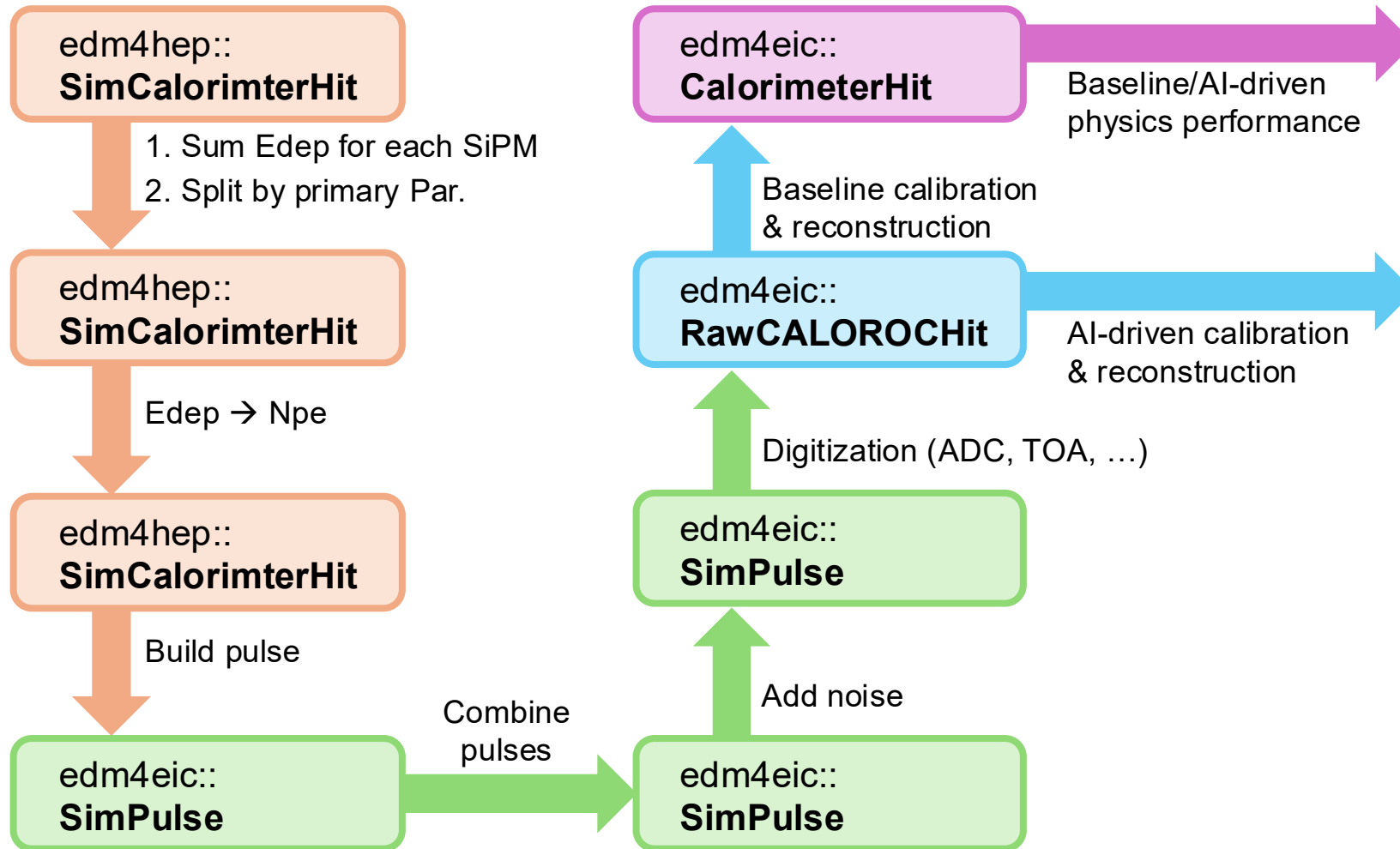


# Progress on baseline analysis of BIC performance.

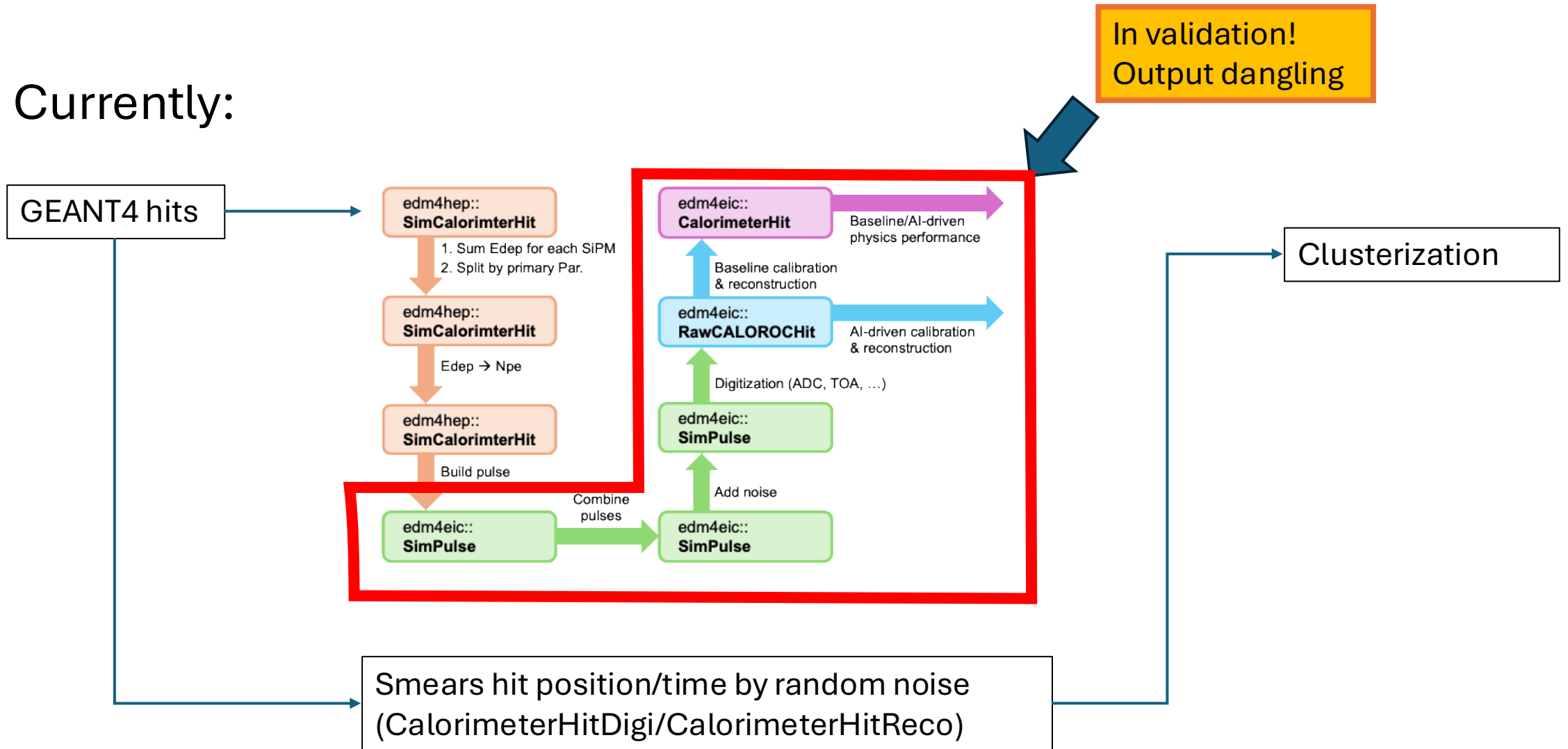
Chun Yuen Tsang  
Argonne National Laboratory

