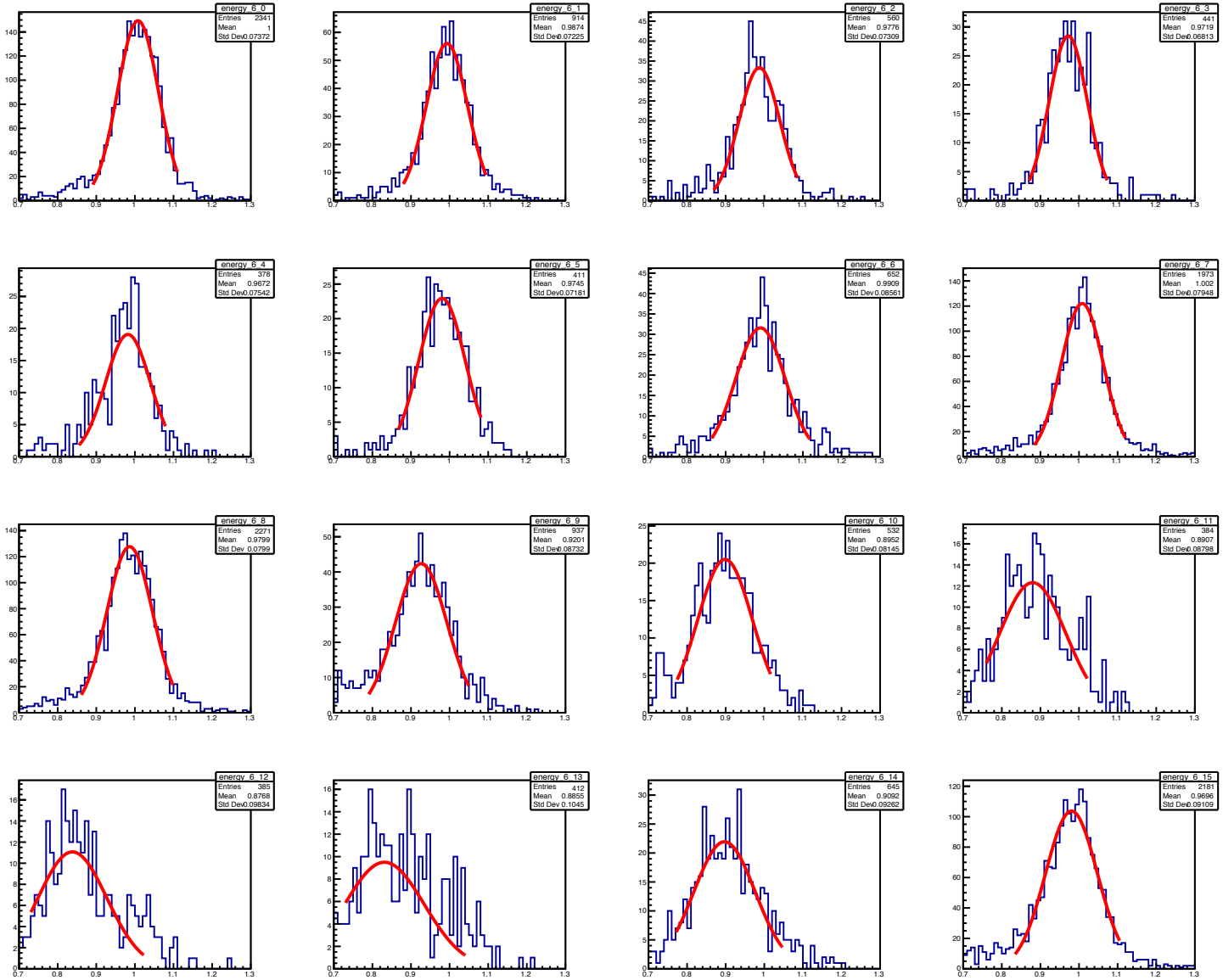
0.5<fmodeta<0.625



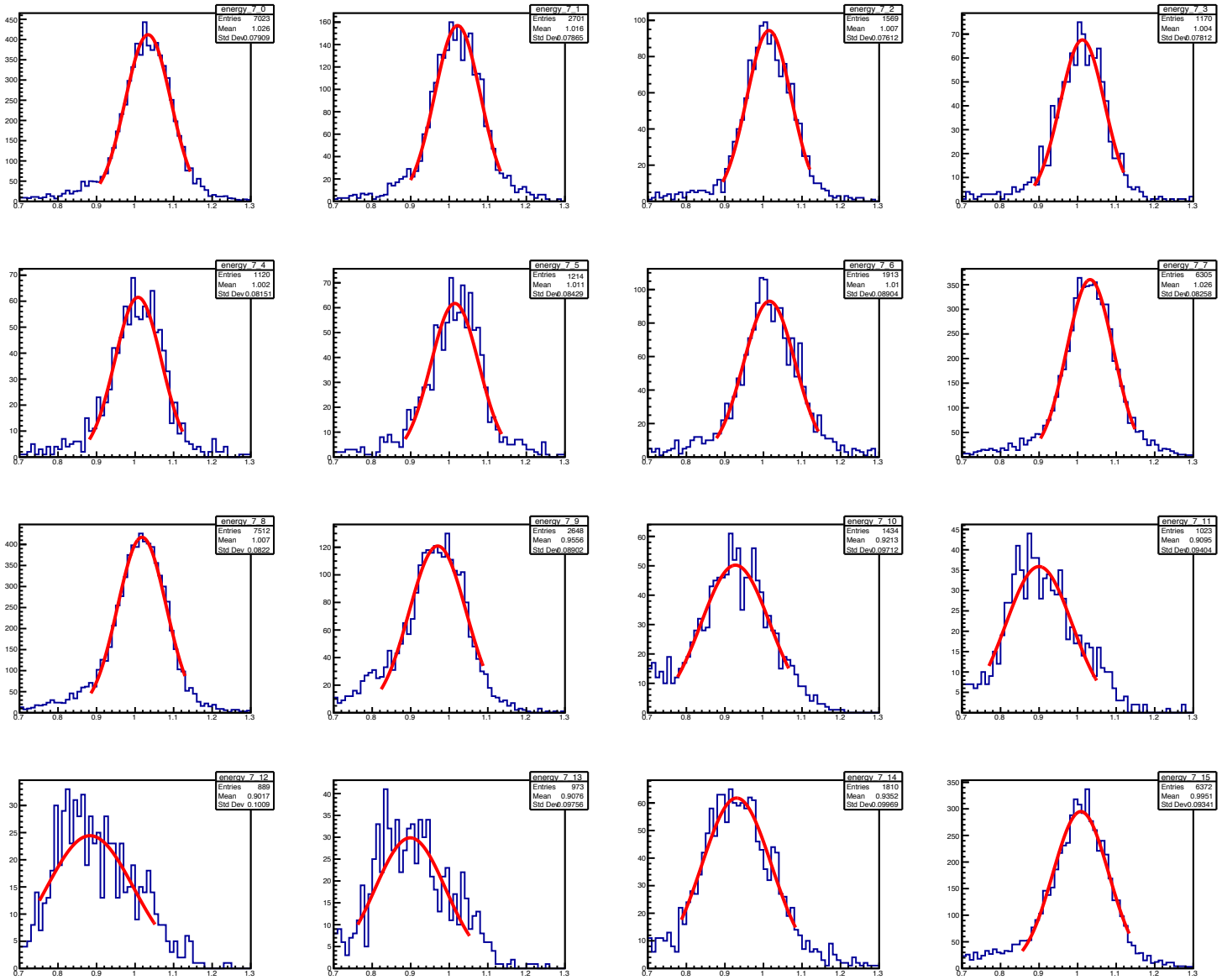
