

Energy and theta corrections for EMC

- implementation into PandaROOT

Aleksandra Biegun

PANDA CM, GSI, 8-12 March 2010

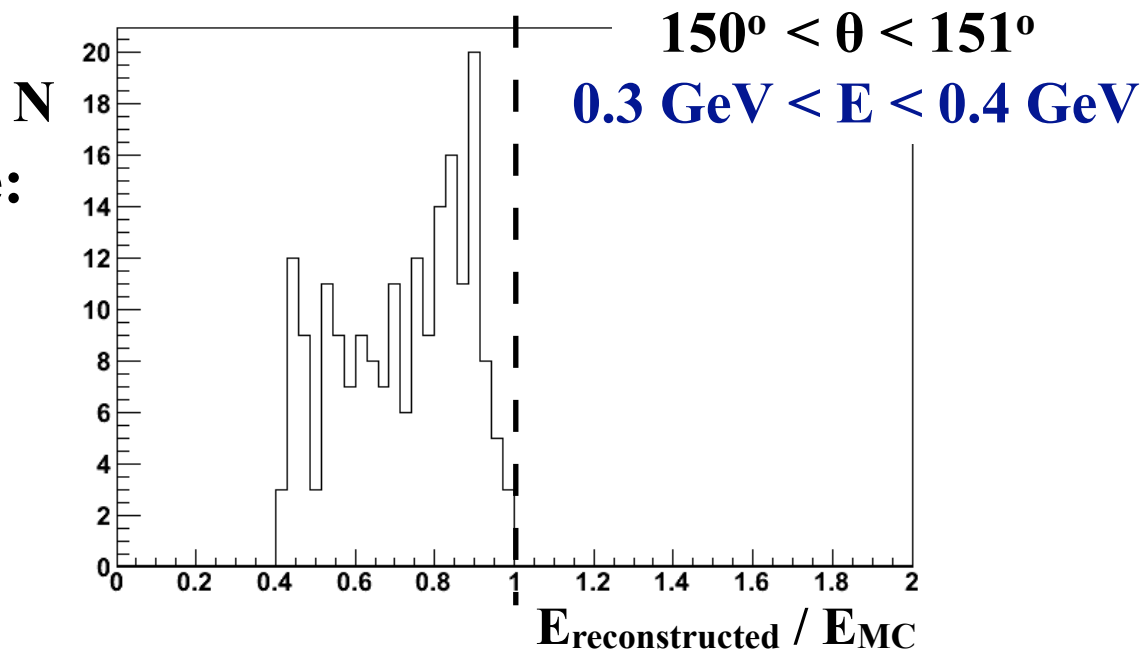


CM @ Juelich, September 2009

◎ Presently output from the code:

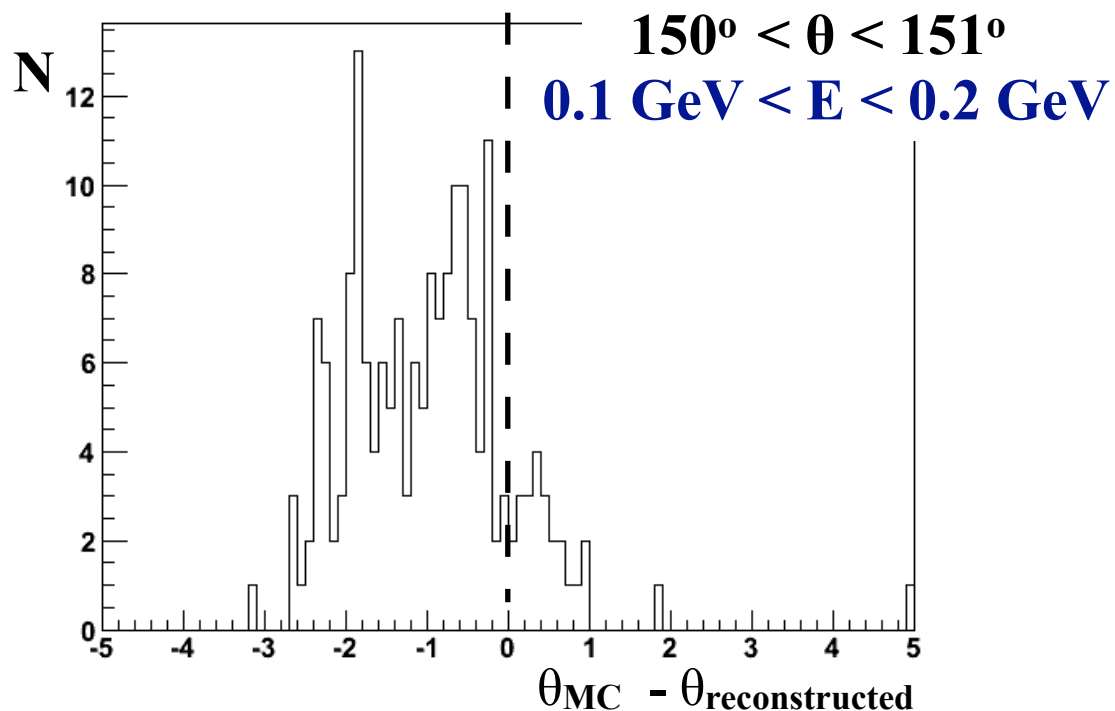
➔ Shift in **energy**

↳ *GetMean()*



➔ Shift in **theta**

↳ *GetMean()*

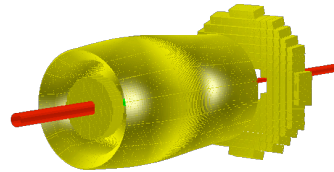


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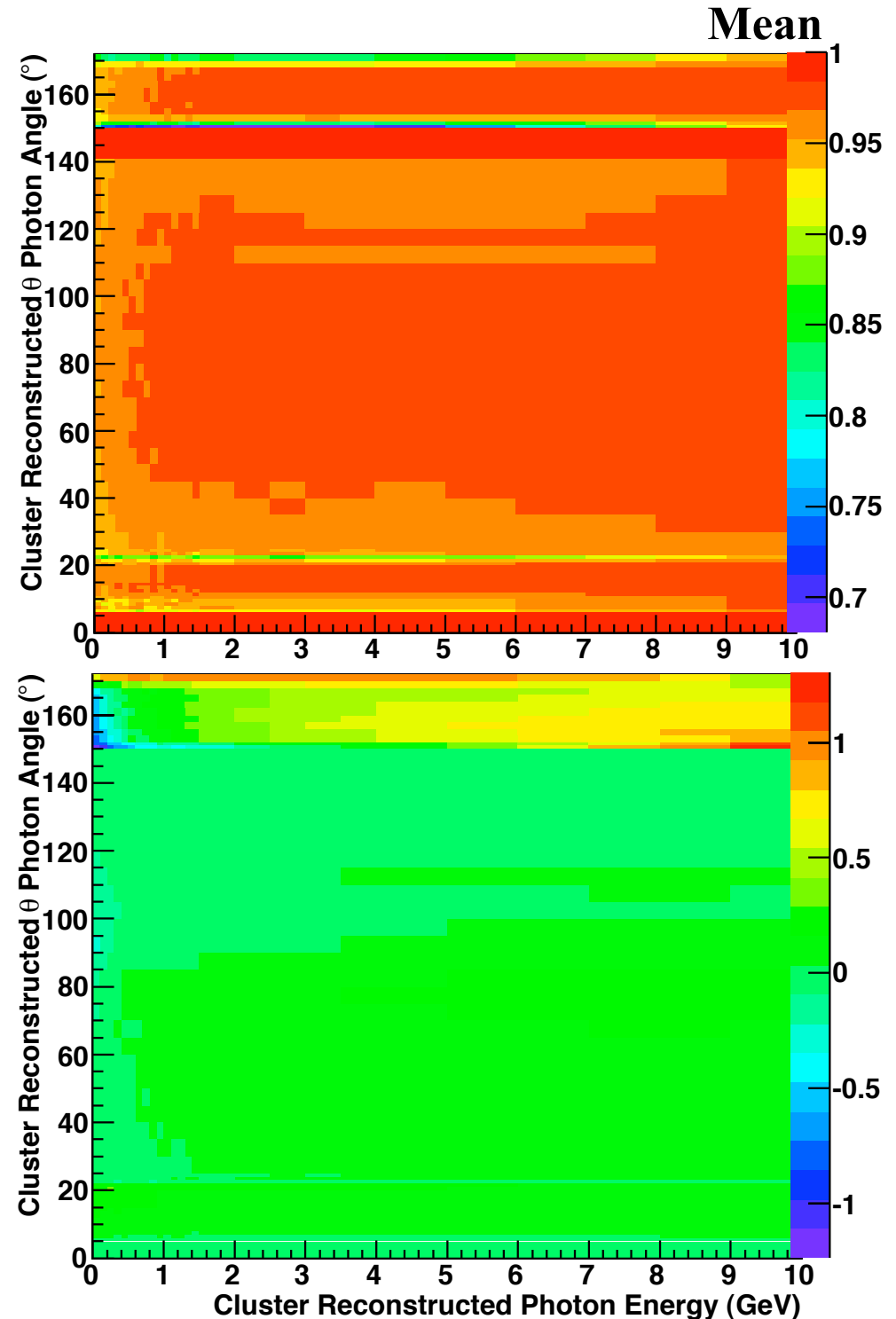
⊙ Presently output from the code:

➔ Shift in **energy**

Target EMC



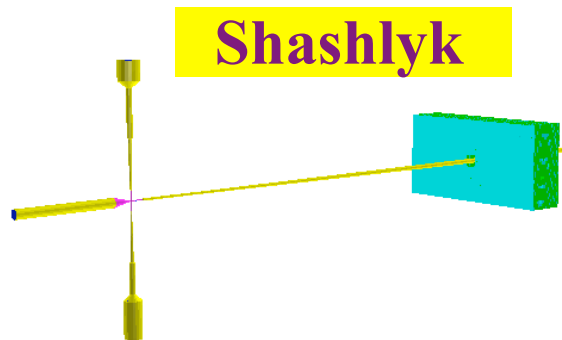
➔ Shift in **theta**



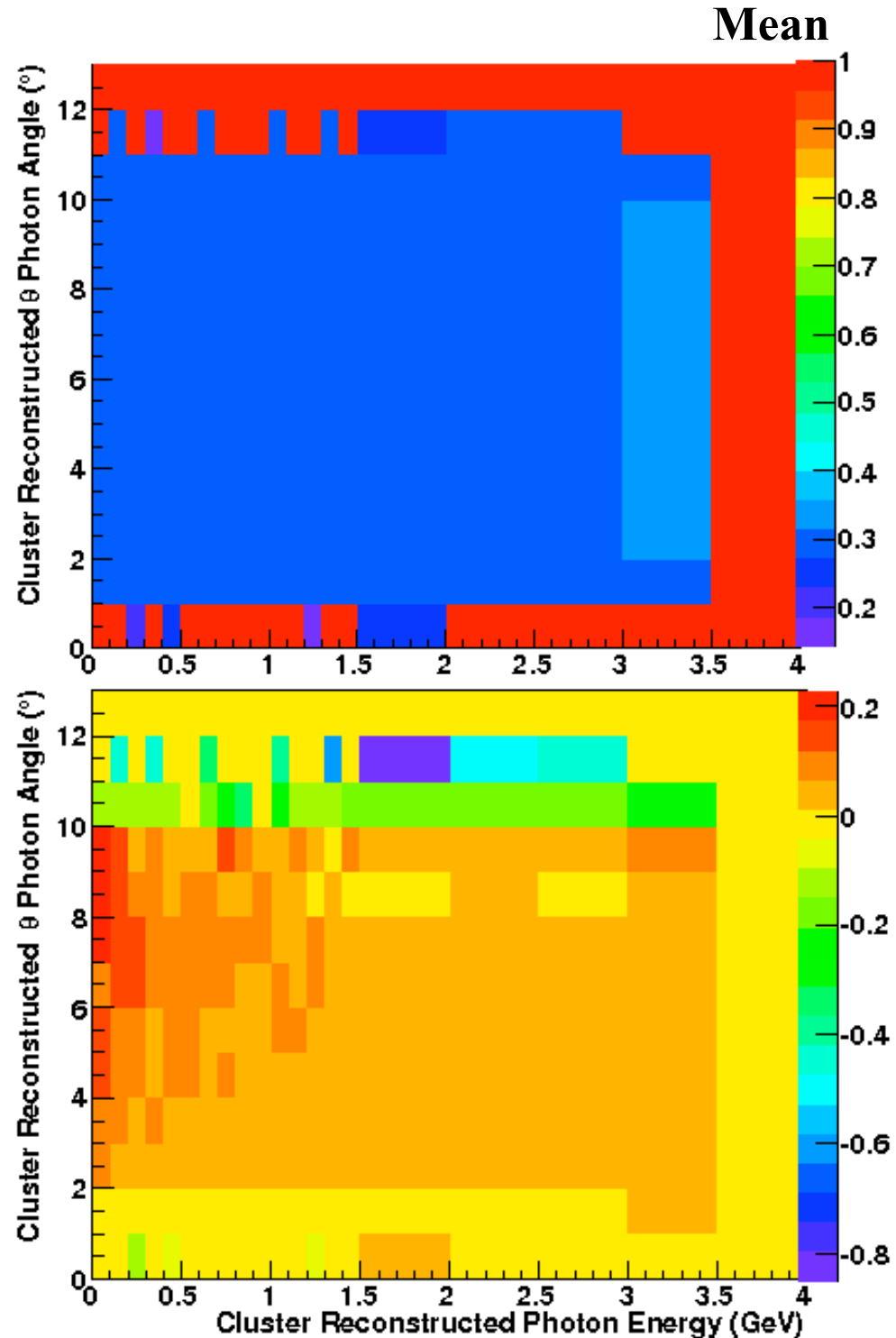
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⊙ Presently output from the code:

➔ Shift in **energy**



➔ Shift in **theta**



- ➔ **Corrections:**
- for **photons**
 - for **GEANT4**

Degrees of freedom

1. Particle (*photon, electron, pion, other*)
2. Transport model (*GEANT3, GEANT4*)
3. Energy
4. Theta

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 - for photons
 - for GEANT4

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2. Transport model (*GEANT3, GEANT4*)
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- ➔ Lookup tables (2-Dim histograms): ../trunk/macro/params/

[particle]_en_th_corr_[TransportModel].root

- gamma_en_th_corr_TGeant4.root
- electron_en_th_corr_TGeant4.root
- pion_en_th_corr_TGeant4.root
- other_en_th_corr_TGeant4.root

← * Copies of gamma's
 ← * Need to be done!
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- ➔ Each file contains 4 histograms:
 - Energy & θ corr. → Target EMC
 - Energy & θ corr. → Shashlyk

➔ **New classes:** *../trunk/emc/EmcCorr/*

PndEmcMakeCorr.cxx (*.h)
PndEmcCorrection.cxx (*.h)

➔ **Added to:** *../trunk/emc/*

CMakeList.cxx
EmcLinkDef.h

➔ `gamma_en_th_corr_TGeant4.root`

└─→ *GetMean()*

`PndEmcMakeCorr::Init()`

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`PndEmcMakeCorr::Init()`

➔ *Energy & Theta* from a cluster type

└─→ “EmcCluster” or “EmcBump”

`PndEmcMakeCorr::Exec()`

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└─→ `“EmcCluster”` or `“EmcBump”`

➔ *Bilinear interpolation - Interpolate the value based on the four nearest bin centers*

└─→ more precise, interpolated correction factors ΔE , $\Delta \theta$

$$E_{\text{corrected}} = E_{\text{reconstructed}} / \Delta E$$

$$\theta_{\text{corrected}} = \theta_{\text{reconstructed}} + \Delta \theta$$

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➔ `New TClonesArray()`

Module, EnCorr**Photon**, EnCorr**Electron**, EnCorr**Pion**, EnCorr**Other**,

ThCorr**Photon**, ThCorr**Electron**, ThCorr**Pion**, ThCorr**Other**,

EnCorrFactor**Photon**, EnCorrFactor**Electron**, EnCorrFactor**Pion**, EnCorrFactor**Other**,

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➔ **Added to:** `../trunk/emc/` `CMakeList.cxx`
`EmcLinkDef.h`

