

HCAL Neutron Energy Calibration

New results

- **Summary**

- Recreated the HCAL digitization constant measurements
- Some questions arose:
 - Which method of calculating the digitization constant should I use
 - Should naming discrepancies in the steering macro be changed? Are the conversion factors used in the steering macro correct?
- **Also**, we should consider a group name to add to our plots to unify them!
 - Lastly, I submitted a poster abstract for the US muon conference for this august, so I hope we can determine a unifying group title by then!

Relevant particle collections

- **Generator level**

- MCParticle: true neutron energy, theta, etc.

- **Sim level**

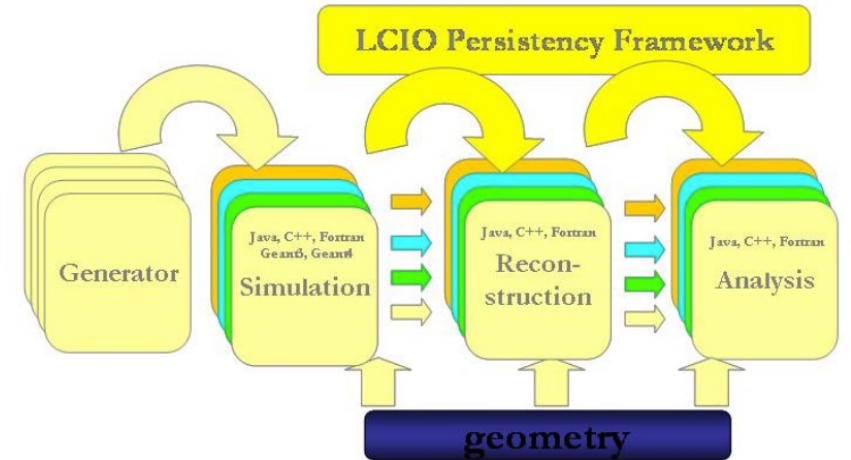
- “ECalBarrelCollection”, “ECalEndcpCollection”,
“HCalBarrelCollection”, “HCalEndcpCollection”

- **Digi level**

- “EcalBarrelCollectionDigi”, “EcalEndcpCollectionDigi”,
“HcalBarrelCollectionDigi”, “HcalEndcpCollectionDigi”

- **Reco level**

- “EcalBarrelCollectionRec”, “EcalEndcpCollectionRec”,
“HcalBarrelCollectionRec”, “HcalEndcpCollectionRec”



Strange change in capitalization from the steering macro

Digitization constant, k

- **Sim to Reco conversion**

- $\frac{Hit_{sim}}{calibration_{mip}} = Hit_{digi}$
- $Hit_{digi} * calibration_{mip-to-reco} = Hit_{reco}$
- $\frac{Hit_{sim}}{calibration_{mip}} * calibration_{mip-to-reco} = Hit_{reco}$
- $\frac{calibration_{mip-to-reco}}{calibration_{mip}} = k$

- **Calibrating k (for barrel or endcap)**

- $k_{guess} = \frac{calibration_{mip-to-reco}}{calibration_{mip}}$
- $k_{calc} = \frac{(E_{true} - \int ECALHit_{reco})}{\int HCALHit_{sim}}$
- $k_{calc,old} = \frac{(\int HCALHit_{reco} - \int ECALHit_{reco})}{\int HCALHit_{sim}}$

I don't think this works because this uses the calibration constant guess that we are trying to calculate, and k_calc could be negative here

Estimated HCAL energy divided by the total sim energy

This assumes that ECALHIT_reco/the ECAL calibration constants are accurate. Is this okay to do?

Should the HCAL and ECAL mip-to-reco calibration values be the same?