# BIC Simulation Chain (From Minho's talk)



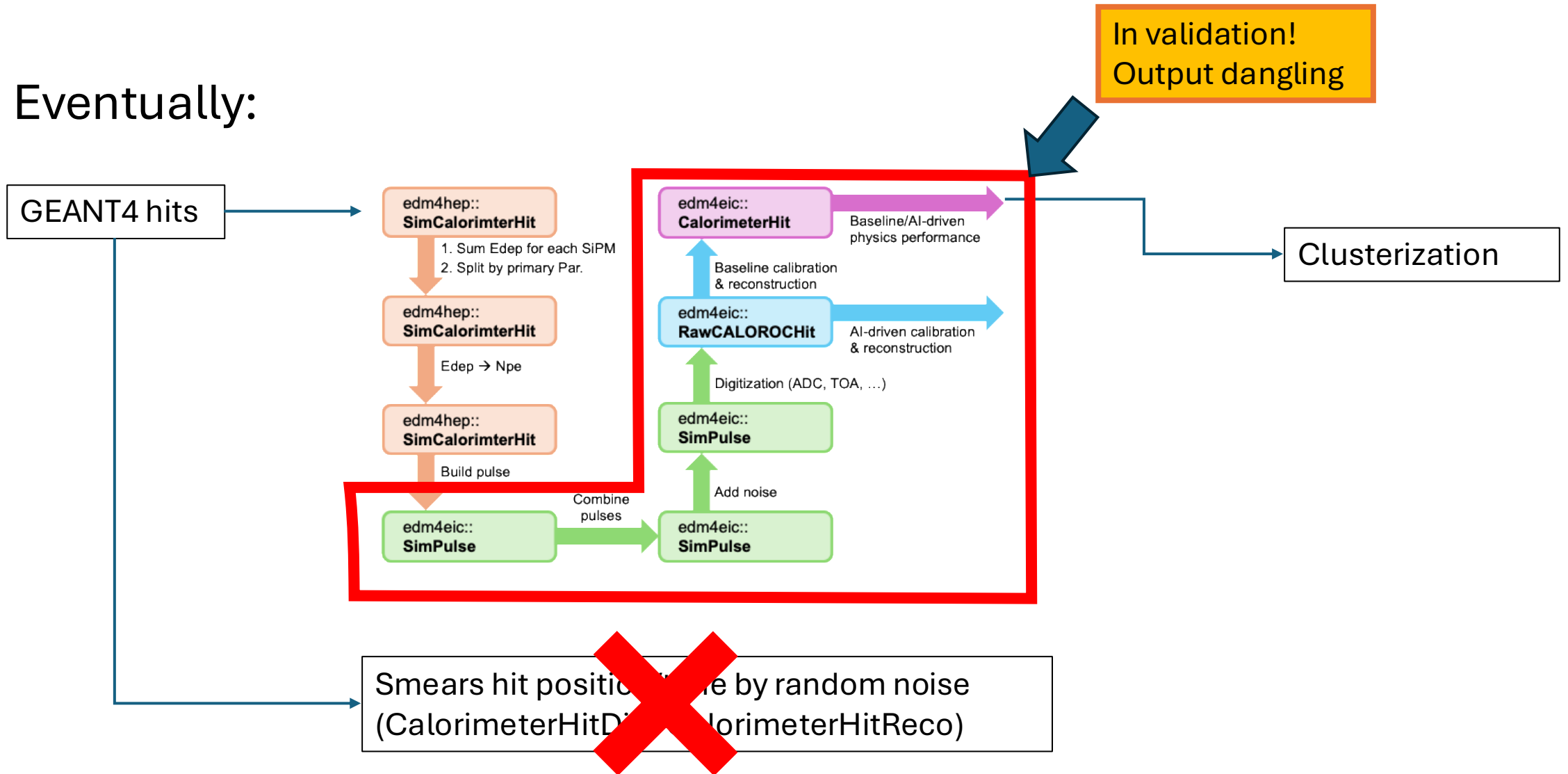
# Analysis routine (zoom out)

- Currently:



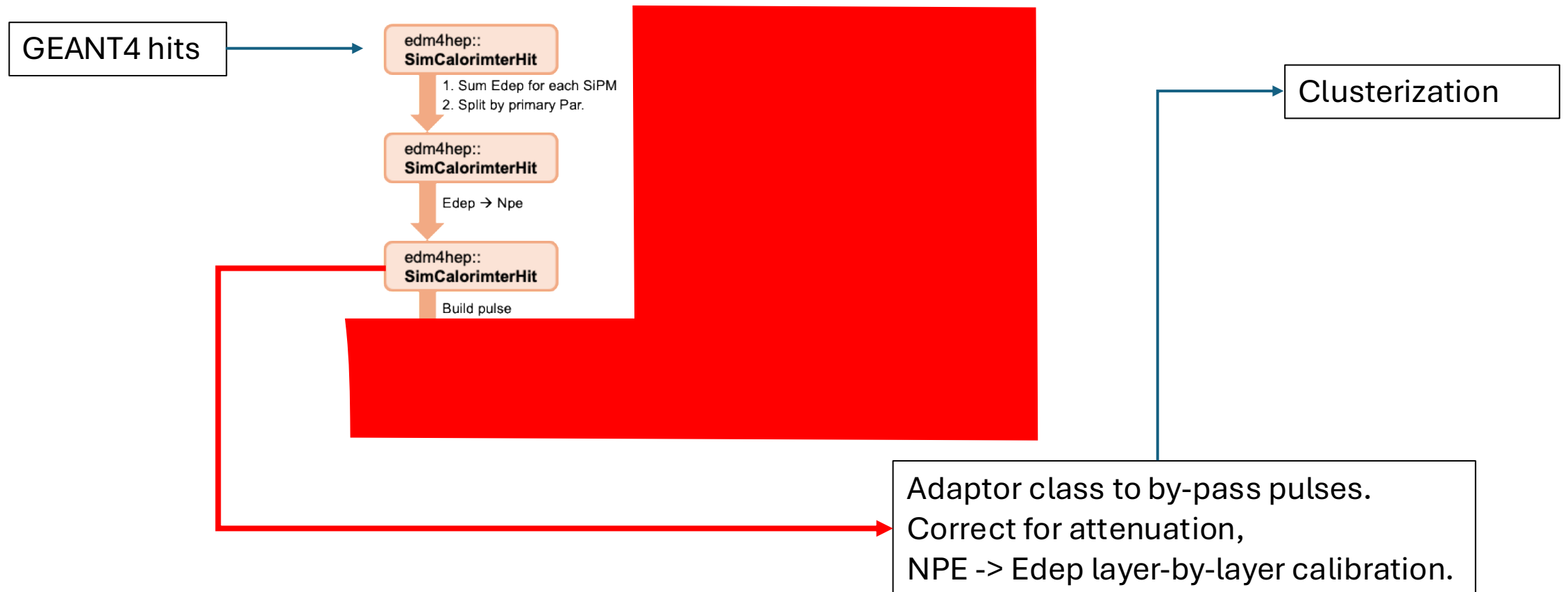
# Analysis routine (zoom out)

- Eventually:



# Analysis routine (zoom out)

- But now (make-shift solution for baseline study):



# Baseline performance study

- Gamma single track simulation.
- $1 < E < 20$  GeV.
- $80 < \theta < 100$  deg ( $-0.175 < \eta < 0.175$ ).
- $0 < \phi < 360$  deg.
- Uniformly distributed in E, theta and phi.

# ScFi performance

Default clusterization algorithm

# Default clusterization chain

```
app->Add(new J0mniFactoryGeneratorT<CalorimeterIslandCluster_factory>(
    "EcalBarrelScFiProtoClusters", {"EcalBarrelScFiRecHits"}, {"EcalBarrelScFiProtoClusters"},
    {
        .adjacencyMatrix{},
        .peakNeighbourhoodMatrix{},
        .readout{},
        .sectorDist = 50. * dd4hep::mm,
        .localDistXY{},
        .localDistXZ = {80 * dd4hep::mm, 80 * dd4hep::mm},
        .localDistYZ{},
        .globalDistRPhi{},
        .globalDistEtaPhi{},
        .dimScaledLocalDistXY{},
        .splitCluster      = false,
        .minClusterHitEdep  = 5.0 * dd4hep::MeV,
        .minClusterCenterEdep = 100.0 * dd4hep::MeV,
        .transverseEnergyProfileMetric{},
        .transverseEnergyProfileScale{},
        .transverseEnergyProfileScaleUnits{}},
    },
    app // TODO: Remove me once fixed
));

app->Add(new J0mniFactoryGeneratorT<CalorimeterClusterRecoCoG_factory>(
    "EcalBarrelScFiClustersWithoutShapes",
    {
        "EcalBarrelScFiProtoClusters", // edm4eic::ProtoClusterCollection
#ifdef EDM4EIC_BUILD_VERSION >= EDM4EIC_VERSION(8, 7, 0)
        "EcalBarrelScFiRawHitLinks", // edm4eic::MCRecoCalorimeterHitLink
#endif
        "EcalBarrelScFiRawHitAssociations" // edm4eic::MCRecoCalorimeterHitAssociation
    },
    {"EcalBarrelScFiClustersWithoutShapes", // edm4eic::Cluster
#ifdef EDM4EIC_BUILD_VERSION >= EDM4EIC_VERSION(8, 7, 0)
    "EcalBarrelScFiClusterLinksWithoutShapes",
#endif
    "EcalBarrelScFiClusterAssociationsWithoutShapes"}, // edm4eic::MCRecoClusterParticleAssociation
    {.energyWeight = "log", .sampFrac = 1.0, .logWeightBase = 6.2, .enableEtaBounds = false},
    app // TODO: Remove me once fixed
));

app->Add(new J0mniFactoryGeneratorT<CalorimeterClusterShape_factory>(
    "EcalBarrelScFiClusters",
    {"EcalBarrelScFiClustersWithoutShapes", "EcalBarrelScFiClusterAssociationsWithoutShapes"},
    {"EcalBarrelScFiClusters",
#ifdef EDM4EIC_BUILD_VERSION >= EDM4EIC_VERSION(8, 7, 0)
    "EcalBarrelScFiClusterLinks",
#endif
    "EcalBarrelScFiClusterAssociations"},
    {.longitudinalShowerInfoAvailable = true, .energyWeight = "log", .logWeightBase = 6.2}, app));
```