➔ **Task called in a macro:** `../trunk/macro/emc/` `emc_complete.C`

```
PndEmcMakeCorr* emcCorrection
= new PndEmcMakeCorr(verbose, storeclusterscorr, transportModel, "EmcBump");
fRun->AddTask(emcCorrection);
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* default setting,
 also "EmcCluster" can be used



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* the name appears
 in the *output.root* file

TreeViewer

File Edit Run Options Help

Command Option Histogram Hist Scan Rec

Current Folder

- TreeList
- cbmsim

Current Tree : cbmsim

MCTrack.fStartT	EmcCluster.fEnergyValid	EmcRecoHit.fEnergy	EventHeader.TM
MCTrack.fPoints	EmcCluster.fEnergy	EmcRecoHit.fEnergyCorrected	EventHeader.TM
EmcPoint	EmcCluster.fWhereValid	EmcRecoHit.fPosition.fX	EventHeader.TM
EmcPoint.fTrackID	EmcCluster.fWhere	EmcRecoHit.fPosition.fY	EventHeader.TM
EmcPoint.fDetectorID	EmcHeader	EmcRecoHit.fPosition.fZ	EventHeader.fR
EmcPoint.fX	EmcHeader.fPx	EmcBumpCorr	MCEventHeader
EmcPoint.fY	EmcHeader.fPy	EmcBumpCorr.fChosenModule	MCEventHeader
EmcPoint.fZ	EmcHeader.fPz	EmcBumpCorr.fEnergyCorrPhoton	MCEventHeader
EmcPoint.fPx	EmcHeader.fHitEnergy	EmcBumpCorr.fEnergyCorrElectron	MCEventHeader