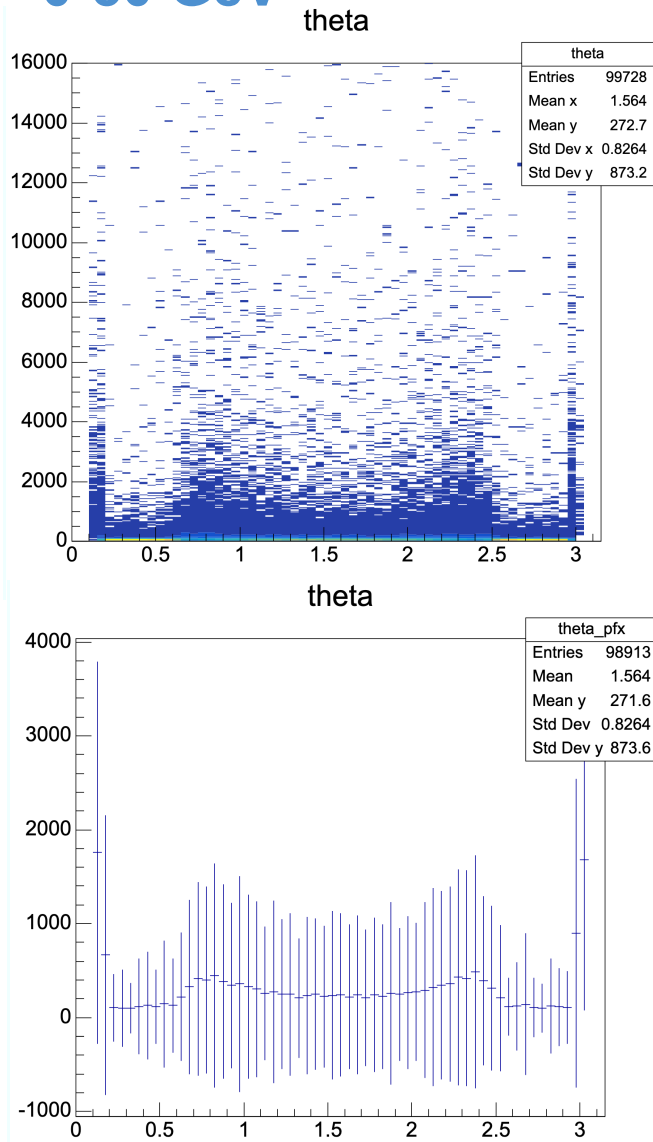
- **Calibration values used in current steering macro**

- $ECALcalibration_{mip} = 0.0001575$
- $ECALcalibration_{mip-to-reco} = 0.0064122$
- $k_{ECAL} = 40.71$
- $HCALcalibration_{mip} = 0.0004825$
- $HCALcalibration_{mip-to-reco} = 0.0231348$
- $k_{HCAL} = 47.95$