0.625<fmodeta<0.75



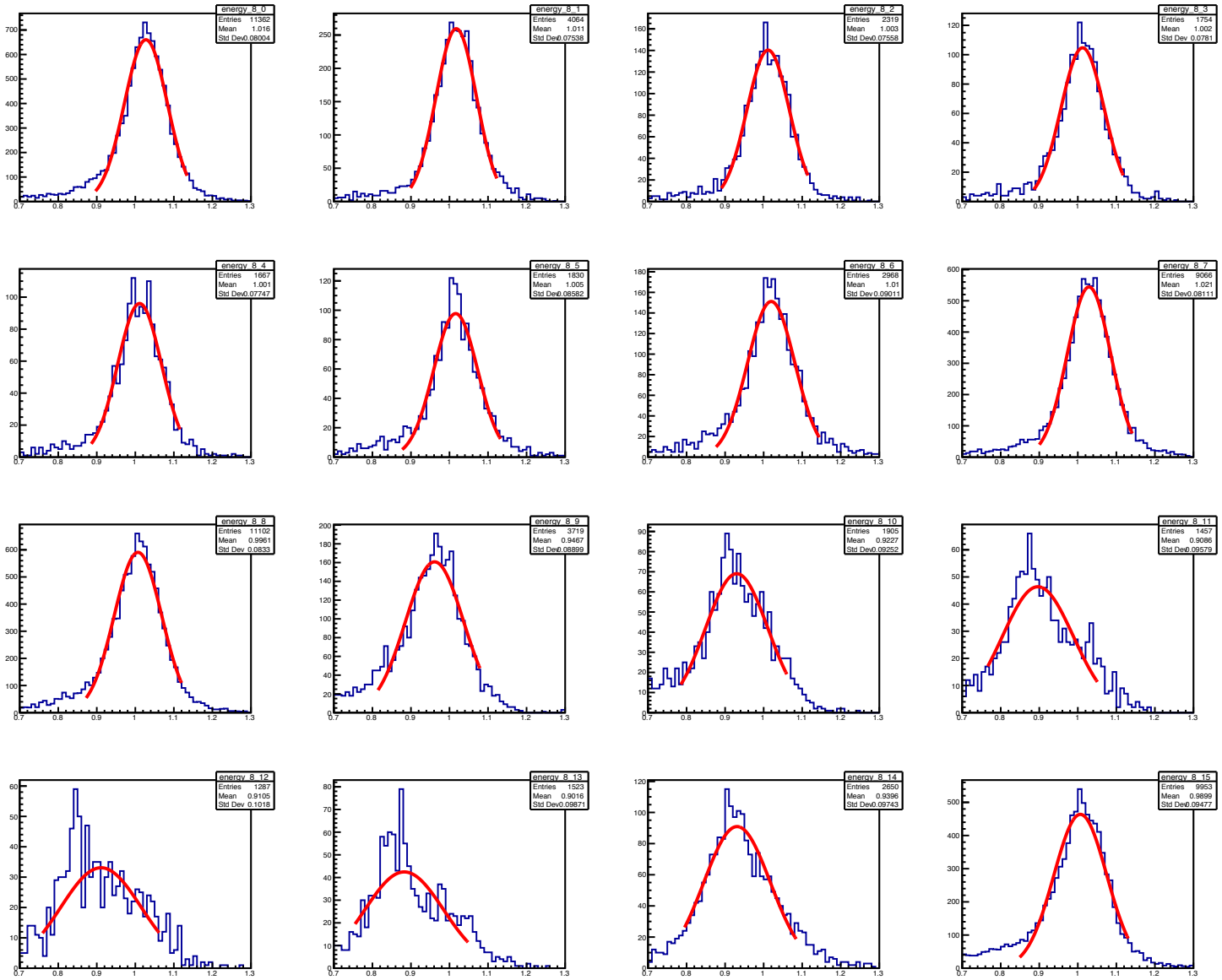
0.75<fmodeta<0.875



0.875<fmodeta<1