EmcPoint.fPy	EmcHeader.fCluEnergy	EmcBumpCorr.fEnergyCorrPion	MCEventHeader
EmcPoint.fPz	EmcHeader.nHitMult	EmcBumpCorr.fEnergyCorrOther	MCEventHeader
EmcPoint.fTime	EmcHeader.nDigiMult	EmcBumpCorr.fThetaCorrPhoton	MCEventHeader
EmcPoint.fLength	EmcHeader.nCluMult	EmcBumpCorr.fThetaCorrElectron	MCEventHeader
EmcPoint.fELoss	EmcBump	EmcBumpCorr.fThetaCorrPion	MCEventHeader
EmcPoint.fEventID	EmcBump.fNbumps	EmcBumpCorr.fThetaCorrOther	MCEventHeader
EmcPoint.nModule	EmcBump.fLocalMaxList	EmcBumpCorr.fEnCorrFactorPhoton	MCEventHeader
EmcPoint.nRow	EmcBump.fDigiList	EmcBumpCorr.fEnCorrFactorElectron	MCEventHeader
EmcPoint.nCrystal	EmcBump.fMcList	EmcBumpCorr.fEnCorrFactorPion	MCEventHeader
EmcPoint.nCopy	EmcBump.fEnergyValid	EmcBumpCorr.fEnCorrFactorOther	MCEventHeader
EmcCluster	EmcBump.fEnergy	EmcBumpCorr.fThCorrFactorPhoton	MCEventHeader
EmcCluster.fNbumps	EmcBump.fWhereValid	EmcBumpCorr.fThCorrFactorElectron	MCEventHeader
EmcCluster.fLocalMaxList	EmcBump.fWhere	EmcBumpCorr.fThCorrFactorPion	MCEventHeader
EmcCluster.fDigiList	EmcBump.fClusterIndex	EmcBumpCorr.fThCorrFactorOther	MCEventHeader
EmcCluster.fMcList	EmcRecoHit	EventHeader.	