# Energy resolution

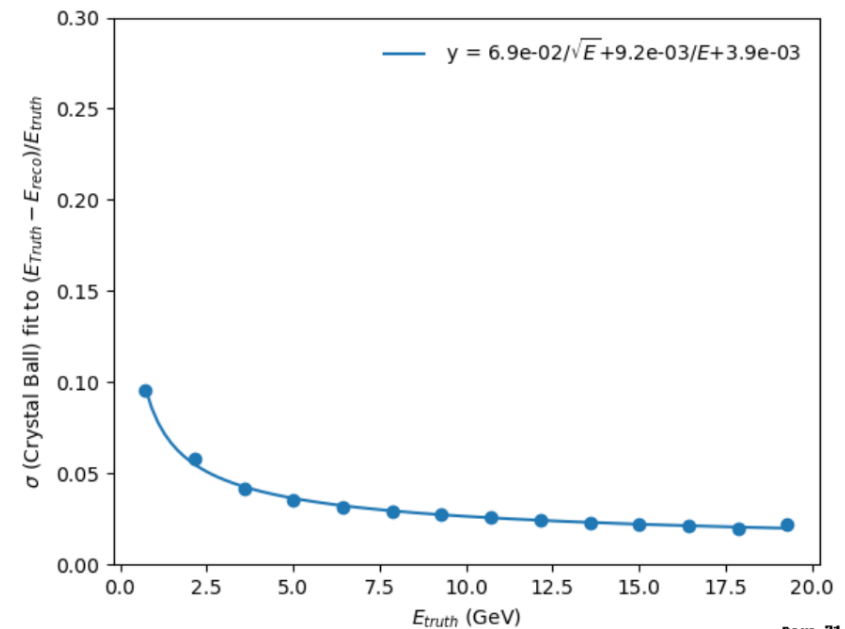
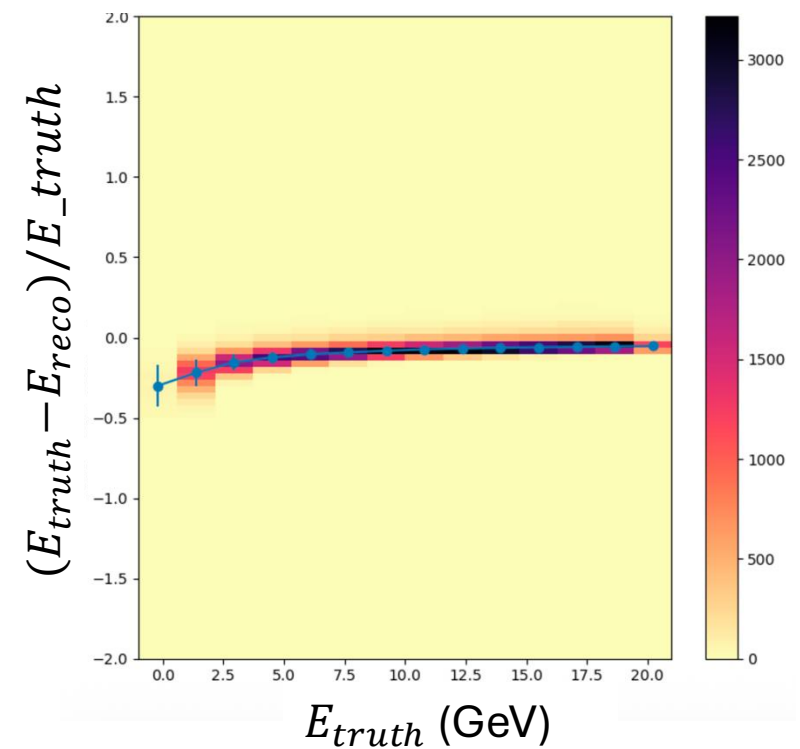
## $80 < \theta < 100$ deg

- $E_{truth}$  slices are fitted to crystal ball function.

$$f(x; \alpha, n, \bar{x}, \sigma) = N \cdot \begin{cases} \exp\left(-\frac{(x-\bar{x})^2}{2\sigma^2}\right), & \text{for } \frac{x-\bar{x}}{\sigma} > -\alpha \\ A \cdot \left(B - \frac{x-\bar{x}}{\sigma}\right)^{-n}, & \text{for } \frac{x-\bar{x}}{\sigma} \leq -\alpha \end{cases},$$

From wikipedia

- Markers and error bars = mean and sigma of the fitted crystal balls.