1<fmodeta<1.125



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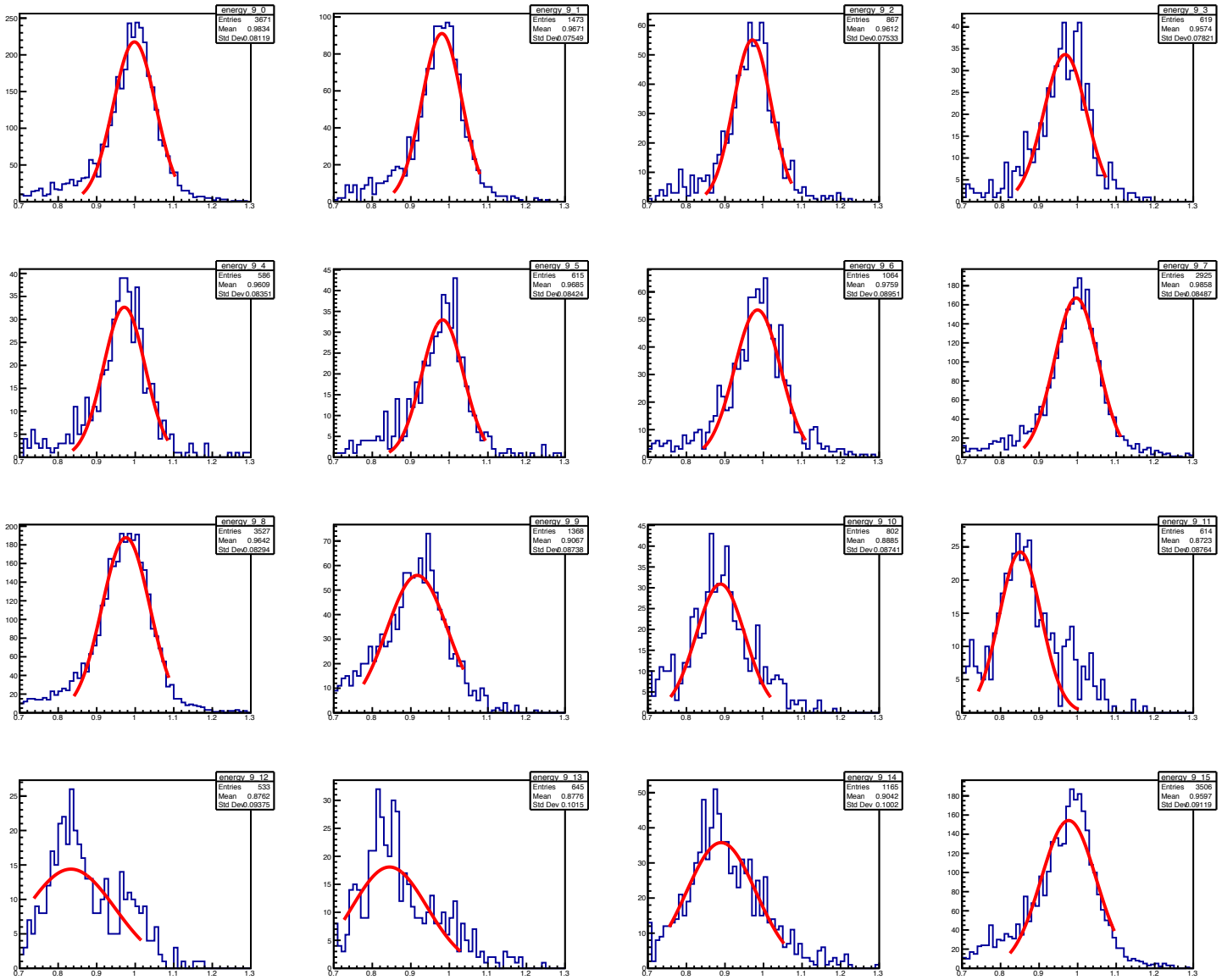