SPIDER STOP

0%

IList OList Leaf : EmcBumpCorr.fChosenModule

RESET

“EmcBumpCorr”

File Edit Run Options

Command

Current Folder

TreeList

cbmsim

- EmcHeader.TFy
- EmcHeader.fPz
- EmcHeader.fHitEnergy
- EmcHeader.fCluEnergy
- EmcHeader.nHitMult
- EmcHeader.nDigiMult
- EmcHeader.nCluMult
- EmcBump
- EmcBump.fNbumps
- EmcBump.fLocalMaxList
- EmcBump.fDigiList
- EmcBump.fMcList
- EmcBump.fEnergyValid
- EmcBump.fEnergy
- EmcBump.fWhereValid
- EmcBump.fWhere
- EmcBump.fClusterIndex
- EmcRecoHit
- EmcBumpCorr.fChosenModule
- EmcBumpCorr.fEnergyCorrPhoton
- EmcBumpCorr.fEnergyCorrElectron
- EmcBumpCorr.fEnergyCorrPion
- EmcBumpCorr.fEnergyCorrOther
- EmcBumpCorr.fThetaCorrPhoton
- EmcBumpCorr.fThetaCorrElectron
- EmcBumpCorr.fThetaCorrPion
- EmcBumpCorr.fThetaCorrOther
- EmcBumpCorr.fEnCorrFactorPhoton
- EmcBumpCorr.fEnCorrFactorElectron
- EmcBumpCorr.fEnCorrFactorPion
- EmcBumpCorr.fEnCorrFactorOther
- EmcBumpCorr.fThCorrFactorPhoton
- EmcBumpCorr.fThCorrFactorElectron
- EmcBumpCorr.fThCorrFactorPion
- EmcBumpCorr.fThCorrFactorOther
- EventHeader.

SPIDER STOP

IList OList Leaf : EmcBumpCorr.fChosenModule

RESET

“EmcClusterCorr”

File Edit Run Options