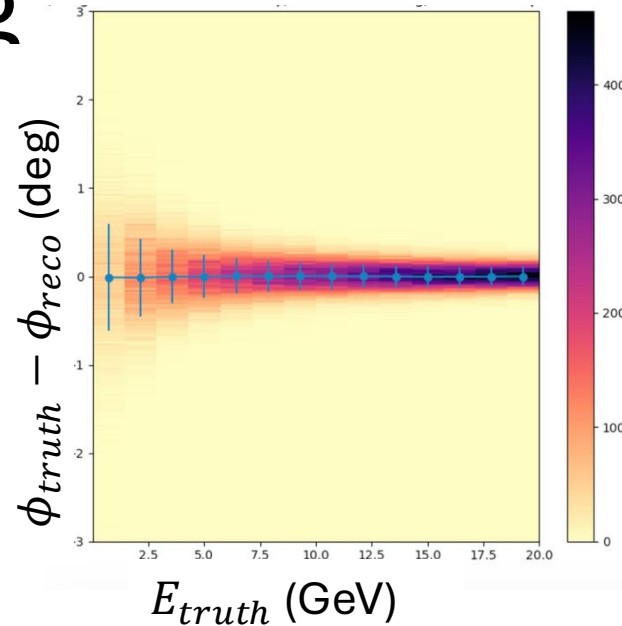


# Angular resolution

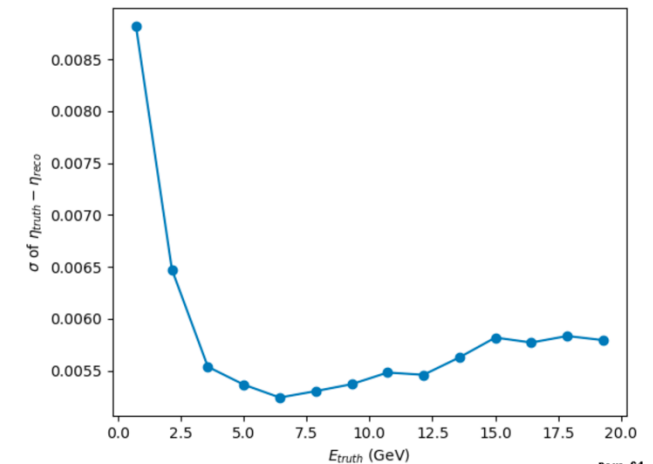
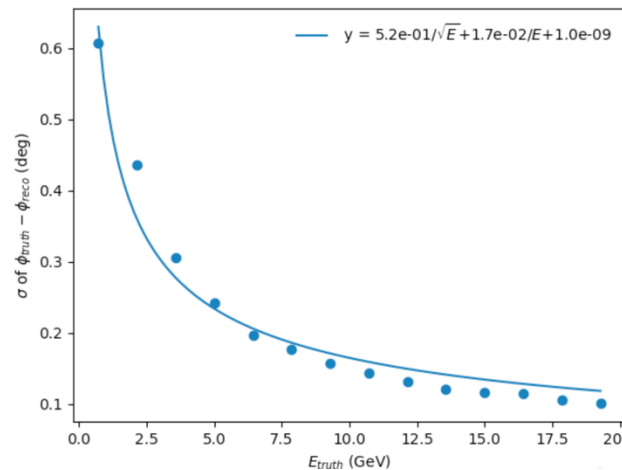
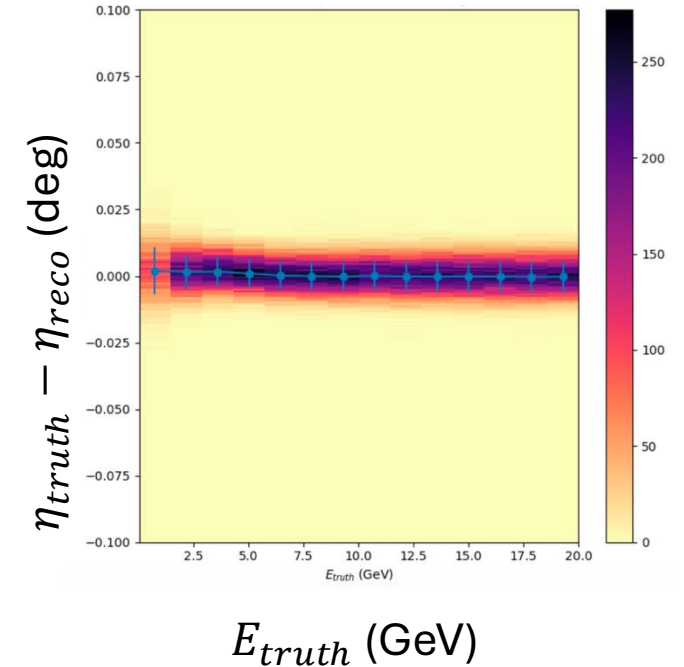
## $80 < \theta < 100 \text{ deg}$

- Error bar = 68.3% confidence interval.
- Central value = median.