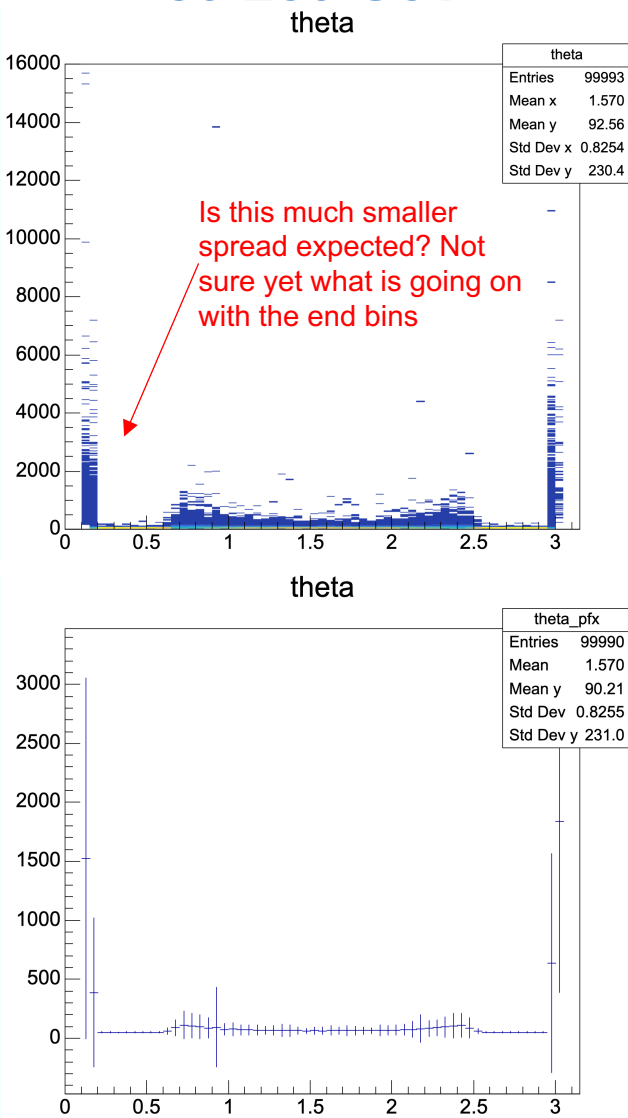
Initial Calibration Results

2D Histo
Profile
$$k_{calc} = \frac{(E_{true} - \int ECALHit_{reco})}{\int HCALHit_{sim}}$$