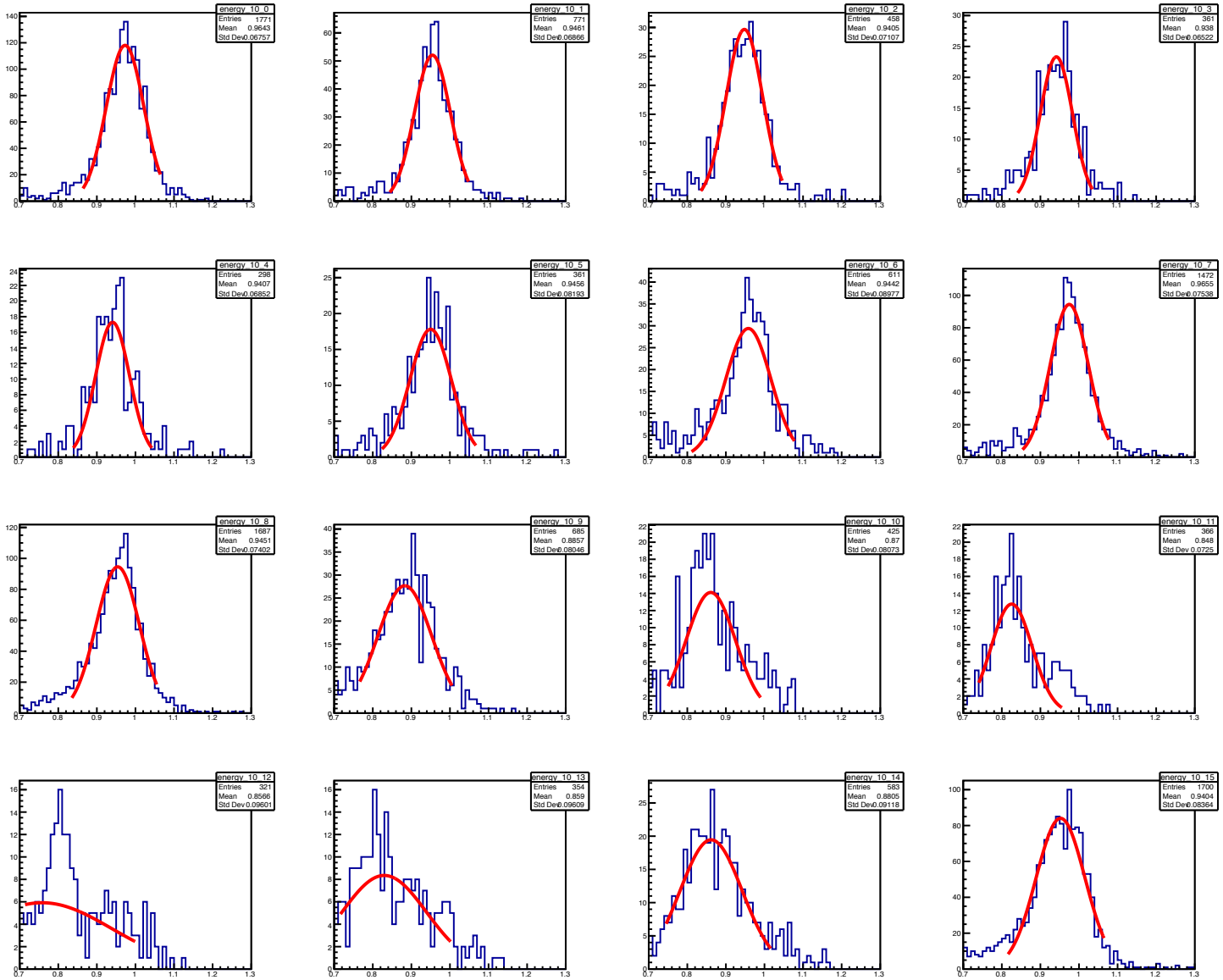


1.25<fmodeta<1.375