Phi resolution



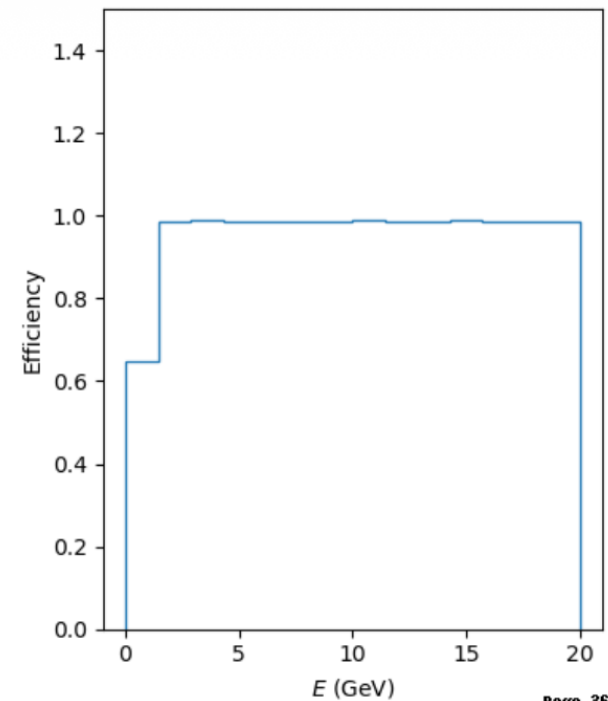
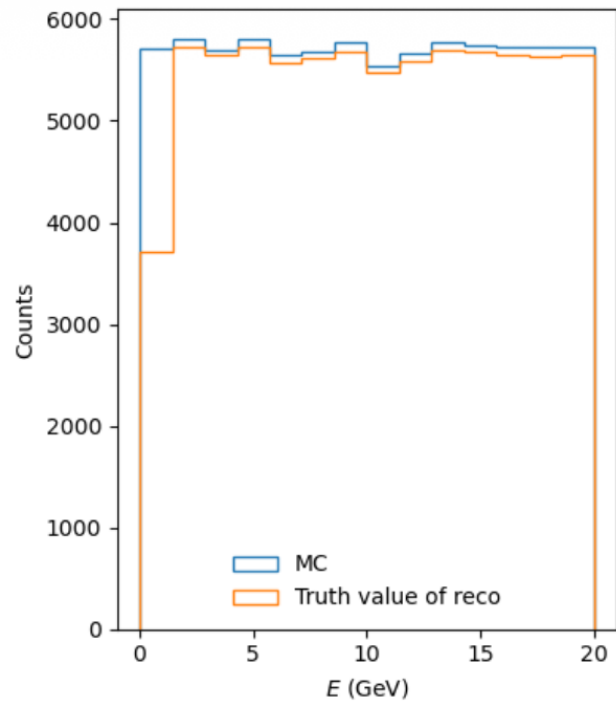
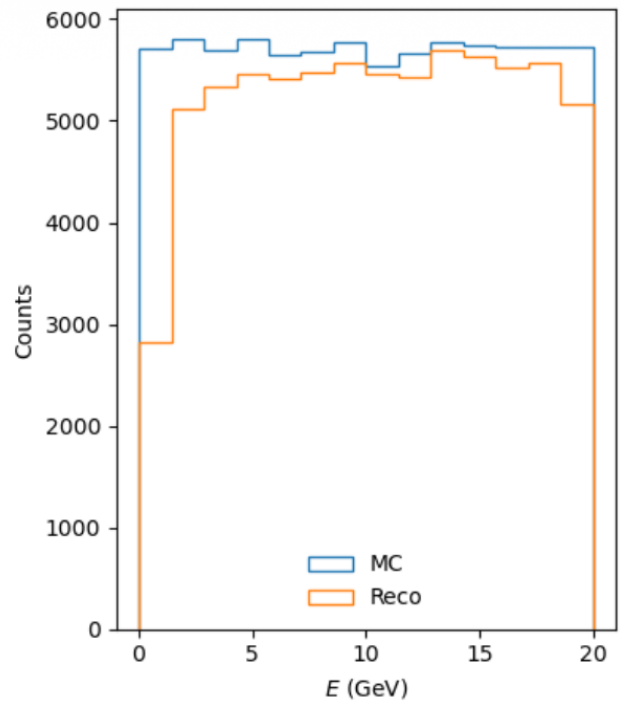
Eta resolution



# Single track efficiency

## $80 < \theta < 100$ deg

Efficiency =  $E_{\text{truth(reconstructed)}}/E_{\text{truth(all)}}$

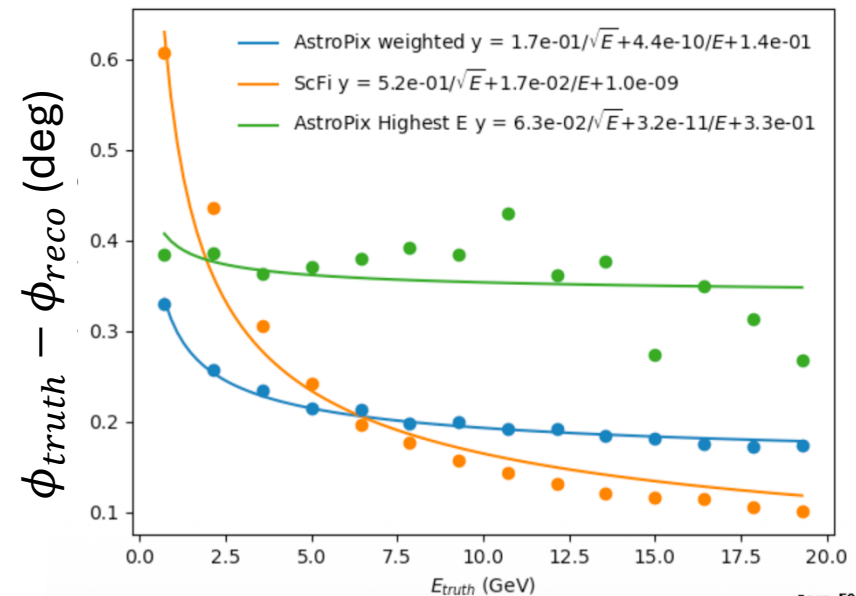
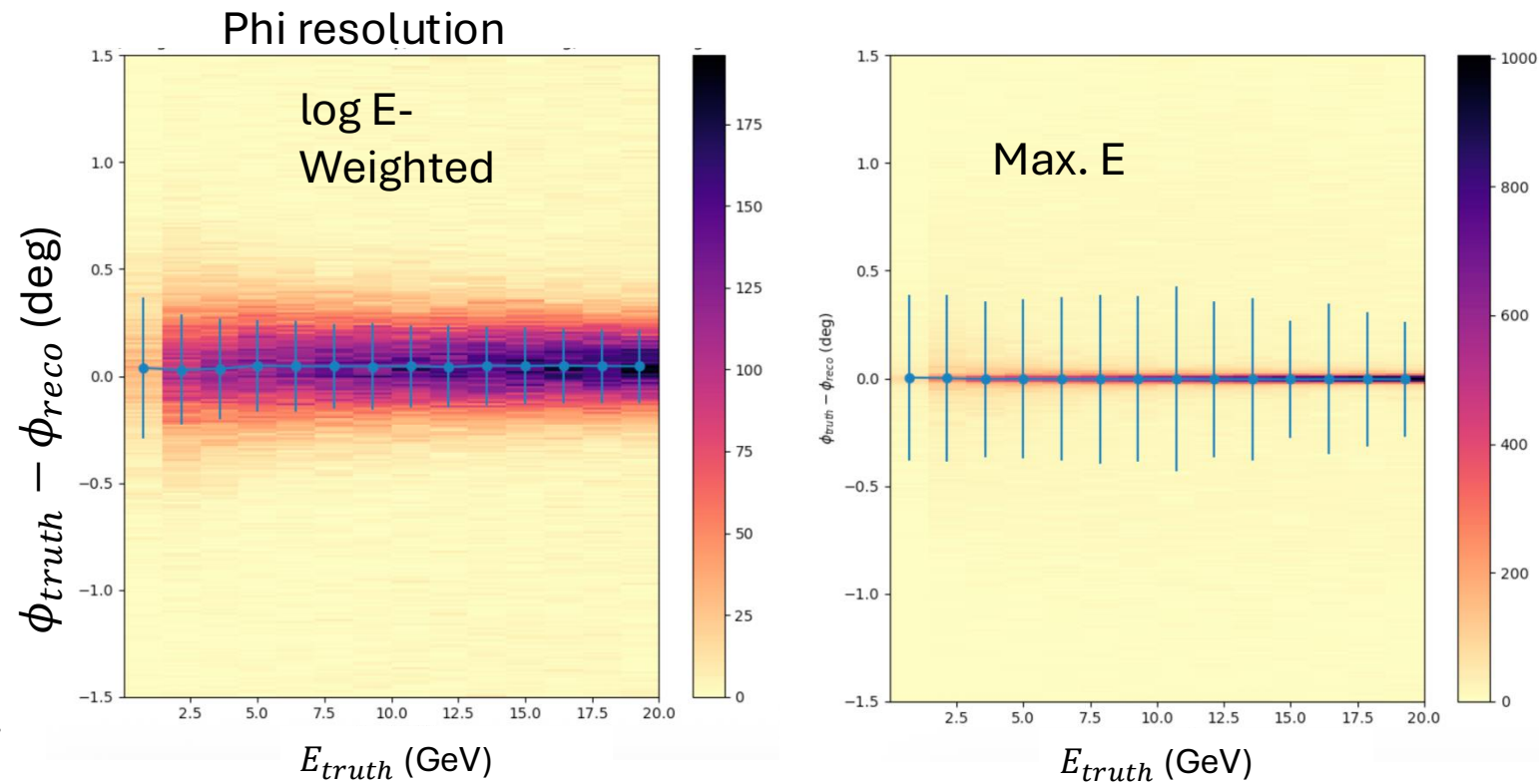