Command

Current Folder

TreeList

cbmsim

SPIDER STOP

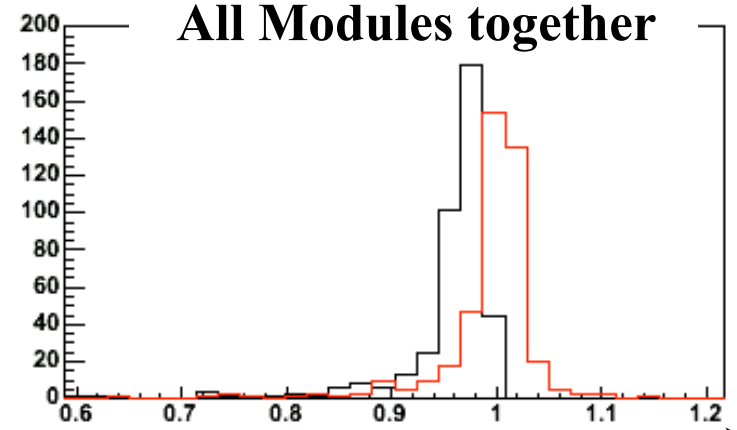
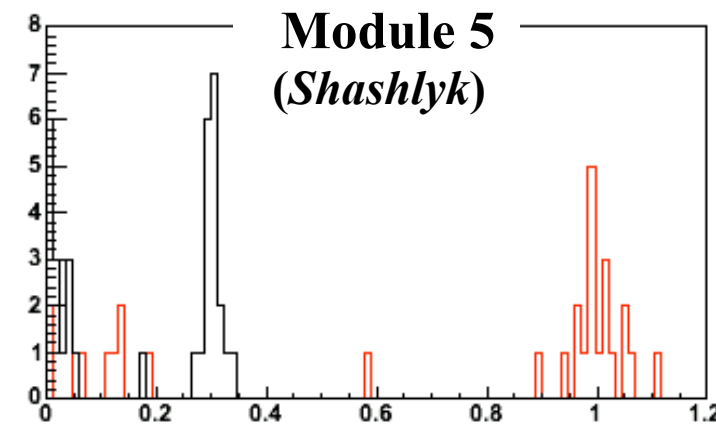
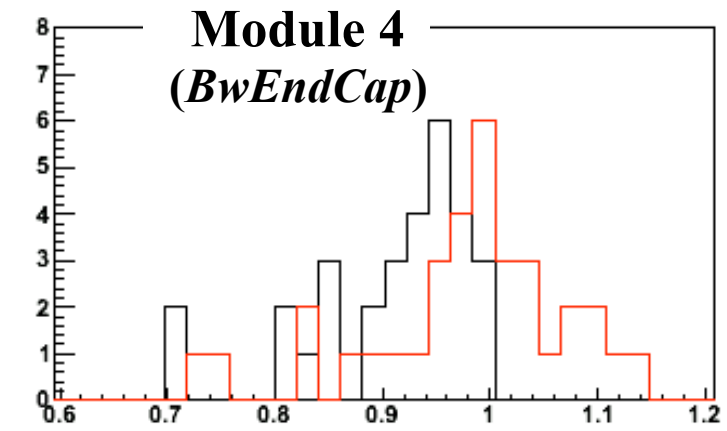
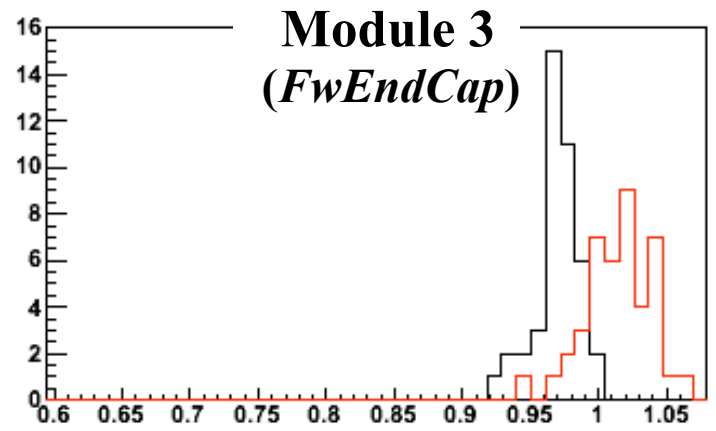
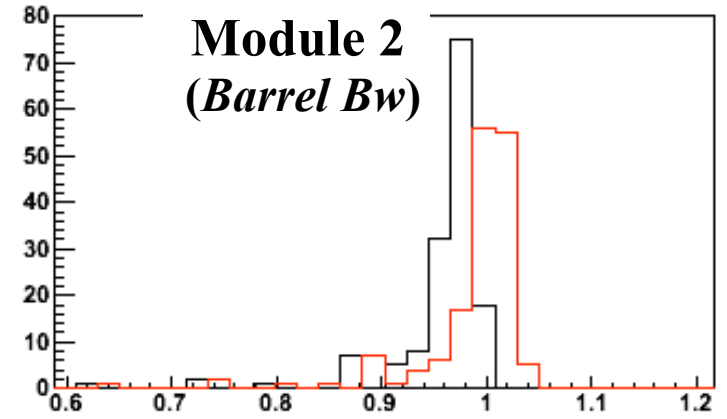
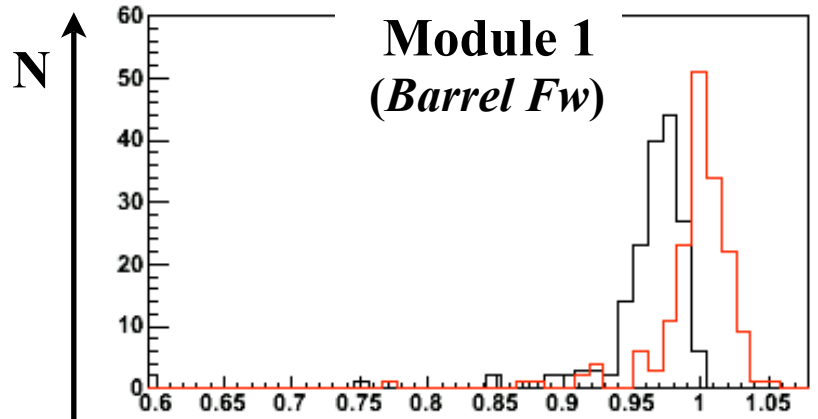
IList OList Leaf : EmcBumpCorr.fChosenModule

RESET

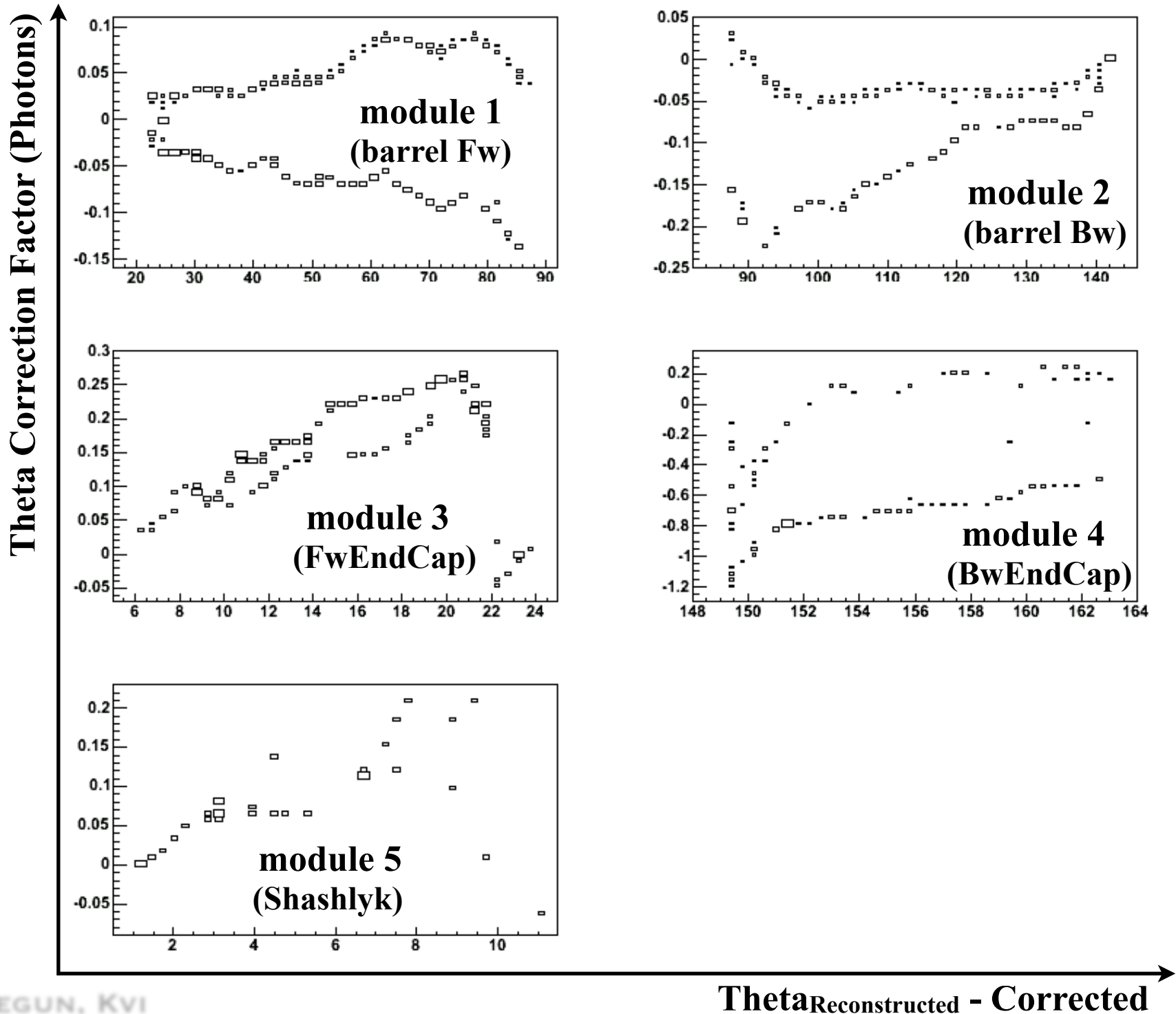
EmcCluster.fEnergyValid	EmcCluster Corr
EmcCluster.fEnergy	EmcCluster Corr.fChosenModule
EmcCluster.fWhereValid	EmcCluster Corr.fEnergyCorr Photon
EmcCluster.fWhere	EmcCluster Corr.fEnergyCorr Electron
EmcHeader	EmcCluster Corr.fEnergyCorr Pion
EmcHeader.fPx	EmcCluster Corr.fEnergyCorr Other
EmcHeader.fPy	EmcCluster Corr.fThetaCorr Photon
EmcHeader.fPz	EmcCluster Corr.fThetaCorr Electron
EmcHeader.fHitEnergy	EmcCluster Corr.fThetaCorr Pion
EmcHeader.fCluEnergy	EmcCluster Corr.fThetaCorr Other
EmcHeader.nHitMult	EmcCluster Corr.fEnCorr Factor Photon
EmcHeader.nDigiMult	EmcCluster Corr.fEnCorr Factor Electron
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EmcBump	EmcCluster Corr.fEnCorr Factor Other
EmcBump.fNbumps	EmcCluster Corr.fThCorr Factor Photon