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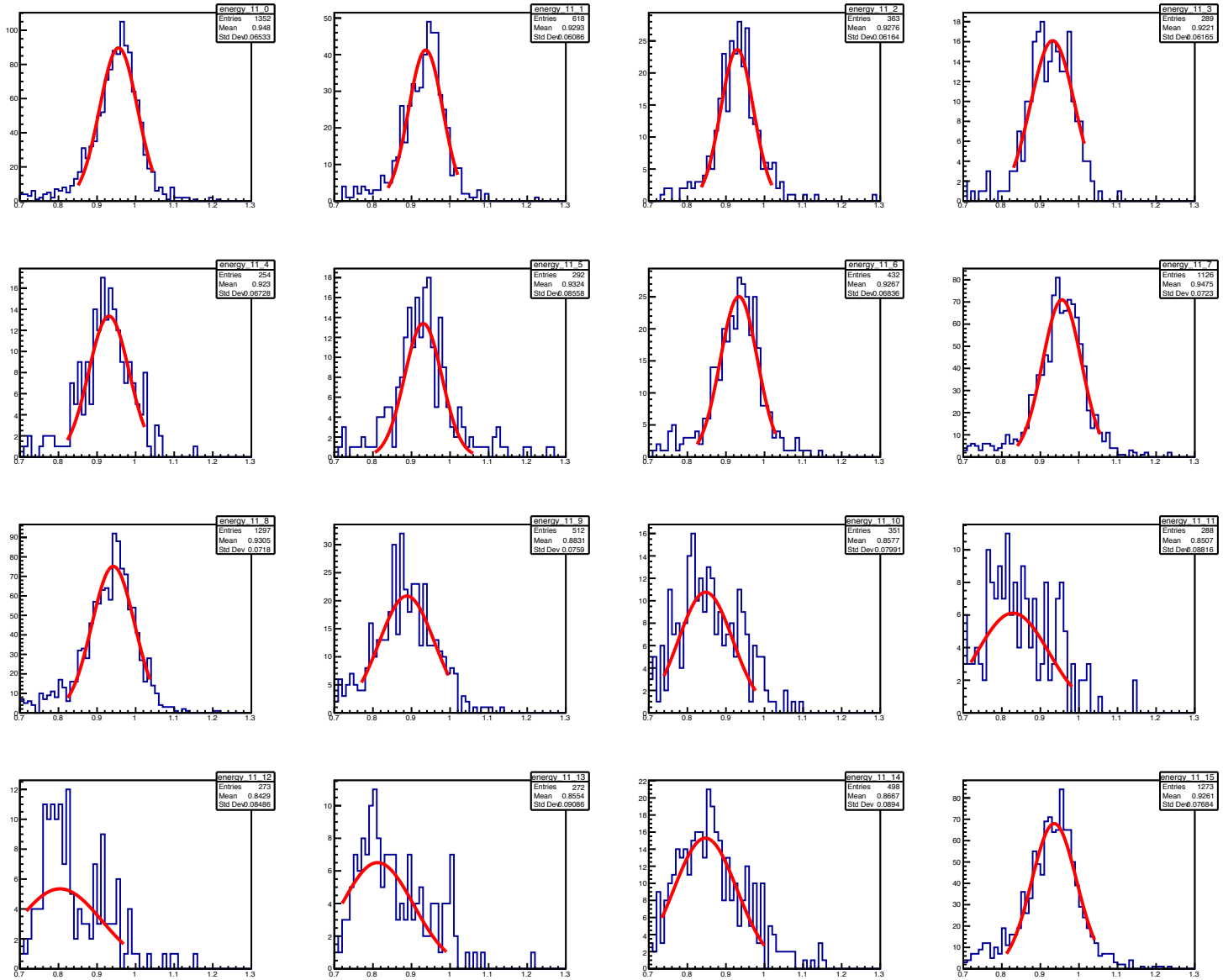

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