# AstroPix performance

Default clusterization algorithm

# Angular resolution $80 < \theta < 100$ deg

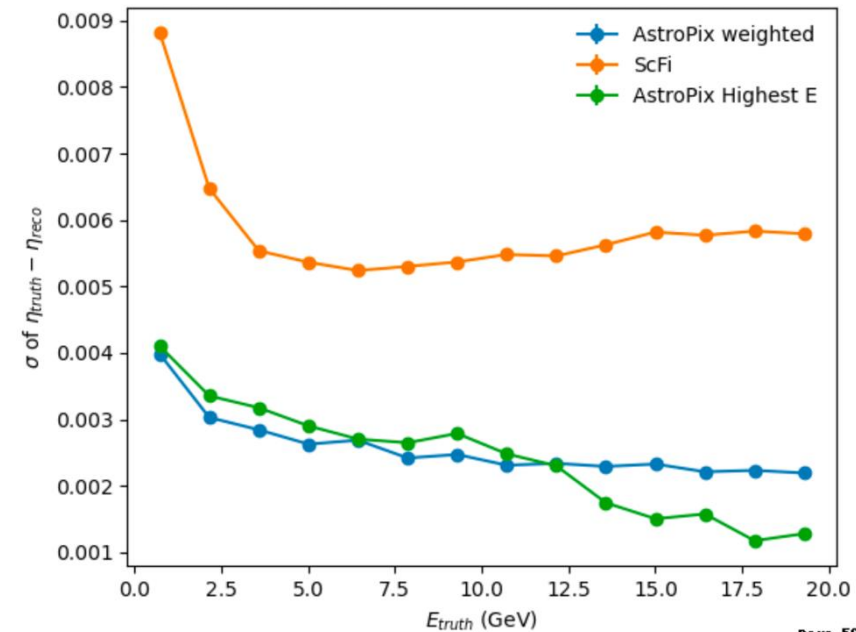
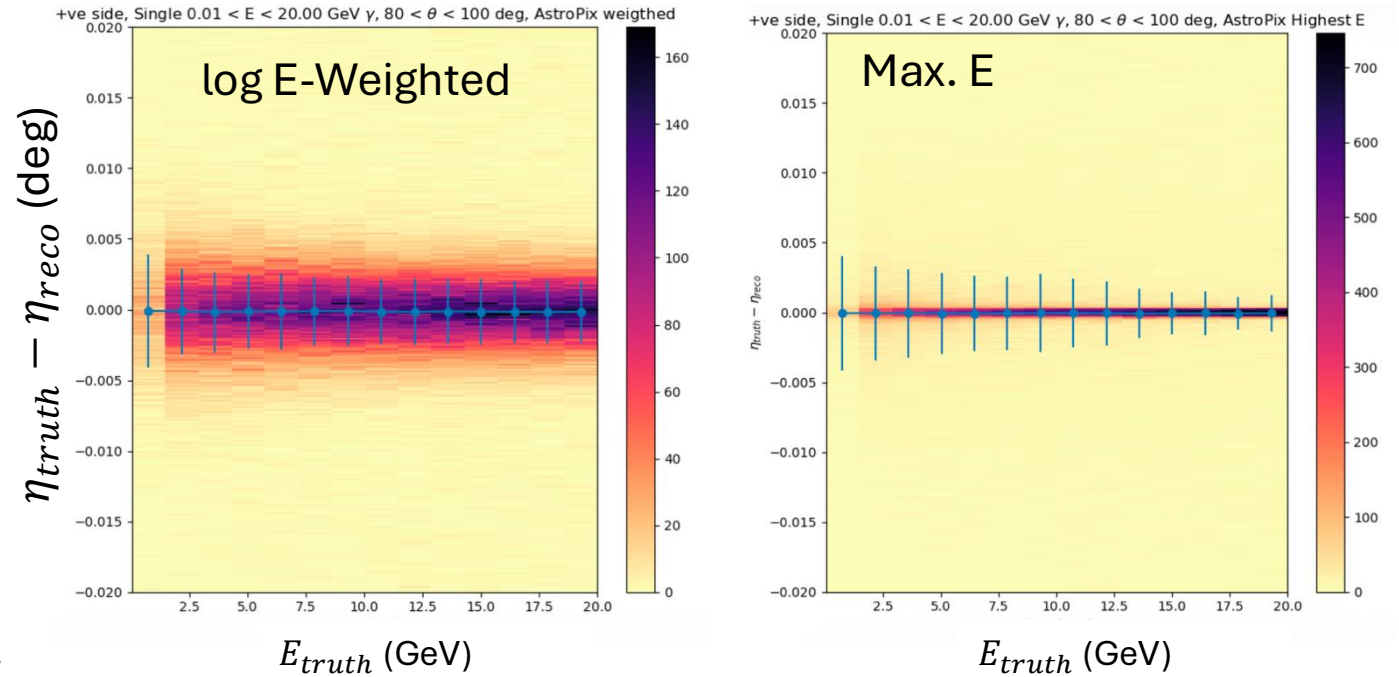
- Error bar = 68.3% confidence interval.
- Central value = median.
- Note: Distribution is highly non-Gaussian when Max. E is used.