EmcBump.fLocalMaxList	EmcCluster Corr.fThCorr Factor Electron
EmcBump.fDigiList	EmcCluster Corr.fThCorr Factor Pion
EmcBump.fMcList	EmcCluster Corr.fThCorr Factor Other

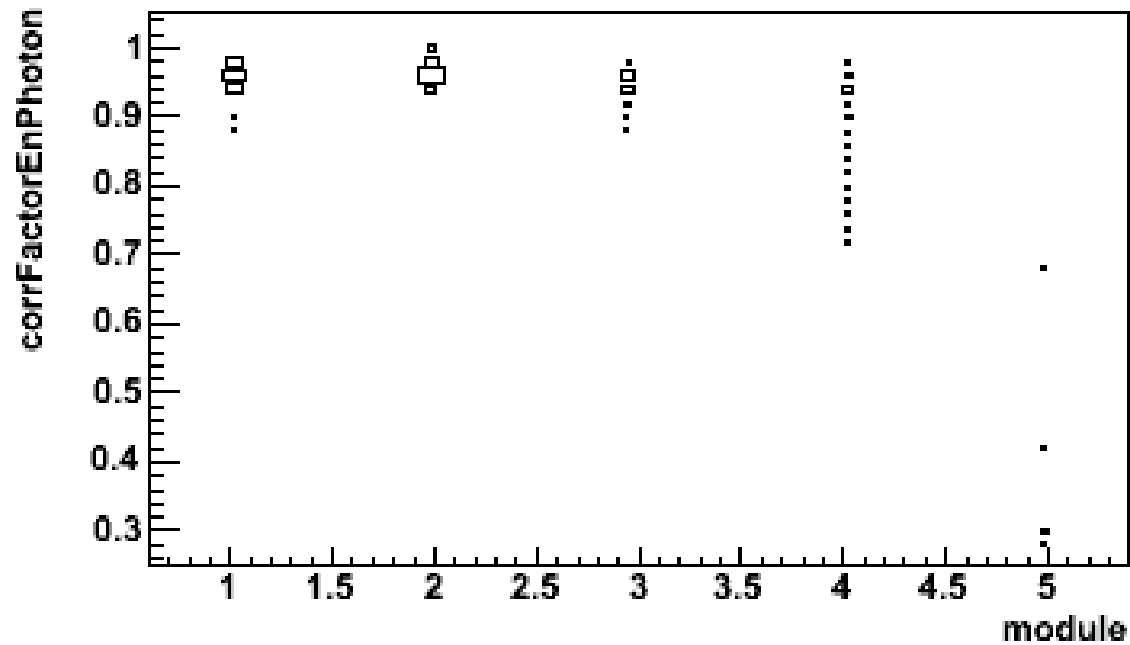
before
after

- * $E_{\text{Photons}} = 1 \text{ GeV}$
- * 100 events
- * GEANT4

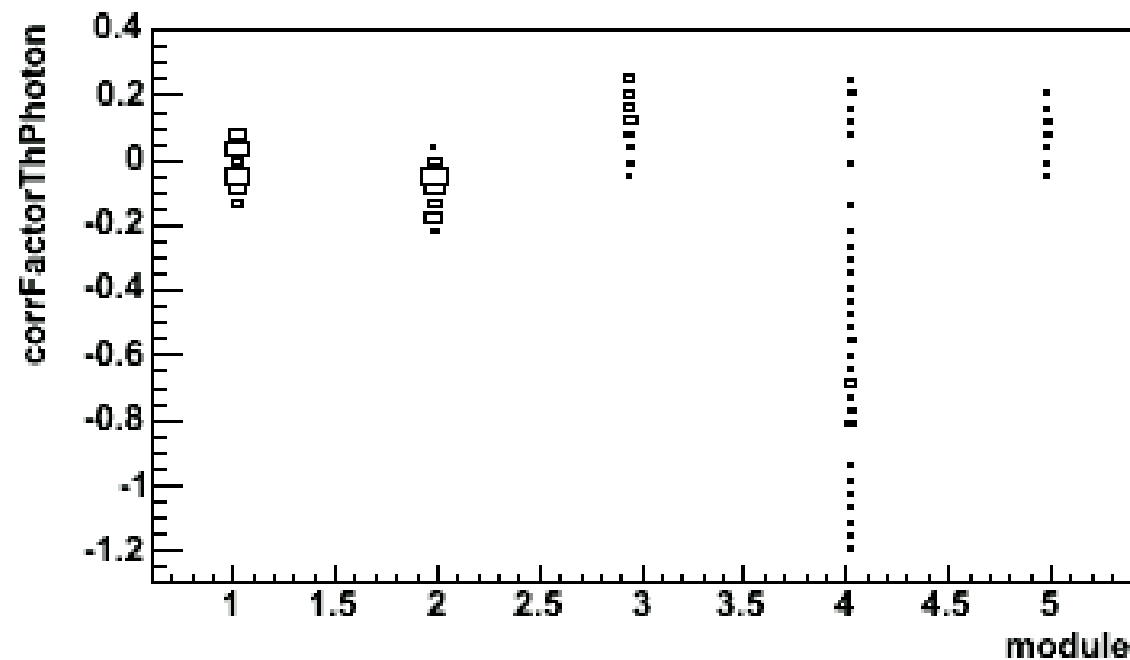


EnergyReconstructed

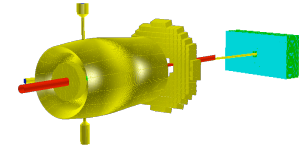




Energy



Theta



✓ The energy and theta correction maps:

- for full EMC
- photons
- GEANT4

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are implemented in the PandaROOT framework

✓ This is a separate task prepared for different particles and transport models

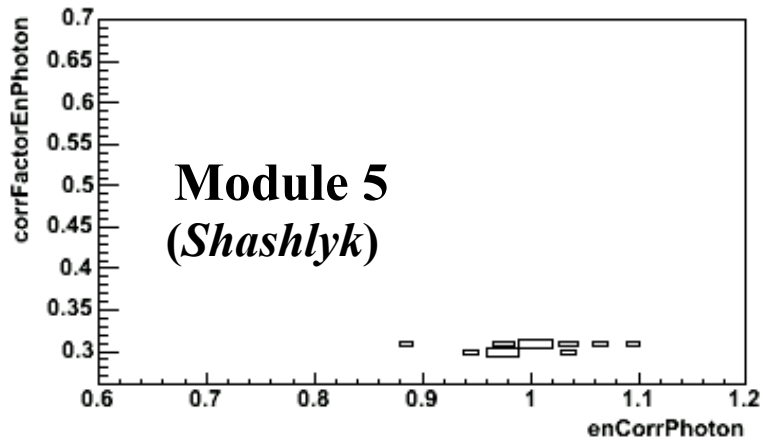
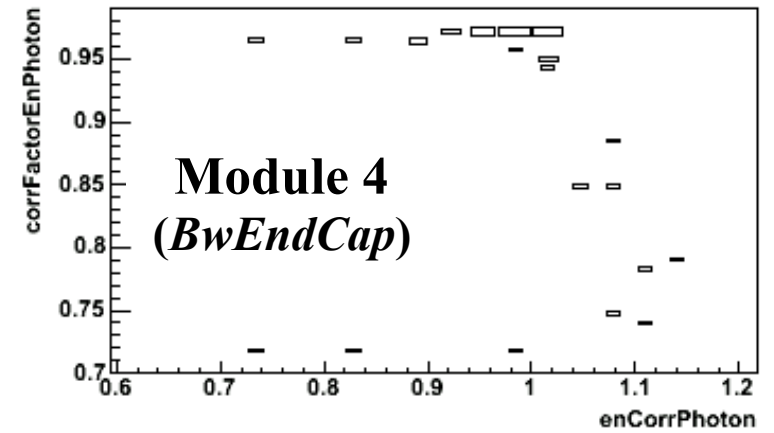
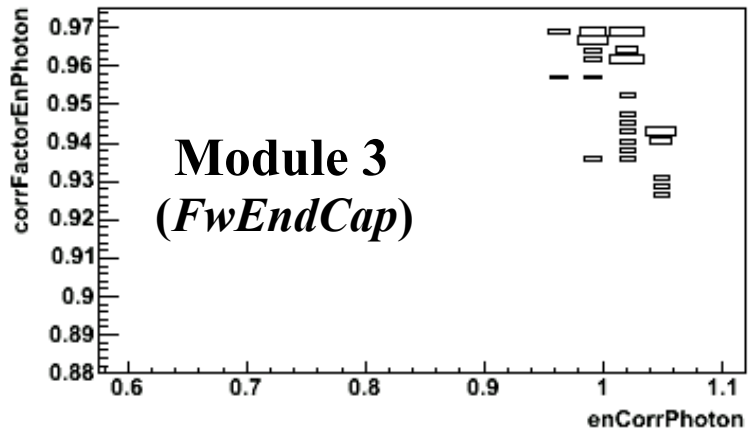
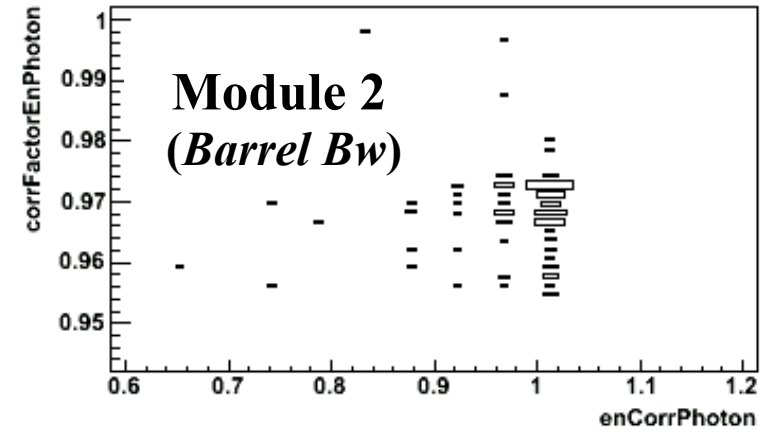
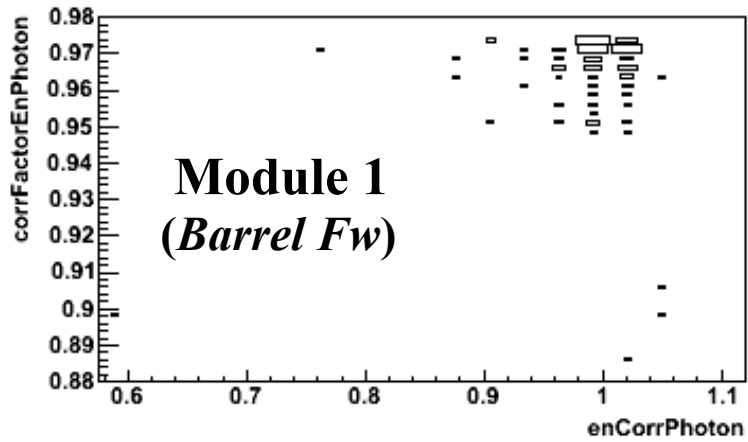
✓ The corrections have been applied to:

“EmcBump” (default) & “EmcCluster”

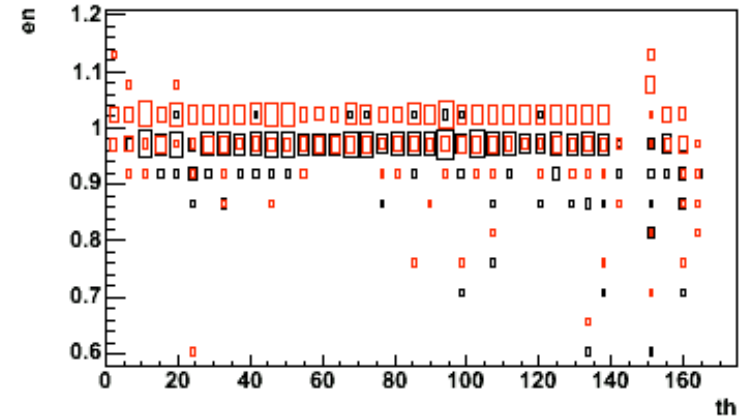
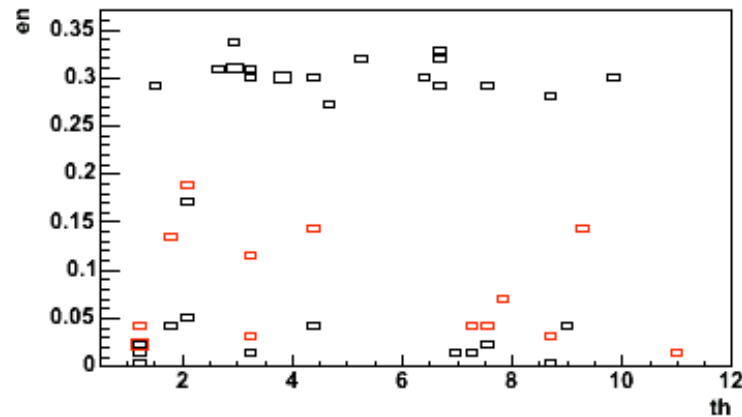
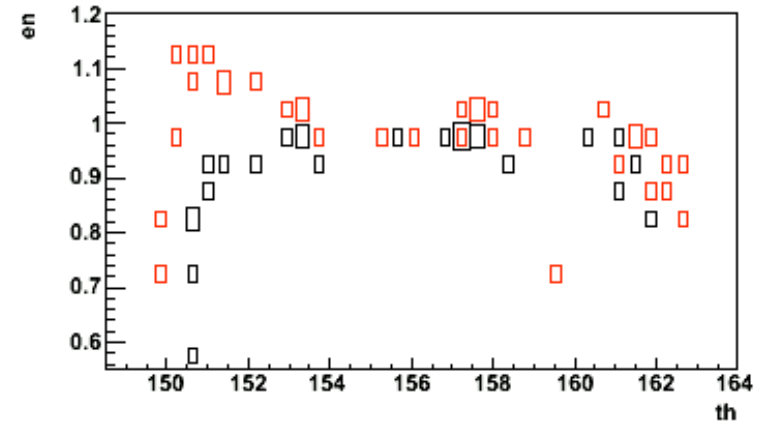
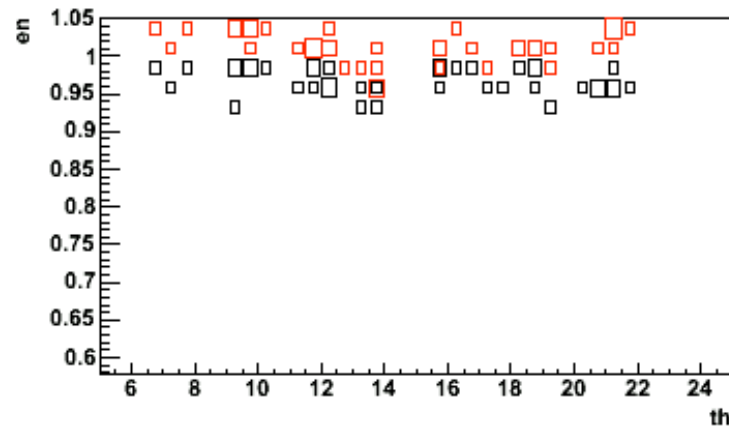
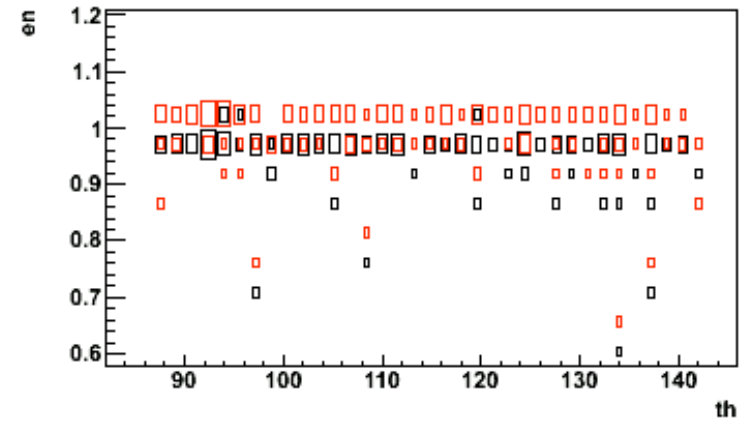