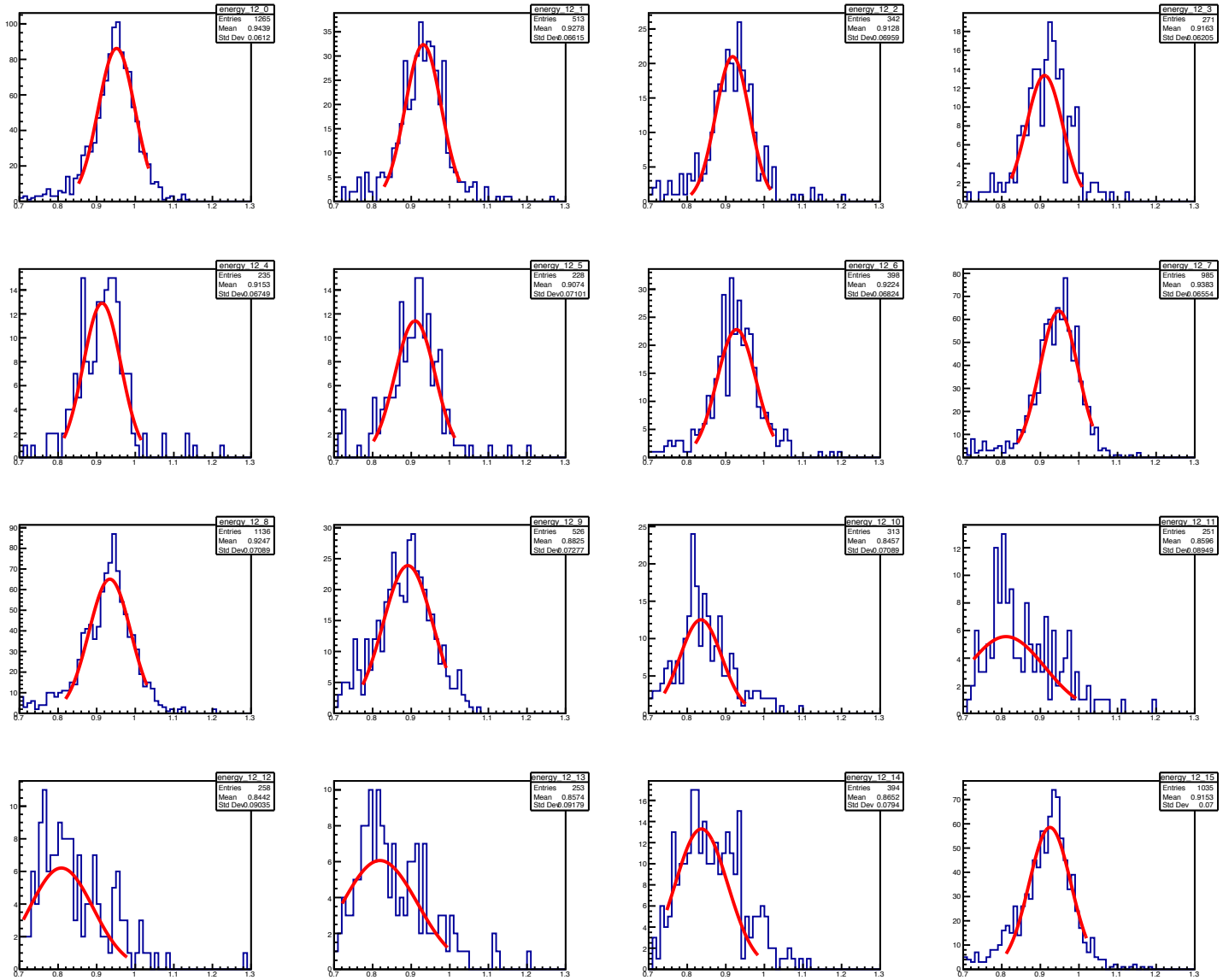

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