# Angular resolution $80 < \theta < 100$ deg

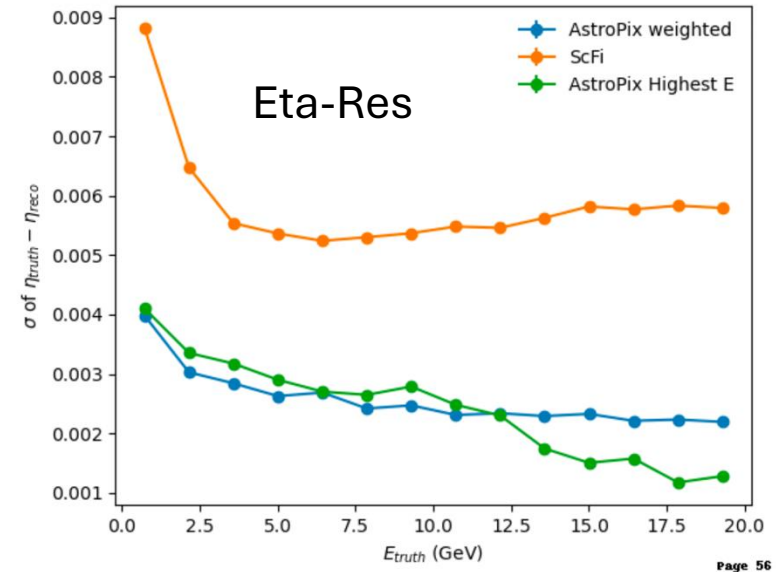
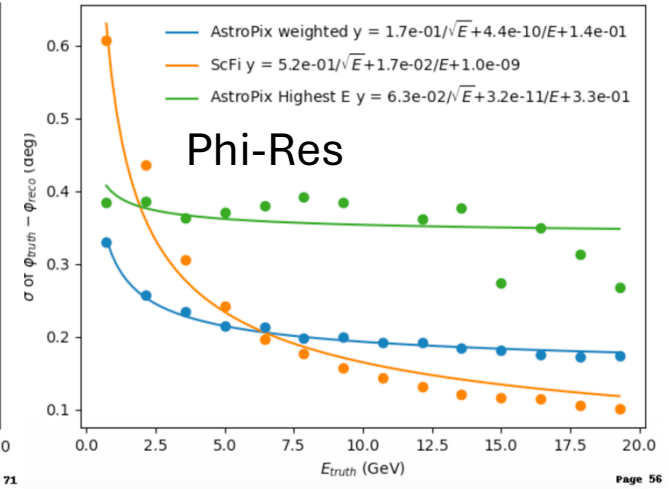
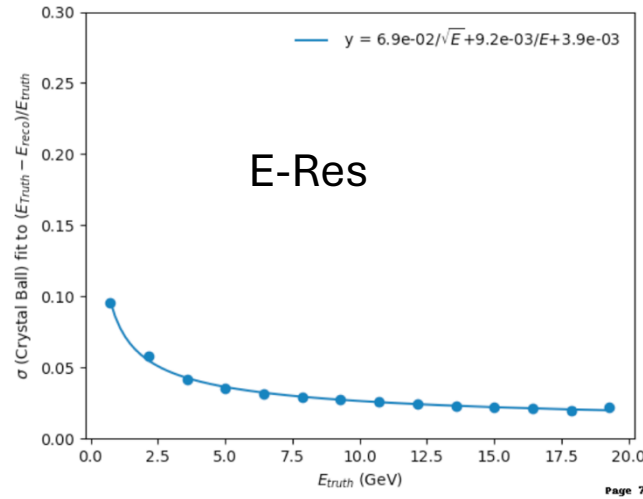
- Error bar = 68.3% confidence interval.
- Central value = median.
- Note: Distribution is highly non-Gaussian when Max. E is used.

## Eta resolution



# Conclusion

- E-/Phi-/Eta- resolutions for ScFi/AstroPix at  $80 < \theta < 100$  deg is estimated.
- Single track efficiency is estimated.
- TBD:
  - Resolution/Efficiency vs. eta.
  - Resolution /Efficiency in DIS.
  - Matching efficiency between ScFi and AstroPix.



# Backup slides

# AstroPix Phi-slice (E = 5 GeV)

- Weighted average