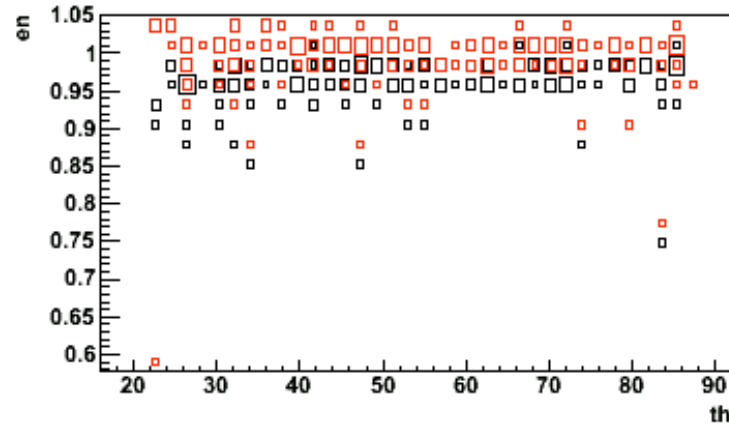
✓ The corrected values of energy & theta together with a correction factors (for different particles) are available in the new *TClonesArray()*

-
- Correction maps need to be done for other particles - e-, π , p and other transport model (GEANT3)

Backup slides



before
after



⦿ **Interpolation through bins (routine of ROOT) was used**

➔ **Interpolate the value via bilinear interpolation
based on the four nearest bin centers**

Bilinear interpolation is an extension of linear interpolation for interpolating functions of two variables on a regular grid. The key idea is to perform linear interpolation first in one direction, and then again in the other direction.

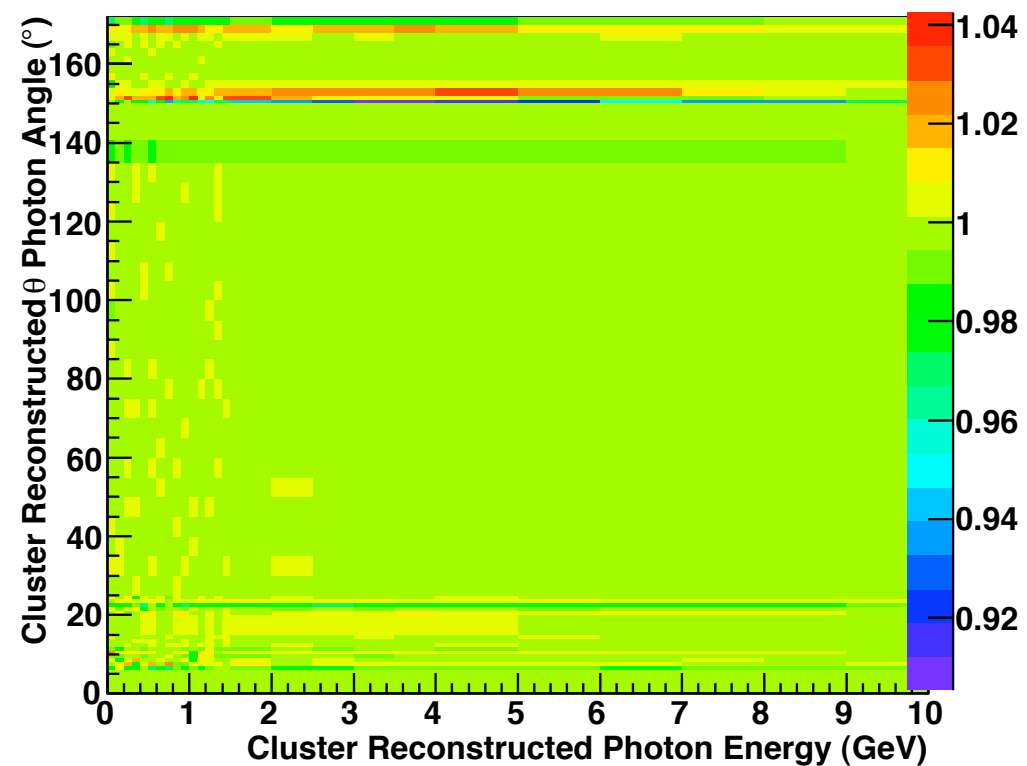
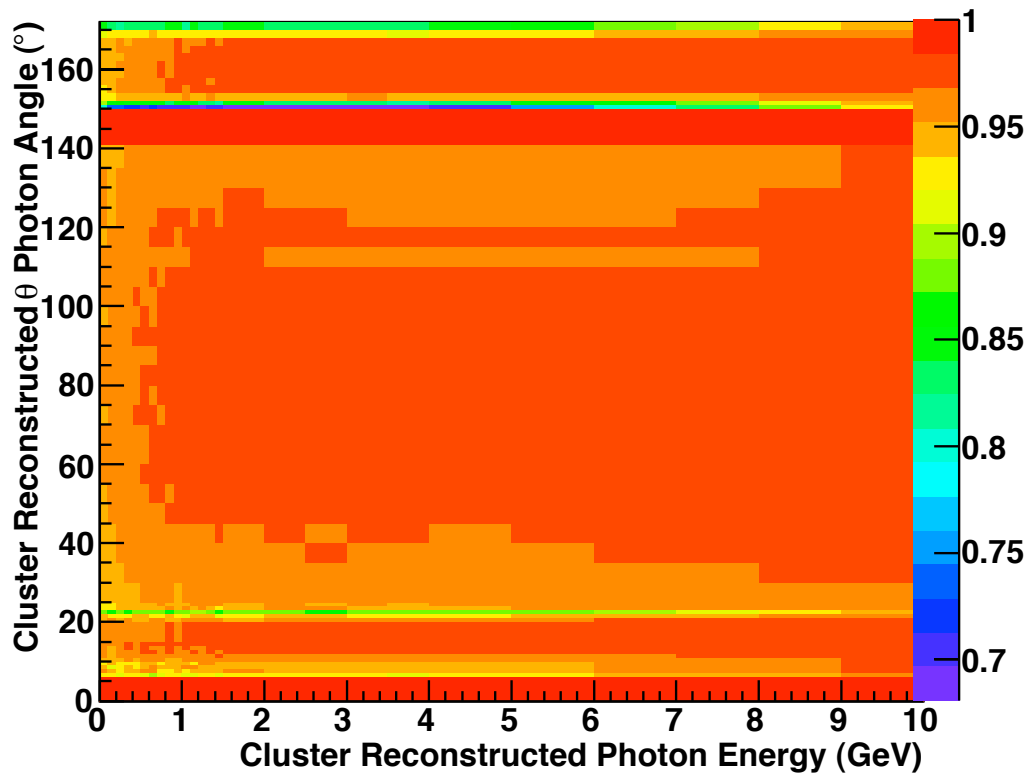
RESULT

• Before correction

✓ After correction

Mean

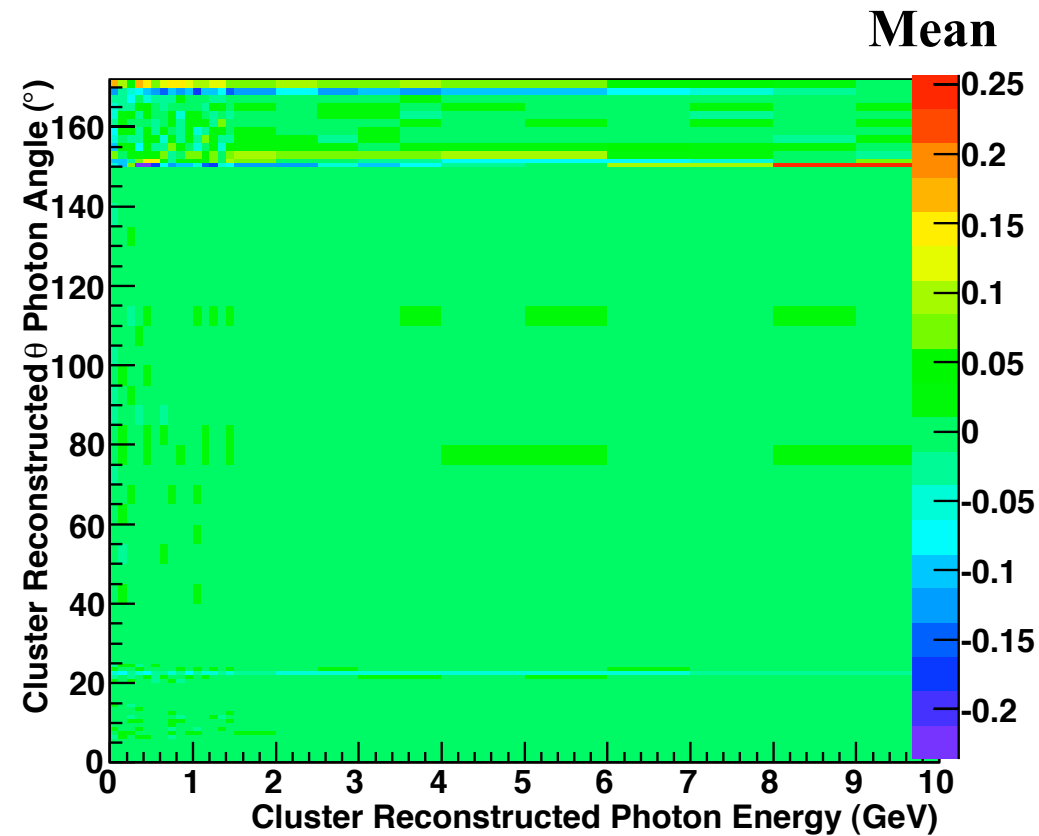
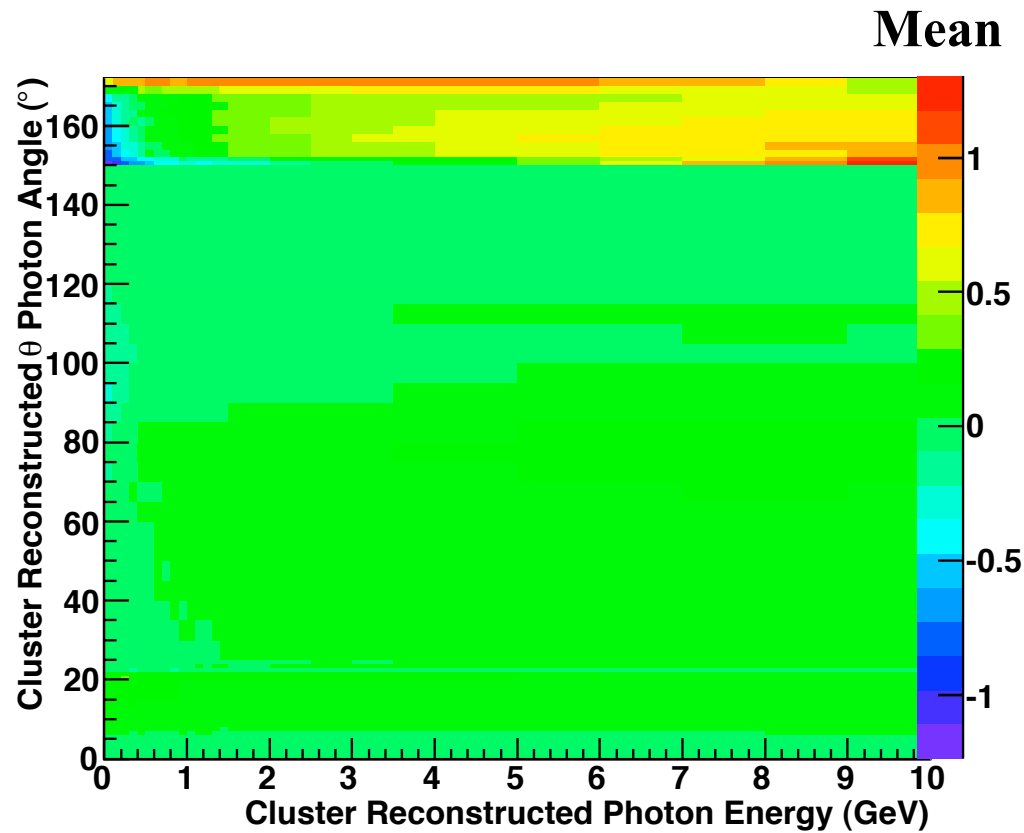
Mean



RESULT

• Before correction

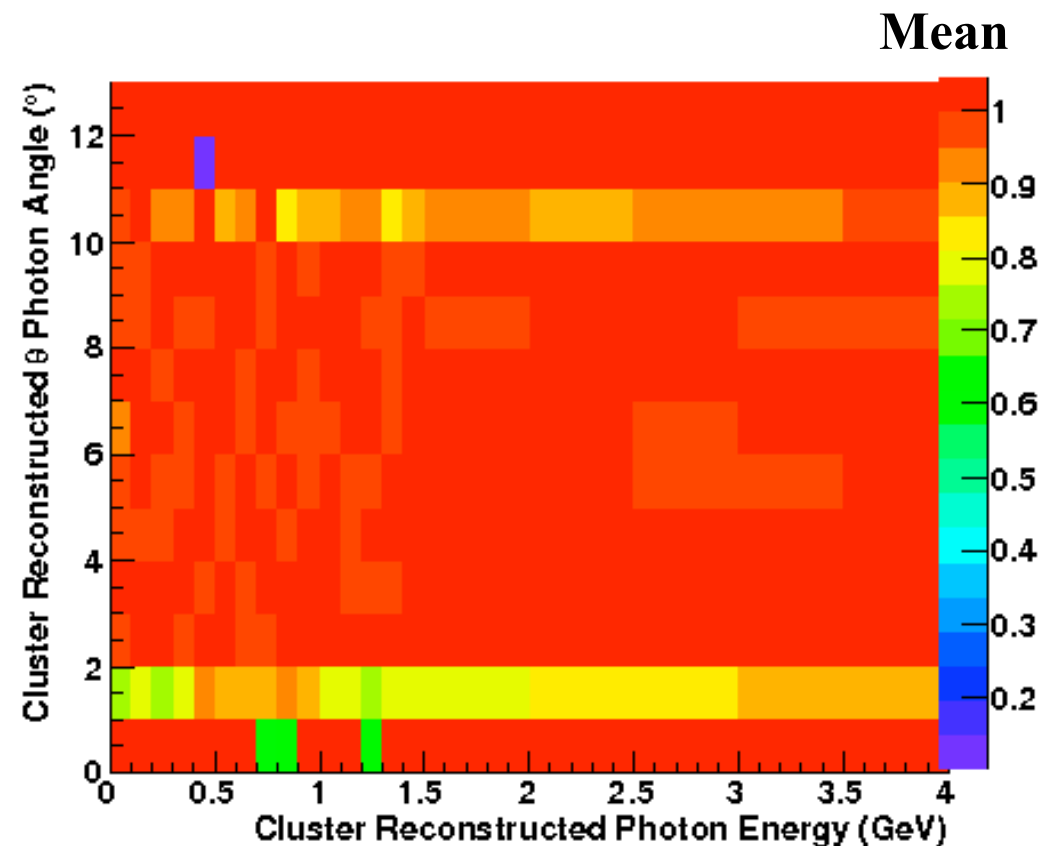
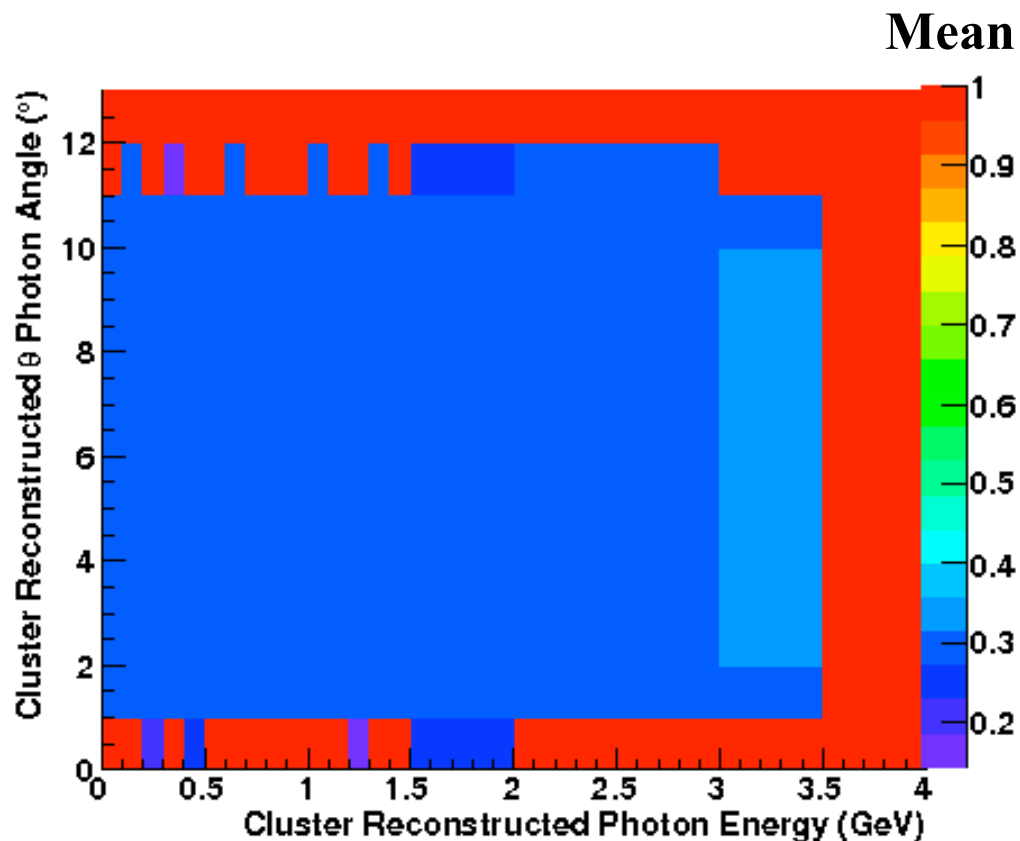
✓ After correction



RESULT

• Before correction

✓ After correction



RESULT

• Before correction

✓ After correction