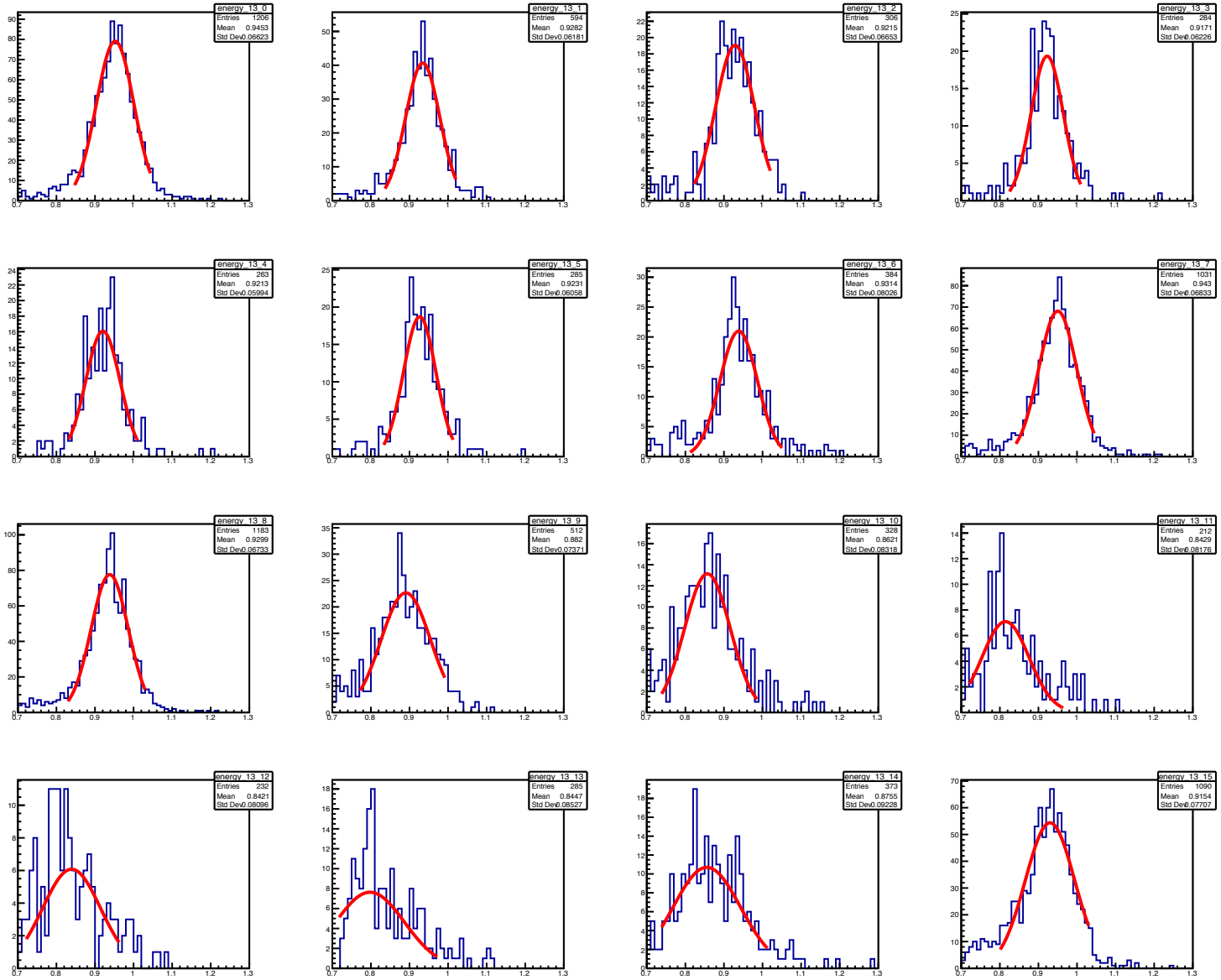

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