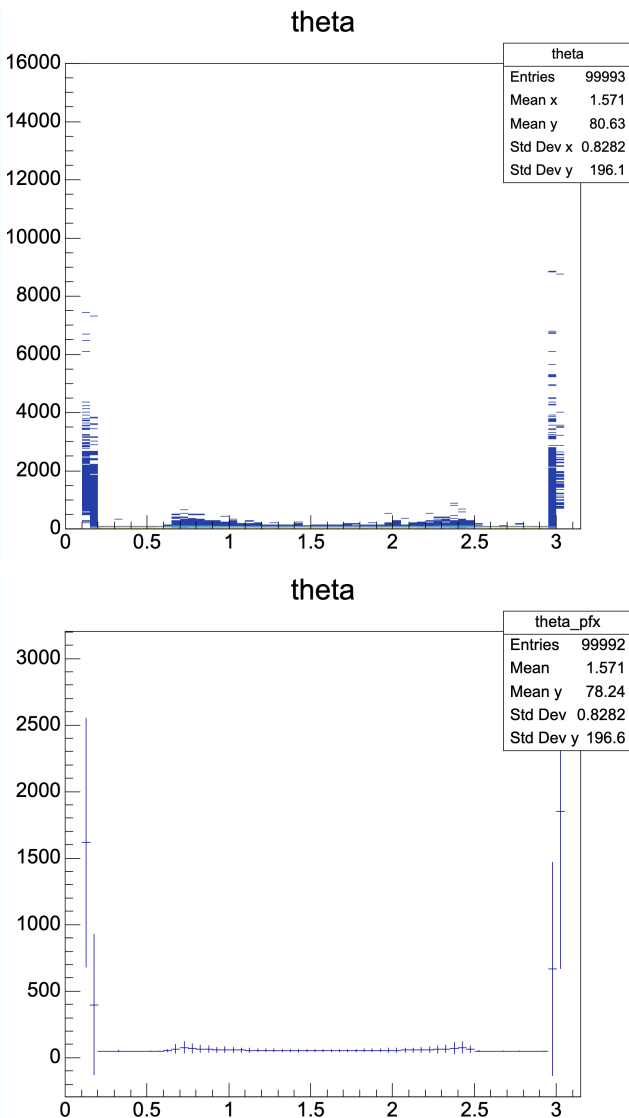
0-50 GeV



50-250 GeV



250-1000 GeV



Digitization constant measurement

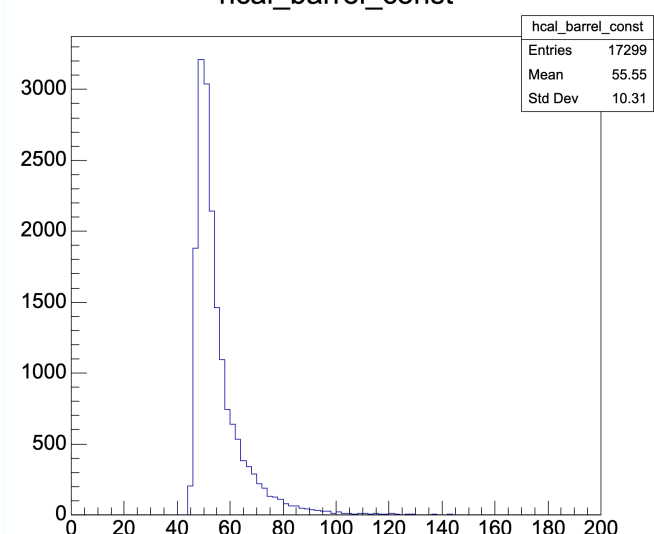
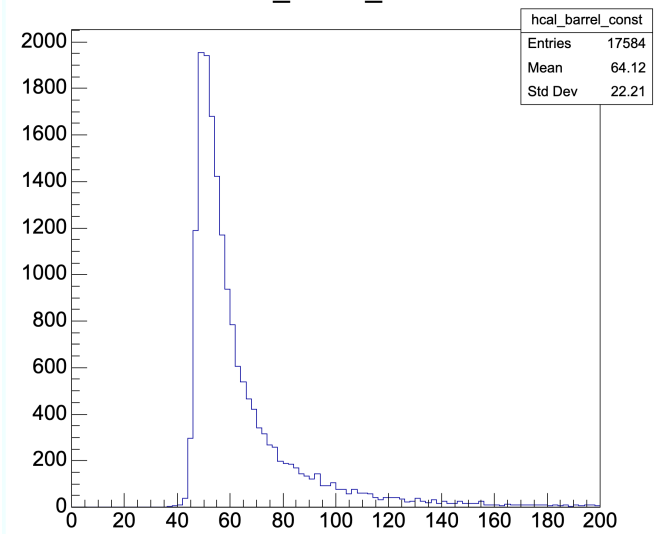
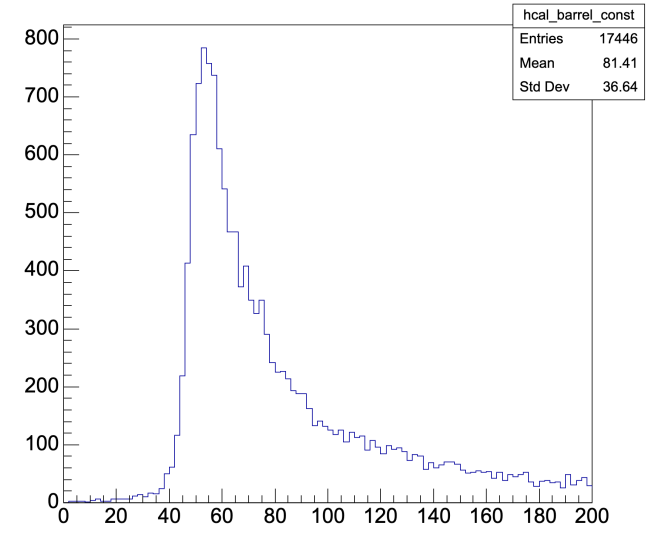
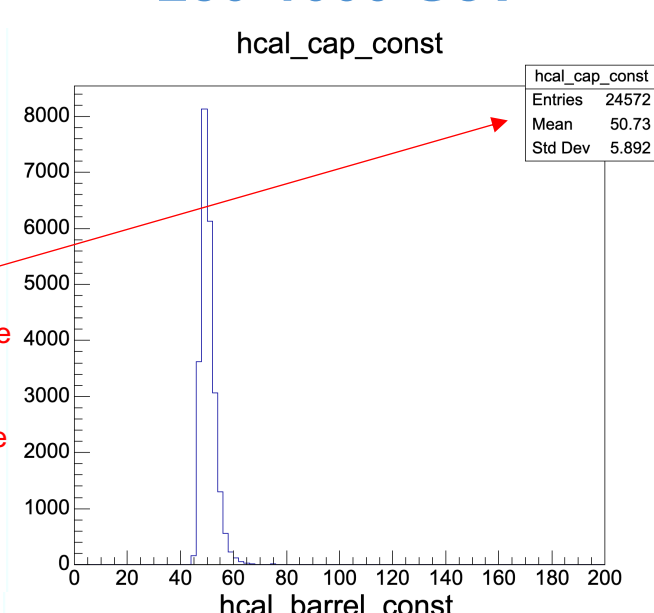
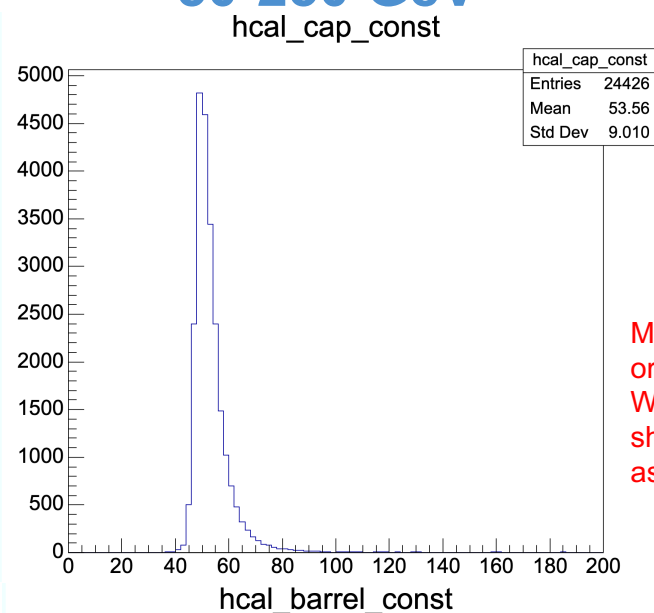