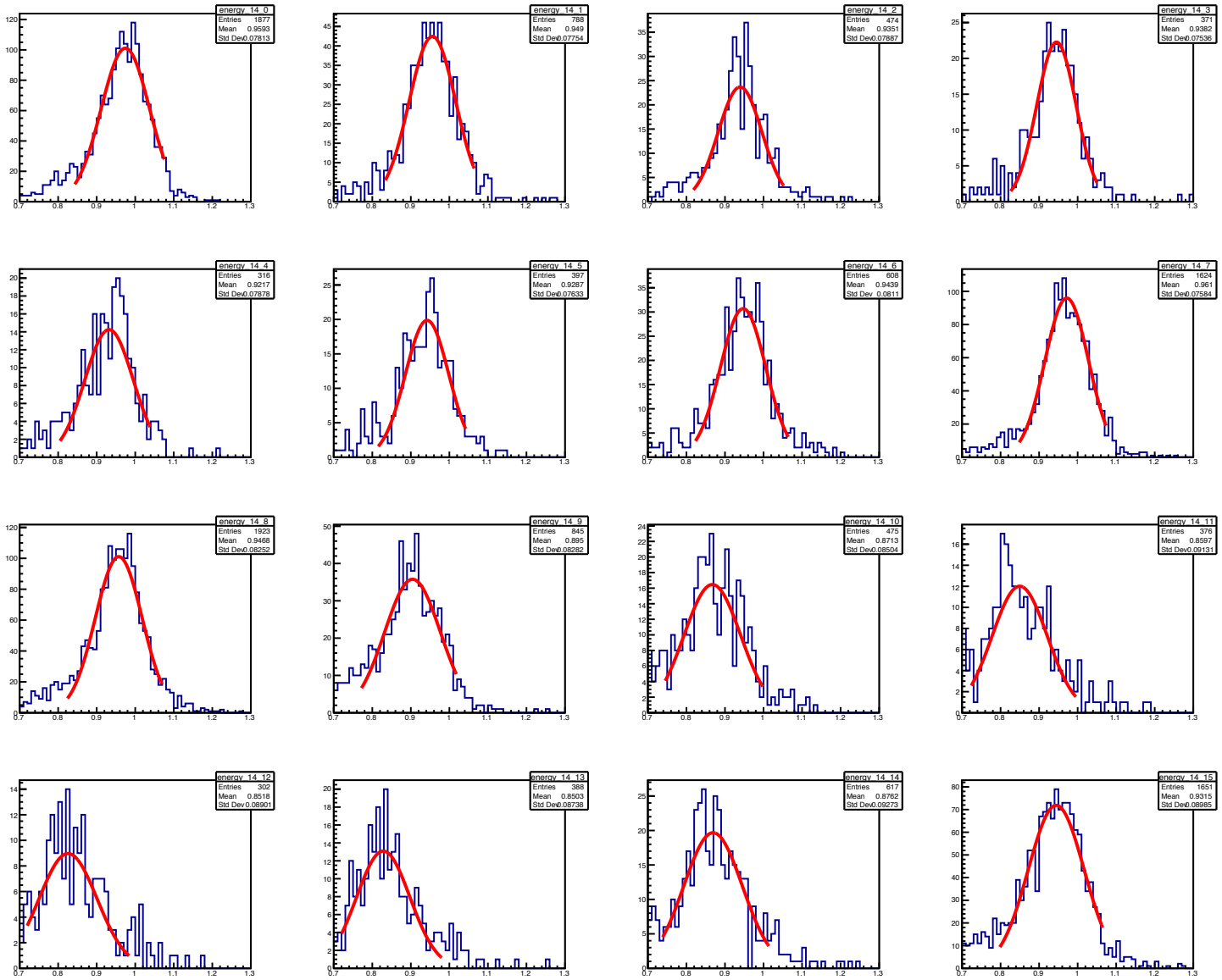
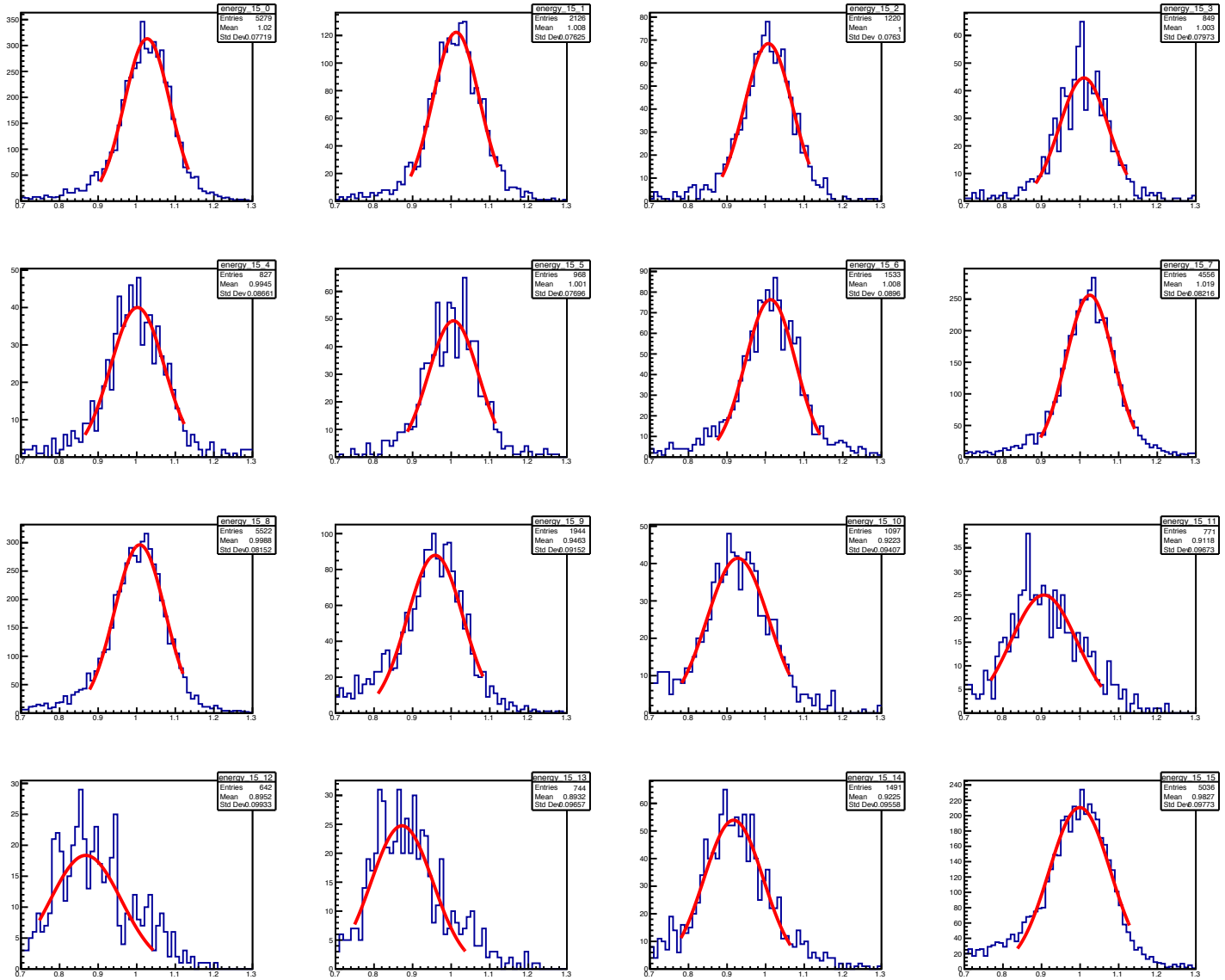
1.875<fmodeta<2