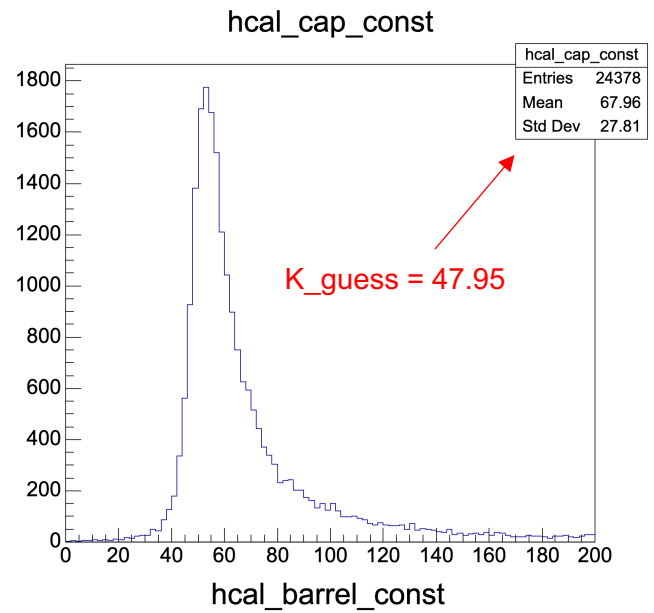
0-50 GeV

50-250 GeV

250-1000 GeV

Endcap
 $0.2 < \theta < 0.5$
 $2.6 < \theta < 3.0$

Barrel
 $1.25 < \theta < 1.75$



Next Steps

- **Next Goals**
 - Use the calculated digitization constant to create 2D calibration histograms in neutron energy and theta